
Green City, Clean Waters

Green Infrastructure Maintenance Manual

**Consent Order & Agreement
Deliverable VIII**

City of Philadelphia Combined Sewer Overflow Long Term Control Plan Update

**Submitted to
The Commonwealth of Pennsylvania
Department of Environmental Protection**

**By The Philadelphia Water Department
Date June 1, 2014**

Attachment 1:

Preamble and Schedule of Future Editions

0.1 Preamble

Appendix G of the 2011 Consent Order and Agreement signed by the Commonwealth of Pennsylvania, Department of Environmental Protection and the City of Philadelphia Water Department requires the Philadelphia Water Department (Water Department) to develop a Green Infrastructure Maintenance Manual to “address the operation and maintenance of the full range of types of green stormwater infrastructure projects that have been, and that are proposed to be, implemented by the City as part of the CSO program.” The manual that follows was developed to be used by City agencies and anyone else who has the responsibility of performing maintenance of green stormwater infrastructure and has been prepared in the format that matches the Green Street Design Manual and other recent efforts of the Water Department.

Section 1.2.1 of the Green Stormwater Infrastructure Maintenance Manual includes maintenance protocols for stormwater management practices (SMPs) currently in practice by the Water Department. The protocols in Section 1.2.1 were based on experience from inspections and maintenance conducted to date. Section 1.2.2 includes maintenance protocols for SMPs in limited practice or not yet in practice by the Water Department. The protocols in section 1.2.2 were developed based on experience to date and a review of the literature for best practices. Several years of data will need to be collected on SMPs in limited practice or not yet in practice by the Water Department before they will be included in Section 1.2.1.

0.2 Schedule of Future Editions

As suggested in Appendix G of the 2011 Consent Order and Agreement, the Green Stormwater Infrastructure Maintenance Manual included in this regulatory deliverable is a first edition. The manual will be updated periodically as the technology of green stormwater infrastructure advances, and as experience is gained with specific practices. Future editions will be published as necessary. Potential conditions that could warrant future editions include:

- additional knowledge is gained by the Water Department on the frequency and activities,
- or as new SMP technologies are used in Philadelphia,
- or updates to guidance for private green stormwater infrastructure.

Green Stormwater Infrastructure Maintenance Manual



Table of Contents

1.1 Introduction	9		
1.1 Introduction	11		
1.2 Stormwater Management Practices	13		
1.2.1 SMPs In Practice By PWD	14		
1.2.1.1 Stormwater Tree Trench	14		
1.2.1.2 Rain Garden	18		
1.2.1.3 Stormwater Planter	22		
1.2.1.4 Stormwater Bump-out	26		
1.2.1.5 Infiltration/Storage Trench	31		
1.2.1.6 Stormwater Wetland	34		
1.2.1.7 Stormwater Swale	38		
1.2.1.8 Stormwater Basin	42		
1.2.1.9 Stormwater Tree	46		
1.2.2 SMPs In Limited Practice Or Not Yet In Practice By PWD	50		
1.2.2.1 Cistern/Rain Barrel	50		
1.2.2.2 Green Roof	54		
1.2.2.3 Pervious Paving	58		
1.2.2.4 Blue Roof	62		
1.2.2.5 Green Gutter	66		
1.2.2.6 Stormwater Drainage Well	70		
2.0 Maintenance Tasks	75		
2.1 Surface Structural Maintenance	76		
2.1.1 Trash, Sediment, And Organic Debris Removal	76		
2.1.1.1 Task Description	76	2.1.1.9 Special Project Conditions	76
2.1.1.2 Documentation	76	2.1.1.10 Standard Operating Procedure	76
2.1.1.3 Health And Safety	76	2.1.1.11 Quality Assurance	77
2.1.1.4 Personnel	76		
2.1.1.5 Materials	76	2.1.2 Erosion Control/Repair	78
2.1.1.6 Equipment	76	2.1.2.1 Task Description	78
2.1.1.7 Access Requirements	76	2.1.2.2 Documentation	78
2.1.1.8 Permits And Approvals	76	2.1.2.3 Health And Safety	78
		2.1.2.4 Personnel	78
		2.1.2.5 Materials	78
		2.1.2.6 Equipment	78
		2.1.2.7 Access Requirements	78
		2.1.2.8 Permits And Approvals	78
		2.1.2.9 Special Project Conditions	78
		2.1.2.10 Standard Operating Procedure	78
		2.1.2.11 Quality Assurance	79
		2.1.3 Concrete, Pavement, And Masonry Repair	79
		2.1.3.1 Task Description	79
		2.1.3.2 Documentation	79
		2.1.3.3 Health And Safety	79
		2.1.3.4 Personnel	79
		2.1.3.5 Materials	79
		2.1.3.6 Equipment	80
		2.1.3.7 Access Requirements	80
		2.1.3.8 Permits And Approvals	80
		2.1.3.9 Special Project Conditions	80
		2.1.3.10 Standard Operating Procedure	80
		2.1.2.11 Quality Assurance	81
		2.1.4 Settlement Repair	81
		2.1.4.1 Task Description	81

2.1.4.2 Documentation	81	2.1.6.7 Access Requirements	84
2.1.4.3 Health And Safety	81	2.1.6.8 Permits And Approvals	84
2.1.4.4 Personnel	81	2.1.6.9 Special Project Conditions	84
2.1.4.5 Materials	81	2.1.6.10 Standard Operating Procedure	84
2.1.4.6 Equipment	82	2.1.6.11 Quality Assurance	85
2.1.4.7 Access Requirements	82		
2.1.4.8 Permits And Approvals	82	2.1.7 Winterization	85
2.1.4.9 Special Project Conditions	82	2.1.7.1 Task Description	85
2.1.4.10 Standard Operating Procedure	82	2.1.7.2 Documentation	85
2.1.4.11 Quality Assurance	82	2.1.7.3 Health And Safety	85
		2.1.7.4 Personnel	85
2.1.5 Graffiti Removal	82	2.1.7.5 Materials	85
2.1.5.1 Task Description	82	2.1.7.6 Equipment	85
2.1.5.2 Documentation	82	2.1.7.7 Access Requirements	85
2.1.5.3 Health And Safety	82	2.1.7.8 Permits And Approvals	85
2.1.5.4 Personnel	82	2.1.7.9 Special Project Conditions	85
2.1.5.5 Materials	83	2.1.7.10 Standard Operating Procedure	85
2.1.5.6 Equipment	83	2.1.7.11 Quality Assurance	86
2.1.5.7 Access Requirements	83		
2.1.5.8 Permits And Approvals	83	2.1.8 Appurtenance Repair	86
2.1.5.9 Special Project Conditions	83	2.1.8.1 Task Description	86
2.1.5.10 Standard Operating Procedure	83	2.1.8.2 Documentation	86
2.1.5.11 Quality Assurance	83	2.1.8.3 Health And Safety	86
		2.1.8.4 Personnel	86
2.1.6 Painting	84	2.1.8.5 Materials	86
2.1.6.1 Task Description	84	2.1.8.6 Equipment	86
2.1.6.2 Documentation	84	2.1.8.7 Access Requirements	86
2.1.6.3 Health And Safety	84	2.1.8.8 Permits And Approvals	86
2.1.6.4 Personnel	84	2.1.8.9 Special Project Conditions	87
2.1.6.5 Materials	84	2.1.8.10 Standard Operating Procedure	87
2.1.6.6 Equipment	84		

2.1.9 Pervious Pavement Cleaning	87		
2.1.9.1 Task Description	87		
2.1.9.2 Documentation	87		
2.1.9.3 Health And Safety	87		
2.1.9.4 Personnel	87		
2.1.9.5 Materials	87		
2.1.9.6 Equipment	87		
2.1.9.7 Access Requirements	87		
2.1.9.8 Permits And Approvals	87		
2.1.9.9 Special Project Conditions	88		
2.1.9.10 Standard Operating Procedure	88		
2.2 Vegetation Maintenance	88		
2.2.1 Mechanical Vegetation Control	88		
2.2.1.1 Task Description	88		
2.2.1.2 Documentation	88		
2.2.1.3 Health And Safety	88		
2.2.1.4 Personnel	88		
2.2.1.5 Materials	88		
2.2.1.6 Equipment	89		
2.2.1.7 Access Requirements	89		
2.2.1.8 Permits And Approvals	89		
2.2.1.9 Special Project Conditions	89		
2.2.1.10 Standard Operating Procedure	90		
2.2.1.11 Quality Assurance	91		
2.2.2 Watering	93		
2.2.2.1 Task Description	93		
2.2.2.2 Documentation	93		
2.2.2.3 Health And Safety	93		
2.2.2.4 Personnel	93		
		2.2.2.5 Materials	93
		2.2.2.6 Equipment	93
		2.2.2.7 Access Requirements	93
		2.2.2.8 Permits And Approvals	93
		2.2.2.9 Special Project Conditions	93
		2.2.2.10 Standard Operating Procedure	93
		2.2.2.11 Quality Assurance	94
		2.2.3 Mulching And Edging	94
		2.2.3.1 Task Description	94
		2.2.3.2 Documentation	94
		2.2.3.3 Health And Safety	94
		2.2.3.4 Personnel	94
		2.2.3.5 Materials	95
		2.2.3.6 Equipment	95
		2.2.3.7 Access Requirements	95
		2.2.3.8 Permits And Approvals	95
		2.2.3.9 Special Project Conditions	95
		2.2.3.10 Standard Operating Procedure	95
		2.2.3.11 Quality Assurance	96
		2.2.4 Planting/Transplanting	96
		2.2.4.1 Task Description	96
		2.2.4.2 Documentation	96
		2.2.4.3 Health And Safety	96
		2.2.4.4 Personnel	96
		2.2.4.5 Materials	96
		2.2.4.6 Equipment	97
		2.2.4.7 Access Requirements	98
		2.2.4.8 Permits And Approvals	98
		2.2.4.9 Special Project Conditions	98

2.2.4.10 Standard Operating Procedure	98	2.2.7.4 Materials	104
2.2.4.11 Quality Assurance	99	2.2.7.5 Equipment	105
2.2.5 Seeding	100	2.2.4.6 Personnel	105
2.2.5.1 Task Description	100	2.2.7.7 Access Requirements	105
2.2.5.2 Documentation	100	2.2.7.8 Permits And Approvals	105
2.2.5.3 Health And Safety	100	2.2.7.9 Special Project Conditions	105
2.2.5.4 Personnel	100	2.2.7.10 Standard Operating Procedure	105
2.2.5.5 Materials	100	2.2.7.11 Quality Assurance	106
2.2.5.6 Equipment	100	2.2.8 Pesticide Pest/Disease Management	108
2.2.5.7 Special Project Conditions	101	2.2.8.1 Task Description	108
2.2.5.8 Standard Operating Procedure	101	2.2.8.2 Documentation	108
2.2.5.9 Quality Assurance	102	2.2.8.3 Health And Safety	108
2.2.6 Tree Pruning	102	2.2.8.4 Personnel	108
2.2.6.1 Task Description	102	2.2.8.5 Materials	108
2.2.6.2 Documentation	102	2.2.8.6 Equipment	108
2.2.6.3 Health And Safety	102	2.2.8.7 Access Requirements	108
2.2.6.4 Personnel	102	2.2.8.8 Permits And Approvals	108
2.2.6.5 Materials	102	2.2.8.9 Special Project Conditions	108
2.2.6.6 Equipment	102	2.2.8.10 Standard Operating Procedure	108
2.2.6.7 Access Requirements	103	2.2.8.11 Quality Assurance	109
2.2.6.8 Permits And Approvals	103	2.2.9 Soil Management	1110
2.2.6.9 Special Project Conditions	103	2.2.9.1 Task Description	110
2.2.6.10 Standard Operating Procedure	103	2.2.9.2 Documentation	110
2.2.6.11 Quality Assurance	104	2.2.9.3 Health And Safety	110
2.2.7 Chemical Vegetation Control	104	2.2.9.4 Personnel	110
2.2.7.1 Task Description	104	2.2.9.5 Materials	110
2.2.7.2 Documentation	104	2.2.9.6 Equipment	110
2.2.7.3 Health And Safety	104	2.2.9.7 Access Requirements	110
		2.2.9.8 Permits And Approvals	110

2.2.9.9 Special Project Conditions	110
2.2.9.10 Standard Operating Procedure	110
2.2.9.11 Quality Assurance	111
2.3 Subsurface Maintenance	111
2.3.1 Vacuum Cleaning	111
2.3.1.1 Task Description	111
2.3.1.2 Documentation	111
2.3.1.3 Health And Safety	111
2.3.1.4 Personnel	111
2.3.1.5 Materials	111
2.3.1.6 Equipment	111
2.3.1.7 Access Requirements	112
2.3.1.8 Permits And Approvals	112
2.3.1.9 Special Project Conditions	112
2.3.1.10 Standard Operating Procedure	112
2.3.1.11 Quality Assurance	113
2.3.2 Jet-rodding	113
2.3.2.1 Task Description	113
2.3.2.2 Documentation	113
2.3.2.3 Health And Safety	115
2.3.2.4 Personnel	115
2.3.2.5 Materials	115
2.3.2.6 Equipment	115
2.3.2.7 Access Requirements	116
2.3.2.8 Permits And Approvals	116
2.3.2.9 Special Project Conditions	116
2.3.2.10 Standard Operating Procedure	116
2.3.2.11 Quality Assurance	119

2.4 Waste Disposal And Decanting	119
2.4.1 Waste Disposal	119
2.4.1.1 Task Description	119
2.4.1.2 Documentation	119
2.4.1.3 Health And Safety	119
2.4.1.4 Personnel	120
2.4.1.5 Materials	120
2.4.1.6 Equipment	120
2.4.1.7 Access Requirements	120
2.4.1.8 Permits And Approvals	120
2.4.1.9 Special Project Conditions	120
2.4.1.10 Standard Operating Procedure	120
2.4.1.11 Quality Assurance	120
2.4.2 Decanting	120
2.4.2.1 Task Description	120
2.4.2.2 Documentation	120
2.4.2.3 Health And Safety	120
2.4.2.4 Personnel	121
2.4.2.5 Materials	121
2.4.2.6 Equipment	121
2.4.2.7 Access Requirements	121
2.4.2.8 Permits And Approvals	121
2.4.2.9 Special Project Conditions	121
2.4.2.10 Standard Operating Procedure	121
2.4.2.11 Quality Assurance	121

3.0 Appendices	123
3.1 Documentation	124
3.2 Health and Safety	124
3.2.1 General Policy	124
3.2.1.2 Personal Protective Equipment	125
3.2.1.3 Hazards	125
3.3 Personnel	126
3.3.1 Personnel Training And Experience	126
3.3.2 Personnel Classifications	126
3.3.2.2 Surface Maintenance Personnel	126
3.3.2.3 Subsurface Maintenance Personnel	127
3.4 Access Requirements	127
3.4.1 Permits And Approvals	127
3.5 Maintenance Event Procedures	128
3.5.1 Pre-Maintenance Event	128
3.5.2 During Maintenance Event	128
3.5.3 Post-Maintenance Event	128
3.6 Points of Contact	129
3.7 Jet-Rodding Nozzels	130
4.0 Glossary	133

Introduction

division





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1.1 Introduction

The City of Philadelphia relies in part on Green Stormwater Infrastructure (GSI) systems—comprised of one or more decentralized stormwater management practices (SMPs) such as rain gardens, stormwater tree trenches, and green roofs—to reduce stormwater volume and pollutants delivered to the City’s combined sewer system.

An effective and rigorous maintenance program is crucial for the long-term sustainability and function of GSI systems. Because GSI systems incorporate vegetation, they can change over time as plant communities grow and establish. In urban environments in particular, GSI may be subject to temperature extremes, pollution, heavy sediment and trash accumulation, and an aggressive weed community—all of which can create a challenging environment for plants. Furthermore, sediment and trash, if allowed to accumulate, can create unsightly conditions and take up space within the SMP. Proper maintenance can ensure that GSI systems remain healthy, attractive, and safe for many years to come.

Typical maintenance tasks described in this document include removing competitive species that can hinder the growth of target plant species; and removing sediment, trash, and debris from storage areas, piping, and other structures. Maintenance tasks may also include a range of other activities including repairing small erosion problems, pruning trees, removing graffiti, and replanting or reseeding areas.

This document contains standard operating procedures for executing specific maintenance tasks such as vegetation removal, sediment removal, and trash removal. Each protocol provides information on required training, materials, health and safety issues, and provides a detailed procedure for executing tasks. Appendices provides supplementary reference materials including health and safety procedures, a comprehensive listing of typical maintenance personnel classifications, and additional guidance on site access and permits.

Stormwater Management Practices

division 1.2



1.2.1 SMPS IN PRACTICE BY PWD

1.2.1.1 STORMWATER TREE TRENCH

DEFINITION

A stormwater tree trench is a subsurface infiltration/storage trench, typically filled with stone, which is planted with one or more trees. Trees are planted within the trench to allow the tree roots to access water stored in the system. Stormwater runoff is conveyed to the trench via green inlets and perforated distribution pipes. Green inlets are typically fitted with pre-treatment devices to prevent trash, sediment, and debris from entering the stormwater tree trench. Stormwater is filtered through the stone in the trench and is either infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipe conveyance. Trees help reduce the volume of stormwater runoff through canopy interception and evapotranspiration.

Stormwater tree trenches are often constructed beneath sidewalks and adjacent to streets to capture street runoff. Figure 1-1 provides examples of stormwater tree trenches. Figure 1-2 shows typical stormwater tree trench features.



Figure 1-1. Examples of Stormwater Tree Trenches in Philadelphia

Stormwater Tree Trench

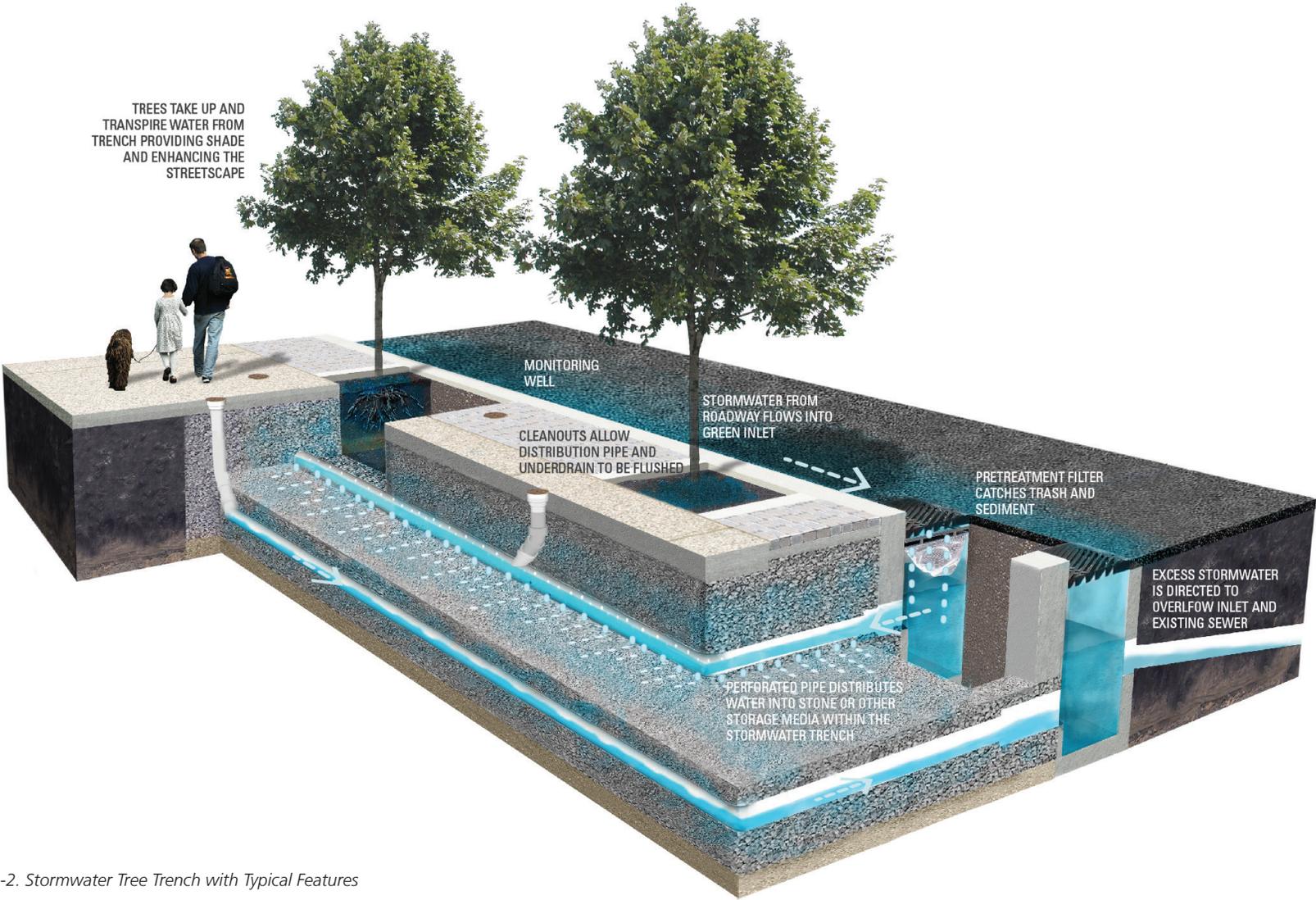


Figure 1-2. Stormwater Tree Trench with Typical Features

STORMWATER TREE TRENCH MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common required maintenance tasks for stormwater tree trenches are listed in Table 1-1. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-1 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Concrete repair (section 2.1.3);

- Settlement repair (section 2.1.4); and

- Pesticide application (section 2.2.8).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-1. Stormwater Tree Trench Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Bimonthly	See 2.1.1; Section 2.1.1.10 B & E
	Clean pretreatment devices	Monthly	See 2.1.1; Section 2.1.1.10 D
	Wipe down signage	Bimonthly	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Bimonthly from March to November	For mechanical removal see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal see 2.2.7; Section 2.2.3 B-C or Table 2-2.
Apply mulch	Apply mulch to landscaped beds as needed	Annually in March	See 2.2.3; Section 2.2.3 B
Prune trees	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water trees	Place water bag(s) on tree(s)	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag(s)	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 23.2.2.10 F.1-d
	Remove water bag(s) from tree(s)	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodding pipes	Jet-rod conveyance, distribution, and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.2 RAIN GARDEN

DESCRIPTION

Rain gardens are shallow, vegetated depressions, typically two (2) feet deep or less, that manage stormwater. A rain garden may be comprised of a single depression, or cell, or multiple cells connected by weirs, trench drains, or culverts that overflow or discharge to a single connection back to the combined sewer system. Stormwater runoff is conveyed to a rain garden via sheet flow or pipe conveyance. Stormwater is filtered through rain garden media and infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated under-drain and flow control structures. Rain garden vegetation helps reduce the volume of captured stormwater through evapotranspiration.

Rain gardens are often integrated into surrounding landscape features, and are commonly planted with a variety of native grasses and shrubs. Figure 1-3 provides examples of rain gardens. Figure 1-4 shows typical rain garden features.



Figure 1-3. Examples of Rain Gardens in Philadelphia

Rain Garden



Figure 1-4. Rain Garden with Typical Features

RAIN GARDEN MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for rain gardens are listed in Table 1-2. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-2 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Erosion control (section 2.1.2);

- Plant replacement (section 2.2.4); and

- Soil amendment (section 2.2.9).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-2. Rain Garden Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces.	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Clean pretreatment devices	Monthly	See 2.1.1; Section 2.1.1.10 D
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
	Dredge large volumes sediment and organic debris from basin and forebay areas using approved equipment	When sediment occupies greater than 50% of the forebay volume or as per site specific maintenance plan	See 2.1.1; Section 2.1.1 D.3
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Apply mulch	Apply mulch to landscaped beds as needed	Annually in March	See 2.2.3; Section 2.2.3 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal see SOP 2.2.7; Section 2.2.3 B-C or Table 2-2.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground	Annually in March	See 2.1.2; Section 2.1.2.9 C
Mow turf and meadow areas	Mow turf areas to a height of 2-4 in.	Monthly from May to October	See 2.2.1; Section 2.2.1.10 E
	Mow naturalized meadow areas to a height of 8 in.	Two (2) times per year in June and October	See 2.2.1; Section 2.2.1.10 E
Prune trees and shrubs	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water trees	Place water bag(s) on tree(s)	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag(s)	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 2.2.2.10 F.1-d
	Remove water bag(s) from tree(s)	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b
Water herbaceous vegetation and shrubs	Water evenly and thoroughly at the base of vegetation so that the top of soil is saturated	Ever four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rod pipes	Jet-rod conveyance, distribution, and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.3 STORMWATER PLANTER

DESCRIPTION

Stormwater planters are structural containers that store and manage stormwater runoff. Stormwater planter walls are constructed of concrete, stone, or brick set at grade level or slightly below grade. Stormwater planters typically have open bottoms lined with geotextile and contain a layer of stone topped with soil media and shrubs and/or herbaceous vegetation. Stormwater runoff is conveyed to stormwater planters via curb cuts, trench drains, downspouts, or openings in the stormwater planter box wall. Stormwater is filtered by the soil media and is infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipes and hydraulic control structures. Vegetation helps reduce the volume of stormwater runoff through evapotranspiration.

Stormwater planters are often integrated into sidewalks, plazas, or along the public right-of-way and can also be found at building downspouts. They are commonly planted with a variety of native grasses and shrubs. Figure 1-5 provides examples of stormwater planters. Figure 1-6 shows typical stormwater planter features.



Figure 1-5. Examples of Stormwater Planters in Philadelphia

Stormwater Planter



Figure 1-6. Stormwater Planter Section Typical Features

STORMWATER PLANTER MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for stormwater planters are listed in Table 1-3. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-3 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Concrete and masonry repair (section 2.1.3);

- Plant replacement (section 2.2.4); and

- Soil amendment (section 2.2.9).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-3. Stormwater Planter Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Paint planter box wells	Apply fresh coat of paint to planter box walls	Every three (3) years	See 2.1.7; Section 2.1.7.10 A-J
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal see 2.2.7; Section 2.2.3 B-C or Table 2-2.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground	Annually in March	See 2.2.1; Section 2.2.1.10 C
Water herbaceous vegetation and shrubs	Water evenly and thoroughly at the base of vegetation so that the top of soil is saturated	Ever four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Prune trees	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodding pipes	Jet-rod conveyance, distribution, and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.4 STORMWATER BUMP-OUT

DESCRIPTION

Stormwater bump-outs are vegetated curb extensions designed to intercept gutter flow and manage stormwater. Stormwater runoff is conveyed to a stormwater bump-out through curb cuts along the curb extension. Stormwater bump-outs are usually lined with geotextile (permeable or impermeable) and are planted with herbaceous and/or woody species in soil media over a layer of stone. Stormwater is filtered by the soil media and is infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipes and hydraulic control structures. Excess runoff typically leaves the system through a downstream curb cut. Stormwater bump-out vegetation helps reduce the volume of stormwater runoff through evapotranspiration. Stormwater bump-outs are sometimes used as pretreatment for water entering other SMPs (e.g., infiltration/storage trenches).

Stormwater bump-outs are usually located within the public right-of-way either mid-block or at intersections, and are commonly planted with a variety of grasses, flowering perennials, and trees. Figure 1-7 provides examples of stormwater bump-outs. Figure 1-8 and Figure 1-9 show typical stormwater bump-out features.



Figure 1-7. Examples of Stormwater Bump-outs in Philadelphia

Mid-Block Stormwater Bump-out

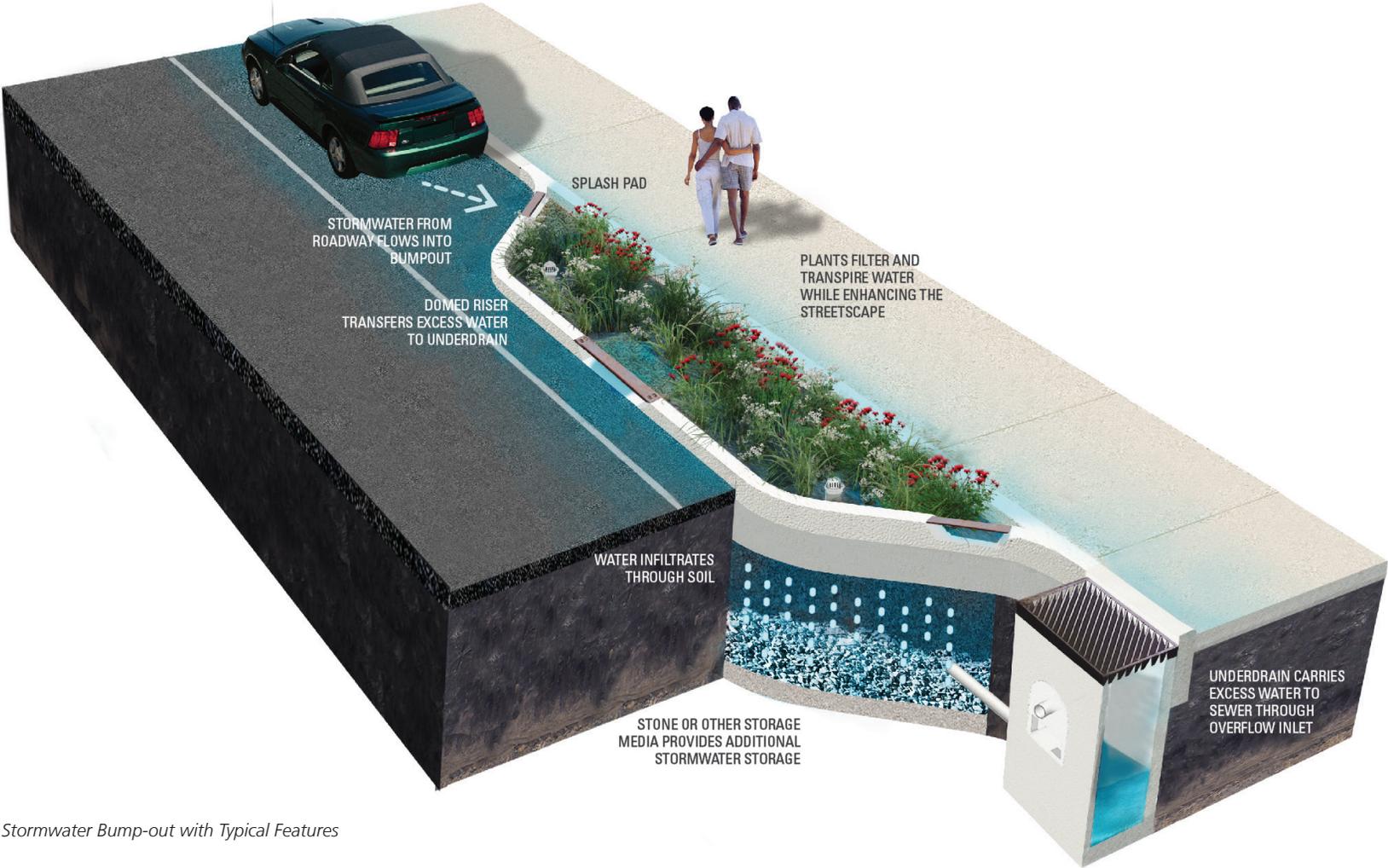


Figure 1-8. Stormwater Bump-out with Typical Features

Corner Stormwater Bump-out

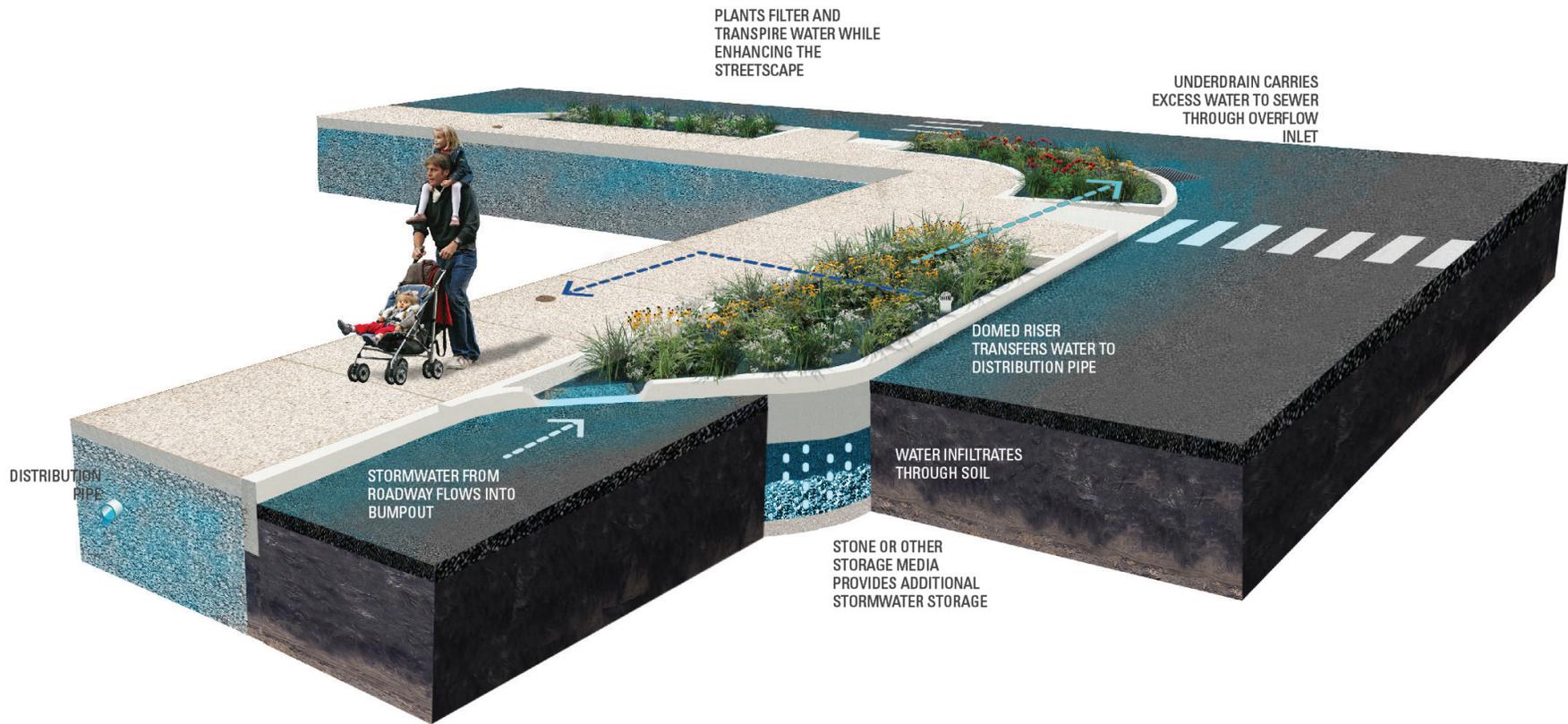


Figure 1-9. Stormwater Bump-out with Typical Features

STORMWATER BUMP-OUT MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common required maintenance tasks for stormwater bump-outs are listed in Table 1-4. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-4 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Erosion control (section 2.1.2);

- Plant replacement (section 2.2.4); and

- Soil amendment (section 2.2.9).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-4. Stormwater Bump-out Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
	Place traffic delineation/snow removal bollards	Annually in November	See 2.1.7; Section 2.1.7.10 D
	Remove traffic delineation/snow removal bollards	Annually in April	See 2.1.7; Section 2.1.7.10 D
Apply mulch	Apply mulch to landscaped beds as needed	Annually in March	See 2.2.3; Section 2.2.3 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal see SOP 2.2.7; Section 2.2.3 B-C or Table 2-2.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground and ensure vegetation does not encroach onto the sidewalk and/or street	Annually in March	See 2.2.1; Section 2.2.1.10 C
Prune trees and shrubs	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water trees	Place water bag(s) on tree(s)	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag(s)	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 2.2.2.10 F.1-d
	Remove water bag(s) from tree(s)	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b
Water herbaceous vegetation and shrubs	Water evenly and thoroughly at the base of vegetation so that the top of soil is saturated	Ever four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodging pipes	Jet-rod conveyance, distribution, and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.5 INFILTRATION/STORAGE TRENCH

DEFINITION

An infiltration/storage trench is a subsurface structure, typically filled with stone, designed to capture and manage stormwater. Stormwater runoff is conveyed to infiltration/storage trenches via green inlets or other inlet structures and perforated distribution pipes. Green inlets are typically fitted with pre-treatment devices to prevent trash, sediment, and debris from entering the infiltration/storage trench. Stormwater is filtered through the stone in the trench and is either infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipe conveyance.

Infiltration/storage trenches can be located under sidewalks, parking lots, lawns, or other pervious and impervious recreational areas (e.g., basketball courts, athletic fields, etc.). They can also be connected to other SMP types, such as stormwater bump-outs, to receive stormwater overflow from these systems. Figure 1-10 provides examples of infiltration/storage trenches. Figure 1-11 shows typical infiltration/storage trench features.

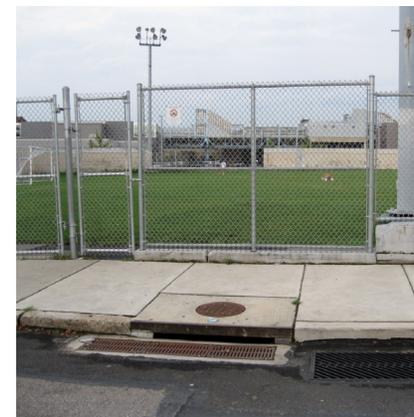


Figure 1-10. Examples of Infiltration/Storage Trenches in Philadelphia

Infiltration Trench

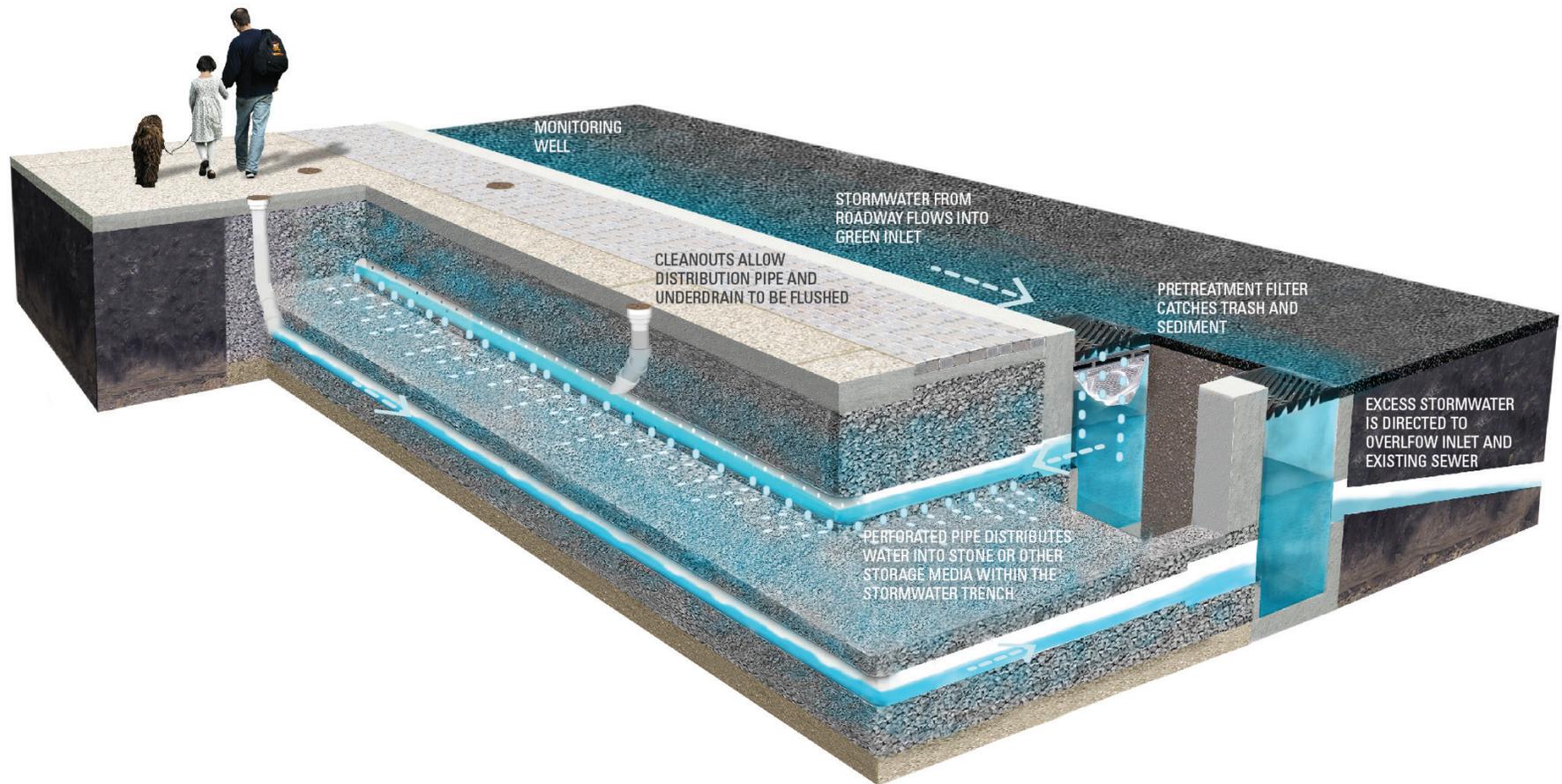


Figure 1-11. Infiltration/Storage Trench with Typical Features

INFILTRATION/STORAGE TRENCH MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for infiltration/storage trenches are listed in Table 1-5. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-5 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

Concrete repair (section 2.1.3);

Settlement repair (section 2.1.4); and

Graffiti removal (section 2.1.5).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-5. Infiltration/Storage Trench Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Bimonthly	See 2.1.1; Section 2.1.1.10 B and E
	Clean pretreatment devices	Monthly	See 2.1.1; Section 2.1.1.10 D
	Wipe down signage	Bimonthly	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodding pipes	Jet-rod conveyance, distribution, and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.6 STORMWATER WETLAND

DESCRIPTION

Stormwater wetlands are generally large, shallow, vegetated basins or regions that are designed to manage and treat stormwater runoff from large contributing drainage areas (generally more than 5 acres). A stormwater wetland typically holds water for longer than 72 hours, and is commonly comprised of a combination of shallow and deep pools connected in series by conveyance and/or flow control elements such as swales, weirs, and spillways. Stormwater runoff can be conveyed to stormwater wetlands by swales or pipe conveyance systems. For pre-treatment, stormwater wetlands will typically have sediment forebays at stormwater inflow points. Dynamic ecological functions of wetland plants, soils, microorganisms, and hydrology allow for removal of pollutants and sediment from stormwater, reduction of stormwater runoff velocities, and/or the slow release of stormwater to existing sewer systems or natural water bodies.

Stormwater wetlands are often constructed in regions originally designated as stormwater basins, within roadside right-of-ways, in areas where native soil conditions do not allow for infiltration, or where the groundwater table is exposed or close to the surface. Stormwater wetlands can also be created in low-lying areas through the use of impermeable liners to induce year-round inundated soil saturation. Wetland vegetation generally consists of a variety of open water, emergent, low/high marsh, and upland plants. Figure 1-12 provides examples of stormwater wetlands. Figure 1-13 shows typical stormwater wetland features.

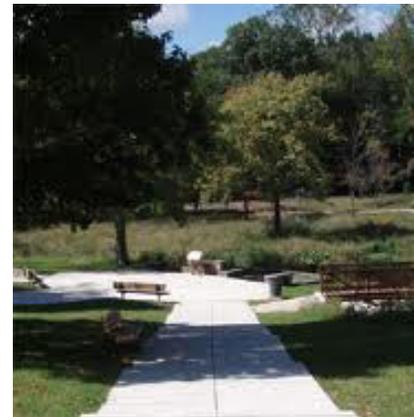


Figure 1-12. Examples of Stormwater Wetlands in Philadelphia

Stormwater Wetland

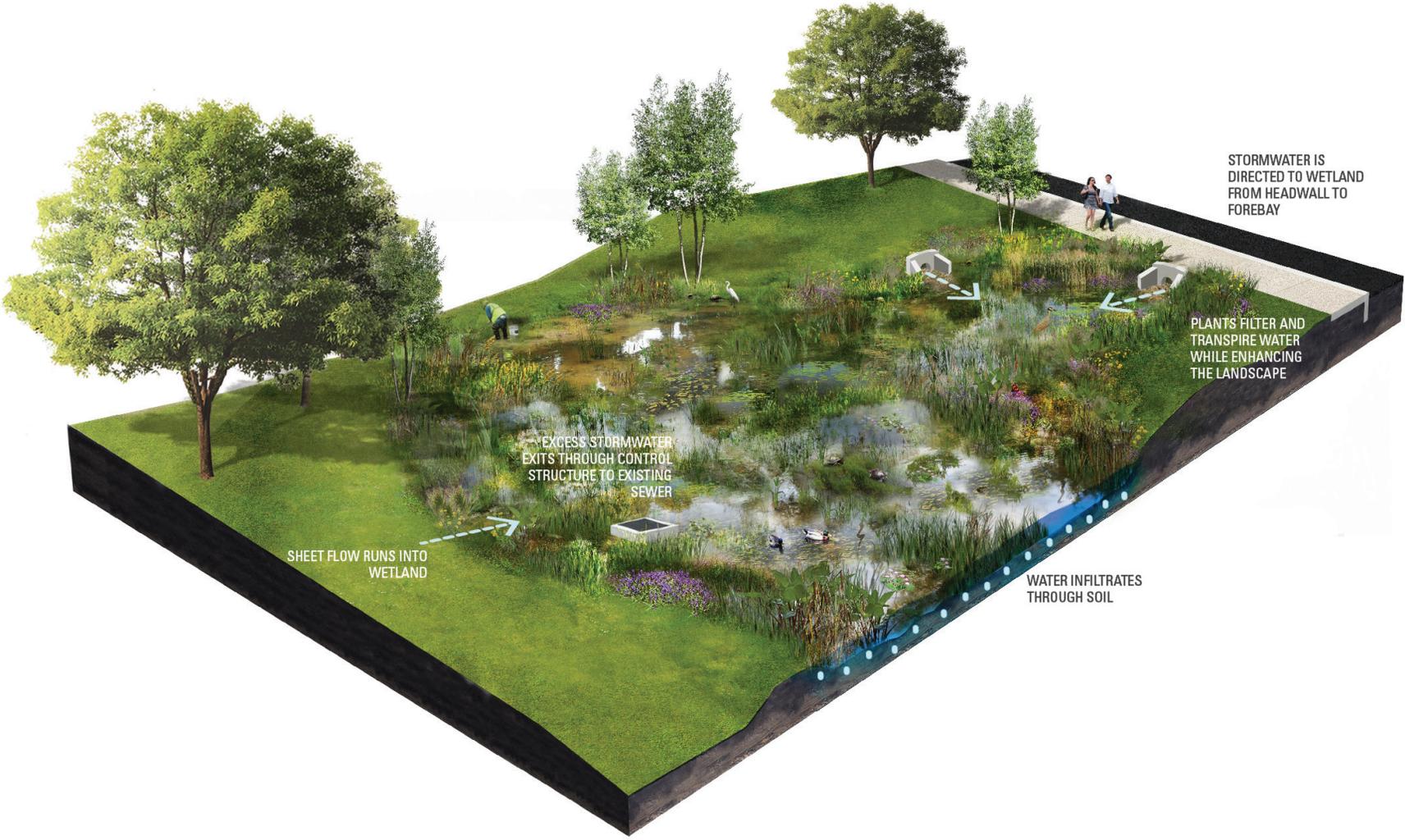


Figure 1-13. Stormwater Wetland with Typical Features

STORMWATER WETLAND MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for stormwater wetlands are listed in Table 1-6. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed are found in Division 2.

Additional maintenance tasks beyond those listed in Table 2-6 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Erosion control (section 2.1.2);

- Plant replacement (section 2.2.4); and

- Pest management (section 2.2.8).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-6. Stormwater Wetland Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Clean pretreatment devices	Monthly	See 2.1.1; Section 2.1.1.10 D
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
	Dredge large volumes of trash, sediment, and organic debris from basin and forebay areas using approved equipment	When sediment occupies greater than 50% of the forebay volume or as per site specific maintenance plan	See 2.1.1; Section D.3
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal, see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal, see 2.2.7; Section 2.2.3 B-C or Table 2-2.
Mow turf and meadow areas	Mow turf areas to a height of 2-4 in.	Monthly from May to October	See 2.2.1; Section 2.2.1.10 E
	Mow naturalized meadow areas to a height of 8 in.	Two (2) times per year in June and October	See 2.2.1; Section 2.2.1.10 E
Prune trees and shrubs	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water trees	Place water bag(s) on tree(s)	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag(s)	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 2.2.2.10 F.1-d
	Remove water bag(s) from tree(s)	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b
Water herbaceous vegetation and shrubs	Water evenly and thoroughly at the base of vegetation so that the top of soil is saturated	Ever four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Subsurface Maintenance			
Jet-rodding pipes	Jet-rod conveyance pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.7 STORMWATER SWALE

DESCRIPTION

A stormwater swale is an open vegetated channel designed to convey stormwater runoff. Stormwater swales are typically designed to control stormwater runoff velocity, filter stormwater pollutants using vegetation, and infiltrate stormwater runoff where feasible. Stormwater swales are often used as pre-treatment or conveyance for another downstream SMP such as a rain garden or stormwater basin.

They may be planted with turf grass and maintained as lawn areas, or they may be densely vegetated with herbaceous plants, shrubs, and trees.

Stormwater swales can be located adjacent to roadways and parking lots, upstream of SMPs, and in areas subject to overland flooding. Figure 1-14 provides examples of stormwater swales. Figure 1-15 shows typical stormwater swale features.



Figure 1-14. Examples of Stormwater Swales

Swale

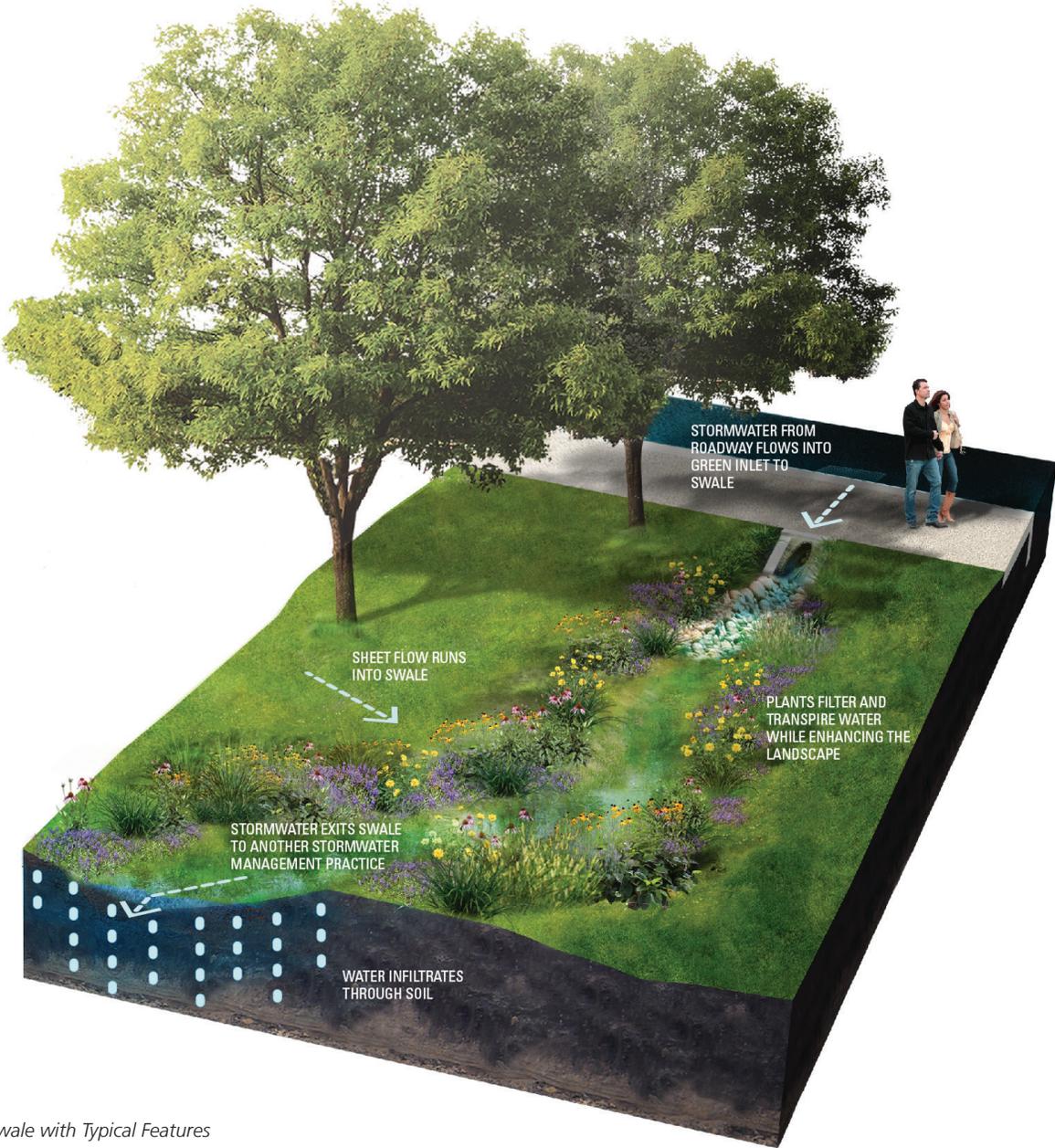


Figure 1-15. Stormwater Swale with Typical Features

STORMWATER SWALE MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for stormwater swales are listed in Table 1-7. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-7 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Erosion control (section 2.1.2);

- Plant replacement (section 2.2.4); and

- Soil amendment (section 2.2.9).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-7. Stormwater Swale Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal, see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal, see 2.2.7; Section 2.2.3 B-C or Table 2-2.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground	Annually in March	See 2.1.2; Section 2.1.2.9 C
Mow turf and meadow areas	Mow turf areas to a height of 2-4 in.	Monthly from May to October	See 2.2.1; Section 2.2.1.10 E
	Mow naturalized meadow areas to a height of 8 in.	Two (2) times per year in June and October	See 2.2.1; Section 2.2.1.10 E
Prune trees and shrubs	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water trees	Place water bag(s) on tree(s)	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag(s)	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 2.2.2.10 F.1-d
	Remove water bag(s) from tree(s)	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b
Water herbaceous vegetation and shrubs	Water evenly and thoroughly at the base of vegetation so that the top of soil is saturated	Every four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E

1.2.1.8 STORMWATER BASIN

DESCRIPTION

Stormwater basins are large turf or meadow depressions used to manage stormwater. Typically they are constructed as a single basin area that overflows or discharges to a single controlled discharge point. Stormwater is conveyed to a stormwater basin by sheet flow, swales, or inlet/pipe conveyance. Stormwater is then either infiltrated back into the groundwater table or slowly released back into an existing sewer or natural water body. Stormwater basins can be shallow and broad in areas, or small and steep if space constraints exist. Stormwater basins are often vegetated with mowed lawn or meadow grasses.

Stormwater basins are often located within margins of traditionally developed residential subdivisions and commercial and industrial sites with adequate open space. Figure 1-16 provides examples of stormwater basins. Figure 1-17 shows typical stormwater basin features.



Figure 1-16. Examples of Stormwater Basins

Stormwater Basin

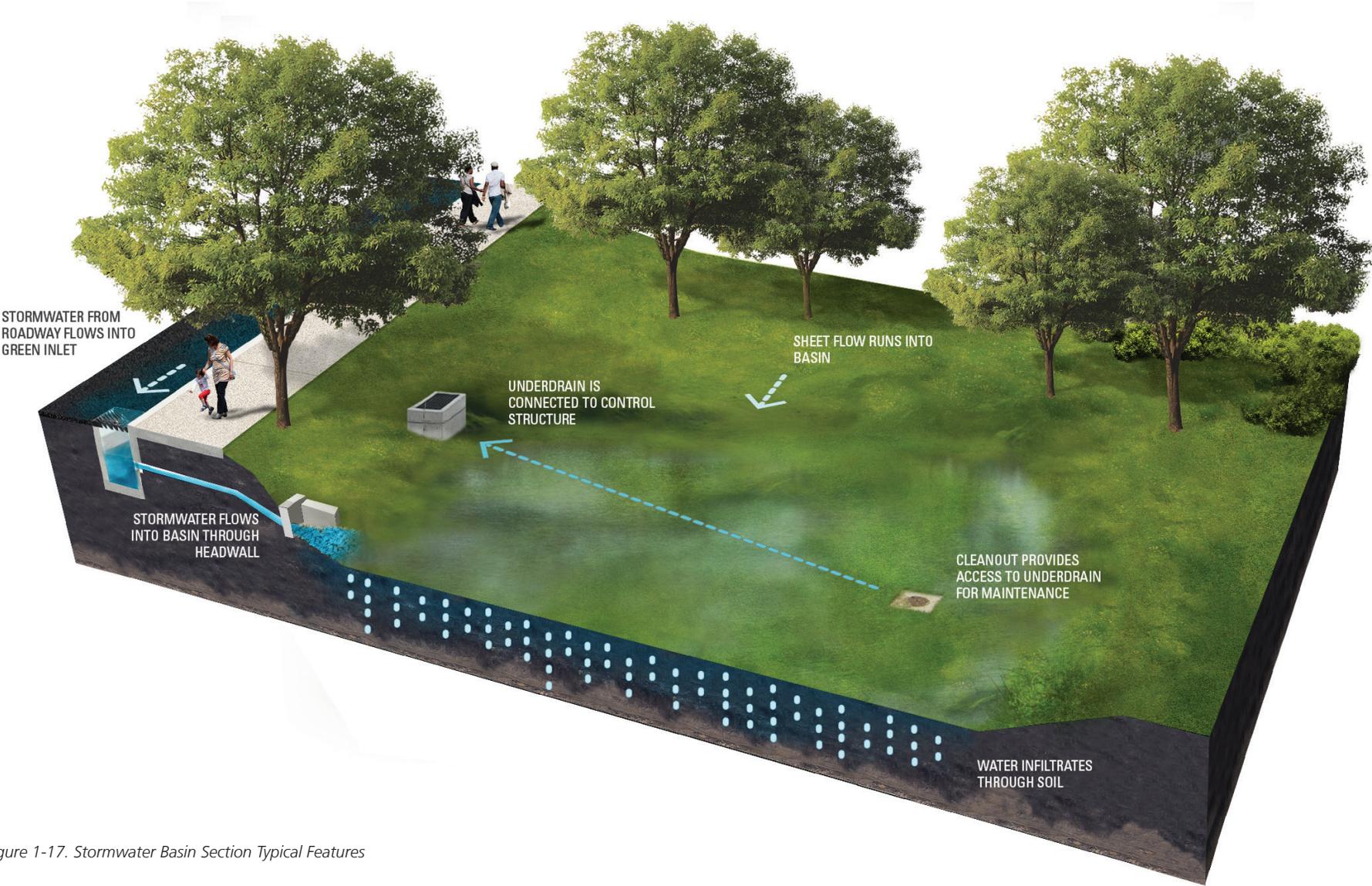


Figure 1-17. Stormwater Basin Section Typical Features

STORMWATER BASIN MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for stormwater basins are listed in Table 1-8. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-8 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Erosion control (section 2.1.2);

- Seeding (section 2.2.5); and

- Plant replacement (section 2.2.4).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-8. Stormwater Basin Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Clean pretreatment devices	Monthly	See 2.1.1; Section 2.1.1.10 D
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
	Dredge large volumes of trash, sediment, and organic debris from basin and forebay areas using approved equipment	When sediment occupies greater than 50% of the forebay volume or as per site specific maintenance plan	See 2.1.1; Section D.3
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Apply mulch	Apply mulch to landscaped beds as needed	Annually in March	See 2.2.3; Section 2.2.3 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal, see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal, see 2.2.7; Section 2.2.3 B-C or Table 2-2.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground	Annually in March	See 2.1.2; Section 2.1.2.9 C
Mow turf and meadow areas	Mow turf areas to a height of 2-4 in.	Monthly from May to October	See 2.2.1; Section 2.2.1.10 E
	Mow naturalized meadow areas to a height of 8 in.	Two (2) times per year in June and October	See 2.2.1; Section 2.2.1.10 E
Prune trees and shrubs	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water trees	Place water bag(s) on tree(s)	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag(s)	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 2.2.2.10 F.1-d
	Remove water bag(s) from tree(s)	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b
Water herbaceous vegetation and shrubs	Water evenly and thoroughly at the base of vegetation so that the top of soil is saturated	Ever four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodding pipes	Jet-rod conveyance and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

1.2.1.9 STORMWATER TREE

DEFINITION

A stormwater tree is a single tree that manages stormwater runoff which is directly conveyed to its tree pit. Typically, stormwater runoff is conveyed to a stormwater tree through a grate opening that is installed along the curb and connected to the tree pit. Stormwater runoff is filtered by the tree pit soil and infiltrated into the underlying soil beneath the tree pit. The stormwater tree helps reduce the volume of stormwater runoff through canopy interception and evapotranspiration.

Stormwater trees are often located along a sidewalk and adjacent to streets to capture street runoff. Figure 1-18 provides examples of stormwater trees. Figure 1-19 shows typical stormwater tree features.



Figure 1-18. Examples of Stormwater Trees in Philadelphia

Stormwater Tree



Figure 1-19. Stormwater Tree with Typical Features

STORMWATER TREE MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Routine maintenance tasks for stormwater tree are listed in Table 1-9. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-9 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Concrete repair (section 2.1.3);

- Settlement repair (section 2.1.4); and

- Pesticide application (section 2.2.8).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-9. Stormwater Tree Routine Maintenance Tasks

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Bimonthly	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Bimonthly	See 2.1.1; Section 2.1.1.10 C
Apply mulch	Apply mulch to tree pit soil surface	Annually in March	See 2.2.3; Section 2.2.3 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Every other month beginning in March and ending in November	For mechanical removal, see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal, see 2.2.7; Section 2.2.3 B-C or Table 2-2.
Prune tree	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, when trees are dormant between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water tree	Place water bag on tree	Annually in March for first 12 months after planting	See 2.2.2; Section 2.2.2.10 F.1-a
	Fill water bag	Weekly, April - October for first 12 months after planting during any period of seven (7) or more days without rain	See 2.2.2; Section 2.2.2.10 F.1-d
	Remove water bag from tree	Annually in November	See 2.2.2; Section 2.2.2.10 F.1-b

1.2.2 SMPS IN LIMITED PRACTICE OR NOT YET IN PRACTICE BY PWD

1.2.2.1 CISTERN/RAIN BARREL

DESCRIPTION

Cisterns and rain barrels are receptacles designed to capture and store stormwater for non-potable, beneficial reuse such as irrigation, toilet flushing, or industrial uses. Stormwater runoff is typically conveyed from roof areas to the rain barrels or cisterns via roof gutters, downspouts, drains, and/or pipes. Screens on gutters and downspouts filter large sediment and debris from stormwater runoff before it enters the rain barrel or cistern. First flush diverters are used in some systems to capture debris and pollutants within the first few gallons of stormwater runoff during a rain storm. Some systems may be designed to detain and slowly release water back to the existing sewer system via an orifice or valve.

Rain barrels are typically located adjacent to buildings at single downspout locations while cisterns may be located above or below ground and usually receive stormwater runoff from multiple downspouts or conveyance manifold systems. Figure 1-20 provides examples of rain barrel/cisterns. Figure 1-21 shows typical cistern/rain barrel elements.



Figure 1-20. Examples of Cisterns and a Rain Barrel

Cistern

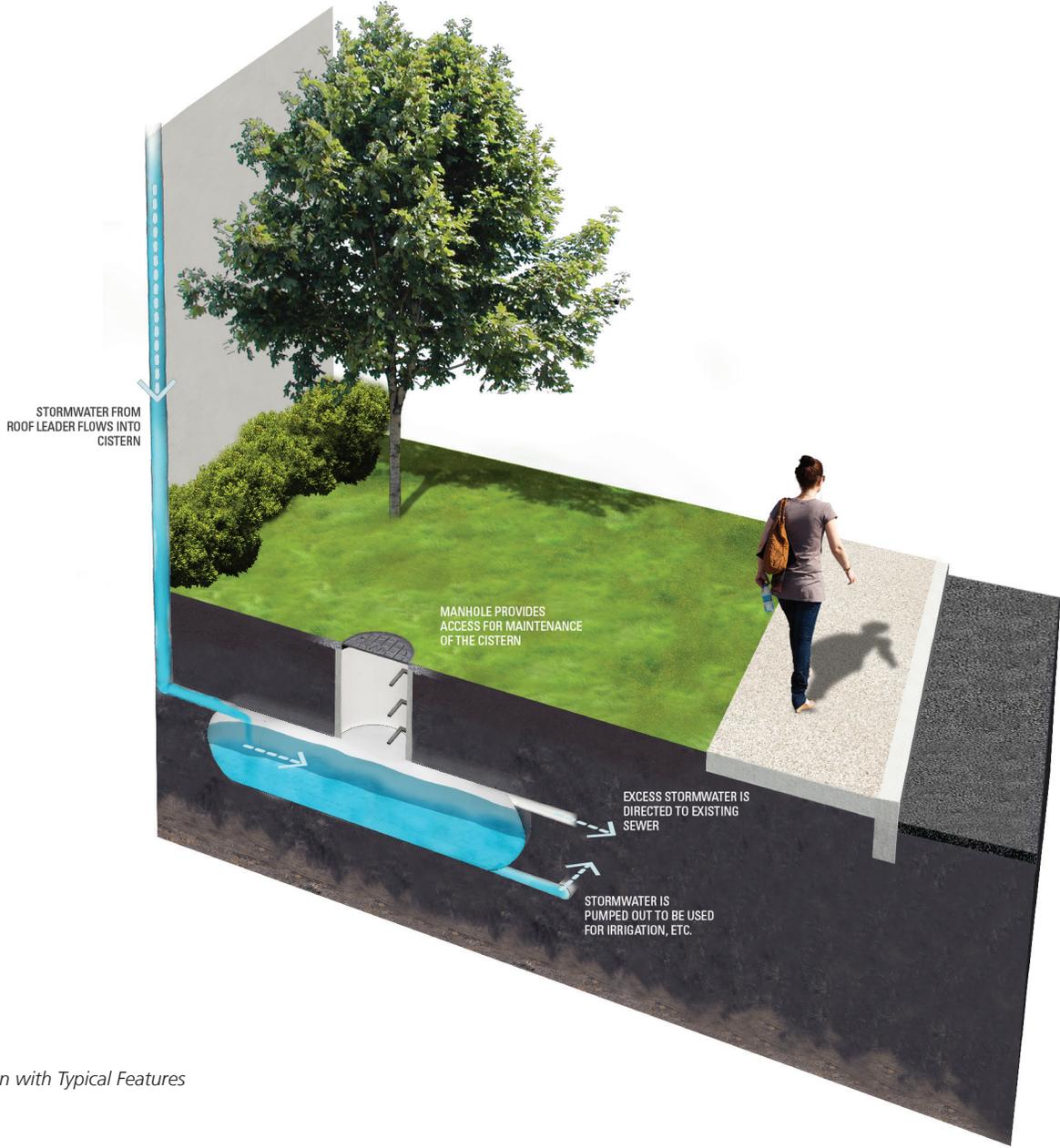


Figure 1-21. Subsurface Cistern with Typical Features

CISTERN/RAIN BARREL MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Routine maintenance tasks for cisterns and rain barrels are listed in Table 1-10. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-10 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Concrete repair (section 2.1.3); and

- Appurtenance repair (section 2.1.8).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-10. Cistern/Rain Barrel Routine Maintenance Tasks*

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Three (3) times per year	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Three (3) times per year	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
	Disinfect cistern/rain barrel storage tank	Annually in November	See 2.1.7; Section 2.1.7.10 C
	Close barrel/cistern storage tank if located above ground or above the frost line for subsurface cisterns	Annually in November	See 2.1.7; Section 2.1.7.10 C
	Open barrel/cistern storage tank if located above ground or above the frost line for subsurface cisterns	Annually in March	See 2.1.7; Section 2.1.7.10 C
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from barrel/cistern storage tank prior to winterization	Annually in November	See 2.3.1; Section 2.3.1.10 C
Jet-rod cisterns and pipes	Flush cisterns and jet-rod pipes	Annually	See 2.3.2; Section 2.3.2.10 F

*Cistern/rain barrel routine maintenance tasks are preliminary and still under development/refinement.

1.2.2.2 GREEN ROOF

DESCRIPTION

A green roof is a vegetated surface installed over a sealed roof membrane that manages stormwater. Typically green roofs are comprised of multiple layers, including waterproofing, a root barrier, a drainage layer, a filter layer, soil media, and plants. A green roof can either be installed as a fixed structure or as a series of removable modules. Unlike traditional roofs which shed rainwater, green roofs capture and evapotranspire rainwater. They can also help insulate the building, lowering energy use.

Green roofs are found on the roofs of buildings and other auxiliary structures. Figure 1-22 provides examples of the creation and final result of a green roof. Figure 1-23 shows a green roof section with typical elements.



Figure 1-22. Examples of Green Roofs

Green Roof

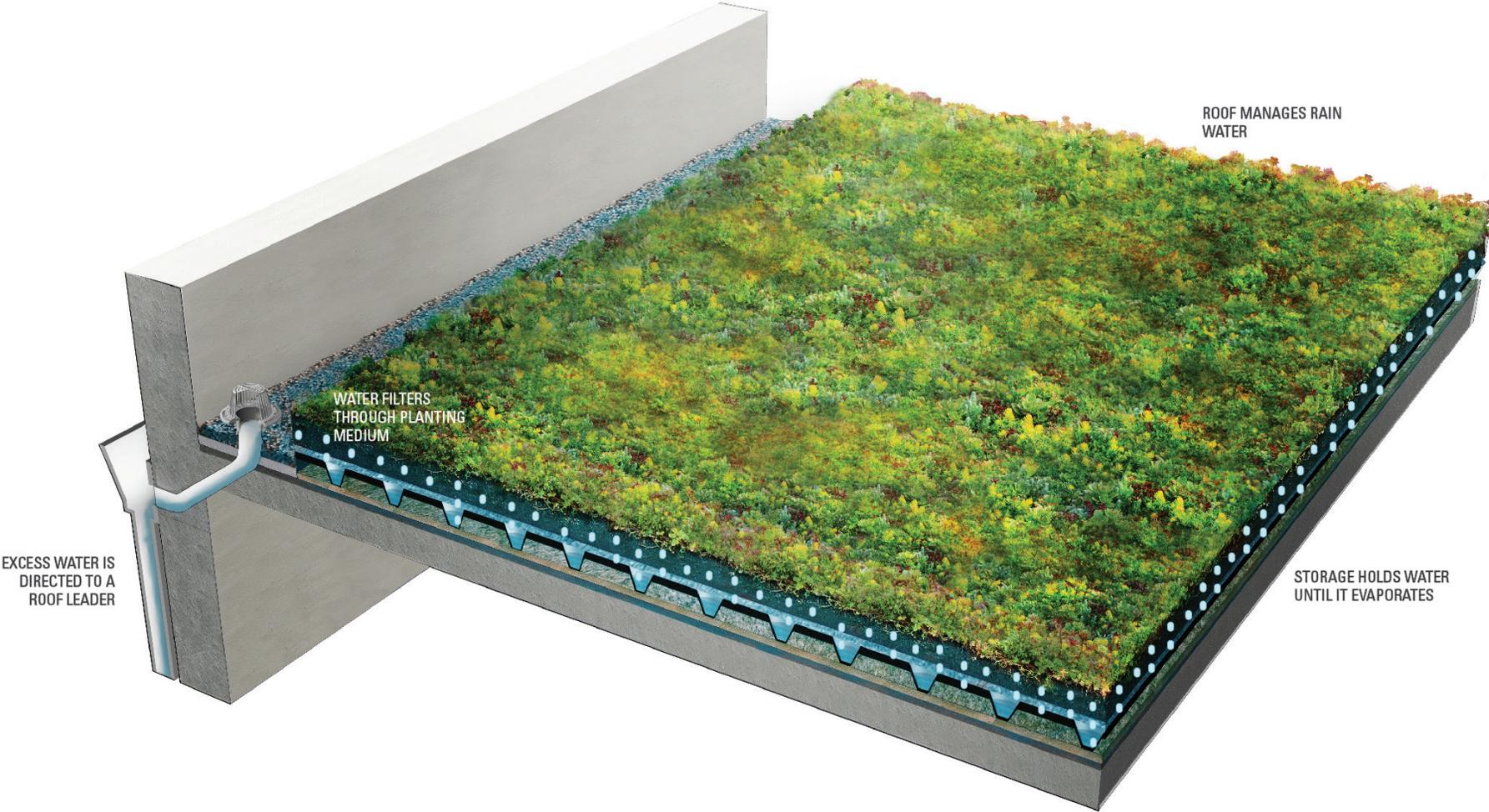


Figure 1-23. Green Roof Section Typical Features

GREEN ROOF MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements and other general topics that apply to different types of SMPs.

Routine maintenance tasks for green roofs are listed in Table 1-11. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional tasks beyond those listed in Table 1-11, such as repairing replanting or amending soil, may be required for green roof maintenance. However, these tasks are not performed routinely, but in response to specific observed issues. Therefore, no pre-set schedule or frequency for these tasks is provided.

Additional maintenance tasks beyond those listed in Table 1-11 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Appurtenance repair (section 2.1.8); and

- Replanting (section 2.2.4).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-11. Green Roof Routine Maintenance Tasks*

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Three (3) times per year from March to November	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Three (3) times per year from March to November	See 2.1.1; Section 2.1.1.10 C
Remove non-target/invasive vegetation	Hand weed non-target/invasive plants	Four (4) times per year for the first 24 months after planting, and two (2) times per year after the first 24 months from March to November	See 2.2.1; Section 2.2.3 B-D or Table 2-1.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground	Annually in March	See 2.2.1; Section 2.2.1.10 C
Water herbaceous vegetation and shrubs	Water evenly and thoroughly so that the top of soil is saturated	Ever four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Manage/amend soil	Test soil for nutrient content	Two (2) times annually or as per designer's recommendations for the first 24 months after planting	See 2.2.9; Section 2.2.9.10 B-C
	Amend soil as needed following nutrient test	Up to two (2) times annually or as per designer's recommendations for the first 24 months after planting, depending on soil test results	See 2.2.9; Section 2.2.9.10 D-F

*Green roof routine maintenance tasks are preliminary and still under development/refinement.

1.2.2.3 PERVIOUS PAVING

DESCRIPTION

Pervious paving is a permeable hardscape surface that allows water to pass through the surface. Pervious paving materials can include concrete, asphalt, or pavers. Systems are typically underlain with a stone bed or infiltration/storage trench (see section 1.1.5) to store stormwater until it is either infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipe conveyance. Stormwater runoff is most often conveyed to the system via direct rainfall and/or sheet flow from surrounding impervious surfaces.

Pervious paving is can be found in hardscape areas designed for pedestrian traffic (e.g., sidewalks) and/or low levels of vehicular traffic (e.g., alleyways, parking stalls, etc.) as well as in hardscape recreational areas such as basketball courts. Figure 1-24 provides examples of pervious paving. Figure 1-25 shows typical pervious paving features.

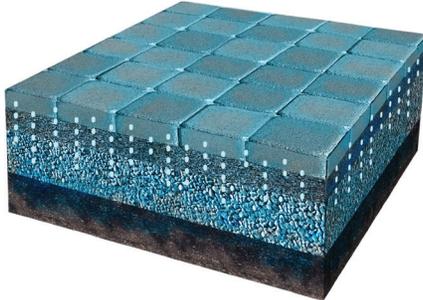


Figure 1-24. Examples of Pervious Paving in Philadelphia

Pervious Paving



Pervious Pavements



Pervious Pavers



Pervious Sidewalk

Figure 1-25. Pervious Paving with Typical Features

PERVIOUS PAVING MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for pervious paving are listed in Table 1-12. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-12 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Pavement repair (section 2.1.3); and

- Graffiti removal (section 2.1.5).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-12. Pervious Paving Routine Maintenance Tasks*

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Three (3) times per year	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Three (3) times per year	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Remove fine sediment and debris	Vacuum or air sweep fine sediment and debris from surface pore space	Two (2) times per year	See 2.1.9; Section 2.1.9.10 A-E
Jet-rodding pipes	Jet-rod underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

*Pervious paving routine maintenance tasks shown are preliminary and under development/refinement.

1.2.2.4 BLUE ROOF

DESCRIPTION

A blue roof is non-vegetated system of rooftop storage structures, installed over a sealed roof membrane, that detain and/or retain stormwater. Typically blue roofs utilize check dams, trays, or modified roof drains to capture and temporarily detain rainwater on the roof surface and/or to slow rainwater before it reaches building downspouts. Rainwater detained by blue roofs is typically then slow released to the roof drains and/or removed through evaporation to the atmosphere, especially during warm, sunny weather.

Blue roofs are best suited for buildings with relatively flat roofs and other auxiliary structures. Figure 1-26 provides examples of several possible blue roof configurations, including retention trays (bottom) and check dams (top). Figure 1-27 shows blue roof tray, check dam, and modified roof drain system sections with typical elements.



Figure 1-26. Examples of Blue Roofs in New York City
(Image credit: 2012 NYC Green Infrastructure Pilot Monitoring Report)

Blue Roof



Figure 1-27. Blue Roof Detention Tray, Check Dam, and Modified Roof Leader System
Sections/Perspectives with Typical Features

BLUE ROOF MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for blue roofs are listed in Table 1-13. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-13 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Appurtenance repair (section 2.1.8).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-13. Blue Roof Routine Maintenance Tasks*

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Three (3) times per year from March to November	See 2.1.1; Section 2.1.1.10 B and E
Winterize SMP	Clean and grease bolts and appurtenances as needed	Annually in November	See 2.1.7; Section 2.1.7.10 B

*Blue roof routine maintenance tasks are preliminary and still under development.

1.2.2.5 GREEN GUTTER

DESCRIPTION

Green gutters are narrow vegetated depressions located along roadway curbs and gutters and designed to intercept sidewalk and roadway stormwater runoff. Stormwater runoff is typically conveyed to a green gutter by traditional curb and gutters and/or as sheet flow from surrounding sidewalks and roadways. Green gutters may be lined with geotextile (permeable or impermeable) and are planted with herbaceous and/or woody species in soil media, often over a layer of stone. Stormwater is filtered by the soil media and is infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipes and hydraulic control structures. Excess runoff typically leaves the system via downslope traditional curb and gutter system or a stormwater inlet. Green gutter vegetation helps reduce the volume of stormwater runoff through evapotranspiration.

Green gutters are typically located within the public right-of-way either mid-block or at intersections, and are commonly planted a variety of grasses, and flowering perennials. Figure 1-28 provides an example of a green gutters. Figure 1-29 shows typical green gutter features.



Figure 1-28. Example of a Green Gutter in Portland, Oregon
(Image credit: PWD Green Streets Design Manual, 2014)

Green Gutter

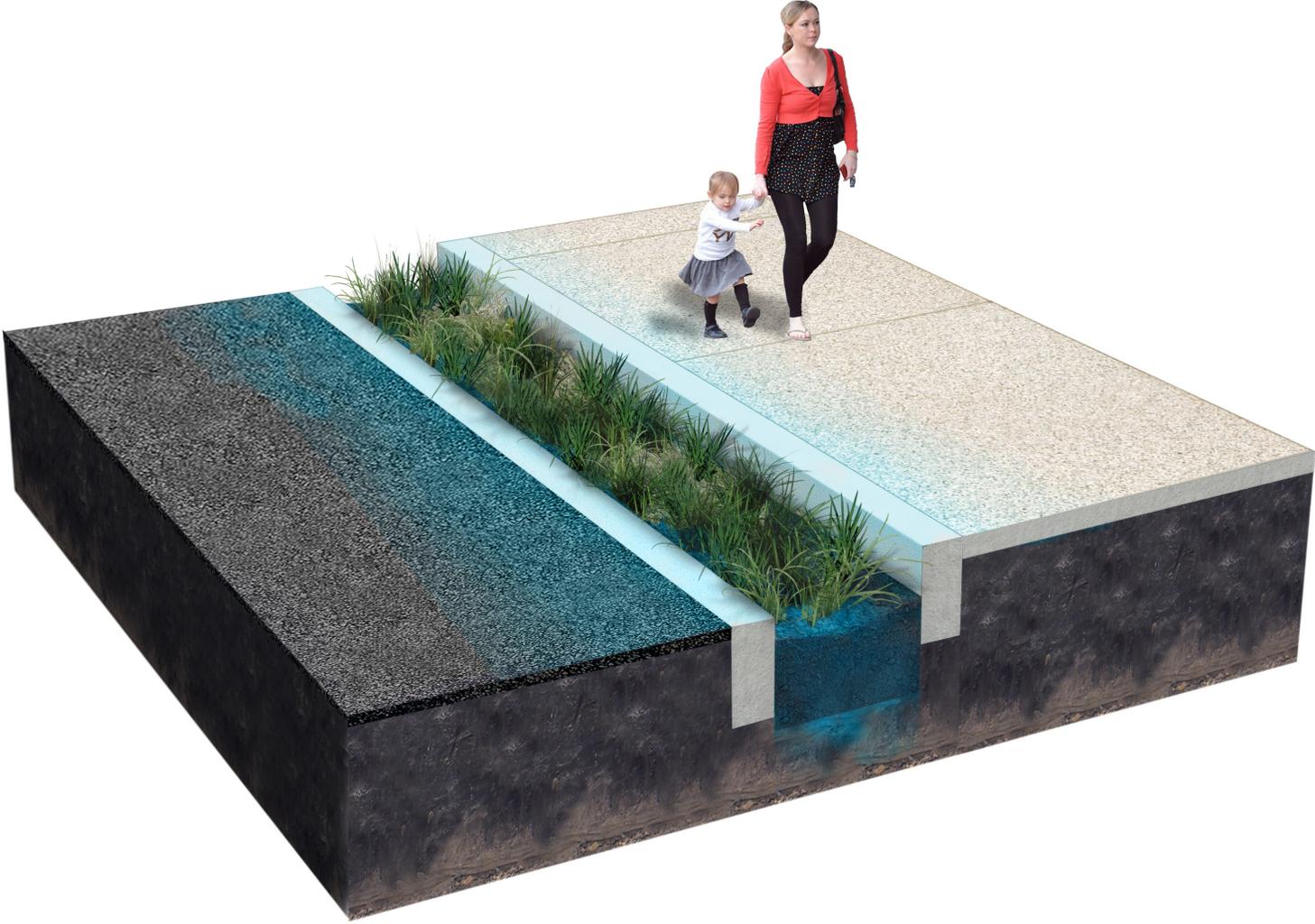


Figure 1-29. Green Gutter Section/Perspective with Typical Features

GREEN GUTTER MAINTENANCE

General requirements for conducting maintenance activities are found in Division 3 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common required maintenance tasks for green gutters are listed in Table 1-14. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-14 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Erosion control (section 2.1.2);

- Plant replacement (section 2.2.4); and

- Soil amendment (section 2.2.9).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-14. Green Gutter Routine Maintenance Tasks*

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Monthly	See 2.1.1; Section 2.1.1.10 B and E
	Wipe down signage	Monthly	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
	Place traffic delineation/snow removal bollards	Annually in November	See 2.1.7; Section 2.1.7.10 D
	Remove traffic delineation/snow removal bollards	Annually in April	See 2.1.7; Section 2.1.7.10 D
Apply mulch	Apply mulch to landscaped beds as needed	Annually in March	See 2.2.3; Section 2.2.3 B
Remove non-target/invasive vegetation	Remove non-target/invasive plants using one or more of the mechanical or chemical methods outlined in Tables 2-1 and 2-2	Monthly from March to November	For mechanical removal see 2.2.1; Section 2.2.3 B-D or Table 2-1. For chemical removal see SOP 2.2.7; Section 2.2.3 B-C or Table 2-2.
Cut back target perennials	Manually cut detrital herbaceous vegetation from the previous growing season to 4-6 in. above the ground	Annually in March	See 2.2.1; Section 2.2.1.10 C
Prune shrubs	Elevate lower limbs and remove dead, rubbing, or crossing limbs	Annually, between September and the end of December	See 2.2.6; Section 2.2.6.10 G
Water herbaceous vegetation and shrubs	Water evenly and thoroughly so that the top of soil is saturated	Every four (4) days during any period of four (4) or more days without rain, June-August for the first 24 months after planting	See 2.2.2; Section 2.2.2.10 E
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodding pipes	Jet-rod under-drain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

*Green gutter routine maintenance tasks are preliminary and still under development.

1.2.2.6 STORMWATER DRAINAGE WELL

DESCRIPTION

A stormwater drainage well is a perforated underground structure designed to collect and manage stormwater. Stormwater runoff is conveyed to stormwater drainage wells via green inlets fitted with pretreatment systems that prevent trash, sediment, and debris from entering the drainage well. Stormwater is collected and slowly release into the surrounding soils through perforations in the bottom and sides of the drainage well.

Stormwater drainage wells can be located under roads, sidewalks, parking lots, lawns, or other pervious and impervious areas. They can also be connected to other SMP types, such as stormwater bump-outs, to receive stormwater overflow from these systems. Figure 1-30 provides a conceptual rendering of a stormwater drainage well.

STORMWATER DRAINAGE WELL

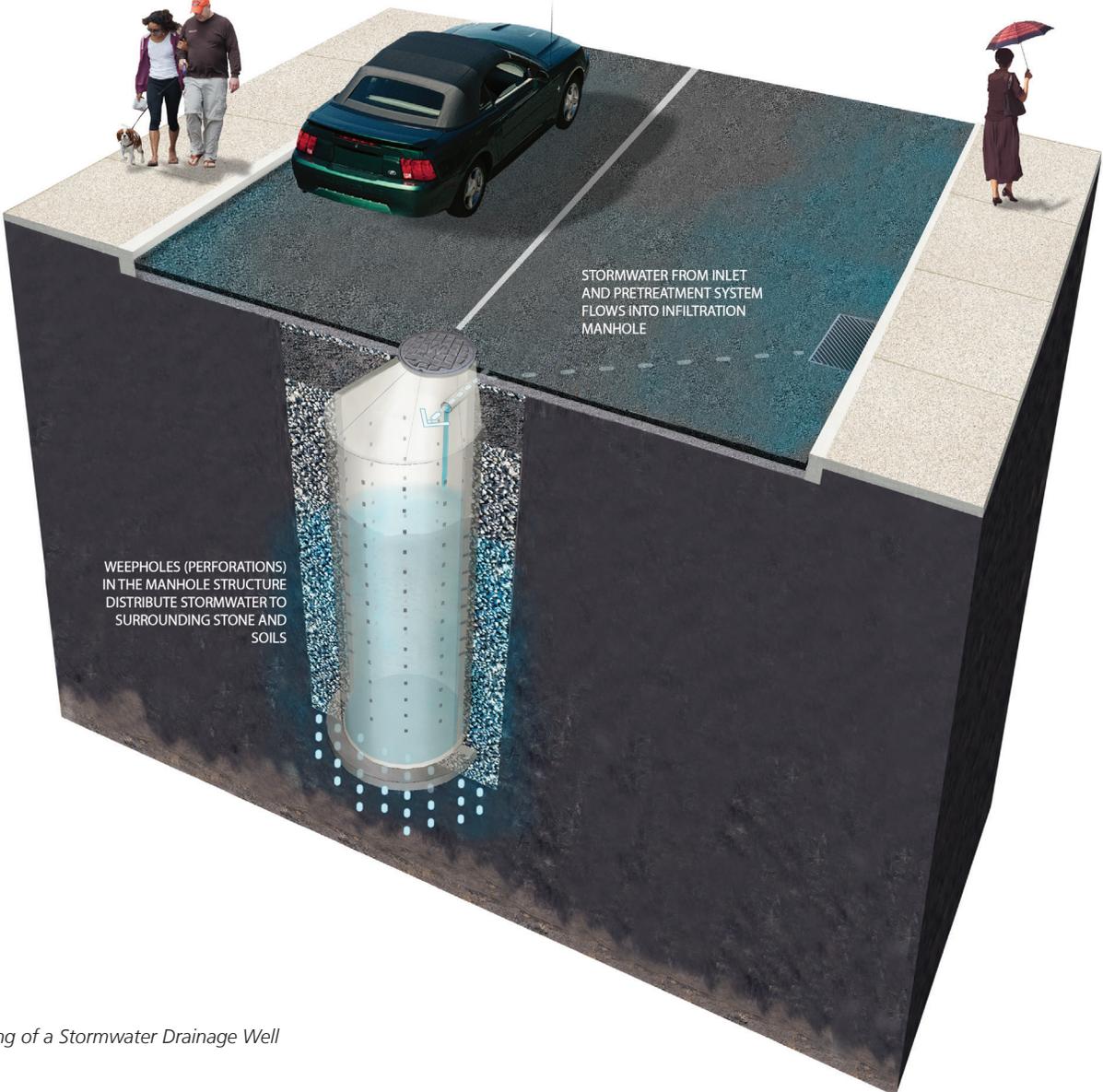


Figure 1-30. Concept Rendering of a Stormwater Drainage Well

STORMWATER DRAINAGE WELL MAINTENANCE

General requirements for conducting maintenance activities are found in Division 2 along with important information on material, equipment, and personnel requirements, and other general topics that apply to different types of SMPs.

Common routine maintenance tasks for stormwater drainage wells are listed in Table 1-15. The frequencies provided in the table are approximate and can be modified as needed to adjust to site-specific conditions. Maintenance protocols for additional tasks not listed here are found in Division 2.

Additional maintenance tasks beyond those listed in Table 1-15 may be required in response to specific observed issues. These tasks may include, but are not limited to, the following:

- Concrete repair (section 2.1.3);

- Graffiti removal (section 2.1.5).

General health and safety, access, and maintenance event procedures provided in Division 3 should be followed for all maintenance activities performed.

Table 1-15. Stormwater Drainage Well Routine Maintenance Tasks*

Task	Description	Frequency	Protocol Reference
Surface Maintenance			
Remove trash, sediment, and organic debris	Remove trash, sediment, and organic debris from all SMP surfaces	Bimonthly	See 2.1.1; Section 2.1.1.10 B and E
	Clean pretreatment devices	Monthly	See 2.1.1; Section 2.1.1.10 D
	Wipe down signage	Bimonthly	See 2.1.1; Section 2.1.1.10 C
Winterize SMP	Clean and grease appurtenances	Annually in November	See 2.1.7; Section 2.1.7.10 B
Subsurface Maintenance			
Vacuum clean structures	Remove trash/sediment/organic debris from subsurface access and flow control/conveyance structures	Annually	See 2.3.1; Section 2.3.1.10 C
Jet-rodding pipes	Jet-rod conveyance, distribution, and underdrain pipes	Annually	See 2.3.2; Section 2.3.2.10 F

*Stormwater drainage well routine maintenance tasks are preliminary and still under development.

Maintenance Tasks

division **2**



2.1 SURFACE STRUCTURAL MAINTENANCE

2.1.1 TRASH, SEDIMENT, AND ORGANIC DEBRIS REMOVAL

2.1.1.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for trash, sediment, and organic debris removal.

2.1.1.2 DOCUMENTATION

1. Documentation for trash, sediment, and organic debris removal shall conform to the requirements set forth in section 3.1.

2.1.1.3 HEALTH AND SAFETY

1. Trash, sediment, and organic debris removal shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.1.4 PERSONNEL

1. Personnel for trash, sediment, and organic debris removal shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.1.5 MATERIALS

1. The following materials may be required for the execution of this task:

- Site map, design plan, or as-constructed plan;
- Hard copies of permits and access permissions;
- 50 gal. plastic contractor bags (1 box);
- All purpose cleaner (2-32 oz. bottles);
- All purpose rags (10); and
- Material Safety Data Sheets (MSDS) as applicable.

2.1.1.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

- Trash claw;
- Leaf blower;
- Tarp or other receptacle;
- Wheelbarrow or push cart;
- Push broom with firm bristles;

- Dust pan and brush;
- Scoop shovel, scraper shovel, digging shovel, edging shovel, snow shovel, and/or drain shovel;
- Spade;
- Leaf rake, shrub rake, row rake, and/or hand rake;
- Set of metric and standard socket wrenches;
- Assorted Phillips and standard screwdrivers;
- Pliers, adjustable wrenches, vice grips, and pipe wrenches; and
- Wire or plastic brush.

2. Additional equipment that may be required for this task includes:

- Portable vacuum excavator or vacuum truck;
- Mini excavator; and
- Backhoe.

2.1.1.7 ACCESS REQUIREMENTS

1. Site access for trash, sediment, organic debris removal shall be secured in accordance with section 3.4.

2.1.1.8 PERMITS AND APPROVALS

1. Permits and approvals for trash, sediment, and organic debris removal shall be obtained in accordance with section 3.5.

2.1.1.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.1.1.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.

Determination of appropriate method for cleaning shall be made prior to maintenance of each structure so that appropriate equipment is transported to the site.

Small quantities of sediment/trash/organic debris and/or sediment/trash/organic material contained within shallow structures or on top of structures can be removed using hand tools.

In some cases, a mini-excavator or backhoe may be needed to remove or dredge sediment from large open storage areas or forebays.

Large quantities of sediment and/or sediment contained within structures that are difficult to access or require confined space entry, may require the use of a portable vacuum excavator or vacuum truck. See section 2.3.1 for Vacuum Cleaning Protocol.

Culverts may require cleaning via jet-rodding as per section 2.3.2.

2. Remove loose trash from media/storage areas, roof storage areas as applicable, and the SMP perimeter, including sidewalk/paved areas adjacent to any grates and curb openings (4 ft. on either side of structure) by hand or using a trash claw.
3. Wipe down signage using an all purpose cleaner and soft rag to remove any attached sediment/trash/organic debris.
4. Remove trash, sediment, and organic debris from structure surfaces and interiors, including culverts, trench drains, pretreatment devices, gutters, and flow control devices (weirs, weir walls, spillways, orifices, modified roof drains).

Sediment/trash/organic debris removal from inlets, control structures, cleanouts, and manholes is considered subsurface maintenance and is covered in section 2.3.1.

If removal of sediment/trash/organic debris from interiors, culverts, trench drains, pretreatment, or flow control devices requires entry into the structure, confined space entry may be required. Depending on crew qualifications, a subsurface maintenance crew may be required to perform work (see section 3.3.4).

Sediment/trash/organic debris shall be removed from pretreatment or flow control devices contained within inlet structures prior to the removal of sediment/trash/organic debris from the inlet itself.

Sediment/trash/organic debris may be removed by a portable vacuum excavator. The addition of vacuum hose attachments or decreasing suction power may prevent damage to “filter-bag” style devices and prevent filter-bag from becoming caught in vacuum hose during cleaning.

If the pretreatment device is not permanently attached to the structure, remove the pretreatment device from the structure by hand or with specialized pretreatment device removal tools, if available.

If removing pretreatment device by hand, remove enough material from the device to achieve a liftable weight (based on surface maintenance personnel judgment) prior to lifting. Once removed, invert and shake or gently tap the device until all material has been removed.

Ensure that structure grates, pipe/structure openings, and screens are free of accumulated sediment/organic debris/trash.

5. Remove accumulated sediment and organic debris deposits from media/storage areas.

Small quantities of sediment/organic debris shall be removed by hand whenever possible, particularly within naturally vegetated areas.

If required, removal of sediment/organic debris using mechanized equipment may necessitate significant disturbance of vegetation with the media/storage areas. As such, plans for quickly re-establishing natural vegetation shall be developed prior to sediment/organic debris removal and implemented immediately following sediment/organic debris removal (see section 2.2.4 and section 2.2.5)

Large equipment shall not traverse or otherwise be staged on the surface of the media storage area to avoid soil compaction.

Large equipment shall not traverse or otherwise be staged on the surface of the media storage area or concrete sidewalks to avoid differential loading to potentially shallow conveyance or under-drain pipes.

Large deposits shall be removed from paved or turf-covered media/storage areas using a mini-excavator or portable vacuum excavator.

Any bare/non-vegetated areas within vegetated media/storage areas that result from sediment/organic debris removal shall be immediately stabilized per section 2.1.2 (see following pages for erosion control protocols).

6. Follow guidelines for WASTE DISPOSAL AND DECANTING (section 2.4) when removing sediment/trash/organic debris from the site.

2.1.1.11 QUALITY ASSURANCE

1. N.A.

2.1.2 EROSION CONTROL/REPAIR

2.1.2.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for the control/repair of damaging soil loss or migration.

2.1.2.2 DOCUMENTATION

1. Documentation for erosion control/repair shall conform to the requirements of section 3.1.

2.1.2.3 HEALTH AND SAFETY

1. Erosion control/repair shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.2.4 PERSONNEL

1. Personnel for erosion control/repair shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.2.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;
 Hard copies of permits and access permissions;
 50 gal. plastic contractor bags (1 box);
 Woven geotextile fabric (50 ft. roll, 8 ft. wide);
 Nonwoven geotextile fabric (50 ft. roll, 8 ft. wide);
 Erosion blanket (North American Green® NAG-125 or SC-150 or equivalent) – (50 ft. roll, 8 ft. wide);
 8 in. erosion blanket staples (1 box of 1,000);
 Clean fill (2A modified gravel or as specified by owner/operator) – as needed;
 Top soil – as needed; and
 Stone, various sizes (as required for repairs).

2.1.2.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Leaf blower;
 Tarp or other receptacle;
 Wheelbarrow or push cart;
 Scoop shovel, scraper shovel, digging shovel, edging shovel, snow shovel, and/or drain shovel;
 Spade;
 Leaf rake, shrub rake, row rake, and/or hand rake;
 Hammer;
 Mallet;
 Hand tamper; and
 Utility blade.

2.1.2.7 ACCESS REQUIREMENTS

1. Site access for erosion control/repair shall be secured in accordance with section 3.4.

2.1.2.8 PERMITS AND APPROVALS

1. Permits and approvals for erosion control/repair shall be obtained in accordance with section 3.5.

2.1.2.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.1.2.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Fill eroded area, if necessary, with material matching that of the surrounding media profile (for example, stone, top soil, etc.).
3. Fine grade material with hoe, rake, or other hand tool to match the grade of the surrounding undamaged surface.
4. Seed the area as per section 2.2.5.

If erosion repair/control is performed outside the normal seasonal seeding window (see section 2.2.5), then postpone seeding until an appropriate time.

At the discretion of the facility/landscape maintenance manager or foreman, some areas may be planted rather than seeded according to methods in section 2.2.4.

5. Gently compact material with a hand tamper.

6. Install erosion blanket.

Dig an 8 in. by 6 in. and 12 in. deep anchor trench perpendicular to the direction of water flow within a basin or channel or at the top of the embankment if on a slope. For installation within a basin or channel, anchor trench shall be located upstream of where water enters the SMP if possible.

Secure the erosion blanket into the anchor trench with staples at a minimum of 12 in. on center and backfill anchor trench.

Unroll erosion blanket in the direction of water flow or down the embankment slope avoiding seam placement on the bottom invert of the basin/channel bottom.

Secure the erosion blanket to soil surface by placing staples at a minimum of 4 in. on center or as per manufacturer's specification.

If necessary, place consecutive erosion blankets end over end with a minimum 6 in. overlap. Use a double row of staples 4 in. apart and 4 in. on center to secure erosion blankets.

Secure the erosion blanket with a double row of staples 4 in. apart and 4 in. on center at a minimum of every 30 ft. along the direction of flow of the basin or channel or down the slope of the embankment.

At the terminal end of the repair (minimum of 3 ft. downstream from the eroded area), dig an 8 in. by 6 in. and 12 in. deep anchor trench perpendicular to the direction of water flow.

Secure the erosion blanket into the anchor trench with staples at a minimum of 12 in. on center and backfill anchor trench.

7. As needed, plant containerized plants (see section 2.2.4) matching the size and species of original planting plan or as per owner/operator specifications.

2.1.2.11 QUALITY ASSURANCE

1. Pennsylvania Department of Environmental Protection Erosion and Sediment Pollution Control Program Manual (2012).
2. Erosion blanket manufacturer's installation specifications.

2.1.3 CONCRETE, PAVEMENT, AND MASONRY REPAIR

2.1.3.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for concrete, pavement, and masonry repair.

2.1.3.2 DOCUMENTATION

1. Documentation for concrete, pavement, and masonry repair shall conform to the requirements of section 3.1.
2. If fire hydrants are used for concrete, pavement, and masonry repair, a monthly Hydrant Operation Report shall be prepared and submitted to the Philadelphia Water Department (PWD) by the owner/operator.

2.1.3.3 HEALTH AND SAFETY

1. Concrete, pavement, and masonry repair shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.3.4 PERSONNEL

1. Personnel for concrete, pavement, and masonry repair shall consist of a crew comprised of the following personnel:

One (1) facility/landscape manager or facility/landscape crew foreman; and

One (1) mason.

2. Additional masons, facility/landscape professionals, and/or labors may be needed as per the scale of the repair and the site specific conditions.

2.1.3.5 MATERIALS

- 1 The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

50 gal. plastic contractor bags (1 box);

Potable municipal or well water and/or harvested rainwater sufficient for repair activities;

All purpose cleaner (2-32 oz. bottles);

All purpose rags (10);

Sandpaper, various grades;

Sand (1-50 lbs. bag);

Portland cement (or equivalent mortar) – (1-20 lbs. bag);
Stone, various sizes (as required for repairs);
Asphalt cold patch (as required);
Concrete cold patch (as required);
Acrylic crack sealant (2-16 oz.-tubes);
Masonry adhesive (1-5 lbs. bucket);
Concrete forms; and
Material Safety Data Sheets (MSDS) as applicable.

2.1.3.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Tarp or other receptacle;
Wheelbarrow or push cart;
Paint scraper, sander, or stripper;
Heavy-duty electric masonry saw (as needed);
Masonry trowel;
Hose with spray nozzle (100 ft.);
Utility blade;
Buckets or tub;
Hand tamper;
Utility blade;
Masonry chisel set and stone hammer;
Mason line;
Line level and stakes;
Crowbar for moving and adjusting stones;
Fire hydrant center compression lock;
Fire hydrant wrench;

Backflow preventer(s) and associated appurtenances in accordance with PWD's approved list of backflow assemblies (<http://www.phila.gov/water/pdfs/BackflowAssembly2010.pdf>);

Water hose of sufficient strength to withstand kinking and abrasion from concrete surfaces or other hoses as appropriate;

Appropriate hose spray nozzles and appurtenances; and

Approved water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank without compromising safety or causing a hazard (if hydrant access is not available).

2.1.3.7 ACCESS REQUIREMENTS

1. Site access for concrete, pavement, and masonry repair shall be secured in accordance with section 3.4.

2.1.3.8 PERMITS AND APPROVALS

1. Permits and approvals for concrete, pavement, and masonry repair shall be obtained in accordance with section 3.5.

2.1.3.9 SPECIAL PROJECT CONDITIONS

1. Concrete, pavement, and masonry repairs shall be limited to days with a temperature range between 40 degrees and 80 degrees F.
2. Concrete, pavement, and masonry repairs shall be avoided within a 48 hr. period of forecasted rain.

2.1.3.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Place tarp over adjacent areas to protect surfaces, soil, and vegetation from spilled materials.
3. Remove loose debris or material from the repair area.
4. Perform concrete and masonry repairs as applicable.

If structure is constructed of cast-in-place concrete, and issue is a crack with maximum width less than 0.5 in., a chip less than 0.3 in. deep, or spalling, then apply a concrete veneer to the surface:

Mix mortar;

Apply mortar veneer over the entire surface so that the repair is not visibly apparent; and

Remove excess mortar.

If structure is constructed of cast-in-place concrete, and issue is a crack with maximum width greater than 0.5 in., chip >0.3 in., or other minor damage, fill the cracked area:

If the damage is too large to support mortar, saw cut concrete and install concrete forms, as needed;

Mix mortar;

Fill repair area and smooth joints; and

Remove excess mortar.

If structure is constructed of masonry (stone or brick), and issue is loose, missing, or displaced bricks, stones or pavers, then replace and/or reset the missing masonry parts:

Remove stone/brick from an area larger than required repair to provide space to tie in newly constructed masonry work;

Place and fine grade subbase according to design documents;

Install geotextile fabric, if applicable, by excavating soil and keying geotextile into edges of excavated area;

Mix mortar or prepare masonry adhesive and plan placement of selected stones/bricks prior to installation;

Apply mortar or adhesive according to the designed aesthetic and required structural strength as decided using best professional judgment and manufacturer recommendations;

Place stone, brick, or paver material; and

Remove excess mortar or adhesive.

If surface is constructed of pervious pavement, and the issue is small divots or damage smaller than 50 sq. ft. and comprising less than 10 percent of the total pervious pavement surface, then patch with standard asphalt:

Cut the damaged areas with an asphalt cutting blade on a masonry saw, and remove material down to the base stone course;

Fill cut hole with asphalt cold patch and pack with a hand tamper; and

Seal patched seams with acrylic sealant.

5. Remove any spilled mortar or other material on turf, hardscape, or soil/planted area.

6. Block repaired area from pedestrian or vehicular traffic.

2.1.3.11 QUALITY ASSURANCE

1. American Society for Testing and Materials (ASTM) C497 - 13 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

2.1.4 SETTLEMENT REPAIR

2.1.4.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for settlement repair.

2.1.4.2 DOCUMENTATION

1. Documentation for settlement repair shall conform to the requirements of section 3.1.

2.1.4.3 HEALTH AND SAFETY

1. Settlement repair shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.4.4 PERSONNEL

1. Personnel for settlement repair shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.4.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

50 gal. plastic contractor bags (1 box);

Clean fill (2A modified gravel or as specified by owner/operator) – as needed;

Clean sand with a high clay content;

Top soil – as needed; and

Stone, various sizes (as required for repairs).

2.1.4.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Tarp or other receptacle;
Wheelbarrow or push cart;
Scoop shovel, scraper shovel, digging shovel, edging shovel, snow shovel, and/or drain shovel;
Spade;
Leaf rake, shrub rake, row rake, and/or hand rake; and
Utility blade.

2.1.4.7 ACCESS REQUIREMENTS

1. Site access for settlement repair shall be secured in accordance with section 3.4.
2. For any ground breaking activities a PA One Call shall be performed (see section 3.7).

2.1.4.8 PERMITS AND APPROVALS

1. Permits and approvals for settlement repair shall be obtained in accordance with section 3.5.

2.1.4.9 SPECIAL PROJECT CONDITIONS

1. Large or deep settled areas or widespread settlement is beyond the scope of this document.

2.1.4.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Remove surface cover above settled area:

Remove pavers or stone by hand and set aside;
Saw cut asphalt or concrete if settlement has resulted in cracking or deformation on the surface;
Dig vegetation and set aside, avoiding root damage; and
Remove turf and associated top soil.
3. Test stability of settled area with a hand tool. If area is unstable and significantly subsides through prodding by hand tools, STOP maintenance and immediately contact owner/operator.
4. Clear around settled area and excavate using hand tools to the bottom of the depression/void space. If soil continues to subside at depths greater than 2 ft., STOP maintenance and immediately contact owner/operator.

5. Fill excavated area with approximately 4 in. to 6 in. of clean fill material (2A modified gravel or as specified by owner/operator).

6. Compact fill material with hand tamper.

7. Fill excavated area above fill material with a 4 in. to 6 in. layer of clean sand with high clay content.

8. Cover excavation with top soil for pervious areas or with stone for hardscape areas.

9. Compact with hand tamper.

10. Repair surface to match existing condition, as applicable:

For planting see section 2.2.4;

For seeding see section 2.2.5; and

For pavers, asphalt, concrete, or stone see section 2.1.3.

2.1.4.11 QUALITY ASSURANCE

1. Pennsylvania Department of Environmental Protection Erosion and Sediment Pollution Control Program Manual (2012).

2.1.5 GRAFFITI REMOVAL

2.1.5.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for graffiti removal.

2.1.5.2 DOCUMENTATION

1. Documentation for graffiti removal shall conform to the requirements of section 3.1.
2. If fire hydrants are used for graffiti removal, a monthly Hydrant Operation Report shall be prepared and submitted to PWD by the owner/operator.

2.1.5.3 HEALTH AND SAFETY

1. Graffiti removal shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.5.4 PERSONNEL

1. Personnel for graffiti removal shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.5.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;
 Hard copies of permits and access permissions;
 50 gal. plastic contractor bags (1 box);
 All purpose cleaner (2-32 oz. bottles)
 All purpose rags (10)
 Graffiti remover solvent for different surface types, as applicable (1-32 oz. bottle);
 Potable municipal or well water and/or harvested rainwater sufficient for watering and cleaning activities, as required; and
 Material Safety Data Sheets (MSDS) as applicable.

2.1.5.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Paint scraper, sander, or stripper;
 Buckets or tub;
 Utility blade;
 Ladder of appropriate height as per site-specific conditions;
 Graffiti remover applicator;
 Metal or plastic brush;
 Power washer;
 Fire hydrant center compression lock;
 Fire hydrant wrench;

Backflow preventer(s) and associated appurtenances in accordance with PWD's approved list of backflow assemblies (<http://www.phila.gov/water/pdfs/BackflowAssembly2010.pdf>);

Water hose of sufficient strength to withstand kinking and abrasion from concrete surfaces or other hoses as appropriate;

Appropriate hose spray nozzles and appurtenances; and

Approved water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank without compromising safety or causing a hazard (if hydrant access is not available).

2.1.5.7 ACCESS REQUIREMENTS

1. Site access for graffiti removal shall be secured in accordance with section 3.4.

2.1.5.8 PERMITS AND APPROVALS

1. Permits and approvals for graffiti removal shall be obtained in accordance with section 3.5.

2.1.5.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.1.5.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Remove spray paint and similar materials (for example, permanent markers, polishes, etc.) from concrete and masonry materials and metal surfaces:
 - Protect all surrounding areas (including plants and soil/mulch) with tarp;
 - Power wash surface at low pressure;
 - Apply chemical graffiti removal solvent as per manufacturer specifications;
 - Scrub surface with metal or plastic brush;
 - Wipe away graffiti removal solvent with rags;
 - Power wash or rinse surface clean;
 - Repeat as needed until graffiti is removed; and
 - If applicable, repaint surface as per owner/operator's specifications (see section 2.1.6).
3. Remove sticker-based graffiti from metal or other smooth surfaces:
 - Scrape sticker from surface holding utility knife at a low angle relative to the surface.

2.1.5.11 QUALITY ASSURANCE

1. N.A.

2.1.6 PAINTING

2.1.6.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for painting.

2.1.6.2 DOCUMENTATION

1. Documentation for painting shall conform to the requirements of section 3.1.
2. If fire hydrants are used for painting, a monthly Hydrant Operation Report shall be prepared and submitted to PWD by the owner/operator.

2.1.6.3 HEALTH AND SAFETY

1. Painting shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.6.4 PERSONNEL

1. Personnel painting shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.6.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;
 Hard copies of permits and access permissions;
 50 gal. plastic contractor bags (1 box);
 All purpose cleaner (2-32 oz. bottles);
 All purpose rags (10);
 Painting tape (2 rolls);
 Paint and primer as per owner/operator specifications; and
 Material Safety Data Sheets (MSDS) as applicable.

2.1.6.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Paint scraper, sander, or stripper;
 Assorted paint brushes and/or paint roller;
 Buckets or tub;
 Utility blade;
 Ladder of appropriate height as per site-specific conditions;

Fire hydrant center compression lock;
 Fire hydrant wrench;

Backflow preventer(s) and associated appurtenances in accordance with PWD's approved list of backflow assemblies (<http://www.phila.gov/water/pdfs/BackflowAssembly2010.pdf>);

Water hose of sufficient strength to withstand kinking and abrasion from concrete surfaces or other hoses as appropriate;

Appropriate hose spray nozzles and appurtenances; and

Approved water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank without compromising safety or causing a hazard (if hydrant access is not available).

2.1.6.7 ACCESS REQUIREMENTS

1. Site access for painting shall be secured in accordance with section 3.4.

2.1.6.8 PERMITS AND APPROVALS

1. Permits and approvals for painting shall be obtained in accordance with section 3.5.

2.1.6.9 SPECIAL PROJECT CONDITIONS

1. Most paint requires temperatures to be above 50 degrees F. Follow product manufacturers' instructions and recommendations for paint application.
2. Do not paint during a precipitation event of any type. Painted surface must be dry. Do not paint if precipitation is forecasted for within 48 hr. of effort.

2.1.6.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Drape all surrounding areas (including plants and soil/mulch) with tarp or paint cloth.
3. Remove existing loose paint, corrosion, and/or deposits from painting surface.
4. Tape all non-soil edges.
5. Without disturbing vegetation, dig soil away from painting surface to maximize paintable area and minimize visible non-painted areas.
6. Apply primer.

7. Wait for primer to dry as specified by manufacturer:

Remove and later reposition tarp or paint cloth if overnight wait is required and site cannot be secured.

8. Apply paint.

9. Install wet paint signs and temporary barriers.

10. Remove wet paint signs and temporary barriers after manufacturer-specified drying time.

2.1.6.11 QUALITY ASSURANCE

1. N.A.

2.1.7 WINTERIZATION

2.1.7.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for winterization.

2.1.7.2 DOCUMENTATION

1. Documentation for winterization removal shall conform to the requirements of section 3.1.

2.1.7.3 HEALTH AND SAFETY

1. Winterization shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.7.4 PERSONNEL

1. Personnel for winterization shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.7.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

All purpose rags (10);

White lithium grease or equivalent metal-to-metal lubricant and rust protector (1-16 oz. spray bottle); and

Material Safety Data Sheets (MSDS) as applicable.

2.1.7.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Assorted Phillips and standard screwdrivers;

Set of metric and standard socket wrenches;

Pliers, adjustable wrenches, vice grips, and pipe wrenches;

Hand chisel;

Mallet;

Metal or plastic brush;

Manhole hooks; and

Crowbar.

2.1.7.7 ACCESS REQUIREMENTS

1. Site access for winterization shall be secured in accordance with section 3.4.

2.1.7.8 PERMITS AND APPROVALS

1. Permits and approvals for winterization shall be obtained in accordance with section 3.5.

2.1.7.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.1.7.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Perform winterization of appurtenances:

Remove appurtenance from the associated structure;

Wipe any grit or other debris and clean threading;

Spray appurtenance with material-appropriate lubricant; and

Replace appurtenance within the associated structure.

3. Drain, clean, and seal any surface cisterns, tanks, and rain barrels or any subsurface systems above the front line:

Remove standing water using approved vacuum cleaning (see section 2.3) and waste disposal and decanting protocols (see section 2.4);

Disinfect and rinse storage areas using approved non-toxic disinfectant, and dispose of waste material using approved waste disposal and decanting protocols (see section 2.4) ;

Close inflow valves as needed to maintain dry conditions within the cistern or rain barrel; and

Open inflow valves again in the spring.

4. For stormwater bump-outs and other structures that include detachable traffic delineators, install bollard elements in fall:

Wipe any grit or other debris and clean threading in bollard base;

Spray base with material-appropriate lubricant; and

Place bollard within the associated base.

5. For stormwater bump-outs and other structures that include detachable traffic delineators, remove bollard elements in the spring and store at an approved location.

2.1.7.11 QUALITY ASSURANCE

1. N.A.

2.1.8 APPURTENANCE REPAIR

2.1.8.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for appurtenance repair.

2.1.8.2 DOCUMENTATION

1. Documentation for appurtenance repair shall conform to the requirements of section 3.1.

2.1.8.3 HEALTH AND SAFETY

1. Appurtenance repair shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.8.4 PERSONNEL

1. Personnel for appurtenance repair shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.8.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

50 gal. plastic contractor bags (1 box);

Biodegradable degreasing agent (1-16 oz. bottle or tube);

All purpose cleaner (2-32 oz. bottles);

All purpose rags (10);

Appropriate replacement appurtenances (for example, bolts, screws, caps, etc.) to site-specific design and manufacturer specifications;

White lithium grease or equivalent metal-to-metal lubricant and rust protector (1-16 oz. spray bottle); and

Material Safety Data Sheets (MSDS) as applicable.

2.1.8.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Assorted Phillips and standard screwdrivers;

Set of metric and standard socket wrenches;

Pliers, adjustable wrenches, vice grips, and pipe wrenches;

Bolt cutters;

Cordless drill and batteries;

Assorted drill bits;

Hand chisel;

Mallet;

Metal or plastic brush;

Tap and die set;

Utility blade;

Manhole hooks; and

Crowbar.

2.1.8.7 ACCESS REQUIREMENTS

1. Site access for winterization shall be secured in accordance with section 3.4.

2.1.8.8 PERMITS AND APPROVALS

1. Permits and approvals for appurtenance repair shall be obtained in accordance with section 3.5.

2.1.8.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.1.8.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Repair damaged or stripped bolt and screws.

Clean components with a rag to remove debris, and turn male and female parts to restore threading.

If necessary, replace stripped bolts with equivalent hardware or rethread using a tap and die set:

Avoid mixing metals (for example, stainless steel, iron, or aluminum) as this can lead to corrosion and binding.

If necessary, rethread stripped taps using tap and die set.

3. Replace missing or damaged appurtenances:

Replace missing or damaged screens, filter and/or strainer bags, support rods, washers, bolts, caps and gaskets with equivalent hardware.

2.1.9 PERVIOUS PAVEMENT CLEANING**2.1.9.1 TASK DESCRIPTION**

1. This section sets forth procedures and requirements for pervious pavement cleaning.

2.1.9.2 DOCUMENTATION

1. Documentation of pervious pavement cleaning shall conform to the requirements of section 3.1.

2.1.9.3 HEALTH AND SAFETY

1. Pervious pavement cleaning shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.1.9.4 PERSONNEL

1. Personnel for pervious pavement cleaning shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.1.9.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;
 Hard copies of permits and access permissions;
 50 gal. plastic contractor bags (1 box);
 Material Safety Data Sheets (MSDS) as applicable.
 All-purpose rags (10);

2.1.9.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Regenerative air sweeper equipment:
 Regenerative air sweeper with the following minimum specifications:
 Sweeping width of 78";
 Storage hopper capacity of 2 cubic yards;
 Dust separator;
 System pressure of 3500 psi; and
 Hydraulic system capacity of 5 GPM;
 Vacuum sweeper equipment:
 Heavy duty vacuuming equipment with the following minimum specifications:
 Sweeping width of 144";
 Storage hopper capacity of 8 cubic yards;
 Total hydraulic system capacity of 16 GPM; and
 10 micron dust filter;
 10 megapixel digital camera with spare batteries;
 Shovel, spades and/or push broom to remove trash/sediment/ organic debris generated from maintenance tasks;
 Measuring wheel to determine distances between structures;

2.1.9.7 ACCESS REQUIREMENTS

1. Site access for pervious pavement sweeping shall be secured in accordance with section 3.4.

2.1.9.8 PERMITS AND APPROVALS

1. Permits and approvals for pervious pavement sweeping shall be obtained in accordance with section 3.5.

2.1.9.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.1.9.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Inspect the stormwater system for any evidence of illicit discharge or any suspected illegal connections or dumping, and check the nearby areas for any signs of erosion. Document and report any concerns to the owner/operator prior to beginning maintenance.
2. Remove large trash/sediment/organic debris from the surface manually.
3. Clean pervious paving using approved regenerative air sweeper listed in section 2.1.9.6:

Start at the upstream end of the pervious paving and move towards the downstream end.

If using a power washer with a vacuum component:

Dislodge material from the pores of the pervious paving using the power washer and vacuum immediately to prevent the material from reentering the system.
4. The following tasks must be avoided on or near pervious paving:

Sanding;

Re-sealing;

Re-surfacing;

Storage of snow piles containing sand;

Storage of mulch or soil materials; and

Construction staging on unprotected pavement.
5. Follow guidelines for WASTE DISPOSAL AND DECANTING (section 2.4) when removing sediment/trash/organic debris from the site.

2.2 VEGETATION MAINTENANCE

2.2.1 MECHANICAL VEGETATION CONTROL

2.2.1.1 TASK DESCRIPTION

1. This section describes the protocol for mechanical vegetation control including:

Hand pulling of herbaceous and small woody vegetation;

String trimming;

Manual cutting of herbaceous and small woody vegetation;

Mowing;

Girdling;

Seed head/fruitlet body removal;

Tilling/hoeing; and

Suffocation.
2. Tree pruning is addressed in section 2.2.6.

2.2.1.2 DOCUMENTATION

1. Documentation for mechanical vegetation control shall conform to the requirements of section 3.1.

2.2.1.3 HEALTH AND SAFETY

1. Mechanical vegetation control shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.2.1.4 PERSONNEL

1. Personnel for mechanical vegetation control shall consist of the standard personnel for surface maintenance as defined in section 3.3.3

2.2.1.5 MATERIALS

1. The following materials may be required for the execution of this task:

Shredded hardwood mulch – shall be double-shredded, well-composted, aged six (6) months to one (1) year, dark brown in color, and free of wood chips, stones or other undesirable matter, including seed of invasive species and wood from allopathic species such as *Acer platanoides* and

Juglans nigra;

Opaque UV-resistant black plastic sheeting;

Re-sealable plastic bags – 1 or 2 gal.; and

Large paper or plastic contractor bags – 50 gal.

2.2.1.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Hand removal of herbaceous or small woody vegetation, or algae:

Shovel;

Leaf or shrub rake; and

Weed or algae rake.

String trimming:

String trimmer – 2-cycle or 4-cycle, gas-powered, lightweight model of sufficient quality to efficiently and neatly trim large areas of thick herbaceous vegetation; and

Scoop and/or digging shovel.

Manual cutting of herbaceous or small woody vegetation, or aquatic vegetation:

Pruning shears, loppers, pruning saw, brush cutter, and/or aquatic weed cutter.

Mowing:

Walk-behind mower – gas-powered, commercial-grade, minimum cutting width of 30 in., and of sufficient quality to efficiently and neatly mow thick herbaceous vegetation;

Flail mower – gas-powered, adjustable cutting height, minimum cutting width of 4 ft., with 26-in. offset for mowing around trees and shrubs, and of sufficient quality to efficiently mow thick herbaceous vegetation; and

Tractor and brush hog – three-point hitch, rotary blades, minimum cutting width of 4 ft., and of sufficient quality to efficiently mow thick herbaceous vegetation.

Girdling:

Chain saw or ax.

Seed head/fruiting body removal:

Pruning or gardening shears.

Tilling/hoeing:

Roto-tiller;

Cultipacker;

Manual tiller; and

Hoe.

Suffocation

Mallet or sledgehammer.

2.2.1.7 ACCESS REQUIREMENTS

1. Site access for mechanical vegetation control shall be secured in accordance with section 3.4.

2.2.1.8 PERMITS AND APPROVALS

1. Permits and approvals for mechanical vegetation control of plants shall be obtained in accordance with section 3.5.

2.2.1.9 SPECIAL PROJECT CONDITIONS

1. Weather:

Mechanical vegetation control shall not be carried out during heavy rain events. Mowing shall not be performed on wet vegetation.

2. Timing:

If string trimming/mowing of vegetation occurs during the spring and summer, it should be timed to reduce potential impact to ground-nesting birds (in other words, prior to or after nesting season: April 15 – July 31).

3. Slope:

When using a walk-behind mower, flail mower or tractor with brush hog, do not mow in close proximity to a swale, steep slope, or any terrain where the control of the mower could be compromised. Walk-behind mowers, riding mowers, or tractors with brush hogs shall not be used on any slope greater than 15 degrees.

When using a flail mower, mow perpendicular to the slope (up and down) and never parallel (along the contours) to any slope that is greater than 5 degrees. Where mowing cannot be performed due to slope or terrain issues, use a string-trimmer instead.

2.2.1.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Hand pulling of herbaceous or small woody vegetation, or algae:

Gather the plant near the base with two hands and pull upward, ensuring removal of the entire root mass including tap root, where applicable.

If necessary, use a shovel or spade to help loosen the soil surrounding the plant root mass to be removed. Hand removal is easiest when the soil is moist.

Note: it is essential that the entire root mass is removed along with the leaves of the plant.

Using a shovel or rake, smooth the surrounding soil to fill in the remaining hole and cover with shredded hardwood mulch.

Properly dispose of the plant material in an approved location off-site, ensuring that no plant pieces or propagules remain on site.

Using a weed or algae rake, remove surface algae and some aquatic weeds from regions of continuous ponding:

Properly dispose of the plant material in an approved location off-site, ensuring that no plant pieces or propagules remain on site.

3. Manual cutting of herbaceous or small woody vegetation, or algae:

Herbaceous vegetation:

Using pruning shears or a brush cutter, cut plants to approximately 4-6 in. above the ground surface.

Rake and properly dispose of the plant material in an approved location off-site, ensuring that no plant pieces or propagules remain on site.

Small woody vegetation:

Using pruning shears, loppers, or a pruning saw, cut the main stem to approximately <4 in. above the ground surface.

Apply chemical herbicide treatment to cut stem per manufacturer's directions (directions may be dependent on plant type) (see section 2.2.7).

Properly dispose of the plant material in an approved location off-site, ensuring that no plant pieces or propagules remain on site.

Aquatic weeds:

Using an aquatic weed cutter, cut the main stem to approximately <4 in. above the bottom surface.

4. String-trimming:

String trimming is to be performed on herbaceous vegetation only.

String-trim plants to approximately 4-6 in. above the ground surface.

To avoid accidental damage, do not string-trim within 1-2 ft. of any tree or shrub. Instead, cut or remove plants by hand within the 2 ft. offset zone.

Maintain an even level of string-trimmed vegetation to create a neat and tidy appearance.

Rake and properly dispose of the plant material in an approved location off-site.

5. Mowing:

Mowing is to be performed on herbaceous vegetation only.

Mow naturalized meadows to approximately 8 in. above the ground surface, and turf grasses to approximately 2-4 in. above the ground surface.

To avoid accidental damage, do not mow within 2 ft. of any tree or shrub. Instead, cut or remove plants by hand within the 2 ft. offset zone.

Rake and remove (approximately 50 percent of the thatch) and properly dispose of the plant material in an approved location off-site.

6. Girdling:

Using a chain saw or ax, notch a groove completely encircling the trunk of the tree at breast height.

If using an ax or hatchet, create the girdle by striking from above and below along a line around the trunk so that a notch of wood and bark is removed.

If using a chain saw to girdle, create two horizontal cuts between 2 and 4 vertical in. apart completely around the tree.

The groove must completely encircle the trunk and penetrate into the wood to a depth of at least 1/2 in. on small trees, and 1 to 1-1/2 in. on larger trees.

7. Seed head/fruitlet removal:

Clip seed head/fruitlet at base using gardening or pruning shears taking care to avoid perturbing the seed head/fruitlet.

Carefully place seed head/fruitlets into a sealed plastic bag and dispose in an approved location off site.

8. Tilling/hoeing:

Till or hoe target area using a hoe, manual tiller, Roto-tiller, or Cultipacker to a depth of 6-8 in.

Replant or reseed affected area per sections 2.2.4 and 2.2.5.

9. Suffocation:

Spread plastic sheeting over the target area, extending 5 ft. beyond the target area in all directions.

Securely fasten plastic sheeting to ground surface using hardwood stakes 8-12 ft. on center, ensuring that the plastic sheeting is taut and in good contact with the ground surface. Hardwood stake shall be driven 2 ft. into the ground using a mallet or sledge hammer.

Remove hardwood stakes and plastic sheeting after 1-2 years.

Till, replant and/or reseed affected area with target vegetation. See sections 2.2.4 and 2.2.5.

2.2.1.11 QUALITY ASSURANCE**1. Reference Standards:**

Occupational Safety and Health Administration (OSHA) standards.

Table 2-1. Recommended Removal Treatments for Commonly-Found Invasive/Non-target Vegetation in Philadelphia Stormwater Management Practices

Species	Recommended Treatment	Minimum Frequency	Comments
Nutsedge (<i>Cyperus sp.</i>)	Hand removal (section 2.2.1.10)	Monthly from April through October	Chemical treatment is recommended for large stands where hand removal will disrupt and leave soil vulnerable to erosion. Selective herbicides are available that do not damage other herbaceous plants.
Foxtail (<i>Alopecurus sp. and Setaria sp.</i>) and crabgrass (<i>Digitaria sanguinalis</i>)	Cut seed heads (section 2.2.1.10)	Monthly from April through October	Both native and introduced species are present in Pennsylvania and identification between these species is difficult. Foxtail and crabgrass species can be aggressive invaders.
Star of Bethlehem (<i>Ornithogalum nutans and O. umbellatum</i>)	Target competition—plant herbaceous early spring emergers (section 2.2.1.10 and section 2.2.4.10)	Once in spring (after last frost and prior to April 15) or in fall.	Star of Bethlehem die back after spring and often do not interfere with target species' growth and survival. Hand removal can disrupt and leave soil vulnerable to erosion; it may be applied to small stands that are not in the direct stormwater flow path.
Lesser celandine (<i>Ranunculus ficaria</i>)	Hand removal (section 2.2.1.10)	Monthly from March through May	N.A.
Jimsonweed (<i>Datura stramonium</i>)	Hand removal (section 2.2.1.10)	Monthly from April through October	Jimsonweed is poisonous; protect skin and do not ingest.
Morning glory (<i>Ipomoea sp.</i>), Porcelainberry (<i>Ampelopsis brevipedunculata</i>), Mile-a-minute (<i>Polygonum perfoliatum</i>), Japanese hops (<i>Humulus japonicus</i>)	Hand removal (section 2.2.1.10)	Monthly during spring and early summer (April through July), before fruit formation	N.A.
Bristled knotweed (<i>Persicaria longisetia</i>)	Cut seed heads (section 2.2.1.10)	Monthly from May through October	Hand removal can disrupt and leave soil vulnerable to erosion; it may be applied to small stands that are not in the direct stormwater flow path.
Paper mulberry (<i>Broussonetia papyrifera</i>), Tree of Heaven (<i>Ailanthus altissima</i>), Princess tree (<i>Paulownia tomentosa</i>), Mimosa tree (<i>Albizia julibrissin</i>)	Hand removal (section 2.2.1.10) when seedling, otherwise chemical treatment (cut stem treatment) (section 2.2.7.10)	Monthly from April through October	Cut stem application is most effective during the growing season (April through August)

2.2.2 WATERING

2.2.2.1 TASK DESCRIPTION

1. This task outlines the protocol for watering vegetation.

2.2.2.2 DOCUMENTATION

1. If watering involves the use of a city fire hydrant, a monthly hydrant report shall be prepared and submitted to PWD.

2.2.2.3 HEALTH & SAFETY

1. Watering shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.2.2.4 PERSONNEL

1. Personnel for watering shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.2.2.5 MATERIALS

1. The following materials may be required for execution of this task:

Water

Water shall be clean and free of toxic substances.

Acceptable sources:

Water shall be sourced from locally (in other words, on-site) collected rain-harvested sources, if available.

The use of municipal potable water, either from private taps or city hydrants, is permissible with proper permits or owner authorization, as applicable, if rain-harvested water is not available.

If both rain-harvested and municipal water are not available, non-potable water transported to the site via a water truck shall be used for watering.

The use of water from groundwater wells or surface waters is not authorized for use in watering.

2.2.2.6 EQUIPMENT

1. The following equipment is required for execution of this task:

If a PWD fire hydrant will be used as a water source, the following is required:

Fire hydrant center compression lock;

Fire hydrant wrench;

Backflow preventer(s) and associated appurtenances in accordance with PWD's approved list of backflow assemblies: <http://www.phila.gov/water/pdfs/BackflowAssembly2010.pdf>

Water hose of sufficient strength to withstand kinking and abrasion from concrete surfaces or other hoses as appropriate;

Appropriate hose spray nozzles and appurtenances; and

Approved water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank without compromising safety or causing a hazard (if hydrant access is not available); and

Tree watering bags - Tregator® 15 gal. original watering bag, or approved equivalent.

2.2.2.7 ACCESS REQUIREMENTS

1. Site access for watering shall be secured in accordance with section 3.4.

2.2.2.8 PERMITS AND APPROVALS

1. Permits and approvals for watering shall be obtained in accordance with section 3.5.

2.2.2.9 SPECIAL PROJECT CONDITIONS

1. Watering shall not be conducted in freezing conditions, when freezing conditions are expected within 48 hr., or on frozen ground.

2.2.2.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Hydrant operation

Personnel shall follow the PWD Fire Hydrant Operation Procedure guidelines to open, operate, and close all city hydrants.

3. Watering truck and tank operation:

If rain-harvested, hydrant, or private tap access is not available, the personnel shall use a watering truck tank as the source of water.

Personnel shall follow the manufacturer's directions for operating the water tank in a safe and effective manner.

4. Private property potable water:

If SMP is on private property and a private potable water source is available, the personnel shall first coordinate with the owner prior to use.

The personnel shall take care to not damage or interfere with activities on the private property when utilizing the potable water source.

5. Watering of herbaceous plants and shrubs:

Water evenly and thoroughly so that the top 6-8 in. of soil is saturated.

Use appropriate sprinkler attachments on hose, taking care to avoid directing concentrated flows at planted/seeded areas, which will prevent erosion of the soil surrounding the plants or washing away of the seed within seeded areas.

Water shall be aimed at the base of the plants, avoiding the leaves.

The key to effective watering is providing adequate water into the soil (not the leaves) at the base of the plant for uptake by the plant roots. Allow the water to soak into the ground within each area of vegetation, moving slowly through each section.

Each 100 sf section of the vegetated SMP shall be evenly and thoroughly watered for five (5) min. before moving on to the next section.

Care must be taken to avoid damage to leaves and to prevent erosion of the soil, which can be caused by forceful and concentrated streams of water.

6. Watering of Trees

Water bag installation, filling, and removal

Install watering bags on any trees that have been in the ground for less than 12 months and do not have watering bags.

Install watering bags per the manufacturer's recommendations.

Watering bags shall be placed on the tree as soon as possible following installation.

During November, remove all watering bags from trees and store in a dry, temperature-controlled environment to prevent dry rotting.

In March, reinstall watering bags on trees that had watering bags the previous year if planted for less than 12 months

Install watering bags per the manufacturer's recommendations.

Fill and refill all watering bags per the manufacturer's recommendations and per the recommended timing and frequency for each tree.

Watering using manual methods

Water each tree for a five (5) minute period.

Using a hose and gentle stream of water, apply water to the base of the tree.

Do not aim the water at the leaves of the plant. The key to effective watering is providing adequate water into the soil (not the leaves) for uptake by the plant roots. Allow the water to soak into the ground. Replace any mulch that has been disturbed during the watering process.

2.2.2.11 QUALITY ASSURANCE

1. N.A.

2.2.3 MULCHING AND EDGING

2.2.3.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for mulching and edging.

2.2.3.2 DOCUMENTATION

1. Documentation for mulching and edging shall conform to the requirements of section 431.

2.2.3.3. HEALTH & SAFETY

1. Mulching/edging shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.2.3.4 PERSONNEL

1. Personnel for mulching/edging shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.2.3.5 MATERIALS

1. The following materials may be required for the execution of this task:

Shredded hardwood mulch – shall be double-shredded, well-composted, aged six (6) months to one year, dark brown in color, and free of wood chips, stones or other undesirable matter, including seed of invasive species and wood from allopathic species such as *Acer platanoides* and *Juglans nigra*.

2.2.3.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Shovel (s) – assorted shovels, of sufficient size and strength to perform edging-related tasks, which may include, but are not limited to the following types: digging, trenching, spade, scoop, scraper, post-hole digger, and trowel;

Tarp – of sufficient size and strength to support hauling and moving of plant clippings and mulch;

Rake – of sufficient size and strength to spread mulch;

Manual landscape edger – corrosion resistant, step on model;

Mechanical landscape edger – gas-powered, caster steering, pneumatic tires, carbide-tipped cutting blades, adjustable cutting depth, curb hop option and appropriate safety guards); and

Walk-behind mower – gas-powered, commercial-grade, minimum cutting width of 30 in., and of sufficient quality to efficiently and neatly mow thick herbaceous vegetation.

2.2.3.7 ACCESS REQUIREMENTS

1. Site access for mulching/edging shall be secured in accordance with section 3.4.

2.2.3.8 PERMITS AND APPROVALS

1. Permits and approvals for mulching/edging shall be obtained in accordance with section 3.5.

2.2.3.9 SPECIAL PROJECT CONDITIONS

1. Weather:

Mulching/edging tasks shall not be carried out during heavy rain events or freezing conditions.

2. Slope:

When using a walk-behind mower, flail mower or tractor with brush hog, do not mow in close proximity to a swale, steep slope, or any terrain where the control of the mower could be compromised. Walk-behind mowers, riding mowers, or tractors with brush hogs shall not be used on any slope greater than 15 degrees.

2.2.3.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Mulching:

Shredded hardwood mulch:

Apply a 3 in. thick layer of mulch extending from the edge of the tree pit or SMP to a radius of 6 in. from the stem of each plant.

Mulch shall not touch or be piled against any woody stem of a shrub or tree.

Mulch shall be applied in a neat and orderly manner.

Where there is more than a 1 in. drop from the edge of pavement to the mulch, add mulch to reduce the gap to a minimum of 0.5 in. from the edge of pavement.

3. Edging:

Mown edging:

Mown edges shall range from approximately 1 ft. to 3 ft. in width, and shall be determined based upon site-specific aesthetics, as intended by the planting arrangement.

Edges surrounding all SMPs shall be mown to a height of 2-4 in. Care shall be taken to not mow too close to the ground, creating bare areas of soil.

Mown edges shall be even and orderly.

Landscape bed edging:

Position the landscape edger near the starting point.

Start by setting the depth control at shallow and follow with a deeper setting.

Run the edger in a smooth, continuous line to create a clearly defined edge of the surrounding turf from the SMP.

2.2.3.11 QUALITY ASSURANCE

1. Reference Standards:

Occupational Safety and Health Administration (OSHA).

2.2.4 PLANTING/TRANSPLANTING

2.2.4.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for tree, shrub, herbaceous container, and herbaceous plug planting and transplanting activities within SMPs. Work includes, but is not limited to the following:

Preparation of areas for planting;

Excavation for plantings;

Furnishing and planting of specified trees, shrubs, and herbaceous containers and plugs;

Procurement of plant material from nursery;

Pickup, delivery and installation of plant materials;

Appropriate storage and handling of plants onsite until time of planting;

Guaranteed warranties for all plant material; and

Final clean up and restoration of any disturbed areas during planting operations to the condition prior to arrival.

2.2.4.2 DOCUMENTATION

1. Documentation for planting/transplanting shall conform to the requirements of section 3.1.

2. Installed plant list – A complete list of installed plants shall be submitted within seven (7) days of completion of the plantings to the owner/operator.

The list shall include botanical and common names, variety, size, quantity, location within SMP, and source of plant materials.

Any change from the originally specified plants must be fully documented.

2.2.4.3 HEALTH AND SAFETY

1. Planting/transplanting shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.2.4.4 PERSONNEL

1. Personnel for planting/transplanting shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.2.4.5 MATERIALS

1. The following materials may be required for the execution of this task:

Plant materials:

Furnish and install plants and pre-tagged and approved trees complying with ANSI Z60.1 in correct locations.

Plants shall be nursery grown under climatic conditions similar to those in the locality of the project (defined as a 100 mile radius from the jobsite) and shall conform to the variety and sizes indicated.

Plants shall conform to the indicated botanical names and standards of size, culture and quality for the highest grades and standards as adopted by the ANSI Z60.1 - American Standard for Nursery Stock.

Plants shall meet specified sizes and be provided as plugs, container grown, field potted, or field balled and burlapped materials as specified.

Container grown materials shall be grown to specified size in a container and shall be healthy, vigorous, well rooted and established in the container in which they are growing.

Container grown plants shall have a well established root system reaching the sides of the containers to maintain a firm root ball, but shall not have excessive root growth encircling the inside of the container.

Field potted materials shall be potted for delivery as they are dug from the field.

Substitutions - Plants that are not available locally shall be placed in nurseries to a maximum distance of a 100 mile radius from the City of Philadelphia.

Only when plants of kinds or sizes specified are not available may substitutions be proposed upon written request.

Plants larger than those shown in the planting schedule on the drawings may be used upon approval but use of such plants shall be at no additional cost.

If the use of larger plants is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant as approved and in accordance with ANSI Z60.1 and spread of roots should be healthy with no girdling, advantageous, or bounding roots present.

Trees and container shrubs:

Single-stemmed tree species must have a single stem with a straight trunk, well-balanced crown, and intact single leader.

Shrubs and multi-stemmed tree species must be multi-stemmed with a well-balanced crown.

Trees are to be a minimum of 1.00 in. to 1.25 in. caliper (measured 6 in. above ground level) unless otherwise specified.

Shrubs must be in a 2 gal. container minimum and at least 3 to 4 ft. tall unless otherwise specified.

Branching height (height of the lowest living branch) must be 1/3 to 1/2 of tree height.

Plant material not obtained from an approved source is prohibited.

Herbaceous containers:

Herbaceous containers shall consist of only species specified on the drawings, if applicable.

Same-species trays of herbaceous containers must be clearly labeled with the scientific name and common name.

Herbaceous containers shall be healthy, vigorous, well rooted and established.

Herbaceous plugs shall have a well established root system, reaching the sides of the containers, but shall not have excessive root growth encircling the inside of the container.

Herbaceous containerized plants shall be free from non-target vegetation and invasive species.

Soil within herbaceous containers shall be kept moist until planting.

Plant material not obtained from an approved source is prohibited.

Herbaceous plugs:

Herbaceous plugs shall consist of only species specified herein and on the drawings, as applicable.

Same-species trays of herbaceous plugs must be clearly labeled with the scientific name and common name.

Herbaceous plugs shall be healthy, vigorous, well rooted and established. Herbaceous plugs shall have a well established root system, reaching the sides of the containers, but shall not have excessive root growth encircling the inside of the container.

Soil within herbaceous plug containers shall be kept moist until planting.

Herbaceous containerized plugs shall be free from non-target vegetation and invasive species.

Tree staking materials:

Hardwood stakes shall be 2 in. x 2 in. square wood, 6 ft. length, and chiseled on one end.

Staking ribbon shall be ArborTie®, or approved equivalent, flat woven polypropylene material, 3/4 in. width, 900 lb. break strength, lock stitch with rounded weave.

Water:

See section 2.2.2.

Mulch:

See section 2.2.3.

Erosion blanket:

See section 2.1.2.

Soil amendments:

See section 2.2.9.

2.2.4.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Hand trowel;

Dibble bar (for plug plantings);

Shovel(s) – assorted shovels, of sufficient size and strength to perform planting-related tasks, which may include, but are not limited to the following types: digging, spade, scoop, and trowel;

Hammer or staple gun.

2.2.4.7 ACCESS REQUIREMENTS

1. Site access for watering shall be secured in accordance with section 3.4.

2.2.4.8 PERMITS AND APPROVALS

1. Permits and approvals for watering shall be obtained in accordance with section 3.5.

2.2.4.9 SPECIAL PROJECT CONDITIONS

1. Timing restrictions:

Perform planting only during fall (September 15 – December 15) or spring (March 15 – June 15) and coordinate installation with maintenance periods to provide required maintenance activities from date of all planting to date of project final acceptance.

If Red maple, American hornbeam, Tulip poplar, hickories, American beech, Sassafras or Black gum are to be planted, they must be planted in early spring when trees are dormant (have not leafed out yet).

2. Soil conditions:

Under no circumstances shall planting soil be worked, handled, hauled, placed or compacted under frozen or saturated conditions.

Soil removed from excavation activity shall be properly piled and covered for no more than two weeks prior to installation to prevent excess moisture from saturating the stockpile.

Access over finished grade soils shall be restricted. If access is required across placed soils, the personnel shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils.

2.2.4.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Delivery, storage, and handling of plants:

Materials shall not be dropped or dumped from vehicles. Materials shall be reviewed for compliance with specified requirements. Unacceptable materials shall be removed and disposed from the job site. Materials shall be stored in designated areas.

Deliver plants freshly dug. Do not prune trees and shrubs, unless directed. Protect bark, branches, and root system from sun scald, drying, sweating, whipping, and other handling and tying

damage. Do not bend or tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during delivery. Carefully handle all trees and shrubs during delivery to avoid mechanical damage. Handle all planting stock by the root ball.

Planting shall be completed on the day of delivery unless otherwise approved. If planting is delayed overnight, set plants in shade, protect from weather and mechanical damage and keep roots moist. Keep plants thoroughly watered, and water sufficiently so that the entire soil mass is wet and water is draining out the pot bottom or root mass of balled and burlapped planting stock. Secure plants from theft and vandalism. Method to be determined on a site by site basis.

No tree shall be planted if the root ball is cracked, broken, or dropped either before or during the planting process.

3. Site and planting preparation:

Planting surfaces shall be free of ruts, compaction, gravel, or other construction related debris. All areas to be planted shall conform to the finished grades as specified on the plans and be free of weeds, trash, debris, brush, clods, loose stones, construction debris, and other foreign materials that would interfere with planting. All gullies, washes or disturbed areas that develop subsequent to final dressing shall be repaired prior to planting. If finished grades are not suitable for planting prior to the beginning of work in each area the appropriate parties shall be notified.

All plants shall be located based upon appropriate plans, if applicable, or as directed in the field. If any obstructions are encountered, adjustments shall be arranged and approved. All adjustments to the plan must be authorized. No planting holes shall be excavated in advance of planting operations. Each plant shall be planted in an individual hole as specified.

Planting shall be completed within two (2) days following preparation of planting soil and application of stapled erosion control blanket, if required. If more time elapses, then personnel are responsible for regrading and loosening areas before planting.

Install plants after stapled erosion control blanket is installed, if required. This should be done by cutting an incision in the blanket and digging a hole for each plug or plant that is the same depth as the soil of the plug or potted plant. For plugs, a 'dibble bar' with the same diameter as the plug can be used to create the hole, when punched through the blanket. For container plants, the stapled erosion control blanket shall be cut in a circular shape to match the diameter of the container. No natural fiber mat erosion control blanket is to rest directly against any tree or plant stem.

4. Installation of trees and shrubs:

Trees and shrubs are to be planted as shown in the landscaping drawings. The personnel shall not deviate from the specified speciation or planting locations unless approved or directed.

All planting pits shall be dug so the walls of pits are vertical or sloping outward. Scarify the walls of the pit after digging.

Excavate the planting pit to at least 1-1/2 times the width of the root mass of the plant to be installed.

The planting pit shall be deep enough to allow the top of the soil surface of the plant to be flush with the existing grade after soil in the bottom of the hole is tamped.

Remove all debris from the pit and tamp loose soil in the bottom of the pit by hand.

Do not handle the plant by the branches, leaves or stem.

Remove plant from container and place straight in the center of the planting pit, carrying the plant by the root mass. Never lift or carry a plant by the trunk or branches.

If a tree or shrub is balled and burlapped, carefully cut and remove burlap and wire baskets from the rootball using the least amount of disturbance as possible. Cut and remove all ropes around the burlapped ball. Remove all nails.

Backfill planting pit with soil and tamp firmly to fill all voids and air pockets. Do not over compact soil. Make sure the plant remains straight during backfilling/tamping procedure.

The top of the root mass of the trees/shrubs shall be flush with, or slightly elevated (no more than 1/4 in. height) above the final grade. Do not cover stem with soil.

Water plants thoroughly immediately after planting to saturate backfill. See section 2.2.2.

A layer of mulch shall be placed around each tree and shrub installed to deter weed growth and enhance establishment rates. Mulch shall be applied to a depth of 3 to 4 in. to a radius of approximately 24 in. from tree/shrub stem(s). No mulch is to rest directly against any tree/shrub stem. See section 2.2.3.

Stakes shall only be installed on trees if directed. Hardwood stakes and ArborTie®, or approved equivalent, shall be used along with an approved staking method.

No planting pits shall be left open at the close of each day.

Remove all tags, labels, strings and wire from the plant materials.

Promptly remove soil debris created by work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other paved areas.

Final cleanup shall be the responsibility of the personnel and consist of removing all trash and materials incidental to the project and disposing of them off-site.

5. Installation of herbaceous containers:

Dig the planting pit to at least 1 1/2 times the width of the root ball. For plugs, a dibble bar can be used to create an opening in the soil.

Remove the plants and soil from the pots or plug trays and position in the holes so that the soil level of each plant is flush with or slightly higher than (no more than 1/4 in.) the surrounding finished grade soil surface. After planting, fill soil in around the plant completely, firming the soil and ensuring there are no air pockets as plants are installed. When planted, cover the top of the potted soil mix with about 1/2 in. of planting soil to match surrounding finished grades and help reduce wicking of moisture out of the potted soil mix.

Water plants thoroughly immediately after planting to saturate backfill. See section 2.2.2.

Where specified on the drawings, install mulch as specified in section 2.2.3.

2.2.4.11 QUALITY ASSURANCE**1. Reference standards:**

American Association of Nurserymen (AAN).

ANSI Z60.1 American Standard for Nursery Stock.

Soil Science Society of America (SSSA) Methods of Soil Analysis, Parts 1, 2, 3 & 4.

American Society of Agronomy (ASA).

International Society of Arboriculture (ISA).

Philadelphia Complete Streets Design Handbook: 2012.

City of Philadelphia Stormwater Management Guidance Manual.

Pennsylvania Stormwater Best Management Practices Handbook.

Philadelphia Parks and Recreation Department Contractor Guidelines.

Philadelphia Streets Department, Standard Construction Items.

Pennsylvania Department of Transportation, Form 408 Specifications.

Occupational Safety and Health Administration (OSHA).

All applicable drawings and schematics.

Plants and trees may be observed at supplier before delivery to site for compliance with requirements for genus, species, variety, size, and quality. Plants must be clearly labeled with scientific and common names when delivered to the site. Substandard plants or trees for size and condition of balls and root systems, insects, injuries and latent defects or defective material may be rejected at any time during progress of work.

2.2.5 SEEDING

2.2.5.1 TASK DESCRIPTION

1. This Section sets forth procedures and requirements for seeding. Work related to seeding that includes, but is not limited to the following:

Preparation of areas for seeding;

Furnishing and planting of seed and erosion and sediment control measures as necessary;

Maintenance of newly seeded areas; and

Final clean up and restoration of any disturbed areas during seeding operations to the original condition.

2.2.5.2 DOCUMENTATION

1. Documentation for seeding shall conform to the requirements of section 3.1.
2. Provide a species composition list for each area that was seeded. Include scientific and common names and percentages of each species within the mix. Label each list by the site and corresponding feature ID. Any change from the originally specified mix must be fully documented.
3. Accompany seed by certification that verifies it meets the requirements of this protocol.

2.2.5.3 HEALTH AND SAFETY

1. Seeding shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.2.5.4 PERSONNEL

1. Personnel for seeding shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2.2.5.5 MATERIALS

1. The following materials may be required for the execution of this task:

Seed:

Seed shall be fresh, clean, and consistent with herbaceous vegetation specified or native to the area.

Seed shall meet the requirements of the Pennsylvania Seed Act (3 Pa. C.S.A. §§7101 – 7122).

Seed shall be labeled and furnished in containers with tags showing variety of seed in mixture, purity, germination, weed content, name of seller, and date on which seed was tested.

Seed species shall conform to the mixes specified. Any substitutions within seed mixes must be approved.

Native Seed shall be certified that the Pure Live Seed (PLS) percentage is as specified. If the PLS is less than specified, the seeding rate shall be increased to compensate for the PLS difference at the personnel expense.

Seed mixes shall be installed at individual rates specified for each seed mix.

All seed and seed varieties must contain only species specified and shall be free from Pennsylvania prohibited noxious weed seeds as defined by the Pennsylvania Department of Agriculture.

Establishment dressings must be one of the following, unless otherwise specified:

Clean straw mulch free of noxious weeds with tackifier added at specified rates;

Biodegradable erosion control blanket; or

Bonded fiber matrix (BFM), wood cellulose, or approved equivalent (for hydroseeding applications).

2.2.5.6 EQUIPMENT

The following equipment may be required for the execution of this task:

Cultipacker, or similar equipment;

Spreader;

Harrow or rake; and

Hydroseed tank, hoses, nozzles and related appurtenances (if applicable)

2.2.5.7 SPECIAL PROJECT CONDITIONS**1. Timing restrictions:**

Seeding shall only be performed in spring (March 1 - May 15) or Fall (August 15 - October 15).

No seeding shall be performed on frozen ground or when the temperature is 32 degrees F/0 degrees C or lower.

2. Soils:

Tilling, amending, regrading, or otherwise working the soil shall not occur when the soil is frozen or saturated.

2.2.5.8 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Seedbed preparation:

Prior to site preparation, no herbicide shall be used without approval of type and methods.

All approved herbicides shall be applied by a licensed commercial applicator.

All areas to be seeded shall be well graded and free of all weeds, trash, debris, brush, clods, loose stones, construction debris, and other foreign materials that would interfere with seeding.

All gullies, washes or disturbed areas shall be repaired prior to seeding.

Seedbed shall be scarified prior to seeding using a harrow/rake.

If area to be seeded is in within the vicinity of trees and shrubs or a woodland opening, care shall be taken to avoid damage to existing trunks and roots by using a hand rake or small rototiller to prepare the site.

3. Seeding - general:

Seeding is to be performed only after all other work in an area is complete.

No fertilizer or lime shall be applied to any seeded areas, unless explicitly approved.

Preferred seeding methods shall be hand broadcast or hydro-seed. Any alternative seeding methods or suggested changes to proposed seeding methods shall be approved prior to the start of work.

All seeding equipment shall be calibrated before application so that the materials are applied accurately and evenly to avoid misses and overlaps.

Seed installed by equipment shall be capable of placing seed at the specified rate.

4. Seeding – hand broadcast:

Seed is to be uniformly distributed throughout the target area.

Seed shall be applied in two different directions.

Harrow or rake site following seeding.

Maximize the seed/soil contact by firming soil around the seed with a Cultipacker, other similar equipment, or by dragging the surface with chain link fence. Do not cover seed with more than 1/4 in. of soil.

Immediately after initial seeding, watered seeded areas evenly and thoroughly – see section 2.2.2.

Mulch and tack all seeded areas within 12 hr. Place weed-free hay or straw uniformly, in a continuous blanket, approximately 3/4 to 1 1/2 in. loose layers, at a minimum rate of 2 tons per acre. If directed, the Contractor shall increase the rate of application, depending upon the material used, season, soil conditions, or method of application. Anchor mulch with tackifier.

5. Seeding – hydro-seed:

Seed is to be uniformly and evenly applied across the entire disturbed area.

Seed-water mixture within the hydro-seeder tank should be applied no later than 1 hr. after the seed is added to the tank.

Comply with equipment manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle.

Hydro-seed shall be applied using a two-step process to ensure good seed to soil contact:

Step 1: The first coat shall be applied evenly and uniformly from opposing directions to the soil surface to cover the entire area. The mix shall contain only the specified seed mixtures at specified rates, hydroseed mulch at 500 lb. per acre (for visual metering only) and tackifier at manufacturer recommended rates.

Step 2: The second coat shall be applied evenly and uniformly on top of the first coat, covering the entire seeded area with an erosion resistant coating of mulch. This mix shall contain water, hydro-seed mulch at 1,500 lb. per acre and tackifier at manufacturer recommended rates.

6. Site clean-up:

After hydro-seed application, thoroughly flush the tank, pumps and hoses to remove all material. Wash all material from the exterior of the machine and remove any slurry spills.

Do not allow seeded areas to be trafficked or subjected to grazing.

7. Warranty:

Personnel are responsible for replacing any plantings that die as a result of improper or insufficient watering during the first year.

2.2.5.9 QUALITY ASSURANCE

1. Applicable Standards include, but are not limited to:

National Association of State Departments of Agriculture (NASDA) - Association of Official Seed Analysts (AOSA).

Pennsylvania Seed Act (3 Pa. C.S.A. §§7101 – 7122).

Pennsylvania Erosion and Sediment Control Standards.

2.2.6 TREE PRUNING

2.2.6.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for tree pruning.
2. This task includes work involved in the maintenance pruning and training of young trees and specifically excludes pruning of trees within or near the vicinity of overhead wires.

2.2.6.2 DOCUMENTATION

1. Documentation for tree pruning shall conform to the requirements of section 3.1.
2. Provide daily reports of all vegetation pruned that includes the following: site and tree/shrub identification, species name, and summary of maintenance actions performed.

2.2.6.3 HEALTH AND SAFETY

1. Tree pruning shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2. All equipment to be used and all work to be performed must be in full compliance with the most current revision of the ANSI A-300 [Part 1] – 2008 and ANSI Z-133.1-2006 standards for tree care operations.

3. Personnel shall not prune any trees located near or within electrical wires. Tree pruning near or within electrical wires shall only be conducted by a qualified line-clearance arborist, an individual who, through related training and on-the-job experience, is familiar with the equipment and hazards in line clearance and has demonstrated the ability to perform the special techniques involved. This individual may or may not be currently employed by a line-clearance contractor.

4. This standard shall not take precedence over arboricultural safe work practices.

2.2.6.4 PERSONNEL

1. Personnel for tree pruning shall consist of the standard personnel for surface maintenance as defined in section 3.3.3.

2. Work must be performed under the direction and supervision of a Certified Arborist.

Pruning shall be done in accordance with the latest revision of the ANSI A300 (Part 1) -2008, "Tree, Shrub and other Woody Plant Maintenance-Standard Practices," pp 4-8, Paragraph 5.1-5.4. (Use ANSI Standards as a reference).

2.2.6.5 MATERIALS

1. The following materials may be required for the execution of this task:

Approved disinfectant – to sterilize pruning equipment.

2.2.6.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Sterilized hand saw, pruning pole saws, and pole clips;

Pruning shears and loppers – sharpened and sterilized;

Gas-powered chain saw in good repair, sharpened and with oil and gas;

Safety lines/ropes, saddles, lowering lines;

Cleanup tools such as rakes, shovels, brooms, etc.;

Power blower (gas);

One (1) aerial lift truck with dump box; and

One (1) chipper trailer type, either disc or drum. Minimum 12 knives. Chipper must be adequate to complete pruning requirements.

2.2.6.7 ACCESS REQUIREMENTS

1. Site access for tree pruning shall be secured in accordance with section 3.4.
2. Blocking of public streets shall not be permitted unless prior arrangements have been made with the City, and coordination with appropriate departments has been established. Traffic control is the responsibility of personnel and shall be in compliance with state, country, and local highway construction codes.
3. For lane or street closings, the personnel must contact:

Right of Way Unit, Room 940 Municipal Services Building

1401 J.F. Kennedy Blvd., Philadelphia, PA 19102

Main Line (215) 686 – 5500

Right of Way Unit must have a minimum seventy-two (72) hours notification prior to Street/lane closure.

2.2.6.8 PERMITS AND APPROVALS

1. Permits and approvals for tree pruning shall be obtained in accordance with section 3.5.

2.2.6.9 SPECIAL PROJECT CONDITIONS

1. Protection of overhead utilities:

Personnel shall make arrangements with the utility company for removal of any limbs or branches, which conflict with overhead conductors and may create a hazardous situation during the course of this contract.

The utility company shall be responsible for the removal of any limbs or branches which conflict with conductors.

Personnel may not commence with work until all potentially hazardous branches or limbs are removed by the utility company.

Personnel shall contact the utility in sufficient time to arrange for the required work by the utility company, delays encountered by the personnel in waiting for the utility company to complete its work shall still be the responsibility of the personnel conducting the work.

2.2.6.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. In general, trees should be pruned when young to maximize healing of pruning cuts.
3. Not more than 25 percent of the foliage should be removed within an annual growing season. The percentage and distribution of foliage to be removed shall be adjusted according to the plant's species, age, and health, and per site conditions.
4. Not more than 25 percent of the foliage of a branch or limb should be removed when it is cut back to a lateral. That lateral should be large enough to assume apical dominance.
5. Pruning shall be performed in accordance with PP&R Tree Pruning standards and with the latest revision of the ANSI A300 (Part 1) -2008, "Tree, Shrub and other Woody Plant Maintenance-Standard Practices," pp 4-8, Paragraph 5.1-5.4. If a conflict is encountered, personnel shall notify owner/operator immediately prior to commencing with work.
6. Pruning shall be performed in accordance with PP&R's Procurement Department's Standards Specification #26-R-4d:00.
7. All tree pruning/maintenance shall be performed in compliance with PP&R Tree Pruning Specification. All clearance requirements and a description of pruning are as listed below:
 - Elevate lower limbs: The extent of elevation depends on the size, species, and location of tree.
 - Remove all dead and dying branches and stubs more than 3/4 in. diameter, or more than 3 in. long.
 - Laterally prune branches (to a lateral large enough to assume terminal role) (no stubs), only those limbs that are directly interfering with objects such as street lights, all wires, buildings, utility poles, etc.
 - Remove all rubbing and crossing limbs.
 - Do not prune any "suspected" dead trees. Any "suspected" dead trees shall be reported to the Street Tree Management Division for inspection.

Overhead clearance requirements:

Elevation Requirements:

10 ft. over sidewalks;

12 ft. over regular streets; and

16 ft. over major highways.

Elevation heights are optimum clearances - elevation level must be adjusted so as not to deform or injure tree.

Clearance from object requirements:

Laterally prune limbs that are directly interfering with or are within the prescribed clearance to objects such as buildings, lights, traffic control devices, utility poles and other obstacles as directed by the City:

10 ft. from buildings, lights, traffic control devices, etc.; and

12 ft. above roofs.

Clearances are optimum standards - clearances must be adjusted as needed so as not to deform or unduly injure trees.

2.2.6.11 QUALITY ASSURANCE

1. Reference standards include, but are not limited to:

All equipment to be used and all work to be performed must be in full compliance with the most current revision of the ANSI A-300 [Part 1] – 2008 and ANSI Z-133.1-2006 standards for tree care operations.

Pruning shall be done in accordance with the latest revision of the ANSI A300 (Part 1) -2008, "Tree, Shrub and other Woody Plant Maintenance-Standard Practices," pp 4-8, Paragraph 5.1-5.4. (Use ANSI Standards as a reference).

2.2.7 CHEMICAL VEGETATION CONTROL

2.2.7.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for chemical vegetation control.

2.2.7.2 DOCUMENTATION

1. Documentation for chemical vegetation control shall conform to the requirements of section 3.1.

2. Additionally, submit the following information to the owner/operator within 24 hr.:

Date of application, and for pesticides specifying a reentry period, the hour of completion;

Name and address of the application site (commercial applicators must also record the name and address of the customer if it differs from the application site);

The brand name, EPA registration number, amount, and rate or dosage of each pesticide used;

Size and identification of the area treated;

Names and certification numbers of all persons involved with the application; and

Application records must also include restricted reentry interval and vegetation treated.

2.2.7.3 HEALTH AND SAFETY

1. Chemical vegetation control shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2. All herbicides shall be applied per label-specific safety instructions and manufacturer's directions.

3. Personnel shall comply with directions on all herbicide label sheets, MSDS sheets, and other applicable sources, as well as all applicable codes and regulations.

2.2.7.4 MATERIALS

1. The following materials may be required for the execution of this task:

Herbicide or other approved chemical treatment – frequently used herbicides include, but are not limited to:

Rodeo® or approved equivalent – glyphosate based, for emerged aquatic vegetation control (systemic and will travel from foliar application to penetrate plant root systems most successfully if applied in early fall, to help prevent re-establishment the following year);

Round-up PRODry® or approved equivalent – glyphosate based, for non-aquatic invasive/non-target species control (systemic and will travel from foliar application to penetrate plant root systems most successfully if applied in early fall, to help prevent re-establishment the following year); and

Scythe® or approved equivalent – a fatty acid based, non-selective, contact herbicide for top kill of perennial species (is not systemic, will only destroy the plant tissue in contact with the chemical and will not penetrate to the roots of the plants).

Potable Water

Potable water shall be clean and free of toxic substances.

2.2.7.5 EQUIPMENT

1. The following equipment is required for execution of this task:

Applicators and calibrated equipment for herbicides— sprayer, wick, injector, etc. as specified in manufacturer’s instructions; and

Storage containers for herbicides, as specified in manufacturer’s instructions.

2.2.7.6 PERSONNEL

1. Personnel performing chemical vegetation control shall include at a minimum:

A Pennsylvania Certified Pesticide Applicator or Registered Technician who is under the supervision of a Pennsylvania Certified Pesticide Applicator that can be on site within five (5) hours if necessary; and

A Noncertified Applicator under the direct supervision of a Pennsylvania Certified Pesticide Applicator who is physically present and within sight of the application being made.

2.2.7.7 ACCESS REQUIREMENTS

1. Site access for chemical vegetation control shall be secured in accordance with section 3.4.

2.2.7.8 PERMITS AND APPROVALS

1. Permits and approvals for chemical vegetation control shall be obtained in accordance with section 3.5.

2.2.7.9 SPECIAL PROJECT CONDITIONS

1. Weather and timing:

Chemical vegetation control shall be performed during periods of dry and windless weather.

2.2.7.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 4.6, as applicable.

2. General procedure:

Notification

Notify the owner/operator no less than three (3) business days prior to treating an area with any herbicide;

Notify anyone listed on the Pennsylvania Pesticide Hypersensitivity Registry whose location is within 500 ft. of an herbicide application site not less than 12 hr. in advance, but not more than 72 hr. prior to application. Notification must be made via email, a telephone answering device, or by giving information to an adult contacted by dialing any of the listed telephone numbers;

Include the following in the hypersensitivity notification information: date, time, location of application, EPA registration number, brand name, common name of active ingredients of the herbicide(s) that may be used, business name, BU number, business phone number, and a copy of the label if requested.

Prepare herbicide solution as per manufacturer’s specifications prior to arriving on site;

Apply the herbicide according to manufacturer’s instructions and recommended safety procedures;

To minimize risk of herbicide spillage, open containers are not to be used on the site during the application process.

In the event that the herbicide is spilled, follow appropriate safety protocols for cleanup and notification of appropriate parties; and

Avoid introducing herbicide agents into native plant areas or onto target plants;

Follow manufacturer and safety specifications for pesticide clean-up and disposal.

3. Procedures for specific treatments:

Cut stem treatments

Protocol to be developed.

Foliar treatments

Protocol to be developed.

Basal bark treatments

Protocol to be developed.

2.2.7.11 QUALITY ASSURANCE

1. Reference standards include, but are not limited to:

United States Department of Agriculture (USDA) National Invasive Species Information Center:
(www.invasivespeciesinfo.gov/unitedstates/pa.shtml)

Pennsylvania Department of Conservation and Natural Resources (DCNR) Invasive Plants: <http://www.dcnr.state.pa.us/forestry/plants/invasiveplants/index.htm>

Pennsylvania Department of Environmental Protection: www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968

United States Environmental Protection Agency (USEPA): www.epa.gov/caddis/ssr_herb_int.html

The Pennsylvania Pesticide Control Act of 1973 (3 P. S. § § 111.21—111.61).

Chapter 128. Pesticides, Pennsylvania Code

Penn State College of Agricultural Sciences Pennsylvania Pesticide Applicator Certification program:

www.extension.psu.edu/pests/pesticide-education/applicators/certification/brochure

Links to access pesticide labels and MSDSs online include, but are not limited to (as transcribed from the Penn State College of Agricultural Sciences Penn State Extension: Pesticide Education – www.extension.psu.edu/pests/pesticide-education/applicators/labels-and-msdss):

National Pesticide Information Retrieval System (NPIRS) State Registration Data: www.state.ceris.purdue.edu/

The GreenBook: www.greenbook.net/

Crop Data Management Systems: www.cdms.net/LabelsMsds/LMDefault.aspx

Search for Pesticide Products Using Multiple Variables: www.cdpr.ca.gov/docs/label/m4.htm

Household Products Database: www.householdproducts.nlm.nih.gov/

Vermont SIRI MSDS Index: www.hazard.com/msds/index.php

List of MSDS Databases: www.jrm.phys.ksu.edu//Safety/msds.html

EXTOXNET: www.extoxnet.orst.edu/ghindex.html

Fact sheets on pesticide-related topics can be found at the following website from the Penn State College of Agricultural Sciences Penn State Extension:

www.extension.psu.edu/pests/pesticide-education/applicators/fact-sheets

Pest management resources from the Penn State College of Agricultural Sciences Penn State Extension can be found at:

www.extension.psu.edu/pests

Pennsylvania Department of Conservation and Natural Resources Forest Pest Insects and Disease:

www.dcnr.state.pa.us/forestry/insectsdisease/index.htm

Table 2-2. Recommended Chemical Vegetation Control Treatments for Commonly-Found Invasive/Non-target Vegetation in Philadelphia Stormwater Management Practices

Species	Recommended Treatment	Minimum Frequency	Comments
Japanese knotweed (<i>Polygonum cuspidatum</i>)	Chemical treatment (cut stem treatment in spring followed by foliar application to new growth in late summer) (section 2.2.7.10)	Cut stem application monthly from April through August Foliar application once in August	N.A.
Thistle (<i>Cirsium sp. and Carduus sp.</i>)	Chemical treatment (section 2.2.7.10)	Monthly for 1-3 months from March through July (bud to bloom)	Both native and introduced species are present in Pennsylvania and identification between these species is difficult.
Phragmites (<i>Phragmites australis</i>)	Chemical treatment (section 2.2.7.10) followed by mechanical vegetation control (section 2.2.1.10 C)	Apply chemical treatment annually (late July through October) Mechanical removal should occur 6-8 weeks post chemical treatment	If found in large stands, mowing is more effective than hand pulling or cutting. Killing and cutting down vegetation does not ensure vegetation will not return. More stringent measures must be taken if complete removal is desired.
Paper mulberry (<i>Broussonetia papyrifera</i>), Tree of Heaven (<i>Ailanthus altissima</i>), Princess tree (<i>Paulownia tomentosa</i>), Mimosa tree (<i>Albizia julibrissin</i>)	Hand removal (section 2.2.1.10) when seedling, otherwise chemical treatment (cut stem treatment) (section 2.2.7.10)	Monthly from April through October	Cut stem application is most effective during the growing season (April through August)

2.2.8 PESTICIDE PEST/DISEASE MANAGEMENT

2.2.8.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for pest/disease management.

2.2.8.2 DOCUMENTATION

1. Documentation for pesticide pest/disease management shall conform to the requirements of section 3.1.

2. Additionally, submit the following information to the owner/operator within 24 hr.:

Date of application, and for pesticides specifying a reentry period, the hour of completion;

Name and address of the application site (Commercial applicators must also record the name and address of the customer if it differs from the application site);

The brand name, EPA registration number, amount, and rate or dosage of each pesticide used;

Size and identification of the area treated;

Names and certification numbers of all persons involved with the application; and

Application records must also include restricted reentry interval and vegetation treated.

2.2.8.3 HEALTH & SAFETY

1. Pesticide pest/disease management shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2. Pesticides shall be applied per label-specific safety instructions and manufacturer's directions.

3. Personnel shall comply with directions on all pesticide label sheets, MSDS sheets, and other applicable sources, as well as all applicable codes and regulations.

2.2.8.4 PERSONNEL

1. Personnel performing pesticide pest/disease management shall include at a minimum:

A Pennsylvania Certified Pesticide Applicator or Registered Technician who is under the supervision of a Pennsylvania Certified Pesticide Applicator that can be on site within five (5) hours if necessary; and

A Noncertified Applicator under the direct supervision of a Pennsylvania Certified Pesticide Applicator who is physically present and within sight of the application being made.

2.2.8.5 MATERIALS

1. The following materials may be required for the execution of this task:

Approved pesticides, including but not limited to:

Imidacloprid –systemic insecticide; can be applied by soil injection, tree injection, application to the skin of the plant, broadcast foliar, granular or liquid soil application, or coated seeds.

2.2.8.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Applicators and injectors for administering pesticide, as specified in manufacturer's instructions; and

Storage containers for pesticides, as specified in manufacturer's instructions.

2.2.8.7 ACCESS REQUIREMENTS

1. Site access for pesticide pest/disease management shall be secured in accordance with section 3.4.

2.2.8.8 PERMITS AND APPROVALS

1. Permits and approvals for pesticide pest/disease management shall be obtained in accordance with section 3.5.

2.2.8.9 SPECIAL PROJECT CONDITIONS

Chemical pest control shall be performed during periods of dry and calm weather.

2.2.8.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. General procedure:

Notification

Notify the owner/operator no less than three (3) business days prior to treating an area with any pesticide.

Notify anyone listed on the Pennsylvania Pesticide Hypersensitivity Registry whose location is within 500 ft. of an herbicide application site not less than 12 hr. in advance, but not more than 72 hr. prior to application. Notification must be made via email, a telephone answering device, or by giving information to an adult contacted by dialing any of the listed telephone numbers.

Include the following in the hypersensitivity notification information: date, time, location of application, EPA registration number, brand name, common name of active ingredients of the herbicide (s) that may be used, business name, BU number, business phone number, and a copy of the label if requested.

Prepare pesticide solution as per manufacturer's specifications prior to arriving on site.

Apply the pesticide according to manufacturer's instructions and recommended safety procedures.

To minimize risk of pesticide spillage, open containers are not to be used on the site during the application process.

In the event that the pesticide is spilled, follow appropriate safety protocols for cleanup and notification of appropriate parties.

Avoid introducing pesticide onto unaffected vegetation or areas of the plant that will not respond to treatment.

Follow manufacturer and safety specifications for pesticide clean-up and disposal.

2.2.8.11 QUALITY ASSURANCE

1. Reference standards include, but are not limited to:

The Pennsylvania Pesticide Control Act of 1973 (3 P. S. § § 111.21—111.61).

Chapter 128. Pesticides, Pennsylvania Code

Penn State College of Agricultural Sciences Pennsylvania Pesticide Applicator Certification program:

www.extension.psu.edu/pests/pesticide-education/applicators/certification/brochure

Potential links to access pesticide labels and MSDSs online include (as transcribed from the Penn State College of Agricultural Sciences Penn State Extension: Pesticide Education – www.extension.psu.edu/pests/pesticide-education/applicators/labels-and-msdss) :

National Pesticide Information Retrieval System (NPIRS) State Registration Data: www.state.ceris.purdue.edu/

The GreenBook: www.greenbook.net/

Crop Data Management Systems: www.cdms.net/LabelsMsds/LMDefault.aspx

Search for Pesticide Products Using Multiple Variables: www.cdpr.ca.gov/docs/label/m4.htm

Household Products Database: www.householdproducts.nlm.nih.gov/

Vermont SIRI MSDS Index: <http://hazard.com/msds/index.php>

List of MSDS Databases: <http://jrm.phys.ksu.edu/Safety/msds.html>

EXTOXNET: <http://extoxnet.orst.edu/ghindex.html>

Fact sheets on pesticide-related topics can be found at the following website from the Penn State College of Agricultural Sciences Penn State Extension:

www.extension.psu.edu/pests/pesticide-education/applicators/fact-sheets

Pest management resources from the Penn State College of Agricultural Sciences Penn State Extension can be found at:

www.extension.psu.edu/pests

Pennsylvania Department of Conservation and Natural Resources Forest Pest Insects and Disease:

www.dcnr.state.pa.us/forestry/insectsdisease/index.htm

Fairmount Park – Street Tree Management Division

Hours: 7:00 am – 3:30 pm Monday through Friday except City holidays

215.685.4363 – fpcc.streettree.info@phila.gov

www.fairmountpark.org/StreetTreeIntro.asp

For alleyway trees only, call 215.683.0222

Occupational Safety and Health Administration (OSHA).

All applicable state, local, and federal regulations.

2.2.9 SOIL MANAGEMENT

2.2.9.1 TASK DESCRIPTION

1. This section sets forth procedures and requirements for testing and analysis for determining the need for organic soil amendments and for applying organic soil amendments.
2. Inorganic fertilizer is intentionally excluded from this section and shall not be used, unless specifically approved for special circumstances.

2.2.9.2 DOCUMENTATION

1. Documentation for soil management shall conform to the requirements of section 3.1.
2. Soil test results/reports are required prior to the use of amendments. The soil test report shall include the basic fertility of the soil, including the amount of potassium, calcium, phosphorous, and magnesium, as well as the pH level. The final report should include the chemical analysis of the soil.

2.2.9.3 PERSONNEL

1. Personnel for soil management shall consist of an Environmental Scientist or Engineer as defined in section 3.3.3.

2.2.9.4 HEALTH & SAFETY

1. Soil management shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.2.9.5 MATERIALS

1. The following materials are required to execute this task:

Organic soil amendments including, but are not limited to the following:

Grass clippings (cut prior to seedhead formation) – to increase organic matter and moisture retention;

Compost (weed-free) – to increase organic matter and moisture retention;

Shredded leaves – to increase organic matter and moisture retention (avoid walnut, eucalyptus, and camphor laurel leaves, as well as any invasive species leaves);

Pine needles – to increase acidity and organic matter;

Sand – to increase permeability; and

Mycorrhizal fungi – to encourage the surface absorbing area of plant roots, and in turn, aid in nutrient uptake and improved ability of the plant to access soil resources. Mycorrhizal fungi are very common in high quality, undisturbed soils, but are significantly less abundant in highly disturbed urban soils.

2.2.9.6 EQUIPMENT

1. The following equipment is required to implement this task:

Soil test kit – each test kit should include directions for taking the sample, paperwork for the report, a sample bag, and mailer.

Shovel(s) – assorted shovels, of sufficient size and strength to perform related tasks, which may include, but are not limited to the following types: digging, trenching, spade, scoop, scraper, post-hole digger, and trowel;

Tarp or bin for storing amendments;

Wheelbarrow;

Rake of sufficient strength for spreading soil amendments; and

Heavy equipment as required to haul and spread amendments.

2.2.9.7 ACCESS REQUIREMENTS

1. Site access for soil management shall be secured in accordance with section 3.4.

2.2.9.8 PERMITS AND APPROVALS

1. Permits and approvals for soil management shall be obtained in accordance with section 3.5.

2.2.9.9 SPECIAL PROJECT CONDITIONS

1. Weather:

Soil tests or soil amendment application shall not be administered during rain events or when soil is frozen.

2.2.9.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during-, and post-maintenance event procedures as set forth in section 3.6, as applicable.

2. Order the soil test kit - available from the Penn State Cooperative Extension Laboratory Services Soil Testing Philadelphia County Extension, or other sources.
3. Take soil samples per the directions within the test kit. Label and package according to the directions within the test kit and send to the lab for analysis.
4. Based on report results and in consultation with a landscape professional, select appropriate soil amendments.
5. Obtain approval from owner/operator prior to adding any soil amendments.
6. Apply and spread soil amendments per recommended methods and using appropriate quantities.

Soil amendments shall be spread evenly over the target area, avoiding clumping or piling of material, and taking care not to injure target vegetation.

If amendments are being applied to vegetated areas, spreading shall be performed by hand.

2.2.9.11 QUALITY ASSURANCE

1. Reference standards:

Soil analysis methods, as summarized by the Penn State College of Agricultural Sciences Agricultural Analytical Services Lab: www.aasl.psu.edu/soil_methods.htm

2.3 SUBSURFACE MAINTENANCE

2.3.1 VACUUM CLEANING

2.3.1.1 TASK DESCRIPTION

1. This section describes the protocol for maintenance of subsurface structural features using vacuum cleaning equipment. The task includes vacuum cleaning structures to remove trash/sediment/organic debris and to dewater a drainage system.

2.3.1.2 DOCUMENTATION

1. Documentation for vacuum cleaning shall conform to the requirements of section 3.1.
2. If vacuum cleaning involves the use of a city fire hydrant, a monthly hydrant report shall be prepared and submitted to PWD by owner/operator.

2.3.1.3 HEALTH AND SAFETY

1. Vacuum cleaning shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2. In addition, the following mechanical equipment requirements shall be followed:

When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the pipe line are used, precautions shall be taken to ensure that the water head pressure does not damage or cause flooding of public or private property being served by the storm sewer.

When hydraulically propelled cleaning tools are used, all access structures that are not used as entry points shall be closed, secured by screws, screw caps, or weight (minimum 40 lbs.) and be cordoned off using safety cones or warning tape.

2.3.1.4 PERSONNEL

1. Personnel for vacuum cleaning tasks shall consist of the standard personnel for subsurface maintenance as defined in section 3.3.4.

2.3.1.5 MATERIALS

1. The following materials may be required for the execution of this task:

Hydrant operation report form;

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

50 gal. plastic contractor bags (1 box);

Duct tape (1 roll);

Potable municipal or well water and/or harvested rainwater sufficient cleaning activities, as required;

Rock salt (winter only) (1-50 lbs. bag);

All-purpose rags (10); and

Electrical tape (1 roll).

2.3.1.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Vacuum cleaning equipment:

Vacuum or jet-rod/vac truck with the following minimum specifications:

Vacuum flow of 2600 cf per minute (cfm);

Vacuum lift of 22 in. of mercury (HG);

600 gal. or 3 cy debris tank with strainer and decanting valve;

600 gal. integrated water tank; and

200 ft. of vacuum tubes ranging from 4 in. to 8 in.

Portable vacuum excavator with minimum specifications:

Vacuum flow of 850 cfm;

Vacuum lift of 22 in. HG;

85 gal. debris storage tank with additional 150 gal. of storage capacity within barrels. Storage tank shall be equipped with strainer and decanting valve;

Air compressor with 185 cfm at 100 psi, or greater as per portable vacuum excavator required power specifications;

Approved portable water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank without compromising safety or causing a hazard (if hydrant access is not available);

200 ft. of vacuum tubes ranging from 1 in. to 6 in; and

High-velocity water gun or air lance and associated hose and appurtenances for power cleaning structure walls and floor.

Hand tools as necessary for assembling and disassembling tubes and hoses;

10 megapixel digital camera with spare batteries;

25 ft. tape measure and/or measuring tape;

Chisel and mallet or hammer;

Set of standard and metric socket wrenches;

Pliers, adjustable wrenches, vice grips, and pipe wrenches;

Manhole hooks;

Crowbar;

Confined space entry harness, tripod, and air monitor as per OSHA standards.

Assorted Phillips and standard screwdrivers;

Assorted metric and standard wrenches and Allen wrenches;

Square key to open covers that are secured, such as cleanout caps or riser covers;

Shovel, spades and/or push broom to remove trash/sediment/ organic debris generated from maintenance tasks;

Measuring wheel to determine distances between structures;

Ladder;

Fire hydrant center compression lock;

Fire hydrant wrench;

Backflow preventer(s) and associated appurtenances in accordance with PWD's approved list of backflow assemblies (<http://www.phila.gov/water/pdfs/BackflowAssembly2010.pdf>); and

Water hose of sufficient strength to withstand kinking and abrasion from concrete surfaces or other hoses as appropriate;

2.3.1.7 ACCESS REQUIREMENTS

1. Site access for vacuum cleaning shall be secured in accordance with section 3.4.

2.3.1.8 PERMITS AND APPROVALS

1. Permits and approvals for vacuum cleaning shall be obtained in accordance with section 3.5.

2.3.1.9 SPECIAL PROJECT CONDITIONS

1. Vacuum cleaning shall not be performed within 48 hrs. of a significant (>1.0 in.) rainfall event unless approved by the owner/operator. This 48 hrs. threshold is based on typical drawdown times of GSI practices.

2.3.1.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 4.6, as applicable.

Determination of appropriate equipment for cleaning shall be made prior to maintenance of each structure so that appropriate equipment is transported to the site.

Confirm that the vacuum/jet-rodder equipment waste storage tank is free of debris from another site or project. If required by owner/operator, take a time stamped photograph of empty storage tanks.

2. Inspect the stormwater system for any evidence of illicit discharge or any suspected illegal connections or dumping, and check the nearby areas for any signs of erosion. Document and report any concerns to the owner/operator prior to beginning maintenance.
3. Remove trash/sediment/organic debris from access and flow control/conveyance structures.

Sweep or vacuum access or flow control/conveyance structure grate and surrounding area collecting trash/sediment/organic debris at least 4 ft. from the structure on all sides.

Open access points (access or flow control/conveyance structures), remove pretreatment devices (for example, inlet inserts, screens, etc.) and open traps, as necessary, to access structures. If pretreatment device is damaged, deformed or impaired function is observed, contact owner/operator so that the device can be replaced.

Remove trash, sediment, and organic debris from pretreatment devices prior to removal of trash/sediment/ organic debris from the flow control/conveyance structure.

If the pretreatment device is not permanently attached to the structure, remove the pretreatment device from the structure by hand or with specialized pretreatment device removal tools, if available.

If removing by hand, remove enough material from the device to achieve a liftable weight (based on surface maintenance personnel judgment) prior to lifting. Once removed, invert and shake or gently tap the device and spray device with water until all material has been removed.

If performed prior to vacuum cleaning of the flow control/conveyance structure, trash/sediment/ organic debris from the pretreatment device may be emptied into the flow control/conveyance structure.

Prior to vacuum cleaning flow control/conveyance structure, trash/sediment/ organic debris from at least 5 ft. on either side of the flow control/conveyance structure should be swept into the flow control/conveyance structure.

Loosen compacted sediment on structure with high-velocity water gun or air lance.

While vacuuming structures, care should be taken to avoid large equipment from traversing or otherwise staged on the surface of the media storage area or concrete sidewalks to avoid differential loading to potentially shallow conveyance or under-drain pipes.

For inlets that connect to the combined sewer, inlets must be refilled with water up to the top of the trap opening to prevent the escape of sewer gases.

4. If dewatering a conveyance pipe, then:

Insert the vacuum hose at the most downstream access point, if possible;

Seal other access points to maximize suction; and

Vacuum conveyance pipe until structure is dewatered.

5. Inspect structure to ensure all traps are closed and pretreatment/screens are latched and/or correctly installed prior to closing access points.
6. Follow guidelines for WASTE DISPOSAL AND DECANTING (Section 2.4) when removing sediment/trash/organic debris from the site.

2.3.1.11 QUALITY ASSURANCE

1. Reference Standards:

National Association of Sewer Service Companies (NASSCO) Manual of Practices Wastewater Collection Systems;

NASSCO Specification Guidelines for Sewer Line Cleaning ;and

PWD Sewer Assessment Program Cleaning Training Manual;

2.3.2 JET-RODDING

2.3.2.1 TASK DESCRIPTION

1. This section describes the protocol for maintenance of subsurface structural features using jet-rodding equipment. The task includes high-pressure cleaning or “flushing” of structures to remove trash/sediment/organic debris, roots and other obstructions or deposits (Figure 2.1 and 2.2.)

2.3.2.2 DOCUMENTATION

1. Documentation for jet-rodding shall conform to the requirements of section 3.1.
2. If jet-rodding involves the use of a city fire hydrant, a monthly hydrant report shall be prepared and submitted to PWD by owner/operator.

Control Structure

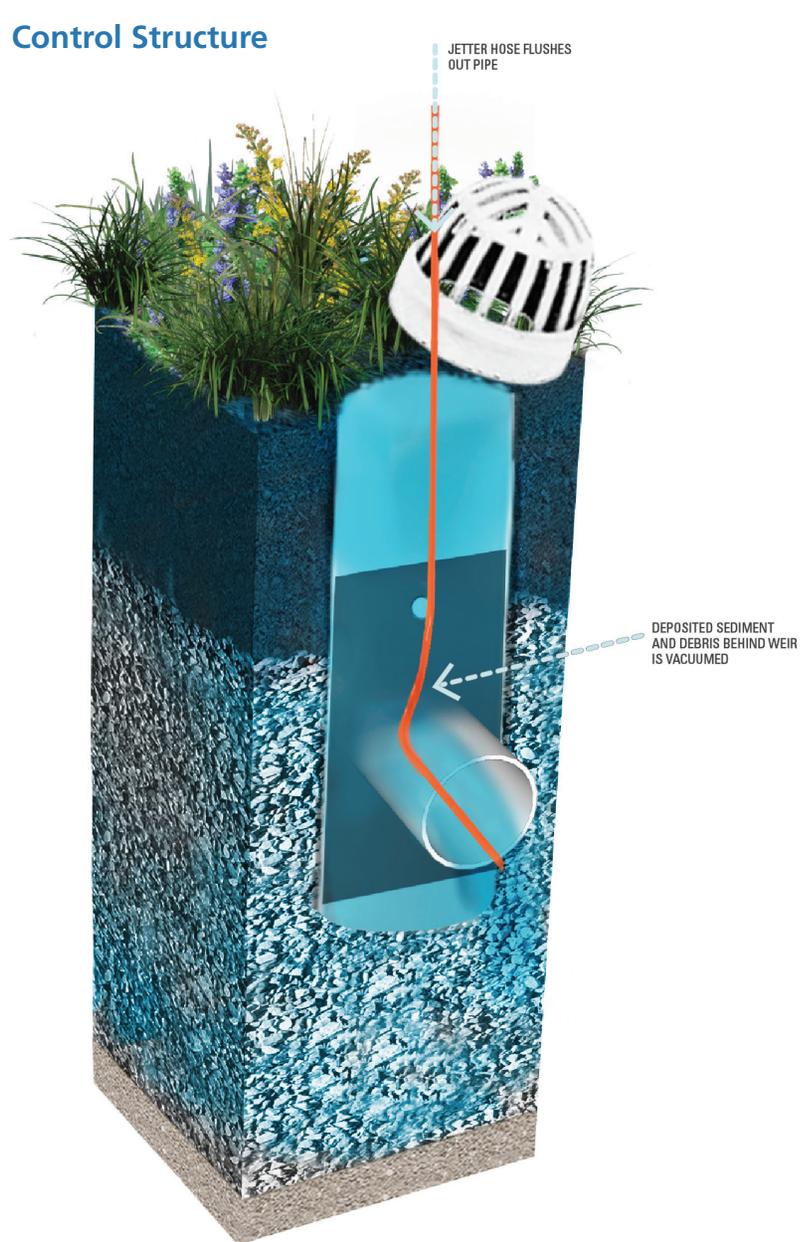


Figure 2.1. Typical Procedure for Jet-rodding from a Control Structure with a Weir

Domed Riser

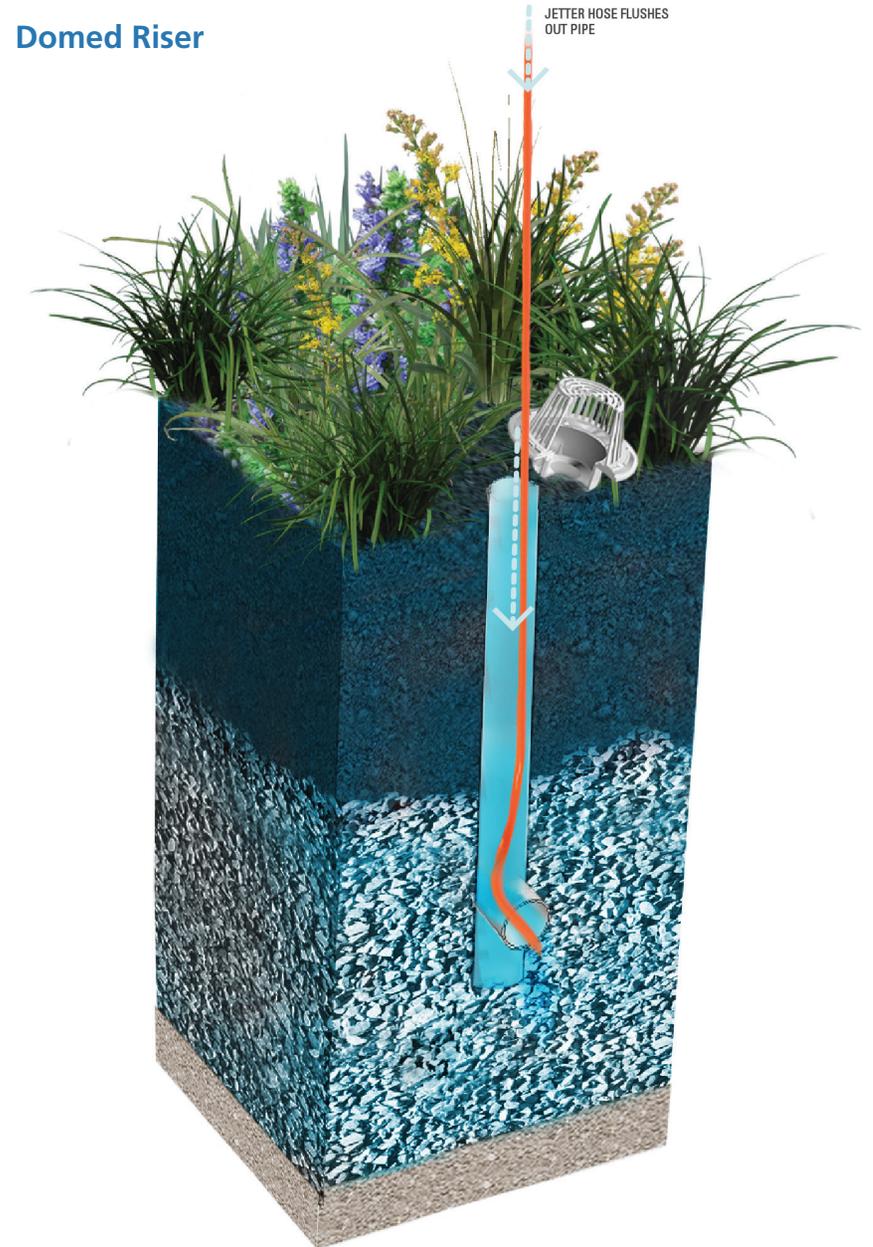


Figure 2.2. Typical Procedure for Jet-rodding from a Domed Riser Access Point

2.3.2.3 HEALTH AND SAFETY

1. Jet-rodding shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.3.2.4 PERSONNEL

1. Personnel for jet-rodding tasks shall consist of the standard personnel for subsurface maintenance as defined in section 3.3.4.

2.3.2.5 MATERIALS

1. The following materials may be required for the execution of this task:

Hydrant operation report form;

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

Duct tape (1 roll);

Potable municipal or well water and/or harvested rainwater sufficient cleaning activities, as required;

Rock salt (winter only) (1-50 lbs. bag);

All-purpose rags (10); and

Electrical tape (1 roll).

2.3.2.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Vacuum/jet-rodder equipment:

Jet-rod/vac truck with the following minimum specifications:

Hose reel with 600 ft. of 1 in. jet-rodder hose capacity;

Water pump with flow of 80 gal. per minute (gpm) @ 2000 pounds per square in. (psi);

600 gal. integrated water tank;

600 ft. of 1 in. jet-rodder hose;

300 ft. of 5/8 in. jet-rodder hose; and

300 ft. of 3/8 in. jet-rodder hose.

Portable jet-rodder with the following minimum specifications:

Hose reel with of 250 ft. of 3/8 in. jet-rodder hose capacity;

Water pump with flow of 12 gpm and pressure of 2,000 psi;

250 ft. of 3/8 in. jet-rodder hose; and

Approved portable water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank without compromising safety or causing a hazard.

Assortment of jet-rodder nozzles appropriate for the hose diameter and water pump pressure of the vacuum/jet-rodder equipment. Exact size of the necessary nozzles shall be determined prior to maintenance by the vacuum/jet-rodder operator; nozzles must include at least one of each type of the following:

Flushing nozzle;

Penetrating nozzle; and

Rotating nozzle.

Flexible hose guard to protect jet-rodder hose from abrasion; and

High-velocity water gun or air lance and associated hose and appurtenances for power cleaning structure walls and floor.

Hand tools as necessary for assembling and disassembling hoses;

10 megapixel digital camera with spare batteries;

25 ft. tape measure and/or measuring tape;

Chisel and small hammer;

16 lb. sledge hammer;

Set of standard and metric socket wrenches;

Pliers, adjustable wrenches, vice grips, and pipe wrenches;

Manhole hooks;

Crowbar;

Confined space entry harness, tripod, and air monitor as per OSHA standards;

Assorted Phillips and standard screwdrivers;

Assorted metric and standard wrenches and Allen wrenches;

Brick hammer;

(3) 8 in. pipe wrenches;

10 in. adjustable wrench;

12 in. adjustable wrench;

10 in. straight screwdrivers;

Square key to open covers that are secured, such as cleanout caps or riser covers;

Round-mouth shovel, spades and/or push broom to remove trash/sediment/organic debris generated from maintenance tasks;

Measuring wheel to determine distances between structures; and

Ladder.

2.3.2.7 ACCESS REQUIREMENTS

1. Site access for vacuum cleaning shall be secured in accordance with section 3.4.

2.3.2.8 PERMITS AND APPROVALS

1. Permits and approvals for vacuum cleaning shall be obtained in accordance with section 3.5.

2.3.2.9 SPECIAL PROJECT CONDITIONS

1. Routine vacuum cleaning shall not be performed within 48 hrs. of a significant (>1.0 in.) rainfall event unless approved by the owner/operator. This 48 hrs. threshold is based on typical drawdown times of GSI practices.

2.3.2.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Confirm that the vacuum/jet-rodder equipment waste storage tank is free of debris from another site or project. If required by owner/operator, take a time stamped photograph of empty storage tanks.

3. Open access points (access or flow control/conveyance structures), remove pretreatment devices (for example, inlet inserts, screens, etc.) and open traps, as necessary, to access structures.
4. Inspect the stormwater system for any evidence of illicit discharge or any suspected illegal connections or dumping, and check the nearby areas for any signs of erosion. Document and report any concerns to the owner/operator prior to beginning maintenance.
5. Position jet-rod/vac truck so that reel is adjacent to manhole, if possible.
6. Remove trash/sediment/organic debris from access and flow control/conveyance structures that serve as access points for jet-rodming (Figure 2.3 and Figure 2.4, see section 2.3.1), if necessary.
7. Select appropriate nozzle (see section 38):

Before installing nozzle, always run water through the hose.

If material to be cleaned is known, select appropriate nozzle; if not, initially use a penetrating type nozzle until material is determined.

8. Jet-rod conveyance pipes:

If jet-rodming through flow control/conveyance structure, first attempt jet-rodming from the most downstream structure.

Insert vacuum tube in the structure from which conveyance pipe will be accessed, and vacuum material generated from pipe cleaning throughout jet-rodming procedure (see section 2.3.1).

Insert jet-rodder hose into the pipe through the flexible hose guard.

Insert flexible hose guard in the pipe to guide the jet-rodder hose and prevent wear from friction.

If personnel must enter flow control/conveyance structure to position the jet-rodder hose, confined space equipment protocols must be followed (see section 3.3.4).

Verify that all structures not used as access points are closed, secured, and cordoned off.

Start high-pressure pump after ensuring the nozzle is fully inserted in the pipe.

Jet-rod conveyance pipe structures moving trash/sediment/organic debris toward the access point for vacuuming and performing as many passes as necessary to clean the structure.

During cleaning, keep the nozzle moving and the water pump operating to prevent damage to pipe.

Stop maintenance immediately if indications of structural damage or failure are observed (for

Inlet

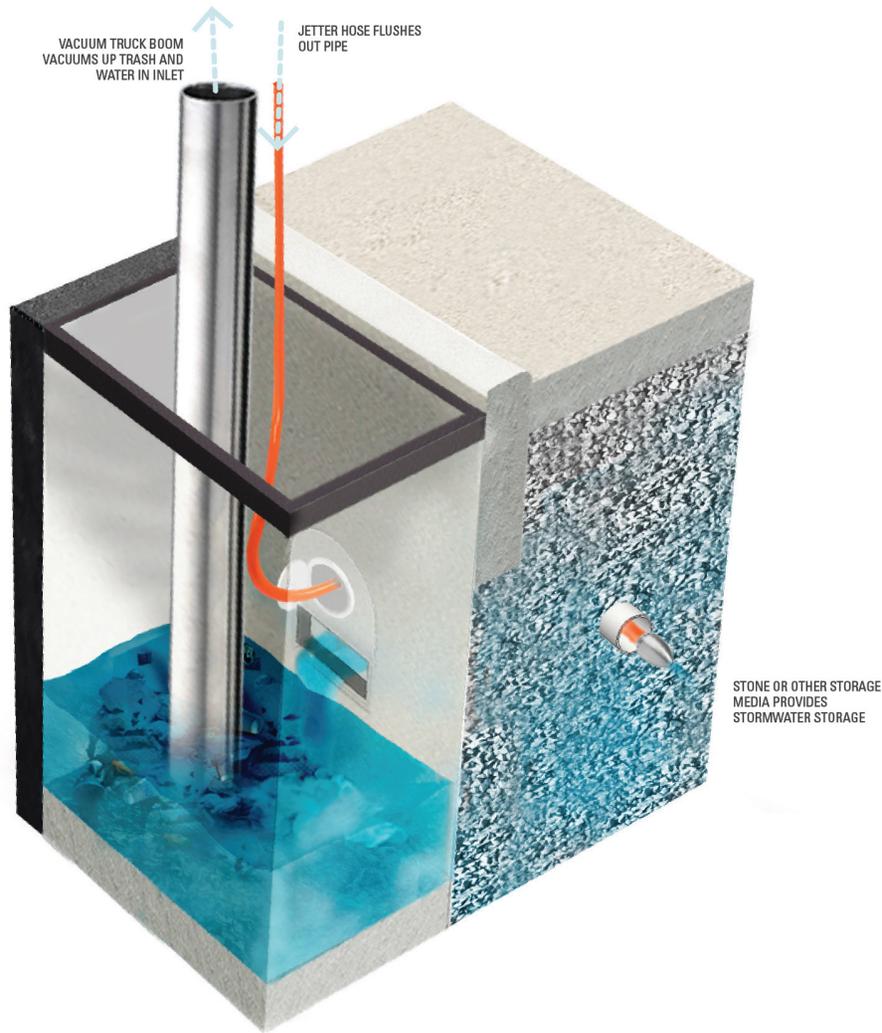


Figure 2.3. Typical Procedure for Jet-rodding and Vacuuming from an Inlet

Manhole



Figure 2.4. Typical Procedure for Jet-rodding and Vacuuming from a Manhole

example, infiltration bed stone is removed during jet-rodding). Report observation to owner/operator immediately.

Jet-rod conveyance pipe until jet-rodding water is clear, unless otherwise instructed by owner/operator.

If pipe cannot be cleaned successfully using initial equipment and techniques, attempt cleaning with additional equipment (for example, other combinations of jet-rodder hose diameter, nozzles, and/or pressure) or from alternative access points.

If pipe has large quantities of debris, is long (for example, over 200 ft.) and/or must be jet-rodded from an upstream access point, perform multiple short passes that remove trash/sediment/organic debris in sections starting closest to the access point.

Decrease pressure and/or reduce jet-rodder hose diameter to maneuver jet-rodder through sharp bends or bends in close proximity (in other words, less than 5 ft. apart).

If the alternative access point is an upstream cleanout structure, flush conveyance pipe using a jet-rodder hose and no nozzle to loosen and push deposits and large debris to the downstream access point.

If the nozzle becomes trapped in the pipe, shut off water supply and attempt to pull it back with the hose reel. If this does not work, turn on the water supply, send the nozzle to the upstream manhole for removal, and then pull back the jet-rodder hose with the hose reel.

If a cleanout must be used as an access structure:

Insert a flexible vacuum hose, with a diameter only slightly smaller than access structure, into cleanout, sealing the area around the hose to maximize suction power.

Cut a small window into the side of the vacuum hose.

Insert the jet-rodder hose into the opening in the vacuum hose.

Vacuum and jet-rod the pipe (Figure 2.5).

If significant blockages are encountered:

Select an appropriate penetrating nozzle.

If nozzle will not move forward, pull back a few feet and let go to sling-shot against the blockage. This pulsating action on nozzle should be used only for extremely heavy blockages.

Once the blockage has been removed, shut down the pressure, wait until flow subsides, and then

make a couple of passes to ensure the pipe is free of blockages.

Change the nozzle as needed, and re-clean the pipe where blockage was first identified.

Verify that conveyance pipe is free of trash/sediment/organic debris using closed-circuit television (CCTV) post-maintenance.

If conveyance pipe is not free of trash/sediment/organic debris, then repeat jet-rodding procedures.

9. Flushing subsurface storage units:

Plug the outlet control structure to contain waste water during procedure.

Insert vacuum tube into the outlet control structure, if applicable, or the most downstream access point. Begin vacuuming (see section 2.3.1) only after a minimum 1 in. of water has been flushed into system and a sustained flow of water is entering the system.

Pump water, at a high flow rate using a hydrant or jet-rodder hose, through access structure until water level in the system is at least 1 in., or as specified by manufacturer's guidelines.

Repeat for all available access structures.

Vacuum all waste water from outlet control structure or most downstream access point.

Verify that subsurface storage unit is free of trash/sediment/organic debris using CCTV post-maintenance.

If subsurface storage unit is not free of trash/sediment/organic debris, then repeat flushing procedures.

Cleanout

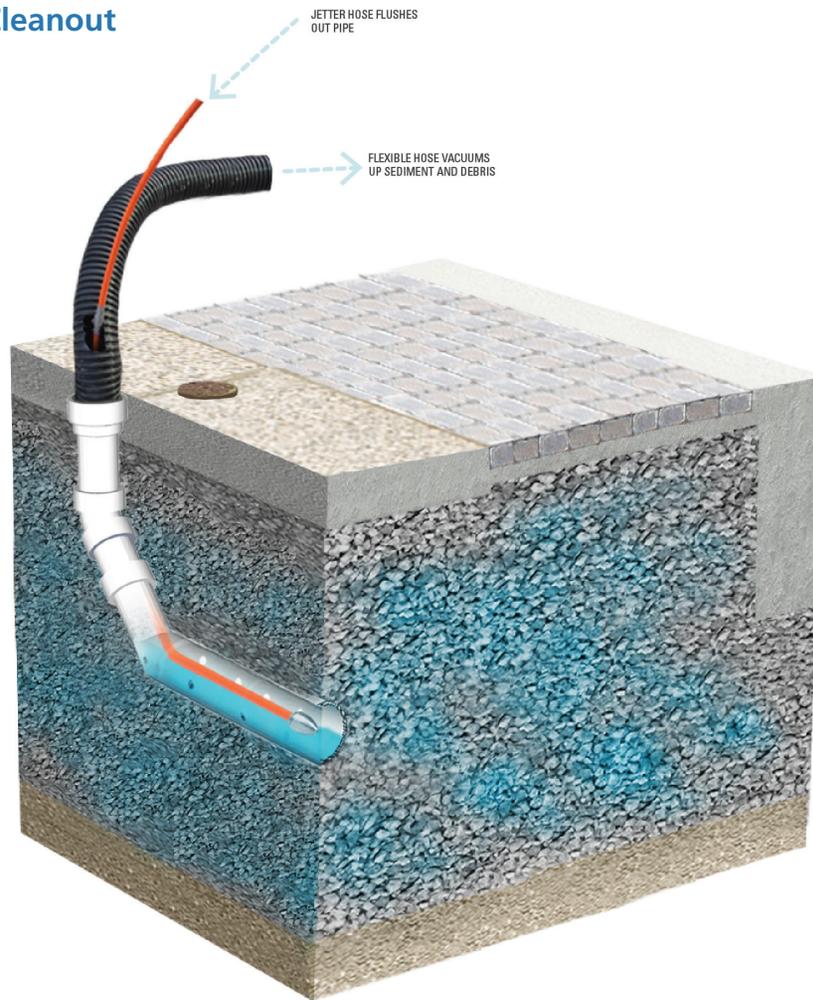


Figure 2.5. Typical Procedure for Vacuuming and Jet-rodding from a Cleanout Access Structure

10. Inspect structure to ensure all access points and traps are closed and pretreatment/screens are latched and/or correctly installed prior to closing access points.

2.3.2.11 QUALITY ASSURANCE

1. Reference Standards:

National Association of Sewer Service Companies (NASSCO) Manual of Practices Wastewater Collection Systems;

NASSCO Specification Guidelines for sewer line cleaning; and

PWD Sewer Assessment Program Cleaning Training Manual;

2.4 WASTE DISPOSAL AND DECANTING

2.4.1 WASTE DISPOSAL

2.4.1.1 TASK DESCRIPTION

1. This section describes the protocol for the disposal of non-hazardous waste materials generated or collected during the performance of vegetation, surface structure and/or subsurface maintenance activities. The task includes proper containment, transport and disposal of waste material.

2.4.1.2 DOCUMENTATION

1. Documentation for waste disposal shall conform to the requirements of section 3.1.
2. In addition, the following information shall be provided to the owner/operator:

Type and quantity of waste material;

Name and address of collection site(s);

Name and address of disposal site;

Dates that the waste accumulation started and ended, and date the material was disposed; and

Laboratory analytical data, if any, for waste characterization, if waste disposal is at a site not owned by the owner/operator.

2.4.1.3 HEALTH AND SAFETY

1. Waste disposal shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.4.1.4 PERSONNEL

1. Personnel for waste disposal tasks shall consist of the personnel that performed the maintenance task that generated the waste material.

2.4.1.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

50 gal. plastic contractor bags (1 box);

Duct tape (1 roll);

Rock salt (winter only) (1-50 lb. bag);

All-purpose rags (10);

Holding tank equipped with filters or baffles to facilitate removal of sediments; and

Silt sock to contain waste at disposal site.

2.4.1.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Hydraulic lift and dolly to move contained material from vehicle to disposal location, if necessary;

Holding tank equipped with filters or baffles to facilitate removal of sediments;

Silt sock to contain waste at disposal site;

10 megapixel digital camera with spare batteries; and

Shovel, spades and/or push broom to remove debris and trash generated from maintenance tasks.

2.4.1.7 ACCESS REQUIREMENTS

1. Site access for waste disposal shall be secured in accordance with section 3.4.

2.4.1.8 PERMITS AND APPROVALS

1. Permits and approvals for waste disposal shall be obtained in accordance with section 3.5.

2.4.1.9 SPECIAL PROJECT CONDITIONS

1. N.A.

2.4.1.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Collect the material removed during the maintenance operation in applicable waste storage container (for example, traps, bins, vacuum/jet-rodder truck storage, etc.).
3. If necessary, decant or filter wet material prior as discussed in section 2.4.2.
4. Check the waste material for any unusual color or odor that might indicate the presence of oil or other chemicals. If any unusual color or odor is found, notify the owner/operator immediately.
5. Transport the waste material to the approved disposal site or beneficial end use location, as directed by the owner/operator.
6. Dispose of the waste material as directed by disposal site or beneficial end use personnel.

2.4.1.11 QUALITY ASSURANCE

1. Reference Standards

National Association of Sewer Service Companies (NASSCO) Manual of Practices Wastewater Collection Systems.

NASSCO Specification Guidelines for sewer line cleaning.

2.4.2 DECANTING

2.4.2.1 TASK DESCRIPTION

1. This section describes the disposal of water generated or collected during the surface and/or subsurface maintenance activities.

2.4.2.2 DOCUMENTATION

1. Documentation for decanting shall conform to the requirements of section 3.1.

2.4.2.3 HEALTH AND SAFETY

1. Decanting shall be conducted in accordance with health and safety requirements set forth in section 3.2.

2.4.2.4 PERSONNEL

1. Personnel for decanting tasks shall consist of the personnel that performed the maintenance task that generated the water.

2.4.2.5 MATERIALS

1. The following materials may be required for the execution of this task:

Site map, design plan, or as-constructed plan;

Hard copies of permits and access permissions;

50 gal. plastic contractor bags (1 box);

Duct tape (1 roll);

Rock salt (winter only) (1-50 lbs. bag); and

All purpose rags (10).

2.4.2.6 EQUIPMENT

1. The following equipment may be required for the execution of this task:

Vacuum/jet-rodder equipment;

Holding tank equipped with filters or baffles to facilitate removal of sediments;

Hand tools as necessary for assembling and disassembling hoses;

10 megapixel digital camera with spare batteries;

Pliers, adjustable wrenches, vice grips, and pipe wrenches;

Manhole hooks;

Crowbar; and

Shovel, spades and/or push broom to remove debris and trash generated from maintenance tasks.

2.4.2.7 ACCESS REQUIREMENTS

1. Site access for decanting shall be secured in accordance with section 3.4.

2.4.2.8 PERMITS AND APPROVALS

1. Permits and approvals for decanting shall be obtained in accordance with section 3.5.

2.4.2.9 SPECIAL PROJECT CONDITIONS

1. Decanting shall not be performed within 48 hrs. of a significant (>1.0 in.) rainfall event unless approved by the owner/operator.

2.4.2.10 STANDARD OPERATING PROCEDURE

1. Implement pre-, during, and post-maintenance event procedures as set forth in section 3.6, as applicable.
2. Collect the material removed during the maintenance operation in the truck holding tank, and allow it to settle.
3. Check the collected water for any unusual color or odor that might indicate the presence of oil or other chemicals. If any unusual color or odor is found, notify the owner/operator immediately.
4. Transport the water to the approved decanting inlet or manhole.
5. Decant or filter the water prior to discharging it into an inlet or as directed by the owner/operator. This may require the insertion of inlet filters. Ensure that no sediments are discharged to the inlet. The solids, in slurry form, should be transported to an approved disposal site as discussed in section 2.4.1.

2.4.2.11 QUALITY ASSURANCE

1. Reference standards:

National Association of Sewer Service Companies (NASSCO) Manual of Practices Wastewater Collection Systems.

NASSCO Specification Guidelines for sewer line cleaning.

Appendices

division 3



3.1 DOCUMENTATION

1. Owner/operator is to develop maintenance checklists for each SMP and to provide checklists to maintenance personnel. Maintenance checklists function to assist maintenance personnel in the field and to serve as records of SMP maintenance.
2. Additional documentation requirements are listed by maintenance task in Division 2.
3. Maintenance personnel are to complete maintenance checklists and other documentation, as required by maintenance task, during each maintenance event and provide checklists to owner/operator for record keeping.
4. All documentation shall be reviewed by the maintenance personnel prior to submission. Inaccuracies and inconsistencies between checklists, forms, videos, etc. will not be accepted.

3.2 HEALTH AND SAFETY

3.2.1 GENERAL POLICY

1. Maintenance activities and equipment operation are to be performed in accordance with all applicable laws and regulations including those of:
 - United States of America;
 - Commonwealth of Pennsylvania; and
 - City of Philadelphia.
2. Personnel executing maintenance shall adhere to terms, conditions, policies, practices, and procedures of the owner/operator's Health and Safety Plan (HASP).
3. In the event of a conflict between the owner/operator's HASP, contractor HASPs, and federal, state, and local regulations, maintenance personnel shall follow the most stringent/protective requirements.
4. All equipment operations and procedures shall conform to standards as set forth in Occupational Safety and Health Administration (OSHA) guidelines, including but not limited to the regulations at 29 CFR 1910.146 Appendix E, applicable to personnel entering a sewer system and to equipment manufacturer's directions.

5. Maintenance personnel shall be solely responsible for pedestrian and vehicular safety and control within the work site and shall provide the necessary warning devices, barricades, and ground personnel required to insure the safety, protection, and warning of persons and vehicular traffic within the area. Personnel must follow any and all applicable PennDOT regulations for highway safety.
6. Federal, state, and local authorities retain the right to inspect or observe the maintenance activities for compliance with applicable requirements and protocols, and for the quality of work. Authorities may issue a "stop work" order if the work does not comply with applicable requirements or if, in the opinion of the authorized inspector, the site conditions or maintenance personnel's practices are unsafe or pose a risk to the environment (for example, leaks, spills, etc.) or personnel are not properly trained.
7. It is recommended that personnel use an effective form of sun protection as needed.
8. It is recommended that personnel apply insect repellent if working in areas of natural vegetation, and perform a self inspection for ticks following work in and around natural vegetation.
9. It is recommended that personnel carry an adequate personal supply of potable water.
10. It is recommended that personnel disclose and maintain a list of any allergies or serious medical conditions on their person.
11. It is recommended that field crews carry a first aid kit in compliance with American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) Specification Z308 in their vehicle.
12. No personnel shall for any reason enter a confined subsurface structure (such as a manhole or access port) without valid confined space entry certification.
13. Maintenance crews shall carry the following additional safety equipment:
 - Caution tape (200 ft. min.);
 - Traffic cones (10 min.);
 - Cellular phone / radio;
 - Local detailed street map or GPS device.

3.2.1.2 PERSONAL PROTECTIVE EQUIPMENT

1. It is recommended that personnel wear protective eye wear when engaged in mowing, string-trimming, sawing, chipping or grinding, operation of power tools or other activities associated with eye hazards. Eyewear shall conform to ANSI Z87.1-1989.
2. It is recommended that personnel wear hard-soled work boots with traction soles and toe guards when conducting maintenance.
3. It is recommended that personnel wear pre-formed or molded ear plugs when operating machinery.
4. It is recommended that personnel wear appropriate respiratory masks when engaged in dusty operations.
5. It is recommended that personnel wear heavy-duty nitrile-coated fabric or leather gloves when performing maintenance activities.
6. It is recommended that personnel wear safety vests when performing work within streets or drive lanes.
7. It is recommended that personnel wear OSHA "Class C" hard hats or protective helmets when on site during the use of heavy equipment, regardless of whether the crew member is operating the equipment. Protective helmets shall conform to ANSI Z89.1-1986.
8. Additional required personal protective equipment is listed by maintenance task in Division 2.

3.2.1.3 HAZARDS

1. Owner/operator and maintenance personnel are all responsible for maintaining safe and healthy working conditions and as part of their daily activities must check worksites for unsafe conditions, watch personnel for unsafe actions and take prompt action to eliminate any hazards.
2. Prior to maintenance events, maintenance personnel shall assess sites for safety issues and direct site safety staging as necessary (for example, places cones, etc.). Typical hazards related to SMP maintenance include but are not limited to:
 - Hand hazards;
 - Hearing hazards;
 - Sight hazards;
 - Slips and trips hazards;

Lifting related injuries;

Heat/cold stress hazards;

Electric hazards;

Fall hazards;

Struck by hazards;

Muscle strain and sprain hazards;

Cut, abrasion, amputation, and laceration hazards;

Pinch points;

Fumes or particulates;

Skin irritants;

Confined space hazards;

Falling and/or spraying objects;

Modified traffic patterns; and

Open utilities.

3. Maintenance personnel shall place cones, temporary guardrails or other appropriate safety/warning measures over any open structures.
4. Maintenance personnel are to follow OSHA confined space entry protocols and utilize air quality monitors whenever entering a combined sewer structure. Combined sewer structures pose health hazards from the hydrogen sulfide gas that accumulates in sewers.
5. Maintenance personnel shall adhere to the following guidance related to hazardous materials:
 - If any hazardous materials or wastes (for example, gasoline from a spill, etc.) are encountered, work must be stopped and the owner/operator notified.
 - Hazardous materials shall be handled only by trained personnel.
6. To reduce hazards associated with fire hydrant use, maintenance personnel operating hydrants shall adhere to the following conditions:

The hydrant operation equipment and hydrant shall be under close observation by maintenance personnel to prevent tampering or theft.

When operating a hydrant during a time where freezing is a risk, road salt shall be applied to all wet areas on the street or sidewalks surrounding the hydrant as well as any areas wet as a result of maintenance.

7. Additional hazards are listed by maintenance task in Division 2.

3.3 PERSONNEL

3.3.1 PERSONNEL TRAINING AND EXPERIENCE

1. All maintenance personnel shall possess the appropriate training and experience as defined by personnel classification below and as applicable to specific maintenance tasks.
2. Personnel operating all equipment will possess all appropriate and applicable certifications and licenses.
3. Personnel handling regulated materials will possess all appropriate and applicable certifications and licenses.

3.3.2 PERSONNEL CLASSIFICATIONS

1. Various aspects of SMP maintenance require the use of specialized personnel. The following personnel classifications are required to carry out one or more tasks described herein:

Botanist — Professional with an accredited degree in the field of botany with experience working on a minimum of two (2) projects involving vegetation identification and health assessment in an urban environment and/or within SMPs.

Certified arborist — Tree care professional recognized by the International Society of Arboriculture (ISA) as an ISA Certified Arborist®.

Certified utility specialist arborist — Tree care professional recognized by the ISA as a Utility Specialist ISA Certified Arborist®.

CCTV camera operator — Professional with a minimum of two (2) years experience in the operation of CCTV equipment for inspection of urban storm sewer systems and/or SMPs.

Engineer or engineering technician — Professional with an accredited degree in the field of engineering with experience working on a minimum of two (2) projects involving SMPs.

Environmental scientist or environment technician — Professional with an accredited degree in the field of environmental science with experience working on a minimum of two (2) projects involving vegetation identification and health assessment in an urban environment and/or within SMPs.

Facility/landscape manager or facility/landscape maintenance crew foreman — Professional with a minimum of five (5) years experience leading facility/landscape operation and maintenance programs and/or maintenance crews and with a minimum of one (1) year experience in the operation and maintenance of SMPs.

Facility/landscape professional — Professional with a minimum of one (1) year experience performing skilled tasks related to facility/landscape maintenance under the direction of a foreman.

Laborer — Paid worker with experience performing unskilled manual tasks related to facility/landscape maintenance under direction of a foreman.

Landscape architect or landscape designer — Professional educated in the field of landscape architecture with experience working on a minimum of two (2) projects involving vegetation identification and health assessment in an urban environment and/or within SMPs.

Mason — Professional with a minimum of two (2) years experience working with concrete and masonry materials.

Vacuum/jet-rodder operator — Professional with a minimum of two (2) years experience with the maintenance of urban storm sewer systems and/or SMPs using vacuuming and jet-rodding equipment.

Vacuum/jet-rodder technician — Professional experienced with the maintenance of urban storm sewer systems and/or SMPs using vacuuming and jet-rodding equipment, traffic control in urban areas, and confined space entry as per OSHA standards.

Volunteer — Unpaid worker capable of performing unskilled manual tasks related to facility/landscape maintenance under direction of a foreman.

3.3.2.2 SURFACE MAINTENANCE PERSONNEL

1. Surface maintenance events shall be executed by a standard surface maintenance crew comprised of the following personnel classifications:

One (1) facility/landscape manager or facility/landscape crew foreman; and

One (1) facility/landscape professional, laborer, or volunteer.

3.3.2.3 SUBSURFACE MAINTENANCE PERSONNEL

1. Subsurface maintenance events shall be executed by a standard subsurface maintenance crew comprised of the following personnel classifications:

One (1) vacuum/jet-rodder operator; and

One (1) vacuum/jet-rodder technician.

2. Additional vacuum/jet-rodder technicians shall be added to the maintenance crew as required for traffic control and confined space entry.

3.4 ACCESS REQUIREMENTS

1. Owner/operator and/or maintenance personnel shall provide clear and safe access to SMPs and sites prior to the execution of maintenance events.
2. Maintenance personnel shall obtain appropriate access permissions from the property owner to access the property prior to commencement of maintenance events.
3. Maintenance personnel shall verify the following conditions are sufficient both at the site and along the proposed travel route for all maintenance equipment prior to transporting equipment to the SMP or site:

Overhead clearances (for example, overpasses, overhead utilities, etc.);

Weight restrictions (for example, bridges, sidewalks, etc.);

Street and access road/path widths;

Physical site barriers (for example, gates, fences, etc.);

Slopes;

Soil stability; and

Distances from vehicular access.

4. Maintenance personnel shall immediately notify the owner/operator if access to the site is blocked during a maintenance event.
5. Blocking of public streets shall not be permitted unless prior arrangements have been made with the City, and coordination with appropriate departments has been established. Traffic control is the responsibility of maintenance personnel and shall be in compliance with state, country, and local highway construction codes.

6. Street and lane closure permitting is described in section 3.5.

7. Additional access requirements are listed by maintenance task in Division 2.

3.4.1 PERMITS AND APPROVALS

1. All required permits and approvals as required for maintenance activities shall be obtained prior to commencement of work by the owner/operator and/or maintenance personnel.
2. Maintenance personnel shall have hard copies of all required permits and approvals on site during maintenance events.
3. Maintenance personnel shall obtain written permission as necessary to perform maintenance activities on private property and on public property.

Maintenance personnel are required to obtain a Philadelphia Parks and Recreation (PP&R) Access Permit prior to executing maintenance with Philadelphia Parks. Owner/operator and/or maintenance personnel shall complete and submit the PP&R Access Permit Application, and contact PP&R to check for updates to the procedure.

4. Maintenance personnel are required to obtain the following background checks prior to executing maintenance on School District of Philadelphia property:

Criminal history check.

Website: www.epatch.state.pa.us/Home.jsp

Child abuse clearance.

Website: www.webgui.phila.k12.pa.us/uploads/OT/CB/OTCBin1EYILfhH4ZP_DS1Q/dpwchildabase.pdf

FBI finger printing.

Website: www.pa.cogentid.com/index.htm

5. Maintenance events requiring the use of a fire hydrant shall require a Fire Hydrant Operation Permit issued by Philadelphia Licenses and Inspections (L&I). Owner/operator and/or maintenance personnel shall follow the Philadelphia L&I's Fire Hydrant Permitting Procedure (Revision 6, 1/27/04), and contact both L&I and PWD to initiate the permitting procedure.

6. Maintenance requiring the closure of a street and/or sidewalk shall require a Street Closure Permit issued by the Philadelphia Streets Department Right-of-Way (ROW) Unit. Owner/operator and/or maintenance personnel shall follow the most up to date permitting procedures as per the Philadelphia Streets Department website.

Website: <http://www.philadelphiastreet.com/highways/street-closure-permits>

ROW Unit must have a minimum 10 business days notification prior to street/lane/sidewalk closure.

7. Additional permit and approval requirements are listed by maintenance task in Division 2.

3.5 MAINTENANCE EVENT PROCEDURES

General maintenance event procedures shall be followed when executing any and all maintenance activities.

3.5.1 PRE-MAINTENANCE EVENT

1. Maintenance personnel shall perform the following general procedures, as applicable, in preparation for maintenance events.

Review all route and site access restrictions, site characteristics, site maps, and other available site-specific information (for example, as-built, construction, and/or design drawings, etc.) to determine the most appropriate personnel, materials, and equipment.

Prepare and print copies of all applicable checklists, access permissions, permits, and approvals.

Transport all personnel, materials, and equipment to the site via a predetermined route that avoids access issues.

Prepare site for maintenance with all necessary warning devices, barricades, and ground personnel required to insure the safety, protection, and warning of persons and vehicular traffic within the area.

If there is a conflict between actual site conditions and the methods specified herein the personnel shall coordinate to change methods as needed per site specific requirements or to facilitate more effective installation. All modifications must be approved prior to the start of work.

Contact owner/operator if site is inaccessible or if unanticipated health and safety issues are present.

3.5.2 DURING MAINTENANCE EVENT

1. Maintenance personnel shall adhere to the following general procedures, as applicable, during maintenance events.

Maintain a safe work zone for personnel, pedestrians, and vehicular traffic. Personnel shall be solely responsible for pedestrian and vehicular safety and control within the work site and shall provide the necessary warning devices, barricades, and ground personnel required to insure the safety, protection, and warning of persons and vehicular traffic within the area. Personnel must follow any and all applicable PennDOT regulations for highway safety.

Personnel shall make all efforts to protect soil structure from excessive traffic, working, or compaction of the soil when conducting work.

Minimize disturbance of soils and vegetation by taking the following precautions:

Use the smallest practicable piece of low ground pressure mechanical equipment in the adjacent areas.

Practice careful foot placement when working in vegetated areas and avoid stepping on plants.

Avoid dragging or driving equipment across vegetated areas.

Avoid compaction of SMP infiltration areas by equipment and personnel.

Restrict or limit vehicular access over finished grade soils in SMPs.

During work, all areas shall be kept neat, clean and free of all trash and debris.

Minimize disruption to vehicular traffic on adjacent roadways.

Minimize disruption to pedestrian traffic on adjacent sidewalks.

Protect adjacent and adjoining structures, utilities, walks, pavements, fences and other facilities, trees, shrubs, mulched beds, plantings, and mulched areas from damage caused by planting operations.

Limit use of water during freezing conditions.

Apply salt to hardscape surfaces to prevent safety hazards during freezing conditions.

Minimize leaking water under freezing conditions.

3.5.3 POST-MAINTENANCE EVENT

1. Maintenance personnel shall perform the following general procedures, as applicable, after

maintenance events.

Complete all checklists and applicable maintenance event documentation.

Remove any soil debris or organic debris from hardscape areas.

Ensure trash/sediment/organic debris from at least 5 ft. on either side of any trench drain, curb-cut or flow control/conveyance structures is removed.

Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other hardscape areas.

All debris shall be cleaned up each day before personnel leave the site, unless permission is given by the city to do otherwise. All lawn areas shall be raked, all streets and sidewalks swept, and all brush, branches, and logs shall be removed from the work site. Work areas are to be left in a condition equal to that which existed prior to the commencement operations.

It shall be the responsibility of maintenance personnel to remove and dispose of in a proper and acceptable manner and in accordance with applicable waste disposal requirements, all debris, trash, and materials resulting from maintenance operations.

Maintenance personnel may not dump woodchips or any debris, etc., at the Fairmount Park Recycling Center. Dumping of any debris at City dump sites should be authorized and coordinated with City staff.

The site shall be inspected to ensure no health and safety hazards or other potential issues either created or unresolved by maintenance activities.

Dispose of materials collected from the site in accordance with applicable waste disposal requirements and as per section 2.4.1 of this document.

2. Perform erosion control/repair as per section 2.1.2, as applicable, after all maintenance events that involve earth disturbance.

3.6 POINTS OF CONTACT

Animal Care and Control Team of Philadelphia

Phone: 267-385-3800

Website: www.acctphilly.org/programs/ac/

Address: 111 W. Hunting Park Ave; Philadelphia

Emergency Police and Fire Services

Phone: 9-1-1

Philadelphia Water Department, Water and Sewer Emergency Line

Phone: 215-685-6300

Philadelphia Health Department - Vector Control

111 West Hunting Park Avenue

Philadelphia, PA 19140

Phone: 215-685-9000

Website: <http://www.phila.gov/health/environment/VectorControl.html>

Philadelphia Electric Company (PECO)

Phone (Emergency): 1-800-4141

Philadelphia Streets Department

Phone: 215-686-5560

Website (Street Closure Permits): www.philadelphiastreet.com/transportation-highways-street_closure-intro.aspx

Website (Illegal Dumping Report): www.potholes.phila.gov/tap.nsf/2cf8da9cb0da9bb9852573c9006b7d99?OpenForm

Website (Dead Animal Report): www.potholes.phila.gov/tap.nsf/85e1a10ac026ffe58525743600760694?OpenForm

Address: Philadelphia Department of Streets; Municipal Services Building; 1401 J.F.K. Blvd.; Philadelphia, PA 19102

Philadelphia Licenses and Inspections

Phone (Permits): 215-686-2567

Phone (Certifications): 215-686-2448

Website: www.phila.gov/li/Pages/default.aspx

Address: Philadelphia L&I; Municipal Services Building, Concourse Level; 1401 J.F.K. Blvd.; Philadelphia, PA 19102

Philadelphia Parks and Recreation

Phone: 215-686-1776

Website: www.phila.gov/parksandrecreation/Pages/default.aspx

Address: One Parkway Building, 10th Floor, 1515 Arch Street, Philadelphia, PA 19102.

Philly 311

Phone: 3-1-1 (215-686-8686)

Website: www.phila.gov/311

Pennsylvania 811 / PA One Call

Phone: 8-1-1 (800-242-1776)

Website: www.pa1call.org

Address: 925 Irwin Run Rd., West Mifflin, PA 15122

3.7 JET-RODDING NOZZLES

1. Flushing Nozzles

Flushing nozzles have rear-facing jet-rods and are used to clean lines that do not have large blockages. These nozzles are similar to the sanitary nozzles used by PWD for sewer cleaning.



Figure 3-1. Small flushing nozzle



Figure 3-2. Sanitary nozzle listed in PWD Sewer Cleaning Manual

2. Penetrating Nozzles

Penetrating nozzles have both forward- and rear-facing jet-rods. The forward-facing jet-rod helps loosen large blockages. These nozzles are similar to those PWD uses for sewer cleaning.



Figure 3-3. Small penetrating nozzle with one front facing and six rear-facing jet-rods



Figure 3-4. Large penetrating nozzle with one front-facing and five-rear facing jet-rods

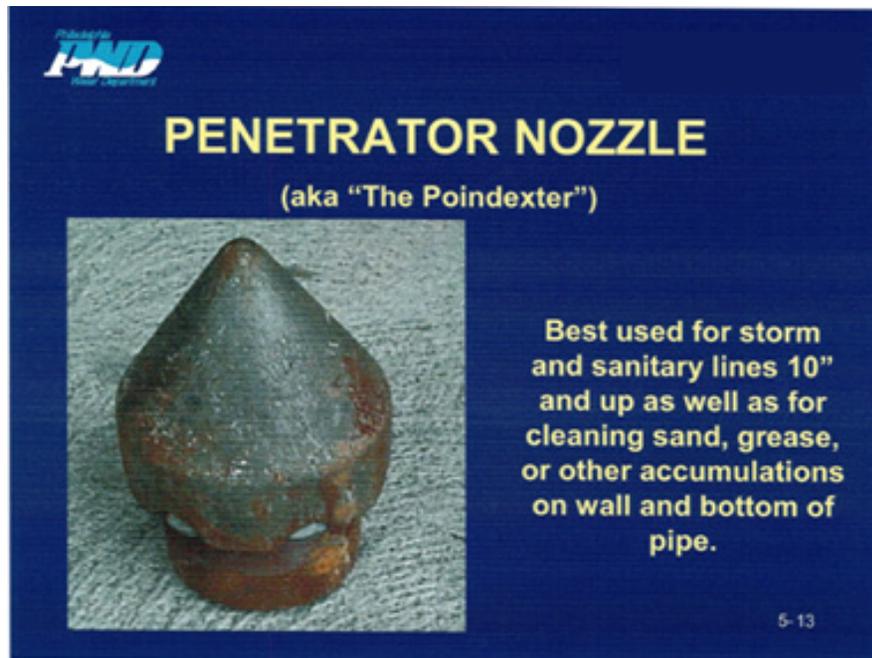


Figure 3-5. Penetrating nozzle listed in PWD Sewer Cleaning Manual

3. Rotating Nozzle

Rotating nozzles can have forward- and/or rear-facing jet-rods. A component of these nozzles rotates, providing lateral cleaning. These nozzles are effective at removing roots as well as debris from pipe walls.



Figure 3-6. Rotating nozzle with three rear-facing jet-rods and rotating center



Figure 3-7: Small rotating, root cutting nozzle

Glossary

division 4



The following terms are defined as they apply to this document.

Access permissions: Documents granting access to or use of a given site (e.g., agreements to enter and maintain SMPs on School District of Philadelphia property, PPR Access Permits, etc.).

Access structure: A portal to the subsurface structures within a rain garden. Access structures may also serve additional functions, such as joining subsurface pipes.

Arborist: An individual engaged in the profession of arboriculture who, through experience, education, and related training, possesses the competence to provide for or supervise the management of trees and other woody plants.

Balled and burlapped stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with the ball size not less than the diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

Bimonthly: Occurring every two months.

Choker/filter course: Permeable layer placed underneath porous paving to provide a level and stable surface. It is typically 1 to 2 in. thick.

Closed-circuit television (CCTV): The use of one or more video cameras to transmit a wired or wireless video signal to one or more monitors and/or to video recording equipment. In the context of this protocol, CCTV refers to the use of remotely controlled camera to view and record the condition of subsurface structures.

Cleanout: A solid vertical pipe capped at the surface that provides access to subsurface pipes for pipe jet-rodding, flushing, vacuum cleaning, and inspection.

Container grown stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching the sides of the container and maintaining a firm ball when removed from the container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plants required.

Conveyance pipes: Pipes that carry stormwater runoff to, from, or within a SMP.

Crown: The leaves and branches of a tree measured from the lowest branch on the trunk to the top of the tree.

Cultipacker: A tool that helps to create a firm seedbed, by pressing down small debris and stones and smoothing the surface.

Decanting: The process by which a mixture or suspension is separated through filtering and/or settlement.

Distribution pipes: Pipes, including perforated and solid pipes that deliver stormwater runoff to an SMP. Distribution pipes are typically located below ground surface within soil media or drainage gravel, but can also be located at the ground surface.

Dredging: The process of excavating and removing unwanted sediment from the bottom of a body of water.

Establishment: The point after planting when a tree's root system has grown sufficiently into the surrounding soil to support shoot growth and anchor the tree.

Establishment watering: A series of watering events that aid in long-term survivorship of newly installed plants.

Failure: Complete loss of function.

Filtering: The process by which a mixture or suspension is separated, by passing the mixture through a filtration medium such as a bed of sand or filter cloth; the fluid phase passes through the medium, while solid materials are trapped.

First flush diverter: An element of a stormwater management practice used to capture debris and pollutants from runoff generated during the initial phase of a rain storm.

Flow control structure: Structural components of stormwater drainage system that detain stormwater and allow its controlled release, for example, weirs, weir walls, orifices, spillways).

Forebay (or sediment forebay): A pool or basin located immediately down-gradient of a stormwater runoff inflow point. Forebays are runoff storage areas designed to trap and settle sediment or other pollutants. Forebays can either be dry (inundated with water during storm events) or wet (inundated with water continuously).

Geotextile: A permeable synthetic fabric that may surround the media and/or drainage stone in an SMP to prevent stormwater from eroding the underlying subbase.

Green inlet: An inlet placed within an existing gutter or other surface flow path that diverts runoff from paved areas and redirects into a green stormwater infrastructure system.

Green stormwater infrastructure (GSI): Engineered systems that use the natural hydrologic processes of infiltration and evaporation to manage stormwater runoff and provide environmental and community benefits.

Hand removal (weeding): The removal of an entire plant (leaves and root system) by pulling with the hands.

Hardscape: a surface or wall composed of traditional or porous asphalt or concrete or masonry that is located above ground.

Hazardous waste: The regulatory definition of solid waste is contained in 40 CFR Part 261. Generally, a hazardous waste is waste that is dangerous or potentially harmful to health or the environment. Hazardous wastes can be liquids, solids, gases, or sludge. Before a material can be classified as a hazardous waste, it must first be a solid waste.

Herbaceous container: A herbaceous plant (annual or perennial flower, grass, sedge or rush) that is approximately 8 in. to 24 in. tall that is available from nurseries in quart, #1, #3, and #5 sized containers. The roots should be healthy, vigorous and established, reaching the sides of the container, but not encircling the sides of the container.

High-pressure vacuum washing: A method used to remove fine soil and sediment from pervious paving. Water at a high pressure is used to dislodge soil particles/sediment, contaminants and debris from the pores of pervious paving. A vacuum should be used in conjunction with the washer to remove the debris.

Herbaceous plug: A young herbaceous plant (annual or perennial flower, grass, sedge or rush) that is approximately 2 in. to 8 in. tall and grown in soil within a cylindrical container cell of a tray. The roots should be healthy, vigorous and established, reaching the sides of the container, but not encircling the sides of the container.

Hydroseeding: A seeding process that uses a slurry comprised of seed, water, and mulch using a tank and hose.

Infiltration: A hydrologic process where water drains downward through SMPs and soil subbase to groundwater.

Inlet: A point of entry into the storm water drainage system (storm sewer). Common types of inlets may include grate inlets, curb opening inlets and combination grate and curb opening inlets. Inlets may be constructed with pretreatment structures such as inlet inserts, sumps, inlet traps, and screens. Inlets are connected to SMPs and/or storm sewer networks by lateral pipes.

Inlet insert: A device installed within an inlet structure, typically just below the inlet grates or curb opening, which allows stormwater runoff to pass while filtering trash, gross pollutants, and sediment. Basic types of inlet inserts are trays, bags, and baskets.

Inlet or catch basin sump: The area within an inlet or catch basin that is below the deepest conveyance pipe outlet of the structure and which provides capacity for sediment accumulation. Sumps within combined sewer inlets are designed to remain filled with water at all times to prevent the release of sewer gas. Sumps within inlets that are not connected to a combined sewer typically drain through weep holes (a series of small diameter drill holes) located in the bottom of the structure.

Inlet trap and hood: A structure installed within an inlet over the connection of an inlet lateral or distribution pipe to provide protection from floatable trash and debris. In inlets directly connected to a combined sewer system, inlet traps define the standing water level of the inlet sump to prevent the escape of sewer gas from the system. Inlet hoods are typically installed in inlets not connected to a combined sewer.

Inorganic fertilizers: Soil additives that are manufactured from minerals or synthetic chemicals.

Invasive vegetation: A non-native, exotic plant species that has been introduced by humans, either by accident or intentionally, such as for agricultural, utilitarian or horticultural uses, into a region or location outside of its naturally occurring extent. Invasive plant species colonize rapidly, outcompeting or overwhelming other native species. Invasive plants grow vigorously and have high reproductive success. Because invasive plant species do not have natural controls, such as pathogens, predators, herbivores and parasites, they pose a threat to native plant communities and biodiversity (www.invasiveplantatlas.org/).

Jet-rodding: The process of cleaning stormwater drainage systems using a truck- or trailer-mounted cleaning system which pumps high-pressure water through nozzles placed inside the drainage system. The high-pressure water jet-rod-cleaning device operates on the principle of high-volume, high-speed water movement to wash away accumulated soil particles/sediment, dirt, contaminants or debris, dissolve blockages, and clean interior surfaces. The nozzles are connected to the water supply by up to 500 ft. of hose coiled on a reel. The thrust generated by the jet-rods of water propels the nozzle assembly through the structure. The process is also referred to as High-Velocity Jet-rod Cleaning, Hydrocleaning, Hydraulic Cleaning, or High Pressure Cleaning.

Lateral pipes: Pipes that connect inlets to SMPs and/or storm sewer networks.

Maintenance event: Any occurrence devoted to preventative as well as corrective maintenance for a SMP. During maintenance events, maintenance personnel execute prescribed maintenance tasks.

Manhole: A concrete chamber within sewer networks or connected to inlets that provides surface access, via cast iron manhole lids, to subsurface pipe networks for inspection, pipe jet-rodding, pipe flushing, vacuum cleaning, and entry of trained personnel.

Mechanical removal: The removal of the leaves or stems of a plant through cutting and the use of a sharpened tool or equipment.

Native vegetation: A plant species that is native to the mid-Atlantic region.

Non-native vegetation: A plant species that is not native to the mid-Atlantic region.

Non-target vegetation: A plant species that was not specifically selected for and planted/seeded within the SMP. Non-target species include both native and non-native species and are often weedy, invasive or aggressive colonizers.

Organic amendments: Various forms of plant debris that are broken down by natural processes and used to ameliorate soil.

Organic debris: Debris from living or decomposing plants including leaf litter, branches, fruit, flowers, bark, etc.

Owner/operator: Organization or individual legally responsible for the operation and maintenance of a SMP.

Pervious area: Surfaces which have the ability to infiltrate water into the soil or subbase.

Pesticides: Substances that control, eradicate, or mitigate pest organisms. They include, but are not limited to, herbicides, fungicides, insecticides, and rodenticides

Plant transpiration: A biological process in which plants absorb water through their roots and ultimately evaporate this water to the atmosphere through their leaves or stems.

Planting/seeding event watering: A watering event that occurs directly following the new installation of plants or seeding of an area.

Regenerative air sweeping: A method used to remove fine soil and sediment from pervious paving. Air at a high pressure and at an angle is used to dislodge soil particles/sediment, contaminants and debris from the surface of pervious paving. The air moves along the width of the sweeping head and the vacuum tube transports the material into the storage hopper. With all the material removed, the clean air is reused.

Pretreatment structures: Structures that capture trash, sediment, and/or other pollutants from stormwater runoff before delivery to a surface detention area or media.

Risers and outlet control structures: Structures that establish a high water level and regulate the overflow of SMPs. These structures typically consist of catch basins or vertical pipes set within a detention area.

Secure container: A container that prevents spilling, leaking or blowing of contained material.

Sediment: Non-organic debris that includes fines, sand, gravel, or soil. The latter may contain some organic components but is still considered sediment.

Settlement: A reduction in ground elevation due to compaction or soil voids.

Soil loss: A reduction in elevation and/or development of void space below surface elevation due to soil migration from its original location.

Soil testing: Laboratory tests to characterize soil properties such as mineral, nutrient, or pollutant content or to measure the range of particle sizes.

Solid waste: The regulatory definition of solid waste is contained in 40 CFR Part 261.2. Generally, a solid waste is a discarded or abandoned material. In this case, solid wastes would be materials such as trash or wastes encountered during GSI maintenance activities.

Storage/media: Storage within a rain garden is provided by an earthen depression storage area and underlying media that accepts, filters, and/or infiltrates stormwater runoff.

Stormwater management practices (SMPs): Individual GSI systems.

Stormwater management practice (SMP) component: A related group of SMP elements (e.g., an underdrain comprised of individual pipe sections, fittings, collars, etc.) associated with a specific SMP.

Stormwater management practice (SMP) element: An individual unit (e.g., a pipe section, pre-treatment device, tree, etc.) associated with a specific SMP.

Stormwater management practice (SMP) feature: Any SMP element or SMP component associated with a specific SMP.

Subbase: The material beneath an engineered or designed surface.

Subsurface maintenance: Any maintenance events and associated tasks that apply to SMP elements that are located below ground and can only be maintained with specialized equipment.

Surface maintenance: Any maintenance events and associated tasks that apply to SMP elements that are located above ground and can be maintained from the surface.

Target vegetation: A plant species that was selected specifically for and planted/seeded within the project area. Within SMPs, target species are typically native; however non-native species are also occasionally planted.

Trench drains: Narrow trenches with solid or grated covers that can convey stormwater runoff. They are typically used to convey stormwater runoff under areas of pedestrian traffic such as sidewalks and are typically constructed of concrete or plastic with cast iron or plastic covers.

Underdrain pipes: Perforated pipes that collect water, often from an infiltration bed, and deliver it to a flow control structure. Underdrain pipes are always located beneath the ground surface and are typically plastic (for example, HDPE, PVC, etc.).

Vacuum cleaning: The use of a truck-mounted stormwater drainage system cleaning device. The cleaning device operates on the principle of large volume, high-speed air movement to lift water, soil particles/sediment, contaminants and debris. A large tube conveys the collected materials into a tank mounted on the truck. The cleaning device also includes a freshwater supply and high-pressure pump system to flush and clean pipes and structures. Collected material is transported in the truck to approved disposal sites. This process is sometimes called vactoring.

