

Stormwater Management Operation and Maintenance Manual

For

Hope Presbyterian Church Proposed Sanctuary Addition

Block 5401, Lot 118
140 Denow Road
Township of Lawrence
Mercer County, NJ

Prepared By:



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PROJECT DETAILS

I. Introduction and Description of Facilities:

The purpose of this report is to provide guidelines and information regarding the required maintenance for the proposed stormwater management facilities to be constructed in association with the development of Block 5401, Lot 118 in the Township of Lawrence, Mercer County, New Jersey. The scope of the study includes the proposed site improvements including a sanctuary expansion with a gross total floor area of 4,566 SF in this area, as well as the addition of a 186 SF foyer to the existing building. The proposed project will also include associated site improvements including parking areas, landscaping, lighting, stormwater management facilities, utilities and other related site improvements as shown on the accompanying engineering drawings. The proposed stormwater management system includes one (1) aboveground small-scale bioretention basin with underdrains, and one (1) pervious pavement system.

The stormwater management facilities will contribute toward the conveyance, storage, treatment and discharge of runoff generated by the proposed development. Every stormwater management system, requires that basic periodic maintenance be performed in order to maintain the proper functioning and operation of the system. This report will outline these procedures, further discuss responsibilities and highlight those responsible for performing said maintenance.

These facilities will require periodic inspections and maintenance. The following information can be considered a guideline for the continued maintenance including suggested inspection scheduling as well as performance objectives.

Hydrology Design Targets for Small Scale Bioretention Basin Systems

1. Small scale bioretention basins are designed as water quality basins and will be intended to discharge runoff via an underdrain system with the following parameters:

BASIN	Min. SHWT Separation (FT)	Net Contributory Area (AC)
Basin	5.5	1.100

Hydraulic Design Targets

1. Design parameters

RUNOFF VOLUME (AC-FT)							
Bio Basin	Water Quality	2 YR Current	10 YR Current	100 YR Current	2 YR Projected	10 YR Projected	100 YR Projected
Basin	0.047	0.095	0.146	0.168	0.110	0.158	0.173

PEAK FLOW RATE (CFS)							
Bio Basin	Water Quality	2 YR Current	10 YR Current	100 YR Current	2 YR Projected	10 YR Projected	100 YR Projected
Basin	0.00	0.68	1.50	7.58	0.92	2.98	10.43

WATER SURFACE ELEVATION (FT)							
Bio Basin	Water Quality	2 YR Current	10 YR Current	100 YR Current	2 YR Projected	10 YR Projected	100 YR Projected
Basin	134.30	135.09	135.90	136.23	135.33	136.08	136.31

Basin Configuration Targets

1. Basins are designed to have a maximum net contributory area of 2.5 acres.
2. The basins have a minimum of one (1) feet of separation between the bottom of the basin and the seasonal high-water table.
3. System must fully drain within 72 hours.
4. System must have a minimum of 85% density of vegetation.
5. System must have a 18" soil bed, 6" sand layer and 12" gravel layer.
6. The soil bed must be free of contaminants.
7. The pH of the soil bed material is recommended to range from 5.5 to 6.5

Critical Maintenance Features (Bioretention Basins)

1. Corrective action should be taken if standing water remains in the basin 72 hours after a storm event.
2. Remove and replace dead vegetation to prevent mosquito problems.

Hydrology Design Targets for Pervious Pavement Systems

1. Pervious Pavement systems are designed as water quality basins with the following parameters:

Pervious Pavement	Min. SHWT Separation (FT)	Depth Of Storage Bed (FT)	BMP Area (SF)	Total Contributory Area (SF)	Contributory Area Ratio
PP	4.0	4.5	9,150	34,848	2.81

Hydraulic Design Targets

1. Design parameters

RUNOFF VOLUME (AC-FT)							
Pervious Pavement	Water Quality	2 YR Current	10 YR Current	100 YR Current	2 YR Projected	10 YR Projected	100 YR Projected
PP	0.055	0.116	0.182	0.289	0.135	0.211	0.336

PEAK FLOW RATE (CFS)							
Pervious Pavement	Water Quality	2 YR Current	10 YR Current	100 YR Current	2 YR Projected	10 YR Projected	100 YR Projected
PP	0.12	0.23	0.31	1.14	0.26	0.34	2.89

WATER SURFACE ELEVATION (FT)							
Pervious Pavement	Water Quality	2 YR Current	10 YR Current	100 YR Current	2 YR Projected	10 YR Projected	100 YR Projected
PP	132.73	133.43	134.22	135.49	133.65	134.55	136.05

Basin Configuration Targets

1. The Pervious Pavement systems have maximum 3 to 1 additional inflow area ratio.
2. Where infiltration is not feasible the separation from SHWT is a minimum of 1 foot or the basin is lined to provide separation from SHWT.
3. The system consists of a pervious surface course, stone choker course, and stone storage bed with perforated pipe.
4. Filter fabric is located along the sides and bottom of the system to provide separation from the soil.
5. Overflow structures in the form of B-inlets are placed periodically to provide collection and detention in the event of pervious pavement clogging. These inlets are placed at the low point in the pavement to help identify a failure condition.
6. Inspection ports are provided at the ends of each underdrain to monitor the system.

Critical Maintenance Features (Pervious Pavement)

1. Pervious pavement should be vacuum swept at least four times per year.
2. Care should be taken when removing snow and ice to avoid damage to the pervious pavement system.
3. Sealants should not be applied to the pervious pavement system.
4. Corrective action should be taken in the event standing water is observed on the surface course.

II. Project Contacts:

The applicant is responsible for maintaining a detailed log of all preventative and corrective maintenance actions for the constructed stormwater facilities incorporated into the design, including record of all inspections and copies of all maintenance-related work orders.

The applicant is also responsible for maintenance to evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and deed as needed. The applicant shall retain a copy of this report onsite should a public entity request this report or documentation of said maintenance in the future.

Property/System Owner:

Hope Presbyterian Church
140 Denow Road
Lawrence, New Jersey 08648

Design Engineer:

Jeffrey S. Haberman, PE, PP
Dynamic Engineering Consultants, PC
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As previously mentioned, this manual, including any future revisions, must be recorded upon the deed of record of the property.

III. Proposed Best Management Practices:

A. Routine Inspection and maintenance of Stormwater Management Facilities

All stormwater management facilities have been designed to control stormwater and reduce flooding and degradation of water quality. Without proper routine inspection and maintenance, the system may lose some or all of its capability to function to its full capacity. Lack of adequate maintenance at these facilities could lead to system failures.

Regularly scheduled maintenance inspections of the stormwater facilities should occur at least four times each year. In addition to the regular scheduled inspections, inspections shall also occur after any major storm events. Major storm events are defined as storm events exceeding 1" of rainfall. The primary purpose of these inspections is to ascertain the operational condition and safeties of the facilities, particularly the condition of embankments, outlet structure, rip rap and other safety-related aspects. Inspections will also provide information on the effectiveness of regularly scheduled Preventative and Aesthetic Maintenance Procedures, and will help to identify where changes in the extent and scheduling of the procedures are warranted. Finally, the facility inspections should also be used to determine the need for and timing of Corrective Maintenance procedures.

Routine maintenance of this facility should be separated into two (2) basic types: Functional Maintenance and Aesthetic Maintenance. Functional Maintenance is further broken down into two (2) categories: Preventative and Corrective. Aesthetic Maintenance, which is necessary to maintain the visual appeal and aesthetic quality of these facilities should be incorporated on the same schedule as the preventative maintenance efforts. Listed below are the Preventative, Corrective and Aesthetic Maintenance Procedures to be performed on a routine basis:

1. Preventative Maintenance Procedures for Bioretention Basins:

a) Grass Cutting:

A regularly scheduled program of mowing and trimming of grass at the basin during the growing season will help to maintain a tightly knit turf, and will also help to prevent diseases, pests and the intrusion of weeds. The infiltration basins proposed on the accompanying civil drawings contain a sand bottom. As a result of that, mowing will

only take place on the grass lined portions of the basins. The actual mowing requirements of an area should be tailored to the specific site conditions, grass type, and seasonal variations in the climate. In general, lawn areas should be mowed at least once a month during the growing season and grass should not be allowed to grow more than 1 to 2 inches between cuttings. Allowing the grass to grow more than this amount prior to cutting it may result in damage to the grass' growing points and limit its continued healthy growth.

b) Grass Maintenance:

Grassed areas require periodic fertilizing, de-thatching and soil conditioning in order to maintain healthy growth and to provide bank stabilization. Additionally, provisions should be made to re-seed and re-establish grass cover in areas damaged by sediment accumulation, stormwater flow, or other causes. Fertilizing and seeding should be performed to manufacturer's guidelines to prevent over seeding and vegetation from growing within the sand bottom of the basin. These tasks should be performed, or at least evaluated, on a quarterly basis.

c) Vegetative Cover

Trees, shrubs, and ground cover require periodic maintenance, including fertilizing, pruning, and pest control in order to maintain healthy growth. Vegetated areas must be inspected at least annually for erosion and scour as well as unwanted growth, which should be removed with minimum disruption to the remaining vegetation. The basin should be evaluated regularly to determine whether excessive plant growth is evident. A correction in the application of fertilizers can often solve these problems. Weeds, which have become a problem, can be cleared through harvesting by professional maintenance technicians.

Note: All use of fertilizers, mechanical treatments, pesticides and other means to ensure optimum vegetation health must not compromise the intended purpose of the storm water management facility. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

d) Removal and Disposal of Trash/Debris and Sediment:

All storm water management 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 one inch of rainfall. Such components may include the pervious pavement system, stormwater conveyance network (piping & inlet), flared end sections and outlet control structure.

These stormwater management components shall be visually inspected for the accumulation of excessive sediment as well as damage in the form of cracking, erosion and rutting. Sediment build-up within the stormwater conveyance network

shall be removed with the use of flushing. Sediment laden water is to be captured with the use of a pipe plug, or approved equal, prior to the storage bed and simultaneously pumped out with the use of pump with sediment bag. Sediment should be disposed of in accordance with all applicable local, state and federal regulations.

Removal of trash and debris will prevent possible damage to trash racks and outlet structure openings and eliminate potential mosquito breeding habitats. Debris and trash must be properly hauled off the site and transferred to an approved disposal site.

The system should also be evaluated for excessive deposition of sediment. Accumulated sediment should be removed utilizing light weight equipment to avoid soil compaction before it threatens the storage volume of the system. Before de-sedimentation activities are performed, consideration should be given to evacuating all standing water from the system. This may be accomplished by clearing any blocked openings of the outlet structure or by mechanical means (pumping). Disposal of discharged water and sediment must comply with all local, county, state and federal regulations. Only suitable disposal sites should be utilized. If stable soil conditions exist on site, sediment deposition should not be an excessive maintenance issue. Should a recurrent stabilization situation develop, the inspector should identify the upstream sources of sediment and recommend required stabilization measures. Access has been provided for inspection and maintenance of the system and its components.

e) Sediment Removal and Disposal:

The basin should also be evaluated for excessive deposition of sediment. Accumulated sediment should be removed before it threatens the storage volume of the basin. Before de-sedimentation activities are performed, consideration should be given to evacuating all standing water from the basin. This may be accomplished by clearing any blocked openings of the outlet structure or by mechanical means such as pumping. If stable soil conditions exist on-site, sediment deposition should not be an excessive maintenance issue. Should a recurrent stabilization situation develop, the inspector should identify the upstream sources of sediment and recommend required stabilization measures.

f) Mechanical Components:

Mechanical components such as valves, sluice gates, pumps, fence gates, locks, and access hatches, should remain functional at all times. Regularly scheduled maintenance should be performed in accordance with the manufactures' recommendations. Additionally, all mechanical components should be operated at least once every three months to assure their continued performance.

g) Elimination of Potential Mosquito Breeding Habitats:

The most effective mosquito control program is one that eliminates potential breeding habitats. Almost any stagnant pool of water can be attractive to mosquitoes, and may become the source of a large mosquito population. A maintenance program dedicated to eliminating potential breeding areas is preferable to chemical means of controlling mosquitoes. The most important maintenance functions, is removal of all obstructions to natural flow patterns before stagnant water conditions can develop.

h) Observations After Rainfall:

This management measure involves monitoring the amount of time the aboveground infiltration basin takes to drain to ensure the basin is working properly. The aboveground infiltration basin should drain to the bottom in less than 72 hours. If significant increases or decreases are observed in the drawdown time, a qualified licensed Professional Engineer shall be contacted to evaluate the basin's bottom surface, subsoil and both groundwater and tailwater elevations to determine what corrective measures may need to be implemented.

2. Preventative Maintenance Procedures Pervious Pavement:

a) Removal and Disposal of Trash/Debris and Sediment:

All storm water management 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 one inch of rainfall. Such components may include the pervious pavement system, stormwater conveyance network (piping & inlet) flared end sections, scour hole, trash racks and outlet control structure.

These stormwater management components shall be visually inspected for the accumulation of excessive sediment as well as damage in the form of cracking, erosion and rutting. Sediment build up within the stormwater conveyance network shall be removed with the use of flushing. Sediment laden water is to be captured with the use of a pipe plug, or approved equal, prior to the storage bed and simultaneously pumped out with the use of pump with sediment bag. Sediment should be disposed of in accordance with all applicable local, state and federal regulations.

Removal of trash and debris will prevent possible damage to trash racks and outlet structure openings and eliminate potential mosquito breeding habitats. Debris and trash must be properly hauled off the site and transferred to an approved disposal site.

The system should also be evaluated for excessive deposition of sediment. Accumulated sediment should be removed utilizing light weight equipment to avoid soil compaction before it threatens the storage volume of the system. Before de-sedimentation activities are performed, consideration should be given to evacuating all standing water from the system. This may be accomplished by clearing any blocked openings of the outlet structure or by mechanical means (pumping). Disposal of discharged water and sediment must comply with all local, county, state and federal regulations. Only suitable disposal sites should be utilized. If stable soil conditions exist on site, sediment deposition should not be an excessive maintenance issue. Should a recurrent stabilization situation develop, the inspector should identify the upstream sources of sediment and recommend required stabilization measures. Access has been provided for inspection and maintenance of the system and its components.

b) Parking Lot Maintenance:

This management measure involves employing pavement cleaning practices, such as parking lot sweeping on a regular basis, to minimize pollutant export to the stormwater conveyance system/basin and downstream of the basin discharge. These cleaning practices are designed to remove sediment, debris, and other pollutants from access drive and parking lot surfaces that are a potential source of pollution impacting urban waterways. Mechanical machines that use vacuum assisted dry sweeping to remove particulate matter shall be utilized as these have the ability to remove finer sediment particles. Parking lots and access drives shall be swept/vacuumed at least once a month. The disposal of the swept material must be properly hauled off the site and transferred to an approved disposal site.

c) Pervious Pavement System Maintenance

The primary goal of pervious pavement maintenance is to prevent the pavement surface and/or the underlying storage bed from being clogged with fine sediments. To keep the system clean throughout the year and prolong its lifespan, the pavement surface should be vacuum swept at least four times a year. All inlet structures within or draining to the storage beds should also be inspected on a biannual basis and after major storm events and cleaned of debris as necessary. Should the pervious pavement system's storage area not drain within 72 hours, the various system components and groundwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the system.

The surface course must be inspected after every storm exceeding 1 inch of rainfall. If mud or sediment is tracked onto the surface course, it must be removed as soon as possible. Removal should take place when all runoff has drained from the surface course.

The surface course must be inspected, at least once annually, for cracking, subsidence, spalling, erosion, deterioration and unwanted vegetation. Remedial measures must be taken as soon as possible. Herbicides must not be applied.

Planted areas adjacent to pervious pavement should be well maintained to prevent soil washout onto the pavement. If any washout does occur it should be cleaned off the pavement immediately to prevent further clogging of the pores. Furthermore, if any bare spots or eroded areas are observed within the planted areas, they should be replanted and/or stabilized at once. Superficial dirt does not necessarily clog the pavement voids. However, dirt that is ground in repeatedly by tires can lead to clogging. Therefore, trucks or other heavy vehicles should be prevented from tracking or spilling dirt onto the pavement. Furthermore, all construction or hazardous materials carriers should be prohibited from entering a porous pavement lot.

d) Vacuuming

It is recommended to vacuum pervious pavement and concrete pavement with a vacuum sweeper at least four times a year. This should be followed by a high pressure hosing or air blowing. All dislodged sediment and other particulate matter must be removed and properly disposed. The first annual maintenance must be performed in the spring and additionally must be performed in the autumn, after the fallen leaves are collected and removed. Acceptable types of vacuum sweepers include the Elgin Whirlwind and the Allianz Model 650. Though much less effective than “pure” vacuum sweepers, regenerative air sweepers, such as the Tymco Model 210, Schwarze 348, Victory, and others, are sometimes used. These units contain a blower system that generates a high velocity air column, which forces the air against the pavement at an angle, creating a 'peeling' or 'knifing' effect. The high-volume air blast loosens the debris from the pavement surface, then transports it across the width of the sweeping head and lifts it into the containment hopper via a suction tube. Thus, sediment and debris are loosened from the pavement and sucked into the unit. (Note: simple broom sweepers are not recommended for pervious pavement maintenance.) If the pavement surface has become significantly clogged such that routine vacuum sweeping does not restore permeability, then a more intensive level of treatment may be required. Recent studies have revealed the usefulness of washing pervious pavements with clean, low pressure water, followed by immediate vacuuming. Combinations of washing and vacuuming techniques have proved effective in cleaning both organic clogging as well as sandy clogging.

Maintenance crews are encouraged to determine the most effective strategy of cleaning their pervious paver installations.

For smaller installations, such as sidewalks, plazas, or small parking lots, “walk behind” vacuum units may prove most effective. Though these units can be loud and somewhat messy to the operator due to the lack of dust suppression, they are also relatively easy to operate and inexpensive. Examples of acceptable “walk behind”

units include the Billy Goat models, the 5700 industrial-strength Scrubber by Tennant, and the sidewalk class vacuum sweepers made by Nilfisk, Advance and Hako. If “walk behind” units are used, it is recommended that the scrub pressure be kept relatively low. The dirtiest areas may need to be power washed after scrubbing to get out the dirt that has been deeply ground in.

e) Winter Maintenance

Winter maintenance for a pervious pavement parking lot may be necessary, but is usually less intensive than that required for a standard asphalt lot. By its very nature, a pervious pavement system with subsurface aggregate bed has superior snow melting characteristics than standard pavement. Therefore, ice and light snow accumulation are generally not as problematic. However, snow will accumulate during heavier storms. Abrasives such as sand or cinders should not be applied on or adjacent to the pervious paver pavement. Snow plowing is necessary for significant snow accumulation, but should be done carefully (i.e. by utilizing a rubber blade guard). De-icing chemicals may not be used on pervious concrete less than one year old. Follow supplier recommendations when applying deicers to pavement.

Each spring, after the last snow or ice event, the infiltration rate of the surface course must be tested in accordance with the methods of either ASTM C1701 or C1781, as corresponds to the post-construction test performed for the system. At least 3 locations must be tested. One of the locations must be in an area where sediment is most likely to be deposited, such as, but not limited to, a parking lot entrance. The other test locations must be evenly spaced across the system surface. The locations and results obtained must be recorded in the maintenance plan for future reference and compared to the as-built testing results as a metric for determining if a system requires corrective action. Please refer to the Test Methods Per ASTM C1701 or C1781 Chart located within the Appendix of this report.

3. Corrective Maintenance Procedures for Bioretention Basin:

a) Removal of Debris and Sediment:

Sediment, debris and trash which threaten the discharge capacity of the system should be removed immediately with the use of light weight equipment to avoid soil compaction and properly disposed. As noted previously, it is recommended that all water be evacuated from the system with a pump before any significant amount of sediment, settled debris or trash is removed from the system. The lack of an available disposal site should not delay the removal of trash, debris and sediment. Temporary disposal sites should be utilized if necessary.

b) Structural Repairs:

Structural damage to outlet and inlet structures, trash rack, access hatches, roadways and walls as a result of vandalism, flood events, settlement or other

causes must be repaired promptly. The urgency of the repairs will depend upon the nature of the damage and its effects on the safety and operation of the facility. The analysis of structural damage and the design and performance of structural repairs should only be undertaken by the consulting Professional Engineer.

c) Embankment and Slope Repairs:

Damage to embankments, and side slopes must be repaired promptly. This damage can be the result of rain or flood events, vandalism, animals, vehicles or neglect. Typical problems include settlement, scouring, cracking, sloughing, seepage and rutting. The urgency of the repairs will depend upon the nature of the damage and its effect on the safety and operation of the facility. The analysis of the damage and the design and performance of geotechnical repairs should only be undertaken by qualified personnel and under the direction of a consulting Professional Engineer. All basin embankments shall be inspected quarterly and after each significant storm greater than one (1) inch of rainfall. Any damage or indication of erosion shall be immediately inspected by a professional engineer.

d) Dewatering:

It may be necessary to remove ponded water from within a malfunctioning basin. This ponding may be the result of a blocked principal outlet or poor bottom drainage. Portable pumps may be necessary to remove the ponded water temporarily until a permanent solution can be implemented.

e) Weed Harvesting:

It may be necessary to remove congested weeds from the basin. Companies with specialized harvesters should be contacted to perform these operations. Note that such work may require the approval of various regulatory agencies.

f) Extermination of Mosquitoes:

If neglected, basins can become an ideal mosquito breeding area. The extermination of mosquitoes will usually require the services of the County Mosquito Commission. If mosquito control in the facility becomes necessary, the preventative maintenance program should be re-evaluated, and more emphasis should be placed on control of mosquito breeding habitats.

g) Erosion Repair:

Vegetative cover or other protective measures are necessary to prevent the loss of soil due to the forces of wind and water. Where a re-seeding program has not been effective in maintaining a non-erosive vegetative cover, or other factors have exposed soils to erosion, corrective steps should be initiated to prevent further loss of soil that may result in danger to the stability of the facility. Soil loss can be

controlled by a variety of materials and methods, including rip-rap, gabion lining, geotextile fabrics, sod, seeding, concrete lining and re-grading.

h) Elimination of Trees, Brush, Roots, and Animal Burrows:

The stability of embankments can be impaired by large roots and animal burrows. Additionally, burrows can present a safety hazard for maintenance personnel. Trees and brush with extensive, woody root systems should be completely removed to prevent destabilization and the creation of seepage routes. Roots should also be completely removed to prevent decomposition within the embankment. Root voids and burrows should be filled with material similar to the existing material, and capped just below grade with stone, concrete or other material. If the filling of the burrows does not discourage the animals from returning, further measures should be taken to either move the animal population or to make critical areas of the facility unattractive to them.

i) Snow and Ice Removal:

Accumulations of snow and ice can threaten the functioning of the pervious pavement, inlets, outlets and emergency spillways. Provision of the equipment, material and personnel to monitor and remove snow and ice from critical areas will assure the function of the facility during the winter months.

4. Corrective Maintenance Procedures Pervious Pavement

a) Removal of Debris and Sediment:

Sediment, debris and trash which threaten the discharge capacity of the system should be removed immediately with the use of light weight equipment to avoid soil compaction and properly disposed. As noted previously, it is recommended that all water be evacuated from the system with a pump before any significant amount of sediment, settled debris or trash is removed from the system. The lack of an available disposal site should not delay the removal of trash, debris and sediment. Temporary disposal sites should be utilized if necessary.

b) Structural Repairs:

Structural damage to outlet and inlet structures, trash rack, access hatches, roadways and walls as a result of vandalism, flood events, settlement or other causes must be repaired promptly. The urgency of the repairs will depend upon the nature of the damage and its effects on the safety and operation of the facility. The analysis of structural damage and the design and performance of structural repairs should only be undertaken by the consulting Professional Engineer.

c) Pervious Pavement System Repair:

Corrective action must be immediately taken to restore the infiltration capacity of the pervious paving system if standing water is observed on the surface course or the testing methods stated above show an infiltration rate of 20 inches per hour or less for a system designed for quantity control or 6.4 or less for a system designed for water quality control only.

Potholes in the pervious pavement are extremely unlikely, though settling might occur if a soft spot in the subgrade is not removed during construction. Damaged pavement should be replaced. Under no circumstance is the pavement surface to ever be seal coated except for those approved by the manufacturer to improve surface course resistance to de-icing chemicals or refresh traffic striping. Over the lifetime of the surface course, no more than 10% of its surface area may be patched with impervious material such as bituminous asphalt or concrete. All patching must be recorded in the maintenance manual for future reference to prevent exceedance of this maximum. Any required repair of drainage structures should be done promptly to ensure continued proper functioning of the system.

With minimal maintenance, pervious pavement systems can function effectively for well over 20 years. However, in the event that maintenance of the pervious pavement system is neglected and it becomes clogged over time, the Owner shall vacuum the lot until the original permeability is restored. (If the original permeability of the lot cannot be restored, the pavement should be removed and replaced with new pavement) Recent research has shown that one of the most effective ways of pervious pavement is applying a pressurized dose of a non-toxic detergent cleaning solution, allowing adequate soak time, and then vacuuming with a high-performance unit (Elgin Whirlwind and the Allianz Model 650). Once again, it is important to note that high pressure washing may drive contaminants further into the porous surface and even into the underlying aggregate. It is therefore recommended that, prior to vacuum sweeping, a low performance pressure washer is used to get the solution to break the surface tension and reach into the pores.

5. Aesthetic Maintenance Procedures

a) Graffiti Removal:

The timely removal of graffiti will restore the aesthetic quality of the facilities. Removal can be accomplished by paint or other cover, or removal with scrapers, solvents or cleansers. Timely removal is important to discourage further graffiti and other acts of vandalism.

b) Grass Trimming/Landscape Maintenance:

The lawn areas around the infiltration and constructed wetlands shall be mowed on a regular basis as necessary to maintain the lawn at a height of 2 to 3-inches (at least once a month during the growing season). These areas shall also be fertilized

twice a year, once in the spring and once in the fall. Fertilizer for lawn areas shall be 10-20-10 applied at a rate of 11 lbs. per 1,000 SF or as determined by a soil test. Any bare, dead or damaged lawn areas shall be re-seeded in accordance with the original procedures as outlined in the Soil Erosion and Sediment Control Plans using the same mix and seeding rates. Stabilization of bare or damaged areas shall be done in a timely fashion so as to avoid exposing the soil to erosion.

If season prevents the re-establishment of turf cover, exposed areas should be stabilized with straw or salt hay mulch as described in the Soil Erosion and Sediment Control Plans until permanent seeding can be done. Seeding can be done between March 15th and June 15th and between September 15th and December 1st, only if adequate water is provided.

The shrubs and vegetation around the basins should also be maintained in order to promote a neat appearance and healthy, vigorous growth. All shrubs should be allowed to grow together in masses as shown on the plans and not pruned into individual plants. The planting beds should be mulched with hardwood mulch every two (2) years in order to provide a suitable growing medium for the shrubbery and to retain moisture around the root zones.

Pruning of shrubs should also be done on a regular basis to maintain the shape and appearance of the shrub masses. The height of the shrubs may vary according to the plants natural growth habits, but should not exceed 6-feet. Pruning should be done as necessary throughout the year to remove dead branches and to control new growth. Any pruning, other than the removal of dead branches, should be done in either late winter/early spring or after the shrub has flowered in the spring.

In the event that a shrub should experience more than 2/3 die back, it should be replaced in kind as soon as possible in either the spring or fall planting season. The replacement shrub should be the same species as the original and installed at the size and condition as specified on the original landscape plans. If, for any reason, a substitution of species or size must be made, it shall be subject to the approval of the project Landscape Architect.

The trees surrounding the basin areas shall be maintained regularly to ensure good health and exhibit an attractive appearance. Their maintenance should include fertilization twice annually, with one application in the spring and another in early fall. The trees shall be pruned in the late winter or early spring. However, dead branches should be removed as soon as they are noticed. Care should be taken to avoid cutting off the central leader of a tree if one is present.

If a tree is severely damaged or experiences more than 2/3 die back, it should be replaced in either the spring or fall planting season, whichever comes first. The only exception to this is if the replacement tree has a fall transplanting hazard. In this case, it should be replanted in the spring. Replacement trees should be planted at the same size and condition as specified on the landscape plans. If it is necessary

to make a substitution of species or size, it shall be subject to the approval of the project Landscape Architect.

c) Control of Weeds:

Although a regular grass maintenance program will minimize weed intrusion, some weeds will appear. Periodic weeding, either chemically or mechanically, will help to maintain a healthy turf, and keep grassed areas looking attractive. Application of chemicals should be monitored closely so as not to affect the ecosystems within the basin. Excessive growth of weeds within the basin can be controlled mechanically as discussed in the previous section.

The recording of all maintenance work and inspections will provide valuable data on the facility's condition. Review of this information will also help to establish more efficient and beneficial maintenance procedures and practices. All recorded information should be directed to the owners of the basin for review and subsequent follow-up on recommendations. Data obtained from informal inspections should be retained; however, this data does not have to be submitted to NJDEP.

6. Summary of Maintenance Procedures:

Preventative Maintenance for Bioretention Basins

- a) Grass Cutting
- b) Grass Maintenance
- c) Vegetative Cover
- d) Removal and Disposal of Trash/Debris and Sediment
- e) Sediment Removal and Disposal
- f) Mechanical Components
- g) Elimination of Potential Mosquito Breeding Habitat
- h) Observation After Rainfall

Preventative Maintenance for Pervious Pavement Systems

- a) Removal and Disposal of Trash/Debris and Sediment
- b) Parking Lot Maintenance
- c) Pervious Pavement System Maintenance
- d) Vacuuming
- e) Winter Maintenance

Corrective Maintenance for Bioretention Basins

- a) Removal of Debris and Sediment
- b) Structural Repairs
- c) Embankment and Slope Repairs
- d) Dewatering

- e) Weed Harvesting
- f) Extermination of Mosquitoes
- g) Erosion Repair
- h) Elimination of Trees, Brush, Roots, and Animal Burrows
- i) Snow and Ice Removal

Corrective Maintenance for Pervious Pavement Systems

- a) Removal of Debris and Sediment
- b) Structural Repairs
- c) Pervious Pavement System Repairs

Aesthetic Maintenance

- a) Graffiti Removal
- b) Grass Trimming/Landscape Maintenance
- c) Control of Weeds

B. Maintenance Equipment and Materials

1. Grass Maintenance Equipment

- a) Riding Mowers
- b) Hand Mowers
- c) Gas Powered Trimmers
- d) Gas Powered Edgers
- e) Seed Spreaders
- f) Fertilizer Spreaders
- g) De-Thatching Equipment
- h) Pesticide and Herbicide Application Equipment
- i) Grass Clipping and Leaf Collection Equipment

2. Vegetative Maintenance Equipment

- a) Saws
- b) Pruning Shears
- c) Hedge Trimmers
- d) Wood Chippers
- e) Aquatic Weed Harvester (owned/operated by subcontractor)

3. Transportation Equipment

- a) Trucks for Transportation of Materials
- b) Trucks for Transportation of Equipment
- c) Vehicles for Transportation of Personnel

4. Debris, Trash and Sediment Removal Equipment

- a) Loader
- b) Backhoe
- c) Grader
- d) Dredging Equipment
- e) Portable Pump for Dewatering

5. Miscellaneous Equipment

- a) Shovels
- b) Rakes
- c) Picks
- d) Wheel Barrows
- e) Painting Equipment
- f) Gloves

6. Materials

- a) Topsoil
- b) Fill
- c) Seed & Soil Amenities (Fertilizer, Lime, etc.)
- d) Chemicals (Pesticides, Herbicides, etc.)
- e) Mulch
- f) Paint Removers
- g) Spare Parts for Equipment

7. Parking Maintenance Equipment

- a) Sweeping/Vacuuming Equipment
- b) Snow Plowing Equipment
- c) Snow Shovels

C. Checklists and Logs

The Appendix of this report contains sample checklists and logs regarding various aspects of the basin maintenance and inspection. A brief description of the use of each form is listed below:

1. "Maintenance Work Order and Checklist" – a comprehensive form outlining both required and completed maintenance work.
2. "Maintenance Log" – a summary table for recording the results of all maintenance of the basin.
3. "Inspection Log" – a summary table for recording the results of all inspections of the basin.

An annual inspection shall be performed by a New Jersey licensed professional engineer that results in the submission of a report to the North Hanover Realty Partners, LLC and to the Township by April 15 of the succeeding year indicating the condition of the stormwater measures and any items requiring repair or corrective action. Within 30 days of the report,

North Hanover Realty Partners, LLC shall submit a remedial action report to the Township outlining the specific measures to be taken and the time required to complete these measures. If the corrective measures are not implemented in accordance with the remedial action report, the Stormwater Management Operation and Maintenance Manual shall grant the Township the authority, but not the obligation, to implement those action and to establish a method of charging North Hanover Realty Partners, LLC for the cost of those actions.

D. Estimated Maintenance Costs and Tasks

The following is a summary of the required maintenance tasks and associated costs in written and tabular form:

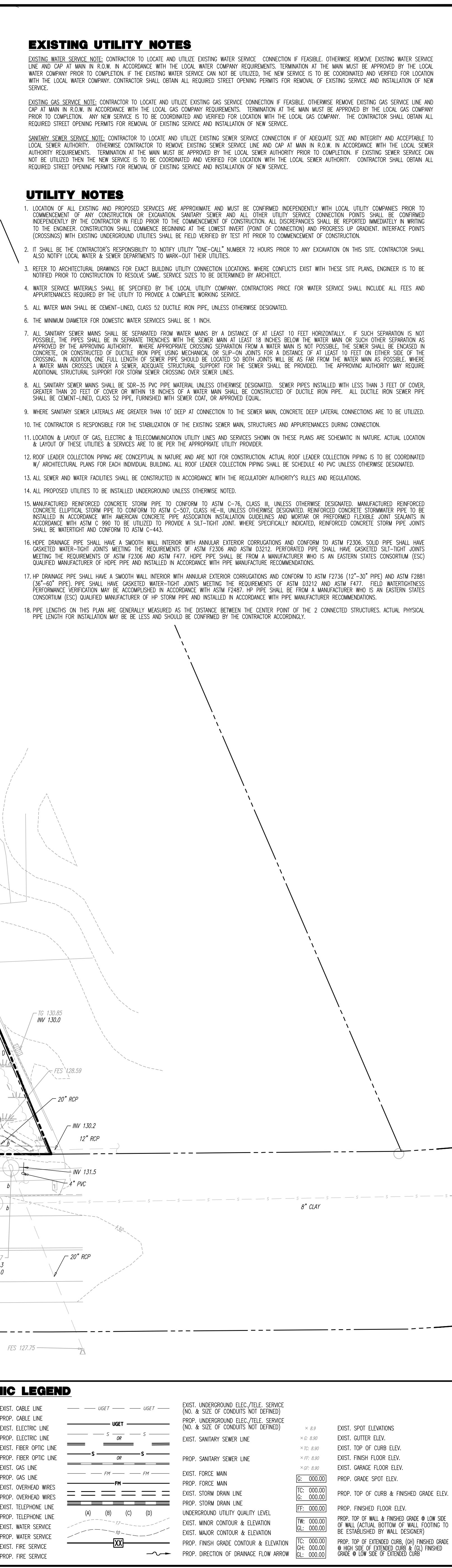
- Inspections to be performed by a consulting engineer on a bi-annual basis. - **\$3,000.00.**
- Inspections for debris and sediment to be performed by the property owner and/or a maintenance designee on a monthly basis and/or after a storm event exceeding 1 inch of rainfall– **Minimal cost associated – Owners responsibility - \$500.00 per inspection.**
- Stormwater conveyance system and outlet control structure access for debris removal to be performed on an annual basis and/or as inspection routine dictates - **\$2,000.00 per inspection.**
- Surface debris removal including garbage and organic matter to be performed in conjunction with lawn and grounds maintenance, includes leave removal in the Fall and removal of excessive amounts of snow, if necessary, in the Winter. These tasks are encouraged as necessary to maintain safe operating conditions (twice a month from Spring through Winter recommended or on as needed basis) - **\$1,000.00.**

Maintenance Schedule Summary

Task Identification	Task Frequency	Task Estimated Cost
Inspection by licensed engineer	Two (2) per year	\$3,000.00
Inspection by property owner and/or maintenance designee	Once (1) per month (or after a storm event exceeding 1 inch of rainfall)	\$500.00 per inspection
Debris removal from stormwater conveyance system (inlets, pipes, manholes, flared end sections, and outlet control structure)	Four (4) times per year (or after storm event exceeding 1 inch of rainfall)	\$2,000.00 per inspection
Surface debris removal (garbage & organic matter) including leaves in the Fall and snow in the Winter	Twice (2) per month (or on an as needed basis)	\$1,000.00

APPENDIX

BMP MAP



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File: P:\USCPC-PROJECTS\6201 Hope Presbyterian Church\26--02267 Lawrence\Jng Site\UG01\26002675CO.dwg, ----- 07 DRAINAGE & UTILITY PLAN

MAINTENANCE WORK ORDER AND CHECKLIST

**MAINTENANCE WORK ORDER AND CHECKLIST
FOR STORMWATER MANAGEMENT FACILITIES**

NAME OF FACILITY: _____
 LOCATION: _____ DATE: _____
 WEATHER: _____ WORK STARTED: _____
 MAINTENANCE PERFORMED BY: _____ WORK COMPLETED: _____

A. PREVENTATIVE MAINTENANCE			
WORK ITEMS	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. OTHERS			
2. GRASS MAINTENANCE			
A. FERTILIZING			
B. RE-SEEDING			
C. DE-THATCHING			
D. PEST CONTROL			
E. OTHERS			
3. VEGETATIVE COVER			
A. FERTILIZING			
B. PRUNING			
C. PEST CONTROL			
D. POISONOUS PLANTS			
E. OTHERS			
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. OTHERS			
5. SEDIMENT REMOVAL			
A. INLETS			
B. OUTLETS AND TRASH RACKS			
C. LOW FLOW CHANNELS			
D. BOTTOMS			
E. OTHERS			
6. PEST CONTROL			
A. GEESE			
B. MOSQUITO BREEDING			
C. RODENTS / RODENT HOLES			
D. OTHERS			
7. STRUCTURAL REPAIRS			
A. VALVES			
B. SLUICE GATES			
C. PUMPS			
D. FENCE GATES			
E. LOCKS			
F. ACCESS HATCHES			
G. OTHER:			
8. POND MAINTENANCE			
A. AERATION EQUIPMENT			
B. DEBRIS AND TRASH REMOVAL			
C. WEED REMOVAL			
D. OTHER:			
9. OTHER PREVENTIVE MAINTENANCE			
A. PARKING LOT SWEEPING			
B. EMPTYING TRASH RECEPTACLES			
C. PUMPS AND VALVES			
D. ELECTRICAL PANEL AND WIRING			
E. DEWATERING			
F. GRAFFITI REMOVAL			
E. OTHER:			

B. CORRECTIVE MAINTENANCE			
WORK ITEMS	ITEMS REQUIRED	ITEMS DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. REMOVAL OF DEBRIS AND SEDIMENT			
2. STRUCTURAL REPAIRS			
3. EMBANKMENTS AND SIDE SLOPES			
4. DEWATERING			
5. BASIN MAINTENANCE			
6. CONTROL OF MOSQUITOES			
7. EROSION REPAIR			
8. FENCE REPAIR			
9. SNOW AND ICE REMOVAL			
10. SAND LAYER REPLACEMENT			
11. OTHER			

C. AESTHETIC MAINTENANCE			
WORK ITEMS	ITEMS REQUIRED	ITEMS DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRAFFITI REMOVAL			
2. GRASS TRIMMING			
3. WEEDING			
4. OTHERS			

GENERAL NOTES AND REMARKS:

WORK ORDER PREPARED BY: _____

WORK COMPLETED BY: _____

MAINTENANCE LOG

**MAINTENANCE LOG
FOR STORMWATER MANAGEMENT FACILITIES**

NAME OF FACILITY: _____
 LOCATION: _____ DATE: _____
 WEATHER: _____ WORK STARTED: _____
 MAINTENANCE PERFORMED BY: _____ WORK COMPLETED: _____

A. PREVENTATIVE MAINTENANCE					
WORK ITEMS	ITEMS REQUIRED	DATE REQUIRED	ITEMS DONE	DATE DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRASS CUTTING					
A. BOTTOMS					
B. EMBANKMENTS AND SIDE SLOPES					
C. PERIMETER AREAS					
D. ACCESS AREAS AND ROADS					
E. OTHERS					
2. GRASS MAINTENANCE					
A. FERTILIZING					
B. RE-SEEDING					
C. DE-THATCHING					
D. PEST CONTROL					
E. OTHERS					
3. VEGETATIVE COVER					
A. FERTILIZING					
B. PRUNING					
C. PEST CONTROL					
D. POISONOUS PLANTS					
E. OTHERS					
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. OTHERS					
5. SEDIMENT REMOVAL					
A. INLETS					
B. OUTLETS AND TRASH RACKS					
C. LOW FLOW CHANNELS					
D. BOTTOMS					
E. OTHERS					
6. PEST CONTROL					
A. GEESE					
B. MOSQUITO BREEDING					
C. RODENTS / RODENT HOLES					
D. OTHERS					
7. STRUCTURAL REPAIRS					
A. PIPES					
B. FLARED END SECTIONS					
C. INLETS					
D. MANHOLES					
E. OUTLET CONTROL STRUCTURES					
F. LOW FLOW CHANNELS					
G. RIP-RAP					
H. EMERGENCY SPILLWAY					
I. ACCESS AREA / ROADS					
J. FENCE					
K. TRASH RACKS					
L. OTHERS					

8. BASIN REPAIR					
A. EROSION					
B. SAND LAYER REPLACEMENT					
C. HARMFUL POLLUTANT REMOVAL					
D. BASIN LAYER					
E. SNOW / ICE REMOVAL					
F. OTHERS					
9. UNDERGROUND BASIN MAINTENANCE					
A. BOTTOMS					
B. OUTLETS AND TRASH RACKS					
C. ACCESS HATCHES					
D. OTHERS					
10. INFILTRATION BASIN MAINTENANCE					
A. TILING BOTTOM					
11. POND MAINTENANCE					
A. AERATION EQUIPMENT					
B. DEBRIS AND TRASH REMOVAL					
C. WEED REMOVAL					
D. PERMANENT POOL LEVEL					
E. OTHERS					
11. OTHER PREVENTIVE MAINTENANCE					
A. PARKING LOT SWEEPING					
B. EMPTYING TRASH RECEPTACLES					
C. PUMPS AND VALVES					
D. ELECTRICAL PANEL AND WIRING					
E. DEWATERING					
F. GRAFFITI REMOVAL					
E. OTHERS					

B. CORRECTIVE MAINTENANCE					
WORK ITEMS	ITEMS REQUIRED	DATE REQUIRED	ITEMS DONE	DATE DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. REMOVAL OF DEBRIS AND SEDIMENT					
2. STRUCTURAL REPAIRS					
3. EMBANKMENTS AND SIDE SLOPES					
4. DEWATERING					
5. BASIN MAINTENANCE					
6. CONTROL OF MOSQUITOES					
7. EROSION REPAIR					
8. FENCE REPAIR					
9. SNOW AND ICE REMOVAL					
10. SAND LAYER REPLACEMENT					
11. OTHER					

C. AESTHETIC MAINTENANCE					
WORK ITEMS	ITEMS REQUIRED	DATE REQUIRED	ITEMS DONE	DATE DONE	COMMENTS AND SPECIAL INSTRUCTIONS
1. GRAFFITI REMOVAL					
2. GRASS TRIMMING					
3. WEEDING					
4. OTHERS					

GENERAL NOTES AND REMARKS:

MAINTENANCE COMPLETED AND BASED ON ALL AREAS VISIBLE AND ACCESSIBLE AT THE TIME OF INSPECTION.

WORK PERFORMED BY: _____

SIGNED: _____ DATE: _____

INSPECTION LOG

**INSPECTION CHECKLIST
FOR
STORMWATER MANAGEMENT FACILITIES**

NAME OF FACILITY: _____
 LOCATION: _____
 WEATHER: _____ DATE: _____

FACILITY ITEM	O.K. ¹	ROUTINE ²	URGENT ³	COMMENTS
1. EMBANKMENTS AND SIDE SLOPES				
A. VEGETATION				
B. LININGS				
C. EROSION				
D. SETTLEMENT				
E. 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:				
4. PONDS (RETENTION)				
A. VEGETATION				
B. SHORELINE EROSION				
C. AERATION EQUIPMENT				
D. TRASH AND DEBRIS				
E. SEDIMENT				
F. WATER QUALITY				
G. OTHER:				
5. INLET STRUCTURE				
A. CONDITION OF STRUCTURE				
B. EROSION				
C. TRASH AND DEBRIS				
D. SEDIMENT				
E. AESTHETICS				
F. OTHER:				
6. OUTLET STRUCTURE				
A. CONDITION OF STRUCTURE				
B. EROSION				
C. TRASH AND DEBRIS				
D. SEDIMENT				
E. MECHANICAL COMPONENTS				
F. AESTHETICS				
G. OTHER:				

A. VEGETATION				
B. LINING				
C. EROSION				
D. TRASH AND DEBRIS				
E. OTHER:				

A. VEGETATION				
B. EROSION				
C. TRASH AND DEBRIS				
D. FENCES AND GATES				
E. AESTHETICS				
G. OTHER:				

A. VEGETATION				
B. ROAD SURFACE				
C. FENCES AND GATES				
D. EROSION				
E. AESTHETICS				
F. OTHER:				

A. EFFECTIVENESS OF EXIST. MAINT. PROGRAM				
B. DAM INSPECTIONS				
C. POTENTIAL MOSQUITO HABITATS				
D. MOSQUITOES				

- | GENERAL NOTES AND REMARKS (REFER TO ITEM NUMBER IF APPLICABLE) | |
|--|--|
| | |

INSPECTOR: _____