

Control measures details provided (SWMP pg 19-53) are inadequate.

Please replace these details with the control measure details I have uploaded with this submission request.

Stormwater Management Plan (SWMP)

Project:

Home Construction within Meridian Ranch Subdivision

Prepared for:

ZRH Construction, LLC

Location:

Meridian Rd and Londonderry Dr

Peyton, Colorado

Project Site Description

1.1 Project Information

Name: Meridian Ranch Subdivision
Location: Meridian Rd and Londonderry Dr

The purpose of this project is to construct single family residential homes in Meridian Ranch Subdivision. This SWMP covers residential construction activities associated with the construction of single family residential homes on pre-developed lots in Meridian Ranch Subdivision. The project is not located on Native American land, nor is it considered a federal facility. This project will fall under the jurisdiction of the El Paso County.

The site consists of a varying number of developed lots in the Meridian Ranch subdivision. The lots currently under construction and/or within this plan are listed in the Schedule of Lots contained herein.

The total area of the lots is shown in the Schedule of Lots contained herein. The entire area of each lot is expected to be disturbed.

Attached hereto and forming part of this plan are maps of the site and individual lots contained therein showing types and locations for BMPs, which together are the site map.

The existing soils are clayey and silty sand and sandstone, as determined by geotechnical investigations and soils test by RMG Engineers.

The site had been overlot graded prior to ZRH Construction, LLC commencing activities and the existing vegetation was a combination of weeds and grasses covering approximately 3% of the ground. It is believed that vegetation prior to any previous disturbance of the land, based on the condition of adjacent ungraded areas, was a combination of weeds and grasses covering approximately 35% of the ground.

Stormwater discharges will be primarily to the existing storm sewer systems in Meridian Ranch, and the ultimate receiving waters will be Black Squirrel Creek to Arkansas River.

1.2 Non-stormwater discharge

The permit and this SWMP do not allow and is not designed for the discharge of non-stormwater. The only exceptions to this rule include:

- Emergency firefighting activities
- Uncontaminated springs
- Landscape irrigation return flow

A discharge to the ground of concrete washout is allowed provided that:

- Source of washout is identified in the SWMP
- BMPs adequately confine washout
- Discharges do not leave the site as surface runoff or to surface waters

Dewatering is only authorized by this SWMP and permit provided that:

- The source is groundwater and/or groundwater combined with stormwater that does not contain pollutants in excess of State groundwater standards in Regulations 5 CCR 1102-41 and 42
- The discharges do not leave the site as surface runoff or to surface waters

There is a potential for each of the allowable sources of non-stormwater discharges from this site, with the exception of natural springs. There are no known natural springs on this site. Landscape irrigation return flow is anticipated from neighboring lots and from the site as landscaping is complete.

Table 1. Non-stormwater discharge management

Non-Stormwater Discharge Management	
Non-Stormwater Discharge	Pollutant Controls
Concrete washout	Locations to be ascertained from time to time and identified on site map. Source of concrete is concrete trucks washing out drums, chutes and hoses after delivery of construction concrete. Washout to be confined by BMP's identified herein. Concrete waste shall be removed and disposed of offsite from time to time.
Discharges from firefighting activities	This is an allowable non-stormwater discharge source in the state of Colorado. Control burns are not planned for this site. Emergency firefighting activities would be handled by the local fire department.
Fire hydrant flushing	Fire hydrant flushing has been completed in this filing. Flushing is the responsibility of the local municipality. It is important that the local municipality leave in place down gradient BMPs prior to flushing.
Waters used to wash vehicles where detergents are not used	Vehicle washing will not be allowed on site. However, Reunion Homes, Inc. does not have control of private homeowners once the homes are transferred to them.
Water used to control dust	Water used to control dust shall be sprayed on areas of disturbed soil, ensuring that all appropriate down gradient BMPs are in place and functioning prior to water application.
Water used to flush waterlines and wash down buildings	There will be no waterline to flush on site. Down gradient controls shall be in place prior to any wash down of any structures or pavement onsite. If the water will come in contact with any other pollutants other than soil then the activities are to cease immediately until those other pollutants have been removed.
Air conditioning condensate	Air conditioning condensate will be discharged into a floor drain in the basement of the completed homes.

Uncontaminated spring water, groundwater and discharges from foundation drains	There are no known spring waters on the site. See comment below regarding groundwater. Foundation drain discharges will not be allowed to infiltrate into the ground. ZRH Construction, LLC does not have control of private homeowner foundation drains once the homes are transferred to them.
Uncontaminated excavation dewatering	Excavation dewatering, if any, will be discharged on to pits on the site, or into the existing storm sewer system. Uncontaminated excavation dewatering is an allowable non-stormwater discharge in the State of Colorado provided that the water does not comingle with groundwater. The dewatering of stormwater must go through adequate BMPs to reduce pollutants to the maximum extent practicable. Excavation dewatering, if any, will be discharged into the existing storm sewer system.
Landscape irrigation	This is an allowable non-stormwater discharge source in the State of Colorado. Down gradient controls will be installed prior to the installation and testing of irrigation lines. These controls include sediment controls. ZRH Construction, LLC does not have control of private homeowner irrigation systems once the homes are transferred to them.

Note: It is the permittee’s responsibility to control offsite runoff on to your project in a manner that will not have the water exiting the site carrying pollutants.

1.3 Stormwater Management Plan Contact Information

Table 2. SWMP Contact Information.

Operator:	SWMP Administrator:
ZRH Construction, LLC 11054 Evening Creek Dr Peyton, CO 80831	ZRH Construction, LLC Vanja Hrustanovic 11054 Evening Creek Dr Peyton, CO 80831 Telephone: (719) 271-1911

2.0 Stormwater Management Controls

The purpose of this section is to describe and delegate the erosion control and SWMP responsibilities, identify all potential pollution sources, and expound on each BMP that will be (or has been) used to reduce the potential for pollutants to enter the waters of Colorado and the United States during the lifetime of the project.

2.1 SWMP Administrator

The SWMP Administrator is responsible for implementing, maintaining and revising the SWMP. The activities and responsibilities of the administrator shall address all aspects of the facility’s SWMP.

Name: Vanja Hrustanovic

Title: General Manager

2.2 Potential Pollutant Sources

All potential sources of pollution must be identified in the SWMP if found to have the potential to contribute pollutants to stormwater discharges. Below is a minimum list of applicable sources that have been evaluated.

- All disturbed and stored soils
- Vehicle tracking of sediments
- Management of contaminated soils
- Outdoor storage activities
- Vehicle and equipment maintenance and fueling
- Significant dust or particulate generating processes
- On-site waste management practices
- Concrete truck/equipment washing, including concrete truck chute and associated fixtures and equipment
- Non-industrial waste sources such as worked trash and portable toilets
- Other areas or procedures where potential spills can occur

Table 4. Potential Pollution Sources

Potential Pollutant Sources	Potential with this project	Associated activities	Planned Best Management Practices (BMPs)
All disturbed and stored soils	Yes	Foundation excavation, backfill, stockpile management, building construction and final stabilization	Perimeter Sediment Control Logs (Straw Wattles) and Silt Fence. Interior surface roughening or other forms of Erosion Control when practicable and in conformance with the El Paso County, phasing, training all workers together. VTCs and street cleaning.
Vehicle tracking of sediments	Yes	Points of ingress and egress	Limit to as few access points as possible. Street sweeping.
Management of contaminated soils	No	No known contaminated soils exist on this site.	If contaminated soils are encountered, work must stop and the SWMP Administrator will be notified. Soils should be properly stored in a 55 gallon drum and disposed of. CMS should also be notified to determine if activities can continue or if further site analysis is required.
Loading and unloading operations	Yes	Delivery of materials	The curb back BMP should be pulled back for access to dry lots only. Tires should be cleaned prior to traveling on paved roads and

			any tracking off the site should be swept. Curb back BMP should be reset per detail in the SWMP after the vehicles has left the site.
Outdoor storage of building materials	Yes	Delivery of materials	Stabilized storage area or per lot, site management practices, perimeter controls.
Outdoor storage of fertilizers, chemicals, etc.	No	None expected	Stabilized storage area or per lot, site management practices, perimeter controls.
Vehicle and equipment maintenance and fueling	Yes	Off-site fueling shall be conducted whenever it is practical. Some equipment may be fueled onsite.	Fueling operations shall be conducted by qualified personnel who are trained in fueling procedures, including the use of drip pans and proper spill cleanup and reporting procedures.
Significant dust or particulate generating processes	Yes	Soil moving activities	Moisture condition soil and/or cease soil disturbing operations during high winds.
Routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, oils, etc.	Yes	Vehicle use and storage, foundation forms, vertical construction and final stabilization	All activities will be conducted by personnel trained in good housekeeping, use of on-site BMPs, perimeter BMPs, and spill response and prevention.
On-site waste management practices (waste piles, liquid wastes, dumpsters, etc.)	Yes	Building construction and final stabilization	Trash shall be removed prior to overflow off site, and all liquid wastes will be hauled off site and properly disposed of. While materials and trash are onsite, they must be stored in a manner where a release of wastes is not likely to occur.
Dedicated asphalt and concrete batch plants	No	Not anticipated for this project	
Non-industrial waste sources such as worked trash and portable toilets	Yes	All activities	Dumpsters, portable toilets and site management practices. Toilets must be properly anchored to avoid tipping.
Other areas or procedures where potential spills can occur	No	None identified at this time	
Non-construction pollutant sources	No	None identified at this time	
Concrete, concrete wash water, mortar, stucco and/or portable mortar mixers	Yes	Foundation construction, flatwork and brick installation	Ensure that all materials are contained in a manner where BMPs are not bypassed and where material is contained onsite. Site should be regularly cleaned up.

Fertilizers, pesticides, herbicides and soil amendments	Yes	Final stabilization	These materials must either be stored in a covered vehicle, covered structure or behind a BMP (soil amendment stockpiles). Trades will remove and properly dispose of waste off site.
Glues, adhesives, caulks and related products	Yes	Utility installation, building construction, final stabilization	These materials will be stored either in side vehicles or inside covered structures onsite (houses). Trades will remove and properly dispose of all unused products and wastes off site.
Paint, stains, solvents and related products	Yes	Utility installation, building construction, final stabilization	These materials will be stored either in side vehicles or inside covered structures onsite (houses). Trades will remove and properly dispose of all unused products and wastes off site.
Petroleum products – fuels, oils, grease and form oil (other hydrocarbons)	Yes	During all construction activities onsite	These products must be stored with individual trade vehicles and use of these products is to be by only those individuals who are trained in spill response and/or are certified mechanics. Any waste or by products shall be hauled offsite and properly disposed of.
Sanitary waste	Yes	During all construction activities onsite	Portable toilets cleaned out by properly trained portable toilet companies.

Structural BMPs shall consist of:

- Straw wattles, manufactured plastic wattles or cut backs and/or with berms placed behind curbs on street frontages;
- Straw wattles, manufactured plastic wattles or silt fence where potential for discharge of sediment from the site exists along rear and side lot lines;
- Straw wattles are expected to be removed as necessary for access of vehicles to the site and delivery of materials. Wattles are to be replaced as soon as practical after access to the site in that location is no longer required, but at least daily;
- If there are areas where straw wattles are not sufficient to control discharge, silt fence or straw bales;
- For concrete wash outs, tracking pads, straw wattles and or earth berms as described in the BMP descriptions appended hereto.

BMPs shall be installed and maintained as described in the BMP descriptions appended hereto, which BMP descriptions are incorporated with and part of this Stormwater Management Plan.

2.3 Best Management Practices (BMPs)

The living nature of a construction project must be reflected by the innovation and creativity of the SWMP Administrator. All changes, amendments, alterations, installations and dismantling of BMPs must be documented in the SWMP routinely so that the SWMP and project always reflect one another.

The process of selecting and installing BMPs is based on specific pollution risks associated with each construction activity and specific site conditions. Preventing pollution from entering public waters is the objective of erosion and sediment control BMPs. Once defined, BMP objectives are developed and the proper BMP is selected. The following is a breakdown of categories of the major BMP purposes for this project.

➤ Control of Erosion and Discharge of Sediment:

- ✓ Minimize Disturbed Areas: Only denude soil when necessary, minimize new land disturbance during the rain times, and avoid clearing and disturbing sensitive areas (e.g. steep slopes and natural watercourses), and other areas where site improvements will not be constructed. For this project, areas to be disturbed immediately prior to the accompanying construction activities.
- ✓ Stabilize Disturbed Areas: Permanently stabilize any disturbed areas that will lie dormant for over 30 days. Once final grade is achieved and activities have ceased in that area, final stabilization must be implemented as soon as possible. Rear yard landscaping will be within the scope of final buyers of the lots and not within the control of Reunion Homes Inc.
- ✓ Protect Slopes (especially 3:1 and greater) and Channels: The Idea is to convey runoff from the top of the slope and stabilize (and remediate) disturbed slopes as soon as possible. Maintain and/or avoid disturbing natural channels. Avoid erosive flows that risk increased channel erosion.
- ✓ Manage the Site Perimeter: Divert upstream run-on safely around or through the construction project. It is important that such diversions not cause downstream property damage. Runoff from the project site should be free of excessive sediment and other constituents.

➤ Manage Non-Stormwater Discharges and Materials:

- ✓ Practice and Preach Good Housekeeping: Beginning with clear communication, all responsible parties must maintain a clean and tidy site. The best way to avoid pollutants coming into contact with stormwater is prevention: implement simple, cost-effective measures to avoid material exposure, spills, spoils, leaks, etc.
- ✓ Contain Materials and Wastes: Store construction and waste materials in approved containment in designated areas, protected from precipitation and contact with stormwater runoff. Dispose of all construction waste and worker trash by hauling off

site in work vehicles. Always be prepared for spills, while avoiding spills at all measures.

Construction BMPs are either structural or non-structural, and are meant to control either erosion (the cause) or sediment (the effect). Refer to table 5 for a better understanding of various BMPs (note: although this table is extensive, it is by no means exhaustive).

Table 5. Comparison of Best Management Practices (BMPs): structural vs. non-structural; erosion vs. sediment.*

	Structural BMP	Non-Structural BMP	
Erosion Control	Stabilized Construction Access Point	Utilizing Existing Vegetation	Erosion Control
	Stabilized Construction Roadway	Temporary Seeding	
	Velocity Dissipation Devices	Soil Roughening	
	Stream Bank Stabilization	Vegetative Buffers	
	Stabilized Staging Area	Hydraulic Mulch	
	Drainage Swales	Hydro Seeding	
	Paved Surfaces	Straw Mulch	
	Wood Mulching	Scheduling	
	Slope Drains	Soil binders	
	Earth Dikes	Phasing	
Sediment Control	Silt Fence	Training/Education (erosion and sediment)	Sediment Control
	Dirt Berm	Phasing	
	Check Dam	Scheduling	
	Fiber Rolls	Street Sweeping	
	Rock Burrito	Good Housekeeping	
	Sediment Trap	Controlling Access Points	
	Sediment Basin	Minimizing Pollution Sources	
	Rock Berm with Weir	Minimizing No. of Stockpiles	
	Area Inlet Protection	Minimizing (Un)Loading Points	
	Sump Inlet Protection	Disturb Least Amount of Area at Any One Time	
	Access Point Tire Wash	Limit No. of Vehicles on Disturbed Areas	
On-Grade Inlet Protection	Clear Communication Among All Involved		
	Structural BMP	Non-Structural BMP	

*Note: This table is meant to be used as an example of structural versus non-structural and erosion versus sediment controls for any persons utilizing this SWMP. BMPs noted in this section may or may not be utilized on this particular project. This table is for educational purposes only.

2.5 Non-Structural Practices for Erosion and Sediment Control

The SWMP clearly describes and locates, as applicable, all non-structural practices implemented at the site to minimize erosion and sediment transport. Descriptions are provided for each BMP used during the life of the Meridian Ranch Subdivision project. Important non-structural BMPs include education and training, phasing and sequencing, and interim and permanent stabilization practices to ensure that existing vegetation is preserved where possible. Non-structural practices include, but are not limited to, temporary vegetation, permanent vegetation, mulching, slope and surface roughening.

Non-structural BMPs will be evaluated, reviewing and revised on a regular basis in order to maintain compliance and maximize site efficiency.

2.5.1 Phased BMP Implementation

Reunion Homes, Inc.:

Phasing of BMPs is as important as the BMPs themselves. The purpose of this section is to make sure that implementation and maintenance of the Meridian Ranch Subdivision BMPs are followed, implemented and maintained in a manageable and sensible order.

Administrative BMPs such as scheduling, training, enforcement, etc. will be employed through the duration of the project. Good housekeeping will be a daily priority. The spill response and prevention BMP will always be implemented during all project phases.

In order to increase efficiency and decrease the potential for pollutants to discharge from the site, the phasing will be divided into 3 separate sections: Initial, Intermediate and Final.

Table 6. Proposed sequencing of Meridian Ranch Subdivision Phased Construction and BMP Implementation

Proposed Sequencing of Phased BMP Implementation		
Phase	Construction	BMP Implementation
I (Initial)	Excavation	Down gradient and perimeter sediment controls (throughout site), Concrete washout and staging area construction, Scheduling, VTC, Limit disturbance of vegetation, Training, Good housekeeping, CWA
II (Interim)	Foundation pouring, Building erection, Tenant finish	Down gradient sediment controls, Surface roughening, Scheduling, Limit disturbance of vegetation, Training, VTC, Good housekeeping, CWA
III (Final)	Final stabilization, Demobilization	Maintain BMPs, Achieve final grade, Install final landscaping,

2.5.1.1 Phase I

- Install inlet protection throughout the site, which is to be done by developer and not ZRH Construction, LLC
- Sedimentation basins throughout the site, which is to be done by developer and not ZRH Construction, LLC.
- Install concrete washout area
- Install back of curb BMPs
- Install any side or rear of lot sediment control
- Non-Structural – preserve vegetation as practicable, realizing that most vegetation will need to be removed
- Implement portable toilets and dumpsters (typically one pot-o-let per 5 houses, one to two dumpsters while house is framing and at least one until house is substantially complete)
- Sweep street as needed to remove any tracked sediment

2.5.1.2 Phase II

By working together, all parties' contributions create and maintain a compliant site.

- Maintain all above BMPs, note as infill lots occur some lots will now need side controls to protect down gradient finished lots
- Educate onsite personnel (many new subcontractors are now onsite, education is imperative)
- Educate workers to be responsible for their own trash and leaking equipment
- Use material handling BMPs
- Control vehicle access (limit points of ingress and egress, utilize designated access points)
- Install construction material behind BMPs or in a manner where pollutants from those materials will not migrate off site or enter the stormwater conveyance system
- Use spill control when necessary
- Follow lot control details
- Aspire to create an environment where all contractors, consultant, internal personnel and regulatory agencies are working together in order to successfully achieve and maintain compliance

2.5.1.3 Phase III

Final stabilization will occur throughout construction as individual houses are landscaped and lots are sold to homeowners. After closing, rear landscaping and perimeter controls are the responsibility of the homeowner.

ZRH Construction, LLC policy is to provide front landscaping only. ZRH Construction, LLC will provide rear yard BMPs if necessary. Upon closing, operational control of that property will be turned over to the control of the homeowner and it will be their responsibility to maintain all front, rear and side lot BMPs.

- Final stabilization will be happening at the end of each building project. It is important that all fertilizers and materials used be handled appropriately. If at all possible, it is strongly recommended that final stabilization practices be implemented throughout the life of the

project as soon as possible. Temporarily remove BMPs to fine grade (reset at end of the day or prior to storm)

- Follow lot control details
- Once final landscaping is installed, homeowners must maintain lot BMPs left in place for front, rear and side of lot.

Once final stabilization has been established, or all lots have been turned over to individual homeowners, all non-permanent BMPs will be removed and a Notice of Inactivation (NOI) filed to the Colorado Department of Public Health and Environment.

2.4 Structural Best Management Practices

This SWMP clearly describes and locates all structural practices implemented at the site to minimize erosion and sediment transport. Practices will include, but are not limited to, perimeter controls, silt fence and rock bags.

Structural BMPs will be evaluated, reviewed and revised on a regular basis in order to maintain compliance and maximize site efficiency. All changes to BMPs, including installation and removal, are reflected in the SWMP and documented on the active site map.

2.5 Materials Handling and Spill Prevention

In case of release that meets or exceeds reportable quantities, contact the CDPHE within a 24 hour period. A written report will be required to be filed within 5 days.

Emergency Local Fire, Police or Ambulance	911
CMS Environmental Solutions	720-343-6561
EPA National Response Center	1-800-424-8802
Colorado Department of Public Health and Environment	1-877-518-5608
Colorado Emergency Planning Committee	303-273-1622
El Paso County	719-520-6460

Reporting

- Immediately document and record all spills, discharges, overflows, upsets, events and leaking equipment in the SWMP.
- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining waterline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours). Use the following measures related to specific activities:

Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials and training employees.

- Fuels
- Lubricants
- Other petroleum distillates
- Concrete
- Fertilizers

Limitations

- In some cases, it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite.

Implementation

The following steps will house reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a “significant spill” is for each material they use, and what is the appropriate response for “significant” and “insignificant” spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Have contractor’s superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater run-on during rainfall to the extent that it doesn’t compromise cleanup activities.
- Do not bury or wash spills with water.
- Store and dispose of used cleanup materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous and accessible location.

- Keep waste storage areas clean, well-organized and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers and liners should be repaired or replaced as needed to maintain proper function.
- Under no circumstances shall materials be stored in the river or between the tops of the two river banks.
- Store materials so that they are protected from stormwater and will not migrate into waters of the United States.

Cleanup

- A spill kit is recommended but not mandated for ZRH Construction, LLC. However, contractors using materials susceptible to spills should have spill kits of their own onsite.
- All spills must be documented and properly removed.
- The contents of the spill kit should include:
 - Spill Prevention and Control Handbook
 - Heavy duty oil or hydrocarbon absorbent pads (oil only), socks and pillows (oil only)
 - Safety goggles
 - Oil-dri® or similar absorbent product
 - Nitrile Rubber gloves
 - Heavy duty disposable bags
- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent materials for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
 - Contain the spread of the spill.
 - Recover spilled materials.
 - Clean the contaminated area and properly dispose of contaminated materials.
- Keep within permitted area.
- It must not threaten any stormwater conveyance.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.
- Spills should be cleaned up immediately:

- Contain the spread of the spill.
- Notify the project foreman immediately.
- If the spill occurs on paved or impermeable surfaces, clean up using “dry” methods (absorbent materials i.e. oil-dri® and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
- If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
- If the spill occurs during rain, cover spill with tarps or other materials to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills (any substance requiring a MSDS response) that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
 - Notify the local emergency response by dialing 911. In addition, the contractor will notify the property county officials. It is the contract’s responsibility to have all emergency phone numbers at the construction site.
 - For spills of federal reportable quantities, see table 7. The contractor should notify the National Response Center at 800-424-8802.
 - Secure the area.
 - Provide first aid.
 - Notify CDPHE and the El Paso County Stormwater Program immediately and provide written documentation to the State within 5 days. Notification should first be made by telephone and followed up with a written report.
 - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
 - Other agencies which may need to be consulted include, but are not limited to, the Fire Department and the Public Works Department.

All staff is to be educated on spill prevention and response procedures:

Spill Prevention: This can be accomplished by using offsite facilities, fueling by trained personnel only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractor in proper fueling procedures. Drip Pans should be used whenever possible.

Response Procedure: Should any material spill down a slope berm, a barrier method should be constructed immediately in order to contain the spill. The spill should be immediately cleaned up with absorbent material. That material should then be bagged, taken offsite and properly disposed of. If the material has absorbed into the soil, then the contaminated soil should be shoveled into plastic bags, taken offsite and properly disposed of. If a spill does occur, an immediate inspection of the site should be conducted documenting the spill and procedures to be taken to prevent spill from reoccurring.

For any spills that are of a reportable quantity, contact the SWMP Administrators, the EPA and CDPHE.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

Table 7. Reportable quantities of spilled materials

Reportable Quantities		
Material	Location of Spill	Reportable Quantity
Engine oil, fuel, hydraulic and brake fluid	Land	25 gallons
Engine oil, fuel, hydraulic and brake fluid	Water	Visible layer
Antifreeze	Land	13 gallons
Battery Acid	Land	13 gallons
Refrigerant	Air	1 pound

In case of release that meets or exceeds reportable quantities, contact the CDPHE within a 24 hour period. A written report will be required to be filed within 5 days.

Final Stabilization

3.0 Final Stabilization Overview ZRH Construction, LLC:

Final stabilization will occur throughout construction as individual houses are landscaped and the lots are sold to homeowners.

ZRH Construction’s policy is to provide front landscaping only. ZRH Construction, LLC will provide any rear yard BMPs that may be necessary in accordance with El Paso County. Once the lot has been purchased, it is up to the individual homeowner to maintain those sediment controls until all landscaping has been installed in accordance with the local HOA.

Landscaping shall be a combination of rock, mulch, sod, trees and shrubs. All landscaping and soil amendments must be handled in accord with section 3 of this plan.

Permit Deactivation

The permit may be inactivated when final stabilization has been achieved, all lots have turned over and all temporary BMPs have been removed.

Upon final stabilization of ZRH Construction, LLC area of disturbance, the CDPHE permit shall be terminated by submitting a Notice of Inactivation.

3.1 Retention of Records

Once the site is stabilized, the SWMP shall be retained for a minimum of 3 years by ZRH Construction, LLC after the permit has been deactivated.

4.0 Inspection and Maintenance

The purpose of this section is to clearly describe the inspection and maintenance procedures implemented in the SWMP.

4.1 Inspection Requirements.

Reunion Homes shall, at a minimum, make a thorough inspection, in accordance with the requirements herein either:

- at least once every 14 calendar days, and within 24 hours of any precipitation or snowmelt event that causes surface erosion. If no construction activities will occur after the end of any precipitation or snowmelt event causing surface erosion, then the post storm inspection may be delayed up to 72 hours after such event, in which case the delay shall be documented in the inspection record;
- [or at least once every 7 calendar days.](#)

Scope of Inspection:

- Construction site perimeter
- All disturbed areas
- Material and/or waste storage areas that are exposed to precipitation
- Discharge locations
- Locations where vehicles access the site shall be inspected for evidence of or the potential for pollutant leaving the construction site boundaries entering the stormwater drainage system or discharging to state waters
- All erosion and sediment control practices shall be evaluated to ensure that they are maintained and operated correctly.

Inspection Reports shall be kept, and shall identify any incidents of non-compliance with the terms and conditions of this permit, and shall include:

- The inspection date;
- Name and title of person making inspection;
- [Weather conditions at time of inspection](#)
- [Construction phase at time of inspection](#)
- [Estimate of disturbed area at time of inspection](#)
- [Inspection frequency utilized.](#)
- Location(s) of discharges of sediment or other pollutants from the site;
- Location(s) of BMPs that need to be maintained;

- Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location;
- Location(s) where additional BMPs are needed that were not in place at time of inspection;
- Deviations from the minimum inspection schedule as provided herein;
- Description of corrective actions for items above, dates corrective actions taken, measures to prevent future violations, including requisite changes to the SWMP, as necessary; and
- After corrective actions have been taken, or where the report does not indicate any incidents requiring corrective action, the report shall contain a signed statement indicating the site is in compliance with the permit to the best of the signer's knowledge and belief.

4.3 BMP Maintenance

All erosion and sediment control practices and other protective measures identified in the SWMP must be maintained in effective operating condition. Proper selection and installation of BMPs and implementation of comprehensive inspection and maintenance procedures should be adequate to meet this condition. BMPs that are not adequately maintained in accordance with good engineering, hydrologic and pollution control practices, including removal of collected sediment outside the acceptable tolerances of the BMPs are considered to be no longer operating effectively and must be addressed.

Adequate site assessment must be performed as part of the comprehensive inspection and maintenance procedures, to assess the adequacy of BMPs at the site and the necessity of changes to the BMPs to ensure continued effective performance. Where site assessment results in the determination that new or replacement BMPs are necessary, the BMPs must be installed to ensure ongoing implementation.

Please see each BMP description and specification for specific maintenance information.

This plan was prepared in accordance with the Clean Water Act. This document was also prepared in accordance with the Colorado Health and Environmental General guidelines. This plan was prepared in accordance with good engineering, hydrologic and pollution control practices.

Project: Meridian Ranch Subdivision
 Certified SWMP for: ZRH Construction, LLC

This plan was prepared in accordance with applicable stormwater regulations. This document represents a planning tool to assist ZRH Construction, LLC to comply with all applicable stormwater regulations during the construction of the project.

It is ZRH Construction's role responsibility on how to operate the construction site.

Description


A sediment control log is a linear roll made of natural materials such as straw, coconut fiber, or compost. The most common type of sediment control log has straw filling and is often referred to as a "straw wattle." All sediment control logs are used as a sediment barrier to intercept sheet flow runoff from disturbed areas.

Appropriate uses

Sediment control logs can be used in the following applications to trap sediment:

- As perimeter control for stockpiles and the site.
- As part of inlet protection designs.
- As check dams in small drainage ditches. (Sediment control logs are not intended for use in channels with high flow velocities.)
- On disturbed slopes to shorten flow lengths (as an erosion control).
- As part of multi-layered perimeter control along a receiving water such as a stream, pond or wetland.

Sediment control logs work well in combination with other layers of erosion and sediment controls.

 Sediment control logs installed as perimeter control around a soil stockpile on a construction site.

 Sediment control log installed in a J-hook configuration along the edge of pavement at the corner of a construction site.

Photographs SCL-1 and SCL-2. Sediment control logs used as 1) a perimeter control around a soil stockpile; and, 2) as a "J-hook" perimeter control at the corner of a construction site.

Design and installation

Sediment control logs should be installed along the contour to avoid concentrating flows. The maximum allowable tributary drainage area per 100 lineal feet of sediment control log, installed along the contour, is approximately 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. Longer and steeper slopes require additional measures. This recommendation only applies to sediment control logs installed along the contour. When installed for other uses, such as perimeter control, it should be installed in a way that will not produce concentrated flows. For example, a "J-hook" installation may be appropriate to force runoff to pond and evaporate or infiltrate in multiple areas rather than concentrate and cause erosive conditions parallel to the BMP.

Sediment control log	Functions
Erosion control	Moderate
Sediment control	Yes
Site/Material management	No

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SC-2 Sediment control log (SCL)

Although sediment control logs initially allow runoff to flow through the BMP, they can quickly become a barrier and should be installed as if they are impermeable.

Design details and notes for sediment control logs are provided in the following details. Sediment logs must be properly installed per the detail to prevent undercutting, bypassing and displacement. When installed on slopes, sediment control logs should be installed along the contours (i.e., perpendicular to flow).

Improper installation can lead to poor performance. Be sure that sediment control logs are properly trenched (if lighter than 8 lb/foot), anchored and tightly jointed.

Maintenance and removal

Be aware that sediment control logs will eventually degrade. Remove accumulated sediment before the depth is one-half the height of the sediment log and repair damage to the sediment log, typically by replacing the damaged section.

Once the upstream area is stabilized, remove and properly dispose of the logs. Areas disturbed beneath the logs may need to be seeded and mulched. Sediment control logs that are biodegradable may occasionally be left in place (e.g., when logs are used in conjunction with erosion control blankets as permanent slope breaks). However, removal of sediment control logs after final stabilization is typically appropriate when used in perimeter control, inlet protection and check dam applications. Compost from compost sediment control logs may be spread over the area and seeded as long as this does not cover newly established vegetation.

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Schematic label: SCL — SCL — SCL

Plan view drawing of a trenched sediment control log installed along a slope. The log is shown as a long cylinder placed in a shallow trench with flow approaching from upslope. Wooden stakes are driven through the log into the ground at regular intervals. Dimensions and labels include: 1 1/2 inch by 1 1/2 inch by 18 inch minimum wooden stakes, 9 inch minimum diameter sediment control log, stakes spaced at a maximum of 4 feet on center, and the log embedded approximately one third of its diameter below the ground surface. An arrow labeled 'FLOW' points downslope along the log. A note bubble references section A at one stake location. A circular symbol with the letters 'SCL' identifies the log type.

- 1 1/2" x 1 1/2" x 18" (min) wooden stake
- 9" diameter (min) sediment control log
- 4' max. on center (typ.) stake spacing
- Flow direction arrow labeled: **Flow**
- Embedded depth: 1/3 diam. of SCL (typ.)
- Label at end of log: **Diam. SCL**
- Circular symbol labeled: **SCL**

Notes:

1. Larger diameter sediment control logs may need to be embedded deeper.
2. Place log against sidewalk or back of curb when adjacent to these features.

Trenched sediment control log

Cross section A of a trenched sediment control log. The log is a 9 inch minimum diameter cylinder set in a shallow trench, with approximately one third of its diameter below existing grade. The excavated trench soil is compacted on the downstream side of the log. Flow approaches from the upslope side. A wooden stake is driven through the center of the log, extending about 3 inches above the top of the log. The bottom of the log is approximately 6 inches below the original ground surface. Labels identify: 'Compacted excavated trench soil', 'Flow' with arrow, '3

- Compacted excavated trench soil
- Flow direction arrow labeled: **Flow**
- 3" dimension from ground surface to top of stake (approximate)
- 6" depth from ground surface to bottom of log
- Center stake in control log
- 9" diameter (min) sediment control log
- 1/3 diam. SCL (typ.)

Section trenched sediment control log A

Plan view detail of log joints for trenched sediment control logs. Two cylindrical logs are shown end to end with a minimum 12 inch overlap along the flow path. At the overlap and at the free ends, 1 1/2 inch by 1 1/2 inch by 18 inch minimum wooden stakes are driven through the logs. Each log has a minimum 9 inch diameter. Arrows indicate the overlapping region and stake placement.

- 12" overlap (min.) between adjacent sediment control logs
- 1 1/2" x 1 1/2" x 18" (min) wooden stake at joints and ends
- 9" diameter (min) sediment control log

Log joints

SCL-1. Trenched sediment control log

Engineering detail sheet showing plan and section views of compost sediment control logs, including stakes, dimensions, flow direction, and notes for installation.

Plan view: compost sediment control log

- Text near circular end of log: SCL
- Dimension callout: 1 1/2" x 1 1/2" x 18" (min) wooden stake
- Dimension callout along length of log: 3" 10' max. on center (typ.)
- Dimension callout at end of log: 6" diam. SCL
- Arrow showing water movement: Flow

Notes:

1. This detail is for use with sediment control logs that are a minimum of 8 lb/ft.
2. Place log against sidewalk or back of curb when adjacent to these features.

Title between details: Compost sediment control log (weighted)

Section view: compost sediment control log (weighted)

- Callout above top of log at stake: Center stake in control log
- Dimension from ground surface to top of log: 3"
- Callout to circular log: 9" diameter (min) compost sediment control log
- Arrow showing water movement at ground surface: Flow
- Callout on upslope side: Blown/placed filter media or soil
- Dimension from ground surface down to stake tip: 6"

Section — compost sediment control log A

Log joints plan view

- Dimension where two logs overlap: 12" overlap (min.)
- Callout at stake: 1 1/2" x 1 1/2" x 18" (min) wooden stake
- Callout to logs: 9" diameter (min) sediment control log

Log joints

SCL-2. Compost sediment control log (weighted)

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Sediment control log (SCL)

Oblique illustration of multiple cylindrical sediment control logs placed across a descending slope. Each log is anchored to the ground with vertical stakes. The logs are spaced down the slope so that runoff is intercepted repeatedly. A note at the uppermost log reads '4' max for trenched SCLs 10' max for compost SCLs'. A vertical dimension arrow alongside the series of logs is labeled 'Vertical spacing varies depending on slope'. At the right-hand edge of the lowest log a note reads 'Continuous SCL at perimeter of construction site'. Beneath the illustration is the label 'SCL-3. Sediment control logs to control slope length'.

SCL-3. Sediment control logs to control slope length

- 4' max for trenched SCLs
- 10' max for compost SCLs
- Vertical spacing varies depending on slope
- Continuous SCL at perimeter of construction site

Sediment control log (SCL)**Sediment control log installation notes**

1. See plan view for location and length of sediment control logs.
2. Sediment control logs that act as a perimeter control shall be installed prior to any upgradient land-disturbing activities.
3. Sediment control logs shall consist of straw, compost, excelsior or coconut fiber, and shall be free of any noxious weed seeds or defects including rips, holes and obvious wear.
4. Sediment control logs may be used as small check dams in ditches and swales. However, they should not be used in perennial streams.
5. It is recommended that sediment control logs be trenched into the ground to a depth of approximately 1/4 of the diameter of the log. If trenching to this depth is not feasible and/or desirable (short term installation with desire not to damage landscape) a lesser trenching depth may be acceptable with more robust staking. Compost logs that are 8 lb/ft do not need to be trenched.
6. The uphill side of the sediment control log shall be backfilled with soil or filter material that is free of rocks and debris. The soil shall be tightly compacted into the shape of a right triangle using a shovel or weighted lawn roller or blown in place.
7. Follow manufacturers' guidance for staking. If manufacturers' instructions do not specify spacing, stakes shall be placed on 4' centers and embedded a minimum of 6" into the ground. 3" of the stake shall protrude from the top of the log. Stakes that are broken prior to installation shall be replaced. Compost logs should be staked 10" on center.

Sediment control log 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. Sediment accumulated upstream of sediment control log shall be removed as needed to maintain functionality of the BMP, typically when depth of accumulated sediments is approximately 1/2 of the height of the sediment control log.
5. Sediment control log shall be removed at the end of construction. Compost from compost logs may be left in place as long as bags are removed and the area seeded. If disturbed areas exist after removal, they shall be covered with top soil, seeded and mulched or otherwise stabilized in a manner approved by the local jurisdiction.

(Details adapted from Town of Parker, Colorado, Jefferson County, Colorado, Douglas County, 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 differences are noted.

Description

A silt fence is a woven geotextile fabric attached to wooden posts and trenched into the ground. It is designed as a sediment barrier to intercept sheet flow runoff from disturbed areas.

Appropriate uses

A silt fence can be used where runoff is conveyed from a disturbed area as sheet flow. Silt fence is not designed to receive concentrated flow or to be used as a filter fabric. Typical uses include:

- Down slope of a disturbed area to accept sheet flow.
- Along the perimeter of a receiving water such as a stream, pond or wetland.
- At the perimeter of a construction site.

Silt fence installed along the edge of a disturbed, bare soil area with trees and development in the background, creating a continuous black barrier across the slope.

Photograph SF-1. Silt fence creates a sediment barrier, forcing sheet flow runoff to evaporate or infiltrate.

Design and installation

Silt fence should be installed along the contour of slopes so that it intercepts sheet flow. The maximum recommended tributary drainage area per 100 lineal feet of silt fence, installed along the contour, is approximately 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. Longer and steeper slopes require additional measures. This recommendation only applies to silt fence installed along the contour. Silt fence installed for other uses, such as perimeter control, should be installed in a way that will not produce concentrated flows. For example, a "J-hook" installation may be appropriate to force runoff to pond and evaporate or infiltrate in multiple areas rather than concentrate and cause erosive conditions parallel to the silt fence.

See Detail SF-1 for proper silt fence installation, which involves proper trenching, staking, securing the fabric to the stakes, and backfilling the silt fence. Properly installed silt fence should not be easily pulled out by hand and there should be no gaps between the ground and the fabric.

Silt fence must meet the minimum allowable strength requirements, depth of installation requirement, and other specifications in the design details. Improper installation of silt fence is a common reason for silt fence failure; however, when properly installed and used for the appropriate purposes, it can be highly effective.

Silt fence

Functions	
Erosion control	No
Sediment control	Yes
Site/material management	No

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SC-1

Silt fence (SF)

Maintenance and removal

Inspection of silt fence includes observing the material for tears or holes and checking for slumping fence and undercut areas bypassing flows. Repair of silt fence typically involves replacing the damaged section with a new section. Sediment accumulated behind silt fence should be removed, as needed to maintain BMP effectiveness, typically before it reaches a depth of 6 inches.

Silt fence may be removed when the upstream area has reached final stabilization.

A line of black silt fence installed along the edge of a paved roadway, separating the pavement from a sloped, partly vegetated soil area.

Photograph SF-2. When silt fence is not installed along the contour, a "J-hook" installation may be appropriate to ensure that the BMP does not create concentrated flow parallel to the silt fence. Photo courtesy of Tom Gore.

SF-2 Urban Drainage and Flood Control District November 2010
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Construction detail drawing of a silt fence showing a vertical wooden post with attached geotextile fabric, dimensions for height above ground and depth of burial, compacted backfill, flow direction over existing ground, and notes about post spacing, overlap, and how to join posts at corners.

SF-1. Silt fence construction details.

Line symbol: SF SF SF SF

Materials and spacing

- 1 1/2 in x 1 1/2 in (recommended) wooden fence post with 10 ft maximum spacing.
- Silt fence geotextile.

Ground and backfill conditions

- Compacted backfill.
- Flow (arrow shown along the slope of existing ground).
- Existing ground.

Dimensions

- 36 in to 48 in typical height of silt fence above ground.
- 18 in minimum depth of post embedment below ground.
- 6 in minimum depth from existing ground surface to the bottom of the trench cut for the buried tail of the geotextile.
- 4 in minimum horizontal length of the buried tail of the silt fence geotextile.
- At least 10 in of silt fence "tail" shall be buried.

Section A — silt fence

Post joining detail

- Join first.
- Rotate second.
- Posts shall be joined as shown, then rotated 180 degrees in direction shown and driven into the ground.

Geotextile and post overlap detail

- Posts shall overlap at joints so that no gaps exist in silt fence.
- Thickness of geotextile has been exaggerated, typ.

Section A

SF-1. Silt fence

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Silt fence installation notes

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 ponding and deposition.
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 be used.
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 trench by hand.
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" down the fabric along 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 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. 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".
5. Repair or replace silt fence when there are signs of wear, such as sagging, 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 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.

(Detail adapted from Town of Parker, Colorado and City of Aurora, 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.

Description

Stockpile management includes measures to minimize erosion and sediment transport from soil stockpiles.

Appropriate uses

Stockpile management should be used when soils or other erodible materials are stored at the construction site. Special attention should be given to stockpiles in close proximity to natural or manmade storm systems.

A construction site with a large bare soil stockpile in the foreground, a silt fence installed around the toe of the slope, and vegetated areas and development in the background.

Photograph SP-1. A topsoil stockpile that has been partially revegetated and is protected by silt fence perimeter control.

Design and installation

Locate stockpiles away from all drainage system components including storm sewer inlets. Where practical, choose stockpile locations that that will remain undisturbed for the longest period of time as the phases of construction progress. Place sediment control BMPs around the perimeter of the stockpile, such as sediment control logs, rock socks, silt fence, straw bales and sand bags. See Detail SP-1 for guidance on proper establishment of perimeter controls around a stockpile. For stockpiles in active use, provide a stabilized designated access point on the upgradient side of the stockpile.

Stabilize the stockpile surface with surface roughening, temporary seeding and mulching, erosion control blankets, or soil binders. Soils stockpiled for an extended period (typically for more than 60 days) should be seeded and mulched with a temporary grass cover once the stockpile is placed (typically within 14 days). Use of mulch only or a soil binder is acceptable if the stockpile will be in place for a more limited time period (typically 30-60 days). Timeframes for stabilization of stockpiles noted in this fact sheet are "typical" guidelines. Check permit requirements for specific federal, state, and/or local requirements that may be more prescriptive.

Stockpiles should not be placed in streets or paved areas unless no other practical alternative exists. See the Stabilized Staging Area Fact Sheet for guidance when staging in roadways is unavoidable due to space or right-of-way constraints. For paved areas, rock socks must be used for perimeter control and all inlets with the potential to receive sediment from the stockpile (even from vehicle tracking) must be protected.

Maintenance and removal

Inspect perimeter controls and inlet protection in accordance with their respective BMP Fact Sheets. Where seeding, mulch and/or soil binders are used, reseeding or reapplication of soil binder may be necessary.

When temporary removal of a perimeter BMP is necessary to access a stockpile, ensure BMPs are reinstalled in accordance with their respective design detail section.

Stockpile management	
Functions	
Erosion control	Yes
Sediment control	Yes
Site/Material management	Yes

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MM-2 Stockpile management (SM)

When the stockpile is no longer needed, properly dispose of excess materials and revegetate or otherwise stabilize the ground surface where the stockpile was located.

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Plan view of an irregularly shaped stockpile surrounded on all sides by a perimeter sediment control, typically silt fence. The stockpile is labeled 'STOCKPILE'. The perimeter control fully encircles the stockpile with a minimum offset distance of 3.0 feet between the toe of the stockpile and the silt fence. A triangle symbol labeled 'A' marks the location of section A. An inset detail shows a smaller plan view of the same arrangement with a hatched pattern on the stockpile.

Stockpile protection plan - plan view with perimeter silt fence.

Silt fence (see SF detail for installation requirements)

3.0' min

Cross-section labeled 'STOCKPILE PROTECTION PLAN, SECTION A'. A soil stockpile with a rounded top is shown behind a line of vertical posts and fabric representing a silt fence located downslope of the stockpile. A note indicates the maximum stockpile side slope is approximately 2 horizontal to 1 vertical. Arrows point to the silt fence with the note 'SILT FENCE (SEE SF DETAIL FOR INSTALLATION REQUIREMENTS)'.

Stockpile protection plan - section A with maximum side slope and silt fence.

Stockpile protection plan

Maximum 2H:1V (maximum side slope of the stockpile)

Silt fence (see SF detail for installation requirements)

Section A

SP-1. Stockpile protection

Stockpile protection installation notes

- See plan view for:
 - Location of stockpiles.
 - Type of stockpile protection.
- Install perimeter controls in accordance with their respective design details. Silt fence is shown in the stockpile protection details; however, other types of perimeter controls including sediment control logs or rock socks may be suitable in some circumstances. Considerations for determining the appropriate type of perimeter control for a stockpile include whether the stockpile is located on a pervious or impervious surface, the relative heights of the perimeter control and stockpile, the ability of the perimeter control to contain the stockpile without failing in the event that material from the stockpile shifts or slumps against the perimeter, and other factors.
- Stabilize the stockpile surface with surface roughening, temporary seeding and mulching, erosion control blankets, or soil binders. Soils stockpiled for an extended period (typically for more than 60 days) should be seeded and mulched with a temporary grass cover once the stockpile is placed (typically within 14 days). Use of mulch only or a soil binder is acceptable if the stockpile will be in place for a more limited time period (typically 30-60 days).
- For temporary stockpiles on the interior portion of a construction site, where other downgradient controls, including perimeter control, are in place, stockpile perimeter controls may not be required.

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MM-2 Stockpile management (SM)

Stockpile protection maintenance notes

- 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.
- Frequent observations and maintenance are necessary to maintain BMPs in effective operating condition. Inspections and corrective measures should be documented thoroughly.
- Where BMPs have failed, repair or replacement should be initiated upon discovery of the failure.

Stockpile protection maintenance notes

- If perimeter protection must be moved to access soil stockpile, replace perimeter controls by the end of the workday.
- Stockpile perimeter controls can be removed once all the material from the stockpile has been used.

(Details adapted from 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 differences are noted.

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Plan and section views of a materials staging stockpile in a roadway, showing a rectangular poly liner with surrounding berms, a covered poly tarp stockpile, tarp anchors, a curb line with a 6-inch PVC drain pipe in the flowline, and labels for soil or landscape material and traffic control devices.

Figure: Materials staging in roadway detail.

- Orange safety cone
- Poly liner
- Berm
- SSA-R
- Soil/landscape material
- Poly tarp
- Tarp anchor
- 6" PVC pipe for drainage in flowline
- Curb line
- Road CL
- Roadway
- Berm material (triangular silt dike, sediment control log, rock sock, or other wrapped material)
- Poly tarp
- 6" max.
- 6" min.
- 6" max., must not be located within a drive lane
- 6" PVC pipe
- Tarp anchor (cinder block, or 5 gallon bucket of water)
- Poly liner

SP-2. Materials staging in roadway

Materials staging in roadways installation notes

1. See plan view for:
 - Location of material staging area(s).
 - Contractor may adjust location and size of staging area with approval from the local jurisdiction.
2. Feature must be installed prior to excavation, earthwork or delivery of materials.
3. Materials must be stationed on the poly liner. Any incidental materials deposited on paved section or along curb line must be cleaned up promptly.
4. Poly liner and tarp cover should be of significant thickness to prevent damage or loss of integrity.
5. Sand bags may be substituted to anchor the cover tarp or provide berming under the base liner.
6. Feature is not intended for use with wet material that will be draining and/or spreading out on the poly liner or for demolition materials.
7. This feature can be used for:
 - Utility repairs.
 - When other staging locations and options are limited.
 - Other limited application and short duration staging.

Materials staging in roadway 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. Inspect PVC pipe along curb line for clogging and debris. Remove obstructions promptly.
5. Clean material from paved surfaces by sweeping or vacuuming.

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 Aurora, Colorado)

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Description

Concrete waste management involves designating and properly managing a specific area of the construction site as a concrete washout area. A concrete washout area can be created using one of several approaches designed to receive wash water from washing of tools and concrete mixer chutes, liquid concrete waste from dump trucks, mobile batch mixers, or pump trucks. Three basic approaches are available: excavation of a pit in the ground, use of an above ground storage area, or use of prefabricated haul-away concrete washout containers. Surface discharges of concrete washout water from construction sites are prohibited.

Example of a concrete washout area at a construction site with a gravel tracking pad, surrounding fencing, and a sign marking the concrete clean out area.

Photograph CWA-1. Example of concrete washout area. Note gravel tracking pad for access and sign.

Appropriate uses

Concrete washout areas must be designated on all sites that will generate concrete wash water or liquid concrete waste from onsite concrete mixing or concrete delivery.

Because pH is a pollutant of concern for washout activities, when unlined pits are used for concrete washout, the soil must have adequate buffering capacity to result in protection of state groundwater standards; otherwise, a liner/containment must be used. The following management practices are recommended to prevent an impact from unlined pits to groundwater:

- The use of the washout site should be temporary (less than 1 year), and
- The washout site should be not be located in an area where shallow groundwater may be present, such as near natural drainages, springs, or wetlands.

Design and installation

Concrete washout activities must be conducted in a manner that does not contribute pollutants to surface waters or stormwater runoff. Concrete washout areas may be lined or unlined excavated pits in the ground, commercially manufactured prefabricated washout containers, or aboveground holding areas constructed of berms, sandbags or straw bales with a plastic liner.

Although unlined washout areas may be used, lined pits may be required to protect groundwater under certain conditions.

Do not locate an unlined washout area within 400 feet of any natural drainage pathway or waterbody or within 1,000 feet of any wells or drinking water sources. Even for lined concrete washouts, it is advisable to locate the facility away from waterbodies and drainage paths. If site constraints make these

Concrete washout area	
Functions	Provided
Erosion control	No
Sediment control	No
Site/material management	Yes

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Setbacks infeasible or if highly permeable soils exist in the area, then the pit must be installed with an impermeable liner (16 mil minimum thickness) or surface storage alternatives using prefabricated concrete washout devices or a lined aboveground storage area should be used.

Design details with notes are provided in Detail CWA-1 for pits and CWA-2 for aboveground storage areas. Pre-fabricated concrete washout container information can be obtained from vendors.

Maintenance and removal

A key consideration for concrete washout areas is to ensure that adequate signage is in place identifying the location of the washout area. Part of inspecting and maintaining washout areas is ensuring that adequate signage is provided and in good repair and that the washout area is being used, as opposed to washout in non-designated areas of the site.

Remove concrete waste in the washout area, as needed to maintain BMP function (typically when filled to about two-thirds of its capacity). Collect concrete waste and deliver offsite to a designated disposal location.

Upon termination of use of the washout site, accumulated solid waste, including concrete waste and any contaminated soils, must be removed from the site to prevent on-site disposal of solid waste. If the wash water is allowed to evaporate and the concrete hardens, it may be recycled.

Construction site with a prefabricated concrete washout container next to a concrete mixer truck, surrounded by soil and temporary construction fencing.

Photograph CWA-2. Prefabricated concrete washout. Photo courtesy of CDOT.

Excavated earthen pit designated as a concrete washout area, surrounded by orange safety fence and construction signage in a developed roadside area.

Photograph CWA-3. Earthen concrete washout. Photo courtesy of CDOT.

Plan view detail for a concrete washout area (CWA). A square earthen berm surrounds a central 8 foot by 8 foot minimum flat-bottomed washout pit. The berm is labeled on each side with side slopes of 3 horizontal to 1 vertical. To the right of the bermed pit is a rectangular vehicle tracking control pad or other stable surface, at least 4 feet away from the pit edge. The combined width from the left edge of the berm to the right edge of the vehicle tracking pad is labeled 25 feet minimum. A triangular flag labeled 'A' identifies the location of Section A. A note points to the right-hand pad and states 'Vehicle tracking control (see VTC detail) or other stable surface.' Another leader points to a sign at the perimeter labeled 'Concrete washout sign.' A circular symbol labeled 'CWA' and a small square symbol are shown as plan symbols for the concrete washout area.

Concrete washout area plan and symbols.

Concrete washout area plan

Section A detail through a concrete washout area. A compacted berm around the perimeter rises approximately 12 inches above surrounding grade, with gentle side slopes shown numerically as at least 4 horizontal to 1 vertical and 3 horizontal to 1 vertical. The subsurface pit is centered between berms and is labeled 8 feet by 8 feet minimum, with the pit bottom at least 3 feet below the surrounding undisturbed or compacted soil surface. To the right, a vehicle tracking pad is shown on undisturbed or compacted soil with a 2 percent slope toward the CWA. The berm is labeled 'Compacted berm around the perimeter.' Dimensions and slope callouts indicate minimum 3-foot depth of the pit and typical berm geometry.

Section A – concrete washout area.

Section A

CWA-1. Concrete washout area

CWA installation notes

- See plan view for:
 - CWA installation location.
- Do not locate an unlined CWA within 400 feet of any natural drainage pathway or waterbody. Do not locate within 1,000 feet of any wells or drinking water sources. If site constraints make this infeasible, or if highly permeable soils exist on site, the CWA must be installed with an impermeable liner (16 mil minimum thickness) or surface storage alternatives using prefabricated concrete washout devices or a lined above ground storage area should be used.
- The CWA shall be installed prior to concrete placement on site.
- CWA shall include a flat subsurface pit that is at least 8 feet by 8 feet. Slopes leading out of the subsurface pit shall be 3 horizontal to 1 vertical or flatter. The pit shall be at least 3 feet deep.
- Berm surrounding sides and back of the CWA shall have minimum height of 1 foot.
- Vehicle tracking pad shall be sloped 2 percent towards the CWA.
- Signs shall be placed at the construction entrance, at the CWA, and elsewhere as necessary to clearly indicate the location of the CWA to operators of concrete trucks and pump rigs.
- Use excavated material for perimeter berm construction.

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MM-1 Concrete washout area (CWA)

CWA maintenance notes

- 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.
- Frequent observations and maintenance are necessary to maintain BMPs in effective operating condition. Inspections and corrective measures should be documented thoroughly.
- Where BMPs have failed, repair or replacement should be initiated upon discovery of the failure.
- The CWA shall be repaired, cleaned, or enlarged as necessary to maintain capacity for concrete waste. Concrete materials, accumulated in pit, shall be removed once the materials have reached a depth of 2'.
- Concrete washout water, wasted pieces of concrete and all other debris in the subsurface pit shall be transported from the job site in a water-tight container and disposed of properly.
- The CWA shall remain in place until all concrete for the project is placed.
- When the CWA is removed, cover the disturbed area with top soil, seed and mulch or otherwise stabilized in a manner approved by the local jurisdiction.

(Detail adapted from Douglas County, Colorado and the City 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 differences are noted.

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Description

Street sweeping and vacuuming remove sediment that has been tracked onto roadways to reduce sediment transport into storm drain systems or a surface waterway.

Appropriate uses

Use this practice at construction sites where vehicles may track sediment offsite onto paved roadways.

Design and installation

Street sweeping or vacuuming should be conducted when there is noticeable sediment accumulation on roadways adjacent to the construction site. Typically, this will be concentrated at the entrance/exit to the construction site. Well-maintained stabilized construction entrances, vehicle tracking controls and tire wash facilities can help reduce the necessary frequency of street sweeping and vacuuming.

On smaller construction sites, street sweeping can be conducted manually using a shovel and broom. Never wash accumulated sediment on roadways into storm drains.

A street sweeper truck and pickup truck operating on a paved roadway in a residential construction area, cleaning sediment along the curb.

Photograph SS-1. A street sweeper removes sediment and potential pollutants along the curb line at a construction site. Photo courtesy of Tom Gore.

Maintenance and removal

- Inspect paved roads around the perimeter of the construction site on a daily basis and more frequently, as needed. Remove accumulated sediment, as needed.
- Following street sweeping, check inlet protection that may have been displaced during street sweeping.
- Inspect area to be swept for materials that may be hazardous prior to beginning sweeping operations.

Street sweeping/ vacuuming	
Functions	
Erosion control	No
Sediment control	Yes
Site/material management	Yes

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This page has no content.

Description

Wind erosion and dust control BMPs help to keep soil particles from entering the air as a result of land disturbing construction activities. These BMPs include a variety of practices generally focused on either graded disturbed areas or construction roadways. For graded areas, practices such as seeding and mulching, use of soil binders, site watering, or other practices that provide prompt surface cover should be used. For construction roadways, road watering and stabilized surfaces should be considered.

Water truck driving on a gravel construction access road, used to spray water for dust suppression near a residential area.

Photograph DC-1. Water truck used for dust suppression. Photo courtesy of Douglas County.

Appropriate uses

Dust control measures should be used on any site where dust poses a problem to air quality. Dust control is important to control for the health of construction workers and surrounding waterbodies.

Design and installation

The following construction BMPs can be used for dust control:

- An irrigation/sprinkler system can be used to wet the top layer of disturbed soil to help keep dry soil particles from becoming airborne.
- Seeding and mulching can be used to stabilize disturbed surfaces and reduce dust emissions.
- Protecting existing vegetation can help to slow wind velocities across the ground surface, thereby limiting the likelihood of soil particles to become airborne.
- Spray-on soil binders form a bond between soil particles keeping them grounded. Chemical treatments may require additional permitting requirements. Potential impacts to surrounding waterways and habitat must be considered prior to use.
- Placing rock on construction roadways and entrances will help keep dust to a minimum across the construction site.
- Wind fences can be installed on site to reduce wind speeds. Install fences perpendicular to the prevailing wind direction for maximum effectiveness.

Wind erosion control/ dust control	
Functions	
Erosion control	Yes
Sediment control	No
Site/material management	Moderate

Maintenance and removal

When using an irrigation/sprinkler control system to aid in dust control, be careful not to overwater. Overwatering will cause construction vehicles to track mud off-site.

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Description

Outlet protection helps to reduce erosion immediately downstream of a pipe, culvert, slope drain, rundown or other conveyance with concentrated, high-velocity flows. Typical outlet protection consists of riprap or rock aprons at the conveyance outlet.

Riprap rock apron installed at a culvert outlet to provide temporary outlet protection.

Photograph TOP-1. Riprap outlet protection.

Appropriate uses

Outlet protection should be used when a conveyance discharges onto a disturbed area where there is potential for accelerated erosion due to concentrated flow. Outlet protection should be provided where the velocity at the culvert outlet exceeds the maximum permissible velocity of the material in the receiving channel.

Note: This fact sheet and detail are for temporary outlet protection, outlets that are intended to be used for less than 2 years. For permanent, long-term outlet protection, see the *Major Drainage* chapter of Volume 1.

Design and installation

Design outlet protection to handle runoff from the largest drainage area that may be contributing runoff during construction (the drainage area may change as a result of grading). Key in rock, around the entire perimeter of the apron, to a minimum depth of 6 inches for stability. Extend riprap to the height of the culvert or the normal flow depth of the downstream channel, whichever is less. Additional erosion control measures such as vegetative lining, turf reinforcement mat and/or other channel lining methods may be required downstream of the outlet protection if the channel is susceptible to erosion. See Design Detail OP-1 for additional information.

Maintenance and removal

Inspect apron for damage and displaced rocks. If rocks are missing or significantly displaced, repair or replace as necessary. If rocks are continuously missing or displaced, consider increasing the size of the riprap or deeper keying of the perimeter.

Remove sediment accumulated at the outlet before the outlet protection becomes buried and ineffective. When sediment accumulation is noted, check that upgradient BMPs, including inlet protection, are in effective operating condition.

Outlet protection may be removed once the pipe is no longer draining an upstream area, or once the downstream area has been sufficiently stabilized. If the drainage pipe is permanent, outlet protection can be left in place; however, permanent outlet protection should be designed and constructed in accordance with the requirements of the *Major Drainage* chapter of Volume 2.

Outlet protection	
Functions	Rating
Erosion control	Yes
Sediment control	Moderate
Site/material management	No

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EC-8 Temporary outlet protection (TOP)

Plan sheet showing a pipe outlet with a riprap apron extending downstream, including top view labeled 'Temporary outlet protection plan' and profile view labeled 'Section A', with dimensions based on pipe diameter Do and notes about riprap thickness and geotextile underlayment. A circular construction BMP symbol labeled 'OP' is shown to the right.

Extend riprap to height of culvert or normal channel depth, whichever is less.

Key dimensions shown include 3(Do) upstream, 4(Do) downstream, and pipe diameter Do.

Temporary outlet protection plan

Additional notes associated with the plan and section views:

- Outlet apron longitudinal slope: 0%.
- Non-woven geotextile under the riprap apron.
- Riprap thickness: $D = 2 \times D_{50}$
- Key in to $2 \times D_{50}$ around perimeter.

Section A

Table OP-1. Temporary outlet protection sizing table

Pipe diameter, Do (inches)	Discharge, Q (cfs)	Apron length, La (ft)	Riprap D50 diameter min (inches)
8	2.5	5	4
	5	10	6
12	5	10	4
	10	13	6
18	10	10	6
	20	16	9
	30	23	12
	40	26	16
24	30	16	9
	40	26	9
	50	26	12
	60	30	16

OP-1. Temporary outlet protection

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Temporary outlet protection installation notes

1. See plan view for:
 - Location of outlet protection.
 - Dimensions of outlet protection.
2. Detail is intended for pipes with slope $\leq 10\%$. Additional evaluation of riprap sizing and outlet protection dimensions is required for steeper slopes.
3. Temporary outlet protection information is for outlets intended to be utilized less than 2 years.

Temporary outlet protection inspection and 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.

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 Aurora, Colorado and previous version of Volume 3, not available in AutoCAD.)

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Rolled Erosion Control Products (RECP)

EC-6

Description

Rolled erosion control products (RECPs) include a variety of temporary or permanently installed manufactured products designed to control erosion and enhance vegetation establishment and survivability, particularly on slopes and in channels. For applications where natural vegetation alone will provide sufficient permanent erosion protection, temporary products such as netting, open weave textiles and a variety of erosion control blankets (ECBs) made of biodegradable natural materials (e.g., straw, coconut fiber) can be used. For applications where natural vegetation alone will not be sustainable under expected flow conditions, permanent rolled erosion control products such as turf reinforcement mats (TRMs) can be used. In particular, turf reinforcement mats are designed for discharges that exert velocities and shear stresses that exceed the typical limits of mature natural vegetation.

Erosion control blanket covering a constructed slope beside maintenance vehicles, protecting the slope surface and supporting revegetation.

Photograph RECP-1. Erosion control blanket protecting the slope from erosion and providing favorable conditions for revegetation.

Appropriate uses

RECPs can be used to control erosion in conjunction with revegetation efforts, providing seedbed protection from wind and water erosion. These products are often used on disturbed areas on steep slopes, in areas with highly erosive soils, or as part of drainageway stabilization. In order to select the appropriate RECP for site conditions, it is important to have a general understanding of the general types of these products, their expected longevity, and general characteristics.

The Erosion Control Technology Council (ECTC 2005) characterizes rolled erosion control products according to these categories:

- **Mulch control netting:** A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion control product to anchor loose fiber mulches.
- **Open weave textile:** A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.
- **Erosion control blanket (ECB):** A temporary degradable rolled erosion control product composed of processed natural or polymer fibers which are mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment. ECBs can be further differentiated into rapidly degrading single-net and double-net types or slowly degrading types.

Rolled erosion control products	
Functions	
Erosion control	Yes
Sediment control	No
Site/Material management	No

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EC-6 Rolled erosion control products (RECP)

- **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, three-dimensional 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.

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Table RECP-1. ECTC standard specification for temporary rolled erosion control products (Adapted from Erosion Control Technology Council 2005).

Product description	Slope applications*		Channel applications*	Minimum tensile strength ¹	Expected longevity
	Maximum gradient	C factor ^{2,5}	Max. shear stress ^{3,4,6}		
Mulch control nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft ² (12 Pa)	5 lbs/ft (0.073 kN/m)	Up to 12 months
Netless rolled erosion control blankets	4:1 (H:V)	≤0.10 @ 4:1	0.5 lbs/ft ² (24 Pa)	5 lbs/ft (0.073 kN/m)	
Single-net erosion control blankets & open weave textiles	3:1 (H:V)	≤0.15 @ 3:1	1.5 lbs/ft ² (72 Pa)	50 lbs/ft (0.73 kN/m)	
Double-net erosion control blankets	2:1 (H:V)	≤0.20 @ 2:1	1.75 lbs/ft ² (84 Pa)	75 lbs/ft (1.09 kN/m)	
Mulch control nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft ² (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 ² (96 Pa)	100 lbs/ft (1.45 kN/m)	
Erosion control blankets & open weave textiles	1:1 (H:V)	≤0.25 @ 1:1	2.25 lbs/ft ² (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.)

1 Minimum average roll values, machine direction using ECTC Mod. [ASTM D 5035](#).

2 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.

3 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.

4 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.

5 Acceptable large-scale test methods may include [ASTM D 6459](#), or other independent testing deemed acceptable by the engineer.

6 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.

Table RECP-2. ECTC standard specification for permanent¹ rolled erosion control products

(Adapted from: Erosion Control Technology Council 2005)

Product type	Slope applications	Channel applications	Minimum tensile strength ^{2,3}
	Maximum gradient	Maximum shear stress ^{4,5}	
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/ft ² (288 Pa)	125 lbs/ft (1.82 kN/m)
	0.5:1 (H:V)	8.0 lbs/ft ² (384 Pa)	150 lbs/ft (2.19 kN/m)
	0.5:1 (H:V)	10.0 lbs/ft ² (480 Pa)	175 lbs/ft (2.55 kN/m)

¹ For TRMs containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

² Minimum average roll values, machine direction only for tensile strength determination using [ASTM D 6818](#) (supersedes Mod. [ASTM D 5035](#) for RECPs).

³ 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.

⁴ 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.

⁵ Acceptable large-scale testing protocols may include [ASTM D 6460](#), 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

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Rolled erosion control products (RECP)

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

- ECB type
- Slope or channel type

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 recommendations.

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 pattern.
- 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.

EC-6 Rolled erosion control products (RECP)

Plan and section details for rolled erosion control products (erosion control blanket, or ECB) at a pipe outlet and small ditch or drainageway, showing anchor trenches, staking, and overlapping joints.

Legend and general notes

- Undisturbed soil
- Perimeter anchor trench, typ.
- Joint anchor trench, typ.
- Top of channel bank
- Circle label: ECB

Type of ECB as indicated in plan view. Install in all disturbed areas of streams and drainage channels to depth D above channel invert. ECB shall generally be oriented parallel to flow direction (i.e. long dimensions of blanket parallel to flowlines). Staking pattern shall match ECB and/or channel type.

ECB-1. Pipe outlet to drainageway

Callouts on perspective view of channel with ECB:

- Joint anchor trench, typ.
- Type of ECB, indicated in plan view
- ECB shall extend to the top of the channel
- 6" topsoil
- Dimensions: L, M, D
- Perimeter anchor trench, typ.
- Compacted subgrade
- Staking pattern per manufacturer spec. or pattern based on ECB and/or channel type (see staking pattern detail)

Anchor details

Perimeter anchor trench

- Geotextile fabric or mat, typ.
- 3" min, typ.
- 6" min, typ.
- Single edge stake, typ.
- Compacted backfill, typ.
- Label: Perimeter anchor trench

Joint anchor trench

- Joint anchor trench
- Two edges of two adjacent rolls

Intermediate anchor trench

- Intermediate anchor trench
- Loop from middle of roll

Overlapping joint

- Flow direction indicated with arrow
- 6" distance between stakes (each side of overlap)
- Label: Overlapping joint

Wood stake detail

- 12" min.
- 3" min.
- Label: Wood stake detail

ECB-2. Small ditch or drainageway

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Plan view of erosion control blanket (ECB) installed on a slope. A diversion ditch is located typically at the top of slope. ECB rolls overlap downslope with stagger overlaps and an overlapping joint between adjacent rolls. The blanket is anchored around the perimeter in a perimeter anchor trench. A note reads: 'Staking pattern per manufacturer spec. or pattern based on ECB and/or slope type (see staking pattern detail).'

ECB-3, Outside of drainageway

Staking patterns for ECB-3 outside of drainageway (by blanket material type):

Straw

- Perimeter anchor trench or joint, typ.
- Roll width W, typ.
- Vertical stake spacing along edges: 6'.
- Horizontal spacing between rows of stakes: 3'.

Straw-coconut

- Vertical stake spacing along edges: 6'.
- Horizontal spacing between rows of stakes: 3'.
- Horizontal spacing between stake lines across the roll: 1/2 W.

Coconut or excelsior

- Vertical stake spacing along edges: 4'.
- Horizontal spacing between rows of stakes: 2'.
- Horizontal spacing between stake lines across the roll: 1/2 W.

Staking patterns by ECB type

4:1 - 3:1 slopes

- Vertical stake spacing along edges: 6'.
- Horizontal spacing between rows of stakes: 3'.
- Horizontal spacing between stake lines across the roll: 1/2 W.

3:1 - 2:1 slopes

- Vertical stake spacing along edges: 6'.
- Horizontal spacing between rows of stakes: 3'.
- Horizontal spacing between interior stake lines: 1/2 W.
- Horizontal spacing between outer stake line and roll edge: 1/4 W.

2:1 and steeper slopes

- Vertical stake spacing along edges: 4'.
- Horizontal spacing between rows of stakes: 2'.
- Horizontal spacing between stake lines across the roll: 1/4 W and 1/2 W (closer spacing near the center and edges).

Low flow channel

- Total blanket width in cross-section: 4'.
- Vertical distance from channel top to first interior row of stakes: 2'.
- Vertical distance from channel invert to next row of stakes: 20".
- Horizontal spacing between rows of stakes near the invert: 1'.
- Horizontal spacing between stake lines across the roll: 1/2 W.

High flow channel

- Total blanket width in cross-section: 4'.
- Vertical distance from channel top to first interior row of stakes: 2'.
- Vertical distance from channel invert to next row of stakes: 20".
- Horizontal spacing between rows of stakes near the invert: 1'.
- Horizontal spacing through the center of the channel: 10'.
- Horizontal spacing between stake lines across the roll: 2' and 1/2 W (tighter spacing near edges).

Staking patterns by slope or channel type

Erosion control blanket installation notes

1. See plan view for:
 - o Location of ECB.
 - o Type of ECB (straw, straw-coconut, coconut, or excelsior).
 - o 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 blanket.
4. Perimeter anchor trench shall be used along the outside perimeter of all blanket areas.
5. Joint anchor trench shall be used to join rolls of ECBs together (longitudinally and transversely) for all ECBs except straw which may use an overlapping joint.
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 on slopes.
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 shall be reseeded and mulched.
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

*Straw ECBs may only be used outside of streams and drainage channel.

**Alternate netting may be acceptable in some jurisdictions.

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Rolled erosion control products (RECP)

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 differences are noted.

(Details adapted from Douglas County, Colorado and Town of Parker Colorado, not available in AutoCAD)

Description

Vehicle tracking controls provide stabilized construction site access where vehicles exit the site onto paved public roads. An effective vehicle tracking control helps remove sediment (mud or dirt) from vehicles, reducing tracking onto the paved surface.

Appropriate uses

Implement a stabilized construction entrance or vehicle tracking control where frequent heavy vehicle traffic exits the construction site onto a paved roadway. An effective vehicle tracking control is particularly important during the following conditions:

- Wet weather periods when mud is easily tracked off site.
- During dry weather periods where dust is a concern.
- When poorly drained, clayey soils are present on site.

Although wheel washes are not required in designs of vehicle tracking controls, they may be needed at particularly muddy sites.

Truck driving over a rock-covered vehicle tracking control pad at a construction site.

Photograph VTC-1. A vehicle tracking control pad constructed with properly sized rock reduces off-site sediment tracking.

Design and installation

Construct the vehicle tracking control on a level surface. Where feasible, grade the tracking control towards the construction site to reduce off-site runoff. Place signage, as needed, to direct construction vehicles to the designated exit through the vehicle tracking control. There are several different types of stabilized construction entrances including:

VTC-1. Aggregate vehicle tracking control. This is a coarse-aggregate surfaced pad underlain by a geotextile. This is the most common vehicle tracking control, and when properly maintained can be effective at removing sediment from vehicle tires.

VTC-2. Vehicle tracking control with construction mat or turf reinforcement mat. This type of control may be appropriate for site access at very small construction sites with low traffic volume over vegetated areas. Although this application does not typically remove sediment from vehicles, it helps protect existing vegetation and provides a stabilized entrance.

Vehicle tracking control	
Functions	Effectiveness
Erosion control	Moderate
Sediment control	Yes
Site/Material management	Yes

VTC-3. Stabilized construction entrance/exit with wheel wash. This is an aggregate pad, similar to VTC-1, but includes equipment for tire washing. The wheel wash equipment may be as simple as hand-held power washing equipment to more advance proprietary systems. When a wheel wash is provided, it is important to direct wash water to a sediment trap prior to discharge from the site.

Vehicle tracking controls are sometimes installed in combination with a sediment trap to treat runoff.

Maintenance and removal

Inspect the area for degradation and replace aggregate or material used for a stabilized entrance/exit as needed. If the area becomes clogged and ponds water, remove and dispose of excess sediment or replace material with a fresh layer of aggregate as necessary.

With aggregate vehicle tracking controls, ensure rock and debris from this area do not enter the public right-of-way.

Remove sediment that is tracked onto the public right of way daily or more frequently as needed. Excess sediment in the roadway indicates that the stabilized construction entrance needs maintenance.

Ensure that drainage ditches at the entrance/exit area remain clear.

A stabilized entrance should be removed only when there is no longer the potential for vehicle tracking to occur. This is typically after the site has been stabilized.

When wheel wash equipment is used, be sure that the wash water is discharged to a sediment trap prior to discharge. Also inspect channels conveying the water from the wash area to the sediment trap and stabilize areas that may be eroding.

When a construction entrance/exit is removed, excess sediment from the aggregate should be removed and disposed of appropriately. The entrance should be promptly stabilized with a permanent surface following removal, typically by paving.

Construction site with a large aggregate vehicle tracking control pad and a small trailer-mounted tank and pump used for wheel washing at the site entrance.

Photograph VTC-2. A vehicle tracking control pad with wheel wash facility. Photo courtesy of Tom Gore.

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VTC-1. Aggregate Vehicle Tracking Control Detail

Vehicle tracking control (VTC) — SM-4

Plan and section drawings of an aggregate vehicle tracking control entrance, showing a rock pad over non-woven geotextile fabric on compacted subgrade, dimensions for length, width, and thickness, and notes on aggregate type and placement.

Aggregate vehicle tracking control entrance detail.

Plan view labels and notes:

- VTC (circular label identifying the vehicle tracking control area).
- 20 foot (width can be less if construction vehicles are physically confined on both sides).
- 50 foot (min.).
- Sidewalk or other paved surface.
- Public roadway.
- Unless otherwise specified by local jurisdiction, use CDOT sect. #703, AASHTO #3 coarse aggregate or 6 inch minus rock.
- Non-woven geotextile fabric between soil and rock.

Section A labels and notes:

- Install rock flush with or below top of pavement.
- Unless otherwise specified by local jurisdiction, use CDOT sect. #703, AASHTO #3 coarse aggregate or 6 inch minus rock.
- 9 inch (min.).
- Non-woven geotextile fabric.
- Compacted subgrade.

Section A

VTC-1. Aggregate vehicle tracking control

SM-4 Vehicle tracking control (VTC)

Plan view drawing of an aggregate vehicle tracking pad across a construction entrance intersecting a public roadway. A rectangular area of coarse aggregate is shown across the entrance, with a narrower transverse rectangular wash rack area in the middle consisting of slotted grating. An inset at the upper left shows a close-up cross-section of the aggregate pad and wash rack at the roadway edge. A circular symbol at the right contains the letters VTC over WW.

Labels shown on the plan view:

- "Public roadway" (text along the road at the edge of the aggregate pad).
- "Ditch to carry wash water to sediment trap or basin" (arrow from the end of the wash rack toward a drainage ditch).
- "Wash rack" (label pointing to the transverse slotted rack area within the aggregate pad).
- "Note: Wash water may not contain chemicals or soaps without obtaining a separate permit." (general note adjacent to the wash rack.)
- Circle symbol with text: "VTC" over "WW".

Cross-section named Section A showing a reinforced concrete rack spanning a drain space within the aggregate vehicle tracking pad. The pad consists of coarse aggregate over subgrade. The reinforced concrete rack or optional steel cattle guard bridges the drain space so vehicle tires cross over the wash rack while water drains below.

Labels and dimensions shown on Section A:

- "6'7" min." (minimum width dimension of the wash rack opening).
- "Reinforced concrete rack (may substitute steel cattle guard for concrete rack)" (label pointing to the rack element supporting vehicle loads).
- "Drain space" (label pointing to the open space beneath the rack where wash water drains).
- "Section A" (title for the cross-section view).

VTC-2. Aggregate vehicle tracking control with wash rack detail

VTC-4

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Vehicle tracking control (VTC)

Symbols: VTC/CM, VTC/TRM.

Plan and profile detail for vehicle tracking control using construction mats or turf reinforcement mats. The plan views show a flared entrance from an existing paved roadway onto a rectangular mat area, and another version with a crosshatched mat surface. The profile view shows a truck traveling from an existing paved roadway onto a mat surface extending at least 50 feet into a disturbed construction or staging area, with the mat surface no steeper than a 10 percent grade. Dimensions and notes are provided and are transcribed in the surrounding text.

Profile view notes:

- 10% max.
- Existing paved roadway.
- 12' min.
- Construction mats, woven or TRM.
- 50' min.
- Disturbed area, construction site, stabilized storage area or staging area.

Plan view of construction mat or turf reinforcement mat vehicle tracking control extending from an existing paved roadway into a disturbed area. The mat is flared at the connection to the roadway, with a 20 foot radius or construction fence to confine vehicles onto the mat, and text indicating mat width, length, and restrictions on vehicle access to the sides. Additional side details show overlap of mat ends secured with spikes, stakes, and strap connectors.

Plan and connection details:

- Existing paved roadway.
- Provide 20' radius or construction fence to restrict vehicle movement to the mat.
- Construction mats, woven or turf reinforcement mat (TRM).
- Restrict const. vehicle access to sides of mat.
- 20' or as required to accommodate anticipated traffic (width can be less if const. vehicles are physically confined on both sides).
- Spikes or stakes.
- 18" min.
- TRM end overlap with spikes or stakes.
- Strap connectors.
- Construction mat end overlap interlock with strap connectors.

VTC-3. Vehicle tracking control w/ construction mat or turf reinforcement mat (TRM)

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SM-4 — Vehicle tracking control (VTC)

Stabilized construction entrance/exit installation notes

1. See plan view for
 - o Location of construction entrance(s)/exit(s).
 - o Type of construction entrance(s)/exit(s) (with/without wheel wash, construction mat or TRM).
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 disturbing activities.
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 in. (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 down storm sewer drains.

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)

VTC-6

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Description

Inlet protection consists of permeable barriers installed around an inlet to filter runoff and remove sediment prior to entering a storm drain inlet. Inlet protection can be constructed from rock socks, sediment control logs, silt fence, block and rock socks, or other materials approved by the local jurisdiction. Area inlets can also be protected by over-excavating around the inlet to form a sediment trap.

Construction site with black silt fence and rock socks installed along a curb and gutter to protect multiple curb opening inlets.

Photograph IP-1. Inlet protection for a curb opening inlet.

Appropriate uses

Install protection at storm sewer inlets that are operable during construction. Consider the potential for tracked-out sediment or temporary stockpile areas to contribute sediment to inlets when determining which inlets must be protected. This may include inlets in the general proximity of the construction area, not limited to downgradient inlets. Inlet protection is not a stand-alone BMP and should be used in conjunction with other upgradient BMPs.

Design and installation

To function effectively, inlet protection measures must be installed to ensure that flows do not bypass the inlet protection and enter the storm drain without treatment. However, designs must also enable the inlet to function without completely blocking flows into the inlet in a manner that causes localized flooding. When selecting the type of inlet protection, consider factors such as type of inlet (e.g., curb or area, sump or on-grade conditions), traffic, anticipated flows, ability to secure the BMP properly, safety and other site-specific conditions. For example, block and rock socks will be better suited to a curb and gutter along a roadway, as opposed to silt fence or sediment control logs, which cannot be properly secured in a curb and gutter setting, but are effective area inlet protection measures.

Several inlet protection designs are provided in the Design Details. Additionally, a variety of proprietary products are available for inlet protection that may be approved for use by local governments. If proprietary products are used, design details and installation procedures from the manufacturer must be followed. Regardless of the type of inlet protection selected, inlet protection is most effective when combined with other BMPs such as curb socks and check dams. Inlet protection is often the last barrier before runoff enters the storm sewer or receiving water.

Design details with notes are provided for these forms of inlet protection:

- IP-1. Block and Rock Sock Inlet Protection for Sump or On-grade Inlets
- IP-2. Curb (Rock) Socks Upstream of Inlet Protection, On-grade Inlets

Inlet protection (various forms)	
Functions	
Erosion control	No
Sediment control	Yes
Site/Material management	No

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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

Proprietary 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.

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Inlet protection (IP)

SC-6

- 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. Remove sediment accumulation from the area upstream of the inlet protection as needed to maintain the functionality of the BMP.
- Proprietary 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.

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

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Detail drawings labeled IP-1 and IP-2 showing block and rock sock inlet protection around a curb inlet and curb rock socks placed upstream of the inlet. The drawings include plan and section views with rock socks surrounding concrete cinder blocks over a curb inlet, and separate curb socks placed at an angle to approaching flow upstream from the inlet.

IP-1. Block and rock sock sump or on grade inlet protection

Text labels within the IP-1 detail drawings:

- IP
- Rock socks
- See rock sock design detail for jointing
- 16" cinder blocks
- Flow
- 2" x 4" wood stud
- Curb inlet
- Section A
- 1' min.
- 2" x 4" wood stud

IP-2. Curb rock socks upstream of inlet protection

Text labels within the IP-2 detail drawings:

- Minimum of two curb socks
- Approx 30 deg.
- Curb sock
- Flow
- 5' min
- 3'-5' typ.
- Block and rock sock inlet protection (see detail IP-1)

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.

IP-2. Curb rock socks upstream of inlet protection

Curb rock sock inlet protection installation notes

1. 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

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Plan and section views showing a square rock sock filled with stone surrounding a grated inlet. Labels indicate the rock sock encircling the inlet grate and a callout to see the rock sock detail for jointing.

Labels in figure: inlet grate; rock sock; see rock sock detail for jointing; IP (symbol).

IP-3. Rock sock sump/area inlet protection

Rock sock sump/area inlet protection installation notes

1. See rock sock design detail for installation requirements.
2. Straw wattles/sediment control logs may be used in place of rock socks for inlets in pervious areas. Install per sediment control log detail.

Two views of silt fence used around a grated inlet: a plan view showing a square silt fence enclosure around the inlet and an elevation showing silt fence posts and fabric surrounding the inlet grate.

Labels in figure: SF at each side of the plan view enclosure; inlet grate; silt fence (see silt fence design detail).

IP-4. Silt fence for sump inlet protection

Silt fence inlet protection installation notes

1. See silt fence design detail for installation requirements.
2. Posts shall be placed at each corner of the inlet and around the edges at a maximum spacing of 3 feet.
3. Straw wattles/sediment control logs may be used in place of silt fence for inlets in pervious areas. Install per sediment control log detail.

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SC-6 Inlet protection (IP)

Plan and profile views of overexcavation inlet protection showing silt fence and erosion control blanket (ECB) around an area inlet. Sheet flow and concentrated flow are directed into a shallow excavated basin with optional rock filter or rock sock where flow is concentrated. Dimensions show a side slope no steeper than 2 horizontal to 1 vertical, minimum 1 foot and maximum 2 feet depth, and a minimum 3-foot distance from inlet to silt fence.

Diagram of overexcavation inlet protection for sheet flow and concentrated flow. Labels in diagram: sheet flow; silt fence; area inlet; ECB; rock filter or rock sock (use if flow is concentrated); concentrated flow; 2:1 max; area inlet; ECB; silt fence; 3' min; 4'; 1' min; 2' max.

IP-5. Overexcavation inlet protection

Overexcavation inlet protection installation notes

1. 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 small contributing drainage area.
2. When using for concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.
3. Sediment must be periodically removed from the overexcavated area.

Plan view of straw bales arranged in a single rectangular row closely surrounding an inlet grate for sump inlet protection.

Diagram of straw bale for sump inlet protection. Labels in diagram: straw bale (see straw bale design detail); inlet grate.

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.

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Culvert inlet protection detail CIP-1 showing a rock sock barrier around a culvert end section. Plan view indicates flow toward the culvert with rock sock curved around the culvert end and labeled section cut locations A and B. Section A shows a cross-section through the rock sock and wattle placed across the flow with a rock-filled sock keyed into the ground, minimum diameter D of 12 inches, length L along the flow, and backfill upstream of the wattle. Section B shows the rock sock crossing the flow path and keyed into surrounding surfaces, with a note to key rock sock 0 inches into bedrock, pavement, or riprap and 2 inches into earth.

Culvert inlet protection

Plan

Section A

Section B

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 detail.

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 documented thoroughly.
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.

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General inlet protection installation notes

1. See plan view for:
 - Location of inlet protection.
 - 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 discovery of the failure.
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 inches when silt fence is used, or one-quarter of the height for straw bales.
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 differences are noted.

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 protection is acceptable.