COLORADO
Department of Transportation

207 and 212 Specifications Guidance
in the Design Phase and Stormwater Management Plan (SWMP) Development
Revised October 28, 2022

Background:

Roadside revegetation is the process of amending topsoil and seeding and occurs after the completion of grading and other infrastructure improvements within CDOT's Right of Way. Successful roadside revegetation supports CDOT's goals for safety and efficiency while stabilizing slopes, protecting infrastructure, supporting pollinator habitat, and improving the visual experience.

CDOT's roadside revegetation process has been under evaluation since 2015, starting with the research paper, Assessment of CDOT Revegetation Practices For Highway Construction Sites, that assessed past and current construction projects. Based on research recommendations, CDOT initiated a pilot program in 2018. Using the lessons learned from the pilot program, CDOT developed standard special provisions (SSPs) for the 207, 212 and 214 specifications allowing for additional evaluation and feedback before the inclusion into the standard specifications. In 2022, the 207, 212 and 214 specifications are being revised based on comments received. These proposed revisions are intended to complement Region best practices and provide methods for revegetating challenging terrain such as rocky soils, steep slopes, and shallow bedrock among other things.

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Design Phase: Tools and Options

The revegetation process starts with the design of the SWMP Permanent Stabilization Plan Sheets and Site Maps (revegetation plan). Early coordination of the revegetation design with other aspects of transportation project planning is crucial for successfully establishing roadside revegetation. The revegetation plan includes the initial site topsoil inventory and topsoil analysis completed during the project design phase to determine where salvaging topsoil is feasible along with topsoil management, soil amendment, and seeding strategies. Several procedures and tools have been developed to assist the SWMP Designer with selecting topsoil, seeding, subsoil decompaction, and mulching strategies. These documents may be found on Landscape Architecture web page and include the following:

- Design Phase Topsoil Testing Procedure
- Topsoil Amendment Calculator
- SWMP Templates

The following provides guidance for SWMP Designers for the use of the 207 and 212:

Step 1 – Determine If and Where Topsoil Should Be Salvaged

Topsoil salvaging is required under the CDPS General Permit: Stormwater Discharges Associated with Construction Activity (COR400000). Part 1 B.1.a.i.(f) states, "*Unless infeasible, topsoil shall be preserved for those areas of a site that will utilize vegetative final stabilization*."

Salvaging topsoil is a cost-effective measure that increases plant establishment for successful revegetation. Retaining on-site native topsoil is important because topsoil contains valuable microbes and stores seed that provide a greater species diversity resulting in higher vegetation success on projects.

To determine if native topsoil should be salvaged, start with coordination with the Region Water Pollution Control Managers (RWPCM) and, if the region's Permanent Stabilization Subject Matter Expert (PSSME) is a different individual, include them in the initial coordination. If the project will salvage topsoil, plan a field visit and review of existing site documents such as NEPA, OTIS weed layers, and Geotechnical Reports. Work with the RWPCM and PSSME to determine if the site meets the following criteria:

- Existing vegetation consists of native plant species with a low percentage (less than 20%) of noxious and invasive weeds. See Step 3 below for a discussion on weeds and their control.
- If approximately 20% or more of the soil surface is composed of rocks (6 inch diameter and larger), salvaging of topsoil should not occur in that revegetation unit. Revegetation units are areas with similar revegetation treatments and site conditions (e.g., soils, climate, and vegetation potential) and are explained in more detail in the topsoil testing procedure. Salvaging topsoil is cost prohibitive when large amounts of rock are present on the soil surface.
- Topsoil to be salvaged that has a high percentage of large rock greater than 6 inch, the project team will have to specify the broadcast or hydraulic seeding method and hydromulching and will require a Project Special Provision if stones over 6 inch in diameter are to remain.
- Rock cut slopes are not revegetated unless determined otherwise by the project team.
- There must be sufficient area to store topsoil onsite or a nearby site. Site conditions must allow all topsoil stockpiles to be placed a minimum of 50 feet away from State waters.

Note: When salvaging topsoil, topsoil testing should be conducted in the design phase by the SWMP Designer, in coordination with the design team, to determine if laboratory results of soil

pH and salts are within an acceptable range or if amendments are needed as separate pay items.

Topsoil should not be placed on slopes steeper than 2H:1V, rock cut slopes, or sandy or silty slopes steeper than 3H:1V, or on rock cut ditches.
Topsoil should not be salvaged in the following site conditions or areas:

- Site conditions do not allow for stockpiling topsoil either onsite or offsite.
- Where noxious weeds on the State or County A and B lists are present.
- Where noxious weeds on the state C list or invasive weeds are present in amounts greater than 20%.
- When soil pH and salt content laboratory results discourage salvaging topsoil.

To find information on noxious and invasive weeds, review the project Biological Resource Report and coordinate with the Region Biologists. To find information on soil pH and salt content collect a soil sample and perform a soil test.

If it is determined that onsite topsoil cannot be salvaged, then the SWMP Designer coordinating with the project design team needs to determine the best option.

- Importing topsoil,
- Engineering topsoil from subsoils, or
- Salvaging topsoil from adjacent appropriate areas.

The Project may apply a combination of techniques. Salvaging topsoil is generally more cost effective than importing topsoil and the project team should take into consideration the cost of importing topsoil compared to engineering topsoil from existing subsoils.

Step 2 – Collect Topsoil Sample

If during Step 1, it is determined that there is sufficient and adequate topsoil, then proceed with topsoil collection for laboratory analysis. The topsoil testing procedure outlines the steps to determine revegetation units, collect topsoil sample(s), and send the sample(s) to a laboratory for analysis.

If it is determined that subsoils may be used to generate engineered topsoil, send a sample of the subsoil. Do not mix topsoil and subsoil samples, they should be sent as separate samples.

Note: for smaller projects, do not analyze a soil sample, use the recommended soil amendment rates in the subsection 212.

Step 3 – Develop Topsoil Management Strategy

A Topsoil Management Strategy is a plan determining where and to what depth to salvage topsoil and where to stockpile the topsoil based on information gathered in Step 1. This Strategy should address if additional topsoil is to be imported or engineered and, based on the topsoil testing procedure, what amendments and in what quantities are necessary to achieve successful site revegetation. Site conditions that can inform topsoil strategies include the presence of desirable plant species, noxious and invasive weeds, rocks, or construction debris. Document this information in the SWMP.

Topsoil can be initially stockpiled and then reapplied after grading and other construction activities are completed. First, determine the quantity of topsoil available for the project site. The outcome of the topsoil survey and testing will provide the depth for topsoil salvage. The recommended minimum depth of topsoil is 6 inches but may vary based on project site conditions. Compare the quantity of onsite topsoil available with the quantity needed for the area to be revegetated. If additional topsoil is needed, it will have to be imported from a local source or engineered from site subsoils.

Coordinate with the Region Wetland Specialist to determine the best course of action for stockpiling wetland topsoil, required maintenance, and length of storage and phasing.

Noxious and Invasive Weeds

If noxious and invasive weeds are present at approximately less than 20% of the total plant cover and it is determined to salvage native topsoil, a Weed Management Plan should be developed as part of the Topsoil Management Strategy. The purpose of this plan is to manage weeds before, during and after construction activities. CDOT's Operation and Maintenance has an Integrated Roadside Vegetation Management Guide full of valuable information. Class A and B noxious weeds on the Colorado Noxious Weed List and County lists must be eradicated before construction activities. Class C and invasive weeds should be treated similarly due to roadsides being a corridor or vector in the continued spread of weeds. Include in your strategy the weeds that are of concern in the project area and the mechanical (mowing) or chemical (herbicide) treatment and include pay items and timing recommendations for weed control.

The presence of weeds can be determined by reviewing the Biological Resource Report and conducting a site visit. The Topsoil Management Plan should include coordinating with the Region PSSME and CDOT Maintenance early in the design process to initiate the control of weeds prior to construction activities. The Topsoil Management Strategy should also include specifications or notes for the Contractor to control weeds during construction activities and while reaching final stabilization. CDOT Maintenance should be engaged to continue monitoring and controlling weeds as necessary in the following years after project completion.

Include weed management pay items in the SWMP.

Imported and Engineered Topsoil

Where subsoils are too rocky, compacted, or poorly drained to amend effectively, an imported topsoil, meeting the requirements of Table 207-1, should be imported from a local source, and placed on the prepared surface. The topsoil depth should be 6 inches or as determined by the project team. Any depth other than 6 inches will have to be documented in the plans. Work with your project team to determine what is the correct course of action for your project conditions.

Engineered Topsoil: When acceptable imported topsoil is unavailable locally, topsoil can be engineered on site using existing subsoils. The subsoils should be sent for laboratory testing to determine if they are suitable and what amendment quantities are necessary. The subsoils for use should be stockpiled, amended to a homogenous mixture to create the engineered topsoil before placement, and then placed on the prepared surface.

Litter and Duff

Litter and duff are the layer of fresh and decomposed plant materials such as needles and leaves covering the ground surface. It can be a valuable source of seeds and nutrients. Based on the site assessment of desirable or problematic pre-existing plant species, direction should be given to either stockpile litter and duff with topsoil or dispose of it offsite.

For wetland soils, work with the Region Wetland Specialist to determine the course of action to salvage and store litter and duff.

Documenting Topsoil Stockpiling Strategy and Quantities. The SWMP Designer documents the topsoil management strategies on the initial, interim, and permanent SWMP Site Maps for easy interpretation by the Contractor for bidding. The site maps should also propose methods and locations of topsoil stockpiling along with the appropriate control measures. The Contractor will ultimately determine where to stockpile, but this design location is used to determine if your project has enough space. Stockpiling can be phased as an alternative for projects with tighter working spaces and phased seeding schedules.

Another consideration is the length of time the topsoil is stockpiled. For stockpiles maintained for over 6 months, additional mycorrhizae should be added at the rate in the specifications to preserve soil conditions for future planting's root development. Document and include quantities in the SWMP.

A project special detail has been developed that may allow the salvaging of topsoil in linear windrows. This special includes control measures' details for protecting the topsoil windrow

from run-on and as a downgradient perimeter control. Topsoil salvaged in windrows shall not be compacted. A volume calculation of the amount of salvaged topsoil should be made to confirm there is enough room within the Limits Of Disturbance (LDA) for the windrow placement.

Document the design topsoil quantities, including amount of native topsoil supplemented by imported or engineered soils, in the Tabulations of Stormwater Quantities in the SWMP Plan.

Topsoil stockpiles will require initial and interim control measures per specification 208.04(e). Document the control measures on the appropriate site maps and include the quantities in the SWMP.

Soil Preservation Management Plan - show areas to be protected or undisturbed and preserved with fencing or kept outside of the LDA. Add notes to inform the Contractor that there should be no driving on, stockpiling, or material or equipment storage in these areas.

Step 4 –Determine Amendments

Enter the results from the laboratory analysis into the Topsoil Amendment Calculator. The results of the Topsoil Amendment Calculator provide the types and quantities of soil amendments specific to the needs of your project. These results are then transferred into the SWMP Plan Sheets (SWMP Template).

The limiting factor(s) for revegetation might be a nutrient, high pH value, low organic matter, soil instability, high nitrogen to carbon ratios, high salts, or other soil property. The Landscape Architecture Section is available to assist with developing or reviewing the topsoil amendment strategies for the project.

Amendments are not added to wetland soils unless determined by the Region Wetland Specialist.

Topsoil Conditioning Amendments:

Organic Fertilizer provides the essential nutrients for plant growth. Fertilizer should not be used in and around permanent water quality ponds and water conveyance swales. Low nitrogen should be utilized for native grasses. High nitrogen should be used as an amendment only when soil testing suggests its use or for sod installation.

Compost improves soil physical properties, including increasing the water infiltration and the water holding capacity of soil.

Prior to specifying compost as an amendment, the SWMP designer should determine if Certified and Tested Compost is locally available and if the manufacturing facility can provide the amount of compost required for your project, when it is likely to be required, as determined by the Topsoil Amendment Calculator.

Facilities can be found on the following STA Certified Compost website.

If compost is not available from a certified provider within a 50-mile radius or less (economic haul distance perimeter), utilize a Biological Soil Amendment (Hydraulic). If referring to soil testing results, use the Topsoil Amendment Calculator and the worksheet tab *Lab R. & No Compost Avail*.

Biotic Soil Amendment increases water and nutrient holding capacity of soils. Used to amend poor quality soils which lack organic matter and have little to no bioactivity. Biotic Soil Amendments are used to facilitate faster plant growth and long-term growth.

Humate provide two primary benefits; slow release of nutrients for microorganisms and reduces nutrients leaching out from the topsoil profile.

Mycorrhizae is a symbiotic fungus that increases plant access to soil moisture and nutrients, which is beneficial during periods of drought.

Sulfur is used to lower pH in sodic soils. Use sulfur as an amendment only when soil testing determines the pH is over 8.5. Sodic soils are defined as soils saturated with sodium salts and with a sodium absorption ratio (SAR) greater than 15.

Step 5 – Develop a Subsoil Strategy

Heavily compacted soils do not support healthy plant growth; therefore, subsoil preparation is important to increase revegetation success. Plants help slow stormwater, allowing more water to infiltrate into the soil which prevents erosion to help protect CDOT infrastructure including roads, bridges, and walls.

Coordinate with the project design team to determine the disturbed areas to be revegetated, the final stabilization methods and where subsoil preparation is or is not appropriate. Document the areas on the SWMP Permanent Stabilization Maps for subsoil decompaction. Discuss with the Engineer how far off the roadway shoulder to decompact the subsoil.

Site Conditions Benefiting from Subsoil Preparation:

- Disturbed areas to be revegetated. These include, but are not limited to, haul and abandoned roads, staging areas and batch plant areas.
- Bioretention areas.

- Fill slopes that conform to the standard 203.03 material requirements for soil and rock embankment material with particle sizes less than 6 inches.

Subsoil Preparation is Not Appropriate Where:

- Earthwork activities are not required for the project (no dozers or graders mobilized).
- Small disturbances where subsoil preparation equipment would create a larger disturbance.
  Note: Rototilling may be appropriate for these small areas.
- Subsoil contains a significant quantity of large rocks.
- Drainage swales that encourage ponding due to slopes less than 2%.
- Sandy or gravelly subsoils.
- Subsurface utilities prohibit ripping operations.
- Cut slope embankments steeper than 2.5:1.
- Subsoils have a high moisture content such as wetland and riparian areas.
- The area under the drip lines or root zones of existing trees and shrubs to remain undisturbed.
- Areas to be irrigated and sodded. Note: These areas should be rototilled to a depth of 6 inches.

Subsoil Preparation for Shallow Depths or Smaller Project Areas

For sites where subsoil preparation is not appropriate at a depth of 14 inches, evaluate if shallower decompaction would be appropriate and if so, then indicate quantities and locations on the Site Maps. If rototilling is to be conducted for smaller project areas, develop a project special provision.

Step 6 – Coordinate Earthwork Tabulations.

The final SWMP topsoil strategies must be entered into the Earthwork Quantities Worksheet in the Plan Set. Potential options that may affect quantities:

- Depth of native topsoil salvage and redistribution, 6-inch depth average or as determined for your project.
- Importing off site topsoil for areas being seeded for final stabilization.
- Exporting excessive, existing topsoil from the project site.
- Topsoil salvage uses the 207 pay items and is no longer paid for as clearing and grubbing.
- Subsoil preparation is calculated in square yards.

Step 7 - Final Stabilization Methods

Native Seed Mix – According to CDOT's procedural directive 503.1, use Colorado's native grasses

and pollinating species. Native seed mixes should be developed for site specific conditions. Plants along the right of way should be low growing, adapted to the site-specific soil conditions, slope, elevation, precipitation requirements, and aspect. Additionally, the seed mix should include 3 or more diverse pollinator species with a mix of species blooming throughout the season to increase habitat.

The project biologist, restoration ecologist, or landscape architect with a knowledge of Colorado native plants should help to develop the seed mix. For assistance in developing or reviewing seed mixes, contact the Region or Headquarters Landscape Architect.

Specifying the Seeding Method(s)

To determine the best method for seeding, it is important to consider access to the revegetation areas and the type of equipment to be used, by evaluating slope lengths, gradients, and if rocky conditions will need to be negotiated by drill seeders.

Preference	Seeding Method	Slope	Suitability	Limitations	Minimum Area
1	Drill	flat to 2.5:1	Preferred seeding method.	Rocky soils, steep slopes, small areas, and sites with limited access	Larger sites > 0.5 acre
2	Hydraulic*	applicable to slopes < 2:1 and difficult to access areas	Alternative method for where drill seeding is not feasible such as rocky soils, steep slopes, and smaller constrained sites.	Seed to soil contact is limited. Water availability in remote areas.	Use for > 0.5 acres
3	Broadcast*	flat to steep	Areas not suitable for drill or hydraulic seeding methods, or smaller sites less than 0.5 acres, should be broadcast seeded.	Seed to soil contact is limited. Large areas.	Small restoration <0.5 acre sites and/or steep slopes or hard to reach areas

* Increase the drill seeding rate by 1.5 times for broadcast and hydraulic seeding.

Permanent Stabilization Mulching Methods and Soil Retention Covering

The following documents and Specifications 213 and 216 are available to assist in selecting your project's permanent stabilization method(s):

- Chapter 5 of the Erosion Control and Stormwater Quality Guide
- Final Stabilization Guidance
- Sections 208, 213 and 216

Additional considerations for hydroseeding and hydro mulching methods include access to water, adjacent land uses, and the size of the project's disturbance. Hydroseeding, hydraulic seeding and hydro mulching require an approved water source. Water cannot be taken from rivers, streams, or ponds without a permit. Potable water with chlorine may not be an appropriate water source for some sites. Coordinate with the Region PSSME. For smaller projects the cost to mobilize hydraulic equipment may be a limiting factor.

Crimped straw mulch is not appropriate for project areas adjacent to riparian waterways and wetlands, except as approved by the Regional Wetland Specialist, or near urban areas or sidewalks. Crimped straw mulch should not be used in detention ponds or near drainage structures, to limit the potential for clogging.

Project Delivery Timeline