

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

**for:**

***The Villas at Claremont Ranch***

**Located at:**

***1250 Meadowbrook Parkway  
Colorado Springs, CO***

**Prepared for:**

***PHI REAL ESTATE SERVICES LLC  
200 West City Center Drive, Suite 200  
Pueblo, CO 81003***

**Prepared by:**



Reference:

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

**Stormwater Best Management Practices**

## Inspection and Maintenance Plan

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## **Stormwater Best Management Practices Inspection and Maintenance Plan**

### **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.

### **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; 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 County 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 El Paso County.

### **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 and 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 County 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 El Paso County 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 El Paso County; however, inspection and maintenance forms shall be completed with the information also being reported on the annual report forms that are submitted to the County.

#### 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 El Paso County, but do require that completed maintenance forms be submitted to El Paso County 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 El Paso County and may require an engineering design with construction plans to be prepared for review and approval by the County. 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 El Paso County and require that completed maintenance forms be submitted to El Paso County 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:

El Paso County  
Attn: Planning and Community Development  
2880 International Circle, Suite 110  
Colorado Springs, CO 80910

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



**MAINTENANCE AGREEMENT**

## **APPENDIX A**

### **DESCRIPTION OF STORMWATER FACILITIES**

## Appendix A

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

#### A. General Site Description

The subject 10.17 acres is proposed to be platted into approximately 83 single family townhome residential lots and is located within the Southwest ¼ of Section 4, Township 14 South, Range 65 West of the 6<sup>th</sup> principal meridian in the county of El Paso, Colorado.

The parcel is bounded to the north by the East Fork of Sand Creek, to the east by residential development being a portion of Claremont Ranch Filing No. 7, to the south by Meadowbrook Parkway, and to the west by Marksheffel Road.

The site has been previously stripped and contains little volunteer vegetation beyond erosion control cover. The existing terrain generally slopes to the west at a 2% grade. A swale has been formed adjacent to the Marksheffel embankment conveying undeveloped flow overland to the East Fork of Sand Creek. The site lies within the Sand Creek Drainage Basin.

Soils in the development parcel consist predominantly of Blendon sandy loam (Hydrologic Group 'B' soils) and also contains Blakeland loamy sand and Ellicot loamy coarse sand (Hydrologic Group 'A' soils) as determined by the Natural Resources Conservation Service Web Soil Survey.

No portion of the development lies within an F.E.M.A. designated floodplain per FIRM 08041C0756 F, as revised to reflect LOMR Caso No. 08-08-0630P.

#### B. General Stormwater Management Description

Stormwater generated within the proposed development is collected in a crowned and curbed roadway section and conveyed to proposed private inlet and pipe system. The private inlet and pipe system conveys flows to a proposed extended detention basin. Outfall from the extended detention basin is conveyed through the outlet structure to the East Fork of Sand Creek

#### 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

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

The proposed Extended Detention Basin is designed to provide full-spectrum detention above the water quality capture volume of the site and release flows near predevelopment levels.

### **Water Quality Facilities**

The proposed extended detention basin is designed to attenuate the water quality capture volume and release the water quality event over a 40 hour period.

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

The overall site infrastructure currently being developed does not include any nonstructural BMPs. Individual lot development may include additional BMP development.

## **APPENDIX B**

### **BMP STANDARD OPERATING PROCEDURE (SOP)**



Standard Operation Procedures  
for  
Inspection and Maintenance  
of  
Extended Detention Basin(s)

THE VILLAS AT CLAREMONT RANCH

Owner:  
PHI REAL ESTATE SERVICES  
200 WEST CITY CENTER DRIVE, SUITE 200  
PUEBLO, CO 81003

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

dotweb@elpasoco.com  
719-520-6900

## **Introduction**

This plan addresses operation and maintenance of public detention / water quality facilities (EDB-B, a single facility) constructed as part of The Villas at Claremont Ranch development project at the parcel bounded to the north by the East Fork of Sand Creek, to the east by residential development **residential development being a portion of Claremont Ranch Filing No. 7, to the south by Meadowbrook Parkway, and to the west by Marksheffel Road. (EPC PCD projects number(s): SF-2228). The plat number of the Villas AT CLAREMONT RANCH is SF-22-028 (70-107).**

## **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 facilities (EDB-B, a single pond) constructed as part of the development project referenced above.

## **Associated Agreements**

Subdivision Improvements Agreement (SIA) for the development to be recorded requires the developer to complete the Pond [EDB-B] public improvements as itemized in the associated Financial Assurance Estimate (FAE). Pond operation and maintenance to be provided by CENTRAL MARKSHEFFEL METROPOLITAN DISTRICT.

## **Funding for and Organization of Facility Operation and Maintenance**

The CENTRAL MARKSHEFFEL METROPOLITAN DISTRICT will be responsible for operations and maintenance of the EDB-B single pond detention facilities upon acceptance of the facilities.

## **Site and Facilities Description**

The single EDB-B pond has been designed to be in Tract F.

- 2) Project site access is available via Meadowbrook Parkway and the two subdivision access roads (Fieldside VW. and Greengate VW.). The pond maintenance access is provided from proposed parking located north of the intersection of Belton Heights and Carrside Grove. Platted drainage and easements are available via the final plat drawing. Final Drainage Report and construction drawing sets have been submitted to El Paso County and are available for review.
- 3) The emergency spillway is located along the northwestern limits of the development. The emergency spillway will consist of a 20' wide trapezoidal weir constructed of soil riprap conveying the undetained 100-YR flow from Design Point 1 of 25.0 cfs at a maximum depth of 0.34'. Emergency overflow will be conveyed directly to the East Branch of Sand Creek.
- 4) Proposed EDB 'B will require a WQCV of 0.139 acre-feet, an EURV Volume of 0.314 acre-feet and a total storage volume of 0.760 acre-ft. The pond provides 0.761 acre-ft of storage below the emergency outfall. Proposed EDB 'B will outfall through an 18" RCP storm sewer to Sand 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 designed. Below is a list and description of the

most common features within an EDB and the corresponding maintenance inspection items that



**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/>

## **APPENDIX C**

### **INSPECTION FORM**



CITY OF COLORADO SPRINGS

# EXTENDED DETENTION BASIN (EDB) INSPECTION FORM

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

Subdivision/Business Name: \_\_\_\_\_ Inspector: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_

Weather: \_\_\_\_\_

Date of Last Rainfall: \_\_\_\_\_ Amount: \_\_\_\_\_ Inches

**Property Classification:** Residential   Multi Family   Commercial   Other: \_\_\_\_\_  
(Circle One)

**Reason for Inspection:** Routine   Complaint   After Significant Rainfall Event  
(Circle One)

**INSPECTION SCORING** - For each facility inspection item, insert one of the following scores:  
0 = No deficiencies identified                                2 = Routine maintenance required  
1 = Monitor (potential for future problem)              3 = Immediate repair necessary  
N/A = Not applicable

## FEATURES

### 1.) Inflow Points

- \_\_\_ Riprap Displaced
- \_\_\_ Erosion Present/Outfall Undercut
- \_\_\_ Sediment Accumulation
- \_\_\_ Structural Damage (pipe, end-section, etc.)
- \_\_\_ Woody Growth/Weeds Present

### 2.) Forebay

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Concrete Cracking/Failing
- \_\_\_ Drain Pipe/Wier Clogged (not draining)
- \_\_\_ Wier/Drain Pipe Damage

### 3.) Trickle Channel (Low-flow)

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Concrete/Riprap Damage
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Erosion Outside Channel

### 4.) Bottom Stage (Micro-Pool)

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Bank Erosion
- \_\_\_ Mosquitoes/Algae Treatment
- \_\_\_ Petroleum/Chemical Sheen

### 5.) Outlet Works

- \_\_\_ Trash Rack/Well Screen Clogged
- \_\_\_ Structural Damage (concrete, steel, subgrade)
- \_\_\_ Orifice Plate(s) Missing/Not Secure
- \_\_\_ Manhole Access (cover, steps, etc.)
- \_\_\_ Woody Growth/Weeds Present

### 6.) Emergency Spillway

- \_\_\_ Riprap Displaced
- \_\_\_ Erosion Present
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Obstruction/Debris

### 7.) Upper Stage (Dry Storage)

- \_\_\_ Vegetation Sparse
- \_\_\_ Woody Growth/Undesirable Vegetation
- \_\_\_ Standing Water/Boggy Areas
- \_\_\_ Sediment Accumulation
- \_\_\_ Erosion (banks and bottom)
- \_\_\_ Trash/Debris
- \_\_\_ Maintenance Access

### 8.) Miscellaneous

- \_\_\_ Encroachment in Easement Area
- \_\_\_ Graffiti/Vandalism
- \_\_\_ Public Hazards
- \_\_\_ Burrowing Animals/Pests
- \_\_\_ Other

Inspection Summary / Additional Comments: \_\_\_\_\_

## OVERALL FACILITY RATING (Circle One)

- 0 = No Deficiencies Identified                                2 = Routine Maintenance Required
- 1 = Monitor (potential for future problem exists)        3 = Immediate Repair Necessary

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

## **APPENDIX D**

### **MAINTENANCE FORM**



CITY OF COLORADO SPRINGS

## EXTENDED DETENTION BASIN (EDB) MAINTENANCE FORM

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

**Maintenance Category:**                      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)
- \_\_\_ MOSQUITO TREATMENT
- \_\_\_ ALGAE TREATMENT

#### RESTORATION WORK

- \_\_\_ SEDIMENT REMOVAL
  - \_\_\_ FOREBAY
  - \_\_\_ TRICKLE CHANNEL
  - \_\_\_ INFLOW
- \_\_\_ EROSION REPAIR
  - \_\_\_ INFLOW POINT
  - \_\_\_ TRICKLE CHANNEL
- \_\_\_ VEGETATION REMOVAL/TREE THINNING
  - \_\_\_ INFLOW(S)
  - \_\_\_ TRICKLE CHANNEL
  - \_\_\_ UPPER STAGE
  - \_\_\_ BOTTOM STAGE
- \_\_\_ REVEGETATION
- \_\_\_ JET-VAC/CLEARING DRAINS
  - \_\_\_ FOREBAY
  - \_\_\_ OUTLET WORKS
  - \_\_\_ INFLOWS

#### REHABILITATION WORK

- \_\_\_ SEDIMENT REMOVAL (DREDGING)
  - \_\_\_ BOTTOM STAGE
  - \_\_\_ UPPER STAGE
- \_\_\_ EROSION REPAIR
  - \_\_\_ OUTLET WORKS
  - \_\_\_ UPPER STAGE
  - \_\_\_ BOTTOM STAGE
  - \_\_\_ SPILLWAY
- \_\_\_ STRUCTURAL REPAIR
  - \_\_\_ INFLOW
  - \_\_\_ OUTLET WORKS
  - \_\_\_ FOREBAY
  - \_\_\_ TRICKLE CHANNEL
- 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 REPORTING FORM**



CITY OF COLORADO SPRINGS

Annual Inspection and Maintenance Reporting Form  
for  
Stormwater BMPs

*(This form to be submitted to El Paso County prior to May 31 of each year)*

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

**To:** El Paso County  
Attn: Planning and Community Development  
2880 International Circle, Suite 110  
Colorado Springs, CO 80910

**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**

### **EROSION AND STORMWATER QUALITY CONTROL PLAN/AS-BUILTS**

## **APPENDIX G**

### **BMP MAINTENANCE COST ESTIMATES**

## 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* |
|---------------------------------|-------------------------------|---------------------|
| <b>Retention Pond</b>           | 5 to 15 years                 | 20 to 50 years      |
| <b>EDB</b>                      | 2 to 10 years                 | 20 to 50 years      |
| <b>Sand Filter</b>              | Every 6 months or as required | 20 to 50 years      |
| <b>PLD</b>                      | 5 to 10 years                 | 10 to 25 years      |
| <b>Grass Swale/Grass Buffer</b> | As needed                     | 10 to 25 years      |
| <b>Porous Paving</b>            | 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/<br/>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



**EDB Yearly Maintenance Cost Estimate**

| <b>DESCRIPTION</b>   | <b>QUANTITY</b> | <b>UNIT COST</b>        | <b>TOTAL COST</b>     |
|--|-----------------|-------------------------|-----------------------|
| <i>SEDIMENT REMOVAL</i>  |                 |                         |                       |
| <i>Volume = 20% * Original WQCV</i>                            |                 |                         |                       |
| <i>Yearly</i>  |                 |                         |                       |
| 1. Mowing  | 1 LS            | \$800 /LS               | \$800                 |
|  |                 | <b>YEARLY PRORATION</b> | <b>\$800</b>          |
| <i>Dredging(anticipated to be needed every 5 years)</i>        |                 |                         |                       |
| 1. Mobilization  | 1 LS            | \$1,000 /LS             | \$1,000               |
| 2. Sediment Dredging (pond 1 wqcv=0.143 acre-ft)               | 46 SY           | \$15 /SY                | \$690                 |
| 4. Hauling and Disposal (OFF-Site)                             | 46 SY           | \$35 /SY                | \$1,610               |
|  |                 | <b>YEARLY PRORATION</b> | <b>\$660</b>          |
| <i>Structure Replacement(anticipated lifespan of 35 years)</i> |                 |                         |                       |
| 1. Replace outfall and appertunances                           | 1 EA            | \$5,500 /LS             | \$5,500               |
|  |                 | <b>YEARLY PRORATION</b> | <b>\$157</b>          |
| <b>YEARLY TOTAL</b>  |                 |                         | <b><u>\$1,617</u></b> |

Cost Opinion Prepared By: David Mijares, PE Date: 10/1/2017

This opinion of probable cost is made on the basis of experience and qualifications and represents Catamount Engineering's best judgment as an experienced and qualified professional firm, familiar with the construction industry. Catamount Engineering cannot and will not guarantee that actual construction costs will not vary from this opinion of probable cost.



## **APPENDIX H**

### **PE CERTIFICATION**

**APPENDIX F-**  
**EROSION AND STORMWATER QUALITY PLANS**  
**(AS BUILTS)**