MASTER STORMWATER MANAGEMENT PLAN

FIELD-WIDE FOR CONSTRUCTION ACTIVITIES

UPLAND EXPLORATION, LLC

Denver-Julesburg Basin
Weld County, Colorado

July 2021

Prepared By:

Aquionix
EHS Services

5545 W. 56th Avenue, Suite E
Arvada, CO 80002
(303) 289-7520
www.aquionix.com

Table of Contents

List of Appendices

INTRODUCTION

This Master Stormwater Management Plan (SWMP) for Field-Wide Construction Activities has been prepared to comply with the Colorado Department of Public Health and Environment's (CDPHE) General Permit (COR400000) for *Stormwater Discharges Associated with Construction Activities.* This SWMP addresses construction activities associated with Upland Exploration, LLC (Upland) petroleum exploration and production activities in the Denver-Julesburg Basin, in Weld County, Colorado. A copy of the Certification to Discharge and the General Permit can be found in Appendix A.

This SWMP is intended to be revised as necessary to address planned developments, new disturbances, and other changes required to manage stormwater and protect surface water quality. Significant changes to the SWMP will be documented in the Revision History table in this Plan.

In addition to adherence to the requirements in General Permit COR400000, the oil and gas facilities covered by this SWMP are subject to local (county) requirements from Weld County. County-specific requirements are on a site-by-site basis; therefore, any county-specific information can be found in Appendix D of this SWMP.

Oil and gas activities in Colorado are subject to the Colorado Oil and Gas Conservation Commission (COGCC) rules and regulations. The 1000 series Reclamation Regulations require that operators implement Stormwater Management under Rule 1002.f. This rule requires operators to implement and maintain control measures at oil and gas locations to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation. This requirement is in effect for the life of the facility (construction to abandonment).

While facilities maintain coverage under the CDPHE General Permit and this SWMP, the requirements of COGCC Rule 1002.f. are satisfied. Once a location achieves final stabilization and is removed from permit coverage under the CDPHE General Permit, the COGCC rules require that a Post-Construction Stormwater Program be implemented.

CERTIFICATION

"I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature: _____

Name: Larry Jenkins

Title: Vice President of Land

Date: _____

SWMP MANAGERS

SWMP MANAGER TABLE			
Name	**Title**	**Phone**	**Email**
Larry Jenkins	VP of Land	580-716-0535	larry@uplandexploration.com
James Jackson	Field Supervisor	405-627-7073	jjackson@crescentconsulting.net
Tom Taylor	Geoscientist	303-717-0191	tom@uplandexploration.com
Terry Chapman	Field Supervisor	970-673-2411 970-302-0529	terrychapman2014@gmail.com

The SWMP Manager(s) is responsible to making sure the SWMP is implemented in its entirety and must be knowledgeable in the principals and practices of erosion and sediment control and pollution prevention, and with the skills to asses conditions at construction sites that could impact stormwater quality and to assess the effectiveness of stormwater controls implemented to meet permit requirements.

Additionally, the SWMP Manager(s) may delegate responsibility for the coordination of the following to specific personnel:

- Implementation of upset condition/clean-up procedures;
- Notification to regulatory agencies, local authorities and local residents in the event of a significant release of stormwater and/or sediment from a construction area;
- Coordination/implementation of control measures;
- Conducting inspections (as long as the person conducting inspections is also a qualified SWMP Manager);
- Maintenance of stormwater-related records; and
- Coordination of a preventative maintenance program and housekeeping measures.

REVISION HISTORY

When this SWMP is amended or updated, the following table should be updated with date of revision, author(s), a description of the revision(s) and an approval signature. A copy of the current SWMP shall be maintained at the construction site and be made available to the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE), EPA, or another Federal, State or local agency having stormwater program authority upon request.

REVISION HISTORY TABLE		
Revision Date	**Revised By**	**Description of Revisions** (Include control measure information (control measure(s) removed, modified; the location of these control measures; and any changes to the control measure(s))
06/2019	Aquionix/Upland	Initial release.
02/2021	Aquionix	Updated Plan throughout to reflect newly modified General Permit COR400000; Updated Site-Specific information in Appendix D to reflect newly modified General Permit COR400000.
07/2021	Aquionix	Updated facility site specifics.

1.0 CONSTRUCTION SITE DESCRIPTION

Upland owns and/or leases oil and natural gas mineral rights in the DJ Basin of Colorado and is in the process of developing those resources. The project area is located in Northern Weld County in Township 11 North and Range 64 West as depicted on the Stormwater Construction Permit Area Map in Appendix B. The entire project site includes well pads and associated flow lines, access roads, and natural gas compression within approximately 36 square miles. The majority of the project is within Individual pad sites ranging from approximately 5 acres to 15 acres. The town of Grover, Colorado is the nearest population center to the majority of Upland's development activities.

Current drilling and development construction activities include pad construction, access road improvement and construction, well drilling, well testing, well completion, installation of associated facilities, and flow line construction.

1.1 Nature of Construction Activity

Construction of Upland facilities within the DJ Basin will be performed using conventional cut and fill earthmoving techniques and trenching. The total estimated final disturbance for all planned pads, flow lines, and access roads is approximately 50 acres. On average, pads are approximately 10 acres during active construction and they are reclaimed down to approximately 5 acres or less after the completion of construction. See Appendix D for a complete list of disturbance areas and associated acreages.

In areas that are disturbed by construction, topsoil will be stripped and stockpiled near the site. All brush, limbs, and other woody material will be stockpiled separately from the topsoil. Soil materials will be managed so that erosion and sediment transport are minimized. Nearby drainages will be protected by appropriate measures.

If a well is not productive, it will be plugged and abandoned in accordance with Colorado Oil and Gas Conservation Commission (COGCC) rules and the pad area will be reclaimed to approximate pre-construction contours and seeded.

1.1.1 Sequence of Construction Activities

The development of an oil well is generally accomplished in six work phases. They include:

- Access Road and Pad Construction
- Well Drilling
- Well Completion
- Production Equipment Installation
- Interim Reclamation
- Final Reclamation

Each work phase is briefly discussed below and the control measures are discussed in Section 3.0 as well as in Appendix C.

1.1.2 Access Road and Pad Construction

Pad and access road construction will be performed using conventional cut and fill construction. Size and maintenance requirements for each access road are based on road location and traffic level. The dimensions and configuration for each access road and/or facility will be defined on an individual basis. Regardless of the dimension or configuration, the construction process will generally adhere to a similar sequence and generally the construction of the facility will occur simultaneously with the construction of the access road.

Basic construction activities conducted during this phase include clearing and grubbing, grading and excavation, compaction, final grading and contouring, and installation of surfacing materials such as gravel or road base. To the extent possible, permanent control measures that will be utilized to control stormwater throughout the life of the facility will be constructed during this phase.

Sediment discharge and small amounts of mobile equipment lubricant and fuel are the main potential pollutants of concern during access road and pad construction.

1.1.3 Well Drilling

The Well Drilling phase includes the drilling of one or more wells. Some locations will not undergo well drilling or completion, these sites will be exclusively used as Production Facilities. Activities associated with the drilling phase may include:

- Mobilization of the drilling rig and associated equipment including generators and drilling-mud handling equipment. In some instances, a smaller surface drilling rig may be used to drill the initial stages of each well prior to the larger drilling rig mobilizing to the location
- Installation of temporary storage, office and housing trailers
- Storage of chemicals, fuels and lubricants
- Installation of potable water tanks and sewage-handling equipment (e.g., portable toilets or sewage vaults)
- Well drilling activities including the installation and cementing of well casing
- Demobilization of the drilling rig and all other equipment at the completion of this phase

Sediment discharge, releases of unused and used chemicals, petroleum products, drilling water/mud, and drill cuttings are potential pollutants of concern during this phase of construction. Drilling mud and water will be used to maintain appropriate down-hole pressures and lubrication. Fresh water and drilling mud (including chemical additives) will be stored on the pad, typically in large frac tanks or skid-mounted vertical tanks. Drilling mud and associated materials are captured in tanks for reuse during closed-loop drilling processes. Products used in the drilling process to fuel, lubricate, and/or maintain equipment including: diesel fuel, unleaded gasoline, gear oil, hydraulic oil, brake fluid, antifreeze, and grease. Materials to be used for cementing casing may also be stored and prepared on location or may be transported to the site.

1.1.4 Well Completion

The Well Completion phase, which may last up to 21 days, may include hydraulic fracturing, cementing, and other processes that stimulate the well and prepare it for production. The basic activities that are conducted during this phase include:

- Mobilization of equipment required for well completion activities
- Storage of down hole chemicals, fuels and lubricants
- Installation of potable water tanks and sewage-handling equipment (e.g., portable toilets or sewage vaults) or continued maintenance of such equipment installed during the drilling phase
- Hydraulic fracturing and other well-stimulation processes
- Drill out of any plugs placed during well completion with a work-over rig
- Flowback of the well to remove frac water, sand and other impurities
- Demobilization of equipment when this phase has been completed

Several temporary facilities/structures will be placed on site during this phase. These will include: frac trucks, storage and office trailers, generators, and frac tanks. During completions, certain chemicals may be used to stimulate the formation for the extraction of oil. Water and chemicals will be stored on the pad. Water recovered during flowback operations will be stored, recycled, used in other operations, or disposed of off-site at permitted disposal facilities.

Sediment discharge releases unused and used chemicals, and flowback water are potential pollutants of concern during this phase of construction. As equipment is demobilized at the completion of this phase, the well pad and surrounding areas will be inspected to identify any spills or leaks that may have occurred that may impact surface water so that those areas can be remediated.

1.1.5 Pipeline

Generally, the installation of sales pipelines will occur simultaneously with the completions phase; however, the actual timing may vary depending on the type of well drilled (i.e., Wildcat) proximity of the well to a third-party sales line and the schedule of the third-party provider. Typically, the pipeline will be laid alongside the access road. Roughening will be used as the primary erosion control measure while the pipeline is being laid. Construction equipment will utilize the graveled access road to minimize additional ground disturbance.

1.1.6 Production Equipment Installation

The Production Equipment Installation phase includes the construction of long-term facilities such as permanent well heads, storage tanks, oil and natural gas processing equipment, flow measurement equipment, and any associated flow lines needed to produce oil and gas from the formation. This phase frequently takes place concurrently with the Drilling and Completions phases. Flow line installation or any required maintenance work is generally accomplished by trenching. The area of disturbance for

each flow line project is determined by location, flow line size, and the scope of the work being done and would be included within the overall disturbance area for the well pad site. Where applicable, flow lines will be tied into existing pipelines maintained by a third party. In some cases, this tie-in takes place on the pad, in other cases the flow lines must be extended beyond the pad to reach the tie-in point.

Sediment discharge, releases of produced fluids, and small amounts of equipment lubricant or fuel, corrosion inhibitors or other chemicals are potential pollutants of concern during this phase.

1.1.7 Disturbance Reduction and Final Stabilization

Following the drilling and completion activities, the well pad may be reduced, thus minimizing the area of disturbance for the production life of the well. Enough working area will remain to allow a safe working environment for pumpers, haulers and/or periodic workover operations, and vehicle traffic is expected to be minimal. The pad may be recontoured, topsoil reapplied, and the reduced area stabilized with seed, hydro-seed, bonded fiber matrix, mulch, etc. as deemed appropriate for the site. Sites located in cultivated fields will be returned to agricultural use during the subsequent growing season.

1.1.8 Production

While the lifespan of the wells covered in this SWMP may last up to 50 years, the actual productive life of a given well will be dependent on the producing formation, location in the field, proximity to other wells, etc. The equipment found onsite during this phase may include, but is not limited to, wellhead(s), separation units, aboveground storage tanks, sales meters, flare, combustor, vapor recovery unit and temporary generator(s). Final stabilization is generally achieved during this phase.

1.1.9 Abandonment

A test well will generally continue to operate for the length of time determined to deem the location drillable, and a well for as long as it is economical. Once either scenario is deemed ready to abandon, the location will be recontoured and reclaimed to pre-disturbance conditions and/or in accordance with the surface owner's wishes.

When a well is plugged and abandoned, the wellhead assembly will be removed and the well permanently plugged down hole. The equipment associated with the well will be removed from the location unless being used by other wells on the location or in the vicinity, and the flow lines may be re-routed or abandoned as required.

Following the removal of all equipment for a well pad, the location and access roads will be recontoured and reclaimed to pre-disturbance conditions and/or in accordance with the surface owner's wishes. Once it is recontoured, topsoil will be reapplied across the location in preparation for seeding and an appropriate seed mixture will be applied.

1.2 Estimate of Total Area of Site and Disturbed Area

The total project site is 36 square miles. The total disturbance area within the project site is approximately 50 acres in size. As new sites are added to or removed from the project Appendix D of this SWMP will be updated to reflect the new disturbances.

1.3 Soil Data and Erosion Potential

Erosion potential is based primarily on-site topography, soil type, and vegetative cover. The major soil types in the project area are: Ascalon fine sandy loam, 0 to 6 percent slopes; Paoli fine sandy loam, 0 to 6 percent slopes; and Vona sandy loam, 3 to 9 percent slopes. The major soil types in the project site are well drained soils with a moderate to high (~7.0 inches to ~9.0 inches) water holding capacity.

The soils typically are situated on nearly level to gently sloping (<9 percent) land. Topsoil is typically shallow, and because if its coarse, sandy nature, the potential for erosion is high to very high, particularly on slopes greater than 3 to 5 percent. The average annual precipitation for the DJ Basin is approximately 14 inches (Western Regional Climate Center).

1.4 Vegetation Description and Estimate

The majority of the project area is located in short grass prairie, agricultural fields, or range land. Existing vegetation may include planted crops, range-type grasses, sage brush, forbs, pinyon, juniper trees, willows, and cottonwoods. Pre-disturbance ground cover varies from approximately 0 to 80 percent.

1.5 Potential Pollution Sources and Locations

The potential pollutant sources for each phase of construction are briefly discussed in Section 2.1, Nature of Construction Activity and are discussed in more detail below. The location of potential pollution sources for each site are shown on the site-specific maps in Appendix D.

1.5.1 Erosion of Disturbed and Stockpiled Soils

The construction activities will involve soil disturbances and stockpiling. Clearing, grading, and otherwise altering previously undisturbed land can greatly increase the rate of soil erosion over pre-disturbance rates. The resulting sediment can impact the water quality of receiving streams.

The site-specific maps in Appendix D show the areas of disturbance including cut and fill and stock piles, along with the control measures implemented to manage stormwater.

1.5.2 Drill Cuttings

During the drilling process cuttings from downhole will be separated from the drilling mud and will be contained and managed on site. After drilling has been completed cuttings will either be hauled offsite to a disposal facility or utilized for beneficial reuse on or off location. In either case, it is anticipated that small quantities of drill cuttings will remain on location

and be incorporated into permanent berms or fill during interim reclaim activities.

1.5.3 Vehicle Tracking of Sediment

Vehicles will be accessing the sites throughout the construction phases. However, the sandy non-cohesive nature of the soils in the project area generally minimize the potential for vehicle tracking making tracking controls unnecessary. The need for tracking control is made on a case by case basis.

1.5.4 Management of Contaminated Soils

In the event of contaminated soils being found during construction, the site-specific information in Appendix D and the control measure information in Appendix C shall be updated, as applicable. Additional control measures will be installed onsite to manage the potential new source of pollution found.

1.5.5 Loading and Unloading Operations

The sites may have tanks for the storage of fuels or other materials used in drilling and completion activities such as drilling mud. The presence of such tanks would require loading and unloading of the tanks and releases of materials during these activities could potentially impact stormwater.

1.5.6 Outdoor Storage and Material Handling Activities

During the drilling and completion phases of the project, quantities of well construction and completion materials such as cement, drilling mud, sawdust, sand, and other materials will be staged on location and moved around the location as wells are drilled and completed. Releases of these materials from storage areas or during material handling activities could potentially impact stormwater.

1.5.7 Vehicle and Equipment Maintenance and Fueling

It is possible that equipment will be maintained or fueled on site. On-site maintenance and fueling could potentially result in leaks or spills of fuel, gear oil, hydraulic oil, brake fluid, antifreeze or grease which could potentially impact stormwater.

1.5.8 Significant Dust or Particulate Generating Processes

Construction activities and vehicle traffic to and from the sites could potentially generate dust. Strong winds, frequently encountered in the project area, have the potential to discharge windblown sediment from disturbed areas.

1.5.9 Routine Maintenance Activities

The use of fertilizers or weed killers is possible at the sites in order to achieve successful revegetation of disturbed areas. See also “vehicle and equipment maintenance and fueling” above.

1.5.10 On-site Waste Management Practices

Trash receptacles will be located on site to contain construction-related or other trash or debris. Used drilling mud and water will be captured in tanks during closed-loop drilling processes. Portable toilets may be utilized on site.

1.5.11 Concrete Truck/Equipment Washing

Concrete truck or equipment washing is not expected. Highly specialized concrete trucks will be on site during well casing operations. The concrete could be prepared onsite and any truck cleaning will also be done offsite by third party contractors.

1.5.12 Dedicated Asphalt and Concrete Batch Plants

Dedicated asphalt and concrete batch plants are not expected.

1.5.13 Non-Industrial Waste Sources

All project phases involve people working on site. This can generate personal and work-related trash and debris and may also necessitate the use of portable toilets. Clearing operations may also generate waste in the form of slash (trees, brush, etc.).

The locations of potential pollutant sources are shown on the site-specific maps in Appendix D.

1.6 Non-Stormwater Discharges

Stormwater discharges from each facility covered by this Plan will consist entirely of runoff from precipitation events and allowable non-stormwater discharges identified below. This condition is verified on a regular basis through site inspections.

Other allowable non-stormwater discharges, provided that appropriate control measures are implemented, may include:

i. Discharges resulting from emergency firefighting activities during the active emergency response;
ii. Discharges from uncontaminated spring water that do not originate from an area of land disturbance;
iii. Discharges of landscape irrigation return flow;
iv. Discharges to the ground of concrete washout water (see below); and
v. Discharges from diversion of state waters within the permitted site.

Concrete washout is not anticipated at Upland construction locations. In the event concrete washout is necessary, concrete washout water from washing tools and concrete mixer chute may be discharged onsite, but only when proper control measures have been installed to protect stormwater and groundwater. If a concrete washout is deemed necessary, the permitted location will be indicated on the site-specific diagram, and signage will be required onsite. Concrete washout water will be discharged into either a lined pit or into an impermeable storage container designed to hold water. Concrete washouts shall be contained onsite and in containers or pits

designed and maintained so that overflows cannot occur due to inadequate sizing, precipitation events, or snowmelt. Concrete washouts will not be located near shallow groundwater, natural drainages, springs, or wetlands. Concrete washout water containments shall be cleaned out (solids and liquids) before 80 percent of storage capacity is attained. Concrete washout waste cannot be disposed of onsite and will be properly disposed of offsite.

COR400000 does not authorize any discharges currently covered by a division Low Risk Discharge Guidance Document, including uncontaminated groundwater discharge to the ground. In the event that uncontaminated groundwater must be discharged to the ground at a construction site, the Division's Low Risk Discharge Guidance shall be followed.

COR400000 also does not authorized discharges associated with construction dewatering, which may include groundwater, surface water, and stormwater that has mixed with groundwater and/or surface water (i.e., commingled stormwater runoff). In the event that discharges associated with dewatering activities are deemed necessary, authorization under the CDPS General Permit, *Construction Dewatering Discharges*. (COG070000) shall be obtained.

1.7 Receiving Waters

The majority of planned disturbances for the DJ Basin lie within the South Platte River watershed. For more detail on receiving waters, see the Stormwater Construction Permit Area Map in Appendix B and site-specific information in Appendix D.

2.0 SITE CONTROL MEASURE MAPS

The control measures used for each location are located on the site-specific maps in Appendix D of this Plan. The maps will be regularly updated to reflect all changes to the sites, and additional maps will be created in response to field activities and construction of new well pads.

2.1 Construction Site Boundaries

For a representation of the construction site boundaries, refer to the site maps. It is expected that the entire area within the construction site boundaries may be disturbed.

2.2 Areas of Ground Disturbance

The areas of ground disturbance are shown on the individual site maps.

2.3 Areas of Cut and Fill

Areas of cut and fill are shown on the individual site control measure maps.

2.4 Storage Areas

Fuel, construction materials, and other chemical storage areas are shown on the individual site maps in Appendix D.

2.5 Location of Asphalt and Concrete Batch Plants

Asphalt or concrete batch plants are not expected within the project site, but, if used, will be included on the individual site maps.

2.6 Locations of Structural Control Measures

The locations of structural control measures are shown on the individual site maps.

2.7 Locations of Non-Structural Control Measures

The locations of non-structural control measures, where applicable, are shown on the individual site maps.

2.8 Locations of Springs, Streams, Wetlands and Other Surface Waters

The locations of springs, streams, wetlands and other surface waters, within the Project Area are shown on the Stormwater Construction Permit Area Map in Appendix B of this SWMP. The direction of and distance to the nearest identified surface water body are shown on the individual site maps in Appendix D.

2.9 Implementation of Control Measures Outside of the Permitted Area

In accordance with the general permit, control measures located outside of the permitted area that are utilized by the construction site for permit compliance but not owned or operated by Upland, must be documented and include a documented use agreement between Upland and

the owner/operator of the control measure(s). Such control measures would be included on individual site maps and associated usage agreement documentation located in Appendix D.

3.0 STORMWATER MANAGEMENT CONTROLS

The following sections present Upland's stormwater management controls to be implemented prior to and during construction activities at construction sites within the D-J Basin. This plan presents the control strategies that are to be followed by Upland personnel and contractors to prevent erosion, control sediment, and prevent impacts to stormwater leaving the site.

3.1 Control Measures for Stormwater Pollution Prevention

This section describes the control measures that will be used in the DJ Basin for stormwater pollution prevention. Appendix C contains the control measure installation and implementation guidance, for control measures that may be implemented at any of the sites. Control measures may be added or removed from Appendix C to accommodate changes in site conditions and activities in the DJ Basin.

3.1.1 Structural Practices for Erosion and Sediment Control

Descriptions, design, installation practices, and maintenance and removal considerations for the structural control measures available for use can be found in Appendix C. The location of structural control measures, if any, can be found on the site-specific maps in Appendix D.

3.1.2 Non-Structural Practices for Erosion and Sediment Control

Descriptions, design, installation practices, and maintenance and removal considerations for the non-structural control measures available for use can be found in Appendix C. The location of all non-structural practices will be found on the site maps.

3.1.3 Phased Control Measure Installation

Control measure implementation will be coordinated with the various stages of construction. Run-on protection and run-off controls will be installed prior to earth disturbing activities where necessary, with consideration given to worker safety, access, and prevailing drainage patterns. As additional areas are disturbed, control measures will be implemented prior to the start of ground disturbing activities where practicable. Additional structural control measures will likely be installed during construction. As portions of the site are completed and previously disturbed areas are stabilized or control measures are no longer needed, the control measures will be removed.

Permanent or temporary stabilization measures for all slopes, channels, ditches, disturbed land areas, and soil stockpiles will be implemented as soon as practicable after final grading or the final ground disturbance has been completed. When it is not possible to permanently stabilize a disturbed area, temporary erosion control measures will be implemented as soon as practicable.

3.1.4 Materials Handling and Spill Prevention

Upland personnel and contractors will handle and store materials in a manner that

prevents stormwater impacts and spills to the extent practicable. Where feasible, significant material storage areas will be kept covered to prevent contact with stormwater.

3.1.5 Stockpile Stabilization

During facility construction topsoil should be piled no higher than 6' high and slopes of the stockpiles should not exceed 2:1 (horizontal:vertical) to minimize erosion potential and facilitate interim stabilization. Whenever possible topsoil should not be stockpiled for longer than six months. Top soil stockpiled for more than six months should be seeded and mulched with a temporary grass cover or should be stabilized using structural and/or non-structural control measures. Spoils piles may be as high as necessary; however, slopes should not exceed 2:1 and adequate room should be provided to allow equipment access for stabilization and maintenance of control measures.

To prevent erosion, stockpiles should be tracked perpendicular to runoff direction, sprayed with mulch or soil binder, or covered with matting. Topsoil stockpiles should be fenced and uniquely identified on facility drawings in accordance with COGCC 1000 series rules. Whenever possible stockpiles should be located away from drainage system components and outfalls, and where practical stockpiles should be placed in areas that will remain undisturbed for the longest period of time as the phases of construction progress. Perimeter control measures such as sediment control logs, rock socks, straw bales, ditch and/or berm with sediment trap(s) or sand bags should be used around the base of unstabilized stockpiles or where there is potential for sediment to come in contact with run off and leave the site.

The following guidelines for storing and managing petroleum products will be implemented:

- All product containers will be clearly labeled
- Drums (if present) will be kept within secondary containment or general site containment (i.e. perimeter berm), and may also need to be kept off the ground. Lids for drummed materials will be securely fastened.
- Fuel tanks will be stored within secondary containment, general site containment, or stored to minimize impacts to stormwater.
- Persons trained in handling spills will be on call at all times; Upland field personnel are trained on spill management procedures annually.
- Spill response equipment and materials (absorbent materials, shovels, etc.) will be easily accessible. Each Upland lease operator in the DJ Basin is equipped with a small spill response kit in their truck.
- Storage areas and containers will be regularly monitored for leaks and repaired or replaced as necessary.

Oily wastes such as used oil filters, empty containers, rags, and sorbent pads and socks containing oils will be placed in proper receptacles and disposed of or recycled. Routine inspections will be conducted to identify leaks from equipment and vehicles and if needed corrective actions will be implemented.

3.1.6 Other Material/Chemical Product Management

Chemicals and other materials such as cement, sand, and sawdust that are utilized during facility construction, drilling, or completions activities will be stored in accordance with manufacturer's recommendations; generally in original packaging and/or otherwise covered to ensure that the raw material does not come into contact with stormwater. Storage or laydown areas employed during construction activities will be regularly inspected for spills, leaks, and the potential of materials commingling with stormwater.

3.1.7 Spill Response

Spills are reported promptly to the SWMP mangers and/or other appropriate Upland contacts. Spills of produced fluids and exploration and production (E&P) waste that are greater than one barrel (42 gallons) outside of secondary containment or greater than 5 barrels that are inside of secondary containment, will be reported to the COGCC by or their designated agent. Spills of refined petroleum products, unused chemicals, and Upland other non-E&P waste will be evaluated on a case-by-case basis and any spills that exceed a reportable quantity will be reported to the appropriate state or federal agency by Upland or their designated agent. As needed, Upland personnel will review Safety Data Sheets (SDS) for information on spills of chemicals or other materials.

Upland will coordinate the appropriate personnel to handle oil spills in accordance with Upland's Emergency Response Plan for the DJ Basin. Spills will be controlled and contained as soon as practicable upon discovery and cleaned up as soon as practicable. Spilled material and/or contaminated soil will be disposed of in accordance with all applicable regulations, generally at a commercial landfill or disposal facility. De minimis spills of inert construction materials such as unused frack sand, bentonite, concrete, and sawdust used in drilling and completion will be cleaned up as soon as practicable after drilling and completion activities are completed.

3.2 Dedicated Asphalt or Concrete Batch Plants

Dedicated asphalt or concrete batch plants are not expected within the project site.

3.3 Vehicle Tracking

In order to limit vehicle tracking of sediment, vehicles will use designated entry points into construction areas. Stabilization methods, such as road base and chemical stabilizers, along with a Tracking Pad (TP) (See TP detail in the Control Measures Manual) will be used where necessary. In general, the use of tracking pads is not anticipated to be necessary in the project area due to the sandy, non-cohesive nature of the soils in the project area. The locations of vehicle tracking control measures will be shown on the site maps. Cattle guards are regularly used in the project area for livestock control and are not considered to be a control measures; site maps will designate when cattle guards are present and are not a control measures.

3.4 Waste Management

3.4.1 Waste Management and Disposal

Exploration and production wastes will be managed in accordance with the COGCC 900 Series rules. Construction-related and other trash will be collected in dumpsters and containers and hauled off-site for disposal in commercial landfills as soon as practicable. Dumpsters will be covered during times when construction activities are not occurring. Upland expects that contractors will pick up loose trash and debris.

Portable toilets may be used to contain sanitary waste, with waste materials regularly pumped and transported off-site for disposal at approved facilities. Portable toilets will be secured when a risk of tippage is present.

Slash from clearing activities will, if possible, be chipped and used on site for mulch, or utilized as a brush barrier at the site perimeter. See Brush Barrier (BB) in the Control Measures Design Manual for control measures descriptions and uses.

3.4.2 Concrete Washout

Concrete washout is not expected within the project site. However, if the need for concrete washout arises, an appropriate containment structure will be utilized. See Section 1.6 above for more information. The locations of any waste containments or concrete washout areas on site will be shown on the site maps.

3.5 Ground Water and Stormwater Dewatering

3.5.1 Groundwater Dewatering

No groundwater dewatering is expected at this time. If groundwater is encountered, refer to Section 1.6 above for information.

3.5.2 Stormwater Dewatering

If the need for stormwater dewatering is encountered, control measures will be utilized to prevent erosion and trap sediment. See Dewatering Operations (DW) in the Control Measures Design Manual for control measures descriptions for dewatering operations. The control measures to be utilized will be shown on the site map. See Section 1.6 above for more information.

3.6 Control Measure Maintenance

Erosion and sediment control measures implemented under this Plan are maintained in effective operational condition, in accordance with the manufacturer’s specifications and good engineering, hydrologic and pollution control practices. Routine inspections include a provision to evaluate the effectiveness of each implemented control measures and identify when maintenance is required.

When control measures maintenance or replacement is required, Upland will correct the issue as soon as possible to minimize the discharge of pollutants. When new control measures are

installed or replaced, this Plan will be updated accordingly.

4.0 FINAL STABILIZATION AND LONG-TERM STORMWATER MANAGEMENT

Final stabilization must be implemented for all construction sites covered under General Permit COR400000. A site is considered to be in final stabilization when (1), (2), and (3) below are complete:

(1) All construction activities are complete;

(2) Permanent stabilization methods are complete. Permanent stabilization methods include, but are not limited to, permanent pavement or concrete, hardscape, xeriscape, stabilized driving surfaces, vegetative cover, or equivalent permanent alternative stabilization methods (alternative methods may be approved by the Division). Vegetative cover must meet the following criteria:

   a. Evenly distributed perennial vegetation; and

   b. Coverage, at a minimum, equal to 70 percent of what would have been provided by native vegetation in a local, undisturbed area or adequate reference site.

(3) The permittee must ensure that all temporary control measures are removed from the construction site once final stabilization is achieved, except when the control measure specifications allow the control measure to be left in place (i.e., biodegradable control measures).

Specific control measures for soil preparation and amendment, soil stabilization, and sediment control during final stabilization will be chosen on a site-by-site basis, based on soil condition and slope. The control measures chosen will be shown on the site maps. The general practices for achieving re-vegetation are described in the seeding detail in Appendix C.

Sites are considered finally stabilized once interim reclamation (in accordance with COGCC Rule 1003) is complete and the above stabilization criteria have been met, even though the site will be disturbed again in the future for final reclamation when the well(s) are plugged and abandoned.

5.0 INSPECTIONS AND MAINTENANCE PROCEDURES

Site inspections will be conducted in accordance with the requirements and minimum schedule outlined in Part I.D.2 of the CDPS General Permit (COR400000). The requirements are as follows:

- The first site inspection must be completed within seven (7) calendar days of the commencement of construction activities.
- Active construction sites will be inspected at one of the two following frequencies:
    - At least one inspection every 7 calendar days;
    - At least one inspection every 14 calendar days, if post-storm event inspections are conducted within 24 hours after the end of any precipitation or snowmelt event that causes surface erosion. Note that post-storm inspections may be used to fulfill the 14-day routine inspection requirement.
- If a site is considered temporarily idle, that is, no construction activities will occur following a storm event, then a post-storm inspection will be conducted prior to re-commencing constructing activities, but no later than 72 hours following the storm event. Routine inspections must still be conducted at least every 14 calendar days.
- For sites or portions of sites in which all construction activities that will result in ground disturbance are completed, all activities for final stabilization, as outlined above in Section 4, with the exception of vegetative coverage are completed, and this SWMP has been amended to locate the areas to be inspected, inspections will be conducted at least once every 30 days, and post-storm inspections are not required.
- Inspections are not required at sites where snow cover exists over the entire site for an extended period of time and construction activities are halted, as long as melting conditions do not exist. The following information must be documented in the inspection record for the use of this exclusion: dates when snow cover occurred, date when construction activities ceased, and date melting conditions began. This only applies when all construction activities cease and typically only at high elevations.
- For sites that discharge to a water body designated as an Outstanding Water by the Water Quality Control Division shall be inspected at least once every 7 calendar days.

A person identified as a SWMP Manager (see beginning of this Plan) will conduct inspections. The scope of the inspection will cover the construction site perimeter, disturbed areas, designated haul routes, material and/or waste storage areas that are exposed to precipitation, discharge locations, and locations where vehicles access the site. These areas will be inspected for evidence of, or the potential for, pollutants leaving the construction site boundaries entering the stormwater drainage system, or discharging to waters of the state. Also, erosion and sediment control practices identified in this SWMP will be evaluated to ensure that they are maintained and operating correctly.

Personnel performing site inspections will record the information as outlined below on the inspection report. This inspection report will identify any incidents of non-compliance with the terms and conditions of the general permit and this SWMP. The inspection report will include:

1. The inspection date;
2. Name(s) and title(s) of personnel making the inspection;
3. Weather conditions at the time of inspection;
4. Phase of construction at the time of inspection;
5. Estimated acreage of disturbance at time of inspection;
6. Location(s) of discharges of sediment or other pollutants from the site;
7. Location(s) of control measures that need to be maintained;
8. Location(s) of control measures that failed to operate as designed or proved inadequate for a particular location;
9. Location(s) where additional control measures are needed that were not in place at the time of inspection;
10. Description of the minimum inspection frequency utilized when conducting inspection;
11. Deviations, and reason for deviation from the minimum inspection schedule as outlined above;
12. Description of corrective action for items 3, 4, 5, and 6, above, dates corrective action(s) taken, and measures taken to prevent future violations, including requisite changes to the SWMP, as necessary; and
13. After adequate corrective action(s) have been taken, or where a report does not identify any incidents requiring corrective action(s), 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.

A sample Routine Inspection Form can be found in Appendix E of this Plan.

Where site inspections note the need for control measures maintenance activities, control measures must be maintained in accordance with the SWMP and the General Permit. Repair, replacement, or installation of new control measures determined necessary during site inspections to address ineffective or inadequate control measures must be conducted in accordance with the permit. SWMP updates required as a result of deficiencies in the SWMP noted during site inspections shall be made in accordance with the General Permit.

6.0 SWMP REVISION, RECORDS AND RETENTION

Pursuant to the General Permit, this SWMP has been prepared prior to commencement of any construction activity. A complete, accurate and signed permit application shall be submitted electronically at least 10 days prior to the commencement of construction activities, except in the event of construction activities in response to a public emergency (in which an application shall be submitted no later than 14 days *after* the commencement of construction activities.

6.1 SWMP Retention Requirements

A copy of the SWMP must be retained on site unless another location, specified by the permittee, is approved by the Division.

6.2 SWMP Review and Changes

The SWMP shall be amended if the following occurs:

- When there is a change in design, construction, operation, or maintenance of the site, which would require the implementation of new or revised control measures; or
- If the SWMP proves to be ineffective in achieving the general objectives of controlling pollutants in stormwater discharges associated with construction activity; or
- When control measures are no longer necessary or removed; or
- When control measures identified in the SWMP are taken onsite that result in a change to the SWMP.

SWMP revisions may include, but are not limited to, potential pollutant source identification; selection of appropriate control measures for site conditions; control measures maintenance procedures; and interim and final stabilization practices. The SWMP changes may include a schedule for further control measures design and implementation, provided that, if any interim control measures are needed to comply with the permit, they are also included in the SWMP and implemented during the interim period.

For SWMP revisions made prior to or following a change(s) onsite, including revisions to sections addressing site conditions and control measures, a notation must be included in the Revision History table at the beginning of this Plan that identifies the date of the site change, the control measures removed or modified, the location(s) of these control measures, and any changes to the control measures.

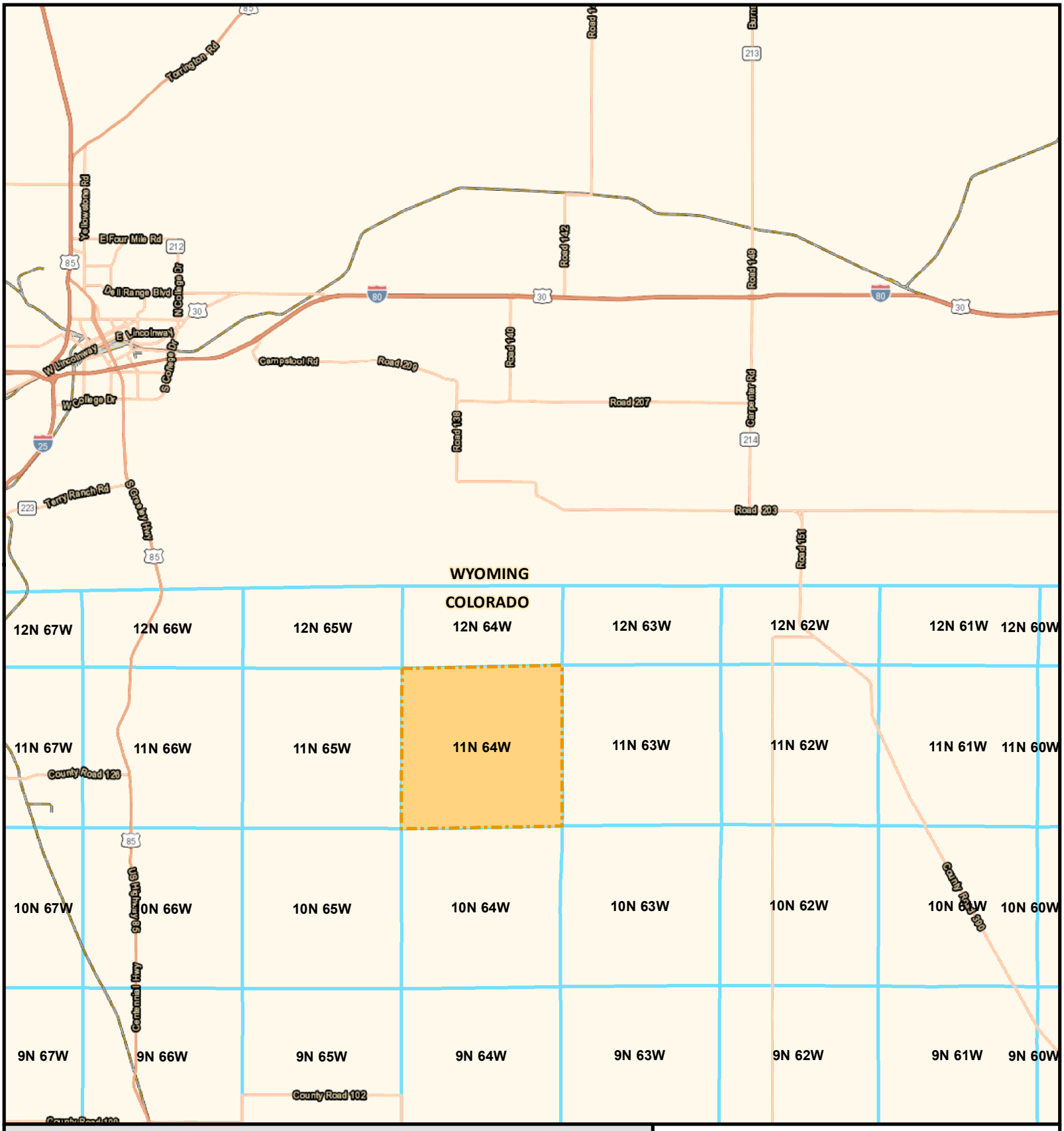
Upland shall ensure the site changes are reflected in the SWMP, or pursuant to Part I.C.3 of COR400000, the permittee shall be considered noncompliant with the general permit until SWMP revisions have been made.

APPENDIX A

CDPS CERTIFICATION AND
GENERAL PERMIT COR400000

APPENDIX B

STORMWATER CONSTRUCTION PERMIT AREA MAP



MAP FEATURES

Boundary of Proposed Permitted Area

Township

N

0 1.25 2.5 5 7.5 10 Miles

Upland Exploration Stormwater Construction Permit COR400000 Application Area

Aquionix EHS Services

5545 West 56th Avenue
Unit E
Arvada, CO 80002
www.aquionix.com

DRAWN BY: MT (Aquionix)

DATE DRAWN: 05/30/2018

MAP SCALE: 1:400,000

COORD. SYSTEM: WGS_1984_Web_Mercator_Auxiliary_Sphere

APPENDIX C

CONTROL MEASURE INSTALLATION AND IMPLEMENTATION SPECIFICS

Control Measure Fact Sheet List:

- Berm
- Check Dam
- Concrete Wash Out
- Ditch
- Employee Training
- Erosion Control Blanket
- Hydromulch
- Low Water Crossing
- Mulching
- Phasing Scheduling
- Portable Toilets
- Rip-rap / Rock Sock
- Roadside Ditches and Turnouts
- Sediment Basin
- Sediment Trap
- Seeding
- Silt Fence
- Slope Drain
- Straw Bale Barrier
- Soil Roughening
- Stockpile Management
- Terracing
- Vehicle Tracking Control
- Vegetative Buffer
- Wind Control

Control Measure Sheet References

California Transportation, Caltrans Division of Construction, *Construction Site Best Management Practices Manual.* California, March, 2003. http://www.dot.ca.gov/hq/construc/stormwater/factsheets.htm

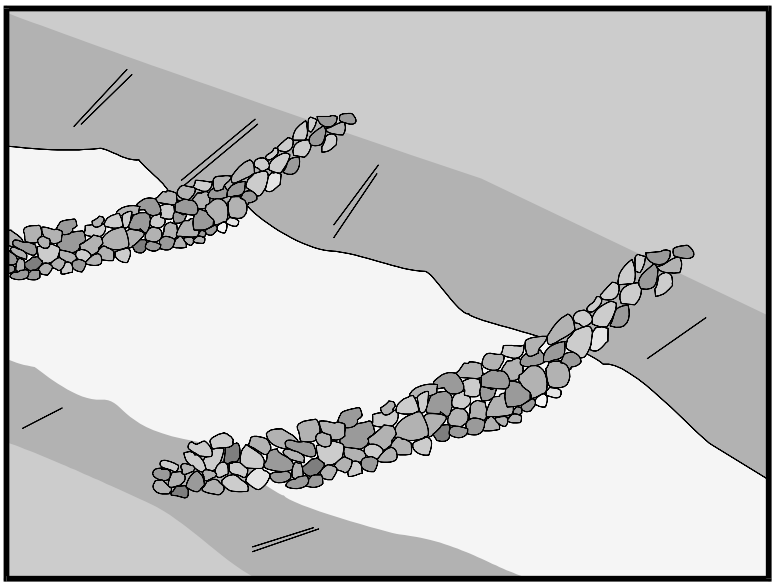
United States Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control.* Washington, D.C., February, 2003. https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater-documents

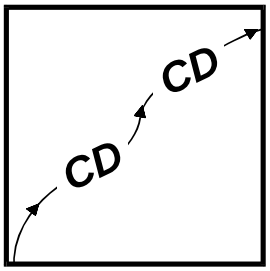
Urban Drainage and Flood Control District, *Urban Storm Drainage Criteria Manual Volume 3.* November 2010. http://udfcd.org/volume-three

Salt Lake County, *Best Management Practices for Construction Activities.* Salt Lake City, UT, February, 2007. http://slco.org/pweng/stormwater/pdf/final_bmp_constructi.pdf

Check Dams

SC-4





Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Check dams reduce scour and channel erosion by reducing flow velocity and encouraging sediment settlement. A check dam is a small device constructed of rock, gravel bags, sandbags, fiber rolls, or other proprietary product placed across a natural or man-made channel or drainage ditch.

Appropriate Applications

- Check dams may be installed:
  - In small open channels that drain 4 ha (10 ac) or less.
  - In steep channels where storm water runoff velocities exceed 1.5 m/s (4.9 ft/sec).
  - During the establishment of grass linings in drainage ditches or channels.
  - In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Resident Engineer (RE).

Limitations

- Not to be used in live streams.
- Not appropriate in channels that drain areas greater than 4 ha (10 ac).
- Not to be placed in channels that are already grass lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping, which can be re-suspended during subsequent storms or removal of the check dam.

- Not to be constructed from straw bales or silt fence.

Standards and Specifications

- Check dams shall be placed at a distance and height to allow small pools to form behind them. Install the first check dam approximately 5 meters (16 ft) from the outfall device and at regular intervals based on slope gradient and soil type.
- For multiple check dam installation, backwater from downstream check dam shall reach the toe of the upstream dam.
- High flows (typically a 2-year storm or larger) shall safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams shall be removed when grass has matured sufficiently to protect the ditch or swale.
- Rock shall be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Fiber rolls may be used as check dams if approved by the RE or the Construction NPDES Coordinator. Refer to SC-5 “Fiber Rolls.”
- Gravel bags may be used as check dams with the following specifications:

Materials

– ***Bag Material:*** Bags shall be either polypropylene, polyethylene or polyamide woven fabric, minimum unit weight 135 g/m2 (four ounces per square yard), mullen burst strength exceeding 2,070 kPa (300 psi) in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

– ***Bag Size:*** Each gravel-filled bag shall have a length of 450 mm (18 in), width of 300 mm (12 in), thickness of 75 mm (3 in), and mass of approximately 15 kg (33 lb). Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the RE for approval prior to deployment.

– ***Fill Material:*** Fill material shall be between 10 mm and 20 mm (0.4 and 0.8 inch) in diameter, and shall be clean and free from clay balls, organic matter, and other deleterious materials. The opening of gravel-filled bags shall be secured such that gravel does not escape. Gravel-filled bags shall be between 13 kg and 22 kg (28 and 48 lb) in mass. Fill material is subject to approval by the RE.

Installation

– Install along a level contour.

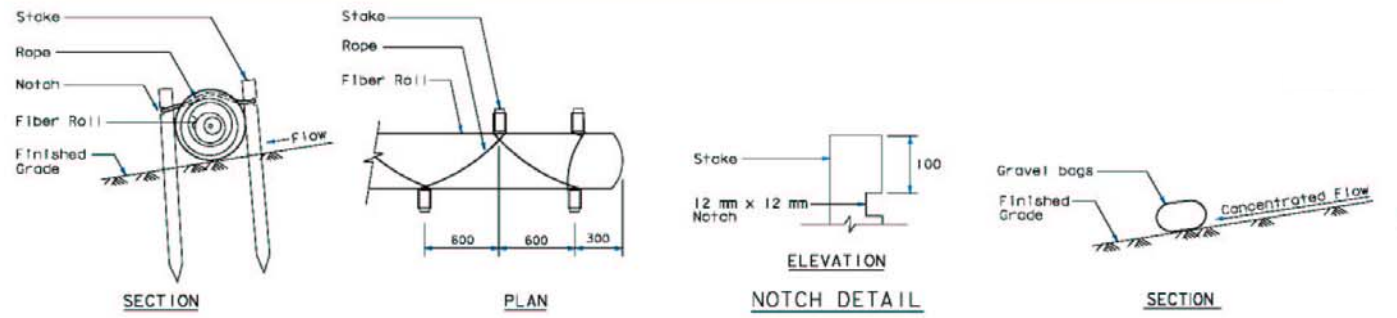
– Tightly abut bags and stack gravel bags using a pyramid approach.

Gravel bags shall not be stacked any higher than 1 meter (3.2 ft).

– Upper rows of gravel bags shall overlap joints in lower rows.

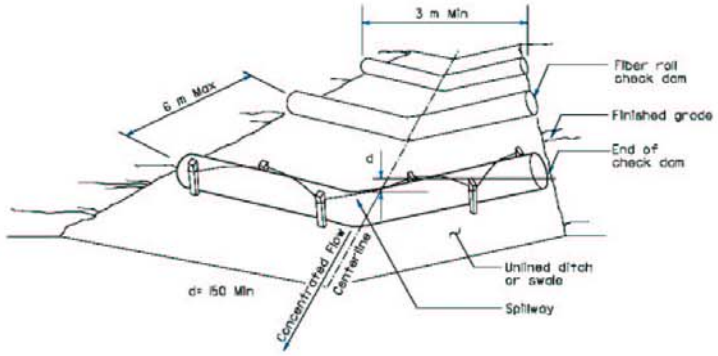
Maintenance and Inspection

- Inspect check dams after each significant rainfall event. Repair damage as needed or as required by the RE.
- Remove sediment when depth reaches one-third of the check dam height.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed or when required by the RE.
- Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.

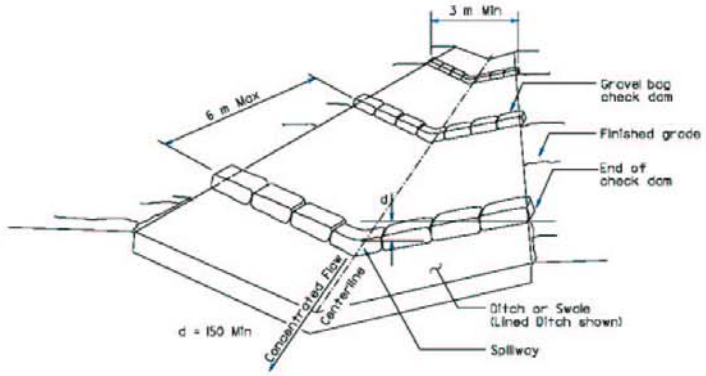


STAKING AND LASHING DETAIL

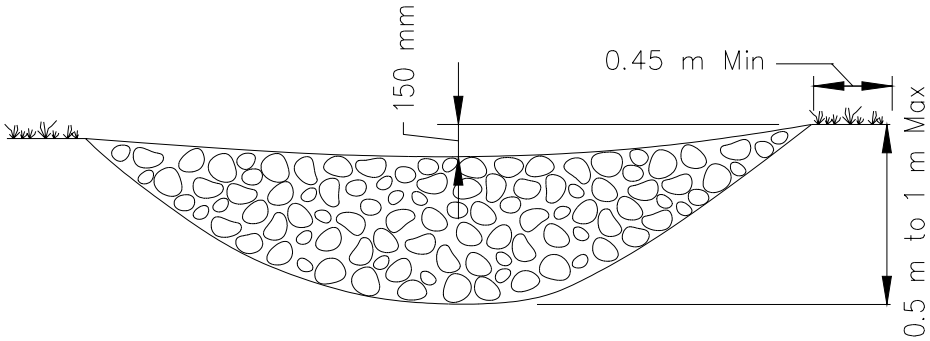
TEMPORARY CHECK DAM (TYPE 2)



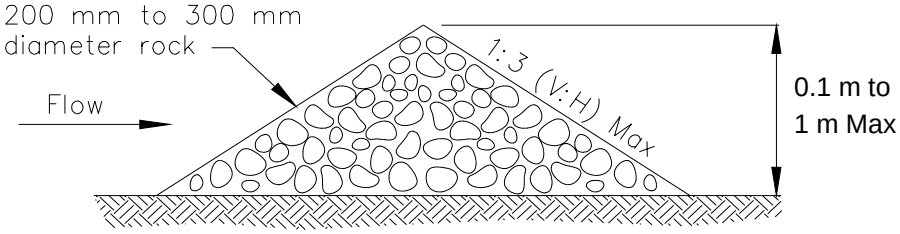
PERSPECTIVE
TEMPORARY CHECK DAM (TYPE 1)



PERSPECTIVE
TEMPORARY CHECK DAM (TYPE 2)



ELEVATION



TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE

EPA United States Environmental Protection Agency

Stormwater Best Management Practice

Concrete Washout

Permits for Clean Water NPDES

Minimum Measure

Construction Site Stormwater Runoff Control

Subcategory

Good Housekeeping/Materials Management

Description of Concrete Washout at Construction Sites

Concrete and its ingredients

Concrete is a mixture of cement, water, and aggregate material. Portland cement is made by heating a mixture of limestone and clay containing oxides of calcium, aluminum, silicon and other metals in a kiln and then pulverizing the resulting clinker. The fine aggregate particles are usually sand. Coarse aggregate is generally gravel or crushed stone. When cement is mixed with water, a chemical reaction called hydration occurs, which produces glue that binds the aggregates together to make concrete.

Concrete washout

After concrete is poured at a construction site, the chutes of ready mixed concrete trucks and hoppers of concrete pump trucks must be washed out to remove the remaining concrete before it hardens. Equipment such as wheelbarrows and hand tools also need to be washed down. At the end of each work day, the drums of concrete trucks must be washed out. This is customarily done at the ready mixed batch plants, which are usually off-site facilities, however large or rural construction projects may have on-site batch plants. Cementitious (having the properties of cement) washwater and solids also come from using such construction materials as mortar, plaster, stucco, and grout.

Environmental and Human Health Impacts

Concrete washout water (or washwater) is a slurry containing toxic metals. It's also caustic and corrosive, having a pH near 12. In comparison, Drano liquid drain cleaner has a pH of 13.5. Caustic washwater can harm fish gills and eyes and interfere with reproduction. The safe pH ranges for aquatic life habitats are 6.5 – 9 for freshwater and 6.5 – 8.5 for saltwater.

Construction workers should handle wet concrete and washout water with care because it may cause skin irritation and eye damage. If the washwater is dumped on the ground (Fig. 1), it can run off the construction site to adjoining roads and enter roadside storm drains, which discharge to surface waters such as rivers, lakes, or estuaries. The red arrow in Figure 2 points to a ready mixed truck chute that's being washed out into a roll-off bin, which isn't watertight. Leaking washwater, shown in the foreground, will likely follow similar

Figure 1. *Chute washwater being dumped on the ground*

Figure 2. *Chute washwater leaking from a roll-off bin being used as a washout container*

paths to nearby surface waters. Rainfall may cause concrete washout containers that are uncovered to overflow and also transport the washwater to surface waters. Rainwater polluted with concrete washwater can percolate down through the soil and alter the soil chemistry, inhibit plant growth, and contaminate the groundwater. Its high pH can increase the toxicity of other substances in the surface waters and soils. Figures 1 and 2 illustrate the need for better washout management practices.

Best Management Practice Objectives

The best management practice objectives for concrete washout are to (a) collect and retain all the concrete washout water and solids in leak proof containers, so that this caustic material does not reach the soil surface and then migrate to surface waters or into the ground water, and (b) recycle 100 percent of the collected concrete washout water and solids. Another

objective is to support the diversion of recyclable materials from landfills. Table 1 shows how concrete washout materials can be recycled and reused.

Table 1 – Recycling concrete washout materials

Uses of Recycled Materials	Concrete Washout Materials					
	Washwater	Cement fines[a]	Fine aggregate	Coarse aggregate	Hardened concrete	Unused wet concrete
Reused to washout additional mixer truck chutes or drums	x					
Reused as a ready mixed concrete ingredient	x	x[b]	x	x		
Reused as an ingredient of precast concrete products, e.g., highway barriers, retaining wall blocks, riprap	x	x	x	x		x
Reused as crushed concrete products, e.g., road base or fill		x	x	x	x	
Reused to pave the yards of ready mixed concrete plants						x
Returned back to a surface water, e.g., river, lake, or estuary	x[c]					

a. Fine particles of cementitious material (e.g., Portland cement, slag cement, fly ash, silica fume)

b. Recyclable, if allowed by the concrete quality specifications

c. Treated to reduce the pH and remove metals, so it can be delivered to a municipal wastewater treatment plant, where it is treated further and then returned to a natural surface water

Washwater recycling, treatment, disposal

Washwater from concrete truck chutes, hand mixers, or other equipment can be passed through a system of weirs or filters to remove solids and then be reused to wash down more chutes and equipment at the construction site or as an ingredient for making additional concrete. A three chamber washout filter is shown in Figure 3. The first stage collects the coarse aggregate. The middle stage filters out the small grit and sand. The third stage has an array of tablets that filter out fines and reduces the pH. The filtered washwater is then discharged through a filter sock. An alternative is to pump the washout water out of the washout container (Fig 4) and treat the washwater off site to remove metals and reduce its pH, so it can be delivered to a publicly owned treatment works (POTW), also known as a municipal wastewater treatment plant, which provides additional treatment allowing the washwater to be discharged to a surface water. The POTW should be contacted to inquire about any pretreatment requirements, i.e., the National Pretreatment Standards for Prohibited Dischargers (40CFR 403.5) before discharging the washwater to the POTW. The washwater can also be retained in the washout container and allowed to evaporate, leaving only the hardened cementitious solids to be recycled.

Figure 3. *Concrete washout filter*

Figure 4. *Vacuuming washwater out of a washout container for treatment and reuse*

Solids recycling

The course aggregate materials that are washed off concrete truck chutes into a washout container can be either separated by a screen and placed in aggregate bins to be reused at the construction site or returned to the ready mixed plant and washed into a reclaimer (Fig. 5). When washed out into a reclaimer, the fine and course aggregates are separated out and placed in different piles or bins to be reused in making fresh concrete. Reclaimers with settling tanks separate cement fines from the washwater, and these fines can also be used in new concrete unless prohibited by the user's concrete quality specifications.

Figure 5. *Ready mixed truck washing out into a reclaimer*

Hardened concrete recycling

When the washwater in a construction site concrete washout container has been removed or allowed to evaporate, the hardened concrete that remains can be crushed (Fig. 6) and reused as a construction material. It makes an excellent aggregate for road base and can be used as fill at the construction site or delivered to a recycler. Concrete recyclers can be found at municipal solid waste disposal facilities, private recycling plants, or large construction sites.

Figure 6. *Crushed concrete stockpile and crusher*

Wet concrete recycling

Builders often order a little more ready mixed concrete than they actually need, so it is common for concrete trucks to have wet concrete remaining in their drum after a delivery. This unused concrete can be returned to the ready mixed plant and either (1) used to pour precast concrete products (e.g., highway barriers, retaining wall blocks, riprap), (2) used to pave the ready mixed plant's yard, (3) washed into a reclaimer, or (4) dumped on an impervious surface and allowed to harden, so it can be crushed and recycled as aggregate. Unused wet concrete should not be dumped on bare ground to harden at construction sites because this can contribute to ground water and surface water contamination.

Washout Containers

Different types of washout containers are available for collecting, retaining, and recycling the washwater and solids from washing down mixed truck chutes and pump truck hoppers at construction sites.

Chute washout box

A chute washout box is mounted on the back of the ready mixed truck. If the truck has three chutes, the following procedure is used to perform the washout from the top down: (1) after the pour is completed, the driver attaches the extension chute to the washout box, (2) the driver then rotates the main chute over the extension chute (Fig. 7) and washes down the hopper first then the main chute, (3) finally the driver washes down the flop down chute and last the extension chute hanging on the box. All washwater and solids are captured in the box.

Figure 7. *Chute washout box*

After the wash down, washwater and solids are returned to the ready mixed plant for recycling. A filter basket near the top of the washout box separates out the coarse aggregates so they can be placed in a bin for reuse either at the construction site or back at the cement plant.

Chute washout bucket and pump

After delivering ready mixed concrete and scraping the last of the customer's concrete down the chute, the driver hangs a washout bucket shown in Figure 8 (see red arrow) on the end of the truck's chute and secures the hose to insure no leaks. The driver then washes down the chute into the bucket to remove any cementitious material before it hardens. After washing out the chute, the driver pumps (yellow arrow points to the pump) the washwater, sand, and other fine solids from the bucket up into the truck's drum to be returned to the ready mixed plant, where it can be washed into a reclaimer. A removable screen at the bottom of the washout bucket prevents course aggregate from entering the pump. This course aggregate can also be returned to the plant and added to the coarse aggregate pile to be reused. All the materials are recycled.

Figure 8. *Chute washout bucket and pump*

Hay bale and plastic washout pit

A washout pit made with hay bales and a plastic lining is shown in Figure 9. Such pits can be dug into the ground or built above grade. The plastic lining should be free of tears or holes that would allow the washwater to escape (Fig. 10). After the pit is used to wash down the chutes of multiple ready mixed trucks and the washwater has evaporated or has been vacuumed off, the remaining hardened solids can be broken up and removed from the pit. This process may damage the hay bales and plastic lining. If damage occurs, the pit will need to be repaired and relined with new plastic. When the hardened solids are removed, they may be bound up with the plastic lining and have to be sent to a landfill, rather than recycled. Recyclers usually accept only unmixed material. If the pit is going to be emptied and repaired more than a few times, the hay bales and plastic will be generating additional solid waste. Ready mixed concrete

Figure 9. *Hay bale and plastic washout pit*

Figure 10. *Leaking washout pit that has not been well maintained*

trucks can use hay bale washout pits, but concrete pump trucks have a low hanging hopper in the back that may prevent their being washed out into bale-lined pits.

Vinyl washout container

Figure 11. *Vinyl washout pit with filter bag*

The vinyl washout container (Fig. 11) is portable, reusable, and easier to install than a hay bale washout pit. The biodegradable filter bag (Fig. 12) assists in extracting the concrete solids and prolongs the life of the vinyl container. When the bag is lifted, the water is filtered out and the remaining concrete solids and the bag can be disposed of together in a landfill, or the hardened concrete can be delivered to a recycler. After the solids have been removed several times and the container is full of washwater, the washwater can be allowed to evaporate, so the container can be reused. The washwater can be removed more quickly by placing another filter bag in the container and spreading water gelling granules evenly across the water. In about five minutes, the water in the filter bag will turn into a gel that can be removed with the bag. Then the gel and filter bag can be disposed to together.

Figure 12. *Extracting the concrete solids or gelled washwater*

Metal washout container

The metal roll-off bin (Fig. 13) is designed to securely contain concrete washwater and solids and is portable and reusable. It also has a ramp that allows concrete pump trucks to wash out their hoppers (Fig. 14). Roll-off providers offer recycling services, such as, picking up the roll-off bins after the washwater has evaporated and the solids have hardened, replacing them with empty washout bins, and delivering the hardened concrete to a recycler (Fig. 15), rather than a landfill. Some providers will vacuum off the washwater, treat it to remove metals and reduce the pH, deliver it to a wastewater treatment plant for additional treatment and subsequent discharge to a surface water. Everything is recycled or treated sufficiently to be returned to a natural surface water.

Figure 13. *Mixer truck being washed out into a roll-off bin*

Figure 14. *Pump truck using the ramp to wash out into a roll-off bin*

Figure 15. *Delivering hardened Concrete to a recycler*

Another metal, portable, washout container, which has a rain cover to prevent overflowing, is shown in Figure 16. It is accompanied by an onsite washwater treatment unit, which reduces the pH and uses a forced weir tank system to remove the coarse aggregate, fine aggregate, and cement fines. The washwater can then be reused at the construction site to wash out other mixer truck chutes and equipment. The solids are allowed to harden together and can be taken to a concrete recycler (Fig. 17) to be crushed and used as road base or aggregate for making precast products, such as retaining wall blocks. All materials are recycled.

Figure 16. *Washout container with a rain cover and onsite washwater treatment*

Figure 17. *Delivering hardened concrete to a recycler*

Siting Washout Facilities

Concrete washout facilities, such as washout pits and vinyl or metal washout containers, should be placed in locations that provide convenient access to concrete trucks, preferably near the area where concrete is being poured. However they

should not be placed within 50 feet of storm drains, open ditches, or waterbodies. Appropriate gravel or rock should cover approaches to concrete washout facilities when they are located on undeveloped property. On large sites with extensive concrete work, washouts should be placed at multiple locations for ease of use by ready mixed truck drivers. If the washout facility is not within view from the pour location, signage will be needed to direct the truck drivers.

Operating and Inspecting Washout Facilities

Concrete washout facilities should be inspected daily and after heavy rains to check for leaks, identify any plastic linings and sidewalls have been damaged by construction activities, and determine whether they have been filled to over 75 percent capacity. When the washout container is filled to over 75 percent of its capacity, the washwater should be vacuumed off or allowed to evaporate to avoid overflows. Then when the remaining cementitious solids have hardened, they should be removed and recycled. Damages to the container should be repaired promptly. Before heavy rains, the washout container's liquid level should be lowered or the container should be covered to avoid an overflow during the rain storm.

Educating Concrete Subcontractors

The construction site superintendent should make ready mixed truck drivers aware of washout facility locations and be watchful for improper dumping of cementitious material. In addition, concrete washout requirements should be included in contracts with concrete delivery companies.

Reference

NRMCA 2009. Environmental Management in the Ready Mixed Concrete Industry, 2PEMRM, 1st edition. By Gary M. Mullins. Silver Springs, MD: National Ready Mixed Concrete Association.

Websites and Videos

Construction Materials Recycling Association
www.concreterecycling.org

National Ready Mixed Concrete Association
www.nrmca.org

National Ready Mixed Concrete Research and Education Foundation
www.rmc-foundation.org

Additional information and videos on concrete washout containers and systems can be found by a web search for "concrete washout."

Photograph Credits

Figures 1, 2. *Mark Jenkins, Concrete Washout Systems, Inc.*
Figure 3. *Mark Shaw, Ultra Tech International, Inc.*
Figure 4. *Mark Jenkins, Concrete Washout Systems, Inc.*
Figure 5. *Christopher Crouch, CCI Consulting*
Figure 6. *William Turley, Construction Materials Recycling Association*
Figure 7. *Brad Burke, Innovative Concrete Solutions, LLC*
Figure 8. *Ron Lankester, Enviroguard*
Figures 9, 10. *Mark Jenkins, Concrete Washout Systems, Inc.*
Figures 11, 12. *Tom Card, RTC Supply*
Figures 13, 14, 15. *Mark Jenkins, Concrete Washout Systems, Inc.*
Figures 16, 17. *Rick Abney Sr., Waste Crete Systems, LLP*

DESCRIPTION:
Employee training, like equipment maintenance, is a method by which to implement BMPs. Employee training should be used in conjunction with all other BMPs as part of the facility's SWPPP.

The specific employee training aspects of each of the source controls are highlighted in the individual information sheets. The focus of this information sheet is more general, and includes the overall objectives and approach for assuring employee training in stormwater pollution prevention. Accordingly, the organization of this information sheet differs somewhat from the other information sheets in this chapter.

OBJECTIVES:
Employee training should be based on four objectives:

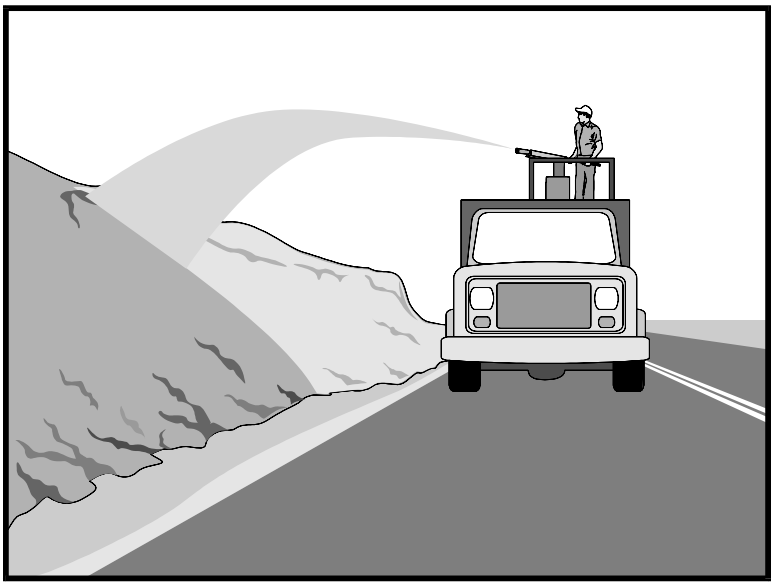
- Promote a clear identification and understanding of the problem, including activities with the potential to pollute stormwater;
- Identify solutions (BMPs);
- Promote employee ownership of the problems and the solutions; and
- Integrate employee feedback into training and BMP implementation.

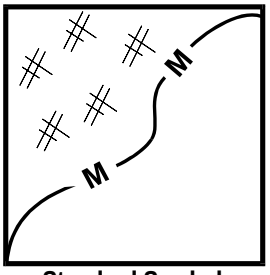
APPROACH:

- Integrate training regarding stormwater quality management with existing training programs that may be required for your business by other regulations.
- Businesses that are not regulated in Federal, State, or local regulations, may use the information in this handbook to develop a training program to reduce their potential to pollute stormwater.
- Employee training is a vital component of many of the individual source control BMPs included in this manual.

Hydraulic Mulch

SS-3





Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Hydraulic mulch consists of applying a mixture of shredded wood fiber or a hydraulic matrix and a stabilizing emulsion or tackifier with hydroseeding equipment, which temporarily protects exposed soil from erosion by raindrop impact or wind. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

- Hydraulic mulch is applied to disturbed areas requiring temporary protection until permanent vegetation is established or disturbed areas that must re-disturbed following an extended period of inactivity.

Limitations

- Wood fiber hydraulic mulches are generally short-lived (only last a part of a growing season) and need 24 hours to dry before rainfall occurs to be effective.
- Paper mulches are not permitted.
- Avoid use in areas where the mulch would be incompatible with immediate future earthwork activities and would have to be removed.

Standards and Specifications

- Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical.
- Hydraulic matrices require 24 hours to dry before rainfall occurs to be effective unless approved by the Resident Engineer.
- Avoid mulch over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.
- Selection of hydraulic mulches by the Contractor must be approved by the Resident Engineer (RE) or Construction Storm Water Coordinator.

- Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to Standard Specifications Section 20-2.07.

- Hydraulic Mulch

- Wood fiber mulch is a component of hydraulic applications. It is typically applied at the rate of 2,250 to 4,500 kilograms per hectare (kg/ha) (2,000 to 4,000 lb/ac) with 0-5% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer) and applied as a slurry. This type of mulch is manufactured from wood or wood waste from lumber mills or from urban sources. Specifications for wood fiber mulch can be found in Standard Specifications Sections 20-2.07 and 20-2.08.

- Hydraulic matrix is a combination of wood fiber mulch and a tackifier applied as a slurry. It is typically applied at the rate of 2,250 to 4,500 kilograms per hectare (kg/Ha) with 5-10% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer).

- Hydraulic Matrix

- Hydraulic matrix is a combination of wood fiber mulch and tackifier applied as a slurry. It is typically applied at the rate of 2,250 to 4,500 kg/ha with 5-10% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer).

- Bonded Fiber Matrix

- Bonded fiber matrix (BFM) is a hydraulically-applied system of fibers and adhesives that upon drying forms an erosion-resistant blanket that promotes vegetation, and prevents soil erosion. BFMs are typically applied at rates from 3,400 kg/ha to 4,500 kg/ha based on the manufacturer's recommendation. The biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM should also be biodegradable and should not dissolve or disperse upon re-wetting. Typically, biodegradable BFMs should not be applied immediately before, during or immediately after rainfall if the soil is saturated. Depending on the product, BFMs require 12 to 24 hours to dry to become effective.

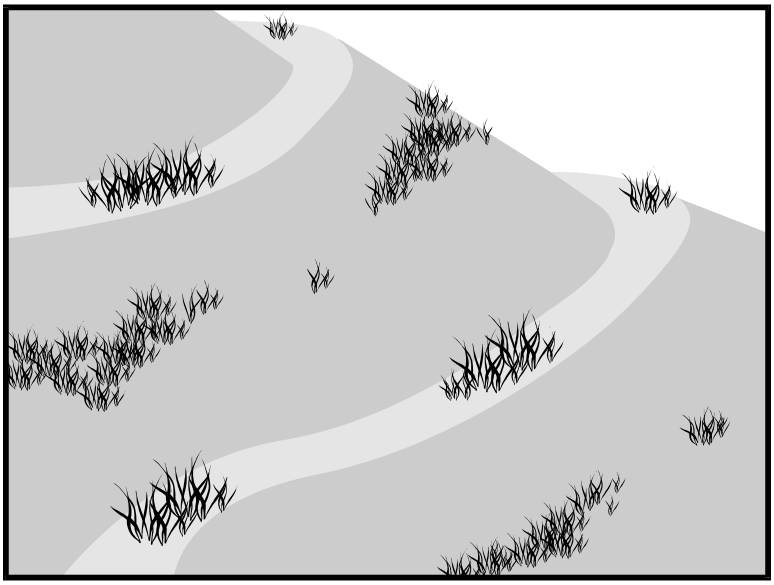
Maintenance and Inspections

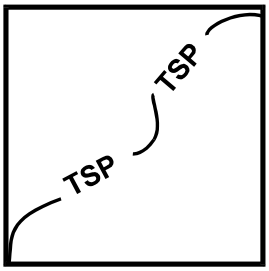
- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked. Inspect before expected rain storms and repair any damaged ground cover and re-mulch exposed areas of bare soil.

- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Hydroseeding

SS-4





Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Hydroseeding typically consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydro-mulch equipment, which temporarily protects exposed soils from erosion by water and wind. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

- Hydroseeding is applied on disturbed soil areas requiring temporary protection until permanent vegetation is established or disturbed soil areas that must be re-disturbed following an extended period of inactivity.

Limitations

- Hydroseeding may be used alone only when there is sufficient time in the season to ensure adequate vegetation establishment and erosion control. Otherwise, hydroseeding must be used in conjunction with a soil binder or mulching (i.e., straw mulch), refer to BMP SS-5, Table 1 for options.
- Steep slopes are difficult to protect with temporary seeding.
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation is not appropriate for short-term inactivity.

Standards and Specifications

To select appropriate hydroseeding mixtures, an evaluation of site conditions shall be performed with respect to:

- Soil conditions
- Site topography
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

- Selection of hydroseeding mixtures shall be approved by the District Landscape Architect and the Construction Storm Water Coordinator.

The following steps shall be followed for implementation:

- Seed mix shall comply with the Standard Specifications Section 20-2.10, and the project's special provisions.

- Hydroseeding can be accomplished using a multiple-step or one-step process; refer to the special provisions for specified process. The multiple-step process ensures maximum direct contact of the seeds to soil. When the one-step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seeds not having direct contact with the soil.

- Prior to application, roughen the slope, fill area, or area to be seeded with the furrows trending along the contours. Rolling with a crimping or punching type roller or track walking is required on all slopes prior to hydroseeding. Track walking shall only be used where other methods are impractical.

- Apply a straw mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow, refer to Standard Specifications Sections 20-2.06 and 20-3.03.

- All seeds shall be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test; provide the Resident Engineer (RE) with such documentation. The container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed shall be pellet-inoculated. Inoculant sources shall be species-specific and shall be applied at a rate of 2 kg of inoculant per 100 kg of seed (2-lb inoculant per 100-lb seed), refer to Standard Specifications Section 20-2.10.

- Commercial fertilizer shall conform to the requirements of the California Food and Agricultural Code. Fertilizer shall be pelleted or granular form.

- Follow-up applications shall be made as needed to cover weak spots, and to maintain adequate soil protection.
- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.

Maintenance and Inspection

- All seeded areas shall be inspected for failures and re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates. Any temporary revegetation efforts that do not provide adequate cover must be reapplied at a scheduled recommended by the Caltrans Landscape Architect or RE.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Construction Phasing/Sequencing (CP) SM-1

Description

Photograph CP-1. Construction phasing to avoid disturbing the entire area at one time. Photo courtesy of WWE.

Effective construction site management to minimize erosion and sediment transport includes attention to construction phasing, scheduling, and sequencing of land disturbing activities. On most construction projects, erosion and sediment controls will need to be adjusted as the project progresses and should be documented in the SWMP.

Construction phasing refers to disturbing only part of a site at a time to limit the potential for erosion from dormant parts of a site. Grading activities and construction are completed and soils are effectively stabilized on one part of a site before grading and construction begins on another portion of the site.

Construction sequencing or scheduling refers to a specified work schedule that coordinates the timing of land disturbing activities and the installation of erosion and sediment control practices.

Appropriate Uses

All construction projects can benefit from upfront planning to phase and sequence construction activities to minimize the extent and duration of disturbance. Larger projects and linear construction projects may benefit most from construction sequencing or phasing, but even small projects can benefit from construction sequencing that minimizes the duration of disturbance.

Typically, erosion and sediment controls needed at a site will change as a site progresses through the major phases of construction. Erosion and sediment control practices corresponding to each phase of construction must be documented in the SWMP.

Design and Installation

BMPs appropriate to the major phases of development should be identified on construction drawings. In some cases, it will be necessary to provide several drawings showing construction-phase BMPs placed according to stages of development (e.g., clearing and grading, utility installation, active construction, final stabilization). Some municipalities in the Denver area set maximum sizes for disturbed area associated with phases of a construction project. Additionally, requirements for phased construction drawings vary among local governments within the UDFCD boundary. Some local governments require separate erosion and sediment control drawings for initial BMPs, interim conditions (in active construction), and final stabilization.

Construction Scheduling	
Functions	
Erosion Control	Moderate
Sediment Control	Moderate
Site/Material Management	Yes

Typical construction phasing BMPs include:

- Limit the amount of disturbed area at any given time on a site to the extent practical. For example, a 100-acre subdivision might be constructed in five phases of 20 acres each.

- If there is carryover of stockpiled material from one phase to the next, position carryover material in a location easily accessible for the pending phase that will not require disturbance of stabilized areas to access the stockpile. Particularly with regard to efforts to balance cut and fill at a site, careful planning for location of stockpiles is important.

Typical construction sequencing BMPs include:

- Sequence construction activities to minimize duration of soil disturbance and exposure. For example, when multiple utilities will occupy the same trench, schedule installation so that the trench does not have to be closed and opened multiple times.

- Schedule site stabilization activities (e.g., landscaping, seeding and mulching, installation of erosion control blankets) as soon as feasible following grading.

- Install initial erosion and sediment control practices before construction begins. Promptly install additional BMPs for inlet protection, stabilization, etc., as construction activities are completed.

Table CP-1 provides typical sequencing of construction activities and associated BMPs.

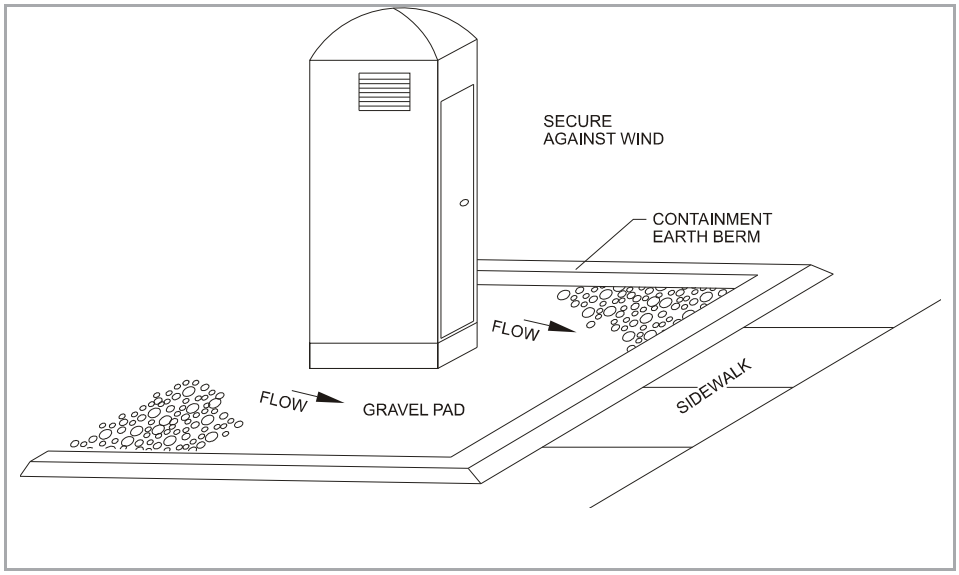
Maintenance and Removal

When the construction schedule is altered, erosion and sediment control measures in the SWMP and construction drawings should be appropriately adjusted to reflect actual "on the ground" conditions at the construction site. Be aware that changes in construction schedules can have significant implications for site stabilization, particularly with regard to establishment of vegetative cover.

Table CP-1. Typical Phased BMP Installation for Construction Projects

Project Phase	BMPs
Pre-disturbance, Site Access	▪ Install sediment controls downgradient of access point (on paved streets this may consist of inlet protection). ▪ Establish vehicle tracking control at entrances to paved streets. Fence as needed. ▪ Use construction fencing to define the boundaries of the project and limit access to areas of the site that are not to be disturbed. **Note: it may be necessary to protect inlets in the general vicinity of the site, even if not downgradient, if there is a possibility that sediment tracked from the site could contribute to the inlets.**
Site Clearing and Grubbing	▪ Install perimeter controls as needed on downgradient perimeter of site (silt fence, wattles, etc). ▪ Limit disturbance to those areas planned for disturbance and protect undisturbed areas within the site (construction fence, flagging, etc). ▪ Preserve vegetative buffer at site perimeter. ▪ Create stabilized staging area. ▪ Locate portable toilets on flat surfaces away from drainage paths. Stake in areas susceptible to high winds. ▪ Construct concrete washout area and provide signage. ▪ Establish waste disposal areas. ▪ Install sediment basins. ▪ Create dirt perimeter berms and/or brush barriers during grubbing and clearing. ▪ Separate and stockpile topsoil, leave roughened and/or cover. ▪ Protect stockpiles with perimeter control BMPs. Stockpiles should be located away from drainage paths and should be accessed from the upgradient side so that perimeter controls can remain in place on the downgradient side. Use erosion control blankets, temporary seeding, and/or mulch for stockpiles that will be inactive for an extended period. ▪ Leave disturbed area of site in a roughened condition to limit erosion. Consider temporary revegetation for areas of the site that have been disturbed but that will be inactive for an extended period. ▪ Water to minimize dust but not to the point that watering creates runoff.

Project Phase	BMPs
Utility And Infrastructure Installation	**In Addition to the Above BMPs:** ▪ Close trench as soon as possible (generally at the end of the day). ▪ Use rough-cut street control or apply road base for streets that will not be promptly paved. ▪ Provide inlet protection as streets are paved and inlets are constructed. ▪ Protect and repair BMPs, as necessary. ▪ Perform street sweeping as needed.
Building Construction	**In Addition to the Above BMPs:** ▪ Implement materials management and good housekeeping practices for home building activities. ▪ Use perimeter controls for temporary stockpiles from foundation excavations. ▪ For lots adjacent to streets, lot-line perimeter controls may be necessary at the back of curb.
Final Grading	**In Addition to the Above BMPs:** ▪ Remove excess or waste materials. ▪ Remove stored materials.
Final Stabilization	**In Addition to the Above BMPs:** ▪ Seed and mulch/tackify. ▪ Seed and install blankets on steep slopes. ▪ Remove all temporary BMPs when site has reached final stabilization.



DESCRIPTION:

Temporary on-site sanitary facilities for construction personnel.

APPLICATION:

All sites with no permanent sanitary facilities or where permanent facility is too far from activities.

INSTALLATION/APPLICATION CRITERIA:

- Locate portable toilets in convenient locations throughout the site.
- Prepare level, gravel surface and provide clear access to the toilets for servicing and for on-site personnel.
- Construct earth berm perimeter (6” tall by 6” wide), control for spill/protection leak.

LIMITATIONS:

- No limitations.

MAINTENANCE:

- Portable toilets should be maintained in good working order by licensed service with daily observation for leak detection.
- Regular waste collection should be arranged with licensed service.
- All waste should be deposited in sanitary sewer system for treatment with appropriate agency approval.

Rock Sock (RS) SC-5

Description

A rock sock is constructed of gravel that has been wrapped by wire mesh or a geotextile to form an elongated cylindrical filter. Rock socks are typically used either as a perimeter control or as part of inlet protection. When placed at angles in the curb line, rock socks are typically referred to as curb socks. Rock socks are intended to trap sediment from stormwater runoff that flows onto roadways as a result of construction activities.

Photograph RS-1. Rock socks placed at regular intervals in a curb line can help reduce sediment loading to storm sewer inlets. Rock socks can also be used as perimeter controls.

Appropriate Uses

Rock socks can be used at the perimeter of a disturbed area to control localized sediment loading. A benefit of rock socks as opposed to other perimeter controls is that they do not have to be trenched or staked into the ground; therefore, they are often used on roadway construction projects where paved surfaces are present.

Use rock socks in inlet protection applications when the construction of a roadway is substantially complete and the roadway has been directly connected to a receiving storm system.

Design and Installation

When rock socks are used as perimeter controls, the maximum recommended tributary drainage area per 100 lineal feet of rock socks is approximately 0.25 acres with disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. A rock sock design detail and notes are provided in Detail RS-1. Also see the Inlet Protection Fact Sheet for design and installation guidance when rock socks are used for inlet protection and in the curb line.

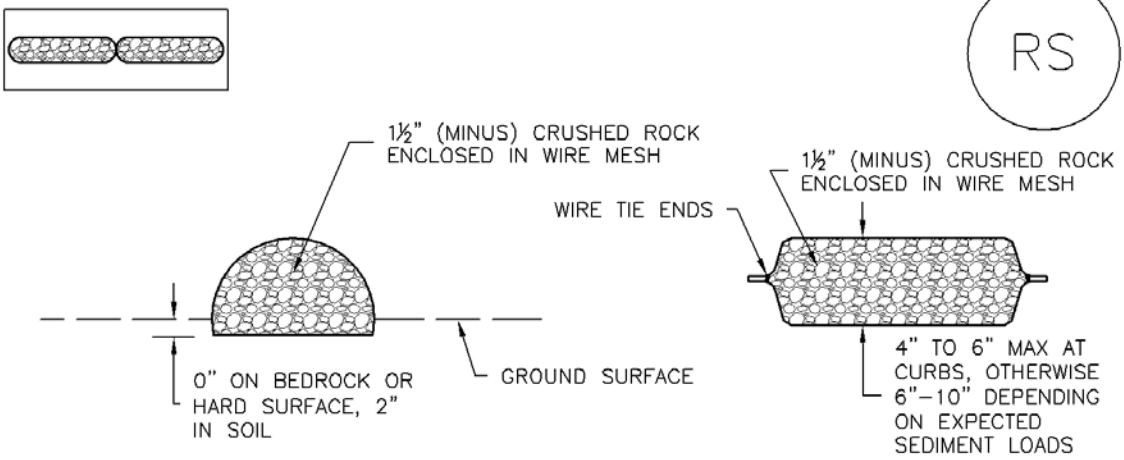
When placed in the gutter adjacent to a curb, rock socks should protrude no more than two feet from the curb in order for traffic to pass safely. If located in a high traffic area, place construction markers to alert drivers and street maintenance workers of their presence.

Maintenance and Removal

Rock socks are susceptible to displacement and breaking due to vehicle traffic. Inspect rock socks for damage and repair or replace as necessary. Remove sediment by sweeping or vacuuming as needed to maintain the functionality of the BMP, typically when sediment has accumulated behind the rock sock to one-half of the sock's height.

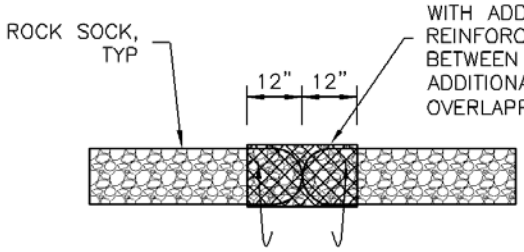
Once upstream stabilization is complete, rock socks and accumulated sediment should be removed and properly disposed.

Rock Sock	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No



ROCK SOCK SECTION

ROCK SOCK PLAN



ANY GAP AT JOINT SHALL BE FILLED WITH AN ADEQUATE AMOUNT OF 1½" (MINUS) CRUSHED ROCK AND WRAPPED WITH ADDITIONAL WIRE MESH SECURED TO ENDS OF ROCK REINFORCED SOCK. AS AN ALTERNATIVE TO FILLING JOINTS BETWEEN ADJOINING ROCK SOCKS WITH CRUSHED ROCK AND ADDITIONAL WIRE WRAPPING, ROCK SOCKS CAN BE OVERLAPPED (TYPICALLY 12–INCH OVERLAP) TO AVOID GAPS.

ROCK SOCK JOINTING

GRADATION TABLE	
SIEVE SIZE	MASS PERCENT PASSING SQUARE MESH SIEVES
	NO. 4
2"	100
1½"	90 – 100
1"	20 – 55
¾"	0 – 15
⅜"	0 – 5
MATCHES SPECIFICATIONS FOR NO. 4 COARSE AGGREGATE FOR CONCRETE PER AASHTO M43. ALL ROCK SHALL BE FRACTURED FACE, ALL SIDES.	

ROCK SOCK INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   –LOCATION(S) OF ROCK SOCKS.

2. CRUSHED ROCK SHALL BE 1½" (MINUS) IN SIZE WITH A FRACTURED FACE (ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN ON THIS SHEET (1½" MINUS).

3. WIRE MESH SHALL BE FABRICATED OF 10 GAGE POULTRY MESH, OR EQUIVALENT, WITH A MAXIMUM OPENING OF ½", RECOMMENDED MINIMUM ROLL WIDTH OF 48"

4. WIRE MESH SHALL BE SECURED USING "HOG RINGS" OR WIRE TIES AT 6" CENTERS ALONG ALL JOINTS AND AT 2" CENTERS ON ENDS OF SOCKS.

5. SOME MUNICIPALITIES MAY ALLOW THE USE OF FILTER FABRIC AS AN ALTERNATIVE TO WIRE MESH FOR THE ROCK ENCLOSURE.

RS–1. ROCK SOCK PERIMETER CONTROL

ROCK SOCK 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 SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED, OR DAMAGED BEYOND REPAIR.

5. SEDIMENT ACCUMULATED UPSTREAM OF ROCK SOCKS SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY ½ OF THE HEIGHT OF THE ROCK SOCK.

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

7. WHEN ROCK SOCKS ARE 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, 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 ROCK SOCK INSTALLATION IN THE DENVER METROPOLITAN AREA. THERE ARE MANY OTHER SIMILAR PROPRIETARY PRODUCTS ON THE MARKET. UDFCD NEITHER NDORSES NOR DISCOURAGES USE OF PROPRIETARY PROTECTION PRODUCTS; 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.

Rolled Erosion Control Products (RECP) EC-6

Description

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

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 sheer stresses that exceed the typical limits of mature natural vegetation.

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

- **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.

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)	24 months
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 Permanent[1] Rolled Erosion Control Products
(Adapted from: Erosion Control Technology Council 2005)

Product Type	Slope Applications	Channel Applications	
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).	Maximum Gradient	Maximum Shear Stress[4,5]	Minimum Tensile Strength[2,3]
	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

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.

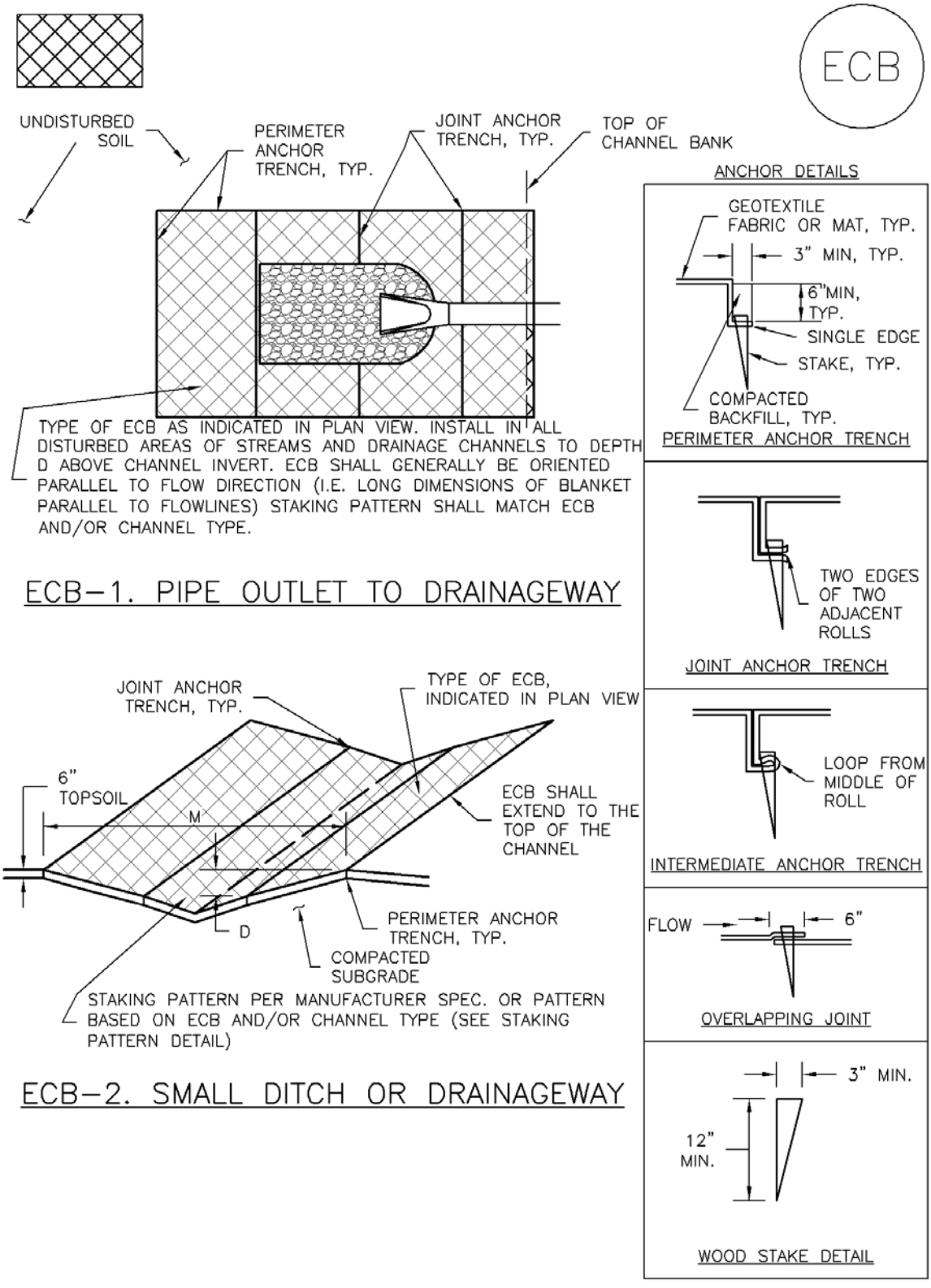
Maintenance and Removal

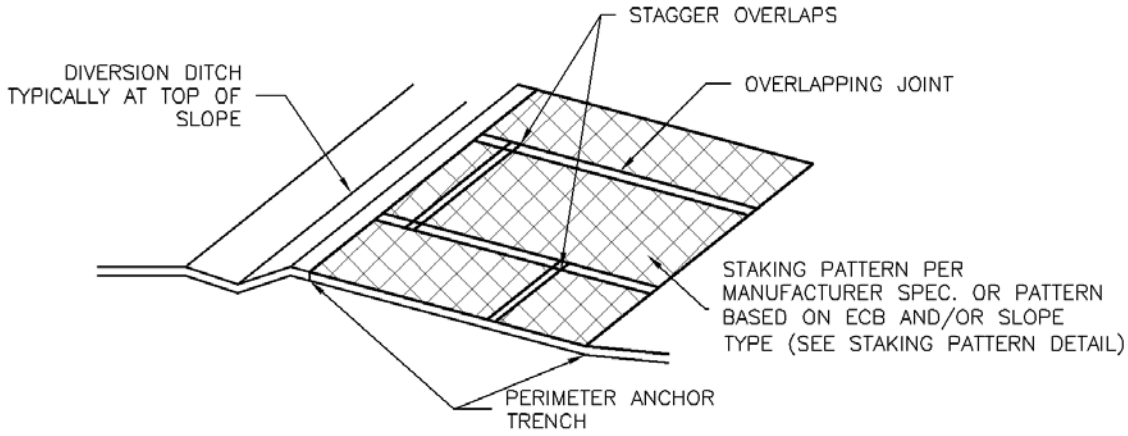
Inspection of erosion control blankets and other RECPs includes:

- 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.

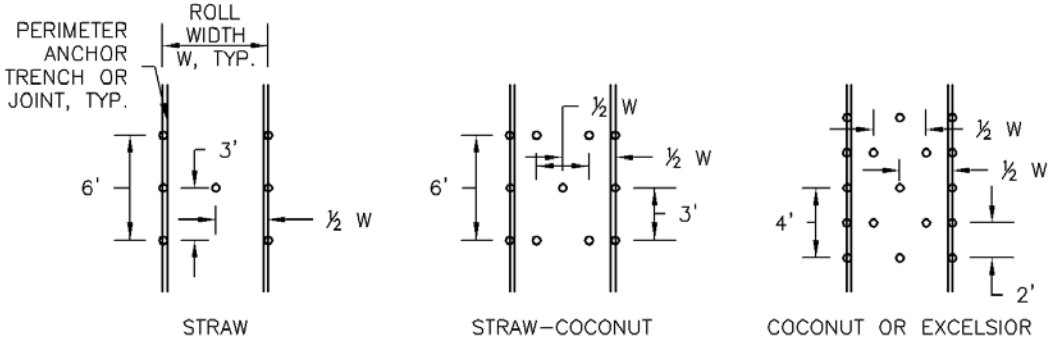
Erosion control blankets and other RECPs that are biodegradable typically do not need to be removed after construction. If they must be removed, then an alternate soil stabilization method should be installed promptly following removal.

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.

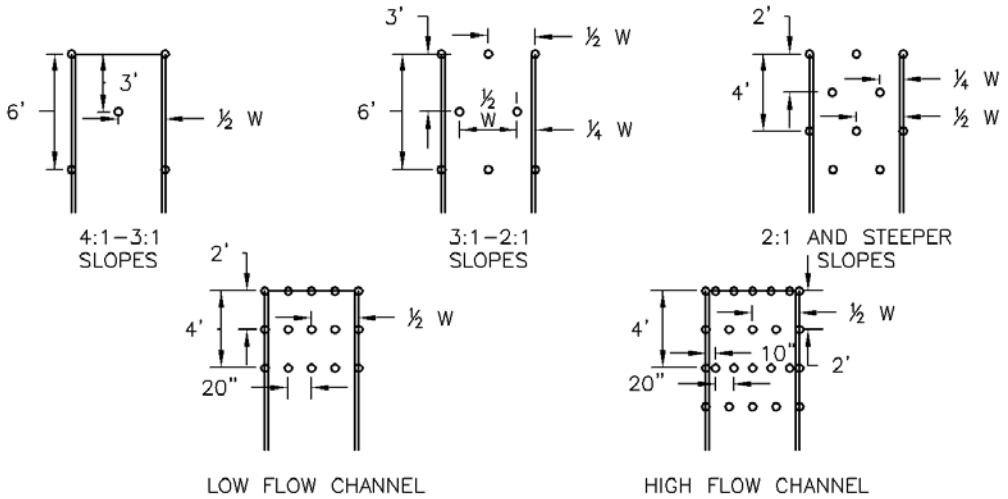

ECB
UNDISTURBED SOIL
PERIMETER ANCHOR TRENCH, TYP.
JOINT ANCHOR TRENCH, TYP.
TOP OF CHANNEL BANK
TYPE OF ECB AS INDICATED IN PLAN VIEW. INSTALL IN ALL DISTURBED AREAS OF STREAMS AND DRAINAGE CHANNELS TO DEPTH D ABOVE CHANNEL INVERT. ECB SHALL GENERALLY BE ORIENTED PARALLEL TO FLOW DIRECTION (I.E. LONG DIMENSIONS OF BLANKET PARALLEL TO FLOWLINES) STAKING PATTERN SHALL MATCH ECB AND/OR CHANNEL TYPE.
ECB–1. PIPE OUTLET TO DRAINAGEWAY
JOINT ANCHOR TRENCH, TYP.
TYPE OF ECB, INDICATED IN PLAN VIEW
6" TOPSOIL
M
ECB SHALL EXTEND TO THE TOP OF THE CHANNEL
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)
ECB–2. SMALL DITCH OR DRAINAGEWAY
ANCHOR DETAILS
GEOTEXTILE FABRIC OR MAT, TYP.
3" MIN, TYP.
6" MIN, TYP.
SINGLE EDGE STAKE, TYP.
COMPACTED BACKFILL, TYP.
PERIMETER ANCHOR TRENCH
TWO EDGES OF TWO ADJACENT ROLLS
JOINT ANCHOR TRENCH
LOOP FROM MIDDLE OF ROLL
INTERMEDIATE ANCHOR TRENCH
FLOW
6"
OVERLAPPING JOINT
3" MIN.
12" MIN.
WOOD STAKE DETAIL



ECB–3. OUTSIDE OF DRAINAGEWAY



STAKING PATTERNS BY ECB TYPE



STAKING PATTERNS BY SLOPE OR CHANNEL TYPE

EROSION CONTROL BLANKET INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF ECB.
   - –TYPE OF ECB (STRAW, STRAW–COCONUT, COCONUT, OR EXCELSIOR).
   - –AREA, A, IN SQUARE YARDS OF EACH TYPE OF ECB.

2. 100% NATURAL AND BIODEGRADABLE MATERIALS ARE PREFERRED FOR RECPs, ALTHOUGH SOME JURISDICTIONS MAY ALLOW OTHER MATERIALS IN SOME APPLICATIONS.

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

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)

Rough Cut Street Control (RCS) EC-9

Description

Rough cut street controls are rock or earthen berms placed along dirt roadways that are under construction or used for construction access. These temporary berms intercept sheet flow and divert runoff from the roadway, and control erosion by minimizing concentration of flow and reducing runoff velocity.

Photograph RCS-1. Rough cut street controls.

Appropriate Uses

Appropriate uses include:

- Temporary dirt construction roadways that have not received roadbase.
- Roadways under construction that will not be paved within 14 days of final grading, and that have not yet received roadbase.

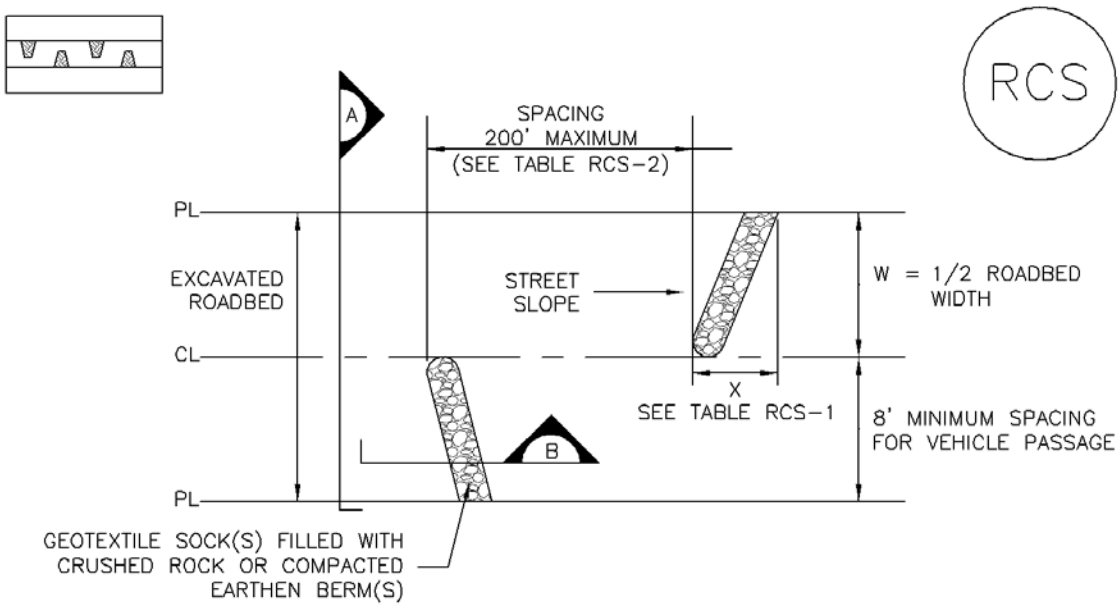
Design and Installation

Rough cut street controls are designed to redirect sheet flow off the dirt roadway to prevent water from concentrating and eroding the soil. These controls consist of runoff barriers that are constructed at intervals along the road. These barriers are installed perpendicular to the longitudinal slope from the outer edge of the roadside swale to the crown of the road. The barriers are positioned alternately from the right and left side of the road to allow construction traffic to pass in the lane not barred. If construction traffic is expected to be congested and a vehicle tracking control has been constructed, rough-cut street controls may be omitted for 400 feet from the entrance. Runoff from the controls should be directed to another stormwater BMP such as a roadside swale with check dams once removed from the roadway. See Detail RCS-1 for additional information.

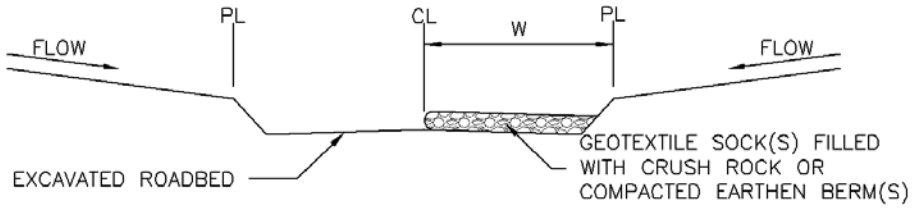
Maintenance and Removal

Inspect street controls for erosion and stability. If rills are forming in the roadway or cutting through the control berms, place the street controls at shorter intervals. If earthen berms are used, periodic recompaction may be necessary. When rock berms are used, repair and/or replace as necessary when damaged. Street controls may be removed 14 days prior to road surfacing and paving.

Rough Cut Street Control	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No



ROUGH CUT STREET CONTROL PLAN



SECTION A

SECTION B

TABLE RCS-1

W (FT)	X (FT)
20-30	5
31-40	7
41-50	9
51-60	10.5
61-70	12

TABLE RCS-2

LONGITUDINAL STREET SLOPE (%)	SPACING (FT)
<2	NOT TYPICALLY NEEDED
2	200
3	200
4	150
5	100
6	50
7	25
8	25

RCS-1. ROUGH CUT STREET CONTROL

ROUGH CUT STREET CONTROL INSTALLATION NOTES

1. SEE PLAN VIEW FOR
   –LOCATION OF ROUGH CUT STREET CONTROL MEASURES.

2. ROUGH CUT STREET CONTROL SHALL BE INSTALLED AFTER A ROAD HAS BEEN CUT IN, AND WILL NOT BE PAVED FOR MORE THAN 14 DAYS OR FOR TEMPORARY CONSTRUCTION ROADS THAT HAVE NOT RECEIVED ROAD BASE.

ROUGH CUT STREET CONTROL 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.

(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.

Sediment Basin (SB) SC-7

Description

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.

Photograph SB-1. Sediment basin at the toe of a slope. Photo courtesy of WWE.

Appropriate Uses

Most large construction sites (typically greater than 2 acres) will require one or more sediment basins for effective management of construction site runoff. On linear construction projects, sediment basins may be impractical; instead, sediment traps or other combinations of BMPs may be more appropriate.

Sediment basins should not be used as stand-alone sediment controls. Erosion and other sediment controls should also be implemented upstream.

When feasible, the sediment basin should be installed in the same location where a permanent post-construction detention pond will be located.

Design and Installation

The design procedure for a sediment basin includes these steps:

- **Basin Storage Volume**: Provide a storage volume of at least 3,600 cubic feet per acre of drainage area. To the extent practical, undisturbed and/or off-site areas should be diverted around sediment basins to prevent "clean" runoff from mixing with runoff from disturbed areas. For undisturbed areas (both on-site and off-site) that cannot be diverted around the sediment basin, provide a minimum of 500 ft^3/acre of storage for undeveloped (but stable) off-site areas in addition to the 3,600 ft^3/acre for disturbed areas. For stable, developed areas that cannot be diverted around the sediment basin, storage volume requirements are summarized in Table SB-1.

- **Basin Geometry:** Design basin with a minimum length-to-width ratio of 2:1 (L:W). If this cannot be achieved because of site space constraints, baffling may be required to extend the effective distance between the inflow point(s) and the outlet to minimize short-circuiting.

- **Dam Embankment**: It is recommended that embankment slopes be 4:1 (H:V) or flatter and no steeper than 3:1 (H:V) in any location.

Sediment Basins	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

- **Inflow Structure**: For concentrated flow entering the basin, provide energy dissipation at the point of inflow.

Table SB-1. Additional Volume Requirements for Undisturbed and Developed Tributary Areas Draining through Sediment Basins

Imperviousness (%)	Additional Storage Volume (ft^3) Per Acre of Tributary Area
Undeveloped	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

- **Outlet Works**: The outlet pipe shall extend through the embankment at a minimum slope of 0.5 percent. Outlet works can be designed using one of the following approaches:

  - **Riser Pipe (Simplified Detail):** Detail SB-1 provides a simplified design for basins treating no more than 15 acres.

  - **Orifice Plate or Riser Pipe**: Follow the design criteria for Full Spectrum Detention outlets in the EDB Fact Sheet provided in Chapter 4 of this manual for sizing of outlet perforations with an emptying time of approximately 72 hours. In lieu of the trash rack, pack uniformly sized 1½ - to 2-inch gravel in front of the plate or surrounding the riser pipe. This gravel will need to be cleaned out frequently during the construction period as sediment accumulates within it. The gravel pack will need to be removed and disposed of following construction to reclaim the basin for use as a permanent detention facility. If the basin will be used as a permanent extended detention basin for the site, a trash rack will need to be installed once contributing drainage areas have been stabilized and the gravel pack and accumulated sediment have been removed.

  - **Floating Skimmer**: If a floating skimmer is used, install it using manufacturer's recommendations. Illustration SB-1 provides an illustration of a Faircloth Skimmer Floating Outlet™, one of the more commonly used floating skimmer outlets. A skimmer should be designed to release the design volume in no less than 48 hours. The use of a floating skimmer outlet can increase the sediment capture efficiency of a basin significantly. A floating outlet continually decants cleanest water off the surface of the pond and releases cleaner water than would discharge from a perforated riser pipe or plate.

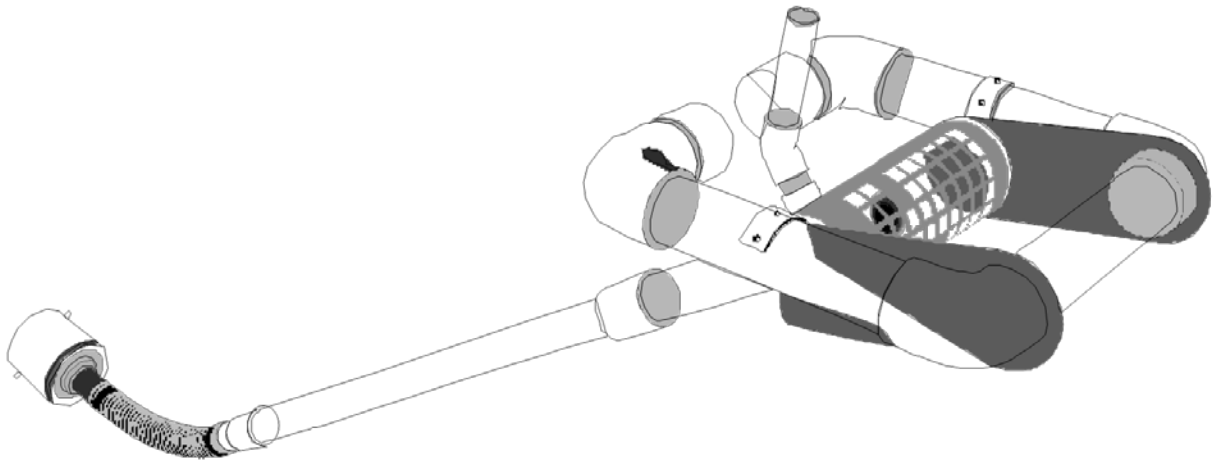


Illustration SB-1. Outlet structure for a temporary sediment basin - Faircloth Skimmer Floating Outlet. Illustration courtesy of J. W. Faircloth & Sons, Inc., FairclothSkimmer.com.

- **Outlet Protection and Spillway:** Consider all flow paths for runoff leaving the basin, including protection at the typical point of discharge as well as overtopping.
  - **Outlet Protection:** Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material of the waterway into which discharge occurs. This may require the use of a riprap apron at the outlet location and/or other measures to keep the waterway from eroding.
  - **Emergency Spillway:** Provide a stabilized emergency overflow spillway for rainstorms that exceed the capacity of the sediment basin volume and its outlet. Protect basin embankments from erosion and overtopping. If the sediment basin will be converted to a permanent detention basin, design and construct the emergency spillway(s) as required for the permanent facility. If the sediment basin will not become a permanent detention basin, it may be possible to substitute a heavy polyvinyl membrane or properly bedded rock cover to line the spillway and downstream embankment, depending on the height, slope, and width of the embankments.

Maintenance and Removal

Maintenance activities include the following:

- Dredge sediment from the basin, as needed to maintain BMP effectiveness, typically when the design storage volume is no more than one-third filled with sediment.
- Inspect the sediment basin embankments for stability and seepage.
- Inspect the inlet and outlet of the basin, repair damage, and remove debris. Remove, clean and replace the gravel around the outlet on a regular basis to remove the accumulated sediment within it and keep the outlet functioning.
- Be aware that removal of a sediment basin may require dewatering and associated permit requirements.
- Do not remove a sediment basin until the upstream area has been stabilized with vegetation.

Final disposition of the sediment basin depends on whether the basin will be converted to a permanent post-construction stormwater basin or whether the basin area will be returned to grade. For basins being converted to permanent detention basins, remove accumulated sediment and reconfigure the basin and outlet to meet the requirements of the final design for the detention facility. If the sediment basin is not to be used as a permanent detention facility, fill the excavated area with soil and stabilize with vegetation.

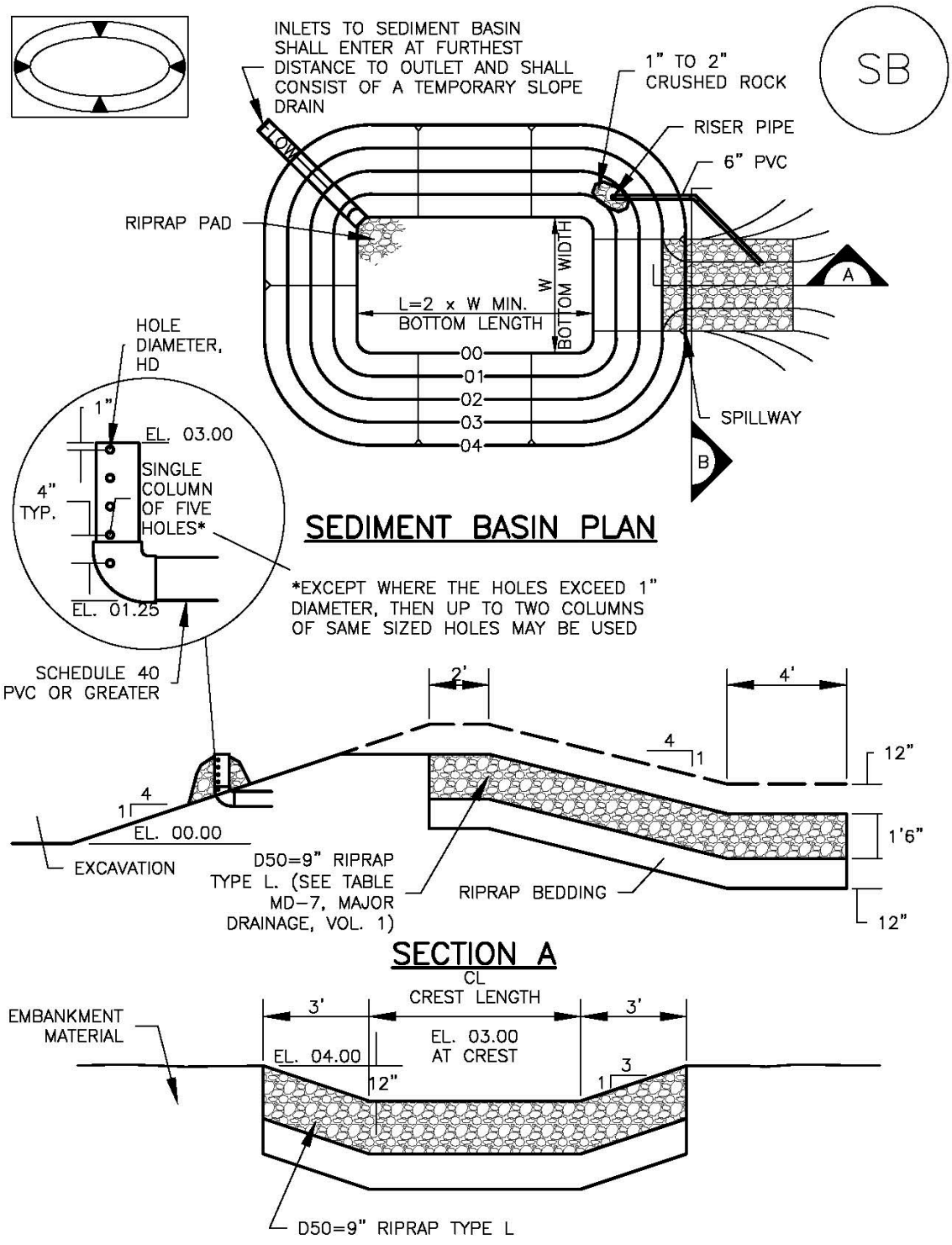

SB
INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
FLOW
1" TO 2" CRUSHED ROCK
RISER PIPE
6" PVC
RIPRAP PAD
W BOTTOM WIDTH
L=2 x W MIN. BOTTOM LENGTH
00
01
02
03
04
A
B
SPILLWAY
HOLE DIAMETER, HD
1"
EL. 03.00
4" TYP.
SINGLE COLUMN OF FIVE HOLES*
EL. 01.25
SCHEDULE 40 PVC OR GREATER
SEDIMENT BASIN PLAN
*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED
2'
4'
4
1
12"
4
1
EL. 00.00
1'6"
EXCAVATION
D50=9" RIPRAP TYPE L. (SEE TABLE MD-7, MAJOR DRAINAGE, VOL. 1)
RIPRAP BEDDING
12"
SECTION A
CL
CREST LENGTH
3'
3'
EMBANKMENT MATERIAL
EL. 04.00
EL. 03.00 AT CREST
12"
3
1
D50=9" RIPRAP TYPE L

TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 ½	2	9/32
2	21	3	13/16
3	28	5	½
4	33 ½	6	9/16
5	38 ½	8	21/32
6	43	9	21/32
7	47 ¼	11	25/32
8	51	12	27/32
9	55	13	⅞
10	58 ¼	15	15/16
11	61	16	31/32
12	64	18	1
13	67 ½	19	1 1/16
14	70 ½	21	1 ⅛
15	73 ¼	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

SEDIMENT BASIN 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 IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).

5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.

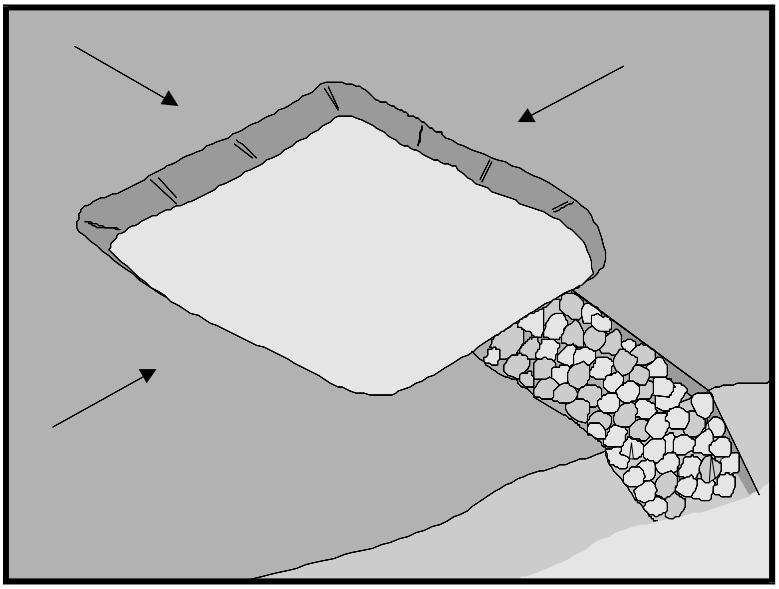
6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

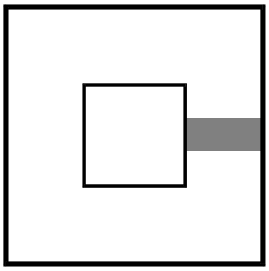
(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

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.

Sediment Trap

SC-3





Standard Symbol

BMP Objectives

- ○ Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

A sediment trap is a temporary containment area that allows sediment in collected storm water to settle out during infiltration or before the runoff is discharged through a stabilized spillway. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

Appropriate Applications

- Sediment traps may be used on construction projects where the drainage area is less than 2 ha (5 ac). Traps should be placed where sediment-laden storm water enters a storm drain or watercourse.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Resident Engineer (RE).
- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 2 ha (5 ac).
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Not to be located in live streams.
- Size may be limited by availability of right-of-way.

Standards and Specifications

- Construct sediment traps prior to rainy season and construction activities.
- Trap shall be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap shall be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 130 m3/ha (67 yd3/ac) and 65 m3/ha (33 yd3/ac) of contributing drainage area, respectively, based on 12.7 mm (0.5 in) of runoff volume over a 24-hr period. Multiple traps and/or additional volume may be required to accommodate site specific rainfall and soil conditions.
- Traps with an impounding levee greater than 1.5 m (5 ft) tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 1000 cubic meters (35,300 cubic feet), shall be designed by a professional Civil Engineer registered with the state of California. The design must be submitted to the Resident Engineer (RE) for approval at least 7 days prior to the basin construction. The design shall include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- Earthwork shall be in accordance with Standard Specifications Section 19 – "Earthwork". Contractor is specifically directed to Standard Specifications Sections 19-5 and 19-6 entitled, "Compaction" and "Embankment Construction," respectively.
- Areas under embankments, structural works, and sediment traps shall be cleared and stripped of vegetation in accordance with Standard Specifications Section 16 – "Clearing and Grubbing."
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing, in accordance with Standard Specifications Section 80 – "Fencing," shall be provided to prevent unauthorized entry.

Maintenance and Inspection

- Inspect sediment traps before and after rainfall events and weekly during the rest of the rainy season. During extended rainfall events, inspect sediment traps at least every 24 hours.
- If captured runoff has not completely infiltrated within 72 hours then the sediment trap must be dewatered.
- Inspect trap banks for embankment seepage and structural soundness.

- Inspect outlet structure and rock spillway for any damage or obstructions. Repair damage and remove obstructions as needed or as directed by the RE.
- Inspect outlet area for erosion and stabilize if required, or as directed by the RE.
- Remove accumulated sediment when the volume has reached one-third the original trap volume.
- Properly disposed of sediment and debris removed from the trap.
- Inspect fencing for damage and repair as needed or as directed by the RE.

United States Environmental Protection Agency

Stormwater Best Management Practice

Silt Fences

Minimum Measure

Construction Site Stormwater Runoff Control

Subcategory

Sediment Control

Purpose and Description

Figure 1. *Silt fence retaining sediment*

The purpose of a silt fence is to retain the soil on disturbed land (Figure 1), such as a construction site, until the activities disturbing the land are sufficiently completed to allow revegetation and permanent soil stabilization to begin. Keeping the soil on a construction site, rather than letting it be washed off into natural water bodies (e.g., streams, rivers, ponds, lakes, estuaries) prevents the degradation of aquatic habitats and siltation of harbor channels. And not letting soil wash off onto roads, which readily transport it to storm sewers, avoids having sewers clogged with sediment. The cost of installing silt fences on a watershed's construction sites is considerably less than the costs associated with losing aquatic species, dredging navigation channels, and cleaning sediment out of municipal storm sewers.

A silt fence is a temporary sediment barrier made of porous fabric. It's held up by wooden or metal posts driven into the ground, so it's inexpensive and relatively easy to remove. The fabric ponds sediment-laden stormwater runoff, causing sediment to be retained by the settling processes. A single 100 foot (ft) run of silt fence may hold 50 tons of sediment in place. Most construction sites today do have silt fences. But many do not work effectively because they are not well designed, installed, or maintained. The focus of this fact sheet is—how to make silt fences work.

Design

The three principal aspects of silt fence design are: proper placement of fencing, adequate amount of fencing, and appropriate materials.

Proper Placement of Fencing

Placement is important because where a fence starts, runs, and ends is critical to its effectiveness. Improper placement can make the fence a complete waste of money. Analyze the construction site's contours to determine the proper placement. Segment the site into manageable sediment storage areas for using multiple silt fence runs. The drainage area above any fence should usually not exceed a quarter of an acre. Water flowing over the top of a fence during a normal rainfall indicates the drainage area is too large. An equation for calculating the maximum drainage area length above a silt fence, measured perpendicular to the fence, is given in Fifield, 2011. Avoid long runs of silt fence because they concentrate the water in a small area where it will easily overflow the fence. The lowest point of the fence in Figure 4 is indicated by a red arrow. Water is directed to this low point by both long runs of fence on either side of the arrow. Most of the water overflows the fence at this low point and little sediment is trapped for such a long fence.

Figure 2. *Create manageable sediment storage areas*

Figure 3. *Water should not flow over the filter fabric during a normal rainfall*

Figure 4. *Avoid long runs of silt fence*

Use J-hooks as shown in Figures 5 and 6, which have ends turning up the slope to break up long fence runs and provide multiple storage areas that work like mini-retention areas. If the fence doesn't create a ponding condition, it will not work well. The silt fence in Figure 7 doesn't pond water or retain sediment. Stormwater will run around the fence carrying sediment to the street, which will transport the water and its sediment load to the storm sewer inlet.

Figure 5. *Use J-hook fences to break up long fence runs*

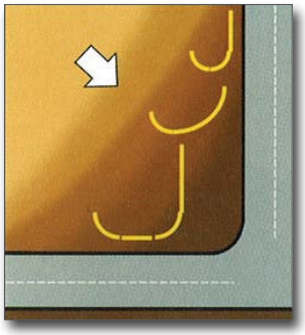


Figure 6. *J-hook silt fences provide multiple storage areas*

Figure 7. *This silt fence doesn't work*

Water flowing around the ends of a silt fence will cause additional erosion and defeat its purpose. The bottom of each end of the fence should be higher than the top of the middle of the fence (Figure 8). This insures that during an unusually heavy rain, water will flow over the top rather than around either end of the fence. Only fine suspended material will spill over the top, which is not as harmful as having erosion at the ends. When there is a long steep slope, install one fence near the head of the slope to reduce the volume and velocity of water flowing down the slope, and another fence 6–10 ft from the toe of the slope to create a sediment storage area near the bottom. A common misconception is that you only have to worry about water running off steep slopes. However, steep slopes may have a relatively small water collection area. The total drainage area of a gentle slope, if large (Figure 10), can be more important than its slope in determining sediment loss. A silt fence should not be placed in a channel with continuous flow (channels in Figures 8 and 9 don't have a continuous flow), nor across a narrow or steep-sided channel. But when necessary a silt fence can be placed parallel to the channel to retain sediment before it enters the watercourse.

Figure 8. *Proper installation, bottom of both ends are above the top of the middle*

Figure 9. *Poor installation, water can flow around the ends causing additional erosion*

Figure 10. *Gentle slopes may require a silt fence*

Paved streets are major conduits of stormwater and silt, and they drain to storm sewer inlets. The best solution is to retain as much sediment as possible before it reaches paved surfaces. Install a silt fence at the inlet side of a storm sewer or culvert, rather than at the discharge where there is greater velocity and less storage area. Streets cut in the grade, but not yet paved, are also prime erosion conduits. If the streets are not going to be paved right away, they need a containment barrier such as a silt fence. Finally as a construction site's dynamics change, the silt fence layout should be adjusted when necessary to maintain its effectiveness.

Designers and contractors should also consider diverting sediment-laden runoff water to a sediment detention pond. If the site can provide a large enough area, this is usually the most effective and economical best management practice for retaining sediments. Silt fences are needed when there is insufficient space for a detention pond or when roads and other structures are in the way.

Adequate Amount of Fencing

The amount of fencing means the total linear length of the silt fencing runs on the construction site. A reasonable rule-of-thumb for the proper amount of silt fence is—100 ft of silt fence per 10,000 square foot (sq ft) of disturbed area. Soil type, slope, slope length, rainfall, and site configuration are all important elements in determining the adequate silt fence protection for a site, and to what extent it fits the 100 ft per 10,000 sq ft rule-of-thumb. If the amount of fencing provides the volume of runoff storage needed, then over-flowing the silt fence runs will be minimized. This is the basic test; if fences are over-flowing after a moderate rainfall event, the amount of fencing probably needs to be increased to avoid undercutting, washouts, and fence failures.

Appropriate Materials

There are different types of porous fabrics available, e.g., woven, non-woven, mono-filament, but all types tend to clog rapidly and don't provide lasting filtration. The support posts and installation method are more important than the fabric type for overall sediment retention. However, a lightweight fabric tends to tear where it is attached to the posts. Posts must hold the fabric up and support the horizontal load of retained water and sediment. Hardwood posts (2″ x 2″) are potentially strong enough to support the loads, but are difficult to drive into the ground more than 6–8″. To hold 2 ft of sediment and water, the posts should be driven 2 ft into the ground. Steel posts are best because they can be driven into compacted soil to a depth of 2 ft. The support posts should be spaced 3–4 ft apart where water may run over the top of the fence, 5 ft in most other areas, and 6–7 ft where there isn't a considerable horizontal load. Improper post depth and spacing is often the cause of sagging fabric and falling posts. Some authorities believe a more robust wire or chain link supported silt fence is needed to withstand heavy rain events. However, this may double the cost of a silt fence installation and entails disposing of more material in a landfill when the fence is removed. Installing silt fencing having five interacting features: (1) proper placement based on the site's contours, (2) adequate amount of fencing without long runs, (3) heavy porous filter fabric, (4) metal posts with proper depth and spacing, and (5) tight soil compaction on both sides of the silt fence will usually obviate the need for wire or chain link reinforced fencing. Prefabricated silt fences, e.g., fabric attached to wooden posts in a 100 ft package, doesn't provide for posting after the ground is compacted or allow variable post spacing.

Figure 11. *Chain link supported silt fence*

Silt Fence Installation

Two commonly used approaches for installing silt fences are the static slicing method and the trenching method.

Static Slicing Method

The static slicing machine pulls a narrow blade through the ground to create a slit 12″ deep, and simultaneously inserts the silt fence fabric into this slit behind the blade. The blade is designed to slightly disrupt soil upward next to the slit and to minimize horizontal compaction, thereby creating an optimum condition for compacting the soil vertically on both sides of the fabric. Compaction is achieved by rolling a tractor wheel along both sides of the slit in the ground 2 to 4 times to achieve nearly the same or greater compaction as the original undisturbed soil. This vertical compaction reduces the air spaces between soil particles, which minimizes infiltration. Without this compaction infiltration can saturate the soil, and water may find a pathway under the fence. When a silt fence is holding back several tons of accumulated water and sediment, it needs to be supported by posts that are driven 2 ft into well-compacted soil. Driving in the posts and attaching the fabric to them completes the installation.

Figure 12. *Static slicing machine*

Figure 13. *Tractor wheel compacting the soil*

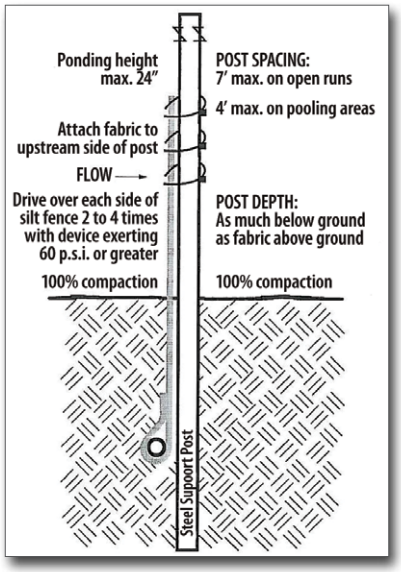


Figure 14. *Silt fence installation using the static slicing method*

Trenching Method

Trenching machines have been used for over twenty-five years to dig a trench for burying part of the filter fabric underground. Usually the trench is about 6″ wide with a 6″ excavation. Its walls are often more curved than vertical, so they don't provide as much support for the posts and fabric. Turning the trencher is necessary to maneuver around obstacles, follow terrain contours or property lines, and install upturns or J-hooks. But trenchers

Figure 15. *Trenchers make a wider excavation at turns*

Figure 16. *Poor compaction has resulted in infiltration and water flowing under this silt fence causing retained sediment washout*

can't turn without making a wider excavation, and this results in poorer soil compaction, which allows infiltration along the underground portion of the fence. This infiltration leads to water seeking pathways under the fence, which causes subsequent soil erosion and retained sediment washout under the fence. The white line on the fence in Figure 16 and red arrow both mark the previous sediment level before the washout. Post setting and fabric installation often precede compaction, which make effective compaction more difficult to achieve. EPA supported an independent technology evaluation (ASCE 2001), which compared three progressively better variations of the trenching method with the static slicing method. The static slicing method performed better than the two lower performance levels of the trenching method, and was as good or better than the trenching method's highest performance level. The best trenching method typically required nearly triple the time and effort to achieve results comparable to the static slicing method.

Proper Attachment

Regardless of the installation method, proper attachment of the fabric to the posts is critical to combining the strength of the fabric and support posts into a unified structure. It must be able to support 24″ of sediment and water. For steel posts use three plastic ties per post (50 lb test strength), located in the top 8″ of the fabric, with each tie hung on a post nipple, placed diagonally to attach as many vertical and horizontal threads as possible. For wooden posts use several staples per post, with a wood lath to overlay the fabric.

Perimeter Silt Fences

When silt fences are placed around the perimeter of a stock pile or a construction site, the conventional silt fence design and materials discussed previously may not be sufficient.

Stock pile example. A stock pile of dirt and large rocks is shown in Figures 17 and 18 with a silt fence protecting a portion of its perimeter. Rocks that roll down the pile would likely damage a conventional silt fence. The bottom of the porous fabric is held firmly against both the ground and base of precast concrete, highway, barriers by light-colored stones. An alternative installation would be having the concrete barriers rest directly on the bottom edge of the filter fabric, which would extend under the barriers about 10″, so the barriers' weight will press the fabric against the ground to prevent washout. Water passing through the silt fence (red arrow in Figure 18) flows to a storm sewer culvert inlet, which is surrounded by a fabric silt fence (yellow arrows in Figures 17 and 18) that reduces the runoff's velocity and allows settling before the water is discharged to a creek.

Figure 17. *Back of silt fence on part of the stock pile's perimeter*

Figure 18. *Front of silt fence on part of stock pile's perimeter*

Bridge abutment example. During the construction of a bridge over a river between two lakes, an excavation on the river bank was needed to pour footings for the bridge abutment. The silt fence along the excavation's perimeter, composed of concrete highway barriers with orange filter fabric, was designed to prevent stormwater from washing excavated spoil into the river and to fend off the river during high flows. A portion of the orange filter fabric that has blown away from the concrete barriers shows the need to overlap and reinforce the joints where two sections of filter fabric are attached.

Figure 19. *Silt fence for bridge abutment excavation*

Highway example. Because of the proximity of a construction site to a highway, a concrete barrier was required by Minnesota's DOT to protect the highway and an underground fiber optic cable next to the highway from construction activities. The concrete barrier was used to support a silt fence along the perimeter of a large amount of dirt that was stock piled before being used for fill at a different location.

Figure 20. *Silt fence protecting a highway and underground fiber optics cable*

Figure 21. *Silt fence protecting a lake shore*

Lake shore example. The lake's shoreline is being restored with plant plugs and seeded with native plant species. A plywood, perimeter, silt fence is used to trap sediment from a construction site on the right-side of the picture, protect the lake shore from boat-wake erosion, and to prevent geese from eating the seeds and young plants. This fencing will be removed when 70% vegetative cover is achieved.

Inspection and Maintenance

Figure 22. *A silt fence full of sediment that needs maintenance*

Silt fences should be inspected routinely and after runoff events to determine whether they need maintenance because they are full (Figure 22) or damaged by construction equipment. The ASTM silt fence specification (ASTM 2003) recommends removing sediment deposits from behind the fence when they reach half the height of the fence or installing a second fence. However, there are several problems associated with cleaning out silt fences. Once the fabric is clogged with sediment, it can no longer drain slowly and function as originally designed. The result is normally a low volume sediment basin because the cleaning process doesn't unclog the fabric. The soil is normally very wet behind a silt fence, inhibiting the use of equipment needed to move it. A back hoe is commonly used, but, if the sediment is removed, what is to be done with it during construction? Another solution is to leave the sediment in place where it is stable and build a new silt fence above or below it to collect additional sediment as shown in Figure 23. The proper maintenance may be site specific, e.g. small construction sites might not have sufficient space for another silt fence. Adequate access to the sediment control devices should be provided so inspections and maintenance can be performed.

Figure 23. *New silt fence below the old fence*

Permanent Soil Stabilization

When the land disturbing activities are sufficiently completed to allow permanent soil stabilization on the site, the silt fences and sediment basins are removed. The fabric and damaged posts go to the landfill. Steel posts and some of the wooden posts can be reused. Then the sediment is spread over the site to provide fertile soil, and the area can be seeded and mulched to support revegetation.

References

ASCE 2001. Environmental Technology Verification Report for Installation of Silt Fence Using the Tommy Static Slicing Method, CERF Report #40565. Washington, DC: American Society of Civil Engineers. www.epa.gov/etv/pubs/08_vs_tommy.pdf

ASTM 2003. Standard Practice for Silt Fence Installation, D 6462-03(2008). West Conshohocken, PA: American Society of Testing Materials International. www.astm.org/SEARCH/search-reskin.html?query=D6462-03&siteType=store-standards&searchType=standards-full

Carpenter, Thomas 2000. Silt Fence That Works. Ankey, Iowa: Thomas Carpenter. www.tommy-sfm.com/pages/resources/Silt%20Fence%20That%20Works%20Manual.pdf

Fifield, Jerald S. 2011. Designing and Reviewing Effective Sediment and Erosion Control Plans, 3rd Edition. Santa Barbara, CA: Forester Press.

U.S. Environmental Protection Agency 2007. Developing Your Stormwater Pollution Prevention Plan, EPA 833-R-06-004. Washington: EPA. Available from EPA hardcopy 800-490-9198 or www.epa.gov/npdes/pubs/sw_swppp_guide.pdf

Photograph Credits

Figures 1–10, 12-16, 22, 23. *Thomas Carpenter, CPESC, Carpenter Erosion Control*

Figure 11. *Pete Schumann, Fairfax County, Virginia, Department of Public Works and Environmental Services*

Figure 17–21. *Dwayne Stenlund, CPESC, Minnesota Department of Transportation*

SS-11 SLOPE DRAINS

A slope drain conveys water down a slope into a stabilized receiving water, trapping device, or stabilized area. Slope drains are used with lined ditches to convey surface flow away from slope areas to protect cut or fill slopes.

Applications

Where concentrated flows are directed over a slope

Key Points

Key Point #1 – Limitations

Severe erosion may result if a slope drain fails due to over topping or pipe separation.

Key Point #2 – Drainage Constraints

Limit the area draining to a slope drain to 4 ha (10 ac) per pipe. Large areas may require the use of a rock-lined channel or a series of pipes. The maximum slope gradient is generally limited to 1:2 (V:H), as the ability to dissipate water velocity from steeper slopes is difficult.

Key Point #3 – Installation

Install slope drains perpendicular to the slope contour (Photo 1). Compact the soil around and under the slope drain inlet, outlet, and along the length of the pipe. Protect the pipe inlet with filter fabric or flared end sections for pipes that are greater than 300 mm (12 in) in diameter. Ensure that pipe connections are watertight. Securely anchor and stabilize the pipe and appurtenances into the soil.

Photo 1

Key Point #4 – Velocity Dissipation

Protect outlet with riprap or velocity dissipation devices. For high-velocity discharges, reinforce riprap with concrete or reinforced concrete devices. It may be necessary to capture discharge and allow sediment to settle out.

Key Point #5 – Inspection and Maintenance

Inspect before and after each rain event and twice monthly until the tributary drainage area has been stabilized. Inspect outlets for erosion and downstream scour. In the event of scour, reduce the flows going into the channel unless other preventive measures can be implemented.

Preventive Measures and Troubleshooting Guide

Field Condition:	Common solutions are:
Pipe separates.	Reconnect pipe sections. Securely anchor and stabilize pipe into soil. Ensure that pipe connections are watertight.
Pipe outlet erodes.	Repair damage and stabilize outlet with a flared end section, riprap, or velocity dissipation device. If necessary, reduce flows being discharged.
Pipe becomes clogged.	Flush out pipe. Place a screen or grate at inlet to capture large particles.
Erosion occurs around inlet.	Stabilize area around inlet with filter fabric or flared end section. Re-grade around inlet to reduce the gradient angle.
Excessive sediment accumulates around inlet/outlet.	Remove accumulated sediment and stabilize upstream area.
Slope drain overtops.	Limit drainage area and flow velocity. Check pipe diameter to ensure that it is sized properly to accept flow. Add additional pipes to carry flows as necessary.

Stockpile Management (SP) MM-2

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.

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.

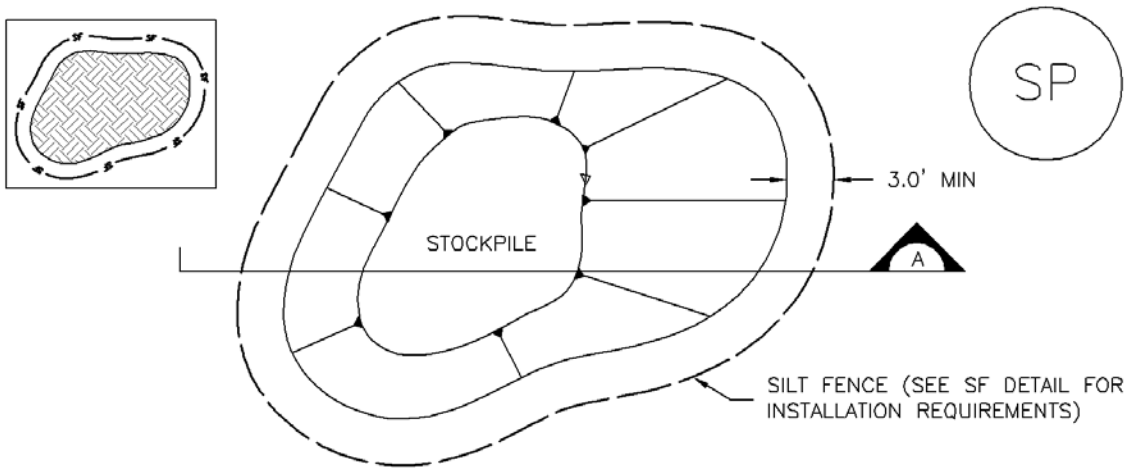
Maintenance and Removal

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.

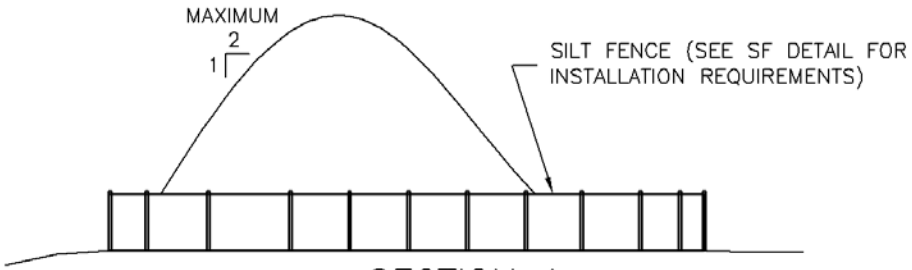
When temporary removal of a perimeter BMP is necessary to access a stockpile, ensure BMPs are reinstalled in accordance with their respective design detail section.

Stockpile Management	
Functions	
Erosion Control	Yes
Sediment Control	Yes
Site/Material Management	Yes

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.



STOCKPILE PROTECTION PLAN



SECTION A

SP–1. STOCKPILE PROTECTION

STOCKPILE PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   –LOCATION OF STOCKPILES.
   –TYPE OF STOCKPILE PROTECTION.

2. 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.

3. 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).

4. 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.

STOCKPILE 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.

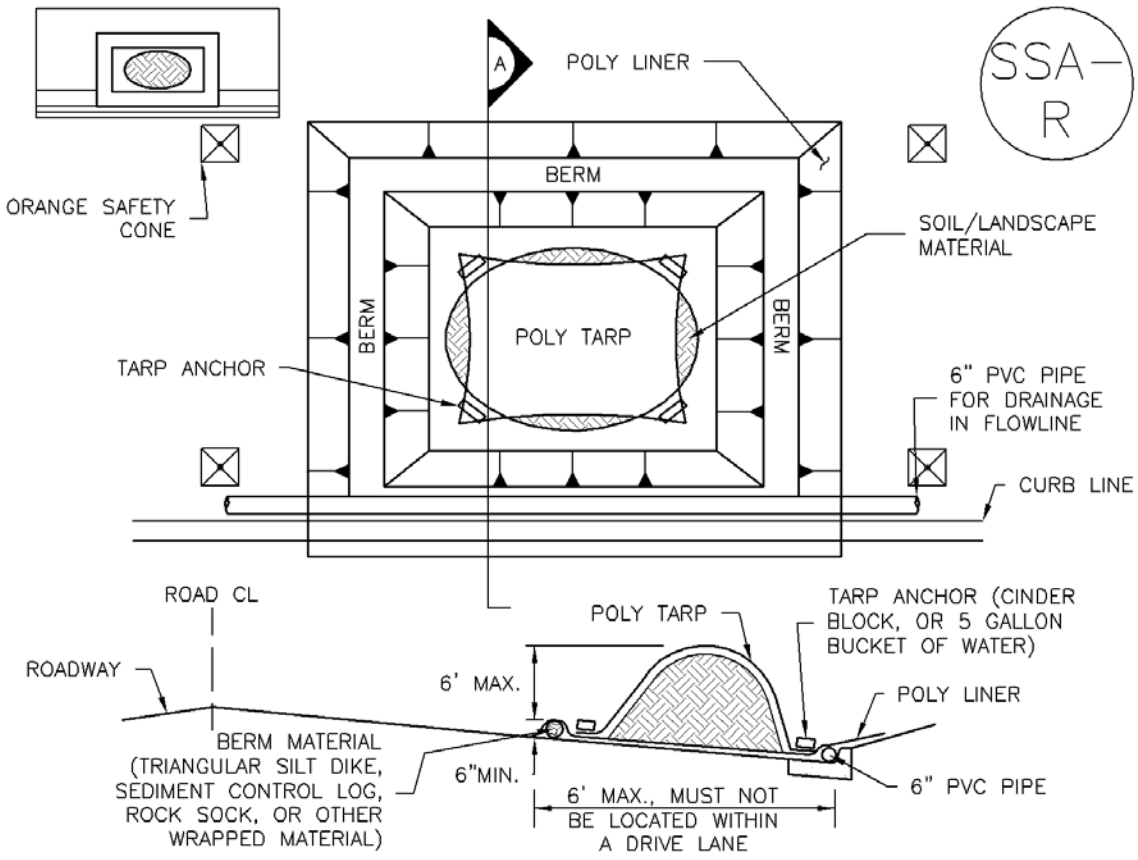
STOCKPILE PROTECTION MAINTENANCE NOTES

4. IF PERIMETER PROTECTION MUST BE MOVED TO ACCESS SOIL STOCKPILE, REPLACE PERIMETER CONTROLS BY THE END OF THE WORKDAY.

5. 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.



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.

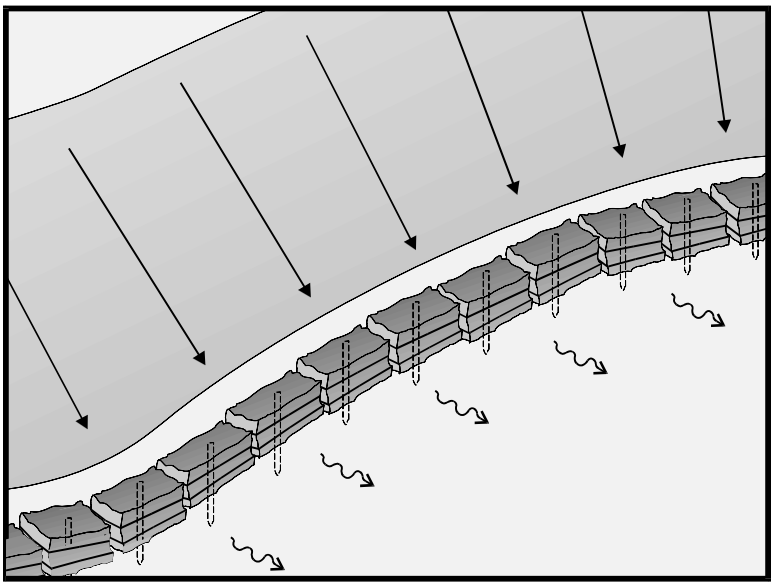
5. CLEAN MATERIAL FROM PAVED SURFACES BY SWEEPING OR VACUUMING.

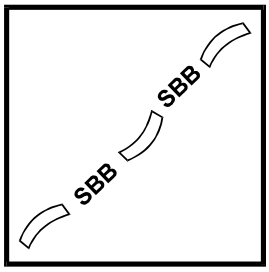
NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM AURORA, COLORADO)

Straw Bale Barrier

SC-9





Standard Symbol

BMP Objectives

- ○ Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

A straw bale barrier is a temporary linear sediment barrier consisting of straw bales, designed to intercept and slow sediment-laden sheet flow runoff. Straw bale barriers allow sediment to settle from runoff before water leaves the construction site.

Appropriate Applications

- This BMP may be implemented on a project-by-project basis in addition to other BMPs when determined necessary and feasible by the Resident Engineer (RE).
- Along the perimeter of a site.
- Along streams and channels.
- Below the toe of exposed and erodible slopes.
- Down slope of exposed soil areas.
- Around stockpiles.
- Across minor swales or ditches with small catchments.
- Around above grade type temporary concrete washouts (See BMP WM-8, “Concrete Waste Management”).
- Parallel to a roadway to keep sediment off paved areas.

Limitations

- Installation can be labor intensive.
- Straw bale barriers are maintenance intensive.
- Degraded straw bales may fall apart when removed or left in place for extended periods.
- Can't be used on paved surfaces.
- Not to be used for drain inlet protection.
- Shall not be used in areas of concentrated flow.
- Can be an attractive food source for some animals.
- May introduce undesirable non-native plants to the area.

Standards and Specifications

Materials

- ***Straw Bale Material:*** Straw bale materials shall conform to the provisions in Standard Specifications Section 20-2.06, "Straw."
- Straw Bale Size: Each straw bale shall be a minimum of 360 mm (14 in) wide, 450 mm (18 in) in height, 900 mm (36 in) in length and shall have a minimum mass of 23 kg (51 lb.) The straw bale shall be composed entirely of vegetative matter, except for the binding material.
- Bale Bindings: Bales shall be bound by either steel wire, nylon or polypropylene string placed horizontally. Jute and cotton binding shall not be used. Baling wire shall be a minimum diameter of 1.57 mm (0.06 inch). Nylon or polypropylene string shall be approximately 2 mm (0.08 inch) in diameter with a breaking strength of 360 N.
- Stakes: Wood stakes shall be commercial quality lumber of the size and shape shown on the plans. Each stake shall be free from decay, splits or cracks longer than the thickness of the stake, or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable. Steel bar reinforcement shall be equal to a number four designation or greater. End protection shall be provided for any exposed bar reinforcement.

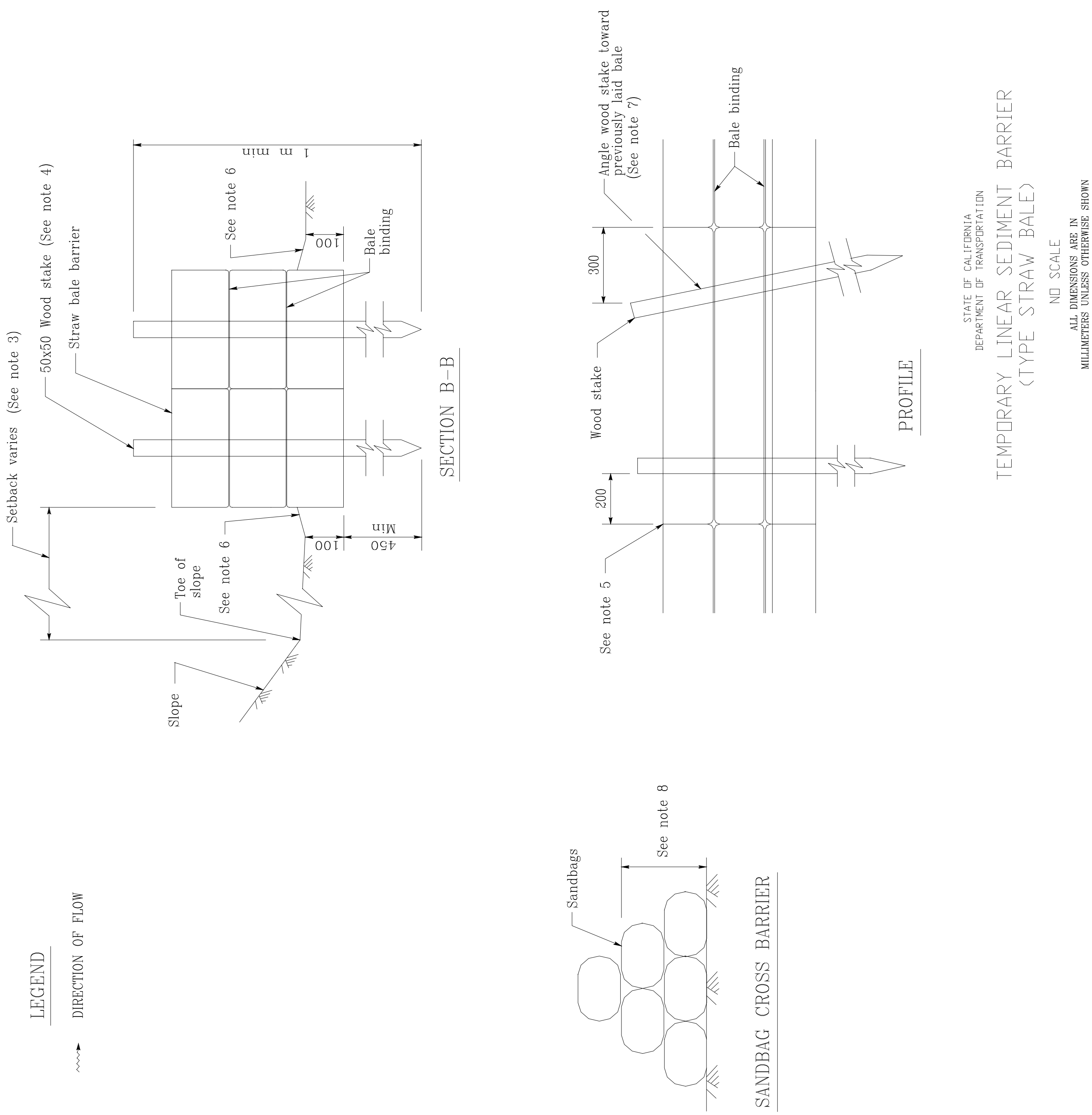
Installation

- Limit the drainage area upstream of the barrier to 0.3 ha/100 m (0.25 ac/100ft) or barrier.
- Limit the slope length draining to the straw bale barrier to 30 m (100 ft.)

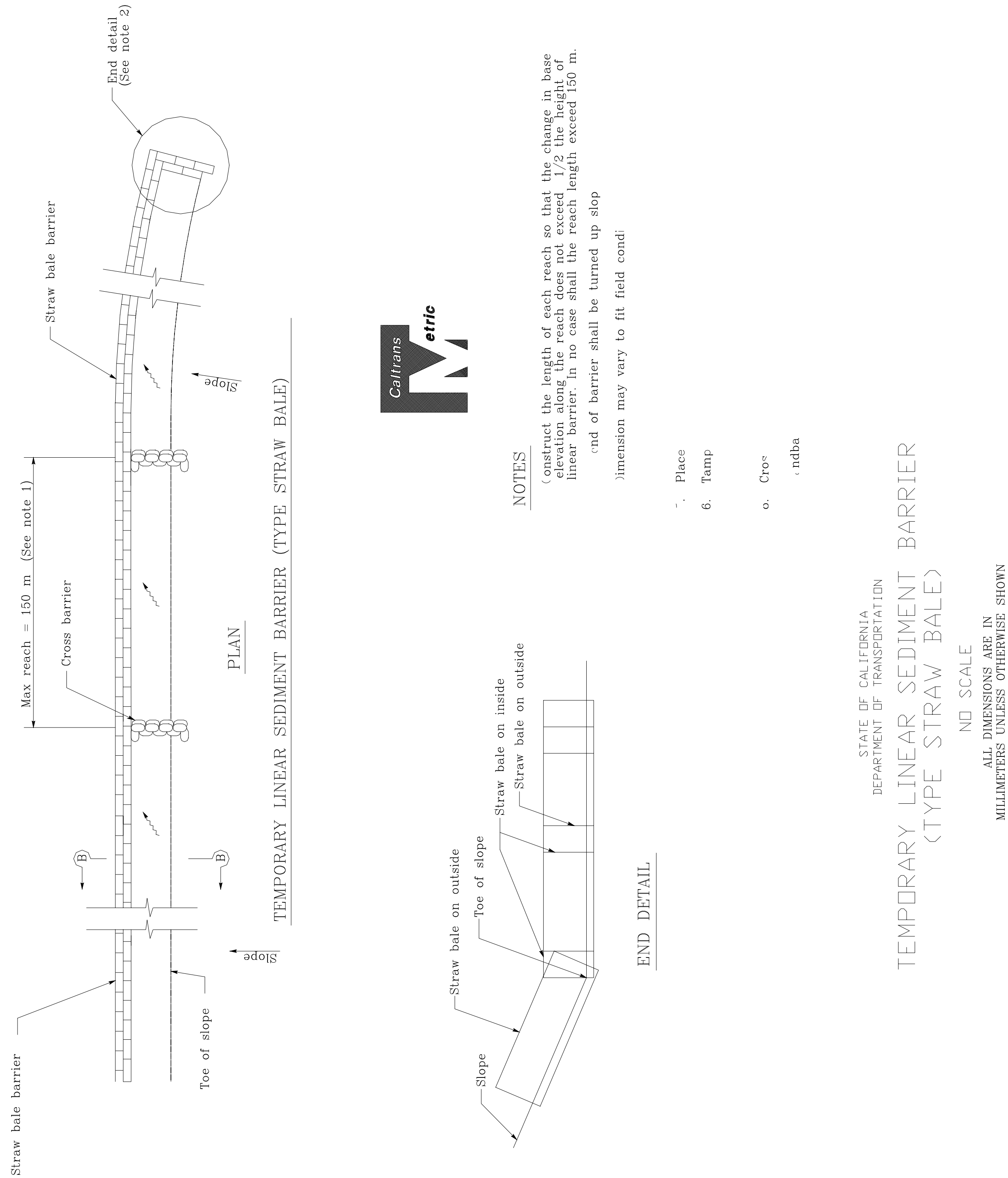
- Slopes of 2:100 (V:H) (2%) or flatter are preferred. If the slope exceeds 1:10 (V:H) (10%), the length of slope upstream of the barrier must be less than 15 m (50 ft).
- Install straw bale barriers along a level contour, with the last straw bale turned up slope.
- Straw bales must be installed in a trench and tightly abut adjacent bales.
- Construct straw bale barriers with a set-back of at least 1 m (3 ft) from the toe of a slope. Where it is determined to be not practical due to specific site conditions, the straw bale barrier may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practical.
- See pages 4 and 5 of this BMP for installation detail.

Maintenance and Inspection

- Inspect straw bale barriers before and after each rainfall event, and weekly throughout the rainy season.
- Inspect straw bale barriers for sediment accumulations and remove sediment when depth reaches one-third the barrier height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.
- Replace or repair damage bales as needed or as directed by the RE.
- Repair washouts or other damages as needed or as directed by the RE.
- Remove straw bales when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilized the area.

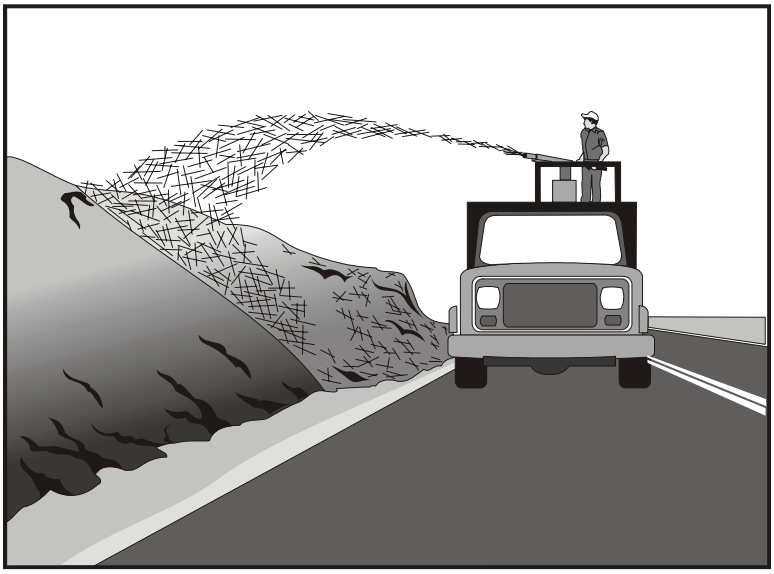


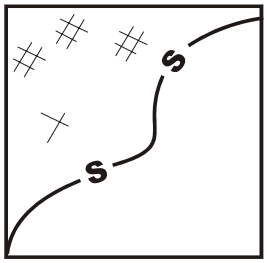
Setback varies (See note 3)
50x50 Wood stake (See note 4)
Straw bale barrier
See note 6
1 m min
100
Bale binding
Toe of slope
See note 6
100
450 Min
Slope
SECTION B-B
Angle wood stake toward previously laid bale (See note 7)
Bale binding
300
Wood stake
200
See note 5
PROFILE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
TEMPORARY LINEAR SEDIMENT BARRIER
(TYPE STRAW BALE)
NO SCALE
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN
LEGEND
DIRECTION OF FLOW
Sandbags
See note 8
SANDBAG CROSS BARRIER


End detail
(See note 2)
Straw bale barrier
Max reach = 150 m (See note 1)
Cross barrier
Slope
Straw bale barrier
Toe of slope
PLAN
TEMPORARY LINEAR SEDIMENT BARRIER (TYPE STRAW BALE)
Caltrans
etric
NOTES
Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of linear barrier. In no case shall the reach length exceed 150 m.
End of barrier shall be turned up slop
Dimension may vary to fit field condi
Place
Tamp
Cros
ndba
Straw bale on inside
Straw bale on outside
Straw bale on outside
Toe of slope
Slope
END DETAIL
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
TEMPORARY LINEAR SEDIMENT BARRIER
(TYPE STRAW BALE)
NO SCALE
ALL DIMENSIONS ARE IN
MILLIMETERS UNLESS OTHERWISE SHOWN

Straw Mulch

SS-6





Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a stabilizing emulsion. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

- Straw mulch is typically used for soil stabilization as a temporary surface cover on disturbed areas until soils can be prepared for revegetation and permanent vegetation is established.
- Also typically used in combination with temporary and/or permanent seeding strategies to enhance plant establishment.

Limitations

- Availability of erosion control contractors and straw may be limited prior to the rainy season due to high demand.
- There is a potential for introduction of weed-seed and unwanted plant material.
- When straw blowers are used to apply straw mulch, the treatment areas must be within 45 m (150 ft) of a road or surface capable of supporting trucks.
- Straw mulch applied by hand is more time intensive and potentially costly.
- May have to be removed prior to permanent seeding or soil stabilization.
- “Punching” of straw does not work in sandy soils.

Standards and Specifications

- Straw shall be derived from wheat, rice, or barley.
- All materials shall conform to Standard Specifications Sections 20-2.06, 20-2.07 and 20-2.11.
- A tackifier is the preferred method for anchoring straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track-walking may also be used to incorporate straw mulch into the soil on slopes. Track walking shall only be used where other methods are impractical.
- Avoid placing straw onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- Straw mulch with tackifier shall not be applied during or immediately before rainfall.

Application Procedures

- Apply loose straw at a minimum rate of 3,570 kg/ha (4,000 lb/ac), or as indicated in the project's special provisions, either by machine or by hand distribution.
- If stabilizing emulsion will be used to anchor the straw mulch in lieu of incorporation, roughen embankment or fill areas by rolling with a crimping or punching-type roller or by track walking before placing the straw mulch. Track walking should only be used where rolling is impractical.
- The straw mulch must be evenly distributed on the soil surface.
- Anchor the mulch in place by using a tackifier or by "punching" it into the soil mechanically (incorporating).
- A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall be selected based on longevity and ability to hold the fibers in place.
- A tackifier is typically applied at a rate of 140 kg/ha (125 lb/ac). In windy conditions, the rates are typically 200 kg/ha (178 lb/ac).
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions and longevity. If the selected method is incorporation of straw mulch into the soil, then do as follows:
  - Applying and incorporating straw shall follow the requirements in Standard Specifications Section 20-3.03.
  - On small areas, a spade or shovel can be used.

- On slopes with soils, which are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife-blade roller or a straight bladed coulter, known commercially as a "crimper."
- On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes. Refer to BMP SS-7, "Geotextiles, Plastic Covers and Erosion Control Blankets/Mats."

Maintenance and Inspections

- The key consideration in Maintenance and Inspection is that the straw needs to last long enough to achieve erosion control objectives.
- Maintain an unbroken, temporary mulched ground cover while DSAs are non-active. Repair any damaged ground cover and re-mulch exposed areas.
- Reapplication of straw mulch and tackifier may be required by the Resident Engineer (RE) to maintain effective soil stabilization over disturbed areas and slopes.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Surface Roughening (SR) EC-1

Description

Surface roughening is an erosion control practice that involves tracking, scarifying, imprinting, or tilling a disturbed area to provide temporary stabilization of disturbed areas. Surface roughening creates variations in the soil surface that help to minimize wind and water erosion. Depending on the technique used, surface roughening may also help establish conditions favorable to establishment of vegetation.

Photograph SR-1. Surface roughening via imprinting for temporary stabilization.

Appropriate Uses

Surface roughening can be used to provide temporary stabilization of disturbed areas, such as when revegetation cannot be immediately established due to seasonal planting limitations. Surface roughening is not a stand-alone BMP, and should be used in conjunction with other erosion and sediment controls.

Surface roughening is often implemented in conjunction with grading and is typically performed using heavy construction equipment to track the surface. Be aware that tracking with heavy equipment will also compact soils, which is not desirable in areas that will be revegetated. Scarifying, tilling, or ripping are better surface roughening techniques in locations where revegetation is planned. Roughening is not effective in very sandy soils and cannot be effectively performed in rocky soil.

Design and Installation

Typical design details for surfacing roughening on steep and mild slopes are provided in Details SR-1 and SR-2, respectively.

Surface roughening should be performed either after final grading or to temporarily stabilize an area during active construction that may be inactive for a short time period. Surface roughening should create depressions 2 to 6 inches deep and approximately 6 inches apart. The surface of exposed soil can be roughened by a number of techniques and equipment. Horizontal grooves (running parallel to the contours of the land) can be made using tracks from equipment treads, stair-step grading, ripping, or tilling.

Fill slopes can be constructed with a roughened surface. Cut slopes that have been smooth graded can be roughened as a subsequent operation. Roughening should follow along the contours of the slope. The tracks left by truck mounted equipment working perpendicular to the contour can leave acceptable horizontal depressions; however, the equipment will also compact the soil.

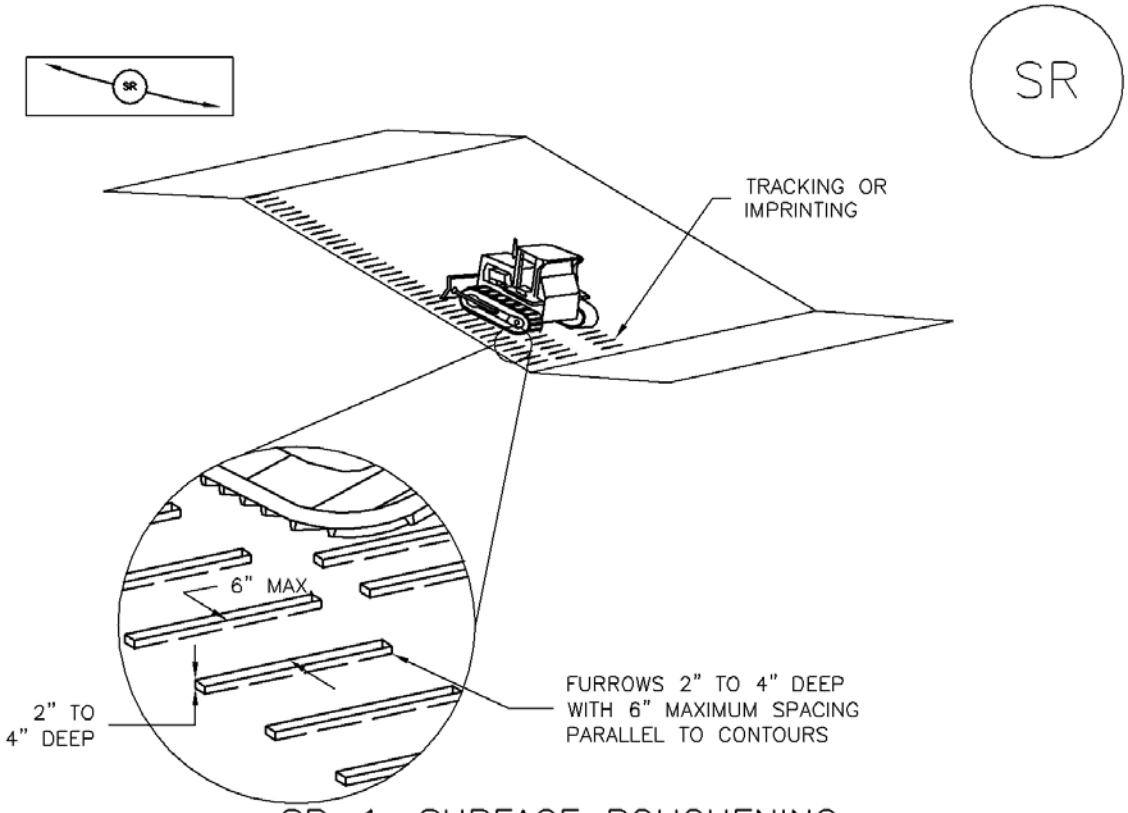
Surface Roughening	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

Maintenance and Removal

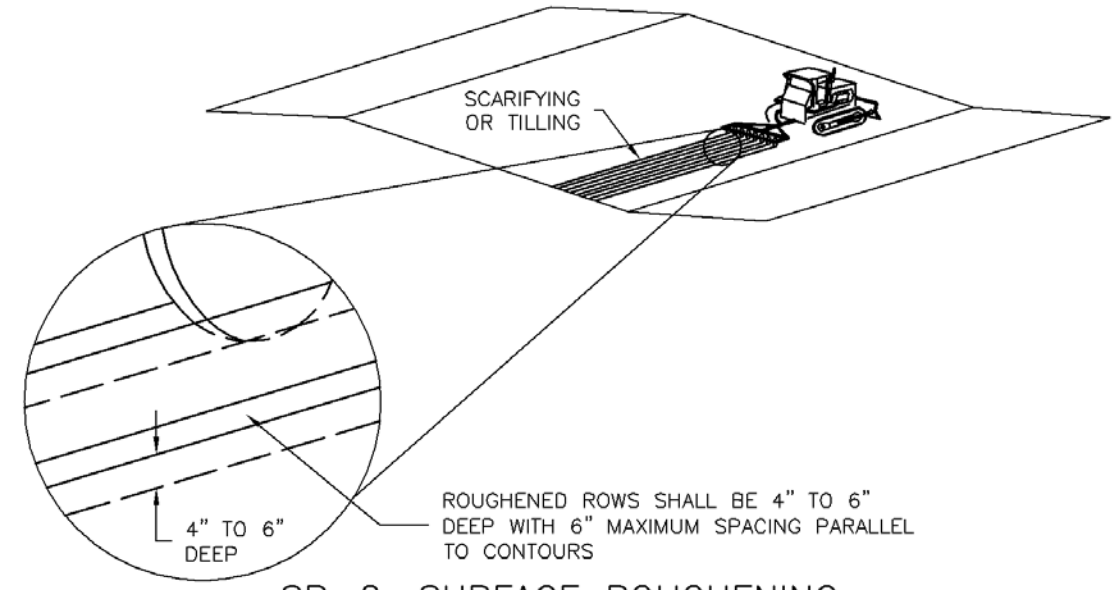
Care should be taken not to drive vehicles or equipment over areas that have been surface roughened. Tire tracks will smooth the roughened surface and may cause runoff to collect into rills and gullies.

Because surface roughening is only a temporary control, additional treatments may be necessary to maintain the soil surface in a roughened condition.

Areas should be inspected for signs of erosion. Surface roughening is a temporary measure, and will not provide long-term erosion control.



SR–1. SURFACE ROUGHENING
FOR STEEP SLOPES (3:1 OR STEEPER)



SR–2. SURFACE ROUGHENING
FOR LOW SLOPES (LESS THAN 3:1)

SURFACE ROUGHENING INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   -LOCATION(S) OF SURFACE ROUGHENING.

2. SURFACE ROUGHENING SHALL BE PROVIDED PROMPTLY AFTER COMPLETION OF FINISHED GRADING (FOR AREAS NOT RECEIVING TOPSOIL) OR PRIOR TO TOPSOIL PLACEMENT OR ANY FORECASTED RAIN EVENT.

3. AREAS WHERE BUILDING FOUNDATIONS, PAVEMENT, OR SOD WILL BE PLACED WITHOUT DELAY IN THE CONSTRUCTION SEQUENCE, SURFACE ROUGHENING IS NOT REQUIRED.

4. DISTURBED SURFACES SHALL BE ROUGHENED USING RIPPING OR TILLING EQUIPMENT ON THE CONTOUR OR TRACKING UP AND DOWN A SLOPE USING EQUIPMENT TREADS.

5. A FARMING DISK SHALL NOT BE USED FOR SURFACE ROUGHENING.

SURFACE ROUGHENING 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 REPLACE UPON DISCOVERY OF THE FAILURE.

4. VEHICLES AND EQUIPMENT SHALL NOT BE DRIVEN OVER AREAS THAT HAVE BEEN SURFACE ROUGHENED.

5. IN NON-TURF GRASS FINISHED AREAS, SEEDING AND MULCHING SHALL TAKE PLACE DIRECTLY OVER SURFACE ROUGHENED AREAS WITHOUT FIRST SMOOTHING OUT THE SURFACE.

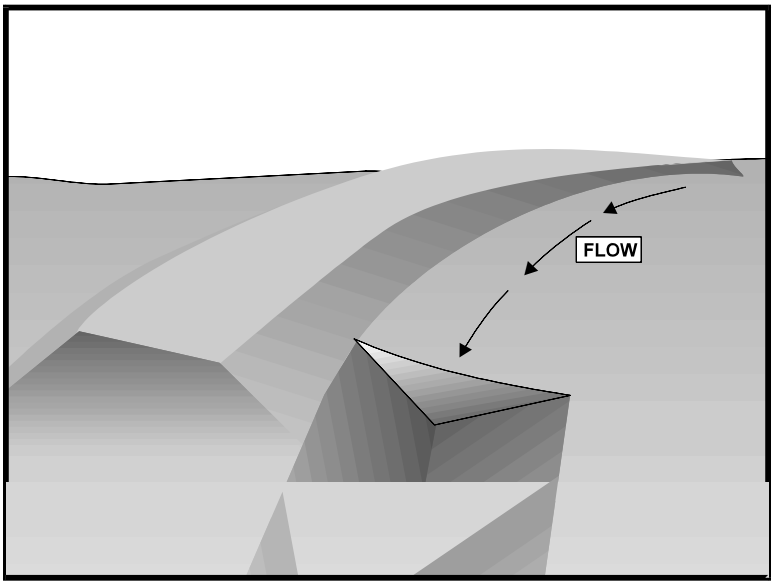
6. IN AREAS NOT SEEDED AND MULCHED AFTER SURFACE ROUGHENING, SURFACES SHALL BE RE-ROUGHENED AS NECESSARY TO MAINTAIN GROOVE DEPTH AND SMOOTH OVER RILL EROSION.

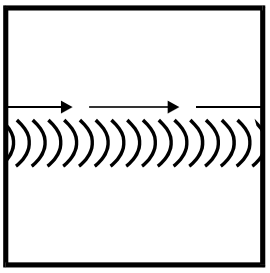
(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

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

Earth Dikes/Drainage Swales and Lined Ditches

SS-9





Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

These are structures that intercept, divert and convey surface run-on, generally sheet flow, to prevent erosion.

Appropriate Applications

- Earth dikes/drainage swales and lined ditches may be used to:
  - Convey surface runoff down sloping land.
  - Intercept and divert runoff to avoid sheet flow over sloped surfaces.
  - Divert and direct runoff towards a stabilized watercourse, drainage pipe or channel.
  - Intercept runoff from paved surfaces.
- Earth dikes/drainage swales and lined ditches also may be used:
  - Below steep grades where runoff begins to concentrate.
  - Along roadways and facility improvements subject to flood drainage.
  - At the top of slopes to divert run-on from adjacent or undisturbed slopes.
  - At bottom and mid-slope locations to intercept sheet flow and convey concentrated flows.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Resident Engineer (RE).

Earth Dikes/Drainage Swales and Lined Ditches

SS-9

Limitations

- Earth dikes/drainage swales and lined ditches are not suitable as sediment trapping devices.
- May be necessary to use other soil stabilization and sediment controls, such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales and ditches.

Standards and Specifications

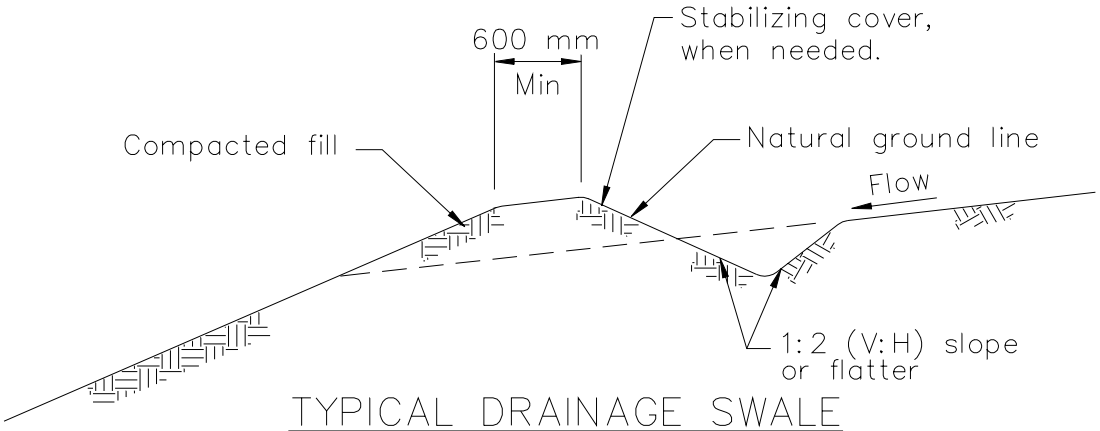
- Care must be applied to correctly size and locate earth dikes, drainage swales and lined ditches. Excessively steep, unlined dikes and swales are subject to erosion and gully formation.
- Conveyances shall be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, over topping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff from the highway right-of-way onto other property.
- When possible, install and utilize permanent dikes, swales and ditches early in the construction process.
- Provide stabilized outlets. Refer to SS-10, "Outlet Protection/Velocity/ Dissipation Devices."

Maintenance and Inspections

- Inspect temporary measures prior to the rainy season, after rainfall events, and regularly (approximately once per week) during the rainy season.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment, and repair linings and embankments as needed or as directed by the RE.
- Temporary conveyances shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

Earth Dikes/Drainage Swales and Lined Ditches

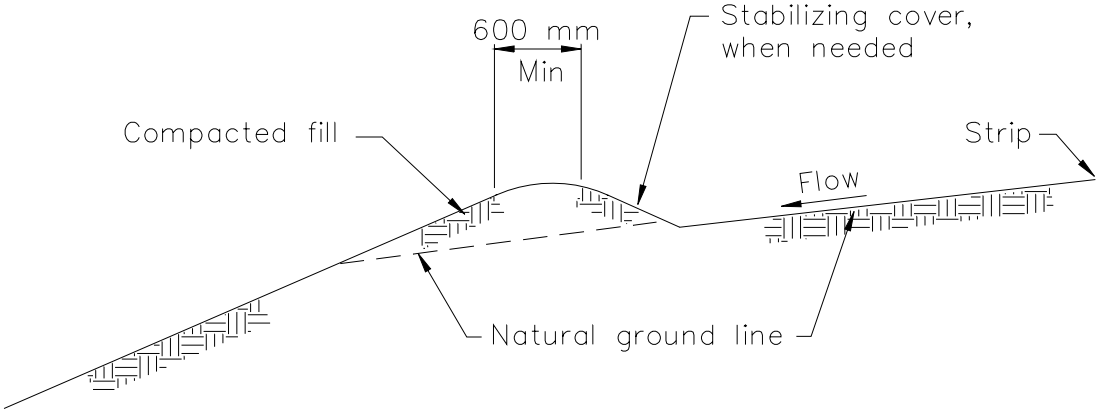
SS-9



TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade, in conformance with Section 19–5 of the Caltrans Standard Specifications.



TYPICAL EARTH DIKE
NOT TO SCALE

Temporary and Permanent Seeding (TS/PS) EC-2

Description

Temporary seeding can be used to stabilize disturbed areas that will be inactive for an extended period. Permanent seeding should be used to stabilize areas at final grade that will not be otherwise stabilized. Effective seeding includes preparation of a seedbed, selection of an appropriate seed mixture, proper planting techniques, and protection of the seeded area with mulch, geotextiles, or other appropriate measures.

Photograph TS/PS -1. Equipment used to drill seed. Photo courtesy of Douglas County.

Appropriate Uses

When the soil surface is disturbed and will remain inactive for an extended period (typically 30 days or longer), proactive stabilization measures should be implemented. If the inactive period is short-lived (on the order of two weeks), techniques such as surface roughening may be appropriate. For longer periods of inactivity, temporary seeding and mulching can provide effective erosion control. Permanent seeding should be used on finished areas that have not been otherwise stabilized.

Typically, local governments have their own seed mixes and timelines for seeding. Check jurisdictional requirements for seeding and temporary stabilization.

Design and Installation

Effective seeding requires proper seedbed preparation, selection of an appropriate seed mixture, use of appropriate seeding equipment to ensure proper coverage and density, and protection with mulch or fabric until plants are established.

The USDCM Volume 2 *Revegetation* Chapter contains detailed seed mix, soil preparations, and seeding and mulching recommendations that may be referenced to supplement this Fact Sheet.

Drill seeding is the preferred seeding method. Hydroseeding is not recommended except in areas where steep slopes prevent use of drill seeding equipment, and even in these instances it is preferable to hand seed and mulch. Some jurisdictions do not allow hydroseeding or hydromulching.

Seedbed Preparation

Prior to seeding, ensure that areas to be revegetated have soil conditions capable of supporting vegetation. Overlot grading can result in loss of topsoil, resulting in poor quality subsoils at the ground surface that have low nutrient value, little organic matter content, few soil microorganisms, rooting restrictions, and conditions less conducive to infiltration of precipitation. As a result, it is typically necessary to provide stockpiled topsoil, compost, or other

Temporary and Permanent Seeding	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

soil amendments and rototill them into the soil to a depth of 6 inches or more.

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

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

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

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

Seed Mix for Temporary Vegetation

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

Seed Mix for Permanent Revegetation

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

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

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

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

Species[a] (Common name)	Growth Season[b]	Pounds of Pure Live Seed (PLS)/acre[c]	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	½
5. Millet	Warm	3 - 15	½ - ¾
6. Sudangrass	Warm	5–10	½ - ¾
7. Sorghum	Warm	5–10	½ - ¾
8. Winter wheat	Cool	20–35	1 - 2
9. Winter barley	Cool	20–35	1 - 2
10. Winter rye	Cool	20–35	1 - 2
11. Triticale	Cool	25–40	1 - 2

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

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

[b] See Table TS/PS-3 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months.

[c] Seeding rates should be doubled if seed is broadcast, or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.

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

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

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

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

[a] All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation.

[b] See Table TS/PS-3 for seeding dates.

[c] If site is to be irrigated, the transition turf seed rates should be doubled.

[d] Crested wheatgrass should not be used on slopes steeper than 6H to 1V.

[e] Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.

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

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

Mulch

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

Maintenance and Removal

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

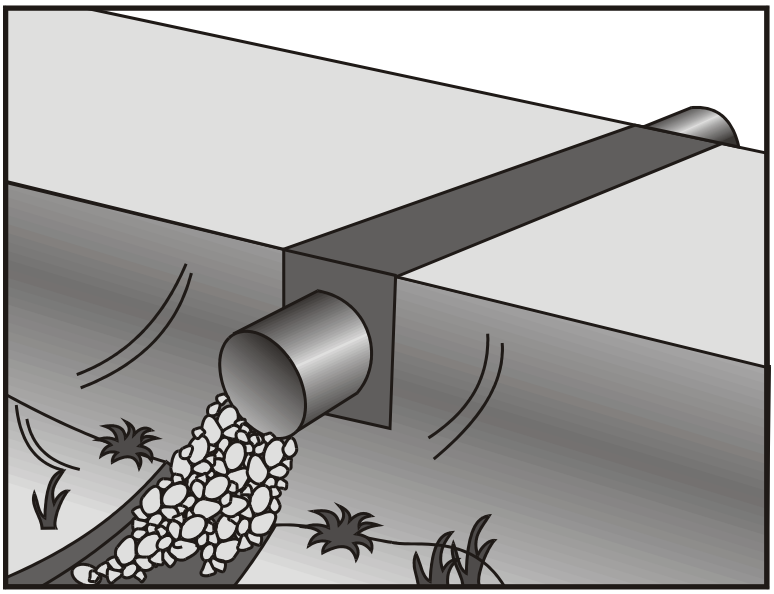
An area that has been permanently seeded should have a good stand of vegetation within one growing season if irrigated and within three growing seasons without irrigation in Colorado. Reseed portions of the site that fail to germinate or remain bare after the first growing season.

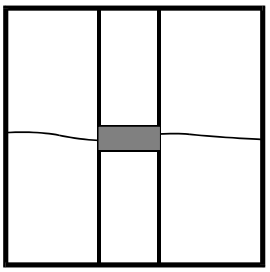
Seeded areas may require irrigation, particularly during extended dry periods. Targeted weed control may also be necessary.

Protect seeded areas from construction equipment and vehicle access.

Temporary Stream Crossing

NS-4





Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ● Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

A temporary stream crossing is a structure placed across a waterway that allows vehicles to cross the waterway during construction, minimizing, reducing, or managing erosion and downstream sedimentation caused by the vehicles.

Appropriate Applications

Temporary stream crossings are installed at sites:

- Where appropriate permits have been secured (1601 Agreements, 404 Permits, and 401 Certification).
- Where construction equipment or vehicles need to frequently cross a waterway.
- When alternate access routes impose significant constraints.
- When crossing perennial streams or waterways causes significant erosion.
- Where construction activities will not last longer than one year.

Limitations

- Will usually disturb the waterway during installation and removal.
- May require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. If monitoring related to these numerical-based water quality standards is not addressed in the contract documents, contact the Resident Engineer (RE).
- Installation may require dewatering or temporary diversion of the stream. See BMP NS-2, “Dewatering Operations” and NS-5, “Clear Water Diversion.”
- May become a constriction in the waterway, which can obstruct flood flow and cause flow backups or washouts. If improperly designed, flow backups can increase the pollutant load through washouts and scouring.

- Use of natural or other gravel in the stream for construction of Cellular Confinement System (CCS) (refer to figure at the end of the section) ford crossing will be contingent upon approval by fisheries agencies.
- Ford crossings may degrade water quality due to contact with vehicles and equipment.
- CCS should not be used in excessively high or fast flows.
- Upon completion of construction activities, CCS blocks must be removed from stream.

Standards and Specifications

General Considerations

Location of the temporary stream crossing shall address:

- Site selection where erosion potential is low.
- Areas where the side slopes from highway runoff will not spill into the side slopes of the crossing.

The following types of temporary stream crossings shall be considered:

- Culverts - Used on perennial and intermittent streams.
- Fords - Appropriate during the dry season in arid areas. Used on dry washes and ephemeral streams, and low flow perennial streams. CCS, a type of ford crossing is also appropriate for use in streams.
- Bridges - Appropriate for streams with high flow velocities, steep gradients and/or where temporary restrictions in the channel are not allowed.

Design and installation requires knowledge of stream flows and soil strength. Designs shall be prepared under direction of, and approved by, a registered civil and/or structural engineer. Both hydraulic and construction loading requirements shall be considered with the following:

- Comply with the requirements for culvert and bridge crossings, as contained in the Caltrans Highway Design Manual, particularly if the temporary stream crossing will remain through the rainy season.
- Provide stability in the crossing and adjacent areas to withstand the design flow. The design flow and safety factor shall be selected based on careful evaluation of the risks due to over topping, flow backups, or washout.
- Avoid oil or other potentially hazardous waste materials for surface treatment.

Construction Considerations:

- Stabilize construction roadways, adjacent work area and stream bottom against erosion.

- Construct during dry periods to minimize stream disturbance and reduce costs.
- Construct at or near the natural elevation of the stream bed to prevent potential flooding upstream of the crossing.
- Install temporary sediment control BMPs in accordance with sediment control BMPs presented in Section 4 to minimize erosion of embankment into flow lines.
- Vehicles and equipment shall not be driven, operated, fueled, cleaned, maintained, or stored in the wet or dry portions of a water body where wetland vegetation, riparian vegetation, or aquatic organisms may be destroyed, except as authorized by the RE, as necessary to complete the work.
- Temporary water body crossings and encroachments shall be constructed to minimize scour. Cobbles used for temporary water body crossings or encroachments shall be clean, rounded river cobble.
- The exterior of vehicles and equipment that will encroach on the water body within the project shall be maintained free of grease, oil, fuel, and residues.
- Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations. Precautions shall be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation shall be replaced with the appropriate soil stabilization measures.
- Riparian vegetation, when removed pursuant to the provisions of the work, shall be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation shall be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble shall be removed upon completion of project activities.
- Any temporary artificial obstruction placed within flowing water shall only be built from material, such as clean gravel, that will cause little or no siltation.
- Drip pans shall be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than one hour.
- Conceptual temporary stream crossings are shown in figures at the end of this section.

Specific Considerations:

- Culverts are relatively easy to construct and able to support heavy equipment loads.
- Fords are the least expensive of the crossings, with maximum load limits.
- Temporary fords are not appropriate if construction will continue through the rainy season, if thunderstorms are likely, or if the stream is perennial.

- CCS crossing structures consist of clean, washed gravel and cellular confinement system blocks. CCS are appropriate for streams that would benefit from an influx of gravel; for example, salmonid streams, streams or rivers below reservoirs, and urban, channelized streams. Many urban stream systems are gravel-deprived due to human influences, such as dams, gravel mines, and concrete channels.
- CCS allow designers to use either angular or naturally-occurring, rounded gravel, because the cells provide the necessary structure and stability. In fact, natural gravel is optimal for this technique, because of the habitat improvement it will provide after removal of the CCS.
- A gravel depth of 152 to 305 mm (6 to 12 inches) for a CCS structure is sufficient to support most construction equipment.
- An advantage of a CCS crossing structure is that relatively little rock or gravel is needed, because the CCS provides the stability.
- Bridges are generally more expensive to design and construct, but provides the least disturbance of the stream bed and constriction of the waterway flows.

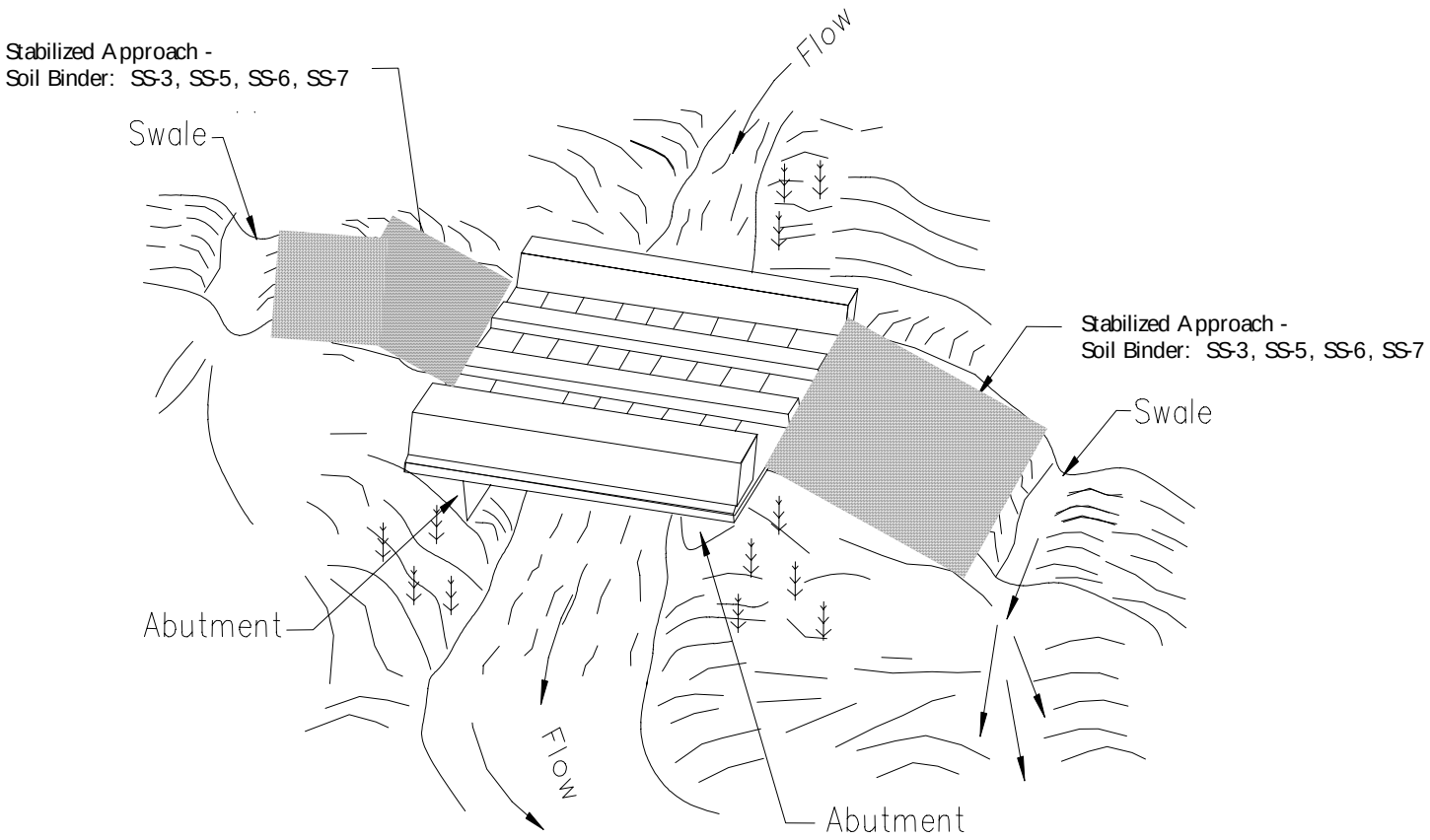
Maintenance and Inspection

Maintenance provisions shall include:

- Periodic removal of debris behind fords, in culverts, and under bridges.
- Replacement of lost protective aggregate from inlets and outlets of culverts.
- Removal of temporary crossing promptly when it is no longer needed.
- Inspection shall, at a minimum, occur weekly and after each significant rainfall, and include:
  - Checking for blockage in the channel, debris buildup in culverts or behind fords, and under bridges.
  - Checking for erosion of abutments, channel scour, riprap displacement, or piping in the soil.
  - Checking for structural weakening of the temporary crossing, such as cracks, and undermining of foundations and abutments.

Temporary Stream Crossing

NS-4

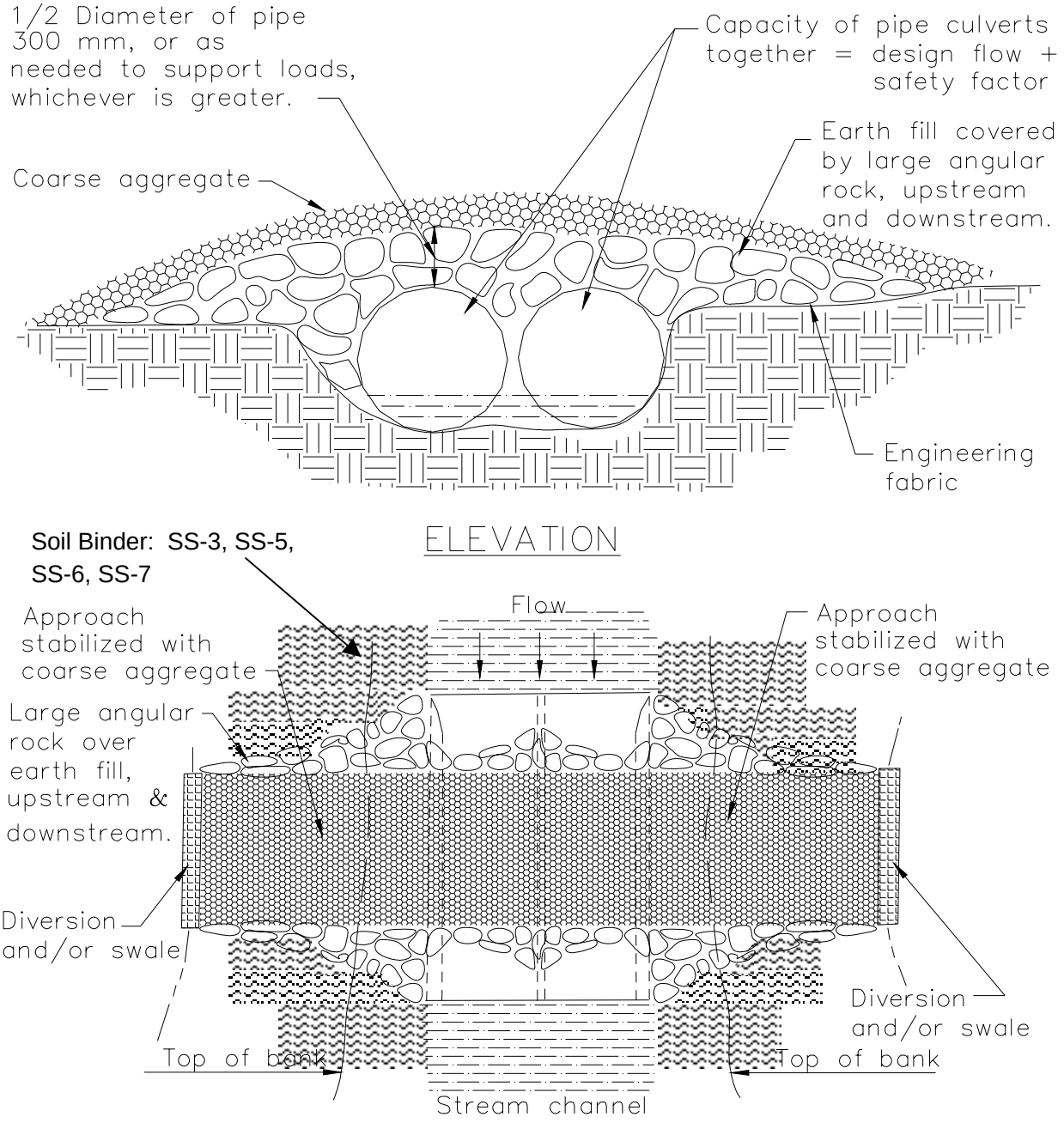


NOTE:
Surface flow of road diverted by swale and/or dike.

TYPICAL BRIDGE CROSSING
NOT TO SCALE

Temporary Stream Crossing

NS-4

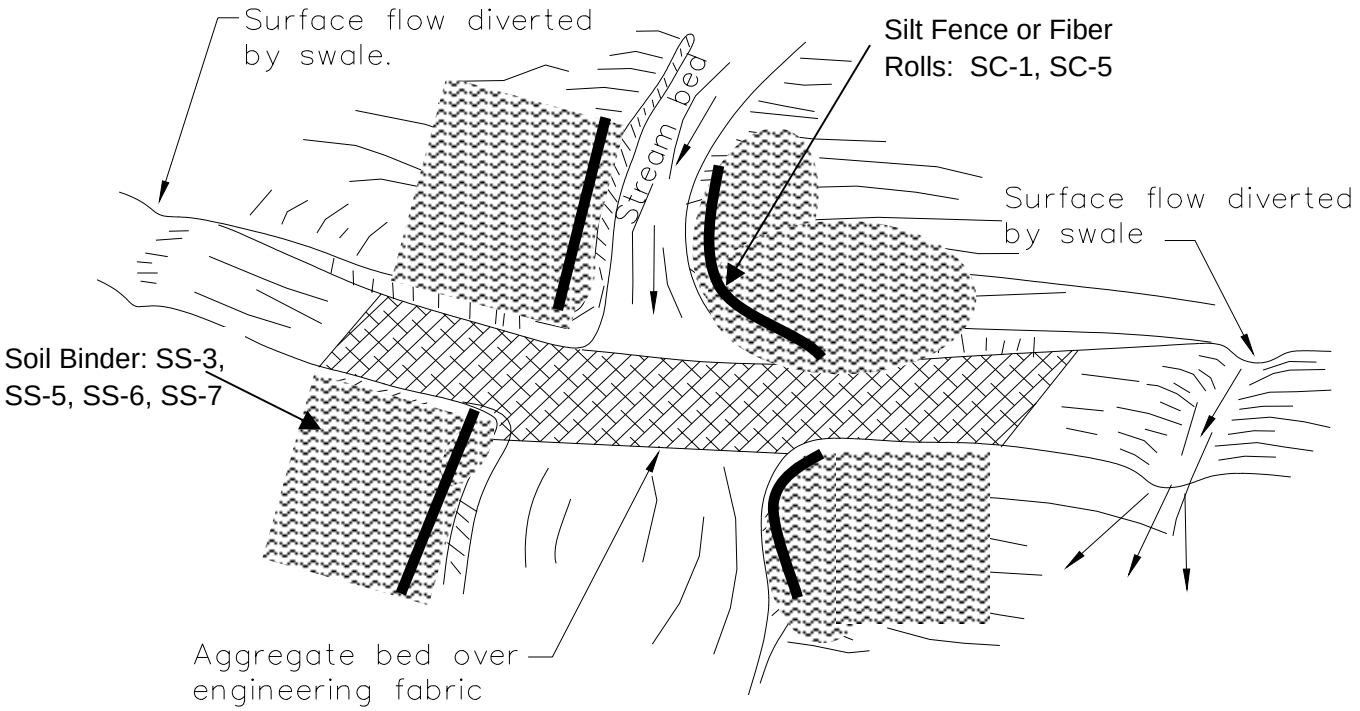


TYPICAL CULVERT CROSSING

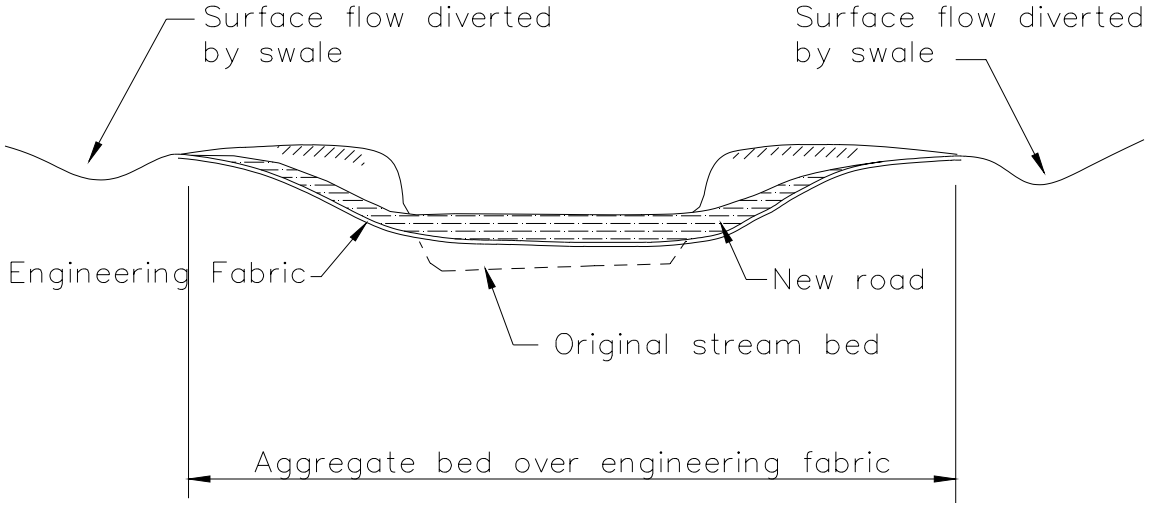
NOT TO SCALE

Temporary Stream Crossing

NS-4



Aggregate approch
1:5 (V:H) Maximum slope on road



TYPICAL FORD CROSSING
NOT TO SCALE

CELLULAR CONFINEMENT SYSTEM

Terracing (TER) EC-11

Description

Terracing involves grading steep slopes into a series of relatively flat sections, or terraces, separated at intervals by steep slope segments. Terraces shorten the uninterrupted flow lengths on steep slopes, helping to reduce the development of rills and gullies. Retaining walls, gabions, cribbing, deadman anchors, rock-filled slope mattresses, and other types of soil retention systems can be used in terracing.

Photograph TER-1. Use of a terrace to reduce erosion by controlling slope length on a long, steep slope. Photo courtesy of Douglas County.

Appropriate Uses

Terracing techniques are most typically used to control erosion on slopes that are steeper than 4:1.

Design and Installation

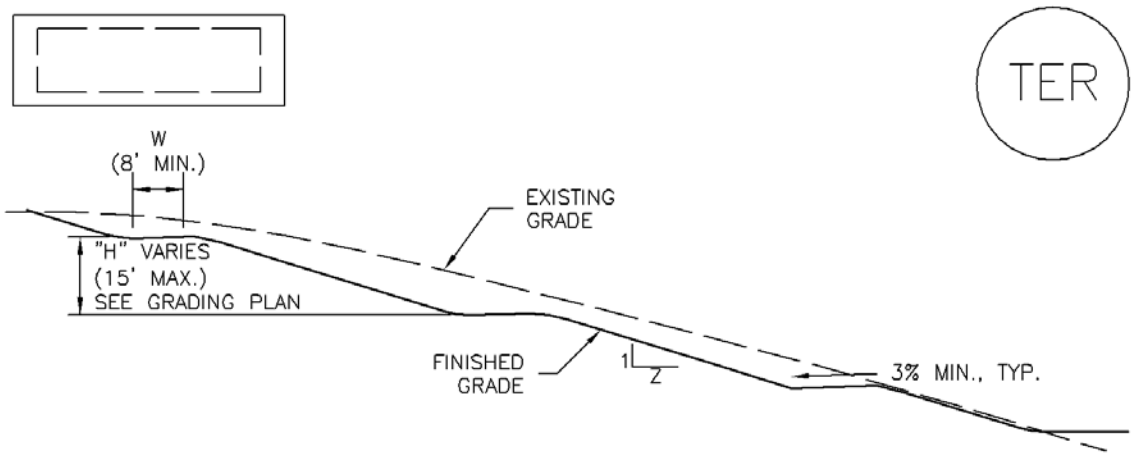
Design details with notes are provided in Detail TER-1.

The type, number, and spacing of terraces will depend on the slope, slope length, and other factors. The Revised Universal Soil Loss Equation (RUSLE) may be helpful in determining spacing of terraces on slopes. Terracing should be used in combination with other stabilization measures that provide cover for exposed soils such as mulching, seeding, surface roughening, or other measures.

Maintenance and Removal

Repair rill erosion on slopes and remove accumulated sediment, as needed. Terracing may be temporary or permanent. If terracing is temporary, the slope should be topsoiled, seeded, and mulched when the slope is graded to its final configuration and terraces are removed. Due to the steepness of the slope, once terraces are graded, erosion control blankets or other stabilization measures are typically required. If terraces are permanent, vegetation should be established on slopes and terraces as soon as practical.

Terracing	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No



TER–1. TERRACING

TERRACING INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   –LOCATION OF TERRACING
   –WIDTH (W), AND SLOPE (Z).

2. TERRACING IS TYPICALLY NOT REQUIRED FOR SLOPES OF 4:1 OR FLATTER.

3. GRADE TERRACES TO DRAIN BACK TO SLOPE AT A MINIMUM OF 3% GRADE.

TERRACING 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. RILL EROSION OCCURRING ON TERRACED SLOPES SHALL BE REPAIRED, RESEEDED, MULCHED OR STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

5. TERRACING MAY NEED TO BE RE–GRADED TO RETURN THE SLOPE TO THE FINAL DESIGN GRADE. THE SLOPE SHALL THEN BE COVERED WITH TOPSOIL, SEEDED AND MULCHED, OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

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

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

Vegetated Buffers (VB) SC-9

Description

Buffer strips of preserved natural vegetation or grass help protect waterways and wetlands from land disturbing activities. Vegetated buffers improve stormwater runoff quality by straining sediment, promoting infiltration, and slowing runoff velocities.

Photograph VB-1. A vegetated buffer is maintained between the area of active construction and the drainage swale. Photo courtesy of WWE.

Appropriate Uses

Vegetated buffers can be used to separate land disturbing activities and natural surface waters or conveyances. In many jurisdictions, local governments require some type of setback from natural waterways. Concentrated flow should not be directed through a buffer; instead, runoff should be in the form of sheet flow. Vegetated buffers are typically used in combination with other perimeter control BMPs such as sediment control logs or silt fence for multi-layered protection.

Design and Installation

Minimum buffer widths may vary based on local regulations. Clearly delineate the boundary of the natural buffer area using construction fencing, silt fence, or a comparable technique. In areas that have been cleared and graded, vegetated buffers such as sod can also be installed to create or restore a vegetated buffer around the perimeter of the site.

Maintenance and Removal

Inspect buffer areas for signs of erosion such as gullies or rills. Stabilize eroding areas, as needed. If erosion is due to concentrated flow conditions, it may be necessary to install a level spreader or other technique to restore sheet flow conditions. Inspect perimeter controls delineating the vegetative buffer and repair or replace as needed.

Vegetated Buffers	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	Yes

Vehicle Tracking Control (VTC) SM-4

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.

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

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.

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	
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.

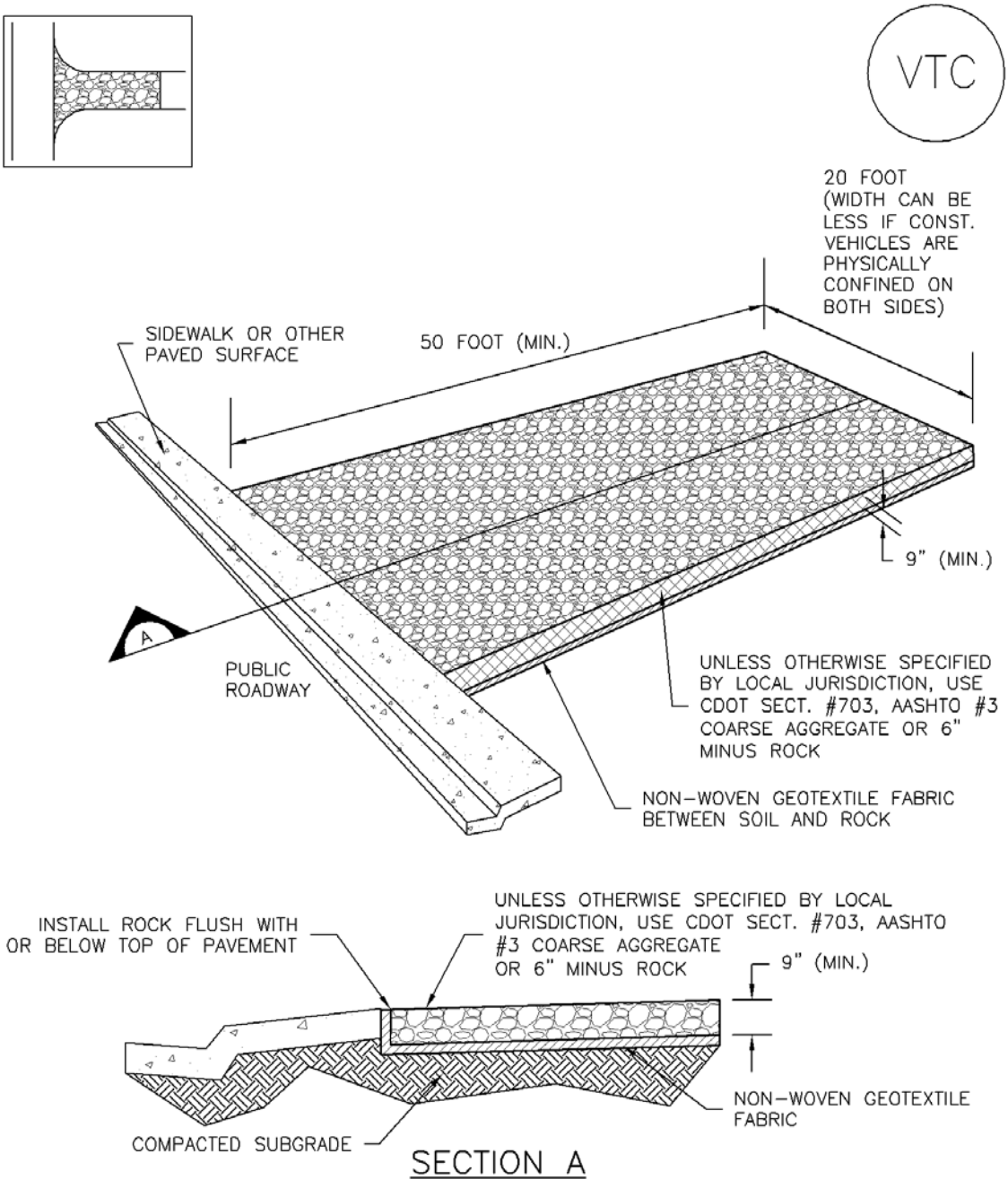
Ensure that drainage ditches at the entrance/exit area remain clear.

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

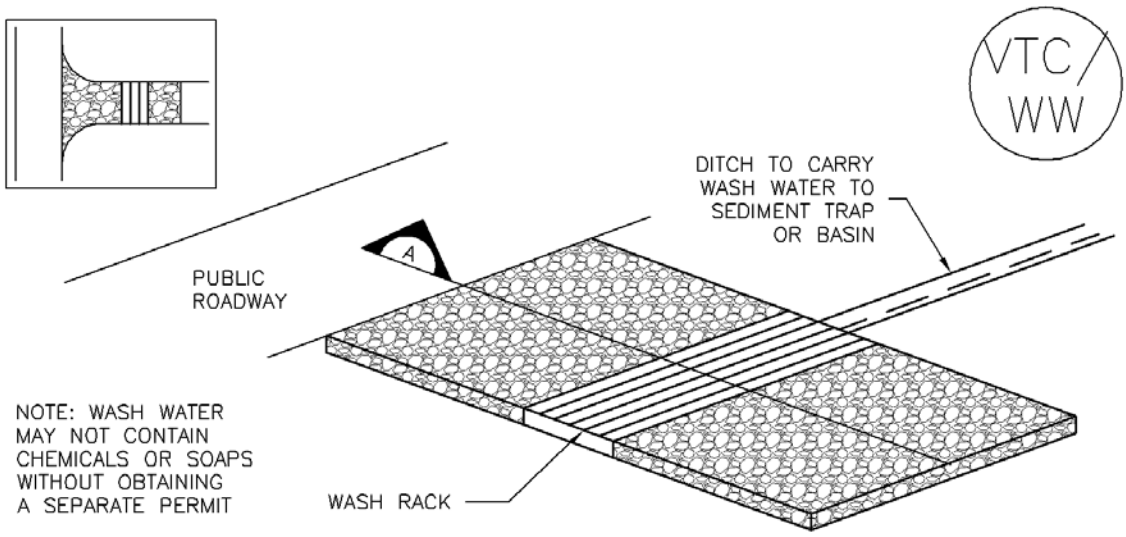
A stabilized entrance should be removed only when there is no longer the potential for vehicle tracking to occur. This is typically after the site has been stabilized.

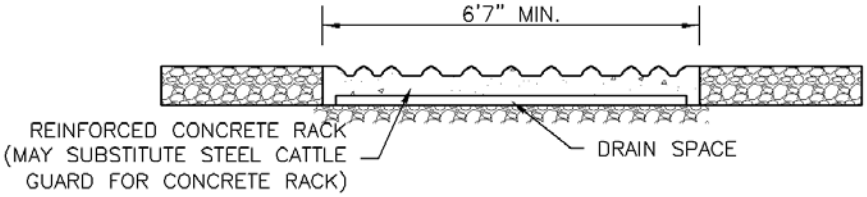
When wheel wash equipment is used, be sure that the wash water is discharged to a sediment trap prior to discharge. Also inspect channels conveying the water from the wash area to the sediment trap and stabilize areas that may be eroding.

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.



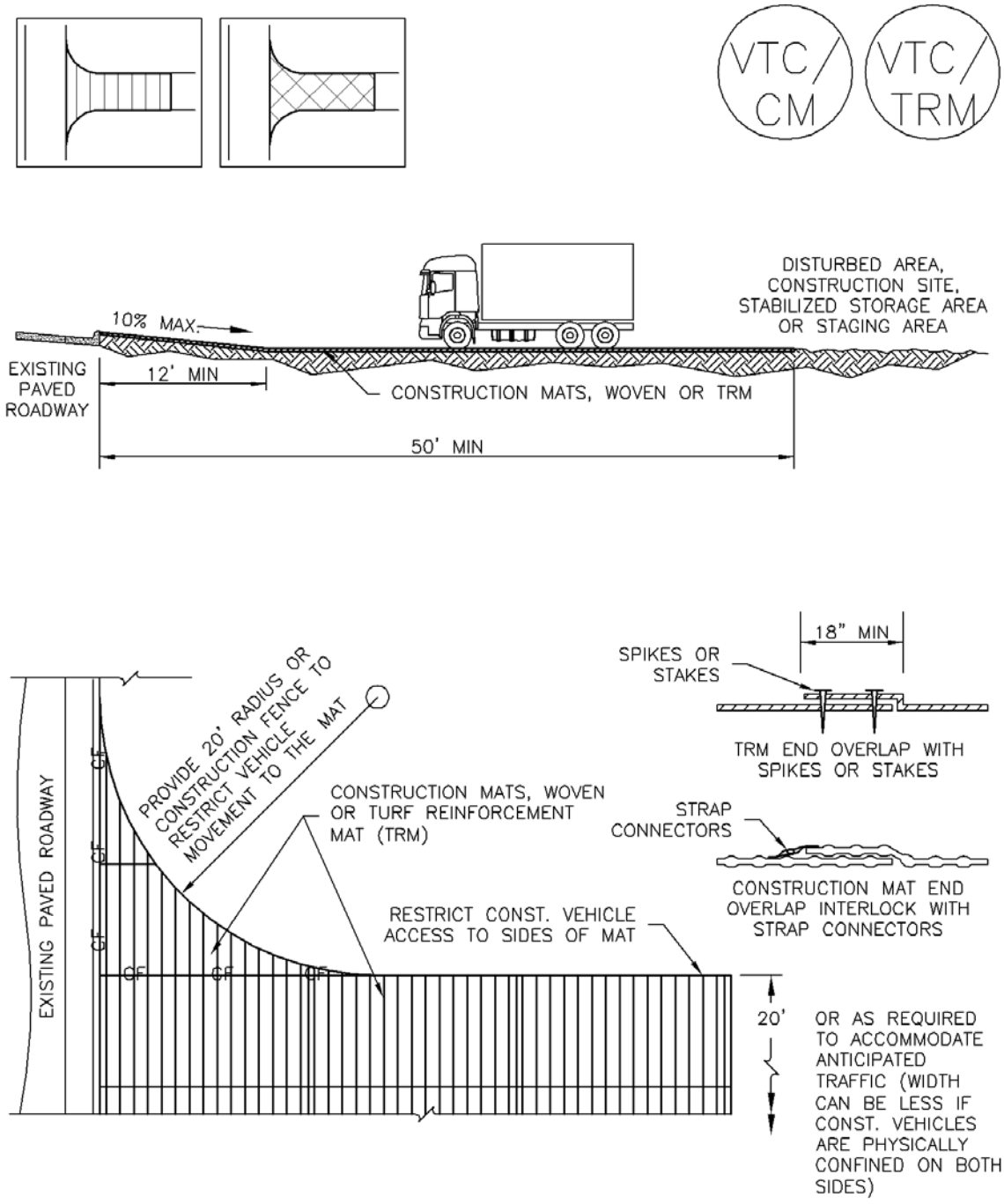
VTC-1. AGGREGATE VEHICLE TRACKING CONTROL





SECTION A

VTC–2. AGGREGATE VEHICLE TRACKING CONTROL WITH WASH RACK



VTC–3. VEHICLE TRACKING CONTROL W/ CONSTRUCTION MAT OR TURF REINFORCEMENT MAT (TRM)

STABILIZED CONSTRUCTION ENTRANCE/EXIT INSTALLATION NOTES

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

Wind Erosion/Dust Control (DC) EC-14

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.

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.

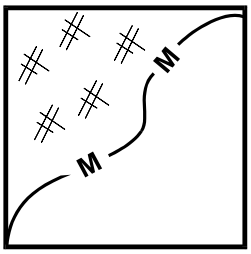
Wind Erosion Control/ Dust Control	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	Moderate

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.

Wood Mulching

SS-8



Standard Symbol

BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Wood mulching consist of applying a mixture of shredded wood mulch, bark or compost. Wood mulch is mostly applicable to landscape projects.

The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Appropriate Applications

Wood mulching is considered a temporary soil stabilization (erosion control) alternative in the following situations:

- As a stand-alone temporary surface cover on disturbed areas until soils can be prepared for revegetation and permanent vegetative cover can be established.
- As short term, non-vegetative ground cover on slopes to reduce rainfall impact, decrease the velocity of sheet flow, settle out sediment and reduce wind erosion.

Limitations

- Wood mulch may introduce unwanted species.
- Shredded wood does not withstand concentrated flows and is prone to sheet erosion.
- Green material has the potential for the presence of unwanted weeds and other plant materials. Delivery system is primarily by manual labor, although pneumatic application equipment is available.

Standards and Specifications

Mulch Selection

There are many types of mulches, and selection of the appropriate type shall be based on the type of application and site conditions. Prior to use of wood mulches, there shall be concurrence with the District Landscape Architect since some mulch use on construction projects may not be compatible with planned or future projects. Selection of wood mulches by the Contractor shall comply with Standard Specifications Section 20-2.08, and must be approved by the Resident Engineer (RE).

Application Procedures

Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with a punching-type roller or by track walking. The construction-application procedures for mulches vary significantly depending upon the type of mulching method specified. Two (2) methods are highlighted here:

- Green Material: This type of mulch is produced by recycling vegetation trimmings such as grass, shredded shrubs and trees. Methods of application are generally by hand, although pneumatic methods are available. Mulch shall be composted to kill weed seeds.
  - It can be used as a temporary ground cover with or without seeding.
  - The green material shall be evenly distributed on site to a depth of not more than 50 mm (2 in).
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Shredded wood/bark is conditionally suitable; see note under limitations.
  - Shall be distributed by hand (although pneumatic methods may be available).
  - The mulch shall be evenly distributed across the soil surface to a depth of 50 mm (2 in) to 75 mm (3 in).
- Avoid mulch placement onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- All material must be removed before re-starting work on the slopes.

Maintenance and Inspection

- Regardless of the mulching technique selected, the key consideration in Maintenance and Inspection is that the mulch needs to last long enough to achieve erosion-control objectives. If the mulch is applied as a stand-alone erosion control method over disturbed areas (without seed), it shall last the length of time the site will remain barren or until final re-grading and revegetation.

- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance shall focus on longevity and integrity of the mulch.

APPENDIX D

SITE-SPECIFIC INFORMATION

SITE-SPECIFIC STORMWATER MANAGEMENT PLAN

Construction Activities Associated with Little Lady 21 South

Prepared For:

Upland Exploration, LLC
Denver-Julesburg Basin
Weld County, Colorado

February 2021

Prepared By:

Aquionix
EHS Services
5545 W. 56th Avenue, Suite E
Arvada, CO 80002
(303) 289-7520
www.aquionix.com

This site-specific Stormwater Management Plan (SWMP) has been prepared for construction activities associated with the Upland Exploration Little Lady 21 South well pad location. Specific information related to the construction of the well pad location are detailed below if they differ from the Upland Exploration Master Field-Wide SWMP.

General Permit Reference	Description	Site-Specific Details	
Part I.A.3	Certification	See Master SWMP.	
Part I.B.1.b	Maintenance	See Master SWMP.	
Part I.C.2.a(i)	Qualified Stormwater Manager	See Master SWMP.	
Part I.C.2.a(ii)	Spill Prevention and Response Plan	See Master SWMP.	
Part I.C.2.a(iii)	Other CDPS Permits	None.	
Part I.C.2.a(iv)	Materials Handling	See Master SWMP.	
Part I.C.2.a(v)	Identification of Potential Pollutant Sources	See Master SWMP.	
Part I.B.1 Part I.C.2.a(vi)	Implementation of Control Measures (BMPs)	See Master SWMP and Site Map for BMPs.	
Part I.C.2.a(vii)(a)	Nature of Construction Activity	This project will include the construction of an access road and well pad.	
Part I.C.2.a(vii)(b)	Sequence of Major Activities	See Master SWMP.	
Part I.C.2.a(vii)(c)	Area of Disturbance	Approximate Disturbance:	9.7 acres
Part I.C.2.a(vii)(d)	Soil Description	See Master SWMP.	
Part I.C.2.a(vii)(e)	Vegetation Description	Vegetation in the vicinity of the facility is dominated by brush rangeland, with 100% existing ground cover (determined by ArcGIS/Google Earth imagery and site observation)	
Part I.C.2.a(vii)(f)	Non-Stormwater Discharges	See Master SWMP.	
Part I.C.2.a(vii)(g)	Drainage Patterns	See Site Map	
Part I.C.2.a(vii)(g)	Receiving Waters	Immediate Receiving Water:	Geary Creek
		Ultimate Receiving Water:	Crow Creek
		Other:	None.
Part I.C.2.a(vii)(h)	Description of Stream Crossings	None.	
Part I.C.2.a(vii)(i)	Alternative Temporary Stabilization Schedule	None.	
Part I.C.2.a(vii)(j)	(Approved) Alternative Diversion Criteria	None.	
Part I.C.2.a(viii)	Site Map	See attached map.	
Part I.C.2.a(ix)	Temporary Stabilization	See Master SWMP.	
Part I.C.2.a(ix)	Final Stabilization and Long-Term Stormwater Management	See Master SWMP.	
Part I.C.2.a(x) Part I.C.4	Inspection	See Master SWMP.	
Part I.C.3	SWMP Review and Revisions	See Master SWMP.	
Part I.C.4	SWMP Availability	See Master SWMP.	
Part II.O	Retention of Records	See Master SWMP.	

MAP FEATURES

- Pad Location
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Artificial Path
- Canal / Ditch
- Lake / Pond

Upland Exploration

Stormwater Management Plan
Surrounding Waters Diagram
Little Lady 21 South
Well and Production Pad

Aquionix EHS Services

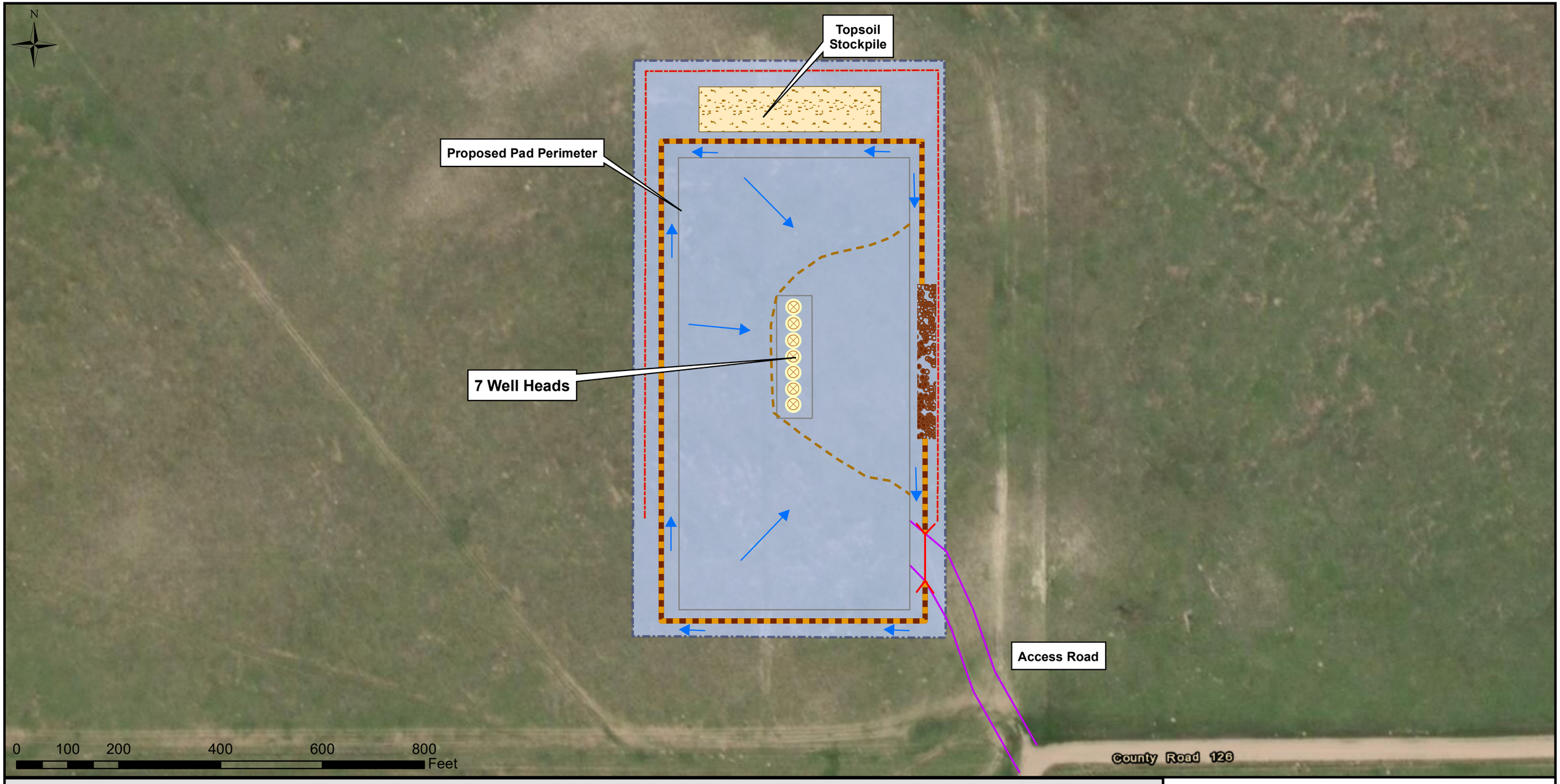
DRAWN BY: MT (Aquionix)

DATE DRAWN: 06/27/2019

MAP SCALE: 1:58,986

COORD. SYSTEM: WGS_1984_Web_Mercator_Auxiliary_Sphere

S:\ArcGIS and AutoCAD files\Upland Exploration\mxds



MAP FEATURES

- Disturbed Area
- Well Head Surface Location
- Surface Flow Direction
- Access Road
- Cut/Fill
- Proposed Production Area
- Perennial Stream
- Intermittent Stream
- Earthen Swale
- Silt Fence
- Topsoil Stockpile
- Sediment Pond with Oversized Rock
- Culvert

Upland Exploration

Stormwater Management Plan
Site-Specific Diagram

Little Lady 21 South Well and Production Pad

Aquionix EHS Services

DRAWN BY: MT (Aquionix)

DATE DRAWN: 08/12/2019

MAP SCALE: 1:2,200

COORD. SYSTEM: WGS_1984_Web_Mercator_Auxiliary_Sphere

S:\ArcGIS and AutoCAD files\Upland Exploration\mxds

SITE-SPECIFIC STORMWATER MANAGEMENT PLAN

Construction Activities Associated with Little Lady 21 North

Prepared For:

Upland Exploration, LLC
Denver-Julesburg Basin
Weld County, Colorado

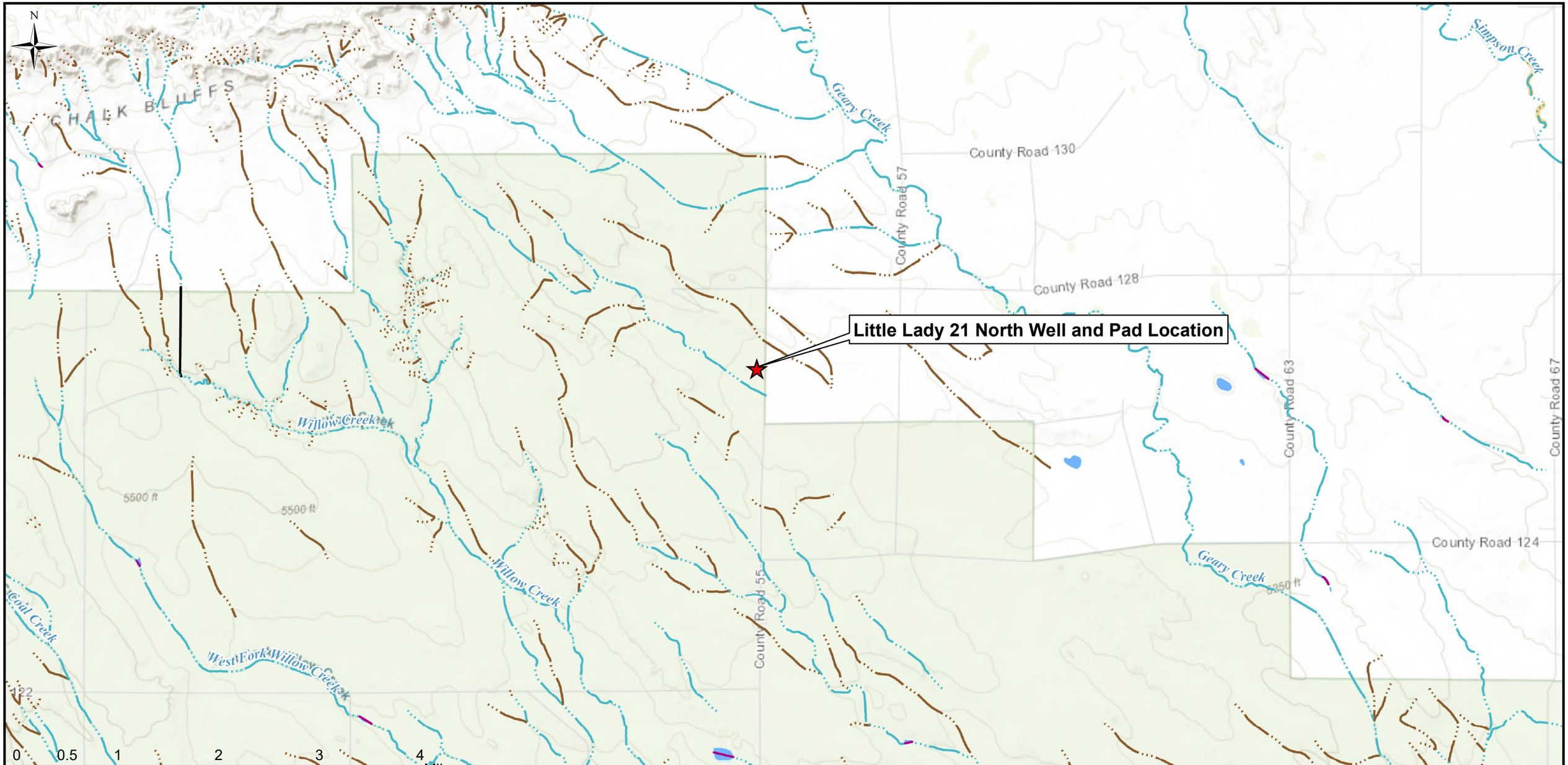
February 2021

Prepared By:

Aquionix
EHS Services
5545 W. 56th Avenue, Suite E
Arvada, CO 80002
(303) 289-7520
www.aquionix.com

This site-specific Stormwater Management Plan (SWMP) has been prepared for construction activities associated with the Upland Exploration Little Lady 21 North well pad location. Specific information related to the construction of the well pad location are detailed below if they differ from the Upland Exploration Master Field-Wide SWMP.

General Permit Reference	Description	Site-Specific Details	
Part I.A.3	Certification	See Master SWMP.	
Part I.B.1.b	Maintenance	See Master SWMP.	
Part I.C.2.a(i)	Qualified Stormwater Manager	See Master SWMP.	
Part I.C.2.a(ii)	Spill Prevention and Response Plan	See Master SWMP.	
Part I.C.2.a(iii)	Other CDPS Permits	None.	
Part I.C.2.a(iv)	Materials Handling	See Master SWMP.	
Part I.C.2.a(v)	Identification of Potential Pollutant Sources	See Master SWMP.	
Part I.B.1 Part I.C.2.a(vi)	Implementation of Control Measures (BMPs)	See Master SWMP and Site Map for BMPs.	
Part I.C.2.a(vii)(a)	Nature of Construction Activity	This project will include the construction of an access road and well pad.	
Part I.C.2.a(vii)(b)	Sequence of Major Activities	See Master SWMP.	
Part I.C.2.a(vii)(c)	Area of Disturbance	Approximate Disturbance:	9.7 acres
Part I.C.2.a(vii)(d)	Soil Description	See Master SWMP.	
Part I.C.2.a(vii)(e)	Vegetation Description	Vegetation in the vicinity of the facility is dominated by brush rangeland, with 100% existing ground cover (determined by ArcGIS/Google Earth imagery and site observation)	
Part I.C.2.a(vii)(f)	Non-Stormwater Discharges	See Master SWMP.	
Part I.C.2.a(vii)(g)	Drainage Patterns	See Site Map	
Part I.C.2.a(vii)(g)	Receiving Waters	Immediate Receiving Water:	Geary Creek
		Ultimate Receiving Water:	Crow Creek
		Other:	None.
Part I.C.2.a(vii)(h)	Description of Stream Crossings	None.	
Part I.C.2.a(vii)(i)	Alternative Temporary Stabilization Schedule	None.	
Part I.C.2.a(vii)(j)	(Approved) Alternative Diversion Criteria	None.	
Part I.C.2.a(viii)	Site Map	See attached map.	
Part I.C.2.a(ix)	Temporary Stabilization	See Master SWMP.	
Part I.C.2.a(ix)	Final Stabilization and Long-Term Stormwater Management	See Master SWMP.	
Part I.C.2.a(x) Part I.C.4	Inspection	See Master SWMP.	
Part I.C.3	SWMP Review and Revisions	See Master SWMP.	
Part I.C.4	SWMP Availability	See Master SWMP.	
Part II.O	Retention of Records	See Master SWMP.	



MAP FEATURES

- Pad Location
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Artificial Path
- Canal / Ditch
- Lake / Pond

Upland Exploration

Stormwater Management Plan
Surrounding Waters Diagram

Little Lady 21 North Well and Production Pad

Aquionix EHS Services

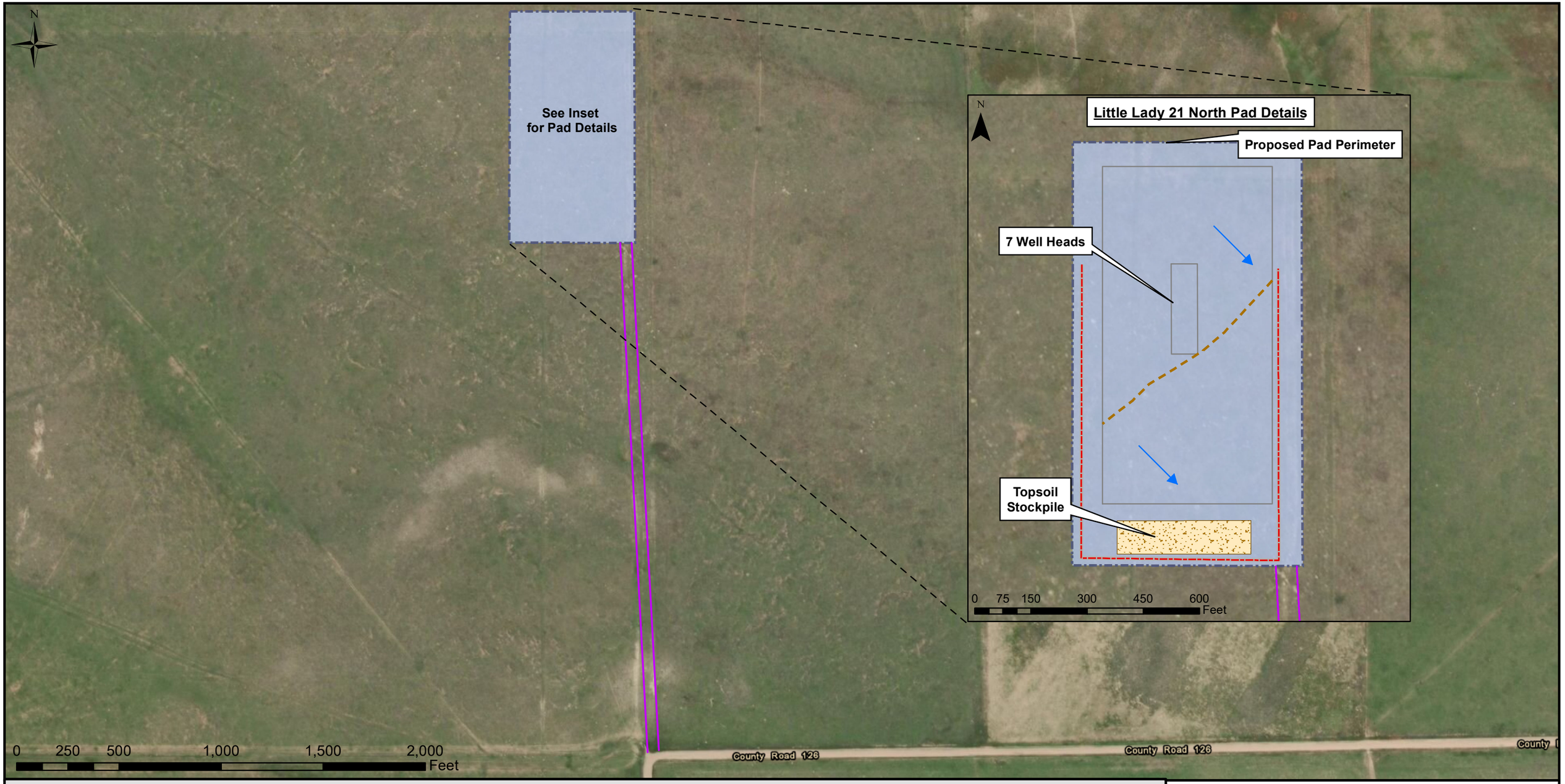
DRAWN BY: MT (Aquionix)

DATE DRAWN: 06/27/2019

MAP SCALE: 1:58,986

COORD. SYSTEM: WGS_1984_Web_Mercator_Auxiliary_Sphere

S:\ArcGIS and AutoCAD files\Upland Exploration\mxds



MAP FEATURES

- Disturbed Area
- Well Head Surface Location
- Surface Flow Direction
- Access Road
- Cut/Fill
- Proposed Production Area
- Perennial Stream
- Intermittent Stream
- Earthen Swale
- Silt Fence
- Topsoil Stockpile

Upland Exploration

Stormwater Management Plan
Site-Specific Diagram

Little Lady 21 North
Well and Production Pad

Aquionix EHS Services

DRAWN BY: MT (Aquionix)

DATE DRAWN: 08/12/2019

MAP SCALE: 1:5,500

COORD. SYSTEM: WGS_1984_Web_Mercator_Auxiliary_Sphere

S:\ArcGIS and AutoCAD files\Upland Exploration\mxds

SITE-SPECIFIC STORMWATER MANAGEMENT PLAN (Template)

Construction Activities Associated with [Well Pad]

Prepared For:

UPLAND EXPLORATION, LLC

Denver-Julesburg Basin
Weld County, Colorado

Date

Prepared By:

Aquionix
EHS Services

5545 W. 56th Avenue, Suite E
Arvada, CO 80002
(303) 289-7520
www.aquionix.com

This site-specific Stormwater Management Plan (SWMP) has been prepared for construction activities associated with Upland's [enter name] well pad location. Specific information related to the construction of the well pad location are detailed below if they differ from the Upland Master Field-Wide SWMP.

General Permit Reference	Description	Site-Specific Details
Part I.A.3	Certification	See Master SWMP.
Part I.B.1.b	Maintenance	See Master SWMP.
Part I.C.2.a(i)	Qualified Stormwater Manager	See Master SWMP.
Part I.C.2.a(ii)	Spill Prevention and Response Plan	See Master SWMP.
Part I.C.2.a(iii)	Other CDPS Permits	
Part I.C.2.a(iv)	Materials Handling	See Master SWMP.
Part I.C.2.a(v)	Identification of Potential Pollutant Sources	See Master SWMP.
Part I.B.1 Part I.C.2.a(vi)	Implementation of Control Measures (BMPs)	See Master SWMP and Site Map for BMPs.
Part I.C.2.a(vii)(a)	Nature of Construction Activity	
Part I.C.2.a(vii)(b)	Sequence of Major Activities	See Master SWMP.
Part I.C.2.a(vii)(c)	Area of Disturbance	Approximate Disturbance:
Part I.C.2.a(vii)(d)	Soil Description	See Master SWMP.
Part I.C.2.a(vii)(e)	Vegetation Description	
Part I.C.2.a(vii)(f)	Non-Stormwater Discharges	See Master SWMP.
Part I.C.2.a(vii)(g)	Drainage Patterns	
Part I.C.2.a(vii)(g)	Receiving Waters	Immediate Receiving Water:
		Ultimate Receiving Water:
		Other:
Part I.C.2.a(vii)(h)	Description of Stream Crossings	
Part I.C.2.a(vii)(i)	Alternative Temporary Stabilization Schedule	
Part I.C.2.a(vii)(j)	(Approved) Alternative Diversion Criteria	
Part I.C.2.a(viii)	Site Map	
Part I.C.2.a(ix)	Temporary Stabilization	See Master SWMP.
Part I.C.2.a(ix)	Final Stabilization and Long-Term Stormwater Management	See Master SWMP.
Part I.C.2.a(x) Part I.C.4	Inspection	See Master SWMP.
Part I.C.3	SWMP Review and Revisions	See Master SWMP.
Part I.C.4	SWMP Availability	See Master SWMP.
Part II.O	Retention of Records	See Master SWMP.

APPENDIX E

ROUTINE STORMWATER INSPECTION FORM

Upland Routine Stormwater Inspection Form – Construction Sites

FACILITY INFORMATION	
Facility Name:	
Date (MM/DD/YYYY):	
Inspector Name/Title:	
Weather:	
Inspection Frequency:	☐ 7-Day ☐ 14-Day/Post-Storm ☐ Monthly
Construction Phase:	
Acreage of Disturbance *(Est.)*	

GENERAL QUESTIONS	YES / NO / NA	COMMENTS
Are there any location(s) of discharges of sediment or other pollutants from the site?	☐ Yes ☐ No ☐ NA	
Are there any control measures that need to be maintained?	☐ Yes ☐ No ☐ NA	
Are there any control measures that failed to operate as designed or proved inadequate for a particular location?	☐ Yes ☐ No ☐ NA	
Are any control measures needed that were not in place at the time of inspection?	☐ Yes ☐ No ☐ NA	
Are there any deviations from the minimum inspection schedule?	☐ Yes ☐ No ☐ NA	

CORRECTIVE ACTION LOG	
Description of Corrective Action and Preventative Measure Taken (If infeasible to install or repair control measure immediately, document (1) why it is infeasible and (2) provide a schedule to installation or repair of the control measure.	**Date Completed and Initials**

CERTIFICATION AND SIGNATURE	
Pursuant to Part I.D.6.b.2(viii) of the general permit, the following signature certifies that after adequate corrective action(s) has been taken or where an inspection does not identify any incidents requiring corrective action, "*I verify that, to the best of my knowledge and belief, all corrective action and maintenance items identified during the inspection are complete, and the site is currently in compliance with the permit*".	
Name /Title	Date

SITE-SPECIFIC STORMWATER MANAGEMENT PLAN

Construction Activities Associated with Salt Ranch Fee 18

Prepared For:

Upland Exploration, LLC
Denver-Julesburg Basin
Weld County, Colorado

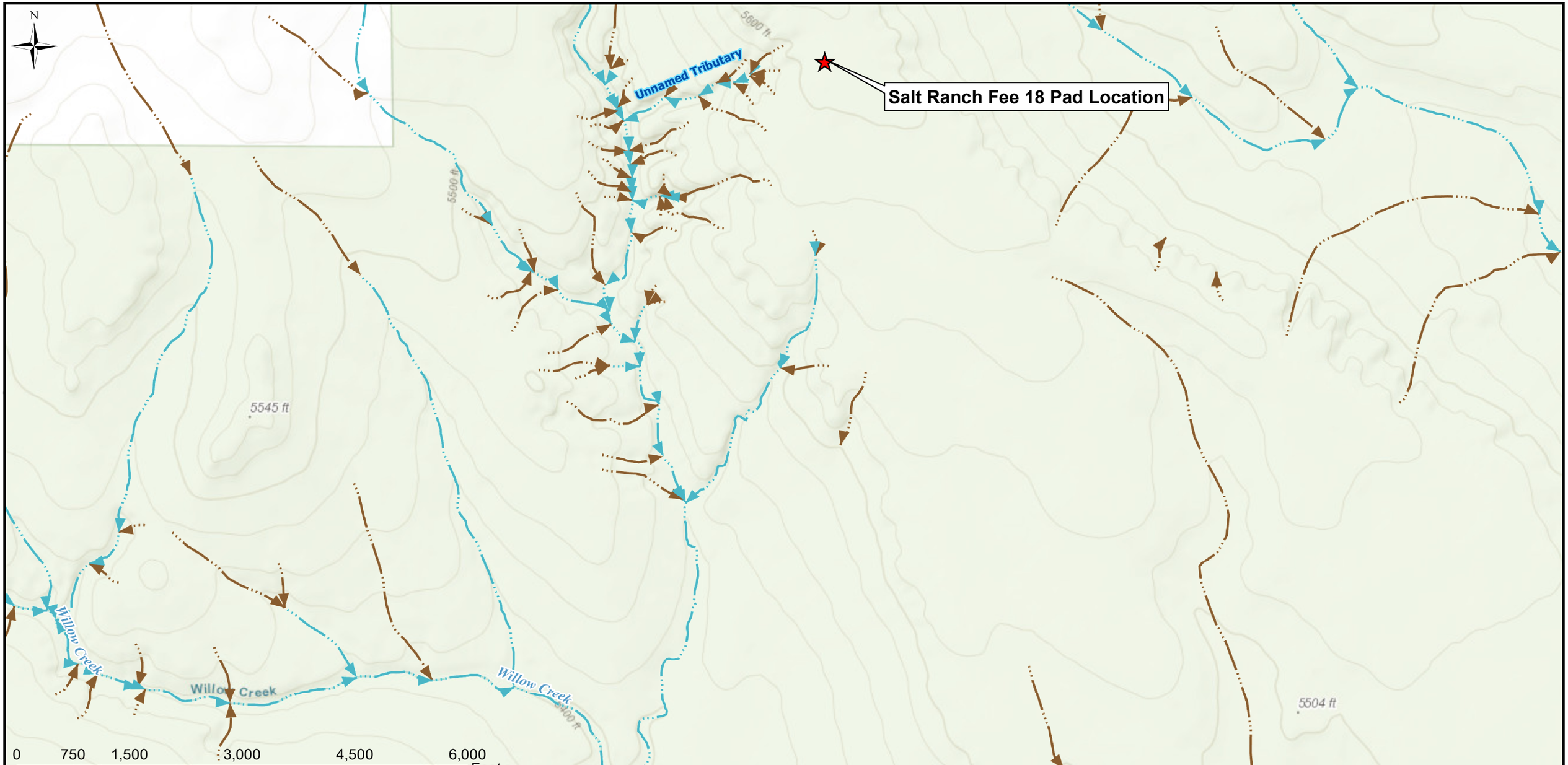
February 2022

Prepared By:

Aquionix
EHS Services
5545 W. 56th Avenue, Suite E
Arvada, CO 80002
(303) 289-7520
www.aquionix.com

This site-specific Stormwater Management Plan (SWMP) has been prepared for construction activities associated with the Upland Exploration Salt Ranch Fee 18 well pad location. Specific information related to the construction of the well pad location are detailed below if they differ from the Upland Exploration Master Field-Wide SWMP.

General Permit Reference	Description	Site-Specific Details	
Part I.A.3	Certification	See Master SWMP.	
Part I.B.1.b	Maintenance	See Master SWMP.	
Part I.C.2.a(i)	Qualified Stormwater Manager	See Master SWMP.	
Part I.C.2.a(ii)	Spill Prevention and Response Plan	See Master SWMP.	
Part I.C.2.a(iii)	Other CDPS Permits	None.	
Part I.C.2.a(iv)	Materials Handling	See Master SWMP.	
Part I.C.2.a(v)	Identification of Potential Pollutant Sources	See Master SWMP.	
Part I.B.1 Part I.C.2.a(vi)	Implementation of Control Measures (BMPs)	See Master SWMP and Site Map for BMPs.	
Part I.C.2.a(vii)(a)	Nature of Construction Activity	This project will include the construction of an access road and well pad.	
Part I.C.2.a(vii)(b)	Sequence of Major Activities	See Master SWMP.	
Part I.C.2.a(vii)(c)	Area of Disturbance	Approximate Disturbance:	7.7 acres
Part I.C.2.a(vii)(d)	Soil Description	See Master SWMP.	
Part I.C.2.a(vii)(e)	Vegetation Description	Vegetation in the vicinity of the facility is dominated by brush rangeland, with 100% existing ground cover (determined by ArcGIS/Google Earth imagery and site observation)	
Part I.C.2.a(vii)(f)	Non-Stormwater Discharges	See Master SWMP.	
Part I.C.2.a(vii)(g)	Drainage Patterns	See Site Map	
Part I.C.2.a(vii)(g)	Receiving Waters	Immediate Receiving Water:	Unnamed Tributary
		Ultimate Receiving Water:	Willow Creek
		Other:	None
Part I.C.2.a(vii)(h)	Description of Stream Crossings	N/A	
Part I.C.2.a(vii)(i)	Alternative Temporary Stabilization Schedule	None.	
Part I.C.2.a(vii)(j)	(Approved) Alternative Diversion Criteria	None.	
Part I.C.2.a(viii)	Site Map	See Site Map.	
Part I.C.2.a(ix)	Temporary Stabilization	See Master SWMP.	
Part I.C.2.a(ix)	Final Stabilization and Long-Term Stormwater Management	See Master SWMP.	
Part I.C.2.a(x) Part I.C.4	Inspection	See Master SWMP.	
Part I.C.3	SWMP Review and Revisions	See Master SWMP.	
Part I.C.4	SWMP Availability	See Master SWMP.	
Part II.O	Retention of Records	See Master SWMP.	



MAP FEATURES

- Pad Location
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Artificial Path
- Canal / Ditch
- Lake / Pond

Upland Exploration, LLC

Stormwater Management Plan
Surrounding Waters Diagram

Salt Ranch Fee 18 Pad

Aquionix EHS Services

DRAWN BY: MT (Aquionix)

DATE DRAWN: 02/15/2022

MAP SCALE: 1:15,000

COORD. SYSTEM: WGS_1984_Web_Mercator_Auxiliary_Sphere

S:\ArcGIS and AutoCAD files\Uplandmxds

N

0 75 150 300 450 600
Feet

MAP FEATURES

- Disturbed Area
- Well Head Surface Location
- Surface Flow Direction
- Access Road
- Cut/Fill
- Proposed Production Area
- Perennial Stream
- Ephemeral Stream
- Earthen Swale
- Silt Fence
- Sediment Trap
- Rip-Rap
- Topsoil Stockpile
- Wattles (Straw or Rock)
- Straw Mulched or Crimped / Hydroseed
- Culvert
- LOD

REVISION	DATE
Initial Release	02/15/2022

Upland Exploration, LLC

Salt Ranch Fee 18 Pad
Site-Specific Stormwater Map

Section 18, Township 11N, Range 64W
Weld County, Colorado

Aquionix EHS Services
5545 W. 56th Ave
Arvada, CO 80002
(303) 289-7520
www.aquionix.com

DESIGNED BY: Aquionix
DATE DRAWN: 02/15/2022
DRAWN BY: MT

SCALE: 1:1,581
COORD. SYSTEM: WGS_1984 _Web_Mercator_Auxiliary_Sphere

S:\ArcGIS and AutoCAD files\Upland\mxds

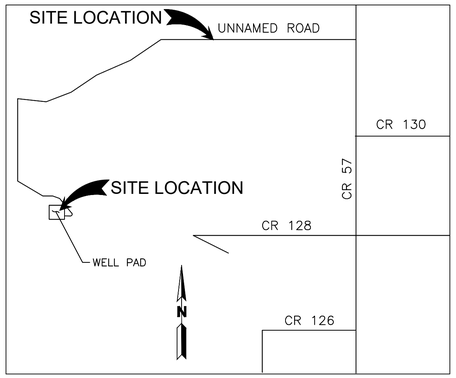
EROSION CONTROL (SWMP) PLANS
UPLAND SALT CREEK EROSION CONTROL PLANS
A PARCEL OF LAND BEING SITUATED IN SECTION 18, TOWNSHIP 11 NORTH, RANGE 64 WEST OF THE SIXTH PRINCIPAL MERIDIAN
COUNTY OF WELD
STATE OF COLORADO

EROSION CONTROL NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED PERMITS AND IMPLEMENTING AND MAINTAINING EROSION AND SEDIMENT CONTROL MEASURES AT ALL TIMES DURING CONSTRUCTION TO PREVENT DAMAGING FLOWS ON THE SITE AND IN THE WATERSHED BELOW THE SITE. CONTROL SYSTEMS SHALL BE INSTALLED PRIOR TO STRIPPING OF NATIVE VEGETATIVE COVER AND AS GRADING PROGRESSES. REFER TO SEDIMENT AND EROSION CONTROL PLANS AND STORM WATER MANAGEMENT PLAN. CONDITIONS IN THE FIELD MAY WARRANT EROSION CONTROL MEASURES IN ADDITION TO WHAT IS SHOWN ON THESE PLANS. THE PLAN MAY BE MODIFIED WITH APPROPRIATE APPROVALS AS FIELD CONDITIONS WARRANT.
2. NATURAL VEGETATION SHALL BE RETAINED AND PROTECTED WHEREVER POSSIBLE. EXPOSURE OF SOIL TO EROSION BY REMOVAL OR DISTURBANCE OF VEGETATION SHALL BE LIMITED TO THE AREA REQUIRED FOR IMMEDIATE CONSTRUCTION OPERATION AND FOR THE SHORTEST PRACTICAL PERIOD OF TIME.
3. TOPSOIL SHALL BE STOCKPILED TO THE EXTENT PRACTICABLE ON THE SITE FOR USE ON AREAS TO BE REVEGETATED. ANY AND ALL STOCKPILES SHALL BE LOCATED AND PROTECTED FROM EROSIVE ELEMENTS.
4. AT ALL TIMES, THE PROPERTY SHALL BE MAINTAINED AND/OR WATERED TO PREVENT WIND–CAUSED EROSION. EARTHWORK OPERATIONS SHALL BE DISCONTINUED WHEN FUGITIVE DUST SIGNIFICANTLY IMPACTS ADJACENT PROPERTY. IF EARTHWORK IS COMPLETE OR DISCONTINUED AND DUST FROM THE SITE CONTINUES TO CREATE PROBLEMS, THE CONTRACTOR SHALL IMMEDIATELY INSTITUTE MITIGATIVE MEASURES AND SHALL CORRECT DAMAGE TO ADJACENT PROPERTY.
5. PERMANENT OR TEMPORARY SOIL STABILIZATION MEASURES SHALL BE APPLIED TO DISTURBED AREAS WITHIN 30 DAYS AFTER FINAL GRADE IS REACHED ON ANY PORTION OF THE SITE. UNLESS SPECIFIED OTHERWISE, TEMPORARY VEGETATION SHALL BE INSTALLED ON ALL DISTURBED AREAS WHERE PERMANENT SURFACE IMPROVEMENTS ARE NOT SCHEDULED FOR INSTALLATION WITHIN THREE MONTHS. TEMPORARY VEGETATION SHALL BE A VIGOROUS, DROUGHT TOLERANT, NATIVE SPECIES MIX. PROJECT SCHEDULING SHOULD TAKE ADVANTAGE OF SPRING OR FALL PLANTING SEASONS FOR NATURAL GERMINATION, BUT SEEDED AREAS SHALL BE IRRIGATED, IF CONDITIONS MERIT. REFER TO THE LANDSCAPE PLAN FOR FINAL LANDSCAPING.
6. TEMPORARY FENCES SHALL BE INSTALLED ALONG ALL BOUNDARIES OF THE CONSTRUCTION LIMITS OR PROPERTY LINES AS SHOWN ON THE APPROVED EROSION CONTROL PLAN, TO PREVENT GRADING ON PROPERTY NOT OWNED BY THE OWNER/DEVELOPER. IN ADDITION, THE [LOCAL JURISDICTION] MAY REQUIRE ADDITIONAL TEMPORARY FENCES IF FIELD CONDITIONS WARRANT.
7. THE CONTRACTOR SHALL PREVENT SEDIMENT, DEBRIS AND ALL OTHER POLLUTANTS FROM ENTERING THE STORM SEWER SYSTEM DURING ALL DEMOLITION, EXCAVATION, TRENCHING, GRADING OR OTHER CONSTRUCTION OPERATIONS THAT ARE PART OF THIS PROJECT. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR REMEDIATION OF ANY ADVERSE IMPACTS TO ADJACENT WATERWAYS, ROADWAYS, WETLANDS, ETC., RESULTING FROM WORK DONE AS PART OF THIS PROJECT.
8. THE CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS SHALL REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN INADVERTENTLY DISCHARGED TO, OR ACCUMULATED IN, THE FLOWLINES AND PUBLIC RIGHT–OF–WAY AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT.
9. THE GRADING CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS SHALL ENSURE THAT ALL LOADS OF CUT AND FILL MATERIAL IMPORTED TO OR EXPORTED FROM THIS SITE SHALL BE PROPERLY COVERED TO PREVENT LOSS OF THE MATERIAL DURING TRANSPORT ON PUBLIC ROADWAYS.
10. APPROVED EROSION AND SEDIMENT CONTROL "BEST MANAGEMENT PRACTICES" [BMP] SHALL BE MAINTAINED AND KEPT IN GOOD REPAIR FOR THE DURATION OF THIS PROJECT. AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL BMPS WEEKLY AND AFTER SIGNIFICANT PRECIPITATION EVENTS. ALL NECESSARY MAINTENANCE AND REPAIR SHALL BE COMPLETED IN A TIMELY MANNER. ACCUMULATED SEDIMENT AND DEBRIS SHALL BE REMOVED FROM A BMP WHEN THE SEDIMENT LEVEL REACHES ONE HALF THE HEIGHT OF THE BMP OR, AT ANY TIME THAT SEDIMENT OR DEBRIS ADVERSELY IMPACTS THE FUNCTIONING OF THE BMP.
11. WATER USED IN THE CLEANING OF CONCRETE TRUCK DELIVERY CHUTES SHALL BE DISCHARGED INTO A PREDEFINED, BERMED CONTAINMENT AREA ON THE JOB SITE. THE REQUIRED CONTAINMENT AREA IS TO BE BERMED SO THAT WASH WATER IS TOTALLY CONTAINED. WASH WATER DISCHARGED INTO THE CONTAINMENT AREA SHALL BE ALLOWED TO INFILTRATE OR EVAPORATE. DRIED CONCRETE WASTE SHALL BE REMOVED FROM THE CONTAINMENT AREA AND PROPERLY DISPOSED OF. SHOULD A PREDEFINED BERMED CONTAINMENT AREA NOT BE AVAILABLE DUE TO THE PROJECT SIZE, OR LACK OF AN AREA WITH A SUITABLE GROUND SURFACE FOR ESTABLISHING A CONTAINMENT AREA, PROPER DISPOSAL OF READY MIX WASHOUT AND RINSE OFF WATER AT THE JOB SITE SHALL CONFORM TO THE APPROVED TECHNIQUES AND PRACTICES IDENTIFIED IN THE COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT'S TRAINING VIDEO ENTITLED "BUILDING FOR A CLEANER ENVIRONMENT, READY MIX WASHOUT TRAINING", AND ITS ACCOMPANYING MANUAL ENTITLED, "READY MIX WASHOUT GUIDEBOOK, VEHICLE AND EQUIPMENT WASHOUT AT CONSTRUCTION SITES." THE DIRECT OR INDIRECT DISCHARGE OF WATER CONTAINING WASTE CONCRETE TO THE STORM SEWER SYSTEM IS PROHIBITED. INFORMATION ABOUT, OR COPIES OF THE VIDEO AND TRAINING MANUAL ARE AVAILABLE FROM THE WATER QUALITY CONTROL DIVISION, COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT, 4300 CHERRY CREEK DRIVE SOUTH, DENVER, COLORADO 80222–1530, 303–692–3555
12. THE CONTRACTOR SHALL PROTECT ALL STORM SEWER FACILITIES ADJACENT TO ANY LOCATION WHERE PAVEMENT CUTTING OPERATIONS INVOLVING WHEEL CUTTING, SAW CUTTING OR ABRASIVE WATER JET CUTTING ARE TO TAKE PLACE. THE CONTRACTOR SHALL REMOVE AND PROPERLY DISPOSE OF ALL WASTE PRODUCTS GENERATED BY SAID CUTTING OPERATIONS ON A DAILY BASIS. THE DISCHARGE OF ANY WATER CONTAMINATED BY WASTE PRODUCTS FROM CUTTING OPERATIONS TO THE STORM SEWER SYSTEM IS PROHIBITED.
13. PAVED SURFACES WHICH ARE ADJACENT TO CONSTRUCTION SITES SHALL BE SWEPT IN A TIMELY MANNER WHEN SEDIMENT AND OTHER MATERIALS ARE TRACKED OR DISCHARGED ON TO THEM. EITHER SWEEPING BY HAND OR USE OF STREET SWEEPERS IS ACCEPTABLE. STREET SWEEPERS USING WATER WHILE SWEEPING IS PREFERRED IN ORDER TO MINIMIZE DUST. FLUSHING OFF PAVED SURFACES WITH WATER IS PROHIBITED.

LEGEND

SF—SF	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
SP SP SP SP SP SP	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
CF—CF	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
SCL—SCL	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC



VICINITY MAP
SCALE: 1"=4000'

PROJECT OWNER/DEVELOPER SIGNATURE BLOCK

I HAVE REVIEWED THE INFORMATION CONTAINED WITHIN THE STORMWATER MANAGEMENT PLAN AND ACCEPT RESPONSIBILITY FOR THE REQUIREMENTS SET FORTH.

_____
TRISHA FANNING DATE

ON BEHALF OF:
ARDOR ENVIRONMENTAL, LLC
11546 W. 26TH PLACE
LAKEWOOD, CO 80215

PLAN PREPARER SIGNATURE BLOCK

I ACKNOWLEDGE MY RESPONSIBILITY FOR THE PREPARATION OF THE STORMWATER MANAGEMENT PLAN.

_____
DAVID M. LE DATE

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2–BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE OR EXCAVATE FOR MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

MARTIN/MARTIN ADDITIONAL NOTES:

EROSION CONTROL NOTES:

1. NATURAL VEGETATION SHALL BE RETAINED AND PROTECTED WHEREVER POSSIBLE. EXPOSURE OF SOIL TO EROSION BY REMOVAL OR DISTURBANCE OF VEGETATION SHALL BE LIMITED TO THE AREA REQUIRED FOR IMMEDIATE CONSTRUCTION OPERATION AND FOR THE SHORTEST PRACTICAL PERIOD OF TIME.
2. TOPSOIL SHALL BE STOCKPILED TO THE EXTENT PRACTICABLE ON THE SITE FOR USE ON AREAS TO BE REVEGETATED. ANY AND ALL STOCKPILES SHALL BE LOCATED AND PROTECTED FROM EROSIVE ELEMENTS.
3. AT ALL TIMES, THE PROPERTY SHALL BE MAINTAINED AND/OR WATERED TO PREVENT WIND–CAUSED EROSION. EARTHWORK OPERATIONS SHALL BE DISCONTINUED WHEN FUGITIVE DUST SIGNIFICANTLY IMPACTS ADJACENT PROPERTY. IF EARTHWORK IS COMPLETE OR DISCONTINUED AND DUST FROM THE SITE CONTINUES TO CREATE PROBLEMS, THE CONTRACTOR SHALL IMMEDIATELY INSTITUTE MITIGATIVE MEASURES AND SHALL CORRECT DAMAGE TO ADJACENT PROPERTY.
4. TEMPORARY FENCES SHALL BE INSTALLED ALONG BOUNDARIES OF THE CONSTRUCTION LIMITS OR PROPERTY LINES AS SHOWN ON THE APPROVED EROSION CONTROL PLAN, TO PREVENT GRADING ON PROPERTY NOT OWNED BY THE OWNER/DEVELOPER. IN ADDITION, THE COUNTY OF WELD MAY REQUIRE ADDITIONAL TEMPORARY FENCES IF FIELD CONDITIONS WARRANT. TEMPORARY FENCE WILL NOT BE REQUIRED IN AREAS WHERE EXISTING PROPERTY FENCE IS IN PLACE.
5. THE CONTRACTOR SHALL PREVENT SEDIMENT, DEBRIS AND ALL OTHER POLLUTANTS FROM ENTERING THE STORM SEWER SYSTEM DURING ALL DEMOLITION, EXCAVATION, TRENCHING, GRADING OR OTHER CONSTRUCTION OPERATIONS THAT ARE PART OF THIS PROJECT.
6. THE GRADING CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS SHALL ENSURE THAT ALL LOADS OF CUT AND FILL MATERIAL IMPORTED TO OR EXPORTED FROM THIS SITE SHALL BE PROPERLY COVERED TO PREVENT LOSS OF THE MATERIAL DURING TRANSPORT ON PUBLIC ROADWAYS.
7. APPROVED EROSION AND SEDIMENT CONTROL "BEST MANAGEMENT PRACTICES" [BMP] SHALL BE MAINTAINED AND KEPT IN GOOD REPAIR FOR THE DURATION OF THIS PROJECT. AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL BMPS WEEKLY AND AFTER SIGNIFICANT PRECIPITATION EVENTS. ALL NECESSARY MAINTENANCE AND REPAIR SHALL BE COMPLETED IN A TIMELY MANNER.
8. PAVED SURFACES WHICH ARE ADJACENT TO CONSTRUCTION SITES SHALL BE SWEPT IN A TIMELY MANNER WHEN SEDIMENT AND OTHER MATERIALS ARE TRACKED OR DISCHARGED ON TO THEM. EITHER SWEEPING BY HAND OR USE OF STREET SWEEPERS IS ACCEPTABLE. STREET SWEEPERS USING WATER WHILE SWEEPING IS PREFERRED IN ORDER TO MINIMIZE DUST. FLUSHING OFF PAVED SURFACES WITH WATER IS PROHIBITED.
9. MAXIMUM SLOPE OF STOCKPILE IS 3H:1V. MAXIMUM SLOPES WITHIN PUBLIC RIGHT–OF–WAY IS 4H:1V.
10. THE OWNER/DEVELOPER RECOGNIZES AND ACCEPTS THIS EARLY GRADING PACKAGE MAY RESULT IN ADDITIONAL GRADING LONG TERM. THE FINAL GRADING IS SUBJECT TO THE ASSOCIATED DRAINAGE REPORTS AND REQUIREMENTS, WHICH MAY RESULT IN REGRADING AREAS COVERED UNDER THIS PERMIT.
11. FUTURE 56TH AVE,. 57TH AVE., TIBET ST., AND PICADILLY RD ROW IS FOR INFORMATION PURPOSES ONLY. DESIGN OF FUTURE 56TH AVE,. 57TH AVE., TIBET ST., AND PICADILLY RD IS IN PROGRESS.

GENERAL CONSTRUCTION AND GRADING NOTES:

1. EXISTING UTILITIES SHOWN ON THE PLANS ARE LEVEL C PER STANDARDS ESTABLISHED BY THE AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE 38–02). CONTRACTOR IS RESPONSIBLE TO LOCATE AND PROTECT ALL UTILITIES ON THE SITE.
2. IF WILDLIFE POPULATIONS DEEMED HAZARDOUS TO DEN AVIATION OPERATIONS BECOME AN ISSUE, EFFORTS MUST BE MADE BY THE LANDOWNER TO MITIGATE THE WILDLIFE OR THE ATTRACTANT. PLEASE CONTACT USDA APHIS WILDLIFE SERVICES (303–342–4886) AS A CONTACT FOR MITIGATION ASSISTANCE.
3. PRIOR TO COMMENCEMENT OF WORK ON SITE, CONTRACTOR SHALL INSTALL A NOTIFICATION SIGN CLEARLY VISIBLE AND LEGIBLE FROM PUBLIC ROW. NOTIFICATION SIGN SHALL DISPLAY CONTRACT INFORMATION AND STATE THAT THE PROJECT CONSISTS OF GRADING OPERATIONS ONLY AT THIS TIME.
4. NO CONSTRUCTION ACTIVITIES MAY BEGIN UNTIL THE STORM WATER PERMIT HAS BEEN OBTAINED AND EXECUTED.
5. THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR CONDITIONS AT AND ADJACENT TO THE JOB SITE, INCLUDING, BUT NOT LIMITED TO, SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK, TRENCH EXCAVATION AND SHORING, TRAFFIC CONTROL AND SECURITY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS.
6. THE COUNTY OF WELD/OWNER/ENGINEER CONSTRUCTION REVIEW OF THE CONTRACTOR'S PERFORMANCE IS NOT INTENDED TO INCLUDE REVIEW OF THE ADEQUACY OF THE CONTRACTOR'S SAFETY MEASURES IN, ON OR NEAR THE CONSTRUCTION SITE.
7. CONTRACTOR SHALL OBTAIN A COLORADO STATE CONSTRUCTION DEWATERING DISCHARGE PERMIT FROM THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT FOR ALL AREAS WHERE DEWATERING IS REQUIRED FROM AN EXCAVATION AND WATER IS DISCHARGED INTO A STORM SEWER, CHANNEL, IRRIGATION DITCH OR ANY WATERS OF THE UNITED STATES. A COPY OF THE APPROVED PERMIT MUST BE SUBMITTED TO THE COUNTY OF WELD ENGINEERING DIVISION PRIOR TO THE START OF ANY DEWATERING. A COPY OF THE APPROVED PERMIT MUST ALSO BE AVAILABLE ON THE PROJECT SITE AT ALL TIMES DURING CONSTRUCTION.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING STORM RUNOFF AND ANY GROUNDWATER ENCOUNTERED DURING THE CONSTRUCTION OF ANY PORTION OF THIS PROJECT. GROUNDWATER SHALL BE PUMPED, PIPED, REMOVED AND DISPOSED OF IN A MANNER WHICH DOES NOT CAUSE FLOODING OF EXISTING STREETS NOR EROSION ON ABUTTING PROPERTIES IN ORDER TO CONSTRUCT THE IMPROVEMENTS SHOWN ON THESE PLANS. NO CONCRETE SHALL BE PLACED WHERE GROUNDWATER IS VISIBLE OR UNTIL THE GROUNDWATER TABLE HAS BEEN LOWERED BELOW THE PROPOSED IMPROVEMENTS. ANY UNSTABLE AREAS, AS A RESULT OF GROUNDWATER, ENCOUNTERED DURING THE CONSTRUCTION OF THE PROPOSED IMPROVEMENTS SHALL BE STABILIZED AS AGREED UPON BY THE CONTRACTOR, THE COUNTY OF WELD, AND THE GEOTECHNICAL ENGINEER AT THE TIME OF OCCURRENCE.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND PROTECTING ALL UTILITIES DURING CONSTRUCTION. REPAIR OF DAMAGED UTILITIES SHALL BE AT THE CONTRACTORS EXPENSE, INCLUDING BUT NOT LIMITED TO UNKNOWN UNDERGROUND UTILITIES.
10. EXISTING FENCES, TREES, SIDEWALKS, CURBS AND GUTTERS, LANDSCAPING, STRUCTURES, AND IMPROVEMENTS DESTROYED, DAMAGED OR REMOVED DUE TO CONSTRUCTION OF THIS PROJECT SHALL BE REPLACED OR RESTORED IN LIKE KIND AT THE CONTRACTOR'S EXPENSE, UNLESS OTHERWISE INDICATED ON THESE PLANS.
11. CONTRACTOR SHALL REVIEW WITH THE GEOTECHNICAL ENGINEER FOR DESIGN AND RECOMMENDATIONS REGARDING EXCAVATION, COMPACTION, MATERIALS, EMBANKMENT, PAVEMENT SUBEXCAVATION, MITIGATION MEASURES WITHIN EXISTING MEADE GULCH, MOISTURE CONTROL, AND TOPSOIL REMOVAL AND REPLACEMENT. FINAL PAVEMENT DESIGN TO BE DETERMINED BY THE GEOTECHNICAL ENGINEER AFTER SUBGRADE IS COMPLETE. CONTRACTOR TO COORDINATE THIS WORK. THE CONSTRUCTION METHODS FOR EXCAVATION/EMBANKMENTS, COMPACTION, AND SUBGRADE PREPARATION SHALL BE IN STRICT CONFORMANCE WITH THE GEOTECHNICAL ENGINEER'S RECOMMENDATIONS. ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF DISCREPANCIES BETWEEN THE GEOTECHNICAL RECOMMENDATIONS AND REQUIREMENTS OF THESE CONSTRUCTION DOCUMENTS AND SPECIFICATIONS.
12. **ALL SITE GRADING EXCAVATION, EMBANKMENT, AND COMPACTION SHALL CONFORM TO THE RECOMMENDATIONS OF THE LATEST GEOTECHNICAL INVESTIGATION FOR THIS PROPERTY AND SHALL FURTHER BE IN CONFORMANCE WITH THE COUNTY OF WELD'S "STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS," LATEST EDITION.**
13. EXISTING ELEVATIONS SHOWN ON THIS DRAWING HAVE BEEN DEPICTED FROM BEST AVAILABLE INFORMATION AND ARE SHOWN TO THE EXTENT KNOWN. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD VERIFY EXISTING GRADE CONDITIONS AT THE LIMITS OF CONSTRUCTION AND AT LOCATIONS THAT INTERFACE WITH EXISTING OR PROPOSED STRUCTURES AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES THAT CONTRADICT THE ENGINEERS INTENT FOR DRAINAGE PATTERNS, MAXIMUM AND MINIMUM SLOPES, AND PROPOSED ELEVATIONS AS SHOWN ON THE PLAN. THE ENGINEER WILL NOT BE LIABLE FOR ANY COSTS ASSOCIATED WITH CHANGES TO THE DESIGN WITHOUT PROPER NOTIFICATION.
14. PROPOSED CONTOURS AND SPOT ELEVATIONS AS SHOWN HEREIN ARE DEFINED AS FINISHED ELEVATION AFTER PAVING, LANDSCAPING, ETC. CONTRACTOR SHALL COORDINATE WITH GEOTECH FOR PAVEMENT THICKNESS AND LANDSCAPE FOR THICKNESS OF TOPSOIL, SOD AND LANDSCAPE MATERIALS.
15. TEMPORARY CUT/FILL SLOPES SHALL NOT EXCEED A STEEPNESS OF [1:1] (H:V). PERMANENT SLOPES SHALL NOT EXCEED [4:1] (H:V) [UNLESS NOTED OTHERWISE] IN AREAS TO BE SEEDED OR SODDED.

SHEET INDEX

SHEET NUMBER	SHEET DESCRIPTION	SHEET TITLE
EC0	01	COVER SHEET
EC1–EC9	02–10	EROSION CONTROL PLANS

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

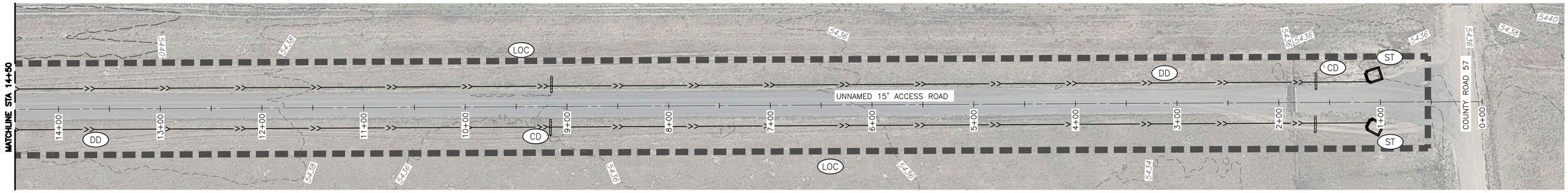
UPLAND SALT CREEK
EROSION CONTROL PLANS
STORMWATER MANAGEMENT

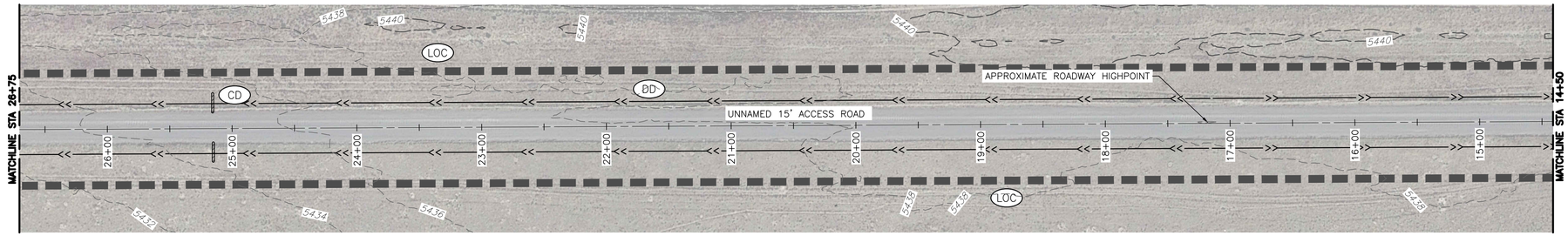
No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

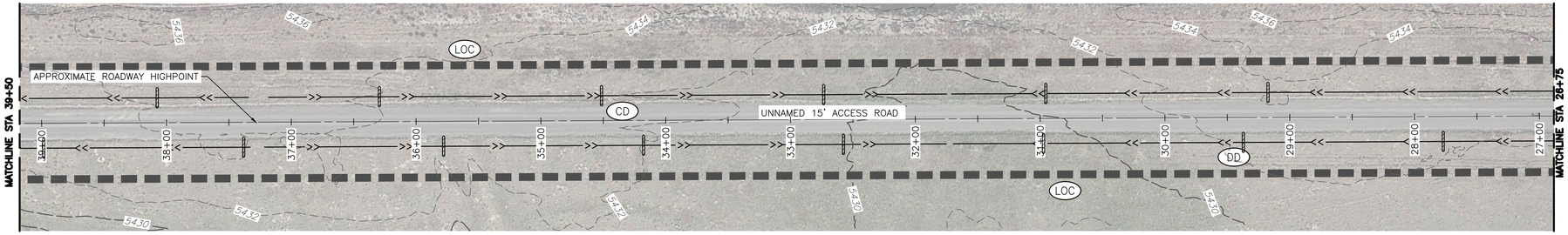
Job Number 23.0876
Project Manager DML
Design By BAM
Drawn By DJB
Principal In Charge DML

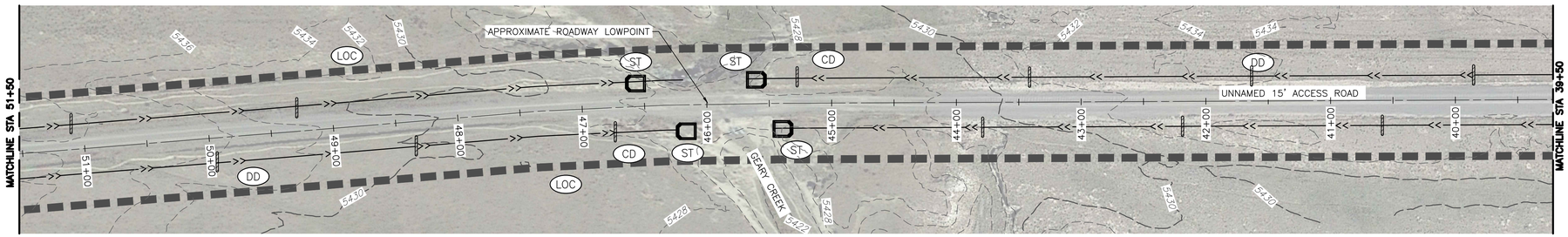
Sheet Number:
EC0

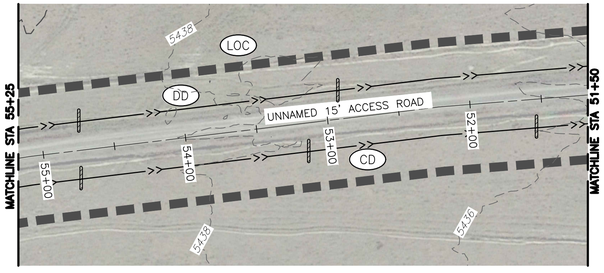
PLOT DATE: Tuesday, September 26, 2023 12:50 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876–Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg







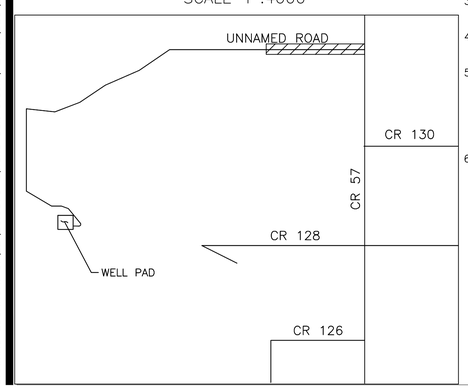




LEGEND

SILT FENCE	SF	
VEHICLE TRACKING CONTROL	VTC	
INLET PROTECTION	IP	
OUTLET PROTECTION	OP	
CULVERT INLET PROTECTION	CIP	
STABILIZED CONSTRUCTION ROADWAY	SCR	
STABILIZED STAGING AREA	SSA	
STOCKPILE MANAGEMENT W/ PROTECTION	SP	
CONCRETE WASHOUT AREA	CWA	
CONSTRUCTION FENCE	CF	
CURB SOCK	CS	
ROCK SOCK	RS	
SEDIMENT CONTROL LOG	SCL	
STRAW BALE BARRIER	SBB	
CHECK DAM	CD	
TEMP. SLOPE DRAIN	TSD	
DIVERSION DITCHES/ CHANNEL	DD	
MULCHING	MU	
SURFACE ROUGHENING	SR	
TEMPORARY SEEDING	TS	
PERMANENT SEEDING	PS	
EROSION CONTROL BLANKET	ECB	
SEDIMENT BASIN	SB	
SEDIMENT TRAP	ST	
LIMITS OF CONSTRUCTION	LOC	

KEYMAP
SCALE 1":4000'



NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

N

50 25 0 50 100
SCALE: 1"=50'
ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

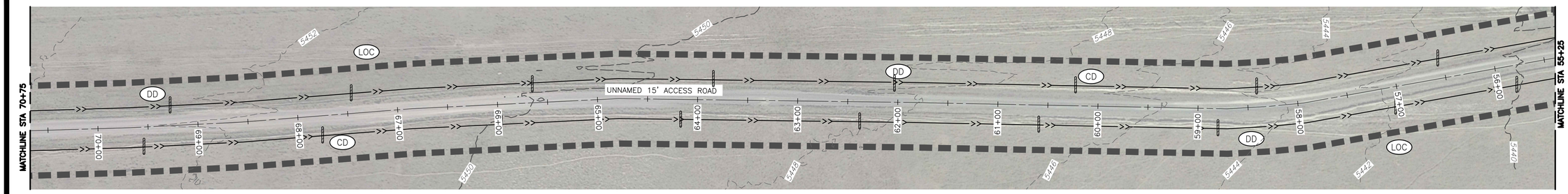
No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

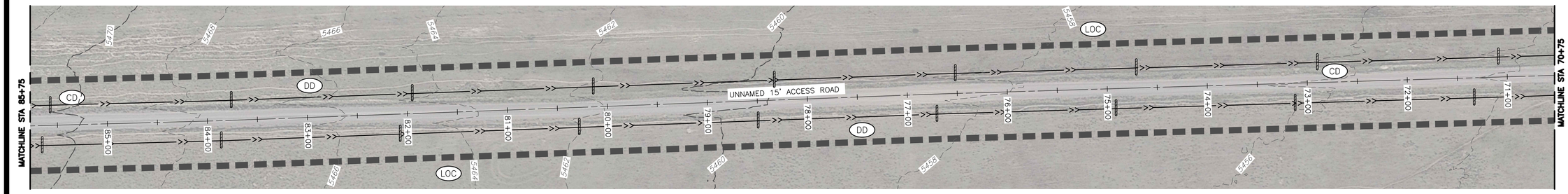
Job Number 23.0876
Project Manager DML
Design By BAM
Drawn By DJB
Principal In Charge DML

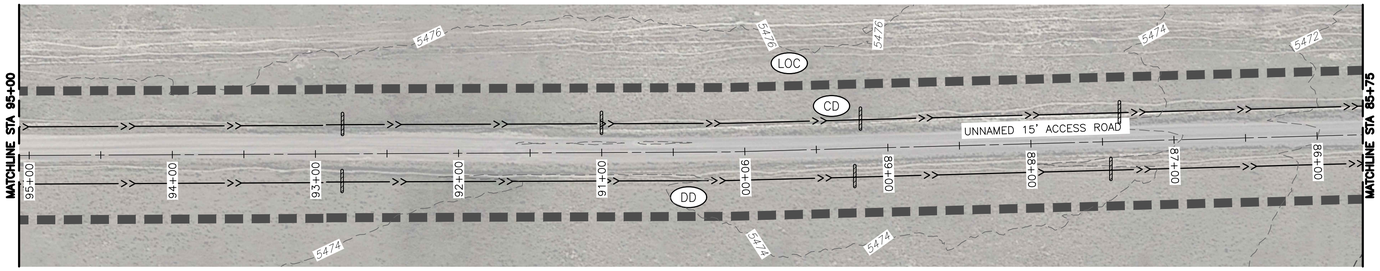
Sheet Number:

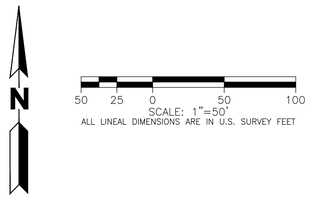
EC1

PLOT DATE: Tuesday, September 26, 2023 11:59 AM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg









50 25 0 50 100
SCALE: 1"=50'
ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

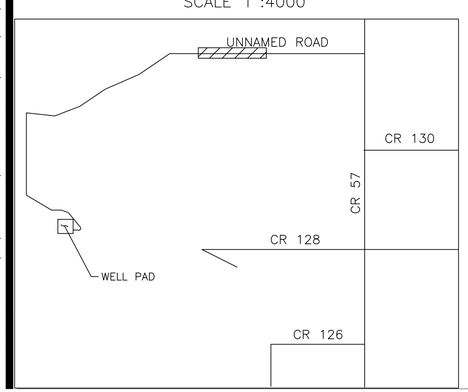
CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D, IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

KEYMAP
SCALE 1":4000'



LEGEND

SF	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
CF	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
SCL	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

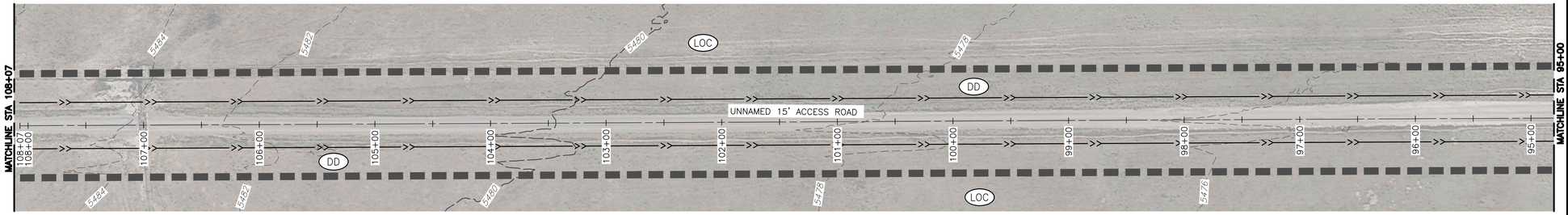
No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

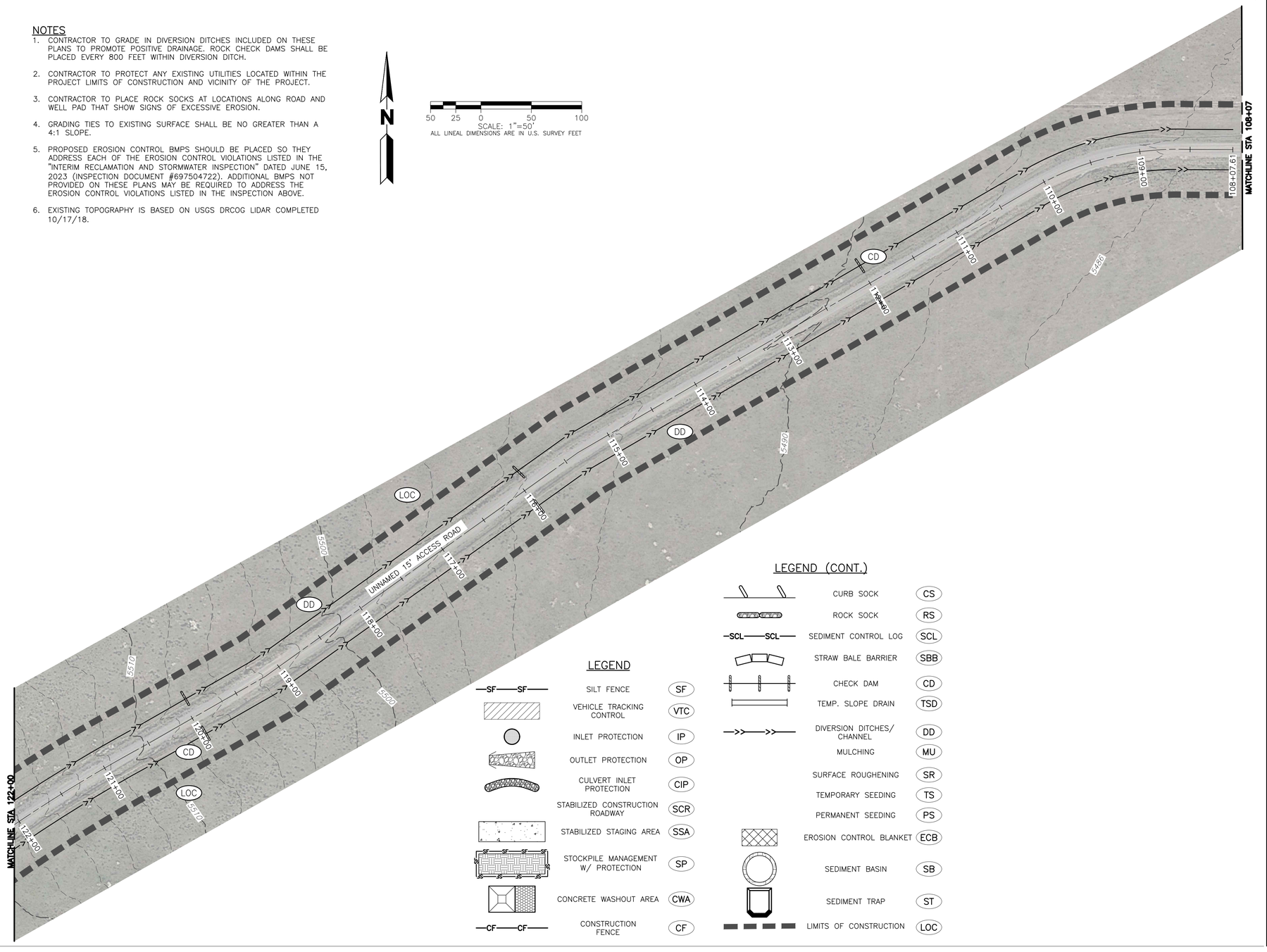
Job Number 23.0876
Project Manager DML
Design By BAM
Drawn By DJB
Principal In Charge DML

Sheet Number:

EC2

PLOT DATE: Tuesday, September 26, 2023 12:07 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg





COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

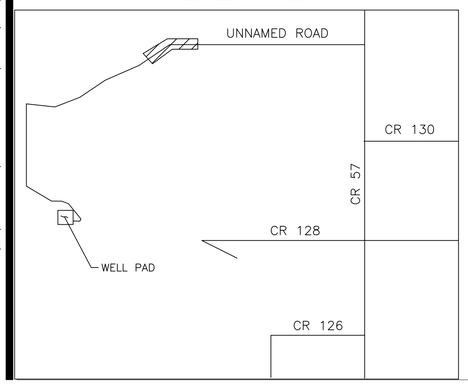
NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

N

50 25 0 50 100
SCALE: 1"=50'
ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

KEYMAP
SCALE 1":4000'



LEGEND

SF	SILT FENCE	SF
VTC	VEHICLE TRACKING CONTROL	VTC
IP	INLET PROTECTION	IP
OP	OUTLET PROTECTION	OP
CIP	CULVERT INLET PROTECTION	CIP
SCR	STABILIZED CONSTRUCTION ROADWAY	SCR
SSA	STABILIZED STAGING AREA	SSA
SP	STOCKPILE MANAGEMENT W/ PROTECTION	SP
CWA	CONCRETE WASHOUT AREA	CWA
CF	CONSTRUCTION FENCE	CF

LEGEND (CONT.)

CS	CURB SOCK	CS
RS	ROCK SOCK	RS
SCL	SEDIMENT CONTROL LOG	SCL
SBB	STRAW BALE BARRIER	SBB
CD	CHECK DAM	CD
TSD	TEMP. SLOPE DRAIN	TSD
DD	DIVERSION DITCHES/ CHANNEL	DD
MU	MULCHING	MU
SR	SURFACE ROUGHENING	SR
TS	TEMPORARY SEEDING	TS
PS	PERMANENT SEEDING	PS
ECB	EROSION CONTROL BLANKET	ECB
SB	SEDIMENT BASIN	SB
ST	SEDIMENT TRAP	ST
LOC	LIMITS OF CONSTRUCTION	LOC

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	W/M

Job Number	23.0876
Project Manager	DML
Design By	BAM
Drawn By	DJB
Principal In Charge	DML

Sheet Number:

EC3

PLOT DATE: Tuesday, September 26, 2023 12:29 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg

LEGEND

—SF—SF—	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
—CF—CF—	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
—SCL—SCL—	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC

N

50 25 0 50 100

SCALE: 1"=50'

ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

COLORADO 811 — KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

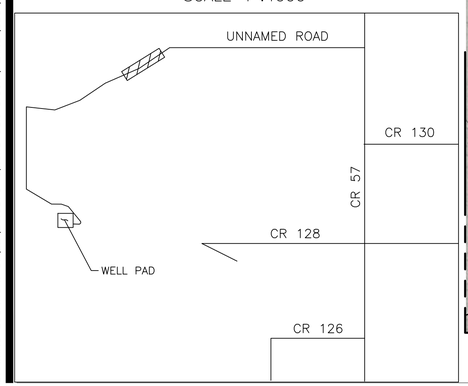
CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

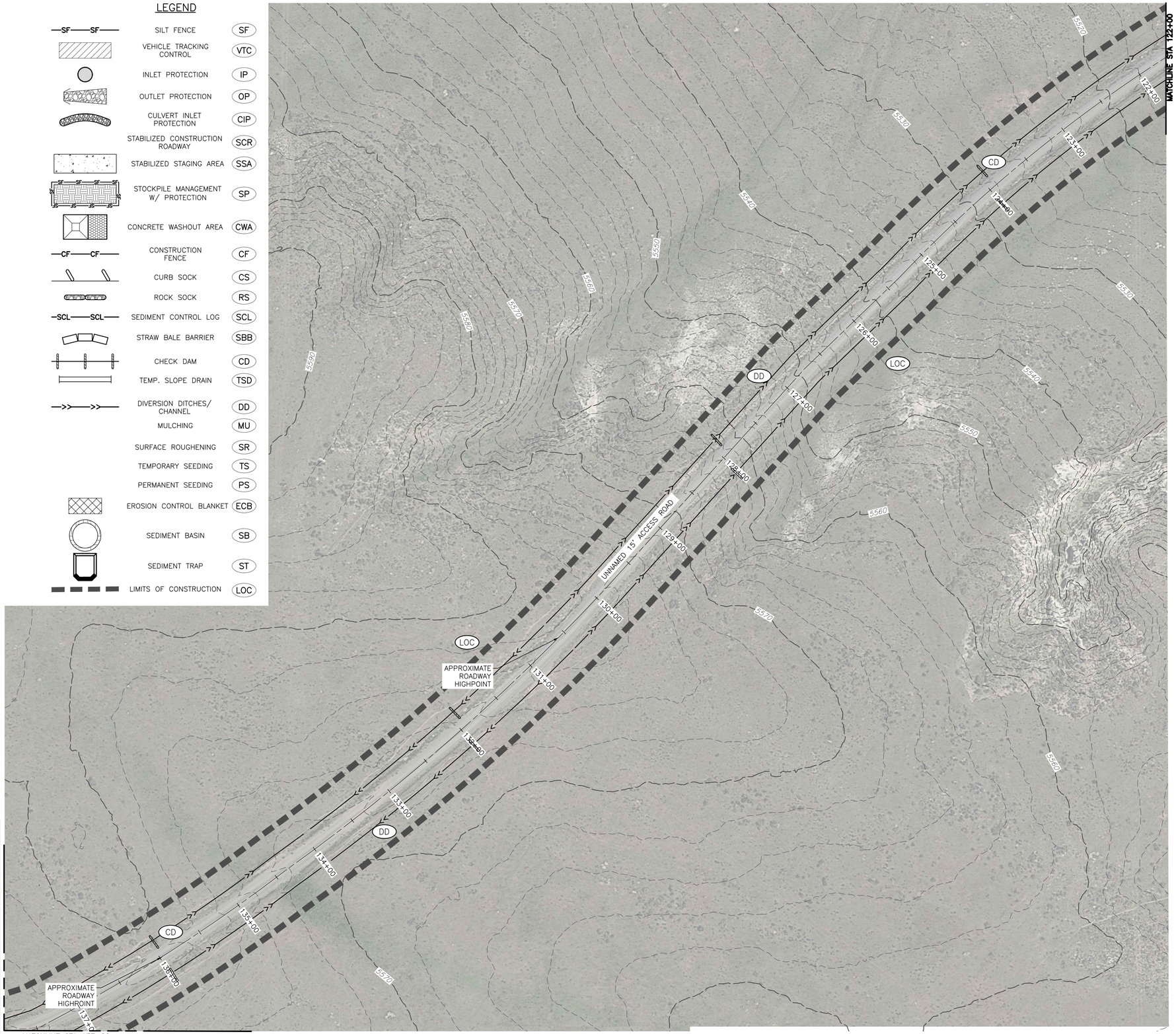
MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

KEYMAP
SCALE 1":4000'





MARTIN/MARTIN CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

Job Number 23.0876
Project Manager DML
Design By BAM
Drawn By DJB
Principal In Charge DML

Sheet Number:

EC4

PLOT DATE: Tuesday, September 26, 2023 12:29 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg

CALL 811 2–BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

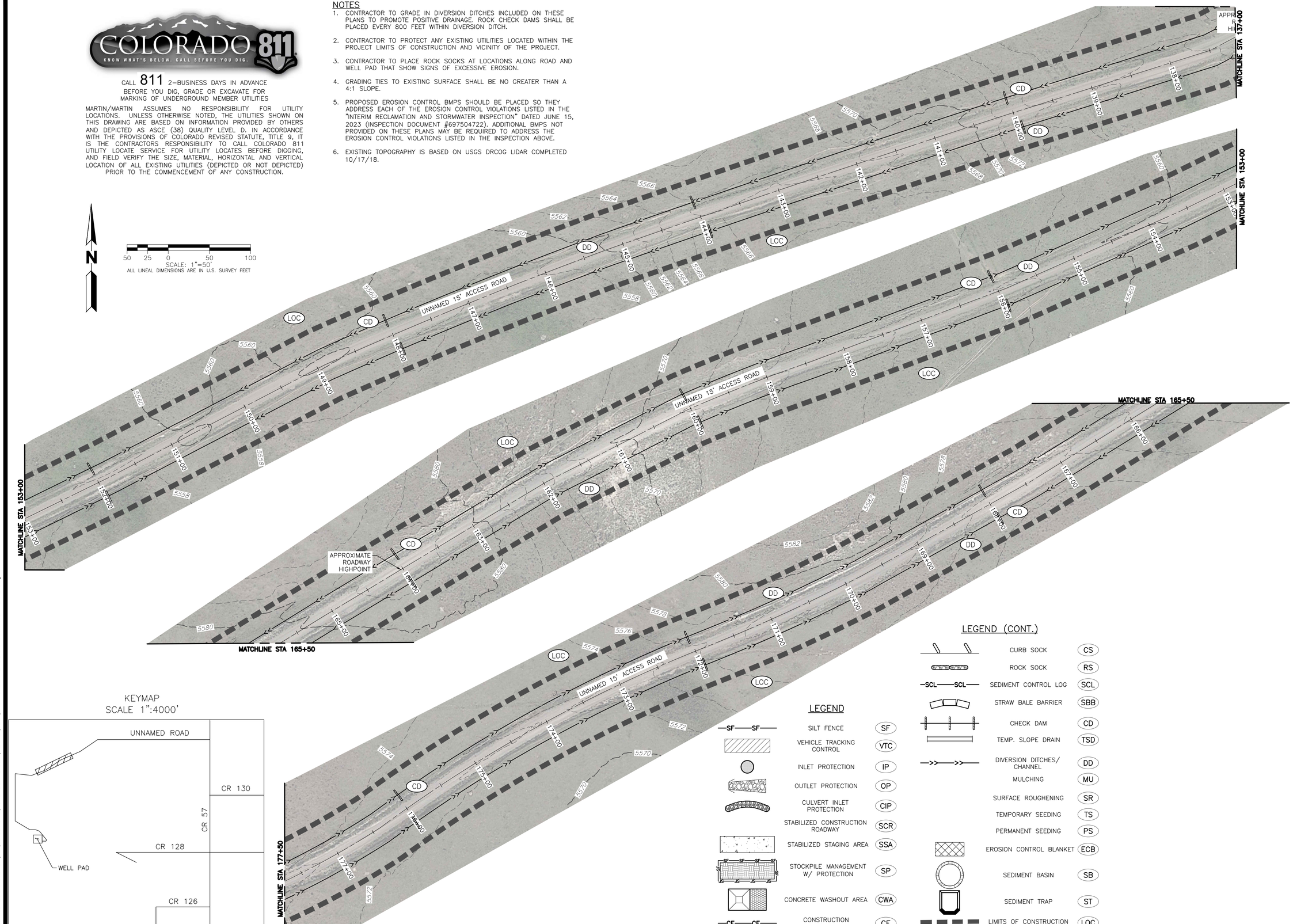
MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

N

50 25 0 50 100
SCALE: 1"=50'
ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET



KEYMAP
SCALE 1":4000'

LEGEND

SILT FENCE	SF
VEHICLE TRACKING CONTROL	VTC
INLET PROTECTION	IP
OUTLET PROTECTION	OP
CULVERT INLET PROTECTION	CIP
STABILIZED CONSTRUCTION ROADWAY	SCR
STABILIZED STAGING AREA	SSA
STOCKPILE MANAGEMENT W/ PROTECTION	SP
CONCRETE WASHOUT AREA	CWA
CONSTRUCTION FENCE	CF

LEGEND (CONT.)

CURB SOCK	CS
ROCK SOCK	RS
SEDIMENT CONTROL LOG	SCL
STRAW BALE BARRIER	SBB
CHECK DAM	CD
TEMP. SLOPE DRAIN	TSD
DIVERSION DITCHES/ CHANNEL	DD
MULCHING	MU
SURFACE ROUGHENING	SR
TEMPORARY SEEDING	TS
PERMANENT SEEDING	PS
EROSION CONTROL BLANKET	ECB
SEDIMENT BASIN	SB
SEDIMENT TRAP	ST
LIMITS OF CONSTRUCTION	LOC

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

Job Number	23.0876
Project Manager	DML
Design By	BAM
Drawn By	DJB
Principal In Charge	DML

Sheet Number:

EC5

PLOT DATE: Tuesday, September 26, 2023 12:32 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg

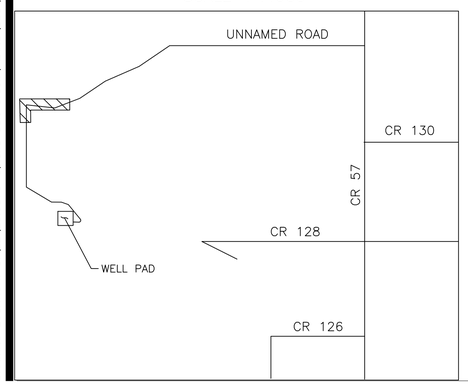
CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

KEYMAP
SCALE 1":4000'



LEGEND

SF	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
CF	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
SCL	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC

50 25 0 50 100
SCALE: 1"=50'
ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

N

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

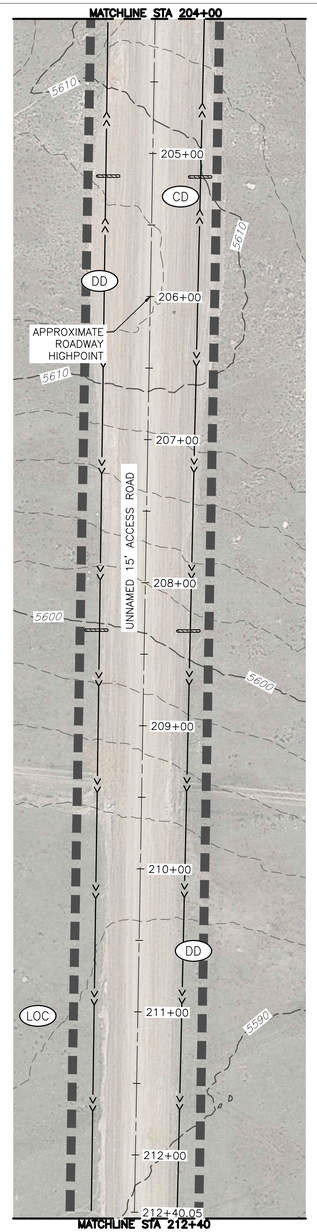
No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

Job Number	23.0876
Project Manager	DML
Design By	BAM
Drawn By	DJB
Principal In Charge	DML

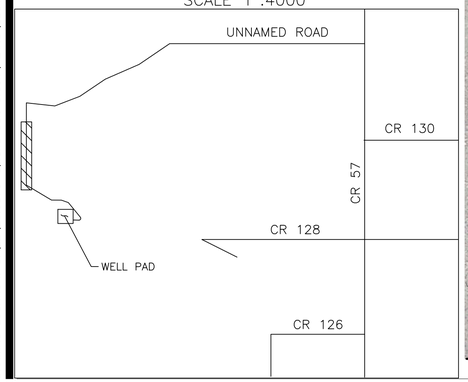
Sheet Number:

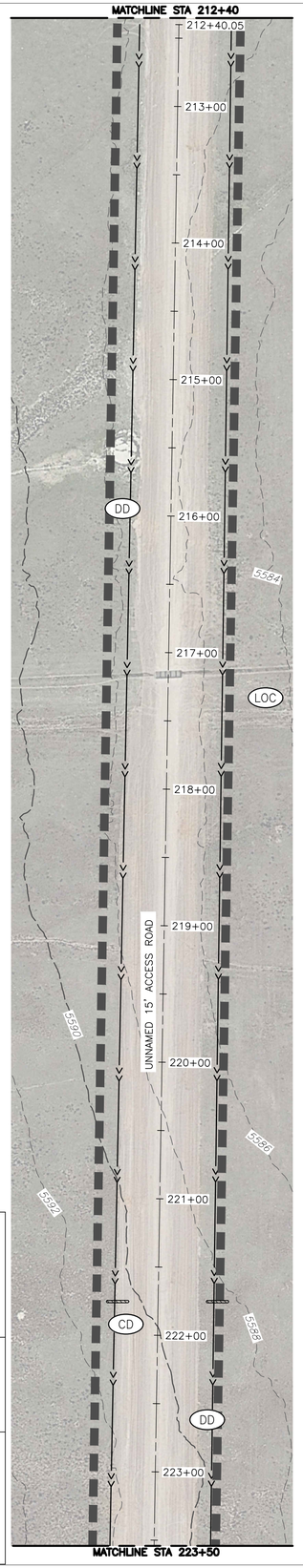
EC6

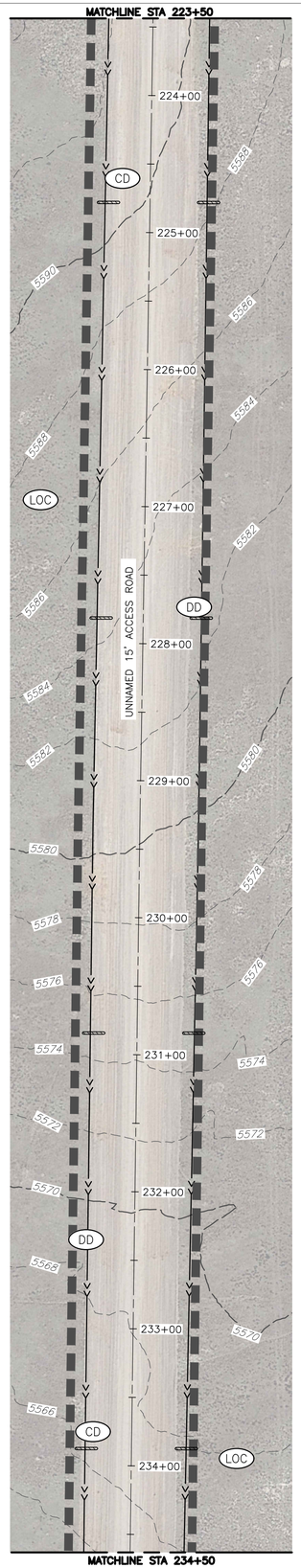
PLOT DATE: Tuesday, September 26, 2023 12:32 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg

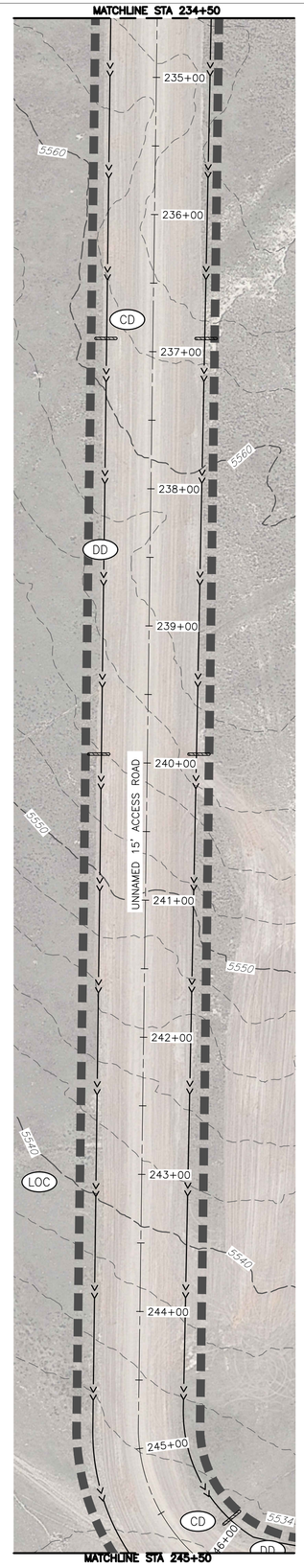


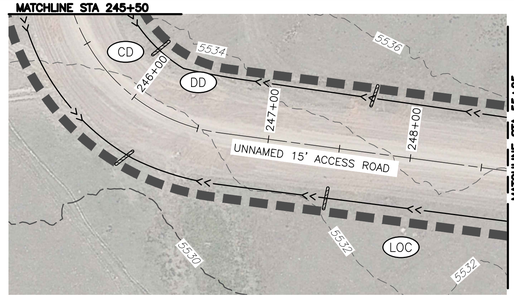
KEYMAP
SCALE 1":4000'

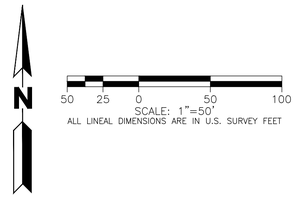












NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

LEGEND

SF—SF	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
SF SF SF	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
CF—CF	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
SCL—SCL	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

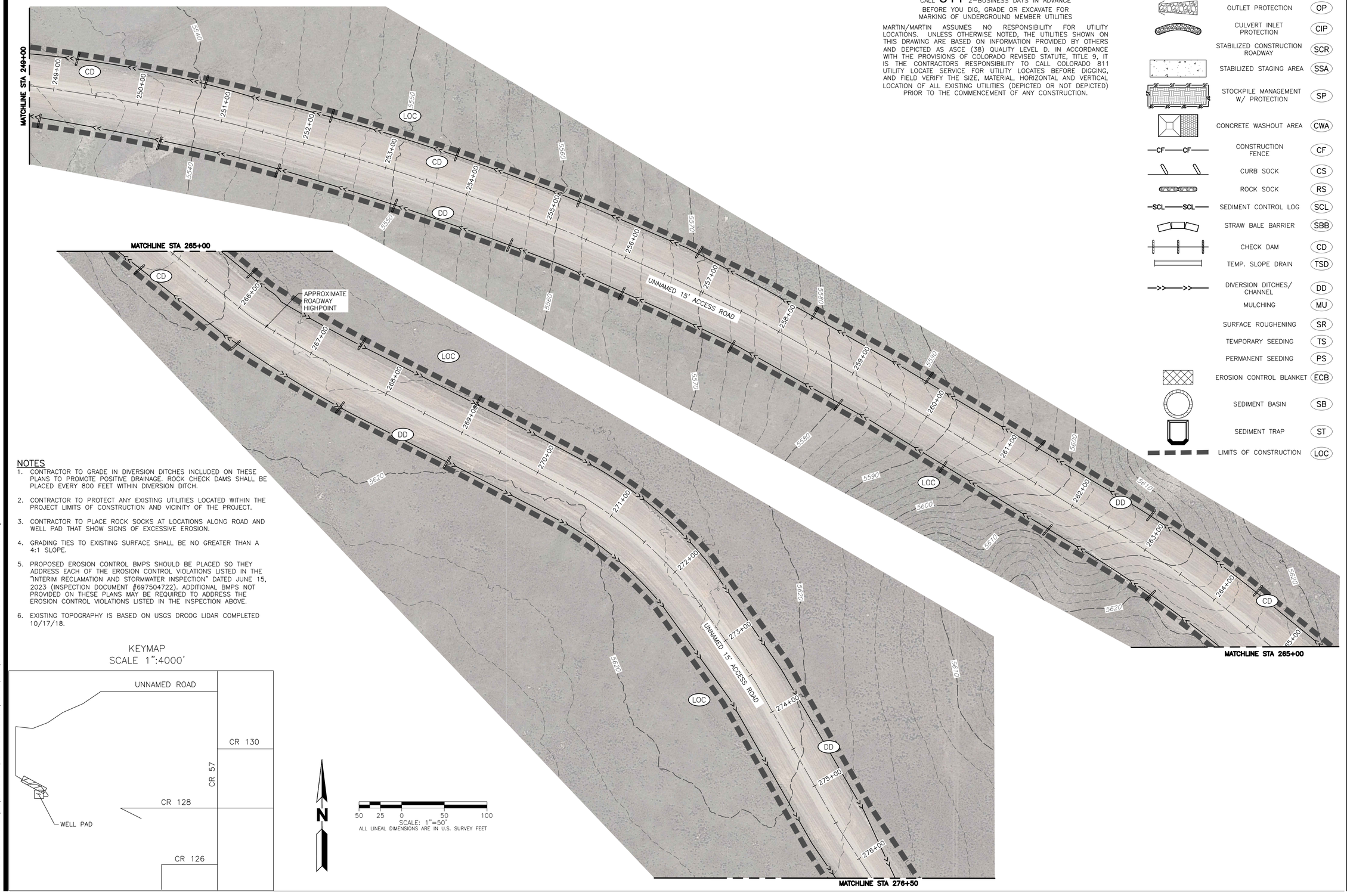
No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

Job Number	23.0876
Project Manager	DML
Design By	BAM
Drawn By	DJB
Principal In Charge	DML

Sheet Number:

EC7

PLOT DATE: Tuesday, September 26, 2023 12:33 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876--Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg



NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

KEYMAP
SCALE 1":4000'

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

LEGEND

SF—SF	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
SP SP SP SP SP SP SP	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
CF—CF	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
SCL—SCL	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

Job Number 23.0876
Project Manager DML
Design By BAM
Drawn By DJB
Principal In Charge DML

Sheet Number:

EC8

PLOT DATE: Tuesday, September 26, 2023 12:34 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LE\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg

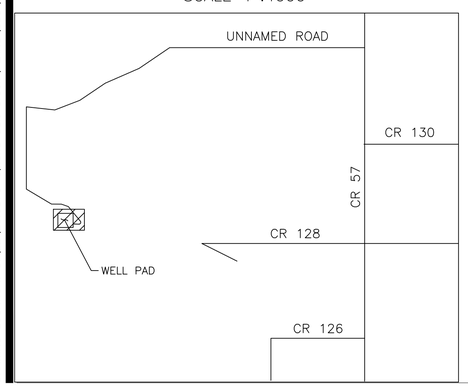
LEGEND

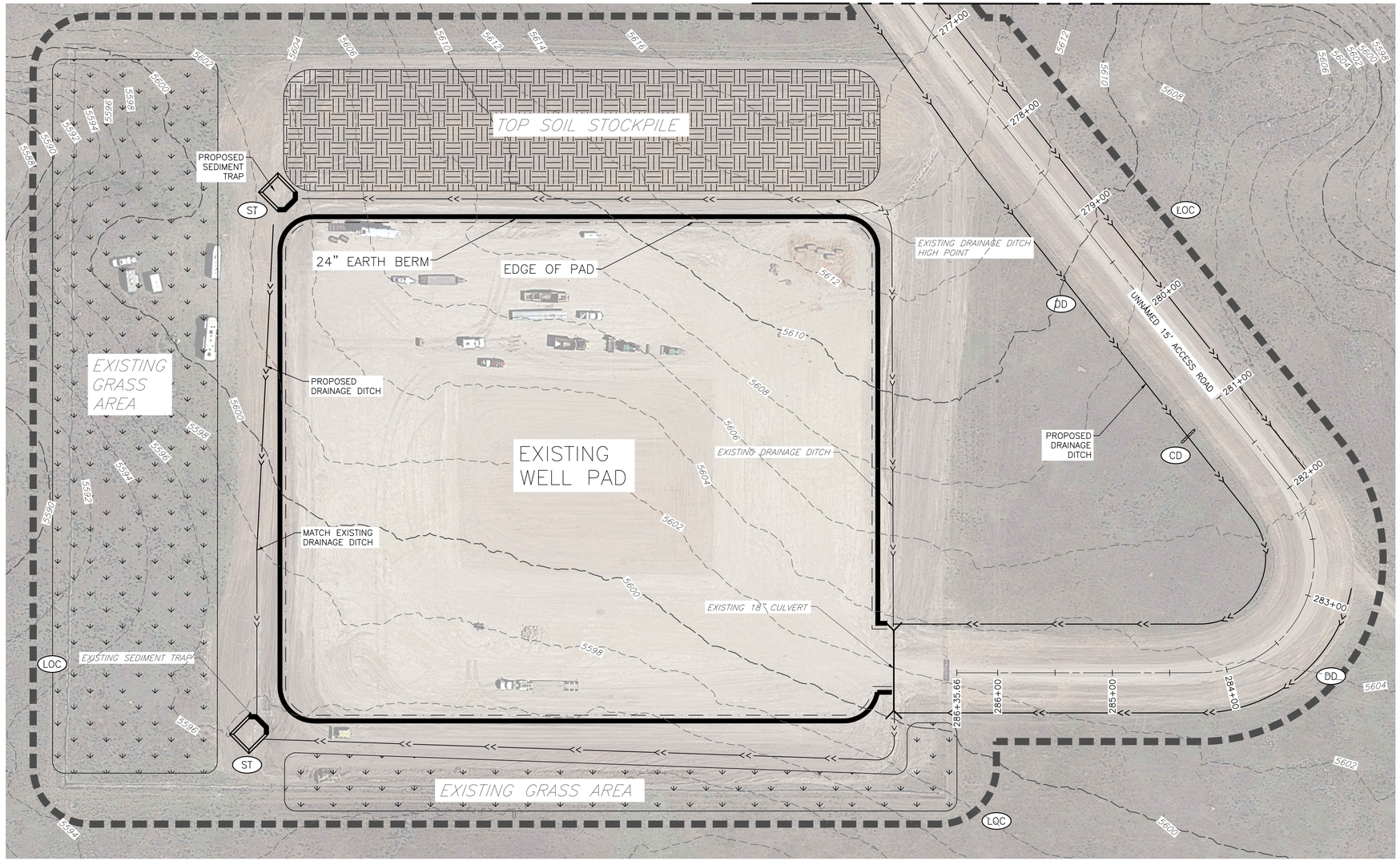
SF—SF	SILT FENCE	SF
	VEHICLE TRACKING CONTROL	VTC
	INLET PROTECTION	IP
	OUTLET PROTECTION	OP
	CULVERT INLET PROTECTION	CIP
	STABILIZED CONSTRUCTION ROADWAY	SCR
	STABILIZED STAGING AREA	SSA
SF SF SF SF SF JS JS JS JS	STOCKPILE MANAGEMENT W/ PROTECTION	SP
	CONCRETE WASHOUT AREA	CWA
CF—CF	CONSTRUCTION FENCE	CF
	CURB SOCK	CS
	ROCK SOCK	RS
SCL—SCL	SEDIMENT CONTROL LOG	SCL
	STRAW BALE BARRIER	SBB
	CHECK DAM	CD
	TEMP. SLOPE DRAIN	TSD
	DIVERSION DITCHES/ CHANNEL	DD
	MULCHING	MU
	SURFACE ROUGHENING	SR
	TEMPORARY SEEDING	TS
	PERMANENT SEEDING	PS
	EROSION CONTROL BLANKET	ECB
	SEDIMENT BASIN	SB
	SEDIMENT TRAP	ST
	LIMITS OF CONSTRUCTION	LOC

NOTES

1. CONTRACTOR TO GRADE IN DIVERSION DITCHES INCLUDED ON THESE PLANS TO PROMOTE POSITIVE DRAINAGE. ROCK CHECK DAMS SHALL BE PLACED EVERY 800 FEET WITHIN DIVERSION DITCH.
2. CONTRACTOR TO PROTECT ANY EXISTING UTILITIES LOCATED WITHIN THE PROJECT LIMITS OF CONSTRUCTION AND VICINITY OF THE PROJECT.
3. CONTRACTOR TO PLACE ROCK SOCKS AT LOCATIONS ALONG ROAD AND WELL PAD THAT SHOW SIGNS OF EXCESSIVE EROSION.
4. GRADING TIES TO EXISTING SURFACE SHALL BE NO GREATER THAN A 4:1 SLOPE.
5. PROPOSED EROSION CONTROL BMPS SHOULD BE PLACED SO THEY ADDRESS EACH OF THE EROSION CONTROL VIOLATIONS LISTED IN THE "INTERIM RECLAMATION AND STORMWATER INSPECTION" DATED JUNE 15, 2023 (INSPECTION DOCUMENT #697504722). ADDITIONAL BMPS NOT PROVIDED ON THESE PLANS MAY BE REQUIRED TO ADDRESS THE EROSION CONTROL VIOLATIONS LISTED IN THE INSPECTION ABOVE.
6. EXISTING TOPOGRAPHY IS BASED ON USGS DRCOG LIDAR COMPLETED 10/17/18.

KEYMAP
SCALE 1":4000'





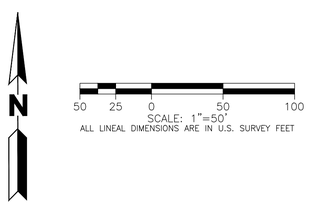
WELL PAD NOTE:

1. CONTRACTOR TO PROVIDE EROSION CONTROL BMPS PER PREVIOUSLY APPROVED "WELL PAD – SALT RANCH FEE 18 EAST DESIGN SUMMARY" BY CLEAR CREEK RESOURCE PARTERNS AND 609 CONSULTING, LLC DATED 10/17/17 AS WELL AS BMPS PROVIDED ON THESE PLANS.

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE OR EXCAVATE FOR
MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.



MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

UPLAND SALT CREEK

EROSION CONTROL PLANS

STORMWATER MANAGEMENT

No.	Issue / Revision	Date	Name
1	FOR OWNER REVIEW	09/26/23	M/M

Job Number	23.0876
Project Manager	DML
Design By	BAM
Drawn By	DJB
Principal In Charge	DML

Sheet Number:

EC9

PLOT DATE: Tuesday, September 26, 2023 12:34 PM LAST SAVED BY: TSTEENERSON
DRAWING LOCATION: G:\LEV\23.0876-Upland Salt Creek\PLANS\CDs\SALT CREEK EROSION CONTROL PLANS.dwg