

OPEN CHANNEL (CODE 582)

(For Practice Standards 326, 395, 580, 582, 584)

1. SCOPE

Work shall consist of furnishing all equipment, materials, labor and performing all operations in connection with construction of the stream restoration as shown on the drawings or as specified.

The following requirements shall pertain, unless otherwise indicated in the special provisions or indicated on the construction drawings.

2. MATERIALS

Construction materials shall conform to the requirements shown on the drawings, or as specified.

Trees for Root Wads

Trees for root wads shall be sufficiently sound to permit installation and backfill without crushing, splitting, or breaking the bole of the tree. The trees shall retain at least 75 percent of the pre-harvest root fan mass and diameter after placement. Multiple trees may be bundled to form the root fan or bole diameter. The bole diameter or diameter breast height (dbh) of bundled trees shall not be less than one-third the diameter of that specified for a single tree or 8 inches in diameter, whichever is greater. The fan diameter of each bundled tree shall not be less than two-thirds of that specified for a single tree. The bole length of single trees and bundled trees shall be the same.

Trees for Footer Logs and Deflector Logs

Trees for footer logs and deflector logs shall be sufficiently sound to permit installation and backfill without crushing, splitting, or breaking the bole of the tree. Limbs do not need to remain attached to the log. The trees should be harvested with the root fan attached.

Trees for Tree Revetments and Woody Debris Structures

Trees for tree revetments shall be freshly harvested Douglas fir or juniper, unless otherwise specified. The limbs shall be “green” and pliable at the time of placement to prevent breakage. The trees shall retain limbs, needles, or leaves immediately before placement to form a single tree canopy of not less than 75 percent of the un-harvested tree.

The trees should be harvested to retain the root fan.

Trees for Log Vanes and Other Structural Measures

Trees for log vanes and other structural measures shall be sufficiently sound to permit installation and backfill without crushing, splitting, or breaking the bole of the tree. Limbs and root fans do not need to be retained; however they can provide anchorage for added stability. The trees shall be sufficiently straight, in order to construct the structures to the lines and grades as indicated on the drawings.

Rock for Individually-Placed-Rock Structural Measures

Rock for individually-placed-rock structural measures shall conform to the following specifications:

- a. A bulk specific gravity of not less than 2.5 per ASTM C127.
- b. An absorption rate of not more than 2 percent.
- c. A weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used per ASTM C88.

- d. Size and gradation as shown on the drawings or specifications, or;
- e. Rock from an existing source may be used if it has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces the same as those anticipated for the rock to be installed under this specification.

The rock shall be dense, sound, and free from cracks, seams, or other defects conducive to accelerated weathering. The least dimension of an individual rock shall not be less than one-half the greatest dimension.

Rock for Riprap

When required, rock materials for loose rock riprap revetments and blankets shall conform to Montana Construction Specification MT-107, Rock Riprap.

Filter Fabrics

National Engineering Handbook, Part 642, Construction Specification 95, Geotextile and Material Specification 592, Geotextile shall be followed.

Erosion Control Fabrics

Woven erosion control fabric shall be constructed of coir (coconut) fibers and shall have a minimum weight (ASTM D3776) of 400 grams per square meter (gr./sq.m.) for slope protection and 700 gr./sq.m. when used for fabric encapsulated soil. The minimum width tensile strength (ASTM D4595) shall be 56 pounds per inch (lbs./in.) for 400 gr./sq.m. blankets and 110 lbs./in. for 700 gr./sq.m. blankets.

Non-woven erosion control blankets shall have a minimum weight (ASTM D3776) of 600 gr./sq.m., a minimum thickness (ASTM D1777) of 0.25 inch, and a minimum tensile strength (ASTM D4596) of 8 pounds per foot (lbs./ft.) in each direction.

Drainfill and Filters

Drainfill and filter material shall conform to Montana Construction Specification MT-117, Drainfill and Filters.

Geotextiles

Woven and non-woven geotextile materials shall meet the requirements outlined in National Engineering Handbook, Part 642, Construction Specification 95, Geotextile and Material Specification 592, Geotextile (Table 1).

Soil Anchors

The soil anchors shall have minimum pullout strength as shown on the plans. The pullout strength shall be based on soil types, anchor depths, and specific anchor. Consult manufacturer's information for proper selection of anchors. The anchor, cables, and clamps shall be made of galvanized steel.

3. EXCAVATION

All excavation shall be classified as common excavation or rock excavation. Common excavation shall be defined as excavation of all materials that can be excavated, loaded, transported, and unloaded by use of heavy ripping equipment and wheel-tractor scrapers with pusher tractors. Also excavated material that can be dumped into place or loaded onto hauling equipment by means of excavators having a rated capacity of one cubic yard shall be classified as common excavation. The equipment shall be equipped with attachments (such as shovel, bucket, backhoe, backhoe with thumb) appropriate to the character of the materials and the site conditions. Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials, the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation.

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single tooth, ripping attachment mounted on a tractor having a power rating of 200 HP or greater.

The presence of isolated boulders or rock fragments larger than 1 cubic yard in size, presence of large trees, frozen soil, excavation below the water surface, and saturated soils will not in themselves be sufficient to change the classification.

4. STRIPPING

Stripping consists of excavating the top layer of soil that contains sod, vegetation, roots, and organic matter. Stripping is required at all sites upon which embankments and fills used to impound or prevent the seepage of water are to be constructed and at required excavations and borrow areas. Stripping shall be to sufficient depth to expose subsoil reasonably free of roots and organic matter.

Use of Stripped Materials

Materials suitable for use in sodding, sod mats and transplanting, or other plantings shall be used for such purposes in the construction of the project to the fullest extent practical prior to the import of materials from off site. The materials shall be stripped, transported, and placed immediately in one operation to the fullest extent practical. Any materials requiring salvage and stockpiling for sodding, transplanting, or other plantings at a later date shall be kept viable by cooling, moistening, or other measures as needed.

Materials that are suitable for spreading over disturbed areas and fill surfaces low in silt, clay, and organic matter shall be stockpiled and subsequently spread as specified.

Materials for use in construction of required earthfill shall be indicated on the drawings.

Unsuitable or excess materials shall be wasted.

Sodding

Viable sod with a minimum thickness of 8 inches for sedge species and 6 inches for grass species shall be placed where indicated on the drawings. The minimum area of each sod mat shall be 6 square feet. Sod shall originate from a similar hydrologic and climatic regime as the zone being sodded to ensure plant species suitability and viability.

The sod shall be set firmly in place to ensure complete contact with the base material. Frozen sod shall not be placed, nor shall sod be placed on frozen ground unless the ground surface is smooth and enables firm sod to ground surface contact. Sod shall be placed to cover the entire required surface without voids or loose and protruding edges that would likely be dislodged by flowing water. Any loose sod shall be pinned or staked to the base materials with wooden stakes (1" x 2" x 16") or other approved methods. Immediately after placement the sod shall be thoroughly wetted.

Tree and Shrub Transplants

Requirements for stream channel vegetation shall be in conformance with Field Office Technical Guide (FOTG), Section IV, specification for practice Critical Area Planting (Code 342) and the following provisions:

Transplants shall be selected and placed as indicated on the drawings. The transplants shall originate from a hydrologic and climatic regime similar to that of the planting site to ensure plant suitability and viability.

Transplants for clump plantings shall be harvested in such a manner that most of the root structure and associated soil is retained as a unit (clump). The clump shall be transported and planted directly into a site prepared for the clump planting. Repetitive handling, loading, unloading, and transport of the clump that damages the integrity of the root-soil mass or reduces the viability of the plants shall not be permitted.

Clump plantings shall be pruned to remove 10 to 50 percent of the vegetation of each stem in lieu of thinning. The pruning operation shall ensure that the majority of the flowering parts of the clump plantings are removed.

Transplants shall be thoroughly wetted immediately after placement.

5. USE OF EXCAVATED MATERIALS

Excavated materials shall be used in the construction of required permanent earthfill or rockfill as shown on the drawings or as specified. The contractor shall not waste or

otherwise dispose of suitable excavated materials. All surplus or unsuitable excavated materials shall be disposed of by the Contractor in accordance to applicable laws and regulations, or as shown on the drawings.

6. BORROW EXCAVATION

When the quantities of suitable materials obtained from the excavations as shown on the drawings are insufficient to construct the fills, additional materials shall be obtained from borrow areas approved by the Technician and the Owner/Operator. Abandoned borrow areas shall be smoothed, topsoiled to a 6-inch depth, shaped, and vegetated in a manner to eliminate unstable side slopes and hazardous or unsightly conditions.

Borrow-pit ponds constructed and reclaimed for the primary purpose of wetland wildlife habitat shall have at least 50 percent of the perimeter on a 5:1 slope or flatter, with the remaining sides close to a 3:1 slope. Wetland wildlife habitat ponds shall have water no deeper than 3.5 feet over at least 25 percent of the surface area and water at least 3 feet deep over at least 25 percent of the surface area, with the maximum depth being 8 feet.

Borrow-pit ponds constructed and reclaimed for fish habitat shall have water deeper than 3.5 feet over at least 75 percent of the area and deeper than 8 feet over at least 25 percent of the surface area. Side slopes for borrow-pit ponds for fish habitat shall be approximately 3:1.

The shoreline of borrow-pit ponds shall be dressed with topsoil and seeded or sodded from the groundwater line to the natural ground surface.

7. FABRIC ENCAPSULATED SOIL

General

Fabric encapsulated soil shall be constructed in accordance with the lines, grades, dimensions, and extent indicated on the drawings.

Surface Preparation

The surfaces on which the erosion control fabric is to be placed shall be reasonably smooth and

free of loose rock, clods, holes, projections, depressions, and muddy conditions. The surfaces will be subject to approval prior to placement of fabric or soil upon the fabric.

Placement

The fabric shall be unrolled along the placement area and loosely laid, without stretching, in such a manner that it will conform to surface irregularities. Fabric placed on deformable banks shall be laid with a slack of approximately 5 percent to permit movement without damage to the fabric. The fabric shall be placed to ensure the largest tensile strength direction of the fabric is oriented up and down slope, i.e., perpendicular to the bank.

The fabric shall be joined by overlapping a minimum of 18 inches and secured to the underlying foundation material. Unless otherwise shown on the plans, stapling patterns recommended by the manufacturer shall be used. All overlaps shall be in the direction of flow.

Damaged fabric shall be repaired by a patch of like fabric that extends a minimum of 2 feet from the edge of any damaged area.

Fill Materials

Fill materials in fabric encapsulated soil shall be silts and clays from the required excavations and approved borrow sources. That portion of each lift that will be exposed and vegetated shall be filled with organic silts and clays to enhance vegetative establishment.

Compaction

Each lift shall be compacted prior to placement of the fabric by a minimum of 2 passes over the entire surface with wheeled excavation equipment or manually directed power tampers, or other approved method.

Compaction shall be halted if damage to underlying fabrics is observed. No compaction is required for granular fill (clean sands, gravel, and cobble).

Shaping and grading of the fabric edges may be required following compaction of fill and prior to placement of additional lifts of the fabric.

Control of Moisture Content

Moisture content of fill materials shall conform to Section 9, Earthfill, of this specification.

Vegetation

Fabric encapsulated soil shall be vegetated in conformance with FOTG, Section IV, specification for practice Critical Area Planting (Code 342).

8. STREAMBANK PROTECTION USING EROSION CONTROL FABRIC AND BLANKETS

General

Erosion control fabric and blankets shall be placed to the lines and grades indicated on the drawings.

Surface Preparation

The surfaces on which the erosion control fabric and blankets are to be placed shall be smooth and free of loose rock, clods, holes, projections, depressions, and muddy conditions. The surfaces will be subject to approval prior to placement of fabric or soil upon the fabric.

Placement

The fabric shall be unrolled laterally across the slope along the placement area and loosely laid, without stretching, in such a manner that it will conform to surface irregularities.

Placement

The fabric shall be unrolled laterally across the slope along the placement area and loosely laid, without stretching, in such a manner that it will conform to surface irregularities.

The fabric shall be joined by lap splicing a minimum of 12 inches on the sides and 36 inches on the ends of each blanket. Anchor the upstream and downstream terminal edges of fabric in 12 inch deep transverse trenches, and anchor terminal lateral fabric edges in 6 inch deep trenches. Install intermediate check slots in 6 inch to 12 inch deep transverse trenches at

30 foot maximum intervals. Stake or pin fabric within the trenches and slots in accordance with manufacturer's recommendations. Unless otherwise shown on the plans, stapling patterns recommended by the manufacturer shall be used. All overlaps shall be in the direction of flow.

The fabric shall be joined by lap splicing a minimum of 8 inches on the sides and 36 inches on the ends of each blanket. The upper and lower ends of each installation shall be buried in a 12-inch deep trench. Unless otherwise shown on the plans, stapling patterns recommended by the manufacturer shall be used. All overlaps shall be in the direction of flow.

Damaged fabric shall be repaired by a patch of like fabric that extends a minimum of 2 feet from the edge of any damaged area.

Vegetation

Slopes shall be vegetated in conformance with FOTG, Section IV, specification for practice Critical Area Planting (Code 342).

9. EARTHFILL

Materials

All fill materials shall be obtained from the required excavations and approved borrow sources. The selection, blending, routing, and placement of the various fills shall be subject to approval.

Fill materials shall not contain sod, brush, roots, perishable materials, or frozen materials.

Foundation Preparation

Areas to be covered by embankments and fills for impounding water or preventing seepage shall be stripped to a sufficient depth to expose subsoil reasonably free of roots and other organic matter. All slopes within the limits of foundations and abutments, except pipe trenches, shall be excavated to slopes not steeper than one horizontal to one vertical, unless otherwise indicated on the drawings. The foundation shall be cleared of all loose unconsolidated material in excess of 3 inches in depth to provide a firm base.

Placement

The placement of fill materials shall follow these guidelines:

1. On sand, gravel, and cobble bed streams, fill materials below bankfull elevation shall be granular materials selected from the required excavations or borrowed from other sources and shall meet the required gradations, if specified. To the fullest extent practical, the coarsest excavated materials shall be placed on the streambed surface and around rock and log structures.
2. On sand, gravel, and cobble bed streams, granular fill shall also be utilized, as available, for required fill sections above bankfull elevation to a vertical extent similar to that of the natural soil profiles within the adjacent floodplain.
3. Sand, silt and clay materials shall be retained for placement above the available granular fill.
4. It may be necessary to over-excavate unsuitable streambed pavements and sub-pavements and replace with suitable bed materials.
5. Fill shall not be placed on frozen soil, snow, or ice.

Compaction

The compaction of fill materials shall follow these guidelines:

1. For clean sands, gravel, and cobble fill materials, no compaction other than that obtained by placement is required, unless compaction is needed to ensure void areas are completely filled. Such may be needed to ensure voids are filled beneath and alongside log and rock structures.
2. Sand, silt, and clay fill materials shall be smoothed and shaped in lifts no thicker than 8 inches prior to compaction. Compaction shall be obtained by a minimum of 2 passes over the entire surface with weighted-wheeled excavation equipment, manually-directed power tampers, or 2 blows with the back of an excavator bucket

with a force that produces compaction comparable to that developed by wheeled excavation equipment. The top 4 inches of surfaces to be seeded or sodded shall not require compaction in addition to that obtained in the smoothing and shaping operation.

Control of Moisture Content

The control of moisture shall follow these guidelines:

1. Where water is readily available, sand, gravel, and cobble fill shall be saturated at the time of placement/compaction.
2. Saturated dirty sands, silts, and clays shall be allowed to drain of free water prior to compaction. Dirty sand, silt, and clay fill materials shall have sufficient moisture prior to compaction that the material tends to form a ball under pressure in one's hand.

10. CHANNEL FILLING AND RE-CONTOURING

Channels designated for filling and re-contouring shall be filled to the historic natural ground surface, and smoothed and shaped to blend with the surrounding landscape.

Fill material shall be routed in order to replicate the adjacent soil profile to the greatest extent practical. The top 4 inches of fill shall consist of sod and topsoil that is free of rock larger than 4 inches. Equipment shall be routed in order to compact the fill during the filling operation. Zones of fill that cannot support earthmoving equipment, and other loose fill zones, shall be over-filled a minimum of 10 percent to allow for settlement.

11. SAFETY

All work shall be in accordance with safety requirements of Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Safety and Health Regulations for Construction, Subpart P, Excavations.

12. WEEDS AND DISEASE

All equipment shall be thoroughly washed to remove all soil and weed seeds prior to mobilization to the project site. All materials imported from off-site, including soil, gravel, rock, sod, transplants, seed, and root wads shall be free of noxious weeds.

13. SPECIAL PROVISIONS

Special provisions will be attached to this construction specification as appropriate, which define site-specific details including dewatering and staging of work.

14. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established, each item will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price for that item. For items of work, for which specific lump sum prices are established, payment will be made at the lump sum price.

Such payment will constitute full compensation for all materials, labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions, but not listed on the bid schedule, will be considered incidental to and included in the pay items listed on the bid schedule.

INSTRUCTIONS FOR THE USE OF CONSTRUCTION SPECIFICATION OPEN CHANNEL

(for Practice Standards 326, 580, 582, 584)

Items to include in Special Provisions and Construction Drawings:

Root Wads:

1. Specify or indicate the allowable range for bole and fan diameter.
2. Specify or indicate the minimum length of bole.
3. Specify if multiple trees are not allowed to form a single root wad.

Footer Logs:

1. Specify or indicate the allowable range of length and size.
2. Specify or indicate the requirements for retaining limbs or root fan.

Tree Retenements and Woody Debris Structures:

1. Specify the species if not Douglas Fir or Juniper.
2. Specify or indicate the minimum diameter and length of tree.
3. Specify if the root fans must remain attached.

Trees for Vanes and Other Structural Measures:

1. Specify species, if appropriate.
2. Specify or indicate the minimum diameter and length.
3. Specify if root fans must remain attached.

Rock:

1. Specify size or gradation.
2. Specify whether or not naturally rounded, or quarry stone.
3. Specify source, as appropriate.

Anchors:

1. Specify or indicate style, type, size, rating, and composition as appropriate.

Erosion Control Fabrics:

1. Specify type, weight per square yard, or meter.
2. Specify or indicate pinning or anchor requirements.

Drainfill and Filters:

1. Specify gradation as appropriate.
2. Specify special placement needs and compaction requirements.
3. Incorporate MT-117, Drainfill and Filters.

Excavation:

1. Specify the classification of other than common excavation.

Sodding:

1. Specify or indicate on drawings the location/extent and thickness.
2. Specify type, species, etc., (use FOTG, Section IV, Critical Area Planting (Code 342)).
3. Specify staking methods if not 1" x 2" x 16" wooden stakes.

4. Specify if use of stream water to wet sod is appropriate.

Transplants:

1. Specify species and size.
2. Specify sources as appropriate.
3. Complete FOTG, Section IV, Critical Area Planting (Code 342), as appropriate.

Earthfill:

1. Specify earthfill requirements other than those specified, as needed.

Placement:

1. Specify or indicate fill material zones other than those indicated, as needed.

Compaction:

1. Specify compaction requirements other than those already specified, as needed.

Control of Moisture Content:

1. Specify moisture requirements other than those already specified, as needed (consider for larger fills and fills that are to restrain movement of water).

Dewatering:

1. Specify site or project specific needs for removal of water or staging of work to limit work within the live stream.

Staging of Work:

1. Specify acceptable dates for construction.

Measurement and Payment:

1. Specify the method.