



Standard Operation Procedures  
for  
Inspection and Maintenance  
of  
Extended Detention Basin(s)  
**Hay Creek Valley Subdivision**

Owner:  
**View Homes Inc.**

El Paso County Department of Public Works  
3275 Akers Drive  
Colorado Springs, CO 80922

[dotweb@elpasoco.com](mailto:dotweb@elpasoco.com)  
719-520-6900

## Introduction

This plan addresses operation and maintenance of public detention / water quality facilities (**Pond 1**) constructed as part of the **Hay Creek Valley Subdivision** development project at the **central-eastern tract of the site** (EPC PCD projects number(s): **SF2324**). The plat number of **Hay Creek Valley Subdivision** is **[insert plat number]**.

## Background

The State of Colorado Department of Public Health and Environment, Water Quality Control Division (CDPHE), has implemented federal regulations within the State of Colorado through permitting, and has included El Paso County as one of numerous Municipal Separate Storm Sewer Systems (MS4s) required to be permitted in compliance with National Pollutant Discharge Elimination System (NPDES) Phase 2 Regulations, as defined within Colorado's Phase 2 Municipal Guidance.

NPDES Phase 2 MS4s stormwater discharges are covered under a general permit under the Colorado Discharge Permit System (CDPS) under Regulation 61, and as a minimum require the MS4's operator (e.g., El Paso County) to develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants to the maximum extent practicable to protect water quality requirements of the Colorado Water Quality Control Act, Colorado Code of Regulations [CCR] 61.8(11)(a)(i).

This Stormwater Facilities Operation and Maintenance Plan (O&M Plan) is for public subregional detention facility (**Pond 1**) constructed as part of the development project referenced above.

## Associated Agreements

**Pond 1 is proposed as private and, as such, a Detention Maintenance Agreement has been signed & completed between El Paso County & the Hay Creek Valley Homeowner's Association.**

## Funding for and Organization of Facility Operation and Maintenance

**Hay Creek Valley Homeowner's Association** will be responsible for operations and maintenance of the **Pond 1** detention facility upon acceptance of the facilities.

## Site and Facilities Description

**Pond 1 of Hay Creek Valley Subdivision consists of the following characteristics:**

- 1) Located in Tract B in the central-eastern region of the site.**
- 2) Access is provided to the pond from a private access road directly off of White Bear Point, a private roadway.**
- 3) The spillway is located on the east side of the pond. In the event of structure clogging and/or failure, overflows will be routed east into an existing ditch that ultimately ties in to Hay Creek.**
- 4) An armored swale & spillway, concrete forebay, concrete outlet structure, concrete trickle channel, & access road are proposed as typically constructed with full spectrum detention ponds. A proposed 18" RCP storm outlet discharges onto a proposed rip rap pad in an existing ditch directly downstream. In the event of structure clogging and/or failure, overflows will be routed east into the existing ditch that ultimately ties in to Hay Creek.**

## **Extended Detention Basin (EDB) Description**

The subsections below describe general EDB operations and maintenance.

### **EDB-1 GENERAL EDB CONCEPT**

Extended Detention Basins (EDBs) are one of the most common types of permanent stormwater control measures utilized within the Front Range of Colorado. An EDB is a sedimentation basin designed to “extend” the runoff detention time, but to drain completely sometime after stormwater runoff ends. An EDB’s drain time for the water quality portion of the facility is typically 40 hours. The basins are considered to be “dry” because the majority of the basin is designed not to have a significant permanent pool of water remaining between runoff events.

EDBs are an adaptation of a detention basin used for flood control, with the primary difference being the addition of forebays, micropools and a slow release outlet design. Forebays are shallow concrete “pans” located at the inflow points to the basin and are provided to facilitate sediment removal within a contained area prior to releasing into the pond. The forebays collect and briefly hold stormwater runoff resulting in a process called sedimentation, dropping sediment out of the stormwater. The stormwater is then routed from the forebay into the concrete trickle channel and upper basin, the large grassy portion of the basin. The EDB includes an outlet structure that extends the drain time of frequently occurring runoff events to facilitate pollutant removal. An EDB also includes a small micropool just upstream of the outlet structure or built into the outlet structure. The micropool is designed to hold a small amount of water to keep sediment and floatables from blocking the outlet orifices.

### **EDB-2 INSPECTING EXTENDED DETENTION BASINS (EDBs)**

#### **EDB-2.1 Access and Easements**

Inspection and maintenance personnel may utilize the attached stormwater facility map containing the location(s) of the access points and maintenance easements of the EDB(s) within this development.

#### **EDB-2.2 Stormwater Management Facilities Locations**

Inspection and maintenance personnel may utilize the attached stormwater facility map located in containing the location(s) of the EDB(s) within this development.

#### **EDB-2.3 Extended Detention Basin (EDB) Features**

EDBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. For example, if a forebay is not properly maintained, it could negatively affect the performance of a downstream feature (trickle channel, micropool, etc.).

Therefore, it is critical that each feature of the EDB is properly inspected and maintained to ensure that the overall facility functions as it was intended. Below is a list and description of the most common features within an EDB and the corresponding maintenance inspection items that can be anticipated:

**Table EDB-1: Typical Inspection & Maintenance Requirements Matrix**

EDB Features	Sediment Removal	Mowing/ Weed Control	Trash & Debris Removal	Erosion	Over-grown Vegetation Removal	Standing Water (mosquito/ algae control)	Structure Repair
Inflow Points (outfalls)	X		X	X			X
Forebays	X		X				X
Low-Flow Channel	X		X	X	X		X
Bottom Stage	X	X	X	X	X	X	
Micropool	X		X		X	X	X
Outlet Works	X		X				X
Emergency Spillway			X	X	X		X
Upper Stage			X	X			
Embankment		X		X	X		

EDB-2.3.1 Inflow Points

Inflow Points or Outfalls into EDBs are the point source of the stormwater discharge into the facility. An inflow point is commonly a storm sewer pipe with a flared end section that discharges into the EDB. In some instances, an inflow point could be a drainage channel or ditch that flows into the facility.

An energy dissipater (riprap or hard armor protection) is typically immediately downstream of the discharge point into the EDB to protect from erosion. In some cases, the storm sewer outfall can have a toe- wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

*The typical maintenance items that are found with inflow points are as follows:*

*a. Riprap Displaced* – Many times, because the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

*b. Erosion Present/Outfall Undercut* – In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

*c. Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in hydraulic performance of the upstream infrastructure, sediment that accumulates in this area must be removed in a timely manner.

*d. Structural Damage* – Structural damage can occur at any time during the life of the facility. Typically, for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

*e. Woody Growth/Weeds Present* – Undesirable vegetation can grow in and around

the inflow area to an EDB that can significantly affect the performance of the drainage facilities discharging into the facility. This type of vegetation includes trees (typically cottonwoods) and dense areas of shrubs (willows). If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the discharge. Also, tree roots can cause damage to the structural components of the inflow. Routine maintenance is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree). In addition, noxious weeds growing in the facility can result in the loss of desirable native vegetation and impact adjacent open spaces/land.

### EDB-2.3.2 Forebay

A forebay is a solid surface (pad), typically constructed of concrete, immediately downstream of the inflow point. The forebay is designed to capture larger particles and trash to prevent them from entering the main portion of the EDB. The solid surface is designed to facilitate mechanical sediment removal (via a skid steer or shovel). The forebay typically includes a small diameter discharge pipe or weir on the downstream end, which is designed to drain the forebay in a specified period of time to promote sedimentation. Forebays vary in size and depth depending on the design and site constraints.

*The typical maintenance items that are found with forebays are as follows:*

- a. Sediment/Debris Accumulation* – Because this feature of the EDB is designed to provide the initial sedimentation, debris and sediment frequently accumulate in this area. If the sediment and debris is not removed from the forebay on a regular basis, it can significantly affect the function of other features within the EDB. Routine sediment removal from the forebay can significantly reduce the need for dredging of the main portion of the EDB using specialized equipment (long reach excavators). Routine removal of sediment from the forebay can substantially decrease the long-term sediment removal costs of an EDB.
- b. Concrete Cracking/Failing* – The forebay is primarily constructed of concrete, which cracks, spalls, and settles. Damage to the forebay can result in decreased performance and impact maintenance efforts.
- c. Drain Pipe/Weir Clogged* – Many times the drainpipe or weir can be clogged with debris, and prevent the forebay from draining properly. If standing water is present in the forebay (and there is not a base flow), the forebay is most likely not draining properly. This can result in a decrease in performance and create potential nuisances with stagnant water (mosquitoes).
- d. Weir/Drain Pipe Damaged* – Routine maintenance activities, vandalism, or age may cause the weir or drain pipe in the forebay to become damaged. Weirs are typically constructed of concrete, which cracks and spalls. The drainpipe is typically constructed with plastic, which can fracture.

### EDB-2.3.3 Trickle Channel (Low-Flow)

The trickle channel conveys stormwater from the forebay to the micro- pool of the EDB. The trickle channel is typically made of concrete.

However, grass lined (riprap sides protected) is also common and can provide for an additional means of water quality within the EDB. The trickle channel is typically 6-9 inches in depth and can vary in width.

*The typical maintenance items that are found with trickle channels are as follows:*

- a. Sediment/Debris Accumulation* – Trickle channels are typically designed with a relatively flat slope that can promote sedimentation and the collection of debris. Also, if a trickle channel is grass lined it can accumulate sediment and debris at a much quicker rate. Routine removal of accumulated sediment and debris is essential in preventing flows from circumventing the trickle channel and affecting the dry storage portion of the pond.
- b. Concrete/Riprap Damage* – Concrete can crack, spall, and settle and must be repaired to ensure proper function of the trickle channel. Riprap can also shift over time and must be replaced/repared as necessary.
- c. Woody Growth/Weeds Present* – Because of the constant moisture in the area surrounding the trickle channel, woody growth (cottonwoods/willows) can become a problem. Trees and dense shrub type vegetation can affect the capacity of the trickle channel and can allow flows to circumvent the feature.
- d. Erosion Outside of Channel* – In larger precipitation events, the trickle channel capacity will likely be exceeded. This can result in erosion immediately adjacent to the trickle channel and must be repaired to prevent further damage to the structural components of the EDB.

### EDB-2.3.4 Bottom Stage (Initial Surcharge)

The bottom stage is at least 4 inches deeper than the upper stage and is located directly in front of the outlet works structure, and typically above the permanent water surface of the micropool and the invert of the trickle channel. The bottom stage is designed to store the smaller runoff events, assists in keeping the majority of the basin bottom dry resulting in easier maintenance operations, and enhances the facility's pollutant removal capabilities. This area of the EDB may develop wetland vegetation.

*The typical maintenance items that are found with the bottom stage are as follows:*

- a. Sediment/Debris Accumulation* – The micropool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.
- b. Woody Growth/Weeds Present* – Because of the constant moisture in the soil surrounding the micropool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micropool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and less disruptive than removing a mature tree).
- c. Bank Erosion* – The micropool is usually a couple feet deeper than the other areas of the ponds. Erosion can be caused by water dropping into the micropool if

adequate protection/armor is not present. Erosion in this area must be mitigated to prevent sediment transport and other EDB feature damage.

*d. Mosquitoes/Algae Treatment* – Nuisance created by stagnant water can result from improper maintenance/treatment of the micropool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micropool may be necessary to reduce these impacts to adjacent homeowners.

*e. Petroleum/Chemical Sheen* – Many indicators of illicit discharges into the storm sewer systems will be present in the micropool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact County Stormwater immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

#### EDB-2.3.5 Micropool

The micropool is a concrete or grouted boulder walled structure directly in front of the outlet works. At a minimum, the micropool is 2.5 feet deep and is designed to hold water. The micropool is critical in the proper function of the EDB; it allows suspended sediment to be deposited at the bottom of the micropool and prevents these sediments from being deposited in front of the outlet works causing clogging of the outlet structure, which results in marshy areas within the top and bottom stages.

*The typical maintenance items that are found with micropools are as follows:*

*a. Sediment/Debris Accumulation* – The micropool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.

*b. Woody Growth/Weeds Present* – Because of the constant moisture in the soil surrounding the micropool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micropool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and less disruptive than removing a mature tree).

*c. Mosquitoes/Algae Treatment* – Nuisance created by stagnant water can result from improper maintenance/treatment of the micropool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micropool may be necessary to reduce these impacts to adjacent homeowners.

*d. Petroleum/Chemical Sheen* – Many indicators of illicit discharges into the storm sewer systems will be present in the micropool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

### EDB-2.3.6 Outlet Works

The outlet works is the feature that drains the EDB in specified release rates and periods of time. The outlet works is typically constructed of reinforced concrete into the embankment of the EDB. The concrete structure typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings for flood control on the outlet structure typically have trash racks over them to prevent clogging. The water quality orifice plate with small diameter holes will typically have a well screen covering it to prevent smaller materials from clogging it. The outlet structure is the single-most important feature in the EDB operation. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the EDB.

*The typical maintenance items that are found with the outlet works are as follows:*

- a. Trash Rack/Well Screen Clogged* – Floatable material that enters the EDB will most likely make its way to the outlet structure. This material is trapped against the trash racks and well screens on the outlet structure (which is why they are there). This material must be removed on a routine basis to ensure the outlet structure drains in the specified design period.
- b. Structural Damage* – The outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel trash racks and well screens are also susceptible to damage.
- c. Orifice Plate Missing/Not Secure* – Many times residents, property owners, or maintenance personnel will remove or loosen orifice plates if they believe the pond is not draining properly. Any modification to the orifice plate(s) will significantly affect the designed discharge rates for water quality and/or flood control. Modification of the orifice plates is not allowed without EPC approval.
- d. Manhole Access* – Access to the outlet structure is necessary to properly inspect and maintain the facility. If access is difficult or not available to inspect the structure, chances are it will be difficult to maintain as well.
- e. Woody Growth/Weeds Present* – Because of the constant moisture in the soil surrounding the outlet works, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate around the outlet works, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and less disruptive than removing a mature tree).

### EDB-2.3.7 Emergency Spillway

An emergency spillway is typical of all EDBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor) and is sometimes buried with soil. The emergency spillway is typically a weir (notch) in the pond embankment. Proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

*The typical maintenance items that are found with emergency spillways are as follows:*

- a. Riprap Displaced* – As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an EDB, the riprap may shift or dislodge due to flow.



*b. Erosion Present* – Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.

*c. Woody Growth/Weeds Present* – Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the EDB and reduce the capacity of the spillway.

*d. Obstruction Debris* – The spillway must be cleared of any obstruction (man-made or natural) to ensure the proper design capacity.

#### EDB-2.3.8 Upper Stage (Dry Storage)

The upper stage of the EDB provides the majority of the water quality flood detention volume. This area of the EDB is higher than the micro- pool and typically stays dry, except during storm events. The upper stage is the largest feature/area of the basin. Sometimes, the upper stage can be utilized for park space and other uses in larger EDBs.

With proper maintenance of the micropool and forebay(s), the upper stage should not experience much sedimentation; however, bottom elevations should be monitored to ensure adequate volume.

*The typical maintenance items that are found with upper stages are as follows:*

*a. Vegetation Sparse* – The upper basin is the most visible part of the EDB, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the EDB by the public. In addition, vegetation can reduce the potential for erosion and subsequent sediment transport to the other areas of the pond.

*b. Woody Growth/Undesirable Vegetation* – Although some trees and woody vegetation may be acceptable in the upper basin, some thinning of cottonwoods and willows may be necessary. Remember, the basin will have to be dredged to ensure volume, and large trees and shrubs will be difficult to protect during that operation.

*c. Standing Water/Boggy Areas* – Standing water or boggy areas in the upper stage is typically a sign that some other feature in the pond is not functioning properly. Routine maintenance (mowing, trash removal, etc.) can be extremely difficult for the upper stage if the ground is saturated. If this inspection item is checked, make sure you have identified the root cause of the problem.

*d. Sediment Accumulation* – Although other features within the EDB are designed to capture sediment, the upper storage area will collect sediment over time. Excessive amounts of sedimentation will result in a loss of storage volume. It may be more difficult to determine if this area has accumulated sediment without conducting a field survey.

Below is a list of indicators:

1. Ground adjacent to the trickle channel appears to be several inches higher than concrete/riprap
2. Standing water or boggy areas in upper stage
3. Uneven grades or mounds
4. Micropool or Forebay has excessive amounts of sediment

e. *Erosion (banks and bottom)* – The bottom grades of the dry storage are typically flat enough that erosion should not occur. However, inadequate vegetative cover may result in erosion of the upper stage. Erosion that occurs in the upper stage can result in increased dredging/maintenance of the micropool.

f. *Trash/Debris* – Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can accumulate and clog the EDB outlet works.

g. *Maintenance Access* – Most EDBs typically have a gravel/concrete maintenance access path to either the upper stage, outlet works, and/or forebay. This access path should be inspected to ensure the surface is still drivable. Some of the smaller EDBs may not have maintenance access paths; however, the inspector should verify that access is available from adjacent properties.

#### EDB-2.3.9      Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the EDB. This category on the inspection form is for maintenance items that are commonly found in the EDB but may not be attributed to an individual feature.

a. *Encroachment in Easement Area* – Private lots/property can sometimes be located very close to the EDBs, even though they are required to be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may affect maintenance or the operation of the facility.

b. *Graffiti/Vandalism* – Damage to the EDB infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the local Sheriff's Office.

c. *Public Hazards* – Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, contact the Sheriff at 911 immediately!

d. *Burrowing Animals/Pests* – Prairie dogs and other burrowing rodents may cause damage to the EDB features and negatively affect the vegetation within the EDB. Consult EPC Environmental Division if this becomes an issue.

e. *Other* – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

### **EDB-3      MAINTAINING EXTENDED DETENTION BASINS (EDBS)**

#### **EDB-3.1 Maintenance Personnel**

Maintenance personnel must be qualified to properly maintain EDBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

#### **EDB-3.2 Equipment**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on an EDB:

- 1.)      Loppers/Tree Trimming Tools
- 2.)      Mowing Tractors

- 3.) Trimmers (extra string)
- 4.) Shovels
- 5.) Rakes
- 6.) All Surface Vehicle (ASVs)
- 7.) Skid Steer
- 8.) Backhoe
- 9.) Track Hoe/Long Reach Excavator
- 10.) Dump Truck
- 11.) Jet-Vac Machine
- 12.) Engineers Level (laser)
- 13.) Riprap (Minimum - Type M)
- 14.) Filter Fabric
- 15.) Erosion Control Blanket(s)
- 16.) Seed Mix (Native)
- 17.) Illicit Discharge Cleanup Kits
- 18.) Trash Bags
- 19.) Tools (wrenches, screw drivers, hammers, etc.)
- 20.) Chain Saw
- 21.) Confined Space Entry Equipment
- 22.) Approved Stormwater Facility Operation and Maintenance Manual

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

### **EDB-3.3 Safety**

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified within the EDB that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

### **EDB-3.4 Maintenance Categories and Activities**

A typical EDB Maintenance Program will consist of three broad categories of work: routine, minor, and major maintenance activities. Within each category of work, a variety of maintenance activities can be performed on an EDB. A maintenance activity can be specific to each feature within the EDB, or general to the overall facility. A variety of maintenance activities are typical of EDBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. The following three sub-sections (3.5, 3.6, and 3.7) explain each of the categories and briefly describes the typical maintenance activities for an EDB, including the objectives and frequency of actions.

### **EDB-3.5 Routine Maintenance Activities**

The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities will normally be performed numerous times during the year. These items can be completed without any prior correspondence with the EPC Stormwater; however, completed

inspection and maintenance forms shall be retained for each inspection and maintenance activity.

The Maintenance Activities are summarized below, and further described in the following sub-sections.

**TABLE – EDB-2 Summary of Routine Maintenance Activities**

<b>MAINTENANCE ACTIVITY</b>	<b>MINIMUM FREQUENCY</b>	<b>LOOK FOR</b>	<b>MAINTENANCE ACTION</b>
<b>Mowing</b>	Twice annually	Excessive grass height/aesthetics	Mow grass to a height of 4" to 6"
<b>Trash/Debris Removal</b>	Twice annually	Trash & debris in EDB	Remove and dispose of trash and debris
<b>Outlet Works Cleaning</b>	As needed – after significant rain events – twice annually at a minimum	Clogged outlet structure; ponding water	Remove and dispose of debris/trash/sediment to allow outlet to function properly
<b>Weed control</b>	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/ herbicide or hand pull; Consult the local weed specialist
<b>Mosquito Treatment</b>	As needed	Standing water/ mosquito habitat	Treat w/ EPA approved chemicals
<b>Algae Treatment</b>	As needed	Standing water/ Algal growth/green color	Treat w/ EPA approved chemicals

EDB-3.5.1 Mowing

Occasional mowing is necessary to limit unwanted vegetation and to improve the overall appearance of the EDB. Native vegetation should be mowed to a height of 4-to-6 inches tall. Grass clippings should be collected and disposed of properly.

*Frequency* – Routine - Minimum of twice annually or depending on aesthetics.

EDB-3.5.2 Trash/Debris Removal

Trash and debris must be removed from the entire EDB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency* – Routine – Prior to mowing operations and minimum of twice annually.

EDB-3.5.3 Outlet Works Cleaning

Debris and other materials can clog the outlet work's well screen, orifice plate(s), and trash rack. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

*Frequency* - Routine – After significant rainfall event or concurrently with other maintenance activities.

EDB-3.5.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the EDB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the Environmental Division at 719-520-7878 is highly recommended prior to the use of herbicide.

*Frequency* – Routine – As needed based on inspections.

EDB-3.5.5 Mosquito/Algae Treatment

Treatment of permanent pools is necessary to control mosquitoes and undesirable aquatic vegetation that can create nuisances. Only EPA approved chemicals/materials can be used in areas that are warranted.

*Frequency* – As needed.

**EDB- 3.6 Minor Maintenance Activities**

This work consists of a variety of isolated or small-scale maintenance or operational problems. Most of this work can be completed by a small crew, tools, and small equipment. These items may require prior correspondence with EPC Stormwater and require completed inspection and maintenance forms to be submitted to EPC upon request for each inspection and maintenance activity.

**Table – EDB-3 Summary of Minor Maintenance Activities**

<b>MAINTENANCE ACTIVITY</b>	<b>MINIMUM FREQUENCY</b>	<b>LOOK FOR</b>	<b>MAINTENANCE ACTION</b>
<b>Sediment Removal</b>	As needed; typically every 1–2 years	Sediment build-up; decrease in pond volume	Remove and dispose of sediment
<b>Erosion Repair</b>	As needed, based upon inspection	Rills/gullies forming on side slopes, trickle channel, other areas	Repair eroded areas Revegetate; address source of erosion
<b>Vegetation Removal/Tree Thinning</b>	As needed, based upon inspection	Large trees/wood vegetation in lower stage of pond	Remove vegetation; restore grade and surface
<b>Drain Cleaning/Jet Vac</b>	As needed, based upon inspection	Sediment build-up/ non draining system	Clean drains; Jet Vac if needed

EDB-3.6.1 Sediment Removal

Sediment removal is necessary to maintain the original design volume of the EDB and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the forebay, inflow(s), and trickle channel can significantly reduce the frequency of major sediment removal activities (dredging) in the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. The major sediment activities will also require surveying with an engineer’s level, and consultation with EPC Stormwater Staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from EDBs do not meet the criteria of “hazardous waste”. However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments from permanent pools must be carefully removed to minimize turbidity, further sedimentation, or other adverse water quality impacts. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

*Frequency* – Nonroutine – As necessary based upon inspections. Sediment removal in the

forebay and trickle channel may be necessary as frequently as every 1-2 years.

#### EDB-3.6.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the EDB, minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to trickle channels, energy dissipaters, and rilling to major gullies in the embankments and spillways. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, erosion control blankets, and turf reinforcement mats. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with EPC Stormwater Staff.

*Frequency* – Nonroutine – As necessary based upon inspections.

#### EDB-3.6.3 Vegetation Removal/Tree Thinning

Dense stands of woody vegetation (willows, shrubs, etc) or trees can create maintenance problems for the infrastructure within an EDB. Tree roots can damage structures and invade pipes/channels thereby blocking flows. Also, trees growing in the upper and lower stages of the EDB will most likely have to be removed when sediment/dredging operations occur. A small tree is easier to remove than a large tree, therefore, regular removal/thinning is preferred. All trees and woody vegetation that is growing in the bottom of the EDB or near structures (inflows, trickle channels, outlet works, emergency spillways, etc) should be removed. Any trees or woody vegetation in the EDB should be limited to the upper portions of the pond banks.

*Frequency* – Nonroutine – As necessary based upon inspections.

#### EDB-3.6.4 Clearing Drains/Jet-Vac

An EDB contains many structures, openings, and pipes that can be frequently clogged with debris. These blockages can result in a decrease of hydraulic capacity and create standing water in areas outside of the micropool. Often the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

*Frequency* – Nonroutine – As necessary based upon inspections.

### **EDB-3.7 Major Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with EPC Stormwater Staff to ensure the proper maintenance is performed. This work requires that the staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. **An ESQCP permit may be required for major maintenance activities.** This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

**Table – EDB-4 Summary of Major Maintenance Activities**

<b>MAINTENANCE ACTIVITY</b>	<b>MINIMUM FREQUENCY</b>	<b>LOOK FOR</b>	<b>MAINTENANCE ACTION</b>
<b>Major Sediment Removal</b>	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond capacity	Remove and dispose of sediment. Repair vegetation as needed
<b>Major Erosion Repair</b>	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
<b>Structural Repair</b>	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works	Structural repair to restore the structure to its original design

**EDB-3.7.1 Major Sediment Removal**

Major sediment removal consists of removal of large quantities of sediment or removal of sediment from vegetated areas. Care shall be given when removing large quantities of sediment and sediment deposited in vegetated areas. Large quantities of sediment need to be carefully removed, transported and disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved.

*Frequency* – Nonroutine – Repair as needed based upon inspections.

**EDB-3.7.2 Major Erosion Repair**

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

*Frequency* – Nonroutine – Repair as needed based upon inspections.

**EDB-3.7.3 Structural Repair**

An EDB includes a variety of structures that can deteriorate or be damaged during the course of routine maintenance. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time.

These structures include items like outlet works, trickle channels, forebays, inflows, and other features. In-house operations staff can perform some of the minor structural repairs. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with EPC Stormwater Staff should take place prior to all structural repairs.

*Frequency* – Nonroutine – Repair as needed based upon inspections.

**Reference:**

**This manual is adapted from SEMSWA and the Town of Parker, Colorado, STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL, October 2004**

For additional resources and contact info, visit the EPC Stormwater website:

<https://publicworks.elpasoco.com/stormwater/>

**Stormwater Best Management Practices  
Inspection and Maintenance Plan (IM Plan)**

**for:**

**Located at:**

**Prepared for and Party Responsible  
for Maintenance and Inspection:**

**Prepared by:**

Reference:

**This plan is adapted from various maintenance manuals developed in the Colorado Front Range**



## Appendix A

### General Location and Description of Stormwater Best Management Practices

#### A. General Site Description

#### B. General Stormwater Management Description

#### C. Stormwater Facilities Site Plan

Inspection or maintenance personnel may utilize the documents in Appendix F for locating the stormwater facilities within this development.

#### D. On-Site Stormwater Management Facilities

##### **Volume Reduction Facilities**

##### **Storage Facilities (Detention)**

##### **Water Quality Facilities**

##### **Source Control Best Management Practices**

**Stormwater Best Management Practices  
Inspection and Maintenance Plan (IM Plan) Procedures/Forms**

**for:**

***Grass Buffers and Grass Swales (GB-GS)***

Reference:

**This plan is adapted from various maintenance manuals developed in the Colorado Front Range**

**Stormwater Best Management Practices  
Inspection and Maintenance Plan Procedures/Forms for  
Grass Buffers and Grass Swales**

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- VIII. Maintaining Stormwater Best Management Practices**
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**Maintenance Agreement** (included in IM Plan submittal to City)

**Appendices**

- Appendix A** - Description of Stormwater Best Management Practices (included in IM Plan submittal to City)
- Appendix B** - Standard Operation Procedures (SOP)
- Appendix C** - Inspection Form
- Appendix D** - Maintenance Form
- Appendix E** - Annual Inspection and Maintenance Submittal Form
- Appendix F** - Erosion and Stormwater Quality Control Plan/As-Builts (included in IM Plan submittal to City)
- Appendix G** - BMP Maintenance Cost Estimates (included in IM Plan submittal to City)
- Appendix H** - PE Certification (included in IM Plan submittal to City)

## **Stormwater Best Management Practices Inspection and Maintenance Plan Procedures/Forms for Grass Buffers and Grass Swales**

### **I. Compliance with Stormwater Best Management Practices Maintenance Requirements**

All property owners are responsible for ensuring that stormwater best management practices (BMPs) or facilities installed on their property are properly maintained and that they function as designed. In some cases, this maintenance responsibility may be assigned to others through special agreements. The maintenance responsibility for a stormwater facility may be designated on the subdivision plat, the site development plan, and/or within a maintenance agreement for the property. Property owners should be aware of their responsibilities regarding stormwater facility maintenance and need to be familiar with the contents of this Inspection and Maintenance Plan (IM Plan). Maintenance agreement(s) associated with this property are provided.

In some cases, the City of Colorado Springs may agree to provide the required inspection and maintenance for some stormwater facilities that once the warranty period has ended will become public. In these cases, a City of Colorado Springs maintenance agreement will be included for those facilities that are agreed to be included in the City of Colorado Springs routine maintenance program.

### **II. Inspection & Maintenance – Annual Reporting**

Requirements for the inspection and maintenance of stormwater facilities, as well as reporting requirements are included in this Stormwater Best Management Practices Inspection and Maintenance Plan.

**Verification that the stormwater BMPs have been properly inspected and maintained and submittal of the required Inspection and Maintenance Forms shall be provided to the City on an annual basis. The annual reporting form shall be provided to the City prior to May 31st of each year.**

Copies of the Inspection and Maintenance forms for each of the stormwater BMPs are located in Appendix C and D. A standard annual reporting form is provided in Appendix E. Each form shall be reviewed and submitted by the property owner or property manager to the City of Colorado Springs/Stormwater Team.

### **III. Preventative Measures to Reduce Maintenance Costs**

The most effective way to maintain your water quality facility is to prevent the pollutants from entering the facility. Common pollutants include sediment, trash & debris, chemicals, pet wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. A thoughtful maintenance program will include measures to address these potential contaminants and will save money and time in the long run. Key points to consider in your maintenance program include:

- Educate property owners/residents to be aware of how their actions affect water quality and how they can help reduce maintenance costs.
- Keep properties, streets and gutters, and parking lots free of trash, debris, and lawn clippings.
- Ensure the proper use, storage, and disposal of hazardous wastes and chemicals. Promptly clean up any spilled materials and dispose of properly.
- Plan lawn care to minimize and properly use chemicals and pesticides.
- Sweep paved surfaces and put the sweepings back on the lawn.
- Be aware of automobiles leaking fluids. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Encourage pet owners to clean up pet wastes.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean any private storm drainage system components, including inlets, storm sewers, and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

#### **IV. Access and Right to Enter**

All stormwater management facilities located on the site should have both a designated access location and the City has the right to enter for the purpose of inspecting and for maintaining BMPs where the owner has failed to do so.

#### **V. Safety**

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc) without proper training, number of personal, and equipment.

Potentially dangerous (e.g., fuel, chemicals, hazardous materials) substances found in the areas must be referred emergency services at 911 (non-emergency number is 444-7000). If a toxic or flammable substance is discovered, leave the immediate area and contact the local emergency services at 911.

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

**If any hazard is found within the facility area that poses an immediate threat to public safety, contact emergency services at 911 immediately.**

#### **VI. Field Inspection Equipment**

It is imperative that the appropriate equipment is taken to the field with the inspector(s). This is to ensure the safety of the inspector and allow the inspections to be performed as efficiently as possible. Below is a list of the equipment that may be necessary to perform the inspections of all Stormwater BMPs:

- Protective clothing and boots.
- Safety equipment (vest, hard hat, confined space entry equipment [if certified to perform confined space entry]).
- Communication equipment.
- IM Plan for the site.

- Clipboard.
- Stormwater BMP Inspection Forms (See Appendix C).
- Manhole Lid Remover
- Shovel.

Some of the items identified above need not be carried by the inspector (manhole lid remover, shovel, and confined space entry equipment), but should be available in the vehicle driven to the site. Specialized equipment may require specific training related to that equipment and should only be used by trained individuals.

## **VII. Inspecting Stormwater BMPs**

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent BMPs. Stormwater BMPs must be periodically inspected to ensure that they function as designed. The inspection will determine the appropriate maintenance that is required for the facility.

### A. Inspection Procedures

All Stormwater BMPs are required to be inspected a minimum of once per year. Inspections should follow the inspection guidance found in the SOP for the specific type of facility. (Appendix B of this manual).

### B. Inspection Report

The person(s) conducting the inspection activities shall complete the appropriate inspection report for the specific facility. Inspection reports are located in Appendix C. A copy of each inspection form shall be kept by the owner a minimum of 5 years.

The following information explains how to fill out the Inspection Forms:

#### General Information

This section identifies the facility location, person conducting the inspection, the date and time the facility was inspected, and approximate days since the last rainfall. Property classification is identified as single-family residential, multi-family residential, commercial, or other.

The reason for the inspection is also identified on the form depending on the nature of the inspection. All facilities must be inspected on an annual basis at a minimum. In addition, all facilities should be inspected after a significant precipitation event to ensure the facility is draining appropriately and to identify any damage that occurred as a result of the increased runoff.

#### Inspection Scoring

For each inspection item, a score must be given to identify the urgency of required maintenance. The scoring is as follows:

0 = No deficiencies identified.

1 = Monitor – Although maintenance may not be required at this time, a potential problem exists that will most likely need to be addressed in the future. This can include items like minor erosion,

concrete cracks/spalling, or minor sediment accumulation. This item should be revisited at the next inspection.

- 2 = Routine Maintenance Required – Some inspection items can be addressed through the routine maintenance program. This can include items like vegetation management or debris/trash removal.
- 3 = Immediate Repair Necessary – This item needs immediate attention because failure is imminent or has already occurred. This could include items such as structural failure of a feature (outlet works, forebay, etc), significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly affect the function of the facility.

N/A This is checked by an item that may not exist in a facility. Not all facilities have all of the features identified on the form (forebay, micro-pool, etc.).

### Inspection Summary/Additional Comments

Additional explanations to inspection items, and observations about the facility not covered by the form, are recorded in this section.

### Overall Facility Rating

An overall rating must be given for each facility inspected. The overall facility rating should correspond with the highest score (0, 1, 2, 3) given to any feature on the inspection form.

### C. Verification of Inspection and Form Submittal

The Stormwater BMP Inspection Form provides a record of inspection of the facility. Inspection Forms for each facility type are provided in Appendix C. Verification of the inspection of the stormwater facilities and the facility inspection form(s) shall be provided to the City of Colorado Springs/Stormwater Team on an annual basis. The verification and the inspection form(s) shall be reviewed and submitted by the property owner or property manager on behalf of the property owner.

Refer to Section II of this Manual regarding the annual reporting of inspections.

## **VIII. Maintaining Stormwater BMPs**

Stormwater BMPs must be properly maintained to ensure that they operate correctly and provide the water quality treatment for which they were designed. Routine maintenance performed on a frequently scheduled basis, can help avoid more costly rehabilitative maintenance that results when facilities are not adequately maintained.

### A. Maintenance Categories

Stormwater BMP maintenance programs are separated into three broad categories of work. The categories are separated based upon the magnitude and type of the maintenance activities performed. A description of each category follows:



### Routine Work

The majority of this work consists of scheduled mowings and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the City of Colorado Springs/Stormwater Team; however, inspection and maintenance forms shall be completed with the information also being reported on the annual report forms that are submitted to the City.

### Restoration Work

This work consists of a variety of isolated or small-scale maintenance and work needed to address operational problems. Most of this work can be completed by a small crew, with minor tools, and small equipment. These items do not require prior correspondence with City of Colorado Springs/Stormwater Team, but do require that completed maintenance forms be submitted to City of Colorado Springs/Stormwater Team with the annual report forms.

### Rehabilitation Work

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater BMP. This work requires consultation with City of Colorado Springs/Stormwater Team and may require an engineering design with construction plans to be prepared for review and approval by the City. This work may also require more specialized maintenance equipment, surveying, construction permits or assistance through private contractors and consultants. These items require prior correspondence with City of Colorado Springs/Stormwater Team and require that completed maintenance forms be submitted to City of Colorado Springs/Stormwater Team with the annual report forms.

## B. Maintenance Personnel

Maintenance personnel should be qualified to properly maintain stormwater BMPs, especially for restoration or rehabilitation work. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs. Periodic training will be offered by the City of Colorado Springs/Stormwater Team (fees apply).

## C. Maintenance Forms

The Stormwater BMP Maintenance Form provides a record of maintenance activities and includes general cost information to assist property owners in budgeting for future maintenance. Maintenance Forms for each facility type are provided in Appendix D. Maintenance Forms shall be completed by the property owner, management company, or contractor completing the required maintenance items. The form shall then be reviewed by the property owner or an authorized agent of the property owner and submitted on an annual basis by May 31st to the following address:

City of Colorado Springs/Stormwater Team  
Attn: Ensure O&M Program Inspector  
PO Box 1575, MC 520  
Colorado Springs, CO 80901-1575

Refer to Section II of this Manual regarding the annual reporting of inspections and maintenance activities performed.

## Appendix B

# Standard Operation Procedures for Inspection and Maintenance

## Grass Buffers and Grass Swales (GB-GS)

May 2008



CITY OF COLORADO SPRINGS

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## **GB-GS-1 BACKGROUND**

Grass Buffers and Grass Swales are common types of Stormwater BMPs utilized within the Front Range of Colorado. Grass Buffers and Grass Swales promote filtration, infiltration, and settling to reduce runoff volume.

Grass Buffers are uniformly graded and densely vegetated areas of turf grass. They are designed to accommodate sheet flow rather than concentrated or channelized flow. They are typically located adjacent to impervious areas such as parking lots or along highways and roads. Grass Buffers are designed to evenly distribute runoff across the width of the buffer to achieve uniform sheet-flow conditions. A flow spreader may be incorporated for this purpose. In some cases, grass buffers may have underdrain systems.

Grass Swales are densely vegetated drainageways with low-pitched side slopes that collect and convey runoff. Design of their longitudinal slope and cross section forces the flow to be slow and shallow, thereby facilitating sedimentation while limiting erosion. Berms or check dams may be installed perpendicular to the flow to decrease the slope and slow down the flow. Grass swales are used in open space and landscaped areas to collect and convey overland flows, and can be used as an alternative to curb and gutter to collect and convey street flows. Some grass swales are designed with underdrain systems.

## **GB-GS-2 INSPECTING GRASS BUFFERS AND SWALES (GB-GS)**

### **GB-GS-2.1 Access and Easements**

Inspection and maintenance personnel may utilize the figures located in Appendix E containing the locations of the access points and potential maintenance easements of the GB-GSs within this development.

### **GB-GS-2.2 Stormwater Best Management Practice (BMP) Locations**

Inspection and maintenance personnel may utilize the figures located in Appendix E containing the locations of the GB-GSs within this development.

### **GB-GS-2.3 Grass Buffer - Grass Swale (GB-GS) Features**

GB-GSs are unique stormwater quality facilities, in that they are typically viewed as landscaping or ground cover, and are often overlooked as water quality treatment facilities. GB-GSs have a number of features that are designed to serve a particular function. It is important for maintenance personnel to understand the function of each of these features. Below is a list of the common features of a Grass Swale or Grass Buffer and the corresponding maintenance inspection items that can be anticipated:

**Table GB-GS-1  
Typical Inspection & Maintenance Requirements Matrix**

	<b>Sediment Removal</b>	<b>Mowing Weed control</b>	<b>Trash &amp; Debris Removal</b>	<b>Erosion</b>	<b>Removal/ Replacement</b>	<b>Structural Repair</b>
<b>Swale Bottom</b>	X	X	X	X		
<b>Side Slope</b>		X	X	X		
<b>Buffer Strip</b>	X	X	X	X		
<b>Inflows</b>	X	X	X	X	X	X
<b>Underdrain System</b>	X				X	
<b>Grade Control/Level Spreader</b>				X		X
<b>Irrigation System</b>					X	

**GB-GS-2.3.1 Grass Swale Bottom and Side Slopes; Grass Buffer Strips**

Grass Swales and Grass Buffers require general maintenance of the turf grass and repair of any rill or gully development. The bottom and side slopes of grass swales and the area of grass buffer strips should be maintained with dense vegetative cover, and should not be eroded or bare. Inspection over the first few years will help to determine if any problems are developing.

*The typical maintenance items that are required at the side slopes and bottoms of grass swales and within grass buffer areas are as follows:*

- a. Sediment Accumulation* – The purpose of the grass swale or buffer is to slow down flow and allow sedimentation to occur. To prevent a loss in performance of the swale or buffer, sediment that accumulates must be removed on a timely basis.
  
- b. Vegetation Sparse* – Grass Swales and Buffers rely on a healthy, dense cover of grass to decrease the flow velocities and promote sedimentation and infiltration. Grasses that are diseased, dying or otherwise damaged should be replaced. All bare areas should be reseeded or patched. Causes which contribute to the damaged grass cover, including lack of adequate irrigation, traces of pedestrian or vehicular traffic, uncontrolled weeds etc., should be identified and remedied.
  
- c. Erosion Present* – Lack of adequate vegetative cover or excessive flow velocities may result in rill or gully development, and erosion of the swale or buffer strip. Erosion will require maintenance to prevent further damage to the area and to prevent sediment transport.
  
- d. Standing Water/Boggy Areas* – Grass swales and buffers are generally intended to drain and be dry in between rain events. If areas of standing water are present, the swale or buffer may need to be evaluated for proper

grade to ensure drainage. In some cases, where underdrains are used, the underdrains should be inspected to ensure that they are not clogged.

#### GB-GS-2.3.2 Inflow Points

Inflow points are the points of stormwater discharge into the swale or buffer. Inflow points are typically pipe outfalls, other grass swales or buffers, or curb cuts from upstream impervious areas, such as parking lots. Some form of energy dissipation is typically provided immediately downstream of the inflow point into the grass swale or buffer. Energy dissipation devices may include riprap aprons, or flow spreader devices.

*The typical maintenance items that are required at inflow points are as follows:*

*a. Riprap Displaced/Rundown Damaged* – Often, because of, the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap rundown or apron appears to have settled, if soil is present between the riprap, or if the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

*b. Erosion Present/Outfall Undercut* – In some situations, an energy dissipater may have not been provided, or may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

*c. Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance, sediment that accumulates in this area must be removed on a timely basis.

#### GB-GS-2.3.3 Underdrain System

Some grass swales and buffers that have a flatter slope or soils which do not allow adequate percolation or are in areas with a continuous base flow may have been installed with an underdrain system. Underdrains typically consist of a layer of geotextile fabric, gravel storage area and perforated PVC pipe. The geotextile fabric is utilized to prevent the filter material from entering the underdrain system. The gravel storage area allows for storage of treated stormwater runoff prior to the discharge of the runoff through the perforated PVC pipe.

*The typical maintenance activities that are required for the underdrain system are as follows:*

With proper maintenance of the grassed areas, there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning in the event that it becomes clogged.

#### GB-GS-2.3.4 Grade Control Level Spreader

Grass swales that are installed in areas with steep longitudinal slopes often necessitate the use of grade control checks or drop structures. Grade control structures are typically either concrete walls or rip rap structures that serve to provide a reinforced drop at specific locations in the channel, reducing the longitudinal slope between the control structures.

Level Spreaders are installed on the upstream of grass buffers to evenly distribute flows along the design length. Level spreaders may consist of slotted curbing, modular block porous pavement, level walls or other spreader devices.

*The typical maintenance activities that are required for grade control structures and level spreaders are as follows:*

*a. Erosion present* – Grade control structures and level spreaders are provided to reduce the potential for erosion of the grassed swale or buffer areas. Erosion within the vicinity of the control structure or level spreader indicates that the structure is not functioning as intended and requires maintenance to prevent future erosion and damage.

*b. Structural damage* – Structural damage can occur at anytime along the life of the facility. Typically, structural damage occurs with the deterioration of concrete, including cracking, spalling or settling and the erosion and deterioration of the riprap structures. Level spreaders may settle unevenly creating low areas, which concentrate the flows.

#### GB-GS-2.3.5 Irrigation

Grass Buffers and Grass Swales depend on healthy, dense turf grass to function, and therefore require an irrigation system, to provide a consistent water supply. Typically, the condition of the grass cover will provide evidence of the effectiveness and maintenance needs of the irrigation system.

*The typical maintenance activities that are required for irrigation systems are as follows:*

Irrigation systems will generally require routine periodic maintenance and adjustment to ensure that proper amounts of water are being applied given the weather conditions, and that they are providing coverage to all areas of the grass to eliminate bare spots.

### GB-GS-2.3.6 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the GB-GS. This category on the inspection form is for maintenance items that are commonly found in the GB-GS, but may not be attributed to an individual feature.

*a. Access* – Access needs to be maintained.

*b. Public Hazards* – Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local emergency services at 911 immediately.**

*c. Burrowing Animals/Pests*– Prairie dogs and other burrowing rodents may cause damage to the GB-GS features and negatively affect the vegetation within the GB-GS.

*d. Other* – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

### **GB-GS-2.4 Inspection Forms**

GB-GS Inspection forms are located in Appendix C. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the City of Colorado Springs/Stormwater Team per the requirements of the Inspection and Maintenance Plan. These inspection forms shall be kept a minimum of 5 years and made available to the City of Colorado Springs/Stormwater Team upon request.

## **GB-GS-3 MAINTAINING GRASS BUFFERS & GRASS SWALES (GB-GS)**

### **GB-GS-3.1 Maintenance Personnel**

Maintenance personnel should be experienced to properly maintain GB-GSs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

### **GB-GS-3.2 Equipment**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a GB-GS:

- 1.) Mowing Tractors
- 2.) Trimmers (extra string)
- 3.) Shovels
- 4.) Rakes



- 5.) All Surface Vehicle (ASVs)
- 6.) Engineers Level (laser)
- 7.) Erosion Control Blanket(s)
- 8.) Mulch
- 9.) Sod or Seed
- 10.) Illicit Discharge Cleanup Kits
- 11.) Trash Bags
- 12.) Approved Inspection and Maintenance Plan

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

### **GB-GS-3.3 Maintenance Forms**

The GB-GS Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The GB-GS Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the City of Colorado Springs/Stormwater Team per the requirements of the Inspection and Maintenance Plan. The GB-GS Maintenance form is located in Appendix B.

### **GB-GS-3.4 Maintenance Categories and Activities**

A typical GB-GS Maintenance Program will consist of three broad categories of work: Routine, Restoration (minor), and Rehabilitation (major). Within each category of work, a variety of maintenance activities can be performed on a GB-GS. A maintenance activity can be specific to each feature within the GB-GS, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a GB-GS.

A variety of maintenance activities are typical of GB-GSs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the GB-GS or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions.

### **GB-GS-3.5 Routine Maintenance Activities**

The majority of this work consists of scheduled mowing, trash and debris pickups and landscape care for the GB-GS during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items do not require any prior approval by City of Colorado Springs/Stormwater Team, however, completed inspection and maintenance forms shall be submitted to City of Colorado Springs/Stormwater Team for each inspection and maintenance period.

The Routine Maintenance Activities are summarized below, and further described in the following sections.

**Table GB-GS-2  
Summary of Routine Maintenance Activities**

Maintenance Activity	Minimum Frequency	Indication Action is Needed:	Maintenance Action
<b>Trash/Debris Removal</b>	Twice annual and before mowing	Trash & debris in GB-GS	Remove and properly dispose of trash and debris
<b>Mowing</b>	Routine – as necessary to maintain 2” – 4” grass height	Excessive grass height/aesthetics	2”-4” grass height for turf grass; 4” to 6” for native grass
<b>Irrigation (Automatic)</b>	Three times annually	Areas of insufficient or excess watering; broken or missing parts	SPRING: start up system; test for even coverage and correct timer settings SUMMER: test for even coverage and correct timer settings FALL: drain and winterized system (follow watering regulations)
<b>Irrigation (Not Automatic)</b>	As needed to maintain healthy grass	Areas of insufficient or excess watering	Water as needed to maintain healthy grass; (follow watering regulations)
<b>Weed Control</b>	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/herbicide or hand pull; consult a local Weed Inspector
<b>Mosquito Treatment</b>	As needed, based upon inspections	Standing water/ mosquito habitat	Perform maintenance to eliminate standing water; Treat w/ EPA approved chemicals
<b>Level Spreader (Grass Buffer only)</b>	As needed, based upon inspections	Evidence of uneven flow/localized erosion	Look for cause; repair, fill or revegetate areas of erosion
<b>Rodent Damage</b>	As needed, based upon inspections	Holes, small piles of dirt, raised burrows	Evaluate damage; contact Parks Dept. or Division of Wildlife for guidance

#### GB-GS-3.5.1 Trash/Debris Removal

Trash and debris must be removed from the GB-GS area to allow for proper functioning and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency* – Routine – Prior to mowing operations and a minimum of twice annually.

### GB-GS-3.5.2 Mowing

Routine mowing of the turf grass embankments is necessary to maintain an appropriate grass height and to improve the overall appearance of the GB-GS. Turf grass should be mowed to a height of 2 to 4- inches (4 – 6- inches for native grass) and shall be bagged to prevent potential contamination of the filter media.

*Frequency* – Routine – as necessary to maintain grass height.

### GB-GS-3.5.3 Irrigation

Irrigation systems should be maintained in proper working order to provide an adequate water supply to support the grass cover. When automatic irrigation systems are not available, alternate methods for providing a water supply during times of drought must be provided.

Automatic irrigation systems should be maintained routinely throughout the growing season to ensure that they are providing the appropriate amounts of water, and are providing complete coverage of the area. Sprinkler heads should be adjusted as necessary, and checked for broken or missing parts.

*Frequency* - Routine as needed throughout the growing season, plus the following:

    SPRING: Start up the system and test for even coverage and correct timer settings.

    SUMMER: Test for even coverage and correct timer settings.

    FALL: Drain and winterize the system.

### GB-GS-3.5.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the GB-GS. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer's recommendations.

*Frequency* – Routine – As needed based upon inspections.

### GB-GS-3.5.5 Mosquito Treatment

GB-GS facilities are intended to drain, and should not have areas of standing water which creates mosquito habitat. Causes of the standing water or boggy conditions should be investigated and remediated as necessary to eliminate the standing water. Only EPA approved chemicals should be applied in accordance with the recommendations of the manufacturer.

*Frequency* – As needed based upon inspections.

**GB-GS-3.5.6 Level Spreader (Grass Buffer only)**

Evidence of uneven flow and localized erosion downstream of the level spreader indicate that the flow is not evenly distributed along the length of the spreader. Areas of erosion should be repaired, filled and revegetated. Causes for the erosion should be investigated and repaired.

*Frequency* – As needed based upon inspections.

**GB-GS-3.5.7 Rodent Damage**

Small holes, piles of dirt, and raised burrows are evidence of rodent damage. Damaged areas should be repaired and revegetated. Consultation with an animal control specialist or the Division of Wildlife may be required for persistent problems.

*Frequency* – As needed based on inspections.

**GB-GS-3.6 Restoration Maintenance Activities**

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items do not require approval by City of Colorado Springs/Stormwater Team. Completed inspection and maintenance forms shall be submitted to City of Colorado Springs/Stormwater Team for each inspection and maintenance activity.

**Table GB-GS-3  
Summary of Restoration Maintenance Activities**

<b>Maintenance Activity</b>	<b>Minimum Frequency</b>	<b>Indication Action is Needed:</b>	<b>Maintenance Action</b>
<b>Sediment Removal</b>	As needed.	Sediment build-up.	Remove and properly dispose of sediment
<b>Erosion Repair</b>	As needed, based upon inspection	Rills and gullies forming on slopes and other areas	Repair eroded areas & revegetate; address cause
<b>Vegetation Removal</b>	As needed, based upon inspection	Trees, willows, shrubs impeding flow	Remove vegetation; restore correct grade and surface
<b>Revegetation</b>	As needed, based upon inspection	Areas without grass	Replace grass by sodding or seeding
<b>Irrigation (Automatic)</b>	As needed, based upon inspection.	Evidence of broken or missing parts	Replace parts and test system
<b>Level Spreader (Grass Buffer Only)</b>	As needed, based upon inspection.	Evidence of uneven flow; erosion; or rills/gullies	Repair sections of level spreader and address cause
<b>Fertilization or Soil</b>	As needed,	Grass with pale color;	Consult with turf

<b>Amendment</b>	minimize fertilization	areas with poor grass growth not due to irrigation problems	specialist; Test soil
<b>Vehicle Tracks (Along Roadways)</b>	As needed, based upon inspection	Depressions from vehicle tracks; vegetation damage	Repair and fill depressions; sod or seed damaged areas

#### GB-GS-3.6.1 Sediment Removal

Sediment removal is necessary to ensure proper function of the grass swale or buffer. Care should be taken when removing sediment to prevent damage to the turf grass and surrounding areas. Excessive amounts of sediment are an indication of upstream erosion or lack of adequate BMPs during construction activities. Causes for contributions of excess sediment should be investigated and addressed.

*Frequency* – As needed based upon inspections.

#### GB-GS-3.6.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper functioning of the GB-GS, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to vegetation and embankments, to rills and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion in a GS-GB is generally the result of excessive velocities caused by steep slopes. It may be necessary to make design improvements to the swale or buffer when erosion becomes a major maintenance item.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.3 Vegetation Removal

Weeds, Shrubs, Willows and other unwanted vegetation that develops in the grass swale or buffer area may impede the flow and cause standing water or back flow problems. It is necessary to remove unwanted vegetation as soon as it appears. Remove the unwanted vegetation, and restore the correct grade. Revegetate with seed or sod.

*Frequency* – As necessary, based upon inspections.

#### GB-GS -3.6.4 Revegetation

Bare areas should be repaired as soon as possible. Repair bare areas with grass or sod. Causes of the problem, such as inadequate water supply or diseased grasses, should be investigated and resolved.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.5 Irrigation (Automatic)

Irrigation systems require routine maintenance in accordance with the manufacturer's recommendations (valves, timer, etc.), and maintenance of the pipe and heads to ensure that even coverage is being applied, and that there are no missing or broken parts. Timing systems should be checked to verify that the correct amount of water is being applied to the grassed areas for the seasonal conditions.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.6 Level Spreader

Level Spreaders that are no longer level, or have developed damaged areas of cracking or spalling, allow flows to concentrate in these depressed areas instead of being distributed over the length of the structure. Also, build up of grasses along the edge of the spreader may create an uneven flow distribution. Rills, gullies and other erosion that develops downstream of level spreaders should be repaired and reseeded or sodded. Causes of the erosion should be investigated and addressed.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.7 Fertilization/Soil Amendment

Grass Buffers and Swales rely on healthy, dense turf in order to function properly. Grasses that appear to be diseased, dying or unhealthy may require amendments. Fertilizers should be applied in the minimum amounts recommended by the manufacturer.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.8 Vehicle Tracks

GB-GSs that are adjacent to roadway sections may be damaged by vehicle tracks. Rutted areas should be filled in and revegetated as soon as possible. Frequent problems associated with vehicle traffic (such as around corners) may require a barrier or sign to avoid vehicular traffic within the grassed areas.

*Frequency* – As necessary, based upon inspections.

### **GB-GB-3.7 Rehabilitation Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with the City's Engineering staff to ensure the proper maintenance is performed. This work requires that the City's Engineering staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. This work may also require

more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

**Table GB-GS-4  
Summary of Rehabilitation Maintenance Activities**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<b>Major Sediment/Pollutant Removal</b>	As needed – based upon scheduled inspections	Large quantities of sediment	Remove and dispose of sediment. Repair vegetation as needed
<b>Major Erosion Repair</b>	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
<b>Structural Repair</b>	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – level spreader, grade control structures, irrigation components, and ponding water.	Structural repair to restore the structure to its original design
<b>GB-GS Rebuild</b>	As needed – due to complete failure of PLD	Removal of filter media and underdrain system	Contact City Engineering

**GB-GS-3.7.1 Major Sediment/Pollutant Removal**

Major sediment removal consists of removal of large quantities of pollutants/sediment /landscaping material. Stormwater sediments removed from GB-GSs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.

*Frequency* – Non-routine – Repair as needed, based upon inspections.

### GB-GS-3.7.2 Major Erosion Repair

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

*Frequency* – Non-routine – Repair as needed, based upon inspections.

### GB-GS-3.7.3 Structural Repair

A GB-GS generally includes level spreader and grade control structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the City's Engineering staff shall take place prior to all structural repairs.

*Frequency* – Non-routine – Repair as needed, based upon inspections.

### GB-GS-3.7.4 GB-GS Rebuild

In very rare cases, a GB-GS may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the GB-GS. Consultation with the City's Engineering staff shall take place prior to any rebuild project.

*Frequency* – Non-routine – As needed based upon inspections.







CITY OF COLORADO SPRINGS

# GRASS BUFFERS AND GRASS SWALES (GB-GS) MAINTENANCE FORM

Subdivision/Business Name: \_\_\_\_\_ Completion Date: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_ Contact Name: \_\_\_\_\_

<b>Maintenance Category:</b>	Routine	Restoration	Rehabilitation
(Circle all that apply)			

## MAINTENANCE ACTIVITIES PERFORMED

### ROUTINE WORK

- MOWING
- TRASH/DEBRIS REMOVAL
- OUTLET WORKS CLEANING (TRASH RACK/WELL SCREEN)
- WEED CONTROL (HERBICIDE APPLICATION)

### RESTORATION WORK

- SEDIMENT REMOVAL
  - INFLOW POINT
  - SWALE BOTTOM
  - SIDE SLOPE
  - BUFFER STRIP
- EROSION REPAIR
  - INFLOW POINT
  - SWALE BOTTOM
  - SIDE SLOPE
  - BUFFER STRIP
  - GRADE CONTROL/LEVEL SPREADER
- REVEGETATION
  - SWALE BOTTOM
  - SIDE SLOPE
  - BUFFER STRIP

### REHABILITATION WORK

- SEDIMENT REMOVAL (DREDGING)
  - SWALE BOTTOM
  - INFLOW POINT
- EROSION REPAIR
  - INFLOW POINT
  - SWALE BOTTOM
  - SIDE SLOPE
  - BUFFER STRIP
- STRUCTURAL REPAIR
  - INFLOW
  - UNDERDRAIN
  - LEVEL SPREADER

OTHER \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

ESTIMATED TOTAL MANHOURS: \_\_\_\_\_

COSTS INCURRED (include description of costs): \_\_\_\_\_

EQUIPMENT/MATERIAL USED (include hours of equipment usage and quantity of material used):

\_\_\_\_\_

COMMENTS/ADDITIONAL INFO:

\_\_\_\_\_

This Maintenance Activity Form shall be kept a minimum of 5 years and made available to the City of Colorado Springs upon request.

# Appendix E: Annual Inspection and Maintenance Submittal Form



Annual Inspection and Maintenance Reporting Form  
for  
Stormwater BMPs

*(This form to be submitted to City of Colorado Springs prior to May 31 of each year)*

**Date:** \_\_\_\_\_

**To: City of Colorado Springs/Stormwater Team**  
**Attn: Ensure Operations and Maintenance Program Inspector**  
**PO Box 1575, MC 520**  
**Colorado Springs, CO 80901-1575**

**Re: Certification of Inspection and Maintenance; Submittal of forms**

Property/Subdivision Name: \_\_\_\_\_

Property Address: \_\_\_\_\_

Contact Name: \_\_\_\_\_

Contact Phone #: \_\_\_\_\_

Contact Email Address: \_\_\_\_\_

I verify that the required stormwater facility inspections and required maintenance have been completed in accordance with the Stormwater BMP Maintenance Agreement and the Inspection and Maintenance Manual associated with the above referenced property.

The required Stormwater Facility Inspection and Maintenance forms are attached to this form.

\_\_\_\_\_  
Name of Party Responsible for Inspection  
& Maintenance

\_\_\_\_\_  
Property Owner

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Signature

**Appendix F**  
**As-Built Plans**  
(When Complete)

## Appendix G

### BMP Maintenance Cost Estimates (2007)

Routine maintenance costs can usually be predicted for an annual budget and may range from four percent of original capital construction costs per year for an EDB to nine percent of original capital costs per year for an infiltration BMP.

A general rule of thumb is that annual maintenance costs may run from \$100 per acre for minor maintenance, such as mowing, to \$500 per acre for more intensive maintenance including weed control, debris removal, etc.

Non-routine maintenance costs, however, can be substantial over the long run, especially when considering the possibility of eventual BMP replacement. To lessen the immediate financial impact of non-routine costs, it is advised that a BMP maintenance fund, with annual contributions, be established.

As an example, for EDBs, which need to have sediment removed once every two to ten years, ten to 50 percent of anticipated dredging costs should be collected annually. In addition, the average EDBs has a life expectancy of 20 to 50 years. A separate fund that collects two to five percent a year should be established for replacement. Anticipated interest may be used to offset the effects of inflation.

Type of BMP	Sediment Removal Frequency	Facility Life Span*
Retention Pond	5 to 15 years	20 to 50 years
EDB	2 to 10 years	20 to 50 years
Sand Filter	Every 6 months or as required	20 to 50 years
PLD	5 to 10 years	10 to 25 years
Grass Swale/Grass Buffer	As needed	10 to 25 years
Porous Paving	3 to 4 times per year	25 years

\*Assumes the facility is maintained on a regular basis.

#### Estimating and Planning for Non-routine Costs for BMPs

Costs for non-routine maintenance of BMPs are highly specific and will vary depending upon:

- the type, size, and depth of the facility;
- the volume of the sediment trapped in the BMP;
- the accessibility of the BMP; and
- whether or not on-site disposal of the sediment is possible.

## Retention Pond and EDB Sediment Removal

The technique used to remove sediment from a retention pond or EDB is very site-specific. The information below provides an estimate of costs associated with the dredging process.

### 🔥 Mobilization and Demobilization of Machinery

*Associated Costs: \$1,000 to \$10,000*

Large retention ponds or regional facilities will often require a waterborne operation during which an excavator or a crane must be mounted to a floating barge and moved into position. For smaller ponds, larger ponds that can be drained or dredged from the shore, and extended detention basins, a perimeter or dry operation will usually suffice. In this case, a backhoe, truck equipment, or crane may be used to scoop out the sediment. Additional costs for the construction and restoration of access roads for trucks and heavy equipment may be accrued.

### 🔥 Dredging

*Associated Costs: \$10 per cubic yard to \$20 per cubic yard*

The cost of dredging a BMP depends on the volume of sediment removed. The cost (expressed by cubic yard) is largely influenced by the depth of the water and the distance between the excavation area and the “staging area” where sediment is transferred to trucks for removal. Another consideration is whether equipment can easily access the BMP bottom. The following equation can be used to estimate the volume of sediment in cubic yards.

#### **Equation to Estimate the Volume of Sediment in a BMP (in cubic yards)**

surface area \_\_\_\_\_ (acres) x depth of sediment \_\_\_\_\_ (feet) x 43,560 = \_\_\_\_\_ cubic feet  
cubic feet \_\_\_\_\_ / 27 = \_\_\_\_\_ **cubic yards**

### 🔥 Disposal

*Associated Costs: \$5 per cubic yard - on-site to \$47 per cubic yard - off-site*

The primary determinant of disposal costs is whether on-site disposal is an option. If on-site disposal is not available, then locating a landfill or large area to apply the spoils may prove challenging and transportation costs may increase considerably. Dredged materials will require special disposal if found to contain hazardous materials.

Adding the likely costs of the sediment removal components establishes a range in which an owner can expect to pay for sediment/pollutant removal. For a facility with a small surface area (0.25 acres) overall costs can range from \$4,000 to \$10,000+. For a large facility (10 acres) overall costs can range from \$170,000 to \$550,000+.

	<b>Maintenance</b>	<b>Annual Associated Cost</b>
<b>PLD</b>	Removal of sediments and replacement of some level of soil is required periodically. Mulch should be replaced annually, or as needed.	Between \$1,500 and \$2,000, depending upon the size and complexity of the facility.
<b>Grass Swale/ Grass Buffer</b>	Remove sediments, replace check dams (usually made of earth, riprap, or wood), reseed or sod (if grassed) or replace dead plants, every two years.	
<b>Porous Paving</b>	Vacuum sediments from surface, twice a year.	Between \$500 and \$1,000, depending on the size of the facility.
<b>Sand Filter</b>	Remove the top filter cloth and remove/replace the filter gravel, when a semiannual inspection reveals that it is necessary. Remove and replace the filter cloth and gravel every three to five years.	Between \$3,000 to \$10,000, depending on the type and size of the sand filter and the amount of impervious surface draining to it.

If an oil sheen is present in the facility, it should be removed by a qualified oil recycler, which increases costs. Other expenses, such as removal of trash and hydrocarbons from water traps may also be required.

Removing sediment from stormwater facilities can be a considerable expense. Look for opportunities to reduce the amount of sediment entering the pond from the surrounding drainage area.

**Reference:** Information adapted from “Maintaining Stormwater Systems, A Guidebook for Private Owners and Operators in Northern Virginia”, January 2007, Northern Virginia Regional Commission

## Appendix H

### Civil Engineer Stormwater Best Management Practice (permanent) Certification Letter

(date)

City of Colorado Springs  
City Engineering Division, Stormwater Enterprise  
30 S. Nevada Avenue, Suite 502  
PO Box 1575, MC 520  
Colorado Springs, CO 80901-1575

Attn.: Lisa Ross, P.E.  
Stormwater Engineering Interim Manager

Gentlemen:

The permanent stormwater Best Management Practices (BMPs) for *(Name of project & Subdivision Name (required) & address)* consist of *(description of the BMPs, e.g., type, WQCV, drainage area, etc.)*. *(Name of Civil Engineering Firm)* has reviewed the attached letter(s) from *(Name of Geotechnical Engineering Firm)* and from *(Name(s) Landscape Architect Firm and/or Other Involved Firms)*, as appropriate. Based upon this information and information gathered during periodic site visits to the project during significant/key phases of the stormwater BMP installation, *(Name of Engineering Firm)* is of the opinion that the stormwater BMPs have been constructed in general compliance with the approved Erosion and Stormwater Quality Control Plan, Construction Plans, and Specifications as filed with the City.

#### **Statement Of Engineer In Responsible Charge:**

I, \_\_\_\_\_ *(print name)*, a registered Professional Engineer in the State of Colorado, in accordance with Sections 5.2 and 5.3 of the Bylaws and Rules of the State Board of Registration for Professional Engineers and Professional Land Surveyors, do hereby certify that I or a person under my responsible charge periodically observed the construction of the above mentioned project. Based on the on-site field observations and review of pertinent documentation, it is my professional opinion that the required permanent BMPs have been installed and are in general compliance with the approved Erosion and Stormwater Quality Control Plan, Construction Plans, and Specifications as filed with the City of Colorado Springs. For BMPs with a Water Quality Capture Volume (WQCV), I have attached the post-construction As-Built drawings. The As-Built drawings accurately depict the final installation of the stormwater BMPs and verify the WQCV.

*(Name of Engineer, P.E.)*  
Colorado No. XXXXX

*Seal & Signature of P.E. Goes Here*