

SECTION 02377

VEGETATIVE EROSION CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. This section addresses permanent and temporary vegetation and cover crops.
- B. Related Work Specified Elsewhere:
 - 1. Section 01210, Erosion Control & Site Restoration Surety
 - 2. Section 01710, Site Cleanup
 - 3. Section 02375, Erosion Control Mattings and Components.
- C. Measurement and Payment Procedures.
 - 1. For public funded capital improvement projects, See Section 01025.
 - 2. For privately funded development projects, Owner will determine measurement and payment requirements.

1.02 SUBMITTALS

- A. Seed: PLS certification.
- B. Fertilizer: manufacturer's guaranteed analysis.
- C. Mulch: weed-free certification.

1.03 QUALITY ASSURANCE

- A. See Section 01010, paragraph 1.08.

1.04 DEFINITIONS

- A. Pure Live Seed (PLS).
 - 1. Viable seed.
- B. Permanent Vegetation
 - 1. Established vegetation provides long term erosion control by preventing initial sediment movement. However, improper use of seed and mulch, such as planting at the wrong time of the year, often results in failure to establish vegetation. Therefore, this section provides information and guidelines for establishment of vegetation for control of rainfall erosion. Permanent vegetation shall be a compound composed of a mix of species listed in Table 1.
- C. Temporary Vegetation and Cover Crops
 - 1. Temporary vegetation is effective for controlling water erosion on sites where earth moving and/or construction operations are phased. Unless temporary vegetation is to be used as a cover crop, topsoil replacement is generally not required to produce adequate cover for erosion control, although the soils must be laboratory tested to provide information on fertilization requirements (Paragraph B). Table 4 provides information on establishing temporary vegetation.

2. Cover crops are a living mulch which can be planted in early to mid-summer to produce an adequate vegetative cover by fall. In the fall, permanent grass seed can be drilled in the cover crop, thus reducing the cost of revegetation. Cover crops have to be planted on slopes flatter than 15 percent. Row spacing shall not exceed 10 inches and may be harvested if stubble is left no less than 6 inches high to reduce wind erosion. See Table 4 for recommended species, seeding rates and planting dates.

PART 2 PRODUCTS

2.01 GENERAL

- A. Lists of products are shown in Tables 1, 2, 3 and 4.

PART 3 EXECUTION

3.01 TIME OF SEEDING

- A. To increase chances of rapid establishment, planting should be completed just prior to the time when precipitation and soil moisture conditions exceed evapotranspiration rates. Permanent dryland grass seeding can occur from October 1, when the seeds will lay dormant, until May 15 when the soil warms in the spring.
- B. **COOL SEASON GRASSES, WHICH MAKE THEIR MAJOR GROWTH IN THE SPRING, SHOULD BE PLANTED NO LATER THAN APRIL 15. WARM SEASON GRASSES, WHICH MAKE THEIR MAJOR GROWTH IN LATE SPRING AND SUMMER, CAN BE PLANTED UP TO MAY 15 (SEE TABLE 1).**

Table 1 Recommended Species and Application Rates of Perennial Dry Land Grass Seed for Loveland, Colorado.						
SOIL TYPE (depth seed is to be drilled into soil)						
Species	Variety ⁽¹⁾	Drilled ⁽²⁾ Pounds of PLS/Acre	Season ⁽³⁾	Mature Height (in)	Form	Type
SANDY AND SANDY LOAM SOILS (½ - 1 inch)						
Sand bluestem	Elida, Woodward	19.8	Warm	48	Sod	Native
Sideoats grama	Vaughn, Butte	10.9	Warm	15	Bunch	Native
Switchgrass	Grenville	5.6	Warm	30	Sod	Native
Prairie sandreed	Goshen	8.0	Warm	48	Sod	Native
Little bluestem	Pastura	8.4	Warm	24	Bunch	Native
Blue grama	Lovington	3.0	Warm	12	Bunch	Native
Pubescent wheatgrass	Luna	21.8	Cool	30	Sod	Introduced
LOAM, SILT LOAM, SANDY CLAY LOAM, CLAY LOAM OR SILTY CLAY LOAM SOILS (¼ - ¾ inch)						
Fairway wheatgrass		7.2	Cool	12	Bunch	Introduced
Crested wheatgrass	Nordan	11.5	Cool	12	Bunch	Introduced
Western wheatgrass	Arriba, Barton	19.8	Cool	12	Sod	Native
Pubescent wheatgrass	Luna	21.8	Cool	30	Sod	Introduced
Sideoats grama	Vaughn or Butte	10.9	Warm	15	Bunch	Native
Blue grama	Lovington	3.0	Warm	12	Bunch	Native
Switchgrass	Grenville	5.6	Warm	30	Sod	Native
Smooth brome	Manchar or Lincoln	16.1	Cool	24	Sod	Introduced
Little bluestem	Pastura or Camper	8.4	Warm	24	Bunch	Native
Green needlegrass	Lodorm	12.1	Cool	24	Bunch	Native
CLAY, SILTY CLAY OR SANDY CLAY SOILS (¼ - ½ inch)						
Fairway wheatgrass		7.2	Cool	12	Bunch	Introduced
Crested wheatgrass	Critana	11.5	Cool	12	Bunch	Introduced
Intermediate wheatgrass	Amur, Oahe	24.8	Cool	30	Sod	Introduced

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Smooth brome	Manchar or Lincoln	16.1	Cool	24	Sod	Introduced
Green needlegrass	Lodorm	12.1	Cool	24	Bunch	Native

(1) For most species, other suitable varieties are available.

(2) Drilled rates are for slopes 4:1 or less and favorable topsoil. Broadcast rates of seed on 4:1 or smaller slopes will be doubled the drilled rates. For slopes greater than 4:1, broadcast rates will be four times the drilled rates.

(3) See Table 4 for planting dates.

- C. Late summer early fall seedings have been successful for cool season plantings in Loveland. In such cases, seed germinates and grows during the fall and becomes established prior to the winter dormancy period (Table 2).
- D. Table 2 summarizes planting dates, types of grasses and applicable mulching methods for establishing grasses in Loveland.

DATE	PERENNIAL GRASSES		TEMPORARY/COVER CROP GRASSES	
	Warm	Cool	Warm	Cool
Jan 01 – Feb 28	Yes	Yes	No	No
Mar 01 - May 15	Yes	Yes	No	Yes
May 16 - May 31	Yes	No	Yes	No
Jun 01 - Jul 31	No	No	Yes	No
Aug 01 - Aug 31	No	Yes	No	Yes
Sep 01 - Sep 30	No	No	No	Yes
Oct 01 - Dec 31	Yes	Yes	No	No

E. Fertilizer Requirements

1. Fertilization increases plant vigor and promotes deeper rooting. If, however, the native topsoil is replaced to an adequate depth, fertilizer use at the time of seeding ordinarily does not increase the percentage of emergence. In some instances, fertilizing at the time of seeding dramatically increases competitive weed growth. All topsoils should be tested to determine if fertilization or other soil amendments are needed. All areas to be reseeded shall be tested by a qualified laboratory to determine fertilizer and other soil amendment requirements. Required minimum test parameters are:
 - a. PH
 - b. % Organic Matter
 - c. CEC
 - d. NO₃-N & TKN
 - e. P
 - f. Texture - actual (not estimated) %sand, %silt, %clay
2. Sites shall be fertilized according to laboratory soil analysis and recommendations. In the absence of a soils analyses (if approved by the City of Loveland), a minimum of 40 pounds of available nitrogen and 40 pounds of available phosphorus will be applied per acre.
3. All fertilizer shall be uniform in composition, dry, free flowing, and have the manufacturer's guaranteed analysis provided. Fertilizer which becomes caked or otherwise damaged making it unsuitable for use shall not be accepted.

F. Seedbed Preparation

1. General

- a. A good seedbed must be firm (well settled) and relatively free of competitive plants. Competitive vegetation should be controlled by shallow tillage or by herbicide application. All soils shall be ripped or tilled to a minimum depth of six (6) inches. All ripping/tilling operations shall be done in a direction which follows the natural contours of the land on slopes of three to one or less. Any irregularities in the ground surface resulting from soil preparation operations shall be corrected and sloped to drain.

2. Topsoil Replacement

- a. Sites to be revegetated with permanent dryland grass must have soils capable of supporting the type and quantity of cover needed for erosion control. Topsoil is frequently the determining factor in obtaining an adequate cover of dryland grass. Grading often exposes subsoils that are infertile, low in organic matter and more susceptible to erosion. The majority of deep soils in the Loveland area have a surface layer rich in organic matter with granular structure. This native topsoil material should be stripped and stockpiled for re-application prior to seeding. In general, 18 inches of soil material, including topsoil, will store moisture and nutrients for supporting adequate dryland grasses in Loveland semi-arid climate. Before applying any topsoil, the underlying disturbed and/or compacted land must be ripped or scarified to a depth of six (6) inches.

3. Seeding

- a. Soils in areas that have supported vehicular traffic or which have been otherwise artificially compacted shall be ripped or tilled to a depth of twelve (12) inches to break up any restrictive layers prior to any seeding operations. All other areas shall be tilled to a depth of six (6) inches. The soil shall be worked until no clods of soil greater than two (2) inches in diameter remain. Fertilizers and other soil amendments which are necessary (Paragraph B) shall be added to the soil and worked into the top four (4) inches.

4. Hay or Straw Mulch

- a. Soils in areas which are to be crimped with hay or straw mulch and not seeded shall be ripped or tilled to a depth of six (6) inches and worked until no clods of soil greater than two (2) inches in diameter remain prior to the application and crimping of the mulch.

G. Depth of Seeding

1. Proper seeding depth is governed by two factors, seed size and soil type. The general rules governing seeding depth are:
 - a. The larger the seed, the deeper it should be planted and, conversely, the smaller the seed, the shallower it should be planted.
 - b. The sandier the soil, the deeper the seed should be planted and the heavier the soil the shallower it should be planted.
2. Broadcast seed covered by harrowing or other method results in some seed being covered too deeply by soil and some seed not being covered with enough soil. A mixture of small and large seeds is often beneficial when broadcasting. Refer to Table 1.

H. Methods of Seeding (Refer to Table 1)

1. Because of increased accuracy of seeding depths and rates, seed should be planted with a grass drill (not a Brillion seeder) on all slopes less than three (3) to one (1). Row spacing shall not exceed seven (7) inches for permanent reseeding, and ten (10) inches for temporary seeding and cover crops. The seed must be drilled into the soil to the depth required for the particular seed mix being used, and must be spread at the PLS rate shown on the plans.
2. Sites that are small, too steep or not accessible for drill seed operations may be broadcast by hand, mechanical spreader or hydraulic equipment. The seed shall be covered by soil to the depth required for the particular seed mix being used.

3. Broadcasting requires twice the application rate as drill seeding since many seeds will be planted too shallow or too deep to germinate (see Section J). In addition, the soil is often poorly compacted around the seed.

I. Recommended Rates and Seed Mixtures

1. The City of Loveland prefers the use of native dryland grass species where permanent vegetative erosion control is used. Introduced species may be used for land that will eventually be developed. In general, introduced species are quicker and easier to establish than native, however, the long term durability of introduced species is unknown. In or adjacent environmentally sensitive areas more detailed criteria may apply.
2. Planting rates are normally expressed in the quantity of viable seed in pounds per acre (pls/acre). The actual number of seeds per unit area is a critical factor. Small-seeded species require fewer pounds per acre because of the larger number of seeds per pound.
3. Table 1 provides detailed information on the types of seed to be used for establishing perennial grasses in Loveland.
4. **TWO OR MORE SPECIES MUST BE USED FOR ESTABLISHING PERENNIAL GRASSES. IF SEED IS PLANTED BY MEANS OTHER THAN DRILL, THE APPLICATION RATE MUST BE DOUBLED FOR SLOPES 4:1 OR FLATTER AND QUADRUPLED FOR STEEPER SLOPES.**
 - a. Seed labeling, quality, and seed testing will be in accordance with the Colorado Seed Law.
 - b. Seed tags will be attached to seed bags at time of delivery to a site and submitted to the Engineer for verification and documentation of the seed used.
5. Seed mixtures for sites with distinctive soil problems (e.g., steep slopes with south or west facing aspects, alkalinity, salinity or high water table) should be developed by a trained specialist.
6. Table 3 illustrates an example of development of a perennial seed mix to be used on loam soil.

Table 3					
Example of Perennial Seed Mix Development.					
Species	Recommended lb PLS/Acre		Percent of Mix		Mixed lb PLS/Acre
Western Wheatgrass	19.8	x	30	=	5.9
Blue Grama	10.9	x	25	=	2.7
Green Needlegrass	12.4	x	25	=	3.0
Switchgrass	5.6	x	20	=	1.1
Total					12.7

Table 4 Recommended Species and Application Rates of Seeds for Temporary Vegetation and/or Cover Crops.		
Species	Season ⁽¹⁾	Drilled Pounds/Acre
Annual Ryegrass	Cool	20
Oats	Cool	70
Cereal Rye	Cool	40
Wheat – Winter	Cool	40
Wheat – Spring	Cool	60
Barley	Cool	60
Millet	Warm	30
Hybrid Sudan	Warm	15
Sorghum	Warm	10

(1) See Table 2 for planting dates.

J. Mulching

1. Mulching is used to conserve moisture, prevent surface crusting, reduce runoff and erosion and help establish plant cover. It is a critical treatment on sites with erosive slopes.
2. **ALL DISTURBED AREAS WHICH ARE SEEDED SHALL BE MULCHED IMMEDIATELY AFTER SEEDING.**
 - a. Hay or Straw Mulch
 - 1) Hay or straw is frequently used as mulch due to its relatively inexpensive cost, and effectiveness when properly installed. In most cases, grass hay is preferable to cereal grain straw for two reasons. First, cereal grain straw often contains large amounts of viable seed and the cereal crop competes with the grass planted. Second, wheat and other cool season cereals possibly produce toxins that limit germination of warm season grasses.
 - a) Hay or straw mulch will be anchored to the soil by one of the following methods:
 - (1) A crimper which will crimp the fiber four inches or more into the soil. At least 70% of the fiber shall be 10 inches or more in length.
 - (2) Manufactured mulch netting installed over the hay or straw according to manufacturers' instructions.
 - (3) Tackifiers sprayed on the mulch to the manufacturer's recommendations.
 - b) All straw or hay must be free of noxious weeds as defined in Article III, Section 20-41 of the Code of the City of Loveland, and must be free of must, mold, cake, or decay. At least 60% of the fibers shall be ten (10) inches or more in length.
 - 2) Hydraulic Mulches
 - a) Hydraulics mulches are typically cellulose (paper) or wood fibers which are mixed with water and a tackifying agent and sprayed uniformly over the soil surface. Fertilizer may also be applied with the hydraulic mulch. Experience in the Colorado Front Range has shown that this method has a limited life span.
 - b) Hydraulic mulch material shall consist of at least ninety (90) percent virgin wood cellulose fiber and be free of any substance or factor which might inhibit germination or growth of grass seed. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water.
 - c) Hydraulic mulch shall be clean and shall not contain the seeds of any noxious weeds or unspecified grasses. It shall be dyed a color to allow visual metering of its application. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover which readily absorbs water, and allows infiltration to the underlying soil.
 - d) Hydraulic mulch, if used, shall be applied immediately after seeding has been completed at the rate of two thousand (2000) pounds per acre. The mulch mixture shall be applied uniformly over all seeded areas with equipment capable of operating at one hundred (100) gallons per minute at one hundred (100) pounds per square inch.

e) **ON SLOPES OF LESS THAN THREE (3) TO ONE (1), HYDRAULIC MULCHES MAY ONLY BE APPLIED BETWEEN MARCH 15 AND MAY 15 WHEN USED AS MULCH FOR PERMANENT DRYLAND GRASSES.**

K. Nettings, Mats, Fabrics and Blankets

1. Synthetic products are available for mulching and erosion control on steep slopes and drainage channels. They are cost effective when used for their intended purpose. **Their use is recommended when conditions warrant.** All erosion control blankets, mats, or other soil stabilizing commercial products used shall be installed and anchored to the ground in accordance with the manufacturer's recommendations.

L. Maintenance

1. The success of permanent dryland grass seeding can rarely be accurately evaluated prior to the end of its second full growing season. Consequently, all areas which are seeded must be maintained by the owner for this period of time.
2. Seeding success depends upon control of weed competition during the first two growing seasons. Mowing at proper times and to proper heights will control many annual weeds. However, control of some annual weeds and most perennial weeds requires herbicide applications.
3. Canada thistle, knapweeds, kochia, and leafy spurge are noxious weeds which are nearly impossible to eradicate. Consequently, early detection of noxious weeds and their control before they become established is essential. Above maintenance shall be accomplished in order to meet the weeds, brush, and rubbish ordinance.
4. Grasses depend entirely upon food reserves which are stored in their roots and crowns for new spring growth. Maximum reserves do not occur until the plant approaches maturity. Therefore, plants should not be mowed during early growth.
5. Fertilization during the establishment period is often beneficial for increasing the vigor of the seeded species; however, it will also increase the vigor of existing weeds. Fertilizing should be based upon laboratory soil analysis and recommendations, and visual assessment of the stand.

M. Acceptance

1. The Developer/Contractor shall maintain all seeded areas for two (2) growing seasons.
2. Areas seeded in the spring will be inspected for required coverage the following fall not later than October 1st. Areas seeded at any other time will be inspected the following two summers not later than August 1. The required coverage for the first inspection shall be ten (10) viable live seedlings of the specified species per 1000 square centimeters (approximately one square foot), or fifty percent (50%) coverage of the specified foliage as measured from five feet (5') directly overhead, with no bare spots larger than 1000 square centimeters. At the time of the second growing season inspection, there shall be ninety percent (90%) foliage cover of the specified species planted as measured from five feet (5') directly overhead. No more than ten percent (10%) of the species noted on the site may be weedy species as defined by the City of Loveland.
3. Determination of required coverage will be based on fixed transects each ten meters in length, randomly placed in representative portions of the seeded areas, with plant species or bare ground/rock/litter being noted every ten (10) centimeters along each transect. It is the responsibility of the Developer/Contractor to initiate cover requirement inspections.
4. The site will be accepted at the end of two growing seasons if the cover and species requirements have been met. Areas that meet the ninety percent (90%) cover and weedy species requirements may be accepted before the second growing season. The Developer/Contractor shall rework and reseed any areas that fail to meet the requirements.

END OF SECTION