

Operation and Maintenance Manual

for

Stormwater Retention Ponds

April 2009

TABLE OF CONTENTS

RP-1	BACKGROUND	3
RP-2	INSPECTING RETENTION PONDS (RP'S).....	3
RP-2.1	ACCESS AND EASEMENTS	3
RP-2.2	STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS.....	3
RP-2.3	RETENTION POND (RP) FEATURES	3
RP 2.4	INSPECTION FORMS	8
RP-3	MAINTAINING RETENTION PONDS (RP'S).....	8
RP-3.1	MAINTENANCE PERSONNEL	8
RP-3.2	EQUIPMENT.....	8
RP-3.3	SAFETY.....	9
RP-3.4	MAINTENANCE FORMS	10
RP-3.5	MAINTENANCE CATEGORIES AND ACTIVITIES.....	10
RP-3.6	ROUTINE MAINTENANCE ACTIVITIES	10
RP 3.7	RESTORATION MAINTENANCE ACTIVITIES.....	12
RP-3.8	REHABILITATION MAINTENANCE ACTIVITIES.....	14

RP-1 BACKGROUND

Stormwater Retention Ponds (RP's) are a type of Stormwater BMP utilized within the Front Range of Colorado. An RP is a stormwater pond designed to retain stormwater within a site, and encourage infiltration to minimize downstream drainage concerns. Depending on local soil characteristics, the basins may be normally "dry" because the majority of stormwater infiltrates into the soil following storm events. During major storms or extended storm events, the basins may have a significant permanent pool of water remaining between runoff events, and for a period of time following runoff events.

RP-2 INSPECTING RETENTION PONDS (RP's)

RP-2.1 Access and Easements

Inspection or maintenance personnel may utilize platted access and drainage easements as required for maintenance access to the ponds.

RP-2.2 Stormwater Best Management Practice (BMP) Locations

Inspection or maintenance personnel may refer to the approved Final Drainage Report for location(s) of the RP(s) within this development.

RP-2.3 Retention Pond (RP) Features

RP's have a number of features that are designed to serve a particular function. Therefore, it is critical that each feature of the RP 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 RP and the corresponding maintenance inspection items that can be anticipated:

**Table RP-1
Typical Inspection & Maintenance Requirements Matrix**

RP Features	Sediment Removal	Mowing/ Weed control	Trash & Debris Removal	Erosion	Overgrown Vegetation Removal	Standing Water (mosquito/ algae control)	Structure Repair
Inflow Points (outfalls)	X		X				X
Bottom Stage	X	X	X	X	X	X	
Emergency Spillway			X	X	X		X
Embankment		X		X	X		

RP-2.3.1 Inflow Points

Inflow Points or Outfalls into RP's 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 RP 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 anytime 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 RP 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.

RP-2.3.2 Bottom Stage

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

a. Sediment/Debris Accumulation – The micro-pool 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 micro-pool, woody growth (cottonwoods/willows) can create operational problems for the RP. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

c. Bank Erosion –Erosion can be caused by water dropping into the pond if adequate protection/armor is not present. Erosion in this area must be mitigated to prevent sediment transport and other RP feature damage.

d. Mosquitoes/Algae Treatment – Nuisance created by stagnant water can result from improper maintenance/treatment of the pond bottom. 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 pond bottom 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 bottom of retention ponds. 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/mitigation of contaminated soils and water in the RP is necessary to minimize any environmental impacts downstream.

RP-2.3.3 Emergency Spillway

An emergency spillway is typical of all RP's 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 RP, 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 RP 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.

RP-2.3.4 Upper Stage (Dry Storage)

The upper stage of the RP 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 RP's.

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 RP, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the RP 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 – 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 RP 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. Standing water or boggy areas in upper stage
2. Uneven grades or mounds

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 micro-pool.

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 RP outlet works.

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

RP-2.3.9 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the RP. This category on the

inspection form is for maintenance items that are commonly found in the RP, but may not be attributed to an individual feature.

a. Access – Access needs to be maintained.

b. Graffiti/Vandalism – Damage to the RP infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the local enforcement agency.

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 local emergency services at 911 immediately!**

d. Burrowing Animals/Pests – Prairie dogs and other burrowing rodents may cause damage to the RP features and negatively affect the vegetation within the RP.

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

RP-2.4 Inspection Forms

Inspection forms shall be completed by the person(s) conducting the inspection activities. These inspection forms shall be kept a minimum of 5 years and made available to the El Paso County Stormwater Team upon request.

RP-3 MAINTAINING RETENTION PONDS (RP'S)

RP-3.1 Maintenance Personnel

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

RP-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 RP:

- 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.) Back Hoe
- 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 Mix)
- 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 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.

RP-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 RP that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

RP-3.4 Maintenance Forms

An RP Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Maintenance forms shall be kept on record with the Homeowners Association.

RP-3.5 Maintenance Categories and Activities

A typical RP 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 an RP. A maintenance activity can be specific to each feature within the RP, or general to the overall facility. This section of the O&M Manual explains each of the categories and briefly describes the typical maintenance activities for an RP.

A variety of maintenance activities are typical of RP's. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. Below is a description of each maintenance activity, the objectives, and frequency of actions:

RP-3.6 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. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year.

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

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

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

RP-3.6.1 Mowing

Occasional mowing is necessary to limit unwanted vegetation and to improve the overall appearance of the RP. 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.

RP-3.6.2 Trash/Debris Removal

Trash and debris must be removed from the entire RP 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.

RP-3.6.3 Outlet Works Cleaning

Debris and other materials can clog the outlet works. 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.

RP-3.6.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the RP. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the local Weed Inspector is highly recommended prior to the use of herbicide.

Frequency – Routine – As needed based on inspections.

RP-3.6.5 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.

RP- 3.7 Restoration 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.

**Table – RP-3
Summary of Restoration Maintenance Activities**

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

RP-3.7.1 Sediment Removal

Sediment removal is necessary to maintain the original design volume of the RP and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the 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 may also require surveying with an engineer’s level, and engineering consultation to ensure design volumes/grades are achieved.

Stormwater sediments removed from RP’s 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.

RP-3.7.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the RP, 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.

Frequency – Nonroutine – As necessary based upon inspections.

RP-3.7.3 Vegetation Removal/Tree Thinning

Dense stands of woody vegetation (willows, shrubs, etc) or trees can create maintenance problems for the infrastructure within an RP. Tree roots can damage structures and invade pipes/channels thereby blocking flows. Also, trees growing in the upper and lower stages of the RP 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 imperative. All trees and woody vegetation that is growing in the bottom of the RP or near structures (inflows, trickle channels, outlet works, emergency spillways, etc) should be removed. Any trees or woody vegetation in the RP should be limited to the upper portions of the pond banks.

Frequency – Nonroutine – As necessary based upon inspections.

RP-3.7.4 Clearing Drains/Jet-Vac

An RP may contain 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 micro-pool. Many times 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.

RP-3.8 Rehabilitation Maintenance Activities

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. This work may require engineering consultation to ensure the proper maintenance is performed. This work requires that the engineering staff review the original design and construction drawings to

access 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. Any proper permits required for this activity must be obtained.

**Table – RP-4
Summary of Rehabilitation Maintenance Activities**

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
Major Sediment Removal	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond capacity	Remove and dispose of sediment. Repair vegetation as needed
Major Erosion Repair	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
Structural Repair	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

RP-3.8.1 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.

RP-3.8.2 Major Erosion Repair

Major erosion repair consist 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.

RP-3.8.3 Structural Repair

An RP may include 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.

Frequency – Nonroutine – Repair as needed based upon inspections.

Reference:

This Manual is adapted from the City of Colorado Springs "Standard Operation Procedure for Inspection and Maintenance, Extended Detention Basins," May, 2008, which was adapted from SEMSWA (2007) and from the Town of Parker, Colorado (2004), STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL