# STORMWATER CONTROL MEASURE MAINTENANCE MANUAL

pennsylvania
DEPARTMENT OF TRANSPORTATION
www.penndot.gov

PUB 888 (11-21)

# TABLE OF CONTENTS

## CH 5 SCMs – Specific Inspection and Maintenance Procedures



## CH 6 Common SCM Components – Specific Inspection and Maintenance Procedures



## Ch 7 Maintenance Scheduling, Charging, and Reporting



## References

## Appendix

# ACRONYMS

ACMM – Assistant County Maintenance Manager
ADE-M – Assistant District Executive for Maintenance
BMP – Best Management Practice
BOMO – PennDOT Bureau of Maintenance and Operations
BOMO-MTLD – PennDOT Bureau of Maintenance and Operations - Maintenance Technical Leadership Division
CA – Condition Assessment
CAI – Condition Assessment Inspection
CMM – County Maintenance Manager
CEM – County Equipment Manager
Commonwealth – Commonwealth of Pennsylvania
CWA – Clean Water Act
DCNR - Pennsylvania Department of Conservation and Natural Resources
DEM – District Environmental Manager
Department – Pennsylvania Department of Transportation
DGS – Pennsylvania Department of General Services
DSMC – District Stormwater Maintenance Coordinator
ECMS – Engineering and Construction Management System
EPA – U. S. Environmental Protection Agency
ESPC – Erosion and Sediment Pollution Control
M-IQ - Maintenance IQ
MS4 – Municipal Separate Storm Sewer Systems
NOT – NPDES Notice of Termination
NPDES – National Pollutant Discharge Elimination System
O&M – Operation and Maintenance
OSHA – Occupational Safety and Health Administration
PPE – Personal Protective Clothing and Equipment
PADEP – Pennsylvania Department of Environmental Protection
PAG-02 – PADEP's NPDES General Permit for Stormwater Discharges Associated with Construction Activities
PennDOT – Pennsylvania Department of Transportation
PCSM – Post Construction Stormwater Management
PID – Potential Illicit Discharge
QA – Quality Assurance
QC – Quality Control
RPC – Roadway Program Coordinator
SCM – Stormwater Control Measure
SEMP – Strategic Environmental Management Program
SWMP – Stormwater Management Program
VS – Visual Screening
VSI – Visual Screening Inspection

# DEFINITIONS

**Best Management Practice (BMP)** – a general term used to describe methods that are the most effective and practical means of preventing or minimizing pollution. A BMP can represent both physical features, engineered structures and non-structural methodology approaches to stormwater management.

**Engineering and Construction Management System (ECMS)** – PennDOT's online portal providing current information on Department construction projects, construction contracts and consultant agreements.

**Hydrophytic vegetation** – plants that have adapted to wet conditions, surviving and growing in the absence of oxygenated soil.

**Illicit discharge** – any discharge to PennDOT's right-of-way that is not composed entirely of stormwater and are not permitted pursuant to another type of NPDES permit (e.g. NPDES permit for industrial activities).

**Invasive vegetation** – exotic plants that have been intentionally or accidentally introduced into native ecosystems. These invasive species displace native species and change the ecological structure of the invaded community, sometimes with dire consequences to native plants and animals.

**Licensed professional** – per Section 102.1 of PA Code Title 25, professional engineers, landscape architects, geologists, and land surveyors licensed to practice in this Commonwealth.

**Maintenance-IQ** – PennDOT's Maintenance Interactive Query Application; the Geographic Information System (GIS) visualization portal for planned and completed maintenance activities across the state.

**Municipal Separate Storm Sewer Systems (MS4)** – a conveyance or system of conveyances that is:

a) Owned by a state, city, town, village, or other public entity that discharges to waters of the Commonwealth;

b) Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.);

c) Not a combined sewer; and

d) Not part of a Publicly Owned Treatment Works (sewage treatment plant).

**National Pollutant Discharge Elimination System (NPDES)** – mandated by Section 402 of the CWA for projects that involve the discharge of pollutants into surface waters (including wetlands) for disposal purposes. The EPA has approved a Pennsylvania NPDES Program administered by DEP under the Clean Streams Law.

**Quality Assurance (QA)** – the independent verification or measurement of the level of quality of a sample product or service.

**Quality Control (QC)** – the enforcement, by a supervisor, of procedures that are intended to maintain the quality of a product or service at or above a specified level.

**Stormwater Control Measure (SCM)** –physical features used to effectively control, minimize and treat stormwater runoff.

**Strategic Environmental Management Program (SEMP)** – a set of processes and procedures to ensure that PennDOT has sound environmental practices in place for its work activities. PennDOT's environmental policy is called the Green Plan Policy and was signed by the Secretary of Transportation.

**Stormwater runoff** – portion of rainfall (or snowmelt) that does not immediately seep into the ground or evaporate and runs off a surface.

**Undesirable vegetation** – any vegetation including native, non-native and invasive species which are problematic in a given setting.

**Wetlands** – areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs and similar areas. Wetlands must be identified in accordance with the 1987 U.S. Army Corps of Engineers Manual for Identifying and Delineating Wetlands.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

The Pennsylvania Department of Transportation (Department or PennDOT) installs Stormwater Control Measures (SCMs) to control stormwater runoff from the highway system and supporting facilities owned by the Department. SCMs are physical features designed to slow down, reduce, and/or treat stormwater runoff before it enters waterbodies and groundwater. These features are a subset of Best Management Practices (BMPs), which are effective and practical means of preventing or minimizing pollution. BMPs include physical features as well as design approaches applied to the project prior to construction. The focus of this Publication is maintenance of SCMs.

Once constructed, SCMs require routine maintenance, periodic inspections, and as-needed corrective maintenance to ensure they continue to function as designed. If SCMs are not functioning properly, adverse environmental impacts such as downstream pollution and erosion can occur. A successful SCM maintenance program includes a variety of elements:

- Standardizing processes so the program is applied consistently across all Counties and Districts.
- Educating staff on the program and providing training for staff to perform their specific duties.
- Communicating efforts between Design, Construction, and Maintenance.
- Providing an accurate inventory of SCMs to owners and operators.
- Performing preventative maintenance on routine schedules.
- Performing corrective maintenance activities as needed in a timely manner.
- Conducting periodic inspections to identify problems and evaluate maintenance practices.
- Documenting program efforts for quality improvement and to maintain regulatory compliance.
- Effective enforcement of the policy.

Cooperation across Department Bureaus and between Central Office, the Districts, and Counties is required for successful implementation of the program. Maintenance is ultimately responsible for maintaining the functionality of SCMs, but Design and Construction play important roles in this process (Figure 1.1.1).

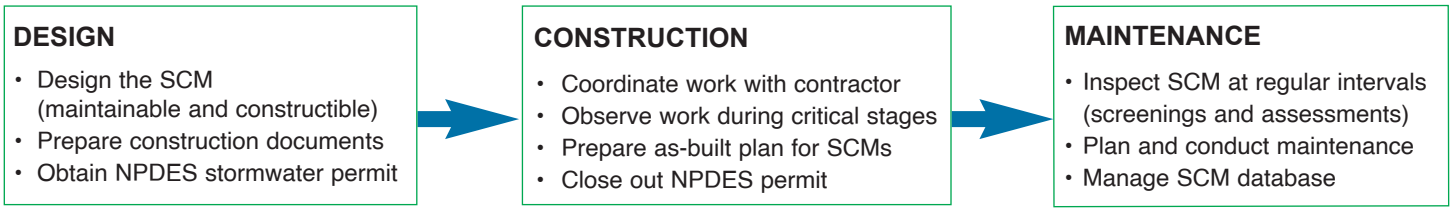



**Figure 1.1.1: Roles of Department Divisions**

This Publication serves as the primary reference for all policies and procedures related to inspection and maintenance of SCMs. It addresses required activities Maintenance is responsible for throughout the SCM's life cycle (Figure 1.1.2), as well as requirements for District and County level activities such as subsequent reporting and recordkeeping. Department personnel at District and County levels can find information about required activities, subsequent reporting, and recordkeeping. While similar in nature to certain SCMs, stream and wetland mitigation projects constructed pursuant to 25 Pa. Code 105 are not governed by this publication.

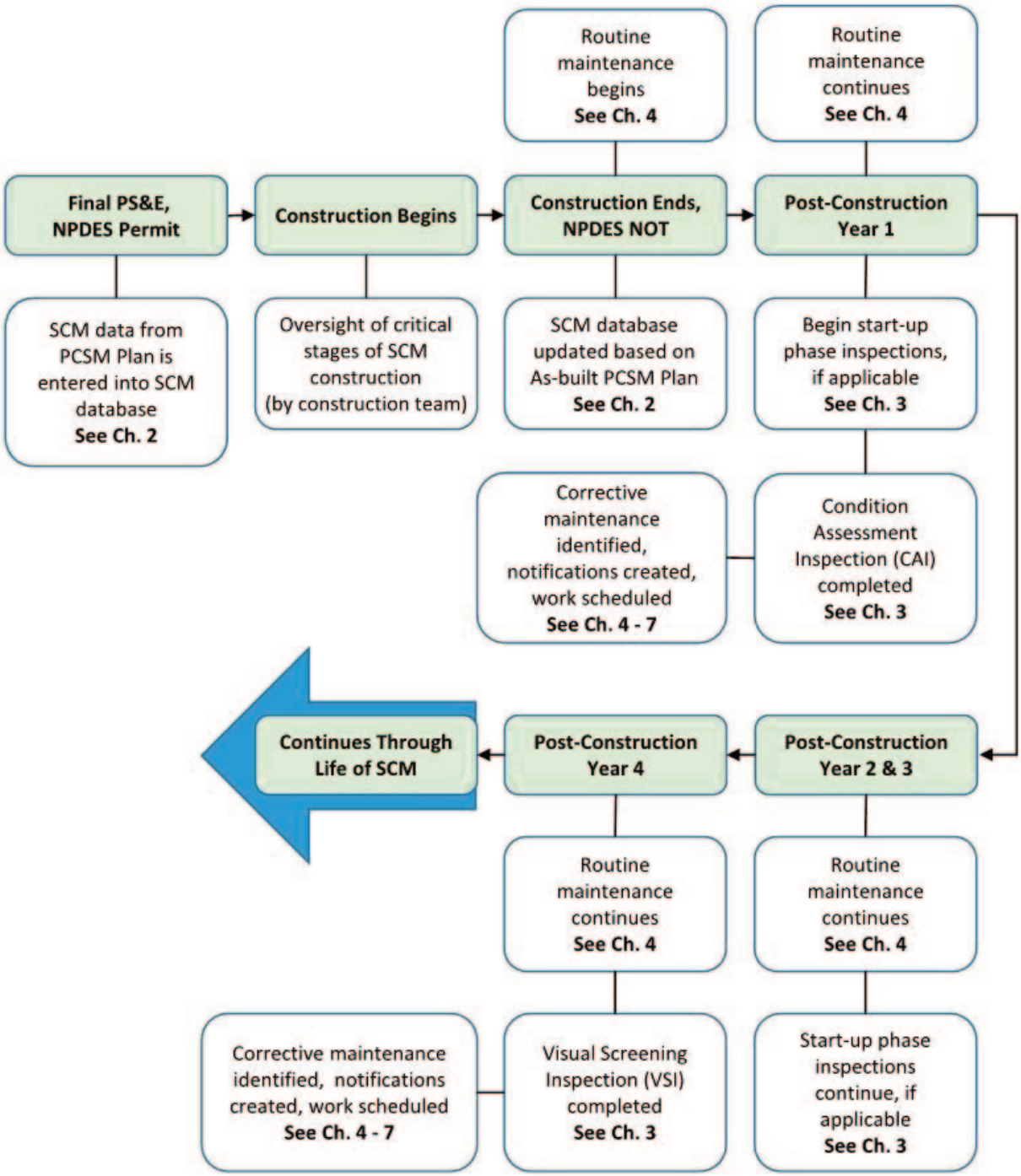



**Figure 1.1.2: SCM Lifetime Maintenance Activities**

The following chapters describe common types of SCMs that are constructed by the Department, how these SCMs should be maintained, and what roles and responsibilities the various units within the Department have in the program.

All Department-owned SCMs located along highways and at Department-owned or leased facilities shall be maintained in accordance with this Publication. Stockpiles, garages, rest areas, and office complexes are examples of facilities owned or leased by the Department.

## 1.2 Meeting Stormwater Objectives

The Department is responsible for maintaining over 40,000 miles of roadways throughout Pennsylvania, most of which either directly or indirectly discharge stormwater runoff to surface waters of this Commonwealth. Adhering to this Publication align the Department's SCM activities with multiple federal and state stormwater and water quality regulations.

Pennsylvania's Post Construction Stormwater Management (PCSM) regulation (25 Pa. Code §102.8) requires a PCSM plan for permits associated with earth disturbance activity. The National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharges Associated with Construction Activities is required for many PennDOT projects. Among other things, the PCSM plan must include a program for long-term operation and maintenance of SCMs (see 25 Pa. Code §102.8(f)(10)).

Additionally, the Department is required to maintain an NPDES Municipal Separate Storm Sewer Systems (MS4) Individual Permit for stormwater discharges in urbanized areas of the state (as defined by the U.S. Census Bureau). It does not include combined sewers (sewage and stormwater) or publicly owned treatment works (sewage treatment plant). PennDOT's MS4 includes "conveyance systems owned and/or operated by PennDOT which are designated or used for collecting or conveying stormwater associated with PennDOT roads, highways, bridges and related structures." SCMs must be maintained in proper working order to achieve the required environmental protection. Adhering to the procedures described in this Publication fulfills the requirements of the permit and any project specific NPDES permits.

An SCM is covered by the PCSM regulation if it was constructed or modified as part of a highway project with an NPDES permit that was issued after the effective date of the regulation. Table 1.2.1 summarizes the applicability of the new regulation to each type of NPDES permit: Individual and General (PAG-02).

**Table 1.2.1: NPDES Permit Types**

| Permit Type | PCSM Regulation Applicability |
|---|---|
| Individual | Permit issued after November 19, 2010 or<br>Permit renewed after January 1, 2013 |
| General | Notice of Intent approved after December 7, 2012 |

Consistent with PennDOT's Green Plan Policy Statement (Pub 712A), the Department will maintain its SCMs in accordance with applicable environmental legislation and regulations.

## 1.3 SCM Types

Design Manual Part 2 (Pub. 13M), Section 13.7.J, describes the types of SCMs that are approved for use along the highway system. The most common SCM types that have been constructed by the Department along roadways include dry extended detention basins, wet basins, infiltration basins, vegetated swales, infiltration trenches, and bioretention (aka, rain gardens). Park-and-rides, rest stops, stockpiles, vehicle maintenance facilities, and other non-highway sites offer opportunities for other types of SCMs, such as pervious pavement and manufactured treatment devices. A standard naming convention was created for the various SCM types that have or may be installed by the Department. Table 1.3.1 presents the SCM name and three-letter abbreviation, called Type Code, for each SCM type.

**Table 1.3.1: SCM Name and Type Code**

| SCM Name | Type Code | SCM Name | Type Code |
|---|---|---|---|
| Basin, Dry Detention | BDD | Non-Basin SCM, Other | NBO |
| Basin, Dry Extended Detention | BED | Pervious Pavement, Asphalt | PPA |
| Basin, Dry Ultra-Extended Detention | BUD | Pervious Pavement, Concrete | PPC |
| Basin, Infiltration Detention | BID | Pervious Pavement, Pavers | PPP |
| Basin, Other | BOT | Reforestation/Tree Plantings | RTP |
| Basin, Naturalized Detention | BND | Regenerative Step Pool | RSP |
| Basin, Wet Detention | BWD | Riparian Buffer Enhancement | RBE |
| Bioretention | BRE | Riparian Buffer Offset | RBO |
| Bioretention w/Underdrain | BRU | Soil Amendment Restoration | SAR |
| Constructed Stormwater Filter | CSF | Stormwater Wetland | SWE |
| Flow Dispersion, Forest/Buffer | FDF | Stream Restoration | SRE |
| Flow Dispersion, Veg. Filter Strip | FDV | Stream Stabilization | SST |
| Forest Preservation | FPR | Subsurface Detention Storage | SDS |
| Infiltration Berm | IBE | Subsurface Infiltration Trench | SIT |
| Landscape Restoration Meadow | LRM | Vegetated Filter Strip | VFS |
| Level Spreader Outfall | LSO | Vegetated Filter Strip, Steep Slope | VSS |
| Manufactured Treatment Devices | MTD | Vegetated Swale | VSW |
| Media Filter Drain | MFD | Vegetated Swale w/ Check Dams | VSC |

A thorough description of each SCM type, including illustrations, relevant inspection information and required maintenance procedures, are included in Chapter 5.

## 1.4 Anatomy of an SCM

SCMs function by temporarily storing collected stormwater runoff where it may be cleaned, soaked in to the ground (infiltrated), used (evapotranspiration), or slowly released (retained) ultimately improving the water quality and decreasing the water quantity.


**Figure 1.4.1: Stormwater Runoff- SCM Process**

(Adapted from Philadelphia Water Department, Stormwater Management Practice Operation & Maintenance Manual)

All SCMs in this Publication are comprised of components that require regular maintenance. Figure 1.4.2 illustrates a typical surface basin type SCM with the various parts labeled. The key features, which are found in other SCM types as well, are described in more detail. Not all features shown appear in all SCMs.

Inflow: The inflow of stormwater runoff for nearly all SCMs include features like channels, pipes, curb cuts and overland sheet flow. An exception is pervious pavement, which may receive inflow only from the actual surface of the SCM (rainfall that falls directly on it).

Pretreatment: Many surface and subsurface SCM designs incorporate a pretreatment feature which functions to capture sediment, debris and trash prior to entering the main SCM storage area. In Figure 1.4.2, the pretreatment area is a forebay directly adjacent to the main SCM. A forebay is a small separate ponding area located at inflow points separated from the main SCM storage area to capture sediment and slow velocities. Some SCMs include pretreatment in the form of inlets with a sump/trap upstream of the inflow point, these should be included in the PCSM plan and verified in the field. Often another SCM may serve as pretreatment, such as a vegetated swale channelizing flows into a detention type SCM, or a vegetated filter strip directing sheet flow into an infiltration type SCM.

Surface Storage: The surface storage area is the main ponding, conveyance, and treatment area of a surface SCM. This is where runoff is temporarily held for infiltration, evapotranspiration, and/or controlled release to downstream points. In vegetated filter strips, the treatment/conveyance area is the surface area of the filter (with no ponding).

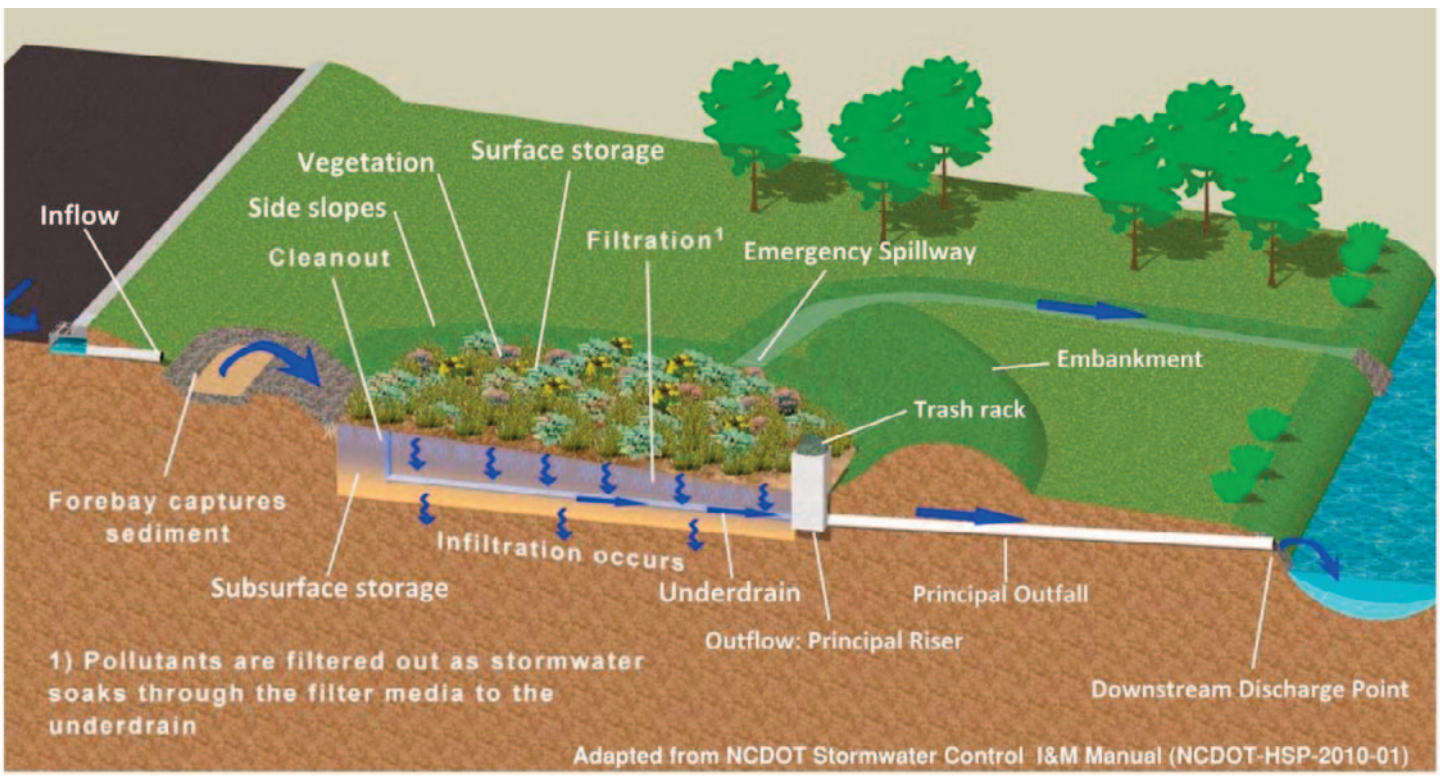



**Figure 1.4.2: Anatomy of a Typical Surface SCM**

Vegetation: SCMs such as bioretention areas utilize vegetation in the surface storage area for enhancing filtration, infiltration, and evapotranspiration properties. Vegetation such as wild grass seed mixes, shrubs and woody plants are used to aid in treatment. Other SCMs, like constructed stormwater filters (CSF), will not have vegetation on the surface.

Filtration: Beneath the surface storage, infiltrating and filtrating surface SCMs may have a layer of engineered soils or filter media placed above native soils. This illustration shows the filter layer with flow arrows through it indicating filtration of pollutants as water drains through the medium. Some SCMs are designed to allow water to infiltrate into the subgrade below the SCM, while others are designed to drain the filtered water through an underdrain and away from the SCM. In karst or contaminated areas, an impermeable liner may be installed to prevent infiltration from occurring (not shown in this figure).

Subsurface Storage: SCMs such as subsurface detention storage and subsurface infiltration trenches are designed to temporarily hold stormwater in a subsurface storage medium for infiltration and/or controlled release. The storage medium may consist of clean stone and/or storm pipes, vaults, and chambers. Subsurface storage systems may be incorporated below surface storage/filtration areas in combination surface/subsurface SCMs or, it may be a standalone subsurface SCM.

Impermeable Liner: Some SCMs may have an impermeable liner installed under the SCM floor, cut slopes, or impounding embankment areas of the SCM. The liner serves to limit water infiltration into the surrounding ground in sensitive locations such as karst or contaminated soils. Impermeable liners may be constructed from geosynthetics (geosynthetic clay liners/geomembranes), clay, or a combination of materials and are typically not visible from the surface (not illustrated in Figure 1.4.2).

Underdrain: Underdrains are installed below the filter or stone storage media to effectively dewater the SCM where an SCM contains impermeable lining, the underlying soil does not provide adequate infiltration rates, or a backup drainage feature is needed. Observation wells and cleanouts are typically installed into the underdrains for inspection and maintenance purposes.

Cleanout: Underdrains should have cleanouts, which can also serve as observation wells, visible on the surface of the SCM. These provide an access point for maintenance to clean out piping systems and allow inspectors to check the subsurface storage area for proper dewatering. SCMs may have an observation well in the filtration media to allow for subsurface storage inspections. Observation wells are similar in appearance to cleanouts on the surface.

Side Slopes and Embankment: Surface SCMs can be built by constructing a berm above existing grade, or excavating a pit below existing grade, or both. Side slopes are the SCM side walls constructed by excavating below grade. Embankments, or berms, are “fill” material constructed above the surrounding ground forming a side wall of the SCM. Larger embankments may be considered a regulated dam structure depending on height and storage. Inspections and maintenance of these must also comply with the requirements of the Dam Safety permit. Embankments and side slopes may not be present in all SCMs like subsurface SCMs (SDS, SIT), pervious pavement (PPA, PPC, PPP), and infiltration berms (IBE).

Outflow - Principal Riser: Except for very rare cases, all SCMs have a flow control structure that serves as the primary or principal outflow point. As depicted in Figure 1.4.2, basin type SCMs often utilize a metal or concrete box (riser) with one or multiple orifices and weirs to release stored water in a controlled manner. In SCMs designed to have a permanent pool or an infiltration/filtration volume (e.g., BID, BWD, CSF, and SWE), the lowest opening in the flow control structure will be above the surface elevation of the SCM. SCMs

designed to draw down completely via the flow control structure (e.g., BDD, BED, and BUD) will have an opening at the surface elevation of the SCM. Subsurface SCMs typically have outlet structures built into a concrete box. SCMs that do not contain water (VFS, VSS, VSW, VSC) do not have flow control structures.

Trash Rack: Trash and debris can block openings in flow control structures. To prevent clogging, a metal or plastic grate structure is commonly installed on the top and/or sides of flow control structures.

Principal Outfall: The principal outfall carries water from the flow control structure to a stable downstream location. The outfall is typically one or a series of storm pipes.

Downstream Discharge Point: The principal outfall leads to a stable downstream location, which is often a stream, engineered channel, or a storm sewer system. In cases where discharge is to a channel or stream, a riprap apron or other energy dissipating feature be may necessary to prevent erosion.

Emergency Spillway: Surface storage SCMs normally incorporate an emergency spillway that provides a stable release of water from the SCM in the event the principal spillway fails. Surface SCMs constructed in fill areas typically have an earthen weir constructed into the berm to function as an emergency overflow point. This area may have surface stabilization such as rip-rap or concrete to ensure peak flows do not erode the underlying berm. SCMs located entirely in cut or surrounded by roads may incorporate a secondary riser structure with the outlet elevation above principal spillway structure.

## 1.5 Maintenance-IQ

The Maintenance Interactive Query Application (Maintenance-IQ) serves as the Department's Geographic Information System (GIS) visualization portal for planned and completed maintenance activities across the state. It is located at https://pdprgisweb.penndot.gov/Maintenance_IQ/ and can be accessed by anyone with a CWOPA account. Maintenance-IQ is an interface for showing sets of map data which can be exported and queried for attribute data. Users can find SCM data, view the results of past inspections, link to inspection documents, and schedule future inspections. For example, a user could produce a map and table of SCMs that are due to be inspected within the next six months to aid in planning the work. A map layer of Department-owned SCMs can be viewed in the application by selecting Layers – Stormwater – Stormwater Control Measures. Figure 1.5.1 shows a screen capture from Maintenance-IQ. The red and cyan dots are Department SCMs; the window to the right is a summary of information for a selected SCM. The SCM map layer is updated by the Regional EMS/MS4 Advisor, which is described in Chapter 2. Instructions on how to utilize Maintenance-IQ to prepare for inspections can be found in Chapter 3.

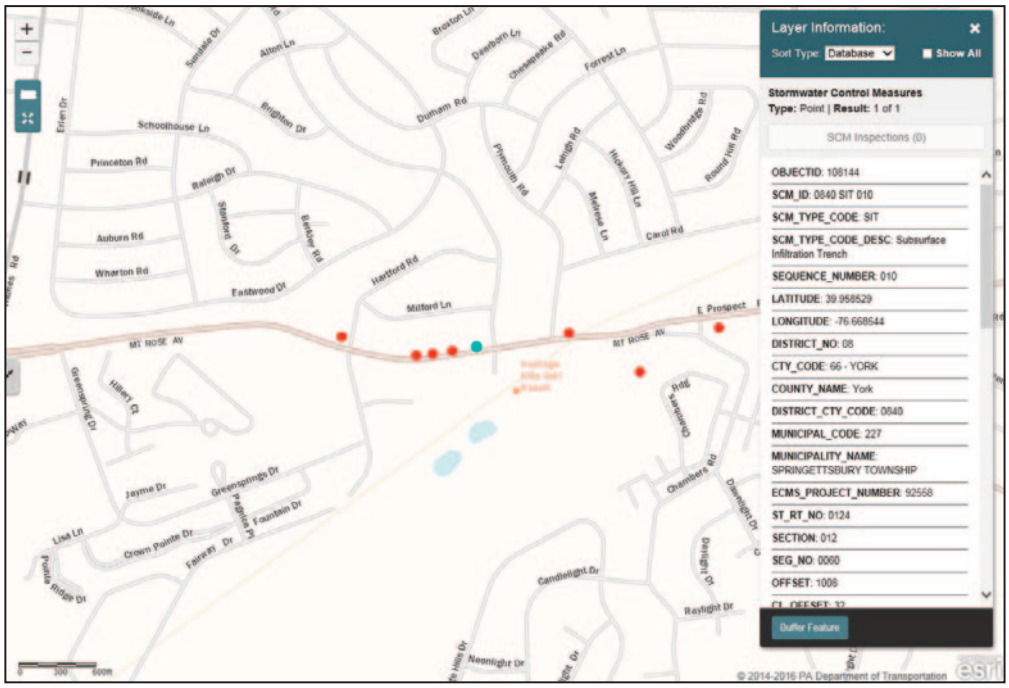



**Figure 1.5.1: Sample Screen from Maintenance-IQ**

## 1.6 Manual Organization

Information on inventorying, inspecting, and maintaining SCMs is organized in this Publication as follows.

Definitions & Acronyms: Defines terminology and acronyms used in the Publication.

Chapter 1 - Introduction: Provides an overview of the Publication purpose and need, outlining the types of SCMs and common components found within SCMs.

Chapter 2 - Inventory Procedure: Describes the processes used to build the statewide SCM inventory database and establishes the required procedure for each District to update and modify the database with new and existing SCMs.

Chapter 3 - Inspection Procedures: Presents the two types of SCM inspections, details field inspection procedures, explains inspection and photograph forms, reporting processes, and the frequency of each. In addition to District-performed inspections, a Central Office QA/QC inspection process is outlined.

Chapter 4 - Maintenance Procedures Overview: Outlines the different maintenance procedures for SCMs, including routine and corrective maintenance, explaining how each type is initiated.

Chapter 5 - SCMs - Specific Inspection and Maintenance Procedures: Contains subsections for each primary SCM, detailing SCM specific information regarding inspections, routing maintenance and corrective maintenance. Each SCM section presents an overview of the key components and relevant terminology, a list of SCM specific inspection points, a table of routine maintenance activities, and a matrix of possible corrective maintenance procedures based on field identified deficiencies.

Chapter 6 - Common SCM Components - Specific Inspection and Maintenance Procedures: Many SCMs have common subcomponents applicable to multiple SCM types. Rather than repeating the same information within each SCM section, Chapter 6 describes the repeated subcomponents, providing a similar overview, inspection points, table of routine maintenance activities, and a matrix of possible corrective maintenance procedures for each.

Chapter 7 - Maintenance Charging, Recording, and Reporting: Reviews the appropriate assemblies, charge codes, WBS elements, methods for creating work notifications based on inspection findings, defines maintenance records storage and central office reporting requirements.

Appendices: Additional references supporting the information presented in the chapters.

## 1.7 Other References

The Publication is intended to be used in conjunction with other PennDOT and industry technical references; it is not a standalone reference. The following list includes some but not all references that may be applicable and consulted as needed. PennDOT publications are available on the Department's website and all others are available on the internet. The most up to date edition of non-Department references at the time of writing is listed, but users should reference the current editions as appropriate.

PennDOT Publications

1. Pub. 13M, Design Manual Part 2, Highway Design
2. Pub. 23, Maintenance Manual
3. Pub. 72M, Roadway Construction Standards
4. Pub. 111, Traffic Control Pavement Markings and Signing Standards
5. Pub. 113, Highway Foreman Manual
6. Pub. 213, Temporary Traffic Control Guidelines
7. Pub. 408, Highway Construction Specifications
8. Pub. 445, Safety Policy Handbook
9. Pub. 584, PennDOT Drainage Manual
10. Pub. 611, Waste Management Guidance Manual
11. Pub. 712A, Green Plan Policy Statement
12. Pub. 756, Invasive Species Best Management Practices
13. Pub. 783, Environmental Permitting Handbook

Other Resources

1. Clark County, Washington, Stormwater Manual 2015, Book 4 - Stormwater Facility Operations and Maintenance, September 2016.
2. EPA, Operation and Maintenance of Green Infrastructure Receiving Runoff from Roads and Parking Lots Technical memorandum, September 2016.
3. EPA, Stormwater Wet Pond and Wetland Management Guidebook (EPA 833-b-09-001), February 2009.
4. New York State Department of Transportation Region 8, Stormwater Facilities Operations & Maintenance Manual, September 2003.
5. North Carolina Department of Transportation, Stormwater Control Inspection and Maintenance Manual (NCDOT-HSP-2010-01), May 2015.
6. PADEP, Pennsylvania Field Guide Common Invasive Plants in Riparian Areas, May 2004.
7. PADEP, Pennsylvania Stormwater Best Management Practices Manual (363-0300-002), December 30, 2006.
8. Washington State Department of Transportation, Highway Runoff Manual, M31-16.04, February 2016.

## 1.8 Disclaimer

This Publication is intended to provide guidance on maintaining typical types of SCMs owned and maintained by the Department. Common SCM configurations and problems likely to be encountered are the focus of the Publication; it is not possible to address every configuration or problem that may be encountered. Therefore, these are guidelines not intended to be a comprehensive reference for all variations of SCMs. Users are expected to apply sound professional judgement. Additional references should be utilized as needed to assess atypical situations encountered to maintain safe and functional SCMs.

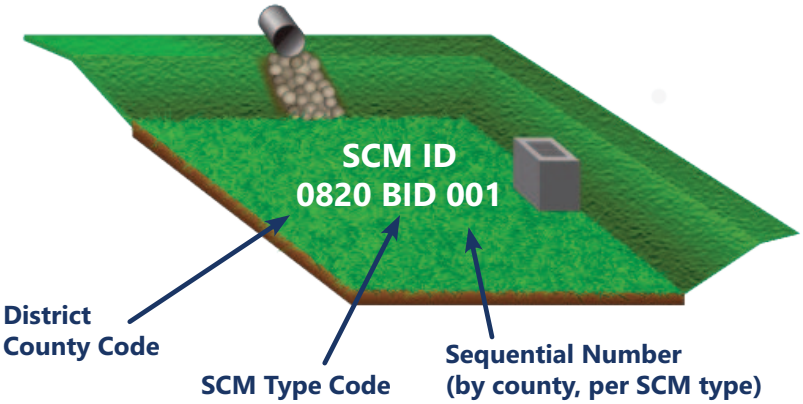
This Publication does not address environmental, historic preservation, traffic control, or safety implications. They may be mentioned for reference only as it pertains to a specific discussion. Although developed with safety and minimizing environmental harm in mind, the procedures presented in this publication may not be appropriate in all situations. The practitioners will be responsible for ensuring that procedures applied are consistent with environmental standards and safety codes within the jurisdictions involved, as well as obtaining the required permits before starting work. Always follow all Department, OSHA, and other applicable requirements.

Finally, the procedures in this Publication are provided for guidance only and are not a legal interpretation or regulations. This Publication established the framework within which the Department will exercise its administrative discretion in the future. The Department reserves the discretion to deviate from this guidance if circumstances warrant. This guidance is for informational purposes only - not regulatory.

# Chapter 2 - Inventory Procedures

## Publication 888 - SCM Maintenance Manual

SCM ID is a unique 10 digit identifier assigned to each SCM the Department is responsible for maintaining.




### SCM Inventory

- Database of Department-owned SCMs
- 40+ data fields
- Displayed in Maintenance-IQ
- New SCMs added when constructed
- Existing SCMs added as discovered
- BOMO reviews data and assigns SCM ID
- As-Built Plans stored in network folder
- Guidance on extracting SCM data from plans

### Procedure to Modify Inspection or Maintenance Requirements

- Evaluate suitability of standard inspection and maintenance cycles
- Form M-80 used to certify completion by a licensed professional
- Evaluation covers:
  - Review of As-Built Plan
  - Design limitations
  - Site limitations
- Inspections and maintenance performed per the PCSM Plan until evaluation completed

### SCM Signage

- Recommended to aid in locating and maintaining SCMs
- Use SCM Marker specification
- Sign placement based on SCM category:
  - Linear
  - Basin
  - Underground

# CHAPTER 2

# INVENTORY PROCEDURES

## 2.1 SCM Identification System

Every SCM the Department is responsible for maintaining is assigned a unique identifier by BOMO. The SCM Identification Code (SCM_ID) contains 10 alphanumeric characters and is grouped into three parts, separated by dashes or spaces. The three parts include, in order:

- 4-digit PennDOT District-County code (Table 2.1.1)
- 3-digit SCM type (Table 2.1.2)
- 3-digit sequentially assigned # (different set starting at 001 for each County)

For example, the first assigned Dry Detention Basin in Cumberland County is 0820-BDD-001. The District (08) and County (Cumberland, 20) are given in the first part. The SCM type (Basin Dry Detention, BDD) is identified in the second part. The last three digits are sequentially assigned as an SCM of a particular type is added to the inventory for that County.

**Table 2.1.1: District-County Codes**

| County | Code | County | Code | County | Code | County | Code |
|---|---|---|---|---|---|---|---|
| Adams | 0810 | Clinton | 0230 | Lackawanna | 0420 | Pike | 0440 |
| Allegheny | 1110 | Columbia | 0310 | Lancaster | 0870 | Potter | 0260 |
| Armstrong | 1010 | Crawford | 0110 | Lawrence | 1140 | Schuylkill | 0560 |
| Beaver | 1120 | Cumberland | 0820 | Lebanon | 0880 | Snyder | 0350 |
| Bedford | 0910 | Dauphin | 0850 | Lehigh | 0530 | Somerset | 0970 |
| Berks | 0510 | Delaware | 0630 | Luzerne | 0430 | Sullivan | 0360 |
| Blair | 0920 | Elk | 0280 | Lycoming | 0320 | Susquehanna | 0450 |
| Bradford | 0390 | Erie | 0120 | McKean | 0250 | Tioga | 0370 |
| Bucks | 0610 | Fayette | 1210 | Mercer | 0140 | Union | 0380 |
| Butler | 1020 | Forest | 0130 | Mifflin | 0270 | Venango | 0150 |
| Cambria | 0930 | Franklin | 0830 | Monroe | 0540 | Warren | 0160 |
| Cameron | 0240 | Fulton | 0940 | Montgomery | 0640 | Washington | 1240 |
| Carbon | 0520 | Greene | 1220 | Montour | 0330 | Wayne | 0460 |
| Centre | 0210 | Huntingdon | 0950 | Northampton | 0550 | Westmoreland | 1250 |
| Chester | 0620 | Indiana | 1040 | Northumberland | 0340 | Wyoming | 0470 |
| Clarion | 1030 | Jefferson | 1050 | Perry | 0890 | York | 0840 |
| Clearfield | 0220 | Juniata | 0290 | Philadelphia | 0650 | Tunnels | 1130 |

**Table 2.1.2: SCM Name and Type Code**

| SCM Name | Type Code |
|---|---|
| Basin, Dry Detention | BDD |
| Basin, Dry Extended Detention | BED |
| Basin, Dry Ultra-Extended Detention | BUD |
| Basin, Infiltration Detention | BID |
| Basin, Other | BOT |
| Basin, Naturalized Detention | BND |
| Basin, Wet Detention | BWD |
| Bioretention | BRE |
| Bioretention w/Underdrain | BRU |
| Constructed Stormwater Filter | CSF |
| Flow Dispersion, Forest/Buffer | FDF |
| Flow Dispersion, Veg. Filter Strip | FDV |
| Forest Preservation | FPR |
| Infiltration Berm | IBE |
| Landscape Restoration Meadow | LRM |
| Level Spreader Outfall | LSO |
| Manufactured Treatment Devices | MTD |
| Media Filter Drain | MFD |

| SCM Name | Type Code |
|---|---|
| Non-Basin SCM, Other | NBO |
| Pervious Pavement, Asphalt | PPA |
| Pervious Pavement, Concrete | PPC |
| Pervious Pavement, Pavers | PPP |
| Reforestation/Tree Plantings | RTP |
| Regenerative Step Pool | RSP |
| Riparian Buffer Enhancement | RBE |
| Riparian Buffer Offset | RBO |
| Soil Amendment Restoration | SAR |
| Stormwater Wetland | SWE |
| Stream Restoration | SRE |
| Stream Stabilization | SST |
| Subsurface Detention Storage | SDS |
| Subsurface Infiltration Trench | SIT |
| Vegetated Filter Strip | VFS |
| Vegetated Filter Strip, Steep Slope | VSS |
| Vegetated Swale | VSW |
| Vegetated Swale w/ Check Dams | VSC |

Standard drainage ditches which function as runoff conveyance measures without PCSM benefit are not included in the SCM inventory. Permanent erosion control measures, such as rock aprons and rock energy dissipaters, are not considered SCMs and are not included in the inventory. Rather, as described in Chapter 6, they are inspected and maintained as part of the overall SCM they are associated with.

## 2.2 Inventory Data

The SCM inventory data for each District is contained in Maintenance-IQ. This includes the SCMs the District is responsible for maintaining and those the District has constructed but whose maintenance, by agreement, is completed by others. While all employees have access to view the data, only BOMO personnel have the ability to update Maintenance-IQ. Districts are responsible for contacting their respective Regional EMS/MS4 Advisor when updates are needed.

Inventory updates shall be conveyed to BOMO via the SCM inventory template. Including the SCM ID, the template contains more than 40 separate fields, ranging from type and location to discharge location, maintenance access, and required inspection frequency. All of the data in the template are transferred into the Maintenance-IQ inventory. The various data fields and their descriptions are listed in Appendix A.

## 2.3 New Construction Projects

SCM data can be compiled during the project design phase by the PCSM Plan preparer. Future projects and those currently in design should be handled as follows.

1. The District staff responsible for the project oversight or its design consultant, completes the SCM_INVENTORY_TEMPLATE (.xlxs) in conjunction with the final PCSM Plan submission in Final Design.

   a. The inventory template is located under: P:\penndot shared\Stormwater Management\SCM Inventory (link accessible to internal PennDOT users only).

   b. Name the completed inventory template file per the following convention: [ECMS#]_SR####_SCMS. For example, 18014_SR1009_SCMS. For non-ECMS projects, use the appropriate Department project number and site location. For example, a DGS project at a welcome center, DGS 356-01 Ph2 Welcome Center Delaware County.

   c. Place the file in the Projects_Temporary folder within the District's inventory folder as shown in Figure 2.3.1. Notify the DSMC or designee when the file is complete.

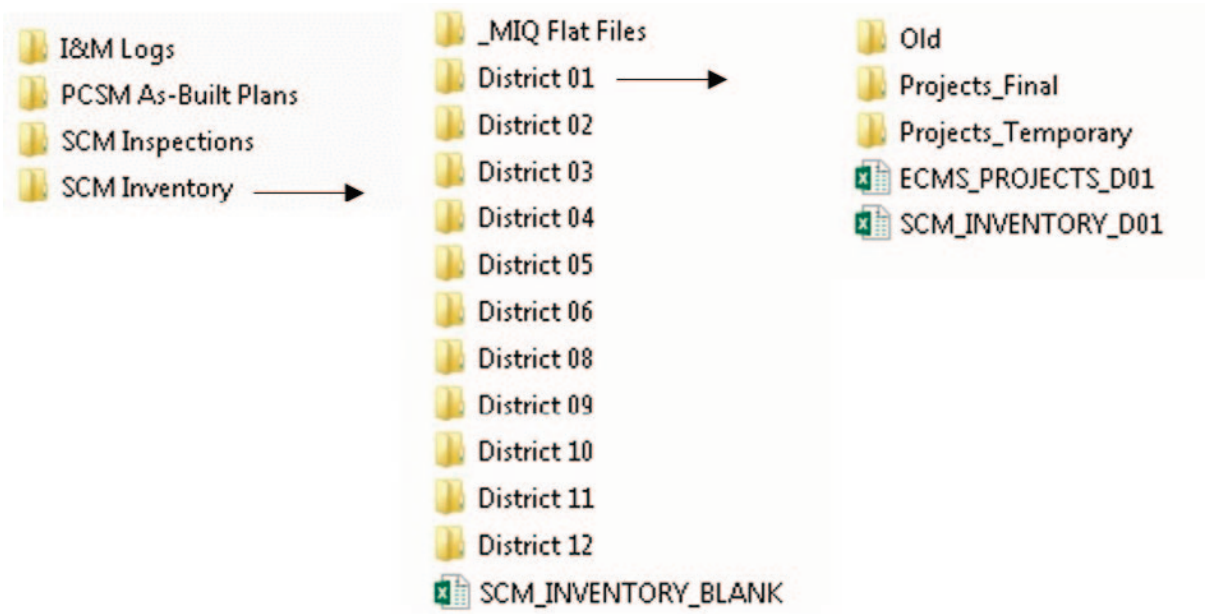



**Figure 2.3.1: "Projects_Temporary" File Path**

2. The final site inspection is conducted and the NPDES Notice of Termination (NOT) is submitted to the applicable County Conservation District or DEP regional office using DEP form 3800-PM-BCW0229B. The NOT requires submission of the As-Built PCSM Plan (certified by a qualified licensed professional).

3. Upon NOT approval, the DSMC or designee shall place a PDF of the As-Built PCSM Plan drawings, narrative and module in the appropriate folder under: P:\penndot shared\Stormwater Management\PCSM As-Built Plans (link accessible to internal PennDOT users only).
   Refer to Section 2.5 for file naming convention.

4. The DSMC or designee shall make any necessary revisions to the SCM_INVENTORY template on the final As-Built PCSM Plan (i.e., to reflect any changes to the design/plan during construction). Move the final file to the Projects_Final folder within the District's inventory folder.

5. Once notified by the District, BOMO will review the data, assign SCM IDs, and update Maintenance-IQ. If the SCM inventory data is not collected before Final Design is completed, it should be gathered from the As-Built PCSM Plan as soon as practicable. Refer to Section 2.4 to learn how this was done to compile the Department's initial SCM inventory.

## 2.4 Existing SCMs

Prior to the issuance of this publication in 2019, several thousand SCMs had been constructed by the Department. In early 2015, BOMO began compiling statewide SCM data from plans obtained from ECMS, primarily for projects advertised between 2006 and 2014. Districts provided some additional data on projects advertised prior to 2006. However, many SCMs have yet to be inventoried. The information in this section describes how data can be collected for existing SCMs.

The primary source of SCM data is the Post Construction Stormwater Management (PCSM) Plan. Projects that require an NPDES Permit for Stormwater Discharges Associated with Construction Activities are required to have a PCSM Plan. PCSM Plans must include SCM locations, design specifications, receiving surface water names and designations, and other information. Most if not all of the data in the SCM inventory database can be found in the PCSM Plan.

NPDES permits did not require a separate PCSM Plan until 2003. Few projects constructed prior to 2003 have a separate plan detailing SCMs. If a PCSM Plan is unavailable for a project in which SCMs were constructed, other construction plans, such as those listed below, may contain SCM information that can be used.

- Erosion and Sediment Pollution Control (ESPC) Plan
- Construction (Roadway) Plan
- Contour Grading and Drainage Plan
- Landscaping Plan

### Data Extraction - SCM Inventory Desktop Review Process

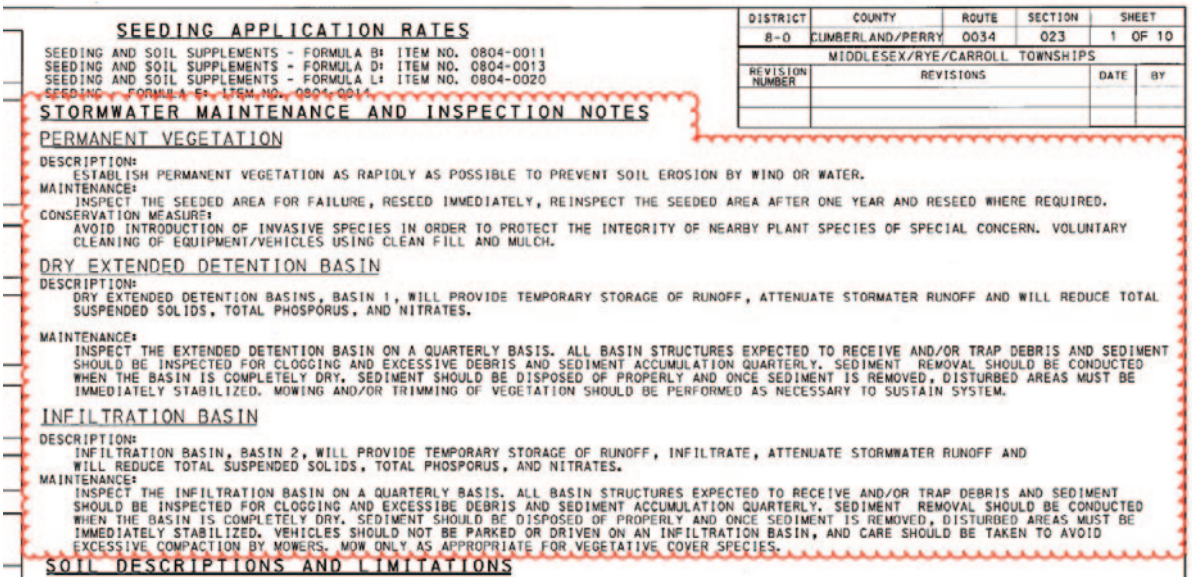
The primary software tools and data sources used to gather information for SCMs found in plans were Bluebeam Revu (similar to Adobe Acrobat), Google Earth, eMapPA, and ArcGIS.

Data for existing SCMs can be extracted and entered into the SCM inventory template using the following desktop review process. Data obtained through desktop review of sources other than the as-built PCSM Plan should be field verified, when possible. Attributes that cannot be identified should be left blank.

**Step 1 - NPDES Permit and Project Plan Review**

1. The NPDES Permit and/or PCSM Plan can provide at a minimum the state route number and section; permit type, number and date of issuance; and receiving water name(s) and Ch. 93 designation(s).
2. Electronic copies of project plan(s) in PDF format must be reviewed to locate SCMs. The PCSM Plan is the preferred data source.
   a. The final phase of an ESPC Plan is a secondary source if the PCSM Plan is not available. This phase often includes conversion of certain temporary ESPC measures into permanent SCMs (e.g., sediment trap into a dry detention basin).
   b. The Roadway Plan, Contour Grading and Drainage Plan, and Landscaping Plan, if available, may contain information to identify SCMs as well.

3. Using Revu or Adobe, draw a red revision cloud around the SCM Operation and Maintenance instructions. Typically these instructions appear at the beginning or the end of the plan (Figure 2.4.1), but are sometimes scattered throughout the plans when included with the SCM details.



| DISTRICT | COUNTY | ROUTE | SECTION | SHEET |
|---|---|---|---|---|
| 8-0 | CUMBERLAND/PERRY | 0034 | 023 | 1 OF 10 |
| MIDDLESEX/RYE/CARROLL TOWNSHIPS | | | | |

| REVISION NUMBER | REVISIONS | DATE | BY |
|---|---|---|---|
| | | | |

SEEDING APPLICATION RATES

SEEDING AND SOIL SUPPLEMENTS - FORMULA B: ITEM NO. 0804-0011
SEEDING AND SOIL SUPPLEMENTS - FORMULA D: ITEM NO. 0804-0013
SEEDING AND SOIL SUPPLEMENTS - FORMULA L: ITEM NO. 0804-0020
SEEDING - FORMULA E: ITEM NO. 0804-0014

STORMWATER MAINTENANCE AND INSPECTION NOTES

PERMANENT VEGETATION

DESCRIPTION:
ESTABLISH PERMANENT VEGETATION AS RAPIDLY AS POSSIBLE TO PREVENT SOIL EROSION BY WIND OR WATER.
MAINTENANCE:
INSPECT THE SEEDED AREA FOR FAILURE, RESEED IMMEDIATELY, REINSPECT THE SEEDED AREA AFTER ONE YEAR AND RESEED WHERE REQUIRED.
CONSERVATION MEASURE:
AVOID INTRODUCTION OF INVASIVE SPECIES IN ORDER TO PROTECT THE INTEGRITY OF NEARBY PLANT SPECIES OF SPECIAL CONCERN. VOLUNTARY CLEANING OF EQUIPMENT/VEHICLES USING CLEAN FILL AND MULCH.

DRY EXTENDED DETENTION BASIN

DESCRIPTION:
DRY EXTENDED DETENTION BASINS, BASIN 1, WILL PROVIDE TEMPORARY STORAGE OF RUNOFF, ATTENUATE STORMATER RUNOFF AND WILL REDUCE TOTAL SUSPENDED SOLIDS, TOTAL PHOSPORUS, AND NITRATES.

MAINTENANCE:
INSPECT THE EXTENDED DETENTION BASIN ON A QUARTERLY BASIS. ALL BASIN STRUCTURES EXPECTED TO RECEIVE AND/OR TRAP DEBRIS AND SEDIMENT SHOULD BE INSPECTED FOR CLOGGING AND EXCESSIVE DEBRIS AND SEDIMENT ACCUMULATION QUARTERLY. SEDIMENT REMOVAL SHOULD BE CONDUCTED WHEN THE BASIN IS COMPLETELY DRY. SEDIMENT SHOULD BE DISPOSED OF PROPERLY AND ONCE SEDIMENT IS REMOVED, DISTURBED AREAS MUST BE IMMEDIATELY STABILIZED. MOWING AND/OR TRIMMING OF VEGETATION SHOULD BE PERFORMED AS NECESSARY TO SUSTAIN SYSTEM.

INFILTRATION BASIN

DESCRIPTION:
INFILTRATION BASIN, BASIN 2, WILL PROVIDE TEMPORARY STORAGE OF RUNOFF, INFILTRATE, ATTENUATE STORMWATER RUNOFF AND WILL REDUCE TOTAL SUSPENDED SOLIDS, TOTAL PHOSPORUS, AND NITRATES.
MAINTENANCE:
INSPECT THE INFILTRATION BASIN ON A QUARTERLY BASIS. ALL BASIN STRUCTURES EXPECTED TO RECEIVE AND/OR TRAP DEBRIS AND SEDIMENT SHOULD BE INSPECTED FOR CLOGGING AND EXCESSIBE DEBRIS AND SEDIMENT ACCUMULATION QUARTERLY. SEDIMENT REMOVAL SHOULD BE CONDUCTED WHEN THE BASIN IS COMPLETELY DRY. SEDIMENT SHOULD BE DISPOSED OF PROPERLY AND ONCE SEDIMENT IS REMOVED, DISTURBED AREAS MUST BE IMMEDIATELY STABILIZED. VEHICLES SHOULD NOT BE PARKED OR DRIVEN ON AN INFILTRATION BASIN, AND CARE SHOULD BE TAKEN TO AVOID EXCESSIVE COMPACTION BY MOWERS. MOW ONLY AS APPROPRIATE FOR VEGETATIVE COVER SPECIES.

SOIL DESCRIPTIONS AND LIMITATIONS

**Figure 2.4.1: SCM Operation and Maintenance Example**

4. Once an SCM is located in the plan, highlight it in green (Figure 2.4.2).

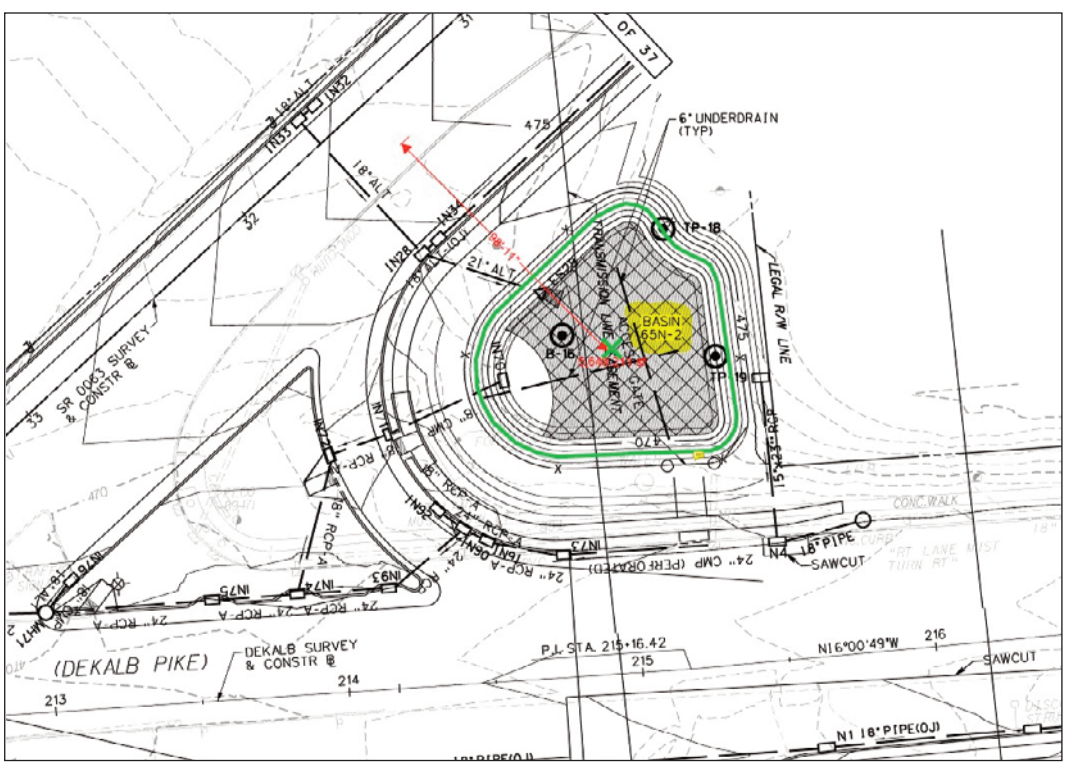



**Figure 2.4.2: SCM Highlighted Plan Location**

5. For basin and bioretention SCMs, measure the surface area using the program's measurement tools.
   a. The measurement tool should be calibrated to each plan's scale prior to measurement.
   b. SCMs should be measured using the topographic plan drawings (i.e., not index or detail sheets).
   c. If phased plans were used, each SCM should be highlighted and measured in only the final phase or stage (i.e., the same SCM was not highlighted in multiple phases).
   d. Generally the surface area is measured as the SCM bottom footprint area. For BWD and SWE, it is measured at principal spillway/outlet elevation (normal water surface).
6. If drawing details of an SCM are available, highlight the detail title in yellow for future reference.
7. Once the plan has been reviewed and all SCMs identified, enter information that can be extracted from the project plan into the inventory template.
8. Save the mark-ups to the plan(s) PDFs.

**Step 2 - SCM Location Identification**

1. Google Maps (or Google Earth), Bing Maps, LatLong.net, and other sites can be used to locate the approximate latitude and longitude of the SCM using satellite imagery. Place a pin at the centroid of the SCM footprint to query the coordinate location (Figure 2.4.3).

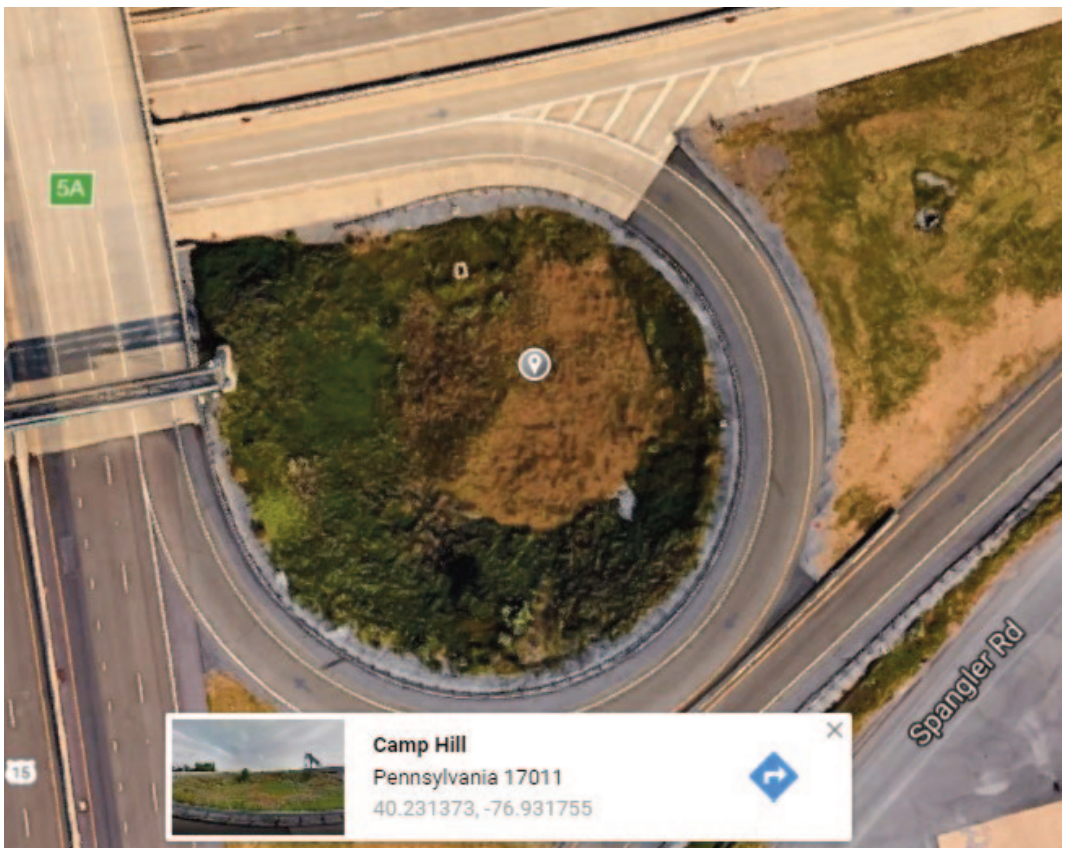



**Figure 2.4.3: SCM Coordinate Determination**

(image c/o Google Maps, November 2017)

   a. Avoid transcription errors by copying and pasting the decimal degree location into the SCM_INVENTORY_TEMPLATE.
   b. If the SCM does not appear in satellite imagery, estimate the location of the SCM's centroid based on the plan.

2. Google Street View or PennDOT VideoLog can be used to determine whether or not the SCM is visible from the road.
3. eMapPA can be used to identify the receiving surface water and its 25 Pa Code Chapter 93 designation when the receiving surface water is not listed in the NPDES Permit or plans.

## Procedure to Modify Inspection/Maintenance Requirements

NPDES permits did not require a separate PCSM Plan until 2003. It was not until about 2007 that PCSM Plans consistently included instructions for long-term operation and maintenance (O&M) of the SCMs (aka, stormwater BMPs). Generally, the instructions called for a combination of regularly scheduled (e.g., yearly) and storm-event-based inspections. The Department is required to adhere to the O&M stipulated by the as-built PCSM Plan.

As a means to create a more consistent protocol, in coordination with PADEP, the Department developed a process to review existing SCMs and apply the appropriate maintenance protocol to them. The goal is to have consistent inspection and routine maintenance activities and cycles for each SCM type to the extent possible, regardless of when they were constructed.

Scenario A:

An existing SCM constructed with no NPDES permit or with no O&M instructions in the PCSM Plan. If the existing SCM was constructed without a PCSM Plan (i.e., not part of an NPDES permit) or prior to the inclusion of O&M instructions in the PCSM Plan, it has no associated regulatory inspection requirement and should follow the standard inspection and maintenance protocols in this publication. Inspections should begin with a Condition Assessment, and then they should follow a schedule based on the standard cycles.

Scenario B:

An existing SCM constructed with an NPDES permit. The NPDES PCSM Plan O&M requirements must be followed until the steps outlined below are completed. In order to replace the O&M requirements in the PCSM Plan, an evaluation of the SCM must be performed to determine if standard procedures are appropriate. Form M-80, Existing Stormwater Control Measure Operation and Maintenance Determination, is used by the licensed professional to guide the evaluation, document findings, and propose changes to the O&M requirements in the PCSM Plan.

The review includes looking at the SCM's design and site limitations, including the following:

Design Limitations

- Excessive loading ratio - Loading ratio exceeding the PA Stormwater BMP Manual guidelines (e.g., 5:1 max. impervious drainage area to SCM infiltration area).
- Lack of pretreatment - The absence of a forebay, grass filter, gravel diaphragm, or other mechanism for reducing sedimentation within the main SCM area.
- Unique SCMs - SCMs designs that are dissimilar to common SCM types.
- Proprietary SCMs - SCMs that would default to manufacturer's O&M guidelines.

Site Limitations

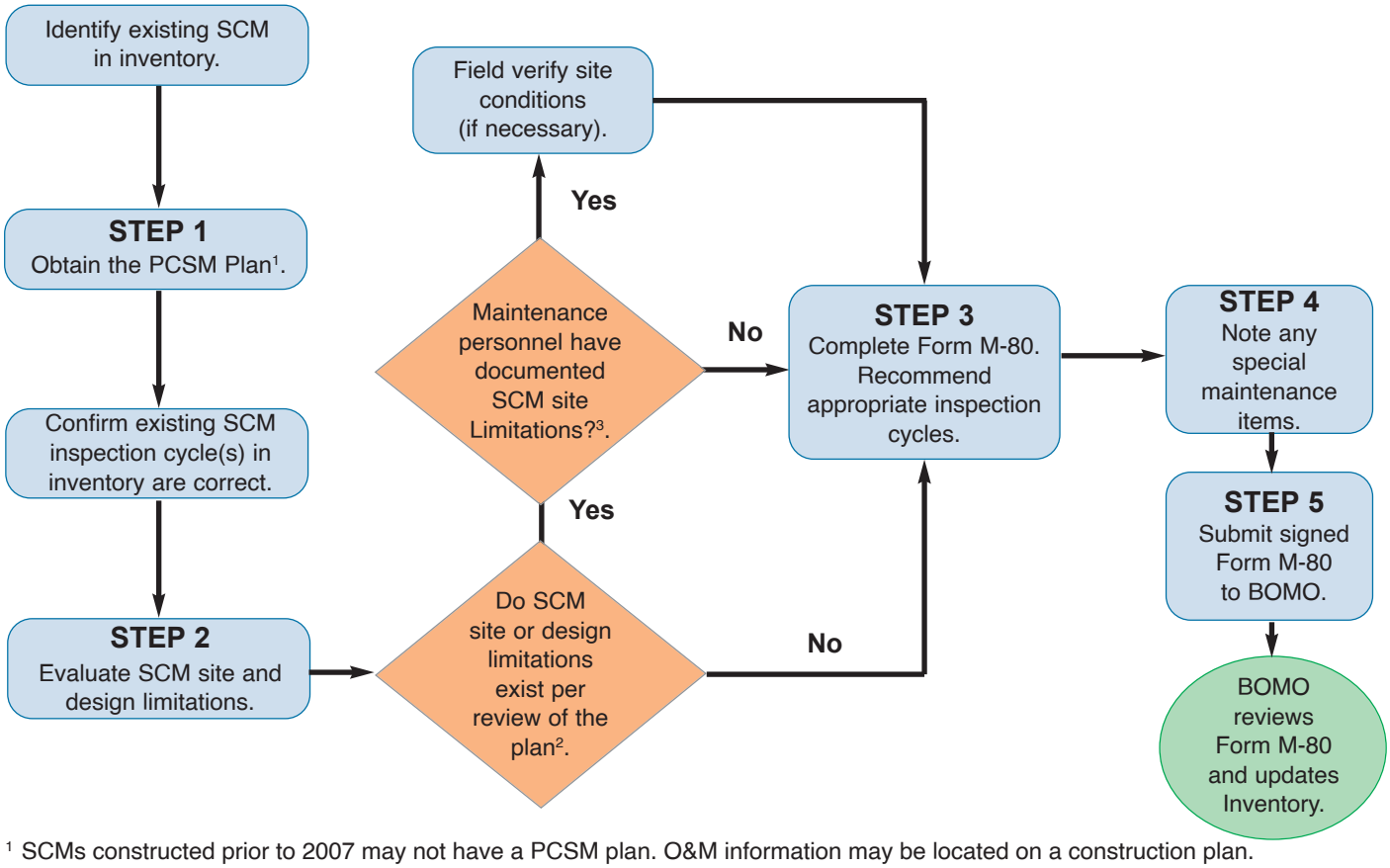
- High risk of failure - An unlined basin in karst terrain with minimal depth to bedrock.
- History of vandalism or illegal dumping.
- History of intensive O&M to maintain SCM function - Consult with maintenance personnel (could be corrected over time via a condition assessment).

Form M-80 provides a systematic approach to verify the applicability of standard inspection and routine maintenance cycles, and to identify SCMs that require special conditions, as noted above. Each question on the form should be answered, and the form is considered complete when the licensed professional has completed the "Certification" section. The completed Form M-80 should be named using the SCM ID and date of completion as follows: 10-digit SCM ID_YYYY-MM-DD_M80

For example, an M-80 for SCM 0610BDD001 completed on June 16, 2019 would be 0610BDD001_2019-06-16_M80.

Each existing SCM must be evaluated separately by a licensed professional (defined in 25 Pa Code 102.1) using the following five-step process. This process is also illustrated in Figure 2.4.4.

1. Obtain the PCSM Plan and confirm the existing SCM inspection cycle(s) in the inventory are correct. If one is not available, use another plan that provides adequate detail. If no plans are available, either (a) wait until a CAI is completed and use the report; or (b) consult with District or County maintenance personnel on known issues.
2. Following the decision points shown in Figure 2.4.4, review the plans to identify potential design limitations associated with the SCM and the surrounding site.
3. Complete Form M-80. Evaluate the SCM for certain limiting conditions, which may indicate the need for more frequent inspections than the standard cycles.
4. Record any special maintenance items on the PCSM Plan that are significantly different than the routine maintenance identified in this publication for that particular SCM type.
5. Submit Form M-80 to BOMO-MTLD Stormwater Section.




[1] SCMs constructed prior to 2007 may not have a PCSM plan. O&M information may be located on a construction plan.

[2] Conditions may include propriety device, excessive loading ratio, lack of pretreatment, etc.

[3] Conditions may include history of vandalism, illegal dumping, clogged outlet structure, etc.

**Figure 2.4.4: Process Flow Chart for Evaluating Existing SCM Maintenance Requirements**

Examples of recommended modifications to existing SCM inspection and routine maintenance cycles are provided in Table 2.4.1 and Table 2.4.2, respectively. BOMO-MTLD Stormwater Section will review the submitted forms and update the SCM inventory database accordingly. Upon request from PADEP, the Department will provide a list containing SCMs with inspection and maintenance activities and cycles that differ from the original PCSM Plan.

**Table 2.4.1: Examples of Inspection Cycle Modifications**

| SCM ID | Current Cycle (yrs) | Recommended Cycle (yrs) | Justification |
|---|---|---|---|
| 0120 BID 005 | 1 + after >1" rainfall event | Standard | Design is consistent with PA Stormwater BMP Manual; no history of problems. |
| 0150 BRE 012 | 1 + after >1" rainfall event | 1 | Excessive impervious area loading ratio; no significant history of problems. |
| 0220 SIT 003 | 1 | No change | County documented multiple incidents of vandalism. |
| 0280 BOT 020 | 3 | Standard | No PCSM Plan or O&M requirements. Condition Assessment did not reveal major problems. |

**Table 2.4.2: Examples of Routine Maintenance Modifications**

| SCM ID | Current Requirement | Recommended Requirement | Justification |
|---|---|---|---|
| 0830 BDD 010 | Mow 3x/yr | Standard | Update to current policy. No apparent need for more frequent mowing. |
| 1020 BWD 002 | Remove sediment 2x/yr | No change | History of sediment accumulation in SCM reported by County Maintenance. |

## 2.5 SCM Plan Storage

Plans containing information about a Department-owned SCM are stored electronically on the Department's network server. A PDF of the plan should be placed in the appropriate folder under P:\penndot shared\Stormwater Management\PCSM As-Built Plans. If the as-built PCSM Plan is not available, the PCSM Plan that was submitted with the NPDES NOI/application should be copied into the folder. Within each District folder are County sub-folders; within each County folder are sub-folders for the project associated with the plan.

Project folders are created by each District and use the following naming convention for ECMS projects.

[ECMS#]_SR ####-[Section]_[Project Name]. For example, 11432_SR 3012-01B _Schantz Road.

The plan file is named according to the following convention:

[ECMS#]_SR####_PCSM. For example, 18014_SR1009_PCSM.

For non-ECMS projects, use the appropriate Department project number and site location.

## 2.6 Adding and Modifying Data

Districts are responsible for notifying their Regional EMS/MS4 Advisor when the SCM inventory in Maintenance-IQ needs updated. District notifications should facilitate the data changes via the SCM inventory data template.

### SCM Inventory Data Template

The SCM inventory data template contains two visible tabs and several hidden tabs. The tab labeled "DIST_XX" is where data is entered for conveyance to BOMO and ultimately entry into Maintenance-IQ. The tab labeled "FIELDS" is for information only and contains brief descriptions of the column headings in the data entry tab as well as formatting and data source information. **Do not** add or delete columns or change column headings in the data entry tab.

As noted on the "FIELDS" tab, some of the data columns require text entry, while others contain a drop-down menu. As soon as information on an SCM becomes available, the District designee should enter data into the template. As explained in Section 2.3, BOMO will assign IDs to each SCM and update Maintenance-IQ. Once an ID is assigned, the District can add or modify data for that SCM whenever needed; however, information in Maintenance-IQ is only updated by the Regional EMS/MS4 Advisor after being notified by the District that a template has been created.

In order for a SCM to be entered into Maintenance IQ SCM inventory and assigned an ID, the minimum information that must be collected includes:

- SCM Type
- Inspection frequency
- Latitude and longitude
- Any special maintenance requirements listed on the PCSM plan

## 2.7 Signage

Effective signage or delineation of an SCM can prevent unintentional disturbances that affect function. Proper signage also aids in locating the SCM in the field while helping to ensure maintenance tasks are performed. Though it is not required by the Department, it is recommended that signage be placed at every SCM.

Some SCM types are more clearly delineated by using multiple signs. Signage placement is dependent on SCM type and is described further in the guidance below. The standard signing utilizes the "Stormwater Control Measure Marker" delineator which utilizes a Type GM-2 or SM-2 delineator per TC-8604 of Publication 111- Traffic Control with an SCM identification sticker. The delineator should be a red, maintenance marker type as described under "Types of Delineators" on Sheet 4 of TC-8604. To prevent possible erosion at the base of the markers located in grassed areas, the surface around the base should be protected with stone.

The primary feature of the SCM Marker is the identification sticker (Figure 2.7.1), which clearly displays the facilities SCM identification code (SCM_ID) defined in Section 2.1. This code is unique to each SCM, includes the SCM type code, and matches the SCM ID in the SCM inventory. The SCM stickers must be manufactured with reflective sheeting and black vinyl legend. The sheeting color must match the color of the closest pavement marking as required under "Types of Delineators" on Sheet 4 of TC-8604 (Pub. 111). Reflective sheeting needs to be on both sides of the delineator unless it is a one-way road. The SCM identification sticker only appears on one side as described below. To ensure proper adhesion, the sticker must be applied to a clean delineator in warm temperatures.

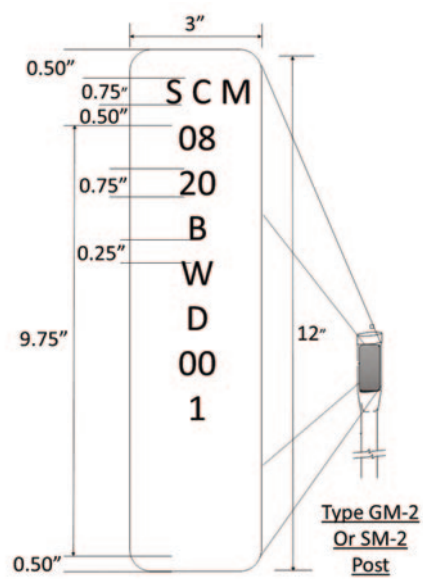



**Figure 2.7.1: Example SCM Marker Identification Sticker. Sticker replaces reflective sheeting.**

In areas where the SCMs are located off the roadway, segment marker signs may be used. The SCM identification code would be placed on the sign. The segment marker sign could be attached at the access point of the SCM, on the right of way fence or on a post.

## Sign Placement

For the purposes of signage, SCMs can be broken down into three categories: linear SCMs, basin SCMs, and underground SCMs (Table 2.7.1). Each category has its own requirements for sign placement (Figure 2.7.2).

### Linear SCMs

SCMs that are generally parallel to the roadway and utilize the shoulder or a pull-off for access should have SCM Markers placed at the beginning and end of the SCM to mark the extents for visibility as well as maintenance. The first marker is located at the start of the facility with respect to the direction of travel on the adjacent travel lane with the SCM ID “Sticker” facing the oncoming traffic. When located in the center median of a divided roadway, the start of the facility and direction of sticker should be the western terminus for east-west roads and should be the southern terminus for north-south roads (conforming to interstate mileage direction). The SCM Marker at the end of the facility should not receive a sticker. Linear SCMs may be placed in succession such that the end of one SCM is the beginning of another. When this is the case, an end marker will only be placed at the end of the series of SCMs. An example of this is as follows: a channel runs along the roadway, midway through the channel is an inlet which will be the end of the first vegetated swale and the beginning of the second. Do not place an end marker for the first SCM at this inlet, simply install the marker for the SCM that starts there. The majority of linear SCMs follow the guidance set forth above and are listed in Table 2.7.1. Examples of linear SCMs include but are not limited to vegetated filer strips, vegetated swales, and restoration SCMs.

Signage for the SCMs listed below follow the guidance for linear SCMs even though these SCMs may traditionally fall into other categories or multiple categories.

- Pervious Pavement (PPA, PPC, PPP) – Pervious pavement is currently not recommended for use within the travel way. Should pervious pavement be located in a parking lot, park and ride or other facility, signage should be placed behind the curb line at either extent of the pervious pavement section.
- Subsurface Infiltration Trench (SIT) – Signing should follow the linear SCM placement guidance, not the underground SCM guidance. Signage should be placed at the beginning and end of the trench area relative to the roadway to delineate its extents.

### Basin SCMs

Basin SCMs are excavated facilities that create an impoundment for the temporary surface storage of stormwater runoff. Examples of Basin SCMs include but are not limited to detention basins, stormwater wetlands, and infiltration basins. At least one SCM Marker is necessary to locate this type of SCM. The marker should be placed at the SCM access point (e.g., road or pull-off) so that it is visible from the roadway. If no formal access is provided, the signage should be placed adjacent to the shoulder at the most logical point of access. In certain situations, it may be necessary to place multiple SCM Markers for a basin SCM. Examples include when the SCM is not visible from the roadway or if multiple SCMs utilize the same access point. In these situations, it is necessary to place an SCM marker at the access point and an additional marker in the vicinity of the SCM itself. Wherever practicable the SCM marker should be visible from the access point.

### Underground SCMs

Underground SCMs include manufactured treatment devices, subsurface detention storage, and other non-basin SCMs such as inlet sumps and water quality inlets. The type of signage employed for underground SCMs depends on the SCMs location relative to the roadway. SCMs located outside of the roadway footprint receive one SCM marker placed in a similar fashion to basin SCMs. If no access road/pull-off is present, the sign may also be placed next to the access manhole for the SCM if present. For underground SCMs within the roadway footprint, the SCM ID may be stenciled directly on the access manhole, inlet, or SCM to signify that the facility is an SCM and not a traditional drainage appurtenance.

**Table 2.7.1: SCM Categories for Sign Placement**

| Type | SCM Name/Type | Code(s) |
|---|---|---|
| Linear | Flow Dispersion/Level Spreader Outfall | FDF, FDV, LSO |
| | Forest Preservation | FPR |
| | Infiltration Berm | IBE |
| | Landscape Restoration Meadow | LRM |
| | Media Filter Drain | MFD |
| | Reforestation/Tree Planting | RTP |
| | Regenerative Step Pool | RSP |
| | Riparian Buffer | RBE, RBO |
| | Soil Amendment Restoration | SAR |
| | Vegetated Filter Strip | VFS, VSS |
| | Vegetated Swale | VSW, VSC |
| | Pervious Pavement | PPA, PPC, PPP |
| | Subsurface Infiltration Trench | SIT |
| Basins | Detention Basins | BDD, BED, BUD, BND |
| | Infiltration Basin | BID |
| | Wet Detention Basin | BWD |
| | Bioretention | BRE/BRU |
| | Other Basins | BOT |
| | Stormwater Wetland | SWE |
| | Constr. Storm. Filter | CSF |
| Underground | Manufactured Treat. Device | MTD |
| | Subsurface Det. Storage | SDS |
| | Non-Basin Other | NBO |

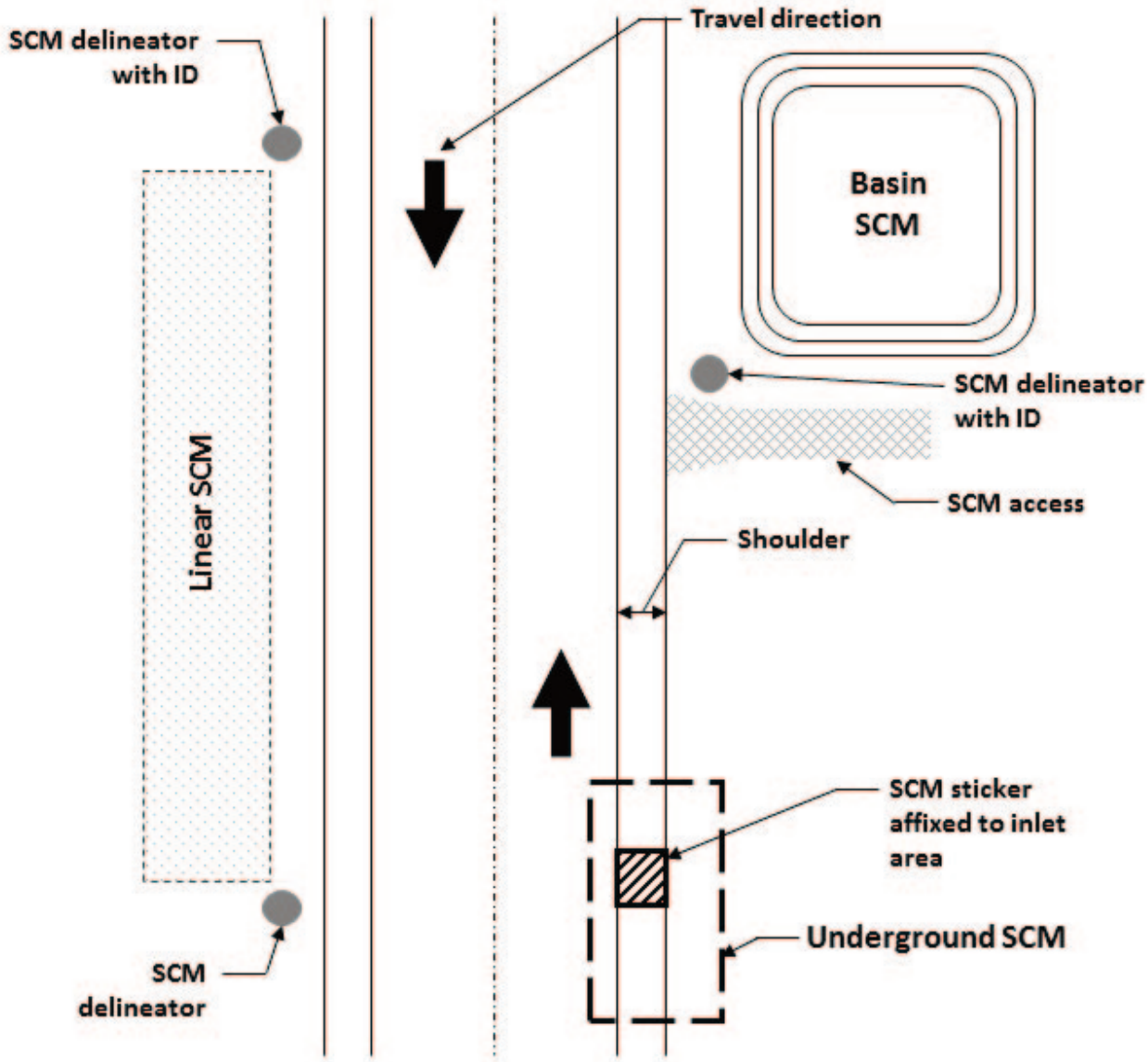



**Figure 2.7.2: Example Sign Placement for Each SCM Category**

# Chapter 3 - Inspection Procedures

## Publication 888 - SCM Maintenance Manual

- Two types of SCM inspections with varying levels of effort
  - Visual Screening
  - Condition Assessment
- Some vegetated SCMs can only be inspected from spring to fall
- Start-up phase inspections needed for some SCM types
- Inspections and maintenance of SCMs are separate activities

### Visual Screening Inspections

- VSI - Routine (1 hour on site)
  - Non-invasive using visual indicators
  - As-Built Plan is not required
  - Documented with Forms M-77 and M-78 (photographs)
  - 3-year cycle for most SCM types

### Condition Assessment Inspections

- CAI - In-depth (2-4 hours on site)
  - Minimally invasive
  - Confirm accuracy of As-Built Plan
  - Documented with Forms M-78 and M-79, plus a full or summary report
  - Overall performance rating of A-F
  - 1 year after construction + every 10 years

### QA/QC Program

- District Quality Control (QC)
  - Inspection reports
  - Inventory data
  - Inspection cycles
  - Maintenance records
- Central Office Quality Assurance (QA)
  - Blind field inspections

# CHAPTER 3

# INSPECTION PROCEDURES

## 3.1 Inspection Types

This chapter describes the inspection procedures required for Department-owned SCMs. Note, the inspections are independent of any routine, preventative maintenance cycles, such as mowing and removal of trash/debris required for SCMs. Refer to Chapters 4, 5, and 6 on general maintenance and SCM specific maintenance for additional guidance.

**Figure 3.1.1 SCM Inspection in Progress**

A key component of the Department's SCM maintenance program is periodic evaluation of the SCM's condition and performance. Two types of evaluations are used with varying levels of effort: Visual Screenings (VS) and Condition Assessments (CA). Each type of evaluation involves an on-site inspection and has standardized timing, methods, and documentation of the inspection process. Note that for both inspection types, personnel must be certified via completion of the appropriate training course offered by the Department. Contact BOMO-MTLD Stormwater Section for requirements.

Visual Screening Inspections (VSI) are routine, non-invasive inspections intended as a “check-up” to identify any obvious problems based on visual indicators. As-built plans (e.g., PCSM Plan, Construction plan, etc.) are not required for this type of inspection, and inspectors are not required to have a professional license. It is anticipated that an average of four VSIs can be completed per day, which includes mobilization and travel between sites. The actual act of inspecting the SCM should take approximately one hour for a VSI. See Table 3.1.1 for an estimate total effort to complete a VSI.

Condition Assessment Inspections (CAIs) are in-depth inspections looking at all SCM components, evaluating all aspects of functionality and performance. A passing grade on a CAI certifies that the SCM should function properly and provide its intended PCSM benefits (peak rate control, volume control, and/or water quality) if it is properly maintained. It is required that an as-built plan, if it exists, be used during the inspection to confirm the SCM was constructed properly. It is recommended that the lead inspector be a licensed professional. Inspectors should anticipate completing the field inspection for two to three CAIs per day depending on complexity and the proximity of SCMs.

In addition to the field work and completed CAI form, a Full CA Report and/or CA Summary Report is required for CAIs. Passing SCMs only require a one-page Summary CA Report; SCMs receiving a failing grade require both a Summary CA Report and a Full CA Report. The report discusses the cause(s) of the failing grade and recommends rehabilitation measures to restore SCM function. It is required that the CA report be reviewed by a licensed professional if the lead inspector preparing the report is not. Report specifics are described in more detail in the section on Condition Assessment Inspection Form and Reports. The total CAI effort when a PCSM plan is on record is anticipated to be 14 to 20 hours, which includes 2 to 4 hours on-site field time per SCM (4 to 8 hours total for a two-person crew). The initial CAI effort when no PCSM plan is anticipated to be approximately 30 hours. Refer to Table 3.1.1 for a breakdown of the total effort necessary to complete a CA.

**Table 3.1.1: Anticipated Level of Effort by SCM Inspection Type**

| Task | VSI (hrs) | CAI (hrs) |
|---|---|---|
| Preparation | 0.5 | 4 |
| Travel | varies | varies |
| On-Site* | 1 (2) | 3 (6) |
| Photo Form (M-78) | 1 | 2 |
| Summary/Report | 0.5 | 6-8 |
| Total 2- person team | 4 | 18-20 |

* Number in ( ) is for two people

## 3.2 Inspection Frequency

A schedule of SCM inspection frequencies for newly constructed general SCM types is outlined in Table 3.2.1 (See end of this section for SCMs constructed pre-2019). Similar SCM types are grouped together. Most SCMs that require regular maintenance require both CA and VS inspections. This results in most SCMs being inspected a minimum of once every three years throughout their lifespan. Only certain SCM types can be inspected during winter months, when vegetation dies or goes dormant and the ground freezes. If vegetation or infiltration is a critical component of the SCM, the inspection must occur between the spring and fall seasons as indicated in the table.

Certain SCM types have a “start-up phase”, or a period of time following construction in which more frequent check-ups are needed to ensure proper vegetative establishment. These check-ups occur in conjunction with the regular maintenance that occurs during the start-up phase. A VSI form is required documentation. The SCM types with a start-up phase are indicated in Table 3.2.1.

Descriptions of these additional start-up requirements are provided in the individual SCM sections in Chapter 5.

**Table 3.2.1: SCM Inspection Requirements**

| General SCM Type | SCM Type Code(s) | Start-Up Phase* | CAI Required | VSI Required | Spring-Fall Only |
|---|---|---|---|---|---|
| Basin | BDD, BED, BUD, BOT, BND, BWD | ●† | ● | ● | ● |
| Bioretention | BRE, BRU | ● | ● | ● | ● |
| Filter | CSF, MFD | | ● | ● | |
| Flow Dispersion | FDF, FDV, LSO | | ● | ● | |
| Infiltration | BID, IBE, SIT | ●† | ● | ● | ● |
| Manuf. Treat. Device | MTD | | ● | ● | |
| Permeable Pavement | PPA, PPC, PPP | | ● | ● | |
| Riparian Buffer | RBE, RBO | ● | | ● | ● |
| Stormwater Wetland | SWE | ● | ● | ● | ● |
| Stream | SRE, SST | ^ | | | |
| Subsurface Detention | SDS | | ● | ● | |
| Vegetated Filter Strip | VFS, VSS | | ● | ● | ● |
| Vegetated Swale | VSW, VSC | | ● | ● | ● |
| Restoration | FPR, RTP, LRM, SAR | ● | | ● | ● |
| Other | RSP, NBO | | ● | ● | |

*Start-up phase check-ups at years 2 and 3 uses VSI form M-77. †BID and BUD only. ^ See Section 5.18.1.

An initial SCM inspection should be conducted approximately one year after the NPDES permit Notice of Termination. The initial inspection is a CAI for all SCMs except Riparian Buffers (RBE, RBO), Streams (SRE, SST), and Restoration SCMs (FRP RTP LRM, SAR). This assessment confirms proper construction, identifies issues that surface after a full year of weather conditions, and establishes a baseline condition for future inspections. For these SCMs, a new CA must be performed approximately every 10 years thereafter. The subsequent assessments are necessary to verify functionality and, if applicable, pollutant reduction credit. The initial VSI will occur three years after the initial CAI has been completed and continues every three years (i.e., triennial cycle) thereafter. Figure 3.2.1 presents a timeline of a typical SCM inspection cycle.

For Riparian Buffers (RBE, RBO) and Restoration SCMs (FRP RTP LRM, SAR), inspections are only required during the first 4 years of service live. A VSI should be conducted approximately one year after the NPDES permit Notice of Termination. Start-up phase inspections should occur at year 2 and 3. A final VSI is required during the fourth year. Figure 3.2.2 presents an inspection timeline for these SCMs.

Stream (SRE, SST) SCMs will receive inspections in accordance with 25 PA Code Ch 105 requirements and are not governed by this publication.

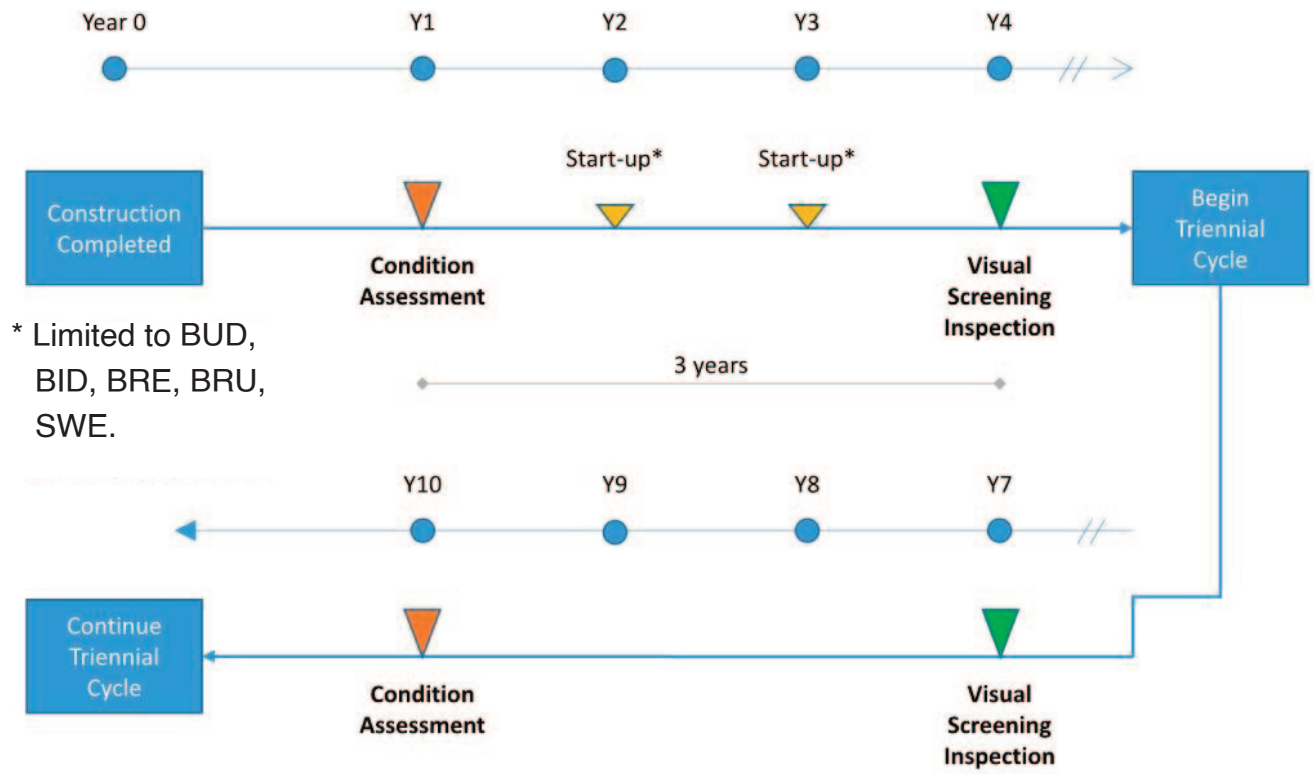



**Figure 3.2.1: SCM Inspection Timeline**

## Existing SCMs (Pre-2019)

Figure 3.2.1 can be applied to existing SCMs after an evaluation using Form M-80 is completed as described in Chapter 2, Section 2.4- Existing SCMs. Until the evaluation is completed, the inspection requirements contained in the PCSM Plan must be followed. If the existing SCM was designed and constructed without a PCSM Plan (not part of an NPDES permit or prior to 2007 PCSM inclusion of O&M), it has no associated regulatory inspection requirement, no Form M-80 evaluation is required, and it should follow the standard cycles.

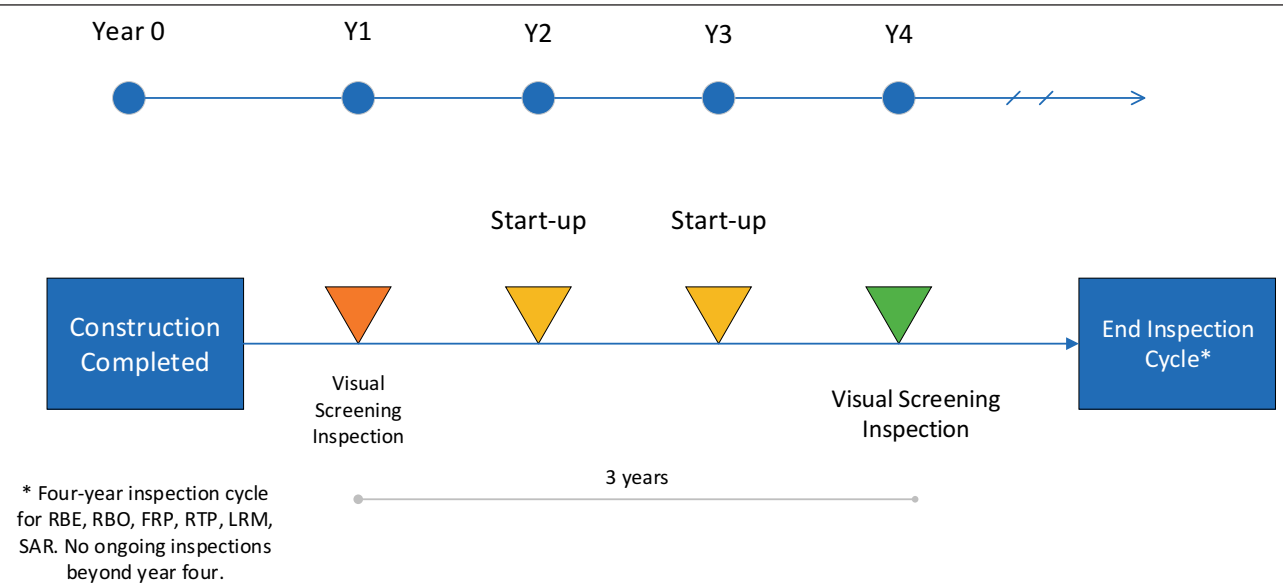



**Figure 3.2.2: RBE, RBO, FPR, RTP, LRM, SAR Inspection Timeline**

## 3.3 Inspection Planning

Inspections may require inspectors to work adjacent to areas of heavy traffic, around impounded water, on steep slopes, or other areas that expose them to the common hazards of field work. For safety reasons, all inspections should be conducted with inspection teams of at least two people.

Prior to going into the field for the inspection, the following preparation is recommended:

- Obtain the location (coordinates) and directions to the SCMs to be inspected. Teams should consider getting a quick visual of the site(s) through Google Street View, PennDOT's VideoLog, or Maintenance-IQ beforehand to minimize potential confusion in the field.
- Have access to enough forms for the type of inspection(s) being conducted to complete the scheduled inspections each day. Take extras if using paper copies of the form.
- Schedule the daily inspections of SCMs in close proximity to minimize travel time.
- Review Maintenance-IQ to obtain previous inspection data, PCSM Plans (for CAIs) and other information about the SCM.
- Assess need for temporary traffic control and make arrangements as needed.

SCM inspectors must adhere to temporary traffic control guidelines in Publication 213. Most SCM inspections can be considered short term with stationary operations lasting approximately one hour with a work space beyond the shoulder. Confirm the proper Pennsylvania Typical Application (PATA) setup is used based on SCM location, access, and staging needs. All inspection vehicles should be equipped with a flashing yellow light.

Schedule inspections during appropriate weather. Avoid performing inspections when the ground and/or standing water is frozen, as it limits inspection of infiltration media and functionality. Winter inspections are not recommended for SCMs which will require vegetative cover identification, as foliage will not be present on deciduous species (see Table 3.2.1). Additionally, densely vegetated SCMs may be challenging to enter during summer and fall months. Early spring, when leaves are present but not in full growth, may be best for these SCMs. Consider scheduling inspections shortly after a rainfall to confirm appropriate drawdown times for detaining, infiltrating and filtrating systems. Typical designs include complete drawdown or infiltration within 72 hours of the rainfall.

Inspectors should be equipped with the proper tools, which will vary from site to site. A list of commonly used equipment is as follows.

- Safety vest, helmet, and other site specific PPE
- Inspection forms, clipboard, paper, pen/pencil, scale
- Tape measure and measuring wheel
- Camera with extra batteries and memory
- Dry erase board and markers
- Manhole pick - opening grates and manholes (CAI only)
- Wrench - unscrewing caps on PVC observation wells
- Waders - SCMs with permanent pool, inadequate infiltration/drainage, or deep layer of deposited sediment
- Keys for gate locks (where applicable)
- Shovel and rake (CAI only)
- As-built PCSM Plan or other plan (required for CAI only)

- Hand soil auger and/or soil probe (CAI only)
- Personal field items such as bug/tick spray, sunscreen, etc.

The Department requires all workers (employees and consultants) engaged in field operations to wear a hard hat meeting ANSI Type 1 requirements and a high-visibility vest, t-shirt, or sweatshirt meeting ANSI Class 2 or 3 safety garment requirements. Therefore, SCM inspectors must wear a hard hat and high-visibility vest at all times when completing inspections to remain visible to traffic. Proper footwear of above ankle design must also be worn. Sneakers and open-toe footwear (flip-flops, sandals, etc.) are not appropriate for SCM inspection work. Follow all applicable PennDOT safety procedures at all times.

In accordance with OSHA regulations, entry into confined spaces is prohibited without proper current OSHA training certification. Confined space is defined by OSHA as a space that (1) is large enough and so configured that an employee can bodily enter it; (2) has limited or restricted means for entry and exit; and (3) is not designed for continuous employee occupancy. Inlets, manholes, and most culverts are examples of spaces meeting the OSHA confined space definition. Should inspections require entry into confined spaces, personnel with OSHA confined space training must conduct the inspections. Trained personnel must follow all applicable OSHA entry requirements including use of appropriate safety measures and obtaining an entry permit when applicable.

### Questions from the Public

When conducting inspections, answer questions from the public honestly and diplomatically to maintain good public relations. Inform the citizen that a condition survey is being conducted to better enable the Department to maintain the SCM. Politely direct any specific questions or concerns to the District office. Keep the appropriate phone numbers on hand for these occasions.

## 3.4 Visual Screening Inspection Form (M-77)

The goal of a VSI is to identify problems that may inhibit an SCM from functioning properly. In order to perform VSIs and insure accurate SCM ratings, inspectors must have completed the Departments Visual Screening Inspection training. Inspectors must fill out the SCM Visual Screen Inspection Form (M-77) to document a visual screening. Form M-77 is a “smart” PDF that allows users to enter information electronically from a computer or tablet. The form fields are coded so that the information entered can be exported to a database for maintenance scheduling, document storage, and reference in Maintenance-IQ. Inspectors may complete the form in paper format in the field if a tablet is not available; however, the information must be re-entered electronically in the office before the form can be submitted. An electronic scan of a handwritten form is not acceptable.

The goal of a VSI is to identify problems that may inhibit SCM functionality. Form M-77 is divided into five primary problem categories: debris/trash, erosion, ponding, vegetation, and miscellaneous. Each category contains multiple items where the inspector must analyze the SCM’s condition and recommend an appropriate maintenance response or action. The response could vary from none being necessary to immediate corrective maintenance. Comments and photographs are important and required when certain ratings are determined by the inspector. Any comments provided by the inspector should be as descriptive as possible so that the potential problems can be accurately assessed upon review. Quality photographs are needed to document the severity of the problem. Additional guidance on SCM inspection photographs can be found in Section 3.6. Additional instructions on completing Form M-77 are available in Appendix B.

Refer to Section 3.7 - Submitting Results for information on submitting the required VS documentation.

## 3.5 Condition Assessment Inspection Form (M-79) and Reports

The CAI is a more detailed inspection of SCMs than the VSI. The CAI serves multiple goals in the SCM maintenance program. The initial CAI establishes as a baseline to confirm construction and initial functionality of the SCM. CAIs identify both easily recognized problems and subtle functionality concerns. In order to perform CAIs, inspectors must have completed the Department's Condition Assessment Inspection training. It is recommended the lead inspector be a licensed professional. It is required that the CA report be reviewed by a licensed professional if the lead inspector preparing the report is not.

### SCM Condition Assessment Inspection Form (M-79)

The Stormwater Control Measure Condition Assessment Inspection Form (M-79) is filled out when completing a CAI. M-79 is a clickable PDF with dropdown menus in some fields that allows users to enter information electronically in the field from a computer or tablet. Inspectors may complete the form in paper format in the field if a tablet is not available; however, the information must be re-entered electronically before submittal. A scan of a handwritten form is not acceptable.

Form M-79 covers the five key SCM areas (inflow, perimeter, bed/treatment, vegetation, and outflow) including a detailed review of the contributing drainage area. To accomplish this, the form is divided into five main sections followed by a summary performance rating section assessing all the SCM components. The main sections include: background information, site conditions, inflow and outflow, treatment performance, and side slopes and embankments. Additional areas are provided for sketches, photograph tracking, supplementary comments. The performance rating section summarizes the condition of the SCM based on the CAI results and assigns an overall performance rating in the form of a letter grade (e.g., A, B, C, etc.) to the SCM. This overall performance rating determines the type of report that must be completed for the condition assessment.

The following is needed to complete the form:

- As-built plan(s) of the SCM
- SCM inventory information in Maintenance-IQ
- Internet/desktop references such as eMapPA, topographic maps, and current aerial images
- An on-site field inspection to document site conditions

Additional instructions on completing Form M-79 are available in Appendix C.

### Obtaining As-Built Plans

A key part of the CAI is to confirm the SCM matches the as-built plan of record. For newer SCMs, the PCSM Plan filed with the NOT is the as-built plan. The PCSM Plan has been a requirement for projects with an NPDES permit since approximately 2003. PADEP refers to the drawings and a narrative report as the PCSM Plan. In this Publication, the term PCSM Plan refers to only the set of plan drawings.

In order to perform the CAI for an SCM constructed in 2003 or later, the inspector must obtain the as-built PCSM Plan for the SCM. Newer SCMs should have the as-built plans filed in the SCM plan database available on the Department's server under the stormwater management folder. However, SCMs constructed prior to the initiation of the SCM inventory tracking program may not have as-built PCSM Plans in the database. Each PennDOT district is responsible for confirming the initial inventory information contains the as-built PCSM Plans for SCMs in their jurisdiction. Prior to performing inspections, every effort must be made to obtain the as-built PCSM Plan and, when possible, the PCSM narrative report. When an as-built PCSM Plan is not found in the database, requests for the as-built PCSM Plan and narrative report should be made to the PennDOT

District Plans Unit, District Stormwater Maintenance Coordinator (DSMC, see Chapter 7), District Environmental Manager or District NPDES Coordinator.

For SCMs that do not have a PCSM Plan, other plans containing the SCM information should be obtained. The as-built Construction Plans and "Also plans" such as Erosion and Sediment Pollution Control (E&S) Plans and Landscape plans should contain all information required to construct the SCM. The Construction Plan set may include sheets called Contour Grading and Drainage Plans illustrating the proposed SCM contours, while the details sheets may include inflow and outflow control structures details. The E&S Plan will likely contain seeding information and may also include grading and flow control structure information.

## CA Reports

A CA report must be completed and certified to complete the condition assessment process. Two different report templates have been developed for use based on factors identified during the CAI: the Stormwater Control Measure Summary Condition Assessment Report (Summary CA Report), and the Stormwater Control Measure Full Condition Assessment Report (Full CA Report). Templates of the summary and full reports are located in P:\penndot shared\Stormwater Management\SCM Inspections (link accessible to internal PennDOT users only). Both reports should be signed by a licensed professional who has attended the Department's SCM Condition Assessment Inspection training.

## Summary CA Report

The Summary CA Report is a one-page form that summarizes the general SCM identification information, the CAI overall performance rating, and any corrective maintenance or rehabilitation items identified by the CAI. It is completed for all CAIs and serves as the executive summary of the CA.

The Summary CA Report includes two tables to list corrective maintenance and rehabilitation action items. The Corrective Maintenance Items table should include deficiencies that can be resolved with routine maintenance tasks or corrective action. These are not things that require design modifications, deviation from the as-built plan, or reconstruction of the SCM. Repairs such as sediment removal or minor concrete structure repair work would be listed in this table. These types of activities would typically correspond with ratings of 1 and 2, sometimes 3, on the Key Areas of Potential Issues/Concerns table of the CAI form.

The Rehabilitation Items table should include situations where an engineering assessment of the design is required, where major SCM reconstruction to address an issue is needed, or where additional field testing and evaluation is needed to properly diagnose the problem. These typically correspond to issues and concerns rated as 4 or 5 on the Key Areas of Potential Issues/Concerns table of the CAI form.

The Summary CA Report must be signed by the overseeing licensed professional.

Refer to Section 3.7 - Submitting Results for information on compiling and submitting all the required CA documentation.

## Full CA Report

The Full CA Report is a multi-page report with detailed descriptions of the SCM, inspection findings, and recommended maintenance and rehabilitation activities. The full report is required for either of two scenarios:

1. The overall CA performance rating is a D or F.
2. It is the first CA of an SCM with no as-built plan.

In the second case, the Full CA Report, along with field sketches and photos of the existing conditions, serve as the as-built plan for future inspections.

The Full CA Report is an opportunity to write detailed descriptions of problems and issues identified during the CAI. Findings and recommendations are written in a report style format using the report template, which uses section numbers and titles matching the CAI form. The report template ensures that there is consistency in content and format amongst reports. The template may be modified from time to time; therefore, the template should be downloaded each time a new report is started. Do not copy and edit an older report.
The template uses [red text in brackets] to indicate information to be modified and completed, while the black text (not in brackets) is standard language that does not need to be modified. The red text in brackets should be replaced with the appropriate information about the SCM in black text. Text highlighted yellow indicates an item that must be attached to the report by the inspector. The last section of the Full CA Report contains the same two tables of corrective maintenance and rehabilitation recommendations that are found on the Summary CA Report. After inserting all the required information, the report should have no remaining red text or yellow highlights. Once all information has been added to the document, the table of contents page numbers should be updated following the instructions provided in the template.

The Summary CA Report must be completed even when the Full CA Report is required and will serve as the executive summary. Refer to Section 3.7 - Submitting Results for information on compiling and submitting all the required CA documentation.

## 3.6 SCM Inspection Photographs Form (M-78)

The SCM Inspection Photographs Form (M-78) is used to organize and label digital photographs that support inspection findings for both visual screenings and conditions assessments.

Photographs are evidence that an inspection was performed, and they assist office personal with trouble shooting and remediation planning. When taking digital photographs, the following should be considered.

- The feature of interest should be clear and centered.
- Include a “wide” view for perspective and a “tight” view for clarity where appropriate.
- Take several photos of any issue found, including from different angles and distances.
- Keep a written log of photo orientation.
- Include an object such as a tape measure in the photo for scale when appropriate.
- Consider sunlight/glare/shadows.
- Try using a flash to minimize shadow effects.
- Include a dry erase board or paper in photo with description.

Form M-78 contains editable fields to insert digital photo files along with supporting information for context such as pertinent notes, the subject’s location within an SCM (e.g., side slope, flow control structure), and the view orientation (e.g., looking northwest toward SCM outfall). At the top of each photo, there is a field labeled “Photo ID.” This field should be used to assign a number to the photo and include a brief name. The numbers in the ID should be numbered sequentially for identification purposes.

Photographs and Form M-78 are required as part of the CA; however, they are only required for a visual screening with a problem requiring an action level of 2 or greater. Whenever Form M-78 is required, an overview photo of the SCM should be taken and inserted as the first photo on the form.

CAI photos should capture the entire facility including both properly functioning and problem areas. Document the whole SCM site, including the drainage area and several pictures of the SCM. Take individual pictures of each SCM component that is covered in Form M-79 and every area of concern identified during the inspection.

When there are a large number of photos or where photo location is not easily discernible, it is recommended to include a photo index map indicating where each photo was taken. Using a copy of the as-built plan or an aerial image, place the "Photo ID" number in a circle at the location the picture was taken with an arrow extending from the circle in the direction the picture is looking (Figure 3.6.1). Other applications generating similar information such as GeoSnap, etc may also be used. This should be added to the M-79 PDF file.


**Figure 3.6.1: Example SCM Photo Index Map**
(image c/o Google Earth, April 2017)

When completing Form M-78 as part of a VSI, the Photo ID should be entered on the corresponding line of the VSI Form (M-77). In addition to the overview photo, VSI photos should include all problems or concerns identified during the inspection.

For VSI photos, GeoSnap may be used instead of Form M-78. Include pertinent notes, the subject's location within an SCM (e.g., side slope, flow control structure), and the view orientation (e.g., looking northwest toward SCM outfall), then upload photos to M-IQ. Document on Form M-77 the location of the photos. For example, photos uploaded in M-IQ.

## 3.7 Submitting Results

### Inspection Record Naming

For a VS, the completed form M-77 should be named using the SCM ID and inspection date as follows: 10-digit SCM ID_YYYY-MM-DD. For example, SCM 0820BDD001 inspection on September 14, 2018 would be named: 0820BDD001_2018-09-14.pdf. If a photo log is also submitted, the naming shall be the same followed by "_p" at the end of the file name. Using the above example, 0820BDD001_2018-09-14_p.pdf.

For a CA, the Summary CA Report, the Full CA Report (when required), form M-79, and form M-78 should be combined, in this order, into a single pdf file. The combined file should be named using the SCM ID and inspection date as follows: 10-digit SCM ID_YYYY-MM-DD. For example, SCM 0820BDD001 inspection on September 14, 2018 would be named: 0820BDD001_2018-09-14.pdf.

### Results Submission

The VS and CA documentation shall be submitted to the DSMC or their designee for review. The individual will review the results and schedule or delegate scheduling follow-up maintenance and/or engineering tasks. Any VSI with action code 5 or CAI with overall failing rating should be reviewed by licensed professional for remediation/rehabilitation recommendations.

## 3.8 Accessing Past Inspections Data

Results of past inspections are available in Maintenance-IQ.

## 3.9 QA/QC Program for Inspections

The accuracy and consistency of the SCM inspection and its documentation are important. The Department employs a Quality Assurance and Quality Control (QA/QC) program for SCM inspections outlined in Table 3.9.1 at the end of this section.

- Quality Control is the enforcement, by a supervisor, of procedures that are intended to maintain the quality of a product or service at or above a specified level.
- Quality Assurance is the independent verification or measurement of the level of quality of a sample product or service.

Quality Control (QC) is the responsibility of each District. The District develops and enforces SCM inspection QC procedures, updates them regularly, and submits an outline of the procedures to the BOMO-MTLD Stormwater Section. BOMO functions as a technical resource to coordinate and standardize the SCM inspection program and disperse appropriate information.

Different personnel are responsible for performing various levels and frequencies of review. The District's QC process involves three tiers of reviews:

- Field inspections reports.
- Completeness of the office SCM records.
- Execution of identified maintenance and/or rehabilitation needs.

The SCM inspection Quality Assurance (QA) Program is an independent, Central Office evaluation function performed by the BOMO-MTLD Stormwater Section to ensure that the Districts are operating in accordance with approved QC plans. QA evaluations will be used to identify areas of non-uniformity in the inspection results throughout the state.

The structure and procedures of the QA Program have been developed to accomplish various objectives:

- Improve the quality of the SCM data contained in Maintenance-IQ, starting with the inventory and continuing with the field information recorded from inspections.

- Improve the accuracy of the condition assessment ratings.
- Improve the accuracy of maintenance item identification and priority level.
- Identify training needs.
- Identify gaps in quality and provide recommendations to close them.

The QA process includes independent re-inspection of SCMs in each of the 11 Districts. Certain activities in the QA Program will be modified or substituted for if it can be determined that the QA process is not providing the best information. The Department anticipates the QA evaluation process undergoing continuous assessment and refinement to provide the most accurate and useful information possible.

## QC Recommendations

The QC of SCM field inspection reports, inventory records, and maintenance activities is an ongoing function at the District level administered by the DSMC or an appointed designee. The DSMC shall conduct an annual meeting with applicable staff or produce and distribute an annual report to review all QC comments and observations. To ensure uniformity and consistency statewide, the following District level QC procedures are recommended.

### QC Review of Inspections

- The Department inspection team leader (or Department PM in the case of consultant inspectors) shall review all VSI and CAI forms, reports and attachments for completeness and accuracy prior to submission.
- The DSMC (or designee) shall review 20% of the VSI and 20% of the CAI inspection forms and reports annually for completeness and accuracy. Review shall be conducted preferably as inspections are completed, at a minimum two times a year, reviewing half the total annual requirement. The selection shall include a representative sampling of SCM types, and from different inspection teams as applicable, from inspections completed within the last six months.

### QC Review of Office Files

The SCM database and SCM files should be reviewed to ensure the information needed for inspections and maintenance is readily available. All documentation of inventory and inspection information should be kept in an orderly and retrievable manner. The District must keep all as-built plans and previous inspection information in the network folders identified in Chapters 2 and 3.

The DSMC (or designee) shall semi-annually:

- Review all recently completed projects to ensure that SCMs have been added to the SCM inventory database and as-built plans are filed appropriately.
- Examine approximately 20% of the files for SCMs that are scheduled for inspection within the next 6 months, confirming that SCM information is available in the SCM inventory via Maintenance-IQ; as-built plans are filed properly; and previous inspection reports are available.
- Review the status of inspections that were due within the past 6 months.

QC Review of Maintenance Activities

To ensure appropriate maintenance is being performed, the ADE of Maintenance (or designee) shall review the routine and corrective maintenance performed on a representative sample of SCMs inspected within the last year in the District. The review should include 10% of VSIs, 100% of all CAIs with a D or F grade, and 10% of other CAIs. The progress and completion of work orders in SAP should be compared to the recommended corrective activities from inspections and known routine maintenance cycles based on SCM type.

## QA Recommendations

The SCM inspections QA Program is administered by BOMO to measure the accuracy and consistency of the SCM inspection program. The findings from the QA Program are used to enhance the Department's SCM inspection training and to address any statewide SCM inspection anomalies. The program involves performing independent, re-inspections of SCMs to compare the ratings to the District inspection. The program shall include the following annual components.

- Perform an independent QA of a representative sample of inspections in each District.
- Selection process for QA inspections:
  - SCM must have been inspected within the previous 3 months.
  - Generally representative of the District's inventory in SCM type and condition.
  - Avoid SCMs reviewed in previous QA cycles to the extent practicable.
- Compile and disseminate to DSMCs a statewide summary that includes:
  - Summary of the SCMs inspected by Central Office.
  - Different overall performance rating (A through F) for CAI.
  - Issue/Concern rating for CAI differs by more than one in either direction.
  - Action rating for VSI differs by more than one in either direction.
  - Component not identified for immediate maintenance action.

For a QA inspection, the completed form should be named using the SCM ID and inspection date as follows: 10-digit SCM ID_YYYY-MM-DD_QA

For example, for a QA inspection on SCM 0610BDD001 on December 13, 2018 would be named: 0610BDDD001_2018-12-13_QA. If a photo log is also submitted, the naming shall be the same followed by "_p" at the end of the file name. Using the above example, 0610BDDD001_2018-12-13_QA_p.

**Table 3.9.1: QA/QC Program**

| Type of Review | Reviewer | Frequency of Review | Level of Review | Number of Inspections to Review/ Work Description |
|---|---|---|---|---|
| QC | Inspection Team Leader[1] | All reports (required) | Inspection/report completeness and accuracy | All reports |
| | District Stormwater Maintenance Coordinator (or Designee) | Semi-annually | Inspection/report completeness and accuracy | 20% of VSI and 20% of CAI |
| | | | Inventory data and as-builts | All projects completed in past 6 months |
| | | | Review SCM database, plans, and inspection files for completeness | 20% of SCMs with inspection due within next 6 months |
| | | | Inspection due dates and progress | All SCMs |
| | ADE Maintenance (or Designee) | Annually | Maintenance records in SAP | 10% VSIs |
| | | | | 10% of CAIs w/ A, B or C rating |
| | | | | All CAIs w/ D or F rating |
| QA | BOMO-MTLD Stormwater Section | Annually | VSI and CAI - Independent Field Inspection | Representative sample in each District |

[1] When inspection team is a consultant, the Department PM should provide a completeness and accuracy review prior to submission.

# Chapter 4 - Maintenance Procedures Overview

## Publication 888 - SCM Maintenance Manual

- SCM maintenance can be divided into two categories
  - Routine, preventative to maintain function
  - Corrective, as-needed to restore function
- Equipment should be appropriate for maintenance response
- Refer to Chapter 7 for information on assembly codes, charging, and reporting.

| SCM | Grass Maint. | Vegetation Mgmt. | Litter Control | Sediment Removal |
|---|---|---|---|---|
| Basin (BDD, BED, BUD, BOT, BND, BWD) | ◐ | ● | ● | ○ |
| Bioretention (BRE, BRU) | ● | ◐ | ● | ○ |
| Filter (CSF, MFD) | ● | ● | ● | ● |
| Infiltration (BID, IBE, SIT) | ◐ | ● | ● | ○ |
| Manuf. Treatment Device (MTD) | X | X | ◒ | ◐ |
| Permeable Pavement (PPA, PPC, PPP) | ◒ | X | ◐ | ◐ |
| Riparian Buffer (RBE, RBO) | X | ○ | ○ | X |
| Stormwater Wetland (SWE) | ● | ● | ● | ○ |
| Subsurface Detention (SDS) | X | X | ◐ | ○ |
| Vegetated Filter Strip (VFS, VSS) | ● | ○ | ● | ○ |
| Vegetated Swale (VSW, VSC) | ◐ | ● | ● | ○ |
| Key: X N/A | ○ As Needed | ● Annual | ◐ Semi-annual | ◒ Monthly |

### Routine Maintenance

- Routine maintenance occurs at regularly scheduled intervals
- Planned in advance
- Activity types:
  - Grass maintenance
  - Vegetation management
  - Litter control
  - Sediment removal

### Corrective Maintenance

- Corrective maintenance is scheduled based on inspection findings
- Reference corrective maintenance tables in Appendix E
- Levels based on response time:
  - Corrective: 6-month response
  - Corrective: 4-week response
  - Emergency: immediate response

### Disposal of Sediment Removed from SCMs

- Small quantities of sediment treated as municipal waste
- Fill requires EDD Form D-1 completion
- Plan ahead to allow adequate time for EDD process
- Refer to Pub. 23, Pub. 281, and DEP's Management of Fill Policy

# CHAPTER 4

# MAINTENANCE PROCEDURES OVERVIEW

## 4.1 Maintenance Overview

SCM related maintenance can generally be grouped into two categories: routine and corrective. Routine maintenance includes activities such as vegetation management that are preventative, general upkeep items which occur on regular cycles. Corrective maintenance involves work outside of routine activities that are initiated because of observed problems with the SCM. The activities associated with each are described in the following sections. Refer to Chapter 7 for information about work assemblies, charge codes, etc.

## 4.2 Routine Maintenance

Routine maintenance involves minimally invasive measures that prevent common problems and prolong the life of SCMs. These measures (e.g., mowing) occur at regular intervals allowing them to be scheduled far in advance of the work. Frequencies for various categories of routine maintenance are summarized in Table 4.2.1. Refer to SCM-specific routine maintenance tables in Chapter 5 for detailed activity descriptions and intervals. Note that any “as needed” activity should be checked during each routine maintenance visit. Factors such as surrounding land uses, contributing drainage area, and visibility can affect these typical frequencies. The SCM information in Maintenance-IQ will note when the maintenance needs of an individual SCM deviates from the routine tables presented in Chapter 5.

The categories of routine maintenance are described in more detail below. Additional SCM specific details are included in the Chapter 5 SCM Specific section of this Publication.

- Grass Maintenance - Regular mowing is specific to site conditions and should be performed as specified herein and in accordance with the Department’s mowing policy in Publication 23, Maintenance Manual. Grass areas within and surrounding an SCM may require periodic fertilizing, de-thatching, and soil conditioning.
- Vegetation Management - Woody vegetation can create stability problems for embankments; invasive/undesirable (Appendix D) plants can overtake an SCM; and uncontrolled growth can block access and hide underlying problems.
- Litter Control - Debris and trash removal reduces the potential for clogging of outlet structures, trash racks, and other SCM components.
- Sediment Removal - Accumulated sediment should be removed to keep flow pathways open, prevent dispersed flow from concentrating, maintain storage capacity, and keep inlets and outlets unobstructed.

**Table 4.2.1: Routine Maintenance Frequency by SCM Category**

| SCM | Grass Maint. | Vegetation Mgmt. | Litter Control | Sediment Removal |
|---|---|---|---|---|
| Basin (BDD, BED, BUD, BOT, BND, BWD) | ◉ | ● | ● | ○ |
| Bioretention (BRE, BRU) | ● | ◉ | ● | ○ |
| Filter (CSF, MFD) | ● | ● | ● | ● |
| Infiltration (BID, IBE, SIT) | ◉ | ● | ● | ○ |
| Manuf. Treatment Device (MTD) | X | X | ◒ | ◉ |
| Permeable Pavement (PPA, PPC, PPP) | ◒ | X | ◉ | ◉ |
| Riparian Buffer (RBE, RBO) | X | ○ | ○ | X |
| Stormwater Wetland (SWE) | ● | ● | ● | ○ |
| Subsurface Detention (SDS) | X | X | ◉ | ○ |
| Vegetated Filter Strip (VFS, VSS) | ● | ○ | ● | ○ |
| Vegetated Swale (VSW, VSC) | ◉ | ● | ● | ○ |
| Key: X N/A | ○ As Needed | ● Annual | ◉ Semi-annual | ◒ Monthly |

## 4.3 Corrective Maintenance

Corrective maintenance requires more extensive and invasive tasks to correct problems and restore the functionality of the SCM. Three tiers of corrective maintenance responses can be prescribed based on the risk the problem poses on SCM functioning: six-month, four-week, and immediate responses. Specific tasks may range from large scale preventative measures to repair or replacement of an SCM component. Although completed on an as-needed basis, corrective maintenance work should be factored into the maintenance budget.

Common corrective maintenance activities are included in Appendix E in table format with columns linking common issues to the VSI and CAI forms for cross referencing. Table E.1.1 contains general concerns that are applicable to the majority of SCMs. Table E.1.2 lists issues associated with the common components included in Chapter 6; Tables E.1.3 through E.1.16 are SCM-specific. Note that Table E.1.3 applies to the SCMs in Sections 5.1, 5.2, and 5.3.

The DSMC or designee can use the SCM-specific, general, and component tables provided in Appendix E to determine appropriate corrective maintenance actions based on the results of an inspection. The tables are developed as a guide and are not intended to be all inclusive.

## 4.4 Post-Construction SCM Modification and PADEP Coordination

PennDOT must restore, repair, or replace an SCM or provide an alternative method of treatment upon any reduction, loss or failure of an SCM that PennDOT maintains. In certain cases, PADEP must be notified prior to commencing modification activities. The two general scenarios that exist for modification after construction and NPDES NOT(where applicable) are described below.

Scenario A

For most "older" SCMs, PennDOT may modify, rehabilitate or reconstruct the SCM without notifying PADEP. To the extent practical, the changes should maintain the qualitative and quantitative design goals (e.g., peak rate control, volume management, or water quality improvement) of the original SCM. The SCMs that this applies to are either:

- Associated with an NPDES Permit approved on or before November 19, 2010 and not subsequently renewed after January 1, 2013.
- Not associated with an NPDES permit.

Scenario B

PADEP must be notified when PennDOT wishes to modify "newer" SCMs. Written notification of the proposed SCM modifications shall be provided at least 30 days prior to the start of construction. This applies to SCMs that are covered by the PCSM regulation, as discussed in Section 1.2.

Examples of activities that require PADEP notification include:

- Modifications to the dimensions that affect storage of an SCM.
- Complete reconstruction of an SCM in a new location.
- Changes to the type of SCM (e.g., changing a BID to a BRE or BUD due to inadequate infiltration).
- Modifications to the dimensions (e.g., orifice configuration) of the outflow structure.

Examples of activities that do not require PADEP notification include:

- Replacement of a clogged filter media layer with new filter media to the original dimensions and similar material.
- Replacement of dead vegetation with the same or similar species.
- Repairs or reconstruction of any portion of an SCM in accordance with the original PCSM Plan.
- Removal of sediment buildup in forebay or main SCM storage area.
- Complete reconstruction of an SCM in the same location.
- Installation of a sediment forebay (that does not affect storage) or other type of pretreatment.

A notification package shall be submitted through the PennDOT DEM, District Permit Coordinator, or designee to the appropriate PADEP office and shall include:

- Transmittal letter with the original NPDES Permit number
- Technical memorandum describing reason for change(s) with supporting calculations attached
- Redline copy of original As-Built PCSM Plan (drawings)
- New supplemental scale drawings, if necessary
- ESPC Plan (if required per Chapter 102 of PA Code Title 25)

The redline PCSM Plan should include a note referring to Publication 888 for all applicable inspection and maintenance requirements for the modified SCM. If the SCM has special maintenance requirements, they should be added to the plan. The ESPC Plan need only cover the area of earth disturbance for the SCM modification work.

The technical memorandum shall detail the reason for the proposed modification(s) and demonstrate that the modified SCM will provide stormwater controls sufficiently equivalent to the original SCM. Supporting calculations should be attached as an appendix to the memorandum. If new supplemental scale drawings are necessary, they shall include reference to the original NPDES permit number, complete details and plans for construction, and delineation of the SCM's drainage area. The redline copy of the As-Built PCSM Plan and any new construction plans and details shall be sealed by a licensed professional.

In either of the aforementioned scenarios (A or B), if the proposed modification involves changing the SCM type, approval from Central Office is required and a new SCM ID will be assigned. The notification package shall be submitted to BOMO-MTLD, Stormwater Section, at least 90 days prior to the planned work. The District may commence work upon review and approval by BOMO, which will have 30 days to respond. An electronic file of the notification package shall be saved with the original electronic As-Built PCSM Plan. Upon completion of construction, the PennDOT DSMC (or designee) shall remove the original SCM data and add the new SCM data to the SCM inventory database. BOMO will assign an ID to the SCM.

## 4.5 Disposal of Sediment Removed from SCMs

Sediment removed from SCMs during maintenance activities is considered fill and may be subject to an Environmental Due Diligence (EDD) clean fill determination. It is recommended that the visual inspection be performed and signed by either the Highway Foreman or Assistant County Manager well in advance of planned field activities to allow adequate time for the EDD process. If the visual inspection reveals no evidence of a spill or release of regulated substances, the material should be disposed of in accordance with clean fill practices. An EDD Phase 2, Step 1, determination shall be performed when the visual inspection indicates or identifies a suspected release. No evidence of a spill or release in this step means that the material may be managed as clean fill. Otherwise, laboratory analysis of the material should be conducted, and a determination of clean fill, regulated fill, or waste made.

Small amounts of sediment may be treated as municipal waste and disposed of as such with collected trash and debris. Material removed from storm inlets normally contains a combination of sediment, trash and organic debris, and should be disposed of in accordance with municipal waste practices.

Both small and large quantities of fill generated from corrective maintenance activities (e.g., bioretention soil replacement) should be treated similarly to shoulder cuttings and require completion of EDD Phase 1 Visual Inspection Form (D-1).

Clean fill may be commingled with other clean fills at maintenance stockpiles while being stored prior to placement in a fill area. Clean fill may be disposed offsite with Form M-666 (Authorization to Enter and Deposit Material). Existing approved offsite disposal locations should be utilized whenever possible.

For more information on clean fill and the EDD process, refer to PennDOT Publication 23, Maintenance Manual, Publication 281, Waste Site Evaluation Procedures Handbook, and PADEP's Management of Fill Policy.

## 4.6 Vegetation Watering

Some SCMs incorporate seed mixtures and/or rooted plants that require watering to aid in plant establishment and survival. The SCM specific routine maintenance tables in Chapter 5 stipulate which SCMs require

establishment watering during the first few years after construction. Typical plant establishment takes one to three growing seasons based on specific site factors. Perform watering as follows:

- Use an appropriate water supply via truck or on-site tank storage.
- Minimize use of sprinklers/overhead watering during sunny days (10am-5pm) to prevent leaf scorch.
- When hand watering herbaceous plants, shrubs, trees and seeded areas:
    - Water at base of plant/tree.
    - Use hose sprinkler attachments and avoid directing concentrated flows around planted/seeded areas.
    - Allow water to soak into ground in each area; each 100 SF area of vegetated SCM should be evenly watered for five minutes or until ground is saturated; each tree should be watered for 5 minutes or until ground is saturated.
- When using bag waterers for trees:
    - Install watering bag in April per manufacturer's recommendations.
    - Fill with 15-20 gallons of water, refilling when bag is empty.
    - Remove bag between October 15 and October 31.

## 4.7 Maintenance Techniques for SCMs

Maintenance activities performed on SCMs require the use of different equipment and procedures than applied in standard roadside activities to ensure SCM functionality. The requirements are determined from two key aspects of the SCM:

1. The SCM Surface type: Many SCMs have a surface of infiltrating/filtrating material. This area is highly sensitive to compaction and sediment laden flows. Any SCM with an infiltrating or filtrating surface must be protected from compaction through the use of minimal disturbance techniques as described below. In addition, activities that expose soil and could cause sediment laden flows must utilize appropriate Erosion and Sediment Pollution Control protective measures to prevent surface clogging.
2. The SCM Vegetation type: While many SCMs are planted with standard mowable grass seed mixes, some are planted with specialty no-mow plants. Tree, shrubs, and perennial herbaceous (pots/plugs) material require hand pruning and other alternative maintenance practices.

### Requirements for All SCM Types

No equipment may enter any type of SCM when the SCM floor is not dry (approximately 5 days after the SCM storage area has totally emptied). This includes equipment like small mowers. All SCMs must be protected from surface rutting, even non-infiltrating/filtrating surfaces.

Prior to mowing any SCM, review the operations and maintenance plan for the facility to confirm vegetation is to be mowed and mowing specifications such as mowed height and mowing frequency.

### Infiltrating/Filtrating SCMs: Minimal Disturbance Techniques

SCM infiltration and filtration ground surface areas (SCM Surface Storage) must be protected from inadvertent compaction and damage to maintain functionality. Table 4.7.1 summarizes which SCMs have infiltrating or filtrating surfaces. Where the table indicates that an infiltrating or filtering surface is "possible", prior to performing maintenance, the SCM Inventory and SCM plans must be checked to determine the presence of infiltrating/filtration surfaces.

**Table 4.7.1: SCMs with Infiltrating and Filtrating Ground Surfaces**

| SCM Name | Type Code | Infiltrating or Filtrating Surface | | |
|---|---|---|---|---|
| | | Yes | Possible | No |
| Basin, Dry Detention | BDD | | | X |
| Basin, Dry Extended Detention | BED | | X | |
| Basin, Dry Ultra-Extended Detention | BUD | X | | |
| Basin, Infiltration Detention | BID | X | | |
| Basin, Other | BOT | | X | |
| Basin, Naturalized Detention | BND | | X | |
| Basin, Wet Detention | BWD | | | X |
| Bioretention | BRE | X | | |
| Bioretention w/Underdrain | BRU | X | | |
| Constructed Stormwater Filter | CSF | X | | |
| Flow Dispersion, Forest/Buffer | FDF | X | | |
| Flow Dispersion, Veg. Filter Strip | FDV | X | | |
| Forest Preservation | FPR | X | | |
| Infiltration Berm | IBE | X | | |
| Landscape Restoration Meadow | LRM | X | | |
| Level Spreader Outfall | LSO | | X | |
| Manufactured Treatment Devices | MTD | | | X |
| Media Filter Drain | MFD | X | | |
| Non-Basin SCM, Other | NBO | | X | |
| Pervious Pavement, Asphalt[1] | PPA | | | X |
| Pervious Pavement, Concrete[1] | PPC | | | X |
| Pervious Pavement, Pavers | PPP | | X | |
| Reforestation/Tree Plantings | RTP | X | | |
| Regenerative Step Pool | RSP | X | | |
| Riparian Buffer Enhancement; Offset | RBE | X | | |
| Riparian Buffer Offset | RBO | X | | |
| Soil Amendment Restoration | SAR | X | | |
| Stormwater Wetland | SWE | | | X |
| Stream Restoration[2] | SRE | X | | |
| Stream Stabilization[2] | SST | X | | |
| Subsurface Detention Storage | SDS | | | X |
| Subsurface Infiltration Trench | SIT | X | | |
| Vegetated Filter Strip | VFS | X | | |
| Vegetated Filter Strip, Steep Slope | VSS | X | | |
| Vegetated Swale | VSW | | X | |
| Vegetated Swale w/ Check Dams | VSC | X | | |

1- PPA & PPC has a filtering/infiltrating ground surface but is not subject to compaction

2- Areas adjacent to channel

When maintenance activities are required on SCMs with infiltrating or filtrating surfaces, employing minimum disturbance techniques can minimize the risk of damage. The following guidelines should be applied as appropriate for the required activities.

**General Equipment Use Around Infiltrating/Filtrating SCMs**

No heavy equipment (greater than 5 tons/axle) shall enter the SCM at any time. Rather, it should work from the banks of the SCM, extending operation arms into the SCM to perform tasks.

If possible, all work shall be performed with equipment operation from outside of the SCM footprint. If exterior operation does not provide sufficient reach, construction/repair activities should use a cell construction approach in larger SCMs, whereby the SCM is split into 500 sq. ft. temporary cells with a 15 foot earth bridge in between, so that cells can be excavated or material placed from the side.

When operating equipment in an SCM within 3 feet vertically of the proposed final surface elevation, Low Ground Pressure (LGP) equipment must be utilized. LGP is defined as:

- Maximum weight of 5 tons/axle load (including all attachments and material loads)
- Equipment shall be ballasted to ensure even load distribution
- Tires:
  - Turf tread
  - Radial ply tired
  - Tire inflation of 7 psi or less (use tire's design to operate within this range)
- Tracks:
  - Manufacturer ground pressure rating for tracked vehicles shall be 5 psi or less

The critical goal is to minimize compaction by using LGP equipment. Additionally, these guidelines shall be followed:

- No equipment should enter the SCM when it is not dry (approximately 5 days after the SCM storage area has totally emptied).
- Use the smallest, lightest equipment with lowest axle loads (note, axle load is not evenly distributed, confirm highest axle load) to accomplished work.
- Minimize the number of times the equipment enters the area and limit the amount of surface area traversed within the footprint. Where multiple trips are needed, follow the same wheel tracks to traverse the SCM to minimize the amount of area impacted.
- Place matting (as specified for wetland crossing in the PADEP ESPC Program Manual using configurations resulting in maximum soil pressure below mats of 7 psi per manufacture load reduction documentation) in one area of the SCM to allow work/reach into the entire area, restricting access to the maximum extent practicable.
- After equipment has completed work in SCM footprint, assess SCM surface for compaction. If compaction has occurred, perform infiltration testing and/or aeriation and tilling (soil loosening) if required to restore functionality. Aeriation should be punch core method; do not use spike aeration equipment.
- Remediate surface rutting caused by LGP vehicles by tilling to restore the surface integrity and soil porosity. Extend tilling to a depth 6 inches below the rutting depth or depth of compaction whichever is greater. The tilling operation shall result in a uniform surface at design elevations. Rutting remediation is to be completed within 1 week of the observed rutting occurrence or as soon as soil moisture conditions permit thereafter.

**Lawn Mowing Infiltrating/Filtrating SCMs**
No equipment should enter the SCM when it is not dry (approximately 5 days after the SCM storage area has totally emptied).

Use hand-held equipment (string trimmers) or small push mowers when possible.

Where hand-held equipment cannot be utilized, boom mowers operated from the perimeter of the SCM may be used when the SCM is dry. Mower arms should not apply pressure to the SCM surface.

When mowing equipment must enter the SCM, LGP equipment must be used. LGP lawn mowing equipment should be the lightest available and have no extra attachments installed while operating on the SCM infiltrating/filtrating surface. Turf tread or similar tires should always be operated at the lowest allowable tire pressure (7 psi or less). Tracked equipment meeting the LGP equipment requirements may be used.

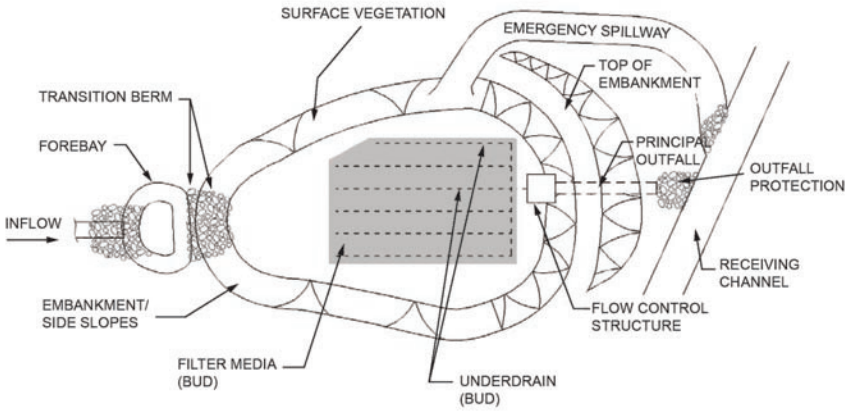
**Material Placement Activities Around Infiltrating/Filtrating SCMs**
Material, including snow, should never be stored on the surface of an infiltrating/filtrating SCM.

Perform all work when SCM is dry (approximately 5 days after the SCM storage area has totally emptied).

When placing new mulch, soil, or similar materials within the footprint of an infiltrating/filtrating SCM, never dump directly onto the surface. Rather, place material adjacent to SCM and spread materials over the surface, preferably by hand. For larger SCMs, spread by pushing material with equipment in a horizontal motion. Do not use vertical or angled motions as it could compact the infiltrating area. Do not compact materials unless directed by an overseeing licensed professional.

# Chapter 5 - Stormwater Control Measures
# Specific Inspection & Maintenance Procedures
## Publication 888 - SCM Maintenance Manual

- SCM types are divided into sections that expand on the general inspection and maintenance procedures in Chapters 3 and 4
- General description and overview of function provided for each SCM
- Differences between SCMs in the same grouping
- Refer to Pub. 584 for detailed design information




### SCM Components

- SCM specific components
  - Key components highlighted
  - Example components
    - Access, fencing, and security
    - Forebay
    - Flow control structures
- Typical SCM plan and section views provided

### Key Inspection Considerations

- Specific inspection procedures focused on SCM's key functional areas
- Inspection form (M-77 & M-79) considerations related to SCM type
- Start-up phase check-up items provided as applicable to ensure plant establishment
- Refer to Chapter 3 for general SCM inspection procedures

### Routine and Corrective Maintenance

- SCM specific maintenance activity descriptions
- Routine maintenance activities
  - Frequency
  - Equipment
  - Procedures
- Corrective maintenance activities
  - Reference tables in Appendix E
  - General and SCM specific tables provided

# CHAPTER 5

# SCMS – SPECIFIC INSPECTION AND MAINTENANCE PROCEDURES

## 5.1 Dry Basins: Dry Detention (BDD), Dry Extended Detention (BED), Dry Ultra Extended Detention (BUD), Naturalized Detention (BND), Other (BOT)

**Figure 5.1.1: Dry Extended Detention Basin**

### 5.1.1 Description and Overview

Many SCMs are a variation of a surface basin designed to retain and or detain stormwater runoff. These SCMs are constructed by excavating below ground or by constructing above-ground berms (embankments) creating a surface depression to collection stormwater. Some basins incorporate both excavation and embankments to create a water collection area. Larger embankments may be considered a regulated dam structure depending on height and storage. Inspections and maintenance of these must also comply with the requirements of the Dam Safety permit and should be noted in the inventory. In all basins, the primary flow control structure (outlet structure) is typically a metal riser pipe or concrete box with orifices at different elevations and many have an earthen emergency spillway constructed into the top of one of the berms or side walls of the SCM. Most basins are typically vegetated with turf grass however some may have taller grasses, shrubs and trees incorporated into the design. As described below, there are several types of basins that fall into the class of SCMs called Dry Basins, which are typically dry between storm events.

Dry Detention Basin (BDD) temporarily stores stormwater runoff during rain events, and slowly releases retained water through a flow control structure over a period of 24 to 72 hours. BDDs are typically dry between storm events. Prior to 2007, dry detention basins where the primary stormwater management measure employed. Their typical purpose focuses on lowering peak stormwater outflow rates with little to no water quality consideration. More recent designs may incorporate some water quality components, such as a pretreatment forebay to increase pollutant removal.

Dry Extended Detention Basin (BED) is a more recent modification of the original BDD which incorporates components to improve water quality while providing rate control. Features such as pretreatment areas, micropools and elongated flow paths improves the quality of temporarily stored stormwater runoff. Similar to BDDs, BEDs release flows through an outlet structure in approximately 24 to 72 hours.

Dry Ultra Extended Detention Basin (BUD) is a variation of a BED which further improve on water quality treatment and can take many forms depending on the treatment and storage system chosen. Ultra-extended detention basins provide the same peak rate control for larger storm events as traditional dry detention basins; however, they also employ a slow release concept that provides volume control and water quality treatment. BUDs provide the necessary volume storage in either an above ground impoundment and/or underground infrastructure while incorporating filter media, native plantings, infiltration, evapotranspiration, and/or other means to treat runoff before it is discharged.

Naturalized Detention Basin (BND) is a modified or retrofitted version of a BDD or BED with improved water quality through the addition of a vegetative mix of native plants, shrubs, and/or trees in place of turf grass.

Other Basin (BOT) is generally a placeholder classification for basin SCMs that could not be definitively categorized during the initial inventory effort. Most BOT entries in the SCM inventory will be re-assigned as more information is gathered on them (e.g., through inspections or locating “as-built” plans). In some watersheds, spill containment facilities are installed to capture contaminants upstream of sensitive resources in the event of an inadvertent release. Where these are directly in-line and connected to an SCM, they should be included as part of the SCM in the inventory. When these facilities are in the form of standalone surface basin-like features, they should be classified as BOTs for inventory tracking. Where these facilities are standalone vaults, tanks or similar storage vessels, they should be classified as NBOs (Section 5.17). In the future, BOT may also be used to inventory new or modified basin type SCMs that do not fit into any of the other SCM categories.

### 5.1.2 SCM Components

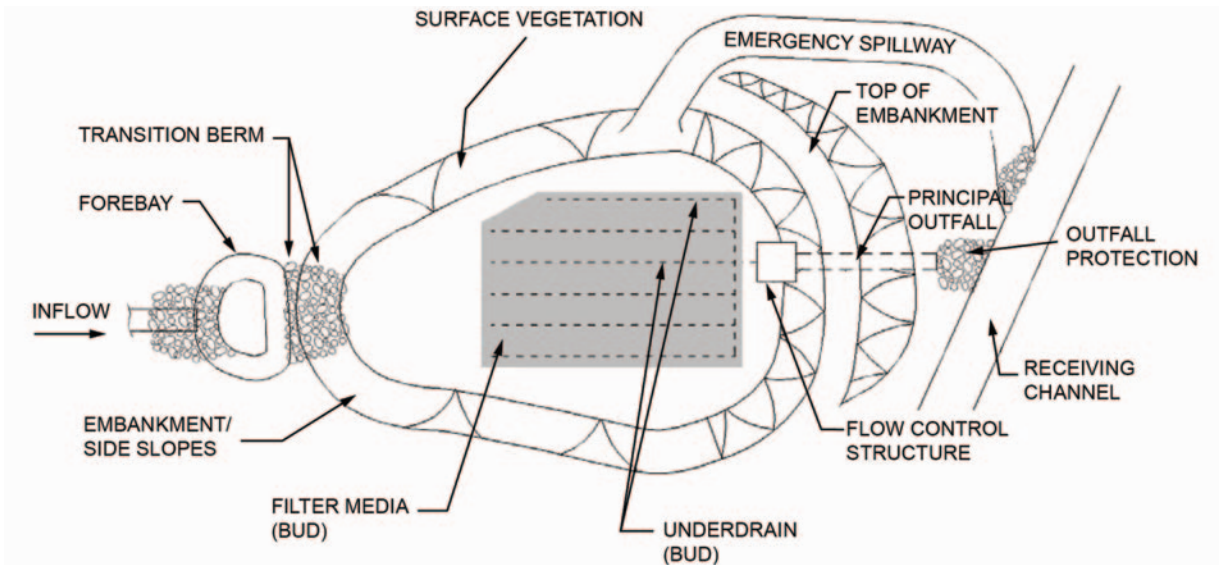
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with these SCMs include:

- Access, Fencing, and Security
- Signage
- Inflow System
- Inlet with Sump/Traps
- Forebay
- Flow Control Structures
- Structures and Appurtenances
- Earthen Emergency Spillway
- Outfall Protection

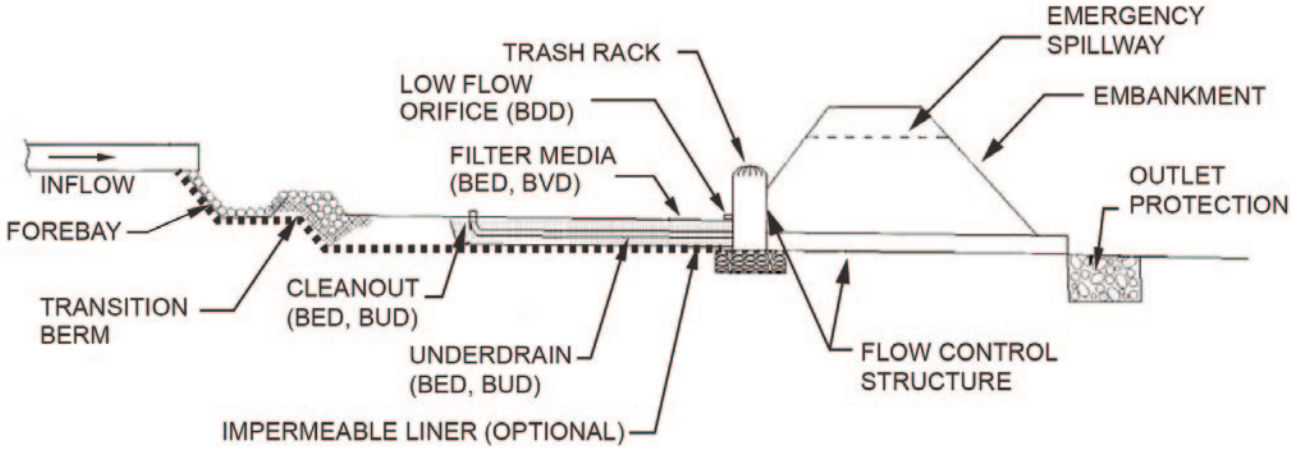
In addition, Dry Basins may include the following other components:

- Filter media
- Perforated underdrains
- Observation well/cleanout
- Impermeable liner (optional)
- Vegetative shrub, woody, or grass plantings
- Turf grass
- Embankment/side slopes
- Receiving channel/discharge system

Figure 5.1.2 illustrates the common components of typical Dry Basins. Runoff enters Dry Basins via directly connected inlets, pipes, channels and sheet flow. Flows travel through the system to an outflow control structure where stormwater release is controlled.




**Plan View**




**Section View**

**Figure 5.1.2: Dry Basins - Common Elements**
(Adapted from NCDOT-HSP-2010-01)

### 5.1.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of Dry Basins should focus primarily on its key functional areas: inflow, ponding area, vegetation, and flow control devices. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- Sediment accumulation should be removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches the lesser of 6 inches in depth, or 10% of the basin storage area, or if it affects inflow or outflow in the SCM. In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- The SCM and vicinity should be checked for signs of erosion, flow channelization, loss of topsoil and sinkhole activity.
- Inspect for appropriate vegetative cover per plan. Surface vegetation should be in good condition with at least 80% coverage and no invasive/undesirable species. Vegetation should not hinder inflow or outflow in the SCM.
- Inspect the basin for signs that standing water remains in the basin longer than 72 hours after a rain event; the presence of hydrophytic vegetation may be an indication.
- The embankment should be assessed for erosion, cracking, settlement, sloughing, burrowing animals, instability, and tree growth. Inspect downstream of the toe of embankment for evidence of seepage, piping, or hydrophytic vegetation.
- Baffles may be in place within the SCM to increase the effective flow length in the basin. If present, verify that the baffles are undamaged.
- When plans indicate an impermeable liner is present, look for unintentionally exposed section or signs of puncture, tears or leaks indicated by surface cover erosion, animal burrow activity or similar.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for Dry Basins, the following should be considered:
VSI Form

- 3B. Subsurface storage not draining – only applies to systems with subsurface storage area.
- 3C. Permanent pool water level very low or dry – does not apply.

CAI Form

- Section 3 – Outflow, Emergency Spillway: some Dry Basins may not have an earthen emergency spillway; instead they may use a secondary concrete or metal riser to release excess flows.

Start-up phase check-ups: Dry Ultra Extended Detention Basin (BUD) areas require more frequent startup phase check-ups during plant establishment through the first three years, as stipulated in Chapter 3. The following items should be inspected during these check-ups:

- Vegetation in and around the SCM should be in good condition and per plan including trees, shrubs and herbaceous/grass plant materials. Coverage should reach 70% or more of plan depicted density by one year after construction, 75% by two years, and 80% by three years after construction. No invasive/undesirable species should be present. Dead plants should be removed and replaced. New plants should receive establishment watering for the first two years as stipulated in the routine maintenance table in Section 5.1.4.
- The SCM and vicinity should be checked for signs of erosion of any form including general loss of topsoil and the formation of rills or gullies.
- Confirm mulch cover (if called for) is in good condition. Mulch should be approximately 3 inches in depth and consist of triple shredded or leaf compost mulch. Wood chips shall not be used as mulch.

- Sediment accumulation should be checked and removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 3 inches in depth or affects inflow or outflow in the SCM.

### 5.1.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

| Frequency | Activity |
|---|---|
| Two times per year | • Mow grassed side slopes and grassed basin bottom to a height of 5 to 8 inches. Perform mowing operations when SCM is completely dry, preferably using hand operated equipment. Do not drive heavy equipment on SCM surface. Do not mow areas planted with no-mow landscaping such shrubs. |
| Annually | • Remove weeds and undesirable plants. Where plan specifies shrubs and trees are present, prune to maintain appearance and functionality. Remove woody vegetation on embankments. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Replace diseased or dead plants per plan; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species.<br>• Remove litter, trash, and debris from SCM surface, side slopes, inflow/outflow points, structures and surrounding area. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

**Table 5.1.1: Routine Maintenance for BDD, BED, BUD, BND, and BOT**

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

### 5.1.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the Basin specific table (E.1.3).

# 5.2 Wet Detention Basin (BWD)

**Figure 5.2.1: Newly Constructed Wet Detention Basin**

## 5.2.1 Description and Overview

A Wet Detention Basin (BWD), also known as a wet pond, is a SCM similar to a Dry Basin, but is designed to hold a permanent pool of water in the basin. Larger embankments may be considered a regulated dam structure depending on height and storage. Inspections and maintenance of these must also comply with the requirements of the Dam Safety permit and should be noted in the inventory. BWDs provide water quality treatment and provide additional capacity above the permanent pool for temporary runoff storage for peak rate control. BWDs are effective for pollutant removal and peak rate mitigation, but do not achieve significant groundwater recharge or volume reduction. In BWDs, the primary flow control structure is typically a metal riser pipe or concrete box with orifices and weirs at different elevations and most have an earthen emergency spillway constructed into the top of one of the berms or side walls of the SCM. The lowest outlet point in the BWD's flow control structure is above the permanent water pool level. In some cases, a reverse slope pipe is used in lieu of the lowest orifice in the outlet structure. A reverse slope typically terminates 2 to 3 feet below the permanent water surface, which minimizes the discharge of warm surface water and is less susceptible to clogging from floating debris.

Unlike other basin types, the permanent pool is a key feature and infiltration is discouraged. BWDs typically have low permeability soils underlying the basin and/or are located close to or below the groundwater table to support permanent water ponding. When necessary, BWDs may include an impermeable liner made of clay or impermeable geotextile to maintain a permanent pool. In BWDs with deeper pools of water, the perimeter of the ponded area includes a safety bench and/or aquatic bench graded into the side slopes. Safety benches are designed to remain above the water surface elevation for all major storm events, whereas aquatic benches will be submerged during major storm events. Some BWDs may have a sluice gate or other emergency drawdown opening at the bottom elevation of the basin to empty the system for maintenance or emergencies.

## 5.2.2 SCM Components

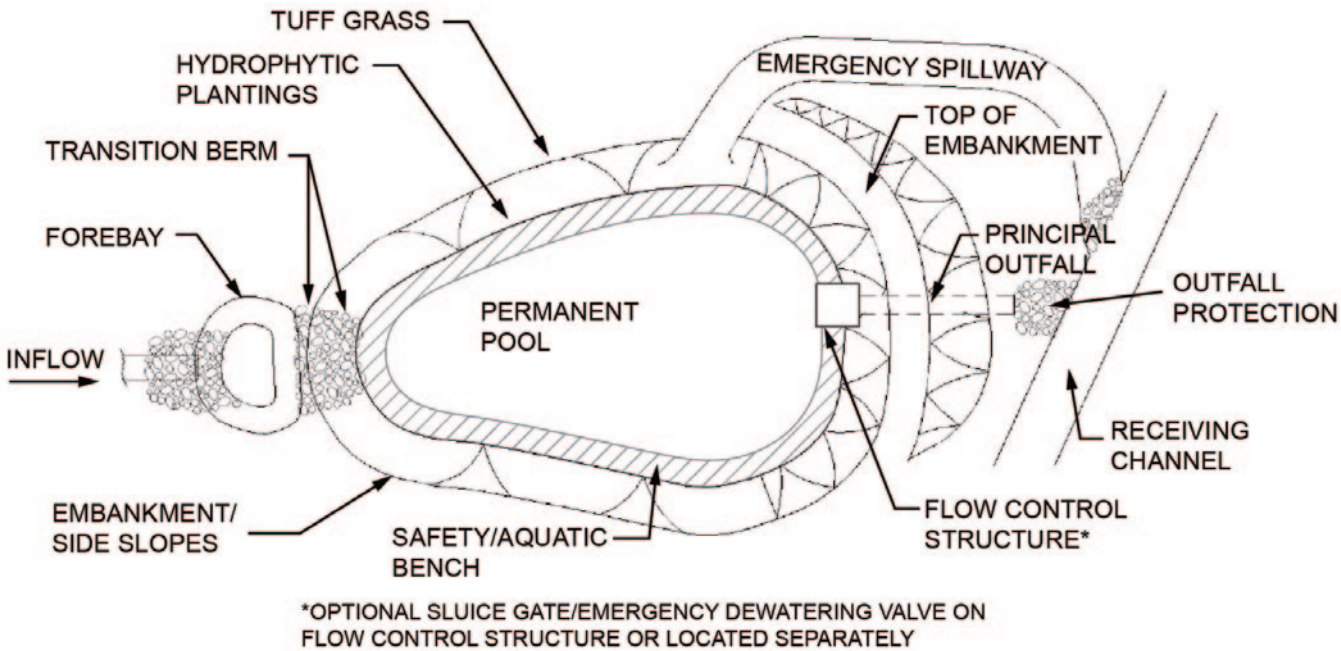
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow Systems
- Inlet with Sump/Traps
- Forebay
- Flow Control Structures
- Structures and Appurtenances
- Earthen Emergency Spillway
- Outfall Protection

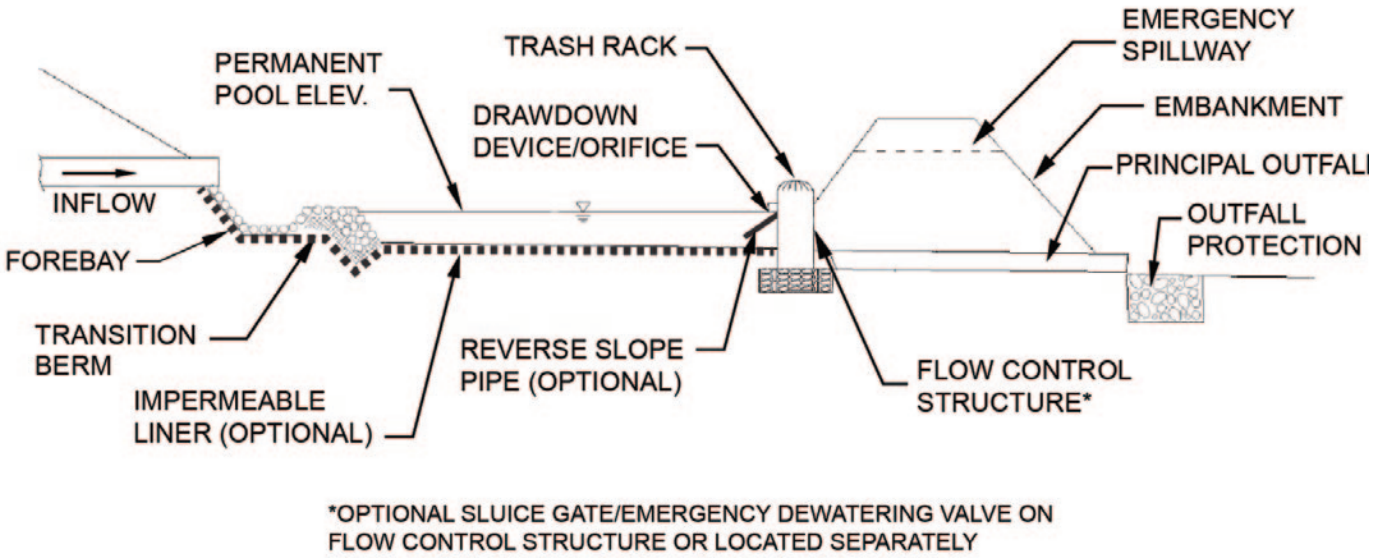
In addition, BWDs may include the following other components:

- Permanent pool
- Impermeable liner
- Hydrophytic (wetland) plantings
- Turf grass
- Embankment/side slopes
- Safety/aquatic benches
- Reverse slope pipe
- Sluice gate/emergency wet pool dewatering valve
- Receiving channel/discharge system

Figures 5.2.2 to 5.2.4 illustrate the common components of a typical BWD. Runoff enters the BWD via directly connected inlets, pipes, channels, and sheet flow. Flows travel through the system to an outflow control structure where the portion above the permanent pool elevation is released at control flow rates.




**Plan View**




**Section View**

**Figure 5.2.2: Wet Detention Basin - Common Elements**
(Adapted from NCDOT-HSP-2010-01)

**Figure 5.2.3: Lift-Type Sluice Gate**
(c/o NCDot-HSP-2010-01)

**Figure 5.2.4: Open Screw-Type Sluice Gate**
(c/o NCDot-HSP-2010-01)

## 5.2.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a BWD should focus on its key functional areas: inflow, ponding area, vegetation, and flow control devices. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- The basin floor should be covered by a permanent pool of water. The water level should be at or near the invert of the drawdown device/orifice except within 72 hours of storm events and during long dry periods. High water levels indicate an outflow component may be clogged, while low levels indicate the basin may not be receiving the design flows, leaking outlet structure, or the stored water is infiltrating more than anticipated.
- Look for evidence of excessive algae in the wet pool. Some algae growth is expected and part of the natural system helping with nutrient removal. Algae growth covering more than 50% of the pool area should be considered excessive and requires removal.
- Look for evidence of excessive permanent waterfowl population. Evidence of approximately 20 or more permanent water fowl inhabitants per pond surface acre should be noted.

- Sediment accumulation should be removed when it reaches 50% of ponding storage area or anytime it impacts SCM performance and flow through the system. Pay particular attention to potential blocking of reverse slope pipe where present. Depth from water surface to sediment can be checked using a probe or survey rod.
- Check for signs of erosion, flow channelization, loss of topsoil and sinkhole activity surrounding the wet pool.
- Surface vegetation around the perimeter of the wet pool should be in good condition with at least 80% coverage with no invasive/undesirable vegetation. The cover type should match original design plans. Hydrophytic vegetation may be present in close proximity to the ponds perimeter with less water tolerant vegetation further up the side slopes. Vegetation should not hinder inflow or outflow in the SCM.
- The embankment should be assessed for erosion, cracking, settlement, sloughing, burrowing animals, instability and tree growth.
- Inspect downstream of the toe of embankment for evidence of seepage, piping, or hydrophytic vegetation.
- Some BWDs may have a sluice gate or other emergency drawdown opening at the invert of the basin to empty the system for maintenance or emergencies. If present, inspect the sluice gate or other emergency draw down valve. Look for excessive corrosion and signs that the mechanisms have frozen or rusted closed, taking care not to open it. Check for signs of leaking.
- When plans indicate an impermeable liner is present, look for unintentionally exposed section or signs of puncture, tears or leaks indicated by surface cover erosion, animal burrow activity or similar.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for BWDs, the following should be considered:
VSI Form

- 3A. Standing water – does not apply.
- 3B. Subsurface storage not draining – does not apply.
- 4E. Presence of hydrophytic vegetation – applies to exterior embankment areas only.

CAI Form

- Section 3 – Types of Inflow: it is important to note that some inflow points may be submerged during the time of inspection as there is a permanent pool of water associated with BWDs.
- Section 3 – Outflow, Principal Spillway Riser-Opening: when emergency draw down valves are present, they should be assessed under “other” in the Principal Spillway Riser-Opening area of Section 3. Include details regarding type, material, size and present functionality/maintenance needs.
- Section 4 – Filtration: does not apply to BWDs.

### 5.2.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM’s information in Maintenance-IQ for potential variations.

**Table 5.2.1: Routine Maintenance for BWD**

| Frequency | Activity |
|---|---|
| April-Oct twice weekly for 6 weeks following planting | • Water all seeded/planted areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 24 hours of scheduled watering. |
| April-Oct every two weeks for first two years following construction | • Water all planted (non-grassed/seeded) areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 7 days of scheduled watering. |
| Two times per year | • Mow grassed side slopes to a height of 5 to 8 inches. Perform mowing operations when slopes are completely dry, preferably using hand operated equipment. Do not allow grass clippings to enter wet pool. |
| Annually | • Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plants; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species maintaining 80% plant cover. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). Non-invasive, hydrophytic vegetation is acceptable, but should not hinder SCM inflow or outflow. Dispose of vegetative cuttings off-site.<br>• Remove litter, trash and debris from SCM surface, side slopes, inflow/outflow points, structures and surrounding area.<br>• Exercise (move/open) valves/sluice gates by briefly opening it enough to ensure that the valve/sluice gate can operate through its full range of motion. If lubrication is necessary, use marine-type grease. |
| As Needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.2.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the Basin specific table (E.1.3).

# 5.3 Infiltration Detention Basin (BID)

**Figure 5.3.1: Infiltration Detention Basin with Engineered Soil Surface**

## 5.3.1 Description and Overview

An Infiltration Detention Basin (BID) is an SCM that looks similar to a dry detention basin (BDD) with a key difference: the lowest outlet point is above the bottom surface of the basin, leaving a volume of collected stormwater to soak into the ground (infiltrate) rather than flow downstream. The infiltration is designed to occur in less than 72 hours after a rain event. The basin bottom may have a layer of engineered soils designed for specific filtration properties, or it may be native soils. The surface of the bottom is typically sand or grass. Infiltration basins provide peak rate, volume and water quality management. The surface ponding area of infiltration basins should not be compacted nor should vehicles or equipment be operated within the basin.

## 5.3.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow Systems
- Inlet with Sump/Traps
- Forebay
- Flow Control Structures
- Structures and Appurtenances
- Earthen Emergency Spillway
- Outfall Protection

In addition, BIDs may include the following other components:

- Filter media
- Observation well/cleanout
- Turf grass
- Embankment/side slopes
- Receiving channel/discharge system

Figure 5.3.2 illustrates the common components of a typical infiltration basin. Runoff enters infiltration basins via directly connected inlets, pipes, channels and sheet flow where it ponds in the SCM storage area. A portion of the runoff held in the main storage area is allowed to infiltrate while higher flows exit the SCM via the outflow control structure where stormwater release is controlled.

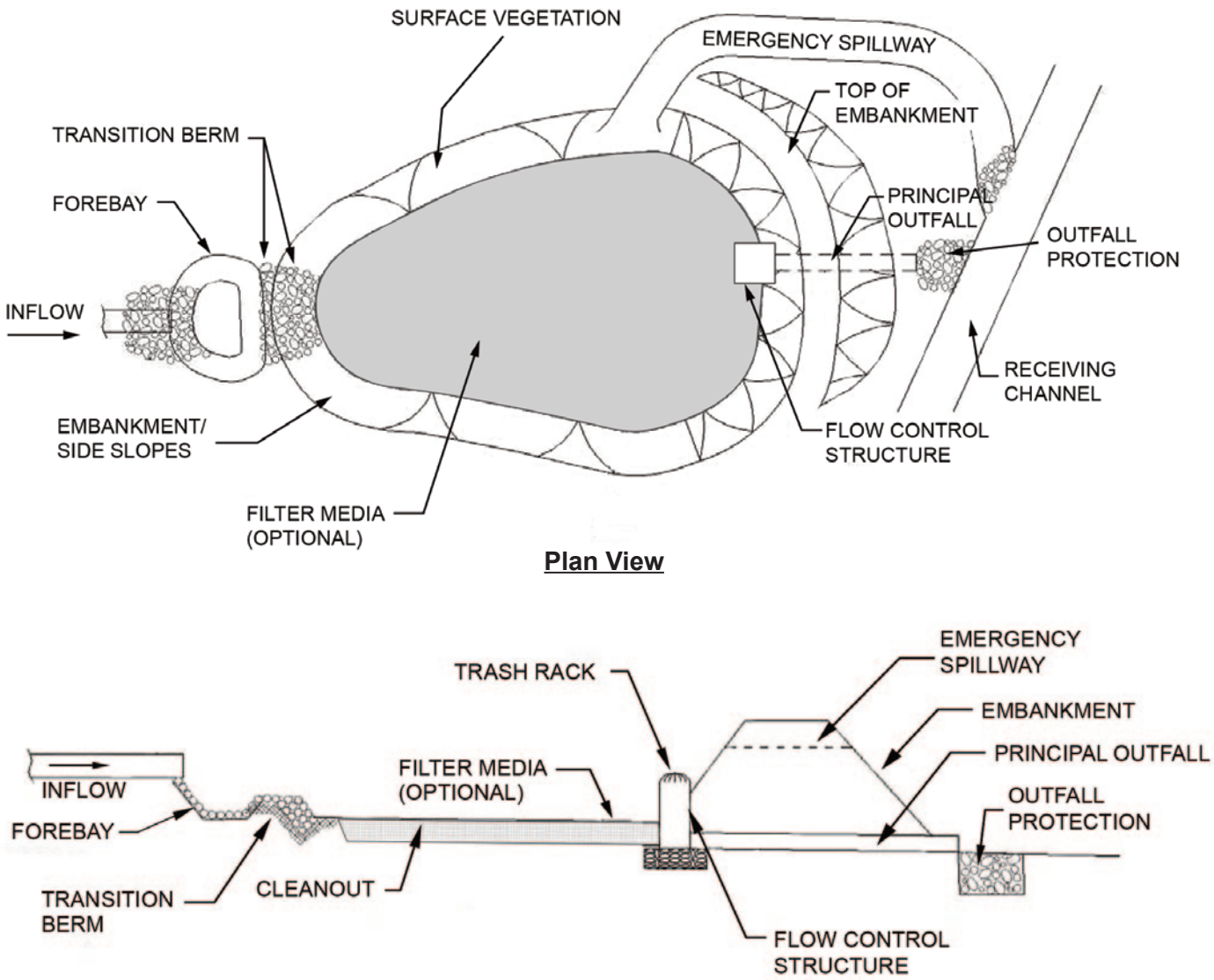



**Figure 5.3.2: Infiltration Detention Basin - Common Elements**
(Adapted from NCDOT-HSP-2010-01)

### 5.3.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a BID should focus on its key functional areas: inflow, ponding area, infiltration, and outflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- Sediment accumulation should be removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 1 inch depth or anytime it affects infiltration rates, inflow, or outflow in the SCM. In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- Infiltration basins are particularly susceptible to clogging from sediment if the drainage area contributes high sediment loads and/or adequate pretreatment is not present. Assess sediment accumulation existing pretreatment measures and make recommendation as appropriate if additional pretreatment measure may be required.
- The SCM and vicinity should be checked for signs of erosion, flow channelization, loss of topsoil and sinkhole activity.
- Inspect for appropriate vegetative cover per plan. Surface vegetation should be in good condition with at least 80% coverage and no invasive/undesirable species. Vegetation should not hinder inflow or outflow in the SCM.
- Inspect the basin and observation wells/cleanouts (if present) for signs that standing water remains in the basin longer than 72 hours after a rain event; the presence of hydrophytic vegetation may be an indication. Prolonged ponding suggests the SCM surface/filter media may be clogged with silt or the subsurface infiltration is inadequate.
- The embankment should be assessed for erosion, cracking, settlement, sloughing, burrowing animals, instability and tree growth. Inspect downstream of the toe of embankment for evidence of seepage, piping or hydrophytic vegetation.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for BIDs, the following should be considered:
VSI Form

- 3B. Subsurface storage not draining – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.

CAI Form

- Section 3 – Outflow, Emergency Spillway: some infiltration basins may not have an earthen emergency spillway; instead they may use a secondary concrete or metal riser to release excess flows.

Start-up phase check-ups: BIDs require more frequent startup phase check-ups during plant establishment through the first three years as stipulated in Chapter 3. The following items should be inspected during these check-ups:

- Vegetation in and around the SCM should be in good condition and per plan including trees, shrubs and herbaceous/grass plant materials. Coverage should reach 70% or more of plan depicted density by one year after construction, 75% by two years and 80% by three years. No invasive/undesirable species should be present. Dead plants should be removed and replaced. New plants should receive establishment watering as needed after installation. Where plans stipulate a non-vegetated BID surface, vegetation within the SCM footprint should be removed.
- The SCM and vicinity should be checked for signs of erosion of any form, including general loss of topsoil and the formation of rills or gullies.

- Sediment accumulation should be checked and removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 1 inch in depth or affects inflow or outflow in the SCM.

## 5.3.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes routine activities and the recommended frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

All maintenance activities must be performed in a manner that does not cause compaction of the BID surface area. Vehicles and construction equipment are not permitted to enter into the SCM.

**Table 5.3.1: Routine Maintenance for BID**

| Frequency | Activity |
|---|---|
| Two times per year | • Mow grassed side slopes and grassed basin bottom to a height of 5 to 8 inches. Perform mowing operations when SCM is completely dry, preferably using hand operated equipment. Do not drive heavy equipment on SCM surface. |
| Annually | • Remove weeds and undesirable plants; prune shrubs and trees (if present) to maintain appearance and functionality. Remove undesirable vegetation, including woody vegetation on embankments. Replace diseased or dead plants; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species. For non-vegetated system, remove all growth using hand methods or herbicide application. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove litter, trash and debris from SCM surface, side slopes, inflow/outflow points, structures and surrounding area. |
| As Needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.3.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the Basin specific table (E.1.3).

# 5.4 Bioretention (BRE); Bioretention with Underdrain (BRU)

**Figure 5.4.1: Bioretention**
(top photo c/o https://c1.staticflickr.com/9/8343/8183562023_18d937722d_b.jpg;
Bottom photo c/o NCDOT HSP-2010-01)

## 5.4.1 Description and Overview

A Bioretention (BRE) also commonly known as a rain garden, is a shallow ponding area that removes sediment and other pollutants in stormwater runoff by settling coarse particles on the surface and filtering finer particles through soil media planted with native vegetation. The surface depression of a BRE is shallow compared to a stormwater basin and typically allows 6 to 18 inches of ponding depth.

The SCM can look similar to a typical detention basin or it may be a much shallower surface depression. The filter soil can be existing in-situ topsoil, a mix of topsoil and sand/organics, or specifically engineered media. Stormwater is filtered by the planted media and infiltrates into the underlying soils where infiltration is feasible. Some BREs contain subsurface infiltration storage (SDS) below the filter soil (see Section 5.6).

A Bioretention with Underdrain (BRU) is a BRE with perforated underdrain(s) installed at the base of the planted filtration layer. The underdrains typically connect to a storm sewer pipe system to carry flows to a downstream discharge point. In cases where a flow control structure is not present, the underdrain may discharge directly through the embankment to the downstream discharge point. A BRU is installed where the underlying soil conditions do not permit infiltration and may include an impermeable lining to prevent infiltration. In areas where infiltration is questionable, some designs may incorporate an underdrain with a valve as a backup feature.

The surface of the ponding area in BREs and BRUs is typically covered with mulch and a mix of vegetation of varying density depending on the design. Vegetation can be grasses, perennials, shrubs, trees, or a combination. The grasses and perennials may be planted by seeds, plugs, or potted plants during construction. Systems with dense vegetation may not require mulch.

Stormwater is directed into the systems in a variety of methods, but most commonly via curb cuts, sheet flow, or pipe discharge. Most BREs and BRUs contain drains in the form of domed grates or standard inlet grates situated above grade at the depth of intended ponding to convey water during large storm events. During smaller storm events, runoff will filter through the media and ultimately infiltrate into the subgrade or drain into underdrains, if present.

### 5.4.2 SCM Components

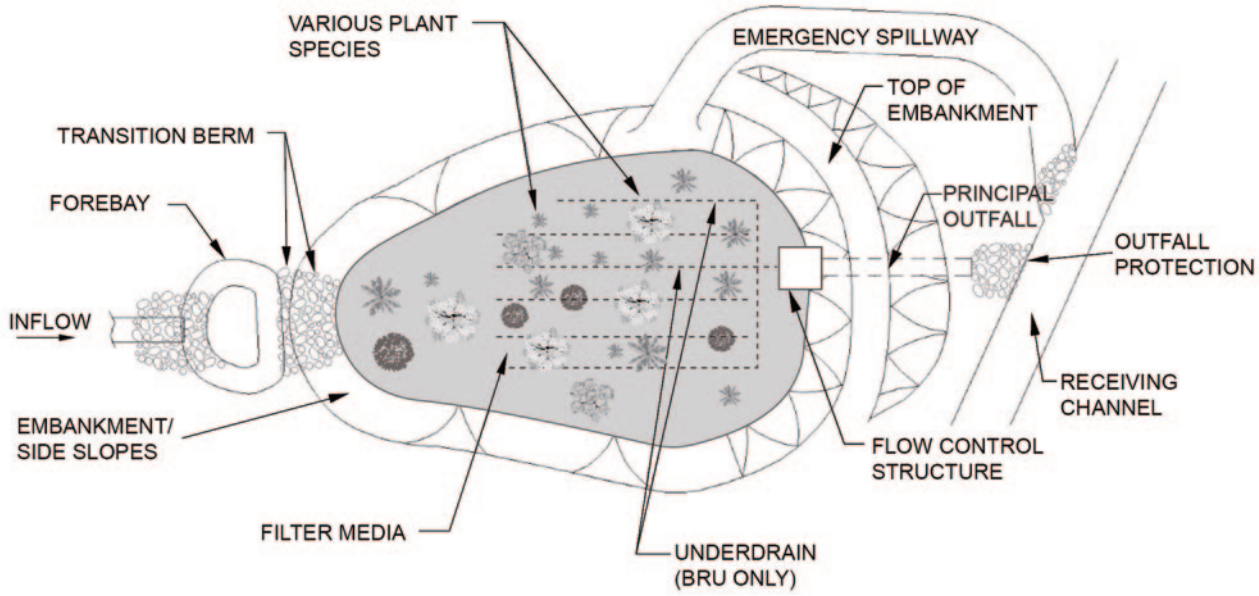
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow System
- Inlet with Sump/Traps
- Forebay
- Flow Control Structures
- Structures and Appurtenances
- Outfall Protection
- Earthen Emergency Spillway

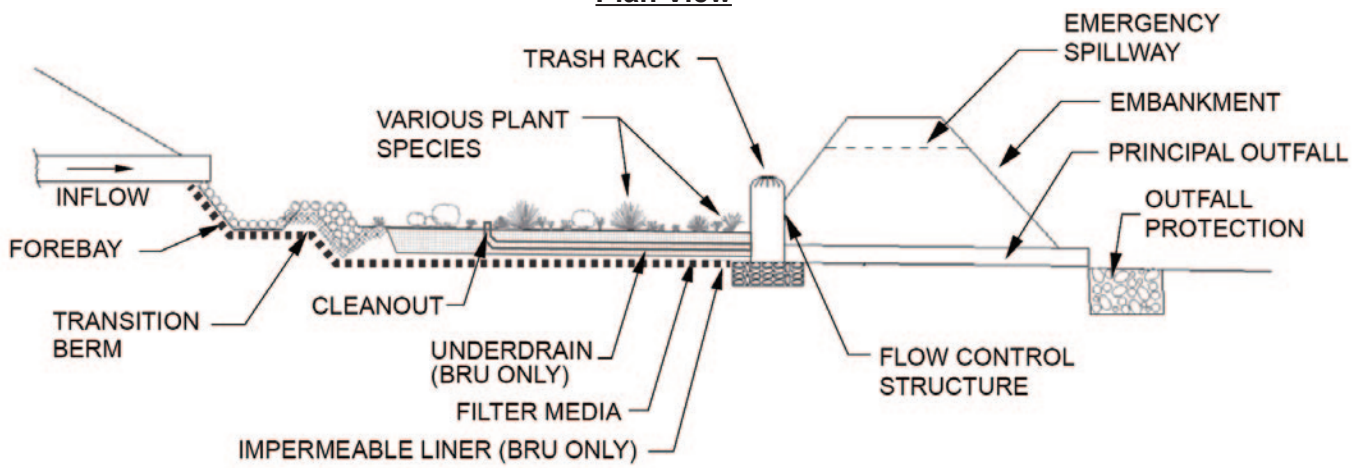
In addition, BREs and BRUs may include the following other components:

- Impermeable liner (BRU only)
- Filter media
- Perforated underdrains (BRU only)
- Observation well/cleanout
- Vegetative shrub, woody, or grass plantings
- Turf grass
- Embankment/side slopes
- Receiving channel/discharge system

Figure 5.4.2 illustrates the components of a typical BRE and BRU. Runoff enters the SCM via directly connected inlets, pipes, channels, and sheet flow. Water ponds in the storage area to a designed depth, when it flows into an outflow control structure where stormwater is slowly released.




**Plan View**




**Section View**

**Figure 5.4.2: Bioretention and Bioretention with Underdrain - Common Elements**
(Adapted from NCDOT-HSP-2010-01)

## 5.4.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a bioretention system should focus on its key functional areas: inflow, infiltration/filtration, and flow control devices. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.

- Sediment accumulation should be removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 3 inches in depth or anytime it affects infiltration, inflow, or outflow in the SCM.
- Bioretention systems are particularly susceptible to clogging from sediment if the drainage area contributes high sediment loads and/or adequate pretreatment is not present. Inspect existing pretreatment measures for sediment accumulation and, if excessive sediment is present, make recommendations as appropriate (e.g., additional pretreatment measures, improve efficiency of existing measures). In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- The SCM and vicinity should be checked for signs of erosion, flow channelization, loss of topsoil and sinkhole activity.
- Inspect for appropriate vegetative cover per plan. Vegetation should be in good condition with at least 80% coverage over the plan depicted planting areas and no invasive/undesirable species. Vegetation should not hinder inflow or outflow in the SCM.
- Confirm mulch cover is in good condition. Mulch should be approximately 3 inches in depth and consist of triple shredded or leaf compost mulch. Wood chips shall not be used as mulch.
- Inspect the basin and observation wells/cleanouts (if present) for signs that standing water remains in the basin longer than 72 hours after a rain event; the presence of hydrophytic vegetation may be an indication of this. Prolonged ponding suggests the filter media may be clogged, the underdrains are clogged, or the designed subsurface infiltration is inadequate.
- When plans indicate an impermeable liner is present (BRU only), look for unintentionally exposed section or signs of puncture, tears or leaks indicated by surface cover erosion, animal burrow activity or similar.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for BREs/BRUs, the following should be considered:
VSI Form

- 3C. Permanent pool water level very low or dry – does not apply.

CAI Form

- Section 3 – Outflow, Principal spillway/riser: the outlet structure can be considered the overflow inlet domes/grates elevated above the ponding area.
- Section 3 – Outflow, Principal spillway/riser: in some instances, a flow control structure may not be present; instead the underdrain may discharge directly to the basin outfall.
- Section 3 – Outflow, Emergency Spillway: many BRE/BRUs may not have an earthen emergency spillway; instead they may use a secondary concrete or metal riser to release excess flows.

Start-up phase check-ups: Bioretention areas require more frequent startup phase check-ups during plant establishment through the first three years, as stipulated in Chapter 3. The following items should be inspected during these check-ups:

- Vegetation in and around the SCM should be in good condition and per plan including trees, shrubs and herbaceous/grass plant materials. Coverage should reach 70% or more of plan depicted density by one year after construction, 75% by two years, and 80% by three years after construction. No invasive/undesirable species should be present. Dead plants should be removed and replaced. New plants should receive establishment watering for the first two years as stipulated in the routine maintenance table in Section 5.4.4.
- The SCM and vicinity should be checked for signs of erosion of any form including general loss of topsoil and the formation of rills or gullies.

- Confirm mulch cover is in good condition. Mulch should be approximately 3 inches in depth and consist of triple shredded or leaf compost mulch. Wood chips shall not be used as mulch.
- Sediment accumulation should be checked and removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 3 inches in depth or affects inflow or outflow in the SCM.

### 5.4.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

All maintenance activities must be performed in a manner that does not cause compaction of the BRE/BRU surface area. Vehicles and construction equipment are not permitted to enter into the SCM.

**Table 5.4.1: Routine Maintenance for BRE and BRU**

| Frequency | Activity |
|---|---|
| April-Oct twice weekly for 6 weeks following planting | • Water all seeded/planted areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 24 hours of scheduled watering. |
| April-Oct every two weeks for first two years following | • Water all planted (non-grassed/seeded) areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 7 days of scheduled watering. |
| Two times per year | • Mow banks of BRE/BRU and surrounding areas to a height of 5 to 8 inches. Perform bank mowing operations when SCM is completely dry, preferably using hand operated equipment. Do not drive heavy equipment on SCM surface.<br>• Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plants; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). |
| Annually | • Mow areas of grass within the BRE/BRU (surface) at the end of the growing season to a height of 5 to 8 inches. Perform mowing operations when SCM is completely dry, preferably using hand operated equipment; do not drive heavy equipment on SCM surface.<br>• Re-level mulch (if present) to a 2 to 3 inch depth and repair bare spots using triple shredded or leaf compost mulch. Wood chips shall not be used.<br>• Remove litter, trash, and debris from SCM surface, side slopes, inflow and outflow points, |
| Once every five years | • Install fresh mulch (if present) 3 inches deep throughout SCM bottom using triple shredded or leaf compost mulch. Wood chips shall not be used as mulch. If mulch is causing outflow structure clogging or other issues, the area may be seeded. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

### 5.4.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the Bioretention specific table (E.1.4).

# 5.5 Subsurface Infiltration Trench (SIT)

**Figure 5.5.1: Subsurface Infiltration Trench**

## 5.5.1 Description and Overview

A Subsurface Infiltration Trench (SIT) is a stormwater control measure that is generally a long, narrow excavated trench with a level bottom, backfilled with a perforated pipe running lengthwise and surrounded by coarse aggregate wrapped in geotextile. A SIT is typically 3 to 6 feet wide and no more than 6 feet deep with cleanout points and/or observation wells connected to the perforated pipe or stone sections. SITs should include an overflow mechanism for larger storm flows to discharge.

The top of the SIT can be exposed or covered. Exposed varieties are designed to receive surface runoff and are normally covered with grass or with gravel/stone. Pretreatment of runoff occurs at the surface. This type can be located beneath a vegetated swale (VSW/VSC) or infiltration berm (IBE) and are designed to infiltrate flows which percolate from the swale into the trench (see Section 5.11 for VSW/VSC and Section 5.12 for IBE related information).

Covered SITs are located beneath paved areas and receive flows via direct pipe/inlet connection. The inflow point to this type of SIT is often an inlet or manhole structure that includes a trap/sump for pretreatment.

## 5.5.2 SCM Components

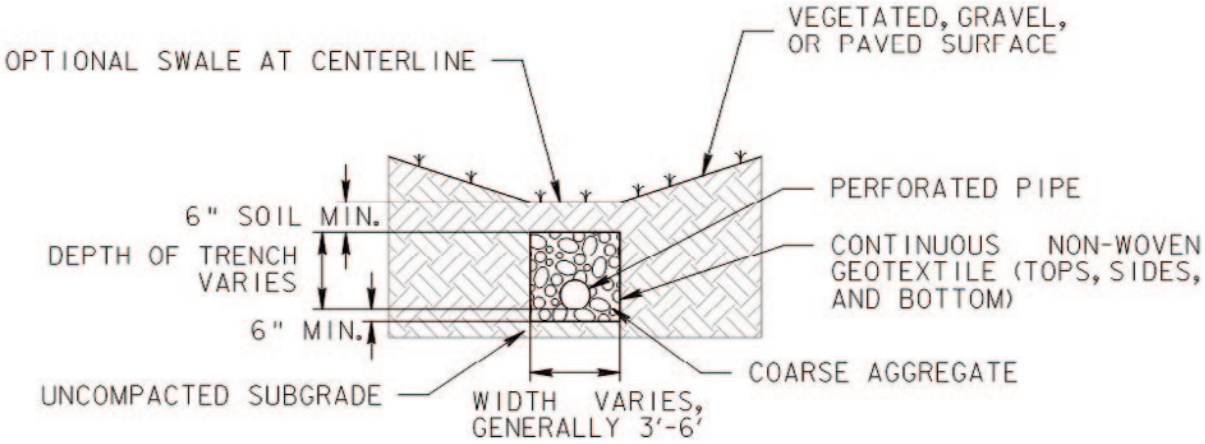
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow System
- Inlet with Sump/Traps
- VSW/VSC SCM

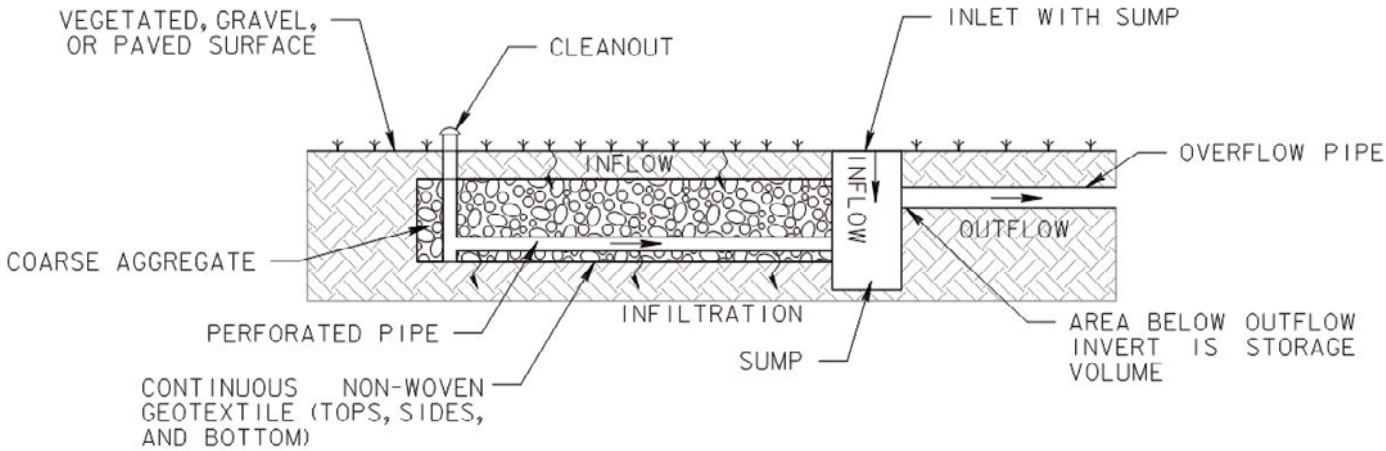
In addition, SITs may include the following other components:

- Vegetated or gravel surface
- Perforated pipe
- Coarse aggregate
- Geotextile
- Observation well/cleanout
- Overflow pipe/device

Figure 5.5.2 illustrates the common components of a typical SIT. Runoff enters the SIT via infiltration from the surface or from directly connected inlets and pipes. Flows exceeding the infiltration capacity of the trench exit via overflow piping. An observation well or cleanout is typically included for inspections and maintenance.




**Section View**




**Profile View**

**Figure 5.5.2: Subsurface Infiltration Trench - Common Elements**

### 5.5.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of SIT should focus on primarily its key functional areas: inflow, infiltration, and overflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- Where SITs are located beneath vegetated areas, surface vegetation should be in good condition with at least 80% uniform coverage, no invasive/undesirable species, and no signs of erosion. Where SITs are located below another SCM, vegetation coverage should meet surface SCM inspection requirements. SITs designed with a gravel surface should have gravel coverage over the entire SIT area with no vegetation present.
- Examine surface for sediment build-up; sediment should be removed when it reaches 3 inches of build-up, inhibits vegetative growth in 10% of the SCM, or anytime it blocks flow entry into the SCM.
- Check water level measured in observation well/cleanout for signs that standing water remains in the SIT longer than 72 hours after a rain event. Prolonged water storage suggests the SCM may be clogged or the subsurface infiltration is inadequate.
- Inspect overflow spillways for obstructions and structural condition.
- The SIT surface and surrounding area should be checked for signs of erosion and sinkhole activity. Report any surface settlement, erosion or depressions.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for SITs, the following should be considered:
VSI Form

- Line items referencing side slopes and embankments do not apply.
- 1D. Sediment forebay or micropool – should be used to assess inlet with sump/trap.
- 2D. Emergency spillway – should be considered a surface inlet grate in the SIT that surcharges in the event the SIT clogs or otherwise fails.
- 3C. Permanent pool water level very low or dry – does not apply.

CAI Form

- Section 3 – Outflow: the overflow pipe (or other device) conveying flows during larger storm events is considered the “Principal Spillway” in Section 3 of the CAI form. In most cases, the overflow pipe will have a higher invert elevation than the SIT invert, but a lower invert than any directly connected inflow pipes.
- Section 3 – Outflow, Emergency Spillway: if the SIT has a surface inlet grate that surcharges in the event the SIT clogs or otherwise fails, this should be assessed as an emergency spillway.
- Section 5 – Side Slopes and Embankment: does not apply.

### 5.5.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM’s information in Maintenance-IQ for potential variations.

**Table 5.5.1: Routine Maintenance for SIT**

| Frequency | Activity |
|---|---|
| Two times per year | • Mow grass, if present in an SIT with vegetated surface to a height of 5-8 inches. Perform bank mowing operations when SCM is completely dry, preferably using hand operated equipment. Do not drive heavy equipment on SCM surface. |
| Annually | • Remove sediment, litter, trash, and debris from SCM surface, side slopes, inflow and outflow points, structures, and surrounding area. Do not drive heavy equipment on SCM surface. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.5.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SIT specific table (E.1.5).

# 5.6 Subsurface Detention Storage (SDS)

**Figure 5.6.1: Subsurface Detention Storage Under Construction**
(photo c/o The Philadelphia Water Department, Stormwater Management Guidance Manual)

## 5.6.1 Description and Overview

Subsurface Detention Storage (SDS) is a stormwater control measure which stores collected stormwater below grade in stone aggregate, pipes, vaults, porous crates, baskets, or modular systems. SDSs can be designed to slowly release and/or infiltrate the stored water. SDSs are rarely constructed under roadways; they can be located under shoulders, pull-off areas, grass areas, or under parking lots at welcome centers and maintenance lots. The surface above the SDS can be impervious, gravel or vegetated. SDS systems are accessible via inlet/manhole access points for inspection and maintenance purposes.

Stormwater enters SDSs through inlet grates or via pipes. Pretreatment areas like sumped/trapped inlets or Manufactured Treatment Devices (MTD) are critical components for SDSs because it can be difficult to rehabilitate infiltration clogging and outlet structure clogging issues (see Section 6.4 for Inlet with Sump/Traps and Section 5.13 for MTD related information). Infiltrating SDSs can be designed using solely a stone storage bed or may include a network of pipes, vaults or other permeable modular chambers within a stone bed. Non-infiltrating SDSs typically utilize water tight pipe storage, chamber storage or a stone bed wrapped in an impermeable liner to temporarily store and release collected stormwater.

The outflow from SDSs is via a subsurface flow control structure typically housed in a manhole or concrete box structure. The flow control structure typically includes a series of orifices and weirs built on an internal baffle wall designed to function similar to a surface SCM flow control structure.

Some SDSs may have multiple entry points, however some may just maintain one entry at the flow control structure. Entry into an SDS is considered confined space entry and is prohibited without proper OSHA training and safety measures in place. Observation wells and cleanouts may be present in an SDS and can be used for maintenance and inspection from the surface.

## 5.6.2 SCM Components

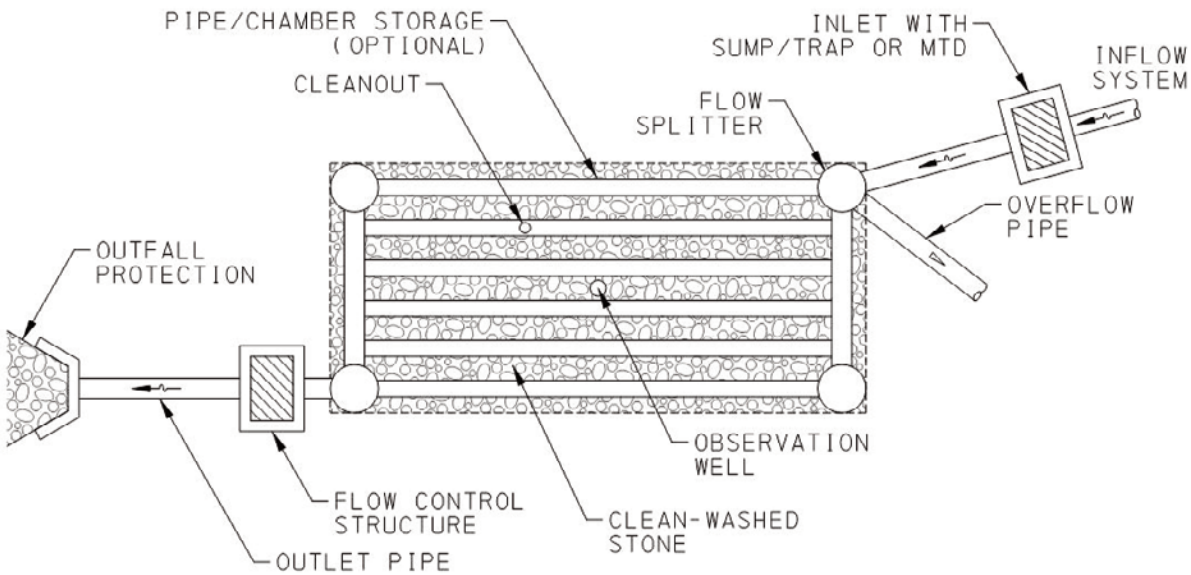
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, Security
- Signage
- Inflow System
- Inlet with Sump/Traps
- Manufactured Treatment Device (MTD)
- Flow Splitter
- Flow Control Structure
- Structures & Appurtenances
- Outfall Protection (if system outlets to surface downstream)

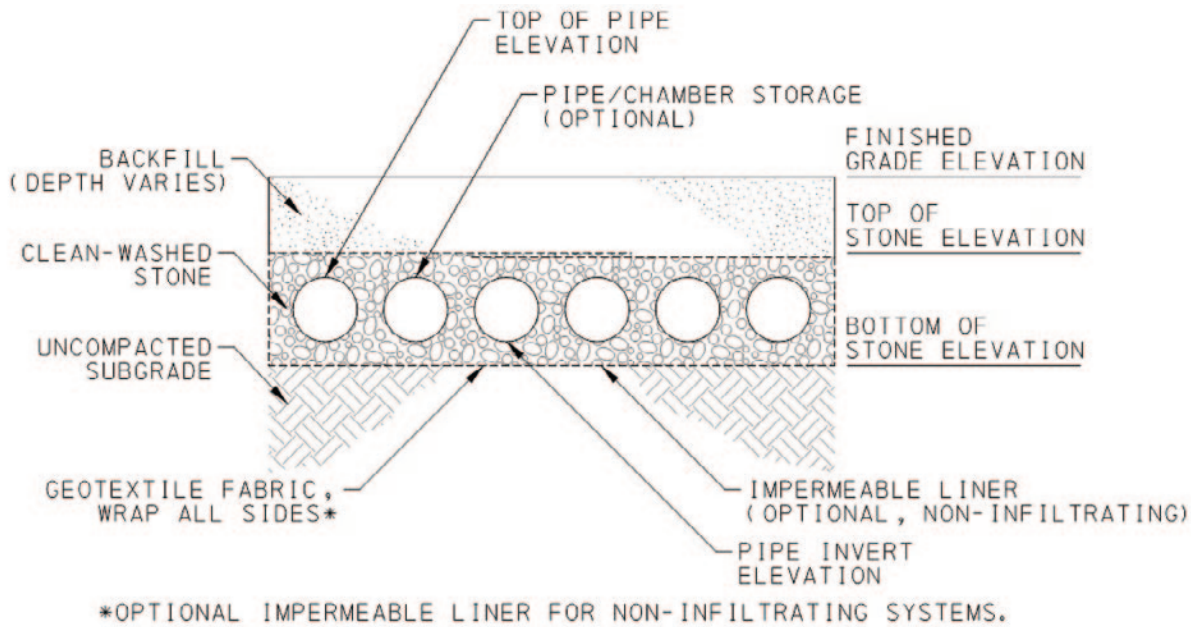
In addition, SDSs may include the following other components:

- Geotextile fabric
- Stone/course aggregate
- Observation well/cleanout
- Overflow pipe/device
- Perforated pipe (infiltrating)
- Impermeable liner (optional; non-infiltrating)

Figure 5.6.2 illustrates the common components of a typical SDS. Runoff enters the SDS through an inflow system that may include a sumped/trapped inlet or an MTD for pretreatment and a flow splitter. Flows are conveyed into a storage system that may include a stone bed, a series of pipes or a modular storage system. Flows exit the storage system through a flow control structure before discharging to an outfall. Outfalls for SDSs can be a direct connection to a downstream closed drainage system or a pipe discharging to a surface water or channel.




**Plan View**




**Section View**

**Figure 5.6.2: Subsurface Detention Storage - Common Elements**

## 5.6.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an SDS should focus primarily on its key areas: inflow, storage system, and flow control structure. Specifically:

- Entry into SDS or any confined space is prohibited without proper OSHA training and safety measures in place. Perform visual inspections from the surface for underground SCMs. If signs indicate the system may not be functioning properly or if sufficient data cannot be obtained from the surface, recommendations for video inspection, confined space entry, or other means of inspection should be made.

- Confirm the design drainage area is reaching the SCM.
- Inspect area surrounding and above SCM for trash/debris, surface erosion, and sinkhole activity.
- Inspect areas above SDS for signs of ground settlement or subsidence and pavement cracking or fractures which may indicate failure of the subsurface components.
- Inspect the SDS inlets, manholes, and observation wells/cleanouts (if present) for signs that standing water remains in the system longer than 72 hours after a rain event. Prolonged standing water suggests the SCM may be clogged with silt/debris or subsurface infiltration is inadequate.
- Note levels of sediment visible in the inlets, manholes, and observation wells/cleanouts. Sediment and debris build up should be removed when it exceeds the plan specified cleanout depth. In the absence of a plan specified depth, sediment should be cleaned out when it exceeds 10% of the depth of the storage area for 1/2 length of storage area; at any point where the depth exceeds 15% of open storage depth; or at any time when infiltration or flow through the system is impeded. Subsurface inspection may be recommended to confirm sediment accumulation.
- Modular or chamber storage SDS components which are proprietary shall be inspected in accordance with their manufacturer specific requirements. Reference as-built plans for requirements.
- Inspect all applicable common components as described in Chapter 6 including subsurface flow control structures and outfall pipes which outlet to surface locations.

When completing the inspection forms for SDS, the following should be considered:
VSI Form

- Line items referencing side slopes and embankments do not apply.
- 1D. Sediment forebay or micropool – should be used to assess inlet with sump/trap.
- 1E. SCM floor/surface or within SCM – applies to sediment within SDS storage area.
- 2B. SCM bottom or side slopes – does not apply.
- 2D. Emergency spillway – may be an overflow structure within the inflow structure, or flow control structure that surcharges in the event the SDS fails.
- 3C. Permanent pool water level very low or dry – does not apply.
- Category 4. Vegetation – applies to SDS drainage area, surface and areas of access to the SDS.

CAI Form

- Section 2 – Site Conditions, Vegetation: may not apply if entire contributing drainage area is impervious; vegetation impeding access to SDS is applicable even if outside of contributing drainage area.
- Section 3 – Inflow: erosion and scour may not apply when inflow is pipe flow only.
- Section 3 – Outflow, Emergency Spillway: the emergency spillway for an SDS is typically an overflow structure in the form of a weir in the flow control structure. The weir invert is constructed at an elevation higher than the other orifice and weir elevations on the primary spillway baffle wall within the subsurface flow control structure.
- Section 4 – SCM Ponding & Conveyance: ponding within an SDS can be inspected in the observation wells, inflow points and flow control structures.
- Section 4 – Filtration: does not apply.
- Section 5 – Side Slopes and Embankment: does not apply.

## 5.6.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.6.1: Routine Maintenance for SDS**

| Frequency | Activity |
|---|---|
| Two times per year | • Mow vegetated surface areas overlying and surrounding SDS to a height of 5-8 inches.<br>• Remove sediment, litter, trash, and debris from surface, inflow and outflow points, structures, and area surrounding SDS. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.6.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SDS specific table (E.1.6).

# 5.7 Stormwater Wetland (SWE)

**Figure 5.7.1: Stormwater Wetland – Extended Detention Shallow Wetland**

## 5.7.1 Description and Overview

Stormwater Wetlands (SWEs) are stormwater control measures consisting of a shallow marsh system which has been planted with emergent vegetation. They are similar to constructed wetlands or engineered wetlands with a key difference: they are specifically designed to treat stormwater runoff. SWEs are designed to accommodate larger drainage areas and may be constructed away from major infrastructure and developed areas, receiving only a portion of the stormwater flows.

Typical SWEs consist of approximately 40% open water, and contain a variety of plant types based on the relative elevation with respect to the open water. Native and beneficial hydrophytic vegetation species are planted within SWEs along the edge of permanent pools of water. These planted areas, referred to as low marsh zones or emergent vegetation zones (water depths up to 18 inches), and high marsh wedges (water depths up to 6 inches), play an integral role in the functionality of these SCMs. SWEs require a larger footprint than most SCMs and require an adequate source of inflow to maintain the permanent water surface elevation necessary to sustain the vegetation.

A pretreatment device or forebay is typically located at each point of major inflow into the SWE, and there are frequently multiple inflows due to the larger drainage areas associated with these SCMs. Within the SWE, water flows through open water zones, ranging from 1.5 feet to 6 feet deep, and then ponds in shallower pools of water of varying depths, known as micropools or wet pools. SWEs with deeper pools of water may have safety benches and/or aquatic benches graded into the side slopes. Safety benches are designed to remain above the water surface in between rain events, whereas aquatic benches will be submerged. As with dry basins, larger embankments may be considered a regulated dam structure depending on height and storage.

Inspections and maintenance of these must also comply with the requirements of the Dam Safety permit and should be noted in the inventory.

Typically, a flow control structure is used to release outflow from the SWE for larger storm events. Flow control structures can include concrete risers, concrete weir walls, or earthen embankments/spillways. An emergency spillway is also normally present. Some SWEs may have a sluice gate or other emergency drawdown opening at the bottom of the storage area to empty the system for maintenance or emergencies (refer to Section 5.2 Wet Detention Basin, Figure 5.2.3 and 5.2.4 for sluice gate photos).

SWEs can be organized into the following four categories:

- Shallow Wetlands – Large surface area, provides water quality treatment through a meandering open water zone in combination with emergent vegetation zones.
- Extended Detention Shallow Wetlands – Similar to the shallow wetland; however, a micropool is utilized along with a flow control structure to provide both water quality and peak rate control.
- Pocket Wetlands – Smaller footprint than shallow wetlands, and typically constructed near the existing water table.
- Pond/Wetland Systems – A combination of a wet pond in series with a shallow wetland.

## 5.7.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, fencing, and security
- Signage
- Inflow System
- Flow Splitter(s)
- Forebay
- Flow Control Structure
- Outfall Protection

In addition, SWEs may include the following other components:

- Micropool/permanent pool(s)
- Open water zones
- High marsh wedges
- Low marsh zones/Emergent vegetation zones
- Hydrophytic vegetation
- Safety/aquatic benches
- Geotextile
- Riprap/gabion baskets
- Embankment/side slopes
- Sluice gate/emergency wet pool dewatering valve
- Receiving channel/discharge system

Figures 5.7.2 to 5.7.4 illustrates the common components of a typical SWE. Runoff enters the SWE through an inflow system that typically discharges to a forebay for pretreatment. Within the SWE, stormwater is conveyed slowly through well-vegetated areas of filtration and shallow storage prior to exiting through a flow control structure. Outfalls for SWEs can be a direct connection to a downstream closed drainage system, to a swale, or directly to a stream.

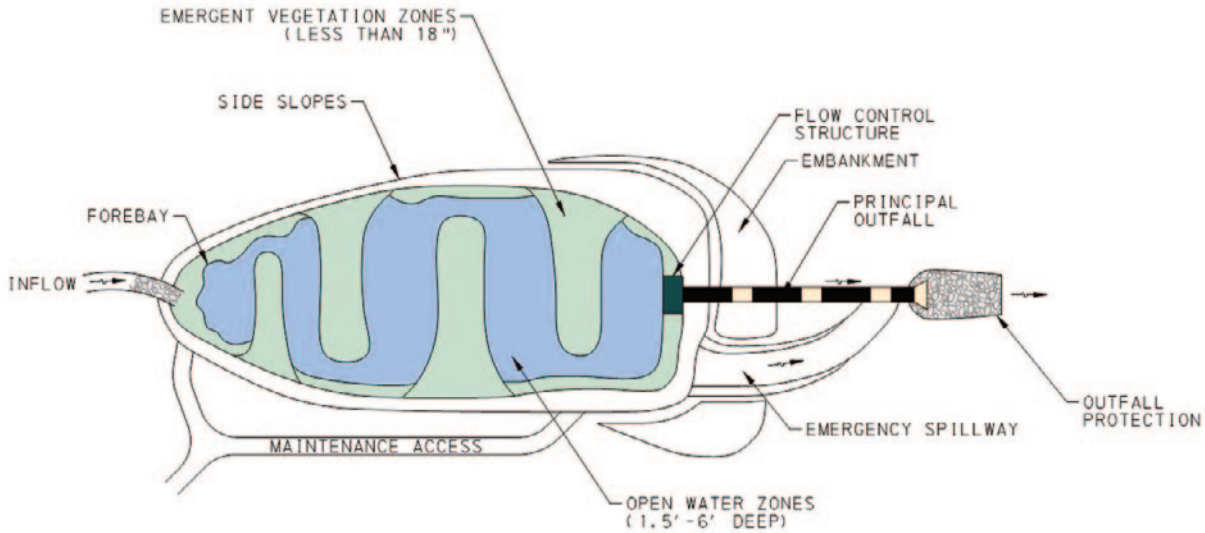



**Figure 5.7.2 – Shallow Wetland - Common Elements**
(Adapted from PA Stormwater Best Management Practices Manual)

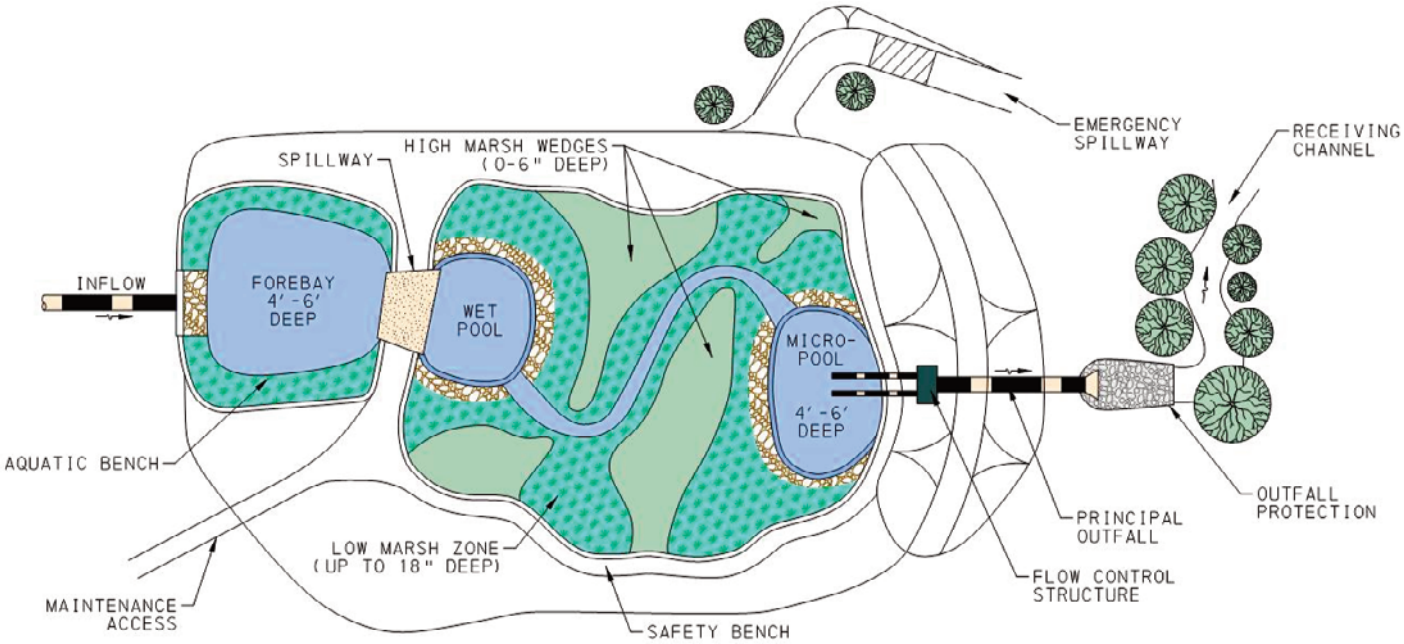



**Figure 5.7.3 – Pond/Wetland System - Common Elements**
(Adapted from PA Stormwater Best Management Practices Manual)

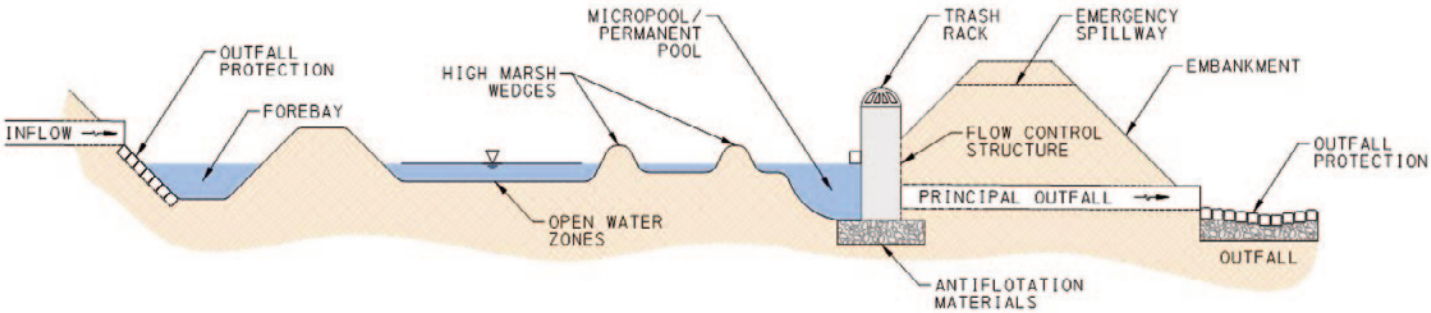



**Figure 5.7.4: Typical SWE – Section View**
(Adapted from NCDOT-HSP-2010-01)

## 5.7.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an SWE should focus primarily on its key functional areas: inflow, storage system, and flow control structures. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect the SWE, side slopes, embankments, inflow and outflow points for presence and note severity of:
  - Trash/debris
  - Surface erosion
  - Sinkhole activity
  - Signs of contaminants (e.g. gas, oil, fertilizers)
  - Evidence of burrowing animals.
- Inspect the SWE's micropool(s) and/or permanent pool(s) and confirm the pool elevations are near the design plans depths. Take note of very low or dry conditions within any of the pools.
- Look for evidence of excessive algae in the wet pool. Some algae growth is expected and part of the natural system helping with nutrient removal. Algae growth covering more than 50% of the pool area should be considered excessive and requires removal.
- Look for evidence of excessive permanent waterfowl population. Evidence of approximately 20 or more permanent waterfowl inhabitants per pond surface acre should be noted.
- Check for sediment accumulation. Sediment accumulation should be removed when it reaches 50% of the permanent pool storage volume or anytime it impacts SCM performance and flow through the system.
- The embankment should be assessed for erosion, cracking, settlement, sloughing, burrowing animals, instability and tree growth.
- Inspect downstream of the toe of embankment for evidence of seepage, piping, or hydrophytic vegetation.
- Inspect wetland and buffer vegetation around the perimeter of the SWE. Vegetation should be in good condition with at least 85% coverage within the emergent vegetation zone. The cover type should match original design plans with no invasive/undesirable species present. Hydrophytic vegetation may be present in and in close proximity to the SWE perimeter with less water tolerant vegetation further up the side slopes. Vegetation should not hinder inflow or outflow in the SCM.
- If present, inspect the sluice gate or other emergency draw down valve. Look for excessive corrosion and signs that the mechanisms have frozen or rusted closed, taking care not to open it. Check for signs of leaking. Some SWEs may have a sluice gate or other emergency drawdown opening at the invert of the facility to empty the system for maintenance or emergencies.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for SWEs, the following should be considered:
VSI Form

- 3B: This item is not applicable to SWEs.
- 4A-F: As the vegetation is imperative to the functionality of the SWEs, this is a critical inspection element and invasive/undesirable species, plant mortality, bare spots, and encroachment of woody vegetation should be carefully documented.

CAI Form

- Section 3 – Types of Inflow: it is important to note that some inflow points may be submerged during the time of inspection as there is a permanent pool of water associated with SWEs.
- Section 3 – Outflow, Principal Spillway Riser-Opening: when emergency draw down values are present, they should be assessed under "Other" in the Principal Spillway Riser-Opening area of Section 3. Include details regarding type, material, size and present functionality/maintenance needs.
- Section 4 – Water Quality: the presence of some algae is acceptable however, over more than 50% of the wet pool area is considered an issue requiring corrective maintenance.
- Section 4 – Filtration: does not apply to SWEs.

Start-up phase check-ups: SWEs require more frequent startup phase check-ups during plant establishment through the first three years as stipulated in Chapter 3. The following items should be inspected during these check-ups:

- Check for sediment, trash, and debris accumulation within the footprint of the SWE.
- Confirm water elevations within the forebays, micropools, and permanent pools match design plans.
- Inspect wetland and buffer vegetation. Vegetation in and around the SCM should be in good condition and per plan including trees, shrubs and herbaceous/grass plant materials. Coverage should reach 70% or more of plan depicted density by one year after construction, 75% by two years, and 85% by three years after construction. No invasive/undesirable species should be present. Dead plants should be removed and replaced, receiving initial post construction water schedule commencing after reinstallation to establish the intended planting zones.
- The SCM and vicinity should be checked for signs of erosion of any form including general loss of topsoil and the formation of rills or gullies.
- Inspect the SWE for unintended flow channelization through the system.
- Confirm inflow and outflow points are clear and functioning.
- Assess bank stability for embankments, side slopes, and conveyance channels.
- Inspect forebays, micropools, and permanent pools for excessive sediment accumulation. Sediment and debris accumulation should be checked and removed when it reaches the depth indicated by the cleanout marker.

## 5.7.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.7.1: Routine Maintenance for SWE**

| Frequency | Activity |
|---|---|
| April-Oct twice weekly for six weeks following planting | • Water all seeded/planted areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 24 hours of scheduled watering. |
| April-Oct every two weeks for first two years following construction | • Water all planted (non-grassed/seeded) areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 7 days of scheduled watering. |
| Two times per year (for the first two years of service) | • Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plant materials; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species maintaining 80% plant cover. Remove undesirable vegetation by hand, especially woody vegetation on embankments. Note: Non-invasive, hydrophytic vegetation is acceptable but should not hinder SCM inflow or outflow. Dispose of vegetative cuttings off-site. |
| Annually | • Mow areas of turf grass surrounding the SCM to a height of 5 to 8 inches. Dispose of vegetative cuttings off-site.<br>• Remove litter, trash, and debris from SCM surface, side slopes, inflow/outflow points, structures and surrounding area.<br>• Exercise (move/open) valves/sluice gates by briefly opening it enough to ensure that the valve/sluice gate can operate through its full range of motion. If lubrication is necessary, use marine-type grease. |
| Every other year | • Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plant materials; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species maintaining 80% plant cover. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). Non-invasive, hydrophytic vegetation is acceptable but should not hinder SCM inflow or outflow. Dispose of vegetative cuttings off-site. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

It is important to dispose of vegetative cuttings off-site so they do not contribute additional nutrients to the SWE or present a clogging concern at the flow control structure.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

### 5.7.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SWE specific table (E.1.7).

# 5.8 Constructed Stormwater Filter (CSF)

**Figure 5.8.1: Open Constructed Stormwater Filter**
(photo c/o PADEP BMP Manual 2006)

## 5.8.1 Description and Overview

Constructed Stormwater Filters (CSF) are SCMs comprised of a filtering layer (sand, compost, organic material, etc.) which the stormwater flows through. CSFs can be above ground (open CSF) or they can be constructed a subsurface vault (enclosed CSF). CSFs temporarily detain stormwater runoff allowing it to percolate through the filter layer which removes pollutants from runoff.

Open CSFs may look similar to a surface detention basin with a sand or gravel bottom. Runoff typically enters the filter area as concentrated flow in an inflow pipe or channel. A flow spreading device, such as a level spreader, may be used to evenly disperse the flows over the filter media. Runoff filters through the media into an underdrain collection system for release to a downstream conveyance system, or it infiltrates into the existing soils below the filter area.

Enclosed CSFs are constructed below ground in a manhole or concrete box structure in which the filter media is enclosed. Stormwater enters the vault area where it passes through the filter media into an underdrain where it flows out of the SCM. Some enclosed CSFs have a sediment collection sump area contained within the structure to remove excess sediment prior to entering the media chamber. Excess flows during large storm events overflow via a bypass weir without passing through the filter media. Enclosed CSFs are considered confined spaces and should not be entered without appropriate confined space training and procedures.

## 5.8.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

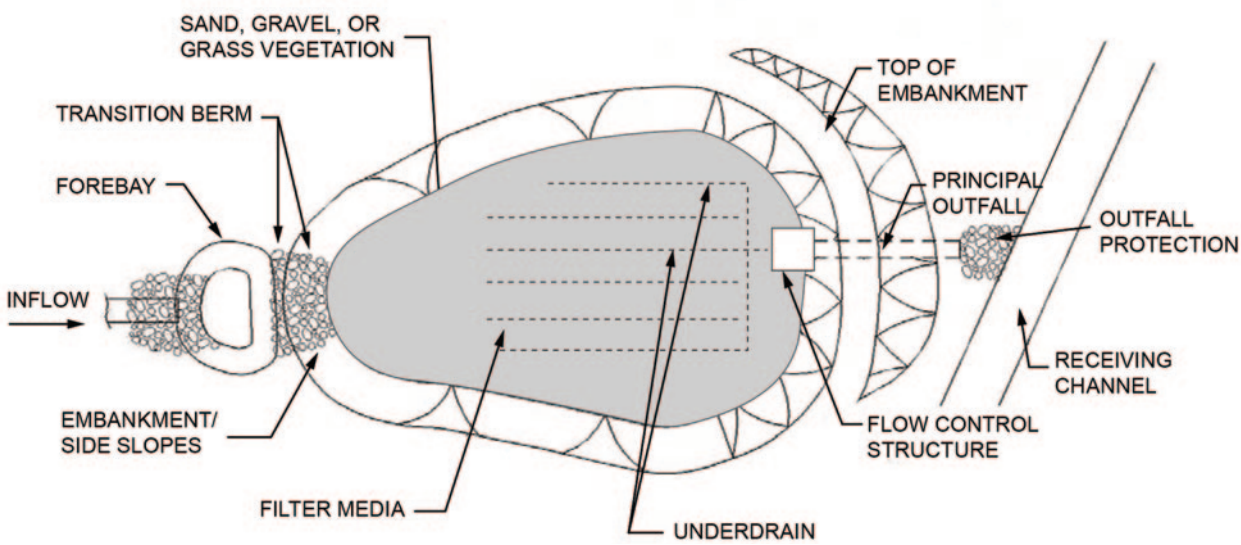
- Access, Fencing, and Security
- Signage

- Inflow Systems
- Inlet with Sump/Traps
- Forebay
- Flow Splitter
- Flow Control Structures
- Structures and Appurtenances
- Earthen Emergency Spillway
- Outfall Protection

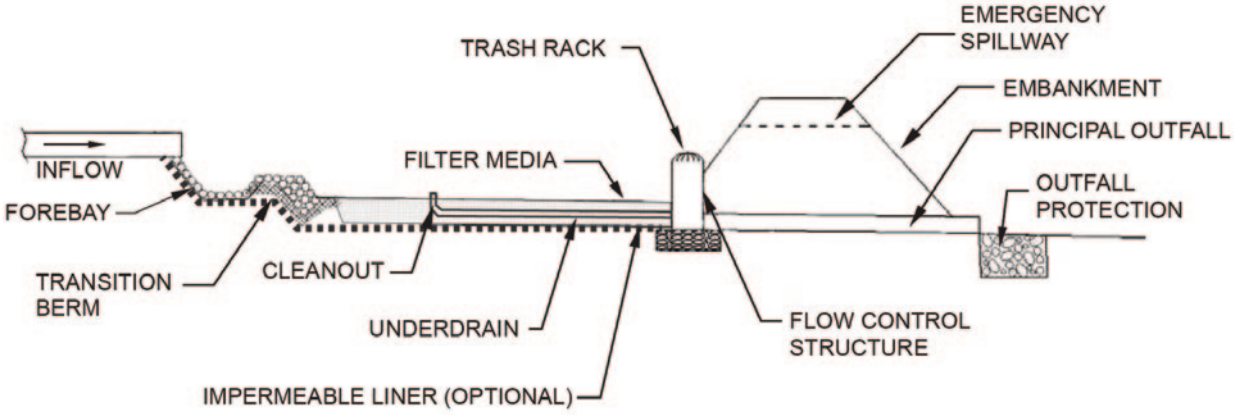
In addition, CSFs may include the following other components:

- Filter media
- Perforated underdrain
- Geotextile
- Observation well/cleanout
- Impermeable membrane (open CSF, optional)
- Vegetation, grass plantings (open CSF, optional)
- Embankment/side slopes
- Receiving channel/discharge system
- Concrete Structure (enclosed CSF)
- Access grate/cover (enclosed CSF)
- Baffles and weirs (enclosed CSF)

Figures 5.8.2 and 5.8.3 illustrate the components of a typical open and enclosed CSF. Runoff enters the SCM via directly connected inlets, pipes, channels, and sheet flow. Water flows through the filter media and out through an underdrain system or infiltration.




**Plan View**




**Section View**

**Figure 5.8.2: Open Constructed Stormwater Filter - Common Elements**
(Adapted from NCDOT-HSP-2010-01)

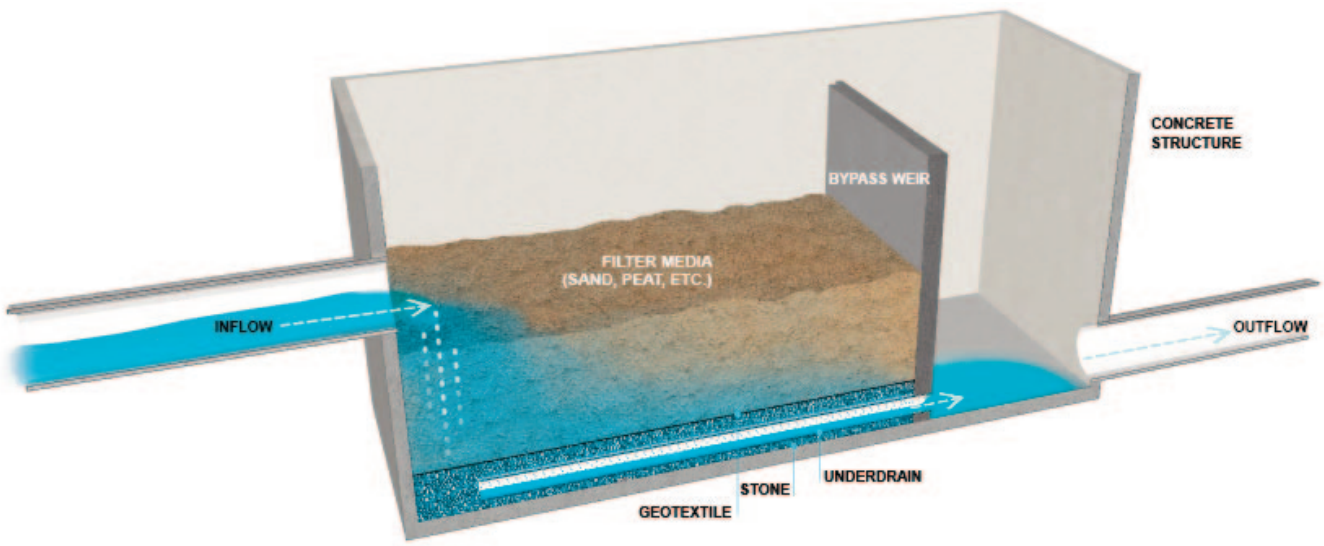



**Figure 5.8.3: Enclosed Constructed Stormwater Filter - Common Elements**
(Adapted from Philadelphia Water Department, Stormwater Management Guidance Manual)

## 5.8.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a CSF should focus on its key functional areas: inflow, infiltration/filtration, and overflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- CSFs are particularly susceptible to clogging from sediment if the drainage area contributes high sediment loads and/or adequate pretreatment is not present. Inspect existing pretreatment measures for sediment accumulation, and if excessive sediment is present, make recommendations as appropriate (e.g., additional pretreatment measures, improve efficiency of existing measures). In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- Sediment accumulation should be removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 1 inch in depth, when there are signs of poor infiltration on the media surface, or it affects inflow or outflow in the SCM.
- Inspect the filter media surface for signs of short circuiting, rills or channelization of flows over the filter media area.
- The SCM side slopes and vicinity should be checked for signs of erosion, flow channelization, and loss of topsoil.
- Inspect for signs of sinkhole activity in the SCM floor, side slopes and vicinity.
- Check for appropriate vegetative cover per plan. The interior and exterior side slopes of the CSF should be stabilized with turf grass at a minimum. Vegetation should only be present on the media if specified by plans. Vegetation should be in good condition with at least 80% coverage with no invasive/undesirable species. Vegetation should not hinder inflow or outflow in the SCM.
- Inspect for saturated soils, ponding, or other signs of decreased infiltration rates.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for CSFs, the following should be considered:
VSI Form

- 3C. Permanent pool water level very low or dry – does not apply.

CAI Form

- Section 3 – Outflow, Emergency Spillway: enclosed CSFs typically do not have an earthen emergency spillway.

## 5.8.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.8.1: Routine Maintenance for CSF**

| Frequency | Activity |
|---|---|
| Two times per year | • Mow side slopes and surrounding area of open CSF surface mid-season and at the end of the growing season to a height of 5 to 8 inches. Perform mowing operations when SCM is completely dry. Where CSF bottom surface is intentionally vegetated, mow surface using only hand operated equipment; do not drive equipment on bottom surface of CSF. |
| Annually | • Open and Enclosed CSF: Remove sediment, litter, trash, and debris from CSF surface, side slopes (open CSF), inflow/outflow points, structures and surrounding area.<br>• Open CSF: Remove vegetation from CSFs with sand/gravel surface. Remove weeds and undesirable vegetation from CSFs with grassed surface. Remove using hand operated equipment and using methods that minimize disturbance. Do not use herbicides.<br>• Remove weeds and undesirable vegetation from side slopes, inflow/outflow points, structures and surrounding area. Do not use herbicides.<br>• Enclosed CSF: Remove sediment accumulation in sump area of vault bottom. Remove per guidelines for Inlet with Sump/Traps tables in Section 6.4. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.8.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the CSF specific table (E.1.8).

# 5.9 Vegetated Filter Strip (VFS); Vegetated Filter Strip on Steep Slope (VSS)

**Figure 5.9.1: Vegetated Filter Strip (VFS)**

## 5.9.1 Description and Overview

Vegetated filter strips (VFSs) are gently sloping, linear strips of dense grass or other vegetation that filter sediment and pollutants from stormwater and encourage infiltration as runoff flows across the surface.

Vegetated Filter Strips, Steep Slope (VSSs) are similar to VFSs, but are constructed on steep slopes (exceeding 8 percent) and typically incorporate special design measures such as turf reinforcement or other surface stabilization measures. Check dams or pervious berms similar to IBEs may be included on a VSS to slow flow (refer to Section 5.12 for IBE related information).

A VFS/VSS is typically seen along the edge of pavement where runoff flows off the pavement via sheet flow and into a filter strip. These VFS/VSS systems are buffers between runoff from impervious areas and a receiving body of water. Variations of VFS/VSS located at the edge of the roadway can incorporate a flow spreading strip of gravel/rock between the pavement and grass strip to filter larger sediment/debris and avoid creating areas of channelized flow. A VFS/VSS located further from the roadway may incorporate level spreaders (refer to Section 5.14 Level Spreader and Flow Dispersion) to transition channelized flow to sheet flow upslope of VFS/VSS system.

## 5.9.2 SCM Components

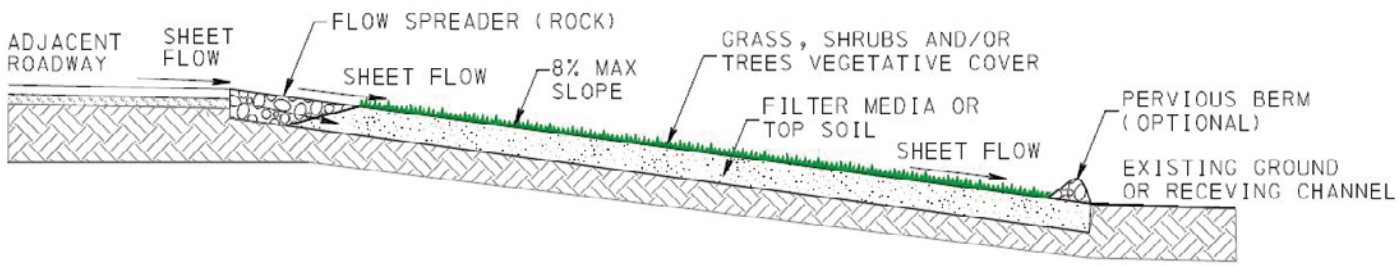
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow System
- LSO SCM
- IBE SCM

In addition, a VFS/VSS may include the following other components:

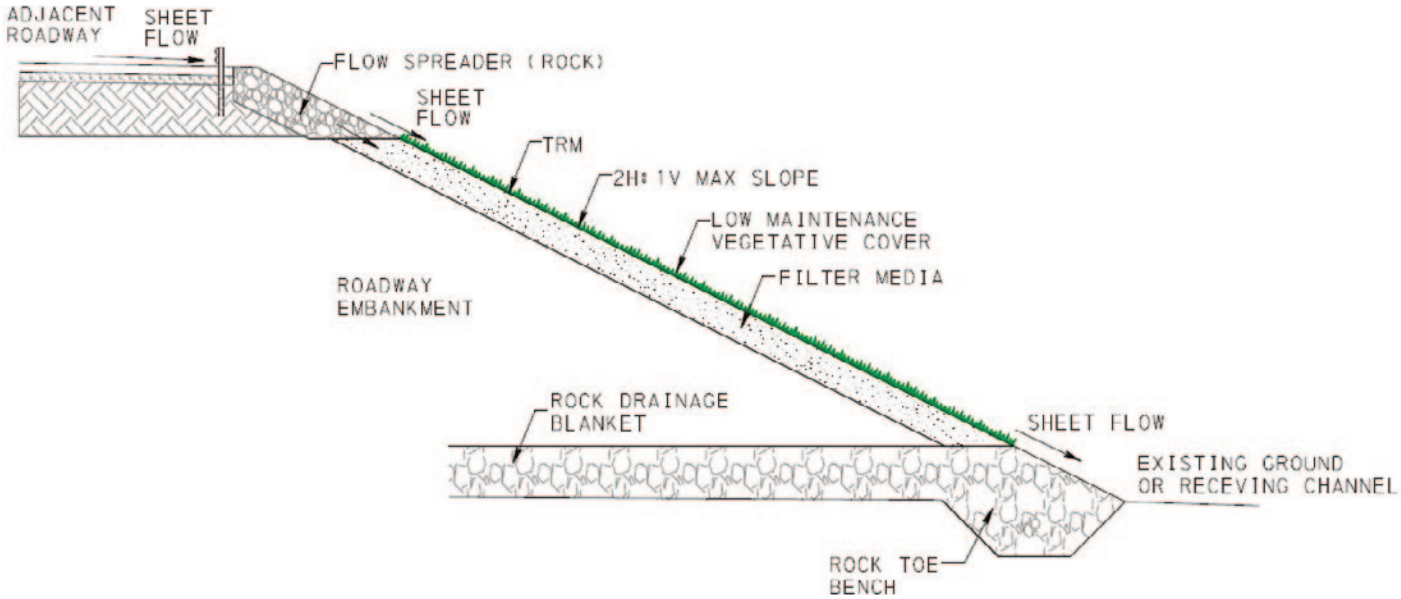
- Flow spreaders
- Filter media
- Vegetative shrub, woody or grass plantings
- Turf grass
- Pervious berm
- Receiving channel/downstream SCM

Figures 5.9.2 and 5.9.3 illustrate the common components of a typical VFS and VSS.




**Section View**

**Figure 5.9.2: Vegetated Filter Strip (VFS)- Common Elements**




**Section View**

**Figure 5.9.3: Vegetated Filter Strip, Steep Slope (VSS) - Common Elements**

## 5.9.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a VFS/VSS system should focus on its key functional areas: inflow, infiltration, and outflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Sediment should be removed from the filter surface when it reaches 2 inches in depth or at any time it affects flow through the SCM. Sediment removal may be required along the upslope edge of the filter more frequently than the filter surface to prevent channelized flows. In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- Inspect for signs of erosion and channelization at the inflow edge and throughout the filter surface. Note any signs of channelization within the filter surface. Small breaks in the sod and small erosion channels can quickly become large erosion problems. These areas should be repaired and reseeded immediately to ensure proper sheet flow of runoff across the filter.
- Inspect filter surface and surrounding area for trash and debris. Note debris that could cause flow channelization.
- Confirm surface vegetation is in good condition with at least 80% coverage throughout filter area and there are no bare patches exceeding 10% of the area.
- Verify that the vegetation is being mowed at the proper frequency. Turf grasses should be mowed at least annually to maintain grass height between 5 and 8 inches. Note if more frequent mowing is required. For VSS systems, a no-mow seed mix may be specified on the plans. If this is the case, mowing is not required.
- If present, inspect rock flow spreader adjacent to roadway.
- If present, inspect IBEs and level spreader as described in Sections 5.12 and 5.14, respectively.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for VFS/VSS, the following should be considered:
VSI Form

- 2C. Outlet/outfall – should be used to assess the sheet flow discharging from the downslope edge of the VFS/VSS.
- 2D. Emergency spillway – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 5B. Structural damage or deterioration – applies to level spreader, if present.

CAI Form

- Section 3: Outflow, Principal Spillway/Riser – Opening, Principal Spillway/Riser – Structure and Emergency Spillway portions do not apply.
- Section 3 – Outflow, Principal Spillway/Riser – Outfall: should be used to assess the sheet flow discharging from the downslope edge of the VFS/VSS under the “sheet flow” option.
- Section 5 – Side Slopes and Embankment: does not apply.

## 5.9.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM’s information in Maintenance-IQ for potential variations.

**Table 5.9.1: Routine Maintenance for VFS and VSS**

| Frequency | Activity |
|---|---|
| Annually | • Mow grass areas of VFS/VSS surface at the end of the growing season to a height of 5 to 8 inches. Perform mowing when surface is completely dry. More frequent mowing may be needed to prevent thatch buildup and smothering of vegetation. For VSS systems, a no-mow seed mix may be specified on the plans. If this is the case, mowing is not required. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove litter, trash, and debris from SCM surface, gravel flow spreader or level spreader (if present), inflow area, and surrounding area. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

## 5.9.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the VFS/VSS specific table (E.1.9).

# 5.10 Media Filter Drain (MFD)

**Figure 5.10.1: Media Filter Drain with Unvegetated Surface**

## 5.10.1 Description and Overview

A Media Filter Drain (MFD), also known as an "ecology embankment" or “bioslope,” is an embankment that treats runoff by rapid filtering through an engineered soil media commonly known as a media filter drain mix. MFDs use a variety of physical, chemical, and biological processes to improve water quality. They are similar to vegetated filter strips, but instead of filtering runoff via sheet flow through vegetation and surface soils, runoff is rapidly infiltrated into a gravel trench and then filtered via subsurface flow through a media filter drain bed consisting of an unvegetated mixture of crushed rock, dolomite, gypsum, and perlite and a perforated underdrain/infiltration trench at the toe of slope. A MFD’s footprint is usually contained within the roadway embankment; however, it can also be located in medians or as an end of pipe treatment when combined with a level spreader (refer to Section 5.14 Level Spreader and Flow Dispersion). The surface of MFDs may be vegetated or, more commonly, an unvegetated exposed engineered filter drain media mix.

## 5.10.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow System
- LSO SCM

In addition, MFDs may include the following other components:

- No-vegetation zone
- Gravel

- Vegetation, grass plantings
- Filter media
- Geotextile
- Perforated underdrain
- Observation well/cleanout

Figure 5.10.2 illustrates the components of a typical MFD.

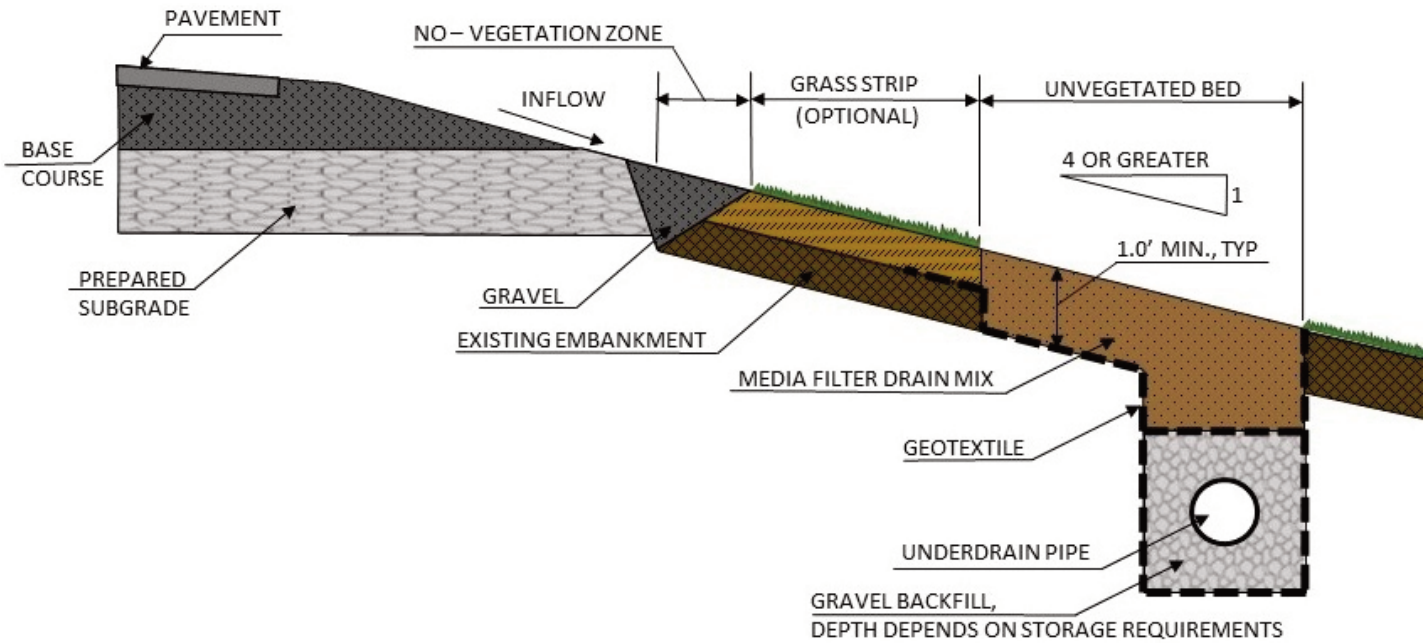



**Figure 5.10.2: Media Filter Drain - Common Elements**

## 5.10.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a media filter drain system should focus on its key functional areas: inflow, infiltration/filtration, and overflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Sediment should be removed from the filter surface when it reaches 2 inches in depth or at any time it affects flow through the SCM. Sediment removal may be required along the upslope edge of the filter to prevent channelized flows. In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- Inspect for signs of erosion and channelization at the inflow edge and throughout the filter surface. Note any signs of channelization within the filter surface. Small breaks in the sod and small erosion channels quickly become larger erosion problems. These areas should be repaired and reseeded immediately to ensure proper sheet flow of runoff through the filter.
- Inspect filter surface and surrounding area for trash and debris. Note debris that could cause flow channelization.
- The SCM and vicinity should be checked for appropriate vegetative cover per plan. Vegetation should only be present on the media filter if specified by plans. Where plans called for vegetation, it should be in good condition, free from weeds and invasive/undesirable species, with at least 80% coverage throughout filter area and there are no bare patches exceeding 10% of the area.

- Verify that the vegetation is being mowed at the proper frequency. Turf grasses should be mowed at least annually to maintain grass height between 5 and 8 inches. Note if more frequent mowing is required.
- Inspect for prolonged saturation of media filter; this suggests the filter media may be silted, the underdrains are clogged, and/or the subsurface infiltration is inadequate.
- Inspect for depressions over underdrain pipes.
- Look for evidence of MFD inundation from flooding of adjacent water bodies. If flooding has occurred, infiltration testing of the media filter should be recommended.
- If present, inspect rock flow spreader adjacent to roadway.
- If present, inspect structural level spreader component as described in Section 5.14.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for MFDs, the following should be considered:
VSI Form

- 2C. Outlet/outfall – should be used to assess the sheet flow discharging from the downslope edge of the MFD.
- 2D. Emergency spillway – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 5B. Structural damage or deterioration – applies to underdrain system and level spreader, if present.

CAI Form

- Section 3 – Outflow, Principal Spillway/Riser-Outfall: should be used to assess the perforated pipe underdrain and/or sheet flow discharging at the downslope edge of the MFD under the “other” option provided.
- Section 3: The Principal Spillway/Riser-Opening, Principal Spillway/Riser-Structure and Emergency Spillway portions are not applicable to a MFD.
- Section 5 – Side Slopes and Embankment: is not applicable for MFD.

### 5.10.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM’s information in Maintenance-IQ for potential variations.

**Table 5.10.1: Routine Maintenance for MFD**

| Frequency | Activity |
|---|---|
| Annually | • Mow grassed areas of vegetated MFD surface at the end of the growing season to a height of 5 to 8 inches. More frequent mowing may be needed to prevent thatch buildup and smothering of vegetation.<br>• Remove vegetation from portions of MFDs specified on plans as non-vegetated surfaces. Remove weeds and undesirable vegetation from portions with grassed surface. Remove using hand operated equipment and methods that minimize disturbance. Do not use herbicides.<br>• Remove litter, trash, and debris from SCM surface, gravel flow spreading strip or level spreader (if present), inflow area, and surrounding area. |
| Once every three years | • Remove sediment build-up at the edge of the filter strip and level gravel area to ensure flow is evenly distributed. |
| Once every ten years | • Excavate and replace all media filter mix within the MFD. Replace with new filter media matching plan materials, restoring slope and geometry to plan dimensions. Restore disturbed areas with vegetation and rolled erosion control product per plans. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

## 5.10.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the MFD specific table (E.1.10).

# 5.11 Vegetated Swale (VSW); Vegetated Swale with Check Dams (VSC)

**Figure 5.11.1: Vegetated Swale (VSW)**
(photo c/o Philadelphia Water Department, Stormwater Retrofit Guidance Manual)

**Figure 5.11.2: Vegetated Swale with Check Dams (VSC)**

## 5.11.1 Description and Overview

Vegetated Swales (VSWs), sometimes called biofiltration swales or bioswales, are linear stormwater control measures consisting of broad, shallow vegetated channels designed to slow runoff, promote infiltration and filter pollutants and sediments while conveying stormwater runoff.

Vegetated Swales with Check Dams (VSCs) are vegetated swales with a series of check dams along the length of the swale. Check dams are small dam-like features designed to capture and infiltrate a small volume of water, or allow retained water to slowly filter through the dam continuing downstream. Check dams vary between 6 to 12 inches in height and are uniformly spaced along the swale. They can be constructed from natural wood, concrete, stone/aggregate, or earth. Check dams are permanent features which should not be confused with temporary erosion and sediment devices. Weep holes, or some other drawdown device, may be present at the base of check dams to allow retained water to slowly pass through the dam following storm events.

VSWs/VSCs (swale) collect surface runoff from roadways, parking areas, and other impervious surfaces directly or indirectly through pipes. Typically located parallel to the roadway at the bottom of the cut slope or toe of fill, runoff is conveyed into the swale via sheet flow leaving the impervious surface. Swales are used as an alternative to curb and gutter storm sewer systems, and can also be used as a form of pretreatment for other SCMs. VSWs/VSCs may appear similar to standard drainage ditches used by the Department, however unlike drainage ditches, VSWs/VSCs provide stormwater benefits such as water quality improvement. VSWs/VSCs are commonly vegetated with a dense and diverse selection of native, water tolerant plants that also have high pollutant removal potential. Some swales include several inches of engineered soil in the bottom of the channel to improve infiltration while others utilize the native soils. VSWs/VSCs may include turf reinforcement or other surface stabilization measures to reduce and/or prevent erosion. Swales typically terminate over an outlet protection (see Chapter 6) into an open grassy/forested area, a stream or another SCM. In these cases, there is no formal outlet structure. Some VSWs/VSCs may outlet into an inlet grate into a piped drainage system. They do not typically have a structural flow control device at the outflow point.

Variations on VSWs/VSCs include the following:

- Vegetated Swales with Subsurface Infiltration Trench (SIT) – Includes an SIT located beneath the VSW/VSC soil planting layer, providing additional infiltration capacity to the swale system (if an SIT is present also see Section 5.5 for SIT related information).
- Grass Swales – Primarily used as pretreatment for other structural SCMs, a grass swale is similar to a standard drainage ditch with much less dense vegetation than a VSW/VSC. Grass swales are usually sized based on flow rates and are designed to convey very small storm events.
- Wet Swales – Placed in areas with a high-water table or poorly drained soils, wet swales are like a stormwater wetland (SWE) in a linear form, maintaining consistently wet to shallowly pooled areas. Typically, they are densely vegetated with hydrophytic vegetation, and located on mild slopes to sustain the permanent pool elevations.

## 5.11.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with this SCM include:

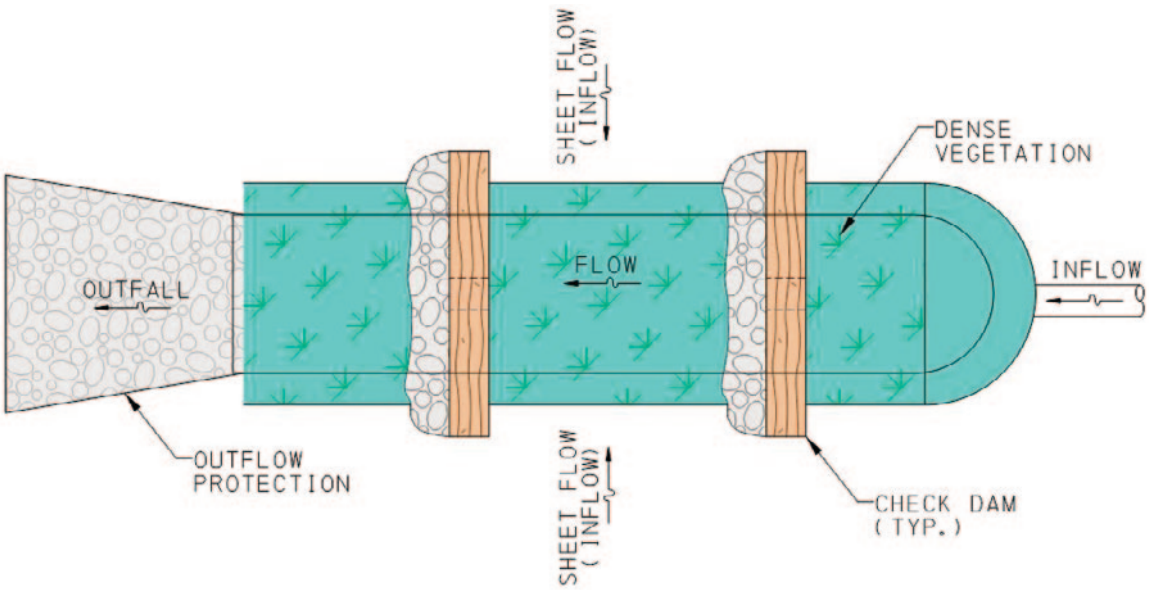
- Access, fencing, and security
- Signage
- Inflow System

- Outfall Protection
- SIT SCM

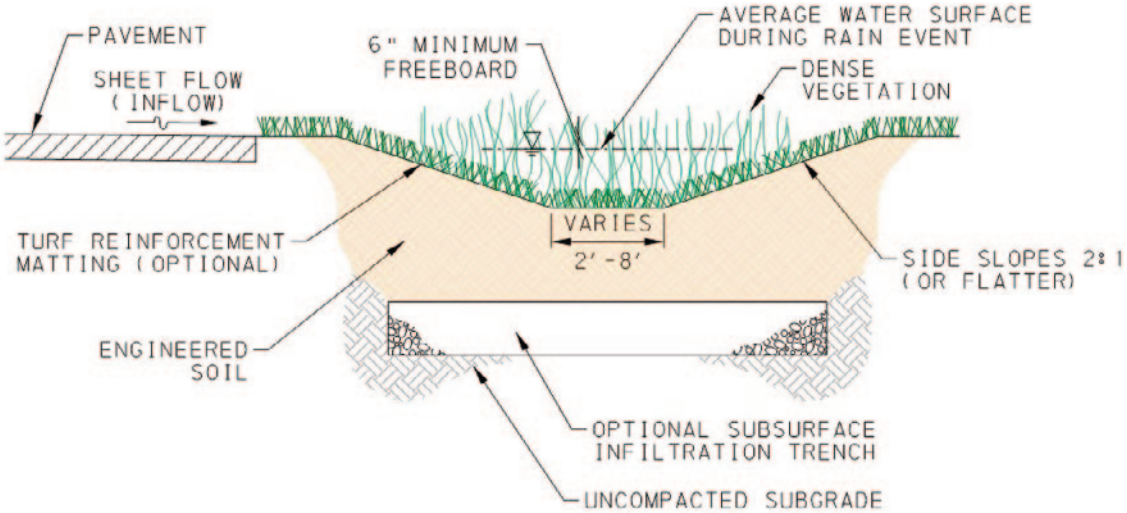
In addition, VSW/VSCs may include the following other components:

- Turf reinforcement matting (optional)
- Engineered soil (optional)
- Vegetation
- Hydrophytic vegetation (wet swales)
- Check dams (VSC only)
- Check dam dewatering device (VSC only)

Figures 5.11.3 and 5.11.4 illustrate the common components of typical VSWs, VSCs, and check dams.

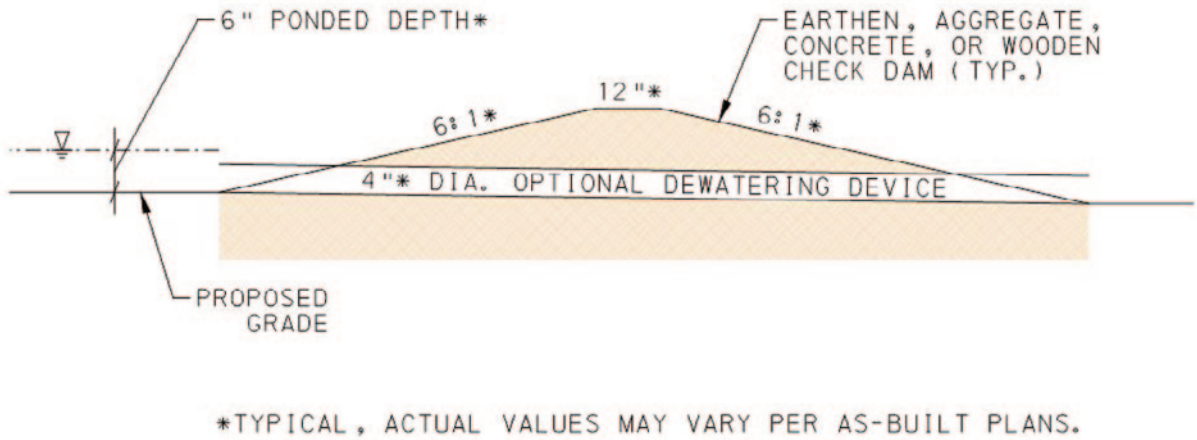



**Plan View**




**Section View**

**Figure 5.11.3: Vegetated Swale (VSW/VSC) - Common Elements**




**Section View**

**Figure 5.11.4: Check Dam - Common Elements**

## 5.11.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a VSW/VSC should focus primarily on its key functional areas: inflow, vegetation, surface area, and outflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect for appropriate vegetative cover per plan. Surface vegetation should be in good condition with at least 90% coverage on the bottom and side slopes. Vegetation should not obstruct flow through the SCM. Inspect for encroachment of woody vegetation and invasive/undesirable species on side slopes and in channel bottom.
- Check for sediment accumulation in the swale, upslope of check dams (where present) and at flow entry points. Sediment accumulation should be removed from swale channel when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 3 inches in depth or inhibits vegetative growth in 10% of the SCM or anytime it blocks flow entry into or through the swale.
- Inspect the VSW/VSCs channel bottom, side slopes, inflow and outflow points for the presence and note severity of:
    - Trash/debris
    - Surface erosion, rills, gullies and/or loss of topsoil
    - Sinkhole activity
    - Signs of contaminants (e.g. gas, oil, fertilizers)
    - Evidence of burrowing animals.
- Inspect the VSW/VSCs conveyance channel for standing water. Signs that standing water or soil saturation remain in the swale longer than 72 hours after a rain event should be noted; the presence of hydrophytic vegetation may be an indication of this (not applicable to wet swales where design calls for hydrophytic plants).
- In VSCs, check dams should be inspected:
    - Confirm the design plan shows permanent check dams as part of the SCM; check dams can look similar to temporary ESPC measures.
    - Confirm check dam material, spacing, and height match the design plans.
    - Note any erosion or deterioration of the check dam material.
    - Note any evidence of flow bypassing around, channelizing over or undermining check dams.
    - Check for sediment accumulation on and upslope of the check dams (removal requirements as described above).

  - Hydrophytic plants, particularly upslope of check dams should be noted. These indicate possible infiltration failure and/or a clogged dewatering device (not applicable to wet swales where design calls for hydrophytic plants).
  - Check that the dewatering device (if present) is free from debris and is sized accordingly to the design plans
- If present, inspect subsurface infiltration trench as described in Section 5.5.
- Inspect all applicable common components as described in Chapter 6 including subsurface flow control structures and outfall pipes which outlet to surface locations.

When completing the inspection forms for VSW/VSCs, the following should be considered:
VSI Form

- 1D. Sediment forebay or micropool – does not apply.
- 1F. Outlet/dewater structure – applies when VSW/VSC discharges into an inlet or similar structural drainage system; does not apply when outlet is to a surface area.
- 2D. Emergency spillway – does not apply.
- 3B. Subsurface storage not draining – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 5A. Temporary ESPC measures present – take care not to confuse permanent check dams as temporary ESPC measures; consult SCM design plans for clarification if needed.
- 5B. Structural damage or deterioration- applies to check dams, if present.

CAI Form

- Section 2 – Site Conditions: check dams can look similar to temporary ESPC measures. Review plans to confirm if the SCM is intended to have permanent check dams present prior to indicating the presence of temporary ESPC measures.
- Section 3 – Outflow, Principal Spillway/Riser – Opening: where a VSW/VSC discharges into an inlet or structural piping system, the entrance opening to this system should be assessed in this section. Where a VSW/VSC discharges to a surface system such as an open area, stream or another SCM, this area does not apply.
- Section 3 – Outflow, Principal Spillway/Riser – Structure: where a VSW/VSC discharges into an inlet or structural piping system, the entrance structure to this system should be assessed in this section. Where a VSW/VSC discharges to a surface system such as an open area, stream or another SCM, this area does not apply.
- Section 3 – Outflow, Principal Spillway/Riser – Outfall: where a VSW/VSC discharges into an inlet or structural piping system, the pipe immediately downstream from the outflow opening should be assessed in this section. Where a VSW/VSC discharges to a surface system such as an open area, stream or another SCM, the outfall point should be described in this section including any outfall protection present.
- Section 3 – Outflow, Emergency Spillway: does not apply.
- Section 4 – Treatment Performance, SCM Ponding & Conveyance: where issues with check dams are present check boxes appropriate boxes for short circuiting, incorrect flow path and/or failing structure components, and/or other and describe concerns in space provided. Presence/severity of check dam structural damage should be indicated in the “structural/other damage” area.
- Section 5 –Embankment Only: most swales are located in cut sections; therefore, this section does not typically apply.

## 5.11.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.11.1: Routine Maintenance for VSW and VSC**

| Frequency | Activity |
|---|---|
| Two Times per Year | • Mow vegetative surface mid-season and at the end of the growing season to a height of 5 to 8 inches. Perform mowing when swale is completely dry. Use hand operated equipment around check dams. Do not drive heavy equipment in swale channel. |
| Annually | • Remove litter, trash and debris from swale bottom, sides, check dams inflow, outflow and surrounding area.<br>• Remove woody vegetation and undesirable species from swale bottom, check dams (if present) and side slopes. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies.<br>• If present, maintain SIT as described in Section 5.5 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.11.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the VSW/VSC specific table (E.1.11).

# 5.12 Infiltration Berm (IBE)

**Figure 5.12.1: Infiltration Berm**

## 5.12.1 Description and Overview

An Infiltration Berm (IBE) is a stormwater control measure consisting of a mound of compacted earth or aggregate, covered with topsoil and seeded. It is typically installed along a continuous elevation (contour) on relatively gently sloping sites. IBEs are used to slow stormwater runoff by providing undulations in the land to retain flow, encourage infiltration, and reduce runoff volume and rate for small storms. They are typically low features, less than 24 inches in height. Design guidance encourages locating the crest of the berm to one side rather than the middle to create an asymmetrical section. The infiltrating area is on the upslope side of the berm where stormwater flows are retained. This area should be carefully protected from compaction. During larger storm events, excess flows pond, gently overtop the berm, and discharge (outflow) downslope into a well vegetated area. Some IBEs have a clay layer to prevent retained flows from seeping through the berm.

IBEs are normally covered in turf grass, but may instead be stabilized with dense and diverse meadow vegetation. IBEs may be constructed in series along a sloping area, and may also be used to divert stormwater flows to another SCM. IBEs may include turf reinforcement matting to reduce erosion potential. In some instances, a subsurface infiltration trench (SIT) is constructed on the upslope side of an IBE to provide additional infiltration capacity (if a SIT is present also see Section 5.5 for SIT related information).

IBEs can be designed to provide additional multifunctional benefits:

- Landscaping Berms – IBEs constructed to provide landscape screening for adjacent development. The berm height may be significantly larger than traditional IBE to enhance screening in addition to stormwater retention.
- Slope Protection – IBEs constructed to help protect steeply sloping areas from erosion. IBEs divert concentrated discharge from a developed area away from the sloped area. IBEs may be installed in series down the slope to retain the flow and act as a level spreading device to discourage concentrated flows.
- Flow Pathway Creation – IBEs constructed within existing or proposed SCMs to increase stormwater runoff travel times within the SCM to promote a meandering channelized flow.

## 5.12.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with this SCM include:

- Access, fencing, and security
- Signage
- Inflow System
- SIT SCM

In addition, an IBE may include the following other components:

- Compacted earth or aggregate
- Topsoil
- Vegetation, shrubs, trees
- Clay layer
- Turf reinforcement matting

Figures 5.12.2 and 5.12.3 illustrate the common components of a typical IBE. Runoff sheet flowing down the slope is intercepted by the IBE. Smaller rainfall events are completely retained by the IBE; during larger events, some flow will overtop the berm and continue downslope.

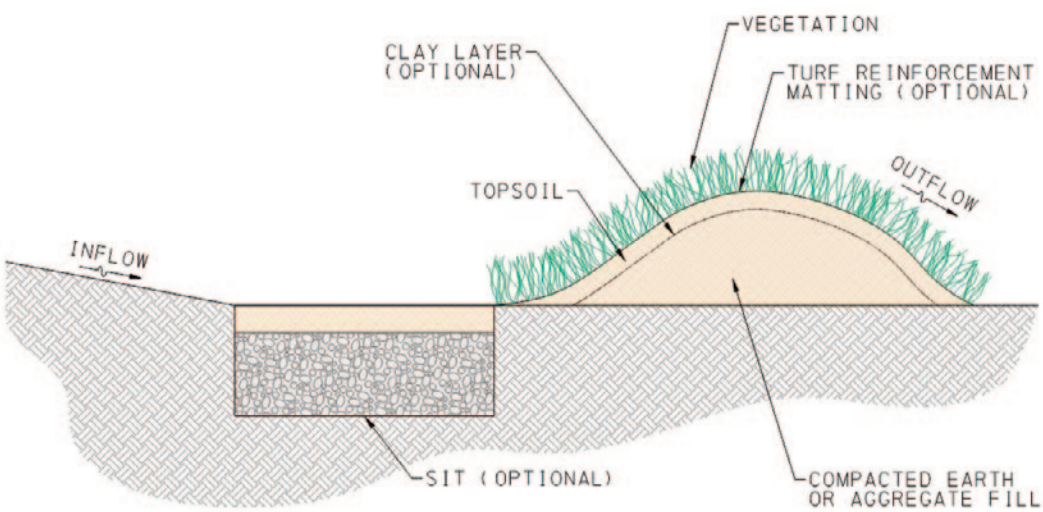



**Figure 5.12.2: IBE - Common Components**

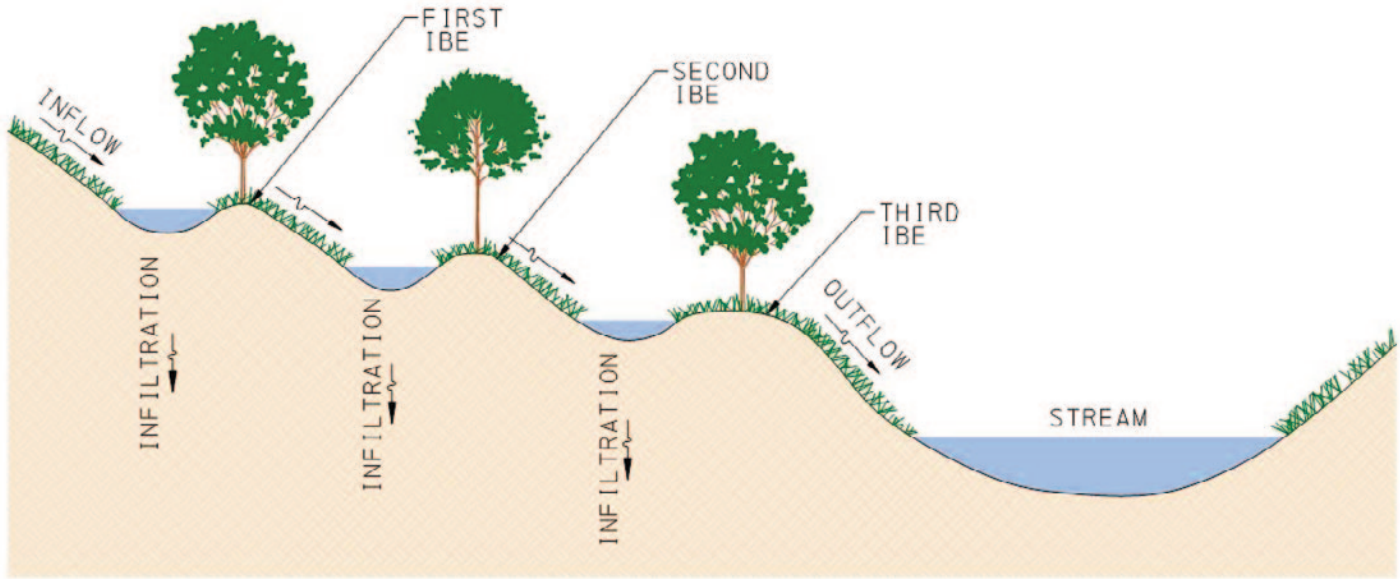



**Figure 5.12.3: IBE in Series**

## 5.12.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an IBE should focus primarily on its functional areas: inflow, vegetation, infiltration and outflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Confirm surface vegetation upslope, on and downslope of IBE is in good condition with at least 80% coverage throughout inflow, storage and outflow areas and no bare patches are observed in 10% of a localized area. Note the presence of invasive/undesirable species.
- Verify that the vegetation is being mowed at the proper frequency. Turf grasses and meadow plantings should be mowed at least annually to maintain grass height between 5 and 8 inches. Note if more frequent mowing is required. Shrubs and trees will require pruning and thinning maintenance as needed based on inspection recommendations.
- Sediment accumulation should be removed when it reaches the depth indicated by the cleanout marker. Where a cleanout marker is not present, sediment should be removed when it reaches 2 inches in depth or at any time it affects infiltration or flow through the IBE. In cases of excessive sedimentation, the drainage area should be inspected for sediment sources.
- Inspect upslope area of IBE for standing water. Signs that standing water or soil saturation remain in the IBE longer than 72 hours after a rain event should be noted; the presence of hydrophytic vegetation may be an indication of this.
- Inspect the inflow areas, IBE's and outflow areas for the presence and note severity of:
    - Trash/debris
    - Surface erosion, rills, gullies and/or loss of top soil
    - Sinkhole activity
    - Signs of contaminants (e.g. gas, oil, fertilizers)
    - Evidence of burrowing animals.
- If present, inspect condition of turf reinforcement matting checking for signs of deterioration, erosion or other concerns.
- If present, inspect for exposure of clay liner. Ensure topsoil and vegetation are present and clay liner is not exposed. Trees and shrubs should not be present on clay lined areas.
- If present, inspect subsurface infiltration trench as described in Section 5.5.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for IBEs, the following should be considered:
VSI Form

- 1B. Inflow channels – should be used for upslope sheet flow contributing drainage area.
- 1C. Side slopes – does not apply.
- 1D. Sediment forebay or micropool – does not apply.
- 1E. SCM floor/surface or within SCM – should be used for ponding area immediately upslope of IBE as well as surface areas of IBE.
- 1F. Outlet/dewatering structure – does not apply.
- 2C. Outlet/outfall – does not apply.
- 2D. Emergency spillway – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 4D. Woody vegetation in embankment – does not apply.

CAI Form

- Section 3 – Outflow, Principal Spillway/Riser – Outfall: should be used to assess the sheet flow from the downslope edge discharging from the IBE under the “sheet flow” option provided.
- Section 4 – Treatment Performance, SCM Ponding & Conveyance: should be used to assess the IBE ponding area and the berm. Comments should be used to define where any noted issues occur such as “two 4 inch erosion rills noted on berm’s downslope face,” etc.
- Section 5 – Side Slopes and Embankment: although not a typical large “embankment,” this section should be used as needed to describe any noted vegetation, stability, or seepage issues on the IBE.

### 5.12.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM’s information in Maintenance-IQ for potential variations.

**Table 5.12.1: Routine Maintenance for IBE**

| Frequency | Activity |
|---|---|
| Annually | • Grassed IBEs: Mow IBE surface at the end of the growing season to a height of 5 to 8 inches. Perform mowing when IBE is completely dry. Use hand operated equipment in upslope ponding areas and on berm. Do not drive mowing equipment on upslope ponding areas. Use appropriate sized mowers and procedures to avoid scalping top of IBE vegetation. More frequent mowing may be needed to prevent thatch buildup and smothering of vegetation.<br>• Landscaped (non-grassed) IBEs: Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plants; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove litter, trash, and debris from IBE surface, inflow/outflow areas and surrounding area. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies.<br>• If present, maintain SIT as described in Section 5.5 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.12.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the IBE specific table (E.1.12).

# 5.13 Manufactured Treatment Device (MTD)

**Figure 5.13.1: Manufactured Treatment Device – Hydrodynamic Separator**

## 5.13.1 Description and Overview

A Manufactured Treatment Device (MTD) is a stormwater control measure which consists of prefabricated proprietary products used in-line with a storm sewer system to provide water quality (WQ) treatment. MTDs, also known as water quality "devices," "inlets," or "inserts," are subsurface systems that may be constructed as a self-contained structure or may be inserted into a storm inlet or manhole. These devices can function as a standalone SCM or can be used as pretreatment for other SCMs. An inlet with sump/trap may be used as pretreatment for MTDs. MTDs are typically located along shoulders, pull-off areas, parking lots, and maintenance lots. Overflow structures or flow splitters can be constructed upstream of the MTD to divert larger flows away from the MTD. Flow control structures can be incorporated at the outflow of the MTD to regulate release rates. Since MTDs are proprietary products, each device is designed differently based on the targeted pollutants and flow capacity. There are several general categories of MTDs; within each the device will vary from manufacturer to manufacturer. The general categories include the following.

Filter Inserts: An insert in the form of a cartridge, tray, basket, or bag is inserted into a standard inlet box to collect sediment. Typically attached to the inlet grate, the insert functions similarly to silt sacks that are commonly used during construction. Filter inserts treat surface runoff entering the inlet.

Inlets with Sump/Traps: See Section 6.4.

Hydrodynamic Separators: Hydrodynamic separators are flow through devices typically in manholes that use a series of baffle plates, vortex devices, tube settlers or inclined plates to settle solids from flow. They can be inserts or be constructed as a single concrete structure with the separators built into the inlet/manhole box and a flow control structure in the form of a baffle wall with orifice/weirs at the outflow. They frequently contain a cylindrical area where incoming flows travel in a spiral path around the perimeter causing heavy particles to settle out of the water.

Oil/Water Separators: An oil/water separator is a concrete structure that contains a series of baffles and walls to remove sediment, solids, and trap oil. The separator mechanically separates oil from the water by allowing it to rise to the surface in a collection area while sediment settles to the bottom. They are used in areas like vehicle service yards where stormwater is anticipated to have high oil concentrations.

## 5.13.2 SCM Components

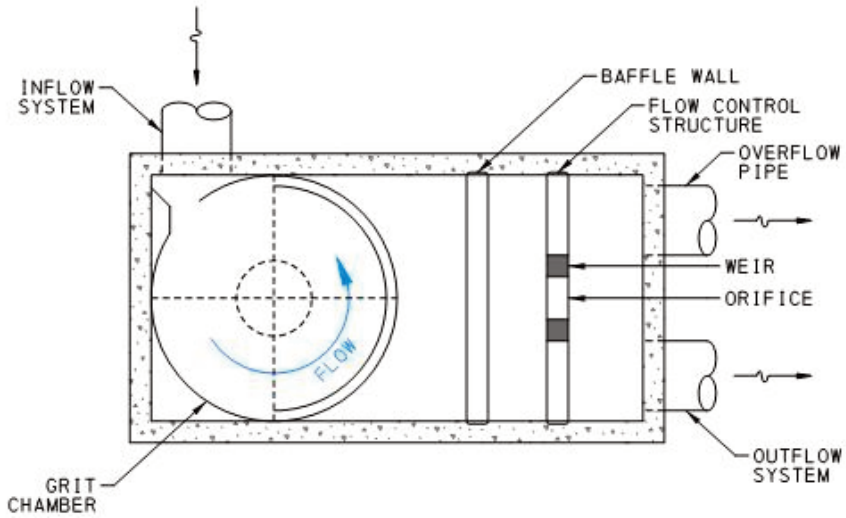
SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, Security
- Signage
- Inflow System
- Flow Control Structure (weirs, orifices)
- Structures & Appurtenances

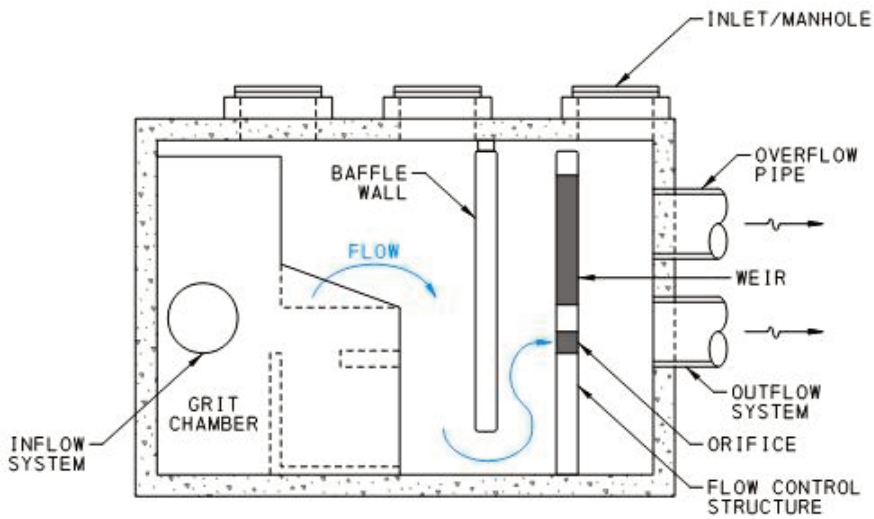
In addition, MTDs may include the following other components:

- Overflow pipe
- Baffle walls
- Grit chambers

Figure 5.13.2 illustrates the common components of a hydrodynamic separator type of MTD. Runoff enters the MTD through an inflow system. Runoff is temporarily stored in the inlet/manhole and is conveyed through the components of the MTD. Each type of MTD is designed uniquely to improve water quality and/or reduce flows. The runoff exits the MTD through an outflow system that typically discharges to a downstream drainage system. Other types of MTDs will involve different components. Refer to the specific manufacture information for each MTD.




**Plan View**




**Section View**

**Figure 5.13.2: Manufactured Treatment Device, Hydrodynamic Separator - Common Elements**

## 5.13.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an MTD should focus primarily on its key areas: inflow, treatment area, and flow control structures. Specifically:

- Entry into MTD or any confined space is prohibited without proper OSHA training and safety measures in place. Perform visual inspections from the surface for underground SCMs. If signs indicate the system may not be functioning properly or if sufficient data cannot be obtained from the surface, recommendations for video inspection, confined space entry or other means of inspection should be made.
- Confirm the design drainage area is reaching the SCM.
- Inspect area surrounding and above MTD for trash/debris, surface erosion, and sinkhole activity.
- Inspect areas above MTD for signs of ground settlement or subsidence and any pavement cracking or fractures which may indicate structural failure of the underlying MTD.

- Review manufacturer required sediment, oil and other cleanout requirements, indicating when system requires cleanout based on system specific criteria. Note any signs of obstructed water flow through the system.
- Inspect water level in MTD chambers. High water levels during periods of dry weather can indicate the SCM is malfunctioning.
- Inspect all MTD components including access ladders and concrete vault for structural integrity, signs of damage and deterioration.
- Inflow points, MTD system and outflow points should be visually inspected for any obstructions or structural deformities such as the following:
    - Organic material
    - Sediment
    - Trash/debris
    - Clogged Openings
    - Missing components
    - Holes/fractures
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for MTDs, the following should be considered:
VSI Form

- Line items referencing side slopes and embankments do not apply.
- 1D. Sediment forebay or micropool – does not apply.
- 1E. SCM floor/surface or within SCM – applies to sediment within MTD storage area.
- 2B. SCM bottom or side slopes – does not apply.
- 2D. Emergency spillway – may be an overflow structure within the inflow structure or flow control structure.
- 3B. Subsurface storage not draining – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 4A-F. Vegetation – applies to MTD drainage area, surface and areas of access to the MTD.

CAI Form

- Section 2 – Site Conditions, Vegetation: may not apply if entire contributing drainage area is impervious; vegetation impeding access to MTD is applicable even if outside of contributing drainage area.
- Section 3 – Inflow: erosion and scour may not apply when inflow is pipe flow only.
- Section 3 – Outflow, Emergency Spillway: the emergency spillway for an MTD is typically a weir overflow structure. The overflow weir can be part of the flow control structure or standalone. The overflow weir invert is typically constructed at an elevation higher than the orifice and weir elevations on the primary spillway baffle wall within the structure housing the MTD.
- Section 4 – Vegetation: does not apply.
- Section 4 – Filtration: Filter cartridges and other filter media should be assessed under the “Other” category.
- Section 5 – Side Slopes and Embankment: does not apply.

## 5.13.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.13.1: Routine Maintenance for MTDs**

| Frequency | Activity |
|---|---|
| Monthly | • Remove trash and debris at all inflow and outflow structures, and from MTD surrounding area. Remove per guidelines of the manufacturer, if applicable. |
| Two times per year | • Remove sediment accumulation from MTD per guidelines of the manufacturer, if applicable. |
| As needed | • Maintain MTD in accordance with manufacturer's recommendations.<br>• Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.13.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the MTD specific table (E.1.13).

# 5.14 Level Spreader Outfall and Flow Dispersion (LSO, FDF, FDV)


**Figure 5.14.1: Level Spreader, Surface Type**
(photo on left c/o NCDOT HSP-2010-01; photo on right c/o PennDOT)

## 5.14.1 Description and Overview

Level spreader outfalls (LSOs) are flow discharge measures designed to redistribute concentrated stormwater flow into sheet flow. By doing so, an LSO may also promote infiltration and improved water quality. The top of LSOs must be level to ensure adequate flow distribution and discourage channelization. Concentrated flow enters the LSO where it is slowed and distributed throughout a long shallow trench or behind a low berm. Water fills the storage area and then spills uniformly over the berm or trench edge.

LSOs can be used as a standalone outfall feature or in combination with another SCM. An LSO used as a standalone feature does not provide significant stormwater control benefits. However, when installed upslope of a protected vegetated area, the LSO combined with the sheet flow across the vegetated area functions as an SCM. An LSO installed upslope of an existing forested area is called a flow dispersion, forest/buffer (FDF); upslope of an existing grassed area it is called a flow dispersion, vegetated filter strip (FDV).

To protect and ensure the future functionality of the system, the FDF and FDV must be included in the Department right-of-way or easements. In the absence of a natural FDV or FDF, a VFS or VSS can be constructed to provide the dispersion area. Follow the inspection and maintenance procedures described in the VFS/VSS Section (5.9) of this manual for care of the FDF and FDV areas. LSOs can also be used at the inflow point into basin type SCMs to spread concentrated flows evenly across the basin floor.

The two main types of LSOs are surface discharging level spreaders and subsurface level spreaders.

Surface discharging LSOs look like a long linear ditch or trough with concrete curb edging or a similar structural edge that creates the downstream weir or lip of the structure that water flows over. Stormwater flows into the trough and fills up to the top, then gently overtops the weir as sheet flow onto the adjacent area, which may contain Turf Reinforcement Mat (TRM, refer to Section 6.10 Outfall Protection). The trough bottom may be gravel, paved or vegetated with low growth grass-type cover.

Subsurface LSOs discharge via a perforated pipe surrounded by gravel bedding material and look like a long, narrow gravel strip on the ground surface. Stormwater enters the LSO and is distributed over the length of the structure in a perforated pipe surrounded in gravel. Similar to a surface LSO, water flows out of the pipe and into the surrounding gravel, filling up the gravel until it reaches the surface and is discharged as sheet flow. Typically, surface cleanouts are connected to the perforated pipe allowing subsurface inspection and maintenance of the perforated piping.

In both types, it is critical that the LSO be constructed along a constant elevation (level) to function effectively and prevent discharging concentrated flow. At times, a flow splitter is installed upstream of the LSO to regulate the maximum flow to the area to prevent erosive flow conditions.

## 5.14.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow System
- Flow Splitter
- Structures and Appurtenances
- VFS/VSS SCM
- Basin type SCM

In addition, LSOs in combination with a FDF, FDV, VFS or VSS system may include the following other components:

- Bypass swale/pipe
- Concrete curb/lip
- Vegetated/concrete trough
- TRM
- Gravel
- Perforated pipe
- Cleanout well/cleanout
- Geotextile
- Vegetative Shrub, woody or grass plantings
- Turf grass
- Sheet flow
- Receiving water body

Figures 5.14.2 and 5.14.3 illustrate the typical components of a surface and subsurface LSO in combination with a FDF, FDV, VFS or VSS system.

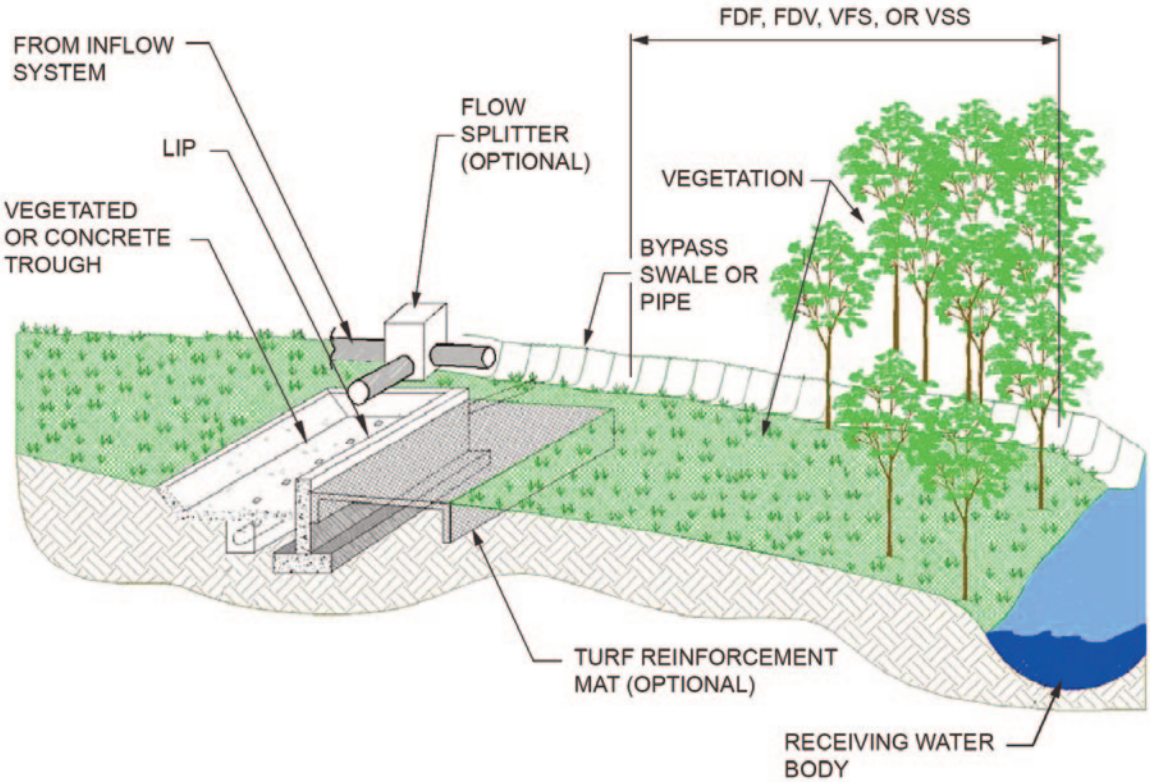



**Figure 5.14.2: Surface LSO - Common Elements**
(Adapted from NCDOT-HSP-2010-01)

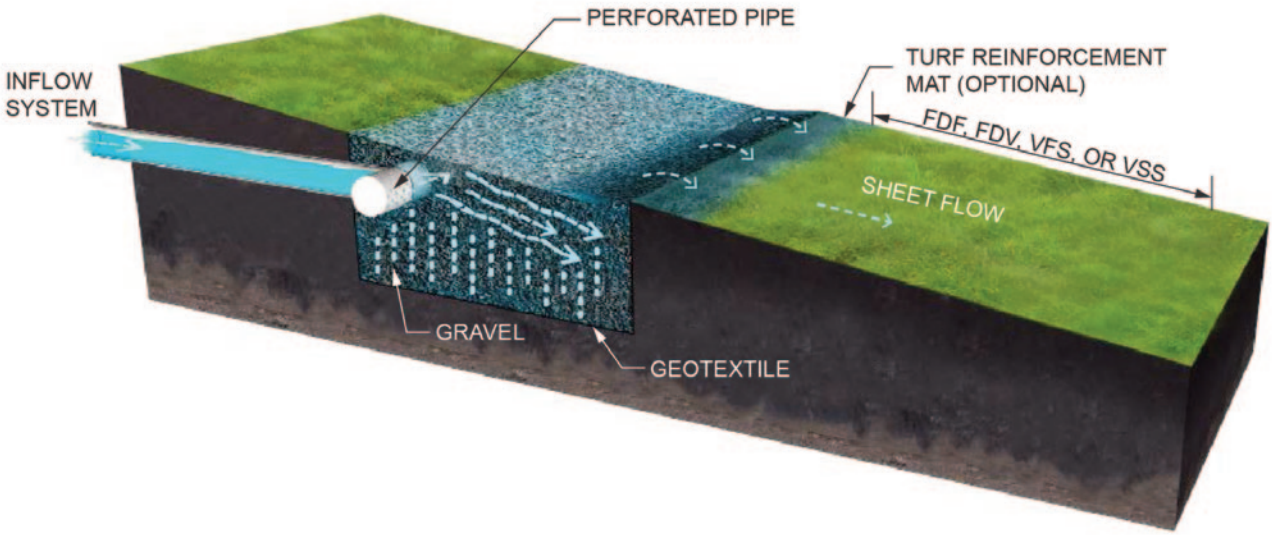



**Figure 5.14.3: Subsurface LSO - Common Elements**
(Adapted from Philadelphia Water Department, Stormwater Management Guidance Manual)

## 5.14.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an LSO should focus primarily on its key functional areas: even distribution of inflow, structural stability, and stability of outflow and downstream surfaces. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- Check for sediment accumulation in LSO. Sediment should be removed before it interferes with the level spreader's ability to distribute flow evenly. Surface LSOs should have sediment removed when buildup is 25% of capacity of the spreading trough. Subsurface LSOs should be checked for sediment by opening cleanouts. Sediment should be removed from the perforated pipe when it reaches 25% capacity.
- Inspect for signs of uneven flow dispersion, including erosion rills/gullies forming at the lip, around the edges, or near the downslope edge of the LSO, or evidence that the downslope edge of the LSO is not a consistent elevation (level).
- Check the structure for signs of uneven settlement potentially causing an uneven lip. For subsurface LSO, check cleanouts (if present) for signs of standing water and sediment build-up.
- Confirm downslope stabilization are in place and sound. Look for undesirable vegetation, including invasive and hydrophytic species (outside of wetlands) and any root systems that could impact the LSO functionality.
- Confirm the downslope area is free of obstructions and features that may facilitate re-concentration of flow.
- Inspect all applicable common components as described in Chapter 6.

When an LSO is associated with an FDF, FDV, VFS, or VSS or as part of an inflow or outflow system to another SCM type, it should be assessed in combination with the other SCM. Only one inspection form is required for a combined system, indicated by a single SCM ID. Follow the inspection processes described in Section 5.9 Vegetated Filter Strip (VFS); Vegetated Filter Strip on Steep Slope (VSS) of this manual for care of the FDF and FDV areas.

In cases where an LSO is listed as an individual SCM with its own SCM ID, it should be assessed individually. When completing the inspection forms for an individual LSO, the following should be considered:
VSI Form

- Line items referencing side slopes and embankments generally will not apply.
- 2D. Emergency spillway – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.

CAI Form

- Section 3 – Outflow, subsection Principal Spillway/Riser – Opening: does not apply.
- Section 3 – Principal Spillway/Riser – Structure: does not apply.
- Section 3 – Principal Spillway/Riser – Emergency Spillway: does not apply
- Section 5 – Side Slopes and Embankment: does not apply.

## 5.14.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine

maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.14.1: Routine Maintenance for LSO**

| Frequency | Activity |
|---|---|
| Two times per year | • Mow grass areas adjacent to LSO mid-season and at the end of the growing season to a height of 5 to 8 inches. Perform mowing operations when SCM is completely dry, preferably using hand operated equipment. Do not drive equipment on SCM surface.<br>• Remove litter, trash, debris, undesirable vegetation from LSO surface, inflow area, outflow area, and surrounding area. Undesirable vegetation includes woody or invasive vegetation immediately downslope (approximately 10 feet) of the LSO. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). |
| Annually | • Remove sediment accumulation and restore level surface of LSO. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies.<br>• Maintain FDF and FDV areas as described in Section 5.9 Vegetated Filter Strip (VFS); Vegetated Filter Strip on Steep Slope (VSS) at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.14.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the LSO specific table (E.1.14).

# 5.15 Pervious Pavement: Asphalt (PPA), Concrete (PPC), Pavers (PPP)


**Figure 5.15.1: Pervious Pavement Pavers (PPP)**
(photo c/o The Philadelphia Water Department, Stormwater Management Guidance Manual)

## 5.15.1 Description and Overview

Pervious pavement consists of a permeable surface course underlain by a uniformly-graded coarse aggregate (stone) bed, which provides temporary storage for stormwater control and promotes infiltration. The surface course may consist of pervious asphalt (PPA), pervious concrete (PPC), or various pervious pavers (PPP). Pervious pavement, unlike conventional pavement surfaces, allows runoff to infiltrate through the SCM where it is temporarily stored and/or infiltrated into and through the void spaces of the underlying stone bed.

PPA and PPC look similar to standard asphalt and concrete surfaces, respectively; however, the material mixes utilize little to no fine-grained materials, creating a finished structure that is more porous than traditional mixes. This allows stormwater to infiltrate quickly through to the underlying aggregate.

There are numerous types of PPPs with varying appearance and functionality. Many are similar in appearance to brick pavers. Some of these brick paver-looking applications utilize pavers constructed from pervious pavement, allowing infiltration through the bricks. Others use interlocking impermeable brick pavers laid in place with a gap in between the bricks filled with coarse grained materials that allows water to infiltrate between the area. Other PPPs utilize open-cell paving grids that look like lattice work with the open grid areas filled with granular material or grass where stormwater infiltrates into the spaces between the lattice material.

In PPA, PPC, and PPP, stormwater enters the system from direct rainfall onto the pavement surface or via curb cuts or sheet flow from adjacent areas. The flows infiltrate through the porous surface material and/or the gaps between the pavers into the underlying aggregate bed. This bed of the pervious pavement systems allows for stormwater storage and/or infiltration into the subgrade soils. It can be constructed with various layers of stone diameter sizes. Where the pavement elevation varies over the surface, the subsurface stone storage area may be terraced or include subsurface compacted earthen berms creating subsurface ponding areas to promote infiltration. Geotextile fabric is used to separate the subgrade soil/stone and the stone/permeable pavement layers. Some systems may include an underdrain throughout the aggregate to

carry excess flows from the SCM. Underdrains may convey runoff to a flow control structure that is housed in an inlet/manhole. A stone trench may be included along the border to the pavement to collect any excess surface flows. Outflow from the SCM may be tied directly to storm sewer piping or may discharge to surface channels.

To allow for monitoring of the water levels in the aggregate bed, some designs incorporate observation wells in the storage areas. In systems with underdrains, underdrain cleanouts also function as an observation well.

Pervious pavement is not commonly used on the Department's roadways; however, it can be installed on driveways, parking lots and sidewalks. It is not recommended for areas with heavy vehicle turning movements (i.e., parking lot circulation lanes) as the structure of the pavement can be comprised and lead to accelerated deterioration of the pavement section. Pervious pavement can be found at welcome centers and other District-owned buildings and parking lots.

## 5.15.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, Security
- Signage
- Inflow System
- Flow Control Structure
- Structures & Appurtenances
- Outfall Protection

In addition, PPA/PPC/PPP may include the following:

- Pervious surface (wearing/binder course, pavers
- Geotextile
- Coarse aggregate (stone)
- Observation well/cleanout
- Perforated underdrain (optional)
- Subsurface compacted earthen berm (optional)

Figure 5.15.2 illustrates the common elements of a typical PPA, PPC and PPP. Runoff enters the system through sheet flow or direct rainfall. Runoff infiltrates into the porous surface and stores temporarily before discharging to the surrounding soil or to an underdrain and flow control structure.

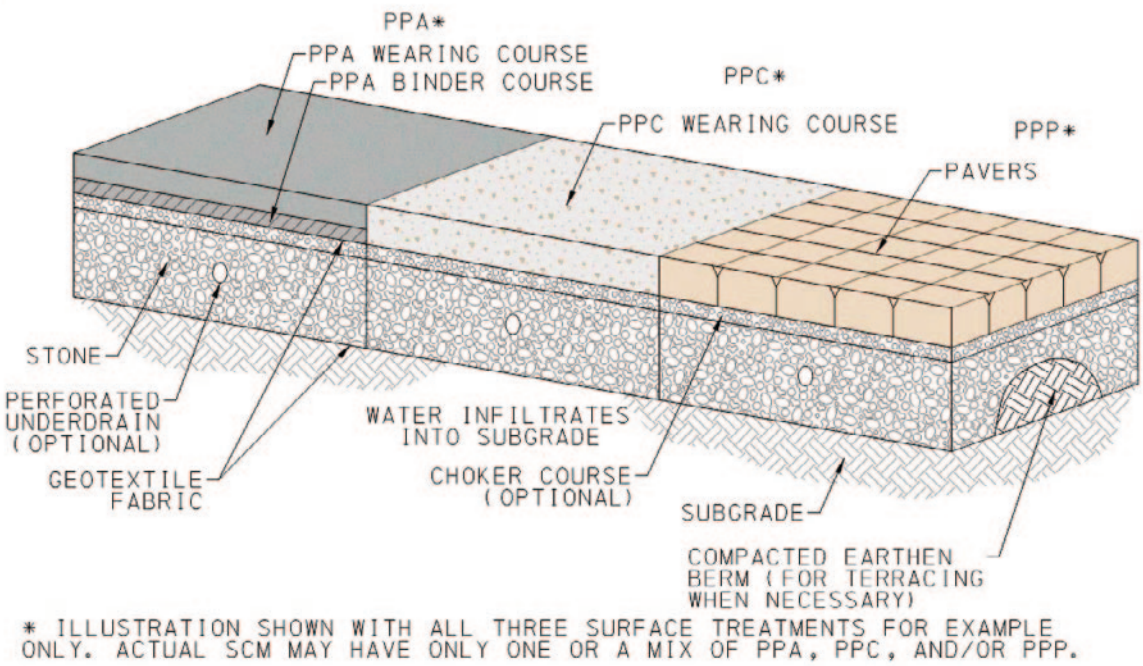



**Figure 5.15.2: Pervious Pavement- Asphalt, Concrete and Pavers - Common Elements**

## 5.15.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of PPA/PPC/PPP should focus primarily on its functional areas: inflow, storage system, and flow control structures. Specifically:

- Entry into any confined space is prohibited without proper OSHA training and safety measures in place. Perform visual inspections from the surface for underground SCMs. If signs indicate the system may not be functioning properly or if sufficient data cannot be obtained from the surface, recommendations for video inspection, confined space entry or other means of inspection should be made.
- Confirm the design drainage area is reaching the SCM.
- Inspect pervious surface and surrounding area for trash/debris, surface erosion, and sinkhole activity.
- Inspect pervious surface for any pavement cracking or fractures, paver damage or missing pavers. Loss of aggregate material from between pavers greater than ½ inch in depth should be noted for repair. Check for surface settlement that inhibits infiltration.
- Inspect pervious pavement surface for signs of sediment build up and clogging. Sediment accumulation covering 10% or more of the surface area requires removal. Moss growth should not inhibit infiltration or cause a slip hazard.
- Pour water onto the surface in several locations to informally assess whether infiltration is adequate; failure to infiltrate should be noted. The formation of an oily sheen when water is applied to the surface indicates surface cleaning is needed.
- Inspect for signs of inappropriate use of sealant treatments (i.e., blacktop sealant), application of sand/cinder winter maintenance material (salt is acceptable), and soil/mulch stockpiling on the surface of the pervious pavement.
- Inspect observation wells and cleanouts for water levels for signs that standing water remains in the system longer than 72 hours after a rain event. Prolonged standing water suggests the stone bed or geotextile may be clogged with silt/debris or the subsurface infiltration is inadequate.
- Note levels of sediment in the observation wells/cleanouts.
- Inspect observation well/cleanout covers for functionality and damage.

- If present, inspect stone trench bordering pervious pavement in accordance with SIT inspections, as described in Section 5.5.
- Inspect surface vegetation at surface inflow and outflow locations (where applicable) and within PPP grid systems which are planted with grass. Adjacent vegetation should not exceed 12 inches nor obstruct water flow at inflow areas; PPA surface vegetation should not exceed 5 inches in height. Vegetated areas should be in good condition with at least 70% coverage.
- Pervious pavement systems designed with flow control structures and outfall pipes that daylight should be visually inspected along with all applicable common components as described in Chapter 6.

When completing the inspection forms for PPA/PPC/PPP, the following should be considered:
VSI Form

- Line items referencing side slopes and embankments do not apply.
- 1D. Sediment forebay or micropool – does not apply.
- 2B. SCM bottom or side slopes – does not apply.
- 2D. Emergency spillway – does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 4A-D. Vegetation – applies to SCM drainage area and areas of access to the SCM as well as vegetation growth in the PPP grid systems which have been planted with grass.
- 5B. Structural Damage – should be used to note loss of gravel in between pavers, missing pavers and/or damaged pavement as well as damage to any other components.

CAI Form

- Section 2 – Site Conditions, Vegetation: may not apply if entire contributing drainage area is impervious; vegetation impeding access to SDS is applicable even if outside of contributing drainage area.
- Section 3 – Inflow: erosion and scour may not apply when inflow is from impervious areas only.
- Section 3 – Outflow Principal Spillway/Riser – Opening: applies to systems with flow control outlet structures only.
- Section 3 – Outflow, Principal Spillway/Riser – Structure: applies to systems with flow control outlet structures only.
- Section 3 – Outflow, Emergency Spillway: does not apply.
- Section 4 – Pretreatment: does not apply.
- Section 4 – SCM Ponding & Conveyance: ponding within a pervious paving system can be inspected in the observation wells, inflow points, and flow control structures.
- Section 4 – Vegetation: applies to PPP lattice systems with grass intentionally growing within the pavers.
- Section 4 – Filtration: does not apply.
- Section 5 – Side Slopes and Embankment: does not apply.

### 5.15.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.15.1: Routine Maintenance for PPA, PPC, and PPP**

| Frequency | Activity |
|---|---|
| Monthly, April to Nov | • Mow PPPs with grassed surfaces to maintain a maximum height of 5 inches. Remove surface cuttings. |
| Two times per year | • Remove sediment, trash, and debris accumulation from the PPA/PPC/PPP surface and surrounding area.<br>• Vacuum surface with regenerative air sweeper or commercial vacuum sweeper. When vacuuming PPP, adjust suction to remove sediment without uptake of aggregate from paver joints. Do not pressure wash surface. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.15.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the Pervious Pavement specific table (E.1.15).

# 5.16 Regenerative Step Pool (RSP)

**Figure 5.16.1. Regenerative Step Pool** (photo c/o PennDOT)

## 5.16.1 Description and Overview

Regenerative Step Pools (RSPs) are SCMs comprised of a series of alternating shallow constructed riffles, cascades and pools that mimic a natural stream environment. Similar to VSW/VSCs, RSPs promote infiltration and filter pollutants and sediments while conveying stormwater runoff. The RSPs are typically located between a stormwater system outfall and the receiving stream. These systems are common on steep slopes or are often retrofitted from eroded channels and designed to be blended into the existing landscape, typically under woodland canopies. RSPs may be situated adjacent to or through a riparian buffer or wetlands, with the RSP conveying low flows and the adjacent buffer/wetland carrying high flows.

Riffle sections consist of a reinforced, sloped rock section that discharges to the pool section, which consists of flat shallow ponded areas. The pool sections consist of infiltrating/filtrating sand and woodchip beds that may incorporate hydrophilic vegetation and standing water if within a wetland system.

A variation on RSP design includes a cascade section followed by a steep rock cascade section, which then leads into a series of three successive ponds with the same bottom elevation separated by rock/cobble weirs.

## 5.16.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 which may be encountered with this SCM include:

- Access, Fencing, and Security
- Signage
- Inflow System
- Outfall Protection

In addition, RSPs may include the following other components:

- Filter media
- Vegetation, grass plantings
- Geotextile
- Pools
- Weir and riffle sections

Figure 5.16.2 illustrates the common elements and subcomponents of a typical RSP.

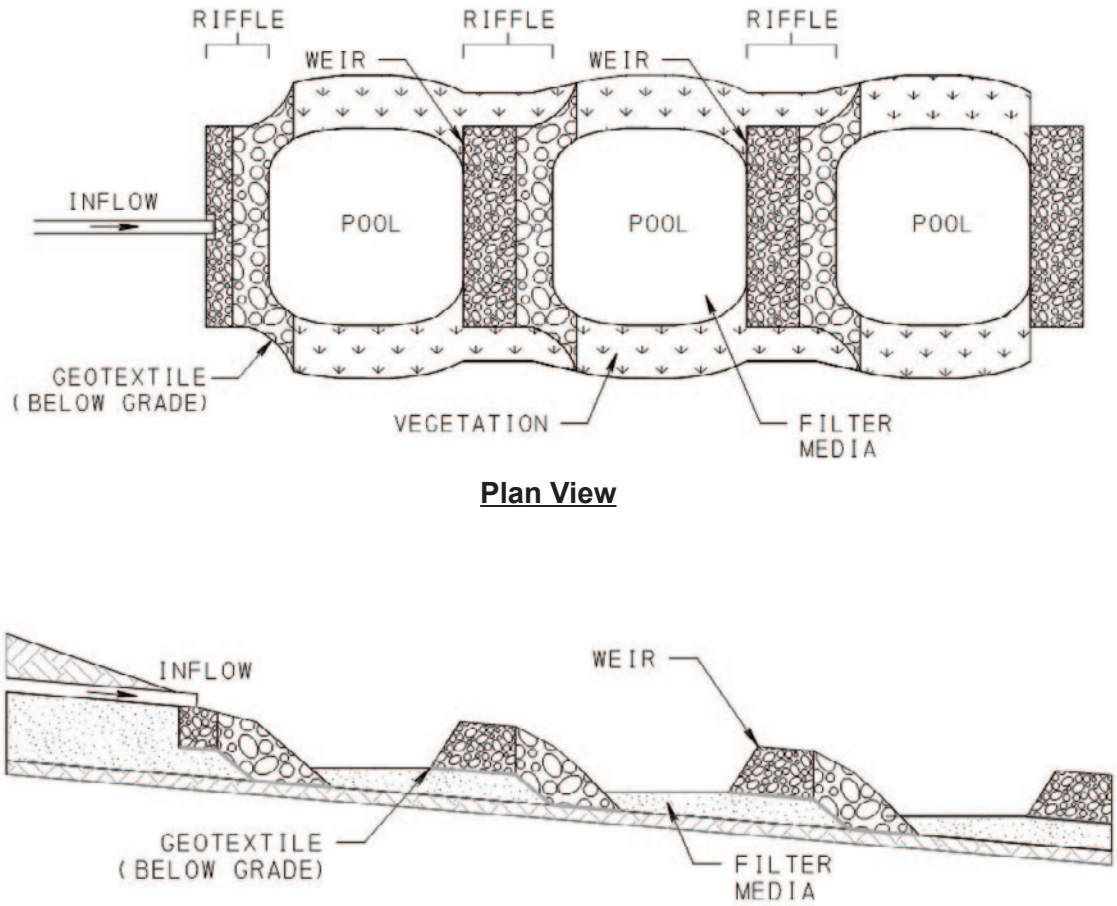



**Figure 5.16.2. Regenerative Step Pool - Common Elements**

## 5.16.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, the key functional items that need to be confirmed in an RSP inspection are inflow, filtration, infiltration, and overflow. Specifically:

- Confirm the design drainage area is reaching the SCM.
- Inspect SCM and surrounding area for trash and debris.
- Vegetation, if present in design plan, should be inspected to be in good condition with no weeds or invasive/undesirable species. If vegetation is present and not in design plans, all vegetation within SCM floor should be removed.

- Presence of hydrophytic vegetation, if not in plans, is an indication of poor drainage and corrective maintenance should be prescribed.
- The filtration/infiltration pool systems can be susceptible to clogging by sediment. If the infiltration capacity is diminished such that the design ponding depth is not reached after 72 hours of a storm event, soil probing within the pools should be performed to assess depth of sediment and need for removal/replacement. Where sediment is causing diminished infiltration capacity, recommendations for sediment removal and replacement of new material should be made.
- Some sediment deposition is expected in the pools. Removal of accumulated sediment should be limited to when it threatens the structural integrity of the system or inhibits filtration/infiltration. Structural integrity is compromised when sediment build-up in upstream pools causes scour to undercut boulder weirs in downstream pools.
- For RSPs with planting in the bottom of the pools, if sediment accumulation in ponds exceed 6 inches in the first year of functioning, place an additional layer of compost and replant the pool bottoms. Assess and note source of sediment.
- All areas within and surrounding the SCM should be checked for evidence of erosion. This may include soil erosion, sediment displacement within the pool, or displaced cobbles or rock within the RSP.
- Weirs should be generally free of obstructions and in good structural condition.
- Inspect all applicable common components as described in Chapter 6.

When completing the inspection forms for RSPs, the following should be considered:
VSI Form

- 1D. Sediment forebay or micropool – can be interpreted to include all pool systems.
- 2C. Outlet/outfall – can be interpreted to mean rock weirs, riffles and, if present, cascades.
- 2D. Emergency Spillway – does not apply.

CAI Form

- Section 3 – Principle Spillway/Riser– Outfall: means the rock weirs, riffles and, if present, cascades.
- Section 3 – Emergency Spillway: does not apply.

## 5.16.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 5.16.1 Routine Maintenance for RSP**

| Frequency | Activity |
|---|---|
| Annually | • Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plants; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove litter, trash, and debris from SCM surface, side slopes, inflow and outflow points, structures, and surrounding area. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 5.16.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the RSP specific table (E.1.16).

# 5.17 Non-Basin SCM, Other (NBO)

**Green Roof**

**Cistern**

**Figure 5.17.1: Non-Basin, Other**
(photos c/o Philadelphia Water Department, Stormwater Management Guidance Manual)

## 5.17.1 Description and Overview

NBO's are SCMs installed and owned by the Department that do not match the typical highway SCMs in the inventory. Examples such as a vegetated roof, cistern, or sumped inlet do not receive their own type code in Department's SCM inventory.

Some of these SCMs, such as cisterns or vegetated roofs, may be installed for stormwater management needs at maintenance facilities, driver's license centers, or other Department buildings. Others SCMs, such as a sumped inlet, would typically be considered a pretreatment device or component of another more common SCM. However, in special circumstances it may be installed, credited, and inventoried separately during the permitting process (refer to Section 6.4).

In some watersheds, spill containment facilities are installed to capture contaminants upstream of sensitive resources in the event of an inadvertent release. Where these are directly in-line and connected to an SCM, they should be included as part of the SCM in the inventory. Where these facilities are standalone vaults, tanks or similar storage vessels, they should be classified as NBOs. When these facilities are in the form of standalone surface basin-like features, they should be classified as BOTs for inventory tracking (Section 5.1).

One should expect to rarely encounter an SCM that falls into the NBO category; therefore, these SCMs will not be covered in detail in this section. For an inlet with a sump or trap, refer to Section 6.4 Inlet with Sump/Trap. For all other NBOs, consult the SCM details and relevant information on the PCSM Plan for inspection and maintenance requirements.

# 5.18 Self-Preserving SCMs: Forest Preservation (FPR); Landscape Restoration Meadow (LRM); Reforestation/Tree Plantings (RTP); Riparian Buffer Enhancement (RBE); Riparian Buffer Offset (RBO); Soil Amendment Restoration (SAR); Stream Restoration (SRE); Stream Stabilization (SST)

## 5.18.1 Description and Overview

There are some SCM types that have a self-preserving nature, resulting in minimal need for regular maintenance and inspection. As introduced in Section 1.3, once construction is complete and initial vegetation establishment occurs, these SCMs should not require extraordinary maintenance or inspections to properly function. These self-preserving SCMs must be included in the SCM Inventory for tracking and protection purposes. While they are subject to inspections like other SCMs, as shown in Table 3.2.1, the lack of structural components results in less in-depth inspections in comparison to structural SCMs. A brief overview of each of these is presented to provide a functional understanding and aid in identification.

**Forest Preservation (FPR)**
**Figure 5.18.1.1: Self-Preserving SCMs**

Forest Preservation (FPR) is accomplished during the project design phase by minimizing required forest clearing by adjusting project layout and limiting construction operations to only those areas that are essential. Well-planned alignments and construction staging activities can reduce the need to disturb wooded areas outside of the construction footprint. This non-structural SCM can be applied to almost every project by placing a protective easement on the FPR area.

**Reforestation/Tree Plantings (RTP)**

**Figure 5.18.1.2: Self-Preserving SCMs**

**Landscape Restoration Meadow (LRM)**

**Figure 5.18.1.3: Self-Preserving SCMs**

Landscape Restoration Meadow (LRM) and Reforestation/Tree Plantings (RTP) are two types of SCMs that fall under the category of landscape restoration, which is the general term used for actively sustainable landscaping practices that are implemented outside riparian (or other specially protected) buffer areas. LRM includes reestablishing meadow and converting turf to meadow. RTP involves the restoration of forest by implementing reforestation and tree plantings over an area. In both types, designs use vegetation (i.e., native species) that does not require significant chemical maintenance by fertilizers, herbicides, and pesticides.

**Riparian Buffer**

**Figure 5.18.1.4: Self-Preserving SCMs**

Riparian Buffer Enhancement (RBE) is a method of revitalizing and improving existing riparian buffers. Riparian buffers are areas adjacent to streams, ponds, etc., that protect those water resources from pollution, prevent bank erosion, provide wildlife food and cover, and shade the adjacent water, moderating temperatures for aquatic species. Buffers are transition areas between aquatic and upland environments. RBE involves complicated natural features requiring a diverse group of expertise to effectively design the enhancement. This SCM is applicable when the development is located adjacent to a body of water with depleted buffers. Riparian Buffers are typically comprised of three distinct zones with different types of vegetation measured from the streambank outward. Zone 1 is the area directly adjacent to the stream which is ideally heavily vegetated undisturbed forest type material approximately 50 feet wide. Zone 2 varies from 15 to 100 feet in width and is vegetated with a mix of managed forest trees and shrubs. Zone 3, located farthest from the stream and sometimes not formally included, is comprised of native meadow grasses and herbaceous type land cover functioning to slow and spread incoming surface runoff.

Riparian Buffer Offset (RBO) is a type of SCM that occurs when a reduction in existing riparian buffer occurs as a result of the land development. The offset is a replacement of the impacted zone through the planting and development of a riparian buffer in the same drainage area as the impacted riparian buffer. The offsetting requirement is dependent on the downstream water body, the amount of disturbance, and the proximity of the disturbance to the water body. This SCM is only applicable when the disturbance impacts an existing riparian buffer.

**Soil Amendment Restoration (SAR)**

**Figure 5.18.1.5: Self-Preserving SCMs**

Soil Amendment Restoration (SAR) may include both mechanical and fertilization techniques, which make the soil more suitable for the growth of plants and increase water retention capabilities. These measures change the physical, chemical, and biological characteristics of the soil allowing it to more effectively reduce runoff volume and filter pollutants. SAR is sometimes done in combination with LRM, which ensures longevity of soil restoration by root growth from dense plantings. Vegetated swales and grass filter strips can be treated with soil amendments to improve performance and increase their permeability. A variety of techniques are included as potential soil amendments including aerating; fertilizing; and adding compost, other organic matter, or lime to the soil.

**Stream Restoration (SRE) - Cross Vane Structures**

**Figure 5.18.1.6: Self-Preserving SCMs**

**Stream Stabilization (SST)**
**Figure 5.18.1.7: Self-Preserving SCMs**

Stream Stabilization (SST) and Stream Restoration (SRE) are methods for correcting unstable, altered or degraded stream habitat. Existing problems may include stream channel or bank erosion, erosive damage to public utilities or facilities (e.g., parks), or sediment transport adversely affecting downstream resources (e.g., Chesapeake Bay). Stream stabilization typically involves corrections to the streambank and/or channel either at a specific site (e.g., protection of public infrastructure with riprap), or on a watershed level using a combination of grading and rock, log, or various natural stabilizing structures to reduce sediment transport, improve stream habitat, or maintain channel capacity before a complete restoration is necessary. Streambank stabilizing protection includes features such as intentionally placed natural features like tree or root revetments, or in more erosive areas, boulders or rock filled gabion baskets placed into the banks to provide stability. Channel grade and flow control structures include features such as boulders intentionally place in various shapes in the stream channel to control the channel grade (elevation) or direct flow. Common structures include “J-Hooks” which are in the shape of a “J” projecting from one stream bank, or “Cross-Vanes” (e.g. rock vanes) which extend in a generally linear pattern across the stream channel. Stream restoration is best described as a reconnection of the channel to its floodplain for events both large and small. Most construction occurs within the riparian corridor utilizing unique materials to improve ecological habitat while restoring pre-development hydraulic conditions. These SCMs are generally reserved for special projects outside the context of Construction Site NPDES permitted highway projects. Stream Restoration (SRE) and Stream Stabilization (SST) inspections are per 25 PA Code Ch 105 and are not governed by this publication.

## 5.18.2 SCM Components

SCMs are comprised of many individual components, some of which are applicable to multiple types of SCMs while others less frequently utilized. Common components that are described in Chapter 6 and related SCMs described in Chapter 5 which may be encountered with these SCMs include:

- Access, fencing, and security
- Signage
- Inflow Systems (sheet flow)
- LSO SCM

In addition, self-preserving SCMs may include the following other components:

- Turf reinforcement matting (optional)
- Engineered soil (optional)
- Turf meadow, forest, scrub-shrubs or special SCM Plantings: Hydrophytic vegetation, native/indigenous vegetation
- Streambank stabilization structures: tree revetments, root revetments, gabion baskets, boulders, etc. (SST and SRE)
- Channel stabilization structures: J-hooks, cross vanes, weirs, etc. (SST and SRE)
- SCM discharge/receiving channel

Figure 5.18.2 illustrates the zones typically encountered in a Riparian Buffer.

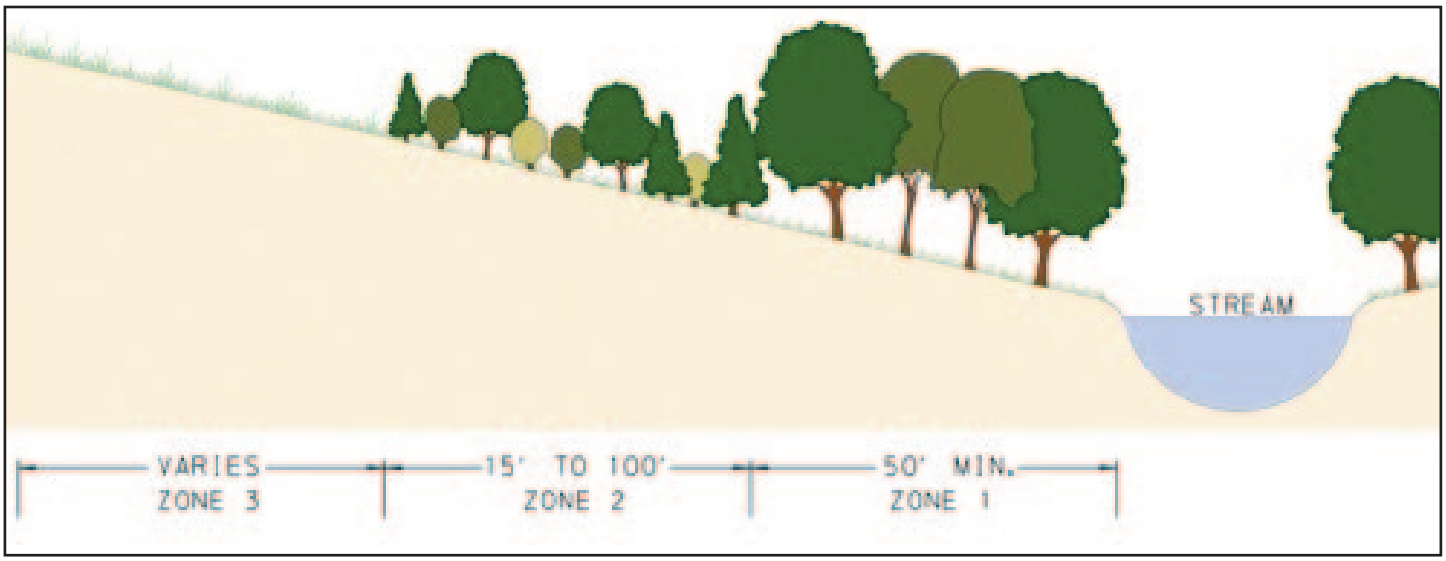



**Figure 5.18.2: Riparian Buffer- Typical Zones**

## 5.18.3 Key Inspection Considerations

Only areas of SAR equal to or greater than 5,000 contiguous SF are subject to regular inspections; areas under 5,000 contiguous SF are exempt from inspection. In addition to the general inspection procedures described in Chapter 3, inspections of a self-preserving SCM should focus primarily on its key functional areas: inflow, vegetation and surface area.

Specifically:

- Confirm the foot print surface area of the self-preserving SCM matches the plan depicted area.
- Inspect for appropriate vegetative cover per plan. Surface vegetation should be in good condition with at least 80% coverage throughout SCM area and there are no bare patches exceeding 10% of the area. Inspect for encroachment of invasive/undesirable species.
- Inspect the self-preserving SCM area for the presence and note severity of:
  - Trash/debris
  - Surface erosion, rills, gullies and/or loss of topsoil
  - Signs of compaction by use or settling.
  - Sinkhole activity
  - Signs of contaminants (e.g. gas, oil, fertilizers)
  - Evidence of burrowing animals.
- SST and SRE: Inspect stream channel for signs of erosion, instability or degradation.

When completing the inspection forms for self-preserving SCMs:
VSI Form

- XXXX

Start-up phase check-ups: Due to the nature of the installation of self-preserving SCMs, they require more frequent startup phase check-ups during plant establishment through the first three years, as stipulated in Chapter 3.

The following items should be inspected during these check-ups:

- SCM vegetation should be in good condition and per plan including trees, shrubs and herbaceous/grass plant materials. Coverage should reach 70% or more of plan depicted density by one year after construction, 75% by two years, and 80% by three years after construction. No invasive/undesirable species should be present. Dead plants should be removed and replaced. New plants should receive establishment watering for the first two years as stipulated in the routine maintenance table in Section 5.18.4.
- The SCM and vicinity should be checked for signs of erosion of any form including general loss of topsoil and the formation of rills or gullies.

## 5.18.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

## 5.18.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2).

**Table 5.18.1: Maintenance Procedures for Self Preserving SCMs**

| Frequency | Activity |
|---|---|
| April-Oct twice weekly for six weeks following planting | • Water all seeded/planted areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 24 hours of scheduled watering. (Excludes FPR and areas of existing established vegetation) |
| April-Oct every two weeks for first two years following planting | • Water all planted (non-grassed/seeded) areas and fill water bags around trees. Watering may be skipped if ¼" of rainfall has occurred within previous 7 days of scheduled watering. (Excludes FPR and areas of existing established vegetation) |
| Three times per year (for the first two years of service) | • Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Remove undesirable vegetation. Do not drive heavy equipment on SCM surface, use LGP equipment (see Section 4.7). When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). |
| Annually | • RTP, RBO, RBE, or any trees with tree shelter: Check tree shelter (protective plastic surround on newly planted trees). Fix any leaning, damaged or downed shelters. Remove top nets when tree reaches net. Remove entire shelter when tree reaches 1.5 to 2" diameter.<br>• SAR and LRM only: Prior to mowing, remove litter, trash, and debris from SCM and surrounding area. Mow areas of SCM indicated to be grass or meadow to a height of 5 to 8 inches. Perform mowing operations within SCM when SCM is completely dry. LGP equipment must be used in the SCM (see Section 4.7); do not drive heavy equipment in the SCM. Do not mow areas planted with no-mow landscaping such as shrubs. |
| Every three years | • Remove weeds and undesirable plants; prune shrubs and trees to maintain appearance and functionality. Replace diseased or dead plant materials; if specific species mortality is reoccurring, assess cause and replace with appropriate alternate species maintaining 80% plant cover. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• LGP equipment must be used in the SCM (see Section 4.7); do not drive heavy equipment in the SCM.<br>• SAR only: Dethatch turf to maintain infiltration. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies.<br>• Repeat SAR amendment processes. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

# Chapter 6 - Common SCM Components
# Specific Inspection & Maintenance Procedures
## Publication 888 - SCM Maintenance Manual

- Certain features are common to many SCM types. Each section in this chapter covers a common SCM component.
- Each component section includes:
  - Description and overview
  - Common elements
  - Key inspection considerations
  - Maintenance procedures

Forebay

### Common Elements

- Elements typically associated with each SCM component
  - Vegetation
  - Side slopes, embankment or berm
  - Weirs, orifices or grates
- Some common SCM components are associated with each other
  - Spillways and outfall protection
  - Inflow systems and forebays

### Key Inspection Considerations

- Specific inspection procedures focused on a component's key functional areas
- Inspection form (M-77 & M-79) considerations related to each component
- Refer to Chapter 3 for general SCM inspection procedures
- Refer to Chapter 5 for specific SCM inspection procedures

### Routine and Corrective Maintenance

- Component specific maintenance activity descriptions
- Routine maintenance activities
  - Frequency
  - Equipment
  - Procedures
- Corrective maintenance activities
  - Reference tables in Appendix E
  - Common component table provided

# CHAPTER 6

# COMMON SCM COMPONENTS – SPECIFIC INSPECTION AND MAINTENANCE PROCEDURES

## 6.1 Access, Fencing, and Security

**Figure 6.1.1: Fencing Surrounding an SCM**

### 6.1.1 Description and Overview

All SCMs and SCM components should be accessible to Department personnel for maintenance-related activities. For some SCMs, this may include a dedicated access road, while others may simply require nearby parking with walking access. Due to highway safety considerations, some SCMs are constructed behind guide rail or other roadside barriers requiring special equipment for access.

While SCMs are normally constructed within the Department's right-of-way, occasionally the SCM and associated access route are located in an easement. It is important that all maintenance and inspection activities remain within the Department's right-of-way or legal easement. The entranceway must be properly maintained to allow for SCM access. Some SCMs also require fencing and security gates to protect from vandalism, damage and unauthorized access.

### 6.1.2 Common Elements

Other common SCM components described in this chapter may be associated with access fencing and security. Refer to the appropriate section of this chapter for the following components:

- Signage

In addition, other elements associated with access, fencing, and security may include:

- Access road
- Vegetation
- Fencing
- Gates
- Lock
- Guide rail

Typical drawings for Department right-of-way fencing and gates can be found in Publication 72M, Sections RC-60M and RC-61M, and guide rail details can be found in Sections RC-51M, RC-53M and RC-54M.

## 6.1.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of access, fencing, and security should focus on its key functional areas. Specifically:

- Inspect all access ways and area near fencing for trash, debris, sediment, or undesired vegetation. Desirable vegetation includes native grasses, shrubs, and trees that are not interfering with the access, fencing, or security. Undesirable vegetation includes excessive invasive species, hazardous trees, poisonous/noxious plants, or any growth that would interfere with maintenance equipment or personnel.
- Inspect access road surface for loss of gravel material, rutting or other conditions that limit access. Inspect access road and entire easement area for bare, eroded soils or signs of rills.
- Inspect for insects, such as wasps and hornets, that would interfere with access for maintenance activities.
- Inspect for holes in fence, around bottom of fence, or near footings that would interfere with security. Check structural integrity of all fence components.
- Inspect for presence and function of gate and/or locking mechanism.
- Inspect all areas for signs of vandalism.

When completing the inspection forms for an SCM, the following should be considered regarding access, fencing, and security:

VSI Form

- 1A. Other (describe) – should include assessment of the access, fencing, and security.
- 5B. Structural damage or deterioration – should include assessment of the fencing.
- 5G. Evidence of burrowing animals – should include assessment of the fencing.
- 5H. Other (describe) – should include assessment of the erosion of access, fencing, and security.

CAI Form

- Access, fencing, and security are assessed in Section 2 – Site Conditions of the CAI form.

## 6.1.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 6.1.1: Routine Maintenance for Access, Fencing, and Security**

| Frequency | Activity |
|---|---|
| Annually | • Remove trash, debris, and/or sediment.<br>• Remove undesirable vegetation including weeds, poisonous plants (e.g. poison ivy), or tree growth that interferes with maintenance activity. Remove trees that are dead, diseased, or dying and in danger of falling onto the access way, fencing, or SCM. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

## 6.1.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

## 6.2 Signage


**Figure 6.2.1: Educational Signage at an SCM**
(Photo c/o https://farm9.staticflickr.com/8339/8245031912_452a53aa50_z.jpg)

### 6.2.1 Description and Overview

While not required, SCMs may have signage or markers to indicate the extents of the SCM area, to aid in locating the facility and prevent unintentional disturbances. The number and location of delineation signage varies based on the type of SCM. Section 2.7 of this publication describes the recommended placement and type of delineation signage.

In addition to delineation, some SCMs in pedestrian friendly areas may include educational signage about the SCM. In more remote or inaccessible locations, signage may be used to prohibit entry.

6.2.2 Common Elements
Other common SCM components described in this chapter may be associated with signage. Refer to the appropriate section of this chapter for the following components:

- Access, Fencing, and Security

Additionally, other elements associated with signage vary depending on the type of signage present and may include:

- Flexible delineator post
- Stormwater control marker
- Sign post (PennDOT Type A through F as applicable)
- Concrete foundation

Typical drawings for Department delineation markers and sign posts can be found in Publication 111M, Sections TC-8604 and TC8702 through 8702E, respectively. Materials information is available in PennDOT Publication 408.

### 6.2.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of signage should focus on its key functions. Specifically:

- Where signage is not present, assess and make recommendation for signage installation where appropriate. SCM delineation is appropriate where the SCM is difficult to locate or at risk of unintentional disturbance.
- Inspect SCM delineator signage for damage. For linear SCM, confirm start and end marker is in place. Ensure SCM ID is readable and accurate.
- Inspect post mounted signs for leaning and foundation issues. Signage leaning more than 8 inches off vertical should be reset to plumb.
- Inspect surface readability of post mounted signage. Signage should be replaced when more than 20% of the surface is unreadable.
- Inspect all signage for evidence of vandalism.
- Check for adequate signage visibility; note vegetation or other items obstructing view.

When completing the inspection forms for an SCM, the following should be considered regarding signage:
VSI Form

- 5H. Other (describe) – should be used to note any observed signage issues.

CAI Form

- Section 2 – Site Conditions, Signage: should be used to note if signage installation is recommended or repairs are required.

### 6.2.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCMs information in Maintenance-IQ for potential variations.

**Table 6.2.1: Routine Maintenance for Signage**

| Frequency | Activity |
|---|---|
| Annually | • Remove vegetation including weeds, shrubs, or tree growth that obstructs view of signage. |
| As needed | • Maintain other applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

### 6.2.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

# 6.3 Inflow Systems

**Figure 6.3.1: Inflow System- Curb Cut**

## 6.3.1 Description and Overview

The majority of SCMs receive stormwater flows from adjacent and nearby areas via a drainage collection system or simply called, an inflow system. Inflow systems can be comprised of different components including inlets, pipes, conveyance channels, and sheet flow. While not every one of these components will be present in every SCM, the inspection and maintenance procedures for all are discussed in this section.

Inlets, or catch basins, are typically rectangular concrete boxes fitted with pipe connections below grade and a slotted metal or plastic grate on the surface. Stormwater flows are directed into the grate, through the box, and to underground pipes. Note: For inlets with a sump (storage volume) below the pipe outlets and/or a hood or trap over the pipe outlets, refer to the component Section 6.4 Inlet with Sump/Traps.

Storm sewer pipes (pipes) come in a variety of materials such as concrete, metal, or plastic. They can be used to convey stormwater into, through, and from SCMs. Some pipes found in SCMs may be perforated to allow stormwater to enter and exit the pipe from the surrounding area. Pipes discharging directly to the surface of an SCM may do so via a headwall or end section into an outfall protection feature (refer to Section 6.8 Structures and Appurtenances and Section 6.10 Outfall Protection component sections).

Conveyance channels (channels) provide above-ground conveyance of stormwater to the SCM surface and may be lined with grass, concrete, or riprap. These channels differ from vegetated swales (VSW and VSC) as they do not incorporate stormwater treatment, such as filtration or infiltration. Note both conveyance channels and VSW/VSC can be used to deliver flow to an SCM; the key difference is conveyance channel simply carries flow to the SCM while a VSW/VSC provides flow treatment while carrying the flows.

Curb cuts allow passage of concentrated stormwater flow along a curb (gutter) line into a conveyance channel or directly into the SCM. They are formed by a break or depressed section in the curb line that leads to the intended SCM. Riprap aprons are frequently installed on the downslope side of a curb cut to prevent erosion (refer to Section 6.10 Outfall Protection).

Sheet flow is the movement of stormwater runoff in a shallow, unconcentrated manner over plane surfaces. Sheet flow enters surface SCMs directly from the drainage area surrounding the SCM.

An SCM's inflow system can incorporate any combination of the above components. Some inflow systems pass through a pretreatment component, such as a forebay, prior to entering to the SCM. Refer to Sections 6.4, 6.5, and 6.6 for pretreatment component information.

### 6.3.2 Common Elements

Several of the common SCM components described in this chapter may be associated with inflow systems. Refer to the appropriate section of this chapter for the following components:

- Inlet with Sump/Traps
- Forebay
- Structures and Appurtenances
- Outfall Protection
- Flow Splitter
- Flow Control Structures

Additionally, other associated elements of typical inflow systems may include:

- Grate/cover
- Concrete curb

Typical drawings for inlets and inlet grates can be found in PennDOT Publication 72M, Sections RC-45M and RC-46M, and curb cuts are illustrated in RC-64M (Sheet 1, Depressed Curb for Driveways detail). Typical conveyance channel details are presented in the PADEP Erosion and Sediment Pollution Control Program Manual.

### 6.3.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an inflow system should focus on its key functional areas. Specifically:

- Confirm stormwater runoff flows freely into the inflow system.
- Inspect all inflow system components for trash, debris, sediment, and undesired vegetation. Undesirable vegetation includes any plants that may impede flow into and through the inflow component including invasive, native, or woody plants. Desirable vegetation includes grass cover in a conveyance channel to prevent soil erosion.
- Check all inflow areas for evidence of erosion. Inspect pipe inflow and outflow points, channels, and sheet flow areas for signs of erosion. Pipe inflow or outflow points showing signs of significant sediment buildup suggest possible sediment buildup throughout the subsurface piping system and should be noted.
- Check for excessive sediment buildup at any entrance to or within a component of an inflow system. If present, check the SCM drainage area for bare soil or other possible sources of sediment.
- Inspect inlets, grates, curbs and curb cuts, headwalls, and any other structural components visible on the surface for signs of structural damage or deterioration.

- Inspect the ground surface above buried pipes and structures for depressions and other signs of pipe or structural damage, deterioration, or joint separation. If there is concern of damage or deterioration of a subsurface feature based on age or surface evidence, consider recommending video inspection or a confined space entry inspection to confirm system functionality.

## 6.3.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 6.3.1: Routine Maintenance for Inflow Systems**

| Frequency | Component | Activity |
|---|---|---|
| Two times per year | All | • Remove trash, debris, and sediment impeding or blocking flow of water to inflow component.<br>• Remove undesirable vegetation. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove animal carcasses from vicinity of inflow system and inside inlet boxes and pipes. |
| | Inlets; curb cuts; sheet flow | • Remove vegetation obstructing flow into inlets, curb cuts, or sheet flow areas. |
| | Channels; sheet flow | • Mow grassed areas to a height of 5 to 8 inches.<br>• Remove undesirable and woody species. |
| As needed | All | • Maintain other applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 6.3.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

# 6.4 Inlet with Sump/Trap

**Figure 6.4.1: Inlet with Sump/Trap**
(photo c/o: Pennsylvania Turnpike)

## 6.4.1 Description and Overview

Inlets with sumps/traps are inlets modified to incorporate stormwater pretreatment capabilities in the inlet box. They consist of a standard inlet box and grate as described under Inflow Systems (Section 6.3) with a sump area below the outlet pipe providing storage volume for sediment and debris to settle out of the collected runoff. Frequently, in conjunction with the sump storage, a trap or hood may be attached over the outflow pipe to prevent floatables or other debris from escaping downstream or clogging the outflow pipe.

## 6.4.2 Common Elements

Several of the common SCM components described in this chapter are associated with an inlet with sump/trap. Refer to the appropriate section of this chapter for the following components:

- Inflow Systems
- Structures and Appurtenances

Additionally, other associated elements of typical inlet with sump/traps may include:

- Grate/cover
- Concrete box
- Trap
- Sump

Figure 6.4.2 illustrates the common elements of a typical inlet with sump/trap system.

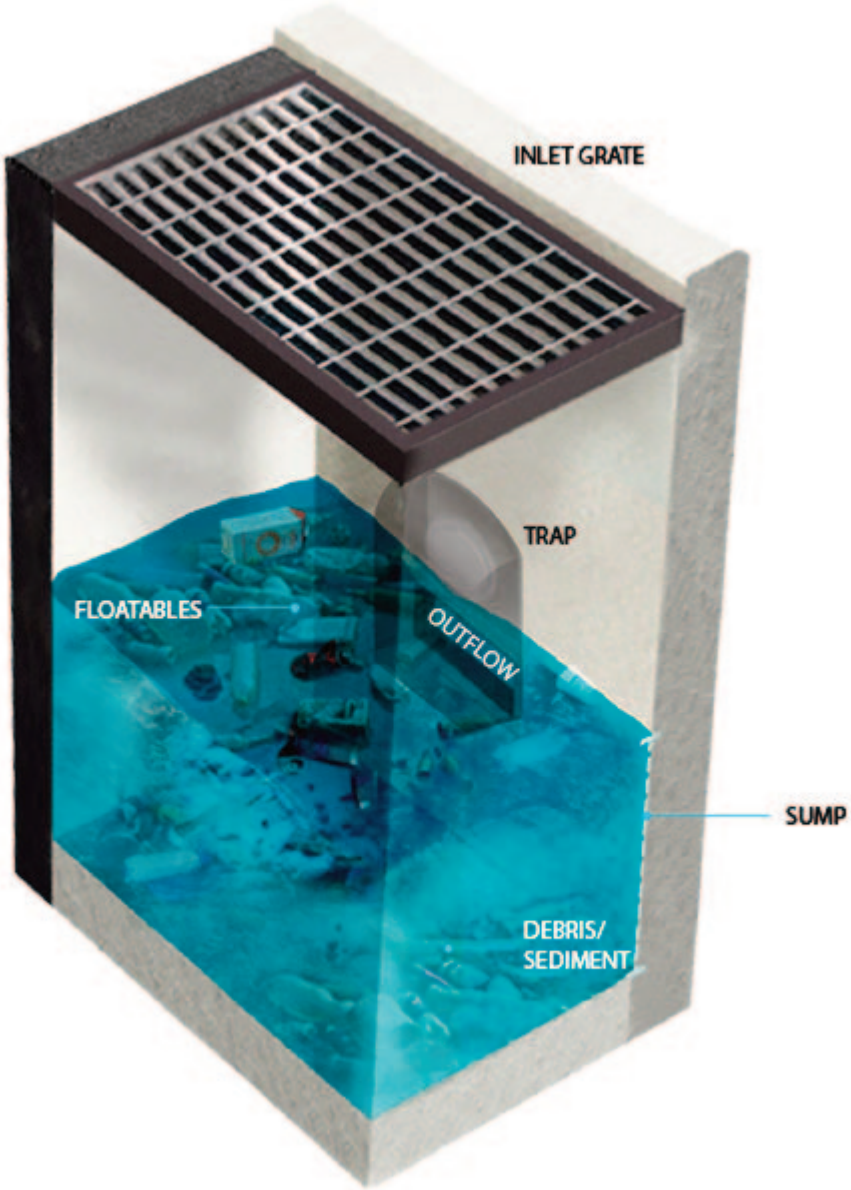



**Figure 6.4.2: Inlet with Sump/Trap - Common Elements**
(photo c/o: Philadelphia Water Department, Stormwater Management Guidance Manual)

## 6.4.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an inlet with sump/traps should focus on its key functional areas. Specifically:

- Stormwater runoff should be allowed to flow freely into the inlet grate and through the sump/trap system. Paving surrounding the inlet structure should be flush with the inlet structure; not impeding inflow. Vegetation growth should not impede stormwater from flowing into the inlet grate.
- Inspect area surrounding the inlet and inside of the inlet with sump/traps for trash, debris, and sediment build up. If excessive sedimentation is occurring on the surface surrounding the inlet grate or within the inlet with sump/traps system, check the drainage area for bare soil or other possible sediment sources.
- Sediment removal in inlets with sumps/traps should occur when the debris is half of the depth of the

storage area. When a trap is installed in the inlet box, the storage area should be measured from the bottom of the trap to the bottom of the inlet box. When no trap is present, the storage area depth should be measured from the invert of the outlet pipe to the bottom of the inlet box.

- Inspect inlets grates, concrete boxes and hoods which are visible from the surface for signs of structural damage or deterioration.
- Inspect the ground surface immediately surrounding the inlet structure for depressions and other signs of pipe or structural damage, deterioration, or joint separation. If there is concern of damage or deterioration of a subsurface feature based on age or surface evidence, consider recommending video inspection or confined space entry inspections to confirm system functionality.

Generally, inlets with sumps/traps will be assessed as a pretreatment measure as part of a primary SCM, however in rare instances one may be a standalone SCM. When completing the inspection forms with an inlet with sump/traps as part of a primary SCM, the following should be considered:
CAI Form

- Section 4 – Treatment Performance: Inlet Sump and/or Hood.

When completing the inspection forms in the rare case where the inlet sump/trap is a standalone SCM, an inlet with only sump should be classified as a “Non-Basin Other (NBO)” and an inlet with a sump and trap should be classified as a “Manufactured Treatment Device (MTD).” In these cases, the following should be considered:
VSI Form

- 1B. Inflow channel(s) – can be interpreted to mean gutter flow into the inlet grate.
- 1C. Side slopes – does not apply.
- 1D. Sediment forebay or micropool – does not apply.
- 2B. SCM bottom or side slopes – does not apply.
- 2C. SCM bottom or side slopes – does not apply.
- 2D. Outlet/outfall- does not apply.
- 3C. Permanent pool water level very low or dry – does not apply.
- 4D. Woody vegetation in embankment – does not apply.

CAI Form

- Section 3 – Inflow & Outflow, Principal Spillway/Riser Opening: should be considered the outlet point to the discharge pipe.
- Section 3 – Inflow & Outflow, subsections Principal Spillway/Riser-Structure and Emergency Spillway: do not apply.
- Section 4 – Treatment Performance, subsections Vegetation and Filtration: do not apply.
- Section 5 – Side Slopes and Embankment: does not apply.

## 6.4.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCMs information in Maintenance-IQ for potential variations.

**Table 6.4.1: Routine Maintenance for Inlets with Sump/Traps**

| Frequency | Activity |
|---|---|
| Two times per year | • Remove trash, debris, and/or sediment from the surface that is blocking or impeding flow of water into inlet sump/trap.<br>• Remove sediment, trash, and debris buildup from the sump area using a vacuum truck or other appropriate method.<br>• Remove vegetation impeding flow into the inlet grate.<br>• Remove animal carcasses from vicinity of inlet and within inlet boxes. |
| As needed | • Maintain other applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 6.4.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

# 6.5 Flow Splitter

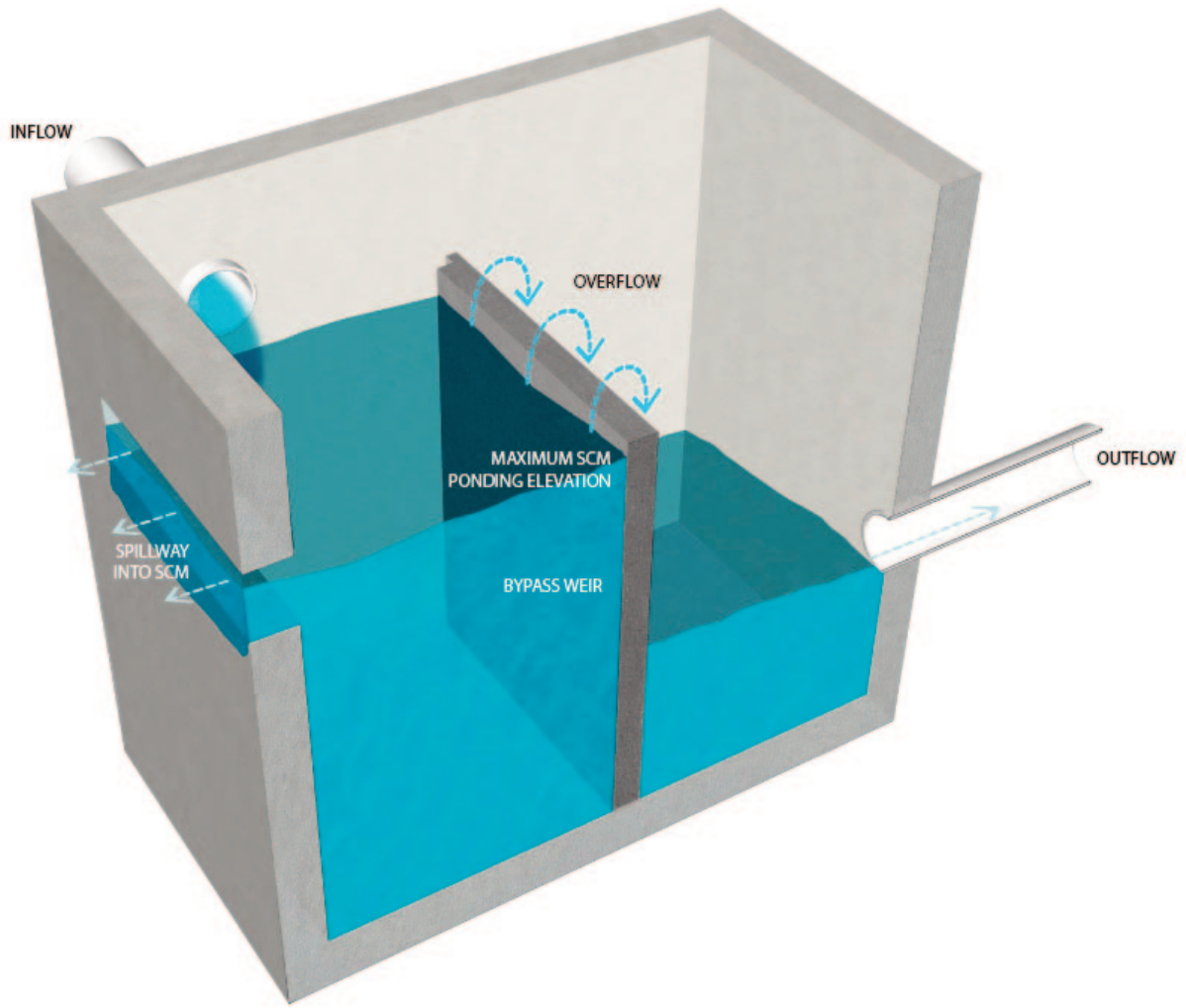



**Figure 6.5.1: Flow Splitter**
(photo c/o: Philadelphia Water Department, Stormwater Management Guidance Manual)

## 6.5.1 Description and Overview

Flow splitters, also called flow bypass structures, are SCM components which direct a portion of stormwater runoff into an SCM while bypassing excess flows from larger events around the SCM. Flow splitters are located at the upstream inflow point of the SCM. Generally, a flow splitter will consist of a small storage area (sump) having one inflow point and two outflow points set at different elevations and/or separated by a weir. The elevations and sizes of the outflow points and/or weirs within the flow splitter are important for proper function.

Subsurface flow splitters are generally constructed utilizing components described in Structures and Appurtenances (Section 6.8) by installing weirs in concrete boxes and manholes.

Forebays can also be used as a form of a surface flow splitter by installing a low flow weir into the SCM and a high flow bypass channel that allows for overflow to a channel around the SCM (refer to Section 6.3 Inflow Systems and Section 6.6 Forebay).

## 6.5.2 Common Elements

Several of the common SCM components described in this chapter are associated with flow splitters. Refer to the appropriate section of this chapter for the following components:

- Inflow Systems
- Inlet with Sump/Traps
- Structures and Appurtenances

Additionally, other associated elements of typical flow splitters may include:

- Concrete boxes or manhole
- Grate/cover
- Concrete joints
- Weir
- Steps/ladder
- Pipes

Figures 6.5.2 and 6.5.3 illustrate the common elements of typical flow splitters.

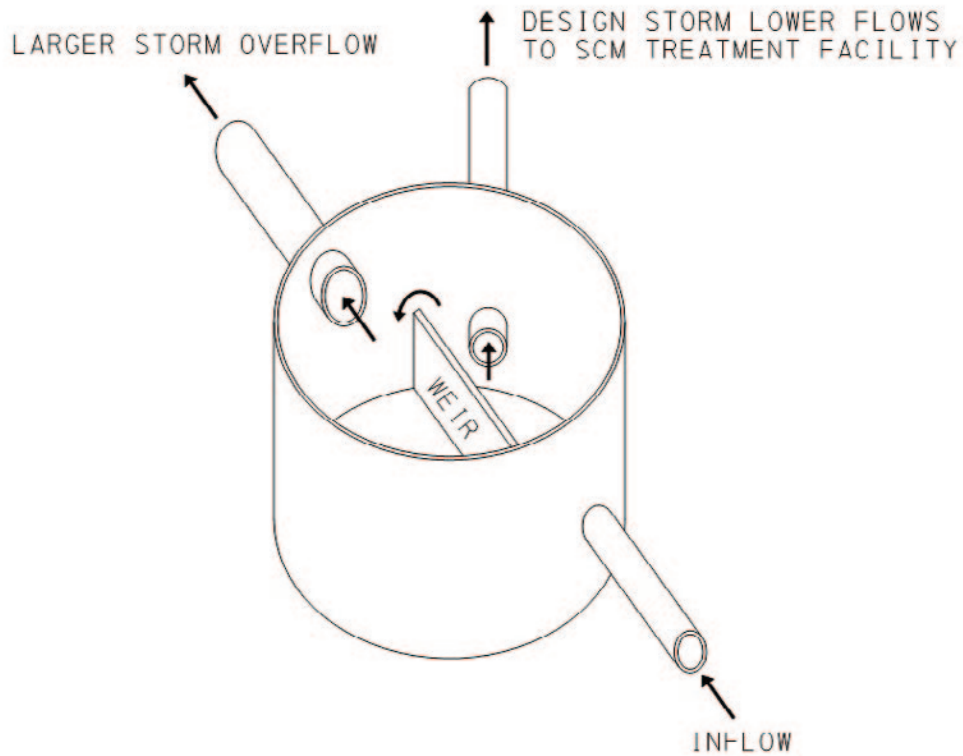
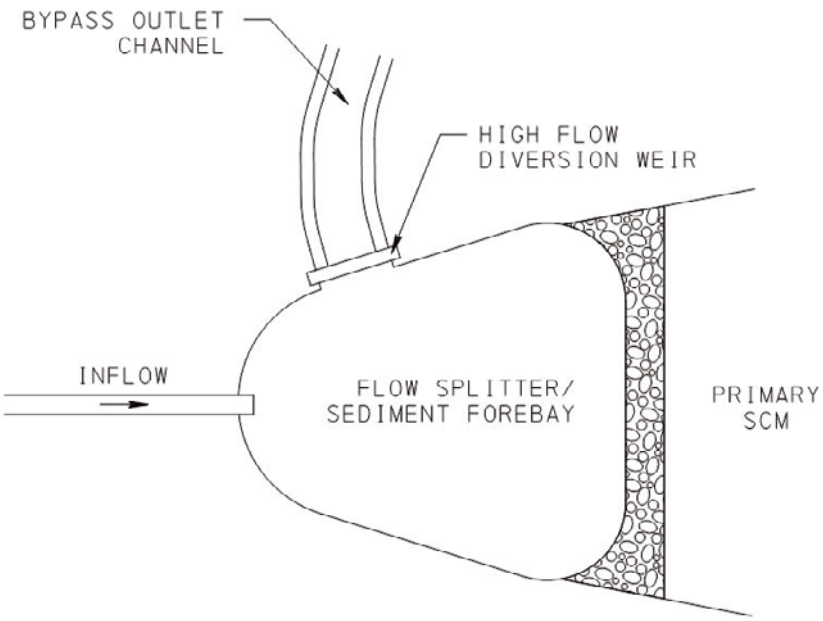
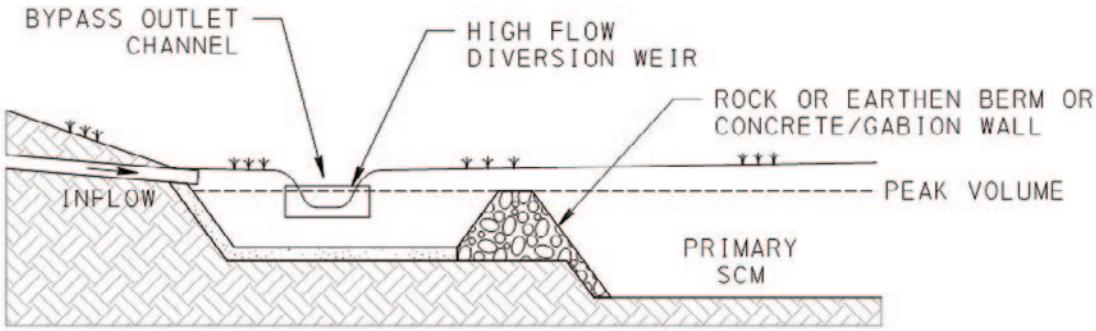



**Figure 6.5.2: Subsurface Flow Splitter – Common Elements**




**Plan View**




**Section View**

**Figure 6.5.3: Surface Flow Splitter – Common Elements**

## 6.5.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a flow splitter should focus on its key functional areas. Specifically:

- Inspect for trash, debris, and/or sediment that is blocking or impeding the flow of water through the flow splitter; flow splitters can be prone to sediment and debris clogging as they are a component found upstream of most pretreatment measures.
- Check for vegetation that impedes flow into, through or out of the flow splitter.
- Check that the top of weir, if present, and pipe connection elevations (with respect to bottom elevation of the splitter) are consistent with design plans.
- Inspect for visual signs the system is receiving flow, such as water present in sump. Inspect for nearby erosion and sedimentation that would indicate the incoming flow is overwhelming the system.
- Inspect all structures and weirs for signs of structural deterioration. Check for corroded, spalling, or damaged structural components.

When completing the inspection forms for an SCM, the following should be considered regarding the flow splitter component:
VSI Form

- 1G. Other– should be used to describe debris/trash concerns in a flow splitter.
- 2A. Inflow channel(s) – can be used to describe erosion in or around a flow splitter.

CAI Form

- Section 3 – Types of Inflow: flow splitters should be assessed under the "other" option in the types of inflow portion of Section 3. In the space provided, describe the flow splitter configuration, including the structural components and inflow/outflow mechanisms. The flow splitter should be listed in addition to the other inflow mechanisms leading to the SCM such as pipes.

## 6.5.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCMs information in Maintenance-IQ for potential variations.

**Table 6.5.1: Routine Maintenance for Flow Splitter**

| Frequency | Activity |
|---|---|
| Two times per year | • Remove trash, debris, undesirable vegetation, and/or sediment blocking flow of water into, through and out of flow splitter. For subsurface flow splitters, use a vacuum truck or other appropriate method. For surface flow splitters, refer to forebay section for sediment removal and maintenance procedures.<br>• Remove animal carcasses from vicinity of and within flow splitter. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 6.5.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

# 6.6 Forebay

**Figure 6.6.1: Forebay with Wet Basin beyond**
(photo c/o PennDOT Publication 584, Chapter 14, 2015 ed.)

## 6.6.1 Description and Overview

Forebays are SCM components which slow flow velocities and capture sediment and debris just upstream of SCM inflow points. They are most commonly found in Stormwater Wetlands (SWE), Wet Basins (BWD), Infiltration Basins (BID) and Dry Basins (BDD, BED, BUD, BOT, BND). A properly functioning forebay will increase the lifecycle of the SCM.

Forebays are physically separated from the rest of the SCM by an earthen or rip-rap berm, or concrete or gabion wall. This transition berm or wall is located at the downstream end of the forebay and acts as a weir (refer to Section 6.8 Structures and Appurtenances) to release flow to the main body of the SCM. Side slopes and embankments may incorporate vegetation such as turf grass or larger grasses and shrubs.

Forebays may have a permanent or temporary ponding area, depending on the design of the associated SCM. The bottoms of forebays may be earthen or lined with rock, concrete, or landscaping pavers. Solid bottoms in permanently ponded forebays help to facilitate sediment removal. Variations of forebays may include a flow splitting function (refer to Section 6.5 Flow Splitter) or dewatering riser (refer to Section 6.8 Structures and Appurtenances).

## 6.6.2 Common Elements

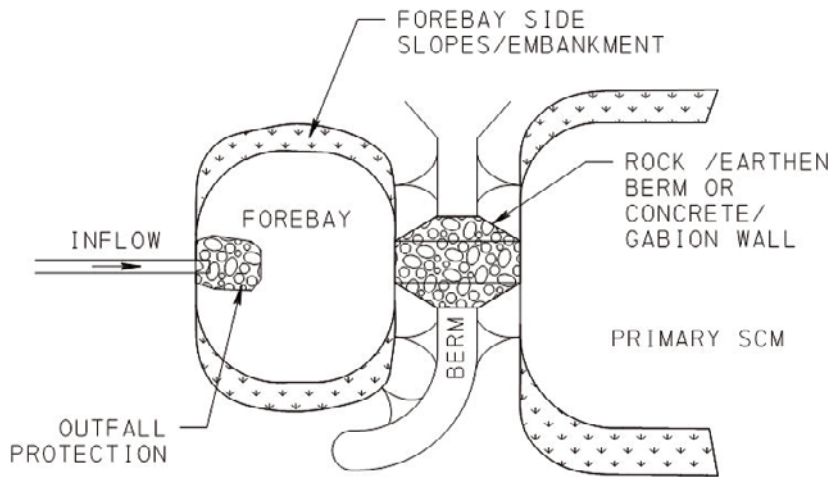
Other common SCM components described in this chapter may be associated with a forebay. Refer to the appropriate section of this chapter for the following components:

- Inflow Systems
- Flow Splitter
- Structures and Appurtenances
- Outfall Protection

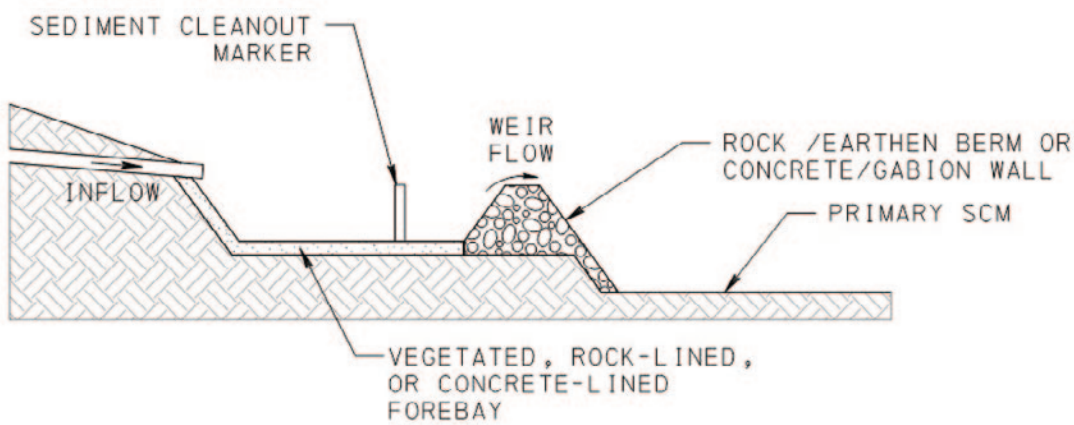
Additionally, other associated elements of typical forebays may include:

- Side slopes/embankment
- Earthen berm or baffle
- Sediment cleanout marker
- Vegetation

Figure 6.6.2 illustrates the common elements of a typical forebay.




**Plan View**




**Section View**

**Figure 6.6.2: Forebay - Common Elements**

## 6.6.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a forebay should focus on its key functional areas. Specifically:

- Inspect forebays for trash, debris, and undesirable vegetation. Vegetation may be present on the side slopes/embankments but is generally not located within the pooling area of solid surface forebays. In earthen forebays, turf and similar low plant growth within the pooling area is acceptable (up to 25% depth of forebay), but if it becomes excessive, removal should be recommended to ensure adequate storage volume and ease of sediment removal.

- Check all embankments/side slopes and transition berm for evidence of erosion and for structural stability.
- Inspect inflow and outflow areas for signs of erosion.
- Determined if sediment removal is needed:
    - Most sediment forebays should have a permanent cleanout marker. Read the marker and note the sediment level compared to the cleanout mark/elevation.
    - If a cleanout marker is not present or damaged, the O&M section of the PCSM plan should have a cleanout level noted for the pretreatment area. If no impermeable liner is present (check PCSM plan), use a soil probe to recover a sample at several locations within the pretreatment area. The sediment depth can be interpreted based on the depth to the base soil from the surface (look for soil type change in texture, grain size, color). Compare the measured depth of sediment to the PCSM plan cleanout depth.
    - In the absence of other information, the sediment should be removed when it is half the depth of the forebay area. Complete a soil probe sample as described above (if no impermeable liner is present) to determine the depth of sediment. The forebay depth should be measured from the invert of the lowest inlet point to the bottom of the forebay (as determined from as-built plans or soil probes).
- If no permanent sediment marker is found in a forebay or plunge pool, make recommendations to add a permanent cleanout marker to aid in maintenance.

## 6.6.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCMs information in Maintenance-IQ for potential variations.

**Table 6.6.1: Routine Maintenance for Forebay**

| Frequency | Activity |
|---|---|
| Two times per year | • Remove undesirable vegetation growth. Remove undesirable or woody vegetation on embankments/side slopes or transition berm before they become well-established. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Mow grassed side slopes of forebay to a height of 5 to 8 inches. Perform mowing operations when forebay is completely dry, preferably using hand operated equipment; do not drive heavy equipment on forebay surface. |
| Annually | • Remove litter, trash, and debris from surface, side slopes, inflow/outflow points, structures and surrounding area. |
| Once every five years or sooner if indicated by cleanout marker | • Remove sediment accumulation in forebay. Perform removal operations when forebay and SCM is completely dry, preferably using vacuum truck; do not drive heavy equipment on earthen and gravel surfaced forebay surfaces. Do not allow heavy equipment or material storage on SCM surface. |
| As needed | • Maintain other applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

### 6.6.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

# 6.7 Flow Control Structures

**Rectangular weirs with side mounted trash rack**

**Circular orifices without trash rack**

**V-notch weir with top mounted trash rack**


**Rectangular weir & circular orifice with trash racks**

**Figure 6.7.1: Flow Control Structures**

## 6.7.1 Description and Overview

Flow control structures, also known as an SCM outlet structures, are an SCM component which restricts flow out of the SCM to a specific design rate. The flow control structure conveys water from the SCM to the downstream drainage system or receiving water. Most SCMs have a flow control structure of some form. Proper maintenance practices on flow control structures will prevent the structure from overtopping or releasing water too quickly.

The most common types of flow control structures are comprised of a concrete box, manhole, or upturned metal pipe structure with a combination of orifices, weirs, and grates that allow flow into the structure, and a pipe carrying flow out of the structure to a downstream drainage system or receiving water (refer to Section 6.8

Structures and Appurtenances). Each orifice, weir, or grate opening is designed to release a different amount of flow to achieve the stormwater requirements for the SCM. In SCMs that are designed to completely dewater, the flow control structure will likely have a low flow orifice or opening that is even with the SCM ground surface elevation. Orifices may be incorporated into the structure by constructing small holes through the concrete box or affixing an orifice plate. An orifice plate is a thin metal or plastic plate with a small hole in it placed over a larger diameter outflow point. Sometimes flow control structures have a sump area below the outlet pipe, which provides storage volume for sediment and debris to settle out of the collected runoff (refer to Section 6.4 Inlet with Sump/Traps).

In its simplest form, a flow control structure commonly associated with infiltrating SCMs, such as Infiltration Basins (BID) and Bioretention (BRE, BRU), can be a standard inlet box/grate installed at a set elevation above the basin bottom. The inlet grate functions as the flow control structure releasing excess stormwater during large storm events while retaining a ponded area for infiltration typically 6 to 18 inches deep.

Other times, where there are weirs/orifices located lower on the structure, the top of the flow control structure may function as an emergency outlet, similar to and in lieu of an Earthen Emergency Spillway (refer to Section 6.9 Earthen Emergency Spillway). Flow control structures are commonly comprised of variations of the components included in Section 6.8 Structures and Appurtenances, such as concrete boxes, metal pipe risers, weirs and trash racks.

Flow control structures associated with subsurface SCMs are typically constructed within a manhole or concrete box. The flow control structure typically includes a series of orifices and weirs built on an internal baffle wall designed to function similar to a surface SCM flow control structure.

## 6.7.2 Common Elements

Several of the common SCM components described in this chapter may be associated with flow control structures. Refer to the appropriate section of this chapter for the following components:

- Inflow Systems
- Inlet with Sump/Traps
- Structures and Appurtenances
- Outfall Protection

Additionally, other associated elements of typical flow control structures may include:

- Grate/cover
- Sump
- Orifices
- Orifice plate
- Pipe
- Steps/ladder

A typical concrete box flow control structure and orifice plate detail can be found in PennDOT Publication 72M, Section RC-71M (Sheet 4, Concrete Outlet Structure).

## 6.7.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of a flow control structure should focus on its key functional areas. Specifically:

- Stormwater should be able to flow freely through all parts of the flow control structure. Inspect for trash, debris, and/or sediment that is blocking or impeding the flow of water into the flow control structure, around weirs, orifices, or grates.
- Check for vegetation that might block flow through the flow control structure.
- Confirm the low flow orifice (if present) is clear without obstructions to flow.
- Inspect for trash, debris, and/or sediment buildup within the riser, concrete box or manhole. If the flow control structure has a sump area, cleanout should be required when the sediment depth exceeds 50% of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin.
- Inspect that the top of weir, orifice, pipe, and bottom elevations are consistent with plans.
- Inspect for erosion and sedimentation that would indicate flow is overwhelming the flow control structure.
- Inspect for signs of structural damage or deterioration including cracks, leaks, corroded, spalling, or damaged structural components. Concrete structures, such as boxes and manholes, shall be checked for holes or cracks greater than 1/2 inch and longer than one foot or other signs of differential settlement. Metal components shall be checked for excessive corrosion. Inspect the ground surface above buried pipes and structures for depressions or other signs pipe or structural damage, deterioration, or joint separation. If there is concern of damage or deterioration of a subsurface feature based on age or surface evidence, consider recommending video inspection or a confined space entry inspection to confirm system functionality.
- Confirm that the outflow points are adequately protected and covered with a trash rack or grate. Inspect for trash and debris buildup on the trash rack/grate.
- Check for evidence of malfunctioning structural components.

When completing the inspection forms with a flow control structure as part of a primary SCM, the following should be considered:
VSI Form

- 1F. Outlet/dewatering structure – refers to the flow control structure
- 2C. Outlet/outfall – is the discharge pipe draining flow from the flow control structure
- 4A. Growth impeding inflow or outflow – should include assessment around the flow control structure

CAI Form

- Flow control structures are assessed in Section 3 – Inflow & Outflow: Principal Spillway/Riser.

## 6.7.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCMs information in Maintenance-IQ for potential variations.

**Table 6.7.1: Routine Maintenance for Flow Control Structures**

| Frequency | Activity |
|---|---|
| Two times per year | • Remove trash, debris, undesirable vegetation, and/or sediment blocking or impeding flow of water in, out, and through flow control structure. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove animal carcasses from vicinity of and within the flow control structure.<br>• Remove obstructions from weirs and orifices. |
| As needed | • Maintain other applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 6.7.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

## 6.8 Structures and Appurtenances

**Metal Riser with Trash Rack and Vortex Plate**
(photo c/o: PADEP E&S Manual)

**Headwall with Trash Rack**
**Figure 6.8.1: Structures and Appurtenances**

## 6.8.1 Description and Overview

The structures and appurtenances described in this section include a combination of different components including headwalls, end sections, concrete boxes, manholes, risers, trash racks, and weirs. While not every one of these components will be present in every SCM, the inspection and maintenance procedures for each are discussed in this section. This information should be applied as applicable to different SCMs.

Headwalls, or endwalls, are typically concrete walls that surround the entry or exit point of a pipe or culvert that help prevent erosion around pipe or culvert installations. Headwalls can be flat vertical walls or can have angular shapes to direct flow into or out of the pipe. Commonly, headwalls will be attached to pipe ends with a form of outfall protection constructed immediately downstream (refer to Section 6.10 Outfall Protection). Headwalls may be fitted with a trash rack as described in this section.

End sections are flared metal or concrete structures typically located on the exit point of a pipe or culvert that help prevent erosion around pipe installations. End sections function similarly to angled headwalls located at a pipe outfall. End sections are frequently installed on pipe ends with a form of outfall protection constructed immediately downstream (refer to Section 6.10 Outfall Protection).

Concrete boxes are rectangular reinforced concrete structures. In SCMs applications, they are most commonly associated with subgrade structures such as inlets (refer to Section 6.3 Inflow Systems) or an inlet with sump/trap (refer to Section 6.4 Inlet Sump/Trap) which are fitted with pipe connections below grade and a slotted metal or plastic grate on the surface. Concrete boxes can also be used as junction boxes combining flows from multiple pipes, points for maintenance access, flow splitters (refer to Section 6.5 Flow Splitter) and Flow Control Structures (refer to Section 6.7 Flow Control Structure). These concrete structures range in size, typically from 2 feet x 4 feet to 10 feet x 10 feet with varying depths from 3 feet to >15 feet. In accordance with PennDOT requirements, access steps should be present when the depth between the finished grade elevation and the interior bottom of the box is greater than 5 feet. A concrete box may include a storage volume, or sump beneath pipe connections or traps over pipe connections (refer to Section 6.4 Inlet with Sump/Traps).

Manholes are cylindrical subgrade concrete structures fitted with pipe connections below grade and fitted with a solid (typically) or grated (occasionally) metal plate on the surface. A manhole's main function in SCMs is to serve as junction or maintenance access point for pipe systems. Manhole diameters range from 4 feet to 12 feet and varying depths from 4 feet to 15 or more feet and typically have steps mounted on the side of the structure to allow access. If a manhole includes a sump or trap, refer to Section 6.4 Inlet Sump/Trap for maintenance procedures.

Pipe Risers are upturned pipe sections located on a pipe inlet. They can be made of metal, plastic or other material and are sometimes perforated. Risers are common appurtenances incorporated into the Flow Control Structure (Section 6.7) for SCMs such as Dry Basins (BDD, BED, BUD, BOT, BND), Wet Basins (BWD), and Stormwater Wetlands (SWE). Metal risers commonly have an open top fitted with a trash rack and may have a vertical plate at the top for vortex prevention.

Trash racks are debris barriers that prevent large materials from entering a closed pipe system to prevent clogging of a pipe or control structure inflow point. Most commonly, a trash rack is a bar grate, typically made of epoxy coated metal reinforcing bar or plastic molded bars fitted over an opening into a pipe or flow control structure. They can also be used to prevent human or animal entry into the system. Trash racks are a common appurtenance of concrete headwalls, metal end sections, metal risers and Section 6.7 Flow Control Structures.

Weirs are a physical barrier that intentionally cause water to pool upstream and release flows over the barrier in a controlled manner. The barrier can be made from metal, concrete, rock, earth, or other material. The crest, or top, of the weir can be flat, or have a rectangular or v-notched shape allowing higher flows to pass more quickly as the pooled elevation increase. Weirs are a common appurtenance of many components of SCMs such as forebays and flow control structures.

The above structures and appurtenances can be standalone components within an SCM or they may be incorporated as parts of other SCM components as listed. Refer to other applicable component sections for more information.

## 6.8.2 Common Elements

Several of the common SCM components described in this chapter may be associated with structures and appurtenances. Refer to the appropriate section of this chapter for the following components:

- Inflow Systems
- Inlet with Sump/Traps
- Flow Control Structure
- Outfall Protection

Additionally, other associated elements of typical structures and appurtenances may include:

- Inlet grate
- Manhole cover
- Concrete joints
- Epoxy-coated reinforcing bars
- Steps

Typical drawings for headwalls/endwalls, end sections, concrete boxes, and manholes can be found in PennDOT Publication 72M Sections RC-31M, RC-33M, RC-46M, and RC-39M, respectively. Metal risers and trash racks are illustrated in PennDOT Publication 72M, Section RC-71M (Sheet 2, Sediment Trap Riser and Trash Rack and Anti-Vortex Device details).

## 6.8.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of structures and appurtenances should focus on its key functional areas. Specifically:

- Inspect for trash, debris, and/or sediment that is blocking or impeding the flow of water through all structures and appurtenances.
- Inspect for signs of structural damage or deterioration of all structures and appurtenances. Concrete structures such as headwalls, concrete boxes, manholes, and weirs shall be checked for cracks greater than 1/2 inch and longer than one foot or other signs of differential settlement. Metal structures such as end sections, risers, trash racks, and weirs shall be checked for corrosion. If there is concern of damage or deterioration of a subsurface feature based on age or surface evidence, consider recommending video inspection or a confined space entry inspection to confirm system functionality.
- Inspect pipe connections to inlets, manholes, concrete headwalls, and end sections for areas of settlement or misalignment.
- Inspect the foundation and subgrade below headwalls and end sections for signs of erosion or undermining of the structure.

- Inspect for presence of trash rack. They should be present on any pipe riser greater than 18 inches in diameter and on smaller orifices/weirs constructed into concrete boxes. Inspect for excessive corrosion (50% or more) and bent (out of shape more than 3 inches) or missing bars on trash racks and protective grates.

When completing the inspection forms for an SCM, the following should be considered regarding structures and appurtenances:
VSI Form

- 1B. Inflow channel(s) – includes assessment of trash racks installed over the inflow point to a pipe.
- 1F. Outlet/dewatering structure – includes assessment of metal riser, headwalls, end sections, and trash rack associated with Flow Control Structures
- 1G. Other (describe) – includes SCM structures other than those associated with inflow, forebays and outlet/dewatering (Flow Control Structures).
- 2A. Inflow channel(s) – includes headwalls and end sections associated with the inflow system
- 2C. Outlet/outfall – includes headwalls and end sections associated with the outflow points
- 5B. Structural damage or deterioration – would be applicable for any structures and appurtenances in this section, including missing features such as trash racks.

CAI Form

- The structures and appurtenances listed in this section should be assessed in the appropriate portion of the CAI form based on their location and function in the SCM.

## 6.8.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCMs information in Maintenance-IQ for potential variations.

**Table 6.8.1: Routine Maintenance for Structures and Appurtenances**

| Frequency | Activity |
|---|---|
| Two times per year | • Remove all trash, debris, and/or sediment blocking or impeding flow of water in, out, and through flow structures. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove animal carcasses from vicinity of and within structures.<br>• Remove vegetation growth which may impede the flow of water. |
| As needed | • Maintain other applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

### 6.8.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

## 6.9 Earthen Emergency Spillway

**Figure 6.9.1: Earthen Emergency Spillway**

### 6.9.1 Description and Overview

An earthen emergency spillway (spillway) is a SCM component found in most surface basin type SCMs. It is an open channel through the SCM side slopes, located at an elevation slightly below the top of main embankment but above the elevation of the primary spillway/flow control structure. The spillway carries occasional to infrequent flows resulting from large storm events or blockage of the primary spillway/flow control structure. Earthen emergency spillways are most commonly found in Infiltration Basins (BID), Stormwater Wetlands (SWE), Wet Basins (BWD), and Dry Basins (BDD, BED, BUD, BOT, BND).

The surface of a spillway is typically grass, turf reinforced matting (TRM), concrete, or riprap. When possible, they are typically constructed by cutting into existing ground as opposed to being constructed through the fill section of an embankment wall. The spillway is comprised of an inlet channel/weir within the SCM and an exit channel that conveys flow beyond the SCM. The inlet channel/weir includes the spillway crest, or level section through the SCM wall. The exit channel is the constructed spillway downstream from the crest. Some spillways include a longer exit channel leading to a downstream discharge point some distance away. Others, particularly those constructed through embankment areas, may include the inlet channel with only a short exit channel that ends just beyond the toe of slope. They are typically constructed approximately 2 feet below the top elevation of the SCM and may be 10 to over 40 feet wide.

## 6.9.2 Common Elements

Other common SCM components described in this chapter may be associated with spillways. Refer to the appropriate section of this chapter for the following components:

- Outfall Protection

Additionally, other associated elements of typical earthen emergency spillways may include:

- Spillway crest
- Side slopes/embankment
- Channel
- Vegetation
- Geotextile
- Riprap or concrete

Typical earthen emergency spillway details can be found in PennDOT Publication 72M, Section RC-71M (Sheets 1-3).

## 6.9.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of an earthen emergency spillway should focus on its key functional areas. Specifically:

- Inspect for trash, debris and undesirable vegetation. In spillways with vegetated surfaces, undesirable vegetation includes invasive species or woody shrubs or trees of any size within the spillway area. Verify grass is maintained between 5 and 8 inches. In spillways with riprap or concrete surfaces, undesirable vegetation includes the presence of any growth.
- Inspect concrete, if present, to ensure it is in good structural condition. Inspect riprap, if present, to ensure adequate amount is present. Rip-rap should be uniform thickness, matching nominal placement thickness per Pub 408 Section 850 with no bare spots.
- Inspect slopes/embankments surrounding area for structural damage or deterioration including signs of uneven settlement and cracking.
- Inspect for signs of erosion and sedimentation, especially where inlet channel meets the base of SCM, exit channel meets toe of embankment, and the spillway weir. Verify the elevation difference between earthen emergency spillway and the embankment is the same as plans and that no excessive settlement has occurred.
- Check that channel and side slopes are structurally sound.

When completing the inspection forms with an emergency spillway as part of a primary SCM, the following should be considered:

VSI Form

- 1G. Other– should include assessment of the emergency spillway
- 5B. Structural damage or deterioration – should include assessment of structural surface linings on Emergency Spillway.

## 6.9.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 6.9.1: Routine Maintenance for Earthen Emergency Spillway**

| Frequency | Activity |
|---|---|
| Two times per year | • Mow grassed side slopes and channel bottom (if grassed) to a height of 5-8 inches.<br>• Remove undesirable vegetation growth. Undesirable growth in grassed spillways includes invasive species, shrubs, or trees. Undesirable growth in rip-rap or concrete spillways is any vegetative growth. Repair disturbed areas with original spillway surface treatment. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist). |
| Annually | • Remove sediment, litter, trash, and debris from channel surface, side slopes, inflow/outflow points, and surrounding area. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 6.9.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

## 6.10 Outfall Protection

**Riprap Apron**

**Plunge Pool**
(photo c/o PADEP Erosion and Sediment Pollution Control Program Manual)
**Figure 6.10.1: Outfall Protection**

## 6.10.1 Description and Overview

Many SCMs have a form of outfall protection to dissipate energy to a non-erosive level at flow discharges into and out of the SCM. Different types of outfall protection such as riprap aprons, plunge pools, or other energy dissipators are chosen based on the required protection. Outfall protection can be seen at any point of concentrated flow at both inflow and outflow points of an SCM. Properly maintained outfall protection ensures stormwater is conveyed without causing erosive damage.

Riprap aprons are typically located at storm sewer system outfalls on mild to flat slopes. Aprons are constructed of large diameter rocks over geotextile liner and fan out from the end of the channel to a certain distance downstream. The size of rock and apron dimensions are a function of flow and pipe/channel size.

Plunge pools, also known as rock basins or stilling basins, are typically located at the outfall of a closed pipe system on a near horizontal grade. They are pre-shaped pools lined with 4- to 12-inch diameter rocks over geotextile. Varieties of designs can include wire gabion baskets, trenches, grouted rock, and specially designed pools or manhole structures.

Other outfall protection is typically used where anticipated velocities exceed the maximum permissible values for riprap aprons and plunge pool. They are features typically located at pipe outfalls constructed with either concrete, rock, turf reinforcement matting or other material. One type known as a concrete energy dissipator typically incorporates a concrete apron with features such as concrete blocks or rocks projecting from the surface to dissipate the flow energy. Turf reinforcement mats (TRM), or transition mats, are permanent geotextiles that are placed on the surface to provide erosion resistance. They generally incorporate a grid of material with open spaces that allow vegetative growth through the material.

## 6.10.2 Common Elements

Several of the common SCM components described in this chapter are associated with outfall protection. Refer to the appropriate section of this chapter for the following components:

- Inflow Systems
- Flow Control Structures
- Structures & Appurtenances
- Earthen Emergency Spillway

Additionally, other associated elements of typical outfall protection may include:

- Pipe outfall
- Riprap, concrete, turf matting
- Vegetation
- Geotextile

Typical drawings for outfall protection can be found in PennDOT Publication 72M Section RC-72M. Riprap aprons are illustrated on Sheets 6 and 7 (Rock Apron-Defined Channel and Rock Apron-Flat Area). Plunge pools are depicted on Sheet 5 (Rock Basin). Energy dissipators are shown on Sheet 5 (Paved Energy Dissipator and Rock Energy Dissipator).

## 6.10.3 Key Inspection Considerations

In addition to the general inspection procedures described in Chapter 3, inspections of outfall protection should focus on its key functional areas. Specifically:

- Inspect for trash, debris, trees and shrubs or unintended vegetation in the outfall protection.
- Inspect riprap, TRM or other hard armor material, if specified on design plans, to ensure adequate amount is present. Riprap should be uniform thickness, matching nominal placement thickness per Pub. 408 Section 850 with no bare spots. Inspect concrete or other structural members, if present, for signs of structural damage or deterioration.
- Inspect for signs of erosion and sedimentation in and around outfall protection, especially where outfall protection meets the adjacent downstream area. If the adjacent downstream area is vegetated, vegetation should be well established at this interface.
- Inspect for sediment accumulation in outfall protection measures as they are not designed to capture sediment. Sediment on top of outfall protection should not exceed 10% of the surface area.
- Inspect for standing water in the plunge pool; water should only be present within 72 hours of the last storm event.

When completing the inspection forms for the primary SCM, the location of the outfall protection feature will dictate where it should be reviewed:

VSI Form

- For outfall protection at inflow points into the SCM, assess it under the inflow portions of the form. For outfall protection located downstream of the SCM, assess it under outlet/outfall portions of the form.
- 1G. Other (describe) – include debris or trash in downstream outfall protection.
- 2C. Outlet/outfall – includes outfall protection installations downstream of the SCM.
- 4C. Non-uniform grass coverage (bare areas) – includes areas within vegetated outfall protections such as TRMs.
- 5B. Structural damage or deterioration – includes damaged or missing riprap, TRM, or concrete in outfall protection.
- 5C. Sediment build-up in or on SCM surface – includes sediment in outlet protection.

CAI Form

- Section 3 – Inflow & Outflow, Inflow: for outfall protection associated with inflow into the SCM.
- Section 3 – Inflow & Outflow, Principal Spillway/Riser – Outfall: for outfall protection associated with outflow from the SCM.

## 6.10.4 Routine Maintenance Procedures

Certain preventative maintenance activities should be performed on regular cycles to maintain functionality and avoid future issues. The following table summarizes the minimum routine activities and the associated frequencies. Occasionally, SCMs with site specific factors may require more frequent or additional routine maintenance activities than those presented below. Refer to the SCM's information in Maintenance-IQ for potential variations.

**Table 6.10.1: Routine Maintenance for Outfall Protection**

| Frequency | Activity |
|---|---|
| Annually | • Remove vegetation growth including grasses, shrubs and trees through riprap areas in plunge pools and riprap aprons. When needed, use herbicide labeled for use in aquatic settings (consult District Roadside Specialist).<br>• Remove sediment, litter, trash, and debris from outfall protection and surrounding area.<br>• Remove animal carcasses from vicinity of and within the outfall protection. |
| As needed | • Maintain applicable common components as described in Chapter 6 at the indicated frequencies. |

All vegetation, trash, debris, liquids, and materials removed from the SCM shall be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment shall be disposed of in accordance with the Department's policy on handling of fill and applicable regulations. See Section 4.5 for more details.

Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

## 6.10.5 Corrective Maintenance Procedures

Corrective maintenance tables are included in Appendix E for use when determining the appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. Users should reference all of the applicable corrective maintenance information presented on the General and Common Component tables (E.1.1 and E.1.2) in addition to the SCM specific tables (E.1.3 through E.1.16).

# CHAPTER 7

# MAINTENANCE SCHEDULING, CHARGING, AND REPORTING

## 7.1 Job Titles Associated with SCM Maintenance

Communicating, planning, executing, and documenting maintenance work on SCMs takes a team. The District Stormwater Maintenance Coordinator (DSMC) is a key team member who ensures the flow of inspection and maintenance activities occurs as required and outline in Figure 7.1.1.

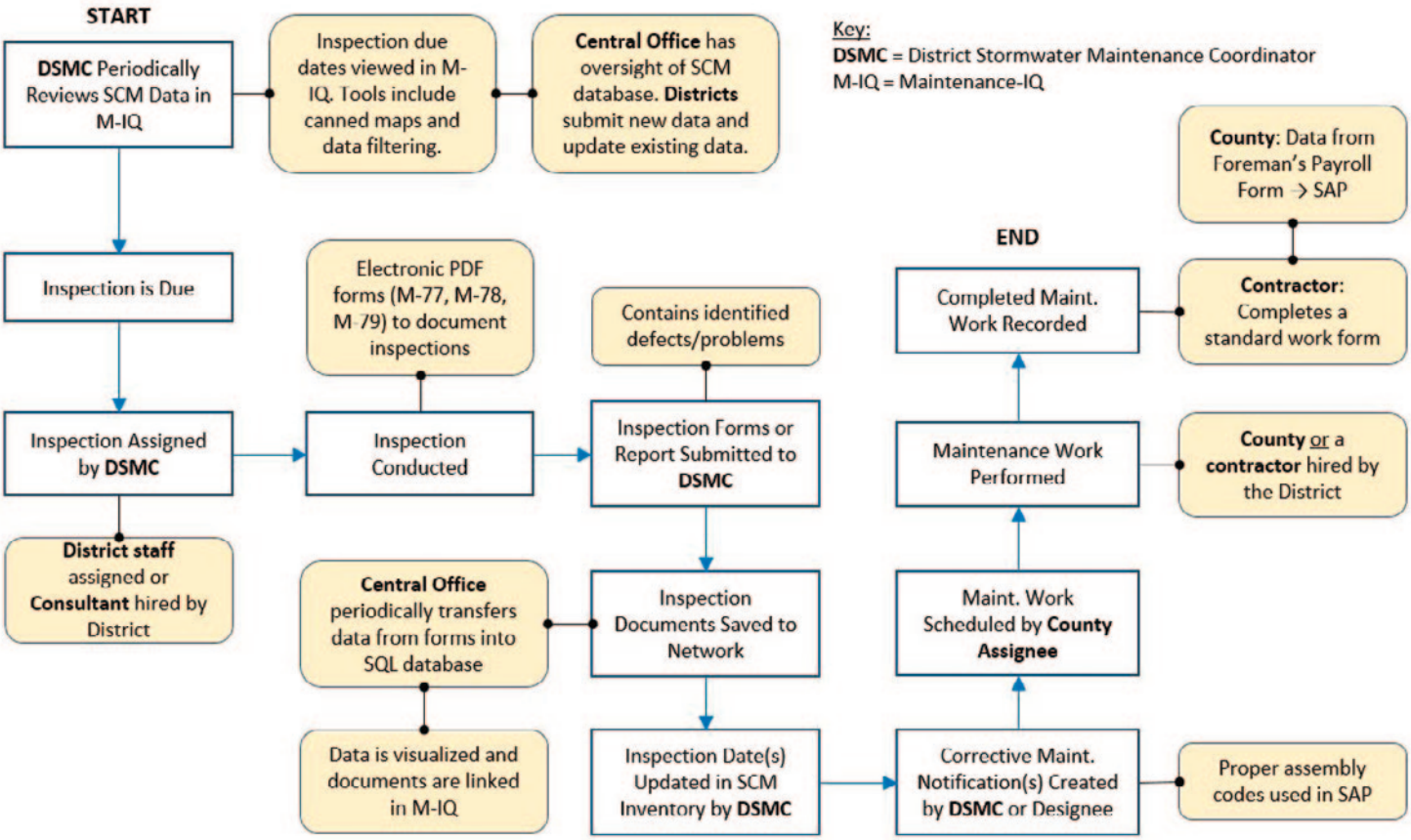



**Figure 7.1.1: PennDOT SCM Inspection and Maintenance Work Flow**

The following is a list of personnel located at District and County offices who contribute to the maintenance processes presented in this Publication, along with brief descriptions of their tasks associated with SCM maintenance.

**County**

Highway Maintenance Manager (HMM)

- Coordinates with the District Stormwater Maintenance Coordinator (DSMC) for generation of a priority list.
- Develops an annual plan of work for the upcoming fiscal year, balancing County resources including personnel, equipment, and materials.

Assistant Highway Maintenance Manager (AHMM)

- Receives notifications from the DSMC (see below) through SAP, and develops work orders for maintenance activities.
- Schedules work for their respective Counties.
- Determines material and equipment needs for maintenance activities and works with Roadway Program Coordinator to procure the necessary resources.
- Supervises the Highway Foremen.

Highway Foreman

- Supervises the Department Forces assigned to the SCM maintenance work.
- Understands SCM Specific maintenance needs.
- Ensures Department Forces utilize appropriate SCM work procedures.

Department Forces

- Understand and adhere to foreman guidance on SCM specific work requirements.
- Performs the SCM maintenance work.

**District Maintenance Unit**

Assistant District Executive for Maintenance (ADE-M, or designee)

Supervises the DSMC (unless assigned to Design Unit).

District Stormwater Maintenance Coordinator (DSMC, may also be in Design Unit)

- Meets with the CMM and the District Environmental Manager or their designee, to program (prioritize, schedule, etc.) SCM maintenance.
- Generates work notifications in SAP.
- Ensures plans and permits are available for scheduled maintenance activities.
- Assists ACMM with coordinating materials and equipment availability for scheduled maintenance activities.
- Reviews the progress and completion of work orders in SAP with ACMM, compared to the recommended corrective activities from inspections.
- Develops repair sketches.

**District Design Unit**

District Environmental Manager (or designee)

- Meets with the DSMC to program SCM maintenance.
- Coordinates the redesign of SCMs, if necessary.
- Prepares and presents Quality Control findings to applicable staff.

## 7.2 Assemblies and Charge Codes

All post-construction work on SCMs is charged to Work Program 711 – General Maintenance. Within this work program are SCM-specific assemblies which comprise the majority of work that is performed on the Department's SCMs. When appropriate, other existing Work Program 711 assemblies in Publication 113 may be used.

Appendix F contains the full descriptions of the SCM assemblies.

For each maintenance activity, the DSMC shall create a notification in SAP by entering the SCM ID in the Notification Description Field and selecting the appropriate 711 assembly number. For maintenance performed by non-county maintenance forces, Districts are asked to work with their Fiscal Officer to create a number for their organization from T-STORMWT9MAN-xxxx-711-2.

Assembly numbers 711-7800-01 and 711-7800-02 are used for SCM visual screening inspections and condition assessment inspections, respectively. For inspections performed by non-county maintenance forces, Districts are asked to work with their Fiscal Officer to create a number for their organization from T-STORMWT9INS-xxxx-711-2.

## 7.3 Creating Work Notifications from Inspection Results

Upon receipt of completed inspection results, designated individuals in each District are responsible for creating notifications for maintenance activities for SCMs in SAP which leads to a work order. The notification activates required maintenance. Normally, the person responsible for the notifications will be the DSMC; however, depending on the organizational structure in the District, it may be a designee of the ADE-M or District Environmental Manager.

**SAP/Plant Maintenance**

SAP is a business-solutions software company that has developed several software modules used by PennDOT for various services, including a module called “Plant Maintenance” used for managing certain components of the SCM maintenance process. SAP/Plant Maintenance (SAP) is the second of two digital tools for managing SCM maintenance programs across the state, the first being Maintenance-IQ, discussed in previous chapters.

**Maintenance Work Order**

The use of Department forces for SCM maintenance begins with a complete work order. Work orders describe and enumerate the personnel to work on a given project, the equipment to be used or procured, and the materials to be used or procured. Work orders are prepared by ACMMs and are based upon notifications generated by the DSMC through SAP.

**Creating a Notification**

The foundation of a work order is a notification that appears in SAP. Notifications are initiated directly in SAP by the DSMC (or designee). An IW24 screen is used to initiate a notification, while an IW23 screen may be used to display the notification. The IW22 screen is the screen used to change a notification, including adding information for routine operations such as SCM mowing. It is also from the IW22 screen that a work order is created. Maintenance-IQ and SAP use different identifiers for SCMs. Maintenance-IQ uses the SCM ID, while SAP uses the SCM’s Segment/Offset as its identifier, which appears on the RI tab of the IW22 screen. The SCM ID must be entered into the Notification Description Field in SAP to link various work to the appropriate SCM.

**Developing a Work Order**

Typically, the ACMM receives the notification in SAP and subsequently converts the SAP notification to an SAP work order by clicking on the appropriate button in the IW22 screen, creating an IW32 screen and allowing time and materials charges by the County. This screen allows changes to be made and ultimately produces a complete work order. The IW32 screen has pull-down menus to close a work order.

**Recording Work and Technically Complete in SAP**

As work is completed, the Highway Foreman submits e-payroll. When a job is complete, the Highway Foreman informs the ACMM who then closes the work order to additional payroll charges. This places the work order in Technically Complete status.

# REFERENCES

Anne Arundel County Maryland (2012). Regenerative Step Pool Storm Conveyance (SPSC), Design Guidelines, Revision 5a, December 2012, Anne Arundel County Government Department of Public Works, Bureau of Engineering, Annapolis, MD.

City of Battle Ground (2014). Stormwater Facility Maintenance Manual, BG02.01, May 2014, Public Works Department, Engineering Division, Battle Ground, WA.

Clark County (2016). Clark County Stormwater Manual: Book 4 – Stormwater Facility Operations and Maintenance, September 2016, Clark County, Washington.

Delaware Division of Natural Resources (DNREC), Division of Watershed Stewardship (2016). 3.06.2 Post Construction Stormwater BMP Standards and Specifications, April 2016, Dover, Delaware.

New York State Department of Transportation Region 8 (2003). Stormwater Facilities Operations & Maintenance Manual, September 2003.

North Carolina Department of Transportation (NCDOT) (2015). Stormwater Control Inspection and Maintenance Manual, NCDOT HSP-2010-01, May 2015, North Carolina Department of Transportation, Raleigh, NC.

Pennsylvania Department of Conservation and Natural Recourses (DCNR), “Invasive Plants in Pennsylvania.” DCNR, http://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx (January 23, 2017).

Pennsylvania Department of Environmental Protection (2012). Erosion and Sediment Pollution Control Program Manual, PADEP 363-2134-008, March 2012.

Pennsylvania Department of Environmental Protection (2004). Pennsylvania Field Guide Common Invasive Plants in Riparian Areas, May 2004.

Pennsylvania Department of Environmental Protection (2006). Pennsylvania Stormwater Best Management Practices Manual, PADEP 363-0300-002, December 30, 2006.

Pennsylvania Department of Transportation (2015). Drainage Manual, Publication 584, March 2015.

Pennsylvania Department of Transportation (2017). Design Manual Part 2, Highway Design, Publication 13M, Change No. 2, August 2017.

Pennsylvania Department of Transportation (2018). Highway Foreman’s Manual, Publication 113, July 2018.

Pennsylvania Department of Transportation (2010). Standards for Roadway Construction, Publication 72M, June 2010.

Pennsylvania Department of Transportation (2012). Waste Site Evaluation Procedures Handbook Volume I, Publication 281, December 2012.

Pennsylvania Department of Transportation (2014). Invasive Species Best Management Practices, Publication 756, April 2014.

Pennsylvania Department of Transportation (2013). Maintenance Manual, Publication 23, July 2013.

Philadelphia Water Department (2016). Green Stormwater Infrastructure Maintenance Manual, V2.0 September 2016, City of Philadelphia, PA.

Philadelphia Water Department (2015). Stormwater Management Guidance Manual, V3.0 July 2016, City of Philadelphia, PA.

Philadelphia Water Department (2014). Stormwater Management Practice Operation & Maintenance Manual, November 2014, City of Philadelphia, PA.

Philadelphia Water Department. Stormwater Retrofit Guidance Manual, < http://www.phila.gov/water/PDF/SWRetroManual.pdf> City of Philadelphia, PA, accessed October 30, 2017.

United States Environmental Protection Agency (2016). Operation and Maintenance of Green Infrastructure Receiving Runoff from Roads and Parking Lots Technical Memorandum, September 2016.

United States Environmental Protection Agency (2009). Wet Pond and Wetland Management Guidebook, EPA 833-b-09-001, February 2009.

Washington State Department of Transportation (WSDOT) (2016). WSDOT Highway Runoff Manual, M31-16.04, February 2016, WSDOT Engineering and Regional Operations Development Division, Design Office.

West Virginia Department of Environmental Protection (WVDEP) (2012). West Virginia Stormwater Management and Design Guidance Manual: Chapter 4.2.7. Regenerative Stormwater Conveyance System (RSC). November 2012, Center for Watershed Protection, Inc.

# APPENDIX A

# INVENTORY DATABASE FIELDS

For new construction projects, refer to the instructions in the SCM_INVENTORY_TEMPLATE (xlxs) to complete inventory fields. See Section 2.3 for more details on the template and its location.

**Table A.1: Field/Attribute Descriptions – Location Information**

| Field | Field Code | Description | Comments/Data Source |
|---|---|---|---|
| A | SCM_ID | 10-digit unique identifier assigned by BOMO | [4-digit District-County code] [3-digit SCM code] [3-digit sequential #]. Example: 1110 BRE 042. |
| B | SCM_TYPE_CODE | 3-digit code, see Table 2.1.2 | The type is based on the function of the SCM. |
| C | LATITUDE | Degrees north of Equator, 4-5 decimal places | Decimal degree notation. Approximate centroid of SCM. |
| D | LONGITUDE | Degrees west of Prime Meridian (negative), 4-5 decimal places | Decimal degree notation. Approximate centroid of SCM. |
| E | DISTRICT_NO | 01-12 | PennDOT District in which SCM is located. |
| F | COUNTY_NAME | e.g., York, see Table 2.1.1 | County in which SCM is located. |
| G | ST_RT_NO | 4-digit state route number | SR in which SCM is located. If between more than one, use nearest adjacent SR. |
| H | SECTION | 3-digit section, project-specific, if applicable | Assigned for duration of project design and construction. Normally found on plans. |

**Table A.2: Field/Attribute Descriptions – Receiving Watershed**

| Field | Field Code | Description | Comments/Data Source |
|---|---|---|---|
| I | DISCHARGE_DEST_CODE | e.g., Perennial Stream, Wetland, see List C Table A.7 | Indicates the nearest downstream feature from the SCM discharge. |
| J | DISCHARGE_DEST_NAME | e.g., UNT to Susquehanna River | In NPDES permit and/or PCSM Plan. |
| K | CH_93_DESIG_USE_1 | CWF, WWF, TSF | eMapPA |
| L | CH_93_DESIG_USE_2 | HQ, EV, HQ-MF, MF, N/A | eMapPA |
| M | IMPAIRMENT_303D_LIST | N/A, sediment, nutrients, sediment and nutrients, other | Integrated Water Quality Report 2014 eMapPA |
| N | TMDL_PLAN_W_PDT_LA | yes or no | TMDL Plan with load allocations for PennDOT |
| O | NHD_REACH_CODE | 14-digit National Hydraulic Dataset code | Distinct stream segments/waterbodies; first 8 digits are the HUC; last 6 digits sequential numbers. eMapPA |

**Table A.3: Field/Attribute Descriptions – Project and Permit Information**

| Field | Field Code | Description | Comments/Data Source |
|---|---|---|---|
| P | ECMS_PROJECT_ NUMBER | N/A or 5-6 digit number | Ties SCM to PennDOT project. |
| Q | NPDES_PERMIT_ NUMBER | N/A or number | Ties SCM to correct permit. |
| R | YEAR_CONSTRUCTED | yyyy | Year SCM construction was completed. If unknown, use NPDES NOT date. |

**Table A.4: Field/Attribute Descriptions – Design and PRP Information**

| Field | Field Code | Description | Comments/Data Source |
|---|---|---|---|
| S | USED_FOR_PRP_ TMDL_CREDIT | yes or no | Repository for PennDOT PRP/TMDL information is not yet available. |
| T | PRP_TMDL_NAME_1 | e.g., Paxton Creek PRP | Name of applicable primary Pollution Reduction Plan (PRP) or Total Maximum Daily Load (TMDL). |
| U | PRP_TMDL_NAME_2 | e.g., Chesapeake Bay TMDL | Name of applicable secondary PRP or TMDL. |
| V | SURFACE_AREA_ SQ_FT | Integer (0 decimal places), $ft^2$ | For infiltration SCMs, surface area measured at permanent storage elevation. For all other SCMs, measured at principal spillway/outlet elevation. |
| W | DA_TREATED_ TOTAL_ACRES | 2-3 decimal places, ac | Estimated total land surface area draining to the SCM; from PCSM Plan or report. |
| X | DA_TREATED_ IMPERVIOUS_ACRES | 2-3 decimal places, ac | Estimated impervious surface area draining to SCM; from PCSM Plan or report. |
| Y | PRETREATMENT | e.g., Forebay, see List D Table A.8 | Pre-treatment feature (in between runoff source and SCM); from PCSM Plan or report. |

**Table A.5: Field/Attribute Descriptions – Access and Owner Information**

| Field | Field Code | Description | Comments/Data Source |
|---|---|---|---|
| Z | MARKED_WITH_ DELINEATOR | yes or no | Repository for PennDOT PRP/TMDL information is not yet available. |
| AA | TYPE_OF_ACCESS_ CODE | e.g., pull-off, removable barrier, see List E Table A.9 | Useful for locating and accessing SCM. |
| AB | TYPE_OF_ACCESS_ NAME | e.g., parking lot = PAL see List E Table A.9 | Desktop review must be field verified. |
| AC | LEGAL_OWNER_ CODE | e.g., PDT = PennDOT see List F Table A.10 | Based on Legal Owner Name. |
| AD | LEGAL_OWNER_ NAME | e.g., Carlisle Borough see List F Table A.10 | Normally PennDOT if within R/W; should document even if non-PennDOT ownership. |

**Table A.6: Field/Attribute Descriptions – Inspection and Maintenance Information**

| Field | Field Code | Description | Comments/Data Source |
|---|---|---|---|
| AE | MAINTENANCE_ AGREEMENT | yes or no | Written agreement in place for other party to maintain the SCM. |
| AF | INSP_FREQ_PCSMP_1 | None specified, 0.33, 0.50, 1, 2, 3, 4, Other | If available, number of regular inspections required per year (e.g., 4 = four inspections per year, 0.33 = inspection every three years). |
| AG | INSP_FREQ_PCSMP_2 | N/A; All runoff events; Significant rainfall events; 0.5”, 1.0”, 2.0” rainfall; 1-yr, 2-yr storm; Other | If available, rainfall-triggered inspection requirement (e.g., any runoff event, 2" storm). |
| AH | SCM_DESCRIPTION | Typically SCM Name from Plan (e.g., Basin No. 1) | Pertinent information not described in other data fields. |
| AI | INSP_PHASE | Start-up, Normal | Indicate if the inspection is in start-up phase or normal cycle. |
| AJ | INSP_FREQ_CURRENT | NA, 0.33, 0.50, 1, 2, 3, 4, Other | Number of regular inspection required per year (e.g., 0.33 = inspection every 3 years). |
| AK | INSP_LAST_DATE | yyyy-mm-dd | Date of the last inspection. |
| AL | INSP_LAST_TYPE | VSI, CAI, None completed, Other | The type of inspection performed last. |
| AM | INSP_NEXT_TYPE | VSI, CAI, Start-up | The type of the next inspection based on the previous inspection in conjunction with the inspection phase and frequency. |
| AN | M80_APPROVE_DATE | yyyy-mm-dd | Date of Form M80 acceptance by BOMO. |
| AO | INSP_FREQ_NOTES | Clarify current inspection frequency (if needed) | If current inspection frequency is different than the available options, explain. |

**Table A.7: Discharge Destination Options (List C)**

| Type | Code | Example |
|---|---|---|
| Another SCM | SCM | Vegetated swale |
| Groundwater Injection | GRI | Dry well |
| Karst Outcrop | KAO | Sinkhole |
| No Defined Channel | NDC | Rock slope |
| Pond or Lake | POL | Conneaut Lake |
| Quarry | QUA | Pennsy Supply |
| Reservoir – water supply | QUA | Kettle Crk Reservoir |
| Sheet Flow | SHF | Unconcentrated |
| Storm Sewer, Combined | SSC | City of Phila. CSS |

| Type | Code | Example |
|---|---|---|
| Storm Sewer, Other | SSO | Under local road |
| Storm Sewer, PDT | SSP | Under state road |
| Stream, Ephemeral | SEP | UNT to Mud Creek |
| Stream, Intermittent | SIN | UNT to Clay Creek |
| Stream, Perennial | SPE | UNT to Susq. River |
| Swale or Ditch | SOD | Roadside swale |
| Vernal Pool | VEP | Temporary pond |
| Wetland | WET | Isolated wetland |
| | | |

**Table A.8: Pre-Treatment Options (List D)**

| Type | Code | Type | Code |
|---|---|---|---|
| Forebay | FBY | SCMs in Series | SER |
| Inlet Sump | SUM | Vegetated Bench | VBE |
| Manufactured Treatment Device | MTD | Vegetated Filter Strip | VFS |
| None | NON | Vegetated Swale | VSW |
| Other | OTH | | |

**Table A.9: Access to SCM Options (List E)**

| Type | Code | Type | Code |
|---|---|---|---|
| Dedicated access road | DAR | Parking lot | PAL |
| Designated pull-off | DPO | Removable guide rail | RGR |
| Local road | LOR | Shoulder pull-off | SPO |
| None, park and walk | NON | | |

**Table A.10: Legal Owner Options (List F)**

| Type | Code | Type | Code |
|---|---|---|---|
| Business | BUS | Non-Governmental Organization | NGO |
| Commonwealth of PA | COP | Other | OTH |
| Conservation District | COD | PA Turnpike | PTC |
| Federal Government | FED | PennDOT | PDT |
| Homeowners Assoc. | HOA | Private | PRI |
| Municipal Authority | MUA | Private Utility | PRU |
| Municipality | MUN | Public Utility | PUU |

# APPENDIX B

# VISUAL SCREENING INSPECTION FORM INSTRUCTIONS

Form M-77 is completed to document a visual screening of a stormwater control measure (SCM). Refer to Section 3.2 for the SCM types that require a visual screening inspection (VSI). The form must be completed electronically and initialed by the inspector before submission. These instructions provide additional guidance on properly completing Form M-77. Reference required training course materials for additional procedures.

## B.1 Problem Categories

Form M-77 is split into five problem categories that may be encountered during a VSI, as listed in Table B.1.1. Each category is further divided into specific problem types and areas of interest (location/type column labeled with a letter) to help guide the screening process. Each primary category has subcategories that are explained in the following sections. The combination of the primary category number and specific location/type letter is used to reference specific problems by a number/letter format. For example, 1c refers to trash/debris on the side slopes of the SCM. Some problems may not apply to all SCMs. Refer to Chapter 5 for specific SCM applicability.

**Table B.1.1: VSI Problem Categories**

| Category Code | Type | Description |
|---|---|---|
| 1 | Debris/Trash | Trash, litter, or discarded materials (non-hazardous, natural or synthetic) that have accumulated in the SCM. |
| 2 | Erosion | Undesirable soil loss from wind or water flow; typically associated with lack of vegetation. |
| 3 | Ponding | Pools of standing water within SCM, which may or may not be by design, depending on SCM function and time since last rainfall that produced runoff. |
| 4 | Vegetation | Types and/or lack of plant coverage around and within the SCM. |
| 5 | Miscellaneous | Items that do not fit under the first four categories, such as damage to or deterioration of structures or sediment build-up within the SCM. |

### Category 1: Debris and Trash

Trash and debris, both natural (e.g., plant debris) and synthetic, can accumulate in SCMs from inflows or unauthorized dumping, and may prevent the SCM from functioning properly. Small amounts of debris and trash are not an immediate concern and can be handled with routine maintenance. Excessive accumulation to the degree that it threatens to block inflows or outflows should be addressed sooner. The SCM should be screened for the type, amount, and location of the material, as detailed in Table B.1.2.

**Table B.1.2: VSI Debris and Trash Problems**

| Code | Location/Type | Notes |
|---|---|---|
| A | Anti-skid material | Accumulation of anti-skid from winter maintenance can alter drainage patterns or reduce storage capacity. Look for excessive build up within and/or around SCM. |
| B | Inflow channel(s) | Debris blocking inflow points can prevent runoff from reaching the SCM. Note the degree to which flow is restricted. |
| C | Side slopes | Debris on slopes can be washed to the flow control structure, potentially blocking outflow. Note location, type, and quantity of trash or debris. |
| D | Sediment forebay or micropool | Accumulation could reduce pre-treatment storage capacity and block outflow to rest of SCM. Note location, type, and quantity of trash or debris. |
| E | SCM floor/surface or within SCM | Accumulation could reduce storage capacity, alter performance, or block outflow. Note location, type, and quantity of trash or debris. |
| F | Outlet or dewatering structure | Debris accumulating on a flow control structure can block outflow. |
| G* | Other (describe) | Any other location or excessive debris/trash accumulations. |

*A comment/description is required on the form. See Section B.3.

## Category 2: Erosion

Erosion can indicate the SCM is experiencing higher flow rates than anticipated, energy reduction measures are needed, or permanent stabilization methods are insufficient. Rills - small erosion channels no more than a few inches deep - that form on a vegetated slope are an early indicator of a significant erosion problem. Depending on severity, addressing observed rills and gullies (deeper and wider than rills) on slopes may need to occur before the next routine maintenance is scheduled. Other areas with observed erosion and where erosive conditions exist (e.g., concentrated flow) may need to be handled as corrective maintenance. Small tire ruts and other types of minor, localized erosion can be handled in the regular maintenance cycle. If erosion is present as detailed in Table B.1.3, measure or estimate the approximate depth, width, and length of any such erosion channels.

**Table B.1.3: VSI Erosion Problems**

| Code | Location/Type | Notes |
|---|---|---|
| A | Inflow channel(s) | Look for erosion forming in the channel or at other inflow points. Measure the extent of erosion. |
| B | SCM bottom or side slopes | Look for erosion on slopes or a channel forming on SCM bottom. Measure the extent of erosion. |
| C | Outlet/outfall | Erosion at spillway and outfall areas can affect the quality of SCM discharge. Measure the extent of erosion if possible. |
| D | Emergency spillway | Look for erosion, displaced rip-rap, and other signs that may indicate water not flowing evenly over the emergency spillway. |

## Category 3: Ponding

Water ponding within an SCM that is not designed to retain water can indicate one or more SCM components is not working properly. SCMs that are not designed to retain water should completely drain (dry cycle) within three days of the last rainfall. An SCM designed to dry cycle, but fails to do so, requires corrective action. The effectiveness of a wet basin, on the other hand, depends on its ability to maintain a permanent pool of water. Similarly, a stormwater wetland requires a continuous source of water to remain wet. SCMs should be inspected for the ponding-related problems in Table B.1.4.

**Table B.1.4: VSI Ponding Problems**

| Code | Location/Type | Notes |
|---|---|---|
| A | Standing water | Determine if a ponding condition is appropriate for the SCM type. Look for evidence of persistent standing water, such as scum or algae formation, and measure the depth. |
| B | Subsurface storage not draining | Utilize observation wells or cleanouts to determine water levels within subsurface SCMs. Note if there are none or they cannot be accessed. |
| C | Permanent pool water level very low or dry | Determine if permanent pool is appropriate for SCM type. If possible, measure pool depth and depth from outlet orifice to the water surface. |
| D* | Other signs of poor drainage (describe) | Any evidence of persistent standing water that does not fit in above categories. Evidence of mosquitoes is one example. |

*A comment/description is required on the form. See Section B.3.

## Category 4: Vegetation

Vegetation can play a very important role in the performance of an SCM. Depending on the SCM type, vegetation can either enhance or hinder its performance. Vegetative cover in the form of grass, trees, or shrubs may be necessary to prevent soil loss, maintain structural integrity, or enhance pollutant removal. Undesirable vegetation, such as invasive species or hydrophytic vegetation, can be a problem for an SCM. Visually inspect all areas of the SCM for potential vegetation problems as detailed in Table B.1.5.

**Table B.1.5: VSI Vegetation Problems**

| Code | Location/Type | Notes |
|---|---|---|
| A | Growth impeding inflow or outflow | Look for vegetation that has grown to restrict flow paths at inflow or outflow points. Note extent to which flow is inhibited. |
| B | Significant plant mortality | Look for large brown or bare spots in grass areas, and evidence of diseased or dead shrubs and trees. |
| C | Non-uniform grass coverage (bare areas) | At least 70% vegetative cover is essential for preventing erosion. Rate grass coverage based on estimated dense grass growth. |
| D | Woody vegetation in embankment | Look for trees or shrubs growing on the embankment of the SCM, which can lead to embankment failure. |
| E | Presence of hydrophytic vegetation | Vegetation that thrives in a wet environment is appropriate for BWD and SWE types, but may indicate undesirable conditions in others. |
| F | Vegetation impeding access to SCM | Describe type and location of vegetation impeding access, and which areas of the SCM that cannot be accessed. |

### Category 5: Miscellaneous

Other potential problems that do not fit under the first four categories are noted in Table B.1.6. One example is when temporary erosion and sediment pollution control (ESPC) control measures are not removed in accordance with the ESPC Plan. These items can be removed during routine maintenance.

An example of an item that may need to be addressed immediately is detection of contaminants. Illicit discharges (see Publication 23, Section 8.9), spills, and waste disposal in the SCM require corrective action. The action depends on the contaminant, quantity, and other factors. Pet waste and non-toxic materials and liquids can generally be addressed during routine maintenance.

**Table B.1.6: VSI Miscellaneous Problems**

| Code | Location/Type | Notes |
|---|---|---|
| A | Temporary ESPC measures present | Temporary ESPC measures were not removed following construction. Presence may be inhibiting SCM function. |
| B | Structural damage or deterioration | Damage or deterioration of a structural element of the SCM is visible. Examples are concrete spalling or cracking; metal corrosion or flaking. |
| C | Sediment build-up in or on SCM surface | Sediment accumulation can reduce storage, clog SCM components, and reduce SCM performance. Measure the depth of sediment accumulation. |
| D | Signs of ground compaction/settlement | Tire ruts and pockets of water are signs of potential compaction or settlement. Note location and potential impact to SCM function. |
| E* | Evidence of sinkhole activity | Depressions or “potholes” can be a sign of a sinkhole forming. Suspected sinkhole activity should be marked with an action level of 5. |
| F | Contamination (e.g. gas, oil, pet waste) | Identify the contaminant and source, if possible. Seriousness depends on quantity and whether the source can easily be identified and eliminated. |
| G | Evidence of burrowing animals | Note any burrow-size holes in the SCM. Holes in embankments may compromise stability and require urgent corrective action. |
| H* | Other (describe) | Anything that does not fall into the other categories but requires action. |

*A comment/description is required on the form. See Section B.3.

## B.2 Assigning Actions to Problems

For each of the items listed in the five problem categories, the inspector must determine whether a problem was observed during the inspection. This is indicated in the “Problem?” column with either a “Y” or “N”. If an item is not applicable to the SCM being inspected, a “N” is entered on the form.

For any “Y”, the appropriate response is indicated on the form with an action code. (Note: When a “N” is entered, no entry should be made in the action box of that row). The action levels consist of a rating scale from 0 to 5, as shown in Table B.2.1. All corrective maintenance items are important, but some problems pose a greater risk of SCM failure if not corrected in a timely manner. A problem rating of 5 requires further evaluation by a licensed professional to determine the appropriate maintenance response.

**Table B.2.1: VSI Problem Action Codes**

| Level | Action for Problem | Description | Action Timeframe |
|---|---|---|---|
| 0 | No Action | Minor problem that needs no action at present time. Comment required to describe situation. | Not applicable |
| 1 | Routine | Regularly scheduled maintenance activities will address problem. | Per maintenance cycle/schedule |
| 2* | Corrective | Routine maintenance will not address problem, but problem does not pose significant risk if corrected within timeframe. | Within 6 months |
| 3* | Corrective | Problem poses significant risk if not corrected within timeframe. | Within 4 weeks |
| 4* | Emergency | Problem poses serious risk of failure or impact on public health/safety if not corrected within timeframe. | Immediate response |
| 5* | Environmental/ Engineering Evaluation | Required for problems that are unclear as to what other level they may fall into or may not be corrected through routine or corrective maintenance. Comment required to detail situation. | Determined by licensed professional |

*Photos are required to document the issue. See Section B.3.

## B.3 Comments and Photographs

Comments and photographs are an important part of documenting an inspection. The comment line is used to explain any findings or relevant information the inspector deems appropriate. Comments are required for issues ranked as:

- Level 0 - No action for identified issue
- Level 5 - Environmental/engineering evaluation by a licensed professional

Comments must have enough detail so that the potential problems can be accurately assessed upon review. If more space is needed for comments, use the comment section at the bottom of the inspection form. Be sure to clearly associate the comments in the additional comment area with the category and problem type by referencing the correct number/letter code.

Photographs are required to document the severity of the problem when an inspector identifies a problem requiring an action level of 2 or greater. Form M-78 (SCM Inspection Photographs Template) should be used to organize the photos that best illustrate the problems encountered during the inspection. Additional guidance on SCM inspection photographs is in Section 3.6.

# APPENDIX C

# CONDITION ASSESSMENT INSPECTION FORM INSTRUCTIONS

Form M-79 is used to document a condition assessment of an SCM. Refer to Section 3.2 for the SCM types that require a CAI. The form must be completed electronically as part of the condition assessment package. Reference required training course materials for additional procedures.

## C.1 Completing Form M-79

All CAIs are conducted using Form M-79 as a guide and a means to document findings in the field. Throughout the inspection process, any observed deviation from the as-built plan should be noted. Each section of the form must be completed; however, not all parts of the form apply to all SCMs. Where appropriate, enter a comment in the appropriate section's comment box indicating it is not applicable. Refer to Chapter 5 for specific SCM applicability.

The electronic Form M-79 allows multiple items to be checked where appropriate and limits selection to a single item where multiple items are not permitted. Dropdown menus are included throughout the form to display options. Whenever "other" is selected from the list of options, a written comment should be provided in the comment section. Throughout the form, a recurring severity rating dropdown menu is used with the same four choices to denote the presence and severity of a specific condition. The rating and associated description for each of the four choices is presented in Table C.1.1.

**Table C.1.1: Condition Presence/Absence Rating**

| Rating | Description |
|---|---|
| None | Issue or concern is not present. Continue routine maintenance. |
| Minor | Issue or concern is present, but is not impacting SCM functionality. Routine maintenance is required within 6 months. |
| Major | Issue or concern is present and poses significant risk of impacting SCM functionality. Corrective maintenance is required within 4 weeks. |
| Severe | Issue or concern is present and affecting SCM functionality. Immediate corrective action or rehabilitation is required. |

## C.2 CAI Form Sections

Form M-79 contains an inspection information area and five main sections:

1. Background Information
2. Site Data
3. Inflow and Outflow
4. Treatment Performance
5. Side Slopes and Embankment

Completing each of these sections is necessary to develop an overall performance rating for the SCM. Descriptions of each of the five sections follows. Determining the overall performance rating is explained in Section C.4.

## Inspection Information

At the top of the first page of the form are fields for entering general information regarding the SCM inspection, including the SCM ID, names of inspectors, etc. The SCM ID is the ten-digit, alphanumeric SCM identifier used to track the SCM in Maintenance-IQ. The first and last name of each inspector should be listed. A dropdown list provides the following certification options: PE, PG, PLS, PLA, PSS, Other, None. If other is selected, the certification must be written in the space provided. An example of "other" would be CPESC.

The recent rainfall timeframe should be indicated along with the data source. Because the most accurate rainfall information sources will vary based on the SCM location across the state, no single source is cited. Two suggestions include:

- National Weather Service/National Oceanic and Atmospheric Administration website offers past weather information for select PA locations: link (click on "past weather" tab).
- Weather Underground offers past weather data listed by local/small/closest airport to a specified zip code: link.

## Section 1 – Background Information

This section includes general SCM data and drainage area characteristics. Much of information in this section can be obtained from computer sources (e.g., Maintenance-IQ, as-built plan) before going into the field.

### General SCM Data

The first dropdown list in this section is SCM types, sorted by SCM Name and Type Code. Select the type of SCM based on the SCM_ID. If there is a discrepancy between the SCM_ID and the actual SCM type based on the inspection findings, complete the form based on the field confirmed SCM type. Notify the designated DSMC of the discrepancy.

The year constructed can be viewed in Maintenance-IQ.

The SCM owner will be PennDOT, but the SCM inventory contains other options shown in Table C.2.1. Some Districts may wish to store information in the database on SCMs constructed as part of a Department project, but were turned over to another party. The SCM owner and individual/entity required to maintain the SCM are not always the same. In most cases, the Department will both own and maintain the SCM. However, in some cases a municipality or private entity may agree to take ownership and/or assume maintenance responsibilities. For example, an SCM may be constructed in the right-of-way as part of a roadway project, but the Department and a municipality may enter into an agreement that establishes the municipality as the party responsible for long-term operation and maintenance of the SCM.

**Table C.2.1: SCM Owner Types**

| Owner Type | Abbreviation |
|---|---|
| Business | BUS |
| Commonwealth of PA | COP |
| Conservation District | COD |
| Federal Government | FED |
| Homeowners Assoc. | HOA |
| Municipal Authority | MUA |
| Municipality | MUN |
| Non-Governmental Organization | NGO |
| Other | OTH |
| PA Turnpike | PTC |
| PennDOT | PDT |
| Private | PRI |
| Private Utility | PRU |
| Public Utility | PUU |

A key role of the CAI is to confirm that the SCM matches the as-built PCSM Plan. Indicate if the as-built plan is available (see Section 3.5). If an as-built plan cannot be located, the information collected during the initial CAI must include detailed sketches.

Location

Maintenance-IQ includes the SCM latitude, longitude, municipality, county, and state route. This information should be confirmed using available online sources such as eMapPA.

The segment and offset is automatically generated in Maintenance-IQ based on the SCM's coordinates. It should also be confirmed using standard PennDOT references and methods such as straight line diagrams or VideoLog.

Past Inspection Data

If this is not the first inspection of the SCM, the last inspection date and type should be available in Maintenance-IQ. The CAI rating and maintenance recommendations from the last inspection can be found in the applicable inspection form or report. Electronic files of past inspections are stored in a central location, which is explained in Section 3.8.

Drainage Area Characteristics

This section should be completed prior to the inspection and confirmed during the inspection. The PCSM Plan and available digital information should be used to determine the required information. The design drainage area, impervious area, and number of contributing inlets to the SCM should be determined using the PSCM Plan. For older SCMs where the surrounding area has changed, newer sources for topographic information should be utilized. A PDF measure tool is a good method to measure the areas for this information.

The present-day land use should be determined using aerial imagery. The present-day coverage should be compared to the land use at the time the SCM was constructed by referencing construction plans and aerial

photography from the period. Indicate if the coverage within the drainage area to the SCM has changed significantly, as this can change the quantity and characteristics of flow reaching the SCM, potentially impacting its function.

The receiving watershed (surface water) name can normally be found on the PCSM Plan. The current designated use and impairment(s) should be confirmed using eMapPA even though this information is listed in Maintenance-IQ, because this information can change with time.

## Section 2 – Site Conditions

This section focuses on characterizing the accessibility to and general surroundings of the SCM. This is intended to be the area immediately surrounding the SCM that could impact its functioning.

### Security

Signage, fencing, access restrictions, and trespassing are security considerations. SCMs may have signage or markers to indicate the SCM is present and delineating the limits of the area. Some SCMs in pedestrian friendly areas may include educational signage about the SCM, while the purpose of signage in other areas may be to discourage entry.

Fencing around the perimeter of SCMs and other public access restrictions like access gates are common for SCMs with standing pools of water. The PCSM Plan should indicate if fencing or access restrictions were part of the original design. The presence or absence of restrictions should be noted along with recommendations to add fencing if needed. Signs of trespassing, including evidence of regular foot traffic, SCM damage, or evidence of squatting should be noted and described.

### Access

There are various types of access associated with an SCM, as noted in Table C.2.2. The maintenance access type is based on available information is found in Maintenance-IQ. The initial CAI should confirm this information. If the actual access differs from that in Maintenance-IQ, notify the designated DSMC of the discrepancy.

The remainder of the access information is related to the accessibility to specific areas of the SCM. For each area, indicate if it can be accessed for general maintenance and inspection on foot or by tractor/skid-steer (e.g., Bobcat). If an area cannot be accessed, indicate why.

**Table C.2.2: SCM Access Types**

| Access Type | Abbreviation | Description |
|---|---|---|
| Dedicated access road | DAR | Dedicated paved or unpaved drive from the SR, local road or access easement to the SCM. |
| Designated pull-off | DPO | Dedicated paved or unpaved pull-off parking area from the SR in close proximity to the SCM. |
| Local road | LOR | Park on the shoulder of a local road in close proximity to the SCM. |
| None, park and walk | NON | Park on the shoulder of an SR or local road not in close proximity to the SCM. |
| Parking lot | PAL | Park in a parking lot (owned by the Department or other with access agreement) in close proximity to the SCM. |
| Removable guide rail | RGR | A section of guide rail must be removed to access the SCM. |
| Shoulder pull-off | SPO | Park on the shoulder of an SR or local road in close proximity to the SCM. |
| Break in guide rail | BGR | Permanent guide rail opening exists to access the SCM from the adjacent roadway. |

Vegetation

Vegetation in the immediate surroundings of the SCM is reviewed in this section. It does not include the plantings in the SCM footprint; rather, it is focused on the slopes above the SCM storage area as well as in the general surrounding area. Make note if the area needs to be mowed, trimmed, or otherwise maintained.

Temporary ESPC Measures Present

Particularly during the initial CAI, temporary erosion and sediment pollution control (ESPC) measures may be found to have been inadvertently left in place from construction. These measures should have been removed after permanent stabilization and agency approval.

## Section 3 – Inflow and Outflow

This section focuses on how the SCM receives and releases stormwater runoff. It includes an evaluation of inflow sources such as sheet flow, swales, and pipes, as well as outflow points such as the principal spillway/riser and downstream areas.

Inflow

An SCM can have multiple inflow points and types. All inflow locations shown on the as-built plan must be field located and in proper working order. The type and dimension of each inflow point is documented, except for sheet flow, where no dimension is required. When the as-built plan is not available, a detailed sketch must be prepared by the inspector during the initial CAI. The sketch should show the location, type, size, and material of the SCM's inflow points.

The condition of the inflow points, based on the presence of trash/debris, sediment, and erosion/scour, is assessed using the Table C.1.1 rating system. Note any observed structural problems such as headwall instability, cracking or failure. Confirm the accuracy of information in the as-built plan and proper functioning of the drainage system upstream from the inflow points.

Outflow

The outflow section is subdivided into the following:

- Principal Spillway/Riser – Opening
- Principal Spillway/Riser – Structure
- Principal Spillway/Riser – Outfall
- Emergency Spillway
- Downstream Condition

All outflow locations shown on the as-built plan must be field located and in proper working order. When the as-built plan is not available, a detailed sketch must be prepared by the inspector during the initial CAI. The sketch should show the location, type, size, and material of the SCM's outflow elements.

The first subsection called "Principal Spillway/Riser – Opening," focuses on the openings into the primary flow control structure, such as weirs and orifices in the side of a concrete riser box. An opening that allows the SCM to drain can be as simple as an outlet pipe at the base of a basin, but is more commonly a complex system of orifices and weirs of different size at different elevations.

The second subsection, "Principal Spillway/Riser – Structure," focuses on the structural condition of the flow control structure. The principal spillway for most SCMs is comprised of a concrete box, manhole, headwall or earthen weir (although earthen weirs are more typically the emergency spillway). Examples of structural damage include cracked or broken concrete, and damaged or improperly secured trash racks. Instability includes undermining of outlet box foundations and slumping or eroded earthen weir areas.

The third subsection looks at the "Principal Spillway/Riser – Outfall." After stormwater flows through the principal spillway, SCMs typically have a pipe that leads to a discharge point. If a level spreader is present, the type should be indicated as a "surface discharge," which uses a concrete edging or earthen berm, or a "subsurface discharge," which uses a perforated pipe surrounded by gravel bedding material. Examples of "Other" outfall types may include pre-formed plunge pools or concrete energy dissipating armoring.

The fourth subsection examines the "Emergency Spillway." Some SCM types, such as basins, incorporate an auxiliary or emergency spillway in the event the principal spillway fails. Surface SCMs constructed in fill areas typically have a weir constructed into the earthen berm that serves as an emergency overflow. This area is often protected with rip-rap or reinforced vegetated lining to ensure flows do not erode the underlying berm. SCMs located in a sump or low spot may incorporate a secondary riser structure with the outlet elevation above principal spillway structure.

The final subsection focuses on the "Downstream Condition" of the SCM, from the outflow points (principal and emergency spillway) to the right-of-way or property line. The SCM data in Maintenance-IQ includes information about what the SCM discharges to, which should be field verified. The dropdown menu provides options as described in Table C.2.3. Inspection activities should not go beyond the Department's legal access to assess downstream conditions; however, erosion or other concerns that appear to extend beyond the right-of-way should be noted in the comments.

**Table C.2.3: SCM Downstream Discharge Type**

| Access Type | Abbrev. | Description |
|---|---|---|
| Another SCM | SCM | Another SCM immediately downstream of the SCM being inspected separately, such as two SCMs in series. |
| Groundwater Injection | GRI | Direct injection via piping or channel into an aquifer. |
| Karst Outcrop | KAO | A known karst (carbonate) geologic rock outcrop or sinkhole. |
| No Defined Channel | NDC | A point discharge to an area with no defined channel banks, such as a field or open area. |
| Pond or Lake | POL | A pond or lake not part of a quarry, reservoir, or other SCM. |
| Quarry | QUA | A known quarry with or without a permanent pool. |
| Reservoir, Water Supply | RES | A pond, lake or impoundment specifically used as a public water supply. |
| Sheet Flow | SHF | Discharged from the SCM in the form of non-concentrated flow such as discharge from a filter strip or a level spreader. |
| Storm Sewer, Combined | SSC | Connection to a combined sanitary and storm sewer system. |
| Storm Sewer, Other | SSO | Connection to a storm sewer owned by an entity other than PennDOT. |
| Storm Sewer, PennDOT | SSP | Connection to a storm sewer owned by PennDOT. |
| Stream, Ephemeral | SEP | Watercourses that do not have well-defined channels and that flow only during or just after rainstorms or snow melts, but are typically dry for most of the year. |
| Stream, Intermittent | SIN | Watercourses with well-defined bed and banks, but typically have flowing water from a headwater source for only a portion of the year. |
| Stream, Perennial | SPE | Watercourses with well-defined bed and banks and continuous flow most years. |
| Swale or Ditch | SOD | Drainage channels constructed for the purpose of carrying runoff away from the roadway or intercepting flow that is draining towards it. |
| Vernal Pool | VEP | Temporary shallow pools of water for variable periods from winter to spring, but may be completely dry for most of summer and fall. |
| Wetland | WET | Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. |
| Unknown | UNK | Applicable when discharge location cannot be determined based on PCSM Plan and field inspection. |

## Section 4 – Treatment Performance

This section deals with the type and performance of the SCM's treatment features. It is comprised of several subsections, some of which will not apply to all SCMs.

### Pretreatment

Properly functioning pretreatment elements treat stormwater prior to it entering the main SCM area, helping to reduce maintenance frequency. Pretreatment varies by SCM type. Basins frequently have a sediment forebay or plunge pool that receives inflow prior to entry into the main basin area. Grass lined channels and filter strips

can be used to deliver runoff into basins, bioretention, subsurface facilities and other SCMs. The storm inlet upstream of an SCM may have a sump, or a sump and hood installation over the outlet pipe, to collect sediment and floatable debris.

Manufactured treatment devices (MTD), when installed upstream of and inline with another SCM, may serve as pretreatment for that SCM. They are specifically designed to improve effluent water quality by targeting certain types of pollutants, such as trash, oils and greases, or particulates. An example of an MTD is a hydrodynamic separator.

Some pretreatment features can also function as stand-alone SCMs. For example, a storm inlet with a sump or an MTD can be a stand-alone SCM, or it can function as pretreatment for a primary SCM, such as an infiltration basin. They may or may not be listed separately (i.e., have their own IDs) in Maintenance-IQ. Generally, if the inlet or MTD is located at the inflow point of a primary SCM and it does not have an ID in Maintenance-IQ, it is reviewed as part of the primary SCM inspection.

Check all pretreatment measures present and describe in detail if “Other” is selected. Confirm plan accuracy and signs of proper functioning.

Stormwater runoff bypassing an SCM is a problem when the SCM is designed to capture runoff from the associated land surface(s). Signs of bypass include gully/channel formation around the SCM and blocked inflow.

Rate the presence/absence of the listed concerns using the dropdown menus. Indicate if sediment removal is needed as detailed in the specific SCM sections in Chapter 5 and Common Component Section in Chapter 6 and as follows:

- Most sediment forebays and similar pretreatment facilities should have a permanent cleanout marker (stake). Read the stake and note the sediment level compared to the cleanout mark.
- If a cleanout marker is not present or it is damaged, the O&M section of the PCSM plan should have a cleanout level noted for the pretreatment area. If the pretreatment area does not contain an impermeable liner (check PCSM plan), use a soil probe to recover a sample at several locations within the pretreatment area. The sediment depth can be interpreted based on the depth from the surface to the base soil (look for soil type change in texture, grain size, color). Compare the measured depth of sediment to the PCSM plan cleanout depth.
- In the absence of other information, the sediment should be removed when it is approximately half the depth of the forebay area. The forebay depth should be measured from the invert of the lowest inflow point to the bottom of the forebay (as determined from as-built plans or soil probes).
- Consider recommending the installation of a permanent cleanout marker to aid in maintenance if one is not present.

SCM Ponding and Conveyance

The treatment performance of an SCM is affected by ponding within the SCM and conveyance into, through, and from the SCM. Each issue described below should be noted if found.

- Water bypasses inlet: Runoff from the tributary drainage area bypasses an SCM inflow point, such as a curb cut and storm inlet grate.
- Ineffective pretreatment: Signs of sediment passing though the pretreatment area and being deposited in the main SCM.

- Incorrect flow path: Unintentional flow paths have formed that allow runoff to bypass the designed low flow areas within the SCM.
- Unstable permanent pool: Indicated by a lack of a pool, water surface elevation below the low flow orifice, or signs of water level fluctuation along the embankment of a wet basin.
- Water bypasses outlet: Signs of runoff entering a flow control structure or subsurface piping though a crack, joint or path other than designed.
- Ineffective treatment: Evidence of excessive sediment accumulation or flows at the SCM outfall.
- Short-circuiting: Formation of a direct flow path from the inflow point to the outflow point.
- Inappropriate soil type for infiltration: The soil layer directly below any surface or subsurface storage zone consists of silts or clays with very low permeability or gravels with excessive permeability.
- Clogged media: A layer of fine grained material covering the surface of the filtration/infiltration layer, which can be identified through soil sampling.
- Inappropriate media material: Infiltration/filtration material that is excessively silty/clayey or gravely that does not provide suitable infiltration properties or vegetation support.
- Clogged underdrain: Standing water and saturated media layer to the depth of the underdrain with no underdrain outflow present.
- Failing structural components: Evidence of any structural components malfunctioning such as underdrain joint separation, cracking concrete components, broken gabion baskets, etc.
- Sinkhole present: Signs of ground settlement or subsidence anywhere within the SCM. Sinkhole location and size should be noted. If it is located over underdrains or outlet piping, explore the possibility of pipe/joint failures. Review the underlying geology for karst potential.
- Impermeable liner exposed/damaged: For SCMs located in karst geology or areas where infiltration is not desirable, impermeable liners are often installed. When the as-built plan denotes such a liner, look for signs of exposure or damage.
- Safety issues: Unintended standing water (mosquito and drowning hazard), possible collapse of embankments supporting roads, buildings, etc.

Take measurements of the SCM to confirm that it matches the as-built plan. In the absence of an as-built plan, develop a sketch plan of the SCM for future reference. For surface SCMs, measure the surface area at the SCM bottom (at the toe of slope, not the top of berm above the SCM). For irregular shaped SCMs, record the longest and shortest length and the narrowest and widest width, explaining each measurement taken. For subsurface SCMs, use surface features such as manholes and inlets located in the SCM to approximate footprint dimensions.

Depth of water quality storage in surface SCMs is the measurement from the ground surface to the lowest outflow opening in the flow control structure. In subsurface SCMs, the as-built plan should be reviewed to assess where the bottom of storage is with respect to visible features such as the flow control structure and observation wells. Some subsurface SCM designs incorporate observations wells to the bottom of the water quality storage. If there is no means to determine the actual field depth, make a note in the comments and include the plan specified depth that could not be confirmed.

The need for sediment removal should be determined in the same manor described in the pretreatment section. If no permanent marker is found, recommendations should include the addition of a permanent cleanout marker.

Surface SCMs that have a subsurface infiltration component, such as a layer of modified soil and/or gravel storage bed, should contain observation wells to confirm subsurface media infiltration. Wells can be difficult to find through vegetation, so use the as-built plan to assist in locating them. Open all wells and measure the depth to standing water from the top of the well, if any. Subtract the height of the well above the SCM surface from this measurement to determine the SCM surface to water depth. Note the findings in the comments. If wells shown on the plan cannot be located, comment on it and include why (e.g., vegetation too thick, buried by sediment, or confirmed missing). If the SCM has a subsurface infiltration component but has no observations wells, indicate in the comments that infiltration function cannot be verified due to lack of wells.

Vegetation within SCM Footprint

Vegetative cover affects the SCM's ability to filter pollutants, enhance soil infiltration (via creation of macropores), promote evapotranspiration, and other things. Determine if the plants present are consistent with the as-built plan. Refer to Appendix D or other Pennsylvania region specific references for plant identification assistance. Use references specific to the Pennsylvania region in which the SCM is located. Some plants thrive in wet conditions in some areas of the country while primarily residing in upland meadows in other states. Certain plants can also be considered native to other parts of the country, but are invasive to Pennsylvania. Indicate if any invasive species are present. If so, note the species identified and approximate percent of affected area.

Assess the total vegetative coverage of the footprint of the SCM (excluding the surrounding area). Estimate the percent coverage by plant type; the total must equal 100%.

Water Quality

Water quality within the SCM is assessed because any issues within the SCM become potential problems for the nearest downstream surface water. Pet/animal waste as well as oil, illegal dumping, illicit discharges and other sources of contaminates can impact the water quality of SCM discharges. All possible contamination or water quality issues should be indicated by checking the appropriate boxes and including comments to describe findings. The contamination option is followed by a dropdown menu which lists several common sources of contamination. If more than one of these is present, select the type that is most severe and list all types in the comments.

If water quality issues are found in the SCM, the source of the pollution should be investigated to the extent practical (inspectors should not leave the public right-of-way or property boundary to do so).

If a strong odor, foam, toilet paper or other obvious non-stormwater pollutant is identified, do not touch the contaminant. Attempt to find where the substance is entering the SCM (do not enter a confined space). Photograph and document the potential illicit discharge (PID). Follow procedures for handling PIDs as specified in Publication 23, Section 8.9 - Inspections.

Excessive algal growth should only be a concern for SCMs with a permanent pool of water. It can occur when excess nutrient loading such as fertilizer or decaying plant material enters the SCM. Note if there is an obvious source of potential fertilizer runoff in the drainage area or if there appears to be significant decaying material in the SCM.

A large, permanent waterfowl population (e.g., Canada geese) can produce enough waste to affect water quality. Evidence of approximately 20 or more permanent waterfowl inhabitants per acre of pond should be noted.

Mosquitoes and other insects can breed in stagnant ponded water. Note possible source of excess mosquito population if encountered. A mosquito problem in dry basins, infiltration basins/trenches and bioretention SCMs can be an early indication of an infiltration/filtration problem.

Filtration

This section is used to describe the makeup of the SCM's filter media, if present. In filtration SCMs, the top 12-24 inches of native soil is often replaced with a modified soil mix. Where subgrade soils do not drain well, an underdrain is used to remove the filtered water from the bottom of the soil mix.

Review the as-built plan to determine the design depth or thickness of the filter media and for possible use of an impermeable liner. Soil probes should not be used in SCMs with impermeable liners, but may be used carefully in SCMs with geotextile fabric (for separation of soil/stone layers). In all others, use soil probes to sample actual field thickness and compare it to the design. Conduct testing with extreme care, terminating the probe when met with resistance that may indicate a liner has been reached. To collect a sample, insert the soil probe by pushing vertically downward while twisting into the soil to the desired depth. Where the desired depth is greater than the probe soil sample collection area, the sample should be collected in increments using multiple insertions/sample removals going no more than the length of the soil collection area with each insertion. The handle of the instrument should be marked with tape measuring the successive sampling depths. Indicate the type and the depth of the filtration material. If multiple materials are present, indicate the depth of each layer and the order in which they occur.

Homogenous soils are uniform in composition and character with similar grain size/material type making up the majority of the material. Look for color/material differentiation to discern media filter from sediment build-up. Refer to desktop references for additional soil identification assistance.

## Section 5 – Side Slopes and Embankment

SCMs with ponding surface storage areas such as dry detention, infiltration and wet basins, as well as bioretention areas, are built by either excavating a pit below or constructing an embankment above the surrounding ground. For inspection definition purposes, side slopes are the inside SCM walls formed below surrounding grade where the inside wall is constructed by excavating below grade. Embankments, or berms, are compacted fill material constructed above the surrounding grade which forms one or more side walls of the SCM. Embankments and side slopes may not be present in some types of SCMs like subsurface facilities, pervious pavement, and infiltration berms.

Embankment and side slope stability is critical for SCM functioning and safety, particularly for taller embankments. Generally, excavated or fill embankments three feet or less in height at the inner face pose minimal safety issues, while taller embankments can pose significant risks in the event of failure. Embankments may be considered a regulated dam structure depending on height, storage capacity and contributing drainage area as defined in 25 Pa Code Chapter 105: Dam Safety and Waterway Management.

Cover

Surface cover is applicable to both side slopes and embankment areas. Uniform protective cover on embankments and side slopes helps ensure slope stability. Look for signs of erosion. Embankments should not have woody vegetation growth, as it can jeopardize the structural integrity of the berm. Side slopes may

have woody vegetation intentionally planted as part of the design. Review the as-built plan and assess each SCM to determine if woody vegetation on the side slopes is a concern. If the as-built plan does not include the final vegetative cover condition, the inspector should look for additional plans.

The presence of burrowing animals should be indicated. Burrows and tunnels in embankments can lead to embankment failure; they do not pose as much of a risk on side slopes.

In SCMs that do not have side slopes nor embankments, the not applicable box in the subsection heading should be checked and the section should not be completed.

Embankment Only
The remaining two portions of Section 5 are applicable to embankment areas only. When there are no embankment areas present, the not applicable box at the top of the subsection heading should be checked and the sections should not be completed.

Stability
Identifying signs of embankment instability can prevent future failures. Soil cracking in the horizontal or vertical direction, uneven settlement, or any indication of embankment movement should be documented. Describe the location of any observed issues in the comments.

Seepage
Generally, seepage is evident on the outside of a fill embankment. Evidence of soil saturation, slope sloughing/rutting, sediment build-up, or piping (formation of moisture carrying micro-passages through the embankment) on the outside face of the embankment could indicate seepage issues. Hydrophytic vegetation, plants adapted to living in wet conditions, found on the outside face of the embankment indicates prolonged moisture and suggests possible seepage issues.

### Inspection Notes
The CAI form includes a large section for additional comments. This section should be used for any additional information or overflow from other comment sections, as needed. These notes will be helpful later when you are writing the report. Any maintenance tasks or rehabilitation recommendations noted in this section must also be included in the CA report.

## C.3 Inspection Photographs and Sketches

Inspection photographs and sketches aid the inspector in explaining the SCM conditions encountered in the field. The entire SCM must be documented with photographs. The inspection photograph section of Form M-79 includes check boxes to track and confirm all key areas have been photographed during the inspection. In addition to this box, Form M-78, SCM Inspection Photographs must be completed as described in Section 3.6 - SCM Inspection Photograph Form (M-78).

Form M-79 also provides a section to sketch any pertinent items related to the inspection findings. Inspection sketches must be included for all components of the SCM when no as-built plan is available. When as-builts are available, sketches are used to describe field conditions that deviate from the as-built or clarify SCM issues. All sketches must include measurements and a description of the subject. Include the SCM ID in the sketch title, the name of the component being sketched, and the direction the sketch is drawn (e.g., north side of flow control structure). If the cardinal direction is not known, use landmarks (e.g., flow control structure, looking toward river).

## C.4 Performance Rating

The last section of Form M-79 is used to summarize the condition of the SCM in two steps.

Key Area of Potential Issues/Concerns

First, key areas of potential issues/concerns are rated using a 0 to 5 scale as described in Table C.4.1.

**Table C.4.1: Performance Rating**

| Rating | Description |
|---|---|
| 0 | Parameter could not be evaluated or not applicable |
| 1 | No problems exist; continue routine maintenance |
| 2 | Minor problems; routine maintenance |
| 3 | Minor problems; non-routine/corrective maintenance |
| 4 | Major problems; immediate corrective maintenance |
| 5 | Severe problems; rehabilitation or reconstruction |

Table C.4.2 lists the 13 key areas of potential issues/concerns along with a brief description. Some of the key areas apply to multiple components of the SCM while others apply to only one, or may not apply at all depending on the SCM type. For example, trash/debris could cause a potential issue in almost any component of an SCM, while embankment only applies to SCMs with embankments.

**Table C.4.2: Key Areas of Potential Issues and Concerns**

| Key Area | Description/Applicable Areas |
|---|---|
| Accessibility | Based on results of Section 2 of the form. |
| SCM Constructed Per Plan | Considers all aspects of the SCM; applicable to multiple sections of the form. If a component does not match the plan, the rating should consider the potential effects. Does it have potential to negatively affect the function, or could the variation possibly improve function? |
| Trash/Debris | Considers all aspects of the SCM; applicable to multiple sections of the form. |
| Pretreatment | Based on results of the pretreatment subsection of Section 4 of the form, confirming their presence per plan, functionality if present, and the need for pretreatment if absent. Some SCMs do not have pretreatment, but inspection findings may suggest it is a need. |
| Embankment | Based on results of Section 5 of the form; not applicable to all SCM types. |
| Erosion | Considers all aspects of the SCM; applicable to multiple sections of the form. |
| Sediment Deposition | Considers all aspects of the SCM; applicable to multiple sections of the form. |
| Structural | Applies to multiple sections of the form. Focuses on structural components such as inflow piping, headwalls, outflow structures, etc. May include metal or concrete appurtenances. |
| Ponding/Conveyance | Based on results of the ponding/conveyance subsection of Section 4 of the form. |
| Water Quality Concerns | Based on results of the water quality concerns subsection of Section 4 of the form. |
| Vegetative Cover (Turf) | Considers all aspects of the SCM where turf (grass) vegetation is present and per plan both within the SCM and in the surrounding area. Applicable to multiple sections of the form. |
| Vegetative Cover (Plantings) | Considers all aspects of the SCM where plantings other than turf (perennials, shrubs, trees) vegetation is present and per plan. Applicable to multiple form sections. |
| Landscape Objective | Considers all aspects of the SCM where vegetation is present both within and surrounding the SCM. Applicable to multiple form sections. |

When determining the rating for a key area that is applicable to multiple parts of the SCM, use the rating for the worst case identified in the inspection. For example, if sediment deposition was minor in at the inflow area, but was causing a 100% blockage of the outfall, a rating of 5 should be assigned.

After each key area has been rated, tally the number of each rating (e.g., 1s, 2s, 3s, 4s, and 5s) in the “TOTAL” row at the bottom of the table. For example, two separate “4” values in the rating column equals a total of 2 in the second to last column from the right (4 column) of the total tally row. Assuming every key area receives a rating (i.e., no 0 values were assigned), the summation of the total tally row should equal 13. This check should be performed to ensure the total row has been correctly completed.

Overall Rating

The second step in the performance rating section determines the SCMs Overall Performance Rating. A letter grade is assigned based on the total row of the key area of potential issues/concern table using the descriptions associated with each letter. The overall performance rating table is presented in Figure C.4.1.

**Figure C.4.1: SCM Overall Performance Rating Table (excerpt from CAI form)**

| **OVERALL PERFORMANCE RATING** (Circle/select one letter based on a count of the rating results from the table above) | | | | |
|---|---|---|---|---|
| Excellent<br>≤ three 2's and<br>no 3's,4's or 5's | Good<br>≤ two 3's and<br>no 4's or 5's | Fair<br>< five 3's and<br>≤ one 4 and no 5's | Poor*<br>≤ four 4's and<br>no 5's | Failing*<br>> four 4's or<br>≥ one 5 |
| ☐ **A** | ☐ **B** | ☐ **C** | ☐ **D** | ☐ **F** |

*Note: Full CA report is required for SCMs with an overall performance rating of D or F.

# APPENDIX D

# PLANT IDENTIFICATION

## D.1 Common SCM Plantings

Most surface SCMs such as bioretention areas, most types of basins, stormwater wetlands and vegetated swales are planted with vegetation in the form of seed mixes, graminoids, forbs, shrubs and/or trees. Graminoids are grass-like, narrow-leaved, herbaceous plants including sedges, rushes and true grasses. Forbs are flowering, broad-leaved, non-graminoid (grass), herbaceous plants.Typically, native species are preferred. There are numerous varieties, however Table D.1.1 presents some commonly found species.

**Table D.1.1: Common SCM Planting Species**

| Common Name | Scientific Name | Plant Type |
|---|---|---|
| Blackgum | Nyssa sylvatica | Tree |
| Swamp White Oak | Quercus bicolor | Tree |
| Sweet Gum | Liquidambar styraciflua | Tree |
| Sweetbay Magnolia | Magnolia virginiana | Tree |
| Dogwood- Silky, Gray or Redtwig | Cornus- amomum, racemosa, or sericea | Shrub |
| Witch hazel | Hamamelis virginiana | Shrub |
| Elderberry | Sambucus canadensis | Shrub |
| Highbush Blueberry | Vaccinium corymbosum | Shrub |
| Arrowwood Viburnum | Viburnum dentatum | Shrub |
| Aster, New England | Symphyotrichum novae-angliae (formerly Aster novae-angliae) | Forb |
| Joe-pye-weed | Eupatorium maculatum | Forb |
| Iris, blue flag | Iris versicolor | Forb |
| Cardinal flower | Lobelia cardinalis | Forb |
| Switchgrass | Panicum virgatum | Grass |
| Fox Sedge | Carex vulpinoidea | Grass-like |
| Soft Rush | Juncus effusus | Grass-like |

Information about the above and other SCM plants can be obtain from internet and desktop references. When researching plantings for SCMs, it is important to check the local growing habits of the species in question. Some plants will grow in wet areas in some parts of the state while growing only in dry areas elsewhere. Likewise, a plant may be considered native to some areas but invasive in others. The PA Stormwater BMP Manual contains an appendix of plants native to Pennsylvania with information about the plants typical habitat. Philadelphia Water Departments Stormwater Management Guidance Manual V3.0 appendix I available via their website contains a thorough landscape guidance for reference.

## D.2 Hydrophytic Vegetation

Prolonged soil saturation causes an oxygen deficiency in the soil. Most plants require oxygen available to their root system for survival. Hydrophytic vegetation are plants that have adapted to wet conditions, thriving and growing in the absence of oxygenated soil. The presence of these plants, particularly combined with the absence of "upland" plants, is an indication of continually wet conditions. Unless the SCM is designed to have a permanent pool of water (such as a wet detention basin or stormwater wetland system), the presence of these plants suggest inadequate SCM drawdown.

Hydrophytic vegetation can be intentional native plantings in an SCM or invasive. When inspecting an SCM with a permeant pool of water, the presence of native hydrophytic vegetation does not necessarily indicate an issue, while presence of invasive species indicates a problem.

## D.3 Invasive Species

The PA Department of Conservation and Natural Resources (DCNR) defines invasive plants as those that are not native to an area, spread quickly and aggressively, and cause economic or environmental harm or harm to human health (DCNR). These non-native or exotic species are usually introduced to new regions by people accidentally or intentionally. Invasive species displace native species and change the ecological structure of the invaded community, sometimes with dire consequences to native plants and animals (PennDOT Pub. 756).

There are numerous references listing hundreds of plants which are invasive in Pennsylvania. To assist users of this Publication, the Table D.3.1 lists invasive species commonly found along roadway right-of-ways and within SCMs. However, this is not an exhaustive list.

For additional information, users are encouraged to use available information sources. Pub. 756- Invasive Species Best Management Practices provides guidance on the Departments approach to invasive species management within the right of way. PA Department of Conservation and Natural Resources (DCNR) has developed an overview brochure and individual species fact sheets to aid in education and identification available at their website.

In addition to the DCNR references, for SCMs in and around streams, wetlands and moist areas, PADEP issued "Pennsylvania Field Guide - Common Invasive Plants in Riparian Areas" which can be found at this link.

**Table D.3.1: Invasive Species Common in SCMs**

| Common Name | ***Scientific Name*** |
|---|---|
| **Vines** | |
| Porcelain Berry | Ampelopsis brevipedunculata |
| Oriental Bittersweet | Celastrus orbiculatus |
| English Ivy | Hedera helix L. |
| Japanese Hops | Humulus japonica |
| Japanese Honeysuckle | Lonicera japonica |
| Kudzu | Pueraria montana var. lobata |
| Mile-a-Minute | Polygonum perfoliatum |
| Chinese & Japanese Wisteria | Wisteria sinensis, W. floribunda |
| **Shrubs** | |
| Japanese & European Barberry | Berberis thunbergii, B. vulgaris |
| Russian Olive & Autumn Olive | Elaeagnus angustifolia L., Elaeagnus umbellata |
| Winged Euonymus (aka Burning Bush) | Euonymus alatus |
| Privets Japanese, Boarder, Chinese & Common | Ligustrum japonicum, L. obtusifolium, L. sinense, L. vulgare |
| Glossy Buckthorn | Rhamnus frangula alnus |
| Multiflora Rose | Rosa multiflora |
| **Trees** | |
| Amur Maple | Acer ginnala |
| Norway Maple | Acer platanoides |
| Sycamore Maple | Acer pseudoplatanus L. |
| Tree-of-Heaven | Ailanthus altissima |
| Empress Tree (aka Princess Tree) | Paulownia tomentosa |

| Common Name | ***Scientific Name*** |
|---|---|
| **Aquatic Plants** | |
| Narrow leaved cattail | Typha angustifolia |
| Hybrid cattail | Typha x glauca |
| Curly Pondweed | Potamogeton crispus |
| **Herbs and Forbs** | |
| Garlic Mustard | Alliaria petiolata |
| Brown, Black & Spotted Knapweed | Centaurea jacea, C. nigra, & C. stoebe |
| Canada & Bull Thistle | Cirsium arvense, C. vulgare |
| Crown-vetch | Coronilla varia |
| Japanese Stilt Grass | Microstegium vimineum |
| Purple Loosestrife | Lythrum salicaria |
| Reed Canary Grass | Phalaris arundinacea |
| Common Reed (Phragmites) | Phragmites australis ssp. austrails |
| Japanese & Giant Knotweed | Fallopia japonica, Fallopia sachalinensis |
| Lesser Celandine | Ficaria verna, (formerly Ranunculus ficaria L.) |

## D.4 Undesirable Vegetation

Undesirable vegetation is any vegetation including native, non-native and invasive species which are problematic in a given setting. For example, woody trees may be appropriate plantings along a roadside, but they are undesirable on SCM embankment slopes where they may impact the structural integrity of the SCM. In an SCM, undesirable vegetation is anything which may hinder the functionality or structural integrity of the SCM. Vegetation that impacts infiltration/filtration, storage, treatment ability, embankment stability, flow through, or any other function of the SCM is considered undesirable and should be removed.

# APPENDIX E

# CORRECTIVE MAINTENANCE TABLES

The corrective maintenance tables presented herein cover all of the SCMs (Chapter 5) and Common SCM Components (Chapter 6) in this Publication. Note Table E.1.3 applies to the SCMs included in Sections 5.1, 5.2 and 5.3.

| TABLE | NAME |
|---|---|
| E.1.1 | General (applicable to all SCMS) |
| E.1.2 | Common Components (all components in Chapter 6) |
| E.1.3 | Basin, Most Types (BDD, BED, BUD, BND, BOT, BWD, BID) |
| E.1.4 | Bioretention (BRE, BRU) |
| E.1.5 | Subsurface Infiltration Trench (SIT) |
| E.1.6 | Subsurface Detention Storage (SDS) |
| E.1.7 | Stormwater Wetland System (SWE) |
| E.1.8 | Constructed Stormwater Filter (CSF) |
| E.1.9 | Vegetated Filter Strip (VFS, VSS) |
| E.1.10 | Media Filter Drain (MFD) |
| E.1.11 | Vegetated Swale (VSW, VSC) |
| E.1.12 | Infiltration Berm (IBE) |
| E.1.13 | Manufactured Treatment Devices (MTD) |
| E.1.14 | Level Spreader Outfall (LSO) |
| E.1.15 | Pervious Pavement (PPA, PPC, PPP) |
| E.1.16 | Regenerative Step Pool (RSP) |

The corrective maintenance tables should be used by the assigned District representative, such as the DSMC or designee, to determine appropriate corrective maintenance actions based on the results of an inspection or a report from maintenance crews. The tables aid in interpreting inspection reports, scheduling needed repairs, and budgeting required work. They are not intended to dictate routine maintenance activities, which are stipulated in the routine maintenance procedure tables, but to guide non-standard, corrective repairs. It is important to reference the applicable corrective maintenance information presented on the general and component tables in addition to the SCM specific table as appropriate.

The tables include scenarios generally encountered in the field, but they cannot cover all potential situations. They are not intended to be a comprehensive guide for major modifications to SCMs that may be required. All repairs should follow applicable Department standards. Designers, inspectors, supervisors and crews should use good judgment when applying repair recommendations and recommended timing for repairs contained in the tables. When in doubt, potentially unsafe situations should be brought to the attention of a supervisor.

Each table contain eight columns, which are described as follows:

- SCM Component: The part of the SCM where the defect is identified. It corresponds to the section/subsection titles on the CAI form (M-79).
- Defect or Problem: Describes the identified concern.
- Defect Code: Corresponds to the defect category and location/type on the VSI form (M-77). For example, 1c is trash/debris on side slopes.
- Inspection Action Code: Indicates the appropriate response time for the concern as found on the VSI form (M-77). Where the severity of the defect impacts the required response time, all potential codes are listed. The appropriate response should be assessed based on inspection recommendations. The action codes are as follows:
  - 0 = No action for identified issue
  - 1 = Routine
  - 2 = Corrective, 6-month response
  - 3 = Corrective, 4-week response
  - 4 = Emergency, immediate response
  - 5 = Environmental/engineering evaluation required
- Maintenance needed when…: Describes the circumstances that require action.
- SCM Component Variations or Cause of Defect/Problem: Where needed, clarifies the defect or conditions applicable to alternative resolutions.
- Recommended Maintenance Activity to Correct Problem: Explains the maintenance action(s) most likely to resolve the identified defect.
- Assembly #: The appropriate assembly code for the corrective maintenance activities described.

The following notes apply to all tables:

- All repairs should be done in conformance with Pub. 23M, Pub. 72M, Pub. 408, and all applicable Department standards.
- The use of the word “plan” in the table refers to the as-built plan on record for the SCM.
- Any earth disturbance over 5,000 square feet requires a written ESPC Plan to be prepared and on site. Earth disturbance over one acre may require an NPDES permit.
- Work in wetlands, waterways, and floodplains may require PADEP permitting prior to the commencement of work.
- Work in SCMs in the City of Philadelphia should be done in coordination with the Philadelphia Water Department when required.
- Maintenance and repairs to storm sewer systems within the roadway right-of-way may be the responsibility of the local municipality. Review applicable agreements and policy prior to proceeding with repairs. In accordance with Pub. 23M, Section 8.5, the Department will not be responsible for maintaining a combined sewer facility under any circumstance.
- Call PA One Call prior to digging.
- Maintenance and protection of traffic must conform to Department policy.
- Invasive plant management should conform with the Departments policy. Reference Pub 756. Removal of invasive and non-invasive plants should be as needed when deemed undesirable or as appropriate in accordance with Pub 756.
- Assembly # “TBD” indicates further evaluation is required prior to determining a course of remediation and assigning an assembly number.
- Budgeting and planning for all work not covered by a maintenance assembly must be done in accordance with Department policy.

**Table E.1.1: General Corrective Maintenance Table**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| All SCM Components: General | Field conditions do not match record plans or inventory information | 5h | 2, 3, 4, 5 | … inspection reveals field conditions of one or more components do not match plans resulting in the potential to impact the SCMs ability to perform appropriately. | | Resolution should be determined by a professional engineer. Possible remediation may include modeling actual field conditions in comparison with intended design to assess the impacts on runoff rate, volume and quality controls. If the SCM is performing within the design requirements, the field conditions may be documented as acceptable and the record plans should be updated. If the SCM is not meeting its design requirements, reconstruction of the nonconforming component may be required. Coordination with PADEP may be required. | TBD |
| | Temporary ESPC measures present | 5a | 2, 3, 4 | …temporary ESPC measures remain in the SCM drainage area after complete stabilization and Conservation District approval to remove. | | Remove temporary ESPC measure, and permanently stabilize areas disturbed by the removal.[3] Note: Riprap outlet protection is typically a permanent measure that should remain. | 711-7801-02 |
| | Floatable trash observed in SCM, pretreatment, side slopes/embankment, inflow/outflow channels/ points, or general area | 1b,1c, 1d,1e,1f, 1g | 3 | …floatable trash can potentially block inflow/outflow structures or escape downstream. | | Remove floatable trash and debris. [3, 4] | 711-7801-02 |
| | Tires, metal, antiskid material, or other non-floatable trash observed in SCM, pretreatment, side slopes/embankment, inflow/outflow channels/ points, or general area | 1a, 1b,1c, 1d, 1e, 1f, 1g | 1, 2 | …trash and debris inhibits function or is aesthetically unacceptable. | | Remove trash and litter. [3, 4] | 711-7801-02 |
| | Woody debris and leaves (other than intentionally placed mulch material) observed in SCM, pretreatment, side slopes/embankment, inflow/outflow channels/ points, or general area | 1b, 1c, 1d, 1e, 1f | 2, 3, 4 | …woody debris and leaves pose a hazard and inhibits function. | | Remove debris. [3, 4] | 711-7801-02 |
| | Hazardous insect nests | 5h | 2 | … insect nests such as wasps and hornets interfere with SCM access or maintenance activities. | | Remove insect nests. [3, 4] | 711-7801-02 |
| | Erosion of soils or bare areas observed | 2a, 2b, 2c, 2d, 4b, 4c | 2, 3 | … general erosion or areas of bare (non-vegetated) soils present causing sediment runoff and continued erosion issues. | | Confirm adequate topsoil and sunlight are present for plant establishment. Add topsoil and adjust planting material for appropriate sun exposure. Replant and establish plan specified vegetation cover material. If problem reoccurs, a landscape architect should design the repair. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management General | Trees in poor condition near/on/in facility observed | 5h | 3, 4 | …trees found to be weakened, unsound, undermined, leaning, or exposed may fall across roadway or on to SCM/embankment. | Facility designed without trees. | Remove hazard trees. [3] | 711-7801-07 |
| | | | | | Facility designed to have trees. | Remove hazard trees. [3] Determine cause of tree loss. This may require consultation with a landscape architect. Replace trees that were removed with species of sizes indicated on plans, or as specified by a landscape architect. | 711-7801-07 |
| Inflow: General | Flow from pipe or into SCM noted during time when no rain has recently occurred | 5f | 4, 5 | ...a substance other than stormwater runoff is suspected to be entering the SCM.<br><br>…flow into SCM is observed during dry weather. | | Do not touch the substance in question. Attempt to find where the substance is originating. Photograph and document the Potential Illicit Discharges (PIDs). Follow procedures for handling PIDs as specified in Publication 23-Chapter 8 – Section 8.9, Inspections.[4] | Pub. 23, Ch. 8.9 |
| Inflow, Outflow, Ponding/Conveyance: General | Sinkhole or depression observed | 5e | 4, 5 | …open holes or depressions are observed in the SCM floor, near embankments/side sloped, or somewhere in the vicinity of the SCM. | No underdrains present and/or large holes/depressions observed. | Surround area with orange construction fence. A geotechnical engineer may be required to evaluate the cause/source of issues. Repair should be designed by a professional engineer. A corrective, local repair may be to place a reverse filter in the hole. A remediation repair my involve installing an impermeable liner on the bottom of the SCM. | 711-7801-06 |
| | | | | | With underdrains, small holes observed in vicinity of underdrain. | If depressions are small and near underdrain or outlet structure, sinkhole may be associated with failure of underdrain system. See "Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe-Settlement observed over underdrain/ outlet pipe" in the appropriate SCM table. | See SCM Specific Table |
| Water Quality: General | Strong odor, discoloration of water, oily sheen, foam, or toilet paper observed | 5f | 4 | …non-stormwater discharges are found entering the SCM.<br><br>…evidence of contaminants discharged from a spill or accident on roadway flowing into SCM. | | Do not touch the substance in question. Attempt to find where the substance is entering the SCM. Photograph and document the PIDs. Follow procedures for handling PIDs as specified in Publication 23-Chapter 8 – Section 8.9, Inspections.[4] | Pub. 23, Ch. 8.9 |
| | Stagnant water | 3a, 3d, 5h | 2, 3 | …when algae is present in standing water. | | See "Ponding" on SCM specific maintenance tables. | See SCM Specific Table |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.2: Common SCM Components Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| **Access, Fencing, Security & Signage** | | | | | | | |
| Access | Access drive rutting observed | 5h | 2 | …stone or mud can be tracked onto adjacent roads, or access is difficult due to condition of access drive. | Stone access drive rutted or loose stone on adjacent roadway. | Sweep stone or soil off of roadway. When ruts occur, the surface should be scarified, graded, add suitable material and roll. | 711-7801-01 |
| | Access drive has excessive vegetation growth | | 2 | | Asphalt access drive rutted or severely cracked. | Repair asphalt by undercutting to a stable subbase and then follow standard procedures for patching and paving. | 711-7801-01 |
| | Stone or soil on adjacent roadway from access drive | 4f | 1 | | Vegetation growing in access drive. | Consult District Roadside Specialist regarding vegetation removal in access drive with herbicide. A qualified professional must perform the work in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters.[3] | 711-7801-07 |
| | Access is blocked | 1g | 3 | …access to key components of the facility is inhibited. | Access blocked by illegal dumping. | Contact District Environmental Manager to examine for potential hazardous material. [3] | TBD |
| | | 4f | 3 | | Access blocked by fallen tree. | Remove fallen trees. [3] | 711-7801-02 |
| | Stabilized access for vehicles/equipment does not exist | 5h | 2, 5 | …lack of access drive to SCM is preventing performance of required inspection and/or maintenance activities. | | Construction of temporary or permanent access road may be required to support maintenance activities. Estimate frequency and type of activities and equipment needed to reach SCM to determine if a temporary or permanent access is required.<br><br>Where access is required over steep slopes, consider hand work alternatives, winching equipment into place, or use of vacuum truck with long hose to reach SCM.<br><br>Where conditions are too wet to traverse or a wetland/stream crossing is required, follow matting and crossing installation and removal requirements in the PADEP ESPC Manual. | 711-7801-01 |
| Security | Fence damage or open/damaged gate observed | 5h | 3 | …unauthorized access to the facility can occur through a damaged fence or gate. | Lock missing or difficult to open. | Replace lock with one designed for outdoor use and that has a master key. | 711-7801-04 |
| | | | | | Hole in fence. | Temporarily repair with 12-gauge galvanized wire. Schedule replacement of fence fabric. | 711-7801-04 |
| | | | | | Fence posts or gate damaged. | Determine if gate can be temporarily secured and do so if feasible. Schedule fence repair. | 711-7801-04 |
| | | | | | Posts or top rail out of plumb more than 6 inches. | Repair post such that it is within 1-1/2 inches of plumb, and bends in top rails are less than 1 inch. | 711-7801-04 |
| | Excessive gap between bottom of fence and ground observed | 5h | 3 | …unauthorized access to the facility can occur through an opening beneath fence or gate. | | Reestablish proper ground elevation such that opening beneath the fence is less than 6 inches in height. Use of rocks or metal edging may be required. Replace fence fabric if necessary. | 711-7801-04 |
| | Signs of trespassing | 5h | 2 | | Plans call for fence but none is present. | Install fence per original plans. | 711-7801-04 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | …evidence in and around SCM suggests unauthorized access to the facility is occurring and presents safety concerns.<br><br>…vandalism is occurring causing damage to the SCM. | Plans do not call for a fence. | Assess the potential safety hazard for unauthorized access to the SCM. If there is a safety concern associated with authorized access or vandalism is causing damage to the SCM, install fencing with locked gate or other security measures to mitigate safety hazards and/or vandalism. | 711-7801-04 |
| Security/Signage | SCM marker, delineation or informational signage | 5h | 2 | …plan depicted signage is damaged or missing. | | Repair damaged signage. Replacing missing signage per plans. | 711-7801-04 |
| | SCM marker, delineation or informational signage needed | | | …no plan depicted signage indicated and SCM location is difficult to located. | | Install delineation signage as indicated in Publication 888, Chapter 2. | 711-7801-04 |
| | Cleanout marker | 5h | 2 | … cleanout marker is damaged, missing, or not present. | | Repair damaged cleanout marker. Replacing missing cleanout marker per plans. If not in plan, install cleanout marker per subcomponent instructions. | 711-7801-04 |
| **Inflow Systems, Inlet with Sump/Traps, Flow Splitter, Forebay, Flow Control Structures (Outlet Structures), Structures & Appurtenances** | | | | | | | |
| Inflow, Outflow, Pretreatment, Ponding/Conveyance | Flows are bypassing or short circuiting an inflow, pretreatment SCM treatment or outflow area | 1b, 5h | 2, 3, 4, 5 | … flow bypasses or short circuits an SCM component allowing untreated or insufficiently treated stormwater flows to be released. | Bypassing/short-circuiting caused by clogging. | Determine the cause of the bypass or short-circuiting of flow. If debris/sediment build-up is the cause, remove build-up and clean area.[3, 4] | 711-7801-02 |
| | | | | | Bypassing caused by structural problem, design related problem, or as a result of poor construction. | If flow bypasses/short circuits a component, determine if topography or misaligned structural features prevent flow from entering area. Review plans to determine the low-flow path through the component. Conduct a topographic survey if needed to assess elevations and define low-flow pathways. Regrade area or repair misaligned structural features to restore flow patterns. If cause cannot be clearly identified, repair should be designed by a professional engineer. | 711-7801-10 |
| Inflow, Pretreatment: Sediment Management Inlet with Sump/Trap, Flow Splitter | Sediment accumulation, trash or debris observed in sumped/trapped inlet structure or in flow splitter observed | 1d | 2, 3 | … accumulation is within 6 inches of base of inlet trap hood, or exceeds 50% of storage volume, or at/above cleanout depth specified on plans.<br><br>…floatable debris is at risk of clogging structure. | | Use vacuum truck or other appropriate means to remove all sediment and debris from inlet structure. [3, 4] | 711-7801-03 |
| | Evidence of oil, gasoline, or contaminants other than stormwater observed | 5f | 2, 3, 5 | …oil sheen or other contaminants present. | | Do not touch the substance in question. Attempt to find where the substance is originating.. Check for signs of gas or diesel fuel spill in the form of staining or evidence of an accident in the drainage area. Photograph and document the Potential Illicit Discharges (PIDs). Follow procedures for handling PIDs as specified in Publication 23-Chapter 8 – Section 8.9, Inspections.[4] | Pub. 23, Ch. 8.9 |
| Inflow, Pretreatment: Flow Splitter | Flow bypassing flow splitter | 1b, 5b, 5h | 3 | …signs of flow splitter being overflowed or bypassed. | | Repair areas of erosion. If cause cannot be clearly identified, repair should be designed by a professional engineer. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Water Quality, Inflow, Pretreatment | Mosquitoes present in pretreatment area or concrete structure | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a significant nuisance or danger to human or animals in the vicinity of the SCM. | | Determine the SCM component with standing water causing the mosquito concern. If an enclosed subsurface structure such as a sumped inlet is the source, a licensed applicator in pest management may be needed to treat enclosed/subsurface standing water with mosquito larvicides. A long-term solution may be necessary and should be evaluated by a professional engineer. [4] | 711-7801-02 |
| Inflow, Pretreatment: Sediment Management | Sediment accumulation in forebay observed | 1d, 5c | 2, 3 | …sediment accumulation affects flow, exceeds depth indicated by cleanout stake, or exceeds ½ the depth of the forebay. | | Conduct work when forebay is dry. Remove sediment from forebay and pipe ends as needed to original bottom elevation. [3] Restore bottom cover to match original design for vegetation, rock, or concrete. | 711-7801-02 |
| Inflow, Pretreatment: Vegetation | Vegetation in forebay observed | 4a | 2, 3 | …vegetation accumulation affects flow or exceeds 50% of forebay area. | | Conduct work when forebay is dry. Remove vegetation from forebay.[3] | 711-7801-07 |
| Inflow, Pretreatment: Forebay | Erosion of forebay embankment, side slopes and/or scouring of bottom | 2a, 2b | 2, 3 | ...gully erosion exceeds 6 inches in depth and/or width. | | Repair areas of erosion. Reestablish vegetative or appropriate protective cover as indicated in the plans. If problem persists, repair should be designed by a professional engineer. | 711-7801-06 |
| | Settlement of forebay embankment, side slopes and/or bottom | 2a, 2b | 2, 3 | ...settlement exceeds 4 inches. | | Repair to height as indicated in the plans. If problem persists, repair should be designed by a professional engineer. | 711-7801-01 |
| | No permanent pool | 5h | 2 | …designed to maintain a permanent pool. | | Line forebay with impermeable geotextile liner to maintain depth specified by plans. Repair should be designed by a professional engineer. | 711-7801-10 |
| Inflow, Outflow | Erosion, scour and/or structural undermining observed at inflow or outflow | 2a, 2c, 2d, 5b | 2, 3, 4, 5 | …flows erode vegetation and expose native soil around discharge point, erosion/scour causing sediment transport and/or undermining structures at inflow/outflow points/channels. | | If rock armoring (per plan) is missing, see "Inflow, Outflow: Riprap Apron". Otherwise, fill and compact the erosion/scour hole with soils and apply original plan specified permanent stabilization treatment. If problem is reoccurring or has undermined the end section, headwall or other nearby structure, repair should be designed by a professional engineer. | 711-7801-06 |
| | Inflow or outflow is partially or totally submerged by standing water | 3a, 3d | 3, 5 | …submerged condition impacts inflow/outflow capacity. | | If submerged condition is a result of standing water in SCM, refer to the SCM-specific corrective maintenance table.<br><br>If submerged outflow point is identified, assess downstream conditions to identify cause of backwater condition. Remove any blockages.[3,4] If cause is from normal high-water level of discharge location, repair should be designed by a professional engineer. | See SCM Specific Table<br><br>711-7801-03 |
| Inflow, Outflow, Ponding/Conveyance: Structure | Concrete or metal structure broken | 5b | 4, 5 | …concrete or metal structure is broken, spalled or otherwise damaged beyond repair and not functioning. | | Replace structure with new structure constructed in accordance with plans and manufacture specifications as appropriate. [3, 4] Ensure all orifices, weirs, pipes, etc. are installed per plans. In the absence of plans, repair should be designed by a professional engineer. | 711-7801-05 |
| | Concrete structure (top, sides or bottom) is damaged, cracked or otherwise compromised | 5b | 3, 4, 2, 5 | …cracks are wider than ½ inch or evidence of soil entering the structure.<br><br>…the structure is otherwise determined not structurally sound. | | Repair or replace structure to restore structural integrity. Repair all cracks wider than ½ inch or any that penetrate through the structure. In the absence of plans, repair should be designed by a professional engineer. [3,4] | 711-7801-05 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Inflow, Outflow: Structure | Cracks or leakage at joints noted in concrete structure or headwall | 5b | 2 | …cracks or open joints are noted. | | Repairs of concrete outlet structures may require application of hydraulic cement. Neoprene gaskets or gluable sheets of neoprene may be an option. [4] | 711-7801-05 |
| | | | 3 | …leaks have caused soil to deposit in pipe or structure. | | Same as above. Leak can be at construction joints or near pipe openings. Clean soil from pipe and outlet structure.[3,4] | 711-7801-05 |
| | Settlement adjacent to an inlet/outlet structure or pipe | 2c, 5b, 5d, 5h | 3, 4, 5 | …any depression near a pipe or structure is larger than 6 inches wide or deep. | | Soil settlement adjacent to an inlet/outlet structure suggests either there was incomplete compaction during construction; or there is a crack in the structure, joint or connecting pipe allowing soil to erode. Examine the inlet/outlet structure for evidence of cracks and soil intrusion. [4] Repair structure if damaged. If structure is sound with no evidence of soil intrusion, excavate over the depression to reveal pipe and confirm pipe/joints are sound. If damage is found, replace pipe or repair crack/joint. Clear pipe system of deposited soil. [3]<br>Apply the appropriate permanent vegetative stabilization in accordance with plans. | 711-7801-05<br>711-7801-03 |
| | Structure damage or misaligned frame on top slab | 5b | 2, 3 | …frame not sitting flush on top slab or frame not securely attached. | | Reattach, repair or replace separation of more than 3/4 inch of the frame from the top slab. If slab is out of level or off grade by 2 inches or more, it should be reset to replaced. Slabs with ½ inch wide cracks, cracks that are through the slab, or pitting of slab more than 2 inches deep should be repaired or replaced. Rusted reinforcement bars in top slab is an indication that replacement is warranted. [4] | 711-7801-05 |
| | Structure has settled or is misaligned | 5b | 2, 3 | …it creates a safety concern or impacts function. | | Settlement and subsequent misalignment indicates inadequate compaction of foundation material or water seepage around the structure. Investigate the cause of settlement. Excavate 2 feet on all sides and repair backfill materials. Plug sources of water seepage and recompact subgrade in 4 inch lifts by hand. If in good condition, reinstall existing structure; if damaged, replace with new structure. Ensure all elevations and connection sizes and configurations match plans. Elevation confirmation should be based on survey or relative measurements with respect to unmodified features as appropriate. | 711-7801-05 |
| | Metal components corroded | 5b | 2, 3 | …corrosion creates a safety concern or impacts function. | | Clean, weld and epoxy coat repairs or replace with corrosion-resistant hardware. Bolts should be stainless steel. Set stainless steel anchors with anchoring epoxy. | 711-7801-05 |
| Inflow, Outflow, Ponding/Conveyance: Pipe | Obstruction or blockage noted in pipe | 5h | 2 | …water does not flow into or out of the outlet structure or piping. | | Remove obstructions to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary). [3, 4] | 711-7801-03 |
| | Sediment buildup observed in pipe | 5c, 5h | 2 | …sediment or debris is buildup is $^1/_3$ or more the pipe diameter. | | Clean pipe. Utilize vacuum methods that do not cause sediment discharge nor erosive flows into the SCM if possible. If pipe jetting is required, place sediment protection at outlet of pipe utilizing straw bales or sand bags and filter cloth. | 711-7801-03 |
| | Cracks at the inlet/outlet pipe joints | 5b | 2 | …Evidence of soil entering through the joint of or cracks in a pipe. | | Repair cracks wider than ½ inch. [3,4] | 711-7801-05 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Inflow, Outflow: Pipe | Obstruction or blockage noted | 5h | 3 | …water does not flow into or out of the SCM. | | Remove obstructions to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary). If no obvious obstruction is visible, pipes may be clogged or collapsed. Arrange for pipe cleaning. Repairs beyond debris removal and pipe cleaning should be designed by a professional engineer. [3, 4] | 711-7801-02<br>711-7801-03 |
| Inflow, Outflow, Ponding/Conveyance: Structure | Access ladder is deteriorating or damaged | 5b | 2 | …ladder is corroded, deteriorated, not securely attached to structure, missing or not accessible. | | Replace corroded or deteriorated ladder using preformed ladder rungs. Secure ladder in accessible location using anchoring epoxy. Follow Department standards for materials and installation. [3,4] | 711-7801-05 |
| | Inlet, manhole or access cover/grate damaged or missing | 5b | 3, 4 | …lid, cover or grate is damaged, not working or missing. | | Secure entry point with fencing or barriers to prevent unauthorized entry or injury until cover has been replaced. Replace missing access covers/grates immediately.[3,4] When replacing grates, match opening size and configuration of original grate shown on plans.<br><br>Damaged grated covers: Repair damaged grated covers by welding replacement bars using materials meeting plan. Clean welds, remove loose rust and debris from entire cover, and apply 2 coats of epoxy paint to all metal components except stainless steel. [3,4] | 711-7801-05 |
| Outflow: Structure | Trash rack is broken or badly deteriorated | 5b | 2 | …openings in trash rack are either smaller or larger than when new, or the trash rack has deteriorated to the point where bars are bending. | | Replace deteriorated bars with new bars meeting requirements of plan. Weld bars together if separated from frame. Clean welds, remove rust and debris from entire trash rack, and apply 2 coats of epoxy paint. All parts of the trach rack should be coated with epoxy paint, except stainless steel. [3,4] | 711-7801-05 |
| | | | 2 | …the trash rack is loose. | | If frame is separated from structure, drill new hole in concrete, set concrete anchor with anchor epoxy, and use 1/2 inch or 3/8 inch stainless bolts. All parts should be double coated with epoxy paint, except stainless steel. [3,4] | 711-7801-05 |
| | | | 3 | …the trash rack is missing or destroyed. | | If the trash rack is missing or damaged beyond repair, Replace with trash rack meeting plan requirements. In the absence of plan information, install trash rack in accordance with Pub 72M RC-71M. [3,4] | 711-7801-05 |
| | Pipe riser, or anti-vortex plate is rusted, bent or leaking | 5b | 2, 5 | …rust has opened pathways for leakage; or when the riser, trash rack or anti-vortex device is severely bent, loose, or otherwise damaged. | | Repair of metal outlet structures may require full replacement. Anti-vortex device can be replaced with new one made of the same type of metal as riser. Openings and elevations must be same as original. In the absence of as-built plans, repair should be designed by a professional engineer. [4] | 711-7801-05 |
| **Earthen Emergency Spillway** | | | | | | | |
| Outflow: Earthen Emergency Spillway | Earthen emergency spillway not present | 5h | 4, 5 | …embankment over 3 feet high and/or there is concern for safety downstream. | | SCM modification should be designed by a professional engineer. | 711-7801-10 |
| | Riprap or hard armor missing/damaged (may not be present in all SCMs) | 2d, 5b, 5h | 2, 5 | …areas of riprap/hard armor is missing or damaged. | Rip-rap missing | Repair or replace rock armoring to original design. Replace geotextile fabric. Repair, regrade, and reseed eroded areas adjacent to rock armoring. If problem is reoccurring, repair should be designed by a professional engineer. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Outflow: Earthen Emergency Spillway | Minor erosion on emergency spillway embankment (fill) area observed | 2d | 2 | … erosion greater than 2 inches but less than 4 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent stabilization or other cover shown on plans to all disturbed areas. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Minor erosion on emergency spillway non-embankment (cut) area observed | 2d | 2 | … erosion greater than 4 inches but less than 12 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent stabilization or other cover shown on plans to all disturbed areas. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Major erosion on emergency spillway embankment (fill) area observed | 2d | 3, 5 | … erosion greater than 4 inches deep on embankment area of spillway. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of erosion. Promptly address erosion that may cause downstream problems (e.g., damage to highway or highway structure, homes, streams wetlands, railroads, etc.). Stabilize slope. Place topsoil and apply the appropriate permanent stabilization or other cover shown on plans to all disturbed areas. | 711-7801-06 |
| | Major erosion on emergency spillway non-embankment (cut) observed | 2d | 4, 5 | … erosion greater than 12 inches deep on non-embankment (cut) area of spillway. | | Take immediate action. A geotechnical engineer may be required to evaluate the cause of erosion. Promptly address erosion that may cause downstream problems (e.g., damage to highway or highway structure, homes, streams wetlands, railroads, etc.). Stabilize slope. Place topsoil and apply the appropriate permanent stabilization or other cover shown on plans to all disturbed areas. | 711-7801-01 |
| | Severe erosion on emergency spillway observed | 2d | 4, 5 | … evidence of erosion that threatens the integrity of the embankment, slope or adjacent structures. | | Take immediate action. A geotechnical engineer may be required to evaluate the cause of issue and direct repairs. Lower water surface by opening pond drain (if one exists). Use of pumps to draw down the pond may be required if standing water is present. Repair should be designed by a professional engineer. [3, 4] | 711-7801-01 |
| | Tree growth on emergency spillway | 4a | 2, 3, 4 | …creates blockage problems and may cause failure of the berm. | | Remove trees by cutting flush to ground (herbicide application may be required to prevent regrowth, consult District Roadside Specialist), and restore embankment to plan. Herbicides must be labeled for use in aquatic settings. Do not excavate into embankment to remove roots. [4] | 711-7801-07 |
| **Outfall Protection** | | | | | | | |
| Inflow, Outflow: Riprap Apron | Insufficient rock armoring observed at inflow or outflow points | 2a, 2c | 2, 5 | …flows expose soil around the rock armored area, or rock is missing from outfalls such as pipe inflow/outflow points, channels, and spillways. | | Repair or replace rock armoring to original design. Replace geotextile fabric, if present on plan. Repair, regrade, and reseed eroded areas adjacent to rock armoring. Repair any undermining of pipe or headwall associated with riprap outlet protection. If problem is reoccurring, repair should be designed by a professional engineer. | 711-7801-06 |
| Inflow, Outflow: Energy Dissipator or plunge pool | Cracks in concrete | 5b | 2, 3 | … concrete slab has spalling larger than 2 square inches and 1 inch depth, or cracks are wider than 1/2 inch. | | Repair spalling areas and cracks wider than ½ inch or replace. Use epoxy-bonding compound in accordance with Standard Special Provision Item 1090-0091. [3,4] | 711-7801-05 |
| Inflow, Outflow: Outfall Protection | Vegetation loss at interface of outfall protection and receiving channel | 2c, 4c | 2, 3 | … vegetation not well established at interface of outfall protection and receiving channel. | | Turf reinforcement mat may be used at this interface to provide additional structure for vegetation. Repair should be designed by a professional engineer. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Inflow, Outflow: Outfall Protection | Sediment accumulation or anti-skid materials in outfall protection | 1a, 1b, 1d, 1g, | 1, 2, 3 | … sediment deposits on top of rock pad or concrete exceeds 10% of the surface. | | Remove material accumulation using vacuum or hand removal methods appropriate for type and size of outfall protection material.[3] | 711-7801-02 |

[1] SCM Component corresponds to applicable sections of the CAI form.

[2] Defect code corresponds to applicable sections of the VSI form.

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.3: Basin, Most Types: Basin, Dry Detention (BDD); Basin, Dry Extended Detention (BED); Basin, Dry Ultra-Extended Detention (BUD); Basin, Naturalized Detention (BND); Basin, Other (BOT); Basin, Wet Detention (BWD); Basin, Infiltration (BID) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management on SCM Floor and SCM Vicinity | Tall or thick vegetation or invasive/undesirable species observed | 4a, 4d, 4e, 4f | 1, 2, 5 | …vegetation growth restricts access, obstructs water flow and interferes with maintenance activity.<br><br>…hydrophytic (wetland) plants are present, which is an indication of poor drainage. (N/A for BWD)<br><br>…invasive/undesirable species in vicinity of SCM jeopardize SCM plantings. | BDD, BED, BID, BUD, BND: Plans call for meadow, shrubs/plantings or special seed mix. | Review the plans to determine proper care. If landscaping plans are not available, an engineer and/or landscape architect should assess. If non-plan specified hydrophytic plants are present, refer to section "Outflow, Ponding/Conveyance: SCM Floor Soils or Media: Standing water is observed in SCM" to assess source of excessive moisture. If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters. Remove dead plants 30 to 60 days after spraying.[3] Mow the basin annually when dry if no conflicting instructions are provided on the plan. | 711-7801-07 |
| | | | 1 | | BDD, BED, BID, BUD, BND: Plans call for grass or turf seed mix. | Review the plans to determine proper care. Mow the basin annually when area is dry if no conflicting instructions are provided on the plan. Follow above procedures for invasive/undesirable species removal. If non-plan specified hydrophytic plants are present, refer to section "Outflow, Ponding/ Conveyance: SCM Floor Soils or Media: Standing water is observed in SCM" to assess source of excessive moisture. | 711-7801-07 |
| | | | 1 | | BID: Plans call for sand or stone. | Consult District Roadside Specialist regarding vegetation removal with herbicide. Remove all vegetation in the sand/stone area 30 to 60 days after spraying.[3] A certified applicator must perform the work with herbicides in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters. | 711-7801-07 |
| | | | 2, 5 | | BWD | Review the plans to determine proper care. If plans are not available, an engineer and/or landscape architect should be contacted to assess. If invasive/undesirable species are present, coordinate with a landscape architect or an environmental scientist to remove invasive/undesirable species and re-establishing native plantings.[3] | 711-7801-07 |
| Vegetation: Management on SCM Floor | Trees/shrubs or woody vegetation observed in ponding area | 4a, 4f | 1, 2, 5 | …tree/shrub/woody growth restricts access, obstructs water flow, or interferes with maintenance activity. | | If landscaping plans are available and indicate trees/shrubs/woody vegetation are not specified, remove trees/shrubs/woody vegetation. Do not drive equipment or trucks into basin that would compact basin floor.[3] If landscaping plans are not available, an engineer and/or landscape architect should be contacted to assess. | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 80% of the planted area is covered by vegetation in the SCM. | Shade is causing poor ground cover. Sun exposure is 6 hours or less per day. | Trim overhanging limbs and remove brushy vegetation that limit sunlight reaching grass and inhibits grass growth. Once sunlight is restored to area apply the appropriate permanent vegetative stabilization.[3] | 711-7801-07 |
| | | | | | Basin bottom is soggy. | Refer to section on "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM." | See Referenced Section |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | Topsoil not present or is insufficient. | Repair should be designed by a professional engineer. Possible remediation may include: Remove 4 inches of poor soil from affected area. Scarify soil surface. Place 4 inches of sandy loam topsoil (BID ONLY: with infiltration rate equivalent to original SCM design rate infiltration basins; do not compact soil.) Install planting or seed in accordance with plans, stabilizing promptly with rolled erosion control product. [3] | TBD |
| | | | | | Other | Review the plans to determine design plant coverage in basin bottom. If density is less than plan, determine cause of vegetation loss; a professional engineer or landscape architect should design the repair. If plans are not available, a professional engineer and/or landscape architect should be contacted to asses. | 711-7801-06 |
| Inflow, Pretreatment: Sediment Management | Sediment accumulation, trash or debris observed in vegetated channel or filter strip pretreatment area observed | 1b, 1e, 5c | 2, 3 | …sediment accumulation affects flow or exceeds allowable VFS, VSS, MFD, VSW, VSC depth or depth indicated on cleanout marker in channel.<br><br>…accumulation blocks flow entry or distribution of runoff into vegetated filter area. | | See applicable corrective maintenance table for Vegetated Filter Strip (VFS), Vegetated Filter Strip, Steep Slope (VSS); Media Filter Drain (MFD); Vegetated Swale(VSW), Vegetated Swale w/Check Dams (VSC). | See SCM Specific Table |
| Inflow, Outflow, Ponding/Conveyance: Sediment Management | Sediment accumulation on SCM floor observed | 1a, 5c | 2, 3, 5 | …sediment accumulation<br>• affects flow<br>• exceeds depth indicated on cleanout marker,<br>• in the absence of a cleanout marker, exceeds:<br>BDD, BED, BUD: the lesser of 6 inches depth or 10% of design basin volume<br>BWD: 50% ponding storage volume<br>BID: 1 inch. | BDD, BED, BUD, BOT, BND, BID | Remove sediment from basin floor areas using minimal disturbance techniques. Restore SCM bottom slope per plan. Apply the appropriate permanent stabilization.[3] | 711-7801-01 |
| | | | | | BWD | Remove sediment to restore capacity using pond dredging methods. Verify grade dimensions and elevation using plans.[3] | 711-7801-01 |
| Embankment/ Side Slopes[5] | Tall grass observed | 4f | 1 | …tall grasses are observed which may indicate that routine mowing is not occurring. | | Mow grass annually. | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 2, 3 | …less than 80% of the area is covered by vegetation on sloped areas. | | Review plans to determine specific vegetative cover. Repair any erosional damage and ensure at least 4 inches of topsoil is present. Reapply the plan specified permanent stabilization. | 711-7801-06 |
| | Trees/shrubs or woody vegetation observed | 4d | 1, 2, 3, 4, 5 | …trees, shrubs or woody vegetation over four feet in height are present. | Embankments (fill) | Woody vegetation should be removed. Cut stump flush to ground surface. Herbicide treatment of trunks may be required to prevent regrowth of trees (consult District Roadside Specialist); herbicides must be labeled use in aquatic settings. If stump removal is required, | 711-7801-07 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | the removal and embankment repair should be designed by a professional engineer. [3] | |
| | | | | | Side slopes (cut) | Review plans to determine if trees/shrubs are part of intended landscaping. If not, assess health and stability of woody vegetation. If the plant is healthy and does not cause a risk to the SCM, it can stay in place. If it could potentially damage the SCM or nearby facilities, it should be removed. Stumps may be left in place. [3] | 711-7801-07 |
| Embankment[5] | Minor erosion on embankment, inflow, outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 2 | …embankment slopes show evidence of erosion greater than 2 inches but less than 4 inches deep and there is the potential for continued erosion. | | Install and compact topsoil filling eroded area and apply the appropriate permanent vegetative stabilization. If repair is reoccurring, engineer should evaluate the cause of erosion. | 711-7801-06 |
| | Major erosion on embankment, inflow, outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 3, 5 | …embankment slopes show evidence of erosion greater than 4 inches deep. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of erosion. Promptly address erosion that may cause downstream problems (e.g., damage to highway or highway structure, homes, streams wetlands, railroads, etc.) due to either embankment failure or sediment migration. Stabilize slope with topsoil and apply the appropriate permanent vegetative stabilization to all disturbed areas. | 711-7801-06 |
| | Severe erosion on embankment, inflow, outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 4, 5 | …embankment slopes show evidence of erosion that threatens the integrity of the embankment. | | Take immediate action. Notify municipal officials if basin embankment failure could cause downstream flooding problems. Contact the District geotechnical engineer and, as directed, lower water surface slowly by opening pond drain (if one exists). Otherwise, obtain pumps and draw down the pond. Care must be exercised to not draw the water down too rapidly as to cause sloughing failure. In the case on BWD or SCM with established pond ecosystem, water draw down can be conducted with consideration to preserving the ecosystem. Repair should be designed by a professional engineer. | TBD |
| | Minor settlement or cracking of embankment not near outlet structure observed | 5d, 5h | 2, 3 | …part of the berm has settled approximately 4-12 inches. | | Repair settled berm to design height with similar materials. Material must be notched into existing pond embankment and properly compacted. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Major settlement or cracking of embankment not near outlet structure observed | 5d, 5h | 4, 5 | …part of the berm has settled more than 12 inches. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of the issue. Repair should be designed by a professional engineer. Possible remediation may include repairing settled berm to design height with similar materials. Material must be notched into existing dam and properly compacted. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Settlement or cracking of embankment near outlet structure observed | 5b, 5d | 3, 4, 5 | …part of the berm near an outlet structure has settled 4 inches or more, and is not leaking. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of issue and design repair. Determine if soil is entering pipe or outlet structure. Pipes and outlet structure may require repairs and cleaning. Compact borrow soil material around | 711-7801-05<br>711-7801-01 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | pipe and structure. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | |
| | Water observed flowing through basin embankment | 5h | 4, 5 | …water is flowing through an embankment, which could cause failure. | | Take immediate action. Notify municipal officials if basin embankment failure could cause downstream flooding problems. Contact the District geotechnical engineer and, as directed, lower water surface slowly by opening pond drain (if one exists). Otherwise, obtain pumps and draw down the pond. Care must be exercised to not draw the water down too rapidly as to cause sloughing failure. In the case on BWD or SCM with established pond ecosystem, water draw down can be conducted with consideration to preserving the ecosystem. Repair should be designed by a professional engineer. | TBD |
| Embankment[5] | Soil saturation or seeps at base of berm/dike observed | 5h | 2, 3, 4, 5 | …water is seeping through the berm or soils are saturated on the exterior face of berm. | | Decision on timing of repair depends on further evaluation. A geotechnical engineer may be required to evaluate the cause of issue. Monitor seep with decreasing regularity (daily, then weekly, then monthly) sufficient to determine if the rate or nature of the leak is changing. Repair should be designed by a professional engineer. | TBD |
| | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the basin embankment and present safety, structural or SCM functional risk. | | Fill holes with the same or similar material used in the embankment and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| | Sloughing or sliding of berm/dike observed | 2b, 5h | 3, 4, 5 | …sloughing or sliding of embankment is observed. | | Take prompt action. A geotechnical engineer should evaluate the cause of issue. Repair should be designed by a professional engineer. A possible repair procedure may be as follows: Excavate effected areas, bench to stepped level 4 feet wide by 4 feet high profile. Compact underlying soil. Place and compact new embankment using suitable soils (typically USCS classified ML to CL), extending 2 feet wider than intended finished profile. All compaction to be to 90% modified proctor density. Trim back to 4 inches less than finished profile. Add topsoil and apply the appropriate permanent vegetative stabilization. | TBD |
| Side Slopes[5] | Minor erosion on side slope observed | 2b | 2 | …slopes show evidence of erosion greater than 4 inches but less than 12 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and correct. | 711-7801-06 |
| | Major erosion on side slope observed | 2b | 3, 5 | …slopes show evidence of erosion greater than 12 inches deep. | | Address erosion that may lead to damage to highway or structures. Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization. A professional engineer should review to assess cause of problem. | 711-7801-01 |
| | Severe erosion on side slope observed | 2b | 4, 5 | …slopes show evidence of erosion that threatens the integrity of the slope, adjacent roadway, or structures. | | Take immediate action. A geotechnical engineer should evaluate the cause of issue and direct repairs. Repair should be designed by a professional engineer. | 711-7801-01 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Pretreatment, Ponding/Conveyance | Flows are bypassing or short circuiting within the pretreatment or SCM treatment area | 5h | 3, 4, 5 | …flow bypasses or short circuits within an SCM component allowing untreated or insufficiently treated stormwater flows to be released. | | Determine the cause of the bypassed or short circuited flow. [4] If debris/sediment build up is cause, resolve by removing material and cleaning area.[3] If flow still bypasses/short circuits the component, determine if topography or misaligned structural features prevent flow from entering area. Review plans to determine if a primary low-flow path through the component has been obstructed/silted. Conduct a topographic survey to assess elevations and define low flow pathways. Regrade area or repair misaligned structural features to restore flow patterns. If cause cannot be clearly identified, repair should be designed by a professional engineer. | 711-7801-02<br>711-7801-03<br>711-7801-10 |
| Outflow, Ponding/Conveyance: SCM Floor Soils or Media | Standing water is observed in SCM (N/A for BWD) | 1f, 3a, 3d, 4b, 4c, 4e, 5c | 2 | …standing water is observed on SCM floor and rainfall did not occur in previous 72 hours. | BDD, BED, BOT, BDN, BUD: Clogged outlet orifice/outlet structure failure. | Examine outlet structure, locating low flow orifice. Remove obstruction/debris. [3, 4] If sediment build up in SCM is causing blockage, remove sediment as described in "Inflow, Outflow, Ponding/Conveyance: Sediment Management- Sediment accumulation on SCM floor observed." If outlet orifice/weirs are not clogged and standing water is observed in flow control structure, investigate downstream outlet point for blockage.<br><br>If no flow is observed, the outlet pipe may be clogged or collapsed. Arrange for video inspection or pipe cleaning. Repair beyond debris removal/pipe cleaning should be designed by a professional engineer. | 711-7801-02<br><br>711-7801-03 |
| | | | | | BID: Sediment or poor soils may be cause of failure. | A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible repair procedure may be as follows: Aeration of soils by mechanically removing plugs, or replacement of soil to a depth as determined by testing. Remove layer of fine sediment and wet soils from bottom of basin[3], rake bottom, and verify infiltration capacity by performing infiltration test(s). If acceptable infiltration rates are confirmed, apply the appropriate permanent vegetative stabilization/topsoil based on plans or as otherwise directed. If infiltration still is not satisfactory, the geotechnical engineer should perform deep pit soils analysis and infiltration testing. Potential remediation's may involve design of a stone filled trench intersecting elevation of acceptable infiltration or installation of an underdrain converting BID into a BED. Dispose of sediment/soil in accordance with Department policy on handling of fill. | TBD |
| | | | | | BID: Thick matted grass may be the cause of failure. | Remove standing water and allow soils to dry for several days. Thatch grass area when dry. Rake up dead grass and clippings.[3] Aeration of soils by mechanically removing plugs may be required. | 711-7801-07 |
| Ponding/Conveyance: SCM Floor Soils or Media | Dying/browning or sparse vegetation is observed, suggesting excessive moisture | 4b, 4c, 4e, 5d | 2, 5 | …saturated soils remain long after a storm event; or standing water is observed on SCM floor when no rain in previous 72 hours. | BDD, BED, BUD, BND, BOT: Basin bottom settlement below low flow orifice or | Conduct field view to determine if low-flow orifice is above the bottom of the SCM floor. [4] If surrounding basin floor is lower than low-flow orifice, place soil to restore slope and geometry to plan dimensions. Soil used must be similar to the type of soil used in the | 711-7801-01 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | (N/A for BWD ) | | | | inadequate slope across basin floor from inflow points to outlet structure. | plans. Reseed/plant as needed to restore permanent vegetated cover as indicated in the plans.<br><br>If low-flow orifice is located flush with basin floor and/or field conditions match plans, the SCM may need to be regraded to provide sufficient slopes to drain water to the outlet structure. Repair should be designed by a professional engineer. Possible repair procedures may include collecting topographic survey of the SCM floor, side slopes/embankments, inflow and outflow features, developing a new grading plan to establish adequate flow. | |
| | | | | | BID: Infiltration capacity may be decreasing or areas may have been inadvertently compacted. | Continue to observe condition of vegetation and basin floor moisture. If basin floor soil is saturated or ponding remains for longer than 72 hours refer to "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM" section. | See Referenced Section |
| Ponding/Conveyance: SCM Floor Ponding Area | Permanent pool water level very low or dry (BWD only) | 3c | 3, 5 | …permanent pool elevations are significantly below proposed depth or basin is dry. | | A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible repair procedure will vary based on diagnosis. Possible causes include infiltration into surrounding soils, defective/damaged impermeable liner, piping/seepage through embankment, insufficient inflow/prolonged drought. | TBD |
| Ponding/Conveyance: SCM Floor General | Impermeable liner (N/A for BID, may be present in others) | 2b, 5b, 5h | 3, 5 | …impermeable liner has become exposed and/or damaged.<br><br>…evidence suggests impermeable liner is leaking below grade. | | Impermeable liners can be clay, geotextile, or composite geosynthetic. Repairs methods utilized should be based on liner material.<br><br>If impermeable liner has become exposed, inspect to confirm no punctures, tears or other damage has occurred. If liner is not damaged, restore cover layer using material consistent with original plan.<br><br>If exposed liner is damaged or evidence suggests a liner is damaged/leaking without being exposed, repair should be designed by a professional engineer. Suspected below grade liner damage requires removal of all planting material to locate damage. Possible repair procedure could involve partial or total liner replacement and consulting with liner manufacture for repair requirements for geosynthetic or bentonite clay liners. | 711-7801-10 |
| Ponding/Conveyance, Water Quality, Embankment/ Side Slopes: SCM Floor General | Beaver dams are observed | 5g, 5h | 1, 3 | …beaver dam inhibits function of SCM, jeopardizes infrastructure or notably reduces effective storage area of basin. | | Contact PA Game Commission to obtain assistance with relocation of beaver inhabitants. After beaver relocation, remove dam debris. [3] | 711-7801-02 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Outflow, Ponding/Conveyance, Water Quality: SCM Drain/ Mechanical Assemblies | Damaged, non-functioning, or missing components found | 5b | 3 | …water continues to flow after shutting the valves/gates or they cannot be opened/closed or are otherwise not functioning properly. | | Install cofferdam to dewater work area if possible; pump or drain pond if needed. Repair or replace valves/gates with similar components.[4] Divert flows when valves are out of service. | 711-7801-05 |
| Outflow, Ponding/Conveyance: Underdrain (N/A for BWD) | Obstruction or blockage noted | 5h | 2 | …water does not flow into or out of the outlet structure or piping from underdrain. | | Look for cause of blockage, such as trash in flow control structure. Remove obstructions from underdrain to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary by flushing or vacuuming pipes from cleanouts).[3, 4] Replace any damaged pipe. Repair may require excavation of underdrain. | 711-7801-03<br>711-7801-05 |
| Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe | Settlement observed over underdrain or outlet pipe | 2b , 5d, 5h | 2 | …soil is entering underdrain or pipe system. | | Soil settlement over an underdrain or pipe is a sign that a pipe wall or pipe joint has failed. Dig up and replace pipe or repair crack/joint. Clear pipe system of deposited soil.[3] Care must be taken not to compact basin floor. In SCMs with infiltration/filtration, hand tamp to compact borrow soil material around pipe within SCM floor. Use mechanical compaction in non-infiltrating/filtrating SCMs. Apply the appropriate permanent vegetative stabilization in accordance with plans. | 711-7801-05 |
| Water Quality | Algae (for BWD) | 3a, 3d, 5h | 2, 5 | … algae growth covers more than 50% of pond area or the pond has an odor. | | Excessive algae growth is an indicator of excess nutrients from fertilizers in the water or decomposing materials on the SCM surface beneath the water. An engineer and/or landscape architect should assess the problem. The short term solution is physical removal of the algae. Pump pond dry and clean out the bottom.<br><br>Long term resolution/prevention of reoccurrence should include a review of the SCM drainage area for possible sources of nutrient runoff. Review SCM construction and maintenance records to identify if excess is from SCM operation activities. If obvious sources cannot be identified/eliminated, the SCM may require additional pretreatment or buffer areas.<br><br>Note: Standing water should be present for prolonged periods only in BWDs. See "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM" for all other SCM types. | TBD |
| | Turbidity | 3a, 3d, 5h | 3, 5 | …sediment laden water present in SCM ponding area. | BDD, BED, BUD, BND, BOT, BWD | Investigate source of sediment laden flows. If a portion of the contributing drainage area has been disturbed, install permanent stabilization such as vegetative cover and monitor for establishment. If no obvious contributing source is identified, the SCM may require additional pretreatment for sediment removal and the repair should be designed by a professional engineer. Resolution may include installation of a forebay, water quality device or other sediment collecting pretreatment means. After turbidity has been resolved, the SCM floor should be clean of accumulated sediment. | 711-7801-06<br>711-7801-02<br>711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | Note: Water should be present for prolonged periods only in BWDs. For all other SCMs, if recent rainfall has not occurred, also see "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM." | |
| | | | | | BID | Turbidity/ suspended solids present a significant risk of clogging the SCM, impacting the SCM's ability to function. After turbidity source issue has been eliminated, the BID should be observed after a storm event to confirm that infiltration still occurs within the design time period. If infiltration appears to be diminished, the repair should be designed by a professional engineer. Resolution may include replacement of a portion or all of infiltration media. | 711-7801-06<br>711-7801-02<br>711-7801-10 |
| Water Quality | Large permanent geese or other waterfowl population (for BWD) | 5f | 2 | …evidence of over 20 permanent waterfowl inhabitants per acre of pond surface area and noted waste accumulation. | | Ensure fecal matter does not cause water quality impacts by monitoring SCM discharge points for elevated fecal coliform. If required, contact PA Game Commission for population relocation assistance. Allowing 3 foot tall grass buffer to surround the SCM for an 5 to 8 foot width will discourage waterfowl from using pond.<br><br>Note: Water should be present for prolonged periods only in BWDs; other basin SCMs should not attract permanent waterfowl residence. | 711-7801-11 |
| | Mosquitoes | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a nuisance or danger to human or animals in the vicinity of the SCM. | | Determine which SCM component has standing water causing the mosquito concern. If an enclosed subsurface structure such as a sumped inlet catch basin is the source, a licensed applicator in pest management should treat enclosed/ subsurface standing water with mosquito larvicides. A long-term solution involving the replacement of the subsurface standing water component can be explored and a professional engineer should design the replacement of the structure with an alternative feature. [4]<br><br>If the ponding is on the SCM surface, for all basins except BWD, see "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM" to resolve prolonged standing water issue. In BWD, excess mosquito presence is an indication of a poorly functioning ecosystem A professional engineer or wetland scientist should assess and develop remediation plan. | 711-7801-02 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

[5] Side Slopes are the inside SCM walls formed below surrounding grade where the SCM side wall is constructed by excavating below grade. Embankments, or berms are 'fill' material constructed above the surrounding ground forming a side wall of the SCM. Embankments may not be present in all SCMs. Embankments may be considered a regulated dam structure depending on height and drainage area.

**Table E.1.4: Bioretention (BRE); Bioretention W/Underdrain (BRU) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Variant or Cause of Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management on SCM Floor | Basin Floor Soils or Media – excessive moisture | 3a, 4b, 4e | 2 | …presence of wetland vegetation or death of originally proposed plant material suggests that basin is not draining as designed. | | Review plans for original vegetative cover requirements, confirming wetland plants were not specified. Examine the underdrain system, outlet structure, and soil media to determine cause of poor drainage as described in "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM floor." Consider that a high water table may be the cause of the problem. Replanting of the facility may be required once the poor drainage is corrected. Follow instructions for original design to replant facility or contact a landscape architect to determine if alternative plants should be recommended. | 711-7801-07 See Referenced Section |
| | Tall or thick grass, vines, weeds, or invasive/undesirable species observed | 4a, 4f | 2 | …vegetation growth crowds out desired plantings, restricts access, obstructs water flow or interferes with maintenance activity. | Plans call for mix of vegetation. | Hand weeding may be required. Weeds must be pulled by roots to prevent regrowth. Be sure to not remove vegetation that is supposed to be there. If invasive/undesirable species are present, a certified applicator should perform the work with herbicides in accordance with District and Department requirements. Herbicide should be labeled for use around surface waters. Remove dead plants 30 to 60 days after spraying. If facility was designed to have mulch, place a 2 to 3 inch layer of shredded hardwood mulch on all areas of the facility. [3] | 711-7801-07 |
| | | | 1 | | Plans call for grass. | Mow grass annually. If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters. Remove dead plants 30 to 60 days after spraying. [3] | 711-7801-07 |
| | Trees and shrubs dying in ponding area but no signs of prolonged inundation observed | 4b | 2 | …trees and shrubs are dying. | | A landscape architect should be contacted to determine why the trees and shrubs are dying and to recommend replacement plants. Remove dead or dying plants. Cut trees flush with the ground. Do not remove roots of trees. Replace the plants as directed by the landscape architect. [3] | 711-7801-07 711-7801-06 |
| | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 80% of the proposed vegetation from the original design has survived. | Shade is causing plant mortality. Sun exposure is 6 hours or less per day. | Trim overhanging limbs and remove brushy vegetation that limit sunlight reaching grass and inhibits grass growth. Once sunlight is restored to area apply vegetation in accordance with the plans. [3] | 711-7801-07 |
| | | | | | Basin bottom is soggy. | Refer to section on "Outflow, Ponding/Conveyance: SCM Floor Soils or Media – Standing water is observed in SCM". | See Referenced Section |
| | | | | | Invasive/undesirable species crowding out desired vegetation. | Refer to section on "Vegetation: Management on SCM Floor – Tall or thick grass, vines, weeds or invasive/undesirable species observed". | See Referenced Section |
| Vegetation: Mulch on SCM Floor | Mulch layer thin | 5h | 1 | …mulch is not thick enough to prevent weed growth. | | Two to three inches of shredded hardwood mulch should be present. Be sure the facility is free of weeds before adding mulch. Weeds must be pulled by roots to prevent regrowth. | 711-7801-07 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Variant or Cause of Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Mulch on SCM Floor | Mulch accumulation near outlet structure | 5h | 2 | …mulch being washed out of facility. | Softwood mulch that is too light to remain in place when facility is full of water may be the cause. | Remove all old mulch. Be sure the facility is free of weeds including weed root systems to prevent regrowth before adding mulch. Apply 2 to 3 inches of shredded hardwood mulch. [3] | 711-7801-06 |
| Inflow, Outflow, Ponding/Conveyance: Sediment Management | Sediment accumulation on SCM floor observed | 1a, 5c | 2, 3 | …sediment accumulation affects flow through bioretention system, exceeds depth indicated by cleanout marker or, in absence of cleanout marker, exceeds 3 inches in depth. | | Conduct work when SCM is dry. Remove sediment and 3 to 4 inches of bioretention soil working around existing plant material taking care not to damage roots. Replace bioretention soil with soil meeting requirements of the plans. Reseed or replant if needed in accordance with the original plans to restore vegetated cover. Apply 3 to 4 inches of shredded hardwood mulch, if indicated on the plans. [3] | 711-7801-01<br>711-7801-10 |
| Embankment/ Side Slopes[5] | Tall grass observed | 4f | 1 | …tall grasses are observed which may indicate that routine mowing is not occurring. | | Review planting plan to assess if tall grass is intentionally planted ornamental grasses intended to be observed height. If tall grasses are not intended to be present, mow grass annually. | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 2, 3 | …less than 80% of the area is covered by vegetation or eroded patches occur on the sloped area. | | Review plans to determine required vegetative cover. Repair any erosional damage and ensure 4” of topsoil is present. Reinstall appropriate permanent vegetative stabilization in accordance with plans. | 711-7801-06 |
| | Trees/shrubs or woody vegetation observed | 4d | 2, 3, 4, 5 | …trees, shrubs or woody vegetation over four feet in height could lead to piping through embankment leading to failure. | Embankments (fill) | Woody vegetation should be removed Cut stump flush to ground surface. Herbicide treatment of trunks may be required to prevent regrowth of trees(consult District Roadside Specialist); herbicide must be labeled for use in aquatic settings. If stump removal is required, the removal and embankment repair should designed by a professional engineer. [3] | 711-7801-07 |
| | | | | | Side slopes (cut) | Review plans to determine if trees/shrubs are part of intended landscaping. If not, assess health and stability of woody vegetation. If the plant is healthy and does not cause a risk to the SCM, it can stay in place. If it could potentially damage the SCM or nearby facilities, it should be removed. Stumps may be left in place. [3] | 711-7801-07 |
| Embankment[5] | Minor erosion on embankment, outlet/outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 2 | …slopes show evidence of erosion greater than 2 inches but less than 4 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization to all disturbed areas. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Major erosion on embankment, outlet/outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 3, 5 | …slopes show evidence of erosion greater than 4 inches deep. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of erosion. Promptly address erosion that may cause downstream problems (e.g., damage to highway or highway structure, homes, streams wetlands, railroads, etc.) due to either embankment failure or sediment migration. Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization to all disturbed areas. | 711-7801-06 |
| | Severe erosion on embankment, outlet/outfall, and/or | 2a, 2b, 2c, 2d | 4, 5 | …slopes show evidence of erosion that threatens the integrity of the embankment. | | Take immediate action. A geotechnical engineer may be required to evaluate the cause of issue and direct repairs. Lower water surface by opening pond drain (if one exists). Use of pumps to draw down | TBD |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Variant or Cause of Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | emergency spillway observed | | | | | the pond may be required. Care must be exercised to not draw the water down too rapidly as to cause sloughing failure. Repair should be designed by a professional engineer. | |
| Embankment[5] | Settlement or cracking of embankment not near outlet structure observed | 5d, 5h | 2, 3 | …part of the berm has settled approximately 4 or more inches. | | Repair settled berm to design height with similar materials. Material must be notched into existing pond berm and properly compacted. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Settlement or cracking of embankment near outlet structure observed | 5b, 5d | 3, 4, 5 | …part of the berm near an outlet structure has settled 4 inches or more, which may be a sign of leaking. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible remediation may include: Determine if soil is entering pipe or outlet structure. Pipes and outlet structure may require repairs and cleaning. Compact borrow soil material around pipe and structure. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-05<br>711-7801-01 |
| | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the basin embankment present safety, structural or SCM functional risk. | | Fill holes with the same or similar material used in the embankment and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| Side Slopes[5] | Minor erosion on side slope observed | 2b | 2 | …slopes show evidence of erosion greater than 4 inches but less than 12 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Major erosion on side slope observed | 2b, 2c, 2d | 3 | …slopes show evidence of erosion greater than 12 inches deep. | | Address erosion that may lead to problems (e.g., damage to highway or structures, etc.). Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Severe erosion on side slope observed | 2b, 2c, 2d | 4, 5 | …slopes show evidence of erosion that threatens the integrity of the slope, adjacent roadway, or structures. | | Take immediate action. A geotechnical engineer should evaluate the cause of issue and direct repairs. Repair should be designed by a professional engineer. | 711-7801-01 |
| Outflow, Ponding/Conveyance: SCM Floor Soils or Media | Standing water is observed in SCM floor | 1f, 3a, 3d, 4b, 4c, 4e, 5c | 2 | …rainfall did not occur in previous 72 hours and observation well or underdrain cleanout in BRU has little to no water above outlet invert. | Thick matted grass, or other vegetation clogging surface. | Remove standing water. Thatch grass area when dry. Rake up dead grass and clippings. [3] | 711-7801-07 |
| | | | | | Top layer of soil clogged. | Use a soil probe or soil auger to examine the SCM soil. If standing water/saturated soil is limited to top few inches of soil, likely the top layer of soil is clogged by sediment. See “Inflow, Outflow, Ponding/Conveyance: Sediment Management -Sediment accumulation on SCM floor observed” for instructions on repair. | See Referenced Section |
| | | | 2, 5 | | Geotextile clogged. | Use a shovel to dig to top of geotextile (if present). Examine the fabric for signs of clogging and water passage. If water not passing through geotextile fabric, the geotextile fabric is likely clogged. Consult with an engineer to design this repair. Possible remediation may include: Remove plants and preserve in shade (water daily). Remove and dispose of mulch. Remove engineered or amended soil and stockpile for reuse. Be sure to not allow soil to fall onto stone under fabric. Remove and dispose of geotextile fabric. Engineer | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Variant or Cause of Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | should specify correct geotextile fabric or determine another repair method. Replace and do not compact engineered or amended soil. Replace plants. Apply 3 to 4 inches of shredded hardwood mulch, if indicated on plans.[3, 4] | |
| | | | 2, 5 | …rainfall did not occur in previous 72 hours and observation well or underdrain cleanout in BRU indicates underdrain is full of water with no flow at outlet point. | Clogged or collapsed underdrain or outlet pipe. | See section titled "Underdrain and Outlet Pipe-Settlement observed over underdrain/ outlet pipe- Settlement observed over underdrain." | See Referenced Section |
| | | | | | Clogged outlet orifice/outlet structure failure. | Remove obstruction/debris, ensuring to completely unclog the low flow outlet in the outlet structure.[3, 4] If outlet is not clogged and standing water is in outlet structure, investigate downstream outlet point for signs of flow. If no flow is observed, the outlet pipe maybe clogged or collapsed. Arrange for pipe cleaning. Repair beyond debris removal/pipe cleaning should be designed and/or approved by a professional engineer. | 711-7801-02<br>711-7801-03 |
| | | | | …water flowing from underdrain in BRU when there has been no rain in last 72 hours. | Suspected high ground water. | See section titled "Outflow, Ponding/Conveyance: Underdrain-prolonged flows." | See Referenced Section |
| | | | 2 | …rainfall did not occur in previous 72 hours for BRE. | Thick matted grass, or other vegetation clogging surface. | Remove standing water. Thatch grass area when dry. Rake up dead grass and clippings. [3] | 711-7801-07 |
| | | | | | Top layer of soil cogged. | See "Inflow, Outflow, Ponding/Conveyance: Sediment Management - Sediment accumulation on SCM floor observed" for instructions on repair. | See Referenced Section |
| | | | 2, 5 | | Geotextile clogged. | See above BRU Geotextile clogged instructions. | See Referenced Section |
| | | | | | Poorly infiltrating underlying soils. | If SCM is non-under drained infiltrating system and media soils/geotextile are not clogged, underlying soils may have insufficient or poor infiltration capacity. A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible repair procedure may be as follows: Remove and stock pile filter media. Conduct test pit explorations and infiltration testing at the bottom of SCM and at successive depths below SCM bottom to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below the original SCM bottom elevation, reconstruct SCM with a new lower bottom elevation, using additional filter media to bring the top surface of the SCM to plan surface geometry. [3] | 711-7801-10 |
| Ponding/Conveyance | Subsurface infiltration area not draining | 3b | 2, 5 | …standing water is observed in SCM observation wells and rainfall did not occur in previous 72 hours. | | Review plans to confirm intended function of subsurface storage. [4] If plans indicate the subsurface storage area is designed as an anaerobic nitrogen treatment area with standing water present, standing water is acceptable and no action is required. If subsurface storage area is intended to be infiltration or slow release storage area that is dry between storm events, see corrective maintenance tables | See Referenced Section |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Variant or Cause of Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | for "Subsurface Infiltration Trench (SIT)" and "Subsurface Detention Storage (SDS)" as appropriate. Note, most systems are designed to be dry between storm events. | |
| Ponding/Conveyance: SCM Floor Soils or Media | Erosion observed | 2b | 2, 3, 4, 5 | …rutting, rills, or scour present in basin bottom, especially from inflow structures. | Erosion limited to mulching layer | Restore mulch to even cover of basin bottom. Replace any damaged vegetation per the plan. Attempt to find reason for channelized flow, check for blockage or damage at inlet structure remove or repair as needed. If issue is reoccurring, install energy dissipator at inlet to disperse flow. | 711-7801-06 |
| | | | | | Erosion extends into soil media. | An engineer may be required to evaluate cause of erosion. Possible remediation may include: Attempt to find reason for the channelized flow that is causing the erosion. Evaluate velocities entering basin and consider adding energy dissipator, rock channel, turf reinforcement matting or grade breaks. Restore soil and mulch. Soil should be as specified on the plans. Replace any damaged vegetation per the plan. Add 2 to 3 inches of shredded hardwood mulch if the facility was designed to have mulch. | TBD |
| | Basin bottom below designed proposed grade | 2b, 5d | 3, 4, 5 | …evidence of settlement of basin bottom. | Amended soil compaction may be cause of lower grade. | An engineer may be required to evaluate cause of settlement. Possible remediation may include: Verify depth of amended/engineered soils. Remove compacted soils. Replace with the appropriate soil mixtures, permanent mulch and plantings as indicated on the original design plans.[3] | TBD |
| | | | | | Erosion of amended soils may be cause of failure. | Refer to Section on "Ponding/Conveyance: SCM Floor Soils or Media – Erosion Observed." | See Referenced Section |
| Ponding/Conveyance: SCM Floor General | Impermeable liner visible and/or damaged (note liners are not be present in all SCMs) | 2b, 5b, 5h | 3, 5 | …impermeable liner has become exposed and/or damaged.<br><br>…evidence suggests impermeable liner is leaking below grade. | | Impermeable liners can be clay, geotextile, or composite geosynthetic. Repairs methods utilized should be based on liner material.<br><br>If impermeable liner has become exposed, inspect to confirm no punctures, tears or other damage has occurred. If liner is not damaged, restore cover layer using material consistent with original plan.<br><br>If exposed liner is damaged or evidence suggests a liner is damaged/leaking without being exposed, repair should be designed by a professional engineer. Suspected below grade liner damage requires removal of all planting material to locate damage. Possible repair procedure could involve partial or total liner replacement and consulting with liner manufacture for repair requirements for geosynthetic or bentonite clay liners. | 711-7801-10 |
| Outflow, Ponding/Conveyance: Underdrain | Prolonged flows | 3d, 5h | 2, 5 | …underdrains carry continuous flow when it has not rained in the previous 72 hours and there is no standing water on SCM surface. | | High or perched groundwater may be present. Repair should be designed by a professional engineer. Process may include test pits and ground water monitor to assess typical water table elevation and assess potential limiting layers beneath the SCM. | TBD |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Variant or Cause of Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Water Quality | Algae | 3a, 3d, 5h | 2, 5 | …excessive algae growth present. | | Water should not be present for periods more than 72 hours to allow algae growth. See "Outflow, Ponding/Conveyance: SCM Floor Soils or Media: Standing water observed in SCM floor" to address standing water problem. | See Referenced Section |
| | Turbidity | 3a, 3d, 5h | 3, 5 | …sediment laden water present in SCM ponding area. | | Investigate source of sediment laden flows. If a portion of the contributing drainage area has been disturbed, install permanent stabilization such as vegetative cover and monitor for establishment. If no obvious contributing source is identified, the SCM may require additional pretreatment for sediment removal, and the repair should be designed by a professional engineer. Resolution may include installation of a forebay, water quality device or other sediment collecting pretreatment means. After the source has been minimized, the SCM floor should be clean of accumulated sediment.<br><br>Turbidity/suspended solids present a significant risk of clogging the top layer of the SCM, impacting the SCM's ability to function. After the source of sediment has been minimized, surface infiltration testing should be performed to confirm actual infiltration rates match design rates.<br><br>If recent rainfall has not occurred, also see "Outflow, Ponding/Conveyance: SCM Floor Soils or Media: Standing water observed in SCM floor." | 711-7801-06<br>711-7801-02<br>711-7801-10 |
| | Mosquitoes | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a nuisance or danger to human or animals in the vicinity of the SCM. | | Determine the SCM component with standing water causing the mosquito concern. If an enclosed subsurface structure such as a sumped inlet catch basin is the source, a licensed applicator in pest management should treat enclosed/subsurface standing water with mosquito larvicides. A long term solution involving the replacement of the subsurface standing water component can be explored and a professional engineer should design the replacement of the structure with an alternative surface feature. [4]<br><br>If the ponding is the SCM surface, see "Outflow, Ponding/Conveyance: SCM Floor Soils or Media: Standing water observed in SCM floor" to resolve prolonged standing water issue. | 711-7801-02 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

[5] Side Slopes are the inside SCM walls formed below surrounding grade where the SCM side wall is constructed by excavating below grade. Embankments, or berms are 'fill' material constructed above the surrounding ground forming a side wall of the SCM. Embankments may not be present in all SCMs. Embankments may be considered a regulated dam structure depending on height and drainage area.

**Table E.1.5: Subsurface Infiltration Trench (SIT) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management in/on SCM | Tall or thick vegetation or invasive/undesirable species observed | 4a, 4e, 4f | 1, 2 | …vegetation growth restricts access, obstructs water flow and interferes with maintenance activity.<br><br>…hydrophytic (wetland) plants are present, which is an indication of poor drainage. | Plans call for meadow, turf or seed mix. | Review the plans to determine proper frequency and height of mowing. Mow the SCM annually when dry to a height of 6 inches if no instructions are provided on the plan. If non-plan specified hydrophytic plants are present, refer to section "Outflow, Ponding/Conveyance: Above or in SCM- Standing water is observed above or in in subsurface storage area" to assess excessive moisture. If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide shall be labeled for use in and around surface waters. Remove dead plants 30 to 60 days after spraying.[3] Mow the basin annually if no instructions are provided on the plan. | 711-7801-07 |
| | | | 1, 2 | | Plans call for sand, gravel or stone surface. | Consult District Roadside Specialist regarding vegetation removal with herbicide. Remove all vegetation in the sand/stone area 30 to 60 days after spraying.[3] A certified applicator must perform the work with herbicides in accordance with District and Department requirements. Herbicide shall be labeled for use in and around surface waters. If non-plan specified hydrophytic plants are present, refer to section "Outflow, Ponding/conveyance: SCM Surface- Standing water is observed on SCM surface or in subsurface storage area" to assess excessive moisture. | 711-7801-07 |
| | Trees/shrubs or woody vegetation observed in SCM | 4a, 4f | 1, 2, 5 | …tree/shrub/woody growth within footprint of infiltration trench. | | Remove trees/shrubs/woody vegetation. Cut trunk flush to ground. Application of herbicide designed to kill trees may be required. Herbicide should be labeled for use around surface waters. Do not drive equipment or trucks into SCM that would cause compaction.[3] | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 80% of the area is covered by vegetation or bare patches occur in more than 10% of the SCM. | Shade is causing poor ground cover. Sun exposure is 4-6 hours or less per day. | Trim overhanging limbs and remove brushy vegetation that limit sunlight reaching grass and inhibits grass growth. Once sunlight is restored to area apply the appropriate permanent vegetative stabilization.[3] | 711-7801-07 |
| | | | | | Topsoil not present. | Replace topsoil, regarding area to original plan contours. Do not compact soil. Reseed in accordance with original SCM plans, stabilizing immediately with rolled erosion control product. If problem is reoccurring, repair should be designed and/or approved by a professional engineer.[3] | 711-7801-06 |
| Inflow, Outflow, Ponding/Conveyance: Sediment Management | Sediment accumulation on SCM surface observed | 5c | 2 | …sediment or debris build up exceeds 3 inches or any depth if infiltration is impeded (in SITs with gravel or vegetated surface where surface flows infiltrate through soil media into the gravel storage area). | | Remove sediment from SCM surface areas using minimal disturbance techniques. Restore slope and geometry to plan dimensions. In vegetative SITs, restore permanent vegetated stabilization indicated by plans. In gravel/sand surface SITs, restore surface using materials matching plan requiremnts.[3] | 711-7801-01 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Outflow, Ponding/Conveyance: Above or in SCM | Standing water is observed above or in subsurface storage area | 1f, 3a, 3b, 3d | 2 | …rainfall did not occur in previous 72 hours and observation well/underdrain cleanout indicates underdrain has no water above outlet invert. | Clogged SIT surface. | Use a soil probe or soil auger to examine the surface soils. If standing water/saturated soil is limited to top few inches of soil, likely the top layer of soil is clogged by sediment. See "Inflow, Outflow, Ponding/Conveyance: Sediment Management - Sediment accumulation on SCM surface observed" section. | See Referenced Section |
| | | | 2, 5 | | Geotextile Clogged. | Use a shovel to dig to top of geotextile (if present). Examine the fabric for signs of clogging and water passage. If water not passing through geotextile fabric, the geotextile fabric is likely clogged. Repair should be designed by a professional engineer. Possible remediation may include: excavate and remove existing trench material and dispose of geotextile fabric. Engineer should specify correct geotextile fabric or determine other repair method. Reconstruct trench. [3, 4] | 711-7801-10 |
| | | | | | Poorly infiltrating underlying soils. | If soils/geotextile are not clogged, underlying soils may have insufficient or poor infiltration capacity. Repair should be designed by a professional engineer. Possible repair procedure may be as follows: Conduct test pit explorations and infiltration testing adjacent to the SIT foot print at the bottom elevation and at successive depths below SIT bottom to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below the original SIT bottom elevation, reconstruct SIT with a new lower bottom elevation, using additional materials to bring the top surface to plan surface geometry. [3] | 711-7801-10 |
| | | | 2, 5 | …rainfall did not occur in previous 72 hours and observation well/underdrain cleanout indicates underdrain is full of water with no flow at outlet point. | Clogged or collapsed underdrain or outlet pipe. | See section on "Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe - Obstruction or blockage noted." | See Referenced Section |
| | | | | | Clogged outlet orifice/outlet structure failure. | Remove obstruction/debris from outlet structure.[3, 4] If outlet is not clogged and standing water is in outlet structure, investigate downstream outlet point for signs of flow. If no flow is observed, the outlet pipe maybe clogged or collapsed. Arrange for pipe cleaning. Repair beyond debris removal/pipe cleaning should be designed and/or approved by a professional engineer. | 711-7801-02<br>711-7801-03<br><br>711-7801-05 |
| | | | 5 | …water flowing constantly from underdrain and it has not rained in the previous 72 hours. | Suspected high ground water. | See section titled "Outflow, Ponding/Conveyance: Underdrain-prolonged flows". | See Referenced Section |
| Ponding/Conveyance: SCM Surface | Signs of general settlement or compaction over grass or paved surface above SCM area | 5d | 2, 5 | …depression detrimentally effects ability to use paved surfaces for intended purpose.<br><br>…depression causes excessive ponding or impacts permeable area. | | Review geology of area to confirm settlement is not due to karst action. If karst area, see "Ponding/Conveyance: SCM Surface-Sinkhole Observed."<br>If no karst geology is present:<br><br>If problem is reoccurring, a geotechnical engineer should to evaluate the cause of issue. | See Referenced Section |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | In paved areas, check integrity of geotextile fabric saw cut a rectangular pavement area 1 feet beyond limit of depression in all directions. [3] Removed settled pavement section to saw cut lines, place subbase material in 6 inch lifts, hand tamping each lift to elevation of original top of subbase course. Reinstall paving in accordance with plan pavement type or current equivalent.<br><br>In pervious area, place soils matching plan specifications over SCM footprint, compacting as specified by plans to bring area to plan specified grade. If no compaction method is specified, place in 6" lifts and hand tamp. Reseed/plant as needed to restore vegetated cover indicated on the plans applying the appropriate permanent vegetative stabilization and rolled erosion control product. In gravel/sand surface SITs, restore surface using materials matching plan requiremnts.[3] | 711-7801-01<br><br>711-7801-01 |
| Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe | Obstruction or blockage noted | 5h | 2 | …water does not flow into or out of the outlet structure or piping. | | Remove obstructions to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary). [3, 4] | 711-7801-02<br>711-7801-03 |
| | Settlement observed over underdrain or outlet pipe | 2b, 5d, 5h | 2 | …soil is entering underdrain or pipe system. | | Soil settlement over an underdrain or pipe is a sign that a pipe wall or pipe joint has failed. Dig up and replace pipe or repair crack/joint. Clear pipe system ofsoil.[3,4] Care must be taken not to compact SIT. Re-install geotextile warp around gravel trench. Hand compact soils above SIT. Apply the appropriate permanent vegetative stabilization rolled erosion control product in accordance with plans. | 711-7801-05 |
| Outflow, Ponding/Conveyance: Underdrain | Standing water in observation well | 3b | 2, 5 | …standing water is observed in observation wells and rainfall did not occur in previous 72 hours. | | See "Outflow, Ponding/Conveyance: Above or in SCM - Standing water is observed above or in subsurface storage area" section for evaluation procedure. | See Referenced Section |
| | Prolonged flows | 3d, 5h | 2, 5 | …underdrains carry continuous flow and it has not rained in the previous 72 hours. | | High groundwater may be present. Repair should be designed by a professional engineer. Process may include test pits and ground water monitor to assess typical water table and assess potential limiting layers beneath the SCM. | TBD |
| Ponding/Conveyance: Observation Wells | Observation well cover missing or damaged | 5b | 2 | …observation well cover is missing or well is damaged. | | Replace missing access cover with cover meeting plan specifications. | 711-7801-05 |
| Water Quality | Mosquitoes | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a nuisance or danger to human or animals in the vicinity of the SCM. | | Determine which SCM component has standing water causing the mosquito concern. If an enclosed subsurface structure such as a sumped inlet catch basin is the source, a licensed applicator in pest management should treat enclosed/subsurface standing water with mosquito larvicides. A long term solution involving the replacement of the subsurface standing water component can be explored and a professional engineer should design the replacement of the structure with an alternative feature. [4] | 711-7801-02 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | If the ponding is in the SCM where continued standing water should not occur, see "Outflow, Ponding/Conveyance: Above or in SCM - Standing water is observed above or in subsurface storage area" to resolve prolonged standing water issue. | |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.6: Subsurface Detention Storage (SDS) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Inflow, Outflow, Ponding/Conveyance: Sediment Management | Sediment accumulation in SCM storage area observed | 5c | 2 | …sediment or debris build up in subsurface vaults, pipes or chamber type storage exceeds:<br>-plan specified cleanout depth, or<br>-10% of open storage space for ½ the length of the open chambers, or<br>-exceeds 15% of open storage depth at any point, or<br>-any amount if infiltration or flow through the system is impeded. | | Remove sediment from SCM storage areas using a vacuum truck or other appropriate means to remove sediment and debris from structure. [3, 4]<br><br>For infiltrating systems, confirm infiltration draw down time is still per plan by observing the system during the next rain event. | 711-7801-03 |
| Outflow, Ponding/Conveyance: SCM storage | Standing water is observed in subsurface storage area | 1f, 3a, 3b, 3d | 2, 5 | …rainfall did not occur in previous 72 hours and SCM storage area has standing water with no evidence of flow discharging from outlet point. | Clogged outlet orifice/outlet structure failure. | If flow is not flowing from outlet structure, possible cause is outlet structure clog or collapse. Remove obstruction/debris from outlet structure.[3, 4] If outlet is not clogged and standing water is in outlet structure, investigate downstream outlet point for signs of flow. If no flow is observed, the outlet pipe maybe clogged or collapsed. Arrange for pipe cleaning. Repair beyond debris removal/pipe cleaning should be designed and/or approved by a professional engineer. | 711-7801-02<br>711-7801-03 |
| | | | | …rainfall did not occur in previous 72 hours and SCM storage area has standing water with evidence of flow discharging from outlet point and probe of standing water in accessible storage (pipe, chamber type areas) indicates bottom is covered with sediment or debris. | Sediment build up is blocking infiltration | See section titled "Inflow, Outflow, Ponding/Conveyance: Sediment Management - Sediment accumulation in SCM storage area observed." | See Referenced Section |
| | | | | …rainfall did not occur in previous 72 hours and SCM storage area has standing water with evidence of flow discharging from outlet point and probe of standing water in accessible storage (pipe, chamber type areas) indicates bottom of open area is free from sediment or debris. | Suspected high ground water | High groundwater may be present. Repair shall be designed by a professional engineer. Process may include test pits and ground water monitor to assess typical water table and assess potential limiting layers beneath the SCM. | TBD |
| | | | | | Geotextile Clogged | Consult with an engineer to design this repair. Possible remediation may include: excavate and remove existing trench material and dispose of geotextile fabric. Engineer should specify correct geotextile fabric or determine other repair method. Reconstruct SDS.[3, 4] | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | Poorly infiltrating underlying soils or clogged geotextile. | A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed and/or approved by a professional engineer. Possible repair procedure may be as follows: Conduct test pit explorations to confirm geotextile functionality. If clogged, replacement of geotextile is required.<br><br>For poorly infiltrating underlying soils, conduct infiltration testing adjacent to the SCM foot print at the bottom elevation and at successive depths below SCM bottom to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below the original SCM bottom elevation, reconstruct SCM with a new lower bottom elevation, using additional materials to bring the top surface to plan surface geometry. [3,4] | 711-7801-10 |
| Ponding/Conveyance: SCM Surface | Signs of general settlement or compaction over grass or paved surface of SCM area | 5d | 2, 5 | …depression detrimentally effects ability to use paved surfaces for intended purpose.<br><br>…depression causes excessive ponding or impacts to permeable area. | | Review geology of area to confirm settlement is not due to karst action. If karst area, see "Ponding/Conveyance: SCM Surface-Sinkhole Observed."<br>If no karst geology is present:<br><br>If problem is reoccurring, a geotechnical engineer should to evaluate the cause of issue.<br><br>In paved areas, saw cut a rectangular pavement area 2 feet beyond limit of depression in all directions. [3] Removed settled pavement section to saw cut lines, place subbase material in 6" lifts, hand tamping each lift to elevation of original top of subbase course. Reinstall paving in accordance with plan pavement type or current equivalent.<br><br>In pervious area, check integrity of geotextile fabric and place soils matching plan specifications over SCM footprint, compacting as specified by plans to bring area to plan specified grade. If no compaction method is specified, place in 6" lifts and hand tamp. Reseed/plant as needed to restore vegetated cover indicated on the plans applying the appropriate permanent vegetative stabilization.[3] | See Referenced Section<br><br>711-7801-01<br><br>711-7801-01 |
| Outflow, Ponding/Conveyance: Storage and Outlet Pipe | Settlement observed over one area of storage pipe/chamber or outlet pipe | 2b, 5d, 5h | 2, 5 | …soil is entering subsurface storage area or outlet pipe system. | | Soil settlement over a section of subsurface storage structure (pipe, chamber, etc) or outlet pipe is a sign that a chamber wall, pipe wall or joint has failed. If settled area is above the outlet pipe and outside of the SCM foot print, dig up and replace pipe or repair crack or joint. Clear pipe system of deposited soil.[3,4]<br><br>If settled area is within the SCM footprint, repair shall be designed by a professional engineer. Possible repair procedure may be as follows: Care must be taken not to compact SCM area. Damaged pipe or | 711-7801-05 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | storage chambers shall be replaced and failing joints shall be repaired. Re-install bedding material and geotextile warp around SCM in accordance with plans. Hand compact soils above SCM. Apply the appropriate permanent vegetative stabilization in accordance with plans. | |
| Outflow, Ponding/Conveyance: Observation Wells | Standing water in observation well | 3b | 2, 5 | …standing water is observed in observation wells and rainfall did not occur in previous 72 hours. | | See section titled "Outflow, Ponding/Conveyance: SCM storage-Standing water is observed in subsurface storage area ." | See Referenced Section |
| Ponding/Conveyance: Observation Wells | Observation well cover missing or damaged | 5b | 2 | …observation well cover is missing or well is damaged. | | Replace missing access cover with cover meeting plan specifications. | 711-7801-05 |
| Water Quality | Mosquitoes | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a nuisance or danger to human or animals in the vicinity of the SCM. | | Determine which SCM component has standing water causing the mosquito concern. If an enclosed subsurface structure such as a sumped inlet catch basin is the source, a licensed applicator in pest management should treat enclosed/subsurface standing water with mosquito larvicides. A long term solution involving the replacement of the subsurface standing water component can be explored and a professional engineer should design the replacement of the structure with an alternative feature. [4]<br><br>If the ponding is in the SCM where continued standing water should not occur, see "Outflow, Ponding/Conveyance: SCM storage-Standing water is observed in subsurface storage area" to resolve prolonged standing water issue. | 711-7801-02 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.7: Stormwater Wetland System (SWE) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management in SCM and SCM Vicinity | Tall or thick vegetation or invasive/undesirable species observed | 4a, 4d, 4e, 4f | 1, 2, 5 | …vegetation growth restricts access, obstructs water flow and interferes with maintenance activity.<br><br>…invasive/undesirable species in vicinity of SCM jeopardize SCM plantings. | | Review plans to determine what kind of vegetation should be present and proper care. If plans are not available, an engineer and/or landscape architect should be contacted to assess. If invasive/undesirable species are present, coordinate with a landscape architect or an environmental scientist to remove invasive/undesirable species and re-stablish native plantings. [3, 5] | 711-7801-07 |
| Vegetation: Management on SCM Floor | Trees/shrubs or woody vegetation observed in ponding area | 4a, 4f | 1, 5 | …tree/shrub/woody growth obstructs water flow, or interferes with maintenance activity. | | Remove only trees/shrubs/woody vegetation that are obstructing flow or hindering maintenance. [3, 5] | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 85% of the emergent vegetation zone is covered by vegetation. | | Review the plans to determine design plant coverage in SWE. If density is less than plan, determine cause of vegetation loss; a professional engineer or landscape architect should design the repair. If plans are not available, a professional engineer or landscape architect should be contacted to asses. | 711-7801-06 |
| Inflow, Outflow, Ponding/Conveyance: Sediment Management | Sediment accumulation on SCM floor observed | 1a, 5c | 2, 3, 5 | …sediment accumulation affects flow through system, exceeds depth indicated by cleanout marker, or, in absence of cleanout marker, exceeds 50% of permanent pool volume. | | Remove sediment to restore plan geometry using pond dredging methods. [3] | 711-7801-01 |
| Embankment/ Side Slopes [6] | Tall grass observed | 4f | 1 | …tall grasses are observed which may indicate that routine mowing is not occurring. | | Mow grass annually above ordinary high water elevation and on embankment to low water elevation. Dispose of vegetative cuttings off-site. [3] | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 2, 3 | …less than 85% of the area is covered by vegetation. | | Review plans to determine specific vegetative cover. Repair any erosional damage and ensure 4 inches of topsoil is present. Reinstall appropriate permanent vegetative stabilization in accordance plans. | 711-7801-06 |
| | Trees/shrubs or woody vegetation observed | 4d | 1, 2, 3, 4, 5 | …trees, shrubs or woody vegetation over four feet in height are present. | Embankments (fill) | Woody vegetation should be removed. Cut stump flush to ground surface. Herbicide treatment of trunks may be required to prevent regrowth of trees (consult District Roadside Specialist); herbicide must be labeled for use in aquatic settings. If stump removal is required, the removal and embankment repair should designed by a professional engineer. [3, 5] | 711-7801-07 |
| | | | | | Side slopes (cut) | Review plans to determine if trees/shrubs are part of intended landscaping. If not, assess health and stability of woody vegetation. If the plant is healthy and does not cause a risk to the SCM, it can stay in place. If it could potentially damage the SCM or nearby facilities, it should be removed. Stumps may be left in place. [3, 5] | 711-7801-07 |
| Embankment [6] | Minor erosion on embankment, inflow, outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 2 | …embankment slopes show evidence of erosion greater than 2 inches but less than 4 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization to all disturbed areas. Determine cause of erosion and remedy if possible. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | Major erosion on embankment, inflow, outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 3, 5 | …embankment slopes show evidence of erosion greater than 4 inches deep. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of erosion. Promptly address erosion that may cause downstream problems (e.g., damage to highway or highway structure, homes, streams wetlands, railroads, etc.) due to either embankment failure or sediment migration. Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization to all disturbed areas. | 711-7801-06 |
| Embankment [6] | Severe erosion on embankment, inflow, outfall, and/or emergency spillway observed | 2a, 2b, 2c, 2d | 4, 5 | …embankment slopes show evidence of erosion that threatens the integrity of the embankment. | | Take immediate action. Notify municipal officials if basin embankment failure could cause downstream flooding problems. Contact the District geotechnical engineer and, as directed, lower water surface slowly by opening pond drain (if one exists). Otherwise, obtain pumps and draw down the pond. Care must be exercised to not draw the water down too rapidly as to cause sloughing failure. In the case on BWD or SCM with established pond ecosystem, water draw down can be conducted with consideration to preserving the ecosystem. Repair should be designed by a professional engineer. | TBD |
| | Settlement or cracking of embankment not near outlet structure observed | 5d, 5h | 2, 3 | …part of the berm has settled approximately 4-12 inches. | | Repair settled berm to design height with similar materials. Material must be notched into existing pond berm and properly compacted. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Significant settlement or cracking of embankment not near outlet structure observed | 5d, 5h | 4, 5 | …part of the berm has settled more than 12 inches. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible remediation may include: Repair settled berm to design height with similar materials. Material must be notched into existing dam and properly compacted. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Settlement or cracking of embankment near outlet structure observed | 5b, 5d | 3, 4, 5 | …part of the berm near an outlet structure has settled 4 inches or more, which may be a sign of leaking. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of issue. Determine if soil is entering pipe or outlet structure. Pipes and outlet structure may require repairs and cleaning. Compact borrow soil material around pipe and structure. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-05<br>711-7801-01 |
| | Water observed flowing through basin embankment | 5b, 5h | 4, 5 | …water is flowing through an embankment, which may cause failure in a short time (hours). | | Take immediate action. Notify municipal officials if basin embankment failure could cause downstream flooding problems. Contact the District geotechnical engineer and, as directed, lower water surface slowly by opening pond drain (if one exists). Otherwise, obtain pumps and draw down the pond. Care must be exercised to not draw the water down too rapidly as to cause sloughing failure. In the case on BWD or SCM with established pond ecosystem, water draw down can be conducted with consideration to | TBD |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | preserving the ecosystem. Repair should be designed by a professional engineer. | |
| Embankment [6] | Soil saturation or seeps at base of berm/dike observed | 5h | 2, 3, 4, 5 | …water is seeping through the berm or soils are saturated on the exterior face of berm. | | Decision on timing of repair depends on further evaluation. A geotechnical engineer may be required to evaluate the cause of issue. Monitor seep with decreasing regularity (daily, then weekly, then monthly) sufficient to determine if the rate or nature of the leak is changing. Repair should be designed by a professional engineer. | TBD |
| | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the basin embankment present safety, structural or SCM functional risk. | | Fill holes with the same or similar material used in the embankment and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| | Sloughing or sliding of berm/dike observed | 2b, 5h | 3, 4, 5 | …sloughing or sliding of embankment is observed. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible repair procedure may be as follows: Correcting the cause of sloughing and repairing berm with similar materials. | TBD |
| Side Slopes [6] | Minor erosion on side slope observed | 2b | 2 | …slopes show evidence of erosion greater than 4 inches but less than 12 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Major erosion on side slope observed | 2b | 3 | …slopes show evidence of erosion greater than 12 inches deep. | | Address erosion that may lead to problems (e.g., damage to highway or structures, etc.). Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Severe erosion on side slope observed | 2b | 4, 5 | …slopes show evidence of erosion that threatens the integrity of the slope, adjacent roadway, or structures. | | Take prompt action. A geotechnical engineer should evaluate the cause of issue and direct repairs. Repair should be designed by a professional engineer. | 711-7801-01 |
| Ponding/Conveyance: SCM Floor Ponding Area | Permanent pool water level very low or dry | 3c | 3, 5 | …permanent pool elevations are significantly below proposed depth or basin is dry. | | A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible repair procedure will vary based on diagnosis. Possible causes include infiltration into surrounding soils, defective/damaged impermeable liner, piping/seepage through embankment, insufficient inflow/prolonged drought. | TBD |
| Ponding/Conveyance: SCM Floor General | Impermeable liner exposed or damaged | 2b, 5b, 5h | 3, 5 | …impermeable liner has become exposed and/or damaged<br><br>…evidence suggests impermeable liner is leaking below grade. | | Impermeable liners can be clay, geotextile, or composite geosynthetic. Repairs methods utilized should be based on liner material.<br><br>If impermeable liner has become exposed, inspect to confirm no punctures, tears or other damage has occurred. If liner is not damaged, restore cover layer using material consistent with original plan.<br><br>If exposed liner is damaged or evidence suggests a liner is damaged/leaking without being exposed, repair should be designed | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | by a professional engineer. Suspected below grade liner damage requires removal of all planting material to locate damage. Possible repair procedure could involve partial or total liner replacement and consulting with liner manufacture for repair requirements for geosynthetic or bentonite clay liners. | |
| Ponding/Conveyance, Water Quality, Embankment/ Side Slopes: SCM Floor General | Beaver dams are observed | 5g, 5h | 1,3 | …beaver dam inhibits function of SCM, jeopardizes infrastructure or notably reduces effective storage of basin. | | Contact Pa Game Commission. After approved relocation, remove dam debris. [3] | 711-7801-02 |
| Outflow, Ponding/Conveyance, Water Quality: SCM Drain/ Mechanical Assemblies | Damaged, non-functioning, or missing components found | 5b | 3 | …water flows after shutting the valves/gates or they cannot be opened/closed or are otherwise not functioning properly. | | Install cofferdam to dewater work area if possible; pump or drain pond if needed. Repair or replace valves/gates with similar components. [4] Divert flows when valve are out of service . | 711-7801-05 |
| Inflow, Outflow | Inflow or outflow point is partially or totally submerged by standing water | 3a, 3d | 3, 5 | …submerged condition impacts inflow/outflow points ability to convey flows effectively. | | If submerged inflow point is observed, reference plans to determine if intended water pool and inlet elevations vary from design. If water pool elevation is high, check outlet structure for obstruction or malfunction. If no visible obstruction or cause is identified or inlet point is lower than plans, repair should be designed by a professional engineer.<br><br>If submerged outflow point is identified, assess downstream conditions to identify cause of backwater condition. Remove any unintended blockages identified. [3, 4] If cause is from high water level in discharge stream/pond, repair should be designed by a professional engineer. | TBD |
| Water Quality | Algae | 3a, 3d, 5h | 2, 5 | …algae growth covers more than 50% of pond area or the pond has an odor. | | Excessive algae growth is an indicator of excess nutrients from fertilizers in the water or decomposing materials on the SCM surface beneath the water. An engineer and/or landscape architect should be contacted to assess the problem. The short term solution is physical removal of the algae. Pump pond dry and clean out the bottom.<br><br>Long term resolution/prevention of reoccurrence should include a review of the SCM drainage area for possible sources of nutrient runoff. Review SCM construction and maintenance records to identify if excess is from SCM operation activities. If obvious sources cannot be identified/eliminated, the SCM may require additional pretreatment or buffer areas. | TBD |
| | Turbidity | 3a, 3d, 5h | 3, 5 | …sediment laden water present in SCM ponding area. | | Investigate source of sediment laden flows. If a portion of the contributing drainage area has been disturbed, install permanent stabilization such as vegetative cover and monitor for establishment. | 711-7801-06<br>711-7801-02 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | If no obvious contributing source is identified, the SCM may require additional pretreatment for sediment removal and the repair should be designed by a professional engineer. Resolution may include installation of a forebay, water quality device or other sediment collecting pretreatment means. After turbidity has been resolved, the SCM floor should be clean of accumulated sediment. | 711-7801-10 |
| Water Quality | Large permanent geese or other water fowl population | 5f | 2 | …evidence of over 20 permanent water fowl inhabitants per acre of pond surface area and noted waste accumulation. | | Ensure fecal matter does not cause water quality impacts by monitoring SCM discharge points for elevated fecal coliform. If required, contact Pa Game Commission for population relocation assistance. Allowing 3 foot tall grass buffer to surround the SCM for an 5 to 8 foot width will discourage waterfowl from using pond. | 711-7801-11 |
| | Mosquitoes | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a nuisance or danger to human or animals in the vicinity of the SCM. | | Determine which SCM component has standing water causing the mosquito concern. If an enclosed subsurface structure such as a sumped inlet catch basin is the source, a licensed applicator in pest management should treat enclosed/ subsurface standing water with mosquito larvicides. A long term solution involving the replacement of the subsurface standing water component can be explored and a professional engineer should design the replacement of the structure with an alternative feature. [4]<br><br>If the ponding is the SCM surface in a SWE, excess mosquito presence is an indication of a poorly functioning ecosystem A professional engineer or wetland scientist should assess/develop remediation plan. | 711-7801-02 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

[5] Avoid spraying nonaquatic herbicides in and around the basin. Remove undesirable vegetation by hand if possible or by wiping plants with herbicide. It is important to dispose of vegetative cuttings off-site so they do not contribute additional nutrients to the stormwater wetland.

[6] Side Slopes are the inside SCM walls formed below surrounding grade where the SCM side wall is constructed by excavating below grade. Embankments, or berms are 'fill' material constructed above the surrounding ground forming a side wall of the SCM. Embankments may not be present in all SCMs. Embankments may be considered a regulated dam structure depending on height and drainage area.

**Table E.1.8: Constructed Stormwater Filter (CSF) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management on Open CSF Floor | Vegetation or invasive/undesirable species observed | 4a, 4d, 4e, 4f | 1, 2 | …vegetation growth restricts access, obstructs water flow and interferes with maintenance activity.<br><br>…hydrophytic (wetland) plants are present, which is an indication of poor drainage. | Plan calls for sand or stone bottom | Review the plans to determine if SCM is to have vegetative cover. If plan indicates no vegetative cover is called for on CSF floor, remove vegetation. [3]<br><br>Remove vegetation annually from CSF media area if no instructions are provided on the plan. [3]<br><br>If non-plan specified hydrophytic plants are present, refer to section "Outflow, Ponding/Conveyance: Open CSF -Floor Media Standing water observed in open CSF" to assess excessive moisture.<br><br>Remove invasive/undesirable species. [3]<br><br>Hand weeding is preferred removal method. Do not use herbicides. [3] Do not drive equipment or trucks into SCM that would compact SCM floor. | 711-7801-07 |
| | | | 1 | | Plans call for grass or meadow seed mix. | Review the plans to determine proper care. Mow the basin annually if no instructions are provided on the plan. | 711-7801-07 |
| | Trees/shrubs or woody vegetation observed | 4a, 4f | 1, 2 | …tree/shrub/woody growth restricts access, obstructs water flow, are growing in CSF, or interferes with maintenance activity. | | If landscaping plans are available and indicate trees/shrubs/woody vegetation is not specified, remove trees/shrubs/woody vegetation and root systems. Repair filter area using materials meeting plan specifications. Do not use herbicides. Do not drive equipment or trucks into SCM that would compact SCM floor. [3]<br><br>Remove vegetation annually from CSF media area if no instructions are provided on the plan. [3] | 711-7801-07 |
| Inflow, Pretreatment: Open CSF Sediment Management | Sediment accumulation on CSF media observed | 5c | 2, 3 | …sediment accumulation affects flow, exceeds depth indicated by cleanout marker or, in absence of cleanout marker, exceeds 1 inch in depth. | | Conduct work when area is dry. Remove sediment from CSF floor areas using minimal disturbance techniques such as hand raking. Restore to plan elevation. Reseed/plant if specified on plan to restore vegetated cover if indicated in the plans applying the appropriate permanent vegetative stabilization.[3] | 711-7801-01 |
| Inflow, Pretreatment: Enclosed CSF Sediment Management | Sediment accumulation in pre-treatment area | 5c | 2, 3 | …sediment accumulation in pre-treatment area affects flow, exceeds cleanout depth indicated by cleanout marker or, in absence of cleanout marker, is less than 6 inches from invert out of storage area. | | Use vacuum truck or other appropriate means to remove all sediment and debris from inlet structure. [3, 4] | 711-7801-02<br>711-7801-03 |
| | Sediment accumulation on CSF filter material observed | 5c | 2, 3 | …sediment accumulation affects flow through system, exceeds cleanout depth indicated by cleanout marker or, in absence of cleanout marker, or exceeds ½" depth. | | Remove sediment and 1 inch of filter media from filter media surface. Scarify media surface, replacing any media which has been clogged with sediment with materials meeting plan requirements.[3, 4] | 711-7801-01 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Embankment/ Side Slopes[5]: Open CSF | Tall grass observed | 4f | 1 | …tall grasses are observed which may indicate that routine mowing is not occurring. | | Mow grass annually. | 711-7801-07 |
| Embankment[5]: Open CSF | Settlement of embankment not near outlet structure observed | 5d, 5h | 2, 3 | …part of the berm has settled approximately 4 or more inches. | | Repair settled berm to design height with similar materials. Material must be notched into existing pond berm and properly compacted. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 |
| | Settlement or cracking of embankment near outlet structure observed | 5d, 5d, 5h | 2, 3 | …part of the berm near an outlet structure has settled 4 inches or more, which may be a sign of leaking. | | Take prompt action. A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed by a professional engineer. Possible remediation may include: Determine if soil is entering pipe or outlet structure. Pipes and outlet structure may require repairs and cleaning. Compact borrow soil material around pipe and structure. Place 4 inches of topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01<br>711-7801-05 |
| | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the SCM embankment present safety, structural or SCM functional risk. | | Fill holes with the same or similar material used in the embankment and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| Embankment/ Side Slopes: Open CSF | Minor erosion on side slope observed | 2b | 2 | …slopes show evidence of erosion greater than 4 inches and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| Inflow: Open CSF Flow Spreader | Flow spreader uneven or clogged | 1b, 1g, 2b, 5h | 1, 2, 5 | …flows are not uniformly distributed across CSF floor. | | Remove cause of clogging.[3] If flow spreader is uneven, see to LSO corrective maintenance table. | 711-7801-02<br>711-7801-10 |
| Outflow, Ponding/Conveyance: Open CSF Floor Media | Standing water observed in open CSF | 1f, 3a, 3d, 5c | 2, 5 | …rainfall did not occur in previous 72 hours and well/underdrain cleanout in open CSF indicates underdrain has little to no water present. | Top layer of media filter may be clogged. | Use a soil probe or soil auger to examine the SCM soil. If standing water/saturated soil is limited to top few inches of soil, likely the top layer of soil is clogged by sediment. Remove layer of fine sediment and top 1 to 2 inches of media soil, rake bottom, and verify infiltration capacity matches original design by inspecting CSF 72 hours after a rain event exceeding 0.1 inches in 24 hours or by performing infiltration test(s).[3] If acceptable infiltration rates are confirmed, install new media filter matching plan materials, restoring geometry to plan elevation. If infiltration still is not satisfactory, a professional engineer may be required to evaluate the cause of issue and design a repair | 711-7801-01<br>711-7801-10 |
| | | | | | Geotextile clogged. | Use a shovel to dig to top of geotextile (if present). Examine the fabric for signs of clogging and water passage. If water is not passing through geotextile fabric, the geotextile fabric is likely clogged. Consult with a professional engineer to design this repair. Possible remediation may include: Remove filter material and stockpile for reuse. Remove and dispose of geotextile fabric. Professional engineer should specify correct geotextile fabric or determine other repair method. Reinstall and do not compact filter material.[3] | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | 2, 5 | …rainfall did not occur in previous 72 hours and well/underdrain cleanout in open CSF indicates underdrain is full of water with no flow from outlet point. | Clogged, or collapsed underdrain. | See section on "Outflow, Ponding/Conveyance: Open and Enclosed CSF Underdrain and Outlet Pipe - Obstruction or blockage noted." | See Referenced Section |
| | | | | | Clogged outlet orifice/outlet structure failure. | Remove obstruction/debris, and unclog the low flow outlet in the outlet structure.[3, 4] If sediment build up in CSF is causing blockage, remove sediment as described in "Inflow, Pretreatment: Open CSF Sediment Management - Sediment accumulation on CSF media observed." If outlet orifice/weirs are not clogged and standing water is in outlet structure, investigate downstream outlet point for signs of flow. If no flow is observed, the outlet pipe maybe clogged or collapsed. Arrange for pipe cleaning. Repair beyond debris removal/pipe cleaning should be designed by a professional engineer. | 711-7801-02<br>711-7801-03<br>711-7801-05 |
| | | | 5 | …water flowing constantly from underdrain in open CSF when it has not rained in the previous 72 hours. | Suspected high ground water. | See section titled "Outflow, Ponding/Conveyance: Underdrain- Prolonged flows". | See Referenced Section |
| Ponding/Conveyance: Open CSF Floor General | Impermeable liner visible and/or damaged<br>(note liners may not be present in all SCMs) | 2b, 5b, 5h | 3, 5 | …impermeable liner has become exposed and/or damaged<br><br>…evidence suggests impermeable liner is leaking below grade. | | Impermeable liners can be clay, geotextile, or composite geosynthetic. Repairs methods utilized should be based on liner material.<br><br>If impermeable liner has become exposed, inspect to confirm no punctures, tears or other damage has occurred. If liner is not damaged, restore cover layer using material consistent with original plan.<br><br>If exposed liner is damaged or evidence suggests a liner is damaged/leaking without being exposed, repair should be designed by a professional engineer. Suspected below grade liner damage requires removal of all bioretention planting material to locate damage. Possible repair procedure could involve partial or total liner replacement, consulting with liner manufacture for repair requirements for geosynthetic or bentonite clay liners. | 711-7801-10 |
| Ponding/Conveyance: Open and Enclosed CSF Floor General | Short circuiting | 5h | 2 | …flows become concentrated across one area of the media. | | Determine and remediate cause of short circuiting: 1) check inlet points and ensure they are directed to a flow spreader if appropriate (see flow section on "Inflow: Open CSF Flow Spreader- Flow spreader uneven or clogged"); 2) check CSF Floor media for grade, ensuring it is not uneven/channelizing flow. After cause of short circuiting is resolved, repair any damage to CSF media, restoring the surface to plan elevations. | 711-7801-10 |
| Outflow, Ponding/Conveyance: Underdrain | Prolonged flows | 3d, 5h | 2, 5 | …underdrains carry continuous flow when it has not rained in the previous 72 hours and there is no standing water on SCM surface. | | High groundwater may be present. Repair should be designed by a professional engineer. Process may include test pits and ground water monitoring to assess typical water table elevation and assess potential limiting layers beneath the SCM. | TBD |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Outflow, Ponding/Conveyance: Open and Enclosed CSF Underdrain and Outlet Pipe | Obstruction or blockage noted | 5h | 2 | …water does not flow into or out of the outlet structure or piping. | | Remove obstructions to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary). [3, 4] | 711-7801-02<br>711-7801-03 |
| | Settlement observed over underdrain or outlet pipe | 2b, 5h | 2 | …soil is entering underdrain or pipe system. | | Soil settlement over an underdrain or pipe is a sign that a pipe wall or pipe joint has failed. Dig up and replace pipe or repair crack/joint. Clear pipe system of deposited soil.[3,4] Care must be taken not to compact SCM floor. Hand compact borrow soil material around pipe. Replace media filter around pipe repair with plans. | 711-7801-05 |
| Inflow, Outflow, Ponding/Conveyance: Enclosed CSF Vault/Structure | Defective internal baffle walls | 5b | 4, 3, 5 | …baffles or walls are corroding, cracking, warping or failing. | | Repair baffles to plan specifications. In the absence of plans, repair should be designed by a licensed professional engineer. [3,4] | 711-7801-05 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

[5] Side Slopes are the inside SCM walls formed below surrounding grade where the SCM side wall is constructed by excavating below grade. Embankments, or berms are 'fill' material constructed above the surrounding ground forming a side wall of the SCM. Embankments may not be present in all SCMs. Embankments may be considered a regulated dam structure depending on height and drainage area.

**Table E.1.9: Vegetated Filter Strip (VFS); Vegetated Filter Strip, Steep Slope (VSS) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management on SCM | Excessively tall vegetation or invasive/undesirable species observed | 4a, 4e, 4f | 1, 2, 5 | …vegetation growth exceeds 12 inches or restricts access, obstructs water flow and interferes with maintenance activity.<br><br>…invasive/undesirable plants material covers more than 10% of SCM area. | | Review the plans to determine proper care. Mow the filter surface annually to a height of six inches if no instructions are provided on the plans. [3]<br><br>If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be a type acceptable for use around surface waters. Remove dead plants 30 to 60 days after spraying. Replant filter area with native plants and/or seed mix per plans. If replanting is required repeatedly, consult a landscape architect for assessment. [3] | 711-7801-07 |
| | Trees/shrubs or woody vegetation observed | 4a, 4d, 4f | 1, 2 | …tree/shrub/woody growth restricts access, obstructs water flow, are growing in SCM, or interferes with maintenance activity. | | If plans are available and indicate trees/shrubs/woody vegetation is not specified, remove trees/shrubs/woody vegetation when the area is dry. Cut stumps flush to ground. Do not drive equipment or trucks onto filter area. Repair disturbed area, replanting and stabilizing per plans immediately.[3]<br><br>Remove trees/shrubs/woody vegetation from filter area when dry if no instructions are provided on the plan. [3] | 711-7801-07 |
| | Grass not growing well | 4a, 4f | 1, 2 | …excessive dead grass prevents growth or area too compacted to allow growth. | | Thatch grass area when dry. Rake up dead grass and clippings.[3] Aeration of soils by mechanically removing plugs may be required. | 711-7801-07 |
| | Hydrophytic (wetland) plants observed | 4e | 3, 5 | …hydrophytic (wetland) plants are present, which is an indication of poor drainage. | | Surface flows through and out of filter area are insufficient. Confirm slope of area matches plan. Regrade surface of filter using soil mix materials matching plans. Re-establish permanent vegetative stabilization per plans. If topography matches the plans and no solution is evident, consult with an engineer to design this repair. Possible remediation may include: assessing groundwater table in area, ensuring adequate surface drainage downslope of the SCM and testing soils for infiltration rates. | 711-7801-10 |
| | Vegetation is sparse | 4c, 4b | 1, 2, 5 | … less than 80% of the area is covered by vegetation or bare patches are observed in more than 10% of filter surface area. | | Replant area using seed mix or plant materials as specified on plans utilizing fertilizers/amendments if indicated by plans. If sparse vegetation is a reoccurring problem or no plans are available, request a landscape architect for revised planting approach.<br><br>If area is excessively shaded (6 hrs. or less of sun/day), trim overhanding limbs and brushy vegetation (if within right of way). Once sunlight is restored, replant as described above.[3] | 711-7801-06<br><br>711-7801-07 |
| Inflow, Pretreatment, Ponding/Conveyance: Sediment Management | Sediment and/or anti-skid material accumulation on filter area | 5c | 2 | …accumulation blocks flow entry or distribution of runoff in filter area.<br><br>…accumulation exceeds 2 inches in depth. | | Remove accumulated sediment/materials. Regrade area so slope is even and flows pass through without concentrating, referencing plans for grading. Equipment should not enter filter area; minimize | 711-7801-01 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | …accumulation inhibits vegetative grown in more than 10% of filter surface area. | | compaction. Restore appropriate permanent vegetative stabilization as indicated on the plans.[3] | |
| Inflow, Pretreatment | Flow spreader area not distributing flow | 1b, 2a, 5h | 2 | …flow spreading area is uneven, clogged with sediment/material causing uneven distribution of flows over SCM vegetative area. | | Remove accumulated sediment/materials. Level area so flows pass through without concentrating, referencing plans for grading.[3] | 711-7801-02<br>711-7801-01 |
| Ponding/Conveyance: SCM Surface | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the SCM filter area. | | Fill holes with the same or similar material used in the filter and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| | Minor erosion, channelization, or short circuiting on slope observed | 2a, 2b, 2c | 2 | …VFS/VSS surface shows evidence of erosion greater than 4 inches. | | Fill erosion areas with materials matching original SCM design and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Major erosion, channelization, or short circuiting on side slope observed | 2a, 2b, 2c | 3, 5 | …VSS surface shows evidence of erosion greater than 12 inches wide/deep. | | Regrade/reconstruct SCM in areas with erosional damage. Utilize appropriate permanent vegetative stabilization per plan. If problem is reoccurring or no plans are available, repair should be designed by a professional engineer. | 711-7801-01 |
| | Standing water or soggy soils are observed in filter area | 3a, 3d, 5c | 2, 5 | …standing water is observed on SCM surface or filter media remains saturated and rainfall did not occur in previous 72 hours. | | Use a soil probe or soil auger to determine if standing water/saturated soil is limited to top few inches of soil. If so, the top layer of soil is likely clogged by sediment. Remove layer of fine sediment and top several inches of filter soils from SCM surface.[3] Install new filter materials matching plan materials, restoring slope and geometry to plan dimensions. Restore disturbed areas with appropriate permanent vegetative stabilization per plans. | 711-7801-01<br>711-7801-10 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.10: Media Filter Drain (MFD) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management on SCM | Vegetation or invasive/undesirable species observed | 4a, 4e, 4f | 1, 2, 5 | …vegetation growth on surface or restricts access, obstructs water flow and interferes with maintenance activity.<br><br>…invasive/undesirable plants material covers more than 10% of SCM area. | | Review the plans to confirm filter surface is to be vegetated and determine specified mow height. If plans do not call for vegetation on the surface, remove growth. Hand weeding is preferred removal method. Do not drive equipment or trucks onto filter area. If surface is to be vegetated, mow the filter surface annually to a height of six inches if no instructions are provided on the plan. [3]<br><br>If invasive/undesirable species are present on the MFD surface, hand weeding is preferred removal method. Do not use herbicides directly on the surface of the MFD. Do not drive equipment or trucks onto filter area.<br><br>Herbicides may be used in areas around/adjacent to the MFD. Utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be a type acceptable for use around surface waters. Remove dead plants 30 to 60 days after spraying. Replant filter area with native plants and/or seed mix per plans. If replanting is required repeatedly, consult a landscape architect for assessment. [3] | 711-7801-07 |
| | Trees/shrubs or woody vegetation observed | 4a, 4d, 4f | 1, 2 | …tree/shrub/woody growth restricts access, obstructs water flow, are growing in SCM, or interferes with maintenance activity. | | If plans indicate trees/shrubs/woody vegetation are not specified, remove trees/shrubs/ woody vegetation when the area is dry. Cut stumps flush to ground. Do not drive equipment or trucks onto filter area. Repair disturbed area, replanting and stabilizing per plans immediately. [3]<br><br>If no instructions are provided on the plan, remove trees/shrubs/woody vegetation from filter area when dry. [3] | 711-7801-07 |
| | Hydrophytic (wetland) plants observed | 4e | 3, 5 | …hydrophytic (wetland) plants are present, which is an indication of poor drainage. | | The engineered soil mix or perforated underdrain may be clogged. Consult with an engineer to design this repair. Possible remediation may include inspection or underdrain observation wells/cleanouts. If standing water is present in underdrain, underdrain maybe clogged. See section on "Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe (MFDs)- Obstruction or blockage noted." If no moisture is present but filter soil is moist, filter soil is most likely clogged. Remove top several inches of filter media to expose dry media material. Install new media material matching plan design material specifications and elevations. | 711-7801-10 |
| | Vegetation is sparse | 4c, 4b | 1, 2, 5 | …less than 80% of the area is covered by vegetation or bare patches are observed in more than 10% of filter surface area. | | Review plans to confirm surface is to be vegetated. If vegetation is called for, replant area using seed mix or plant materials as originally specified on the plans utilizing fertilizers/amendments only if indicated by plans. If sparse vegetation is a reoccurring problem or | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | no plans are available, consult a landscape architect for revised planting approach.<br><br>If area is excessively shaded (6 hrs. or less of sun/day), trim overhanding limbs and brushy vegetation if within right of way. Once sunlight is restored, replant as per above.[3] | 711-7801-07 |
| Inflow, Pretreatment, Ponding/Conveyance: Sediment Management | Sediment and/or anti-skid material accumulation on filter area | 5c | 2 | …accumulation blocks flow entry or distribution of runoff in filter area.<br><br>…accumulation exceeds 2 inches in depth.<br><br>…accumulation inhibits vegetative grown in more than 10% of filter surface area. | | Remove accumulated sediment/materials. Regrade area so slope is even and flow pass through without concentrating, referencing plans for grading. Equipment shall not traverse filter area; utilize minimal compaction construction methods. Restore appropriate permanent stabilization as indicated in the plans.[3] | 711-7801-01 |
| Inflow, Pretreatment | No-vegetation zone not distributing flow | 1b, 2a, 5h | 2 | …no vegetation zone is uneven, clogged with sediment/material causing uneven distribution of flows over SCM area. | | Remove accumulated sediment/materials as needed. Level the no-vegetation zone so flows pass through without concentrating, referencing plans for grading.[3] | 711-7801-02<br>711-7801-01 |
| Ponding/Conveyance: SCM Surface | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the SCM filter area. | | Fill holes with the same or similar material used in the filter and apply the appropriate permanent stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| | Minor erosion, channelization, or short circuiting on slope observed | 2a, 2b, 2c | 2 | …slopes show evidence of erosion greater than 4 inches but less than 12 inches wide/deep. | | Fill erosion areas with materials matching original SCM design and apply the appropriate permanent stabilization. Determine cause of erosion and remedy if possible. | 711-7801-06 |
| | Major erosion, channelization, or short circuiting on side slope observed | 2a, 2b, 2c | 3, 5 | …slopes show evidence of erosion greater than 12 inches wide/deep. | | Regrade/reconstruct SCM in areas with erosional damage. Utilize appropriate permanent vegetative stabilization per plan. If problem is reoccurring or no plans are available, repair should be designed by a professional engineer. | 711-7801-10 |
| | Severe erosion, channelization, or short circuiting on side slope observed | 2a, 2b, 2c | 4, 5 | …slopes show evidence of erosion that threatens the integrity of the slope, adjacent roadway, or structures. | | Take prompt action. A professional engineer should evaluate the cause of issue and direct repairs. | TBD |
| | Standing water or soggy soils are observed in filter area | 3a, 3d, 5c | 2, 5 | …rainfall did not occur in previous 72 hours and observation well/underdrain cleanout in filter indicates underdrain has little to no water present. | Top layer of filter clogged. | Remove layer of fine sediment and a minimum of the top 1 to 2 inches of filter media from SCM surface; remove sufficient depth of media to expose clean, unclogged media. If entire media is clogged, remove full depth of media.[3] Install new filter media matching plan materials, restoring slope and geometry to plan dimensions. Restore disturbed areas with Appropriate permanent stabilization. | 711-7801-01<br><br>711-7801-10 |
| | | | | …rainfall did not occur in previous 72 hours and observation well/underdrain cleanout indicates underdrain is full of water with no flow from outlet point. | Clogged or collapsed underdrain. | See section on "Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe - Obstruction or blockage noted" and Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe - Settlement observed over underdrain or outlet pipe." | See Referenced Section |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | Clogged/collapsed outlet pipe. | Examine outlet location. Remove obstruction/debris.[3, 4] If standing water is in underdrains, investigate downstream outlet location for signs of flow. If no flow is observed, the outlet pipe maybe clogged or collapsed. Arrange for pipe cleaning. Repair beyond debris removal/pipe cleaning should be designed by a professional engineer. | 711-7801-02<br>711-7801-03<br>711-7801-05 |
| | | | 5 | …water flowing from underdrain and it has not rained in the previous 72 hours or more. | Suspected high ground water. | See section titled "Outflow, Ponding/Conveyance: Underdrain-Prolonged flows". | See Referenced Section |
| Ponding/Conveyance: SCM Surface | Evidence of flooding of MFD | 3a, 3b, 3d, 5h | 3 | …MFD is/was inundated by flood water. | | Perform infiltration testing on MFD surface and within media layer to confirm infiltration rates meet design values. If infiltration rates are not sufficient, remove media filter material and replace with new filter media matching plan materials, restoring slope and geometry to plan dimensions. Restore disturbed areas Appropriate permanent stabilization per plans. [3] | 711-7801-10 |
| Outflow, Ponding/Conveyance: Underdrain | Prolonged flows | 3d, 5h | 2, 5 | …underdrains carry continuous flow and it has not rained in the previous 72 hours. | | High groundwater may be present. Repair should be designed by a professional engineer. Process may include test pits and ground water monitor to assess typical water table and assess potential limiting layers beneath the SCM. | TBD |
| | Settlement observed over underdrain | 5d, 5b, 5h, 2b | 2 | …soil is entering underdrain or pipe system. | | Soil settlement over an underdrain is a sign that a pipe wall or pipe joint has failed. Dig up and replace pipe or repair crack/joint. Clear pipe system of deposited soil. [3] Care must be taken not to compact SCM floor. Hand compact borrow soil material around pipe. Replace media filter around pipe repair with original SCM plans. | 711-7801-05 |
| Outflow, Ponding/Conveyance: Underdrain and Outlet Pipe | Obstruction or blockage noted | 5h | 2 | …water does not flow into or out of the outlet structure or piping. | | Remove obstructions to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary). [3, 4] | 711-7801-02<br>711-7801-03 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.11: Vegetated Swale(VSW); Vegetated Swale W/Check Dams (VSC) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management in SCM and SCM vicinity | Excessively tall vegetation or invasive/undesirable species observed | 4a, 4d, 4e, 4f | 1, 2 | …vegetation growth restricts access, obstructs water flow and interferes with maintenance activity. | | Review the plans to determine vegetation mow height and frequency in channel bottom and side slopes. Mow the swale bottom and sides annually to a height of 6 inches if no instructions are provided on the plan.<br><br>If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be a type acceptable for use around surface waters. Remove dead plants 30 to 60 days after spraying. [3] | 711-7801-07 |
| Vegetation: Management in SCM | Trees/shrubs or woody vegetation observed | 4a, 4d 4f | 1, 2 | …tree/shrub/woody growth restricts access, obstructs water flow, are growing in channel bottom or on side slopes, or interferes with maintenance activity. | | If plans indicate trees/shrubs/woody vegetation are not specified, remove trees/shrubs/woody vegetation and root systems from channel bottom and/or side slopes when SCM is dry. Do not drive equipment or trucks into channel. Repair disturbed area, replanting and stabilizing per plans.[3]<br><br>If no instructions are provided on the plan, remove woody vegetation annually from channel bottom and side slopes when area is dry. [3] | 711-7801-07 |
| | Hydrophytic (wetland) plants observed | 4e | 3, 5 | …hydrophytic (wetland) plants are present, which is an indication of poor drainage. | Hydrophytic vegetation immediately upslope of check dams only | See "Ponding/Conveyance: Channel- Check dams are retaining water" | See Referenced Section |
| | | | | | Without subsurface infiltration trench (SIT) below | Surface flows through and out of the channel area are likely insufficient. Confirm profile slope of channel matches plan. Regrade surface of filter using soil mix materials matching plans. Re-establish appropriate permanent vegetative stabilization per plans. If topography matches the plans and wet conditions exist, consult with an engineer to design repair. Possible remediation may include: assessing groundwater table in area, ensuring adequate surface drainage downslope of the SCM and testing soils for infiltration rates. | 711-7801-10 |
| | | | | | With SIT below | Reference SIT corrective maintenance table. | See SCM Specific Table |
| | Vegetation is sparse | 4c, 4b | 1, 2, 5 | …less than 90% of the area is covered by vegetation or bare patches occur in more than 10% of the SCM. | | Confirm a minimum of 4 inches of topsoil or plan specified modified soils mix is present. If depth is not sufficient, place topsoil or modified soils specified by design plan to a depth of at least 4 inches. Do not mechanically compact. Replant area using appropriate permanent vegetative stabilization per plans. If sparse vegetation is a reoccurring problem or no plans are available, consult a landscape architect for revised planting approach. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | If area is excessively shaded (6 hrs. or less of sun/day), trim overhanding limbs and brushy vegetation if within right of way. Once sunlight is restored, replant as per above.[3] | 711-7801-07 |
| | | | | …less than 20% of area is covered by vegetation and turf reinforcement mat (TRM) is visible. | | It is possible that TRM is choking plant roots. Contact a landscape architect to evaluate problem. If TRM is not in contact with soil, work soil under matting in problem areas. Work soil into TRM in problem areas and reseed using vegetation per original design plans. | 711-7801-06 |
| Inflow, Pretreatment, Ponding/Conveyance: Sediment Management | Sediment and/or anti-skid material accumulation on SCM surface observed | 5c | 2 | …accumulation blocks flow entry or through swale.<br><br>…accumulation exceeds 3 inches in depth.<br><br>…accumulation inhibits vegetative grown in more than 10% of SCM surface area. | | Remove accumulated sediment/materials. Regrade swale so slope is even and flow passes, referencing plans for grading. Equipment should not traverse SCM area; utilize minimal compaction construction methods. Reseed/plant as needed to restore vegetated cover as indicated in the plans applying the appropriate permanent vegetative stabilization.[3] | 711-7801-01 |
| Side Slopes[5] | Tall grass observed | 4f | 1 | …tall grasses are observed which may indicate that routine mowing is not occurring. | | Mow area surrounding SCM annually to height specified on plans. Mow to a height of 6 inches if no instructions are provided on the plans. | 711-7801-07 |
| | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the SCM | | Fill holes with the same or similar material used in swale and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| | Minor erosion on side slope observed | 2b | 2 | …slopes show evidence of erosion greater than 4 inches and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. Remove any sediment deposited in swale as described under sedimentation management. | 711-7801-06 |
| Outflow, Ponding/Conveyance: Swale surface | Standing water or soggy area observed in swale underlain by a SIT | 3a, 3b, 3d, 5c | 2, 5 | …standing water or saturation is observed in swale or channel bottom and rainfall did not occur in previous 72 hours. | | See subsurface infiltration trench (SIT) corrective maintenance table. | See SCM Specific Table |
| | Standing water or soggy bottom is observed in swale not underlain by a SIT | 3a, 3b, 3d, 5c | 2, 5 | …rainfall did not occur in previous 72 hours and standing water is observed in swale or channel bottom with no flow from outlet point. | Clogged outlet. | Remove obstruction/debris.[3, 4] If sediment build up in SCM is causing blockage, remove sediment as described in "Inflow, Pretreatment, Ponding/Conveyance: Sediment Management - Sediment accumulation in SCM surface observed." If standing water extends downstream of SCM, see "Inflow Outflow-Inflow or Outflow point is partially or totally submerged by standing water". | 711-7801-02 |
| | | | | | Soil Clogged. | A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed and/or approved by a professional engineer. Possible repair procedure may be as follows: Conduct test pit explorations and infiltration testing at the bottom of SCM and at successive depths below SCM bottom to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below the original SCM bottom elevation, reconstruct SCM with engineered soils providing sufficient | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | infiltration rate to a depth reaching the identified acceptable subgrade infiltration depth, reshaping the surface of the SCM and replanting to original plan surface geometry. [3] | |
| | | | 2, 5 | …rainfall did not occur in previous 72 hours and standing water is observed in swale or channel bottom with no obstruction at outlet point. | Top layer of soil clogged. | Use a soil probe or soil auger to examine the soil in the swale. If standing water/saturated soil is limited to top few inches of soil, likely the top layer of soil is clogged by sediment. See "Inflow, Pretreatment, Ponding/conveyance: Sediment Management - Sediment accumulation in SCM surface observed" section. | See Referenced Section |
| | | | | | Geotextile clogged. | Use a shovel to dig to top of geotextile (if present). Examine the fabric for signs of clogging and water passage. If water not passing through geotextile fabric, the geotextile fabric is likely clogged. Consult with an engineer to oversee this repair. Possible remediation may include: Remove top soil material and stockpile for reuse. Remove and dispose of geotextile fabric. Engineer should specify correct geotextile fabric or determine other repair method. Reconstruct swale and replant per original plans. [3] | 711-7801-10 |
| | | | | | Poorly infiltrating underlying soils. | If soils/geotextile are not clogged, underlying soils may have insufficient or poor infiltration capacity A geotechnical engineer may be required to evaluate the cause of issue. Repair should be designed and/or approved by a professional engineer. Possible repair procedure may be as follows: Conduct test pit explorations and infiltration testing at the bottom of SCM and at successive depths below SCM bottom to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below the original SCM bottom elevation, reconstruct SCM with engineered soils providing sufficient infiltration rate to a depth reaching the identified acceptable subgrade infiltration depth, reshaping the surface of the SCM and replanting to original plan surface geometry. [3] | 711-7801-10 |
| | | | 5 | …water flowing constantly from swale for a week or more. | Suspected high ground water. | Repair should be designed by a professional engineer. Process may include test pits and ground water monitor to assess typical water table and assess potential limiting layers beneath the SCM. | TBD |
| Ponding/Conveyance: Channel | Check dams are retaining water (VSC only) | 1e, 3a, 4e, 5c | 2, 5 | …standing water or channel bottom remains saturated immediately upslope of check dams and rainfall did not occur in previous 72 hours.<br><br>…hydrophytic (wetland) plants are present immediately upslope of check dams, which is an indication of localized poor drainage. | Infiltrating dams | Poorly infiltrating underlying soils or high ground water are likely the cause of failure, see "Outflow Ponding/conveyance: Swale surface- Standing water or soggy bottom is observed in swale". | See Referenced Section |
| | | | | | Slow flow dams | Check dam is likely clogged, silted or debris covered. Remove obvious trash/debris present. When areas are dry, remove silt accumulation from check dam. Stabilize any disturbed areas using appropriate permanent vegetative stabilization as specified by original plans. If problem persists, repair should be designed and/or approved by a professional engineer. | 711-7801-02 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Ponding/Conveyance: Channel | Impermeable liner visible and/or damaged (note liners may not be present in all SCMs) | 2b, 5b, 5h | 3, 5 | …impermeable liner has become exposed and/or damaged.<br><br>…evidence suggests impermeable liner is leaking below grade. | | Impermeable liners can be clay, geotextile, or composite geosynthetic. Repairs methods utilized should be based on liner material.<br><br>If impermeable liner has become exposed, inspect to confirm no punctures, tears or other damage has occurred.<br>If liner is not damaged, restore cover layer using material consistent with original plan.<br><br>If exposed liner is damaged or evidence suggests a liner is damaged/leaking without being exposed, repair should be designed by a professional engineer. Suspected below grade liner damage requires removal of all bioretention planting material to locate damage. Possible repair procedure could involve partial or total liner replacement, consulting with liner manufacture for repair requirements for geosynthetic or bentonite clay liners. | 711-7801-10 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

[5] Side Slopes are the inside SCM walls formed below surrounding grade where the SCM side wall is constructed by excavating below grade. Embankments, or berms are 'fill' material constructed above the surrounding ground forming a side wall of the SCM. Embankments may not be present in all SCMs. Embankments may be considered a regulated dam structure depending on height and drainage area.

**Table E.1.12: Infiltration Berm (IBE) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management in SCM and SCM vicinity | Excessively tall vegetation or invasive/undesirable species observed | 4a, 4d, 4e, 4f | 1, 2 | …vegetation growth restricts access and interferes with maintenance activity. | | Review the plans to determine appropriate vegetation. In areas intended to be mowed, mow berm and adjacent area at plan specified height. Perform all mowing must be performed when the area is dry. Do not remove trees, shrubs or other plants intended to be present based on the plans. Mow berm and surrounding area annually to a height of 6 inches if no instructions are provided on the plan and only turf or meadow grasses are present. If woody growth is present and plans are not available to clarify design plantings consult a professional engineer and/or landscape architect for direction.<br><br>If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be a type acceptable for use in and around surface waters. Remove dead plants 30 to 60 days after spraying. [3] | 711-7801-07 |
| Vegetation: Management in SCM | Trees/shrubs or woody vegetation observed | 4a, 4d 4f | 1, 2, 5 | …tree/shrub/woody growth restricts access, obstructs water flow, are growing on berm, or interferes with maintenance activity. | | If landscaping plans are available and indicate trees/shrubs/woody vegetation should not be permitted to grow on the berm, remove trees/shrubs/woody vegetation. Do not drive equipment or trucks onto berm or surrounding areas. Repair disturbed area, replanting and stabilizing per plans immediately.[3]<br><br>If plans do not clearly indicate woody vegetation must be removed, consult a professional engineer or landscape architect for guidance. | 711-7801-07 |
| | Hydrophytic (wetland) plants observed | 4e | 3, 5 | …hydrophytic (wetland) plants are present, which is an indication of poor drainage. | Hydrophytic vegetation immediately upslope of berm only | See "Outflow, Ponding/Conveyance- Standing water or soggy area observed upslope of berm" to resolve excessive moisture. After resolution, restore planting to original plan design. | See Referenced Section |
| | | | | | With subsurface infiltration trench (SIT) below | Reference SIT corrective maintenance table. | See SCM Specific Table |
| | | | | | Hydrophytic vegetation both upslope and down slope of berm | Refer to plans to confirm wetlands were not originally present in the area. Consult an environmental scientist and professional engineer to assess. | TBD |
| | Vegetation is sparse | 4c, 4b | 1, 2, 5 | …less than 80% of the area is covered by vegetation or bare patches occur in more than 10% of the berm and surrounding area. | | Confirm a minimum of 4 inches of topsoil or plan specified modified soils mix is present. If depth is not sufficient, place topsoil or modified soils specified by plan to a depth of at least 4 inches. Do not mechanically compact soil. Replant area using seed mix or plant materials as specified on plans utilizing fertilizers/amendments if indicated by plans. Install rolled erosion control product meeting plan specifications. If sparse vegetation is a reoccurring problem or | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | no as-built plans are available, consult a landscape architect for revised planting approach.<br><br>If area is excessively shaded (6 hrs. or less of sun/day), consult a landscape architect to assess restoration of sunlight or revised planting approach. | 711-7801-07 |
| Ponding/Conveyance: Berm Surface | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the IBE surface or adjacent roadway embankment present safety, structural or SCM functional risk. | | Fill holes with the same or similar material used in the berm and apply the appropriate permanent vegetative stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |
| | Minor erosion on berm surface observed | 2b | 2 | …berm surface shows evidence of erosion greater than 3 inches but less than 6 inches deep and there is the potential for continued erosion. | | Perform work when area is dry. Add topsoil or plan specified modified soils mix and apply the appropriate permanent vegetative stabilization per plan. Determine cause of erosion and remedy if possible. Remove any sediment deposited in area using minimal compaction methods such as hand raking.[3] | 711-7801-06 |
| | Major erosion on berm surface observed | 2b | 3 | …slopes show evidence of erosion greater than 6 inches deep. | | Determine cause of erosion and/or concentrated flows. After erosive flows have been resolved, repair berm as described in "Ponding/Conveyance: Berm Surface- Minor erosion on berm surface observed."<br><br>If no cause of erosive flow is identified, consult a professional engineer to resolve erosion problem and develop restoration plan. Address erosion that may lead to problems (e.g., damage to highway or structures, etc.). Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01 See Referenced Section<br><br>TBD |
| **IBEs are typically located on the side slope or embankment of roadways where the IBE surface is actually part of the roadway fill structure. Malfunctioning IBEs could lead to flow channelization causing erosion of areas crucial to the stability of adjacent roadways and structures. Embankment concerns may be within and extending above the SCM. For purposes of this table, the words 'Embankment' and 'Side slope' refer to roadway structural fill and 'Berm Surface' refers to the cross-sectional area of the berm mound structure.**<br>**Where erosion or other concerns exist regarding the overall roadway side slope or embankment, refer to the "Basin, Most Types" Corrective Maintenance tables section on Embankment/Side Slopes for defect resolution guidance.** | | | | | | | |
| Inflow, Outflow, Ponding/Conveyance | Minor erosion on roadway embankment/ side slope in vicinity of SCM observed | 2a, 2b, 2c | 4, 5 | …roadway embankment/ slopes show evidence of erosion which is being deposited at berm. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. Remove sediment build up in vicinity of berm when area is dry using minimum compaction methods such as hand raking .[3] | 711-7801-06 |
| | Major/severe erosion on roadway embankment/ side slope in vicinity of SCM observed | 2a, 2b, 2c | 4, 5 | …roadway embankment/ slopes show evidence of erosion that threatens the integrity of the slope, adjacent roadway, or structures. | | Take immediate action. A geotechnical engineer may be required to evaluate the cause of issue and direct repairs. Repair should be designed by a professional engineer. | TBD |
| | Standing water or soggy area observed upslope of berm underlain by a SIT. | 3a, 3b, 3d, 5c | 2, 5 | …standing water is observed upslope of berm or upslope area remains saturated and rainfall did not occur in previous 72 hours. | | See subsurface infiltration trench (SIT) corrective maintenance table. | See SCM Specific Table |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Outflow, Ponding/Conveyance | Standing water or soggy area observed upslope of berm | 3a, 3b, 3d, 5c | 2 | …standing water is observed upslope of berm or upslope area remains saturated and rainfall did not occur in previous 72 hours. | Trash and debris preventing infiltration | Remove trash and litter.[3] | 711-7801-02 |
| | | | | | Thick matted grass, or other vegetation clogging surface. | Remove standing water. Thatch grass area when dry. Rake up dead grass and clippings. [3] | 711-7801-07 |
| | | | 2, 5 | | Top layer of soil may be clogged. | See "Inflow, Pretreatment, Ponding/Conveyance: Sediment Management - Sediment and/or anti-skid material accumulation on or upslope of berm observed" section. | See Referenced Section |
| | | | | | Poorly infiltrating underlying soils may be cause of failure. | Repair should be designed by a professional engineer. Possible repair procedure may include conducting test pit explorations and infiltration testing upslope of berm to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below surface elevation, excavate to depth of suitable infiltration and place engineered soils providing sufficient infiltration rate to grade, reshaping the surface of the SCM to original geometry and applying appropriate permanent vegetative stabilization per plan.[3,4] | 711-7801-10 |
| | | | | | Suspected high ground water. | Repair should be designed by a professional engineer. Process may include test pits and ground water monitor to assess typical water table and assess potential limiting layers beneath the SCM. | TBD |
| Ponding/Conveyance: Berm Surface | Clay layer visible and/or damaged, eroded/ (note clay layer may not be present in all SCMs) | 2b, 5b, 5h | 3, 5 | …clay layer has become exposed and/or damaged or eroded. | | Determine cause of erosions/damage and resolve to prevent future damage. Reconstruct clay layer using material consistent with plan. If issue is reoccurring, repair should be designed by a professional engineer. | 711-7801-10 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.13: Manufactured Treatment Device (MTD) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management Around SCM | Tall or thick vegetation or invasive/undesirable species surrounding the SCM observed | 4a, 4f | 1, 2 | …vegetation growth restricts access, and interferes with maintenance activity. | | Mow the area surrounding the SCM in accordance with District mowing policy. | 711-7801-07 |
| | Trees/shrubs or woody vegetation surrounding the SCM observed | 4a, 4f | 1, 2, 5 | …tree/shrub/woody growth restricts access, and interferes with maintenance activity. | | Remove trees/shrubs/woody vegetation. Repair disturbed area with top soil and seed meeting original plan specifications. [3] | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 70% of the pervious contributing drainage area to MTD is covered by vegetation and sediment is reaching MTD. | Shade is causing poor ground cover. Sun exposure is 6 hours or less per day. | Trim overhanging limbs and remove brushy vegetation that limit sunlight reaching grass and inhibits grass growth. Once sunlight is restored to area apply the appropriate permanent vegetative stabilization. [3] | 711-7801-07 |
| | | | | | Topsoil not present. | Replace topsoil, regrading area to plan contours. Do not compact soil. Apply permanent vegetative stabilization in accordance with plans. If problem is reoccurring, repair should be designed by a professional engineer. [3] | 711-7801-06 |
| Inflow, Pretreatment: Sediment Management | Sediment accumulation, trash or debris in SCM vicinity or inflow gutter/channel. | 1a, 1b, 1g | 1, 3 | …accumulation obstructs flows from entering the SCM.<br><br>…floatable debris has or could clog SCM inflow points | | Remove trash and debris. [3, 4] | 711-7801-08 |
| Inflow, Pretreatment, Ponding/Conveyance: Sediment Management | Sediment accumulation, trash or debris in WQ filter insert tray/bag structure observed | 1a, 1d, 1e, 1f, 1g, 5c | 1, 3 | …accumulation exceeds cleanout depth specified on plans or by manufacture.<br><br>…accumulation inhibits inlets function. | | Filters can be bags or cartridges. Large filters require the use of backhoe and chain to remove filter. Small filters can be removed by hand. Replace filter insert in accordance with manufacture recommendations. [3, 4] Some filters include oil absorbent pretreatment that may require frequent replacement. | 711-7801-08 |
| | Sediment accumulation, trash or debris in oil/water separator structure or hydrodynamic separator observed | 1a, 1d, 1e, 1f, 1g, 5c | 1, 3 | …accumulation exceeds cleanout depth specified on plans, field marked cleanout depth or by manufacture.<br><br>…accumulation inhibits SCM function. | | Use vacuum truck or other appropriate means described by manufacture recommendations to remove all sediment and debris from structure.[3, 4] | 711-7801-08 |
| Inflow, Pretreatment, Ponding/Conveyance | Missing or expired chemical/oil absorption cartridge | 5h | 1, 3 | …plan specified chemical/oil absorption cartridge is missed or out of date, no longer providing intended WQ treatment. | | Replace with chemical/oil absorption cartridge meeting original plan/manufacture requirements. Check for odor of gas or diesel prior to replacement. If detected, consider it a hazardous material implement appropriate Department procedures for removal and disposal. [4] | 711-7801-08 |
| Ponding/Conveyance | Oil accumulation in treatment chamber observed | 5f | 1, 3 | …oil accumulation on water surface. | | Do not touch the substance in question. Attempt to find where the substance is originating. Check for signs of gas or diesel fuel spill in the form of staining or evidence of an accident in the drainage area. Photograph and document the Potential Illicit Discharges (PIDs). Follow procedures for handling PIDs as specified in Publication 23-Chapter 8 – Section 8.9, Inspections. [4] | Pub. 23, Ch. 8.9 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Inflow, Outflow, Ponding/Conveyance: Structure | Defective internal filter tray/bag, baffle, walls or other members | 5b | 3, 4, 5 | …filter tray/bag, baffles, walls or other members are corroding, cracking, warping or failing. | | Repair or replace filter tray/bag, baffles, walls or other members to plan specifications in accordance with manufacture recommendations. In the absence of plans, repair should be designed by a professional engineer. [3,4] | 711-7801-08 |
| | Hood broken or missing | 5b | 3 | …plastic or metal hood is broken, leaking, or missing. | | Replace hood using plumbers putty or gasket to seal crack between wall and hood. | 711-7801-08 |
| | No water in sump | 5b | 2, 3 | …no standing water in sump allows oils and floatables to pass. | | Review plans for intentional weep holes or other means for sump to drain. If plans indicate no drains and sump is intended to maintain water surface, check for and repair cracks or damage to the structure causing lack of water. Consider adding a filter bag and oil absorbing bags. | 711-7801-08 |
| Water Quality | Mosquitoes | 3a | 2, 3 | …a large mosquito population is present due to standing water in an SCM component causing a significant nuisance or danger to human or animals in the vicinity of the SCM. | | Determine the SCM component with standing water causing the mosquito concern. Reference manufacture recommended solutions for proprietary devices. If a non-proprietary SCM such as a sumped inlet is the source, a licensed applicator in pest management maybe needed to treat enclosed/subsurface standing water with mosquito larvicides. A long term solution involving the replacement of the subsurface standing water component can be explored and a professional engineer should design the replacement of the structure with an alternative feature. [4] | 711-7801-08 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.14: Level Spreader Outfall (LSO) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management in SCM Vicinity | Excessively tall vegetation or invasive/undesirable species observed | 4e, 4f | 1, 2 | …vegetation growth restricts access and interferes with maintenance activity. | | In areas intended to be mowed, mow adjacent area at plan specified height. All mowing must be performed when the area is dry. Do not remove trees, shrubs or other plants intended to be present based on the plans. Mow area surrounding SCM annually to a height of 6 inches if no instructions are provided on the plans.<br><br>If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters. Remove dead plants 30 to 60 days after spraying. [3] | 711-7801-07 |
| Vegetation: Management in SCM | Trees/shrubs or other vegetation observed | 4a, 4d, 4e 4f | 1, 2, 5 | …tree/shrub/vegetation growing in LSO or in proximity to interfere with SCM function. | | Review LSO plans to confirm surface treatment does not call for vegetative cover. Remove trees/shrubs/vegetation in a fashion that does not damage the LSO. Do not drive equipment or trucks onto the SCM. Repair disturbed area, replanting and stabilizing surrounding area per plans. [3] | 711-7801-07 |
| Vegetation: Management Downslope of SCM | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 80% of the area is covered by vegetation or bare patches occur in more than 10% of the area immediately downslope of the LSO. | | Confirm a minimum of 4 inches of topsoil or plan specified modified soils mix is present. If depth is not sufficient, place topsoil or modified soils specified by design plan to a depth of at least 4 inches. Do not mechanically compact soil. Replant area using appropriate permanent vegetative stabilization as specified on original design plans utilizing fertilizers/amendments if indicated by original design plans. If sparse vegetation is a reoccurring problem or no plans are available, consult a landscape architect for revised planting approach.<br><br>If area is excessively shaded (6 hrs. or less of sun/day), consult a landscape architect to assess restoration of sunlight or revised planting approach. | 711-7801-06<br><br>711-7801-07 |
| Ponding/Conveyance: Sediment Management | Sediment and/or anti-skid material accumulation in surface LSO through or in pipes of subsurface LSO observed | 5c | 2, 3 | …accumulation blocks flow entry or even distribution of runoff into downslope area.<br><br>…sediment accumulation in surface LSO exceeds 25% of the capacity of the trough<br><br>…sediment accumulation in subsurface LSO exceeds 25% of the capacity of perforated pipe | | Conduct work when area is dry. Do not drive equipment around or onto SCM.<br><br>Surface LSO: Remove sediment from LSO trench area using minimal disturbance techniques such as hand raking. Restore bottom geometry to plan dimensions, restoring design cover. [3]<br><br>Subsurface LSO: remove sediment accumulation from distribution pipes using pipe clean methods such as a vacuum truck that minimize sediment escape into the surrounding gravel trench.[3] | 711-7801-02<br>711-7801-01<br><br>711-7801-02<br>711-7801-03 |
| Ponding/Conveyance | Burrowing animal holes observed | 5g | 2, 3 | …holes that are likely formed by a burrowing animal are located in the LSO | | Fill holes with soil and apply the appropriate permanent stabilization. If the problem persists, trapping of burrowing animal may be required. Contact PA Game Commission for assistance. | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | surface present safety, structural or SCM functional risk. | | | |
| Ponding/Conveyance, Outflow | Unlevel downslope discharge edge | 2b, 2c, 5b, 5d | 3, 5 | …flows are not spread evenly over the downslope discharge lip of the LSO. | Potential causes include differential settlement, frost heaving or improper construction of the downslope edge. | Resolution should be designed by a professional engineer. Possible remediation may include repairing the downslope edge of the LSO to a uniform elevation by either (1) retrofitting the structural edge with a level plate/weir or, (2) total reconstruction of the LSO.<br>Confirm remedial efforts result in a downslope edge of uniform elevation by conducting topographic survey, comparing the elevation at frequent (<5 foot) intervals. | 711-7801-10 |
| Ponding/Conveyance: Surface LSO | Flow is short circuiting around end of LSO surface structure | 2b, 2c, 5b, 5d | 3, 5 | …flows have short circuited and are flowing around the end of the structure, causing concentrated discharge. | Potential causes include inadequate design or improper construction. | Resolution should be designed by a professional engineer. Possible remediation may include repairing the end by constructing an extended concrete edging, turning upslope (perpendicular to the downslope edge), keying into the upslope ground surface. Repair downslope erosion and install appropriate permanent vegetative stabilization per plan. | 711-7801-10 |
| | Flow from the upstream inflow piping is overtopping the LSO downslope weir lip | 2b, 2c, 5h | 3, 5 | …flows from the upstream inflow pipe overtop the LSO downslope weir lip allowing a concentrated discharge. | Potential causes include inadequate trough length/depth, poor horizontal and/or vertical alignment, weir to close to inflow pipe. | Resolution should be designed by a professional engineer. Possible remediation may include resolving overtopping by retrofitting the structure with a small raised section directly in front of the inflow pipe to divert flow into trough, blocking over toping. If overtopping is not adequately resolved, compete redesign by an engineer and reconstruction should be considered. | 711-7801-10 |
| | Flow from the LSO is undercutting the structural weir | 2b, 2c, 5h | 3, 5 | …flow from the LSO has undercut and is flowing beneath the downslope weir. | Potential causes include inadequate weir invert, inadequate footer depth, construction on fill, improper construction and vandalism. | Resolution should be determined by a professional engineer. Possible remediation may include repair of the undercut area with flowable fill. Repair downslope erosion and install appropriate permanent vegetative stabilization per plan.<br><br>If undercutting is not adequately resolved, complete redesign by an engineer and reconstruction should be considered. | 711-7801-10 |
| | Flow from LSO is discharging through a failed joint in the downslope structural weir | 2b, 2c, 5b, 5d, 5h | 2, 3 | …flow from the LSO is discharging through a fail joint or break in the downslope structural weir. | Potential causes include inadequate joint filler, improper construction and vandalism. | If flow is from a joint, repair the joint by installing a water tight plate spanning the joint or installing proper joint filler that can withstand freeze/thaw. Repair downslope erosion and install appropriate permanent vegetative stabilization per plans.<br><br>If flow is from a break in the structural weir, reconstruct a minimum of 4 foot length of the downslope weir in accordance with plans. Repair downslope erosion and install appropriate permanent vegetative stabilization per plans. | 711-7801-05 |
| Outflow | Minor erosion on vegetated surface downslope of the LSO observed | 2c | 2, 5 | …area downslope of LSO shows evidence of erosion rills/gullies greater than 3 inches but less than 6 inches deep. | | Perform work when area is dry. Add topsoil or plan specified modified soils mix and apply the appropriate permanent vegetative stabilization per plan. Determine cause of erosion and remedy if possible. Remove any sediment deposited in area using minimal | 711-7801-06 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | compaction methods such as hand raking.[3] If rills/gullies reform, consult a professional engineer to develop a restoration plan. | |
| Outflow | Major erosion on vegetated surface downslope of the LSO observed | 2c | 3, 5 | …area downslope of LSO shows evidence of erosion rills/gullies greater than 6 inches deep. | | Determine cause of erosion and/or concentrated flows. After erosive flows have been resolved, repair the area by adding topsoil or plan specified modified soils mix and apply the appropriate permanent vegetative stabilization per plan.<br><br>If no cause of erosive flow is identified, consult a professional engineer to resolve erosion problem and develop a restoration plan. Address erosion that may lead to problems (e.g., damage to highway or structures, etc.). Stabilize slope. Place topsoil and apply the appropriate permanent vegetative stabilization. | 711-7801-01<br>711-7801-06<br><br>TBD |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.15: Pervious Pavement, Asphalt (PPA); Concrete (PPC); And Pavers (PPP) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Security | Signage | 5h | 4 | …no signage is present indicating the limits of the pervious pavement.<br><br>…no signage is present indicating the special maintenance requirements of pervious paving. | | Install signed delineating the extents of the pervious paving area. Signage should notify maintenance crews of special requirements such as special plowing producers, specific de-icing requirements and prohibited use of seal coating products. This signage should be installed even if not indicated on the plans. In addition, the frequency of vacuuming should be indicated. | 711-7801-04 |
| Vegetation: Management at SCM Outflow Points | Excessively tall vegetation or invasive/undesirable species observed at SCM outflow (where applicable) | 4a, 4e, 4f | 1, 2, 5 | …vegetation growth exceeds 12 inches or obstructs water flow and interferes with maintenance activity. | | If surface discharge is into another SCM (vegetated swale (VSW, VSC) or filter strip (VFS, VSS)), refer to appropriate maintenance tables.<br><br>Review the plans to determine proper care. Mow the adjacent area annually to a height of six inches if no instructions are provided on the plan. [3]<br><br>If invasive/undesirable species are present, utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters. Remove dead plants 30 to 60 days after spraying. Replant area with native plants and/or seed mix per plans. If replanting is required repeatedly, consult a landscape architect for assessment. [3] | 711-7801-07 |
| | Vegetation is sparse | 4b, 4c | 1, 2, 5 | …less than 70% of the surface outflow points from the SCM are covered by vegetation or bare patches are observed in more than 10% of area. | | If surface discharge is into another SCM (vegetated swale (VSW, VSC) or filter strip (VFS, VSS)), refer to appropriate maintenance tables.<br><br>Replant area using seed mix or plant materials as specified on plans. If sparse vegetation is a reoccurring problem or no plans are available, consult a Landscape architect for revised planting approach.<br><br>If area is excessively shaded (6 hrs. or less of sun/day), trim overhanding limbs and brushy vegetation if within right of way. Once sunlight is restored, replant as per above.[3] | See SCM Specific Table<br><br>711-7801-06<br><br>711-7801-07 |
| Vegetation: Management on SCM (open cell paving grid PPA) | Grass coverage is sparse | 4b, 4c | 1, 2, 5 | …less than 70% of the PPA (open cell paving grid) surface is covered by vegetation or bare patches are observed in more than 10% of area. | | Replant area using seed mix as specified on plans utilizing fertilizers/amendments if indicated by plans. In the absence of plans, utilize PennDOT Formula B seed mix. If sparse vegetation is a reoccurring, consult a Landscape architect for revised planting approach.<br><br>If area is excessively shaded (6 hrs. or less of sun/day), trim overhanding limbs and brushy vegetation if within right of way. Once sunlight is restored, replant as per above.[3] | 711-7801-06<br><br>711-7801-07 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Ponding/Conveyance: SCM Surface | Sediment, trash/debris, and/or anti-skid material accumulation on pavement surface area | 1a, 5c | 3 | …accumulation blocks flow entry or distribution of runoff across paving surface area.<br><br>…accumulation prevents infiltration into pavement. | | Follow sediment removal methods on plans. In the absence of plans, remove accumulated sediment/materials from paving surface using a pure high pressure vacuum truck or a regenerative air sweeper. Do not use a standard brush or sweeper. Sweep while surface is dry. Do not spray surface. Control dust by adding water to hopper.<br>PPP: Conduct a test of method on a small section of pavers and adjust settings to remove all visible sediment without dislodging granular joint material between pavers high pressure washing is not recommended for sediment removal from PPPs. [3] | 711-7801-11 |
| | Accumulation of leaves, pine needles or other vegetative debris | 1e, 5c | 2 | …accumulation on top of pervious pavement covering more than 10% of surface area. | | Remove debris with leaf blower (PPA, PPC or PPP) or pure high pressure vacuum or regenerative sweeper (PPA and PPC only). | 711-7801-02<br>711-7801-11 |
| | Moss growth on pervious pavement observed | 3a, 4a, 5h | 2 | …moss growth inhibits infiltration or pose a slip safety hazard. | | Remove moss using hand removal methods such as raking. Clean surface of pervious pavement as described in "Ponding/Conveyance: SCM Surface- Sediment, trash/debris, and/or anti-skid material accumulation on pavement surface area"<br>After cleaning, confirm infiltration of surface by performing surface infiltration testing. If infiltration rates do not meet or exceed design rates, consult a professional engineer for additional corrective measures. | 711-7801-02<br>See Referenced Section |
| | An oily accumulation is observed | 5f | 3 | …an oily sheen forms when water is applied to pervious pavement surface.<br><br>…ponding on surface or water flows off pervious pavement during rain event. | | Determine source of oil contamination, remediate and prevent additional occurrences.<br><br>After source has been removed, clean surface of pervious pavement by hand held pressure washing applied at a low to the ground angle (about 30°) being careful not to force oil and debris into pores. Pure high pressure vacuuming could be done after pressure washing if required to remove loose material.<br>PPP: Adjust pressure and angle of pressure washing and suction of vacuuming equipment to avoid dislodging granular joint material between pavers.<br><br>After cleaning, confirm infiltration of surface by performing surface infiltration testing. If infiltration rates due not design rates, consult a professional engineer for additional corrective measures. | 711-7801-02<br><br>711-7801-11 |
| | Surface of pervious pavement is clogged | 1e, 3a, 3d, 5c, 5h | 4, 5 | …ponding on surface or water flows off pervious pavement during rain event. | Evidence of clogging from inappropriate winter de-icing material such as sand. | Refer to sediment removal methods on plans. In the absence of plans:<br><br>PPA and PPC: Remove accumulated sediment/materials from paving surface using pure high pressure vacuum truck or a regenerative air sweeper. Do not use a standard brush or sweeper. Sweep while surface is dry. Do not spray surface. Control dust by adding water to hopper. [3] | 711-7801-11 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | PPP: Wet the surface of the clogged areas using large amounts of water. Vacuum aggregate from between pavers to a depth that removes all visible fine sediment. Replace with clean permeable joint material matching material specified on plans.<br><br>After cleaning, confirm infiltration of surface by performing surface infiltration testing. If infiltration rates do not meet or exceed design rates, consult a professional engineer for additional corrective measures. Repairs may require the following steps;<br>1. Micro-mill 1 inch of material from surface. Core asphalt to determine structural integrity and thickness. Examine condition of geotextile fabric looking for evidence of clogging.<br>2. If geotextile is clogged, full depth of pavement and geotextile replacement maybe required. Consider eliminating geotextile and replacing with mixture of pea and rice gravel.<br>3. Overlay of 1" pervious asphalt wearing course (maximum aggregate size 5/8 inch) can be considered. | |
| | | | | | Sediment laden flows caused siltation. | Address cause of sediment laden flows, installing appropriate E&S measures until permeant stabilization is achieved. Clean surface in accordance with above section "Evidence of clogging from inappropriate winter de-icing material such as sand." | 711-7801-06<br>711-7801-11 |
| | | | | | Sealant inadvertently applied. | Repair should be designed by a professional engineer. Repairs may require total reconstruction of pervious pavement, or micro-milling between 0.2 and 1 inch off the surface and pressure washing milling debris away. Pure high pressure vacuuming should be done after pressure if milling debris remains. | 711-7801-10 |
| Ponding/Conveyance: SCM Surface | Pervious pavement (PPA or PPC) damaged is observed | 5b | 2, 3, 4, 5 | …asphalt or concrete surface has cracking, spalling, raveling, rutting, or other trip hazards. | | Small areas of damage (approximately 2 feet x 2 feet) may be repaired using conventional asphalt (for PPA) or concrete (for PPC). Larger deformities should be reconstructed using pavement that meets the plan specifications. Prior to large scale repairs, an engineering evaluation should be performed to assess the reason for failure if the SCM has not reach expected service length at the time of failure. | 711-7801-10 |
| | Pervious pavement paver (PPP) damage or missing pavers are observed | 5b | 2, 3, 4, 5 | …individual paver blocks are missing or damaged. | | Replace damaged and missing pavers with new pavers. Utilize plan specified pavers, bedding and installation procedures, restoring surface to finished grades per plan. | 711-7801-10 |
| | Loss of aggregate surrounding pervious pavement pavers (PPP) is observed | 2B, 5b, 5d, 5h | 2, 3, 4, 5 | …loss of permeable granular joint material from in between pavers greater than ½ inch in depth. | | Investigate cause of permeable granular joint material loss and remediate, preventing future occurrence.<br>Utilize plan specified materials. Hand sweep material into crack. and installation procedures to fill the void space. In the absence of plans, use double washed course masonry sand. | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Ponding/Conveyance: SCM Surface | Settlement of pavement surface is observed | 5b, 5d, 5h | 2, 3, 4, 5 | …settlement of pavement surface inhibits infiltration, creates a safety hazard or compromises SCM functionality. | | Confirm settlement is not related to possible sinkhole activity; see "Ponding/conveyance: SCM Surface- sinkhole observed" if sinkhole is suspected.<br><br>PPA and PPC: Small areas (approximately 2 feet x 2 feet) may initially be repaired using conventional asphalt (for PPA) or concrete (for PPC) to fill the settled area.<br><br>PPP: For small areas (approximately 4 feet x 4 feet), remove pavers and install additional base aggregate to subbase level and reinstall pavers using plan materials and installation methods restoring surface to finished grades per plan.<br><br>PPA, PPC and PPP: For larger areas and reoccurring small areas of settlement, consult a geotechnical engineer to assess settlement cause and develop remediation plan. | 711-7801-10 |
| Outflow, Ponding/Conveyance: Underdrain | Prolonged flows | 3d, 5h | 2, 5 | …underdrains carry continuous flow and it has not rained in the previous 72 hours. | | High groundwater may be present. Repair should be designed by a professional engineer. Process may include test pits adjacent to area and ground water monitor to assess typical water table and assess potential limiting layers beneath the SCM. | TBD |
| Outflow, Ponding/Conveyance: Underdrain or Outlet Pipe | Obstruction or blockage noted | 5h | 2 | …water does not flow into or out of the outlet structure or piping. | | Remove obstructions to restore flow (e.g., remove trash, debris, sediment, or vegetation as necessary) from piping using water jet cleaning methods. [3, 4] | 711-7801-03 |
| Ponding/Conveyance: Observation Wells | Standing water in observation well | 3b | 2, 5 | …standing water is observed in observation wells and rainfall did not occur in previous 72 hours. | | Confirm the standing water is not associated with high ground water flows (See "Outflow, Ponding/Conveyance: Underdrain- Prolonged flows").<br><br>Prolonged standing water in the observation well can indicate the subsurface infiltration portion of the SCM is malfunctioning with possibly poorly infiltrating underlying soils or clogged geotextile. Repair should be designed by a professional engineer. Possible repair procedure may be as follows: Conduct small (1 foot x 1 foot) test pit explorations through pervious pavement to confirm geotextile functionality. If clogged, replacement of geotextile is required.<br>For poorly infiltrating underlying soils, conduct infiltration testing adjacent to the SCM foot print at the bottom elevation and at successive depths below SCM bottom to assess infiltration capacity and limiting zones of underlying soils. If suitable infiltration rates with no limiting zones are identified below the original SCM bottom elevation, reconstruct the pervious paving with a thicker aggregate sublayer to lower bottom elevation to the depth of suitable infiltration, reinstall pervious pavement surface to plan surface geometry with plan specified materials and installation methods. [3,4] | TBD |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Ponding/Conveyance: Observation Wells | Observation well cover missing or damaged | 5b | 2 | …observation well cover is missing or well is damaged. | | Replace missing access cover with cover meeting original plan specifications. | 711-7801-05 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

**Table E.1.16: Regenerative Step Pool (RSP) Corrective Maintenance**

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| Vegetation: Management in SCM and SCM Vicinity | Excessively tall vegetation or invasive/undesirable species observed | 4a, 4d, 4e, 4f | 1, 2 | …vegetation growth restricts access, obstructs water flow and interferes with maintenance activity. | | If invasive/undesirable species are present utilize selective herbicide application by a qualified professional in accordance with District and Department requirements. Herbicide should be labeled for use in and around surface waters. Remove dead plants 30 to 60 days after spraying.[3] | 711-7801-07 |
| Vegetation: Management in SCM | Trees/shrubs or woody vegetation observed | 4a, 4f | 1, 2 | …tree/shrub/woody growth restricts access, obstructs water flow, are growing in pool bottom or interferes with maintenance activity. | | If landscaping plans are available and indicate trees/shrubs/woody vegetation are not specified, remove trees/shrubs/woody vegetation and root systems from channel bottom and/or side slopes when SCM is dry. Repair disturbed area, replanting and stabilizing per plans.[3]<br><br>Remove woody vegetation occasionally from channel bottom and side slopes when area is dry if no other instructions are provided on the plan. [3] | 711-7801-07 |
| | Hydrophytic (wetland) plants observed | 4e | 3, 5 | …hydrophytic (wetland) plants are present, but not included on plans, is an indication of poor drainage. | Hydrophytic vegetation in pools. | See "Outflow, Ponding/Conveyance: Pool surface" | See Referenced Section |
| | Vegetation is sparse | 4c, 4b | 1, 2, 5 | …less than 80% of plant species originally planted on plans are surviving. | Originally planted with Hydrophytic vegetation. | Confirm that pools are retaining water at correct depth. If they are, replant area using seed mix or plant materials as specified on plans. If sparse vegetation is a reoccurring problem or no plans are available, consult a landscape architect for revised planting approach.<br><br>If water is not retained in pools or sparse vegetation is a reoccurring problem or no plans are available, consult landscape architect for revised planting approach. | 711-7801-06<br><br>711-7801-07 |
| Inflow, Pretreatment, Ponding/Conveyance: Sediment Management | Sediment and/or anti-skid material accumulation in SCM observed | 5c | 2, 3 | …sediment accumulation in pools exceeds 6" depth in first year of functioning. | | Conduct work when area is dry. Install/spray an additional layer of compost on sediment build up and replant pool bottoms per plans. Do not drive equipment onto riffle, cascade, or pool areas. | 711-7801-06 |
| | | | | …sediment accumulation threatens structural integrity or the system. | | Conduct work when area is dry. Remove sediment from pool areas using backhoe if slope allows or a vacuum hose if on steep slope or access is restricted. Replace sand/woodchip mixture. Do not drive equipment onto riffle, cascade, or pool areas. Winching equipment into place may be required on steep slopes. Restore geometry to plan dimensions. Restore appropriate permanent vegetative stabilization as indicated in the plans.[3] | 711-7801-01 |
| | Sand/woodchip mixture has washed out of pools<br><br>Geotextile has clogged | 5c | 2, 3 | …sediment and/or sand/woodchip mixture has washed out due to high flows.<br><br>…geotextile clogging inhibits SCM performance. | | Remove sand/woodchip mixture from pool areas using backhoe if slope allows or a vacuum hose if steep slope or access is restricted. Remove rocks/boulders overlying geotextile fabric. Replace geotextile fabric, rock/boulders, and sand/woodchip mixture. Do not drive equipment onto riffle, cascade, or pool areas. Restore geometry to plan dimensions. Restore appropriate permanent vegetative | 711-7801-10 |

| SCM Component [1] | Defect or Problem | Defect Codes [2] | Inspection Action Code | Maintenance is Needed When… | SCM Component Variations or Cause of Defect/Problem | Recommended Maintenance Activity to Correct Problem | Assembly # |
|---|---|---|---|---|---|---|---|
| | | | | | | stabilization as indicated in the plans.[3] If condition persists, add clean #3 stone to surface of sand/woodchip areas. | |
| Side Slopes | Minor erosion on side slope observed | 2b, 2c | 2 | …slopes show evidence of erosion greater than 4 inches but less than 12 inches deep and there is the potential for continued erosion. | | Add topsoil and apply the appropriate permanent vegetative stabilization. Determine cause of erosion and remedy if possible. Remove any sediment deposited in SCM as described under sedimentation management. Evidence of large by-pass flows may require consultation with a professional engineer. | 711-7801-06 |
| Outflow, Ponding/Conveyance: Pool surface | Standing water or soggy bottom is observed in pool in non-wetland seepage system. | 3a, 3b, 3d, 5c | 2, 5 | …standing water is observed in pool bottom remains saturated and rainfall did not occur in previous 72 hours. | Standing water/saturation is limited to top few inches of the media. | Top layer of sand/woodchip may be clogged. See "Inflow, Pretreatment, Ponding/Conveyance: Sediment Management" section. | See Referenced Section |
| | | | | | Standing water/saturation extends through media. | Suspected high ground water. Repair should be designed by a professional engineer or landscape architect. Process may include redesign to allow wetland plants to exist. | TBD |
| Inflow, Outflow: Principle Spillway | Movement of rock/boulders from riffle, cascade or weir sections. | 2b, 2c | 2 | …movement of rock/boulders from riffle, cascade or weir sections but has not impeded function of SCM. | Displaced rock and can be moved back into place by hand. | Replace rock to its original configuration and reinforce rock with concrete. If problem is reoccurring, repair should be designed by a professional engineer. | 711-7801-10 |
| | | | 3, 5 | …movement of rock/boulders from riffle, cascade or weir sections has impeded function of SCM. | Displaced rock must be moved back by equipment. | Repair should be designed by a professional engineer. | 711-7801-10 |

[1] SCM Component corresponds to the CAI form (M-79).

[2] Defect code corresponds to the VSI form (M-77).

[3] All vegetation, trash, debris, liquids, and materials removed from the SCM should be disposed of in accordance with the Department's waste management policy and all applicable regulations. Sediment should be disposed of in accordance with Department policy on handling of fill and applicable regulations.

[4] Do not enter manholes, inlets, or any structure meeting OSHA standards for confined space without current confined space training and appropriate safety measures in place. Do not attempt to perform maintenance activities while water is standing in or flowing through the system without proper training and safety measures in place.

# APPENDIX F

# SCM WORK ASSEMBLIES

**711-7800-01 SCM** Visual Screening
A routine inspection of an SCM.

**711-7800-02** SCM Condition Assessment
A detailed evaluation of an SCM's functionality.

**711-7801-01** SCM Earthwork
Earth moving to repair or rebuild access roads, basin embankments, and other similar activities.

a. Repair or rebuild stone access road
b. Repair or rebuild basin embankment
c. Excavate accumulated sediment/debris to restore basin capacity (more than routine material removal)
d. Restore basin capacity
e. Regrade basin bottom to eliminate ponding areas

**711-7801-02** SCM Material Removal
Preventative and corrective removal and disposal of trash, debris, and sediment that collects in and around the SCM.

a. Remove trash and debris
b. Remove minor, localized sediment accumulation (e.g., in sediment forebay, at pipe outfalls)
c. Removed downed trees
d. Remove hazardous waste, chemical containers, etc.
e. Contain and remove oil sheen
f. Remove insect nest/hive or populations

**711-7801-03 SCM** Storm Sewer Cleaning
Cleaning of storm sewer system elements tributary to the SCM.

a. Remove accumulated material in storm inlets
b. Flush sediment and debris from pipes

**711-7801-04 SCM** Fencing and Signs
Repair, replace, or install fencing, delineators or other signage.

a. Fence, fence gate, lock
b. SCM delineator
c. Signage (e.g., no mow area)
d. Removable guiderail section

**711-7801-05 SCM** Structure Upkeep and Repairs

Repair and general upkeep of structural and mechanical components of an SCM. Components may be buried, exposed above-ground, or contained in a chamber/tank.

a. Reset or replace damaged monitoring well
b. Flow control structure components (e.g., repair trash rack, orifice plate, vent, valve)
c. Concrete headwall, endwall, riser (e.g., repair cracks, spalling)
d. Repair damaged or deteriorated pipe section
e. Repair separated pipe joints (e.g., underdrains, outfalls)
f. Reseal pipe junction with flow control structure

**711-7801-06 SCM** Earth Stabilization

Installation or application of ground cover on earthen areas to minimize future erosion potential.

a. Repair rill or gully formation on slope
b. Repair or replace channel lining (e.g., re-staple turf reinforcement mat)
c. Install or repair scour protection at inflow channel or outfall
d. Fill or plug animal burrow
e. Repair sinkhole
f. Establish or reestablish ground cover (e.g., seed and rolled erosion control product)

**711-7801-07 SCM** Vegetation Management

Control of vegetative growth in and around the SCM.

a. Prune or cut down trees
b. Brush control (e.g., brush hogging)
c. Mowing
d. Application of growth regulator
e. Weed control in shrub beds (e.g., bioretention)

**711-7801-08** SCM Manufactured Treatment Devices

Any maintenance associated with (proprietary) manufactured treatment devices.

a. Replace media
b. Replace filters/cartridges

**711-7801-10** SCM Replacement

Major restoration work to restore SCM function, including the replacement of all or part of the SCM.

a. Remove and replace stone bed filter in an infiltration trench
b. Replace bioretention soil, media filter drain mix, or constructed stormwater filter media

**711-7801-11** SCM Other

Maintenance activities that are do not fit within the other assemblies. It is somewhat of a placeholder for future maintenance needs that arise from inspection observations.

**SAP ASSEMBLY NUMBER:** 711-7800-01
**ACTIVITY TITLE:** SCM VISUAL SCREENING
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

## REFERENCES

PUB 213 Work Zone Traffic Control

## SCHEDULING CONSIDERATIONS

Visual screening inspections (VSI) are performed on 3-year (triennial) cycles for most SCM types. The actual act of inspecting the SCM in the field should take approximately one hour. It is anticipated that four to six VSIs can be completed per day depending on factors such as access, SCM complexity, and travel time. Personnel must have taken and passed PennDOT's SCM Visual Screening Inspection Training to be eligible to inspect SCMs.

## WORK AREA

The inspection focuses on five areas of an SCM: inlet or inflow points, perimeter, bed, vegetation, and outlet or outflow points. The work area will typically be outside of the roadway shoulder.

## ACTIVITY DESCRIPTION

A visual screening is a non-invasive inspection of an SCM using visual indicators to quickly identify common problems. The as-built plan is not required for this inspection. Refer to Chapter 3 for additional guidance on VSIs. All incidental activities related to the VSI shall be charged to this assembly.

## PROCEDURE DESCRIPTION

1. Locate SCMs to be inspected using Maintenance-IQ or other means. Geographically grouping SCMs together reduces travel time making inspections more efficient.
2. Work Zone Traffic Control shall be set up in accordance with Pub. 213 at all SCM sites.
3. Complete on-site inspection of SCM. Take photographs to document problems found.
4. Record inspection findings on Form M-77. Organize and annotate inspection photos using Form M-78 (as applicable). Forms must be completed electronically.
5. Submit inspection forms to the District Stormwater Maintenance Coordinator, or their designee per the procedure outlined in Chapter 3.

**SAP ASSEMBLY NUMBER:** 711-7800-02
**ACTIVITY TITLE:** SCM CONDITION ASSESSMENT
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

## REFERENCES

PUB 213 Work Zone Traffic Control

## SCHEDULING CONSIDERATIONS

Condition assessment inspections (CAI) are performed within one year of construction and then approximately every ten years for most SCM types. The actual act of inspecting the SCM in the field should take approximately three hours for most SCM types. It is anticipated that the fieldwork for two CAIs can be completed per day if SCMs are grouped geographically to reduce travel time. Personnel must have taken and passed PennDOT's SCM Condition Assessment Inspection Training to be eligible to inspect SCMs.

## WORK AREA

The inspection focuses on five areas of an SCM (inlet, perimeter, bed, vegetation, and outlet) and its contributing drainage area. The work area will typically be outside of the roadway shoulder.

## ACTIVITY DESCRIPTION

A condition assessment is an in-depth inspection of an SCM using minimally invasive techniques to establish a baseline condition and uncover any issues that may affect performance. The as-built plan is required for this inspection to compare to the constructed SCM in the field. Refer to Chapter 3 for additional guidance on CAIs. All incidental activities related to the CAI shall be charged to this assembly.

## PROCEDURE DESCRIPTION

1. Locate SCMs to be inspected using Maintenance-IQ or other means. Geographically grouping SCMs together reduces travel time making inspections more efficient.
2. Work Zone Traffic Control shall be set up in accordance with Pub. 213 at all SCM sites.
3. Complete on-site inspection of SCM. Take photographs to document the inspection and any problems found.
4. Record inspection findings on Form M-79. Organize and annotate inspection photos using Form M-78. Forms must be completed electronically.
5. Submit inspection forms to the District Stormwater Maintenance Coordinator, or their designee per the procedure outlined in Chapter 3.

**SAP ASSEMBLY NUMBER:** 711-7801-01
**ACTIVITY TITLE:** SCM EARTHWORK
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 213 Work Zone Traffic Control
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections. It is preferred that this assembly be performed during the growing season between March 1 and October 31 depending on geographic location and weather conditions. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
The SCM and the surrounding area including access roads, basin embankments, outflow points, or anywhere else SCM related earthwork is needed.

**ACTIVITY DESCRIPTION**
Earth disturbance to repair or rebuild an SCM and its appurtenances. This activity does not cover routine maintenance activities. Corrective actions covered includes: repair or rebuild access road, repair or rebuild basin embankment, excavate accumulated sediment and debris to restore basin capacity, reconfigure basin to maintain or increase capacity, regrade base bottom to eliminate ponding areas.

**PROCEDURE DESCRIPTION**
1. Work Zone Traffic Control shall be set up in accordance with Pub. 213.
2. Install temporary erosion and sediment control measures as required for site conditions.
3. Avoid placing heavy equipment on SCM areas designed to infiltrate or filter stormwater runoff. Either use lightweight, low ground pressure equipment on SCM bottom surfaces or stage equipment and perform maintenance from perimeter.
4. Work should be performed during dry SCM conditions. Clogged or ponded SCMs may be drained using pumped water filter bags or other measures that prevent discharge of sediment laden waters to offsite areas.
5. Complete SCM earthwork as directed by the County Manager, District Stormwater Maintenance Coordinator or their designee.
    a. Repair Access Road:
        i. Stone Access Road
            1. Minor repairs can be made by placing additional rock (No. 1 coarse aggregate or match existing stone) to maintain access road thickness.
            2. Major reconstruction due to washout or other extensive damage.
                a. Remove access road materials to existing ground.
                b. Scarify and grade existing ground to remove damage in preparation for access road stone placement.
                c. Install geotextile, class 4, type A on the access road footprint in preparation for rock placement.
                d. Construct access road by placing a No. 1 coarse aggregate to a

minimum depth of 8-inches.

ii. Seeded Access Road
   1. Scarify and grade access road to remove corrugations, potholes, and other damage.
   2. Shape access road to restore crown and cross section.
   3. Compact access road with roller to stabilize. Avoid compacting areas outside the access road footprint. Use assembly 711-7801-06 to stabilize access road.
   4. Consider conversion to a stone access road or contact licensed professional at sites where erosion or other chronic maintenance issues are a concern.

b. Repair Basin Embankment:
   i. Repair or rebuild the SCM basin embankment, side slopes, or emergency spillway (i.e., work area) as directed by licensed professional to ensure structural integrity of impoundment.
   ii. Grade work area to original dimensions shown on the as-built plan or as directed by a licensed professional.

c. Restore Basin Capacity:
   i. Excavate deposited sediment as directed to restore SCM capacity. Take care to remove only deposited material and minimize impact to original SCM bottom.
   ii. Grade SCM as necessary to restore original dimensions on as-built plan as or as directed by licensed professional.
   iii. Perform infiltration testing to confirm bottom permeability in SCMs with infiltration and filtration beds.

d. Reconfigure Basin:
   i. Obtain any necessary clearances from regulatory agencies and licensed professional to reconfigure SCM.
   ii. Grade SCM basin to dimensions shown on as-built plan or as directed by licensed professional.

e. Regrade Basin Bottom:
   i. Consult SCM as-built plan for appropriate material (e.g., filter media, permeable topsoil, compacted clean fill, etc.) to fill low spots and ponding areas on basin bottom.
   ii. Grade SCM basin bottom as required to eliminate ponding areas.
   iii. Perform infiltration testing to confirm bottom permeability in SCMs with infiltration and filtration beds.

6. Remove accumulated sediment, excavated material, and other construction wastes from the site and dispose of at a proper disposal or fill site.
7. Stabilize any disturbed work areas as required by site conditions and charge to assembly 711-7801-06 SCM Earth Stabilization.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As Required | To be determined based on need | As Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-02
**ACTIVITY TITLE:** SCM MATERIAL REMOVAL
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 213 Work Zone Traffic Control
PUB 445 Safety Policy Handbook
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections, and as required as part of an SCM's for routine maintenance schedule. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
The SCM and the surrounding area including access roads, basin embankments, outflow points, or anywhere else SCM related earthwork is needed.

**ACTIVITY DESCRIPTION**
Removal and disposal of trash, debris, and sediment that collects in and around the SCM. Removal of minor, localized sediment accumulations, downed trees, and contamination (e.g., oil sheens, hazardous wastes, and chemical containers) are covered. Activity will vary based on need. Tasks that would result in earth moving should be charged to assembly 711-7801-01 SCM Earthwork.

**PROCEDURE DESCRIPTION**
1. Work Zone Traffic Control shall be set up in accordance with Pub. 213.
2. Install temporary erosion and sediment control measures as required for site conditions.
3. Avoid placing heavy equipment on SCM areas designed to infiltrate or filter stormwater runoff. Either use lightweight, low ground pressure equipment on SCM bottom or stage equipment and perform maintenance from the perimeter.
4. Complete material removal at SCM locations as directed by the County Manager, District Stormwater Maintenance Coordinator (DSMC), or their designee.
    a. Trash and debris:
        i. Remove minor accumulations of trash and debris from areas in around the SCM by hand.
        ii. Larger items and accumulations may require removal by mechanical means.
    b. Minor, localized sediment accumulation:
        i. Remove minor localized sediment accumulations at pipe outfalls, in sediment forebays and other SCM areas by hand.
        ii. Larger localized accumulations (e.g., up to the cleanout stake in a sediment forebay) may be removed by mechanical means provided the task will not result in earth moving or disturbance.
    c. Downed trees:
        i. Collect twigs and small branches associated with downed trees in SCMs by hand.
        ii. Utilize chain saws and other hand tools to process large branches and trunks of downed trees for removal.

iii. Wood should be cut into lengths of not less than two feet.

d. Hazardous waste, chemical containers, etc.:
   i. Follow District Environmental Unit provided procedure for removing hazardous and potentially hazardous materials from the SCM and remediating the work area.
   ii. Personnel will need appropriate equipment for personal protection, containment and waste disposal for materials deemed hazardous. Refer to Pub. 445 and contact District Safety Coordinator before starting work to ensure all safety measures have been established when dealing with potentially hazardous waste.

e. Contain and remove oil sheen:
   i. Follow District Environmental Unit provided procedure for removing hazardous and potentially hazardous materials from the SCM and remediating the work area.

f. Insect nests, hives, and populations:
   i. Remove the insects and/or nests as directed by the District Roadside Specialist.
   ii. Insecticide applications must be made by a certified pesticide applicator, a trained application technician, or any other person provided a certified pesticide applicator is present at the work site.

5. Collect and dispose of removed materials at a proper disposal or fill site.
6. Stabilize any disturbed work areas as required by site conditions and charge to assembly 711-7801-06 SCM Earth Stabilization.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As<br>Required | To be determined based on need | As<br>Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-03
**ACTIVITY TITLE:** SCM STORM SEWER CLEANING
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 213 Work Zone Traffic Control
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections. Work is limited to Department storm sewers that are tributary to SCMs. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
Department storm sewers that are directly tributary to SCMs and the SCM itself.

**ACTIVITY DESCRIPTION**
This activity is for the cleaning of storm sewer system elements (e.g., inlets and pipes) that are tributary to an SCM using mechanized means. This includes removing accumulated material from inlets and flushing material (e.g., sediment and debris) from pipes. All incidental activities related to the task shall be charged to this assembly.

The manual removal of minor material accumulations from inlets tributary to SCMs should be charged to 711-7801-02.

**PROCEDURE DESCRIPTION**
1. Work Zone Traffic Control shall be set up in accordance with Pub. 213.
2. Remove grating from storm sewer inlet.
3. Remove dirt and debris from inlets. Clogged inlets with large accumulations of material should be cleaned mechanically with a vacuum truck. Routine removal of small accumulations of material may be done manually with hand shovels and charged to 711-7801-02.
4. Debris removed should be collected, loaded onto trucks, and properly disposed.
5. Before beginning pipe cleaning install erosion and sediment control measures as required for site conditions to prevent removed material from being washed into SCM. At a minimum, straw bales or silt fence are to be installed at the outlet of the storm sewer during cleaning.
6. Clean storm sewer pipes with hydraulic unit or sewer rooter as described below.
   a. Hydraulic Unit – Flush out pipes with hydraulic pipe cleaner and remove material at end of pipe as necessary.
   b. Sewer Rooter – Position and prepare sewer rooter at outlet end of pipe. Attach smallest auger to sewer rooter and begin working auger several feet into the blockage, pull auger out with material. Continue operation 8 to 10 feet then increase auger size and repeat operation. Increase auger sizes until entire blockage is removed. Flush any remaining material with water supplied by water truck.
7. Remove any remaining material at end of pipe as required and dispose of properly.

## ACTIVITY RECOMMENDATIONS

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1 | Foreman | 1 | Crew Cab | | No material required. |
| 2 | Crew Members | 1 | Haul Truck | | |
| 1 | Equipment Operator (Haul) | 1 | Vacuum Truck | | |
| 1 | Equipment Operator | 1 | High Velocity Sewer Cleaner | | |
| | | 1 | Water Truck with Pump | | |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| 0.25 SCM/HR | 2 SCMs/DAY | 20 MH/SCM |

**SAP ASSEMBLY NUMBER:** 711-7801-04
**ACTIVITY TITLE:** SCM FENCING AND SIGNS
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 213 Work Zone Traffic Control
PUB 408 Specifications

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections. Work is limited to areas of fencing, signage, and removable guiderail directly associated with SCMs. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
Perimeter or immediate surroundings of SCMs where fencing or signage exists to either provide or limit SCM access. Work area will typically be outside of the roadway shoulder except for removable guiderail work.

**ACTIVITY DESCRIPTION**
Any action related to maintaining fencing and signs for SCMs. This includes the erection, repair, replacement, or removal of SCM fencing, including gates and locks, SCM markers, signage, and removable guiderail for the purpose of SCM access. Activity will vary based on need.

**PROCEDURE DESCRIPTION**
Repair, replacement, or new installation of any SCM fencing or signs as directed by the County Manager, District Stormwater Maintenance Coordinator, or their designee. Work Zone Traffic Control shall be set up in accordance with Pub. 213. All work should be in accordance with Pub. 408 and Pub. 888.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As Required | To be determined based on need | As Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-05
**ACTIVITY TITLE:** SCM STRUCTURE UPKEEP AND REPAIRS
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 72M Roadway Construction Standards
PUB 213 Work Zone Traffic Control
PUB 408 Specifications
PUB 445 Safety Policy Handbook
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
Structural components of the SCM including flow control structures (i.e., outlet structures), pipes, endwalls, underdrains, and observation wells. Components may be buried, exposed above-ground, or contained in a chamber or tank. Work will typically be outside of the roadway shoulder.

**ACTIVITY DESCRIPTION**
Repair and general upkeep of structural and mechanical components of an SCM. Typical activities may include the following:

- Reset or replace damaged monitoring well.
- Repair or replace flow control structure components (e.g., trash racks, valves, orifice).
- Repair concrete endwall.
- Repair damaged or deteriorated pipe section.
- Repair separated pipe joints.
- Reseal pipe junction with flow control structure.

Unless otherwise noted, all incidental activities related to the work shall be charged to this assembly.

**PROCEDURE DESCRIPTION**

1. Work Zone Traffic Control shall be set up in accordance with Pub. 213.
2. Install temporary erosion and sediment control measures as required for site conditions.
3. Avoid placing heavy equipment on SCM areas designed to infiltrate or filter stormwater runoff.
4. All work should be in accordance with specifications in Pub. 408, construction standards in Pub. 72M, and design guidelines in Pub. 464 and Pub. 584
5. Complete structural work at SCM locations as directed by the County Manager, District Stormwater Maintenance Coordinator, or their designee, or as needed to stabilize work areas under other SCM assemblies.
    a. Replacement: Replacement of any SCM structural component should either be in accordance with the as-built plan or as specified by a licensed professional.
    b. Repair:
        i. Concrete components – Repair cracks or open joints using hydraulic cement, neoprene gasket or sheets, or as directed.

ii. Metal components – Repair corroded components as directed or clean, weld and epoxy coat metal.
iii. Miscellaneous – Complete all other repairs as directed by licensed professional.

6. Collect and dispose of any waste materials at a proper disposal or fill site.
7. Stabilize any disturbed work areas as required by site conditions and charge to assembly 711-7801-06 SCM Earth Stabilization.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As<br>Required | To be determined based on need | As<br>Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-06
**ACTIVITY TITLE:** SCM EARTH STABILIZATION
**UNIT OF MEASUREMENT**: EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 72M Roadway Construction Standards
PUB 213 Work Zone Traffic Control
PUB 408 Specifications
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls
PUB 584 PennDOT Drainage Manual

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections and as required for stabilization of the work area in response to activities covered under other SCM assemblies. This assembly is typically performed during the growing season between May 1 and October 1. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
The SCM and the surrounding area including basin embankments, perimeter, inflow and outflow points, or anywhere else SCM related stabilization is needed.

**ACTIVITY DESCRIPTION**
Corrective maintenance activities for the installation or application of ground cover on SCM earthen areas to minimize future erosion potential.

**PROCEDURE DESCRIPTION**
1. Work Zone Traffic Control shall be set up in accordance with Pub. 213.
2. Install temporary erosion and sediment control measures as required for site conditions.
3. Avoid placing heavy equipment on SCM areas designed to infiltrate or filter stormwater runoff.
4. All work shall be in accordance with the specifications in Pub. 408 and the design recommendations in Pub. 464 and Pub. 584.
5. Complete earth stabilization at SCM locations as directed by the County Manager, District Stormwater Maintenance Coordinator (DSMC), or their designee, or as needed to stabilize work areas under other SCM assemblies.
    a. Side Slopes: Repair rill or gully formation on slope.
        i. Minor localized areas of erosion may be stabilized by placing rock or coarse aggregate. Topsoil and seeding may also be used if erosion source is located and eliminated.
        ii. Larger eroded areas should be prepared for stabilization by removing unstable material, backfilling and compacting area as necessary. Consult the DSMC if it is believed modification of the existing slope dimensions are necessary to ensure stabilization.
        iii. Permanently stabilize the eroded area based on the following.
            1. Slopes shallower than 3H:1V may be protected using mulch and binder unless otherwise directed.

2. All slopes 3H:1V and steeper require installation of rolled erosion control products (RECP).
3. Establish vegetation per Step 5.f below on all slopes.

b. Channels: Repair or replace channel lining.
   i. Minor erosion can be temporarily stabilized with rock or coarse aggregate.
   ii. When regrading of the channel is necessary, the excavation should be charged to assembly 711-7801-01 SCM Earthwork. Regrade channel to original dimensions on as-built plan or as directed.
   iii. Permanently stabilize the eroded channel segment based on the following.
      1. Consult the DSMC or designee on appropriate channel lining.
      2. Vegetated channels
         a. Install RECP per the as-built plan or as directed.
         b. Establish vegetation per Step 4.f below.
      3. Rock lined channels
         a. Place geotextile between bare earth and rock.
         b. Place rock to a minimum thickness of 1.5 times the maximum stone size.
         c. Ensure rock is uniformly distributed on the geotextile to the desired dimensions.

c. Outlet Protection: Install or repair scour protection at inflow and outflow points.
   i. Repair:
      1. Place rock to restore scour protection dimensions.
      2. Match existing rock size or as directed. Notify DSMC if existing rock size is believed to be inadequate.
      3. Ensure rock is uniformly distributed to the desired dimensions.
   ii. New installation:
      1. Consult the DSMC or designee for scour protection type and dimensions.
      2. Construct on level or close to level ground.
      3. Prepare area by removing unstable material and providing enough room for rock placement.
      4. Place geotextile between bare earth and rock.
      5. Place rock to a minimum thickness of 1.5 times the maximum stone size.
      6. Ensure rock is uniformly distributed on the geotextile to the desired dimensions.

d. Animal Burrows:
   i. Notify PA Game Commission for animal removal via the County Manager if a recurring problem exists.
   ii. Fill hole with coarse aggregate to a depth of one foot below the ground surface.
   iii. Place topsoil or similar material of the surrounding area to fill the rest of the hole.
   iv. Lightly (manually) compact placed material to be flush with surrounding ground.
   v. Establish vegetation per Step 4.f below to match surrounding area.

e. Sinkholes:
   i. Repair SCM as directed by the County Manager, DSMC, or their designee.
   ii. Establish vegetation per Step 4.f below to match surrounding area.

f. Vegetation: Establishment or re-establishment of vegetated ground cover.
   i. Work shall be programmedby the DSMC or District Roadside Specialist who will determine the plantings or seed formula and material application rates for each project.
   ii. Seeded areas:
      1. RECPs shall be used to protect seeded areas on slopes 3H:1V and greater, or within 100 feet of a special protection surface water or 50 feet of all other surface waters.

2. Apply seed and protect with mulch or RECP in accordance with Pub. 408 and as-built plan or as directed.

iii. Planted areas (trees/shrubs):
1. Refer to as-built plan for replacement plant species for small numbers of dead trees or shrubs.
2. Consult the DSMC in cases of large scale disease or die off to determine replacement plant types.
3. Cut dead trees flush with ground.
4. Replace plants in kind (Step 1) or as directed (Step 2).

iv. Mulched areas:
1. Maintain a two to three-inch layer of shredded hardwood mulch in accordance with the as-built plan or as directed.
2. Rake mulched areas to evenly redistribute material where float or minor erosion has occurred.
3. Remove old much and weed as needed before placing new mulch.

6. Remove any remaining erosion or sediment control measures after all earthen work areas have been stabilized.
7. Remove any remaining construction wastes from the site and dispose of at a proper disposal or fill site.
8. Schedule informal check-up between May 1 and October 1 to ensure proper vegetative establishment and notify the County Manager, DSMC, or their designee.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As Required | To be determined based on need | As Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-07
**ACTIVITY TITLE:** SCM VEGETATION MANAGEMENT
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 213 Work Zone Traffic Control

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections, and as required as part of an SCM's for routine maintenance schedule. This assembly is typically performed during the growing season between May 1 and October 1. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
The SCM and the surrounding area including basin embankments, perimeter, inflow and outflow points, or anywhere else SCM related vegetation management is needed.

**ACTIVITY DESCRIPTION**
Preventative and corrective control of vegetative growth in and around the SCM. Activities include pruning or cutting down trees, brush control and mowing, application of vegetative growth regulators, and weed control in SCM shrub beds. All incidental activities related to the task shall be charged to this assembly.

**PROCEDURE DESCRIPTION**
1. Work Zone Traffic Control shall be set up in accordance with Pub. 213.
2. Vegetation management should be done during dry SCM conditions. Care must be taken when using mowers within an SCM to avoid rutting and other damage to the SCM. Avoid placing heavy equipment on SCM areas designed to infiltrate or filter stormwater runoff.
3. Complete vegetation management at SCM locations as directed by the County Manager, DSMC, or their designee per the recommendations below.
    a. Mowing or Brush Control: Mow SCM and related areas using power driven mowers or tractor mounted mechanized mowers (rotary, flair, bar or combination).
        i. The area should be checked for trash, debris, and mowing obstructions before mowing begins.
        ii. Grass should be dry before mowing to allow for proper dispersal of clippings so that no pickup of clippings is required. A well maintained SCM should not require clippings to be collected. Grass clippings should only be collected as directed by the DEM.
        iii. Grass should be cut to the heights required for each SCM type as described in Pub 888.
        iv. Contact the District Roadside Specialist and coordinate mowing operations with herbicide applications when necessary.
    b. Tree Pruning or Cutting: Includes tree trimming, pruning, selective thinning and tree removal. This work can be performed at any time of the year.
        i. Tree pruning and trimming should be done in accordance with good arboricultural and silvicultural practices.
        ii. Tree trimming and removal should be completed using appropriate equipment (e.g., chain saws, hand tools, hydraulic trimming tools, etc.) as necessary.
        iii. Wood should be cut into lengths of not less than two feet.

iv. Stump Treatment

1. Stumps to Remain: Apply an oil-herbicide mixture to the cut surface of all live stumps, including root collar and exposed roots, immediately after cuts have been made. When applying herbicides, always follow precautions for personal safety as outlined on manufacturer's label. Tree stumps in SCM embankments shall remain in place unless embankment restoration measures are provided by a licensed professional.
2. Stump Removal: Stump removal is performed by a contract or rental agreement where specific locations dictate this removal. The contractor is responsible for all equipment, safety and traffic control required.

c. Growth Regulator Application and Weed Control: Includes applications of plant growth regulator for reducing mechanical cutting frequency and herbicides for weed control.

i. All herbicides applied in and around SCMs shall be selective herbicides for the control of undesirable weeds and woody plant growth, and of a type acceptable for use in and around surface waters.

ii. Coordinate applications with the SCM mowing schedule. Weed control applications produce the best results when applied to foliage of plants between June 1 and July 15. Contact the District Roadside Specialist for guidance.

iii. Applications must be made by a certified pesticide applicator, a trained application technician, or any other person provided a certified pesticide applicator is present at the work site.

4. Stabilize any disturbed work areas as required by site conditions and charge to assembly 711-7801-06 SCM Earth Stabilization.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As Required | To be determined based on need | As Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-08
**ACTIVITY TITLE:** SCM MANUFACTURED TREATMENT DEVICES
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 213 Work Zone Traffic Control

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by either manufacturer's recommended cycles or Stormwater Control Measure (SCM) inspections. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
Proprietary stormwater treatment devices that have specific maintenance needs identified by the manufacturer. Work may be within the roadway footprint.

**ACTIVITY DESCRIPTION**
Any maintenance activities associated with (proprietary) manufactured treatment devices. Tasks may include replacing media, filters, or cartridges. All incidental activities related to the project shall be charged to this assembly.

**PROCEDURE DESCRIPTION**
Varies based on manufacturer. All work shall be in accordance with the manufacturer's maintenance instructions. Collect and dispose of any wastes at a proper disposal or fill site. Work Zone Traffic Control shall be set up in accordance with Pub. 213.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As Required | To be determined based on need | As Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-10
**ACTIVITY TITLE:** SCM REPLACEMENT
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 213 Work Zone Traffic Control
PUB 408 Specifications
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls
PUB 584 PennDOT Drainage Manual

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
Existing SCM sites where facility function has been severely reduced or eliminated. Work will typically be outside of the roadway shoulder.

**ACTIVITY DESCRIPTION**
Major restoration work to restore SCM function, including the replacement of all or part of the SCM. Activity will vary significantly based on need. Examples include replacement of a stone bed in an infiltration trench, bioretention soil, or filter media in various SCM types. Any activity proposed shall be at the direction of a licensed professional. All incidental activities related to the project shall be charged to this assembly.

**PROCEDURE DESCRIPTION**
Major restoration or replacement an SCM as directed by the County Manager, District Stormwater Maintenance Coordinator (DSMC), or their designee. All work should be in accordance with Pub. 408 and the design recommendations in Pub. 464 and Pub. 584. Work Zone Traffic Control shall be set up in accordance with Pub. 213. All waste materials should be removed and properly disposed of.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As Required | To be determined based on need | As Required | To be determined based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |

**SAP ASSEMBLY NUMBER:** 711-7801-11
**ACTIVITY TITLE:** SCM OTHER
**UNIT OF MEASUREMENT:** EACH SCM
**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**
PUB 23 Maintenance Manual
PUB 213 Work Zone Traffic Control
PUB 408 Specifications
PUB 464 Maintenance Field Reference for Erosion and Sedimentation Controls

**SCHEDULING CONSIDERATIONS**
Based on need as indicated by Stormwater Control Measure (SCM) inspections. Environmental concerns shall be considered and verified with the District Environmental Unit during the planning process.

**WORK AREA**
The SCM, perimeter, and contributing area where SCM related maintenance may occur.

**ACTIVITY DESCRIPTION**
SCM maintenance activities that do not fit within the other SCM maintenance assemblies. All incidental activities related to the project shall be charged to this assembly.

**PROCEDURE DESCRIPTION**
Any SCM maintenance as directed by the County Manager, District Stormwater Maintenance Coordinator (DSMC), or their designee that does not fall under any other SCM assembly. All work should be in accordance with Pub 408 and the design recommendations in Pub. 464 and Pub. 584. Work Zone Traffic Control shall be set up in accordance with Pub. 213. All waste materials should be removed and properly disposed of.

Stabilize any disturbed work areas as required by site conditions and charge to assembly 711-7801-06 SCM Earth Stabilization.

**ACTIVITY RECOMMENDATIONS**

| LABOR | | EQUIPMENT | | MATERIAL | |
|---|---|---|---|---|---|
| NUMBER | CLASSIFICATION | NUMBER | TYPE | AMOUNT | DESCRIPTION |
| 1<br>As Required | Foreman<br>Crew Members | As<br>Required | To be<br>determined<br>based on need | As<br>Required | To be<br>determined<br>based on need |

| PRODUCTION UNITS/HOURS | PLANNING UNITS | PERFORMANCE STANDARD |
|---|---|---|
| VARIES | VARIES | VARIES |