

STORMWATER MAINTENANCE MANUAL

FOR

**DAUGHTERS OF ISRAEL
1155 PLEASANT VALLEY WAY
LOT 12, BLOCK 171**

SUBMITTED TO:

WEST ORANGE ZONING BOARD OF ADJUSTMENT

PREPARED BY:

**PETRY ENGINEERING, LLC
155 PASSAIC AVENUE
FAIRFIELD, NEW JERSEY 07004
973-227-7004**



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I. INTRODUCTION

This Manual presents specific maintenance information about structural and nonstructural stormwater management measures that shall be used to address stormwater quality and quantity requirements of the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, as applied to the proposed site. One specific structural measure, also known as a Best Management Practices (BMPs), included in this manual is:

1. Subsurface Detention Basin #1A
2. Subsurface Detention Basin #1B
3. Detention Basin #2
4. Detention Basin #3
5. Green Roof

The specific maintenance plans for the structural/non-structural BMPs included in this Manual will be followed by those parties responsible for their operation and maintenance. To assist the operator and maintenance inspector of the on-site stormwater management facilities, copies of tables, sample checklists, and logs from the NJDEP Stormwater Management Facilities Maintenance Manual are included in the Appendix of this Manual. A maintenance guide from GreenGrid Roofs is also included in the Appendix of this Manual.

The responsible party for the subject site operation and maintenance is:

Daughters of Israel
1155 Pleasant Valley Way
West Orange, New Jersey 07052
(973) 731-5100

II. SUBSURFACE DETENTION BASIN

A. GENERAL MAINTENANCE

- Inspection of each of the subsurface detention systems as well as the orifi within each of the outlet structures associated with the basins shall be performed at a minimum of once per year or after a major rainfall event.
- Cleaning should be done at the discretion of individuals responsible to maintain proper storage and flow.
- Use a stadia rod to check the depth of sediment within the system. Cleaning should be considered when sediment build up is between 5% and 20% of the pipe diameter. Cleaning should occur at the next earliest opportunity if sediment build up exceeds 20% of the pipe diameter.



- Cleaning and maintenance shall be scheduled during a relatively dry season.
- Access and inspection to each subsurface detention basin is through the 4'X4' Box Outlet structure associated with that basin, and the 36" access risers provided at each corner of the subsurface detention basins. Those structures as well as the 6" cleanout ports can be used for cleaning with a vacuum truck or a water-jetting device.
- See HDPE Detention System Maintenance Technical Note (attached within this manual) for additional information.

III. SURFACE DETENTION BASIN

A. GENERAL MAINTENANCE

- All detention basin components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. These components shall include bottoms, riprap or gabion aprons and inflow points.
- Sediment removal shall take place when the basin is thoroughly dry (See Appendix, Exhibit 1, for recommended hand tools).
- Disposal of debris, trash, sediment, and other waste material must be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

B. VEGETATED AREAS

- Grass shall be mowed to a height of 2 to 3 inches at least once a month during the growing season.
- Vegetated areas must be inspected at least annually for erosion and scour.
- Vegetated areas shall also be inspected at least annually for unwanted growth, which shall be removed with minimum disruption to the bottom surface and remaining vegetation.
- The structure must be inspected for unwanted tree growth at least once a year.



- At the time of initial establishment of the permanent grass mixture specified for the detention basin, bi-weekly inspections of vegetation health shall be performed during the first growing season or until the grass vegetation is established. The New Jersey recommended grass seed mixture is No. 14 Turf-Type Tall Fescue (Blend of 3 cultivars) at planting rate of 3.5 lbs/1000 square feet (Appendix, Exhibit 1). Once established, inspections of vegetation (grass) health, density, and diversity shall be performed at least twice annually during both the growing and non-growing seasons.
- The vegetative cover (grass mixture) should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be re-established by overseeding with the above-specified grass seed mixture in accordance with the original specifications contained in the project Landscape Plan and Soil Erosion and Sediment Control Plan.
- All use of fertilizers, mechanical treatments, pesticides, and other means to assure optimum vegetation health must be minimized as to not compromise the intended purpose of the detention basin. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. STRUCTURAL COMPONENTS

- All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually (See Appendix, Figure 1 – Stormwater Location Plan)

D. OTHER MAINTENANCE PROCEDURES

- The detention basins have been designed to drain in less than 72 hours as the approximate time it would normally take to completely drain the maximum design storm runoff volume (100 yr storm) from each basin. If significant increases or decreases in the normal drain time are observed, the basin's outlet structure, underdrain system, and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the basin. Below is a table relating the approximate times to drain versus inches of rainfall:

Storm Event (yr.)	Inches of Rainfall	Time to Drain (hrs.) Basin #2	Time to Drain (hrs.) Basin #3
100	8.66	27	27



- The detention basins shall be inspected and monitored for mosquito breeding conditions. If significant mosquito breeding is observed, the Essex County Department of Public Works-Mosquito Control shall be contacted at (973) 239-0342.

E. ACCESS

- Access to the detention basins is shown on Figure 1 in the Appendix of this Manual.

IV. **MAINTENANCE COST ESTIMATE**

Sub-Surface Detention Basins	\$1,500 – \$2,000 per year
Surface Detention Basins.....	\$1,500 per year
Green Roof.....	\$1,000 per year

Maintenance cost estimate includes all maintenance tasks, including seed, equipment, sediment, trash and debris removal. Maintenance cost estimates are based on engineering assumptions, manufacturer's recommendations as well as the relative frequency of maintenance. Actual costs may differ from estimate.

V. **APPENDIX**

TABLE 4 – 1 SUMMARY OF MAINTENANCE PROCEDURES

TABLE 4 – 2 MAINTENANCE EQUIPMENT AND MATERIALS

TABLE 4 – 3 MAINTENANCE WORK ORDER AND CHECKLIST

TABLE 4 – 4 MAINTENANCE LOG

TABLE 4 – 5 INSPECTION CHECKLIST

TABLE 4 – 6 INSPECTION LOG

EXHIBIT 1

GREEN ROOF MAINTENANCE GUIDE



HDPE PIPE REPAIR OPTIONS





TECHNICAL NOTE

HDPE Pipe Repair Options

TN 5.03
January 2010

Introduction

High-density polyethylene (HDPE) pipe is lightweight and very easy to handle. The attributes that make the pipe easy to use can also make it easy to abuse, resulting in damaged pipe or joints. This technical bulletin discusses some of the products available that can be used to repair damaged HDPE pipe or joints in the field.

Repair Options

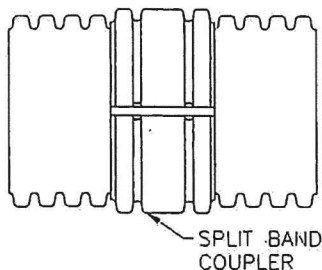
One of the primary considerations in selecting a repair method is the degree of joint performance required. Watertight repairs are generally used on pipe with watertight joints, and soil-tight repairs on pipe with soil-tight joints. This helps keep costs in line and prevents the repair from being the weak area of the pipe system.

The way in which a pipe can be accessed is another primary consideration which influences what type of repair alternative is selected. Pipe that is not yet buried, or can be easily excavated, can be repaired from the exterior. If the pipe is buried and cannot be conveniently excavated, an internal repair may be the best alternative. If the pipe is too small to enter, there are companies with remote controlled equipment that can install the product. Each situation must be considered individually.

The repair options addressed below are divided into external repairs and internal repairs. During any pipe repair, backfill should be placed and compacted per project specifications to provide proper support for the pipe and coupler.

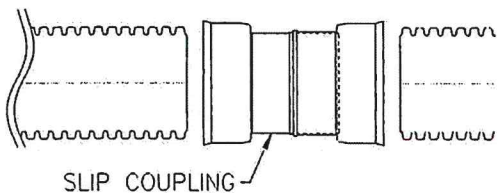
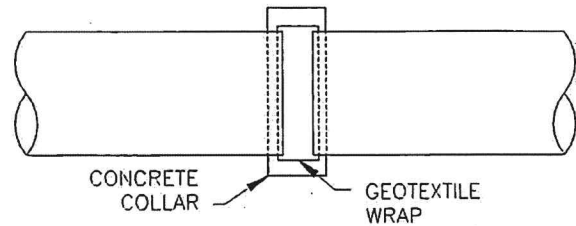
External Mechanical Repairs

Mar Mac Polyseal Pipe Coupler, 4- through 60-inch (100 - 1500 mm), consists of a mastic adhesive base layer, a cross-laminated polyethylene middle layer with a spun-bonded geotextile polypropylene cloth outer layer. The coupler incorporates a self-adhering rubberized bonding mastic and securing bands to insure a positive seal around the pipe. . If the pipe itself is damaged, the damaged area will need to be removed and a new pipe section spliced in before installing a coupler around both ends. Polyseal Pipe Couplers are reasonably priced, especially when considering the quality of the finished repair, and are typically used with soil-tight smooth interior corrugated HDPE pipe products. *Note: Mar-Mac bands shall be installed in accordance with manufacturer's recommendations.*



Snap couplers, 4- through 8-inch (100 – 200 mm), and *split band couplers*, 10- through 30-inch (250 – 750 mm), will provide a soil-tight repair with or without gaskets. This repair method should only be used if the damaged area is in a non-trafficked green area, is cosmetic in nature, confined to a single corrugation, and is not defined as structural damage. The coupler shall be centered around the damaged area of pipe and tightened down with the nylon straps. If the damaged area is large or significant, the damaged area is to be cut out, and replaced with a new section of pipe. The replacement section is to be 'spliced' in place using snap or split band couplers. They are a convenient, low-cost repair alternative, and are typically used to repair soil-tight smooth interior corrugated HDPE pipe products.

Concrete collars also provide a soil-tight repair, dependent on the integrity of the installation. Installing a concrete collar involves building a form around the area to be repaired and encasing it in concrete. A geotextile is usually wrapped around the repair area prior to pouring the collar to keep the concrete from seeping into the pipe. Typically, approximately 6" (0.15m) is excavated beneath the pipe to allow for proper application of the geotextile and concrete encasement. If the pipe itself is damaged, the damaged area shall be removed and a replacement pipe section spliced in prior to pouring the collar. In order to provide a greater level of joint performance, a gasket can be installed on the pipe in the concrete encasement. Concrete collars are typically more costly and time consuming than snap couplers or split band couplers but are reasonable repair options for soil-tight smooth interior corrugated HDPE pipe products. .



Slip Couplings 4- through 24-inch (100 – 600 mm), provides a watertight repair that will meet most pressure testing requirements, when installed correctly. The slip coupling uses PVC bells with gaskets. The gaskets are placed in the valleys on either side of the section to be repaired and slip couplings are then slid over the gaskets. PVC slip couplings are most commonly used with watertight smooth interior corrugated HDPE pipe products. .

Internal Repairs

Internal mechanical repair products generally consist of a flexible cylindrical gasket sleeve, which is expanded to conform to the inner wall of the pipe. The feasibility of this repair method depends on the size of the damaged section or joint and available access into the pipe. Internal mechanical seals slightly restrict the inside diameter of the pipe. This should be considered when assessing the risk of debris obstruction.

NPC Internal Joint Seal, 18- through 60-inch (450 – 1500 mm), consists of an EPDM rubber seal and stainless steel bands. The rubber seal is inserted into the pipe and positioned over the joint. A torque wrench is used to expand the bands against the inner wall of the pipe. The Internal Joint Seal is designed to seal joints – not repair damaged pipe sections. The damaged area of the pipe must be removed and a replacement section spliced in if necessary in order to use the Internal Joint Seal. This system may provide a watertight joint when installed as recommended. The manufacture should be contacted to verify the product meets the specific application requirements including test requirements, if specified. If pressure tests are required, NPC should be contacted to ensure that the product is suitable for the specific test criteria.

Internal mechanical seals will slightly restrict the inside diameter of the pipe. This should be considered when assessing the risk of debris obstruction.

Link Pipe Grouting Sleeve™, 4 through 60 inch (100 – 1500 mm), is a stainless steel grouting sleeve that is installed with an inflatable plug. The sleeve may be used to seal a joint or repair short sections of damaged pipe. The manufacture should be contacted to verify the product meets the specific application requirements including test requirements, if specified.

Internal chemical sealing is another method of internal joint repair using chemically activated gel or grout to minimize joint leakage. The grout is typically applied with specialized remote-controlled equipment. Test/seal



packer is used to remotely seal a joint. The grouting chemicals are forced through the joint out into the surrounding soil where they gel with the soil. The gelled mass forms a waterproof collar around the pipe. The result is significantly reduced leakage. There are several types of chemical grouts available and the manufacturer should be contacted to review the specific situation and any joint tightness or pressure test criteria. Companies such as Avanti International, Strata Tech Inc., and Carylton Corporation manufacture and/or install chemical grout. Stephen's Technologies *New Life Coatings* and *NewLife Liner Systems* as well as Avast Hydro-Lining International, are examples of companies that offer cured in place epoxy lining systems that have been effectively used with HDPE pipe. Most pipe diameters can be chemically grouted provided the grouting contractor has the appropriate equipment.

Manufacturer Contact Information

Contact the Regional Engineer or Application Engineering Department for assistance with other unique conditions or for contact information regarding any companies listed in this technical note.

Note: The HDPE pipe products are solely intended for the conveyance of fluids. Access into this product for maintenance, inspection, repair, or other reason should be done in strict accordance with OSHA recommendations for confined space entry.

HDPE DETENTION SYSTEM MAINTENANCE



TECHNICAL NOTE

Retention/Detention System Maintenance

TN 6.01
February 2007

This document is provided for informational purposes only and is meant only to be a guide. Individuals using this information should make their own decisions as to suitability of this guideline for their individual projects and adjust accordingly.

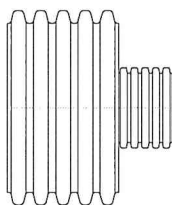
Introduction

A retention/detention system is comprised of a series of pipes and fittings that form an underground storage area, which retains or detains storm water runoff from a given area. As sediment and debris settle out of the detained stormwater, build up occurs that requires the system to be regularly inspected and cleaned in order for the system to perform as originally designed. The following provides the available fittings and guidelines for inspection and maintenance of an HDPE underground storage system.

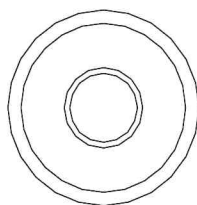
System Accessories and Fittings

Concentric Reducers

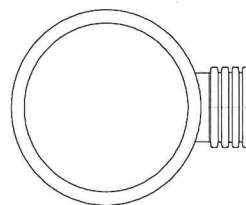
Concentric Reducers are fittings that transition between two pipes, either in line with one another or at perpendicular angles. The centerlines of the two pipes are at the same elevation. When a concentric reducer is used to connect the manifold pipe to the lateral pipes, most debris will be trapped in the manifold pipe.



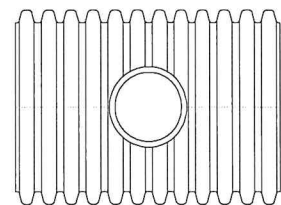
SIDE VIEW



SECTION VIEW



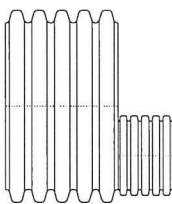
SIDE VIEW



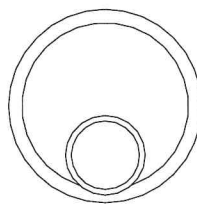
SECTION VIEW

Eccentric Reducers

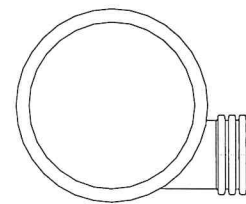
Eccentric Reducers are fittings that transition between two pipes, either in line with one another or at perpendicular angles. The inverts of the two pipes are at the same elevations. When an eccentric reducer is used to connect the manifold pipe to the lateral pipes, most debris will follow the flow of the storm water into the lateral pipes.



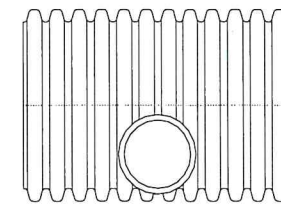
SIDE VIEW



SECTION VIEW



SIDE VIEW



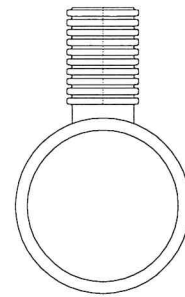
SECTION VIEW

Riser

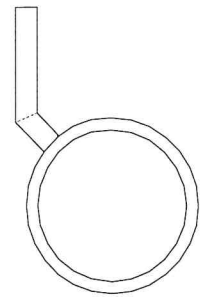
Each retention/detention system typically has risers strategically placed for maintenance and inspection of the system. These risers are typically 24" in diameter or larger and are placed on the manifold fittings.

Cleanouts

Cleanout ports are usually 4-, 6-, or 8-in diameter pipe and are placed on the manifold fittings. They are used for entrance of a pipe from a vacuum truck or a water-jetting device.



RISER
CROSS-SECTION VIEW



CLEANOUT
CROSS-SECTION VIEW

For a complete listing of available fittings and components please refer to the *ADS Fittings Manual*.

Maintenance Overview of a Retention/Detention System

Maintaining a clean and obstruction-free retention/detention system helps to ensure the system performs the intended function of the primary design. Build up of debris may obstruct flow through the laterals in a retention system or block the entranceway of the outlet pipe in a detention system. This may result in ineffective operation or complete failure of the system. Additionally, surrounding areas may potentially run the risk of damage due to flooding or other similar issues.

Inspection/Maintenance Frequency

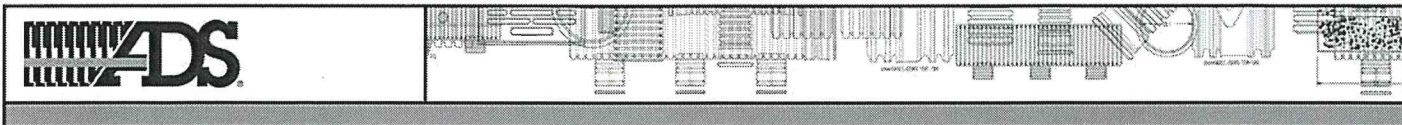
All retention/detention systems must be cleaned and maintained. Underground systems may be maintained more cost effectively if these simple guidelines are followed. Inspection should be performed at a minimum of once per year. Cleaning should be done at the discretion of individuals responsible to maintain proper storage and flow. While maintenance can generally be performed year round, it should be scheduled during a relatively dry season.

Pre-Inspection

A post-installation inspection should be performed to allow the owner to measure the invert prior to accumulation of sediment. This survey will allow the monitoring of sediment build-up without requiring access to the retention/detention system.

The following is the recommended procedure for pre-inspections:

- 1) Locate the riser section or cleanouts of the retention/detention system. The riser will typically be 24" in diameter or larger and the cleanouts are usually 4", 6" or 8" in diameter.
- 2) Remove the lid of the riser or clean outs.
- 3) Insert a measuring device into the opening and make note to a point of reference on the stick or string. (This is done so that sediment build up can be determined in the future without having to enter the system.)



Inspection/Maintenance

A retention/detention system should be inspected at a minimum of one time a year or after major rain events if necessary.

The following is the recommended procedure to inspect system in service:

- 1) Locate the riser section of the retention/detention system. The riser will typically be 24" in diameter or larger.
- 2) Remove the lid from the riser.
- 3) Measure the sediment buildup at each riser and cleanout location. Only certified confined space entry personnel having appropriate equipment should be permitted to enter the retention/detention System.
- 4) Inspect each manifold, all laterals, and outlet pipes for sediment build up, obstructions, or other problems. Obstructions should be removed at this time.
- 5) If measured sediment build up is between 5% - 20% of the pipe diameter, cleaning should be considered; if sediment build up exceeds 20%, cleaning should be performed at the earliest opportunity. A thorough cleaning of the system (manifolds and laterals) shall be performed by either manual methods or by a vacuum truck.

MAINTENANCE COST ESTIMATE

Sub-Surface Detention Basin\$1,500 – \$2,000 per year

Maintenance cost estimate includes all maintenance inspections, equipment, sediment, trash and debris removal. Maintenance cost estimates are based on engineering assumptions, manufacturer’s recommendations as well as the relative frequency of maintenance. Actual costs may differ from estimate.



APPENDIX



MAINTENANCE EQUIPMENT AND PROCEDURES

TABLE 4-1

N.J. DEPARTMENT OF ENVIRONMENTAL PROTECTION STORMWATER MANAGEMENT FACILITY MAINTENANCE MANUAL

SUMMARY OF MAINTENANCE PROCEDURES

A. PREVENTATIVE MAINTENANCE

1. Grass Cutting
2. Grass Maintenance
3. Vegetative Cover
4. Removal and Disposal of Trash and Debris
5. Sediment Removal and Disposal
6. Mechanical Components
7. Elimination of Mosquito Breeding Habitats
8. Pond Maintenance
9. Inspection
10. Reporting

B. CORRECTIVE MAINTENANCE

1. Removal of Debris and Sediment
2. Structural Repairs
3. Dam, Embankment, and Slope Repairs
4. Dewatering
5. Pond Maintenance
6. Extermination of Mosquitoes
7. Erosion Repair
8. Fence Repair
9. Elimination of Trees, Brush, Roots, and Animal Burrows
10. Snow and Ice Removal

C. AESTHETIC MAINTENANCE

1. Graffiti Removal
2. Grass Trimming
3. Control of Weeds
4. Details

MAINTENANCE EQUIPMENT AND PROCEDURES

TABLE 4-2

N.J. DEPARTMENT OF ENVIRONMENTAL PROTECTION STORMWATER MANAGEMENT FACILITY MAINTENANCE MANUAL

MAINTENANCE EQUIPMENT AND MATERIALS

This Table lists the equipment and materials which are typically required to maintain a SWMF. It is presented as a general guide to assist owners, maintenance directors, designers, and financial planners in establishing specific facility maintenance programs. The reader should note that actual equipment and materials requirements must be determined on an individual basis for each facility. Additionally, specific manufacturers, brand names, and types of equipment are not included, as availability, personal preference, and specific usage must also be determined for each maintenance program.

A. GRASS MAINTENANCE EQUIPMENT

1. Tractor-Mounted Mowers
2. Riding Mowers
3. Hand Mowers
4. Gas Powered Trimmers
5. Gas Powered Edgers
6. Seed Spreaders
7. Fertilizer Spreaders
8. De-Thatching Equipment
9. Pesticide and Herbicide Application Equipment
10. Grass Clipping and Leaf Collection Equipment

B. VEGETATIVE COVER MAINTENANCE EQUIPMENT

1. Saws
2. Pruning Shears
3. Hedge Trimmers
4. Wood Chippers

C. TRANSPORTATION EQUIPMENT

1. Trucks for Transportation of Materials
2. Trucks for Transportation of Equipment
3. Vehicles for Transportation of Personnel

MAINTENANCE EQUIPMENT AND PROCEDURES

TABLE 4-2 (CONTINUED)

D. DEBRIS, TRASH, AND SEDIMENT REMOVAL EQUIPMENT

1. Loader
2. Backhoe
3. Grader

E. MISCELLANEOUS EQUIPMENT

1. Shovels
2. Rakes
3. Picks
4. Wheel Barrows
5. Fence Repair Tools
6. Painting Equipment
7. Gloves
8. Standard Mechanics Tools
9. Tools for Maintenance of Equipment
10. Office Space
11. Office Equipment
12. Telephones
13. Safety Equipment
14. Tools for Concrete Work (Mixers, Form Materials, etc.)
15. Welding Equipment (for Repair of Trash Racks, etc.)

F. MATERIALS

1. Topsoil
2. Fill
3. Seed
4. Soil Amenities (Fertilizer, Lime, etc.)
5. Chemicals (Pesticides, Herbicides, etc.)
6. Mulch
7. Paint
8. Paint Removers (for Graffiti)
9. Spare Parts for Equipment
10. Oil and Grease for Equipment and SWMF Components
11. Concrete

Maintenance Work Order and Checklist for Stormwater Management Facilities

Name of Facility: _____

Location: _____ Date: _____

Crew: _____ Work Started: date _____ time _____

Equipment: _____ Work Completed: date _____ time _____

Weather: _____ Total Manhours of Work: _____

A. Preventative Maintenance

Work Item	Items Required (✓)	Items Done (✓)	Comments and Special Instructions
1. Grass Cutting			
A. Bottoms			
B. Embankments and Side Slopes			
C. Perimeter Areas			
D. Access Areas and Roads			
E. Other:			
2. Grass Maintenance			
A. Fertilizing			
B. Re-Seeding			
C. De-Thatching			
D. Pest Control			
E. Other:			
3. Vegetative Cover			
A. Fertilizing			
B. Pruning			
C. Pest Control			
D. Other:			
4. Trash and Debris Removal			
A. Bottoms			
B. Embankments and Side Slopes			
C. Perimeter Areas			
D. Access Areas and Roads			
E. Inlets			
F. Outlets and Trash Racks			
G. Other:			
5. Sediment Removal			
A. Inlets			
B. Outlets and Trash Racks			
C. Bottoms			
D. Other:			

SWM Maintenance List

 Items
Required
(√)

 Items
Done
(√)

Comments and Special Instructions

Page 2 of 3

Work Item

6. Mechanical Components

A. Valves			
B. Sluice Gates			
C. Pumps			
D. Fence Gates			
E. Locks			
F. Access Hatches			
G. Other:			

7. Elimination of Potential Mosquito Breeding Habitats

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8. Pond Maintenance

A. Aeration Equipment			
B. Debris & Trash Removal			
C. Weed Removal			
D. Other:			

9. Other Preventative Maintenance

A.			
B.			
C.			

B. Corrective Maintenance

Work Item	Items Required (√)	Items Done (√)	Location, Comments and Special Instructions
1. Removal of Debris & Sediment			
2. Structural Repairs			
3. Dam, Embankment & Slope Repairs			
4. Dewatering			
5. Pond Maintenance			
6. Control of Mosquitoes			
7. Erosion Repair			
8. Fence Repair			
9. Elimination of Trees, Brush, Roots & Animal Burrows			
10. Snow & Ice Removal			
11. Other			

C. Aesthetic Maintenance

Work Item	Items Required (✓)	Items Done (✓)	Location & Comments
1. Graffiti Removal	☐	☐	
2. Grass Trimming	☐	☐	
3. Weeding	☐	☐	
	☐	☐	

Remarks (Refer to Item No., If Applicable):

Work Order Prepared By: _____

Work Completed By: _____

[illegible]

[illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible][illegible]

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[illegible]

C. Aesthetic Maintenance

Work Item

1. Graffiti Removal

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2. Grass Trimming

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3. Weeding

--	--	--	--	--	--	--	--	--	--

4. Other:

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Remarks (Refer to Item No., If Applicable):

Table 4-5

Inspection Checklist for Stormwater Management Facilities

Name of Facility: _____

Location: _____ Date: _____

Weather: _____

Facility Item	O.K. ¹	Routine ²	Urgent ³	Comments ⁴
1. Embankments and Side Slopes				
A. Vegetation				
B. Linings				
C. Erosion				
Settlement				
Sloughing				
F. Trash and Debris				
G. Seepage				
H. Aesthetics				
I. Other:				
2. Bottoms (Detention and Infiltration)				
A. Vegetation				
B. Erosion				
C. Standing Water				
D. Settlement				
E. Trash and Debris				
F. Sediment				
G. Aesthetics				
H. Other:				
3. Low Flow Channels (Detention)				
A. Vegetation				
B. Linings				
C. Erosion				
D. Settlement				
E. Standing Water				
F. Trash and Debris				
G. Sediment				
H. Other:				

Facility Item

O.K.¹Routine²Urgent³Comments⁴

4. Ponds (Retention)

A. Vegetation				
B. Shoreline Erosion				
C. Aeration Equipment				
D. Trash & Debris				
E. Sediment				
F. Water Quality				
G. Other:				

5. Inlet Structure

A. Condition of Structure				
B. Erosion				
C. Trash & Debris				
D. Sediment				
E. Aesthetics				
F. Other:				

6. Outlet Structure (Detention & Retention)

A. Condition of Structure				
B. Erosion				
C. Trash & Debris				
D. Sediment				
E. Mechanical Components				
F. Aesthetics				
G. Other:				

7. Emergency Spillway

A. Vegetation				
B. Lining				
C. Erosion				
Trash & Debris				
Other:				

8. Perimeter

A. Vegetation				
B. Erosion				
C. Trash & Debris				
D. Fences & Gates				
E. Aesthetics				
F. Other:				

9. Access Roads

A. Vegetation				
B. Road Surface				
C. Fence & Gates				
D. Erosion				
E. Aesthetics				
F. Other:				

Facility Item O.K.¹ Routine² Urgent³ Comments⁴

10. Miscellaneous

A. Effectiveness of Exist. Maint. Program				
B. Dam Inspections				
C. Potential Mosquito Habitats				
D. Mosquitoes				
E.				
F.				
G.				

¹ The item checked is in good condition, and the maintenance program is adequate.

² The item checked requires attention, but does not present an immediate threat to the facility function or other facility components.

³ The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.

⁴ Provide explanation and details if columns 2 or 3 are checked.

Remarks (Refer to Item No., if Applicable):

Inspector: _____

4. Ponds (Retention)

A. Vegetation									
B. Shoreline Erosion									
C. Aeration Equipment									
D. Trash & Debris									
E. Sediment									
F. Water Quality									
G. Other:									

[illegible]

A. Condition of Structure									
B. Erosion									
C. Trash & Debris									
D. Sediment									
E. Mechanical Components									
F. Aesthetics									
G. Other:									

[illegible][illegible][illegible]

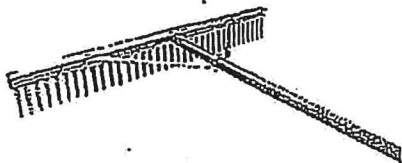
Facility Item

10. Miscellaneous

A. Effectiveness of Exist. Maint. Program										
B. Dam Inspections										
C. Potential Mosquito Habitats										
D. Mosquitoes										
E.										
F.										
G.										

- ¹ The item checked is in good condition, and the maintenance program is adequate.
- ² The item checked requires attention, but does not present an immediate threat to the facility function or other facility components.
- ³ The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.

Remarks (Refer to Item No., if Applicable):



Specially designed for sifting, grading and screening. The tool of choice when you have to sift or screen stones and debris from sand or fine soil.

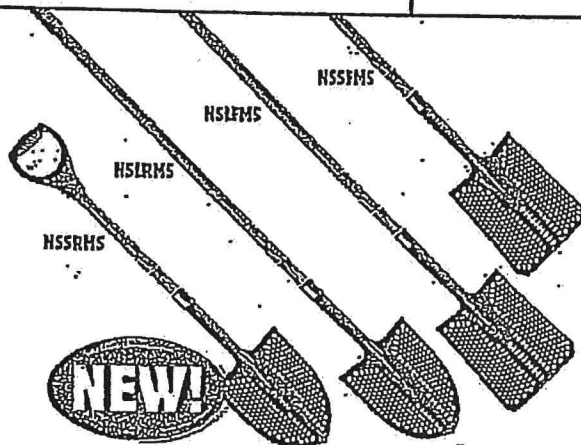
All Rakes have a 66" L handle with 5" L vinyl grip for increased comfort.

No.	Description	Weight	1-2	3+
6JB-60777	24"W Landscape Rake	4.5 lb.	\$40.50	\$36.50
6JB-60778	36"W Landscape Rake	5.3 lb.	49.70	44.90
6JB-60779	48"W Landscape Rake	8.0 lb.	67.80	52.10
6JB-60780	24"W Screening Rake	4.0 lb.	48.90	44.10
6JB-60781	36"W Screening Rake	4.5 lb.	50.20	52.50

SCREENING RAKE BY BEN MEADOWS
(OR APPROVED EQUAL)

50 lb/bag PINELANDS GREEN TURF FESCUE
PLUS MIX (SUN OR SHADE) \$73.00/bag
40% Jubilee tall fescue
40% Morgan tall fescue
14% Saint perennial ryegrass
6% Cache Kentucky bluegrass

GRASS SEED MIXES BY
PINELANDS NURSERY
(OR APPROVED EQUAL)



Mud Slingers

Dig these 4 great new additions to our already outstanding line of shovels and spades.

- Holes in blade allow for superior mud-release.
- The blade is almost 1 pound lighter.
- Fiberglass handle and cushion grip.
- Satisfaction Guaranteed.

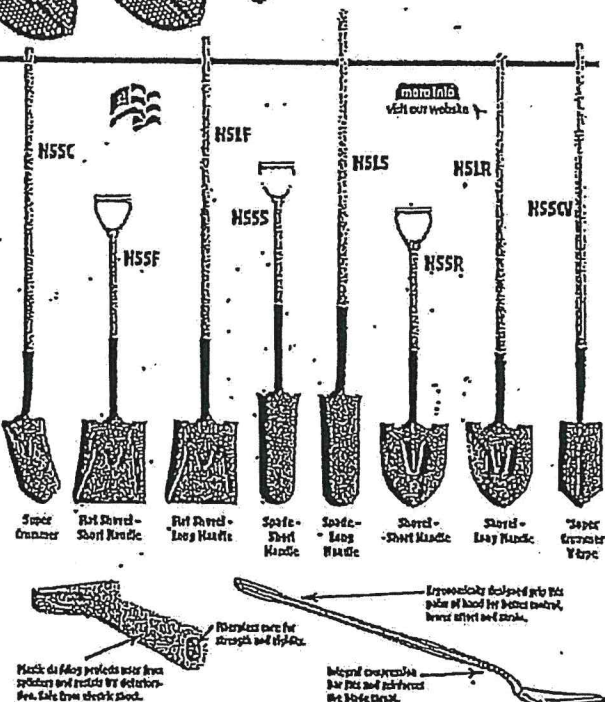
All Mud Slingers\$46.47 ea.

Indestructible Shovels & Spades!

No more broken handles!

- Heavy 14-gauge blades with hollow-back construction.
- Solid fiberglass handles that are guaranteed for a lifetime.
- Forward turned steps for foot comfort and easier penetration.
- Does not absorb moisture, resists industrial chemicals.
- Easily cleaned of concrete, tar, etc.
- Easy to handle in extreme temperatures.
- Ergonomic design for comfort and stress reduction.
- Excellent rigidity reduces wasted effort.

"Super Crummer V-type"\$36.19 ea.
All Others\$31.19 ea.
Handles only\$16.70 ea.



MUD SLINGERS, SHOVELS &
SPADES BY AGRI DRAIN
(OR APPROVED EQUAL)

EXHIBIT 1

NOTE:
ITEMS SHALL BE USED FOR REMOVAL OF
SAND AND DEBRIS.



GREEN ROOF MAINTENANCE GUIDE

Performing routine, preventative maintenance is essential to keeping your green roof healthy. All maintenance should be performed by trained and qualified personnel and using horticultural and safety best practices. Working on elevated structures may require safety training and specialized, protective equipment. Please consult applicable safety regulations and building codes. This installation guide outlines the basic tasks associated with ongoing green roof plant care and maintenance.

Seasonal plant care and green roof maintenance is outlined below for traditional 'extensive' (nominal 4" depth) green roofs. Green roofs involving 'semi-intensive' (6") and 'intensive' (8") modules (aka "roof gardens"), typically incorporate larger and more diverse plantings like ornamental grasses and herbaceous perennials. The associated care and maintenance for these applications is generally more frequent and similar to ground-level landscaping.

MAINTENANCE ACTIVITIES AND SCHEDULE

The type of maintenance activities required for a green roof will depend on the plantings and regional climate. The seasonal guidelines noted below are typical for 'extensive' green roofs planted with low-growing, drought-tolerant sedum and succulents in most moderate climates (Zones 3-7) with 30-50 inches per year of precipitation. Basic green roof maintenance involves watering, weeding, and plant care. Proactive maintenance will always be best.

Watering

Green roof systems are typically designed using hardy, drought-resistant varieties that can thrive in a harsh roof top environment. Extensive green roofs typically don't require built-in irrigation systems in most regions. However, during periods of prolonged drought, the extensive green roof should be watered to sustain plant health. As a general rule, if natural precipitation is < 0.5-inch in a 10-15 day period during the growing season, watering may be needed or plants may become dormant or fail. Prolonged temperatures above 85 degrees F and/or very windy locations may need to be watered sooner. Supplemental irrigation should include the application of approximately 1 inch of water once per week until more moderate precipitation patterns resume. In arid climates (including Southern CA, Southwest U.S., High Plains and Mountain states and central TX) as well as the Southeast U.S. and Gulf Coast regions, permanent irrigation systems are recommended for all green roof systems.

Weeding

The green roof should be visually inspected and spot-weeded every 2-4 weeks during the growing season. It is important to remove weeds before they flower and set seed to minimize future efforts. Like any garden, preventative, regular weeding has the best results with the least total effort. In most climates, for green roofs < 5,000 sf, weeding will require about 10 to 20 man-hours per year. While weeding, it is a good idea to inspect the roof drains and insure that water not utilized by the green roof can drain freely off the roof.

Plant Care

Green roof plant care has two primary components – fertilizing and trimming. Fertilizing should be conducted at least annually in spring for the first 3-5 years after installation, and then on a reduced schedule if soil testing and plant performance suggest it is advisable. Late summer or early fall fertilizing may also be suggested depending on the plant mix and region, but is

generally not necessary. Avoid feeding during the hottest/driest parts of the year or late in the season when plants should be entering a dormant or less active phase. Nutrients should be added with granular, slow-release fertilizer (minimum 3 months) with a target N-P-K ratio of 18-6-12. Alternatively, a generic 10-10-10 slow-release general landscaping fertilizer can be used and is often available at garden and home centers. We recommend Harrells, Osmocote®, and Nutricote® products. Where an organic fertilizer is preferred, Plant Tone (Espoma), or Earthworks Replenish are also effective. Apply fertilizers in accordance with the manufacturer's recommendations and instructions on the container. Soil tests are recommended every year or every other year, with target values the same as for general landscaping.

Every two to three years, trim the green roof to encourage additional leaf development at the plant crown and to spread regenerative cuttings across the system during the spring season. A string trimmer or even a lawn mower set at the maximum height with a mulching blade can be used. Everybody likes a haircut, and so do your plants!

During each green roof maintenance event (or monthly) it is advisable to monitor plant health. These observations may adjust the timing or needs for other maintenance tasks. An overview about green roof maintenance in each season and general sequencing about plant care seasonal is illustrated below.

SEASONAL GREEN ROOF MAINTENANCE – MOST U.S. REGIONS

Plant Type	Spring	Summer	Fall
Sedums	Fertilize (April) Weed (May) Trim* (optional – May)	Weed (every 2-4 weeks) Watering (during droughts)	Weed (October)
Perennials	Trim* (March-Apr) Fertilizer (April) Replant* (if necessary)	Weed (every 2 weeks) Activate irrigation system	Weed (October) Replant* (if necessary) Winterize irrigation
Ornamental Grasses	Trim* (March-April) Fertilizer (April) Replant* (if necessary)	Weed (every 2 weeks) Set Watering Schedule (or use irrigation system)	Weed (October) Replant* (if necessary) Winterize irrigation

**Trimming of grasses and perennials should be conducted early spring before new growth appears, or late fall, depending on the specific plant variety. Sedum trimming should be conducted during active growth in spring. Replanting in spring or fall will also be determined by the specific plant variety.*

SPRING SEASON

- Conduct routine inspections and spot weeding (2-3 week intervals) to prevent flowering and reseed.
- If soil testing suggests it is required, or in the absence of a soil test, apply slow release fertilizer.
- Monitor plant health and replace any plants, as necessary, taking note of any areas impacted by rooftop microclimates (shady spots, exhaust vents, drip edges, intense reflected light, etc.) where replanting may not be successful, and alternate plantings or an alternate approach (i.e., decorative stone) may be necessary.
- Do not apply herbicides or pre-emergent weed control without first consulting a horticulturalist or your GreenGrid representative.

SUMMER SEASON

- Conduct routine inspections and spot weeding (2-3 week intervals) to prevent flowering and reseed.
- Establish the irrigation schedule for permanently irrigated systems.
- Water non-irrigated systems during prolonged drought as noted above, applying 1" of water once per week. Heat waves, sustained wind and solar glare conditions (from reflective glass) may warrant more frequent watering of 2-3 times per week.
- Monitor plant health and for microclimate effects.
- Address pests if needed using organic, essential-oils based products, if possible. Apply preventative and/or curative fungicides if necessary, particularly in hot, humid climates in the Southeast U.S. and Gulf Coast.

FALL SEASON

- Conduct routine inspections and spot weeding (3-4 week intervals).
- Monitor plant health and replant as needed.
- Be cautious if you need to apply fertilizer during the early fall season as it may affect plant hardiness during the winter months. If it is absolutely necessary, we suggest diluting the application rate by 50-75%.
- If the irrigation system is permanent, drain and winterize in cold regions by October 15th.
- Plants will become dormant as colder temperatures persist in northern climates. In warmer climates, plants may go dormant or semi-dormant and weeds will continue, so remain vigilant by periodically weeding.

OTHER CONSIDERATIONS

- For intensive green roofs and garden-style settings, plant maintenance and care is more frequent and generally consistent with the requirements of ground-level landscaping. A horticulturalist or landscape professional can assist or make recommendations for your specific garden-roof installation.
- Restorative maintenance on green roofs that have not been well maintained should be under the guidance of a GreenGrid representative or landscape professional. Restoration may include combination slow release and foliar (liquid) feeding, replanting or application of plant cuttings, temporary irrigation, etc.
- Modules installed with less than full coverage, planted on site, or not fully rooted on delivery due to schedule demands will require a short period of additional maintenance on the roof, which may include additional watering and weeding in particular. As the plants mature, and less of the media is exposed, the frequency of maintenance will decrease.

DOCUMENTATION

Maintenance activities should be recorded to document the type of activities completed, resources used and timing for future events. ***Routine submission of maintenance documentation is required to maintain plant warranty.***

The maintenance log and photos should record the following:

- Person conducting maintenance, date and time. Time required for maintenance tasks.
- Type of cutting, trimming or other plant care provided.
- Soil testing results, fertilizer type/brand and application rate, if applicable.
- Notations or photos about plant stress, watering rates, drought periods, and plant replacement(s).
- Photos of all green roof areas, with close up photos of any problem spots.