

Exhibit 4, Attachment C

Major Repairs and Maintenance

Major repairs or maintenance work should include the same level of inspection and documentation as original installations. Inspection checklists and record logs should be kept in a known set location.

Routine maintenance costs are associated with the following activities:

- Conducting BMP inspections at the specified intervals.
- Maintaining site safety, including any perimeter fences and other access inhibitors (trash racks or pipe grates).
- Removing trash.
- Removing sediment that has accumulated in any components of the BMP.
- For infiltration-type systems, maintaining the filtering media and cleaning or replacing it when necessary.
- Restoring soils to assure performance.
- Pruning woody vegetation pruning.
- Replacing dead vegetation.
- Stabilizing any eroding side slopes.
- Repairing damaged or eroded outlet devices and conveyance systems.
- Repairing embankments, dams, and channels due to erosion or rodents.

Summary of BMP Maintenance Tasks

1. Emergency Maintenance

Maintenance after floods and other emergencies requires immediate mobilization. It can include replanting and repairs to structures. Living systems are likely to need at least minor repairs after emergencies. Following an emergency such as a flood, standing water may pose health risks because of mosquitoes. Mosquito control should be considered if this becomes a problem.

For all installations obstructions and debris deposited during storm events should be removed immediately. Exceptions include debris that provides habitat and does not damage vegetation or divert currents to, from, or in the BMP. In fact, because of the high-quality habitat that can be found in woody debris, careful re-positioning rather than complete removal may be desirable. There may be instances where debris is even added. Such locations should be noted so that this debris is not accidentally removed. Educating adjacent property owners about the habitat benefits of debris and vegetation can decrease requests for removal.

2. Debris and Litter Removal

Regularly removing debris and litter can be expected to help in the following ways:

- Reduce the chance of clogging in outlet structures, trash racks, and other facility components.
- Prevent damage to vegetated areas.
- Reduce mosquito breeding habitats.
- Maintain facility appearance.
- Reduce conditions for excessive surface algae.
- Reduce the likelihood of stagnant pool formation.

Special attention should be given to removing floating debris, which can clog the outlet device or riser.

3. Sediment Removal and Disposal

The frequency of sediment removal is based on the sediment accumulation rate versus the amount of sediment storage volume that is inherently provided in the BMP without affecting treatment efficiency or stormwater storage volume. Again, the frequency of sediment removal is BMP and site specific, and could be as frequent as every couple years, or as long as 15-25 years. The volume of sediment needing to be removed and disposed of per dredging cycle is the volume calculated above multiplied by any density or dewatering factors, as appropriate.

Wet sediment is more difficult and expensive to remove than dry sediment. Ideally, the entire facility can be drained and allowed to dry sufficiently so that heavy equipment can operate on the bottom. However, in many impoundments periodic rainfall keeps the sediment soft, preventing access by heavy equipment. In these cases, sediment may have to be removed from the shoreline by using backhoes, grade-alls, or similar equipment.

Proper disposal of the sediment removed from a BMP is required. It is least expensive if an onsite area or a nearby site has been set aside for the sediment. This area must be located outside of the floodplain. If such a disposal area is not set aside, transportation and landfill tipping fees can greatly increase the cost of the BMP, especially where disposal of wet sediment is not allowed in the local landfill. Often, the material must be dewatered before disposal, which again adds more cost and requires land area where wet material can be temporarily placed to dry.

4. Stability and Erosion Control

The best way to promote soil stability and erosion control is to maintain a healthy ground cover in and around BMPs. Areas of bare soil quickly erode, potentially clogging the facility with soil and threatening its integrity. Therefore, bare areas must be restabilized as quickly as possible. Newly seeded areas should be protected with mulch and/or an erosion mat that is securely staked. For BMP's that rely on filtration, such as bioretention facilities, it is critical that adjacent soils do not contaminate the selected media during or after construction. If the site is not permanently stabilized with vegetation when the filter media is installed, the

best design practice is to specify sod or other robust erosion control practices for all slopes in and immediately around the BMP.

Erosion is quite common in or around the inlet and outlet of the BMP facility and should be repaired as soon as possible. Erosion control activities should also extend to areas immediately downstream of the BMP.

The roots of woody growth such as young trees and bushes in embankments are destabilizing. Consistent mowing of the embankment controls stray seedlings that take root. Woody growth, such as trees and bushes, further away from the embankment should not pose a threat to the stability of the embankment and can provide important runoff filtering benefits. Trees and bushes should be planted outside maintenance and access areas.

Animal burrows also diminish the structural integrity of an embankment. Muskrats, in particular, burrow tunnels up to 6 inches in diameter. Efforts should be made to control animal burrowing. Burrows should be filled as soon as possible.

5. Maintenance of Mechanical Components

Each type of BMP may have mechanical components that need periodic attention. For example, valves, sluice gates, fence gates, locks, and access hatches should be functional at all times. The routine inspection, exercising, and preventive maintenance on such mechanical components should be included on a routine inspection/maintenance checklist.

6. Vegetation Maintenance

Vegetation maintenance is an important component of any maintenance program. The grasses and plants in all BMPs, but particularly in vegetative BMPs such as filter strips, grass swales, restored riparian buffers, bioretention facilities, and storm water wetlands, require regular attention. The development of distressed vegetation, bare spots, and rills indicates that a BMP is not functioning properly. Problems can have many sources, such as:

- Excessive sediment accumulation, which clogs the soil pores and produces anaerobic conditions.
- Nutrient deficiencies or imbalances, including pH and potassium.
- Water-logged conditions caused by reduced soil drainage or high seasonal water table.
- Invasive weeds.

The soil in vegetated areas should be tested every other year and adjustments made to sustain vigorous plant growth with deep, well-developed root systems. Aeration of soils is recommended for filter strips and grassed swales where sediment accumulation rates are high. Ideally, vegetative covers should be mown infrequently, allowing them to develop thick stands of tall grass and other plant vegetation. Also, trampling from pedestrian traffic should be prevented.

Areas immediately up- and downstream of some BMP plant installations often experience increased erosion. Although properly designed, located, and transitioned installations

experience this effect to only a minor degree, all erosion should be repaired immediately to prevent spreading. Live stakes, live fascines, and other soil bioengineering techniques, possibly in combination with 3-D geotextiles, can be applied to erosion in natural drainage ways with minor grading.

7. Maintenance of the Aquatic Environment

An important yet often overlooked aspect of non-routine maintenance of BMPs that maintain a permanent pool of water is the need to regularly monitor and manage conditions to promote a healthy aquatic environment. An indicator of excess nutrients (a common problem) is excessive algae growth in the permanent pool of water. In most cases, these problems can be addressed by encouraging the growth of more desirable aquatic and semi-aquatic vegetation in and around the permanent pool. The plants selected should be tolerant of varying water levels and have a high capacity to incorporate the specific nutrients associated with the problem. If algae proliferation is not addressed, algae-laden water will be washed downstream during rain events and may contribute to nuisance odors and stresses in downstream aquatic habitat.

8. Insect Control

Ponded water can function as breeding grounds for mosquitoes and other insects. Mosquito problems can be minimized through proper design and maintenance. The best control technique for BMPs that maintain a permanent pool of water is to ensure that it does not develop stagnant areas. BMPs with permanent pools should include a source of steady dry-weather flow. Promptly removing floatable debris helps eliminate areas where water can collect and then stagnate. In larger basins, fish, which feed on mosquito larvae, can be stocked. Additionally, splash aerators can be employed to prevent stagnant water, however, this requires electricity at the site, increases maintenance costs, and must be properly designed so as to not decrease the settling efficiency of the BMP.

9 Vegetation Maintenance for BMPs

Replacement of Dead Plants

All dead plants should be removed and disposed of. Before vegetation that has failed on a large scale is replaced, the cause of such failure should be investigated. If the cause can be determined, it should be eliminated before any reinstallation.

Fertilization

The objective of fertilizing at a BMP is to secure optimum vegetative growth rather than yield (often the objective with other activities such as farming). Infertile soils should be amended before installation and then fertilized periodically thereafter. Fertilizer can be composed of minerals, organic matter (manure), compost, green crops, or other materials.

Irrigation/ Watering

Watering of the vegetation can often be required during the germination and establishment of the vegetation, as well as occasionally to preserve the vegetation through drought

conditions. This can typically be accomplished by pumping water retained in the BMP or from the stream, installing a permanent irrigation system or frost-proof hose bib, or using portable water trucks.

Mulching

Mulching should be used to maintain soil temperature and moisture, as well as site aesthetics. A half-inch layer is typically adequate. Ideally, mulch should be removed before winter to prevent an infestation of rodents.

Weeding

Weeding is often necessary in the first growing season, particularly if herbaceous grasses are out-competing the young woody vegetation growth. The need for weeding may be largely eliminated by minimizing the amount of seed used for temporary erosion control. Weeding may also be required if, over time, invasive or undesirable species are entering the site and outcompeting plants that are specifically involved in the treatment of the storm water.

Cultivating/ Hoeing

Hoeing is often required to loosen overly compacted soil and eliminate weeds that compete with the desirable vegetation.

Pruning

Pruning is used to trim to shape and remove dead wood. It can force single shoot shrubs and trees to assume a bushier configuration.

Thinning

Thinning dense brush may be necessary for particular species to thrive, increase the vigor of individual specimens, to reduce flow obstructions, and to increase the ability of maintenance staff to access the entire BMP. Tall maturing trees, for the most part, have no place in a BMP (except for buffers) and should be removed as soon as possible.

Staking

Saplings of tall trees planted in or near the BMP may require staking. Care should be taken not to damage the tree's roots with stakes. Stakes should be kept in place for 6 to 18 months, and the condition of stakes and ties should be checked periodically.

Wound Dressing

The wounds on any trees found broken off or damaged should be dressed following recommendations from a trained arborist.

Disease Control

Based on monitoring observations, either insecticides or (preferably) organic means of pest and fungal control should be used.

Protection from Animals and Human Foot Traffic

Fencing and signage should be installed to warn pedestrians and to prevent damage due to trampling. These measures are often most necessary during the early phases of installation but may be required at any time. Measures for controlling human foot traffic include signs, fencing, floating log barriers, impenetrable bushes, ditches, paths, and piled brush. Wildlife damage is caused by the animals browsing, grazing, and rubbing the plants. The use of chemical wildlife repellents should be avoided. Fences and meshes can be used to deter entry to the BMP. Tree tubes can be used to prevent damage to individual specimens.

Mowing

Mowing of perennial herbaceous grasses and wildflowers, especially once seed heads have set, promotes redistribution of seed for this self-sustaining system. Mowing should be carefully controlled, however, especially when performed for aesthetics. As adjacent property owners and customers in general learn more about BMPs, their vision of what is aesthetically pleasing can change. Grasses, in healthy herbaceous stands, should never be mown more than once per year.

10 Maintenance of Other Project Features

All other devices and features associated with the BMP should be monitored and maintained appropriately. These additional items could affect the safety or aesthetics of the facility, which can be as important if not more important than the operational efficiency of the facility. Such items could include:

- Fences
- Access roads
- Trails
- Lighting
- Signage (e.g. no trespassing, emergency notification contact information, etc.)
- Nest boxes
- Platforms
- Watering systems