# Stormwater Management Facility Operation and Maintenance (O&M) Manual

for:

Homestead at Sterling Ranch Filing No. 2

### Located at:

Homestead at Sterling Ranch Filing No. 2: Bounded by Wheatland Drive, Briargate Parkway, Dines Boulevard and Sand Creek

### Prepared for:

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### Prepared by:

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#### Reference:

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

### Stormwater Management Facility Operation and Maintenance (O&M) Manual

### **Table of Contents**

- I. Compliance with Stormwater Facility Maintenance Requirements
- II. Inspection & Maintenance- Annual Reporting
- III. Preventative Measures to Reduce Maintenance Costs
- IV. Access and Easements
- V. Safety
- VI. Field Inspection Equipment
- VII. Inspecting Stormwater Management Facilities
  - A. Inspection Procedures
  - B. Inspection Report
  - C. Verification of Inspection and Form Submittal
- VIII. Maintaining Stormwater Management Facilities
  - A. Maintenance Categories
  - B. Maintenance Personnel
  - C. Maintenance Forms

### **Appendices**

- **Appendix A** Maintenance Agreement(s)
- **Appendix B Description of Stormwater Management Facilities**
- Appendix C Standard Operation Procedures (SOP) for each facility type
- **Appendix D -** Inspection Form(s)
- **Appendix E** Maintenance Form(s)
- **Appendix F** Stormwater Facilities Map; Facility plan and detail sheets

# Stormwater Management Facility Operation and Maintenance (O&M) Manual

### I. Compliance with Stormwater Facility Maintenance Requirements

All property owners are responsible for ensuring that stormwater 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. Maintenance agreement(s) associated with this property are provided in Appendix A.

### II. Inspection & Maintenance – Annual Reporting

Requirements for the inspection and maintenance of stormwater facilities, as well as reporting requirements are included in this Stormwater Management Facility Operation and Maintenance (O&M) Manual.

Verification that the Stormwater facilities have been properly inspected and maintained; submittal of the required Inspection and Maintenance Forms and Inspector qualifications shall be provided to EPC on an annual basis.

Copies of the Inspection and Maintenance forms for each of the stormwater facilities are located in Appendix D and E.

### 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 in the first place. Common pollutants include sediment, trash & debris, chemicals, dog 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 disposal of hazardous wastes and chemicals.
- Plan lawn care to minimize the use of 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.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the upstream components of the storm drainage system, including inlets, storm sewers and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

### IV. Access and Easements

All stormwater management facilities located on the site have both a designated access location as well as a maintenance easement. Refer to the Stormwater Facilities Map located in Appendix G for access and easement locations.

### 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 or equipment. A confined space should never be entered without at least one additional person present.

If a toxic or flammable substance is discovered, leave the immediate area and contact the local Sheriff at 911.

Potentially dangerous (e.g., fuel, chemicals, hazardous materials) substances found in the areas must be referred to the local Sheriff's Office immediately for response by the Hazardous Materials Unit. The emergency contact number is 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 identified within the pond that 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 the local Sheriff's Office 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 Management Facilities:

- Protective clothing and boots.
- Safety equipment (vest, hard hat, confined space entry equipment).
- Communication equipment.
- Operation and Maintenance Manual for the site including stormwater management facility location maps.
- Clipboard.
- Stormwater Facility Maintenance Inspection Forms (See Appendix D).
- 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). However, this equipment should be available in the vehicle driven to the site.

### VII. Inspecting Stormwater Management Facilities

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent best management practices. Stormwater management facilities 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 management facilities are required to be inspected by a qualified individual at a minimum of once per year. Inspections should follow the inspection guidance found in the SOP for the specific type of facility. (Appendix C 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 D.

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 should 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 (See SOP in appendix A). 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. <u>Verification of Inspection and Form Submittal</u>

The Stormwater Management Facility Inspection Form provides a record of inspection of the facility. Inspection Forms for each facility type are provided in Appendix D. Verification of the inspection of the stormwater facilities, the facility inspection form(s), and Inspector Qualifications shall be provided to EPC on an annual basis. The verification and the inspection form(s) shall be reviewed and submitted by the property owner or property manager.

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

### VIII. Maintaining Stormwater Management Facilities

Stormwater management facilities 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 management facility maintenance programs are separated into three broad categories of work. These categories are based largely on the Urban Drainage and Flood Control District's Maintenance Program for regional drainage facilities. 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 EPC; however, completed inspection and maintenance forms shall be submitted to EPC upon request, for each inspection and maintenance activity.

### **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 require prior correspondence with EPC and require that completed maintenance forms be submitted to EPC for each maintenance activity.

### Rehabilitation Work

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater management facilities. This work requires consultation with EPC and may require an engineering design with construction plans to be prepared for review and approval. 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 EPC and require that completed maintenance forms be submitted to EPC for each maintenance activity.

### B. Maintenance Personnel

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

### C. Maintenance Forms

The Stormwater Management Facility Maintenance Form provides a record of maintenance activities. Maintenance Forms for each facility type are provided in Appendix E. Maintenance Forms shall be completed by the 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 saved for proof of the maintenance.

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

**APPENDIX A** 

#### **DETENTION BASIN /**

# STORMWATER QUALITY BEST MANAGEMENT PRACTICE MAINTENANCE AGREEMENT AND EASEMENT

This PRIVATE DETENTION BASIN / STORMWATER QUALITY BEST MANAGEMENT PRACTICE MAINTENANCE AGREEMENT AND EASEMENT (Agreement) is made by and between EL PASO COUNTY by and through THE BOARD OF COUNTY COMMISSIONERS OF EL PASO COUNTY, COLORADO (Board or County) and SR Land, LLC ("Owner or Developer") and STERLING RANCH METROPOLITAN DISTRICT NO. 1 ("District"), a quasi-municipal corporation and political subdivision of the State of Colorado. The above may occasionally be referred to herein singularly as "Party" and collectively as "Parties."

### Recitals

- A. WHEREAS, the District provides various municipal services to certain real property in El Paso County, Colorado referred to as Sterling Ranch; and
- B. WHEREAS, Developer is the owner of certain real estate in El Paso County, Colorado, which Property is legally described in <u>Exhibit A</u> attached hereto and incorporated herein by this reference; and
- C. WHEREAS, Developer desires to plat and develop on the Property a subdivision to be known as Homestead at Sterling Ranch Filing No. 2; and
- D. WHEREAS, the development of this Property will substantially increase the volume of water runoff and will decrease the quality of the stormwater runoff from the Property, and, therefore, it is in the best interest of public health, safety and welfare for the County to condition approval of this subdivision on Developer's promise to construct adequate drainage, water runoff control facilities, and stormwater quality structural Best Management Practices ("BMPs") for the subdivision; and
- E. WHEREAS, Chapter 8, Section 8.4.5 of the El Paso County <u>Land Development Code</u>, as periodically amended, promulgated pursuant to Section 30-28-133(1), Colorado Revised Statutes (C.R.S.), requires the County to condition approval of all subdivisions on a developer's promise to so construct adequate drainage, water runoff control facilities, and BMPs in subdivisions; and
- F. WHEREAS, the <u>Drainage Criteria Manual</u>, <u>Volume 2</u>, as amended by Appendix I of the El Paso County <u>Engineering Criteria Manual</u> (ECM), as each may be periodically amended, promulgated pursuant to the County's Colorado Discharge Permit System General Permit (MS4 Permit) as required by Phase II of the National Pollutant Discharge Elimination System (NPDES), which MS4 Permit requires that the County take measures to protect the quality of stormwater from sediment and other contaminants, requires subdividers, developers, landowners, and owners of facilities located in the County's rights-of-way or easements to provide adequate permanent stormwater quality BMPs with new development or significant redevelopment; and
- G. WHEREAS, Section 2.9 of the El Paso County <u>Drainage Criteria Manual</u> provides for a developer's promise to maintain a subdivision's drainage facilities in the event the County does not assume such responsibility; and

- H. WHEREAS, developers in El Paso County have historically chosen water runoff detention basins as a means to provide adequate drainage and water runoff control in subdivisions, which basins, while effective, are less expensive for developers to construct than other methods of providing drainage and water runoff control; and
- I. WHEREAS, Developer desires to construct for the subdivision two detention basin/stormwater quality BMP(s) and 26 Sand Filter Basin BMPs ("detention basin/BMP(s)") as the means for providing adequate drainage and stormwater runoff control and to meet requirements of the County's MS4 Permit, and to provide for operating, cleaning, maintaining and repairing such detention basin/BMP(s); and
- J. WHEREAS, Developer desires to construct the detention basin/BMP(s) on property that is or will be platted as Homestead at Sterling Ranch Filing No. 2, Lots 24-27, Tract B and the SFBs on Lots 13-24 & Lots 28-41, and as set forth on Exhibits B attached hereto; and
- K. WHEREAS, Developer and the District shall be charged with the duty of constructing the detention basin/BMP(s) and the District shall be charged with the duties of operating, maintaining and repairing the detention basin/BMP(s) on the Property described in <u>Exhibits B</u>; and
- L. WHEREAS, it is the County's experience that subdivision developers and property owners historically have not properly cleaned and otherwise not properly maintained and repaired these detention basins/BMPs, and that these detention basins/BMPs, when not so properly cleaned, maintained, and repaired, threaten the public health, safety and welfare; and
- M. WHEREAS, the County, in order to protect the public health, safety and welfare, has historically expended valuable and limited public resources to so properly clean, maintain, and repair these detention basins/BMPs when developers and property owners have failed in their responsibilities, and therefore, the County desires the means to recover its costs incurred in the event the burden falls on the County to so clean, maintain and repair the detention basin/BMP(s) serving this Subdivision due to the Developer's or the District's failure to meet its obligations to do the same; and
- N. WHEREAS, the County conditions approval of this Subdivision on the Developer's promise to so construct the detention basin/BMP(s), and further conditions approval on the District's promise to reimburse the County in the event the burden falls upon the County to so clean, maintain and/or repair the detention basin/BMP(s) serving this Subdivision; and
- O. WHEREAS, the County could condition subdivision approval on the Developer's promise to construct a different and more expensive drainage, water runoff control system and BMPs than those proposed herein, which more expensive system would not create the possibility of the burden of cleaning, maintenance and repair expenses falling on the County; however, the County is willing to forego such right upon the performance of Developer's and the District's promises contained herein; and
- P. WHEREAS, the County, in order to secure performance of the promises contained herein, conditions approval of this Subdivision upon the Developer's grant herein of a perpetual Easement over a portion of the Property for the purpose of allowing the County to periodically access, inspect, and, when so necessary, to clean, maintain and/or repair the detention basin/BMP(s); and

Q. WHEREAS, Pursuant to Colorado Constitution, Article XIV, Section 18(2) and Section 29-1-203, Colorado Revised Statutes, governmental entities may cooperate and contract with each other to provide any function, services, or facilities lawfully authorized to each.

### Agreement

NOW, THEREFORE, in consideration of the mutual Promises contained herein, the sufficiency of which are hereby acknowledged, the Parties agree as follows:

- 1. <u>Incorporation of Recitals</u>: The Parties incorporate the Recitals above into this Agreement.
- 2. <u>Covenants Running with the Land</u>: Developer and the District agree that this entire Agreement and the performance thereof shall become a covenant running with the land, which land is legally described in <u>Exhibits A</u> attached hereto, and that this entire Agreement and the performance thereof shall be binding upon themselves, their respective successors and assigns.
- 3. Construction: Developer or the District shall construct on that portion of the Property described in Exhibits B attached hereto and incorporated herein by this reference, two detention basins/BMP(s) and 26 SFB(s). Developer or the District shall not commence construction of the detention basin/BMP(s) until the El Paso County Planning and Community Development Department (PCD) has approved in writing the plans and specifications for the detention basin/BMP(s) and this Agreement has been signed by all Parties and returned to the PCD. Developer or the District shall complete construction of the detention basin/BMP(s) in substantial compliance with the Countyapproved plans and specifications for the detention basin/BMP(s). Failure to meet these requirements shall be a material breach of this Agreement, and shall entitle the County to pursue any remedies available to it at law or in equity to enforce the same. Construction of the detention basin/BMP(s) shall be substantially completed within one (1) year (defined as 365 days), which one year period will commence to run on the date the approved plat of this Subdivision is recorded in the records of the El Paso County Clerk and Recorder. Rough grading of the detention basin/BMP(s) must be completed and inspected by the El Paso County Planning and Community Development Department prior to commencing road construction.

In the event construction is not substantially completed within the one (1) year period, then the County may exercise its discretion to complete the project, and shall have the right to seek reimbursement from the Developer or the District and their respective successors and assigns, for its actual costs and expenses incurred in the process of completing construction. The term actual costs and expenses shall be liberally construed in favor of the County, and shall include, but shall not be limited to, labor costs, tool and equipment costs, supply costs, and engineering and design costs, regardless of whether the County uses its own personnel, tools, equipment and supplies, etc. to correct the matter. In the event the County initiates any litigation or engages the services of legal counsel in order to enforce the Provisions arising herein, the County shall be entitled to its damages and costs, including reasonable attorney fees, regardless of whether the County contracts with outside legal counsel or utilizes in-house legal counsel for the same.

4. <u>Maintenance</u>: The District agrees for itself and its successors and assigns, that it will regularly and routinely inspect, clean and maintain the detention basin/BMP(s), and otherwise keep the

same in good repair, all at its own cost and expense. No trees or shrubs that will impair the structural integrity of the detention basin/BMP(s) shall be planted or allowed to grow on the detention basin/BMP(s).

- 5. <u>Creation of Easement</u>: Developer hereby grants the County and the District a non-exclusive perpetual easement upon and across that portion of the Property described in <u>Exhibit B</u>. The purpose of the easement is to allow the County and the District to access, inspect, clean, repair and maintain the detention basin/BMP(s); however, the creation of the easement does not expressly or implicitly impose on the County a duty to so inspect, clean, repair or maintain the detention basin/BMP(s).
- 6. <u>County's Rights and Obligations</u>: Any time the County determines, in the sole exercise of its discretion, that the detention basin/BMP(s) is not properly cleaned, maintained and/or otherwise kept in good repair, the County shall give reasonable notice to the Developer, the District and their respective successors and assigns, that the detention basin/BMP(s) needs to be cleaned, maintained and/or otherwise repaired. The notice shall provide a reasonable time to correct the problem(s). Should the responsible parties fail to correct the specified problem(s), the County may enter upon the Property to so correct the specified problem(s). Notice shall be effective to the above by the County's deposit of the same into the regular United States mail, postage pre-paid. Notwithstanding the foregoing, this Agreement does not expressly or implicitly impose on the County a duty to so inspect, clean, repair or maintain the detention basin/BMP(s).
- 7. Reimbursement of County's Costs / Covenant Running With the Land: The Developer and the District agree and covenant, for themselves, their respective successors and assigns, that they will reimburse the County for its costs and expenses incurred in the process of completing construction of, cleaning, maintaining, and/or repairing the detention basin/BMP(s) pursuant to the provisions of this Agreement.

The term "actual costs and expenses" shall be liberally construed in favor of the County, and shall include, but shall not be limited to, labor costs, tools and equipment costs, supply costs, and engineering and design costs, regardless of whether the County uses its own personnel, tools, equipment and supplies, etc. to correct the matter. In the event the County initiates any litigation or engages the services of legal counsel in order to enforce the provisions arising herein, the County shall be entitled to its damages and costs, including reasonable attorney's fees, regardless of whether the County contracts with outside legal counsel or utilizes in-house legal counsel for the same.

- 8. <u>Contingencies of Subdivision Approval</u>: Developer's and the Metro District's execution of this Agreement is a condition of subdivision approval. Additional conditions of this Agreement include, but are not limited to, the following:
  - a. Conveyance of Lots 24-27 and Tract B, Homestead at Sterling Ranch Filing No. 2, from Developer to the District (which will include a reservation of easement in favor of the County for purposes of accessing, inspecting, cleaning, maintaining, and repairing the detention basin/BMP(s)), and recording of the Deed for the same; and
  - b. A copy of the Covenants of the Subdivision, if applicable, establishing that the District is obligated to inspect, clean, maintain, and repair the detention basin/BMP(s).

The County shall have the right, in the sole exercise of its discretion, to approve or disapprove any documentation submitted to it under the conditions of this Paragraph, including but not limited to, any separate agreement or amendment, if applicable, identifying any specific maintenance responsibilities not addressed herein. The County's rejection of any documentation submitted hereunder shall mean that the appropriate condition of this Agreement has not been fulfilled.

- 9. Agreement Monitored by El Paso County Planning and Community Development Department and/or El Paso County Department of Transportation: Any and all actions and decisions to be made hereunder by the County shall be made by the Director of the El Paso County Planning and Community Development Department and/or the Director of the El Paso County Department of Transportation. Accordingly, any and all documents, submissions, plan approvals, inspections, etc. shall be submitted to and shall be made by the Director of the Planning and Community Development Department and/or the Director of the El Paso County Department of Transportation.
- 10. <u>Indemnification and Hold Harmless:</u> To the extent authorized by law, Developer and the District agree, for themselves, their respective successors and assigns, that they will indemnify, defend, and hold the County harmless from any and all loss, costs, damage, injury, liability, claim, lien, demand, action and causes of action whatsoever, whether at law or in equity, arising from or related to their respective intentional or negligent acts, errors or omissions or that of their agents, officers, servants, employees, invitees and licensees in the construction, operation, inspection, cleaning (including analyzing and disposing of any solid or hazardous wastes as defined by State and/or Federal environmental laws and regulations), maintenance, and repair of the detention basin/BMP(s), and such obligation arising under this Paragraph shall be joint and several. Nothing in this Paragraph shall be deemed to waive or otherwise limit the defense available to the County pursuant to the Colorado Governmental Immunity Act, Sections 24-10-101, et seq. C.R.S., or as otherwise provided by law.
- 11. <u>Severability:</u> In the event any Court of competent jurisdiction declares any part of this Agreement to be unenforceable, such declaration shall not affect the enforceability of the remaining parts of this Agreement.
- 12. <u>Third Parties:</u> This Agreement does not and shall not be deemed to confer upon or grant to any third party any right to claim damages or to bring any lawsuit, action or other proceeding against either the County, the Developer, the District, or their respective successors and assigns, because of any breach hereof or because of any terms, covenants, agreements or conditions contained herein.
- be suspected or identified as solid waste or petroleum products, hazardous substances or hazardous materials (collectively referred to herein as "hazardous materials"), the Developer and the District shall take all necessary and proper steps to characterize the solid waste or hazardous materials and properly dispose of it in accordance with applicable State and/or Federal environmental laws and regulations, including, but not limited to, the following: Solid Wastes Disposal Sites and Facilities Acts, §§ 30-20-100.5 30-20-119, C.R.S., Colorado Regulations Pertaining to Solid Waste Disposal Sites and Facilities, 6 C.C.R. 1007-2, et seq., Solid Waste Disposal Act, 42 U.S.C. §§ 6901-6992k, and Federal Solid Waste Regulations 40 CFR Ch. I. The County shall not be responsible or liable for identifying, characterizing, cleaning up, or disposing of such solid waste or hazardous materials. Notwithstanding the previous sentence, should any refuse cleaned up and disposed of by the County be determined to be solid waste or hazardous materials, the Developer and the District, but not the County, shall be

responsible and liable as the owner, generator, and/or transporter of said solid waste or hazardous materials.

- 14. <u>Applicable Law and Venue</u>: The laws, rules, and regulations of the State of Colorado and El Paso County shall be applicable in the enforcement, interpretation, and execution of this Agreement, except that Federal law may be applicable regarding solid waste or hazardous materials. Venue shall be in the El Paso County District Court.
- 15. Limitation on <u>Developer's Obligation and Liability</u>: The obligation and liability of the Developer hereunder shall only continue until such time as the Final Plat as described in Paragraph Three (3) of the Recitals set forth above is recorded and the Developer or District completes the construction of the detention basin/BMP(s) and the Developer has transferred all applicable maintenance and operation responsibilities to the District. By execution of this agreement, the District agrees to accept all responsibilities and to perform all duties assigned to it, including those of the Developer, as specified herein, upon transfer of Tracts CC and F from Developer to the District.

IN WITNESS WHEREOF, the Parties affix their signatures below.

Executed this 13th day of MAY, 2020, by:
SR LAND, LLC  By: James Morley, Its Manager
The foregoing instrument was acknowledged before me this day of day of 2020, by James Morley, Manager, SR Land, LLC.
Witness my hand and official seal.  My commission expires: MPC 30, 7022
ERIC S HOWARD Notary Public State of Colorado Notary ID # 20144021884 My Commission Expires 05-30-2022  Executed this

STERLING RANCH METROPOLITA	AN DISTRICT NO. 1
By: Daniel Marle	
James Morley, President	<i></i>
	ERIC S HOWARD Notary Public
Attest:	State of Colorado Notary ID # 20144021884 My Commission Expires 05-30-2022
By:	
Secretary	, mar
The foregoing instrument was acknowled	ged before me this 30th day of 2020,
•	<i>6</i> *
by James Morley, President, STERLING	RANCH METROPOLITAN DISTRICT No. 1
Witness my hand and official seal.	
My commission expires:	Tory O
	(leathara)
	Notary Public
E	•
Executed this day of	, 2020, by:
OF EL PASO COUNTY, COLORADO  By:	<b>)</b>
, Chair	C
Attest:	
2 Ktost.	
County Clerk and Recorder	
771 6 1 1 1 1	1 1 11 0 11 0
The foregoing instrument was ack	nowledged before me this day of
Colorado, as Attested to by	the Board of County Commissioners of El Paso County, County Clerk and Recorder.
Witness my hand and official seal.	
My commission expires:	
	Notary Public

Approved as to Content and Form:	
Assistant County Attorney	
EL PASO COUNTY PLANNING AND COM	IMUNITY DEVELOPMENT DEPARTMENT
By: Craig Dossey, Executive Director	<del></del> ,



20 Boulder Crescent, STE 110 Colorado Springs, CO 80903 Mail to: PO Box 1360 Colorado Springs, CO 80901 719.955.5485

# POND 1 – HOMESTEAD AT STERLING RANCH FILING NO. 2 MAINTENANCE AGREEMENT EXHIBIT "A"

M&S Job No. 09-007 FEBRUARY 22, 2019

A PARCEL OF LAND LOCATED IN A PORTION OF THE SOUTHWEST QUARTER (SW 1/4) OF THE NORTHEAST QUARTER (NE 1/4) OF SECTION 33, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO;

BASIS OF BEARINGS: THE SOUTH LINE OF THE SOUTHWEST QUARTER (SW1/4) OF SECTION 34, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPLE MERIDIAN, THE SECTION CORNER COMMON TO SECTIONS 33, 34, 3, AND 4 BEING MONUMENTED WITH A 2-1/2" ALUMINUM CAP STAMPED "LS 11624" AND AT THE QUARTER CORNER COMMON TO SECTIONS 34 AND 3 WITH A 2-1/2" ALUMINUM CAP STAMPED "LS 11624", SAID LINE BEARS N89°14'14" E, A DISTANCE OF 2,722.56 FEET.

COMMENCING AT SAID SOUTHWEST CORNER OF SAID SOUTHWEST QUARTER (SW1/4) OF SAID SECTION 34; THENCE N31°01"13" W, A DISTANCE OF 4121.66 FEET TO A POINT A POINT ON THE WESTERLY LINE OF TRACT D AS SHOWN ON THE PLAT OF "STERLING RANCH FILING NO. 1" UNDER RECEPTION NUMBER 218714151 OF THE RECORDS OF EL PASO COUNTY, COLORADO, AND THE POINT OF BEGINNING OF THE PARCEL HEREIN DESCRIBED;

THENCE ALONG SAID WESTERLY LINES OF TRACT D THE FOLLOWING THREE (3) COURSES):

- 1) THENCE S69°43'31"W A DISTANCE OF 88.65 FEET:
- 2) THENCE S81°55'47"W A DISTANCE OF 111.14 FEET;
- 3) THENCE N71°56′55″W, A DISTANCE OF 75.60 FEET TO THE NORTHEAST CORNER OF TRACT F OF AFORESAID "STERLING RANCH FILING NO. 1";

THENCE ALONG THE NORTHERLY LINES OF SAID TRACT F THE FOLLOWING THREE (3) COURSES):

- 1) THENCE N71°56'55"W, A DISTANCE OF 80.38 FEET;
- 2) THENCE N54°41'05"W, A DISTANCE OF 37.80 FEET;
- 3) THENCE N31°24'46"W, A DISTANCE OF 36.61 FEET;

THENCE N35°18'43"E A DISTANCE OF 131.72 FEET;

THENCE 268.18 FEET ON THE ARC OF A NON-TANGENT CURVE TO THE LEFT, SAID CURVE HAVE A RADIUS OF 225.00 FEET, A CENTRAL ANGLE OF 68°17'28" (THE CHORD OF WHICH BEARS S76°07'45"E A DISTANCE OF 252.58 FEET) TO A POINT OF TANGENT:

THENCE N69°43'31"E A DISTANCE OF 30.37 FEET;

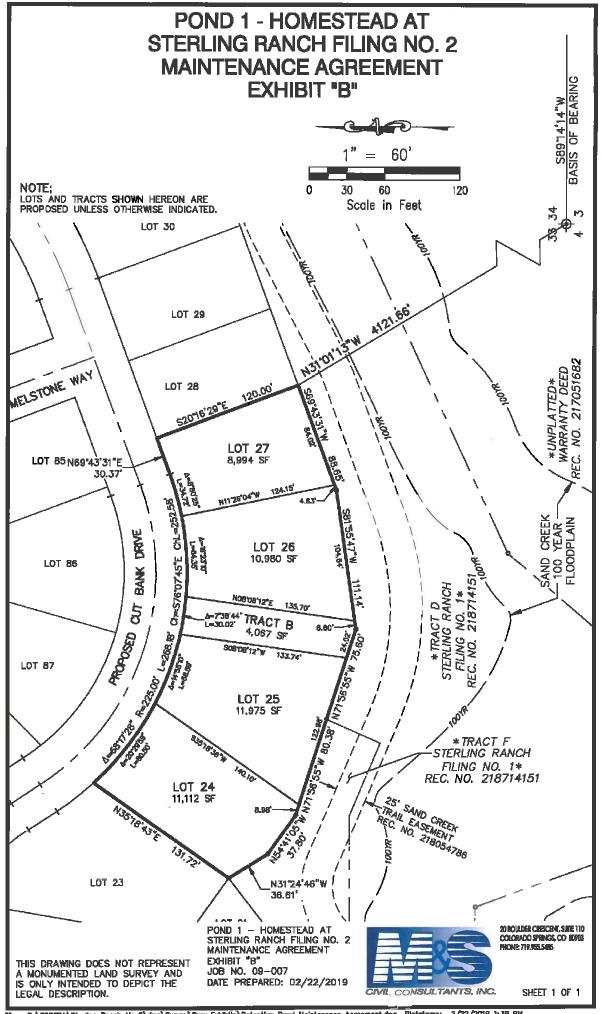
THENCE S20°16'29"E A DISTANCE OF 120.00 FEET TO THE POINT OF BEGINNING;

CONTAINING A CALCULATED AREA OF 47,128 SQUARE FEET (1.082 ACRES) MORE OR LESS.

PREPARED BY:

VERNON P. TAYLOR, COLORADO PLS NO. 25966
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903

DATE





102 E. Pikes Peak Ave, STE 500 Colorado Springs, CO 80903 Mail to: PO Box 1360 Colorado Springs, CO 80901 v 719.955.5485

# EXHIBIT A- LEGAL DESCRIPTION SAND FILTER BASIN

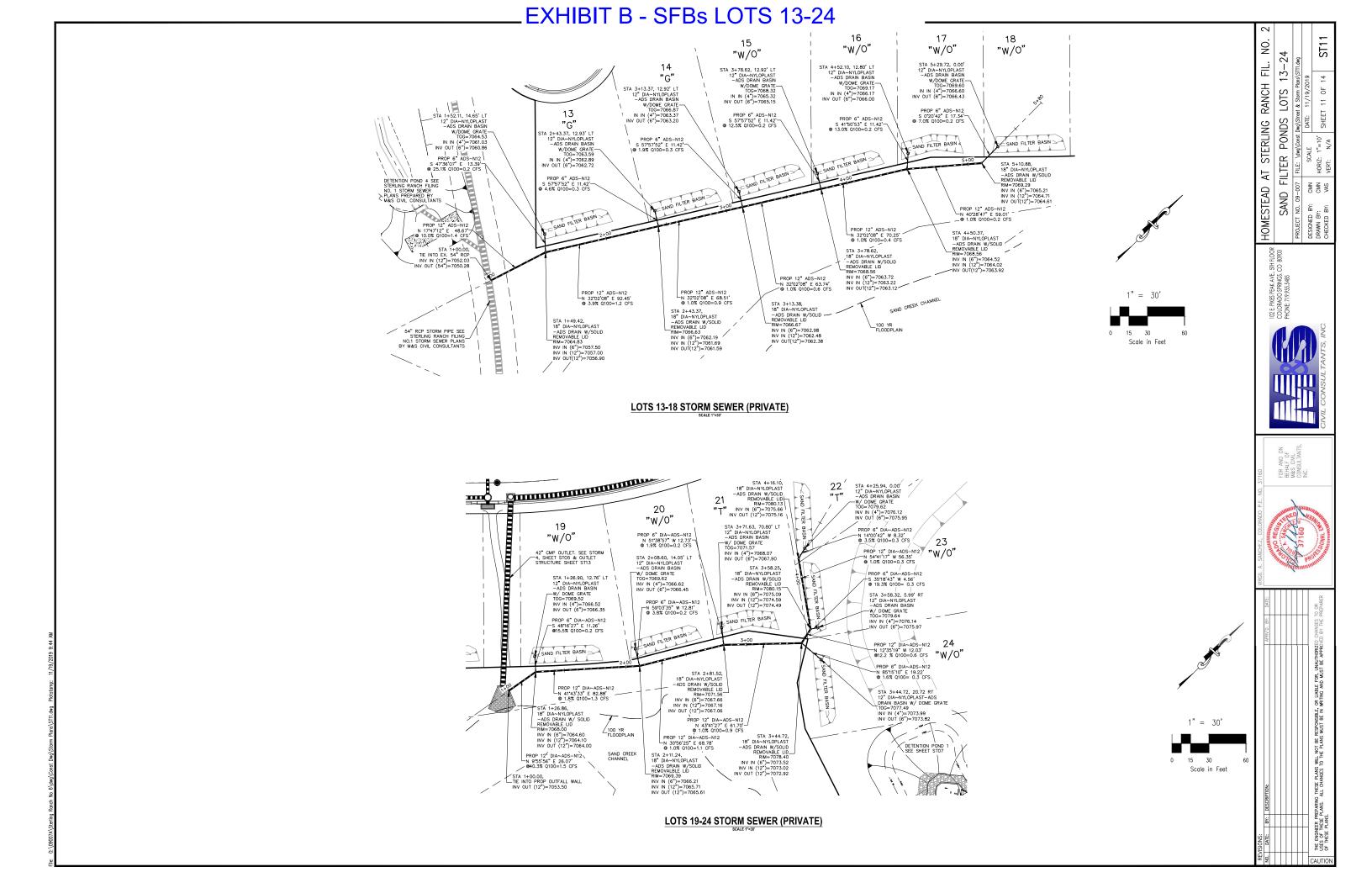
20 FOOT WIDE STRIPS OF LAND IN SECTION 33, T12S, R65W OF THE SIXTH P.M., EL PASO COUNTY, COLORADO BEING SHOWN ON THE ATTACHED EXHIBIT B1 AND EXHIBIT B2 AND MORE PARTICULARLY DESCRIBED AS FOLLOWS;

THE SOUTHEASTERLY AND\OR REAR 20 FEET OF LOTS 13 THRU 21, AND THE SOUTHWESTERLY AND\OR REAR 20 FEET OF LOTS 22 THRU 24, AND THE SOUTHEASTERLY AND\OR REAR 20 FEET OF LOTS 28 THRU 41 OF THE "HOMESTEAD AT STERLING RANCH FILING NO. 2" PLAT TO BE RECORDED IN THE EL PASO COUNTY RECORDS.

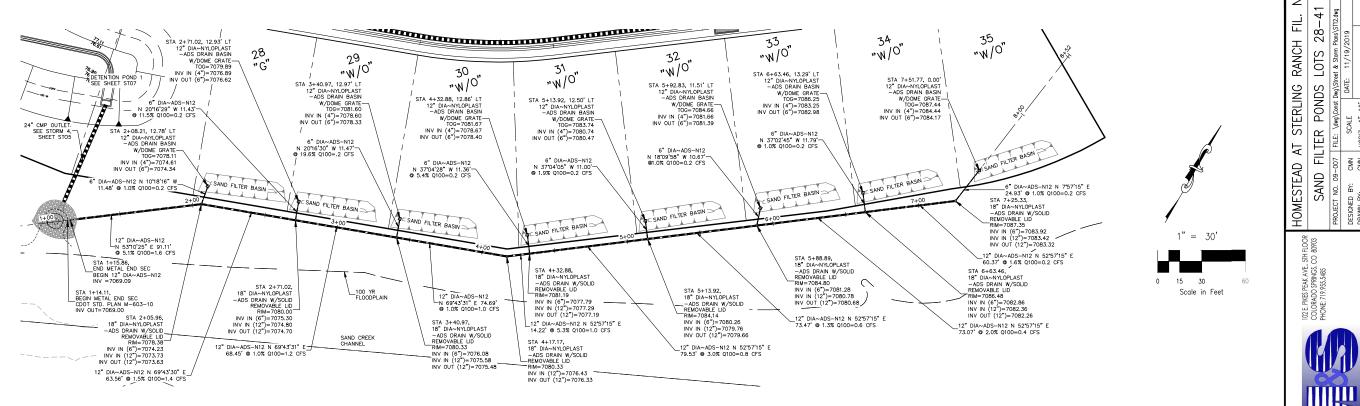
PREPARED BY:

VERNON P. TAYLOR COLORADO PLS NO 25966

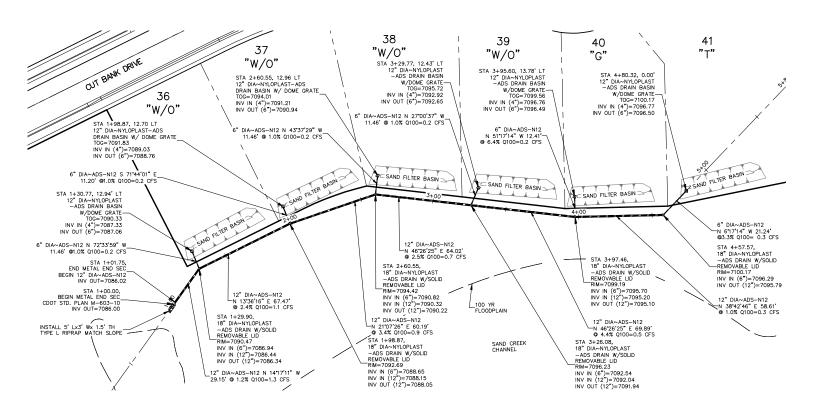
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS

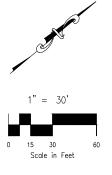


### EXHIBIT B - SFBs LOTS 28-41



### **LOTS 28-35 STORM SEWER (PRIVATE)**





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102 E. PIKES PEAK AVE., 5 COLORADO SPRINGS, C PHONE: 719.955.5485

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**LOTS 36-41 STORM SEWER (PRIVATE)** 

**APPENDIX B** 

### Appendix B

## **General Location and Description of Stormwater Management Facilities**

### A. General Site Description

Homestead at Sterling Ranch Filing No. 2 is located in the SE ¼ of the NW ¼, the SW ¼ of the NE ¼, and the NW ¼ of the NE ¼ of Section 33, Township 12 South, Range 65 West of the 6<sup>th</sup> Principal Meridian, and the NE ¼ of the SW ¼ of Section 33, Township 12 South, Range 65 West of the 6<sup>th</sup> Principal Meridian within unincorporated El Paso County, Colorado. The site is bound on the south by an existing detention pond, to the north by Briargate Parkway and to the east by Sand Creek. Existing Dines Boulevard runs along the western site boundary. An existing residential development, Homestead at Sterling Ranch Filing No. 1, bounds the site to the west and a future commercial parcel bounds the site to the northwest. Sterling Ranch lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

Homestead at Sterling Ranch Filing No. 2 consists of 29.658 acres and is presently undeveloped. Vegetation is sparse, consisting of native grasses. Existing site terrain generally slopes from north to southwest at grade rates that vary between 2% and 6%.

### **B.** General Stormwater Management Description

All stormwater is conveyed via curb and gutter and conventional reinforced concrete pipe (RCP) storm sewer to a Full Spectrum Detention Facility. "Pond 1" functions as a water quality facility for runoff produced from onsite tributary Basins. Runoff produced within the residential backyard lots, adjacent to Sand Creek will be conveyed in backyard swales and as sheet flow to a Sand Filter Basin (SFBs) within each lot. The <u>treated</u> flows will be collected by private storm sewer systems and discharged into the Sand Creek Channel.

### C. Stormwater Facilities Site Plan

Inspection or maintenance personnel may utilize the Stormwater Facilities Map located in Appendix G for locating the Pond 1 within this development.

### D. On-Site Stormwater Management Facilities

### **Volume Reduction Facilities**

Roof drains will be directed to side yard swales to aid in minimizing direct connection of impervious surfaces. For the lots subject to the rear yard SFBs, the roof drains for the entire house should be directed to the front of the lot as much as possible.

### Storage Facilities (Detention)

Pond 1, the water quality facility is designed to treat 0.245 ac-ft of water quality storage (WQCV), 0.741 ac-feet of excess urban runoff volume (EURV) and 1.331 ac-

ft of 100-year storage. An emergency spillway, riprap stilling basin and trickle channel, outlet structure, and maintenance access road has been designed for Pond 1.

Runoff produced within the residential backyard lots, of Basins X1, X2, W1 and Y1 will be conveyed in backyard swales and as sheet flow to a Sand Filter Basin within each lot. The <u>treated</u> flows will be collected by private storm sewer systems and discharged into the Sand Creek Channel. This water quality facility, for each Sand Filter Basin, is designed to treat 0.001 ac-ft of water quality storage (WQCV), 0.005 ac-feet of excess urban runoff volume (EURV) and 0.014 ac-ft of 100-year storage

### **Water Quality Facilities**

Pond 1, the water quality facility is designed to treat 0.245 ac-ft of water quality storage (WQCV). Individual Sand filter basins for lots 13-41 except for lots 25-27, are designed to treat 0.005 ac-ft of water quality storage (WQCV).

### Source Control Best Management Practices

The O&M manual does not include any nonstructural BMPs.

### Maintenance

The maintenance of Pond 1 and the smaller backyard SFBs will be by the Sterling Ranch Metropolitan District. Access to these facilities will be from the Trail, maintenance access path along the Sand Creek Channel. A 20' foot wide access easement has been dedicated and recorded with Sterling Ranch Filing No. 1. The final design of the Trail/Access path will be completed with the final channel improvement plans by Kiowa Engineering. Prior to the completion of the channel improvements, the backyard SFB's will need to be maintained. Access for the maintenance of these SFB's can be from the from the front of the home with the owner's permission, or from the rear of the yard. The existing 3:1 slopes can be traversed with small equipment, and/or the SFB's can be maintained by hand. The size of these SFB's should not require large equipment, unless filter media needs to be replaced. Minimal disturbance to the backyards should be a priority when maintaining the SFB's.

**APPENDIX C** 

# Standard Operation Procedures for Inspection and Maintenance

Extended Detention Basins (EDBs)

November 2007

### **TABLE OF CONTENTS**

EDB-1	BACKGROUND	3
EDB-2	INSPECTING EXTENDED DETENTION BASINS (EDBS)	3
EDB-2	2.1 Access and Easements	3
	2.2 STORMWATER MANAGEMENT FACILITIES LOCATIONS	
EDB-2	2.3 Extended Detention Basin (EDB) Features	3
ED	B-2.3.1 Inflow Points	4
	DB-2.3.2 Forebay	
	DB-2.3.3 Trickle Channel (Low-Flow)	
	DB-2.3.4 Bottom Stage	
	DB-2.3.5 Micropool	
	DB-2.3.6 Outlet Works	
ED	DB-2.3.7 Emergency Spillway	10
ED	DB-2.3.8 Upper Stage (Dry Storage)	11
	DB-2.3.9 Miscellaneous	
EDB-3	MAINTAINING EXTENDED DETENTION BASINS (EDBS)	13
EDB-3	3.1 Maintenance Personnel	13
EDB-3	3.2 EQUIPMENT	13
	3.3 Safety	
	3.4 Maintenance Forms	
	3.5 Maintenance Categories and Activities	
	3.6 ROUTINE MAINTENANCE ACTIVITIES	
	DB-3.6.1 Mowing	
	DB-3.6.2 Trash/Debris Removal	
	DB-3.6.3 Outlet Works Cleaning	
	DB-3.6.4 Weed Control	
	DB-3.6.5 Mosquito/Algae Treatment	
	DB-3.7.1 Sediment Removal	
	DB-3.7.2 Erosion Repair	
	DB-3.7.3 Vegetation Removal/Tree Thinning	
	DB-3.7.4 Clearing Drains/Jet-Vac	
	3.8 Major Maintenance Activities	
	DB-3.8.1 Major Sediment Removal	
	DB-3.8.2 Major Erosion Repair	
	DB-3.8.3 Structural Repair	

### EDB-1 BACKGROUND

Extended Detention Basins (EDBs) are one of the most common types of Stormwater Management Facilities utilized within the Front Range of Colorado. An EDB is a sedimentation basin designed to "extend" the runoff detention time, but to drain completely dry sometime after stormwater runoff ends. The 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 is the addition of forebays, micropools and a slow release outlet design. Forebays are shallow concrete "pans" located at the inflow point to the basin and are provided to facilitate sediment removal within a contained area prior to releasing into the pond. These 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 uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. An EDB should have a small micropool just upstream of the outlet. This 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 or maintenance personnel may utilize the stormwater facility map located in Appendix G 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 or maintenance personnel may utilize the stormwater facility map located in Appendix G 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 feature downstream (trickle channel, micropool, etc.). Therefore, it is critical that each feature of the EDB is properly inspected and

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

Table EDB-1

Typical Inspection & Maintenance Requirements Matrix

EDB Features	Sediment Removal	Mowing/ Weed control	Trash & Debris Removal	Erosion	Overgrown Vegetation Removal	Standing Water (mosquito/ algae control)	Structure Repair
Inflow Points (outfalls)	X		Х				X
Forebay	Х		Х				X
Low-flow	Х		Х	Х	Х		X
channel							
<b>Bottom Stage</b>	X	X	Χ	X	X	X	
Micropool	Х		Х		Χ	Х	Χ
Outlet Works	Х		Х				Χ
Emergency			Х	Х	Χ		Χ
Spillway							
Upper Stage			Х	Х			
Embankment		Х		Х	Х		

### 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 toewall 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 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 (skid steer). The forebay typically includes a small diameter discharge pipe or v-notch weir on the downstream end and designed to drain the forebay in a specified period of time to promote sedimentation. The 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 deceased 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 smaller in diameter and constructed with plastic, which can fracture.

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

The trickle channel conveys stormwater from the forebay to the micropool 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/repaired 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

The bottom stage is at least 1.0 to 2.0 feet deeper than the upper stage and is located in front of the outlet works structure. 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 facilities 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 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 EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, 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 "quieter" than a mature tree).

- c. Bank Erosion The micro-pool is usually a couple feet deeper than the other areas of the ponds. Erosion can be caused by water dropping into the micro-pool 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 micro-pool. 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 micro-pool 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 micro-pool 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/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

### EDB-2.3.5 Micro-pool

The micro-pool 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 micro-pool is critical in the proper function of the EDB; it allows suspended sediment to be deposited at the bottom of the micro-pool 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 micro-pools 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 EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, 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 "quieter" than a mature tree).

- c. Mosquitoes/Algae Treatment Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. 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 micro-pool 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 micro-pool 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/mitigation 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 quantities 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 (flood control) on the outlet structure typically have trash racks over them to prevent clogging. The water quality orifice plate (smaller 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 approval from EPC.
- 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 "quieter" than 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 micropool 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 micro-pool 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. Micro-pool 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 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 EDB outlet works.
- g. Maintenance Access Most EDBs 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 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 local 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.
- e. Other Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

#### **EDB-2.4 Inspection Forms**

EDB Inspection forms are located in Appendix D. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the El Paso County per the requirements of the Operations and Maintenance Manual. These inspection forms shall be kept indefinitely and made available to the El Paso County upon request.

#### 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.) 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 Foothills)
- 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 Forms**

The EDB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The EBD Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the El Paso County per the requirements of the Operations and Maintenance Manual. The EDB Maintenance form is located in Appendix E.

#### **EDB-3.5 Maintenance Categories and Activities**

A typical EDB Maintenance Program will consist of three broad categories of work. 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. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for an EDB.

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. Below is a description of each maintenance activity, the objectives, and frequency of actions:

#### **EDB-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 well screens and trash racks. It also includes activities such as includes weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the El Paso County; however, completed inspection and maintenance forms shall be submitted to the EPC for each inspection and maintenance activity.

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

TABLE - EDB-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 EDB	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

#### EDB-3.6.1 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-3.6.2 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-3.6.3 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-3.6.4 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 local Weed Inspector is highly recommended prior to the use of herbicide.

Frequency – Routine – As needed based on inspections.

#### EDB-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.

#### **EDB- 3.7 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 require prior correspondence with EPC and require completed inspection and maintenance forms to be submitted to EPC for each inspection and maintenance activity.

## Table – EDB-3 Summary of Minor 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	As needed,	Large trees/wood	Remove vegetation;
Thinning	based upon inspection	vegetation in lower chamber of pond	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

#### EDB-3.7.1 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 Engineering 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-3.7.2 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 engineering staff.

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

#### EDB-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 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 imperative. 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-3.7.4 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 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.

#### **EDB-3.8 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 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. A Construction Activity permit shall be required for all 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

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

#### EDB-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.

#### EDB-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.

### EDB-3.8.3 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 Engineering Staff should take place prior to all structural repairs.

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

#### Reference:

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

**APPENDIX D** 

## EXTENDED DETENTION BASIN (EDB) INSPECTION FORM

	Date:
Subdivision/Business Name:	
Subdivision/Business Address:	
Weather:	
Date of Last Rainfall:	Amount:Inches
<b>Property Classification:</b> Residential Multi Fami (Circle One)	ily Commercial Other:
Reason for Inspection: Routine Co (Circle One)	omplaint After Significant Rainfall Event
INSPECTION SCORING - For each facility inspection iter	n, insert one of the following scores:
0 = No deficiencies identified	2 = Routine maintenance required
1 = Monitor (potential for future problem) N/A = Not applicable	3 =Immediate repair necessary
<u>FEATURES</u>	
1.) Inflow Points	2.) Forebay
Riprap Displaced	Sediment/Debris Accumulation
Erosion Present/Outfall Undercut	Concrete Cracking/Failing
Sediment Accumulation	Drain Pipe/Wier Clogged (not draining)
Structural Damage (pipe, end-section, etc.)	Wier/Drain Pipe Damage
Woody Growth/Weeds Present	
3.) Trickle Channel (Low-flow)	4.) Bottom Stage (Micro-Pool)
Sediment/Debris Accumulation	Sediment/Debris Accumulation
Concrete/Riprap Damage	Woody Growth/Weeds Present
Woody Growth/Weeds Present	Bank Erosion
Erosion Outside Channel	Mosquitoes/Algae Treatment
	Petroleum/Chemical Sheen
5.) Outlet Works	6.) Emergency Spillway
Trash Rack/Well Screen Clogged	Riprap Displaced
Structural Damage (concrete,steel,subgrade)	Erosion Present
Orifice Plate(s) Missing/Not Secure	Woody Growth/Weeds Present
Manhole Access (cover, steps, etc.)	Obstruction/Debris
Woody Growth/Weeds Present	
7.) Upper Stage (Dry Storage)	8.) Miscellaneous
Vegetation Sparse	Encroachment in Easement Area
Woody Growth/Undesirable Vegetation	Graffiti/Vandalism
Standing Water/Boggy Areas	Public Hazards
Sediment Accumulation	Burrowing Animals/Pests
Erosion (banks and bottom)	Other
Trash/Debris	
Maintenance Access	
Inspection Summary / Additional Comments:	
OVERALL FACILITY PATING (Circle Co.)	
OVERALL FACILITY RATING (Circle One) 0 = No Deficiencies Identified	2 = Routine Maintenance Required
1 = Monitor (potential for future problem exists)	3 = Immediate Repair Necessary
Mornio (potential for fatale problem exists)	o minodiato Ropali Noocoodi y

This inspection form shall be kept indefinitely and made available to the El Paso County upon request.

**APPENDIX E** 

## EXTENDED DETENTION BASIN (EDB) MAINTENANCE FORM

livision/Business Name:			
ivision/Business Address:		Contact Name	e:
Maintenance Category: cle All That Apply)	Routine	Restoration	Rehabilitation
MAINTENANCE ACTIV	VITIES PERFORME	ED .	
	S CLEANING (TRASH DL (HERBICIDE APPLIC EATMENT	RACK/WELL SCREEN) CATION)	
RESTORATION WORL	<u>K</u>	REHABILITATIO	N WORK
INFL EROSION REPA INFL TRIC VEGETATION R TRIC TRIC UPP BOT REVEGETATION JET-VAC/CLEAI OUT	EBAY CKLE CHANNEL OW AIR OW POINT CKLE CHANNEL REMOVAL/TREE THINN OW(S) CKLE CHANNEL ER STAGE TOM STAGE N RING DRAINS	EROSION RE I  IING	OUTLET WORKS JPPER STAGE BOTTOM STAGE SPILLWAY
ESTIMATED TOTAL MANH	IOURS:		
EQUIPMENT/MATERIAL U	SED:		
COMMENTS/ADDITIONAL	INFO:		

This Maintenance Activity Form shall be kept indefinitely and made available to the El Paso County upon request.

**APPENDIX F** 

AT THE JOB SITE AT ALL TIME INCLUDING THE FOLLOWING:

CONSTRUCTION. CALL 811 TO CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO SPRINGS. 3. CONTRACTOR SHALL KEEP A COPY OF THESE APPROVED PLANS, THE GRADING AND EROSION CONTROL PLAN, THE STORMWATER MANAGEMENT PLAN (SWMP). THE SOILS AND GEOTECHNICAL REPORT AND THE APPROPRIATE DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS

3.1 EL PASO COUNTY ENGINEERING CRITERIA MANUAL (ECM) 3.2 CITY OF COLORADO SPRINGS/EL PASO COUNTY ENGINEERING CRITERIA MANUAL VOLUMES 1 AND 2.

3.3 COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) STANDARDS SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION.

3.4 CDOT M&S STANDARDS

4. IT IS THE DESIGN ENGINEERS RESPONSIBILITY TO ACCURACY SHOW EXISTING CONDITION BOTH ONSITE AND OFFSITE ON THE CONSTRUCTION PLANS. ANY MODIFICATION NECESSARY DUE TO CONFLICT OMISSIONS OR CHANGED CONDITIONS WILL BE ENTIRELY THE DEVELOPERS

5. ONCE THE ESQCP HAS BEEN ISSUED, THE CONTRACTOR MAY INSTALL THE INITIAL STAGE EROSION AND SEDIMENT CONTROL BMPS AS INDICATED ON THE GEC. A PRECONSTRUCTION MEETING BETWEEN THE CONTRACTOR, ENGINEER, AND EL PASO COUNTY WILL BE HELD PRIOR TO ANY CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE THE MEETING TIME AND PLACE WITH COUNTY PCD

6. IT IS THE CONTRACTORS RESPONSIBILITY TO UNDERSTAND THE REQUIREMENTS OF ALL JURISDICTIONAL AGENCIES AND TO OBTAIN ALL REQUIRED PERMITS, INCLUDING BUT NOT LIMITED TO EL PASO COUNTY EROSION AND STORM WATER QUALITY CONTROL PERMIT (ESQCP). US ARMY CORPS OF ENGINEER ISSUED 401 AND/OR 404 PERMITS AND COUNTY AND STATE FUGITIVE DUST PERMITS.

7. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE CONSTRUCTION SITE AT APPROVED CONSTRUCTION ACCESS POINTS.

8. ANY TEMPORARY SIGNAGE AND STRIPING SHALL COMPLY WITH EL PASO COUNTY DOW AND MUTCD CRITERIA

9. CONTRACTOR SHALL OBTAIN ANY PERMITS REQUIRE BY EL PASO COUNTY DOT INCLUDING WORK WITHIN THE RIGHT-OF-WAY AND SPECIAL

10. THE LIMITS OF CONSTRUCTION SHALL REMAIN WITHIN THE PROPERTY LINE UNLESS OTHERWISE NOTED. THE OWNER/DEVELOPER SHALL OBTAIN WRITTEN PERMISSION AND EASEMENTS, WHERE REQUIRED, FROM ADJOINING PROPERTY OWNER(S) PRIOR TO ANY OFFSITE DISTURBANCE

## GRADING AND EROSION CONTROL NOTES:

STORMWATER DISCHARGES FROM CONSTRUCTION SITES SHALL NOT CAUSE OR THREATEN TO CAUSE POLLUTION, CONTAMINATION. OR DEGRADATION OF STATE WATERS. ALL WORK AND EARTH DISTURBANCE SHALL BE DONE IN A MANNER THAT MINIMIZES POLLUTION OF ANY ON-SITE OR OFF-SITE WATERS, INCLUDING

NOTWITHSTANDING ANYTHING DEPICTED IN THESE PLANS IN WORDS OR GRAPHIC REPRESENTATION, ALL DESIGN AND CONSTRUCTION RELATED TO ROADS, STORM DRAINAGE AND EROSION CONTROL SHALL CONFORM TO THE STANDARDS AND REQUIREMENTS OF THE MOST RECENT VERSION OF THE RELEVANT ADOPTED EL PASO COUNTY STANDARDS, INCLUDING THE LAND DEVELOPMENT CODE, THE ENGINEERING CRITERIA MANUAL, THE DRAINAGE CRITERIA MANUAL. AND THE DRAINAGE CRITERIA MANUAL VOLUME 2. ANY DEVIATIONS FROM REGULATIONS AND STANDARDS MUST BE REQUESTED, AND APPROVED, IN WRITING.

A SEPARATE STORMWATER MANAGEMENT PLAN (SMWP) FOR THIS PROJECT SHALL BE COMPLETED AND AN EROSION AND STORMWATER QUALITY CONTROL PERMIT (ESQCP) ISSUED PRIOR TO COMMENCING CONSTRUCTION. MANAGEMENT OF THE SWMP DURING CONSTRUCTION IS THE RESPONSIBILITY OF THE DESIGNATED QUALIFIED STORMWATER MANAGER OR CERTIFIED EROSION CONTROL INSPECTOR. THE SWMP SHALL BE LOCATED ON SITE AT ALL TIMES DURING CONSTRUCTION AND SHALL BE KEPT UP TO DATE WITH WORK PROGRESS AND CHANGES IN THE FIELD.

ONCE THE ESQCP IS APPROVED AND A 'NOTICE TO PROCEED" HAS BEEN ISSUED, THE CONTRACTOR MAY INSTALL THE INITIAL STAGE EROSION AND SEDIMENT CONTROL MEASURES AS INDICATED ON THE APPROVED GEC. A PRECONSTRUCTION MEETING BETWEEN THE CONTRACTOR, ENGINEER, AND EL PASO COUNTY WILL BE HELD PRIOR TO ANY CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE THE MEETING TIME AND PLACE WITH COUNTY STAFF.

CONTROL MEASURES MUST BE INSTALLED PRIOR TO COMMENCEMENT OF ACTIVITIES THAT COULD CONTRIBUTE POLLUTANTS TO STORMWATER. CONTROL MEASURES FOR ALL SLOPES, CHANNELS, DITCHES, AND DISTURBED LAND AREAS SHALL BE INSTALLED IMMEDIATELY UPON COMPLETION OF THE DISTURBANCE

ALL TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE MAINTAINED AND REMAIN IN EFFECTIVE OPERATING CONDITION UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED AND FINAL STABILIZATION IS ESTABLISHED. ALL PERSONS ENGAGED IN LAND DISTURBANCE ACTIVITIES SHALL ASSESS THE ADEQUACY OF CONTROL MEASURES AT THE SITE AND IDENTIFY IF CHANGES TO THOSE CONTROL MEASURES ARE NEEDED TO ENSURE THE CONTINUED EFFECTIVE PERFORMANCE OF THE CONTROL MEASURES. ALL CHANGES TO TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES MUST BE INCORPORATED INTO THE STORMWATER MANAGEMENT PLAN.

TEMPORARY STABILIZATION SHALL BE IMPLEMENTED ON DISTURBED AREAS AND STOCKPILES WHERE GROUND DISTURBING CONSTRUCTION ACTIVITY HAS PERMANENTLY CEASED OR TEMPORARILY CEASED FOR LONGER THAN 14 DAYS.

FINAL STABILIZATION MUST BE IMPLEMENTED AT ALL APPLICABLE CONSTRUCTION SITES. FINAL STABILIZATION IS ACHIEVED WHEN ALL GROUND DISTURBING ACTIVITIES ARE COMPLETE AND ALL DISTURBED AREAS EITHER HAVE A UNIFORM VEGETATIVE COVER WITH INDIVIDUAL PLANT DENSITY OF 70 PERCENT OF PRE-DISTURBANCE LEVELS ESTABLISHED OR EQUIVALENT PERMANENT ALTERNATIVE STABILIZATION METHOD IS IMPLEMENTED. ALL TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED UPON FINAL STABILIZATION AND BEFORE PERMIT CLOSURE.

ALL PERMANENT STORMWATER MANAGEMENT FACILITIES SHALL BE INSTALLED AS DESIGNED IN THE APPROVED PLANS. ANY PROPOSED CHANGES THAT EFFECT THE DESIGN OR FUNCTION OF PERMANENT STORMWATER MANAGEMENT STRUCTURES MUST BE APPROVED BY THE ECM ADMINISTRATOR PRIOR TO IMPLEMENTATION

10 FARTH DISTURBANCES SHALL BE CONDUCTED IN SUCH A MANNER SO AS TO EFFECTIVELY MINIMIZE ACCELERATED SOIL EROSION AND RESULTING SEDIMENTATION. ALL DISTURBANCES SHALL BE DESIGNED, CONSTRUCTED, AND COMPLETED SO THAT THE EXPOSED AREA OF ANY DISTURBED LAND SHALL BE LIMITED TO SHORTEST PRACTICAL PERIOD OF TIME. PRE-EXISTING VEGETATION SHALL BE PROTECTED AND MAINTAINED WITHIN 50 HORIZONTAL FEET OF A WATERS OF THE STATE UNLESS SHOWN TO BE INFEASIBLE AND SPECIFICALLY REQUESTED AND APPROVED.

11. COMPACTION OF SOIL MUST BE PREVENTED IN AREAS DESIGNATED FOR INFILTRATION CONTROL MEASURES OR WHERE FINAL STABILIZATION WILL BE ACHIEVED BY VEGETATIVE COVER. AREAS DESIGNATED FOR INFILTRATION CONTROL MEASURES SHALL ALSO BE PROTECTED FROM SEDIMENTATION DURING CONSTRUCTION UNTIL FINAL STABILIZATION IS ACHIEVED. IF COMPACTION PREVENTION IS NOT FEASIBLE DUE TO SITE CONSTRAINTS, ALL AREAS DESIGNATED FOR INFILTRATION AND VEGETATION CONTROL MEASURES MUST BE LOOSENED PRIOR TO INSTALLATION OF THE CONTROL MEASURE(S).

ANY TEMPORARY OR PERMANENT FACILITY DESIGNED AND CONSTRUCTED FOR THE CONVEYANCE OF STORMWATER AROUND, THROUGH, OR FROM THE EARTH DISTURBANCE AREA SHALL BE A STABILIZED CONVEYANCE DESIGNED TO MINIMIZE EROSION AND THE DISCHARGE OF SEDIMENT OFF SITE.

CONCRETE WASH WATER SHALL BE CONTAINED AND DISPOSED OF IN ACCORDANCE WITH THE SWMP. NO WASH WATER SHALL BE DISCHARGED TO OR ALLOWED TO ENTER STATE WATERS, INCLUDING ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR FACILITIES. CONCRETE WASHOUTS SHALL NOT BE LOCATED IN AN AREA WHERE SHALLOW GROUNDWATER MAY BE PRESENT, OR WITHIN 50 FEET OF A SURFACE WATER BODY, CREEK OR STREAM.

14. DURING DEWATERING OPERATIONS OF UNCONTAMINATED GROUND WATER MAY BE DISCHARGED ON SITE, BUT SHALL NOT LEAVE THE SITE IN THE FORM OF SURFACE RUNOFF UNLESS AN APPROVED STATE DEWATERING PERMIT IS IN PLACE.

15. EROSION CONTROL BLANKETING OR OTHER PROTECTIVE COVERING SHALL BE USED ON SLOPES STEEPER THAN 3:1.

CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL WASTES FROM THE CONSTRUCTION SITE FOR DISPOSAL IN ACCORDANCE WITH LOCAL AND STATE REGULATORY REQUIREMENTS. NO CONSTRUCTION DEBRIS, TREE SLASH, BUILDING MATERIAL WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURIED,

17. WASTE MATERIALS SHALL NOT BE TEMPORARILY PLACED OR STORED IN THE STREET, ALLEY, OR OTHER PUBLIC WAY, UNLESS IN ACCORDANCE WITH AN APPROVED TRAFFIC CONTROL PLAN. CONTROL MEASURES MAY BE REQUIRED BY EL PASO COUNTY ENGINEERING IF DEEMED NECESSARY, BASED ON SPECIFIC

TRACKING OF SOILS AND CONSTRUCTION DEBRIS OFF-SITE SHALL BE MINIMIZED. MATERIALS TRACKED OFF-SITE SHALL BE CLEANED UP AND PROPERLY DISPOSED OF IMMEDIATELY.

THE OWNER/DEVELOPER SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL CONSTRUCTION DEBRIS, DIRT, TRASH, ROCK, SEDIMENT, SOIL, AND SAND THAT MAY ACCUMULATE IN ROADS, STORM DRAINS AND OTHER DRAINAGE CONVEYANCE SYSTEMS AND STORMWATER APPURTENANCES AS A RESULT OF SITE DEVELOPMENT.

20. THE QUANTITY OF MATERIALS STORED ON THE PROJECT SITE SHALL BE LIMITED, AS MUCH AS PRACTICAL, TO THAT QUANTITY REQUIRED TO PERFORM THE WORK IN AN ORDERLY SEQUENCE. ALL MATERIALS STORED ON-SITE SHALL BE STORED IN A NEAT, ORDERLY MANNER, IN THEIR ORIGINAL CONTAINERS, WITH ORIGINAL

21. NO CHEMICAL(S) HAVING THE POTENTIAL TO BE RELEASED IN STORMWATER ARE TO BE STORED OR USED ONSITE UNLESS PERMISSION FOR THE USE OF SUCH CHEMICAL(S) IS GRANTED IN WRITING BY THE ECM ADMINISTRATOR. IN GRANTING APPROVAL FOR THE USE OF SUCH CHEMICAL(S), SPECIAL CONDITIONS AND

22. BULK STORAGE OF ALLOWED PETROLEUM PRODUCTS OR OTHER ALLOWED LIQUID CHEMICALS IN EXCESS OF 55 GALLONS SHALL REQUIRE ADEQUATE SECONDARY CONTAINMENT PROTECTION TO CONTAIN ALL SPILLS ONSITE AND TO PREVENT ANY SPILLED MATERIALS FROM ENTERING STATE WATERS, ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR OTHER FACILITIES.

23. NO PERSON SHALL CAUSE THE IMPEDIMENT OF STORMWATER FLOW IN THE CURB AND GUTTER OR DITCH EXCEPT WITH APPROVED SEDIMENT CONTROL MEASURES.

OWNER/DEVELOPER AND THEIR AGENTS SHALL COMPLY WITH THE "COLORADO WATER QUALITY CONTROL ACT" (TITLE 25, ARTICLE 8, CRS), AND THE "CLEAN WATER ACT" (33 USC 1344), IN ADDITION TO THE REQUIREMENTS OF THE LAND DEVELOPMENT CODE, DCM VOLUME II AND THE ECM APPENDIX I. ALL APPROPRIATE PERMITS MUST BE OBTAINED BY THE CONTRACTOR PRIOR TO CONSTRUCTION (1041, NPDES, FLOODPLAIN, 404, FUGITIVE DUST, ETC.). IN THE EVENT OF CONFLICTS BETWEEN THESE REQUIREMENTS AND OTHER LAWS, RULES, OR REGULATIONS OF OTHER FEDERAL, STATE, LOCAL, OR COUNTY AGENCIES, THE MOST RESTRICTIVE LAWS, RULES, OR REGULATIONS SHALL APPLY.

25. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE SITE ONLY AT APPROVED CONSTRUCTION ACCESS POINTS.

26. PRIOR TO CONSTRUCTION THE PERMITTEE SHALL VERIFY THE LOCATION OF EXISTING UTILITIES.

27. A WATER SOURCE SHALL BE AVAILABLE ON SITE DURING EARTHWORK OPERATIONS AND SHALL BE UTILIZED AS REQUIRED TO MINIMIZE DUST FROM EARTHWORK

28. THE SOILS REPORT FOR THIS SITE HAS BEEN PREPARED BY CTL THOMPSON, INC., AND SHALL BE CONSIDERED A PART OF THESE PLANS.

29. AT LEAST TEN (10) DAYS PRIOR TO THE ANTICIPATED START OF CONSTRUCTION, FOR PROJECTS THAT WILL DISTURB ONE (1) ACRE OR MORE, THE OWNER OR OPERATOR OF CONSTRUCTION ACTIVITY SHALL SUBMIT A PERMIT APPLICATION FOR STORMWATER DISCHARGE TO THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, WATER QUALITY DIVISION. THE APPLICATION CONTAINS CERTIFICATION OF COMPLETION OF A STORMWATER MANAGEMENT PLAN (SWMP). OF WHICH THIS GRADING AND EROSION CONTROL PLAN MAY BE A PART. FOR INFORMATION OR APPLICATION MATERIALS CONTACT:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT WATER QUALITY CONTROL DIVISION WQCD - PERMITS

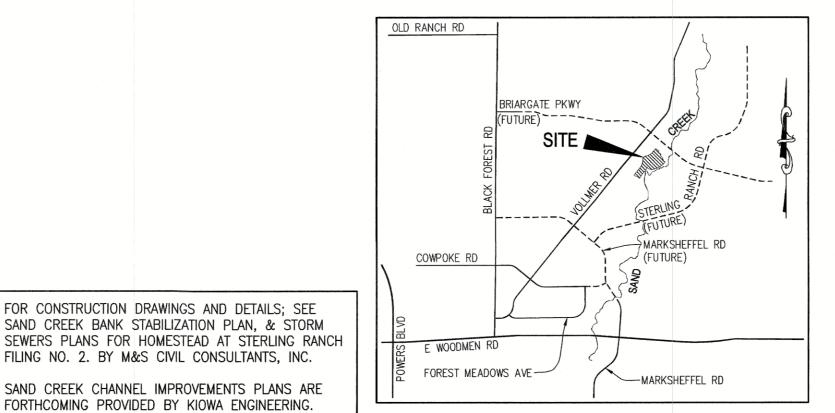
4300 CHERRY CREEK DRIVE SOUTH DENVER, CO 80246-1530 ATTN: PERMITS UNIT

# HOMESTEAD AT STERLING RANCH FILING NO. 2

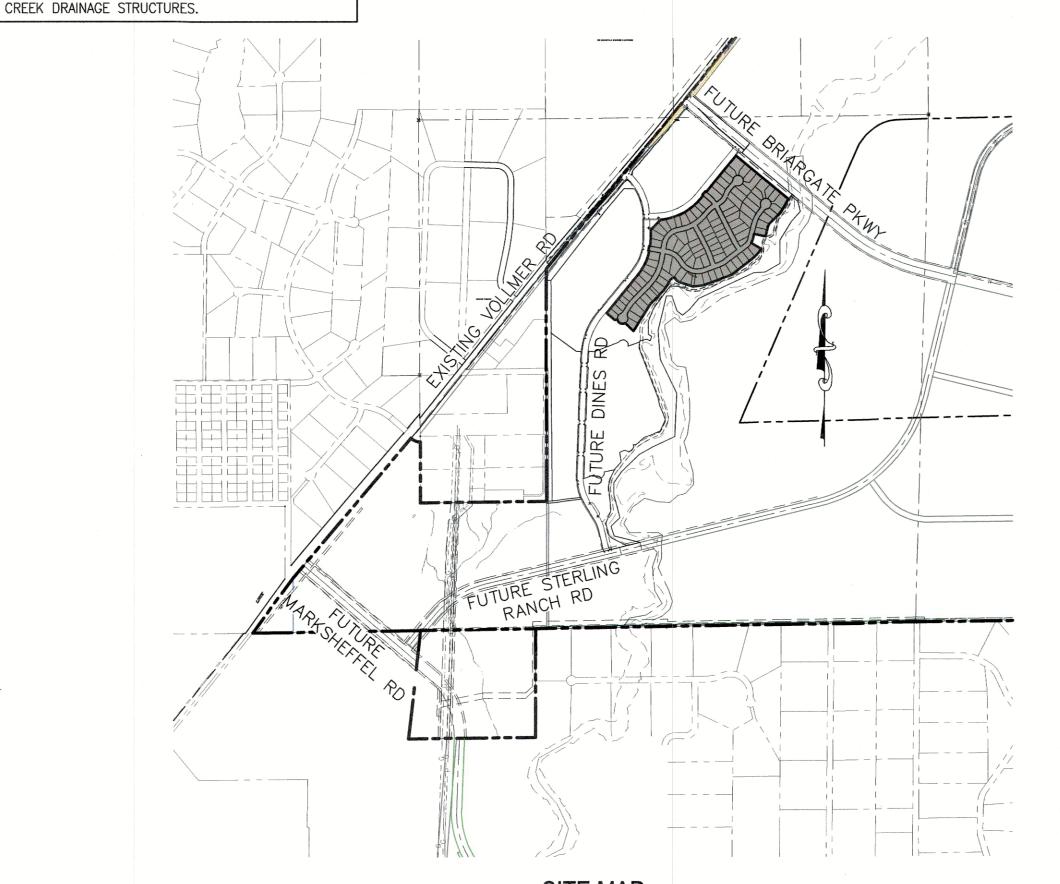
COUNTY OF EL PASO, STATE OF COLORADO

# FINAL GRADING/EROSION CONTROL PLANS

**MARCH 2020** SF-19-004



N.T.S.



## SITE MAP N.T.S.

## ADDITIONAL NOTES:

STAGING AREA TO BE DETERMINED BY CONTRACTOR IN THE FIELD. THE LOCATIONS SHALL BE DELINEATED ON THIS PLAN BY THE CONTRACTOR.

THE EROSION CONTROL DELINEATED ON THIS PLAN SHALL BE REGULARLY UPDATED BY THE CONTRACTOR.

FOR CONSTRUCTION DRAWINGS AND DETAILS; SEE

SAND CREEK BANK STABILIZATION PLAN, & STORM

FILING NO. 2. BY M&S CIVIL CONSULTANTS, INC.

SAND CREEK CHANNEL IMPROVEMENTS PLANS ARE

THESE PLANS WILL DEPICT THE IMPROVEMENTS TO

SAND CREEK CHANNEL, THE FINAL TRAIL LOCATION

AND MAINTENANCE ACCESS LOCATIONS FOR THE SAND

FORTHCOMING PROVIDED BY KIOWA ENGINEERING.

TEMPORARY SEDIMENT TRAP LOCATIONS WILL BE DETERMINED BY THE CONTRACTOR IN THE FIELD.

EXISTING SITE TERRIAN GENERALLY SLOPES FROM NORTH TO SOUTHWEST AT

GRADE RATES THAT VARY BETWEEN 2% TO 6%.

THERE ARE NO BATCH PLANTS ON SITE.

AREAS LEFT OPEN FOR 30 DAYS OR MORE, OTHER THAN FOR UTILITY AND DRAINAGE CONSTRUCTION SHALL BE SEEDED AND/OR

NO PORTION OF THE PLATTED SINGLE FAMILY LOTS ARE LOCATED WITHIN A DESIGNATED FEMA FLOODPLAIN IN ACCORDANCE WITH FLOOD INSURANCE RATE MAPS (FIRM) 08041C0535G, EFFECTIVE DATE JULY 23, 2009.

## **BENCHMARKS**

1. THE TOP OF AN ALUMINUM SURVEYORS CAP, STAMPED "9853", AT THE SOUTHEAST BOUNDARY CORNER OF BARBARICK SUBDIVISION NORTHING = 411416.273

EASTING = 235167.071ELEVATION = 7023.42

ELEVATION = 7000.40

EASTING = 233849.817

ELEVATION = 7030.82

2. THE TOP OF A RED PLASTIC SURVEYORS CAP, ILLEGIBLE, AT THE NORTHWEST BOUNDARY CORNER OF PAWNEE RANCHEROS SUBDIVISION NORTHING = 410095.404EASTING = 235052.131

3. THE TOP OF A RED PLASTIC SURVEYORS CAP, STAMPED "38141", AT THE SOUTHWEST BOUNDARY CORNER OF BARBARICK SUBDIVISION NORTHING = 411399.962

**AGENCIES** 

OWNER/DEVELOPER:

COUNTY ENGINEERING

WATER RESOURCES:

SR LAND. LLC 20 BOULDER CRESCENT, SUITE 201 COLORADO SPRINGS, CO 80901 JIM MORLEY (719) 471-1742

CIVIL ENGINEER: M & S CIVIL CONSULTANTS, INC. 102 E. PIKES PEAK, 5TH FLOOR COLORADO SPRINGS, CO 80903 VIRGIL A. SANCHEZ P.E. (719) 955-5485

> EL PASO COUNTY PLANNING AND COMMUNITY DEVELOPMENT

2880 INTERNATIONAL CIRCLE, SUITE 110 COLORADO SPRINGS, CO 80910 JEFF RICE, P.E. (719) 520-6300

TRAFFIC ENGINEERING: EL PASO COUNTY DEPARTMENT OF PUBLIC WORL 3275 AKERS DRIVE

> COLORADO SPRINGS, CO 80922 JENNIFER IRVINE, P.E. (719) 520-6460

STERLING RANCH METRO DISTRICT ENGINEERS

JDS-HYDRO CONSULTANTS 545 E. PIKES PEAK AVE., SUITE 300 COLORADO SPRINGS, CO 80903 JOHN MCGINN (719) 668-8769

FIRE DISTRICT:

BLACK FOREST FIRE PROTECTION DISTRICT 11445 TEACHOUT ROAD COLORADO SPRINGS, CO 80908

CHIEF BRYAN JACK (719) 495-4300

GAS DEPARTMENT

COLORADO SPRINGS UTILITIES 7710 DURANT DR. COLORADO SPRINGS, CO 80947 TIM WENDT (719) 668-3556

ELECTRIC DEPARTMENT: MOUNTAIN VIEW ELECTRIC

11140 E. WOODMEN ROAD FALCON, CO 80831 (719) 495-2283

COMMUNICATIONS:

QWEST COMMUNICATIONS (U.N.C.C. LOCATORS) (800) 922-1987 AT&T (LOCATORS) (719) 635-3674

## ENGINEER'S STATEMENT:

THIS GRADING AND EROSION CONTROL PLAN WAS PREPARED UNDER MY DIRECTION AND SUPERVISION AND IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. SAID PLAN HAS BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE COUNTY FOR GRADING AND EROSION CONTROL PLANS. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARING THIS PLAN.



3/31/2020

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160 FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

## OWNER'S STATEMENT

I, THE OWNER/DEVELOPER HAVE READ AND WILL COMPLY WITH THE REQUIREMENTS OF THE GRADING AND EROSION CONTROL PLAN.

EL PASO COUNTY

COLORADO SPRINGS, CO 80903

20 BOULDER, SUITE 201

COUNTY PLAN REVIEW IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH COUNTY DESIGN CRITERIA. THE COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

FILED IN ACCORDANCE WITH THE REQUIREMENTS OF THE EL PASO COUNTY LAND DEVELOPMENT CODE, DRAINAGE CRITERIA MANUAL VOLUMES 1 AND 2, AND ENGINEERING CRITERIA MANUAL. AS AMMENDED.

IN ACCORDANCE WITH ECM SECTION 1.12, THESE CONSTRUCTION DOCUMENTS WILL BE VALID FOR CONSTRUCTION FOR A PERIOD OF 2 YEARS FROM THE DATE SIGNED BY THE EL PASO COUNTY ENGINEER. IF CONSTRUCTION HAS NOT STARTED WITHIN THESE 2 YEARS, THE PLANS WILL NEED TO BE RESUBMITTED FRO APPROVAL, INCLUDING PAYMENT OF REVIEW FEES AT THE PLANNING AND COMMUNITY DEVELOPMENT DIRECTOR'S DISCRETION.

JENNIFER IRVINE, P.E. COUNTY ENGINEER/ECM ADMINISTRATOR

## SHEET INDEX

SHEET 1 TITLE SHEET GRADING & EROSION CONTROL PLAN GRADING & EROSION CONTROL PLAN SHEET 4 GRADING & EROSION CONTROL DETAILS GRADING & EROSION CONTROL DETAILS GRADING & EROSION CONTROL DETAILS

SHEET 8 GRADING & EROSION CONTROL DETAILS

GRADING & EROSION CONTROL DETAILS

STATEMENT:

RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN: THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER APPROVAL DATE.

FOR BURIED UTILITY INFORMATION CALL 1-800-922-1987

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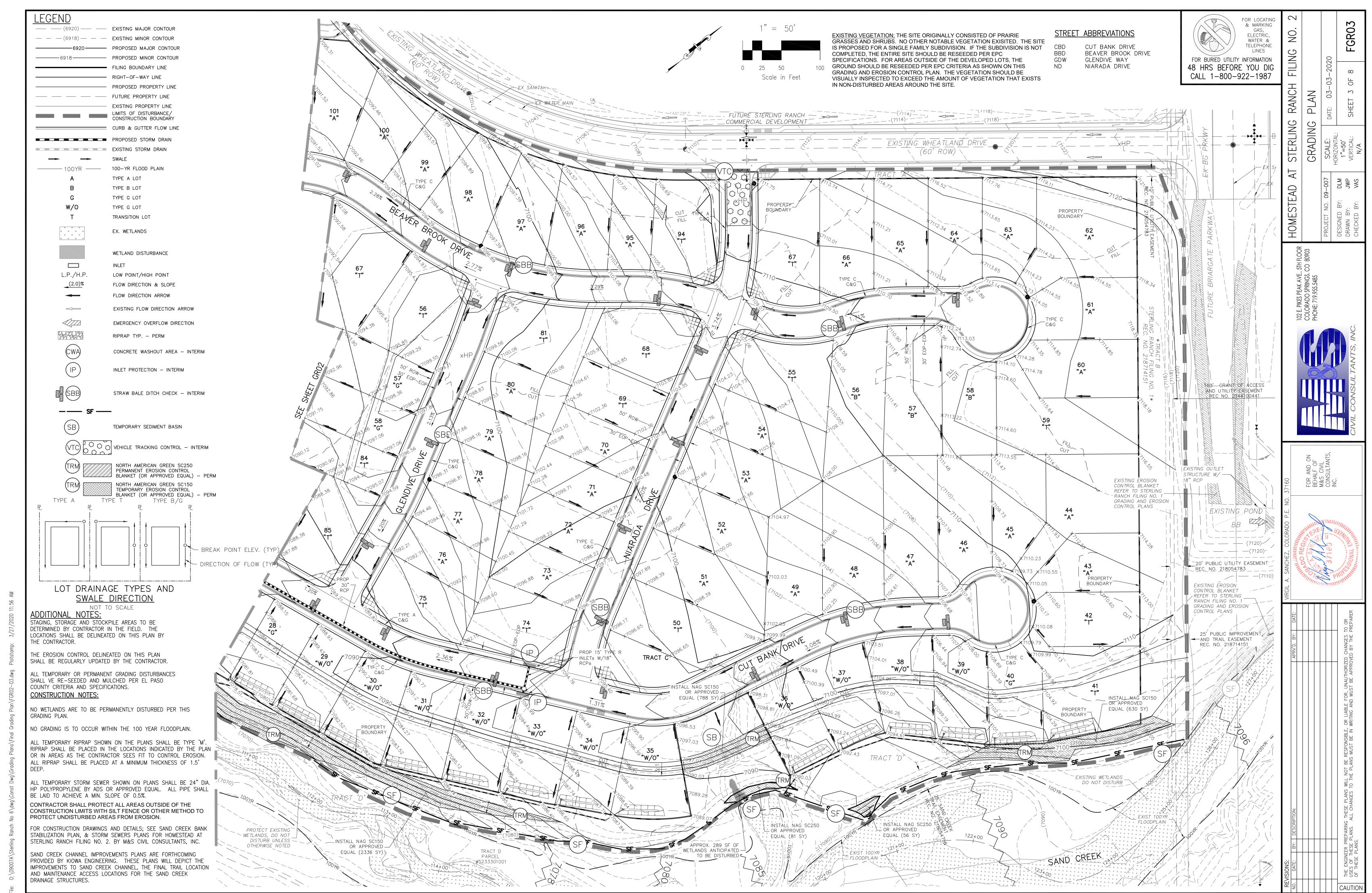
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& MARKING ELECTRIC. WATER &: **TELEPHONE** 

File: 0:\09007A\Sterling Ranch No 6\dwg\Const Dwg\Grading Plans\Final Grading Plan\FGR02—03.dwg Plotstamp: 3/27/2020 11:55 AM

DEPICT THE IMPROVEMENTS TO SAND CREEK CHANNEL, THE FINAL TRAIL LOCATION AND MAINTENANCE ACCESS LOCATIONS

FOR THE SAND CREEK DRAINAGE STRUCTURES.



Topsoil should be salvaged during grading operations for use and spread on areas to be revegetated later. Topsoil should be viewed as an important resource to be utilized for vegetation establishment, due to its water-holding capacity, structure, texture, organic matter content, biological activity, and nutrient content. The rooting depth of most native grasses in the semi-arid Denver metropolitan area is 6 to 18 inches. At a minimum, the upper 6 inches of topsoil should be stripped, stockpiled, and ultimately respread across areas that will be revegetated.

Where topsoil is not available, subsoils should be amended to provide an appropriate plant-growth medium. Organic matter, such as well digested compost, can be added to improve soil characteristics conducive to plant growth. Other treatments can be used to adjust soil pH conditions when needed. Soil testing, which is typically inexpensive, should be completed to determine and optimize the types and amounts of amendments that are required.

If the disturbed ground surface is compacted, rip or rototill the surface prior to placing topsoil. If adding compost to the existing soil surface, rototilling is necessary. Surface roughening will assist in placement of a stable topsoil layer on steeper slopes, and allow infiltration and root penetration to greater depth.

Prior to seeding, the soil surface should be rough and the seedbed should be firm, but neither too loose nor compacted. The upper layer of soil should be in a condition suitable for seeding at the proper depth and conducive to plant growth. Seed-to-soil contact is the key to good germination.

## **Seed Mix for Temporary Vegetation**

To provide temporary vegetative cover on disturbed areas which will not be paved, built upon, or fully landscaped or worked for an extended period (typically 30 days or more), plant an annual grass appropriate for the time of planting and mulch the planted areas. Annual grasses suitable for the Denver metropolitan area are listed in Table TS/PS-1. These are to be considered only as general recommendations when specific design guidance for a particular site is not available. Local governments typically specify seed mixes appropriate for their jurisdiction.

## **Seed Mix for Permanent Revegetation**

To provide vegetative cover on disturbed areas that have reached final grade, a perennial grass mix should be established. Permanent seeding should be performed promptly (typically within 14 days) after reaching final grade. Each site will have different characteristics and a landscape professional or the local jurisdiction should be contacted to determine the most suitable seed mix for a specific site. In lieu of a specific recommendation, one of the perennial grass mixes appropriate for site conditions and growth season listed in Table TS/PS-2 can be used. The pure live seed (PLS) rates of application recommended in these tables are considered to be absolute minimum rates for seed applied using proper drill-seeding equipment.

If desired for wildlife habitat or landscape diversity, shrubs such as rubber rabbitbrush (*Chrysothamnus* nauseosus), fourwing saltbush (Atriplex canescens) and skunkbrush sumac (Rhus trilobata) could be added to the upland seedmixes at 0.25, 0.5 and 1 pound PLS/acre, respectively. In riparian zones, planting root stock of such species as American plum (*Prunus americana*), woods rose (*Rosa woodsii*), plains cottonwood (Populus sargentii), and willow (Populus spp.) may be considered. On non-topsoiled upland sites, a legume such as Ladak alfalfa at 1 pound PLS/acre can be included as a source of nitrogen

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

## **Temporary and Permanent Seeding (TS/PS)**

Seeding dates for the highest success probability of perennial species along the Front Range are generally in the spring from April through early May and in the fall after the first of September until the ground freezes. If the area is irrigated, seeding may occur in summer months, as well. See Table TS/PS-3 for appropriate seeding dates.

Table TS/PS-1. Minimum Drill Seeding Rates for Various Temporary Annual Grasses

Species <sup>a</sup> (Common name)	Growth Season <sup>b</sup>	Pounds of Pure Live Seed (PLS)/acre <sup>c</sup>	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	1/2
5. Millet	Warm	3 - 15	1/2 - 3/4
6. Sudangrass	Warm	5–10	1/2 - 3/4
7. Sorghum	Warm	5–10	1/2 - 3/4
8. Winter wheat	Cool	20–35	1 - 2
9. Winter barley	Cool	20–35	1 - 2
10. Winter rye	Cool	20–35	1 - 2
11. Triticale	Cool	25–40	1 - 2

Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or mowed closer than 8 inches.

Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching should be applied as a separate operation, when practical, to prevent the seeds from being encapsulated in

See Table TS/PS-3 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months. Seeding rates should be doubled if seed is broadcast, or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

## **Temporary and Permanent Seeding (TS/PS)**

## Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses

Common <sup>a</sup> Name	Botanical Name	Growth Season <sup>b</sup>	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Alakali Soil Seed Mix				1	
Alkali sacaton	Sporobolus airoides	Cool	Bunch	1,750,000	0.25
Basin wildrye	Elymus cinereus	Cool	Bunch	165,000	2.5
Sodar streambank wheatgrass	Agropyron riparium 'Sodar'	Cool	Sod	170,000	2.5
Jose tall wheatgrass	Agropyron elongatum 'Jose'	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	Agropyron smithii 'Arriba'	Cool	Sod	110,000	5.5
Total					17.75
Fertile Loamy Soil Seed Mix					
Ephriam crested wheatgrass	Agropyron cristatum 'Ephriam'	Cool	Sod	175,000	2.0
Dural hard fescue	Festuca ovina 'duriuscula'	Cool	Bunch	565,000	1.0
Lincoln smooth brome	Bromus inermis leyss 'Lincoln'	Cool	Sod	130,000	3.0
Sodar streambank wheatgrass	Agropyron riparium 'Sodar'	Cool	Sod	170,000	2.5
Arriba western wheatgrass	Agropyron smithii 'Arriba'	Cool	Sod	110,000	7.0
Total					15.5
High Water Table Soil Seed Mix	K				
Meadow foxtail	Alopecurus pratensis	Cool	Sod	900,000	0.5
Redtop	Agrostis alba	Warm	Open sod	5,000,000	0.25
Reed canarygrass	Phalaris arundinacea	Cool	Sod	68,000	0.5
Lincoln smooth brome	Bromus inermis leyss 'Lincoln'	Cool	Sod	130,000	3.0
Pathfinder switchgrass	Panicum virgatum 'Pathfinder'	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	Agropyron elongatum 'Alkar'	Cool	Bunch	79,000	5.5
Total					10.75
Transition Turf Seed Mix <sup>c</sup>					
Ruebens Canadian bluegrass	Poa compressa 'Ruebens'	Cool	Sod	2,500,000	0.5
Dural hard fescue	Festuca ovina 'duriuscula'	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	Lolium perenne 'Citation'	Cool	Sod	247,000	3.0
Lincoln smooth brome	Bromus inermis leyss 'Lincoln'	Cool	Sod	130,000	3.0
Total					7.5

TS/PS-4

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

Mulching (MU)

## **Temporary and Permanent Seeding (TS/PS)**

## Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses (cont.)

Common Name	Botanical Name	Growth Season <sup>b</sup>	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Sandy Soil Seed Mix	'				
Blue grama	Bouteloua gracilis	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	Schizachyrium scoparium 'Camper'	Warm	Bunch	240,000	1.0
Prairie sandreed	Calamovilfa longifolia	Warm	Open sod	274,000	1.0
Sand dropseed	Sporobolus cryptandrus	Cool	Bunch	5,298,000	0.25
Vaughn sideoats grama	Bouteloua curtipendula 'Vaughn'	Warm	Sod	191,000	2.0
Arriba western wheatgrass	Agropyron smithii 'Arriba'	Cool	Sod	110,000	5.5
Total					10.25
Heavy Clay, Rocky Foothill Seed	l Mix				
Ephriam crested wheatgrass <sup>d</sup>	Agropyron cristatum 'Ephriam'	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	e Intermediate wheatgrass  Agropyron intermedium 'Oahe'		Sod	115,000	5.5
Vaughn sideoats grama <sup>e</sup>	sideoats grama <sup>e</sup> Bouteloua curtipendula 'Vaughn'		Sod	191,000	2.0
Lincoln smooth brome	Bromus inermis leyss 'Lincoln'	Cool	Sod	130,000	3.0
Arriba western wheatgrass	Agropyron smithii 'Arriba'	Cool	Sod	110,000	5.5
Total					17.5

- All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If
- hydraulic seeding is used, hydraulic mulching should be done as a separate operation.
- See Table TS/PS-3 for seeding dates.
- If site is to be irrigated, the transition turf seed rates should be doubled.
- Crested wheatgrass should not be used on slopes steeper than 6H to 1V.
- Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.

## **Temporary and Permanent Seeding (TS/PS)**

## Table TS/PS-3. Seeding Dates for Annual and Perennial Grasses

	(Numbers in	Grasses table reference able TS/PS-1)	Perennial Grasses		
Seeding Dates	Warm	Cool	Warm	Cool	
January 1–March 15			✓	✓	
March 16–April 30	4	1,2,3	✓	✓	
May 1–May 15	4		✓		
May 16–June 30	4,5,6,7				
July 1–July 15	5,6,7				
July 16–August 31					
September 1–September 30		8,9,10,11			
October 1–December 31			✓	✓	

## Mulch

Cover seeded areas with mulch or an appropriate rolled erosion control product to promote establishment of vegetation. Anchor mulch by crimping, netting or use of a non-toxic tackifier. See the Mulching BMP Fact Sheet for additional guidance.

## **Maintenance and Removal**

Monitor and observe seeded areas to identify areas of poor growth or areas that fail to germinate. Reseed and mulch these areas, as needed.

An area that has been permanently seeded should have a good stand of vegetation within one growing season if irrigated and within three growing seasons without irrigation in Colorado. Reseed portions of the site that fail to germinate or remain bare after the first growing season.

Seeded areas may require irrigation, particularly during extended dry periods. Targeted weed control may also be necessary.

Protect seeded areas from construction equipment and vehicle access.

- Clean, weed-free and seed-free cereal grain straw should be applied evenly at a rate of 2 tons per acre and must be tacked or fastened by a method suitable for the condition of the site. Straw mulch must be anchored (and not merely placed) on the surface. This can be accomplished mechanically by crimping or with the aid of tackifiers or nets. Anchoring with a crimping implement is preferred, and is the recommended method for areas flatter than 3:1. Mechanical crimpers must be capable of tucking the long mulch fibers into the soil to a depth of 3 inches without cutting them. An agricultural disk, while not an ideal substitute, may work if the disk blades are dull or blunted and set vertically; however, the frame may
- Grass hay may be used in place of straw; however, because hay is comprised of the entire plant including seed, mulching with hay may seed the site with non-native grass species which might in turn out-compete the native seed. Alternatively, native species of grass hay may be purchased, but can be difficult to find and are more expensive than straw. Purchasing and utilizing a certified weed-free straw is an easier and less costly mulching method. When using grass hay, follow the same guidelines as for straw (provided
- On small areas sheltered from the wind and heavy runoff, spraying a tackifier on the mulch is satisfactory for holding it in place. For steep slopes and special situations where greater control is needed, erosion control blankets anchored with stakes should be used instead of mulch.
- Hydraulic mulching consists of wood cellulose fibers mixed with water and a tackifying agent and should be applied at a rate of no less than 1,500 pounds per acre (1,425 lbs of fibers mixed with at least 75 lbs of tackifier) with a hydraulic mulcher. For steeper slopes, up to 2000 pounds per acre may be required for effective hydroseeding. Hydromulch typically requires up to 24 hours to dry; therefore, it should not be applied immediately prior to inclement weather. Application to roads, waterways and existing vegetation
- Erosion control mats, blankets, or nets are recommended to help stabilize steep slopes (generally 3:1 and steeper) and waterways. Depending on the product, these may be used alone or in conjunction with grass or straw mulch. Normally, use of these products will be restricted to relatively small areas. Biodegradable mats made of straw and jute, straw-coconut, coconut fiber, or excelsior can be used instead of mulch. (See the ECM/TRM BMP for more information.)
- Some tackifiers or binders may be used to anchor mulch. Check with the local jurisdiction for allowed tackifiers. Manufacturer's recommendations should be followed at all times. (See the Soil Binder BMP for more information on general types of tackifiers.)
- Rock can also be used as mulch. It provides protection of exposed soils to wind and water erosion and allows infiltration of precipitation. An aggregate base course can be spread on disturbed areas for temporary or permanent stabilization. The rock mulch layer should be thick enough to provide full coverage of exposed soil on the area it is applied.

## **Maintenance and Removal**

have to be weighted to afford proper soil penetration.

After mulching, the bare ground surface should not be more than 10 percent exposed. Reapply mulch, as needed, to cover bare areas.

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

## June 2012

## EROSION CONTROL CRITERIA:

EROSION CONTROL MEASURES SHALL BE IMPLEMENTED IN A MANNER THAT WILL PROTECT PROPERTIES AND PUBLIC FACILITIES FROM THE ADVERSE EFFECTS OF EROSION AND SEDIMENTATION AS A RESULT OF CONSTRUCTION AND EARTHWORK ACTIVITIES WITHIN THE PROJECT SITE.

- 1. PRIOR TO START OF GRADING OPERATIONS, LOCATE AND SET THE SEDIMENT BERM AND VEHICLE TRACKING CONTROL AS SHOWN ON THE EROSION CONTROL PLAN.
- 2. THE SEDIMENT BERM SHALL BE KEPT IN PLACE AND MAINTAINED UNTIL EROSION AND SEDIMENTATION POTENTIAL IS MITIGATED. REMOVAL OF SILT AND SEDIMENT COLLECTED BY THE SEDIMENT BERM IS REQUIRED ONCE IT REACHES HALF THE HEIGHT OF THE SEDIMENT BERM.
- 3. EROSION CONTROL DEVICES SHOULD BE CHECKED AFTER EVERY STORM OR NOT MORE THAN EVERY 14 DAYS. REPAIRS OR REPLACEMENT SHOULD BE MADE AS NECESSARY TO MAINTAIN PROPER PROTECTION.

SOIL EROSION CONTROL MEASURES FOR ALL SLOPES, CHANNELS, DITCHES, OR ANY DISTURBED LAND AREA SHALL BE COMPLETED WITHIN TWENTY-ONE (21) CALENDAR DAYS AFTER FINAL GRADING, OR FINAL EARTH DISTURBANCE HAS BEEN COMPLETED. DISTURBED AREAS AND STOCKPILES WHICH ARE NOT AT THE FINAL GRADE BUT WILL REMAIN DORMANT FOR LONGER THAN 30 DAYS SHALL ALSO BE MULCHED WITHIN 21 DAYS AFTER INTERIM GRADING. AN AREA THAT IS GOING TO REMAIN IN AN INTERIM STATE FOR MORE THAN 60 DAYS SHALL ALSO BE SEEDED. ALL TEMPORARY SOIL EROSION CONTROL MEASURES AND BMP'S SHALL BE MAINTAINED UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED.

DETAILS FILING CONTROL RANCH

STERLING EROSION AT

HOMESTEAD

GRADING



& MARKING GAS, ELECTRIC, WATER & TELEPHONE

FOR BURIED UTILITY INFORMATION 48 HRS BEFORE YOU DIG CALL 1-800-922-1987

June 2012

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 TS/PS-5

TS/PS-6 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

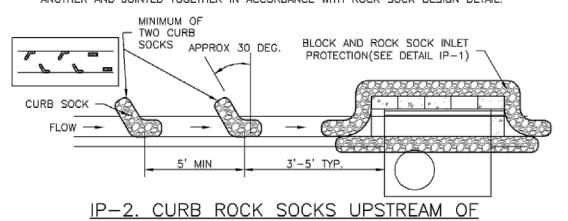
June 2012

IP-1. BLOCK AND ROCK SOCK SUMP OR ON GRADE INLET PROTECTION

BLOCK AND CURB SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL FOR INSTALLATION REQUIREMENTS. 2. CONCRETE "CINDER" BLOCKS SHALL BE LAID ON THEIR SIDES AROUND THE INLET IN A

SINGLE ROW, ABUTTING ONE ANOTHER WITH THE OPEN END FACING AWAY FROM THE CURB. 3. GRAVEL BAGS SHALL BE PLACED AROUND CONCRETE BLOCKS, CLOSELY ABUTTING ONE ANOTHER AND JOINTED TOGETHER IN ACCORDANCE WITH ROCK SOCK DESIGN DETAIL.



INLET PROTECTION CURB ROCK SOCK INLET PROTECTION INSTALLATION NOTES

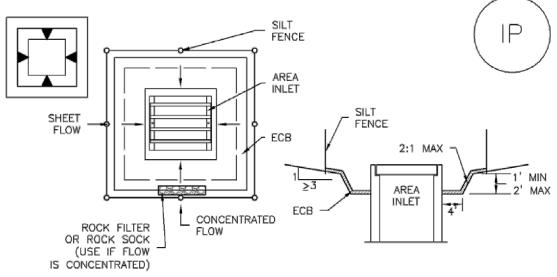
- SEE ROCK SOCK DESIGN DETAIL INSTALLATION REQUIREMENTS.
- 2. PLACEMENT OF THE SOCK SHALL BE APPROXIMATELY 30 DEGREES FROM PERPENDICULAR IN THE OPPOSITE DIRECTION OF FLOW.
- 3. SOCKS ARE TO BE FLUSH WITH THE CURB AND SPACED A MINIMUM OF 5 FEET APART.
- 4. AT LEAST TWO CURB SOCKS IN SERIES ARE REQUIRED UPSTREAM OF ON-GRADE INLETS.

IP-4 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

**Inlet Protection (IP)** 

August 2013

#### **SC-6 Inlet Protection (IP)**

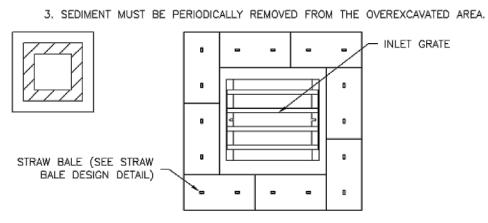


IP-5. OVEREXCAVATION INLET PROTECTION

OVEREXCAVATION INLET PROTECTION INSTALLATION NOTES

I. THIS FORM OF INLET PROTECTION IS PRIMARILY APPLICABLE FOR SITES THAT HAVE NOT YET REACHED FINAL GRADE AND SHOULD BE USED ONLY FOR INLETS WITH A RELATIVELY

2. WHEN USING FOR CONCENTRATED FLOWS, SHAPE BASIN IN 2:1 RATIO WITH LENGTH ORIENTED TOWARDS DIRECTION OF FLOW.



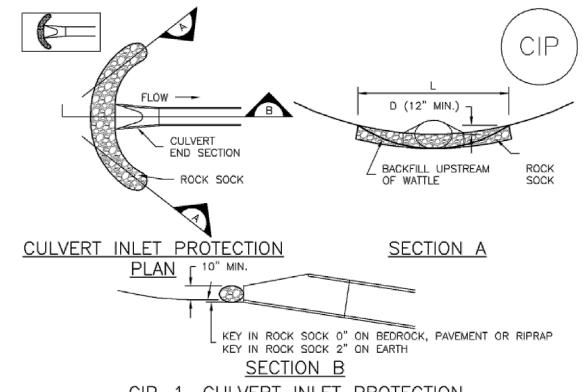
IP-6. STRAW BALE FOR SUMP\_INLET PROTECTION

STRAW BALE BARRIER INLET PROTECTION INSTALLATION NOTES 1. SEE STRAW BALE DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. BALES SHALL BE PLACED IN A SINGLE ROW AROUND THE INLET WITH ENDS OF BALES TIGHTLY ABUTTING ONE ANOTHER.

August 2013 IP-6 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

**SC-6 Inlet Protection (IP)** 



CIP-1. CULVERT INLET PROTECTION

CULVERT INLET PROTECTION INSTALLATION NOTES 1. SEE PLAN VIEW FOR

-LOCATION OF CULVERT INLET PROTECTION. 2. SEE ROCK SOCK DESIGN DETAIL FOR ROCK GRADATION REQUIREMENTS AND JOINTING

CULVERT INLET PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION. AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF THE CULVERT SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS 1/2 THE HEIGHT OF THE ROCK SOCK.

5. CULVERT INLET PROTECTION SHALL REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED AND APPROVED BY THE LOCAL JURISDICTION. (DETAILS ADAPTED FROM AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

August 2013

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 IP-7

**SC-6** 

**SC-6** 

1. SEE PLAN VIEW FOR: -LOCATION OF INLET PROTECTION.

GENERAL INLET PROTECTION INSTALLATION NOTES

-TYPE OF INLET PROTECTION (IP.1, IP.2, IP.3, IP.4, IP.5, IP.6)

2. INLET PROTECTION SHALL BE INSTALLED PROMPTLY AFTER INLET CONSTRUCTION OR PAVING IS COMPLETE (TYPICALLY WITHIN 48 HOURS). IF A RAINFALL/RUNOFF EVENT IS FORECAST, INSTALL INLET PROTECTION PRIOR TO ONSET OF EVENT.

3. MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

INLET PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON

4. SEDIMENT ACCUMULATED UPSTREAM OF INLET PROTECTION SHALL BE REMOVED AS NECESSARY TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN STORAGE VOLUME REACHES 50% OF CAPACITY, A DEPTH OF 6" WHEN SILT FENCE IS USED, OR 14 OF THE HEIGHT FOR

5. INLET PROTECTION IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED, UNLESS THE LOCAL JURISDICTION APPROVES EARLIER REMOVAL OF INLET PROTECTION IN STREETS.

6. WHEN INLET PROTECTION AT AREA INLETS IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOP SOIL, SEEDED AND MULCHED, OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD) NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN

NOTE: THE DETAILS INCLUDED WITH THIS FACT SHEET SHOW COMMONLY USED, CONVENTIONAL METHODS OF INLET PROTECTION IN THE DENVER METROPOLITAN AREA. THERE ARE MANY PROPRIETARY INLET PROTECTION METHODS ON THE MARKET. UDFCD NEITHER ENDORSES NOR DISCOURAGES USE OF PROPRIETARY INLET PROTECTION; HOWEVER, IN THE EVENT PROPRIETARY METHODS ARE USED, THE APPROPRIATE DETAIL FROM THE MANUFACTURER MUST BE INCLUDED IN THE SWMP AND THE BMP MUST BE INSTALLED AND MAINTAINED AS SHOWN IN THE MANUFACTURER'S DETAILS.

NOTE: SOME MUNICIPALITIES DISCOURAGE OR PROHIBIT THE USE OF STRAW BALES FOR INLET PROTECTION. CHECK WITH LOCAL JURISDICTION TO DETERMINE IF STRAW BALE INLET

**SC-6** 

**Inlet Protection (IP)** 

IP-3. Rock Sock Inlet Protection for Sump/Area Inlet

IP-4. Silt Fence Inlet Protection for Sump/Area Inlet

IP-5. Over-excavation Inlet Protection

IP-6. Straw Bale Inlet Protection for Sump/Area Inlet

CIP-1. Culvert Inlet Protection

Propriety inlet protection devices should be installed in accordance with manufacturer specifications.

More information is provided below on selecting inlet protection for sump and on-grade locations.

## **Inlets Located in a Sump**

When applying inlet protection in sump conditions, it is important that the inlet continue to function during larger runoff events. For curb inlets, the maximum height of the protective barrier should be lower than the top of the curb opening to allow overflow into the inlet during larger storms without excessive localized flooding. If the inlet protection height is greater than the curb elevation, particularly if the filter becomes clogged with sediment, runoff will not enter the inlet and may bypass it, possibly causing localized flooding, public safety issues, and downstream erosion and damage from bypassed flows.

Area inlets located in a sump setting can be protected through the use of silt fence, concrete block and rock socks (on paved surfaces), sediment control logs/straw wattles embedded in the adjacent soil and stacked around the area inlet (on pervious surfaces), over-excavation around the inlet, and proprietary products providing equivalent functions.

## **Inlets Located on a Slope**

For curb and gutter inlets on paved sloping streets, block and rock sock inlet protection is recommended in conjunction with curb socks in the gutter leading to the inlet. For inlets located along unpaved roads, also see the Check Dam Fact Sheet.

## **Maintenance and Removal**

Inspect inlet protection frequently. Inspection and maintenance guidance includes:

- Inspect for tears that can result in sediment directly entering the inlet, as well as result in the contents of the BMP (e.g., gravel) washing into the inlet.
- Check for improper installation resulting in untreated flows bypassing the BMP and directly entering the inlet or bypassing to an unprotected downstream inlet. For example, silt fence that has not been properly trenched around the inlet can result in flows under the silt fence and directly into the inlet.
- Look for displaced BMPs that are no longer protecting the inlet. Displacement may occur following larger storm events that wash away or reposition the inlet protection. Traffic or equipment may also crush or displace the BMP.
- Monitor sediment accumulation upgradient of the inlet protection.

August 2013

**Inlet Protection (IP)** 

the functionality of the BMP.

• Remove sediment accumulation from the area upstream of the inlet protection, as needed to maintain BMP effectiveness, typically when it reaches no more than half the storage capacity of the inlet protection. For silt fence, remove sediment when it accumulates to a depth of no more than 6 inches.

 Propriety inlet protection devices should be inspected and maintained in accordance with manufacturer specifications. If proprietary inlet insert devices are used, sediment should be removed in a timely manner to prevent devices from breaking and spilling sediment into the storm drain.

Remove sediment accumulation from the area upstream of the inlet protection as needed to maintain

Inlet protection must be removed and properly disposed of when the drainage area for the inlet has reached final stabilization.

7

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FILING

RANCH

STERLING

AT

STEAD

HOME

CONTROL

EROSION

GRADING

GR05



Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 August 2013

IP-2

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 August 2013 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

1. SILT FENCE MUST BE PLACED AWAY FROM THE TOE OF THE SLOPE TO ALLOW FOR WATER PONDING. SILT FENCE AT THE TOE OF A SLOPE SHOULD BE INSTALLED IN A FLAT LOCATION AT LEAST SEVERAL FEET (2-5 FT) FROM THE TOE OF THE SLOPE TO ALLOW ROOM FOR

Silt Fence (SF)

2. A UNIFORM 6" X 4" ANCHOR TRENCH SHALL BE EXCAVATED USING TRENCHER OR SILT FENCE INSTALLATION DEVICE. NO ROAD GRADERS, BACKHOES, OR SIMILAR EQUIPMENT SHALL

3. COMPACT ANCHOR TRENCH BY HAND WITH A "JUMPING JACK" OR BY WHEEL ROLLING. COMPACTION SHALL BE SUCH THAT SILT FENCE RESISTS BEING PULLED OUT OF ANCHOR

4. SILT FENCE SHALL BE PULLED TIGHT AS IT IS ANCHORED TO THE STAKES. THERE SHOULD BE NO NOTICEABLE SAG BETWEEN STAKES AFTER IT HAS BEEN ANCHORED TO THE STAKES. 5. SILT FENCE FABRIC SHALL BE ANCHORED TO THE STAKES USING 1" HEAVY DUTY STAPLES OR NAILS WITH 1" HEADS. STAPLES AND NAILS SHOULD BE PLACED 3" ALONG THE FABRIC DOWN THE STAKE.

6. AT THE END OF A RUN OF SILT FENCE ALONG A CONTOUR, THE SILT FENCE SHOULD BE TURNED PERPENDICULAR TO THE CONTOUR TO CREATE A "J-HOOK." THE "J-HOOK" EXTENDING PERPENDICULAR TO THE CONTOUR SHOULD BE OF SUFFICIENT LENGTH TO KEEP RUNOFF FROM FLOWING AROUND THE END OF THE SILT FENCE (TYPICALLY 10' - 20').

7. SILT FENCE SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES. SILT FENCE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE FROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON

4. SEDIMENT ACCUMULATED UPSTREAM OF THE SILT FENCE SHALL BE REMOVED AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY 6".

TEARING, OR COLLAPSE. 6. SILT FENCE IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION, OR IS REPLACED BY AN EQUIVALENT PERIMETER

5. REPAIR OR REPLACE SILT FENCE WHEN THERE ARE SIGNS OF WEAR, SUCH AS SAGGING,

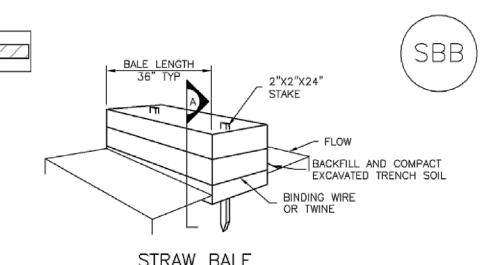
SEDIMENT CONTROL BMP. 7. WHEN SILT FENCE IS REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

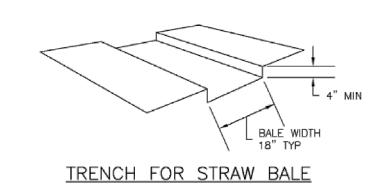
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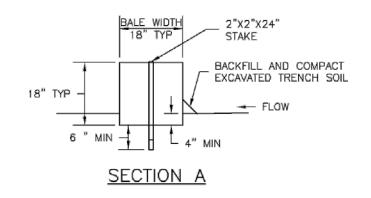
 $\underline{\text{NOTE:}}$  MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN

Urban Drainage and Flood Control District November 2010 Urban Storm Drainage Criteria Manual Volume 3

SC-3 **Straw Bale Barrier (SBB)** 







SBB-1. STRAW BALE

Urban Drainage and Flood Control District November 2010 Urban Storm Drainage Criteria Manual Volume 3

**Straw Bale Barrier (SBB)** 

STRAW BALE INSTALLATION NOTES 1. SEE PLAN VIEW FOR:

-LOCATION(S) OF STRAW BALES.

2. STRAW BALES SHALL CONSIST OF CERTIFIED WEED FREE STRAW OR HAY. LOCAL JURISDICTIONS MAY REQUIRE PROOF THAT BALES ARE WEED FREE.

3. STRAW BALES SHALL CONSIST OF APPROXIMATELY 5 CUBIC FEET OF STRAW OR HAY AND WEIGH NOT LESS THAN 35 POUNDS.

4. WHEN STRAW BALES ARE USED IN SERIES AS A BARRIER, THE END OF EACH BALE SHALL BE TIGHTLY ABUTTING ONE ANOTHER.

5. STRAW BALE DIMENSIONS SHALL BE APPROXIMATELY 36"X18"X18".

6. A UNIFORM ANCHOR TRENCH SHALL BE EXCAVATED TO A DEPTH OF 4". STRAW BALES SHALL BE PLACED SO THAT BINDING TWINE IS ENCOMPASSING THE VERTICAL SIDES OF THE BALE(S). ALL EXCAVATED SOIL SHALL BE PLACED ON THE UPHILL SIDE OF THE STRAW BALE(S)

7. TWO (2) WOODEN STAKES SHALL BE USED TO HOLD EACH BALE IN PLACE. WOODEN STAKES SHALL BE 2"X2"X24". WOODEN STAKES SHALL BE DRIVEN 6" INTO THE GROUND. STRAW BALE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. STRAW BALES SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED, ROTTEN, OR DAMAGED BEYOND REPAIR.

5. SEDIMENT ACCUMULATED UPSTREAM OF STRAW BALE BARRIER SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY 1/4 OF THE HEIGHT OF THE STRAW BALE BARRIER.

6. STRAW BALES ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

7. WHEN STRAW BALES ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN

November 2010

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

**SC-3** 

7

NO.

FILING

RANCH

STERLING

AT

STEAD

HOME

& MARKING GAS, ELECTRIC, WATER & TELEPHONE

FOR BURIED UTILITY INFORMATION 48 HRS BEFORE YOU DIG CALL 1-800-922-1987

DETAIL

CONTROL

EROSION

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GRADING

**Vehicle Tracking Control (VTC)** 

SF-4

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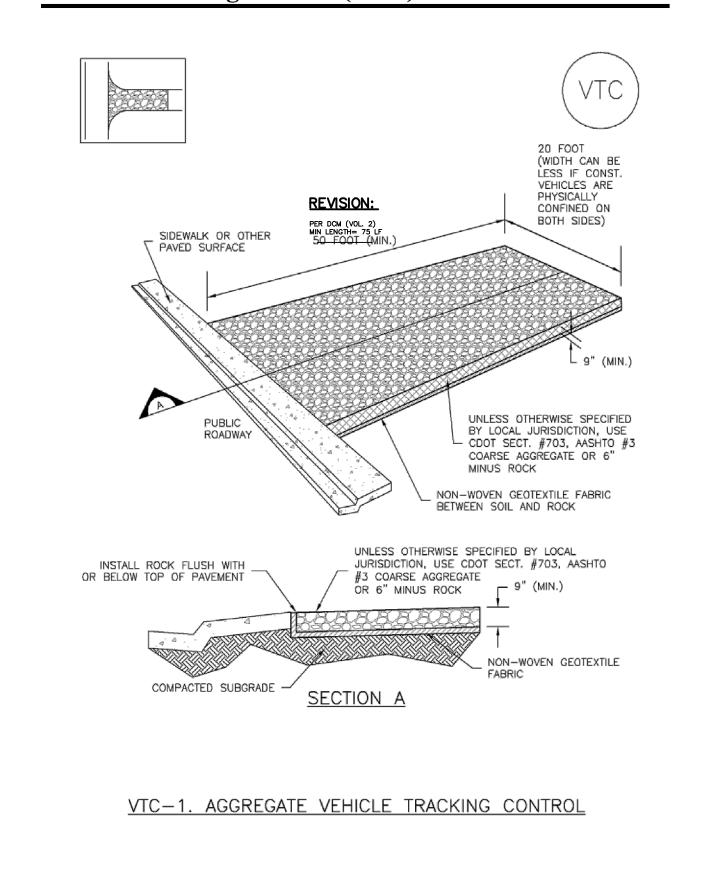
**SM-4** 

Silt Fence (SF)

SBB-2

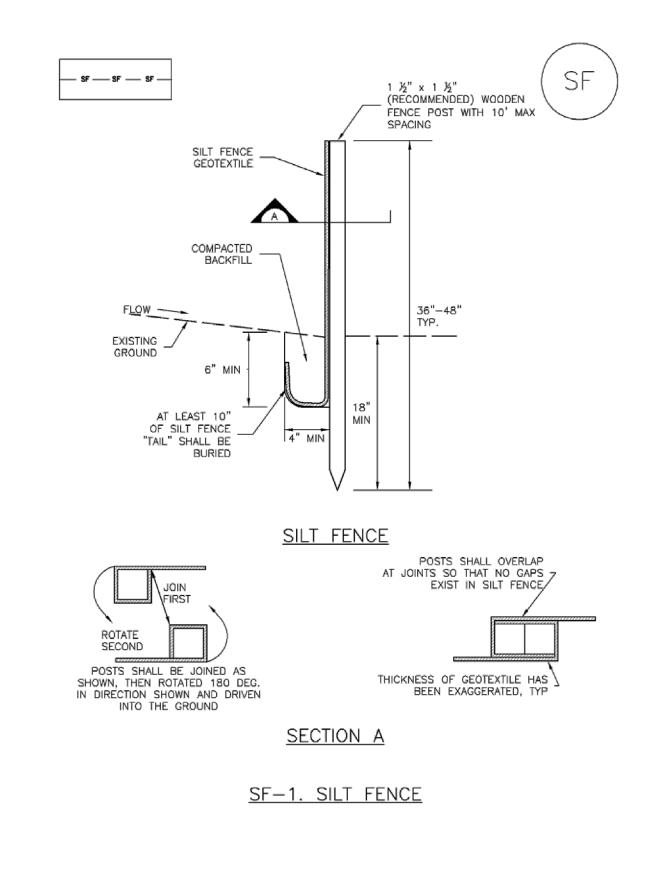
SC-1

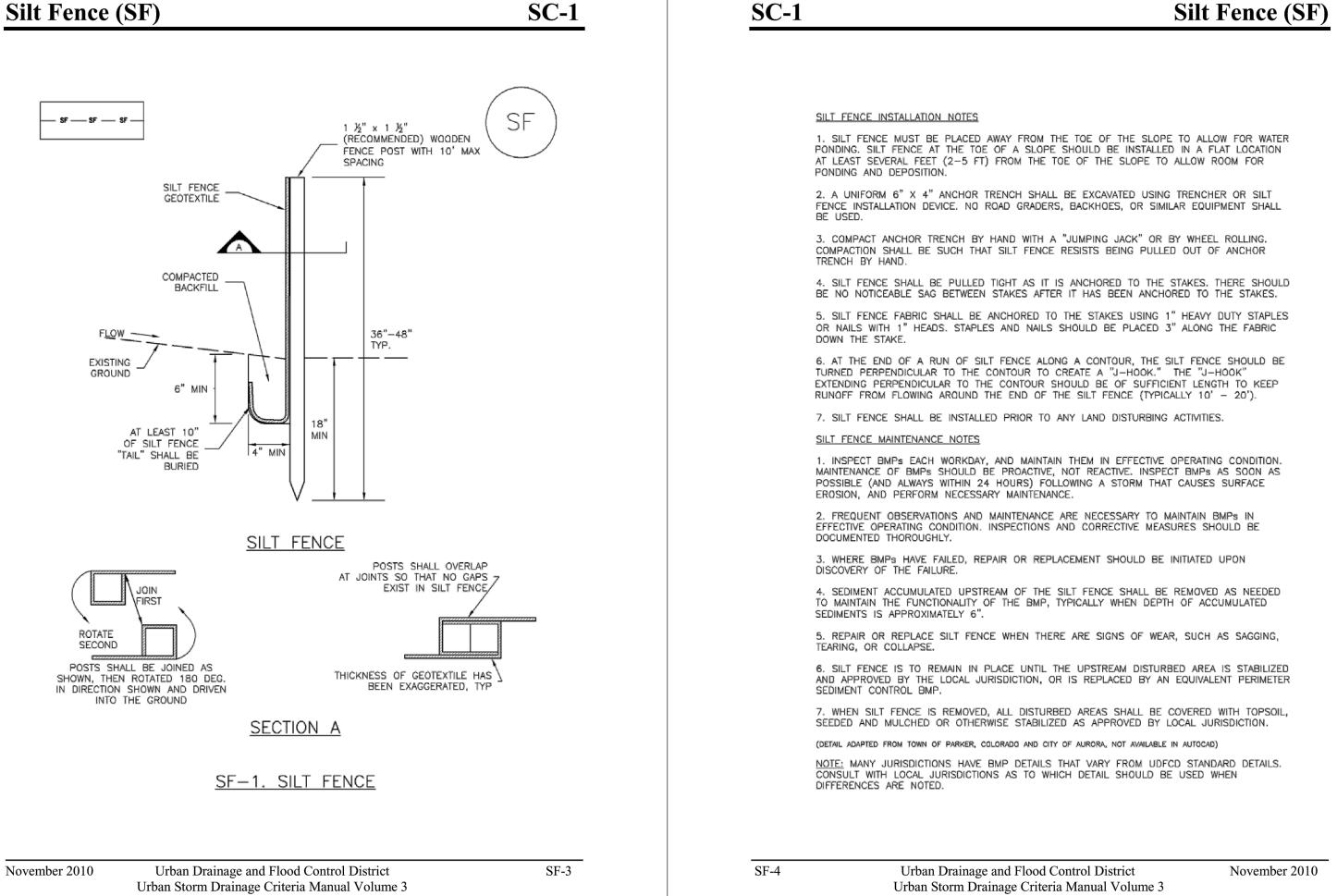
Silt Fence (SF)



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Urban Storm Drainage Criteria Manual Volume 3







STABILIZED CONSTRUCTION ENTRANCE/EXIT INSTALLATION NOTES

1. SEE PLAN VIEW FOR -LOCATION OF CONSTRUCTION ENTRANCE(S)/EXIT(S). -TYPE OF CONSTRUCTION ENTRANCE(S)/EXITS(S) (WITH/WITHOUT WHEEL WASH,

2. CONSTRUCTION MAT OR TRM STABILIZED CONSTRUCTION ENTRANCES ARE ONLY TO BE USED ON SHORT DURATION PROJECTS (TYPICALLY RANGING FROM A WEEK TO A MONTH) WHERE THERE WILL BE LIMITED VEHICULAR ACCESS.

3. A STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE LOCATED AT ALL ACCESS POINTS WHERE VEHICLES ACCESS THE CONSTRUCTION SITE FROM PAVED RIGHT-OF-WAYS. 4. STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE INSTALLED PRIOR TO ANY LAND

5. A NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED UNDER THE STABILIZED CONSTRUCTION ENTRANCE/EXIT PRIOR TO THE PLACEMENT OF ROCK.

6. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

STABILIZED CONSTRUCTION ENTRANCE/EXIT MAINTENANCE NOTES 1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY TO THE STABILIZED ENTRANCE/EXIT TO MAINTAIN A CONSISTENT DEPTH.

5. SEDIMENT TRACKED ONTO PAVED ROADS IS TO BE REMOVED THROUGHOUT THE DAY AND AT THE END OF THE DAY BY SHOVELING OR SWEEPING. SEDIMENT MAY NOT BE WASHED

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM CITY OF BROOMFIELD, COLORADO, NOT AVAILABLE IN AUTOCAD)

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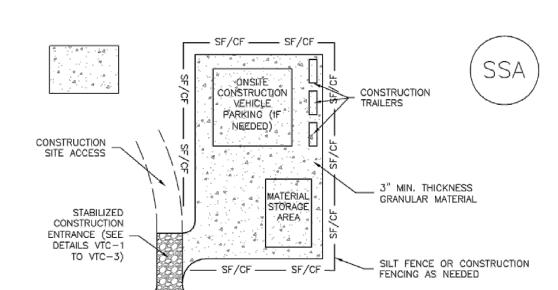
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## **Stabilized Staging Area (SSA)**

**SM-6** 

SSA-3

**EC-6** 



EXISTING ROADWAY SSA-1. STABILIZED STAGING AREA

STABILIZED STAGING AREA INSTALLATION NOTES

 SEE PLAN VIEW FOR
 -LOCATION OF STAGING AREA(S). CONTRACTOR MAY ADJUST LOCATION AND SIZE OF STAGING AREA WITH APPROVAL

2. STABILIZED STAGING AREA SHOULD BE APPROPRIATE FOR THE NEEDS OF THE SITE. OVERSIZING RESULTS IN A LARGER AREA TO STABILIZE FOLLOWING CONSTRUCTION.

3. STAGING AREA SHALL BE STABILIZED PRIOR TO OTHER OPERATIONS ON THE SITE. 4. THE STABILIZED STAGING AREA SHALL CONSIST OF A MINIMUM 3" THICK GRANULAR

5. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

6. ADDITIONAL PERIMETER BMPs MAY BE REQUIRED INCLUDING BUT NOT LIMITED TO SILT FENCE AND CONSTRUCTION FENCING.

STABILIZED STAGING AREA MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY. 3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON

4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY IF RUTTING OCCURS OR UNDERLYING SUBGRADE BECOMES EXPOSED.

November 2010

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

disturbed.

SSA-2

**SM-6** 

**Stabilized Staging Area (SSA)** 

## **Minimizing Long-Term Stabilization Requirements**

Utilize off-site parking and restrict vehicle access to the site.

- Use construction mats in lieu of rock when staging is provided in an area that will not be disturbed
- Consider use of a bermed contained area for materials and equipment that do not require a
- stabilized surface. Consider phasing of staging areas to avoid disturbance in an area that will not be otherwise

See Detail SSA-1 for a typical stabilized staging area and SSA-2 for a stabilized staging area when materials staging in roadways is required.

## **Maintenance and Removal**

Maintenance of stabilized staging areas includes maintaining a stable surface cover of gravel, repairing perimeter controls, and following good housekeeping practices.

When construction is complete, debris, unused stockpiles and materials should be recycled or properly disposed. In some cases, this will require disposal of contaminated soil from equipment leaks in an appropriate landfill. Staging areas should then be permanently stabilized with vegetation or other surface cover planned for the development.

Sand Filter 4" SLOTTED PIPE AT 20' O.C. SEE TABLE SF-2 PROVIDE MAINTENANCE -ACCESS TO FILTER CLEAN OUT WITH (2) 45" BENDS AND WATERTIGHT CAP RIPRAP FILL VOIDS WITH ----4" MIN. UNDERDRAIN MEETING TABLE SF-2
SLOPE AT 0.5% MIN. NOTE: THIS DETAIL SHOWS A PARTIAL INFLITATION SECTION. FOR FULL INFLITATION CUMINATE UNDERGRAM AND PROVIDE 1"-6" OF FILTER MATERIAL, FOR NO INFLITATION PROVIDE IMPRIMEMENTE MEMBRANE SECURED TO GAST—IN-PLACE CONCRETE WALL SEC COURS. SF-2 AND SECURED TO GAST—IN-PLACE CONCRETE WALL SEC Figure SF-1. Sand Filter Plan and Sections Urban Drainage and Flood Control District

November 2015 Urban Storm Drainage Criteria Manual Volume 3

## **Stabilized Staging Area (SSA)**

5. STABILIZED STAGING AREA SHALL BE ENLARGED IF NECESSARY TO CONTAIN PARKING, STORAGE, AND UNLOADING/LOADING OPERATIONS.

6. THE STABILIZED STAGING AREA SHALL BE REMOVED AT THE END OF CONSTRUCTION. THE GRANULAR MATERIAL SHALL BE REMOVED OR, IF APPROVED BY THE LOCAL JURISDICTION, USED ON SITE, AND THE AREA COVERED WITH TOPSOIL, SEEDED AND MULCHED OR

NOTE: MANY MUNICIPALITIES PROHIBIT THE USE OF RECYCLED CONCRETE AS GRANULAR MATERIAL FOR STABILIZED STAGING AREAS DUE TO DIFFICULTIES WITH RE-ESTABLISHMENT OF VEGETATION IN AREAS WHERE RECYCLED CONCRETE WAS PLACED.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

## **Rolled Erosion Control Products (RECP)**

Staking patterns are also provided in the design details according to these factors:

ECB type

November 2010

For other types of RECPs including TRMs, these design details are intended to serve as general guidelines for design and installation; however, engineers should adhere to manufacturer's installation

## **Maintenance and Removal**

Inspection of erosion control blankets and other RECPs includes:

- Check for general signs of erosion, including voids beneath the mat. If voids are apparent, fill the void with suitable soil and replace the erosion control blanket, following the appropriate staking
- Check for damaged or loose stakes and secure loose portions of the blanket.

Erosion control blankets and other RECPs that are biodegradable typically do not need to be removed after construction. If they must be removed, then an alternate soil stabilization method should be installed promptly following removal.

Turf reinforcement mats, although generally resistant to biodegradation, are typically left in place as a dense vegetated cover grows in through the mat matrix. The turf reinforcement mat provides long-term stability and helps the established vegetation resist erosive forces.

## **Rolled Erosion Control Products (RECP)**

Urban Drainage and Flood Control District

Urban Storm Drainage Criteria Manual Volume 3

EROSION CONTROL BLANKET MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION, INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

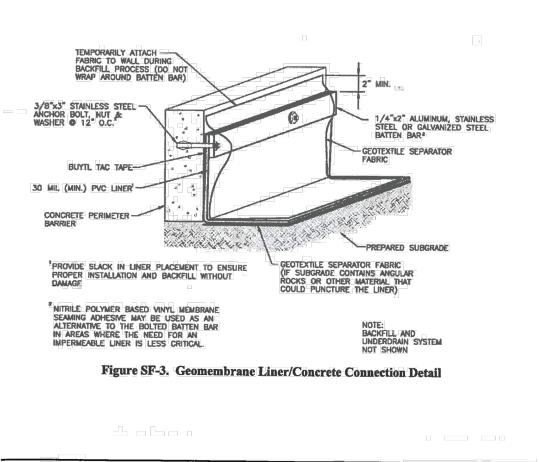
4. ECBs SHALL BE LEFT IN PLACE TO EVENTUALLY BIODEGRADE, UNLESS REQUESTED TO BE REMOVED BY THE LOCAL JURISDICTION. 5. ANY ECB PULLED OUT, TORN, OR OTHERWISE DAMAGED SHALL BE REPAIRED OR REINSTALLED. ANY SUBGRADE AREAS BELOW THE GEOTEXTILE THAT HAVE ERODED TO CREATED A VOID UNDER THE BLANKET, OR THAT REMAIN DEVOID OF GRASS SHALL BE REPAIRED, RESEEDED AND MULCHED AND THE ECB REINSTALLED.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO AND TOWN OF PARKER COLORADO, NOT AVAILABLE IN AUTOCAD)

# Sand Filter STAINLESS STEEL BUYTL TAC TAPE -PROVIDE SLACK 30 MIL (MIN.) PVC LINER BACKFILL NOT SHOWN

Figure SF-2. Geomembrane Liner/Underdrain Penetration Detail



Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

SSA-4

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 RECP-5

November 2010 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 RECP-9

November 2010

**EC-6** 

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7

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CONTROL

EROSION

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GRADING

• Turf Reinforcement Mat (TRM): A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh, and/or other elements, processed into a permanent, threedimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.

Tables RECP-1 and RECP-2 provide guidelines for selecting rolled erosion control products appropriate to site conditions and desired longevity. Table RECP-1 is for conditions where natural vegetation alone will provide permanent erosion control, whereas Table RECP-2 is for conditions where vegetation alone will not be adequately stable to provide long-term erosion protection due to flow or other conditions.

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 November 2010

November 2010

**Rolled Erosion Control Products (RECP)** 

**EC-6** 

**Table RECP-1. ECTC Standard Specification for Temporary Rolled Erosion Control Products** (Adapted from Erosion Control Technology Council 2005)

<b>Product Description</b>	Slope Applications*		Channel Applications*	Minimum Tensile Strength <sup>1</sup>	Expected Longevity	
	Maximum Gradient	C Factor <sup>2,5</sup>	Max. Shear Stress <sup>3,4,6</sup>			
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft <sup>2</sup> (12 Pa)	5 lbs/ft (0.073 kN/m)		
Netless Rolled Erosion Control Blankets	4:1 (H:V)	≤0.10 @ 4:1	0.5 lbs/ft <sup>2</sup> (24 Pa)	5 lbs/ft (0.073 kN/m)	Up to 12	
Single-net Erosion Control Blankets & Open Weave Textiles	3:1 (H:V)	≤0.15 @ 3:1	1.5 lbs/ft <sup>2</sup> (72 Pa)	50 lbs/ft (0.73 kN/m)	months	
Double-net Erosion Control Blankets	2:1 (H:V)	≤0.20 @ 2:1	1.75 lbs/ft <sup>2</sup> (84 Pa)	75 lbs/ft (1.09 kN/m)		
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft <sup>2</sup> (12 Pa)	25 lbs/ft (0.36 kN/m)	24 months	
Erosion Control Blankets & Open Weave Textiles (slowly degrading)	1.5:1 (H:V)	≤0.25 @ 1.5:1	2.00 lbs/ft <sup>2</sup> (96 Pa)	100 lbs/ft (1.45 kN/m)	24 months	
Erosion Control Blankets & Open Weave Textiles	1:1 (H:V)	≤0.25 @ 1:1	2.25 lbs/ft <sup>2</sup> (108 Pa)	125 lbs/ft (1.82 kN/m)	36 months	

\* C Factor and shear stress for mulch control nettings must be obtained with netting used in conjunction with pre-applied mulch material. (See Section 5.3 of Chapter 7 Construction BMPs for more information on the C Factor.)

<sup>1</sup> Minimum Average Roll Values, Machine direction using ECTC Mod. ASTM D 5035.

<sup>2</sup> C Factor calculated as ratio of soil loss from RECP protected slope (tested at specified or greater gradient, H:V) to ratio of soil loss from unprotected (control) plot in large-scale testing.

<sup>3</sup> Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in) soil loss) during a 30-minute flow event in large-scale testing. <sup>4</sup> The permissible shear stress levels established for each performance category are based on historical

experience with products characterized by Manning's roughness coefficients in the range of 0.01 - 0.05. <sup>5</sup> Acceptable large-scale test methods may include ASTM D 6459, or other independent testing deemed acceptable by the engineer.

<sup>6</sup> Per the engineer's discretion. Recommended acceptable large-scale testing protocol may include ASTM D 6460, or other independent testing deemed acceptable by the engineer.

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 **Rolled Erosion Control Products (RECP)** 

Table RECP-2. ECTC Standard Specification for Permanent<sup>1</sup> Rolled Erosion Control Products (Adapted from: Erosion Control Technology Council 2005)

Product Type	Slope Applications	<b>Channel Applications</b>	
	Maximum Gradient	Maximum Shear Stress <sup>4,5</sup>	Minimum Tensile Strength <sup>2,3</sup>
TRMs with a minimum thickness of 0.25 inches (6.35 mm) per ASTM D 6525 and UV stability of 80% per ASTM D 4355 (500 hours exposure).	0.5:1 (H:V)	6.0 lbs/ft² (288 Pa)	125 lbs/ft (1.82 kN/m)
	0.5:1 (H:V)	8.0 lbs/ft <sup>2</sup> (384 Pa)	150 lbs/ft (2.19 kN/m)
	0.5:1 (H:V)	10.0 lbs/ft² (480 Pa)	175 lbs/ft (2.55 kN/m)

<sup>1</sup> For TRMs containing degradable components, all property values must be obtained on the nondegradable portion of the matting alone.

<sup>2</sup> Minimum Average Roll Values, machine direction only for tensile strength determination using <u>ASTM</u> <u>D 6818</u> (Supersedes Mod. <u>ASTM D 5035</u> for RECPs)

<sup>3</sup> Field conditions with high loading and/or high survivability requirements may warrant the use of a TRM with a tensile strength of 44 kN/m (3,000 lb/ft) or greater.

<sup>4</sup>Required minimum shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in.) soil loss) during a 30-minute flow event in large scale testing.

<sup>5</sup> Acceptable large-scale testing protocols may include <u>ASTM D 6460</u>, or other independent testing deemed acceptable by the engineer.

**Design and Installation** 

RECPs should be installed according to manufacturer's specifications and guidelines. Regardless of the type of product used, it is important to ensure no gaps or voids exist under the material and that all corners of the material are secured using stakes and trenching. Continuous contact between the product and the soil is necessary to avoid failure. Never use metal stakes to secure temporary erosion control products. Often wooden stakes are used to anchor RECPs; however, wood stakes may present installation and maintenance challenges and generally take a long time to biodegrade. Some local jurisdictions have had favorable experiences using biodegradable stakes.

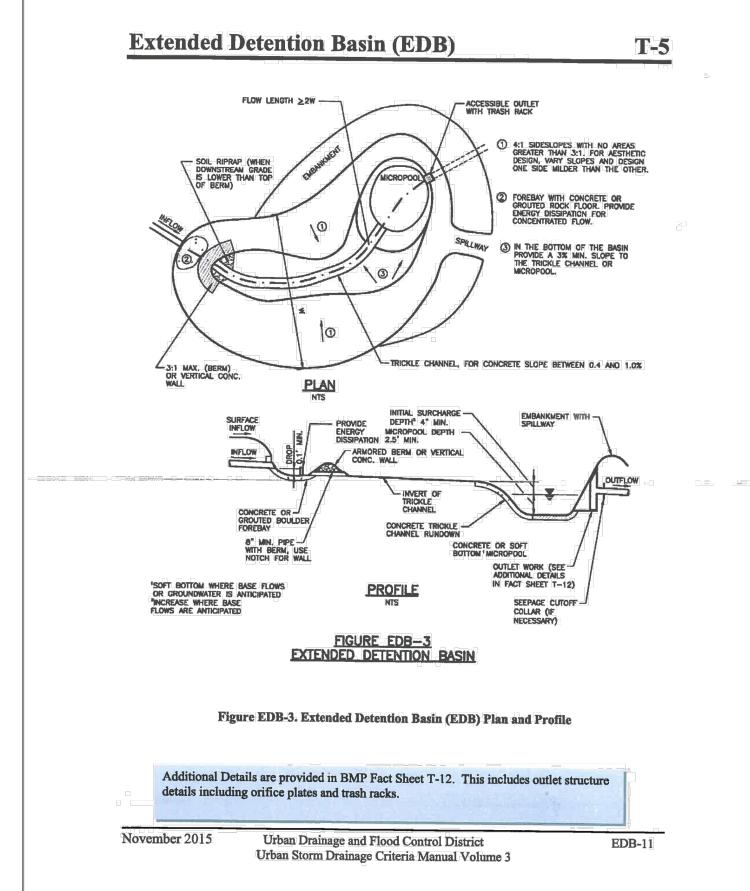
This BMP Fact Sheet provides design details for several commonly used ECB applications, including:

ECB-1 Pipe Outlet to Drainageway

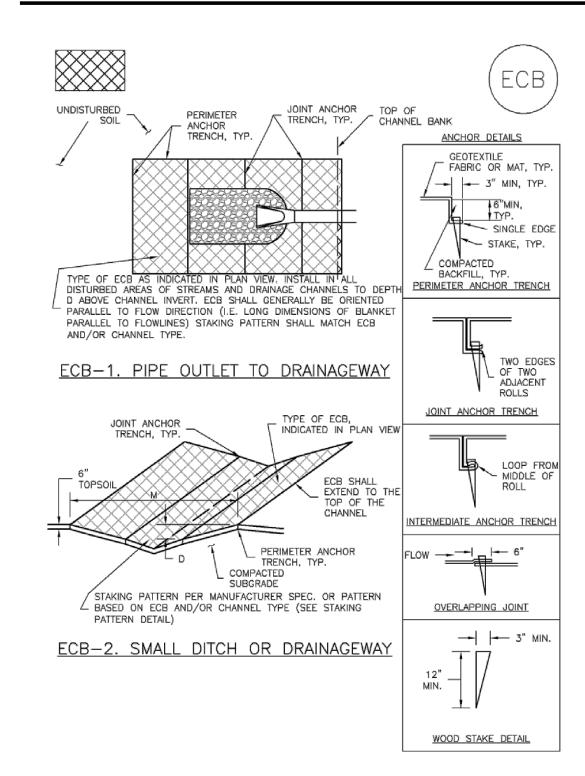
ECB-2 Small Ditch or Drainageway

ECB-3 Outside of Drainageway

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3 November 2010



**Rolled Erosion Control Products (RECP)** 



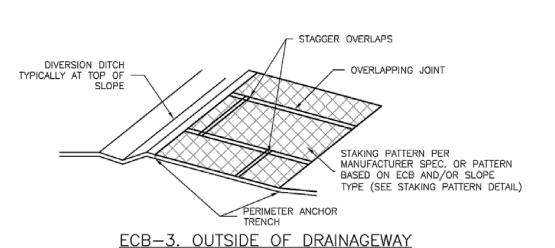
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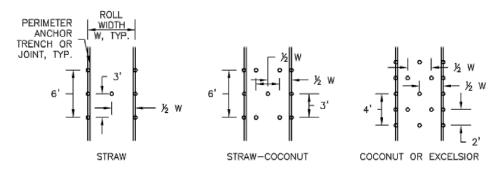
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**Rolled Erosion Control Products (RECP)** 

**EC-6** 

RECP-3





STAKING PATTERNS BY ECB TYPE

November 2010

Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

STAKING PATTERNS BY SLOPE OR CHANNEL TYPE

LOW FLOW CHANNEL

RECP-7

**Rolled Erosion Control Products (RECP)** 

EROSION CONTROL BLANKET INSTALLATION NOTES SEE PLAN VIEW FOR:
 LOCATION OF ECB.

-TYPE OF ECB (STRAW, STRAW-COCONUT, COCONUT, OR EXCELSIOR). -AREA, A, IN SQUARE YARDS OF EACH TYPE OF ECB. 2. 100% NATURAL AND BIODEGRADABLE MATERIALS ARE PREFERRED FOR RECPS, ALTHOUGH SOME JURISDICTIONS MAY ALLOW OTHER MATERIALS IN SOME APPLICATIONS.

3. IN AREAS WHERE ECBs ARE SHOWN ON THE PLANS, THE PERMITTEE SHALL PLACE TOPSOIL AND PERFORM FINAL GRADING, SURFACE PREPARATION, AND SEEDING AND MULCHING. SUBGRADE SHALL BE SMOOTH AND MOIST PRIOR TO ECB INSTALLATION AND THE ECB SHALL BE IN FULL CONTACT WITH SUBGRADE. NO GAPS OR VOIDS SHALL EXIST UNDER THE

4. PERIMETER ANCHOR TRENCH SHALL BE USED ALONG THE OUTSIDE PERIMETER OF ALL

5. JOINT ANCHOR TRENCH SHALL BE USED TO JOIN ROLLS OF ECBs TOGETHER (LONGITUDINALLY AND TRANSVERSELY) FOR ALL ECBs EXCEPT STRAW WHICH MAY USE

6. INTERMEDIATE ANCHOR TRENCH SHALL BE USED AT SPACING OF ONE-HALF ROLL LENGTH FOR COCONUT AND EXCELSIOR ECBs.

7. OVERLAPPING JOINT DETAIL SHALL BE USED TO JOIN ROLLS OF ECBs TOGETHER FOR ECBs

8. MATERIAL SPECIFICATIONS OF ECBs SHALL CONFORM TO TABLE ECB-1. 9. ANY AREAS OF SEEDING AND MULCHING DISTURBED IN THE PROCESS OF INSTALLING ECBS

10. DETAILS ON DESIGN PLANS FOR MAJOR DRAINAGEWAY STABILIZATION WILL GOVERN IF DIFFERENT FROM THOSE SHOWN HERE.

TABLE ECB-1. ECB MATERIAL SPECIFICATIONS							
TYPE	COCONUT CONTENT	STRAW CONTENT	EXCELSIOR CONTENT	RECOMMENDED NETTING**			
STRAW*	_	100%	-	DOUBLE/ NATURAL			
STRAW- COCONUT	30% MIN	70% MAX	-	DOUBLE/ NATURAL			
COCONUT	100%	-	-	DOUBLE/ NATURAL			
EXCELSIOR	_	-	100%	DOUBLE/ NATURAL			

RECP-8 Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual Volume 3

November 2010

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