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SEEDING**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Certification of Products
- B. Acceptance and Warranty
- C. Seed Types and Mixes
- D. Equipment
- E. Application of Seed

1.02 DESCRIPTION OF WORK

Includes the requirements for seedbed preparation; furnishing, applying, and covering the seed; and compaction of the seedbed.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Submit certification of products to the Engineer prior to seed placement:
 - 1. Seed: Submit a laboratory analysis for all seeds, specifying the purity and germination. Provide a lot number on all submittals and labeling. Ensure lot number is the same on all records pertaining to a particular seed. Provide 48 hours notice prior to mixing the seed and give the Engineer an opportunity to witness the seed mixing. Submit a mechanically printed seed tag from an Iowa Crop Improvement Association-approved seed conditioner or grower.
 - 2. Fertilizer: Submit certification of the fertilizer analysis with scale weight and statement of guaranteed analysis. Submit from a certified fertilizer dealer, a mechanically printed commercial fertilizer label, or bill of lading. Comply with the inspection and acceptance requirements of [Iowa DOT Materials I.M. 469.03](#).
 - 3. Wood Cellulose Fiber Mulch: Submit certification of the degradable wood cellulose fiber mulch ingredients with applicable use and rate, and the water retention capacity by manufacturer or supplier.
 - 4. Wood Excelsior Mulch: Bale wood excelsior and determine the mass (weight). Use the mass of the material, furnished by the manufacturer, to determine the rate of application.
 - 5. Straw Mulch: Certify weight. Furnish a list of the number of bales and a corresponding ticket from an approved scale for the mulch material to be used on the project.
 - 6. Compost: Submit certification of composted organics analysis with U.S. Compost Council's Seal of Testing Assurance (STA), recommended rates of application, and manufacturer's estimated cubic yards per ton.
 - 7. Inoculant: Furnish information from inoculant packaging.
 - 8. Tackifier: Submit certification of the tackifier ingredients, recommended rates of application, and expiration date.
- B. Submit written instructions recommending procedures for maintenance of seeded areas.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Deliver packaged materials in original, unopened, and undamaged containers. Do not mix or blend materials except in the presence of the Engineer.
- B. Deliver, handle, and store all materials according to product recommendations, and protect from loss, damage, and deterioration.
- C. Materials not meeting these requirements will be rejected.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Coordinate the seeding schedule with all other work on the project. Notify the Engineer at least three calendar days prior to the start of seeding operations.
- B. After all land-disturbing activities are complete and the seedbed has been approved by the Engineer, perform seeding operations.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Conventional Seeding:****1. Seeding:**

- a. **Measurement:** Measurement will be in acres for each type of seed.
- b. **Payment:** Payment will be in unit price per acre for each type of seed.
- c. **Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

2. Fertilizing:

- a. **Measurement:** Measurement will be in acres of fertilizer.
- b. **Payment:** Payment will be at unit price per acre of fertilizer.

3. Mulching:

- a. **Measurement:** Measurement will be in acres of mulch.
- b. **Payment:** Payment will be in unit price per acre of mulch.

1.08 MEASUREMENT AND PAYMENT (Continued)**B. Seeding, Fertilizing, and Mulching for Hydraulic Seeding:**

1. **Measurement:** Measurement will be in acres for each type of seed.
2. **Payment:** Payment will be in unit price per acre for each type of seed.
3. **Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

C. Seeding, Fertilizing, and Mulching for Pneumatic Seeding:

1. **Measurement:** Measurement will be in acres for each type of seed.
2. **Payment:** Payment will be in unit price per acre for each type of seed.
3. **Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

D. Watering:

1. **Measurement:** Measurement will be by metering of water applied. If metering is not available, measurement will be by counting the loads from a transporting tank of known volume and gauging the contents of the transporting truck for partial loads.
2. **Payment:** Payment will be at the unit price per 1,000 gallons (MGAL) of water used.
3. **Includes:** Unit price includes, but is not limited to, water, pumps, meters, equipment, water tanker/container, transportation, hoses, and sprinklers.

E. Warranty:

1. **Measurement:** Lump sum item; no measurement will be made.
2. **Payment:** Payment will be at the lump sum price for the warranty.
3. **Includes:** Lump sum price includes, but is not limited to, all work required to correct any defects in the original placement of the seeding for the period of time designated.

PART 2 - PRODUCTS**2.01 SEED****A. General:**

1. Provide fresh, clean, new crop, certified seed complying with tolerance for germination and purity and free of poa annua, bent grass, and noxious weed seed. Furnish all seeds, including grass, legume, forbs, and cereal crop seeds, from an established seed dealer or certified seed grower. All materials and suppliers are to follow Iowa Seed Law and Iowa Department of Agriculture and Land Stewardship regulations, and be labeled accordingly.
 - a. Provide turfgrass with a certified "blue tag" or "gold tag."
 - b. Provide native grass and forbs that are source-identified as G0-Iowa certified "yellow tag," when available. If G0-Iowa certified "yellow tag" sourced seed is unavailable, or is only available from a single source, a substitution may be approved by the Engineer.
2. Mix seed to the specified proportions by weight. Use methods approved by the Engineer.

- B. Seed Quality:** Ensure the seed provided meets or exceeds the minimum requirements of purity and germination stated on an independent certificate of seed analysis document according to the Association of Official Seed Analysis (AOSA) rules. The seed certification tag and seed analysis document provided must be from the same lot number as shown on the seed tag. Ensure the date of test results is no greater than 9 months from the seed application date. Approval of all seed for use will be based on the accumulated total of Pure Live Seed (PLS) for each phase of work. PLS is obtained by multiplying purity times germination. PLS shall not be less than the accumulated total of the PLS specified.

If the seed does not comply with minimum requirements for purity and germination and such seed cannot be obtained, the Engineer may approve use of the seed on a basis of PLS or may authorize a suitable substitution for the seed specified.

C. Requirements on Containers:

1. **Seed:** Provide seed with a tag on each container. Ensure the seed analysis on the label is mechanically printed.
2. **Mulch:** When packaged, provide mulch in new labeled containers.
3. **Tackifier:** Provide tackifier packaged in new labeled containers.
4. **Inoculant:** Use inoculant that has a manufacturer's container, indicating the specific legume seed to be inoculated and the expiration date. All inoculant must meet requirements of the Iowa Seed Law. Follow precautions specified on the product label.
5. **Sticking Agent:** Use a commercial sticking agent recommended by the manufacturer of the inoculant. For quantities less than 50 pounds, the sticking agent need not be a commercial agent, but requires approval by the Engineer. Apply sticking agent separately prior to application of inoculant. Follow safety precautions specified on the product label.

2.01 SEED (Continued)**Table 9010.01: Domestic Grasses**

Common Name	Scientific Name	Purity (%)	Germination (%)
Bluegrass, Kentucky	<i>Poa pratensis</i>	85	80
Brome, smooth-LINCOLN	<i>Bromus inermis</i>	90	85
Fescue, creeping, red	<i>Festuca rubra</i>	98	85
Fescue, tall, FAWN	<i>Festuca arundinacea</i> -FAWN	98	85
Orchardgrass	<i>Dactylis glomerata</i>	90	90
Red top	<i>Agrostis alba</i>	92	85
Ryegrass, perennial	<i>Lolium perenne</i>	95	90
Wildrye, Canada	<i>Elymus Canadensis</i>	95	85
Wildrye, Russian	<i>Psathyrostachys junceus</i>	95	85

Table 9010.02: Legumes

Common Name	Scientific Name	Purity (%)	Germination (%)
Alfalfa, RANGER/VERNAL	<i>Medicago sativa</i>	99	90*
Alfalfa, travois	<i>Medicago</i> spp.	99	90*
Clover, Alsike	<i>Trifolium hybridum</i>	99	90*
Clover, red, medium	<i>Trifolium pratense</i>	99	90*
Clover, white	<i>Trifolium repens</i>	98	90*
Hairy vetch	<i>Vicia villosa</i>	96	85*
Lespedeza, Korean	<i>Lespedeza stipulacea</i>	98	80*

* Includes hard seed.

Table 9010.03: Stabilizing Crop

Common Name	Scientific Name	Purity (%)	Germination (%)
Oats	<i>Avena sativa</i>	97	90
Rye	<i>Secale cereale</i>	97	90
Sudangrass, PIPER	<i>Sorghum vulgare</i> var. sudanese	98	85

2.01 SEED (Continued)**Table 9010.04: Native Grasses**

Common Name	Scientific Name
Big bluestem*	<i>Andropogon gerardii</i>
Blue grama	<i>Bouteloua gracilis</i>
Blue-joint grass	<i>Calamagrostis Canadensis</i>
Bottlebrush sedge	<i>Carex hystericina</i>
Buffalograss*	<i>Buchloe dactyloides</i>
Common rush	<i>Juncus effusus</i>
Fowl bluegrass	<i>Poa palustris</i>
Fowl manna grass	<i>Glyceria striata</i>
Fox sedge	<i>Carex vulpinoidea</i>
Green bulrush	<i>Scirpus atrovirens</i>
Hairy wood chess	<i>Bromus purgans</i>
Indiangrass*	<i>Sorghastrum nutans</i>
Intermediate wheatgrass	<i>Agropyron intermedium</i>
Little bluestem*	<i>Andropogon scoparius</i>
Prairie dropseed	<i>Sporobolus heterolepis</i>
Reed manna grass	<i>Glyceria grandis</i>
Rice cutgrass	<i>Leersia oryzoides</i>
Rye grass, annual	<i>Lolium italicum</i>
Sand bluestem*	<i>Andropogon gerardii</i> , var. <i>paucipilus</i>
Sand dropseed	<i>Sporobolus cryptandrus</i>
Sand lovegrass	<i>Eragrostis trichodes</i>
Sideoats grama*	<i>Bouteloua curtipendula</i>
Slender wheatgrass	<i>Agropyron trachycaulum</i> , var. <i>unilaterale</i>
Spike rush	<i>Eleocharis palustris</i>
Softstem bulrush	<i>Schoenoplectus tabernaemontani</i>
Switchgrass*	<i>Panicum virgatum</i>
Tussock sedge	<i>Carex stricta</i>
Virginia wild-rye	<i>Elymus virginicus</i>
Weeping lovegrass	<i>Eragrostis curvula</i>
Western wheatgrass*	<i>Agropyron smithii</i>
Wool grass	<i>Scirpus cyperinus</i>

2.01 SEED (Continued)**Table 9010.05: Forbs**

Common Name	Scientific Name
Black-eyed Susan	<i>Rudbeckia hirta</i>
Blue-flag iris	<i>Iris virginica-shrevii</i>
Boneset	<i>Eupatorium perfoliatum</i>
Canadian anemone	<i>Anemone canadensis</i>
Common mountainmint	<i>Pycnanthemum virginianum</i>
Common rush	<i>Juncus effusus</i>
Fowl manna grass	<i>Glyceria striata</i>
Golden Alexanders	<i>Zizia aurea</i>
Great blue lobelia	<i>Lobelia siphilitica</i>
Grey-headed coneflower	<i>Ratibida pinnata</i>
Heath aster	<i>Symphyotrichum ericoides</i>
Ironweed	<i>Veronia fasciculata</i>
Joe-pye weed	<i>Eupatorium maculatum</i>
Meadow blazingstar	<i>Liatris ligulistylis</i>
Milkweed, butterfly	<i>Asclepias tuberosa</i>
Milkweed, swamp	<i>Asclepias incarnata</i>
New England aster	<i>Symphyotrichum novae-angliae</i>
Ohio spiderwort	<i>Tradescantia ohiensis</i>
Oxeye sunflower	<i>Heliopsis helianthoides</i>
Pale purple coneflower	<i>Echinacea pallida</i>
Partridge pea	<i>Chamaecrista fasciculata</i>
Prairie blazing star	<i>Liatris pycnostachya</i>
Purple prairie clover	<i>Dalea purpurea</i>
Rattlesnake master	<i>Eryngium yuccifolium</i>
Reed manna grass	<i>Glyceria grandis</i>
Rice cutgrass	<i>Leersia oryzoides</i>
Showy goldenrod	<i>Solidago speciosa</i>
Showy tic-trefoil	<i>Desmodium canadense</i>
Stiff goldenrod	<i>Solidago rigida</i>
Swamp aster	<i>Aster puniceus</i>
White wild indigo	<i>Baptisia alba</i>
Wild bergamot	<i>Monarda fistulosa</i>

2.02 SEED MIXTURES AND SEEDING DATES

See the contract documents for the specified seed mixture. If a mixture is not specified, use the following. The Contractor may submit a modification of the mixture for the Engineer's consideration.

- A. Type 1 (Permanent Lawn Mixture):** Used for residential and commercial turf site, fertilized, and typically mowed. Use between March 1 and May 31 and between August 10 and September 30.

Table 9010.06: Type 1 Seed Mixture¹

Common Name	Application Rate lb/acre
Creeping red fescue	25
Turf-type perennial ryegrass ²	20
Turf-type perennial ryegrass ²	20
Kentucky bluegrass cultivar ³	65
Kentucky bluegrass cultivar ³	65
Kentucky bluegrass cultivar ³	65

¹ A commercial mixture may be used if it contains a high percentage of similar bluegrasses; it may or may not contain creeping red fescue.

² Choose two different cultivars of turf-type perennial ryegrass, at 20 lbs/acre each.

³ Choose three different cultivars of Kentucky bluegrass, at 65 lbs/acre each.

- B. Type 2 (Permanent Cool Season Mixture for Slopes and Ditches):** Not typically mowed. Reaches a maximum height of 2 to 3 feet, low fertility requirements, grows in the spring and fall, and can go dormant in the summer. Use between March 1 and May 31 and between August 10 and September 30.

Table 9010.07: Type 2 Seed Mixture

Common Name	Application Rate lb/acre
Fawn fescue	100
Kentucky bluegrass	20
Ryegrass, perennial	75

- C. Type 3 (Permanent Warm-Season Slope and Ditch Mixture):** Not typically mowed. Reaches a height of 5 to 6 feet, stays green throughout summer, and responds well to being burned in spring; no fertilizer. Use between March 1 and June 30.

Table 9010.08: Type 3 Seed Mixture

Common Name	Application Rate lb/acre
Big bluestem*	3 PLS
Grain rye	40
Indiangrass*	4 PLS
Little bluestem*	3 PLS
Oats	16
Sideoats grama*	5 PLS
Switchgrass*	1 PLS

* Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa.

2.02 SEED MIXTURES AND SEEDING DATES (Continued)

- D. Type 4 (Urban Temporary Erosion Control Mixture):** Short lived (6 to 8 months) mix for erosion control.

Table 9010.09: Type 4 Seed Mixture

Common Name	Application Rate lb/acre
<i>SPRING - March 1 - May 20</i>	
Annual ryegrass	40
Oats*	65
<i>SUMMER - May 21 - August 14</i>	
Annual ryegrass	50
Oats*	95
<i>FALL - August 15 - September 30</i>	
Annual Ryegrass	40
Grain rye	65

* Engineer may delete for previously established urban areas.

- E. Type 5 (Rural Temporary Erosion Control Mixture):** Short lived mix for erosion control.

Table 9010.10: Type 5 Seed Mixture

Common Name	Application lb/acre
<i>March 1 - October 31</i>	
Canada wildrye	5 PLS/acre
Grain rye	50
Oats	50
<i>November 1 - February 28 (or 29)</i>	
Canada wildrye	7 PLS/acre
Grain rye	62
Oats	62

Seed does not need to be certified Source Identified Class (Yellow Tag).

- F. Type 6 (Salt-resistant Mixture):** Use for grass medians and areas immediately back of curb on streets subject to regular salt applications for winter de-icing. Apply between March 1 and May 31 and between August 10 and September 30.

Table 9010.11: Type 6 Seed Mixture

Common Name	Application Rate lb/acre	Purity (%)	Germination (%)
Blue chip Kentucky bluegrass	37.5	90	85
Fults alkali grass	75	98	85
Hard fescue	50	95	85
Nublu Kentucky bluegrass	37.5	90	85
Sheeps fescue	50	90	85

2.02 SEED MIXTURES AND SEEDING DATES (Continued)

- G. Wetland Seeding:** Between April 1 and June 30, use the following seed mixture for wetland grass seeding areas.

Table 9010.12: Wetland Grass Seed Mixture

Common Name	Scientific Name	PLS** (per ac)
Arrowhead	<i>Sagittaria latifolia</i>	4 oz
Big bluestem*	<i>Andropogon gerardii</i>	1 lb
Bluejoint grass	<i>Calamagrostis</i>	1 oz
Blue vervain	<i>Verbena Hastata</i>	1 oz
Boneset	<i>Eupatorium perfoliatum</i>	1 oz
Broom sedge	<i>Carex scoparia</i>	2 oz
Dark green bulrush*	<i>Scirpus atrovirens</i>	1 oz
Fox sedge*	<i>Carex vulpinoidea</i>	4 oz
New England aster*	<i>Symphyotrichum novae-angliae</i>	2 oz
Nodding bur marigold	<i>Bidens cernua</i>	8 oz
Porcupine sedge	<i>Carex hystericina</i>	8 oz
Prairie cordgrass	<i>Spartina pectinata</i>	1 lb
Rice cutgrass	<i>Leersia oryzoides</i>	4 oz
Sneezeweed	<i>Helenium autumnale</i>	2 oz
Softstem bulrush	<i>Schoenoplectus tabernaemontani</i>	8 oz
Spike rush	<i>Eleocharis palustris</i>	4 oz
Swamp milkweed*	<i>Asclepias incarnata</i>	1 lb
Switchgrass*	<i>Panicum virgatum</i>	8 oz
Tussock sedge	<i>Carex stricta</i>	2 oz
Virginia wild-rye*	<i>Elymus virginicus</i>	5 lbs
Water plantain	<i>Alisma plantago-aquatica</i>	4 oz

* Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa.

** Seeding rates for wetland grasses are given as PLS. Either the germination test or Tetrazolium (TZ) test is acceptable to determine PLS for native species.

2.02 SEED MIXTURES AND SEEDING DATES (Continued)

H. Native Grass and Forbs (Wildflower) Seeding: Between April 1 and June 30, use the following seed mixture for areas designated for native grass and wildflower seeding.

Table 9010.13: Native Grass and Forbs (Wildflower) Seeding Mixture

Common Name	Scientific Name	Application Rate**
GRASSES		lb/acre
Big bluestem*	Andropogon gerardii	1.0
Canada wild rye	Elymus Canadensis	1.5
Indiangrass*	Sorghastrum nutans	1.0
Little bluestem*	Schizachyrium scorparium	2.0
Sideoats grama*	Boutelouea curtipendula	2.5
Switchgrass*	Panicum virgatum	0.5
FORBS (WILDFLOWERS)		oz/acre
Black-eyed Susan	Rudbeckia hirta	3.0
Butterfly milkweed	Asclepias tuberosa	4.0
Canadian anemone	Anemone canadensis	0.5
Common mountainmint	Pycnanthemum virginianum	0.25
Golden Alexanders	Zizia aurea	8.0
Grey-headed coneflower	Ratibida pinnata	2.75
Heath aster	Symphotrichum ericoides	0.25
Ironweed	Veronia fasciculata	3.0
New England aster	Symphotrichum novae-angliae	1.25
Ohio spiderwort	Tradescantia ohiensis	7.0
Oxeye sunflower	Heliopsis helianthoides	12.0
Pale purple coneflower	Echinacea pallida	15.0
Partridge pea	Chamaecrista fasciculata	32.0
Prairie blazing star	Liatris pycnostachya	4.5
Purple prairie clover	Dalea purpurea	2.5
Rattlesnake master	Eryngium yuccifolium	1.75
Showy goldenrod	Solidago speciosa	0.50
Stiff goldenrod	Solidago rigida	1.0
Swamp milkweed	Asclepias incarnata	4.0
White wild indigo	Baptisia alba	2.0
Wild bergamot	Monarda fistulosa	1.25
NURSE CROP		lb/acre
Oats (spring seeding - April 1 to June 30)		32
Winter wheat (dormant/frost seeding - November 1 to March 31)		25

* Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa.

** Seeding rates for native grass and forb species are given as PLS. Either the germination test or Tetrazolium (TZ) test is acceptable to determine PLS for native species.

2.03 FERTILIZER

Use fertilizer of the grade, type, and form specified that complies with rules of the Iowa Department of Agriculture and Land Stewardship and the following requirements:

- A. Grade:** Identify the grade of fertilizer according to the percent nitrogen (N), percent of available phosphoric acid (P_2O_5), and percent water soluble potassium (K_2O), in that order, and base approval on that identification.

The Contractor may substitute other fertilizer containing analysis percentages different from those specified, provided that the minimum amounts of actual nitrogen, phosphate, and potash per acre are supplied, and that in no case does the total amount per acre of the three fertilizer elements be exceeded by 30% of the following minimum amounts.

- 1. For Conventional Seeding, Permanent:** Apply a 6-24-24 commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate of 300 pounds per acre.
- 2. For Conventional Seeding, Temporary:** Apply commercial fertilizer to all seeded areas at the rate of 250 pounds per acre of 13-13-13 (or equivalent) for rural mixes and 300 pounds per acre of 6-24-24 (or equivalent) for urban mixes, unless otherwise specified in the contract documents.
- 3. For Hydraulic Seeding:** Apply fertilizer in combination with seeding by a hydraulic seeder and as specified in [Iowa DOT Article 2601.03, B](#). Apply a commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate specified for the type of seeding being applied.
- 4. For Pneumatic Seeding:** Based on the compost nutrient analysis, supply any additional commercial fertilizer necessary to meet the 13-13-13 units of nitrogen, phosphate, and potash at the rate of 450 pounds per acre as the compost is applied.

- B. Type:** Use fertilizer that can be uniformly distributed by the application equipment. Furnish fertilizer either as separate ingredients or in chemically-combined form.

2.04 STICKING AGENT

- A.** Use a sticking agent that is a commercial material recommended by the manufacturer to improve adhesion of inoculant to the seed. For small quantities less than 50 pounds, the sticking agent need not be a commercial agent, but it must be approved by the Engineer and must be applied separately, prior to application of inoculant.
- B.** Follow safety precautions specified on the product label. A sticking agent is not required if a liquid formulation of inoculant is used.

2.05 INOCULANT FOR LEGUMES

An inoculant is a culture of bacteria specifically formulated for each legume seed (alfalfa, clovers, lespedesa, and hairy vetch). Ensure the manufacturer's container indicates the specific legume seed to be inoculated and the expiration date. Use inoculant that meets the requirements of the Iowa Seed Law. Follow the safety precautions specified on the product label.

2.06 WATER

Use water that is free of any substance harmful to seed germination or plant growth.

2.07 MULCH**A. For Conventional Seeding:**

1. Material used as mulch may consist of the following:
 - a. Dry cereal straw (oats, wheat, barley, or rye)
 - b. Prairie hay
 - c. Wood excelsior composed of wood fibers, at least 8 inches long, based on an average of 100 fibers, and approximately 0.024 inch thick and 0.031 inch wide. The fibers must be cut from green wood and be reasonably free of seeds or other viable plant material.
2. Do not use other hay (bromegrass, timothy, orchard grass, alfalfa, or clover).
3. All material used as mulch must be free from all noxious weed, seed-bearing stalks, or roots and will be inspected and approved by the Engineer prior to its use.
4. The Contractor may use other materials, subject to the approval of the Engineer.

B. For Hydraulic Seeding:

1. Wood Cellulose:
 - a. Use material that is a natural or cooked cellulose fiber processed from whole wood chips, or a combination of up to 50% of cellulose fiber produced from whole wood chips, recycled fiber from sawdust, or recycled paper (by volume).
 - b. Product contains a colloidal polysaccharide tackifier adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing.
 - c. Form a homogeneous slurry of material, tackifier, and water.
 - d. Use a slurry that can be applied with standard hydraulic mulching equipment.
 - e. Dye the slurry green to facilitate visual metering during application.
 - f. Do not use materials that have growth or germination-inhibiting factors or any toxic effect on plant or animal life when combined with seed or fertilizer.
2. Bonded Fiber Matrix (BFM):
 - a. Manufactured to be applied hydraulically.
 - b. Dyed green to facilitate visual metering.
 - c. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
 - d. Meet the following requirements:
 - 1) Contain non-toxic tackifiers that upon drying become insoluble and non-dispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
 - 2) Contain no germination or growth inhibiting factors and do not form a water-resistant crust that can inhibit plant growth.
 - 3) Hydraulic mulch that is completely photo-degradable or biodegradable.
 - 4) Contain a minimum of 90% organic material according to ASTM D 2974.
 - 5) Have a rainfall event (R-factor) of $140 < R$ according to ASTM D 6459.
 - 6) Have a cover factor of $C \leq 0.03$ according to ASTM D 6459.
 - 7) Vegetation Establishment of 400% minimum according to ASTM D 7322.
 - 8) Water Holding Capacity 600% minimum according to ASTM D 7367.
3. Mechanically-Bonded Fiber Matrix (MBFM):
 - a. Manufactured to be applied hydraulically.
 - b. Dyed green to facilitate visual metering.
 - c. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.

2.07 MULCH (Continued)

- d. Meet the following requirements:
- 1) Contain non-toxic tackifiers that upon drying become insoluble and non-dispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
 - 2) Contain no germination or growth inhibiting factors and do not form a water-resistant crust that can inhibit plant growth.
 - 3) Hydraulic mulch that is completely photo-degradable or biodegradable.
 - 4) Contain a minimum of 90% organic material according to ASTM D 2974.
 - 5) Have a rainfall event (R-factor) of $175 < R$ according to ASTM D 6459.
 - 6) Have a cover factor of $C \leq 0.01$ according to ASTM D 6459.
 - 7) Vegetation establishment of 500% minimum according to ASTM D 7322.
 - 8) Water holding capacity of 700% minimum according to ASTM D 7367.

C. For Pneumatic Seeding: Use compost meeting the following requirements.

1. Derived from a well-decomposed source of organic matter.
2. Produced using an aerobic composting process, meeting Code of Federal Regulations (CFR) 503 for time, temperature, and heavy metal concentrations.
3. No visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
4. Certified by the U.S. Composting Council's Seal of Testing Assurance (STA) program.
5. Conforms to chemical, physical, and biological parameters of AASHTO R 52, with the following additional requirements:
 - a. Follow U.S. Composting Council's TMECC guidelines for all testing.
 - b. Organic Matter Content: 30% minimum.
 - c. pH: between 6.0 and 8.0.
 - d. Maturity (growth screening): Minimum 90% emergence for all compost to be vegetated.
 - e. Particle Size:

Sieve Size	Percent Passing*
2"	100
1"	90-100
3/4"	65-100
3/8"	0-75

*6 inch maximum particle length.

PART 3 - EXECUTION**3.01 EQUIPMENT**

- A. Aerial Equipment:** When aerial application of seed and fertilizer is specified, use aerial equipment capable of providing a uniform distribution of seed and fertilizer on the specified area.
- B. Compost Blower:** A compost blower is pneumatic equipment to blow compost over the desired area. It may be equipped with a supplemental seed injection system. Use equipment with sufficient power to cover the required area without driving on the prepared seedbed.
- C. Cultipacker:** Use a pull-type cultipacker with individual rollers or wheels. Cultipackers with sprocket-type spacers between the wheels may be used. The cultipacker must produce a corrugated surface on the area being compacted. Operate the cultipacker separately from all other operations, and do not attach the cultipacker to the seeder or disk, unless combined cultipacker seeder is manufactured to operate as a unit. Make provisions for addition of weight.
- D. Disk:** When preparing a seedbed on ground having heavy vegetation, use a disk with cutaway blades. Make provisions for the addition of weight to obtain proper cutting depth.
- E. Drop Seeder:** Use one piece of equipment containing pulverizer rollers in front of the seed tubes, ground driven seed meters, maximum seed tube spacing of 3 inches delivering seed between the pulverizer rollers and packer wheels, and packer wheels that press and firmly pack seed into the soil.
- F. Endgate Cyclone Seeders:** Endgate cyclone seeders must be suitably mounted. Movement must be provided by mechanical means. The seed drops through an adjustable flow regulator onto a rotating, power driven, horizontal disk or fan.
- G. Expanded Mesh Roller:** Use equipment that is an open grid type or a cultipacker type, modified by covering with expanded metal mesh.
- H. Field Tiller:** Use equipment designed for the preparation of the seedbed to the degree specified.
- I. Gravity Seeders:** Gravity seeders must provide agitation of the seed, have an adjustable gate opening, and uniformly distribute seed on the prepared seedbed. Use a seed hopper equipped with baffle plates spaced no more than 2 feet apart. The baffle plates must extend from the agitator shaft to within approximately 2 inches of the top of the seed hopper. Wind guards are required to facilitate seeding when moderate wind conditions exist and when ordered by the Engineer. Place wind guards in front or in back (or both) of the seed outlet and extend them to near the ground line. This seeder may be used for application of fertilizer.
- J. Hand Cyclone Seeders:** Hand cyclone seeders are carried by the person dispensing seed. The seed drops through an adjustable flow regulator onto a rotating, hand driven, horizontal disk or fan.
- K. Hydraulic Seeder:** Use hydraulic seeding equipment with a pump rated at no less than 100 gallons per minute. Inoculant, seed, and fertilizer may be applied in a single operation. The equipment must have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks must have a means of agitation. Calibrate tanks and provide them with a calibration stick or other approved device to indicate the volume used or remaining in the tank.
- L. Mowers:** Use mowers that are rotary, flail, disk, or sickle type. Do not use mowers that bunch or windrow the mowed material.

3.01 EQUIPMENT (Continued)

- M. Mulch Anchoring Equipment:** Use mulch anchoring equipment designed to anchor straw or hay mulch into soil by means of dull blades or disks. It should have flat blades or disks, may have cutaway edges and must be spaced at approximately 8 inch intervals. The mulch anchoring equipment must be pulled by mechanical means and weigh approximately 1,000 pounds. When directed by the Engineer, increase the weight by addition of ballast.
- N. Native Grass Seed Drill:** Use a native grass seed drill designed to provide uniform distribution of native grass and wildflower seeds. Provide separate seed boxes to apply both small seeds as well as fluffy bearded seeds. If a no-till attachment is specified, use an attachment of the same manufacturer as the drill.
- O. Pneumatic Seeder:** Use an air blown system with sufficient power and hose to reach 300 feet.
- P. Pulverizer:** Use equipment designed to break up compacted soil to prepare a seedbed.
- Q. Rotary Tiller:** Use equipment with rotary-type blades designed for the preparation of seedbed to the degree specified.
- R. Slit Seeder:** Use a gas, diesel or electric powered mechanical slit seeder that is capable of cutting vertical grooves a maximum of 1/4 inch deep into the soil with a maximum horizontal blade spacing of 3 inches, deposits metered seed directly after the formation of the vertical grooves, and contains packer wheels that press and firmly pack seed into the soil.
- S. Slope Harrow:** Use a slope harrow, consisting of a rolling weight attached by heavy chain to a tractor. The chain must be of suitable length, with picks attached, and a means of rotating the picks as the rolling weight is pulled in a direction parallel to the movement of the tractor.
- T. Spike Tooth Harrow:** Use equipment designed to provide adjustment of the spike teeth to level the ground, or to be used as specified by the Engineer.
- U. Straw Mulching Machine:** Use a machine to uniformly apply mulch material over the desired area without excessive pulverization. Excessive pulverization is the general absence of straw longer than 6 inches after distribution.

3.02 AREA OF SEEDING

Place seed only in the areas specified in the contract documents. Repair damaged areas that are disturbed outside the contract limits at the expense of the Contractor. Do not disturb areas having a satisfactory growth of desirable grasses or legumes.

3.03 FINISH GRADING AND TOPSOIL

See [Section 2010](#) for finish grading and topsoil placement.

3.04 CONVENTIONAL SEEDING

- A. Order of Operations:** 1) fertilizing, 2) seedbed preparation, 3) seed preparation/application, and 4) mulching.
- B. Fertilizing:**
1. Apply fertilizer immediately prior to seedbed preparation. Incorporate the fertilizer into the top 2 to 3 inches of topsoil during the seedbed preparation. Equipment that results in ruts or excessive compaction will not be allowed.
 2. Do not apply fertilizer with native grass, wildflower, or wetland seeding.

3.04 CONVENTIONAL SEEDING (Continued)**C. Seedbed Preparation, Permanent:**

1. Limit preparation of seedbed to areas that will be seeded immediately upon completion.
2. Work areas accessible to field equipment to a depth of no less than 3 inches. Use mechanical rotary tillage equipment for the preparation of seedbed on earth shoulders, urban or raised medians, and rest areas. Prepare by hand areas inaccessible to field machinery, to a depth of no less than 2 inches. Use care that the entire width of the shoulder and areas around headwalls, wingwalls, flumes, and other structures are prepared in the manner specified. Where weed growth has developed extensively, they may be disked into the ground. If weed growth develops sufficiently to interfere with proper seedbed preparation, mow the weeds and remove them from the project at no additional cost to the Contracting Authority.

Use crawler type or dual-wheeled tractors for seedbed preparation. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Harrow ridging in excess of 4 inches due to operation of tillage equipment prior to rolling with the cultipacker. Roll the area with no less than one pass of the cultipacker prior to permanent seeding.

3. Shape and fine grade to remove rills or gullies, water pockets, undesirable vegetation, and irregularities to provide a smooth, firm, and even surface true to grade and cross-section. For Type 1 (lawn seeding), prepare to a fine texture and without soil lumps. Coordinate preparation of all ditches designated for special ditch control with the seedbed preparation. Till parallel to the contours.
4. Smooth the seedbed with a cultivator-type tillage tool having a rake bar or a rock rake. Pick up and remove all debris, such as rocks, stones, concrete larger than 2 inches (1/2 inch maximum for lawn seeding), or roots and other objectionable material that will interfere with the seeding operation. A spring tooth cultivator may be used in lieu of a rock picker. Remove the rock by hand after each use of the cultivator; repeat the process until the soil is relatively free of rock as determined by the Engineer.
5. Choose equipment to minimize soil compaction. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Roll the area with at least one pass of the cultipacker. Remove ruts that develop during the sequence of operations before subsequent operations are performed. This must be completed just prior to seeding and the work approved by the Engineer before the seeding application.

D. Seedbed Preparation, Temporary: Till the soil to a minimum depth of 5 inches with a disk, harrow, or field cultivator.

E. Seeding:**1. Seed Preparation:**

- a. Thoroughly mix all seed specified for the contract prior to placing the seed in the seed hopper. Provide 48 hours notice prior to mixing the seed, and give the Engineer an opportunity to witness the seed mixing. The mixing of a certified blue tag seed mix at an approved (by Iowa Crop Improvement Association) seed conditioner's facility need not be witnessed.
- b. Treat all legume seed with a commercial sticking agent to be applied prior to application of inoculant, or as a mixture when the sticking agent is compatible with other materials. A sticking agent is not required if a liquid formulation of inoculant is used. Use mechanical mixing equipment to apply sticking agent and inoculant on seed quantities over 50 pounds.

3.04 CONVENTIONAL SEEDING (Continued)

- c. Inoculate all legumes with a standard product humus culture before being mixed with other seeds for sowing.
 - d. Inoculate all legumes with a standard culture at the rate specified by the manufacturer of the inoculant according to [Iowa DOT Article 4169.04](#). Do not expose inoculated seed to direct sunlight for more than 30 minutes. Re-inoculate seed that is not sown within 8 hours after inoculation prior to use. Pre-inoculated seed with manufacturer's recommended protective coating may be used in lieu of seed with Contractor-applied inoculant.
 - e. When the gravity or cyclone seeder is used for application of seed, inoculate legume seed according to the manufacturer's recommended procedures, before mixing with other grass seeds for sowing. Furnish and apply inoculant.
- 2. Seed Application, Permanent:**
- a. Prior to seeding, the seedbed will be inspected and approved by the Engineer. Use methods and procedures consistent with equipment manufacturer's recommendations; however, do not operate ground-driven equipment at speeds greater than 10 mph.
 - b. On all areas accessible to machinery, sow seed with a gravity seeder, endgate cyclone seeder, or seed drill.
 - c. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be allowed, but no other hand-seeding methods will be accepted.
 - d. The application of grass and legume seed with hand seeders on early spring work must be performed as separate operations. No mixing of the two types of seed will be allowed.
 - e. All seeded areas will have one pass with a roller or cultipacker to firm the soil.
- 3. Seed Application, Temporary:**
- a. On areas accessible to field machinery, sow seed with an endgate cyclone seeder.
 - b. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be allowed, but no other hand-operated seeding methods will be accepted.
 - c. Cover the seed and fertilizer by lightly tilling the seeded area with a disk, rigid harrow, spring tooth harrow, or field cultivator.
- 4. Seeding Outside of the Specified Seeding Dates:** With the agreement of the Engineer and at the full responsibility of the Contractor, seeding operations for all seed types may be conducted outside the specified seeding dates. Should the seeded areas require reseeded, it must be done as specified and at no additional cost to the Contracting Authority.
- a. Dormant Seeding:** When winter dormant seeding is allowed or specified by the Jurisdiction, complete it when air temperatures are consistently below 40°F and prior to December 25 of a given year. Dormant seeding is not allowed on snow.
 - 1) Prepare the seedbed before the ground freezes.
 - 2) To ensure protection of the seed, apply on a frosty morning or before a predicted snow.
 - 3) Seeding may be done by hand or with seeding equipment.
 - 4) For hydraulic seeding, apply the fertilizer at no more than 0.5 pounds nitrogen per 1000 square feet, followed by the seed.
 - b. Frost Seeding (Overseeding):**
 - 1) Complete frost seeding, also referred to as overseeding, in the spring when the ground is friable from frost action (February 1 to April 1).
 - 2) Frost seeding is not allowed on more than 1 inch of snow.
 - 3) Seeding can be done with a hand-operated cyclone seeder or other equipment.
 - 4) Seedbed preparation will not be required provided the ground is friable from frost action.

3.04 CONVENTIONAL SEEDING (Continued)**F. Mulching:**

1. Mulch all conventionally seeded areas the same day the seed is sown. Uniformly distribute the mulch over the required areas at a rate of 1.5 tons/acre for dry cereal straw, or native grass straw. Prairie hay is not suitable for Type 1 (lawn seeding).
2. Work the mulch into the soil with mulch anchoring equipment designed to anchor the mulch into the soil by means of dull blades or disks with a minimum of two passes. Operate equipment in a manner to minimize displacement of the soil and disturbance of the design cross-section.
3. Do not operate mulch-blowing equipment on slopes steeper than 2.5 to 1 or on slopes that may rut. Use attachments to apply mulch without traversing slopes.
4. Do not mulch when wind velocities exceed 15 mph.

3.05 HYDRAULIC SEEDING**A. Order of Operations:**

1. Seedbed preparation
2. Seed application, fertilizing, and mulching

B. Seedbed Preparation: Follow seedbed preparation for conventional seeding in Section 9010, 3.04.

C. Seed Preparation: Inoculant, in the quantities specified above, may be applied directly into the supply tank with seed, water, and other material.

D. Seed Application, Fertilizing, and Mulching:

1. Application Process:
 - a. Combination: Place all material, seed, fertilizer, mulch, and tackifier (if applicable) in hydraulic mulching equipment specifically manufactured for hydraulic seeding.
 - b. Separate: At the Contractor's option and at no additional cost to the Contracting Authority, the hydraulic seeding, fertilizing, and mulching may be undertaken separately. If hydraulic seeding is done separately, add 50 pounds of wood cellulose fiber complying with Section 9010, 2.07, B as a tracer for each 500 gallons of water in the hydraulic seeder tank. If operations are undertaken separately, complete fertilizing and mulching application within 24 hours of completing seeding work. Do not separate the applications if inclement weather is forecasted within 24 hours of the scheduled application period.
2. Ensure the hydraulic equipment, pump, and application process do not damage or crack seeds.
3. Mix materials with fresh potable water using a combination of both recirculation through the equipment's pump, and mechanical agitation to form a homogeneous slurry.
4. Apply mixture within 1 hour after seed and fertilizer are placed in the hydraulic seeder.
5. If necessary, dampen dry, dusty soil, to prevent balling of the material during application.

3.05 HYDRAULIC SEEDING (Continued)

6. Apply the slurry evenly over all specified areas at component material rates specified.
 - a. Wood Cellulose Mulch:
 - 1) Mulch: Minimum 3,000 lb/acre dry weight.
 - 2) Tackifier: Minimum 50 lb/acre.
 - b. Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
 - c. Mechanically-bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
 7. Retain and count empty bags of mulch to ensure final application rate.
 8. Hydromulching may be done over conventional seeding and/or fertilizing, if approved by the Engineer.
- E. Native Grass, Wildflower, and Wetland Grass Seeding:** Hydraulic seeding of native grasses, wildflowers, and wetland grasses is allowed only if approved by the Engineer. If allowed, increase specific seed rates by 25%. Do not apply fertilizer.

3.06 PNEUMATIC SEEDING

- A. Order of Operations:** 1) seedbed preparation, 2) seed preparation, and 3) seed application.
- B. Seedbed Preparation:** Follow seedbed preparation for conventional seeding in Section 9010, 3.04.
- C. Seed Preparation:** Follow seed preparation for conventional seeding in Section 9010, 3.04. Pre-inoculate seed in the quantities specified above prior to placing in the seed equipment.
- D. Seed Application:**
1. Place all material, seed, fertilizer, and compost in equipment with a calibrated seeder attachment specifically designed for pneumatic seeding. Do not apply fertilizer with native grass, wildflower, or wetland seeding.
 2. Apply compost to a 1 inch minimum depth on all designated disturbed areas. Apply the compost with a pneumatic (air blower) system with sufficient power and hose to reach 300 feet. Driving on the soil to apply compost will not be allowed.
 3. Inject seed and fertilizer into the top 1/4 inch to 1/2 inch of compost during application with a calibrated seed injector at the specified rate. Do not inject native grasses and forbs more than 1/4 inch.

3.07 WATERING

- A.** Provide water, equipment, transportation, water tanker, hoses, and sprinklers.
- B.** Use enough water to keep the soil and mulch moist to a depth of 1 inch and ensure growth of the seed. For turfgrass seeding areas, sufficiently water to keep the soil moist for a minimum of 21 days. If natural rainfall is adequate to keep the soil and mulch moist, artificial watering may not be needed.

3.08 RE-SEEDING

- A.** When all work related to seeding, fertilizing, and/or mulching has been completed on an area, and is washed out or damaged, re-seed, fertilize, and/or mulch the area at the contract unit price(s) when so ordered by the Engineer.
- B.** When work related to seeding, fertilizing, and/or mulching has not been completed in an area and is washed out or damaged, re-seed, fertilize, and/or mulch the area as necessary at no additional cost to the Contracting Authority.

3.09 CLEAN UP

All work related to clean up throughout the project and upon completion is the responsibility of the Contractor, at no additional cost to the Contracting Authority.

- A. Remove all excess materials, debris, and equipment upon completion of work.
- B. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.
- C. Repair any damage resulting from seeding operations.
- D. Remove hydraulic slurry and other excess debris related to seeding operations from buildings, landscaping, mulch, pavement, signs, sign posts, and any other areas not specified for application, at the end of each day.

3.10 ACCEPTANCE AND WARRANTY**A. Acceptance:**

- 1. Guarantee in writing that all work has been completed as specified and provide the date that all activities were completed. When a warranty is a separately-bid item, this also establishes the beginning of the warranty period.
- 2. Acceptance will occur, provided seeded areas are in a live, healthy, growing, and well-established condition without eroded areas, bare spots, weeds, undesirable grasses, disease, or insects.
 - a. Projects without a separately-bid warranty will be accepted no sooner than 60 days from the date that all activities were completed.
 - b. When a warranty is established as a bid item and the warranty period exceeds 60 days, projects may be accepted after all specified work, excluding the warranty, is satisfactorily completed, and a supplemental contract for the warranty is executed according to the Code of Iowa Section 573.27.

B. Warranty:

- 1. Required only when established as a bid item by the Engineer.
- 2. The warranty is to guarantee completed seeding areas for a maximum period of twelve months.
- 3. During the warranty period, correct and reseed any defects in the seeded areas and grass stand, such as weedy areas, eroded areas, and bare spots, until all affected areas are accepted by the Engineer.
- 4. Replace or repair to original condition, all damages to property resulting from the seeding operation or from the remedying of defects, at the Contractor's expense.
- 5. Replacement costs are the Contractor's responsibility, except for those resulting from loss or damage due to occupancy of the project in any part, vandalism, civil disobedience, acts of neglect on the part of others, physical damage by animals, vehicles, fire, or losses due to curtailment of water by local authority, or by "Acts of God."

END OF SECTION

SODDING**PART 1 - GENERAL****1.01 SECTION INCLUDES**

Sod Installation

1.02 DESCRIPTION OF WORK

This section includes preparation of the sodbed, furnishing and installing sod, fertilizing, watering, and maintenance for completed sodded areas.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Sod grower's certification of grass species and location of sources.
- B. Certification of the fertilizer analysis.
- C. Written instructions recommending procedures for maintenance of sodded lawns, prior to final acceptance of sod.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Harvest, deliver, and transplant sod within a period of 24 hours unless a suitable preservation method is approved by the Engineer prior to delivery.
- B. Do not harvest or transport sod when moisture content may adversely affect sod survival.
- C. Protect sod that cannot be placed immediately on delivery from sun, wind, dehydration, and rain prior to installation.
- D. Sod showing visible signs of heating or dehydration will be rejected.
- E. Do not tear, stretch, or drop sod during handling and installation.
- F. Deliver fertilizer to the site in original, unopened, and non-damaged containers, each bearing the manufacturer's guaranteed analysis.
- G. Store packaged materials off the ground and protect from moisture and deterioration.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Notify the Engineer at least 3 calendar days prior to start of sodding operations.
- B. Perform sod installation after planting and other work affecting ground surface has been completed, or as approved by Engineer.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Sod:**

- 1. Measurement:** Measurement will be in squares, each square containing 100 square feet of sod.
- 2. Payment:** Payment will be at the unit price per square of sod.
- 3. Includes:** Unit price includes, but is not limited to, preparation of sod and sodbed, stakes, fertilizing, watering, maintenance, and clean up. Also includes any necessary sod replacements during maintenance period.

PART 2 - PRODUCTS**2.01 SOD**

- A. Provide a well-established (no less than 12 months old), well rooted, healthy, nursery-grown sod blend of improved Kentucky Bluegrass with a uniform color, leaf texture, density, and varieties consisting of a minimum of two and no more than four cultivars selected from the following list:

Allowed Kentucky Bluegrass Cultivars:

4-Seasons	Bluenote	NuBlue
Arrowhead	Concerto	NuGlade
Award	Everest	Prosperity
Bewitched	Impact	Ridgeline
Beyond	Jackpot	Rubicon
Blue Chip Plus	Liberator	Rugby II
Blue Devil	Midnight	Skye
Blueberry		

- B. Sod grown in peat bedded soil will not be accepted.
- C. Ensure sod is free from objectionable grasses and broadleaf weeds, roots of trees or shrubs, stones, thatch, and other objectionable materials, nematodes and soil-born insects, and free from disease. Sod will be considered free of weeds if less than two such plants are found per 100 square feet of area.
- D. Mow at a height of 2 inches prior to cutting.
- E. Cut sod with a sod machine in strips of uniform width and length, with square ends. Cut to a uniform soil thickness of approximately 1/2 inch to 1 inch; thickness measurement excludes top growth.
- F. Ensure sod is moist when placed.

2.02 FERTILIZER

Comply with [Iowa DOT Article 4169.03](#).

2.03 STAKES

- A. Softwood Stakes:** 3/4 inch diameter and 8 inches long.
- B. Steel Pins:** Tee shaped with a 4 inch head and 8 inch leg.

2.04 WATER

Unless otherwise specified in the contract documents, provide water and watering equipment such as hoses and sprinklers. Provide water free of substances harmful to plant growth.

PART 3 - EXECUTION**3.01 PREPARATION OF SODBED**

- A. Limit preparation to areas that will be immediately sodded.
- B. Where weed growth has developed, remove all weeds and weed debris.
- C. Shape and fine grade sodbed to remove washes or gullies, water pockets, and irregularities. Provide an even surface, true to grade and cross-section.
- D. Rototill and cultivate sodbed to a fine and mellow condition to a minimum depth of 3 inches. Clear the top 3 inches of soil lumps, stones over 3/4 inch, and foreign material using hand labor as required.

3.02 FERTILIZING - FIRST APPLICATION

- A. Provide a guaranteed analysis of 20-26-6 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) by weight at the rate of 200 pounds per acre.
- B. Incorporate fertilizer into soil to a depth of 1 1/2 inches prior to placing sod.

3.03 SOD INSTALLATION

- A. Do not install sod between the dates of June 15 and August 15, unless authorized by the Engineer.
- B. Do not lay frozen sod; do not lay sod on frozen soil or when freezing conditions are forecasted within 24 hours.
- C. Dampen dry soil prior to placing sod.
- D. Firm or heal in soil along the edges of the sodded areas.
- E. Carefully place sod in rows or strips evenly, with the longest edge parallel to the finished contours, and at right angles to the centerline of ditches and channels. On slopes, begin placing sod at the bottom and progress upward.
- F. Minimize traffic on newly laid sod during installation. Provide plank or wood sheets to protect sod already laid from equipment and vehicles.
- G. Tightly fit each strip against each other without voids. Do not overlap edges. Stagger joints at the ends of sod strips with adjacent strips of sod.
- H. Finish sod edges at walks, curbs, planting, mulch edges, and other vertical surface by cutting and fitting tightly to edge.
- I. Place sod mat approximately 1 inch below finished surface of walks, pavement, curbs, or other permanent features. Remove any sod not conforming to this requirement, adjust the subgrade, and re-lay the sod.
- J. Where new sod joins existing lawns, cut straight and neatly into existing lawn and level subgrade to match height.
- K. Stake sod on grades exceeding 4:1 and in drainage channels. Stake each roll at 2 foot intervals or as required to prevent movement during rainfall and stormwater runoff events.
- L. Roll lightly-watered sod with a small mechanical or hand sod roller to sufficiently set or heal sod into soil and remove lumps. Roll as required to firm and level the sodded areas.

3.04 WATERING

- A. Water sod within 1 hour of placement. During initial watering, thoroughly wet sod and sodbed.
- B. Water all sodded areas during the maintenance period as necessary to maintain sod and soil moisture, supplement rainfall, promote growth and proper rooting, ensure sod survival, and prevent dormancy. As a guideline, watering of sod should provide a minimum of the following:
 - 1. Week 1: 1/4 inch per day
 - 2. Week 2: 1/4 inch every other day
 - 3. Week 3: 1/4 inch every third day
 - 4. Week 4: 1/4 inch every fourth day
- C. Actual watering quantities depend upon weather conditions during the maintenance period. Ensure waterings are sufficient to thoroughly saturate sod, sodbed, and adjacent disturbed areas to a depth of approximately 4 inches.
- D. Apply water uniformly and consistently on all sodded areas to prevent damage to sod, trees, and shrubs.

3.05 FERTILIZING - SECOND APPLICATION

Apply second application of fertilizer with a guaranteed analysis of 10-10-10 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) at the rate of 300 pounds per acre 3 weeks after laying sod and prior to final acceptance.

3.06 MAINTENANCE

- A. Begin maintenance immediately following installation of sod and continue for a period until the sod is well established with sod rooted in place. The maintenance period will be for 30 days.
- B. Maintenance of sodded areas includes:
 - 1. Watering.
 - 2. Weeding.
 - 3. Mowing. Each time sod has grown to a height between 3 and 4 inches, mow to a 2 to 2 1/2 inch height.
 - 4. Remove and replace sodded areas that fail to survive.

3.07 CLEAN UP

- A. Remove all excess materials, debris, and equipment from site.
- B. Clean all paved surfaces.
- C. Repair any damage resulting from sodding operations.

3.08 ACCEPTANCE

- A. Sod acceptance will be based on the following criteria:
1. All requirements for the completed installation and maintenance have been met.
 2. Sodded areas are healthy and even-colored, and a viable lawn is established, free from weeds, undesirable grass species, disease, and insects.
 3. Sod is knit down to the soil so that it cannot be pulled up.
 4. Sodded areas are without scattered bare spots and dead or dormant sod.
 5. Clean up operations are completed.
- B. Replacement sod work will be re-inspected before acceptance.

END OF SECTION

PLANT MATERIAL AND PLANTING**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Plant Material and Planting
- B. Tree Drainage Wells
- C. Warranty for Plant Material

1.02 DESCRIPTION OF WORK

- A. Furnishing, preparing, and installing plant material.
- B. Constructing tree drainage wells.
- C. Maintaining and replacing plants for completed planting work.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Submit copy of current certification that the Supplier is an Iowa Department of Agriculture and Land Stewardship Certified Nursery Dealer or Grower prior to starting work.
- B. Prior to final acceptance, submit written maintenance instructions recommending procedures for maintenance of all plant material types, including watering, insect and disease control, fertilizing, pruning, tree protection, and staking.
- C. When requested, provide certification stating container-grown material has been grown in the container for no less than 1 year.
- D. Provide a sample of the proposed mulch for approval by the Engineer.
- E. When requested, submit a schedule of unit prices for each size and variety of tree, shrub, and ground cover plant specified in the contract documents.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Where evidence is submitted that a specified plant cannot be obtained, substitution may be made upon approval of the Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Protect plant root systems during transportation and storage, as necessary, with wet straw, moss, or other suitable material that will ensure root systems are maintained in a moist, healthy condition.
- B. Protect all plants with a tarpaulin when being transported in an open vehicle.
- C. When approved by the Engineer, temporary storage of plants on the project site may be allowed. When temporary on-site storage is not approved, provide such facilities and location at no additional cost to the Contracting Authority.

1.05 DELIVERY, STORAGE, AND HANDLING (Continued)

- D. During temporary storage, heel-in plants and maintain them by providing moist straw, moss, or other suitable material to protect root systems; watering; and protecting from excessive sun, wind, and inclement weather conditions.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Comply with the optimum planting dates specified in Section 9030, 3.01.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Plants, By Count:**

1. **Measurement:** Each tree, shrub, or ground cover plant accepted in place will be counted.
2. **Payment:** Payment will be at the unit price for each tree, shrub, or ground cover plant. Payment will be made in increments according to the following schedule:
 - a. 70% of unit price at acceptance.
 - b. 30% of unit price at end of 1 year establishment period, upon installation of replacements.
3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

B. Plants, By Count, With Warranty:

1. **Measurement:** Each tree, shrub, or ground cover plant accepted in place will be counted.
2. **Payment:** Payment will be at the unit price for each tree, shrub, or ground cover plant. Payment will be made in increments according to the following schedule:
 - a. 70% of unit price at acceptance.
 - b. 15% of unit price at end of 1-year establishment period, upon installation of replacements.
 - c. 15% of unit price at end of 2-year warranty period, upon installation of replacements.
3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty periods; and replacements.

1.08 MEASUREMENT AND PAYMENT (Continued)**C. Plants, Lump Sum:**

1. **Measurement:** Lump sum item; no measurement will be made.
2. **Payment:** Payment will be at the lump sum price for plants. Payment will be made in increments according to the following schedule:
 - a. 70% of lump sum price at acceptance.
 - b. 30% of lump sum price at end of 1 year establishment period, upon installation of replacements.
3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

D. Plants, Lump Sum, With Warranty:

1. **Measurement:** Lump sum item; no measurement will be made.
2. **Payment:** Payment will be at the lump sum price for plants. Payment will be made in increments according to the following schedule:
 - a. 70% of lump sum price at acceptance.
 - b. 15% of lump sum price at end of 1 year establishment period, upon installation of replacements.
 - c. 15% of lump sum price at end of 2 year warranty period, upon installation of replacements.
3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty period; and replacements.

E. Tree Drainage Wells:

1. **Measurement:** Each tree drainage well will be counted.
2. **Payment:** Payment will be at the unit price for each tree drainage well.
3. **Includes:** Unit price includes, but is not limited to, excavation, furnishing and placing rock, engineering fabric, and placing backfill material.

PART 2 - PRODUCTS**2.01 PLANT MATERIALS****A. General:**

1. Ensure plant material meets the minimum requirements of size and grade as stated in the latest edition of American Standard for Nursery Stock, ANSI Z60.1.
2. Provide all plants true to name and tagged legibly as to name according to nursery standards of practice as recommended by the American Nursery and Landscape Association. Plant names indicated comply with the latest edition of "Standardized Plant Names" as adopted by the American Joint Committee of Horticultural Nomenclature.
3. Plants larger than those specified in the plant list with corresponding root system may be used upon approval of the Engineer.
4. Match plants planted in rows in form and size, unless otherwise specified in the contract documents.

B. Plant Material Quality:

1. Provide nursery plants suitable to and grown in the same USDA Plant Hardiness Zone as the project location.
2. One-sided branching plants from tightly planted nursery rows will be rejected.
3. Provide healthy specimens without objectionable deformities, voids, and open spaces, with well-developed branch and root systems. Ensure specimens are true to height, shape, and character of growth of the species or varieties. Provide plants showing appearance of good health and vigor.
4. Provide plants free of the following:
 - a. Harmful insects, insect eggs, borers, and all forms of infestation
 - b. Plant diseases and moldy or dried roots
 - c. Damage to trunk, bark, branches, leaders, root systems, or cut-leaders
 - d. Defects, disfiguring knots, sunscald injuries, and frost cracks
 - e. Rodent damage to bark and buds
5. Plants with broken or cut back terminal leaders or with circling roots may be rejected.

C. Balled and Burlapped Plants:

1. Provide firm, moist, unbroken root balls of the specified size.
2. Broken or loose root balls will be rejected.
3. No manufactured or artificially produced or mudded-in root balls will be accepted.
4. A container grown plant, in lieu of a balled and burlapped root ball, will be accepted provided it meets the specified size, species, complies with American Standard for Nursery Stock, ANSI Z60.1, and meets criteria for container grown plants.

D. Container Grown Plants:

1. Grow plants in sufficiently sized container for a minimum of 1 year, with a root system developed to hold its soil together, firm, whole, and moist when taken from the container.

2.01 PLANT MATERIALS (Continued)

2. No loose root systems in the container, root-bound, or circling of the root system will be accepted (ANSI Z60.1).
3. Containers with holes, shaping, or made of fabric as a means of preventing root growth from reaching the sides of the container, or pruning, or training roots to grow laterally rather than encircling the container are acceptable (ANSI Z60.1).

E. Bare Root Plants:

1. Only use where specified in the contract documents or as approved by Engineer.
2. Ensure plants have substantially all of the root system intact, with clean cuts on roots. Root system is to be packed in moisture-retaining material and bagged to protect the root system from drying out.
3. Prior to planting, properly prune and sweat according to the nursery source instructions.
4. Ensure plants are dormant or breaking bud if sweated at the time of planting.
5. Do not plant later than May 15.

2.02 MULCH

Provide hardwood or softwood mulch complying with the following:

- A. Shredded bark and shredded wood mixture containing no more than 50% wood chips.
- B. Produced by a mechanical debarker and chipping machine.
- C. Reasonably free from leaves, twigs, dust, toxic substances, and any other foreign material.
- D. Not in an excessively wet or decomposed condition.

2.03 BACKFILL MATERIAL

- A. Retain backfill material for plantings from soil excavated from the planting pit.
- B. Ensure backfill material is loose, friable, and free of clods, sod, vegetation, and rocks 2 inches in diameter or larger. Do not use frozen or muddy soil as backfill material.

2.04 STAKING MATERIAL

- A. **Stakes:** Comply with [Iowa DOT Article 4154.09](#). Minimum length of 6 feet.
- B. **Trunk Support Strapping:**
 1. Breathable, flexible strap material or arbor tie or other material approved by the Engineer.
 2. Provide strapping material of adequate length to prevent restriction of trunk, branches, or stems and contact of staking or guying wire with tree trunk.
- C. **Wire:** Provide minimum 17 gauge, rust inhibitive wire to resist breaking during high winds and natural weathering conditions.

2.04 STAKING MATERIAL (Continued)

D. Manufactured Staking System: Upon approval of the Engineer, manufactured staking systems may be used in lieu of stakes, wire, and trunk support strapping.

2.05 GUYING MATERIAL**A. Earth Anchors:**

1. Steel auger type with looped end; minimum 3/4 inch diameter, 36 inch long anchor shank, with 5 inch minimum diameter anchor disk.
2. Driven style earth anchors with a minimum 1,000 pound capacity in normal soils.

B. Trunk Support Strapping: Comply with Section 9030, 2.04, B.

C. Cable: 1/8 inch galvanized wire rope or equivalent cable with a minimum 1,500 pound capacity. Provide cable with ends clean and unfrayed.

D. Cable Clamps: Match size and strength of cable. Provide two for each end of cable.

E. Flagging Material: Brightly colored, minimum 12 square inches.

2.06 TREE PROTECTION

Install a correctly fitted mesh (corrugated or vinyl plastic) or corrugated or crepe paper, specifically manufactured for tree trunk protection, having qualities to resist insect infestation and to allow free air flow to trunk tissues, or similar material approved by the Engineer.

2.07 WATER

Provide water and watering equipment such as hoses, tanks, reels, bags or bladders, mobile equipment, nozzles, and sprinklers for the purpose of regular watering activities during the establishment period. Provide water free of substances harmful to plant growth. No fertilizers, pesticides, or growth regulators will be used in the water.

2.08 TREE DRAINAGE WELLS

A. Porous Backfill Material: Comply with [Iowa DOT Section 4131](#).

B. Engineering Fabric: Comply with [Iowa DOT Article 4196.01](#).

2.09 HERBICIDE

Provide a granular pre-emergent herbicide as approved by the Engineer.

PART 3 - EXECUTION**3.01 ALLOWABLE PLANTING DATES**

Install plant material during the following times:

- A. Evergreen Plants:** September 1 to September 30 and March 1 to April 30, but not after candles exceed 1 inch.
- B. Deciduous Plants (Balled and Burlapped and Container):** October 1 to November 30 and March 1 to May 15.
- C. Deciduous Plants (Bare Root):** In the spring prior to May 15.
- D. Weather Restrictions:** Planting may be conducted under unseasonable conditions, except in weather below 32°F or above 90°F. No variance from plant warranty or other requirements will be given for plants installed outside the specified periods.

3.02 PREPARATION

- A. Provide notice to the Engineer 3 days prior to planting.
- B. All plants will be inspected by the Engineer prior to planting. Plants may be inspected and approved at the place of growth by the Engineer for compliance with the specifications for quality, size, and variety. Such approval does not waive the right to reject any plant material after it has been delivered to the site and/or installed.
- C. Provide barriers or fencing as approved by Engineer to protect the public from injury when planting installation is within the right-of-way.

3.03 LOCATION OF PLANTS

- A. Mark the location of all plants with flags or lathe according to the contract documents. Mark trees individually. Stake the outline of bedded plants or shrub groups for the quantity on the plans without marking individual plants. The Engineer will approve the locations marked prior to excavation of planting pits.
- B. Make field adjustments in plant locations where underground or overhead obstruction is encountered, or where changes have been made as approved by the Engineer.

3.04 EXCAVATION OF PLANTING PIT

- A. Excavate the plant pit, centered at the location marks, cylindrical in shape with a diameter 3 times larger than ball or root condition, with sloped sides and flat bottom. Excavate plant pit to a depth to match the nursery grade of the root flare for all balled and container root systems with well-draining soils. Do not over excavate the pit for container or balled and burlapped plants. Excavate plant pit to a depth 6 inches deeper for bare-rooted systems.
- B. Scarify sides of excavated pit.
- C. If specified, following excavation of planting pit for all trees, fill the pit full of water; allow to stand (without adding water) for an 18 hour period to determine porosity of the soil.
- D. If the soils are too impervious, provide a tree drainage well per [Figure 9030.103](#) or plant 2 to 3 inches above the surrounding grade, per [Figure 9030.101](#), as directed by the Engineer.

3.05 TREE DRAINAGE WELLS

Install drainage wells when specified in the contract documents or when directed by the Engineer due to the presence of impervious soils.

- A. Locate the drainage well at the edge of the excavated planting pit.
- B. Auger an 8 inch to 12 inch diameter hole to existing pervious soil or to a maximum depth of 10 feet. If pervious soil is encountered, extend hole a minimum of 12 inches into the pervious layer.
- C. Fill the excavated hole with porous backfill material and cover the aggregate with engineering fabric.
- D. Following completion of drainage well, fill the pit full of water; allow to stand for an 18 hour period to verify sufficient drainage exists. The Engineer will determine if the drainage is sufficient.

3.06 PLANTING**A. Bare Root Plants:**

- 1. Remove all ties, ribbons, wrap, and other items except plant identification from the branch system.
- 2. Remove all root packing and prune broken roots to sound wood with clean cuts.
- 3. Build a firm cone-shaped mound of soil in the middle of the planting pit.
- 4. Place the plant centered, upright, plumb, and with desired orientation in the planting pit, with the root flare matching existing grade.
- 5. Spread and arrange roots in their natural position laterally away from the central trunk to prevent kinking or circling. Do not fold, crimp, or mat roots together.
- 6. Carefully place backfill material in layers, filling all voids and avoiding injury to the root system until two thirds of the planting pit is complete; fill the pit with water and allow the soil to settle.
- 7. Continue placing backfill material up to grade level. Water in the tree. Allow water to completely soak into soil.

B. Balled and Burlapped and Container Plants:

- 1. Ensure root systems are moist at the time of planting.
- 2. Remove all ties and wrap from branch system, except plant identification.
- 3. Container Plants:
 - a. Remove plant root system carefully from container prior to planting without disturbance to root systems.
 - b. Inspect root system and cut any circled (girdled) roots.
 - c. Place plants centered, upright, plumb, and with desired orientation in planting pit with the root flare matching existing grade.

3.06 PLANTING (Continued)

4. Balled and Burlapped Plants:
 - a. Place plants centered, upright, plumb, and with desired orientation in planting pit with the root flare at or slightly above existing grade or 2 to 3 inches above grade if in compacted clay or poorly drained soils.
 - b. After plant placement, cut and remove the top 1/2 of the wire, burlap, and twine from root ball
5. Carefully place and lightly tamp a small amount of backfill material around the root ball base to stabilize the root ball.
6. Place loose excavated soil 2/3 of the depth of the planting pit. Water in the tree. Allow water to completely soak into soil.
7. Continue placing backfill material up to grade level. Lightly tamp but do not compact the soil around the plant. Water in a second time.
8. If specified, rototill soil in a 4 foot radius around the planting pit to break up compacted soil.

C. Planting on Slopes:

1. Place the top of the root flare at or slightly above the finished grade at the center of the planting pit.
2. For all plants planted on significant slope, form a saucer as a dam or shoulder on the downhill side to catch and hold water and to discourage erosion.

3.07 WATERING

- A. Water each plant immediately after planting.
- B. Water plants a minimum of 10 to 15 gallons per plant per week when less than 1 inch of precipitation is received in the immediate location. Apply sufficient water to soak the plant's root zone. Follow this watering procedure throughout the establishment period.

3.08 MULCHING

- A. Dig edges of mulched areas to ensure the top of the mulch at the edge of the planting area matches the existing ground surface.
- B. Place mulch 3 inches deep in the planting saucer within 2 calendar days of planting.
- C. Mulch an area around tree trunks and shrub branch lines a minimum of 6 inches larger than the tree canopy.
- D. Provide a continuous mulch area around plant groupings.
- E. Following mulch placement, pull mulch back 6 inches from the base of all trees and shrubs to allow air circulation.

3.09 TREE PROTECTION

- A. When specified in the contract documents, or when directed by the Engineer, protect the trunk of deciduous trees in the fall of the year in which the tree is planted.
- B. Inspect the trunk for injuries and evidence of insect infestation prior to wrapping.
- C. Protect trunk from the ground line to the height of the first branch. If plant has multiple stems, cover each stem separately.
- D. Remove tree protection by April 1 of the next spring.

3.10 STAKING AND GUYING**A. General:**

- 1. Maintain all plants in an upright and plumb condition.
- 2. Complete staking or guying by the end of the day in which they were installed for all single stem plants over 1 inch diameter.
- 3. Do not stake clump form plants and plants in paved pedestrian areas unless approved by the Engineer.

B. Staking:

- 1. Provide two stakes for each tree for trees 2 1/2 inches in diameter and smaller. Place one of the stakes on the southwest side of the tree, or as directed by the Engineer, and place the second stake directly opposite the first.
- 2. Provide three stakes for each tree for trees 2 1/2 to 4 inches in diameter. Locate one stake on the southwest side of the tree with remaining stakes equally spaced around the tree.
- 3. Locate stakes uniformly from the trunk of the tree at a distance equal to 1/4 to 1/3 of the height of the tree, or 2 feet minimum. Place stakes outside of the planting pit and within the mulch area.
- 4. Set posts vertically into unexcavated soil at a minimum 2 foot depth or until firm, providing a required post height above grade.
- 5. Attach wire with trunk protection to trunk at a minimum of 4 feet above grade or between one half and two thirds distance from finished grade to the top of the tree with slight slack in wire to allow for tree movement.
- 6. Secure wire to stakes at 6 inches from the top of the stake; mark all wire with flagging material.
- 7. Install manufactured staking system according to manufacturer's published recommendations.

3.10 STAKING AND GUYING (Continued)**C. Guying:**

1. Provide three earth anchors and cables for evergreen trees 10 feet and taller and deciduous trees over 4 inches in diameter. Locate one anchor on the southwest side of the tree with remaining anchors equally spaced.
2. Locate the anchor a distance from the trunk equal to 1/3 of the tree height.
3. Attach the cable with a trunk protector to the trunk between 1/3 and 1/2 of the tree height, or near the lowest main branches for deciduous trees.
4. Screw an auger style anchor into unexcavated soil until only the looped top is exposed. Install driven style anchors a minimum of 2 1/2 feet into the soil.
5. Secure cable to anchor with slight slack in cable; mark all anchor cables with flagging material.
6. Install manufactured staking system according to the manufacturer's published recommendations.

D. Removal: Remove all staking and anchoring materials from all plants at the end of the 1 year establishment period and remove from site.

3.11 PRUNING**A. General:**

1. Provide proper and sharp pruning tools to provide a clean cut without injuring the branch collar.
2. Prune in such a manner as to retain the natural shape of the plant. Do not prune the terminal leader of a plant. Leave no protruding stubs, and prune to the closest outward growing bud.
3. Plant materials incorrectly pruned will be rejected.

B. Deciduous Trees:

1. Prune broken, damaged, or otherwise defective branches. Remove all branches that may not develop properly. Also, eliminate narrow crotches or competing leaders.
2. Prune to develop an upright leader that will promote the symmetry of the tree. Prune flowering or specimen trees to develop their natural form.
3. Prune all trees in Class A sidewalks or other paved pedestrian areas to provide a 7 foot height clearance, unless otherwise directed by the Engineer.

C. Evergreen Trees and Shrubs: Remove dead and broken branches.

D. Deciduous Shrubs: Remove dead or irregular branches. Prune to develop their natural form.

3.12 CLEAN UP

- A. Perform cleaning during installation and upon completion of work.
- B. Remove all excess materials, trimmings, branches, soils, debris, and equipment from the site.
- C. Repair any damage resulting from planting operations.
- D. Clean all paved areas with a broom.
- E. Remove all tags and labels from plants following acceptance by the Engineer.

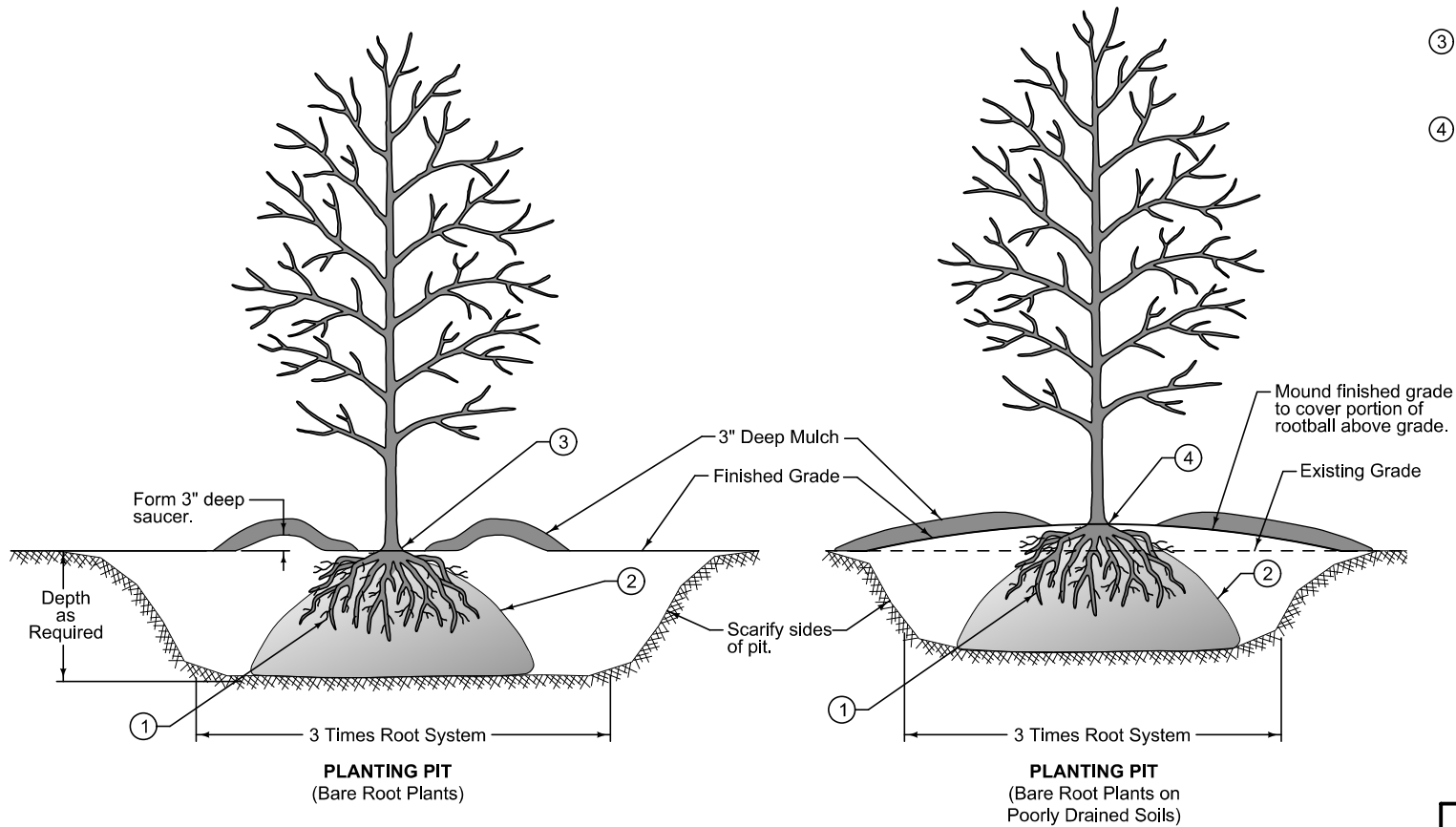
3.13 ESTABLISHMENT AND WARRANTY PERIODS AND ACCEPTANCE

- A. Establishment Period:** The plant establishment period is 1 year after the installation is accepted by the Engineer. A plant inspection will be made by the Engineer prior to the expiration of the establishment period.
- B. Warranty Period:** If a plant warranty is specified in the contract documents, the 1 year warranty period begins immediately after the expiration of the 1 year establishment period. Inspection of plants will be made by Engineer at the end of the 1 year establishment period and again prior to the expiration of the warranty period.
- C. Maintenance:** Care for all plants during the establishment or warranty period as required to keep plants in a live, healthy growing condition.
 - 1. Prune plants to maintain a desirable shape and to remove any dead or broken limbs.
 - 2. Remove weeds and grasses from planting beds and mulch areas. Apply a pre-emergent herbicide to control weed growth when directed by the Engineer.
 - 3. Water as required to enhance early root growth and maintain a moist soil.
 - 4. Adjust stakes and ties to maintain plant in an upright and plumb condition.
 - 5. Re-set settled plants to proper grades and position. Restore planting saucer and mulch; add backfill material and mulch as may be required.
 - 6. Apply appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.
- D. Plant Condition:** Ensure all plants are in a live, healthy, and growing condition both at the date of acceptance of the installation by the Engineer, at the end of the plant establishment period, and at the end of the warranty period.
- E. Replacement:** Replace all plants not found to be in a live, healthy, and growing condition during inspection at the 1 year establishment period and again at the warranty period (if specified) at no additional cost to the Contracting Authority.
 - 1. Upon notice from Engineer, remove rejected plants from the site and replace with plant material of the same species and size as originally specified. Install replacement plants complying with the contract documents.
 - 2. Plants damaged due to fire or flooding beyond the contractors control or ice storms, hail, tornados, or acts of vandalism do not require replacement.

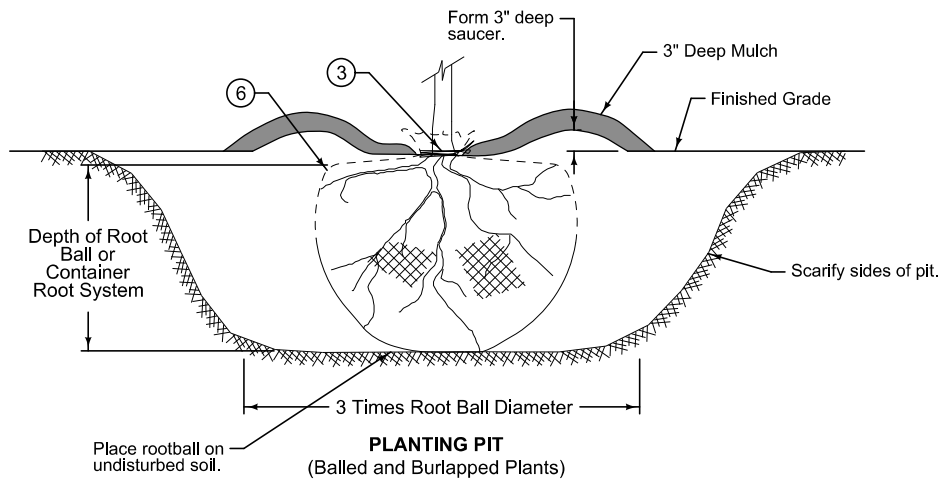
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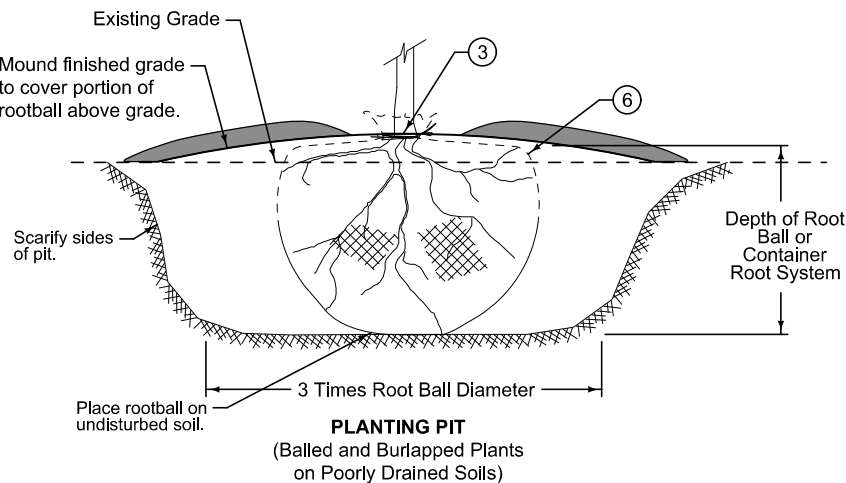
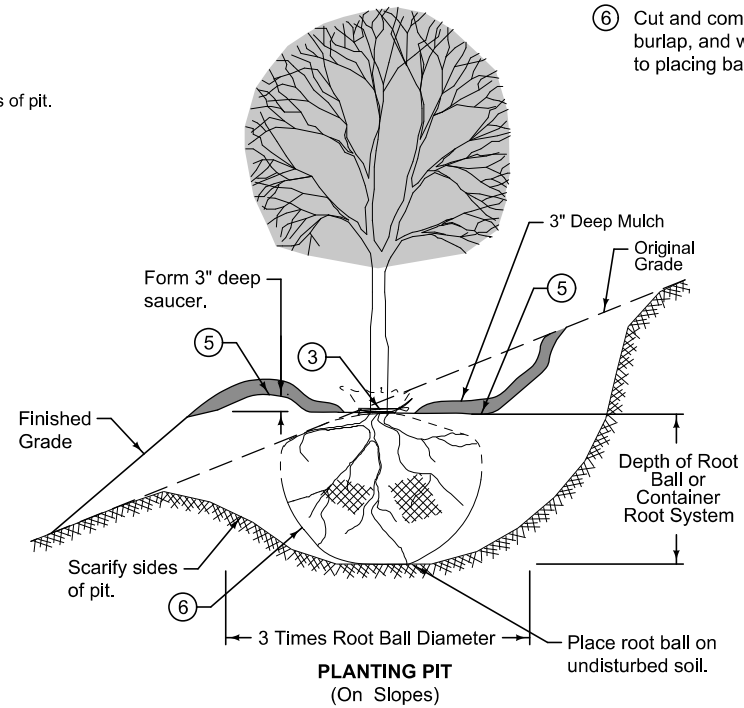
- ① Spread root system in natural position with soil excavated from pit.
- ② Build a firm cone-shaped mound of soil in the middle of the planting pit.
- ③ Install with root flare at or slightly above grade. Do not place mulch within 6 inches of trunk.
- ④ Install root flare 2 to 3 inches above grade. Do not place mulch within 6 inches of trunk.

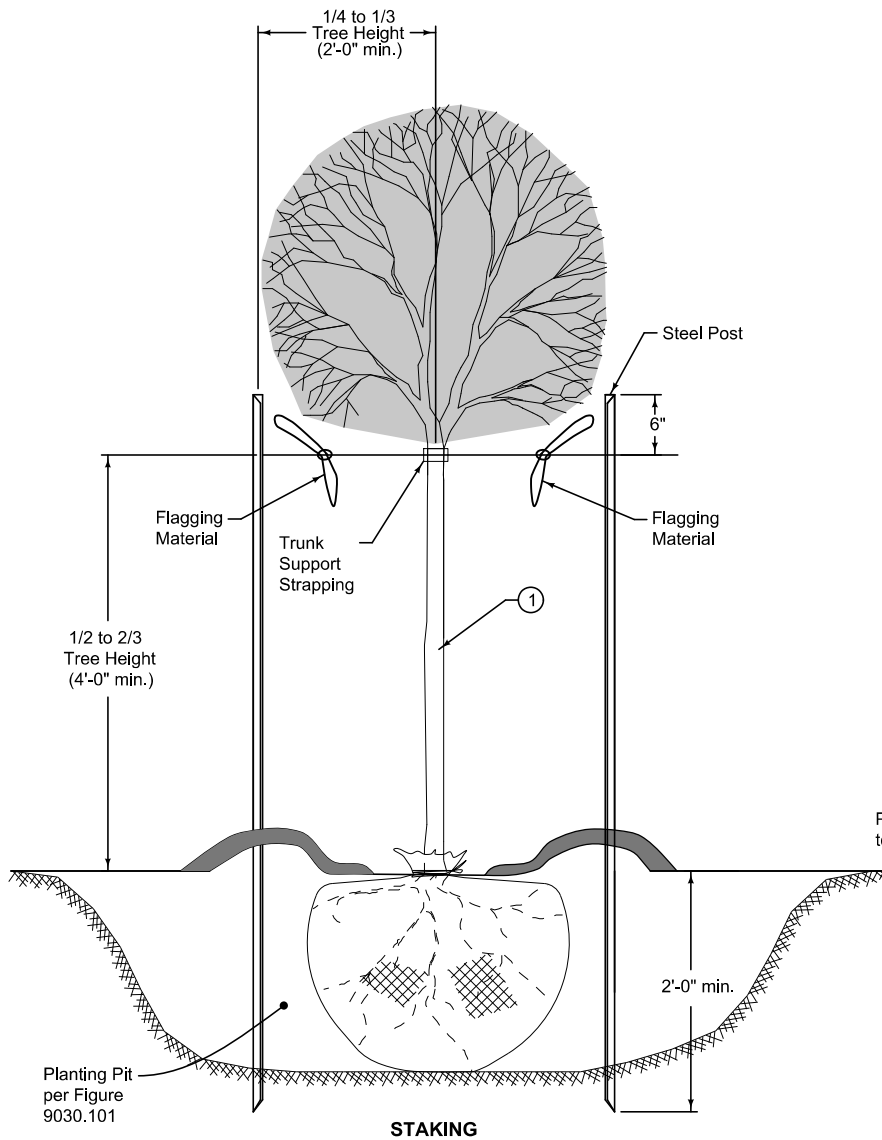


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PLANTING PIT		

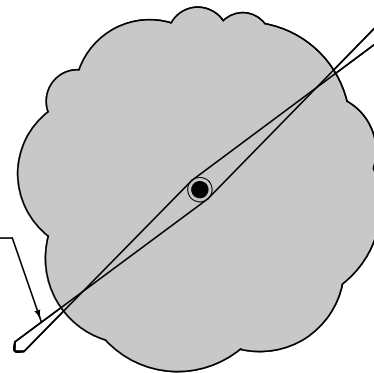


- ③ Install with root flare at or slightly above grade. Do not place mulch within 6 inches of trunk.
- ④ Install root flare 2 to 3 inches above grade. Do not place mulch within 6 inches of trunk.
- ⑤ Begin transition at edge of root ball.
- ⑥ Cut and completely remove top 1/2 of twine, burlap, and wire baskets from root ball prior to placing backfill material.





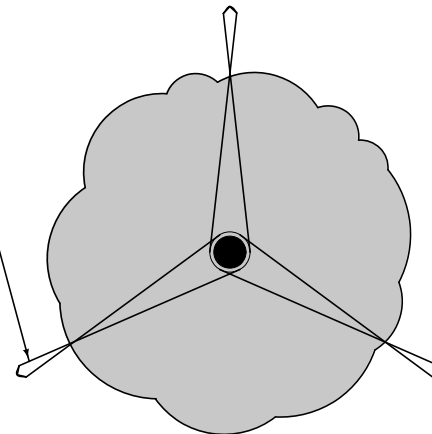
Place one stake to southwest.



STAKING PLAN
(Trees 2 1/2 inch diameter or smaller)



Place one stake to southwest.

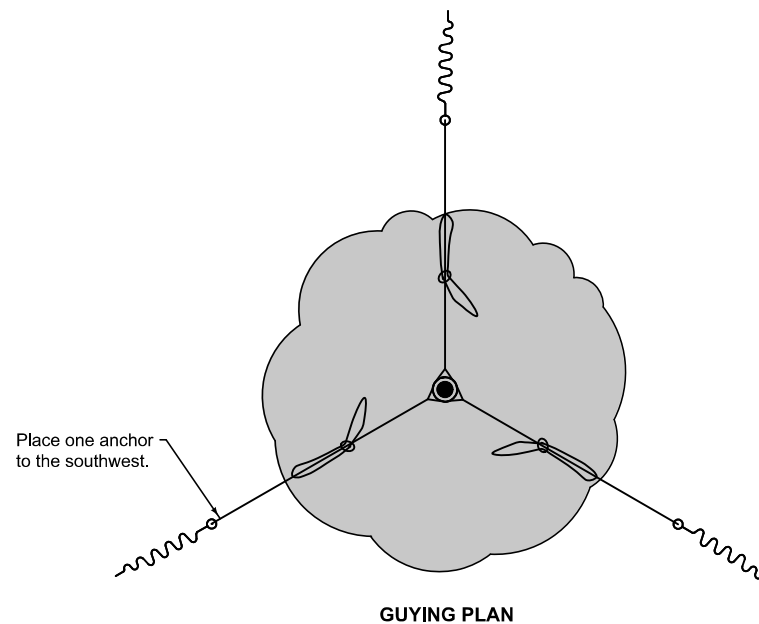
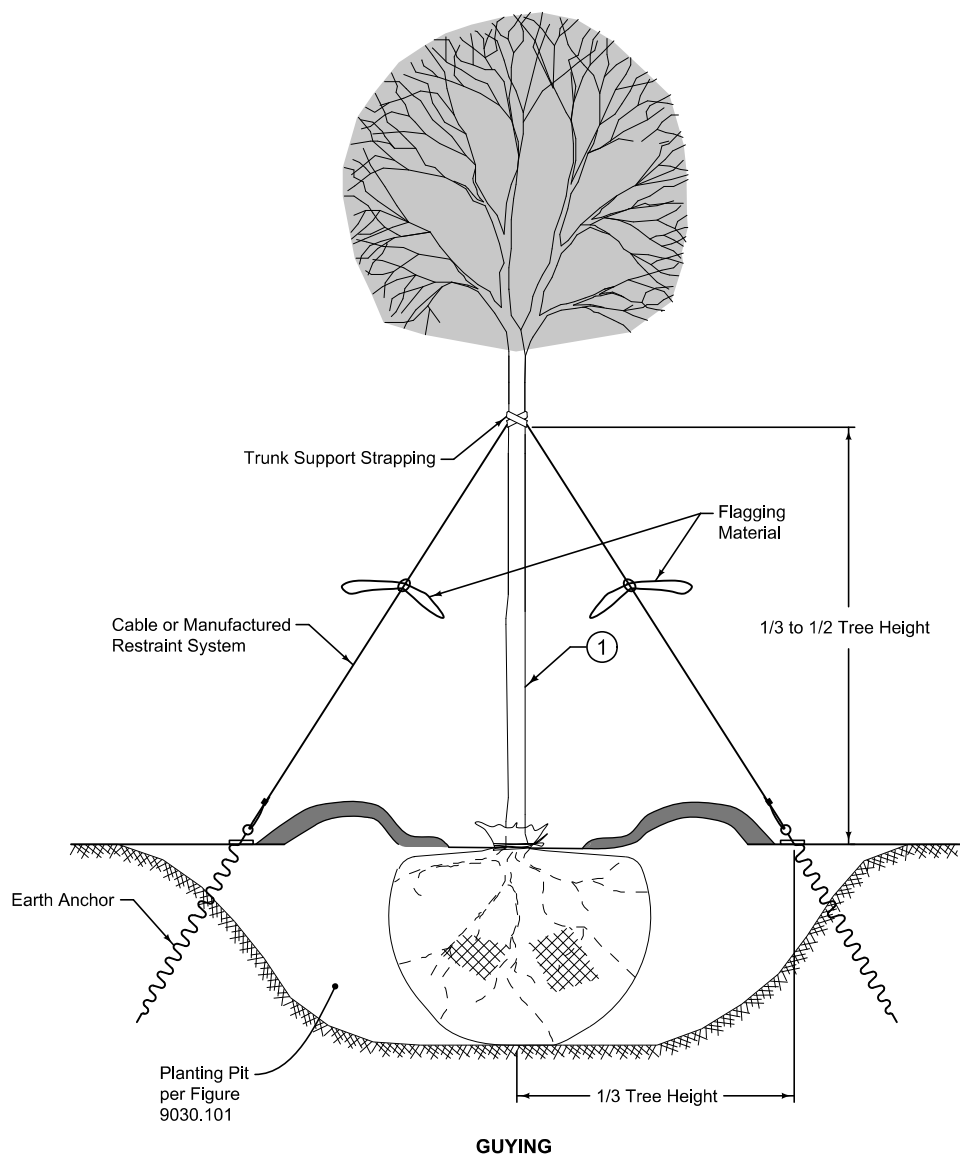


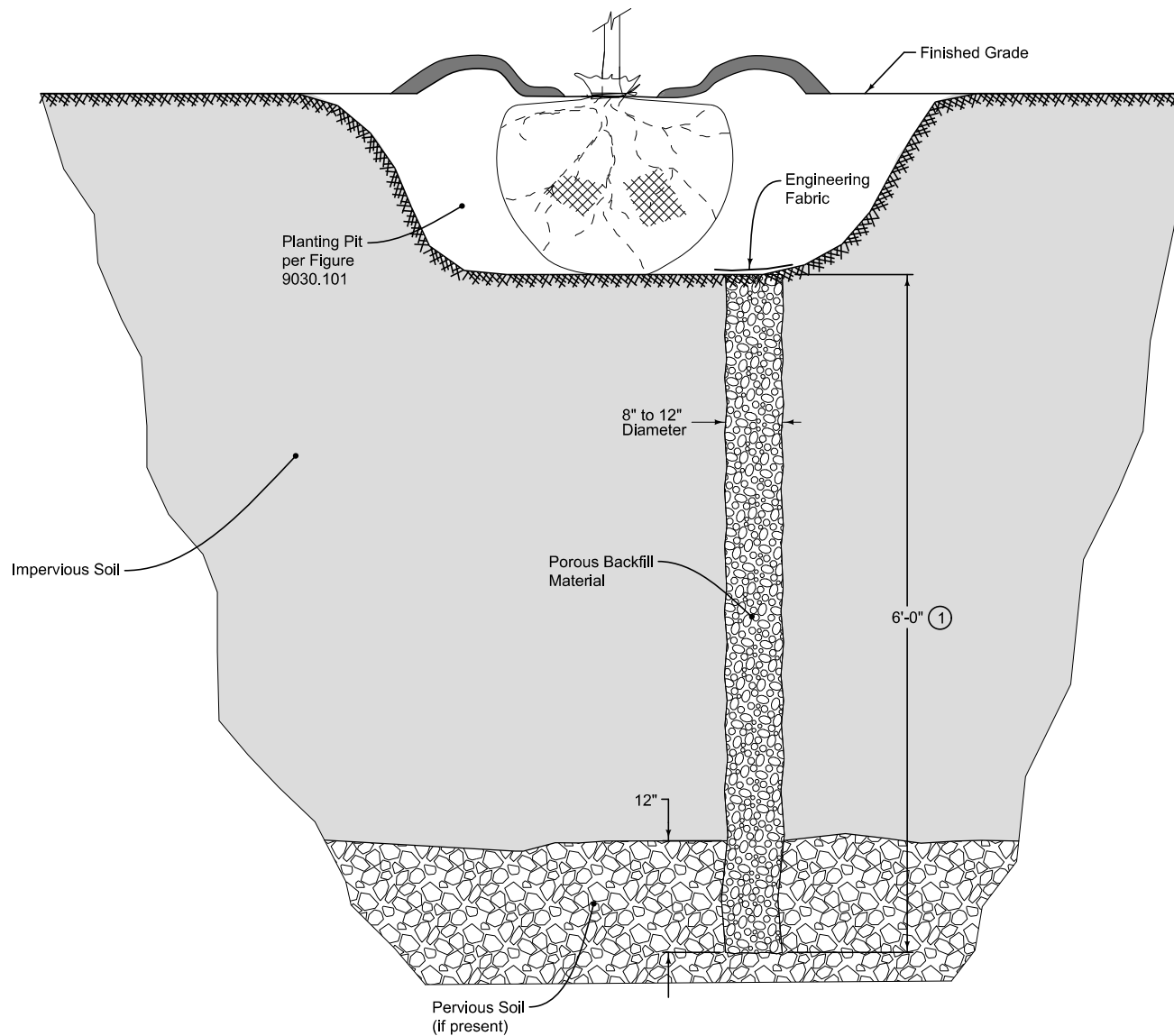
STAKING PLAN
(Trees larger than 2 1/2 inch diameter)

- ① Protect trunk from ground line to first branch when specified in the contract documents.

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TREE STAKING, GUYING, AND WRAPPING		

- ① Protect trunk from ground line to first branch when specified in the contract documents.





- ① If pervious soil is encountered at a depth less than 6 feet, the drainage well may be terminated when the well extends a minimum of 12 inches into the pervious soil layer.

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TREE DRAINAGE WELL		

EROSION AND SEDIMENT CONTROL**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. NPDES General Permit No. 2
- B. Stormwater Pollution Prevention Plan (SWPPP)
- C. Erosion Control Measures
- D. Velocity and Flow Control Measures
- E. Sediment Control Measures
- F. Application/Installation of Measures
- G. Removal/Replacement of Measures

1.02 DESCRIPTION OF WORK

- A. Furnish all materials; install, construct, maintain, and remove specified erosion control devices; at locations specified in the contract documents, or where specified by the Engineer.
- B. Complete the required construction work on this project, while minimizing soil erosion and controlling water pollution. Maintain these features as specified, from initial construction stages to final completion of the project.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Upon request, provide copies of all records and documentation related to compliance with the Iowa DNR NPDES Permit.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Implement erosion and sediment control measures at the appropriate time(s).
- B. Coordinate construction to minimize damage to erosion and sediment control devices.

1.07 SPECIAL REQUIREMENTS**A. Permit:**

1. When applicable, comply with the requirements of the Iowa Department of Natural Resources, *NPDES (National Pollutant Discharge Elimination System) General Permit No. 2 for Stormwater Discharge Associated with Industrial Activity for Construction Activities*, and the Stormwater Pollution Prevention Plan.
2. For projects covered under the Iowa DNR General Permit No. 2, sign on as a co-permittee with the owner and any other contractors or subcontractors.
3. When applicable, comply with the local jurisdiction's permitting requirements.

B. Protection of Property: Prevent accumulation of soil, sediment, or debris from project site onto adjoining public or private property. Remove any accumulation of soil or debris immediately, and take remedial actions for prevention.

C. Permit Compliance: When applicable, conduct all operations in compliance with the Iowa DNR NPDES General Permit No. 2. Labor, equipment, or materials not included as a bid item, but necessary to prevent stormwater contamination from construction related sources, are considered incidental. Incidental work related to compliance with the permit may include, but is not limited to: hazardous materials protection, fuel containment, waste disposal, and providing employee sanitary facilities.

D. Project Staging: Replacing erosion and sediment control practices that are damaged or removed by the contractor in a manner that is inconsistent with the current project staging or SWPPP is the Contractor's responsibility and will be at the Contractor's expense.

1.08 MEASUREMENT AND PAYMENT**A. Stormwater Pollution Prevention Plan (SWPPP):****1. Preparation:**

- a. **Measurement:** Lump sum item; no measurement will be made.
- b. **Payment:** Payment will be at the lump sum price for SWPPP preparation.
- c. **Includes:** Lump sum price includes, but is not limited to, development of a SWPPP by the Contractor meeting local and state agency requirements, filing the required public notices, filing a Notice of Intent for coverage of the project under the Iowa DNR NPDES General Permit No. 2, and payment of associated NPDES permit fees.
- d. **Other:** Item will be paid for upon approval of the SWPPP by the Engineer, and after the Notice of Intent has been filed by the Contractor.

2. Management:

- a. **Measurement:** Lump sum item; no measurement will be made.
- b. **Payment:** Payment will be at the lump sum price for SWPPP management.
- c. **Includes:** Lump sum price includes all work required to comply with the administrative provisions of the Iowa DNR NPDES General Permit No. 2; including record keeping, documentation, updating the SWPPP, filing the Notice of Discontinuation, etc. Item also includes weekly inspections required to satisfy the provisions of General Permit No. 2, unless otherwise specified in the contract documents.
- d. **Does Not Include:** Unit price does not include installation or maintenance of erosion and sediment control practices.
- e. **Other:** The Engineer may make partial payments based on estimates of the project completion. Final payment will be made when the site reaches final stabilization and the Notice of Discontinuation is filed.

1.08 MEASUREMENT AND PAYMENT (Continued)**B. Compost Blankets:**

1. **Measurement:** Measurement will be in square feet for each thickness of compost blanket.
2. **Payment:** Payment will be at the unit price per square foot for each thickness of compost blanket.

C. Filter Berms:

1. **Measurement:** Measurement will be in linear feet for each size of filter berm, measured longitudinally along the top of the berm.
2. **Payment:** Payment will be at the unit price per linear foot for each size of berm.

D. Filter Socks:

1. **Installation:**
 - a. **Measurement:** Measurement will be in linear feet for each size of filter sock.
 - b. **Payment:** Payment will be at the unit price per linear foot for each size of filter sock.
 - c. **Includes:** Unit price includes, but is not limited to, anchoring stakes.
2. **Removal:**
 - a. **Measurement:** Measurement will be in linear feet of filter sock removed.
 - b. **Payment:** Payment will be at the unit price per linear foot of filter sock removed.
 - c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of filter socks and accumulated sediment.

E. Temporary Rolled Erosion Control Products (RECP):

1. **Measurement:** Measurement will be in square yards, based on the width specified in the contract documents and actual measured length, for each type of temporary RECP.
2. **Payment:** Payment will be at the unit price per square yard for each type of temporary RECP.
3. **Includes:** Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

F. Wattles:

1. **Installation:**
 - a. **Measurement:** Measurement will be in linear feet for each type and size of wattle.
 - b. **Payment:** Payment will be at the unit price per linear foot for each type and size of wattle.
 - c. **Includes:** Unit price includes, but is not limited to, anchoring stakes.
2. **Removal:**
 - a. **Measurement:** Measurement will be in linear feet of wattle removed.
 - b. **Payment:** Payment will be at the unit price per linear foot of wattle removed.
 - c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of wattle and accumulated sediment.

1.08 MEASUREMENT AND PAYMENT (Continued)**G. Check Dams:****1. Rock Check Dams:**

- a. Measurement:** Measurement will be in ton of stone installed.
- b. Payment:** Payment will be at the unit price per ton of stone installed.
- c. Includes:** Unit price includes, but is not limited to, engineering fabric.

2. Manufactured Check Dams:**a. Installation:**

- 1) Measurement:** Measurement will be in linear feet for each type and size of manufactured check dam.
- 2) Payment:** Payment will be at the unit price per linear foot for each type and size of manufactured check dam.
- 3) Includes:** Unit price includes, but is not limited to, anchoring stakes.

b. Removal:

- 1) Measurement:** Measurement will be in linear feet for each type of manufactured check dam removed.
- 2) Payment:** Payment will be at the unit price per linear foot for each type of manufactured check dam removed.
- 3) Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of manufactured check dam and accumulated sediment.

H. Temporary Earth Diversion Structures:

- 1. Measurement:** Measurement will be in linear feet for each type and size of temporary earth diversion structure.
- 2. Payment:** Payment will be at the unit price per linear foot of temporary earth diversion structure.
- 3. Includes:** Unit price includes, but is not limited to, removal of the structure upon completion of the project.

I. Level Spreaders:

- 1. Measurement:** Measurement will be in linear feet of level spreaders.
- 2. Payment:** Payment will be at the unit price per linear foot of level spreader.
- 3. Includes:** Unit price includes, but is not limited to, maintaining the spreader during the period of construction and removal upon completion of the project, unless otherwise specified in the contract documents.

J. Rip Rap:

- 1. Measurement:** Measurement will be in tons for each type of rip rap.
- 2. Payment:** Payment will be at the unit price per ton of rip rap.
- 3. Includes:** Unit price includes, but is not limited to, engineering fabric.

1.08 MEASUREMENT AND PAYMENT (Continued)**K. Temporary Pipe Slope Drains:**

1. **Measurement:** Measurement will be in linear feet for each type and size of temporary pipe slope drain, measured from end of apron to end of apron.
2. **Payment:** Payment will be at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, excavation, furnishing and installing pipe and pipe aprons, grading, and removal of the slope drain upon completion of the project.

L. Sediment Basin:

1. **Outlet Structure:**
 - a. **Measurement:** Each size of sediment basin outlet structure will be counted.
 - b. **Payment:** Payment will be at the unit price for each sediment basin outlet structure.
 - c. **Includes:** Unit price includes, but is not limited to, concrete base, dewatering device, anti-vortex device, outlet pipe, and anti-seep collars (if specified).
 - d. **Does Not Include:** Unit price does not include earthwork required for construction of the sediment basin.
2. **Removal of Sediment:**
 - a. **Measurement:** Each occurrence of sediment removal will be counted.
 - b. **Payment:** Payment will be at the unit price for each occurrence of sediment removal.
 - c. **Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.
3. **Removal of Outlet Structure:**
 - a. **Measurement:** Each sediment basin outlet structure removed will be counted.
 - b. **Payment:** Payment will be at the unit price for each sediment basin outlet structure removed.
 - c. **Includes:** Unit price includes, but is not limited to, dewatering and off-site disposal of the outlet structure, concrete base, emergency spillway, and accumulated sediment.
 - d. **Does Not Include:** Unit price does not include earthwork required to remove the sediment basin and restoration of the area to finished grade.

M. Sediment Trap Outlet:

1. **Installation:**
 - a. **Measurement:** Measurement will be in tons of crushed stone placed.
 - b. **Payment:** Payment will be at the unit price per ton of crushed stone.
 - c. **Includes:** Unit price includes, but is not limited to, engineering fabric.
 - d. **Does Not Include:** Unit price does not include earthwork required for construction of the sediment trap.
2. **Removal of Sediment:**
 - a. **Measurement:** Each occurrence of sediment removal will be counted.
 - b. **Payment:** Payment will be at the unit price for each occurrence of sediment removal.
 - c. **Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.

1.08 MEASUREMENT AND PAYMENT (Continued)**3. Removal of Device:**

- a. **Measurement:** Each sediment trap outlet removed will be counted.
- b. **Payment:** Payment will be at the unit price for each sediment trap outlet removed.
- c. **Includes:** Unit price includes, but is not limited to, dewatering and off-site disposal of sediment trap outlet and accumulated sediment.
- d. **Does Not Include:** Unit price does not include earthwork required to remove the sediment trap outlet and restoration of the area to finished grade.

N. Silt Fence or Silt Fence Ditch Check:**1. Installation:**

- a. **Measurement:** Measurement will be in linear feet of silt fence or silt fence ditch check.
- b. **Payment:** Payment will be at the unit price per linear foot of silt fence or silt fence ditch check.
- c. **Includes:** Unit price includes, but is not limited to, anchoring posts.

2. Removal of Sediment:

- a. **Measurement:** Measurement will be in linear feet of silt fence or silt fence ditch check.
- b. **Payment:** Payment will be at the unit price per linear foot of silt fence or silt fence ditch check.
- c. **Includes:** Unit price includes, but is not limited to, anchoring posts.

3. Removal of Device:

- a. **Measurement:** Measurement will be in linear feet of silt fence removed.
- b. **Payment:** Payment will be at the unit price per linear foot of silt fence removed.
- c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of fence, posts, and accumulated sediment.

O. Stabilized Construction Entrance:**1. Stabilized Construction Entrance by Square Yard:**

- a. **Measurement:** Measurement will be in square yards of material placed.
- b. **Payment:** Payment will be at the unit price per square yard of material placed.
- c. **Includes:** Unit price includes, but is not limited to, subgrade stabilization fabric.

2. Stabilized Construction Entrance by Ton:

- a. **Measurement:** Measurement will be in tons of material placed.
- b. **Payment:** Payment will be at the unit price per ton of material placed.
- c. **Includes:** Unit price includes, but is not limited to, subgrade stabilization fabric.

P. Dust Control:**1. Water for Dust Control:**

- a. **Measurement:** Measurement will be by metering of water applied to haul roads and other areas to control dust. If metering is not available, measurement will be by counting the loads from a transporting tank of known volume and gauging the contents of the transporting truck for partial loads.
- b. **Payment:** Payment will be at the unit price per 1,000 gallons of water used.
- c. **Includes:** Unit price includes, but is not limited to, furnishing, transporting, and distributing water to the haul road.

2. Dust Control Product:

- a. **Measurement:** Measurement will be in square yards of the treated area.
- b. **Payment:** Payment will be at the unit price per square yard of product applied.

1.08 MEASUREMENT AND PAYMENT (Continued)**Q. Erosion Control Mulching:**

- 1. Conventional Mulching:**
 - a. Measurement:** Measurement will be in acres of conventional mulch.
 - b. Payment:** Payment will be at the unit price per acre of conventional mulch.
- 2. Hydromulching:**
 - a. Measurement:** Measurement will be in acres for each type of hydromulch.
 - b. Payment:** Payment will be at the unit price per acre for each type of hydromulch.

R. Turf Reinforcement Mats (TRM):

- 1. Measurement:** Measurement will be in squares for each type of turf reinforcement mat, each square containing 100 square feet.
- 2. Payment:** Payment will be at the unit price per square for each type of turf reinforcement mat.
- 3. Includes:** Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

S. Surface Roughening:

- 1. Measurement:** Measurement will be in square feet of surface roughening, including directional tracking or grooving/furrowing.
- 2. Payment:** Payment will be at the unit price per square foot of surface roughening.

T. Inlet Protection Device:

- 1. Installation:**
 - a. Measurement:** Each type of inlet protection device will be counted.
 - b. Payment:** Payment will be at the unit price for each inlet protection device.
 - c. Includes:** Unit price includes, but is not limited to, removal of the device upon completion of the project.
- 2. Maintenance:**
 - a. Measurement:** Each inlet protection device maintenance occurrence will be counted.
 - b. Payment:** Payment will be at the unit price for each inlet protection device maintenance occurrence.
 - c. Includes:** Unit price includes, but is not limited to, removal and off-site disposal of accumulated sediment.

U. Flow Transition Mat:

- 1. Measurement:** Measurement will be in square feet of flow transition mat.
- 2. Payment:** Payment will be at the unit price per square foot of flow transition mat.
- 3. Includes:** Unit price includes, but is not limited to, anchoring devices.

V. End of Season Temporary Erosion Control:

- 1. Measurement:** Measurement will be in acres of end of season temporary erosion control applied.
- 2. Payment:** Payment will be at the unit price per acre for end of season temporary erosion control.
- 3. Includes:** Unit price includes, but is not limited to, furnishing, placing, and maintaining the end of season temporary erosion control throughout the winter season.

PART 2 - PRODUCTS**2.01 COMPOST BLANKETS**

Comply with [Section 9010, 2.07, C](#) for compost material requirements for compost blankets.

2.02 COMPOST BLANKET AND FILTER BERM TACKIFIER

- A. Use a biodegradable, organic binding agent or polyacrylamide that can be mixed with, or injected into, compost or filter material as it is placed, which is not detrimental to the establishment of vegetation.
- B. Use in filter berms or compost blankets when specified in the contract documents.
- C. Apply at the rate recommended by the manufacturer.

2.03 FILTER MATERIAL

Material for use in filter socks, filter berms, and other areas, as specified in the contract documents.

- A. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.
- B. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
- C. Use material meeting the following particle sizes:

Sieve Size	Percent Passing ¹
2"	100
1"	90-100
3/8"	0-30

¹The target flow rate of in-place material is 10 gal/min/lf. The Engineer may approve use of alternate materials meeting the target flow rate.

2.04 FILTER SOCK

- A. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 5 mil thickness, photodegradable HDPE.
- B. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 500 denier polypropylene.
- C. Use 1 inch by 2 inch (minimum) hardwood stakes or stakes of equivalent strength.

2.05 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

Use temporary rolled erosion control products that are classified and have material properties according to the Erosion Control Technology Council's (ECTC) guidelines as follows:

A. Material Classification:

- 1. **RECP Type 1 (Ultra Short-term):** Functional longevity of 3 months or less and classified as follows:
 - a. **RECP Type 1.A:** Mulch control net, consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
 - b. **RECP Type 1.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.

2.05 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

- c. **RECP Type 1.C:** Single-net erosion control blankets and open weave textiles, consisting of processed degradable natural and/or polymer fibers, mechanically bound together by a single rapidly-degrading, synthetic or natural fiber netting, or an open weave textile of processed rapidly-degrading natural or polymer yarns or twines woven into a continuous matrix.
 - d. **RECP Type 1.D:** Double-net erosion control blankets, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two rapidly-degrading, synthetic or natural fiber nettings.
- 2. **RECP Type 2 (Short-term):** Functional longevity between 3 and 12 months and classified as follows:
 - a. **RECP Type 2.A:** Mulch control net, consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
 - b. **RECP Type 2.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
 - c. **RECP Type 2.C:** Single-net erosion control blankets and open weave textiles, consisting of an erosion control blanket composed of processed degradable natural or polymer fibers, mechanically bound together by a single degradable synthetic or natural fiber netting to form a continuous matrix, or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.
 - d. **RECP Type 2.D:** Double-net erosion control blanket, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two degradable synthetic or natural fiber nettings.
- 3. **RECP Type 3 (Extended Term):** Functional longevity between 12 and 24 months and classified as follows:
 - a. **RECP Type 3.A:** Mulch control nets, consisting of a slow-degrading synthetic mesh or woven natural fiber netting.
 - b. **RECP Type 3.B:** Erosion control blankets and open weave textiles, consisting of processed slow-degrading natural or polymer fibers, mechanically bound together between two slow-degrading synthetic or natural fiber nettings to form a continuous matrix, or an open weave textile composed of processed slow-degrading natural or polymer yarns or twines woven into a continuous matrix.
- 4. **RECP Type 4 (Long Term):** Functional longevity of 36 months and classified as follows: Erosion control blankets and open weave textiles, consisting of processed slow-degrading natural or polymer fibers, mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix, or an open weave textile composed of processed slow-degrading natural or polymer yarns or twines woven into a continuous matrix.

B. Properties and Performance:

- 1. Testing performed according to the ECTC's Testing Procedures for Rolled Erosion Control Products. Verify manufacturer's test results by independent testing.

2.05 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

2. Material properties meeting the Erosion Control Technology Council's (ECTC) Standard Specifications for Rolled Erosion Control Products as follows:

Classification	Slope Application	Channel Application	Min. Tensile Strength
	Max. Grade*	Permissible Shear Stress	
RECP Type 1.A	5:1 (H:V)	0.25 lb/ft ²	5 lb/ft
RECP Type 1.B	4:1 (H:V)	0.50 lb/ft ²	5 lb/ft
RECP Type 1.C	3:1 (H:V)	1.50 lb/ft ²	50 lb/ft
RECP Type 1.D	2:1 (H:V)	1.75 lb/ft ²	75 lb/ft
RECP Type 2.A	5:1 (H:V)	0.25 lb/ft ²	5 lb/ft
RECP Type 2.B	4:1 (H:V)	0.50 lb/ft ²	5 lb/ft
RECP Type 2.C	3:1 (H:V)	1.50 lb/ft ²	50 lb/ft
RECP Type 2.D	2:1 (H:V)	1.75 lb/ft ²	75 lb/ft
RECP Type 3.A	5:1 (H:V)	0.25 lb/ft ²	25 lb/ft
RECP Type 3.B	1.5:1 (H:V)	2.00 lb/ft ²	100 lb/ft
RECP Type 4	1:1 (H:V)	2.25 lb/ft ²	125 lb/ft

*Product tested according to ECTC Test Method No. 2 and meeting the ECTC Standard Specifications for "C" factor.

- C. RECP Anchors:** Stakes or staples as recommended by manufacturer, with a minimum length of 6 inches.

2.06 WATTLES

- A. Netting:** Open weave, degradable netting. Nominal diameter of 9 inches, or as specified.
- B. Fill Material:** Straw, wood excelsior, coir, or other natural materials approved by the Engineer.
- C. Stakes:** 1 inch by 1 inch (minimum) wooden stakes, or stakes of equivalent strength.

2.07 CHECK DAMS**A. Synthetic Permeable Check Dam (HDPE):**

- 1. Ditch Berm:**
 - a. Installed height of 9 to 10 inches.
 - b. Manufactured check dam constructed from sheets of perforated, UV-stabilized High Density Polyethylene (HDPE).
 - c. Perforations of 30 to 40% open area.
- 2. RECP for Permeable Check Dam (when specified):** RECP Type 4, 4 feet wide.
- 3. Anchors:** As recommended by the manufacturer.

B. Triangular Foam Check Dam: Triangular-shaped device with a height of 8 to 10 inches and a base of 16 to 20 inches.

- 1. Inner Support Material:** Urethane foam.
- 2. Outer Cover:** Woven geotextile material shaped to fit around the inner support material, extending 2 to 3 feet beyond the bottom edge of the triangular-shaped inner support.
- 3. Length:** 7 feet.

2.07 CHECK DAMS (Continued)**C. Rock Check Dam:**

1. **Aggregate:** Erosion stone complying with [Iowa DOT Article 4130.04](#).
2. **Engineering Fabric:** Comply with Section 9040, 2.20.

2.08 LEVEL SPREADERS

- A. Provide 2 inch by 8 inch (minimum) pressure-treated timber of the length specified.
- B. Use timbers that are relatively straight and have a minimum length of 5 feet each.

2.09 RIP RAP

- A. **Class A Revetment:** Comply with [Iowa DOT Section 4130](#).
- B. **Class B Revetment:** Comply with [Iowa DOT Section 4130](#).
- C. **Class D and E Revetment:** Comply with [Iowa DOT Section 4130](#).
- D. **Erosion Stone:** Comply with [Iowa DOT Section 4130](#).

2.10 TEMPORARY PIPE SLOPE DRAINS

- A. PVC, HDPE, and metal pipes as specified in [Section 4020, 2.01](#).
- B. HDPE, Type C (corrugated interior).
- C. All pipes listed are allowed for use within the right-of-way.

2.11 SEDIMENT BASIN OUTLET STRUCTURES

- A. **Base:** Class C concrete unless otherwise specified in the contract documents.
- B. **Riser:** CMP complying with [Section 4020](#); diameter as specified in the contract documents.
- C. **Dewatering Device:**
 1. Drill holes in the riser of the number, diameter, and at the elevation specified in the contract documents.
 2. 1/4 inch by 1/4 inch or 1/2 inch by 1/2 inch wire mesh for hardware cloth.
- D. **Barrel:** CMP complying with [Section 4020](#); diameter as specified in the contract documents.
- E. **Anti-Vortex Device:** CMP complying with [Section 4020](#); diameter according to [Figure 9040.116](#) and riser diameter as specified in the contract documents.
- F. **Anti-Seep Collar:**
 1. Corrugated metal sheet of same material and gage as barrel section.
 2. Size according to [Figure 9040.117](#).

2.12 SEDIMENT TRAPS

- A. Erosion Stone:** Comply with Section 9040, 2.09.
- B. Engineering Fabric:** Comply with Section 9040, 2.20.

2.13 SILT FENCE

- A. Fabric:** Comply with [Iowa DOT Article 4196.01](#).
- B. Posts:** 4 foot minimum steel (T-section) weighing at least 1.25 pounds per foot, exclusive of anchor plate. Painted posts are not required.
- C. Fastener:** Wire or plastic ties with a minimum tensile strength of 50 pounds.

2.14 STABILIZED CONSTRUCTION ENTRANCE

- A. Entrance Stone:** Comply with [Iowa DOT Section 4122](#), Gradation 13, Macadam crushed stone.
- B. Subgrade Stabilization Material:** Use woven, UV-stabilized geotextile with a minimum tensile strength of 135 lb/ft.

2.15 DUST CONTROL

- A. Water:** Use potable water or water from a source approved by the engineer.
- B. Calcium Chloride:** Comply with [Iowa DOT Article 4194.01](#).
- C. Lignosulfonate (Tree Sap):** Use a commercially-available product with known lignin content.
- D. Soapstock (Soybean Oil):**
 - 1. Use a commercially-available, undiluted, soybean oil soapstock emulsion.
 - 2. Comply with manufacturer's recommendations for storage, transportation, temperature, and application equipment requirements.

2.16 EROSION CONTROL MULCH

- A. Conventional Mulch:**
 - 1. Use dry cereal straw (oats, wheat, barley, or rye) or native grass straw.
 - 2. Use material that is free of noxious weeds, seed-bearing stalks, or roots, and will be inspected and approved by the Engineer prior to use.
 - 3. Other materials, subject to the approval of the Engineer, may be used.
- B. Hydromulch:**
 - 1. **Wood Cellulose Mulch:** Comply with [Section 9010, 2.07](#).
 - 2. **Bonded Fiber Matrix (BFM):** Comply with [Section 9010, 2.07](#).
 - 3. **Mechanically Bonded Fiber Matrix (MBFM):** See [Section 9010, 2.07](#).

2.17 TURF REINFORCEMENT MATS (TRM)**A. Material Classification:**

- 1. TRM Type 1:** Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion, or the placement of synthetic fibers between two high-strength, biaxially-oriented nets, mechanically bound by parallel stitching with polyolefin thread. Products may contain a degradable component.
- 2. TRM Type 2 and 3:** Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, monofilaments, or fibers that are entangled or woven to form a strong and dimensionally stable mat. Non-woven bonding methods include polymer welding, thermal or polymer fusion, or the placement of fibers between two high-strength, biaxially oriented nets, mechanically bound by parallel stitching with polyolefin thread. Use only components that are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation.
- 3. TRM Type 4:** Use a high performance/survivability TRM that is composed of monofilament yarns woven into a resilient uniform configuration. Use a mat that has a matrix that exhibits very high interlock and reinforcement capacities with both soil and root systems and demonstrate a high tensile modulus. TRMs manufactured from discontinuous or loosely held together by stitched or glued, netting, or composites are not allowed in this category. Use only components that are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation. Use this category when field conditions exist with high loading and/or high survivability requirements.

B. Properties and Performance: Meet the minimum material and performance requirements contained in the following table:

Property ¹		Test Method	Type 1	Type 2	Type 3	Type 4
Material	Thickness	ASTM D 6525	0.25 in	0.25 in	0.25 in	0.25 in
	Tensile Strength ²	ASTM D 6818	125 lb/ft	240 lb/ft	750 lb/ft	3,000 lb/ft
	UV Resistance ³	ASTM D 4355	80% @ 500 hrs	80% @ 1,000 hrs	80% @ 1,000 hrs	90% @ 3,000 hrs
Performance	Maximum Shear Stress ⁴ (Channel Applications)	ASTM D 6460	7 lb/ft ²	10 lb/ft ²	12 lb/ft ²	15 lb/ft ²
	Maximum Slope Gradient (Slope Applications)	N/A	1:1 (H:V) or flatter	1:1 (H:V) or flatter	1:1 (H:V) or greater	1:1 (H:V) or greater

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

2 Minimum Average Roll Values, machine direction only.

3 Tensile strength of structural components retained after UV exposure.

4 Minimum shear stress that fully-vegetated TRM can sustain without physical damage or excess erosion (0.5 in soil loss) during a 30 minute flow event in large scale testing. Acceptable large scale testing protocol includes ASTM D 6460 or independent testing conducted by the Texas Transportation Institute, Colorado State University, Utah State University, or other approved testing facility. Bench scale testing is not acceptable.

2.18 INLET PROTECTION**A. Drop-in Intake Protection:**

1. Use a manufactured device that is inserted into the intake and is capable of trapping or filtering sediment from runoff prior to entering the storm sewer.
2. All components must be contained entirely below the surface of the intake grate.
3. Incorporate means of emergency outflow to prevent flooding if plugged with sediment.

B. Surface-applied Intake Protection:

1. Use devices or filter socks, placed around or over the intake, that are capable of trapping or filtering sediment from runoff prior to entering the storm sewer.
2. Do not allow the device to completely block or plug the intake, preventing inflow.

2.19 FLOW TRANSITION MATS

Comply with the following and [Iowa DOT Materials I.M. 469.10](#).

A. Mat:

1. Constructed of 85% minimum UV resistant material with a maximum ground cover of 80%.
2. Meet the requirements of the following table:

Property	Test Method	Value
Mass/Unit Area (max.)	ASTM D 6566	3 lbs/SF
Minimum Thickness	ASTM D 6525	0.4 inch
Maximum Thickness	ASTM D 6525	1.1 inch
Tensile Strength	ASTM D 6818	550 lbs/ft
Minimum Percent Open Area	ASTM D 6567	20%
UV Stability	ASTM D 4355	85%

B. Anchoring Devices:

1. Furnish bullet tip style anchors made of a metal alloy attached to a wire rope.
2. Anchors capable of withstanding a minimum 300 pounds (136 kg) of pull out resistance in cohesive soils.
3. Wire rope a minimum of 30 inches (762 mm) in length with a minimum breaking strength of at least 300 pounds (136 kg).
4. The top washer a minimum of 3 inches (76 mm) in diameter and constructed of a UV resistant plastic.
5. Each anchor equipped to allow the retightening of the anchor when deemed necessary by the Engineer.

2.20 ENGINEERING FABRIC

Comply with [Iowa DOT Article 4196.01, B, 3](#).

PART 3 - EXECUTION**3.01 SWPPP PREPARATION**

- A. Prepare a SWPPP according to the requirements of the Iowa DNR NPDES General Permit No. 2.
- B. Ensure that controls utilized in the SWPPP conform to the type and quantity of erosion and sediment controls specified in the contract documents.
- C. Submit the completed SWPPP to the Engineer for review and approval prior to filing the Notice of Intent.
- D. Upon approval of the Engineer, file public notices, as required by the NPDES General Permit No. 2.
- E. File the Notice of Intent and fee, as required by the NPDES General Permit No. 2.

3.02 SWPPP MANAGEMENT

Coordinate and carry out all requirements of Iowa DNR NPDES General Permit No. 2 and any local ordinance requirements, including:

- A. Update the SWPPP according to the requirements of the NPDES General Permit No. 2.
- B. Revise the SWPPP and implement changes, as necessary, to prevent sediment or hazardous materials from being transported off the site.
- C. Submit all SWPPP revisions to the Engineer for review and approval.
- D. Perform and maintain records of weekly erosion and sediment control site inspections, unless otherwise specified in the contract documents.
- E. Maintain records of transfer of responsibility under the NPDES General Permit No. 2.
- F. Retain all records on-site, or as required by the NPDES General Permit No. 2.
- G. After final stabilization, file a Notice of Discontinuation, according to the NPDES General Permit No. 2.
- H. Provide all records and documentation to the Engineer upon completion of the project. Retain a copy of all records for the period required under the Permit.
- I. Continue to perform the work required under this item throughout the duration of the project, and until final stabilization is achieved and a Notice of Discontinuation is filed.

3.03 EROSION AND SEDIMENT CONTROL INSPECTION

- A. Perform inspections according to and at frequency required by the Iowa DNR NPDES General Permit No. 2.
- B. Schedule necessary maintenance or improvements for items that are included in the contract documents.
- C. Notify the Engineer immediately of situations requiring attention beyond that provided for in the contract documents.

3.03 EROSION AND SEDIMENT CONTROL INSPECTION (Continued)

- D. Provide copies of the inspection reports to the Engineer.

3.04 EQUIPMENT

Comply with [Iowa DOT Article 2601.03](#).

3.05 COMPOST BLANKETS ([Figure 9040.101](#))

- A. Loosen the ground surface to a minimum depth of 1 inch.
- B. Evenly spread compost, as specified in the contract documents, or as directed by the Engineer.
- C. Divert concentrated flows away from the slope.
- D. Do not operate heavy equipment over the compost blanket after placement, or throughout the required period of protection.
- E. Inspect the ground under the blanket at regular intervals for signs of erosion.

3.06 FILTER BERMS ([Figure 9040.102](#))

- A. Install filter berm along the contour as specified in the contract documents, or as directed by the Engineer.
- B. Turn the ends of the filter berm uphill to prevent runoff from flowing around the end of the berm.
- C. When a vegetated berm is specified, apply seed to the surface of the berm.
- D. Replace the berm when sediment accumulation reaches one-half of the height of the berm.

3.07 FILTER SOCKS ([Figure 9040.102](#))**A. Installation:**

1. Fill mesh filter sock with filler material to the size and length specified in the contract documents.
2. Place the filter sock along the contour as specified in the contract documents, or as directed by the Engineer.
3. Construct a "J-hook" at each end of a continuous run of filter sock, by turning the end of the sock uphill, as necessary to prevent runoff from flowing around the ends when water behind the sock ponds up to a level even with the top of the sock.
4. Drive stakes into the ground at a maximum spacing of 10 feet, and as required to secure the sock and prevent movement.
5. Repair or replace non-functioning filter socks that allow water to flow under the sock, are torn, or are otherwise damaged, due to inadequate installation.
6. Remove filter material from damaged socks that are located along streambanks, around intakes, in ditches, or in other locations where the material may be carried to surface waters.

3.07 FILTER SOCKS (Continued)

B. Removal: When specified in the contract documents, or as directed by the Engineer; remove the filter sock upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

1. Upon completion of the project, completely remove socks and filter material that are located along streambanks, around intakes, in ditches, or in other locations where the filter material may be carried to surface waters if the sock degrades and/or tears.
2. Slice the sock longitudinally. Remove and dispose of the filter sock material and stakes.
3. Spread the filter material and accumulated sediment to match finished grade and to ensure proper drainage.
4. If the site has been brought to finished grade and prepared for permanent seeding, spread and incorporate the filter material into the surface by tilling, or as required to break up any large particles and provide a finished surface suitable for permanent seeding.

C. Replacement:

1. When accumulated sediment reaches a level one-half the height of the sock, or when the sock becomes clogged with sediment and no longer allows runoff to flow through, remove the sock as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing filter sock and accumulated sediment may be left in place, and a new filter sock installed up-slope from the existing filter sock.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) ([Figures 9040.103](#) and [9040.104](#))

Install temporary RECPs according to the manufacturer's published installation recommendations, subject to the following minimum requirements:

A. Slope Application:

1. Grade and smooth surface. Remove all rocks, clods, vegetation, or other obstructions that will prevent direct contact between the RECP and the soil surface.
2. When specified, prepare seedbed and place seed and fertilizer according to [Section 9010](#) prior to placing RECP.
3. Install anchor trench at top of slope. Seed and fertilize trench after backfill and compaction, if seeding is specified.
4. Unroll the RECP down or horizontally across the slope.
5. Place consecutive blankets down the slope end-over-end, shingle style.
6. Overlap ends of consecutive rolls a minimum of 3 inches, and install anchors at a maximum spacing of 18 inches along all overlaps.
7. Overlap edges of adjacent rolls a minimum of 2 inches.
8. Install anchors at edge seams between rows.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)**B. Channel/Ditch Application:**

1. When specified, prepare seedbed and place seed and fertilizer according to [Section 9010](#), prior to placing RECP.
2. Place end of first roll in the anchor slot at the center of the upstream channel and secure with anchors.
3. Position adjacent rolls in the anchor slot, overlapping adjacent rolls a minimum of 3 inches.
4. Place backfill material in anchor slot and compact. Unroll RECP over compacted slot and secure with anchors.
5. Unroll RECP downstream. Maintain a minimum 3 inch overlap between adjacent rolls. Secure edge lap with anchors.
6. Install intermittent staple check slots every 30 feet.
7. Construct end lap at end of roll and beginning of new roll. Overlap roll ends with upstream RECP on top.
8. Excavate longitudinal trench along both sides of the channel at the outside edges of installation. Place outer edges of RECP into longitudinal slot. Install anchors, place backfill material, and compact.
9. Terminate installation at downstream end with staple check.
10. Install anchors in a regular pattern over entire area covered according to manufacturer's published recommendations (minimum three anchors per square yard).

3.09 WATTLES ([Figure 9040.105](#))**A. Installation:**

1. Construct a shallow trench, 2 to 4 inches deep, matching the width and contour of the wattle.
2. Install wattle along contour of slope.
3. Turn ends of wattle uphill to prevent water from flowing around ends.
4. Place and compact excavated soil against the wattle, on the uphill side.
5. Drive stakes through the center of the wattle, into the ground at a maximum spacing of 4 feet along the length of the wattle, and as needed to secure the wattle and prevent movement.
6. Abut ends of adjacent wattles tightly. Wrap joint with a 36 inch wide section of silt fence and secure with stakes.

- B. Removal:** When specified in the contract documents, or as directed by the Engineer, remove the wattle upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

3.09 WATTLES (Continued)

1. Completely remove the wattle netting, filler material, and stakes.
2. Spread the accumulated sediment to match finished grade and to ensure proper drainage.
3. When allowed by the Engineer, the wattle netting may be sliced open and the filler material spread out over the ground. Removal of netting and stakes and spreading of sediment is still required.

C. Replacement:

1. When accumulated sediment reaches a level one-half the height of the wattle, or when the wattle becomes clogged with sediment and no longer allows runoff to flow through, remove the wattle as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing wattle and accumulated sediment may be left in place, and a new wattle installed up-slope from the existing wattle.

3.10 CHECK DAMS ([Figure 9040.106](#))**A. Synthetic Permeable Check Dam (HDPE):**

1. Install according to the manufacturer's recommendations.
2. When specified, provide an RECP under the check dam, installed according to the manufacturer's recommendations.

B. Triangular Foam Check Dam: Install according to the manufacturer's recommendations.**C. Rock Check Dam:** Construct according to [Figure 9040.107](#).**D. Removal:** When specified in the contract documents, or as directed by the Engineer, remove check dams upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

1. Remove the check dam and dispose of materials, or salvage to the contractor.
2. Remove the accumulated sediment or spread to match finished grade; ensure proper drainage.
3. Stabilize the area disturbed by removal operations.

3.11 TEMPORARY EARTH DIVERSION STRUCTURES ([Figure 9040.108](#))

- A. Ensure positive drainage along the diversion toward the outlet area.
- B. Adequately compact fill to prevent failures or seepage.
- C. Outlet the diversion to undisturbed and/or stabilized areas only.
- D. Stabilize the surface of the earth diversion with temporary erosion control seeding, as specified in [Section 9010](#).

3.12 LEVEL SPREADERS ([Figure 9040.109](#))

- A. Butt multiple timbers together, as necessary to provide the required length.
- B. Ensure the spreader is installed level in all directions. Adjust as necessary during construction to maintain spreader in a level condition.
- C. Excavate a depression behind the spreader to the depth specified in the contract documents. The depression may be over-excavated up to 1 foot to provide an area for sediment accumulation.
- D. Grade as required to prevent flow around the ends of spreader.
- E. Remove the accumulated sediment from the depression when the depth is reduced below that specified in the contract documents.

3.13 RIP RAP ([Figures 9040.110](#) and [9040.111](#))

Install rip rap (revetment stone or erosion stone) as shown on [Figures 9040.110](#) and [9040.111](#).

3.14 TEMPORARY PIPE SLOPE DRAINS ([Figure 9040.112](#))

- A. Place slope drain on undisturbed soil or well compacted fill.
- B. Carefully compact cohesive soils around inlet ends of the drain in 6 inch lifts.
- C. Discharge slope drain to a stable outlet or to a sediment retention device.

3.15 SEDIMENT BASIN OUTLET STRUCTURES ([Figures 9040.113](#) and [9040.114](#))

- A. **Concrete Base:** Construct the concrete base and anchor riser section, as shown on [Figure 9040.115](#).
- B. **Dewatering Device:**
 - 1. Drill holes in the riser section. The number, diameter, and configuration will be specified in the contract documents.
 - 2. Wrap the perforated section of the riser pipe with metal hardware cloth.
- C. **Anti-vortex Device:** If required by the contract documents, firmly attach the cylinder to the top of the riser by welding or other means. Comply with [Figure 9040.116](#).

3.16 ANTI-SEEP COLLAR ([Figure 9040.117](#))

- A. **General:** Place backfill material and compact over-excavation areas to a minimum of 95% Standard Proctor Density per [Section 3010](#).
- B. **Concrete Collar:**
 - 1. Place collars a minimum of 2 feet from pipe joints.
 - 2. Provide Class C concrete per [Section 6010](#).

3.16 ANTI-SEEP COLLAR (Continued)**C. CMP Collar:**

1. Provide collar of same gage as the pipe barrel on which it is used.
2. Paint or tag unassembled collars to identify matching pairs.
3. Furnish each collar with two 1/2 inch diameter rods with tank lugs for connecting collars to pipe.
4. Install collar with corrugations vertical.
5. Seal the tap between the two half sections and between the pipe and connecting band with a bituminous jointing compound at the time of installation.

3.17 SEDIMENT TRAPS ([Figure 9040.118](#))

Construct the storage area to the size and elevations specified in the contract documents.

3.18 SILT FENCES ([Figure 9040.119](#))**A. Installation:**

1. Install material along the contour of the ground, as specified in the contract documents, or as directed by the Engineer.
2. Install silt fence with a mechanical soil slicing machine that creates a slit in the ground while simultaneously installing the fabric. The trenching method may be used when situations will not allow soil slicing, as determined by the Engineer.
3. Construct a "J-hook" at each end of a continuous run of silt fence, by turning the end of the silt fence uphill, as necessary to prevent runoff from flowing around ends when water behind the fence ponds to a level even with the top of the fence.
4. Insert 12 inches of fabric to a minimum depth of 6 inches (fabric may be folded below the ground line).
5. Compact installation by driving along each side of the silt fence, or by other means, as necessary to adequately secure the fabric in the ground, to prevent pullout and water flow under the fence.
6. Drive steel posts into the ground alongside the silt fence, to a minimum depth of 20 inches, unless otherwise specified by the Engineer. Space posts as shown on [Figure 9040.119](#) or as required to adequately support silt fence.

B. Maintenance: Repair or replace non-functioning silt fence that allows water to flow under the fence, is torn, or is otherwise damaged, due to inadequate installation, at no additional cost to the Contracting Authority.

C. Removal:

1. Remove the silt fence upon final stabilization of the project area, or according to the staging indicated in the SWPPP.
2. Remove and dispose of silt fence and posts.
3. Remove sediment or spread to match finished grade; ensure proper drainage.
4. Stabilize the area disturbed by removal operations.

3.18 SILT FENCES (Continued)**D. Replacement:**

1. When accumulated sediment reaches a level one-half the height of the fence, remove the silt fence as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing silt fence and accumulated sediment may be left in place, and a new silt fence installed up-slope from the existing silt fence.
3. When allowed by the Engineer, the existing silt fence may be left in place and the accumulated sediment removed to the original ground line and within 6 inches of the silt fence. Carefully inspect the existing silt fence for structural integrity and signs of undermining. Make any necessary repairs.

3.19 STABILIZED CONSTRUCTION ENTRANCE ([Figure 9040.120](#))

- A. Install a stabilized construction entrance at all locations where construction traffic leaving the site presents the potential for sediment track-out.
- B. Remove vegetation and excavate soft soils from entrance area. Thoroughly compact subgrade prior to placing stone.
- C. Install culvert under entrance if necessary to maintain drainage.
- D. Grade entrance to prevent runoff from flowing onto street. Direct all runoff from entrance to a sediment retention device.
- E. When specified, install subgrade stabilization fabric prior to placing crushed stone.
- F. Install layer of crushed stone to the thickness (6 inches minimum) and dimensions specified in the contract documents.
- G. Remove the accumulated sediment and install new stone, as required to prevent track-out.

3.20 DUST CONTROL

A. Water: Apply frequent light watering to ground surface, as required to control dust.

B. Calcium Chloride: Apply according to [Iowa DOT Section 2314](#).

C. Lignosulfonate (Tree Sap):

1. Loosen the top 1 to 2 inches of the roadway surface.
2. Apply solution with a 50% residual concentration, at a rate of 0.50 gal/yd², to deliver a 25% residual. For diluted solutions, increase the application rate, as required, to deliver an equivalent 25% residual.
3. Allow product to penetrate through the loosened material.
4. Tight-blade road surface.

D. Soapstock (Soybean Oil):

1. Loosen the top 1 to 2 inches of the roadway surface.
2. Apply undiluted soapstock at a rate of 0.70 gal/yd².

3.20 DUST CONTROL (Continued)

3. Allow product to penetrate through the loosened material.
4. Tight-blade road surface.

3.21 EROSION CONTROL MULCHING**A. Conventional Mulching:**

1. Use conventional mulching when the surface cannot be stabilized by seeding, due to season or ground conditions.
2. Uniformly distribute mulch over the required areas, at a rate of 2 tons/acre for dry cereal straw, or 2.5 tons/acre for prairie hay.
3. Work the mulch into the soil with a mulch tucker, designed to anchor the mulch into the soil, by means of dull blades or disks.

B. Hydromulching:

1. Place mulch and tackifier (if applicable) in equipment specifically manufactured for hydraulic mulching.
2. Mix materials with fresh, potable water using a combination of re-circulation through the equipment's pump and mechanical agitation to form a homogeneous slurry.
3. If necessary, dampen any dry, dusty soil as required to prevent balling of the material during application.
4. Apply hydromulch in multiple layers from opposing directions, where possible.
5. Apply the slurry evenly over all specified areas, at the minimum component material rates specified:
 - a. Wood Cellulose Mulch:
 - 1) Mulch: Minimum 3,000 lb/acre dry weight.
 - 2) Tackifier: Minimum 50 lb/acre.
 - b. Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
 - c. Mechanically Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
6. Retain and count empty bags of mulch to ensure final application rate.

3.22 TURF REINFORCEMENT MATS

Install according to the manufacturer's published installation literature for the product specified and application (slope or channel).

3.23 SURFACE ROUGHENING**A. Directional Tracking:**

1. Do not use on slopes steeper than 3:1.
2. Operate tracked equipment up and down exposed slope to create ridges perpendicular to the slope.
3. Continue operation until the entire surface has been tracked.

3.23 SURFACE ROUGHENING (Continued)**B. Grooving/Furrowing:**

1. May be used on all slopes.
2. Use rippers, disks, harrows, chisel plows, or other equipment capable of operating on the slope and creating grooves a maximum of 15 inches apart and 3 inches deep.
3. Operate equipment along the contour of the slope to create grooves that are perpendicular to the slope.
4. Perform over all exposed slopes as specified.

3.24 INLET PROTECTION

- A. Install inlet protection devices according to the manufacturer's recommendations.
- B. Remove the accumulated sediment, as required to maintain the inlet protection device in working order. Remove any accumulated sediment from streets open to traffic if it encroaches into the traveled roadway.

3.25 FLOW TRANSITION MATS

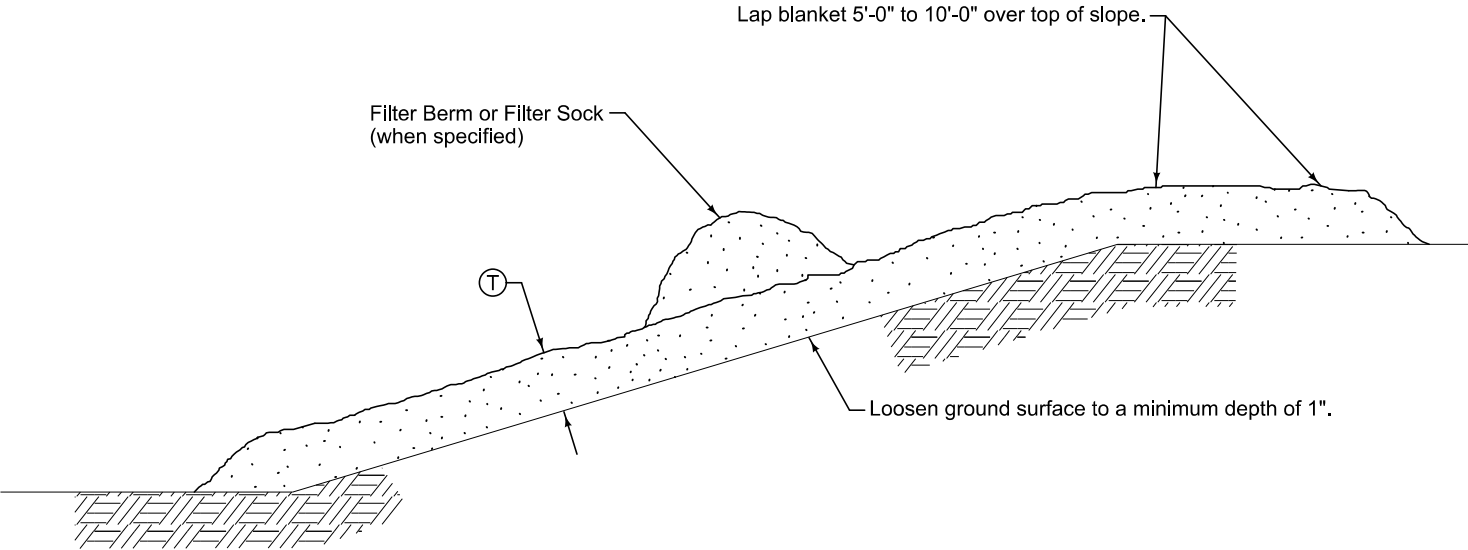
Install according to the manufacturer's published recommendations.

3.26 TEMPORARY EROSION CONTROL SEEDING

Comply with [Section 9010](#).

END OF SECTION

Compost blanket may be vegetated or unvegetated as specified in the contract documents.



COMPOST BLANKET DETAIL

MINIMUM COMPOST BLANKET THICKNESS

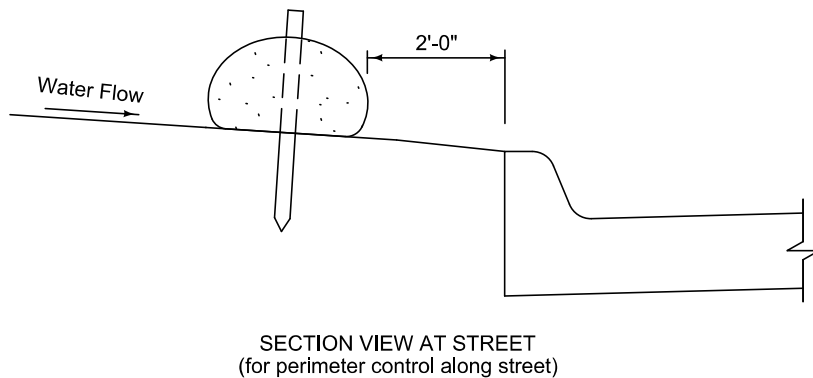
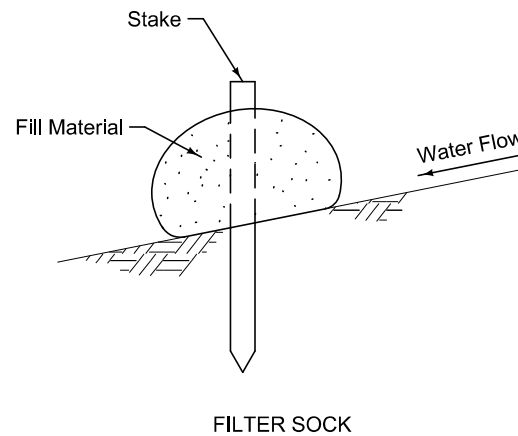
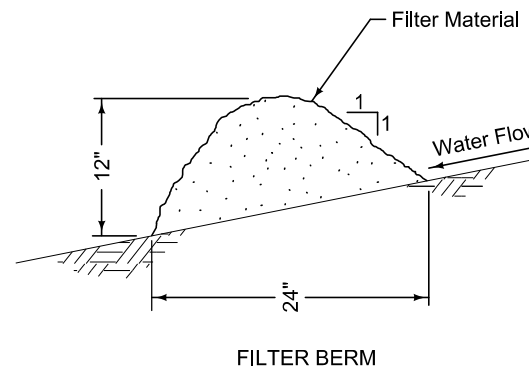
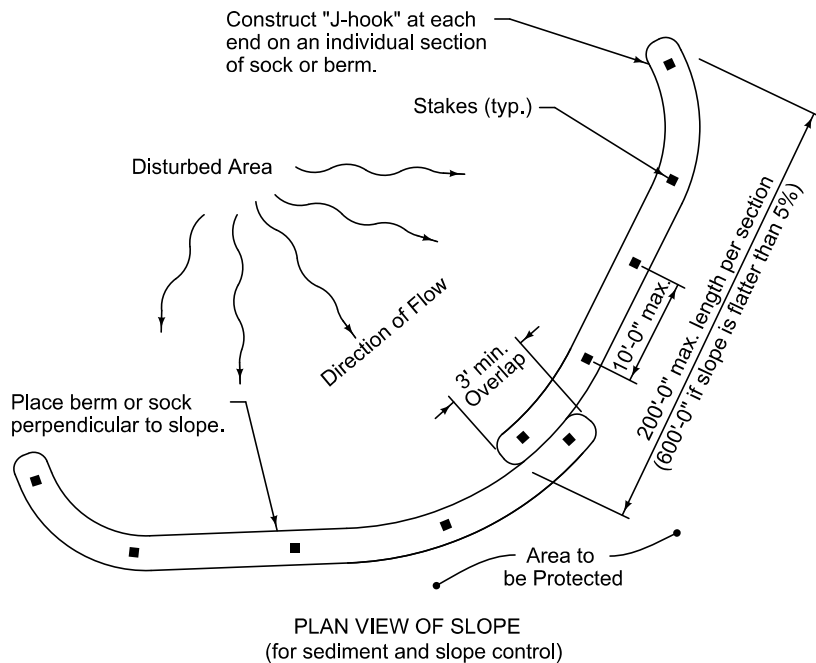
SLOPE	BLANKET THICKNESS Ⓣ
3:1	3"
≤ 4:1	2"

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9040.101
SHEET 1 of 1

SUDAS Standard Specifications

COMPOST BLANKET



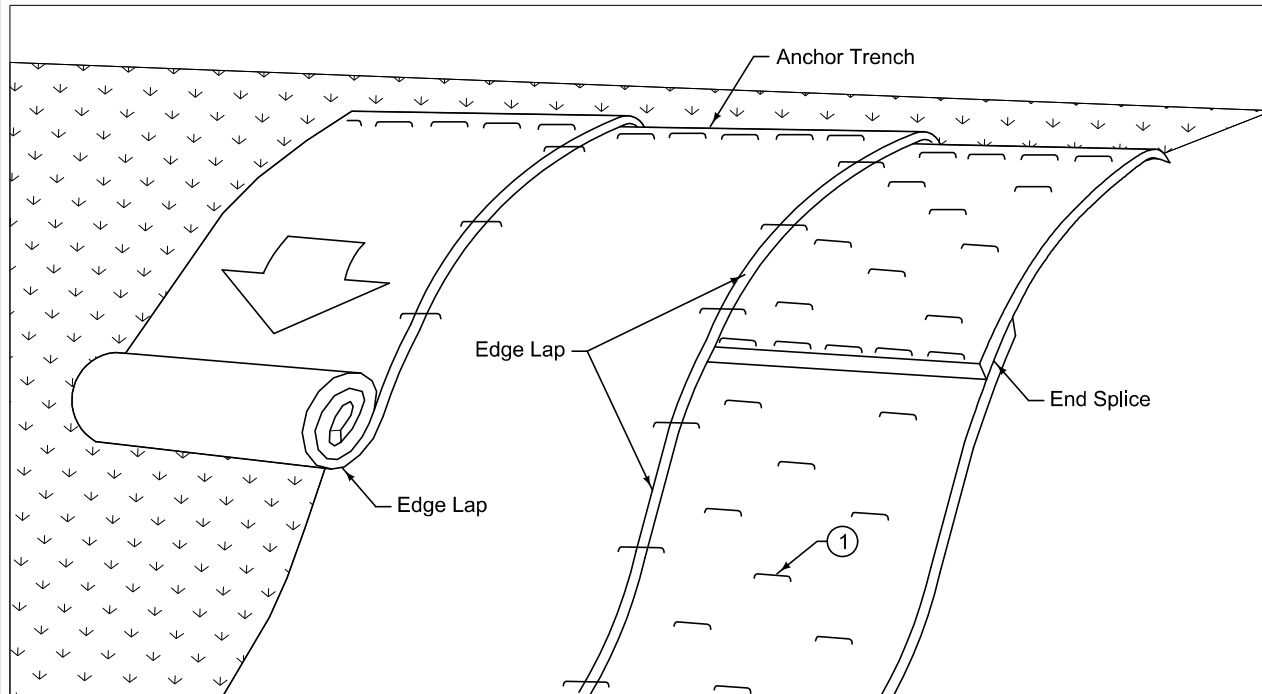
Berm shown is typical for slopes flatter than 3:1. For steeper slopes, increase berm size as directed by the Engineer.

Place berm in uncompacted windrow perpendicular to the slope at locations specified in the contract documents.

Filter sock diameter as specified in the contract documents.

TYPICAL PLACEMENT OF BERM OR SOCK

	SUDAS	
	9040.102	
	SHEET 1 of 1	
SUDAS Standard Specifications		
FILTER BERM AND FILTER SOCK		



- ① Secure blanket to ground according to manufacturer's recommended anchoring pattern and minimum shown in Table 1.

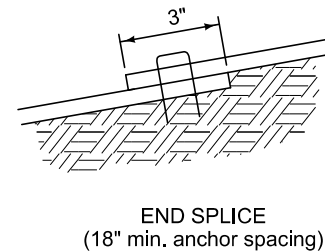
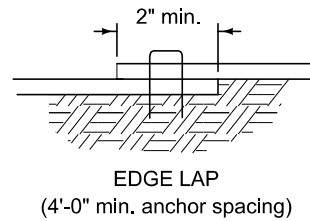
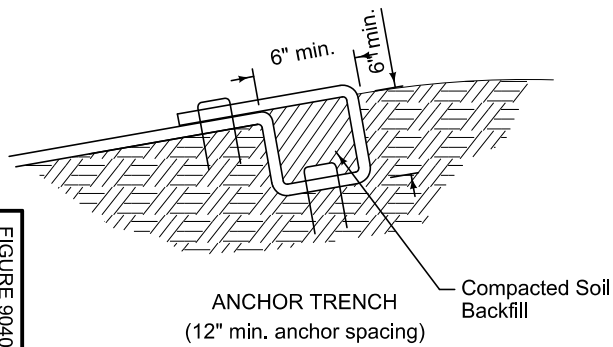
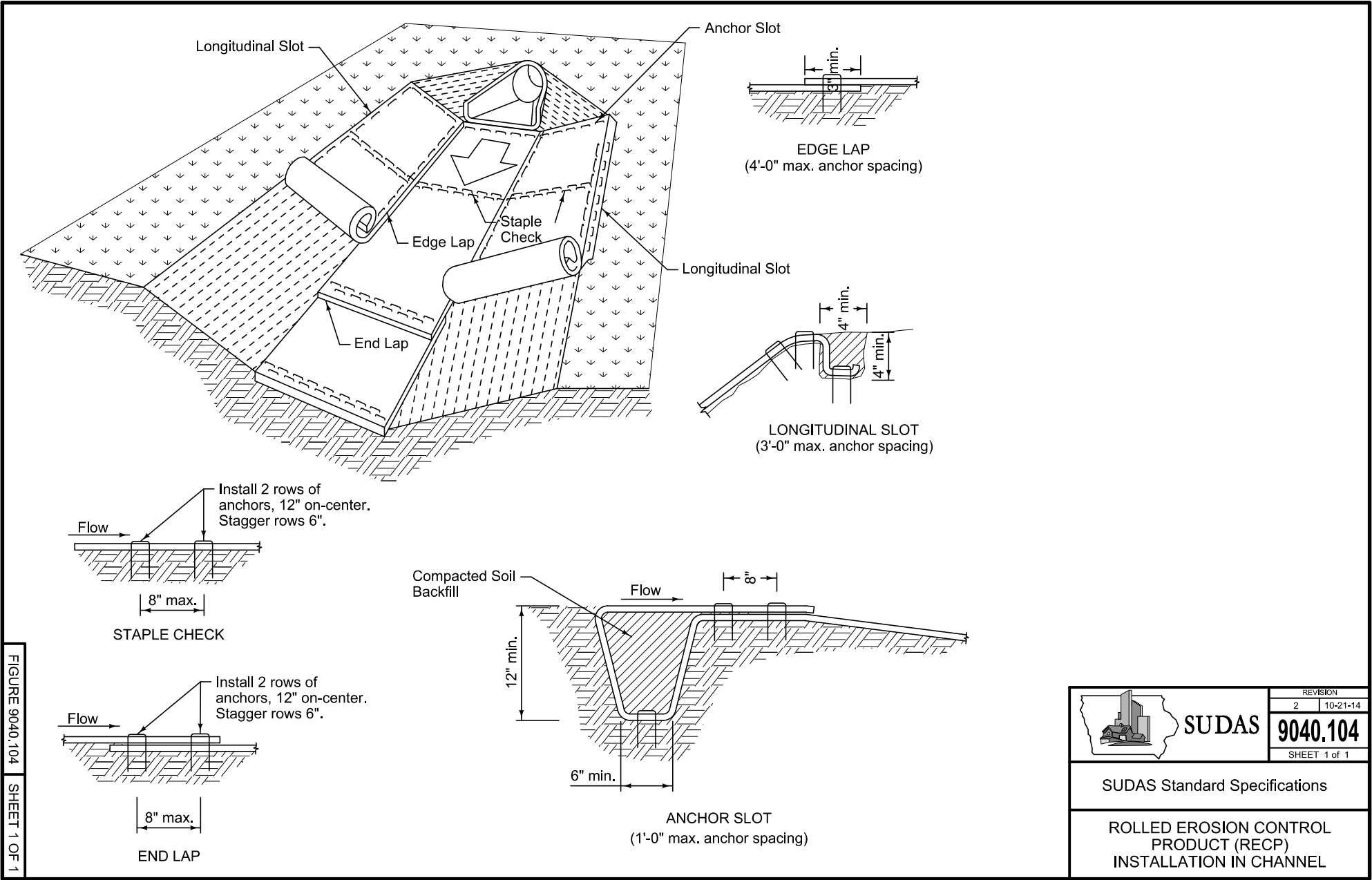


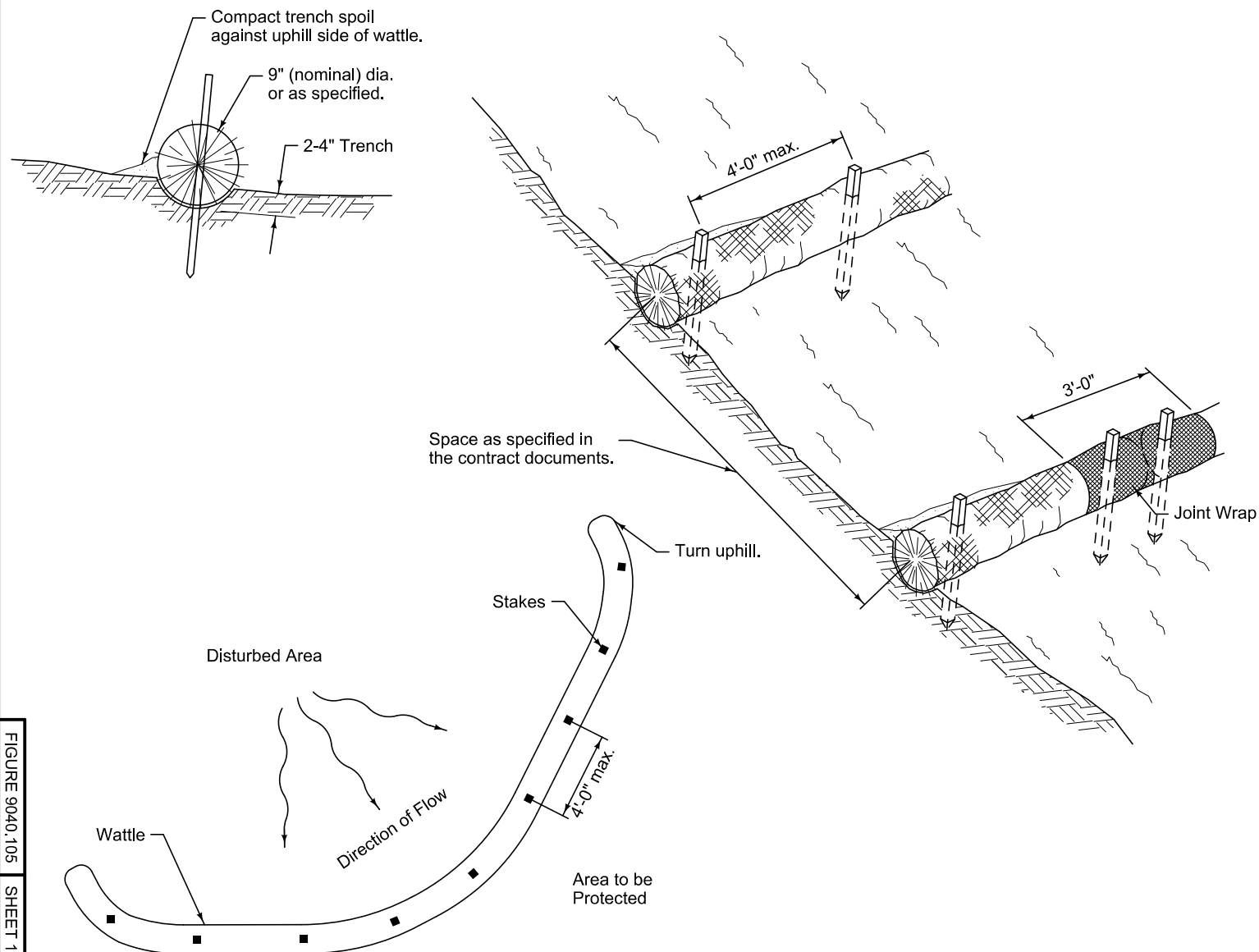
TABLE 1

Max. slope	Min. anchors
≤ 3:1	1.5/yd ²
2:1	2/yd ²
1:1	2.5/yd ²

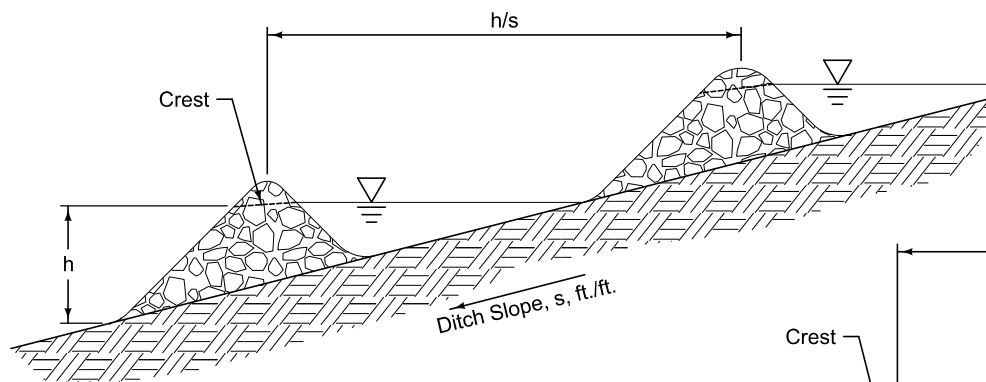
	REVISION 2 10-21-14	
	9040.103	
	SHEET 1 of 1	
SUDAS Standard Specifications		
ROLLED EROSION CONTROL PRODUCT (RECP) INSTALLATION ON SLOPES		



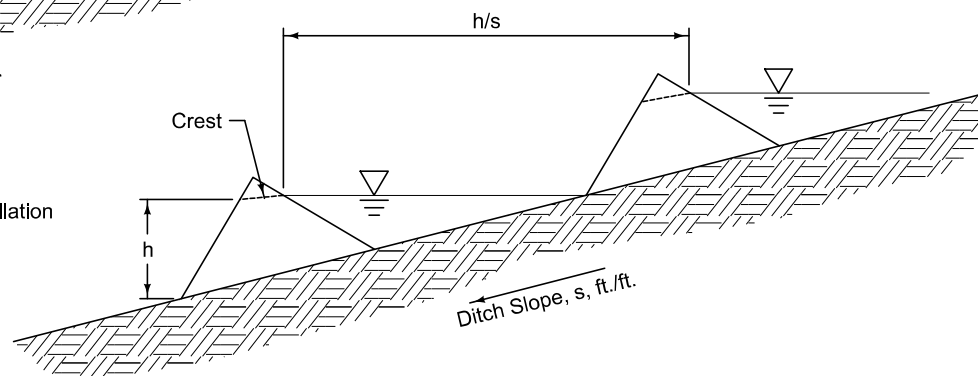
	REVISION	
	2	10-21-14
	9040.104	
SHEET 1 of 1		
SUDAS Standard Specifications		
ROLLED EROSION CONTROL PRODUCT (RECP) INSTALLATION IN CHANNEL		



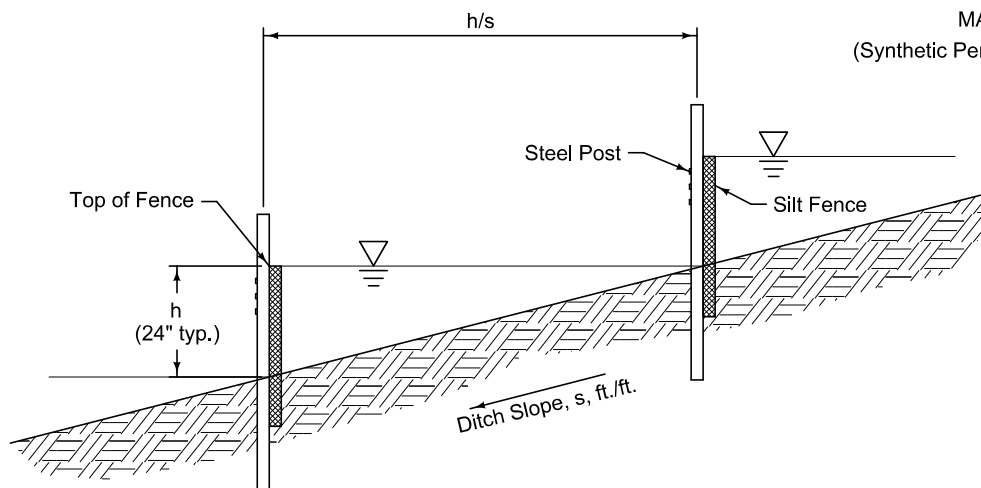
	REVISION	
	2	10-21-14
	9040.105	
	SHEET 1 of 1	
SUDAS Standard Specifications		
WATTLE		



ROCK CHECK DAM
(See Figure 9040.107 for installation of Rock Check Dams.)

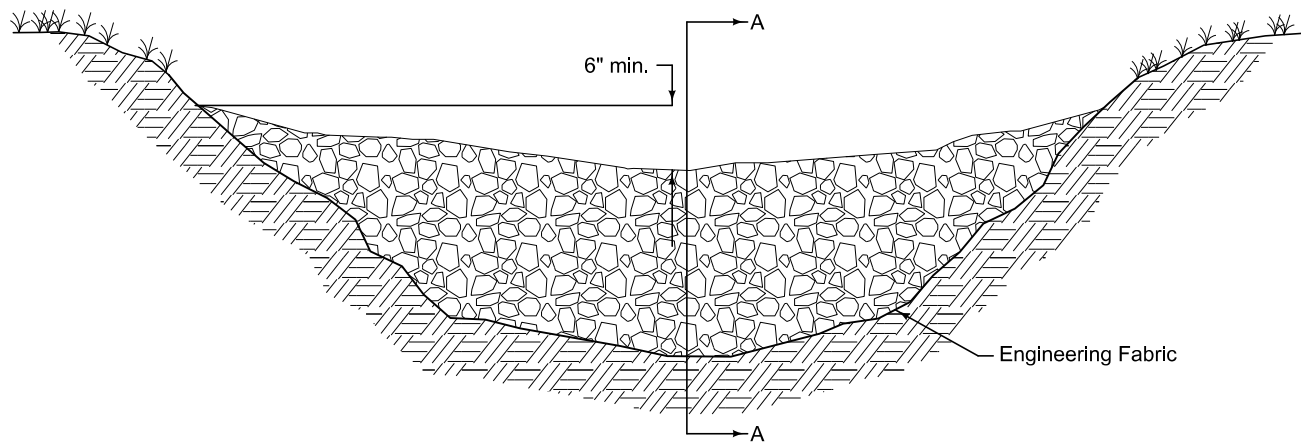


MANUFACTURED CHECK DAM
(Synthetic Permeable and Triangular Foam Check Dam)

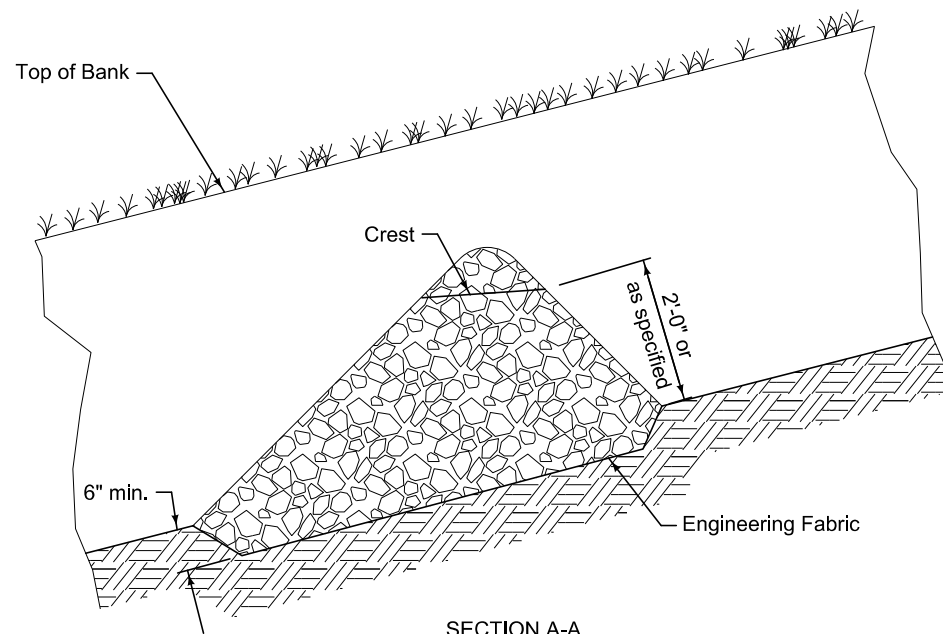


SILT FENCE CHECK DAM (DITCH CHECK)
(See Figure 9040.119 for installation of Silt Fence Ditch Checks.)

	SUDAS	
	9040.106	
	SHEET 1 of 1	
SUDAS Standard Specifications		
CHECK DAM SPACING		

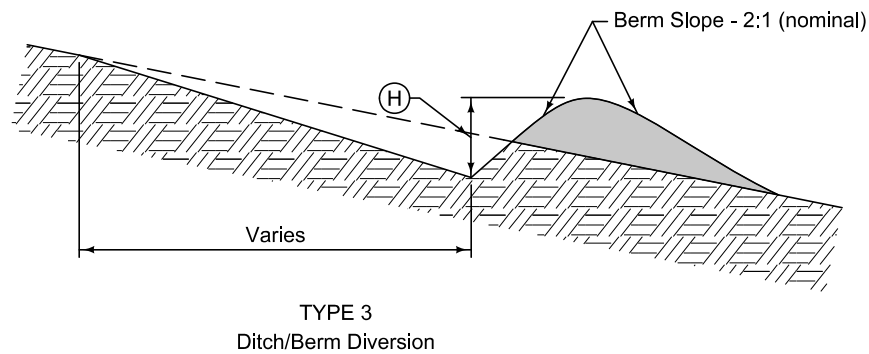
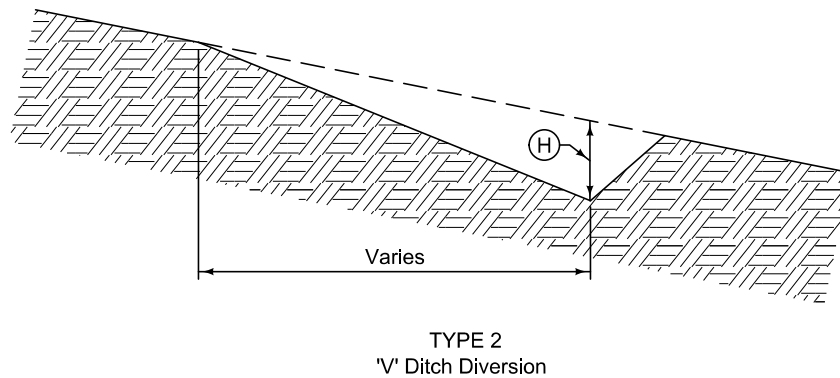
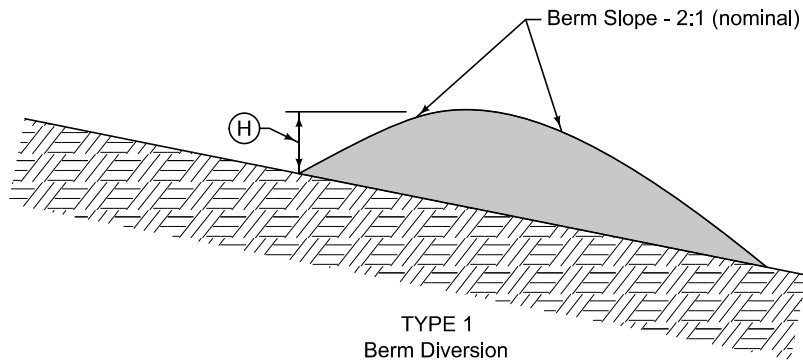


DITCH CROSS-SECTION



SECTION A-A

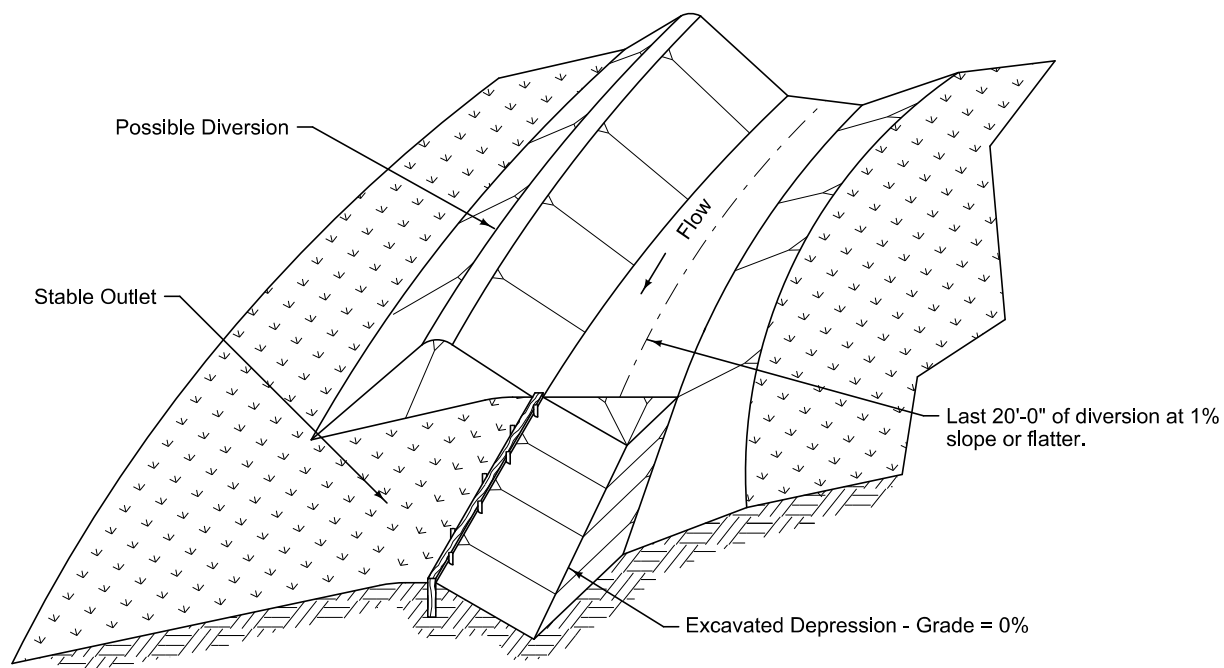
	REVISION	
	2	10-21-14
	9040.107 SHEET 1 of 1	
SUDAS Standard Specifications		
ROCK CHECK DAM		



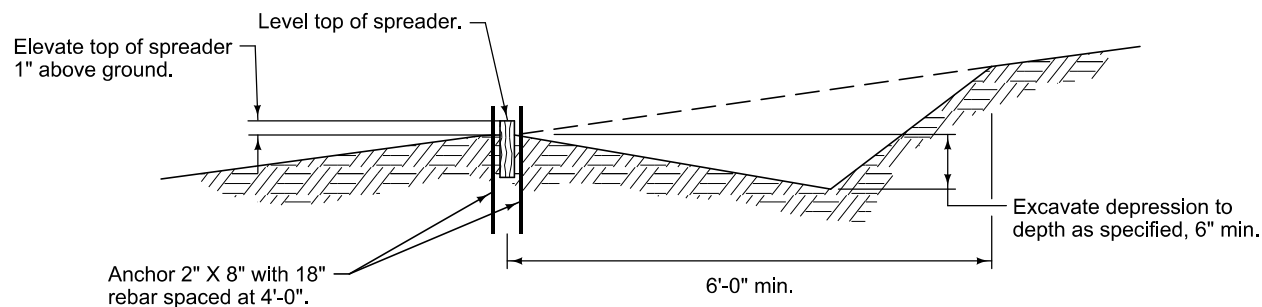
Diversion Types 1, 2, and 3 may be used interchangeably unless otherwise specified in the contract documents.

Alternate configurations may be used upon approval from the Engineer.

(H) Total height of diversion (swale and berm): 18 inch minimum or as specified.



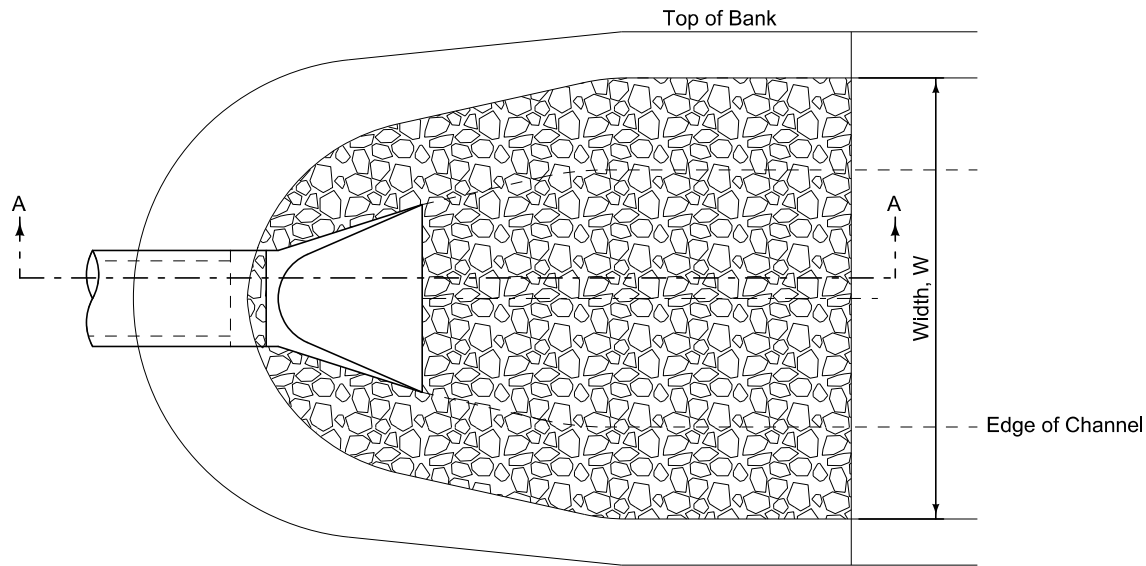
PERSPECTIVE VIEW



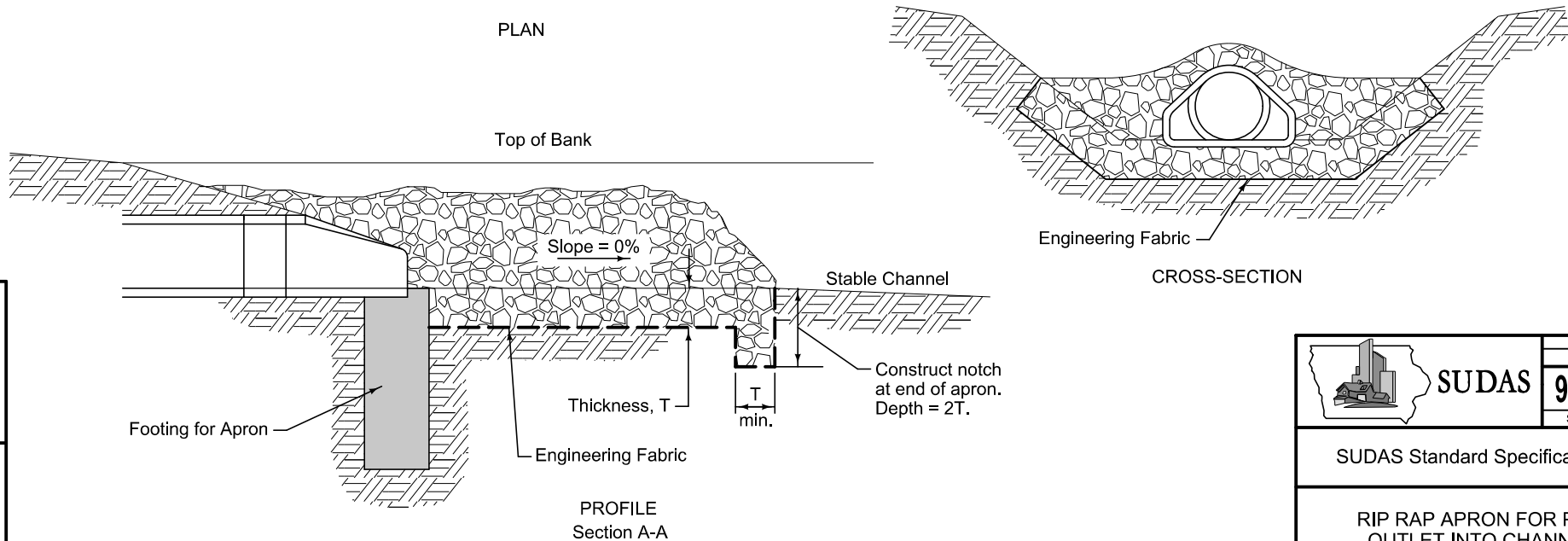
CROSS-SECTION

 SUDAS	REVISION	
	2	10-21-14
	9040.109 SHEET 1 of 1	
SUDAS Standard Specifications		
LEVEL SPREADER		





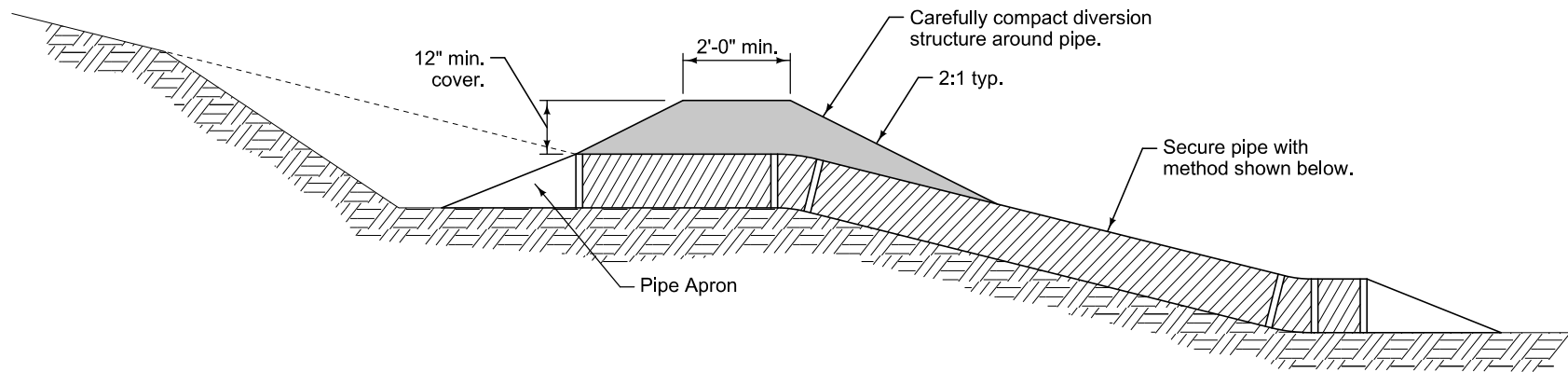
PLAN



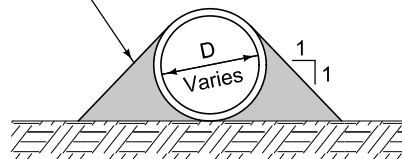
PROFILE
Section A-A

CROSS-SECTION

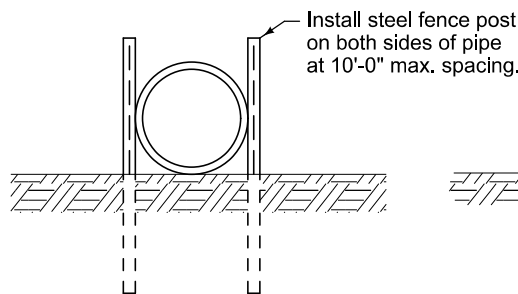
	REVISION	
	3	10-21-14
	9040.111 SHEET 1 of 1	
SUDAS Standard Specifications		
RIP RAP APRON FOR PIPE OUTLET INTO CHANNEL		



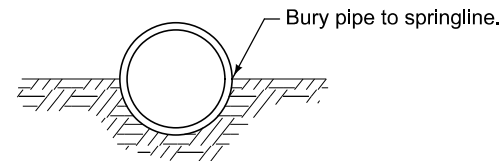
Place and compact fill along sides of pipe.



OPTION A



OPTION B



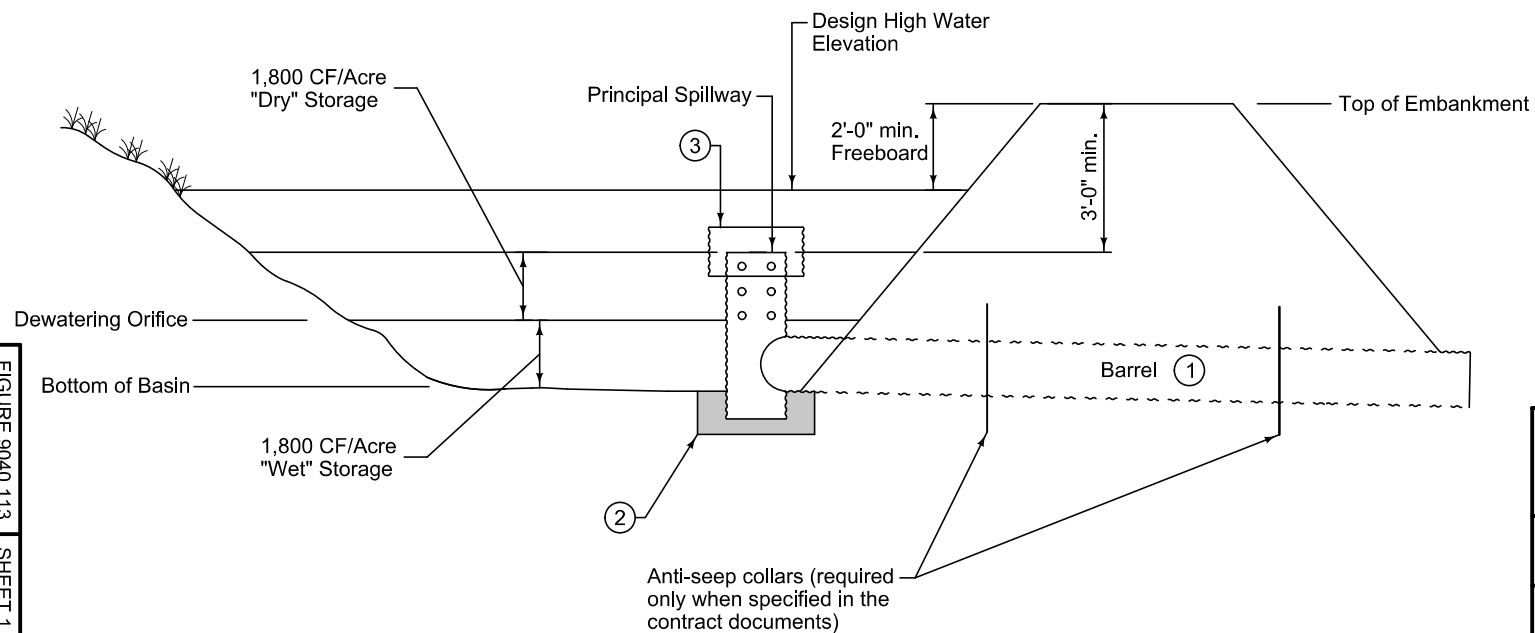
OPTION C

(May also be combined with options A or B)

SLOPE DRAIN ANCHORING OPTIONS
(Options A, B, and C are interchangeable unless otherwise specified in the contract documents)

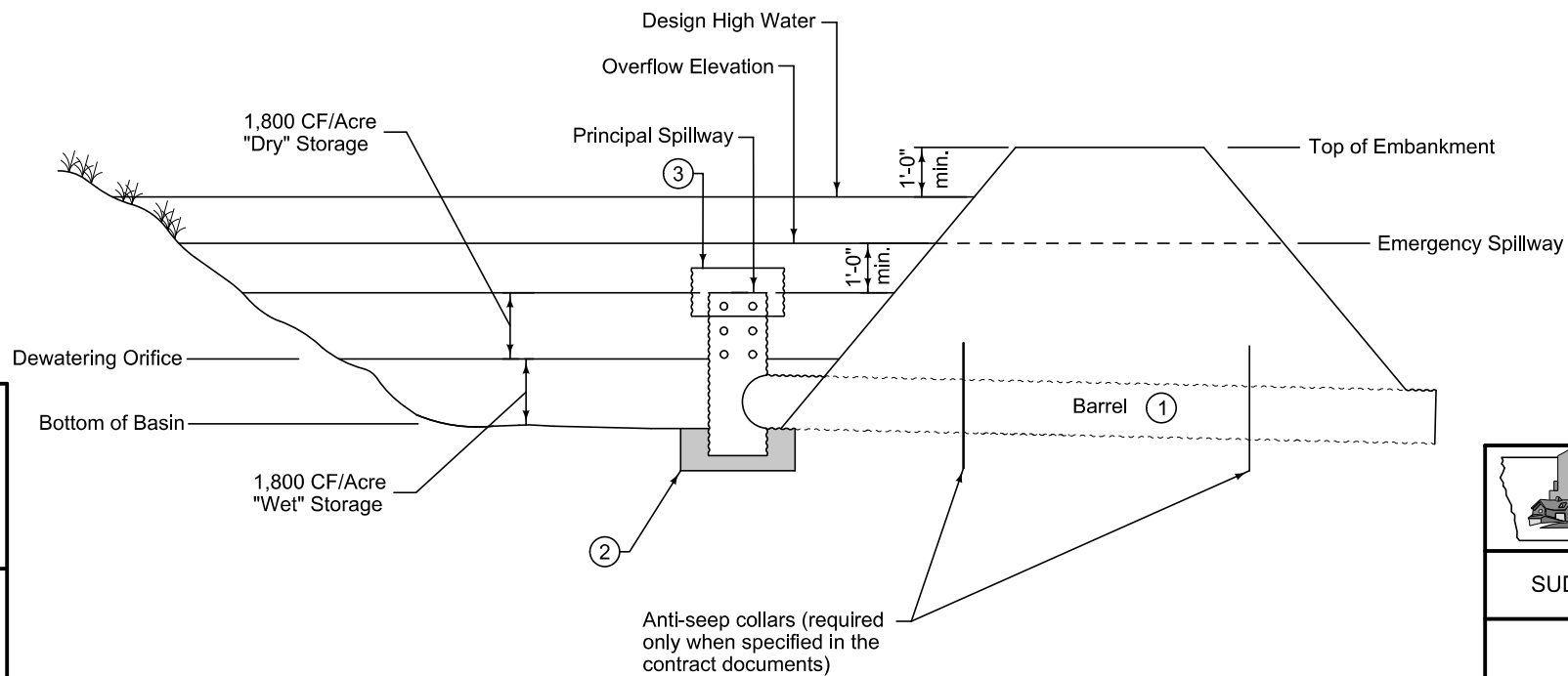
	REVISION	
	2	10-21-14
	9040.112	
	SHEET 1 of 1	
SUDAS Standard Specifications		
TEMPORARY PIPE SLOPE DRAIN		

- ① Barrel length and diameter as specified in the contract documents.
- ② Riser pipe and base/dewatering device: See Figure 9040.115.
- ③ Anti-vortex device: See Figure 9040.116.

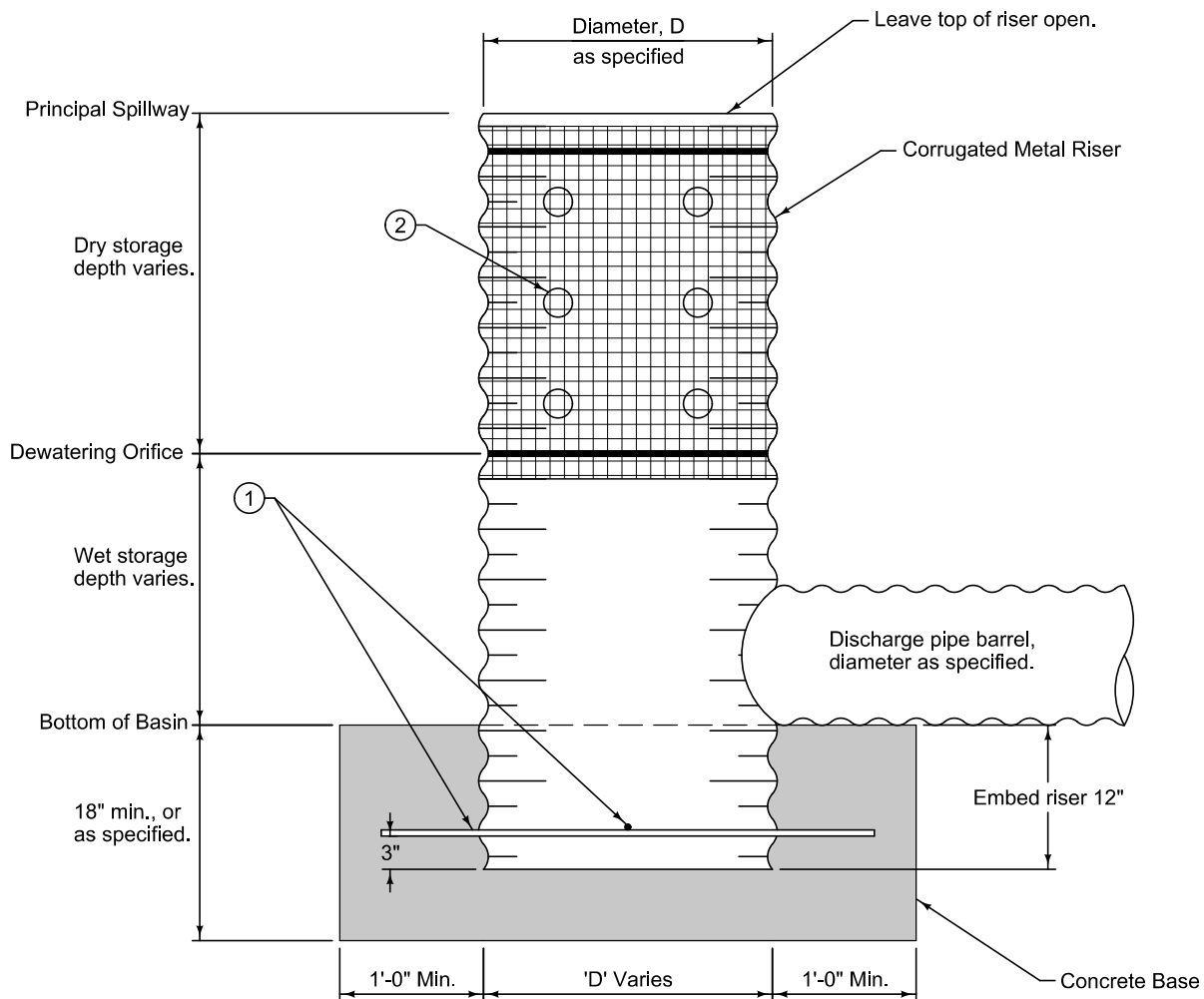


 SUDAS	REVISION	
	2	10-21-14
	9040.113	
SHEET 1 of 1		
SUDAS Standard Specifications		
SEDIMENT BASIN WITHOUT EMERGENCY SPILLWAY		

- ① Barrel length and diameter as specified in the contract documents.
- ② Riser pipe and base/dewatering device: See Figure 9040.115.
- ③ Anti-vortex device: See Figure 9040.116.



 SUDAS	REVISION	
	2	10-21-14
	9040.114	
SHEET 1 of 1		
SUDAS Standard Specifications		
SEDIMENT BASIN WITH EMERGENCY SPILLWAY		

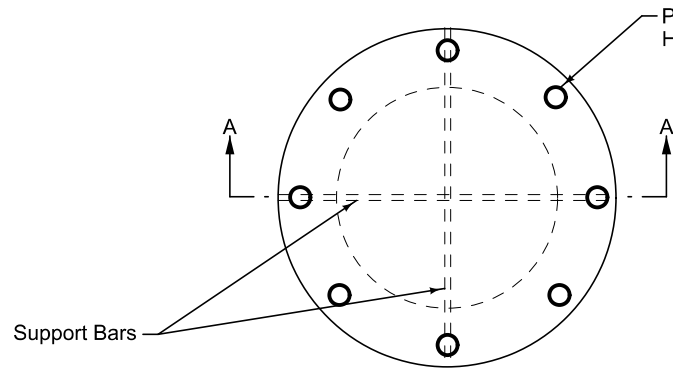


Elevations and dimensions not given are as specified in the contract documents.

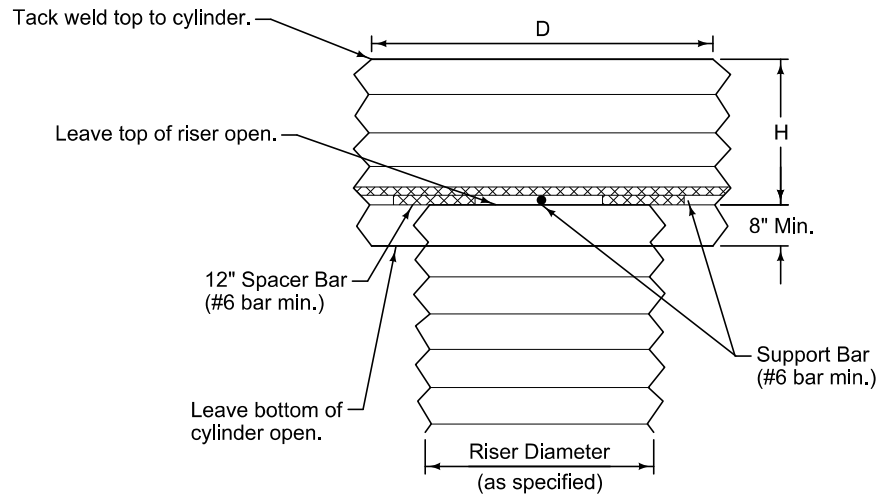
- ① Drill four, 5/8 inch diameter holes, 3 inches from bottom of riser pipe and insert two, #4 bars in an "X" configuration. Length of bars = $D+16$ inches
- ② Provide perforation configuration as specified in the contract documents.

	REVISION	
	2	10-21-14
	9040.115	
SHEET 1 of 1		
SUDAS Standard Specifications		
SEDIMENT BASIN DEWATERING DEVICE (PERFORATED RISER)		

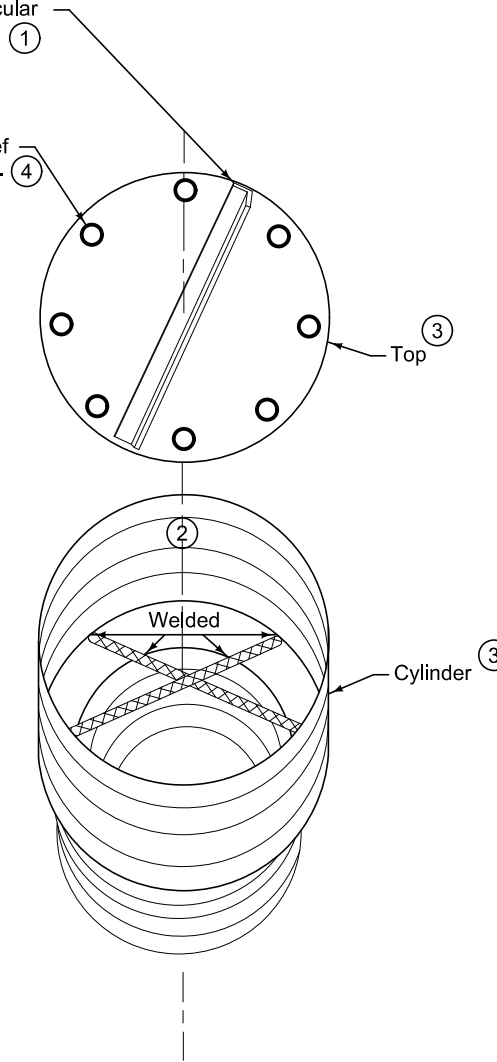
Orient top stiffener (if required) perpendicular to corrugations and weld to top.



PLAN VIEW



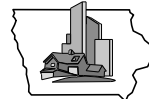
SECTION A-A



ISOMETRIC

Alternate anti-vortex device configurations may be utilized upon approval of the Engineer.

- ① See sheet 2 for dimensions of cylinder support bars, top plate, and top stiffener.
- ② Firmly attach the anti-vortex cylinder to the top of the riser by welding or other means.
- ③ Corrugated metal or 1/8 inch steel plate cylinder and top.
- ④ Pressure relief holes may be omitted if ends of corrugations are left fully open when the top is attached.

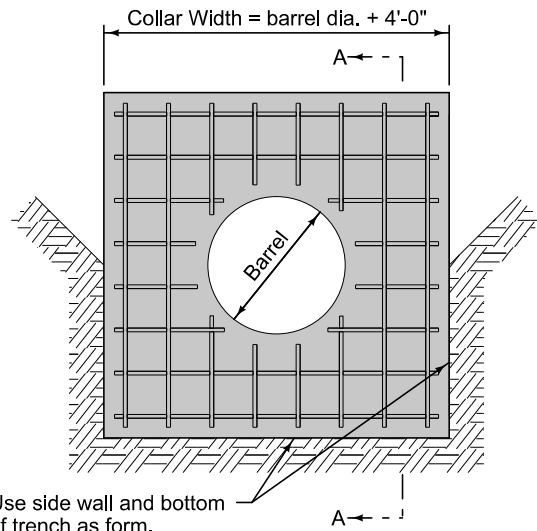
 SUDAS	REVISION	
	2	10-21-14
	9040.116	
SUDAS Standard Specifications		
ANTI-VORTEX DEVICE		

RISER	CYLINDER				MINIMUM TOP	
Diameter (in.)	Diameter (in.)	Thickness (gage)	Height (H) (in.)	Minimum Size Support Bar	Thickness	Stiffener
12	18	16	6	#6 rebar or 1 1/2" X 3/16" angle	16 ga F & C	----
15	21	16	7	#6 rebar or 1 1/2" X 3/16" angle	16 ga F & C	----
18	27	16	8	#6 rebar or 1 1/2" X 3/16" angle	16 ga F & C	----
21	30	16	11	#6 rebar or 1 1/2" X 3/16" angle	16 ga (C), 14 ga (F)	----
24	36	16	13	#6 rebar or 1 1/2" X 3/16" angle	16 ga (C), 14 ga (F)	----
27	42	16	15	#6 rebar or 1 1/2" X 3/16" angle	16 ga (C), 14 ga (F)	----
36	54	16	17	#8 rebar	14 ga (C), 12 ga (F)	----
42	60	16	19	#8 rebar	14 ga (C), 12 ga (F)	----
48	72	16	21	1 1/4" pipe or 1 1/4" X 1 1/4" X 1/4" angle	14 ga (C), 10 ga (F)	----
54	78	16	25	1 1/4" pipe or 1 1/4" X 1 1/4" X 1/4" angle	14 ga (C), 10 ga (F)	----
60	90	14	29	1 1/2" pipe or 1 1/2" X 1 1/2" X 1/4" angle	12 ga (C), 8 ga (F)	----
66	96	14	33	2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2" X 2" X 1/4" angle
72	102	14	36	2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2 1/2" X 2 1/2" X 1/4" angle
78	114	14	39	2 1/2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2 1/2" X 2 1/2" X 1/4" angle
84	120	12	42	2 1/2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2 1/2" X 2 1/2" X 5/16" angle

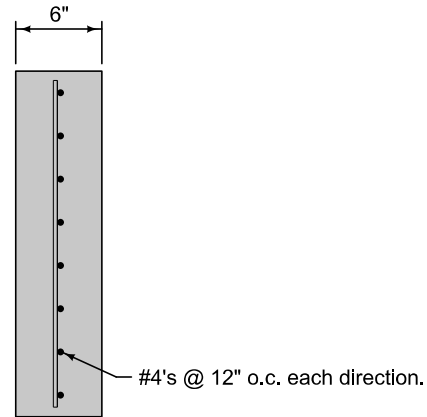
Notes:

- The criterion for sizing the cylinder is that the area between the inside of the cylinder and the outside of the riser is equal to or greater than the area inside the riser. Therefore, the above table is invalid for use with concrete pipe risers.
- C - Corrugated F - Flat.

	REVISION	
	2	10-21-14
	9040.116 SHEET 2 of 2	
SUDAS Standard Specifications		
ANTI-VORTEX DEVICE		

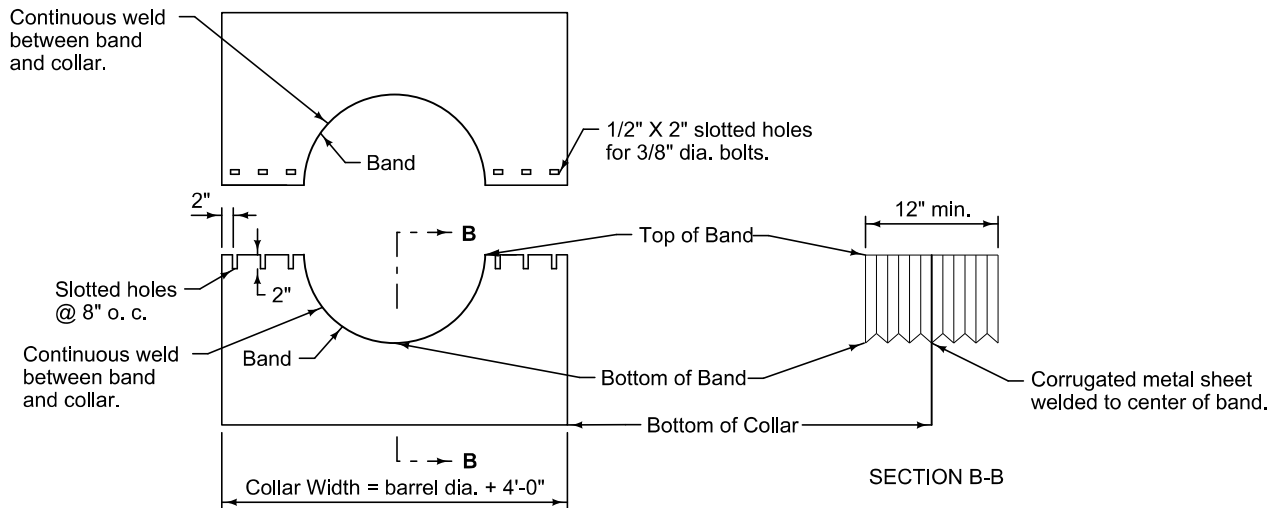


CONCRETE COLLAR



SECTION A-A

Anti-seep collars are not required unless specified in the contract documents.



SECTION B-B

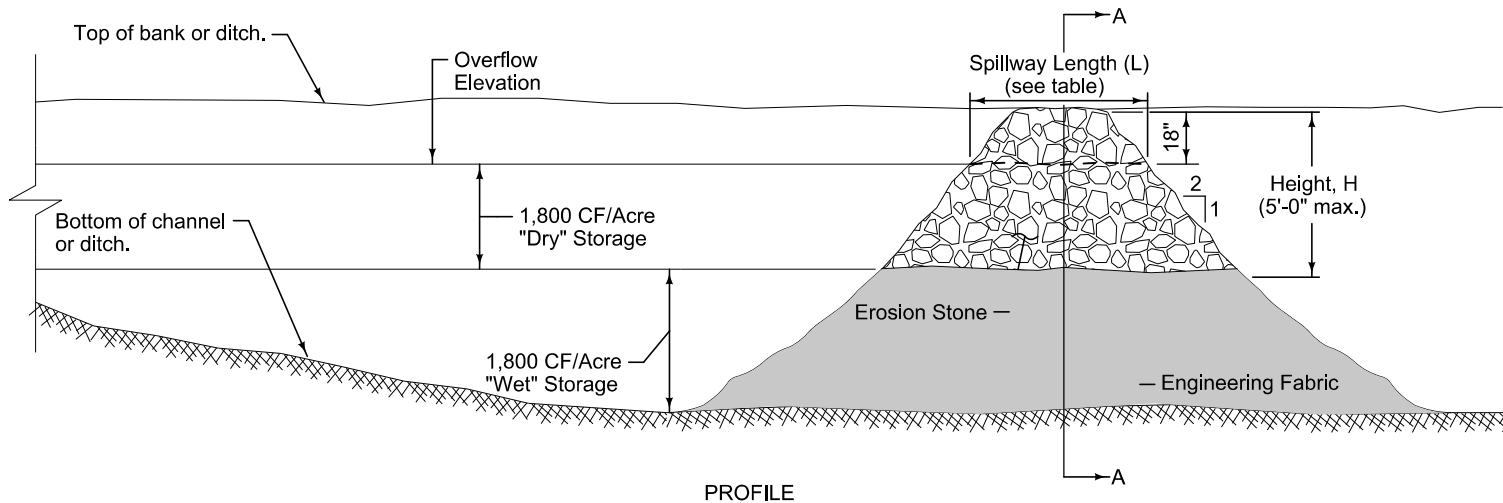
CMP COLLAR

	REVISION	
	2	10-21-14
	9040.117	
	SHEET 1 of 1	
	SUDAS	

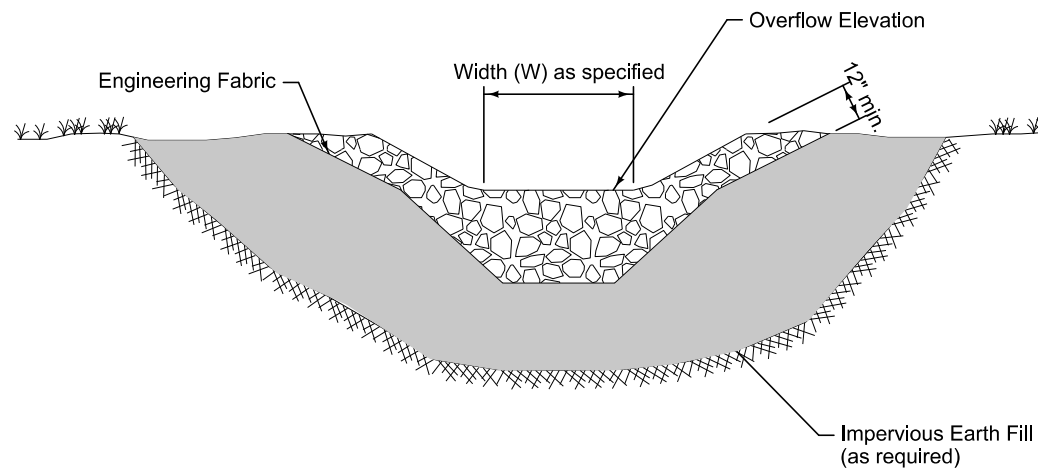
SUDAS Standard Specifications

ANTI-SEEP COLLAR

Remove accumulated sediment when level reaches one-half the height of the wet storage.



PROFILE

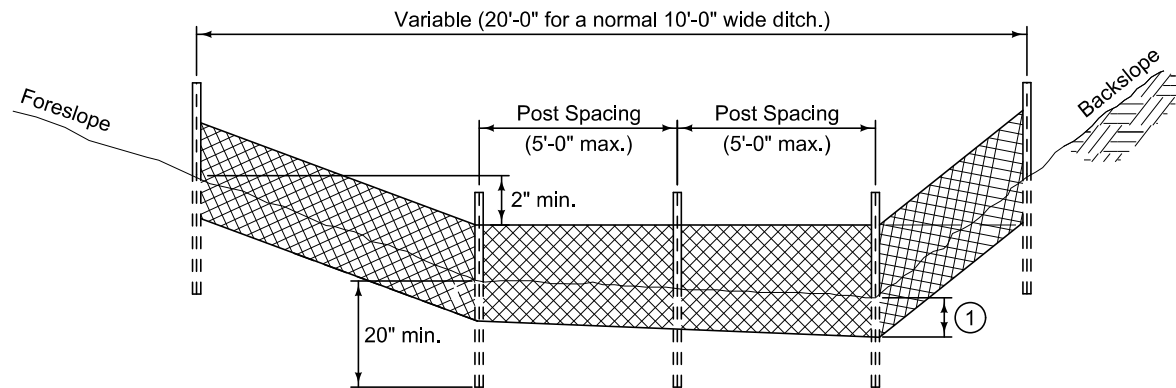


SECTION A-A

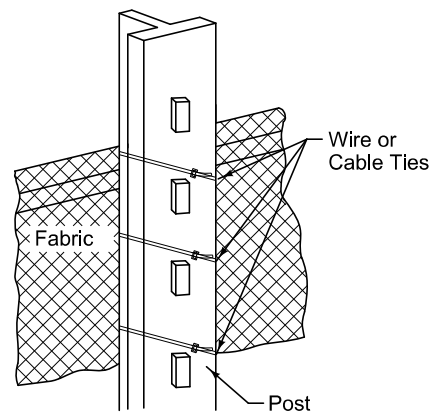
Spillway Length

H (ft.)	L (ft.)
1.5	2.0
2.0	2.0
2.5	2.5
3.0	2.5
3.5	3.0
4.0	3.0
4.5	4.0
5.0	4.5

	REVISION 2 10-21-14	
	SUDAS	
	9040.118 SHEET 1 of 1	
SUDAS Standard Specifications		
SEDIMENT TRAP		



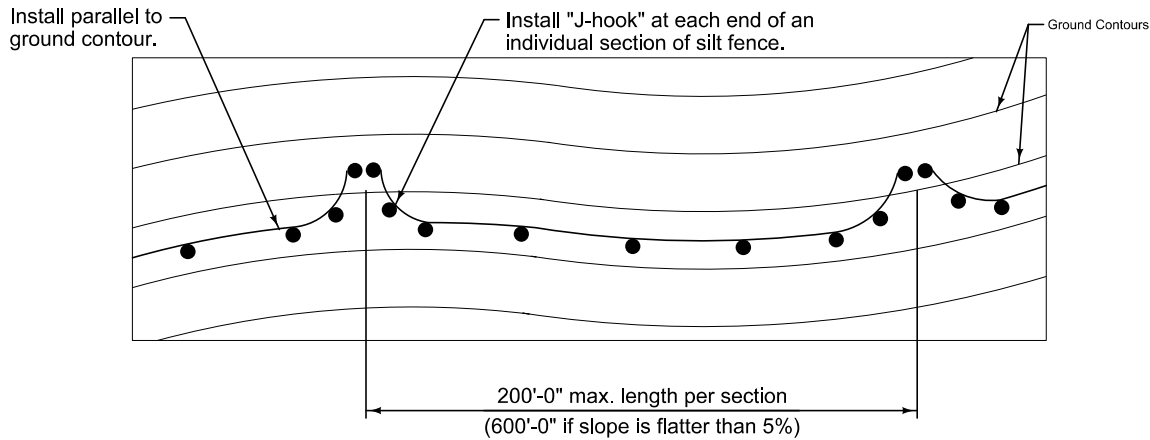
TYPICAL SILT FENCE DITCH CHECK



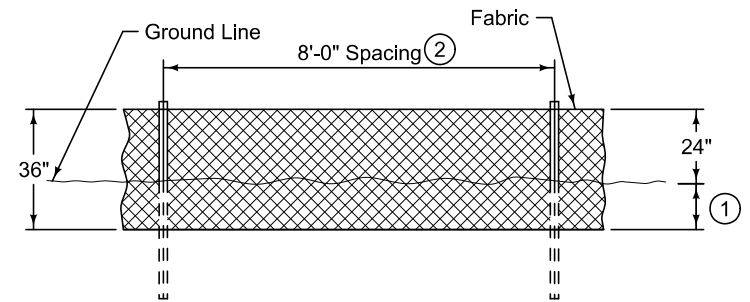
ATTACHMENT TO POST

- ① Insert 12 inches of fabric a minimum of 6 inches deep (fabric may be folded below the ground line).

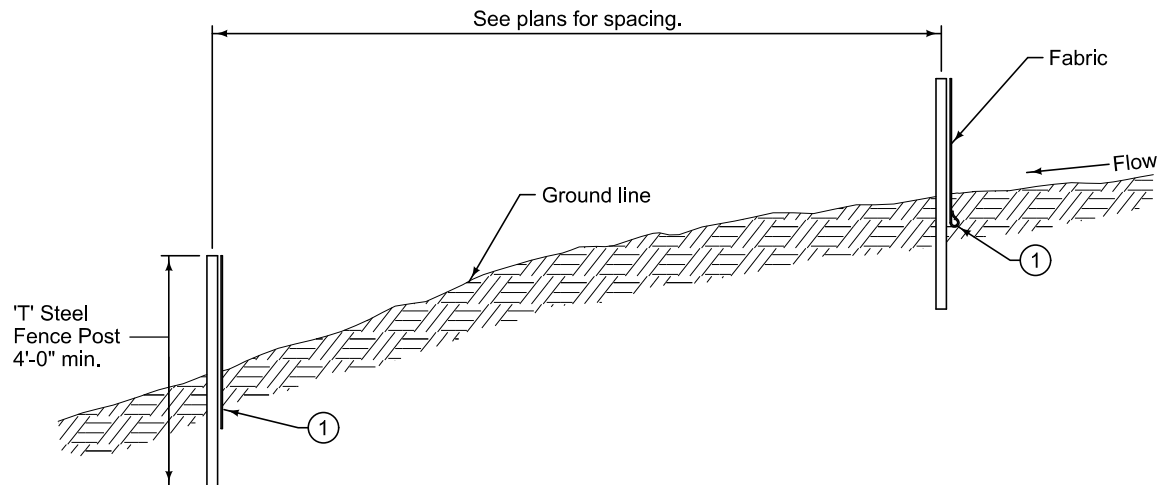
	REVISION	
	2	10-21-14
	9040.119	
	SHEET 1 of 2	
SUDAS Standard Specifications		
SILT FENCE		



TYPICAL SILT FENCE INSTALLATION ON LONGITUDINAL SLOPES
(Plan View)



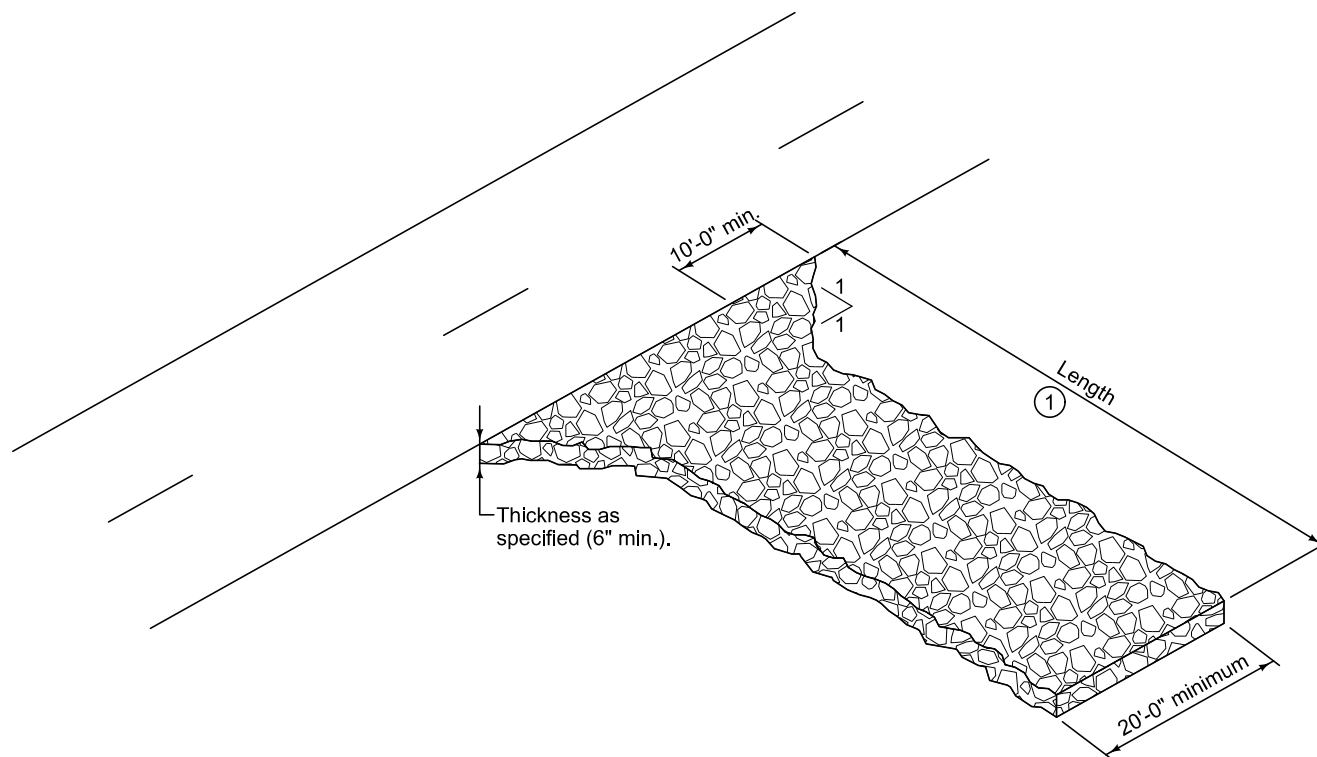
DETAILS OF SILT FENCE ON LONGITUDINAL SLOPES



TYPICAL SILT FENCE INSTALLATION ON LONGITUDINAL SLOPES
(Profile View)

	REVISION	
	2	10-21-14
	9040.119	
	SHEET 2 of 2	
	SUDAS Standard Specifications	
SILT FENCE		

- ① Entrance length: 50 foot minimum (30 foot for single family residential), or as specified in the contract documents. Length of entrance may be increased if sediment track-out occurs.



	REVISION	
	2	10-21-14
	9040.120	
	SHEET 1 of 1	
SUDAS Standard Specifications		
STABILIZED CONSTRUCTION ENTRANCE		

GABIONS AND REVET MATTRESSES**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Gabions
- B. Revet Mattresses (Gabion Mattresses)

1.02 DESCRIPTION OF WORK

- A. Assembly and installation of gabions.
- B. Assembly and installation of revet mattresses.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Upon request, submit certification that products supplied comply with identified specifications.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Gabions:**

- 1. Measurement:** Measurement will be the plan quantity in cubic yards for the total volume of each type of gabion installed.
- 2. Payment:** Payment will be at the unit price per cubic yard for each type of gabion installed.
- 3. Includes:** Unit price includes, but is not limited to, furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing gabion stone, engineering fabric, and anchor stakes.

1.08 MEASUREMENT AND PAYMENT (Continued)**B. Revet Mattresses:**

- 1. Measurement:** Measurement will be the plan quantity in cubic yards for the total volume of each type of revet mattress installed.
- 2. Payment:** Payment will be at the unit price per cubic yard for each type of revet mattress installed.
- 3. Includes:** Unit price includes, but is not limited to, furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing mattress stone, engineering fabric, and anchor stakes.

C. Excavation: Comply with [Section 2010, 1.08, E.](#)

PART 2 - PRODUCTS**2.01 DOUBLE TWISTED WIRE BASKETS**

Utilize double twisted wire baskets unless otherwise specified in the contract documents.

A. General: Fabricate baskets according to ASTM A 975.

B. Wire:

1. **Galvanized:** Comply with ASTM A 975, Style 1 for mesh, selvedge, and lacing wire.
2. **PVC Coated:** Comply with ASTM A 975, Style 3 for mesh, selvedge, and lacing wire.
3. **Tensile Strength:** Minimum tensile strength of 60,000 psi. Maximum tensile strength as specified in ASTM A 975.

C. Connections:

1. **Galvanized Gabion and Revet Mattresses:** Provide metallic coated steel lacing wire or ring fasteners complying with ASTM A 975.
2. **PVC Coated Gabions and Revet Mattresses:** Provide only stainless steel ring fasteners complying with ASTM A 975.

2.02 WELDED WIRE BASKETS

Utilize welded wire baskets only when specified in the contract documents.

A. General: Fabricate baskets according to ASTM A 974.

B. Welded Wire:

1. **Galvanized:** Comply with ASTM A 974, Style 2 for wire, selvedge, and lacing wire.
2. **PVC Coated:**
 - a. Provide Style 2, galvanized wire fabric with a minimum nominal wire diameter of 0.120 inches for gabion baskets and 0.087 inches for revet mattresses.
 - b. Coat wire with PVC. Comply with ASTM A 974, Style 5.
3. **Tensile Strength:** Minimum tensile strength of 80,000 psi. Maximum tensile strength as specified in ASTM A 974.

C. Connections:

1. **Galvanized Gabions and Revet Mattresses:** Provide metallic-coated lacing wire with a nominal diameter of 0.120 inches. Comply with the requirements of ASTM A 764 as follows:
 - a. **Tensile Strength:** Class I (Finish 1 or 2).
 - b. **Coating:** Class 3, Type B or C.
2. **PVC Coated Gabions and Revet Mattresses:** Provide stainless steel lacing wire with a nominal diameter of 0.120 inches complying with ASTM A 313, Type 302, Class 1.

2.03 GABION AND MATTRESS STONE

Comply with [Iowa DOT Section 4130](#).

2.04 ENGINEERING FABRIC

Comply with [Iowa DOT Article 4196.01, B](#) for embankment erosion control.

2.05 ANCHOR STAKES

When anchor stakes are specified in the contract documents provide 2 inch galvanized standard weight pipe complying with ASTM A 53. Provide stakes with length as specified in the contract documents.

2.06 GRANULAR SUBBASE

Comply with [Iowa DOT Section 4123](#) for modified subbase.

PART 3 - EXECUTION**3.01 SUBGRADE PREPARATION AND BEDDING**

- A. When applicable, cut and reshape the area behind a proposed gabion wall as specified in the contract documents to allow for placement of the wall.
- B. Excavate the subgrade area to the required elevation and smooth as necessary for proper placement of the gabions or mattresses.
- C. Prepare a firm unyielding subgrade foundation. In fill areas, construct and compact subgrade to no less than 95% of maximum Standard Proctor Density according to ASTM D 698.
- D. If unsuitable foundation materials exist, remove and replace with suitable materials and compact to no less than 95% of maximum Standard Proctor Density according to ASTM D 698.
- E. If specified in the contract documents, place and compact granular subbase materials to the dimensions specified in the contract documents.

3.02 ENGINEERING FABRIC

- A. Install engineering fabric under the proposed gabion or mattress installation.
- B. Extend fabric behind gabion walls to the top of the wall.
- C. Overlap adjacent sections of engineering fabric a minimum of 3 inches, with the upstream strip on top.

3.03 CONNECTIONS

Make all connections with lacing wire or approved fasteners.

A. Lacing Wire:

- 1. Loop or twist lacing wire to secure it to the wire mesh or fabric.
- 2. Proceed to lace with alternating double and single loops through every mesh or fabric opening, approximately every 3 to 4 inches, pulling each loop tight.
- 3. Secure end of lacing wire to the wire mesh or fabric by twisting or looping.

B. Fasteners: Install fasteners according to manufacturer's specified spacing.**3.04 GABION ASSEMBLY AND INSTALLATION**

- A. Refer to the contract documents for special details of gabion wall installation including height, slope of wall, gabion setback, special backfill materials, and tieback requirements. Construct these features as specified in the contract documents.
- B. Unfold baskets and flatten all kinks and bends. Erect the sides, ends, and diaphragms, ensuring all panels are in the correct position and the tops of all sides are aligned.
- C. Connect the four corners of the gabion first, followed by connecting the diaphragms to the outside walls.

3.04 GABION ASSEMBLY AND INSTALLATION (Continued)

- D. Install and secure gabion baskets together.
 - 1. After initial assembly, move baskets into their final position.
 - 2. Join empty baskets together along the vertical and top edges.
- E. Fill gabion baskets with gabion stone.
 - 1. When PVC coated baskets are specified, take care not to damage PVC coating during stone placement.
 - 2. Fill baskets in lifts not exceeding 1 foot each.
 - 3. Manually orient stones after placement of each lift.
 - 4. Machine placement of stone will be allowed. However, considerable handwork is required to provide maximum density without bulges, a compact and dense exposed face, and maximum aggregate contact with the lid and other baskets to be placed in the structure.
 - 5. For gabions 3 feet high, install internal connecting wires after placement of each lift. Internal connecting wires are not required on gabions with a height of 18 inches or less.
 - a. Connect each exposed cell face to the opposite face or diaphragm with internal connecting wires.
 - b. Install two connecting wires on each exposed face, in each cell, in between each lift.
 - c. Locate wires with equal horizontal spacing approximately 1 foot apart.
 - d. Install wires by looping each end around two mesh or fabric openings, then wrapping wire tightly around itself for at least four full turns, locking the end of the wire in place by lacing it under the previous lap.
 - e. A 3 foot high cell with one exposed face requires four connecting wires. A 3 foot high end cell with two exposed faces requires eight connecting wires.
 - 6. Fill adjacent cells consecutively. Do not allow stone fill in one cell to be more than 1 foot higher than an adjacent cell.
 - 7. Overfill gabions 1 to 2 inches to allow for settlement.
- F. Attach gabion lids.
 - 1. Pull edges of lids tight until lid meets the perimeter edge of the gabion.
 - 2. Install lacing wire or fasteners at edges and diaphragms to connect lid.
- G. Place and compact backfill behind gabion walls to the same level as the filled gabions as gabions are installed.
- H. If structure requires more than one layer, connect the upper empty baskets to the top of the completed lower gabions along the front and back edges of the baskets.

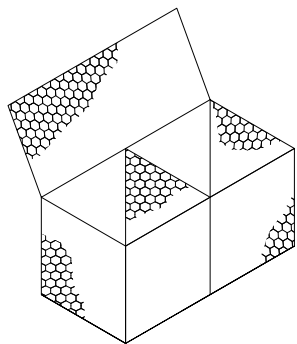
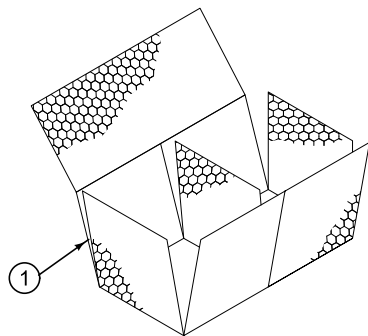
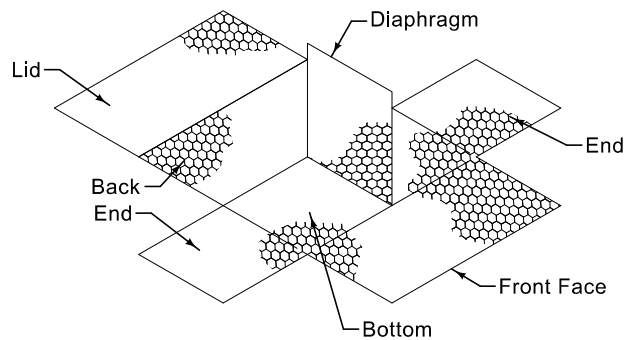
3.05 REVET MATTRESS ASSEMBLY AND INSTALLATION

- A. Assemble revet mattresses in their final location. Unroll mattress and flatten all kinks and bends.
- B. Erect the sides, ends, and diaphragms, ensuring that all panels are in the correct position and the tops of all sides are aligned.

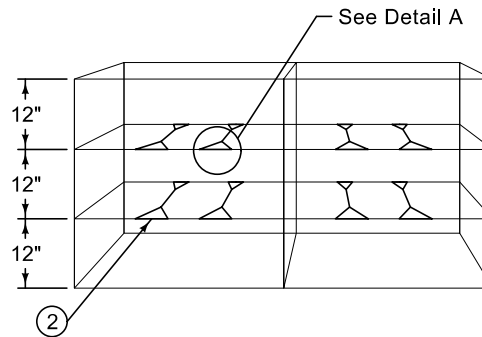
3.05 REVET MATTRESS ASSEMBLY AND INSTALLATION (Continued)

- C. Connect the four corners of the mattress first followed by connecting the diaphragms to the outside walls.
- D. Join adjacent empty mattresses together along the vertical and top edges.
- E. If anchor stakes are specified in the contract documents, install stakes at required spacing. Drive stakes into ground so the top of the stake is flush with the top of the mattress. Tie anchor stakes to baskets at the top and base of the mattress.
- F. Fill revet mattresses with mattress stone.
 - 1. When PVC coated baskets are specified, take care not to damage PVC coating during stone placement.
 - 2. Machine placement of stone will be allowed. However, handwork is required to provide maximum density without bulges or voids.
 - 3. Fill mattresses in stages as required to prevent bulges between adjacent cells.
 - 4. Overfill mattresses 1 to 2 inches to allow for natural settlement of stone.
- G. Attach mattress lids.
 - 1. Pull edges of lids tight until lid meets the perimeter edge of the mattress.
 - 2. Install lacing wire or fasteners at edges and diaphragms to connect lid.

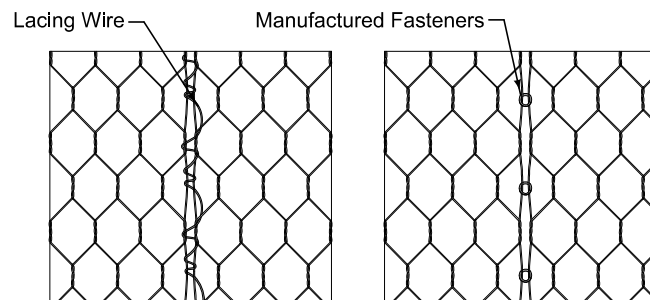
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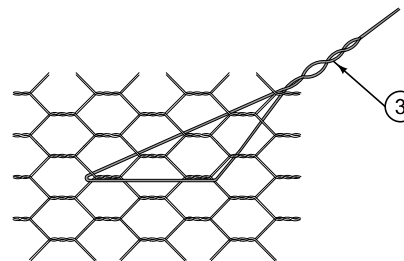
GABION ASSEMBLY



CONNECTING WIRE LOCATION



EDGE CONNECTIONS



DETAIL A

- ① Connect edges of basket with lacing wire or fasteners.
- ② Install connecting wires on exposed gabion faces.
- ③ Twist wire a minimum of four turns.

CHAIN LINK FENCE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Chain Link Fence
- B. Removal and Reinstallation of Existing Fence
- C. Temporary Fence

1.02 DESCRIPTION OF WORK

- A. Installation of chain link fence.
- B. Removal and reinstallation of existing fences.
- C. Installation and removal of temporary fence.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Materials and color samples for vinyl-coated fence fabric.
- B. Upon request, submit certification that products supplied comply with identified specifications.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Provide chain link fencing and gates as completed units, constructed by a single source, including necessary erection accessories, fittings, and fastenings.

1.08 MEASUREMENT AND PAYMENT**A. Chain Link Fence:**

1. **Measurement:** Measurement will be in linear feet for each type and height of fence, measured along the bottom of the fence fabric, excluding the length of gates.
2. **Payment:** Payment will be at the unit price per linear foot for each type and height of fence installed.
3. **Includes:** Unit price includes, but is not limited to, posts, fabric, rails, braces, truss rods, ties, tension wire, tension bands, tension bars, grounds, fittings, PVC coating (if specified in the contract documents), excavation of post holes, and concrete encasement of posts.

1.08 MEASUREMENT AND PAYMENT (Continued)**B. Gates:**

1. **Measurement:** Each type, height, and span of gate will be counted.
2. **Payment:** Payment will be at the unit price for each type, height, and span of gate.
3. **Includes:** Unit price includes, but is not limited to, gate rails, fabric, stretcher bars, braces, vertical stay, hinges, latches, keepers, drop bar lock, center gate stop, and barbed wire (if specified in the contract documents).

C. Barbed Wire:

1. **Measurement:** Measurement will be in linear feet for the length of fence to which barbed wire is applied, measured along the top of fence.
2. **Payment:** Payment will be at the unit price per linear foot of barbed wire.
3. **Includes:** Unit price includes, but is not limited to, furnishing and installing all necessary strands of barbed wire, anchors, and barbed wire supporting arms.

D. Removal and Reinstallation of Existing Fence:

1. **Measurement:** Measurement will be in linear feet for each type and size of fence removed and reinstalled, measured along the bottom of the fence fabric, including length of gates.
2. **Payment:** Payment will be at the unit price per linear foot for each size and type of fence removed and reinstalled.
3. **Includes:** Unit price includes, but is not limited to, removing vegetation; removing all fence fabric, appurtenances, posts, and gates; removal of concrete encasement from posts; storage of the removed fencing materials to prevent damage; reinstallation of the posts, gates, and fabric, including all appurtenances; and replacement of any fence parts that are not able to be salvaged and reinstalled. Replace items damaged from Contractor's operations with new materials, at no additional cost to the Contracting Authority.

E. Removal of Fence:

1. **Measurement:** Measurement will be in linear feet of fence removed, measured along the bottom of fence fabric, including length of gates.
2. **Payment:** Payment will be at the unit price per linear foot of fence removed.
3. **Includes:** Unit price includes, but is not limited to, off-site disposal of fence (including posts, concrete encasement of posts, gates, grounds, and barbed wire) and placing and compacting backfill material in post holes.

F. Temporary Fence:

1. **Measurement:** Measurement will be in linear feet for each type and height of temporary fence, measured along the bottom of the fence fabric, excluding the length of gates.
2. **Payment:** Payment will be at the unit price per linear foot for each type and height of temporary fence.
3. **Includes:** Unit price includes, but is not limited to, furnishing, installing, and removing posts, fabric, ties, and fittings.

PART 2 - PRODUCTS**2.01 FABRIC**

- A. General:** Provide fence fabric manufactured from wire meeting the requirements of ASTM A 817. Use No. 9 gauge wire woven in a 2 inch mesh. Construct knuckled selvage at the top and bottom of the fabric.
- B. Zinc-coated Fabric:** Comply with ASTM A 392.
1. **Wire Coated Prior to Weaving:** Use Type II, Class 5 zinc coating per ASTM A 817.
 2. **Fabric Coated After Weaving:** Use Class 2 coating per ASTM A 392.
- C. Aluminum-coated Fabric:** Meet the requirements of ASTM A 491. Coat wire prior to weaving fabric per ASTM A 817, Type I coating.
- D. PVC-coated Fabric:** Comply with ASTM F 668, Class 2b.
1. Apply PVC coating to zinc or aluminum-coated wire prior to weaving fabric.
 2. PVC coating color as specified in the contract documents, complying with ASTM F 934.

2.02 POSTS, RAILS, AND BRACES

- A.** Standard weight (Schedule 40) pipe complying with ASTM F 1083.
1. Galvanize pipe inside and out.
 2. Unless otherwise specified in the contract documents, provide the following nominal sizes for the respective uses:

Post Use	Fence Height		
	48" and under (nominal diameter)	48" to 96" (nominal diameter)	Greater than 96" (nominal diameter)
Line Post	2"	2 1/2"	3"
Terminal Post*	2 1/2"	3"	4"
Top/intermediate Rail Braces	1 1/4"	1 1/4"	1 1/4"
Gate Post	Refer to contract documents and ASTM F 900		
*Includes corner, angle, end, and pull posts.			

- B.** Pipe meeting the requirements of ASTM F 1043, Group 1A (Type A coating) or Group 1C (Type B coating). Use nominal sizes specified in ASTM F 1043.
- C.** When PVC-coated fence is specified in the contract documents, coat all posts, rails, and braces with a PVC-coated finish according to ASTM F 1043.
1. Zinc-coated post per ASTM F 1083 prior to application of PVC coating.
 2. Color as specified in the contract documents, complying with ASTM F 934.
- D.** Ensure all posts, rails, and braces provided for a given section of fence have similar coatings and shapes.
- E.** Provide caps for all posts. Comply with ASTM F 626.

2.03 FITTINGS

- A. Comply with ASTM F 626.
- B. Provide attachments to connect braces to posts by fittings that will hold both post and brace rigidly.
- C. Provide 3/8 inch diameter round steel diagonal tension rods with an appropriate commercial means for tightening. Provide a locknut or other device to hold the tightening device in place.
- D. Provide a suitable sleeve or coupling device, recommended by the manufacturer, to connect sections of top rail and provide for expansion and contraction.
- E. Use stretcher (tension) bars of the size specified in ASTM F 626 with suitable bands for attaching fabric to corner, end, or gate posts.

2.04 TIE WIRE AND TENSION WIRE

- A. **Tie Wire:** Provide tie wires for chain link fence that are the size and type the manufacturer recommends, but no smaller than No. 9 diameter for post ties or No. 12 diameter for rail and brace ties. Comply with ASTM F 626.
- B. **Tension Wire:** Comply with ASTM A 824, with Type I or Type II (Class 3) coating per ASTM A 817.

2.05 BARBED WIRE SUPPORTING ARMS

- A. Comply with ASTM F 626 for type of arm configuration specified in the contract documents, as listed below:
 - 1. Type I: Single slanted arm for three barbed wire strands.
 - 2. Type II: Single vertical arm for three barbed wire strands.
 - 3. Type III: V-shaped arm for six barbed wire strands.
 - 4. Type IV: A-shaped arm for five barbed wire strands.
- B. Anchor arms to line, end, corner, and pull posts

2.06 BARBED WIRE

Comply with ASTM A 121, design number 12-4-5-14R, Type A or Type Z (Class 3) coating.

2.07 GATES

- A. Provide the type, height, and width of gates as specified in the contract documents.
- B. Comply with ASTM F 900.
- C. Provide coating on gate, gate posts, and fabric as required for adjacent fence.

2.08 CONCRETE

Provide concrete materials complying with [Section 6010](#).

2.09 ELECTRICAL GROUND

- A. **Ground Rod:** 5/8 inch diameter, 8 foot long copper-clad rod.
- B. **Ground Wire:** No. 6 AWG bare copper wire.

PART 3 - EXECUTION**3.01 CHAIN LINK FENCE INSTALLATION**

A. General: Comply with ASTM F 567. Construct fence at the location and height specified in the contract documents.

B. Posts:

1. Post Location:

- a. Place posts in the line of the fence with equal spacing not to exceed 10 feet on center.
- b. Set terminal (end, corner, and gate) posts at the beginning and end of each continuous length of fence and at abrupt changes in vertical and horizontal alignments. Place pull posts so that no more than 300 linear feet of fence is constructed with only line posts.

2. Post Setting:

- a. Dig or drill post holes to the dimensions specified in the contract documents.
- b. Set posts in concrete. Ensure all posts are set plumb in a vertical position.
- c. Form top of concrete footing so it extends 1 inch above grade and is sloped to direct water away from the post. To prevent frost heave, ensure footing is a uniform size to full depth without flare at the top of grade.
- d. Install posts no less than 24 hours prior to installation of fabric.
- e. Set terminal, corner, angle, pull, and gate posts with the required brace-post assembly as specified in the contract documents.

C. Rails:

- 1. Top Rail:** Pass the top rail through the base of the line post caps to form a continuous brace from end to end of each stretch of fence. Join rail sections with sleeve or coupling device to allow for expansion and contraction. Securely fasten the top rail to the terminal posts with pressed steel connectors.
- 2. Intermediate Rail:** Securely fasten the intermediate rail between all line posts and terminal posts with pressed steel fasteners. Intermediate rail is required only on fences 8 feet tall and taller.

D. Braces:

1. Securely fasten braces to the post by means of malleable iron or pressed steel connections; then truss from the line post back to the end, gate, or corner post.
2. Tighten the diagonal tension rod (truss rod) to produce proper tension.

E. Fabric:

1. Install fabric on the outside of the posts from the area being fenced or on the roadway side of the posts.
2. Secure one end of the fabric by a stretcher bar inserted in the final link of the fabric. Pull fabric taut with bottom selvedge, 2 inches above grade, before making attachment elsewhere.
3. Tighten and secure each end of each run of chain link fabric by a stretcher bar inserted in the final link of the fabric. Secure stretcher bar to the end post by tension bands equally spaced no more than 15 inches apart.
4. Attach fence fabric securely to the braces, top rail, tension wire, and all intermediate posts with wire ties or bands at intervals of no more than 12 inches.

3.01 CHAIN LINK FENCE INSTALLATION (Continued)**F. Bottom Tension Wire:**

1. Install bottom tension wire on fence 5 feet high and taller.
2. Stretch bottom tension wire taut from terminal post to terminal post and securely fasten to each intermediate post within the bottom 6 inches of fabric.

G. Barbed Wire (When Specified):

1. Install 3 parallel wires on each barbed wire supporting arm on the outside of the area being secured, unless otherwise specified in the contract documents.
2. Pull wires taut, without kinks or twists, for tension.

H. Gates: Install gates as specified in the contract documents.**I. Electrical Grounds:**

1. Install electrical grounds as specified in the contract documents at the following locations:
 - a) Where a primary electrical transmission line (not a secondary feeder line for individual service) passes over the fence. Also install the ground on the fence at a distance of 25 to 50 feet in each direction from the crossing.
 - b) Where the fence is adjacent to and within 50 feet of a primary electrical transmission line, install the ground at 500 foot maximum intervals.
 - c) In at least one location on each applicable straight section of fence.
2. Drive ground rod vertically until the top is 6 inches below the ground surface.
3. Clamp ground wire to the rod and to the fence in such a manner that each element of the fence is grounded.

3.02 REMOVAL OF EXISTING FENCE

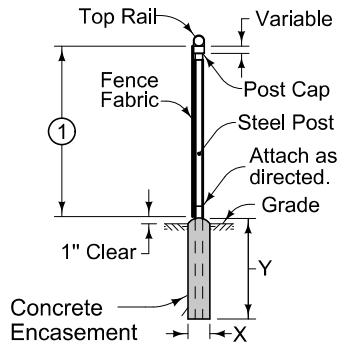
Remove all fences, including posts and footings, within work areas unless otherwise specified in the contract documents. Remove fence to first line post beyond construction limits. Replace items damaged from Contractor's operations with new materials, at no additional cost to the Contracting Authority.

3.03 TEMPORARY FENCE

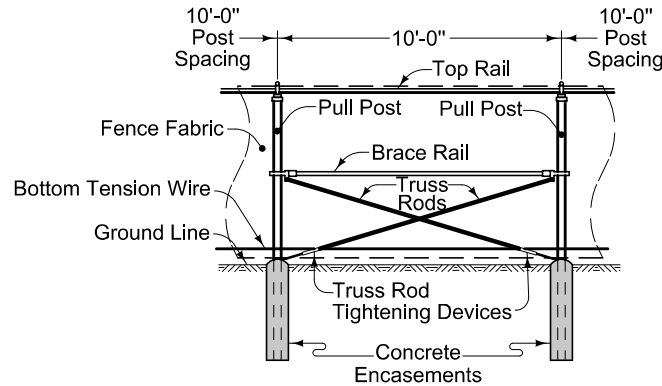
- A. Furnish and install chain link fence fabric, posts, ties, and other materials for the height specified in the contract documents.
- B. Install according to permanent fence installation specifications, with the following exceptions:
 1. Drive posts into the ground. Do not set posts in concrete except at corner or temporary gate posts.
 2. Top rail, tension wire, and bracing will not be required.
- C. Remove temporary fence and materials when no longer necessary. Place suitable backfill material in post holes. Fence materials will remain the property of the Contractor and removed from the site.

END OF SECTION

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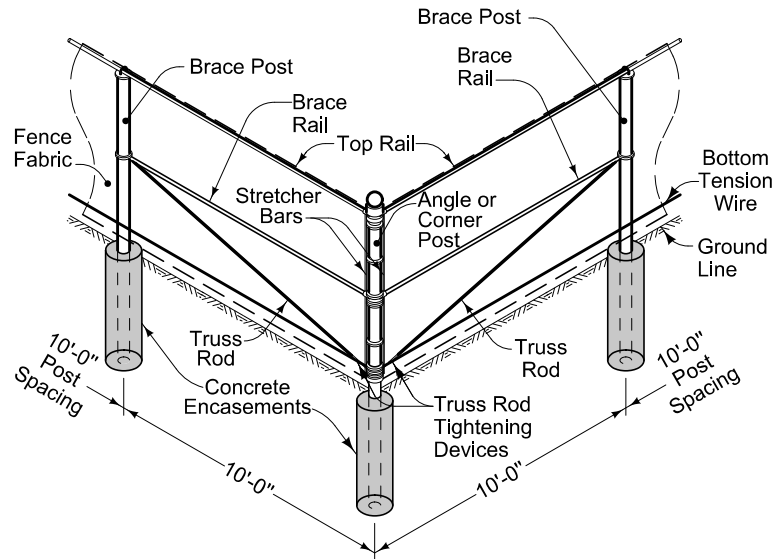
POST INSTALLATION



PULL POST INSTALLATION

Place fence fabric on roadway side of post. For certain curves, stream crossings, or other locations, the Contractor has the option to place fabric on the side of the post away from the roadway.

- ① Fabric width as specified in the contract documents.
- ② For fence heights greater than 8 feet, the depth of the fence post footing is 3 feet plus 3 inches for each 1 foot in height over 8 feet.
- ③ Install the fence on the roadway side of the right-of-way when specified in the contract documents.

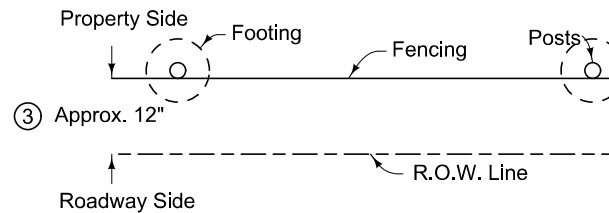


ANGLE OR CORNER POST INSTALLATION

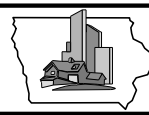
FENCE POST FOOTING DEPTH AND DIAMETER

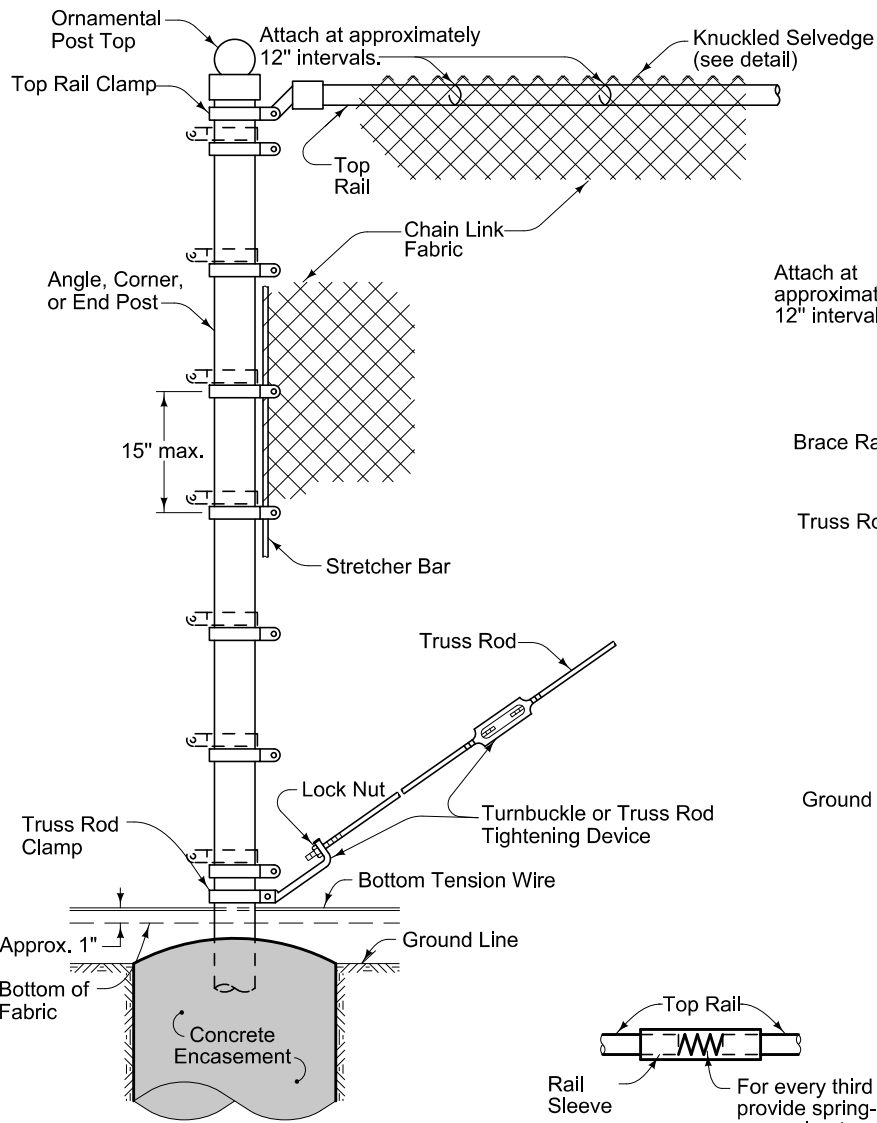
USE IN FENCE	FENCE HEIGHT					
	4'-0" and less		Over 4'-0" to 8'-0"		Over 8'-0"	
	X	Y	X	Y	X	Y
Line and Brace Posts	0'-8"	3'-0"	0'-10"	3'-0"	1'-0"	②
Terminal Post*	0'-10"	3'-0"	1'-0"	3'-0"	1'-4"	②

*Includes corner, angle, end, and pull posts.

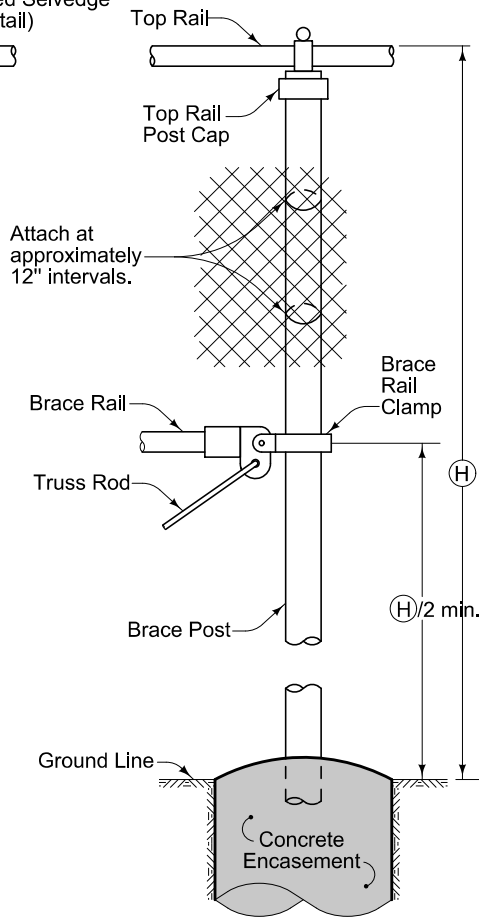


PLAN OF FENCE

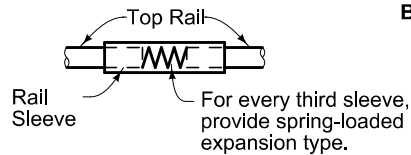
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SHEET 1 of 2		
SUDAS Standard Specifications		
CHAIN LINK FENCE		



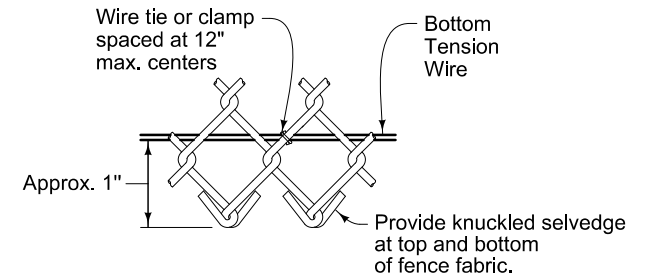
**ANGLE, CORNER, OR
END POST ASSEMBLY**



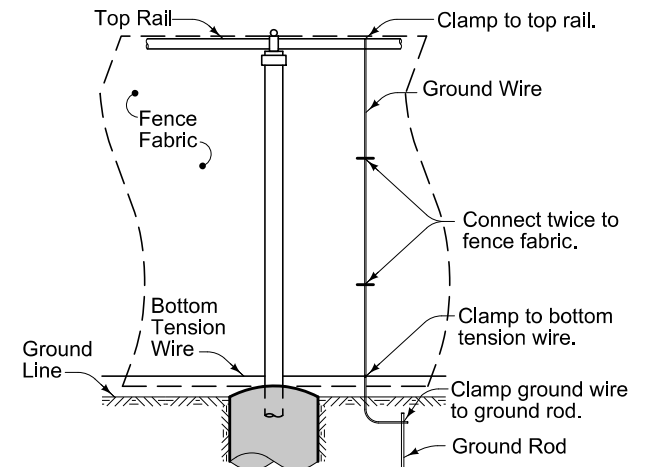
BRACE POST ASSEMBLY



RAIL SLEEVE



**BOTTOM TENSION WIRE
AND KNUCKLED SELVEDGE**

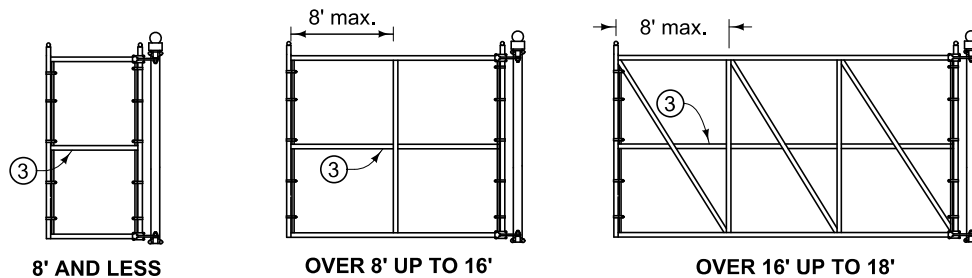


GROUND ROD INSTALLATION

FIGURE 9060.101

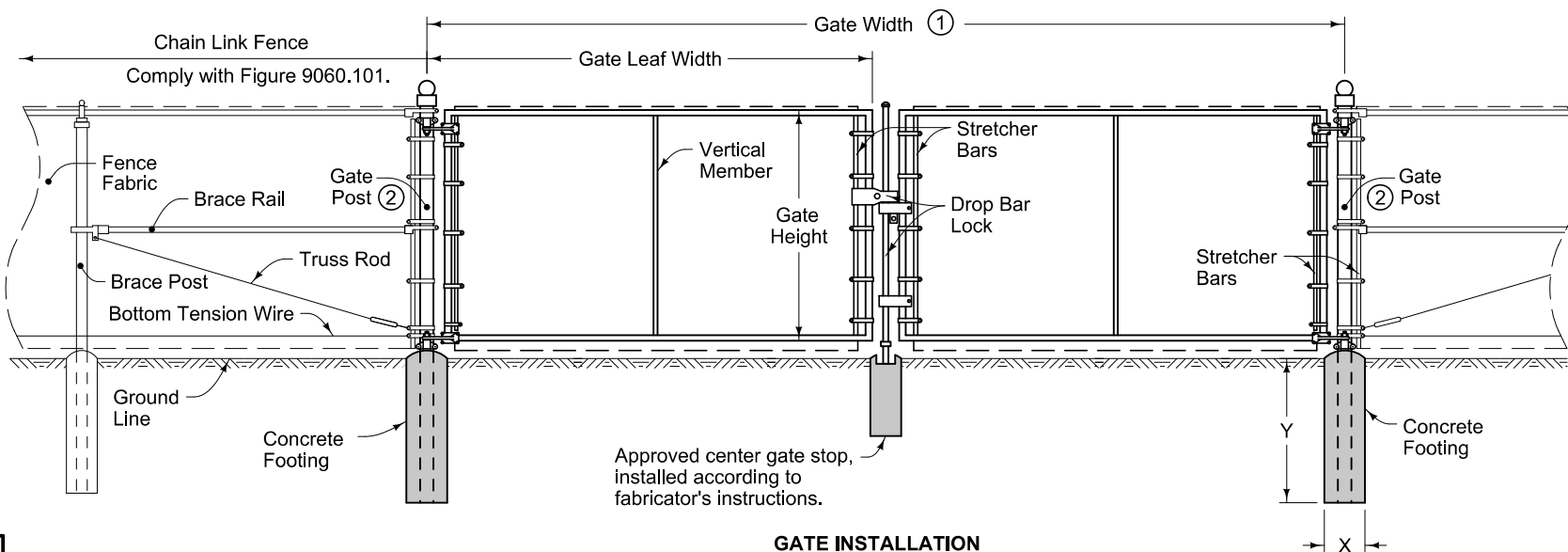
SHEET 2 OF 2

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	SHEET 2 of 2	
SUDAS Standard Specifications		
CHAIN LINK FENCE		



FRAME PATTERNS FOR VARIOUS GATE OPENINGS

- ① Double swing gate is required only for widths greater than 16 feet. Exact details of gate design are subject to approval of the Engineer. Furnish gate with approved stop, latch, and means for locking. Install as recommended by the manufacturer.
- ② End post used to terminate run of fence if no gate is proposed.
- ③ Horizontal members are required only if the fabric height is 8 feet or greater.

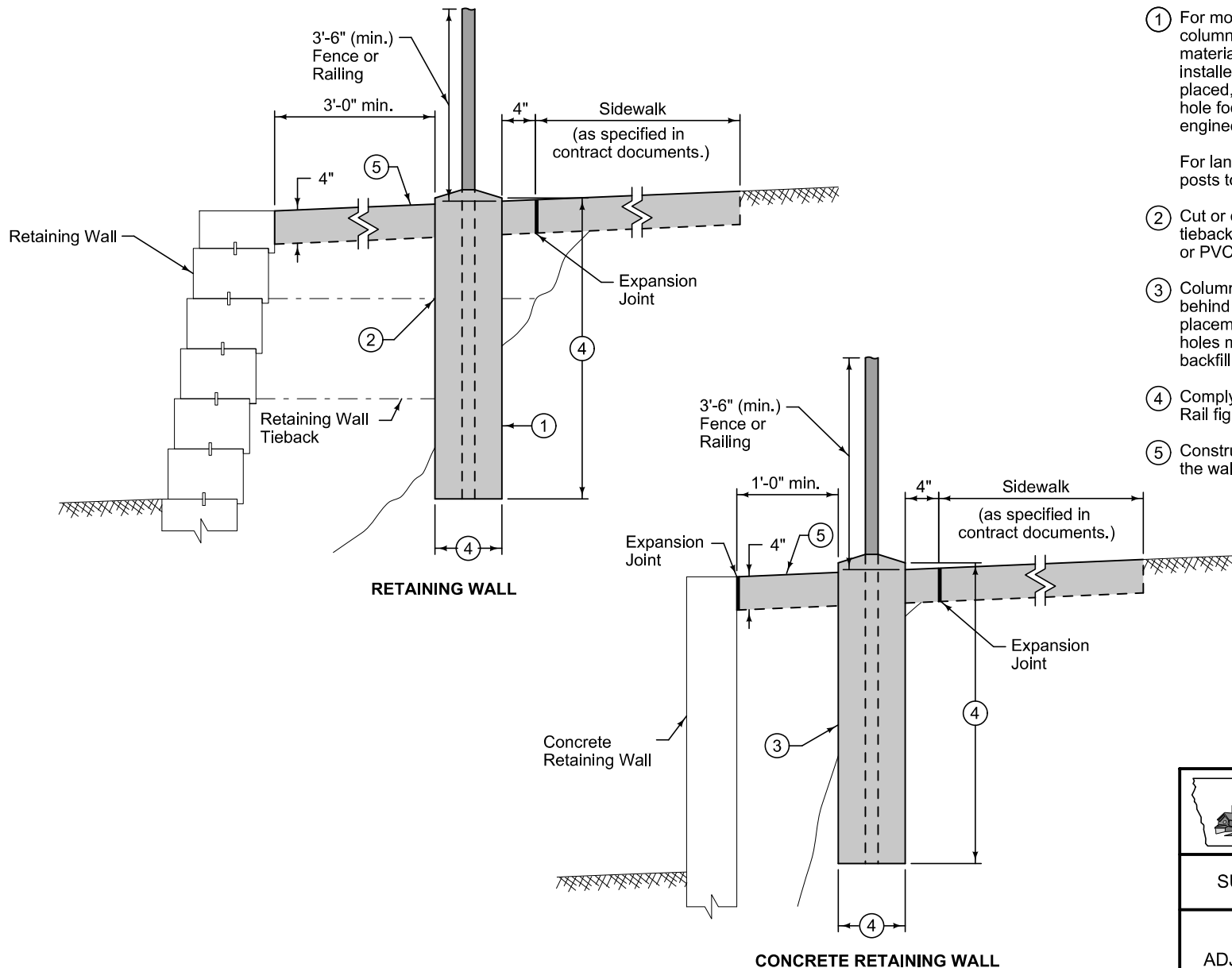


GATE INSTALLATION

GATE POST FOOTING DEPTH AND DIAMETER

GATE HEIGHT	GATE LEAF WIDTH	X	Y
6'-0" or less	4'-0" or less	0'-10"	3'-0"
6'-0" or less	over 4'-0" to 10'-0"	0'-12"	3'-0"
6'-0" or less	over 10'-0" to 18'-0"	1'-2"	3'-0"
over 6'-0"	6'-0" or less	0'-10"	3'-0"
over 6'-0"	over 6'-0" to 12'-0"	1'-0"	3'-0"
over 6'-0"	over 12'-0" to 18'-0"	1'-4"	3'-6"
over 6'-0"	over 18'-0" to 24'-0"	1'-6"	4'-0"

	REVISION
	New 10-18-11
	9060.102
SHEET 1 of 1	
SUDAS Standard Specifications	
CHAIN LINK GATE	



- ① For modular block retaining walls, install column tube or PVC pipe as backfill material is placed. When fence is installed after backfill material is placed, utilize hand excavation of post hole footings to avoid damaging engineering fabric tiebacks.
- For landscape timber walls, locate fence posts to avoid timber tiebacks.
- ② Cut or displace engineering fabric tiebacks (if present) around column tube or PVC pipe.
- ③ Column tubes or PVC pipes may installed behind PCC retaining walls during placement of backfill material or post holes may be excavated upon completion of backfill material placement.
- ④ Comply with Chain Link Fence or Safety Rail figures for post footing dimensions.
- ⑤ Construct a PCC cap between the back of the wall and the fence or rail.

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SUDAS	
9060.103	
SHEET 1 of 1	

SUDAS Standard Specifications

POST INSTALLATION
ADJACENT TO RETAINING WALLS

LANDSCAPE RETAINING WALLS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Modular Block Retaining Walls
- B. Limestone Retaining Walls
- C. Landscape Timber Retaining Walls

1.02 DESCRIPTION OF WORK

- A. Construction of modular block retaining walls.
- B. Construction of limestone retaining walls.
- C. Construction of landscape timber retaining walls.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Upon request, submit certification that products supplied comply with identified specifications.
- B. Test results on modular blocks, if required.
- C. Catalog cuts for modular retaining wall blocks and cap stones indicating the size, type, and color proposed for installation.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Modular Block Retaining Wall:**

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall, including coping or cap stones.
2. **Payment:** Payment will be at the unit price per square foot of retaining wall.
3. **Includes:** Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing wall units, geogrid (if necessary), leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, granular backfill material, suitable backfill material, and shoring as necessary.

B. Limestone Retaining Wall:

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall.
2. **Payment:** Payment will be at the unit price per square foot of retaining wall.
3. **Includes:** Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing leveling pad, limestone, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

C. Landscape Timbers:

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall.
2. **Payment:** Payment will be at the unit price per square foot of retaining wall.
3. **Includes:** Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing leveling pad, landscape timbers, spikes, reinforcing bar, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

D. Excavation and Suitable Backfill Material: If bid separately, excavation for wall construction and placement of suitable backfill material will be measured and paid according to [Section 2010, 1.08](#).**E. Fence:** Comply with [Section 9060, 1.08, A](#).**F. Safety Rail:** Comply with [Section 9080, 1.08, C](#).

PART 2 - PRODUCTS**2.01 MATERIALS****A. Modular Block Walls:****1. Dry-cast Concrete Wall Units:**

- a. Comply with ASTM C 1372 and [Iowa DOT Section 2430](#). Test units and provide samples according to ASTM C 140.
- b. Provide certification that the blocks comply with the freeze-thaw durability requirements of ASTM C 1262 and [Iowa DOT Materials I.M. 445.04](#).
- c. Furnish from an approved supplier listed in [Iowa DOT Materials I.M. 445.04](#), Appendix A ([MAPLE](#)).
- d. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
 - 1) [Iowa DOT Materials I.M. 445.04](#), Appendix B ([MAPLE](#)) lists approved systems.
 - 2) Test the required number of blocks from the lot to be installed according to [Iowa DOT Materials I.M. 445.04](#).
 - 3) Submit results of test data to the Engineer.

2. Wet-cast Concrete Wall Units: Comply with [Iowa Section 2430](#).

- a. Furnish from an approved supplier listed in [Iowa DOT Materials I.M. 445.05](#), Appendix A ([MAPLE](#)).
- b. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
 - 1) [Iowa DOT Materials I.M. 445.05](#), Appendix B ([MAPLE](#)) lists approved systems.
 - 2) Test the required number of blocks from the lot to be installed according to [Iowa DOT Materials I.M. 445.05](#).
 - 3) Submit results of test data to the Engineer.

B. Limestone: Furnish limestone slabs with a flat bottom and top and a clean face. Provide slabs with a minimum depth of 8 inches, or as specified in the contract documents, to ensure stability of the wall.

C. Landscape Timbers:

1. Minimum 6 inch by 6 inch (nominal) pressure-treated landscape timbers rated for ground contact. Ensure timbers are straight, solid, have at least three good sides, and are free of visible dry rot, with only a minor amount of splitting or cracking. Ensure all timbers used in a wall have the same cross-sectional area.
2. Provide 3/8 inch diameter galvanized spikes, 10 to 12 inches long.

D. Leveling Pad: Provide material recommended by the wall manufacturer or supplier.

1. **Granular Material:** Comply with [Iowa DOT Section 4132](#).
2. **Concrete:** Comply with [Section 6010](#). Provide Class C Concrete.

E. Subdrain: Comply with [Section 4040, 2.02](#). Minimum 4 inch diameter pipe.

F. Porous Backfill Material (for Subdrain): Comply with [Section 4040, 2.04](#).

G. Engineering Fabric: Provide fabric complying with [Iowa DOT Article 4196.01](#) for subsurface drainage.

H. Unit Fill Material: Comply with [Iowa DOT Section 4131](#).

2.01 MATERIALS (Continued)**I. Backfill Material:**

- 1. Granular Backfill Material:** Comply with [Iowa DOT Section 4133](#) when granular backfill material is necessary according to the manufacturer's requirements. Crushed stone meeting the requirements of [Iowa DOT Section 4131](#) may be substituted for granular backfill.
- 2. Suitable Backfill Material:** Comply with [Section 2010](#).

J. Fence: If the contract documents require a fence, comply with [Section 9060](#).

K. Safety Rail: If the contract documents require a safety rail, comply with [Section 9080](#).

PART 3 - EXECUTION**3.01 EXCAVATION AND EMBANKMENT**

- A. Prior to beginning wall construction, compact proposed embankment behind the wall according to the field quality control requirements of [Section 2010](#) with the following exception: compact to a minimum of 90% of maximum Standard Proctor Density.
- B. Excavate to the line and grade specified in the contract documents. Minimize over-excavation. Install sheeting, shoring, or other retention systems as required to ensure the stability of the excavation.

3.02 INSTALLATION**A. General:**

- 1. **Height:** Overall wall height is limited to 4 feet.
- 2. **Foundation Soil Preparation:** Excavate and compact 12 inches of native soil beneath the leveling pad to 95% of maximum Standard Proctor Density.
- 3. **Leveling Pad:**
 - a. Construct a minimum 6 inch thick leveling pad of granular material, at a depth such that the entire first course will be completely below the finished grade at the base of the wall.
 - b. Compact granular material with a minimum of three passes of a vibratory plate compactor.
- 4. **Subdrain:**
 - a. Install subdrain behind the first course of retaining wall. Place porous backfill material around the subdrain to a minimum cover of 3 inches, and ensure a trench width of at least 8 inches.
 - b. Wrap porous backfill material with engineering fabric.
 - c. Ensure positive drainage on subdrain, and outlet subdrains into a storm sewer or along a slope at an elevation lower than the lowest point in the pipe behind the wall.
- 5. **Fence:** If the contract documents require a fence, comply with [Section 9060](#).
- 6. **Safety Rail:** If the contract documents require a safety rail, comply with [Section 9080](#).

B. Modular Block Retaining Wall:

- 1. **Unit Installation:**
 - a. Place units side by side for the full length of wall alignment. Establish alignment by means of a string line or offset from the base line.
 - b. Ensure units are in full contact with the leveling pad.
 - c. Install connecting pins. Fill open cells of blocks with unit fill material; tamp the fill.
 - d. Sweep all excess material from top of units and install the next course. Ensure each course is completely filled prior to proceeding to the successive course.
 - e. Place each course so that pins protrude into adjoining courses a minimum of 1 inch or to tolerances recommended by the supplier/manufacturer. Two pins are required per unit. Repeat the above procedure for each course to the top of wall height.
 - f. At the end of each course, where the wall changes elevation, turn the units into the backfill material. Place units to create the minimum radius possible. Install a minimum of three units into the grade. Ensure only the front face of the units is visible from the side of the wall.

3.02 INSTALLATION (Continued)**2. Backfill Material Placement:**

- a. Place each lift of granular backfill material following the erection of each lift of wall. Where reinforcement material is present, roughly level the backfill material before placing and connecting the reinforcement. If necessary, decrease the lift thickness to obtain the specified density.
- b. At the end of each day's operations, shape the last level of backfill material to allow runoff of rain water away from the wall face.
- c. Compact granular backfill material according to the field quality control requirements of [Section 2010](#) with the following exception: ensure the moisture content falls within a range from 3% under optimum moisture to no more than the optimum moisture content.
- d. Place and compact backfill material without disturbing or distorting the tieback reinforcement (if present) or the wall. Do not use tamping type rollers or other rollers that may damage the reinforcing. Use light mechanical tampers to achieve the required compaction in a strip 3 feet wide adjacent to the backside of the wall; compaction density testing will not be required within 3 feet of the back of the wall.

- 3. Tieback Reinforcement Installation:** Install tieback reinforcement according to the manufacturer's requirements.

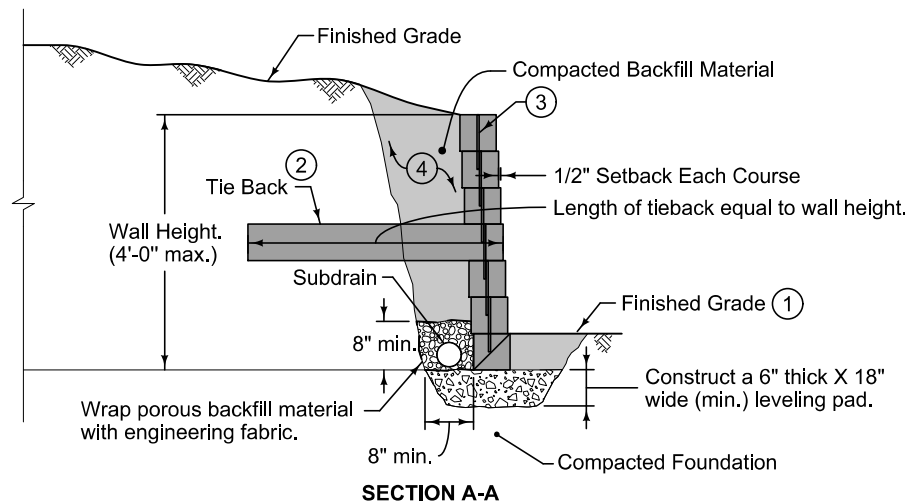
C. Limestone Retaining Wall:

1. Place limestone slabs. Ensure adjacent slabs are in full contact without gaps.
2. Stagger vertical joints so no joint is located closer than 2 feet to a joint in the course below it.
3. After each course is laid, place backfill material behind the wall and compact with hand tools to a density equal to or greater than the existing soil behind the wall.

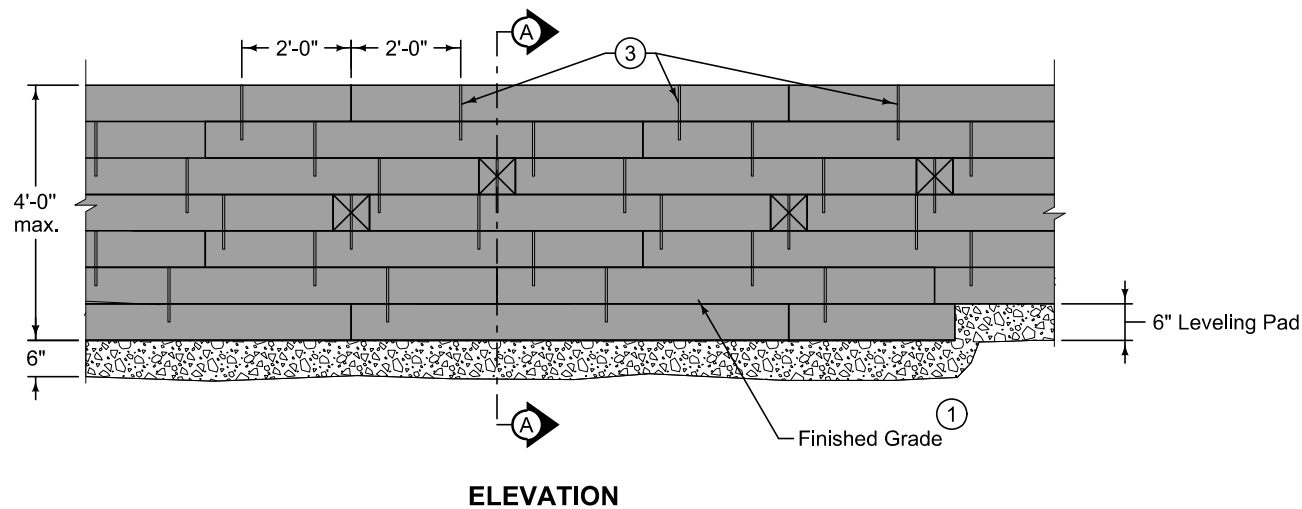
D. Landscape Timbers:

1. Lay first course of timbers horizontally, ensuring timbers are level. Set back each succeeding course 1/2 inch.
2. Secure each course to the course below it using spikes placed 2 feet from each joint and spaced at no more than 4 feet. Drill pilot holes in timbers to facilitate installation of spikes.
3. Stagger vertical joints so no joint is located closer than 2 feet to a joint in the course below it.
4. Install tiebacks with length equal to the wall height, perpendicular to the wall face, spaced at 8 feet. Stagger location of tieback on each course. Do not install tiebacks in bottom three courses or upper two courses of timbers. Ensure the end of the tieback is flush with the front of the retaining wall. Attach tieback to course below it using a spike.
5. After each course is laid, place backfill material behind the wall and compact with hand tools to a density equal to or greater than the existing soil behind the wall.

END OF SECTION

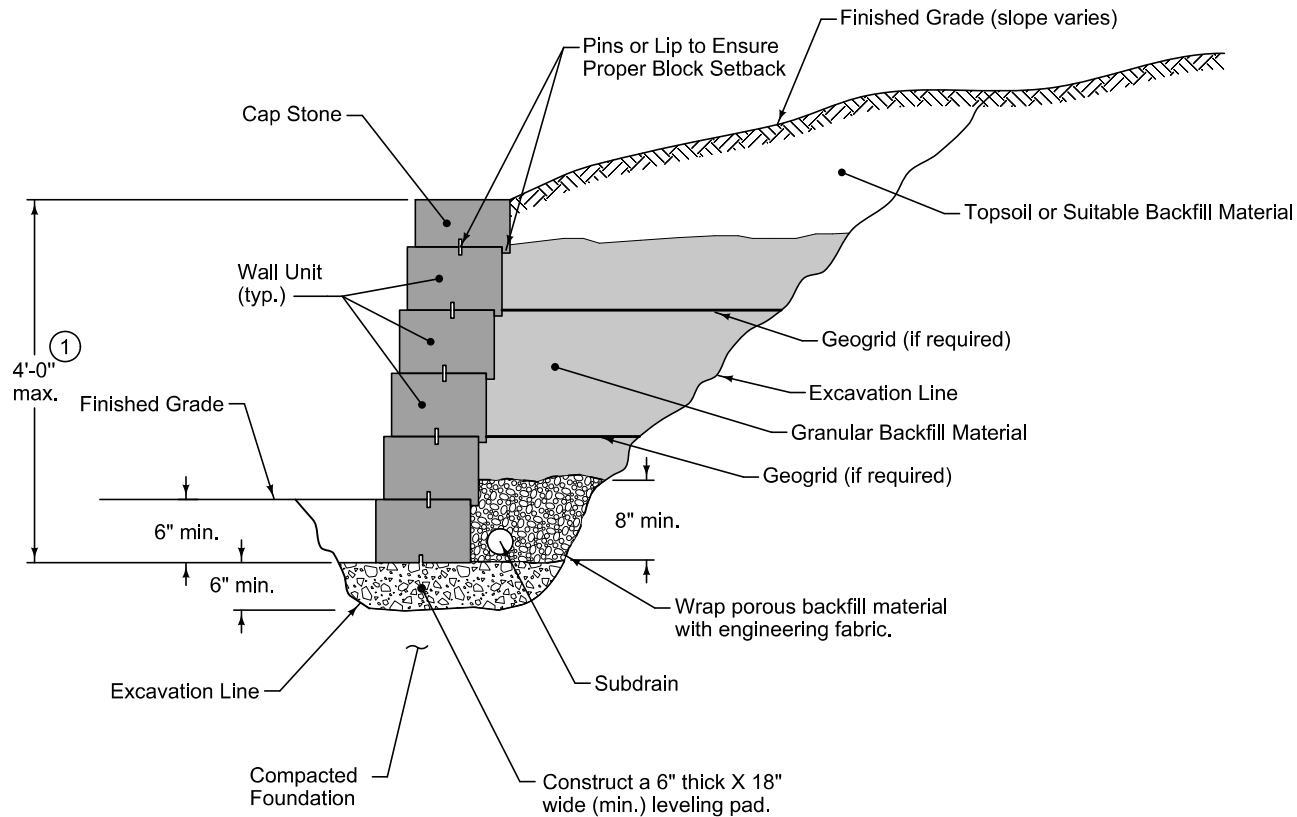


- ① Construct entire first course of timbers beneath finished grade.
- ② No tie backs in upper two courses or lower three courses of timbers. Stagger tie back location.
- ③ Secure each course with spikes.
- ④ Excavate and place backfill material. Use suitable soil or granular material.



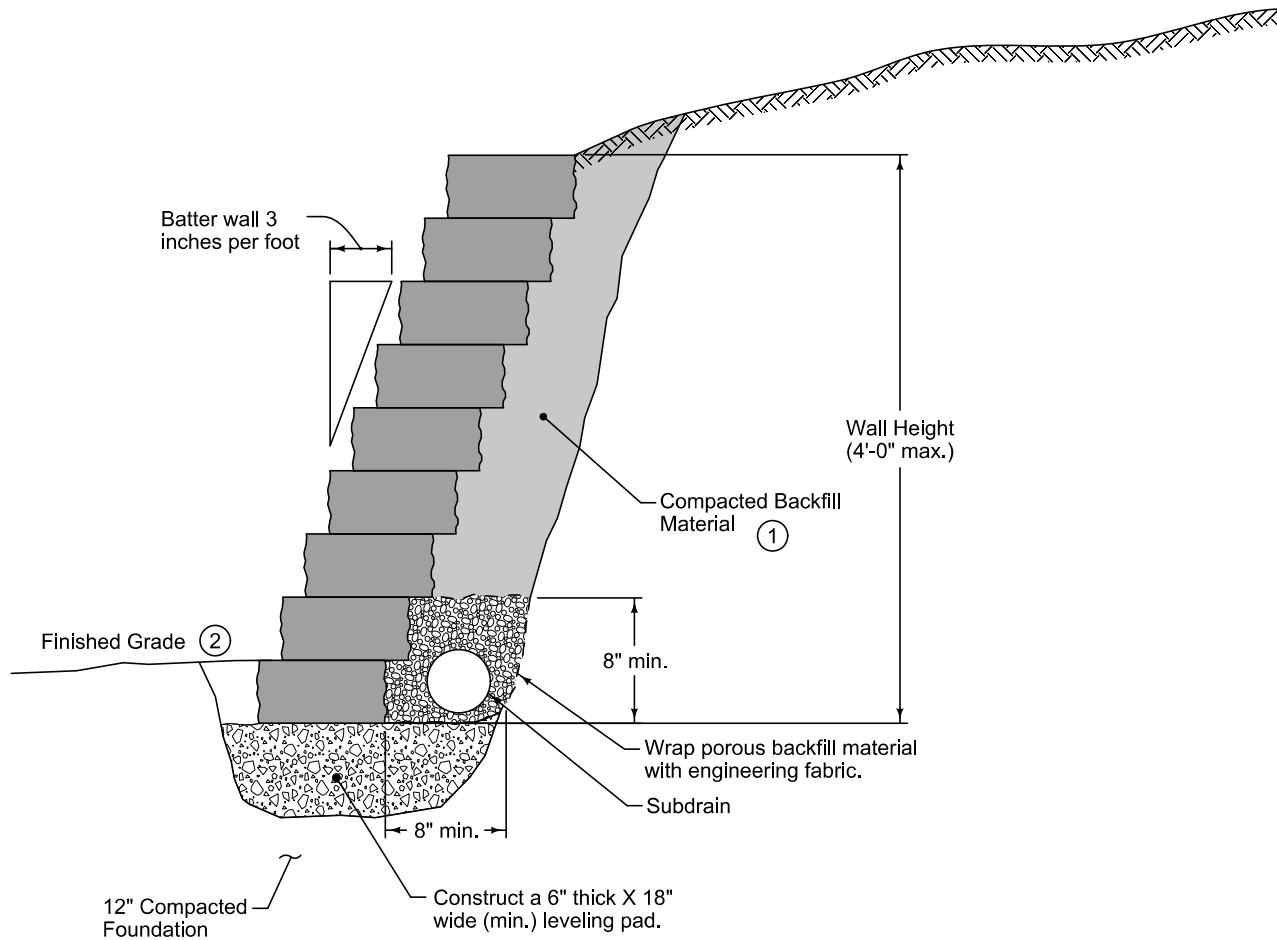
Exact dimensions, wall batter, backfill limits, reinforcement, and leveling pad materials and dimensions will be specified by the wall manufacturer.

- ① For walls higher than 4 feet, use segmental block retaining wall.



TYPICAL SECTION

	REVISION	
	New	10-18-11
	9070.102	
	SHEET 1 of 1	
SUDAS Standard Specifications		
MODULAR BLOCK RETAINING WALL		



TYPICAL SECTION

- ① Compact backfill material as wall construction progresses.
- ② Construct entire first course of limestone below finished grade.

	REVISION	
	New	10-18-11
	9070.103 SHEET 1 of 1	
SUDAS Standard Specifications		
LIMESTONE RETAINING WALL		

SEGMENTAL BLOCK RETAINING WALLS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

Segmental Block Retaining Walls

1.02 DESCRIPTION OF WORK

Constructing segmental block retaining walls.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Upon request, submit certification that products supplied comply with identified specifications.
- B. Detailed design calculations (including soil bearing pressure), construction drawings, and shop drawings for all segmental block retaining walls, prepared by a licensed Professional Engineer in the State of Iowa.
- C. A detailed explanation of the design properties of geogrid reinforcement and quality control tests limits.
- D. Test results on segmental blocks, if required.
- E. Catalog cuts of segmental retaining wall blocks and cap stones indicating the size, type, and color specified for installation.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

- A. A licensed Professional Engineer in the State of Iowa must prepare, sign, and seal detailed design calculations, construction drawings, and shop drawings for all segmental block retaining walls.
- B. Ensure design complies with the National Concrete Masonry Association (NCMA) "Design Manual for Segmental Retaining Walls."

1.08 MEASUREMENT AND PAYMENT**A. Segmental Block Retaining Wall:**

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall, including coping or cap stones.
2. **Payment:** Payment will be at the unit price per square foot of retaining wall.
3. **Includes:** Unit price includes, but is not limited to, design by a Licensed Professional Engineer in the State of Iowa, excavation, foundation preparation, furnishing and placing wall units, geogrid, leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

B. Excavation and Suitable Backfill Material: If bid separately, excavation for wall construction and placement of suitable backfill material will be measured and paid according to [Section 2010, 1.08](#).

C. Granular Backfill Material:

1. **Measurement:** Measurement will be in tons for material used in connection with segmental block retaining walls.
2. **Payment:** Payment will be at the unit price per ton of granular backfill material.
3. **Includes:** Unit price includes, but is not limited to, furnishing, transporting, placing, and compacting material.

D. Fence: Comply with [Section 9060, 1.08, A](#).

E. Safety Rail: Comply with [Section 9080, 1.08, C](#).

PART 2 - PRODUCTS**2.01 MATERIALS****A. Segmental Block Walls:****1. Dry-cast Concrete Wall Units:**

- a. Comply with ASTM C 1372 and [Iowa DOT Section 2431](#). Test and provide samples according to ASTM C 140.
- b. Provide certification that the blocks comply with the freeze-thaw durability requirements of ASTM C 1262 and the additional requirements for concrete units of [Iowa DOT Materials I.M. 445.04](#).
- c. Furnish from an approved supplier.
 - 1) [Iowa DOT Materials I.M. 445.04](#), Appendix A ([MAPLE](#)) lists approved suppliers.
 - 2) Provide written certification that blocks comply with ASTM C 1372 and the additional materials requirements of [Iowa DOT Materials I.M. 445.04](#), Appendix A ([MAPLE](#)).
- d. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
 - 1) [Iowa DOT Materials I.M. 445.04](#), Appendix B ([MAPLE](#)) lists approved systems.
 - 2) Test the required number of blocks from the lot to be installed according to [Iowa DOT Materials I.M. 445.04](#).
 - 3) Submit results of test data to the Engineer.

2. Wet-cast Concrete Wall Units: Comply with the materials and compressive strength requirements of [Iowa DOT Section 2431](#) and [Materials I.M. 445.05](#).

- a. Furnish from an approved supplier.
 - 1) [Iowa DOT Materials I.M. 445.05](#), Appendix A ([MAPLE](#)) lists approved suppliers.
 - 2) Provide written certification that blocks comply with [Iowa DOT Materials I.M. 445.05](#).
- b. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
 - 1) [Iowa DOT Materials I.M. 445.05](#), Appendix B ([MAPLE](#)) lists approved systems.
 - 2) Test the required number of blocks from the lot to be installed according to [Iowa DOT Materials I.M. 445.05](#).
 - 3) Submit results of test data to the Engineer.

3. Geogrid: Provide geogrid as specified in the retaining wall design.**B. Leveling Pad:** Provide material recommended by the wall manufacturer or supplier.**1. Granular Material:** Comply with [Iowa DOT Section 4132](#).**2. Concrete:** Comply with [Section 6010](#). Use Class C Concrete.**C. Subdrain:** Comply with [Section 4040, 2.02](#). Minimum 4 inch diameter pipe.**D. Porous Backfill Material (for Subdrain):** Comply with [Section 4040, 2.04](#).**E. Engineering Fabric:** Provide fabric complying with [Iowa DOT Article 4196.01](#) for subsurface drainage.**F. Unit Fill Material:** Comply with [Iowa DOT Section 4131](#).

2.01 MATERIALS (Continued)**G. Backfill Material:**

1. **Granular Backfill Material:** Comply with [Iowa DOT Section 4133](#) within the reinforced earth zone of segmental block retaining walls. Crushed stone meeting the requirements of [Iowa DOT Section 4131](#) may be substituted for granular backfill.
2. **Suitable Backfill Material:** Comply with [Section 2010](#).

H. Fence: If the contract documents require a fence, comply with [Section 9060](#).

I. Safety Rail: If the contract documents require a safety rail, comply with [Section 9080](#).

PART 3 - EXECUTION**3.01 EXCAVATION AND EMBANKMENT**

- A. Prior to beginning wall construction, compact proposed embankment behind the wall according to the field quality control requirements of [Section 2010](#) with the following exception: compact to a minimum of 90% of maximum Standard Proctor Density.
- B. Excavate to the line and grade specified in the contract documents. Minimize over-excavation. Install sheeting, shoring, or other retention systems as required to ensure the stability of the excavation.

3.02 INSTALLATION

- A. **Foundation Soil Preparation:** Excavate and compact 12 inches of native soil beneath the leveling pad to 95% of maximum Standard Proctor Density.
- B. **Leveling Pad:** Construct a minimum 6 inch thick leveling pad of material as specified in the contract documents.
- C. **Unit Installation:** Install materials at the proper elevation and orientation specified in the contract documents. Install the concrete segmental units and geogrid reinforcement according to the approved submittals.

D. Subdrains:

- 1. Install subdrains as specified in the contract documents to maintain gravity flow of water to the outside of the reinforced earth zone. Outlet subdrains into a storm sewer or along a slope at an elevation lower than the lowest point of the pipe within the reinforced earth zone.
- 2. Place porous backfill material around the subdrain to a minimum cover of 3 inches.
- 3. Wrap porous backfill material with engineering fabric.

E. Backfill Material Placement:

- 1. Place the backfill material in maximum 8 inch lifts, spread, and compact in such a manner that eliminates the development of wrinkles and/or movement of the geogrid reinforcement.
- 2. Compact granular backfill material according to the field quality control requirements of [Section 2010](#) with the following exception: ensure the moisture content falls within a range from 3% under optimum moisture to no more than the optimum moisture content.
- 3. Use only hand-operated compaction equipment within 3 feet of the front of the wall face.
- 4. Do not operate tracked construction equipment directly on the geogrid reinforcement. A minimum thickness of 6 inches of backfill material is required over the geogrid reinforcement prior to operation of tracked vehicles. Minimize turning of tracked vehicles to prevent tracks from displacing the fill and damaging the geogrid reinforcement.
- 5. Rubber-tired equipment may pass over the geogrid reinforcement, if done according to the manufacturer's recommendations. Avoid sudden braking and sharp turning.

3.02 INSTALLATION (Continued)**F. Geogrid Installation:**

1. Do not overlap the geogrid in the design strength direction; use one continuous piece of material. The design strength direction is perpendicular to the wall face. Butt adjacent sections of geogrid in a manner to ensure 100% coverage after placement.
2. Install the geogrid reinforcement under tension. Apply a nominal tension to the reinforcement and maintain it by staples, stakes, or hand tensioning. The tension applied may be released after the geogrid reinforcement has been covered and held in place with soil fill.

G. Fence: If the contract documents require a fence, comply with [Section 9060](#).

H. Safety Rail: If the contract documents require a safety rail, comply with [Section 9080](#).

END OF SECTION

COMBINED CONCRETE SIDEWALK AND RETAINING WALL**PART 1 - GENERAL****1.01 SECTION INCLUDES**

Combined Concrete Sidewalk and Retaining Wall

1.02 DESCRIPTION OF WORK

Constructing combined concrete sidewalk and retaining wall.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Upon request, submit certification that products supplied comply with identified specifications.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Combined Concrete Sidewalk and Retaining Wall:**

- 1. Measurement:** Measurement will be in cubic yards for the volume of combined sidewalk and retaining wall.
- 2. Payment:** Payment will be at the unit price per cubic yard of combined sidewalk and retaining wall.
- 3. Includes:** Unit price includes, but is not limited to, excavation; foundation preparation; furnishing and placing concrete and reinforcing steel; joint material; subdrain; porous backfill material; suitable backfill material; finishing disturbed areas; and shoring as necessary.

B. Fence: Comply with [Section 9060, 1.08, A.](#)

C. Safety Rail: Comply with [Section 9080, 1.08, C.](#)

PART 2 - PRODUCTS**2.01 MATERIALS****A. Combined Concrete Sidewalk and Retaining Wall:**

1. **Portland Cement Concrete:** Comply with [Section 6010, 2.03](#).
2. **Reinforcing Steel:** Comply with [Iowa DOT Section 4151](#).
3. **Expansion Joint:** Comply with [Iowa DOT Article 4136.02](#). Use resilient filler when the type is not specified.

B. Subdrain: Comply with [Section 4040, 2.02](#). Minimum 4 inch diameter.

C. Porous Backfill Material (for Subdrain): Comply with [Section 4040, 2.04](#).

D. Suitable Backfill Material: Comply with [Section 2010](#).

E. Rodent-proof Hardware Cloth: Comply with [Iowa DOT Materials I.M. 443.01](#).

F. Fence: If the contract documents require a fence, comply with [Section 9060](#).

G. Safety Rail: If the contract documents require a safety rail, comply with [Section 9080](#).

PART 3 - EXECUTION**3.01 EXCAVATION AND EMBANKMENT**

- A. Prior to beginning wall construction, compact proposed embankment behind the wall according to the field quality control requirements of [Section 2010](#) with the following exception: compact to a minimum of 90% of maximum Standard Proctor Density.
- B. Excavate to the line and grade specified in the contract documents. Minimize over-excavation. Install sheeting, shoring, or other retention systems as required to ensure the stability of the excavation.

3.02 INSTALLATION**A. General:**

- 1. Comply with [Section 6010](#).
- 2. Forming the back of the wall is not required. Where the back of the walls is not formed and sloughing occurs, remove the loose material, and replace with concrete at no additional cost to the Contracting Authority.
- 3. Install 3 inch diameter weep holes at 8 foot intervals. Form weep holes with an approved rustproof device backed with rodent-proof hardware cloth.
- 4. Install 8 inch wide trench of porous backfill behind the wall. Install subdrain within porous backfill trench. Ensure positive drainage on subdrain.

B. Backfill Material Placement:

- 1. Place the backfill material in maximum 8 inch lifts, spread, and compact.
- 2. Compact granular backfill material according to the field quality control requirements of [Section 2010](#) with the following exception: ensure the moisture content falls within a range from 3% under optimum moisture to no more than the optimum moisture content.
- 3. Use only hand-operated compaction equipment within 3 feet of the front of the wall face.

C. Fence: If the contract documents require a fence, comply with [Section 9060](#).

D. Safety Rail: If the contract documents require a safety rail, comply with [Section 9080](#).

3.03 JOINTS

- A. Form ED joints in the wall at no more than 60 foot spacing. Affix expansion material to retaining wall.
- B. Form C joints in the wall at no more than 20 foot spacing.
- C. Form E joints in the sidewalk to coincide with ED joints in the wall. Form C joints in the sidewalk at spacing equal to the sidewalk width.
- D. Form a longitudinal joint in the sidewalk when the sidewalk width is greater than 8 feet.

3.04 RUSTICATION

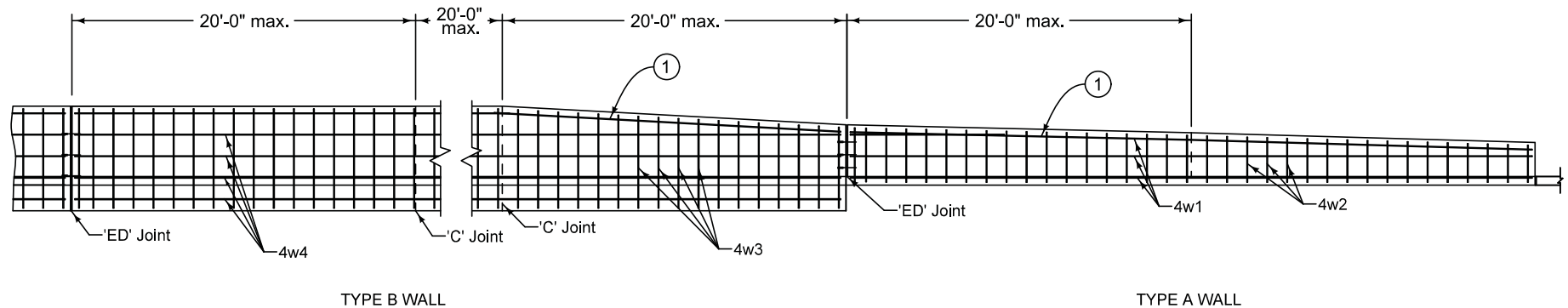
Decorative form liners or inserts may be used when forming the face of the wall with the approval of the Engineer. Form rustications as specified in the contract documents.

END OF SECTION

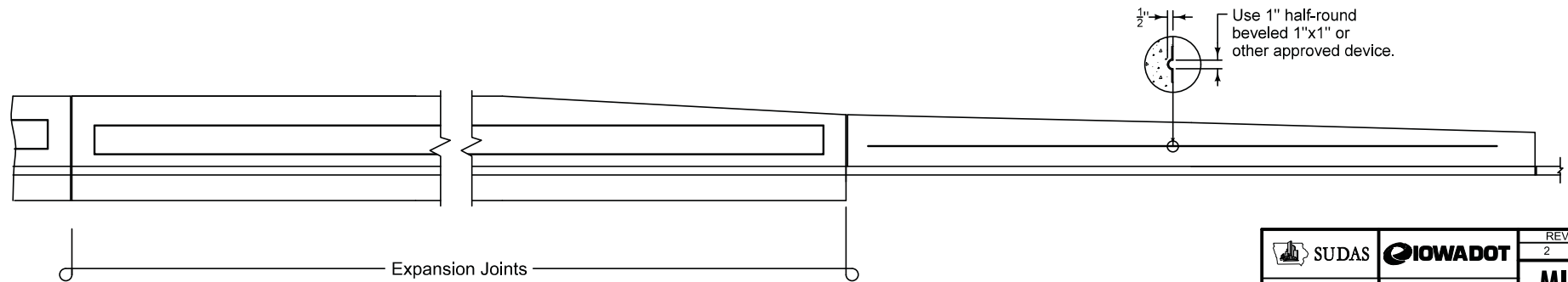
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Provide a minimum concrete cover to near reinforcement of 1 1/2 inches. Provide 3 inches minimum cover at the ends of bars.

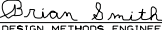
- ① Top bar parallel to top of wall. Lap 6 inch minimum as necessary. Tie securely.

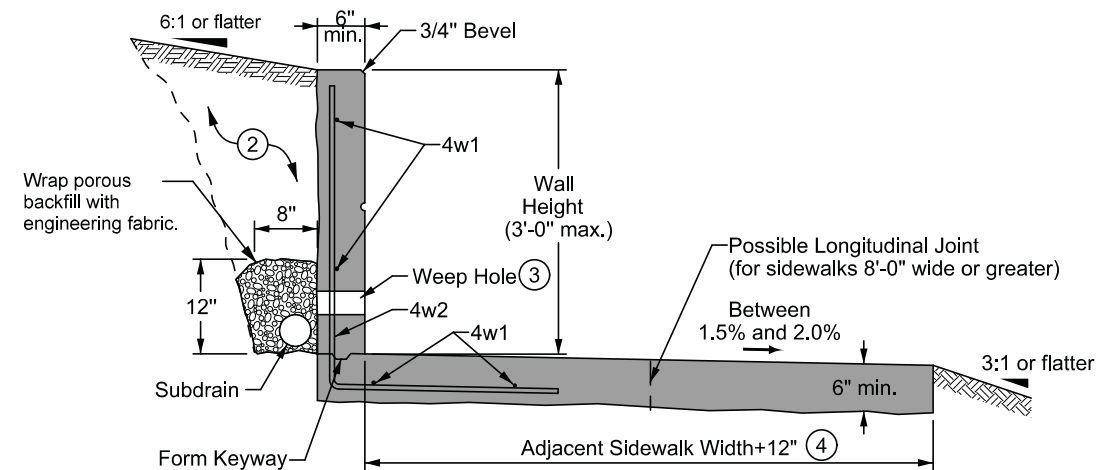


TYPICAL LONGITUDINAL SECTION OF RETAINING WALL

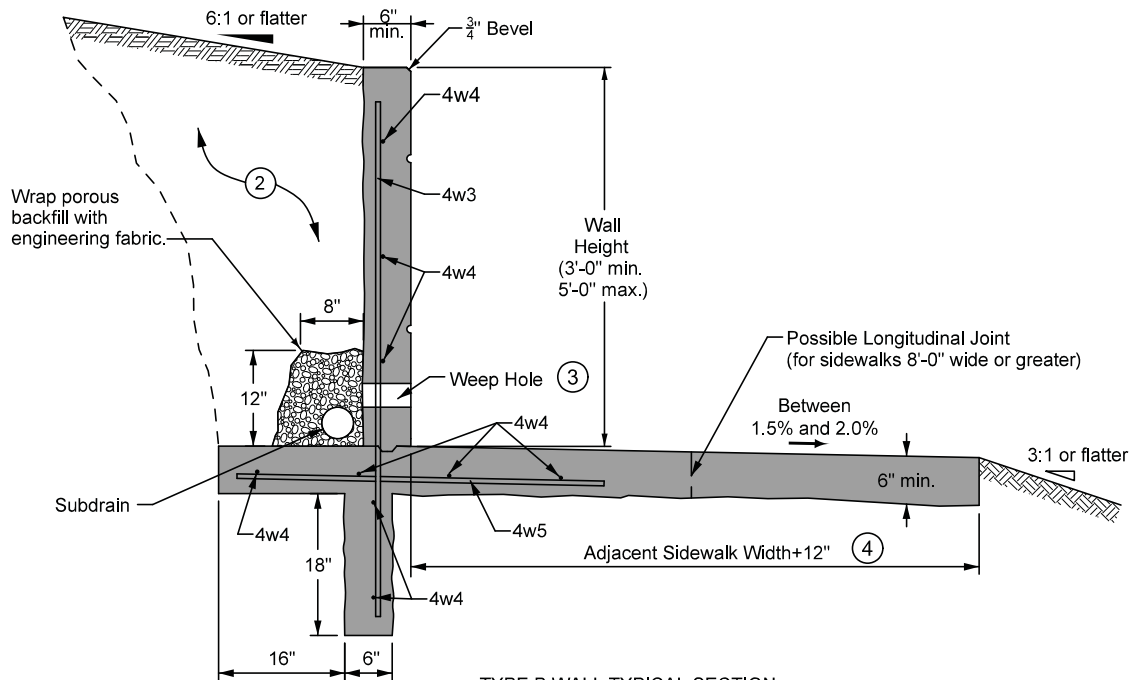


TYPICAL RUSTICATION DETAIL

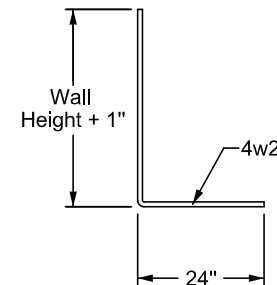
 SUDAS	 IOWADOT	REVISION
		2 10-20-15
FIGURE 9072.221	STANDARD ROAD PLAN	MI-221
		SHEET 1 OF 2
REVISIONS: Replaced DOT and SUDAS logos with new versions,		
 SUDAS DIRECTOR		 DESIGN METHODS ENGINEER
COMBINED RETAINING WALL - SIDEWALK		



TYPE A WALL TYPICAL SECTION



TYPE B WALL TYPICAL SECTION



BENT BARS

Provide a minimum concrete cover to near reinforcement of 1 1/2 inches. Provide 3 inches minimum cover at the ends of bars.

- ② Excavate and place backfill material as necessary.
- ③ Provide 3 inch diameter weep holes at 8 foot intervals. Install rodent guards in weep holes. Align bottom of weep hole with top of subdrain.
- ④ Additional 12 inch width is adjacent to wall.

REINFORCING BAR LIST

Wall Type	Mark	Size	Shape	Length	Spacing
Type A	4w1	4	—	Variable	15"
	4w2	4	L	Variable	14"
Type B	4w3	4	—	Wall Height + 18"	14"
	4w4	4	—	Variable	15"
	4w5	4	—	3'-10"	14"

SUDAS IOWADOT FIGURE 9072.221 STANDARD ROAD PLAN	REVISION 2 10-20-15 MI-221 SHEET 2 OF 2
	REVISIONS: Replaced DOT and SUDAS logos with new versions. <i>Paul D. Wigand</i> SUDAS DIRECTOR <i>Brian Smith</i> DESIGN METHODS ENGINEER
COMBINED RETAINING WALL - SIDEWALK	

CONCRETE STEPS, HANDRAILS, AND SAFETY RAIL**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Concrete Steps
- B. Handrails
- C. Safety Rail

1.02 DESCRIPTION OF WORK

- A. Construction of concrete steps.
- B. Furnishing and installation of handrails.
- C. Furnishing and installation of safety rail.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Submit color samples and product literature for primer, paint, and powder coating to be used on handrails and safety rail.
- B. Submit shop drawings for handrails and safety rail.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

- A. Provide 1 gallon of color matched exterior grade polyurethane paint for each color specified, for the Contracting Authority's maintenance use.
- B. Label each container with the manufacturer's name, product number, and color number.

1.08 MEASUREMENT AND PAYMENT**A. Concrete Steps:**

1. **Measurement:** Measurement will be the area of concrete steps in square feet for each type of concrete step. The length will be the horizontal length between expansion joints, and the width will include curbs.
2. **Payment:** Payment will be at the unit price per square foot of concrete steps.
3. **Includes:** Unit price includes, but is not limited to, reinforcement, expansion joint material, and preparation of subgrade.

B. Handrail:

1. **Measurement:** Measurement will be in linear feet for each type of handrail, measured along the top of the handrail from end of rail to end of rail.
2. **Payment:** Payment will be at the unit price per linear foot for each type of handrail.
3. **Includes:** Unit price includes, but is not limited to, posts, mounting hardware or concrete grout, and finishing (painted, galvanized, or powder coated).

C. Safety Rail:

1. **Measurement:** Measurement will be in linear feet for safety rail, measured along the top of the safety rail from end post to end post.
2. **Payment:** Payment will be at the unit price per linear foot of safety rail.
3. **Includes:** Unit price includes, but is not limited to, posts, pickets, mounting hardware, epoxy grout, and finishing (painted, galvanized, or powder coated).

PART 2 - PRODUCTS**2.01 STEPS**

- A. Concrete:** Class C concrete complying with [Section 6010, 2.03](#).
- B. Reinforcing Steel:** Comply with [Iowa DOT Section 4151](#) for epoxy coated reinforcement. Comply with ACI-318 for dowel bar substitutes.
- C. Expansion Joint:** Comply with [Iowa DOT Section 4136.03, A](#).
- D. Forms:** Comply with [Iowa DOT Section 2403](#).

2.02 HANDRAIL

1 1/4 to 2 inches in diameter; ensure post diameter matches handrail diameter.

- A. Steel:** Welded or seamless black steel pipe and posts complying with ASTM A 53, Grade A or B.
- B. Aluminum:** Aluminum-alloy extruded structural pipe complying with ASTM B 429, alloy 6061-T6 or 6063-T6, schedule 40 (if specified; for use with grouted connection only).
- C. Bends:** Provide manufactured pipe bends and connections for handrail. Do not field bend pipe.

2.03 SAFETY RAIL

- A. Rails and Posts:** Provide 2 1/2 inch by 2 1/2 inch tubular high strength steel with 1/4 inch minimum wall thickness. Comply with ASTM A 500, Grade B.
- B. Pickets:** Provide 1 inch by 1 inch tubular high strength steel with 1/8 inch minimum wall thickness. Comply with ASTM A 500, Grade B.

2.04 FINISH

- A. Painted:** Provide factory-mixed paint / primer.
 - 1. Primer:** Provide single component, water-based rust and corrosion resistant primer specifically designed for use on steel surfaces.
 - 2. Paint:** Provide water-based, abrasion-resistant paint specifically designed for use on steel surfaces.
- B. Galvanized:** When specified in the contract documents, galvanize handrail and safety rail.
 - 1. Provide zinc coating complying with ASTM A 123.
 - 2. Hot-dip galvanize components after fabrication.
 - 3. For hot-dip galvanized components that will be powder coated, utilize the dry-kettle (pre-fluxing) process. Air cool galvanized components. Do not quench in water or chromate.
- C. Powder Coated:** Apply powder coat to steel, galvanized steel, or aluminum handrail and safety rail when specified in the contract documents. Comply with the manufacturer's recommendations for surface preparation, application of primer, and application of the powder coating, in addition to the following minimum requirements.

2.04 FINISH (Continued)**1. Surface Preparation:****a. Steel Substrate:**

- 1) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1. Rinse thoroughly with hot water or water pressure and dry completely.
- 2) Remove loose rust, loose mill scale, and other foreign substances by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
- 3) Remove all dirt, grease, rust scale, mill scale, paint, slag, and other foreign substances by blast cleaning. Comply with SSPC-SP 6.
- 4) Remove all blast cleaning products by means of vacuuming or compressed air.
- 5) Chemically clean surface to remove residual contamination, apply conversion coating, and apply sealing agent to prepare the surface for powder coating.
- 6) Begin powder coating as soon as possible after surface preparation to prevent the development of iron oxide on the surface of the steel.

b. Galvanized Steel Substrate:

- 1) Remove all tears, spikes, high spots, or other surface defects caused by the galvanizing process using hand or power tools.
- 2) Apply an alkaline solution, with a pH between 11 and 12, to remove traces of oil, grease, and dirt.
- 3) Remove residual zinc oxide by spraying surface with a mild acidic solution (pH of 3.5 to 4.5).
- 4) Apply conversion coating to the surface and apply sealing agent to prepare the surface for powder coating.

c. Aluminum Substrate:

- 1) Clean surface by power washing to remove contaminants.
- 2) Clean surface with an aqueous alkaline solution by immersion or scrubbing with a soft brush. Do not scrub with a steel bristle brush. Dry completely after cleaning.
- 3) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1.
- 4) Remove light deposits of aluminum reaction by-products by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
- 5) Remove aluminum oxide by sweep blasting or chemical treatment:
 - a) Sweep Blasting:
 - i) Utilize oil-free compressed air to prevent contamination of cleaned surface.
 - ii) Utilize blast media with a MOH hardness of 5 or less, or utilize organic media such as corn cobs or walnut shells. Do not roughen surface.
 - iii) Powder coat surface within 60 minutes of sweep blasting to prevent re-formation of aluminum oxide.
 - b) Chemical Treatment: Comply with ASTM D 1730 for Type B treatment.
- 6) Chemically clean surface to remove residual contamination, apply conversion coating, and apply sealing agent to prepare the surface for powder coating.

2. Priming: Apply as recommended by coating manufacturer for specific substrate to all surfaces, unless specifically not required by coating manufacturer.**3. Coating:****a. General:**

- 1) Provide complete multi-coat systems formulated and recommended by the manufacturer for the application indicated.
- 2) Provide urethane, TGIC polyester, polyester wrinkle, or non-TGIC polyester based powder coatings as recommended by the powder coating manufacturer to provide long term exterior durability.

2.04 FINISH (Continued)**b. Application:**

- 1) Apply coating to the thickness specified by the coating manufacturer. Comply with coating manufacturer's recommendations for application of powder coating.
- 2) Apply coating in uniform thickness coats without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

4. **Curing:** Cure the powder coating at the temperature and for the time recommended by the powder coating manufacturer.

2.05 ATTACHMENT**A. Bolted Connection:**

1. **Anchor plate:** 1/4 inch thick, 6 inch by 6 inch steel anchor plate with a 46,000 psi yield strength. Paint or galvanize anchor plate to match handrail or safety rail.
2. **Bolts:** Provide 3/8 inch galvanized anchor bolts or threaded rod with length as required to provide a 3 inch embedment. Comply with ASTM A 36.
3. **Adhesive Anchoring Material:**
 - a. Epoxy complying with ASTM C 881, Type IV. Provide appropriate epoxy class based upon concrete temperature at time of installation.
 - b. Grout on approved products list in [Iowa DOT Materials I.M. 491.11](#), Appendix C.

B. Grouted Connection:

1. **Polymer Grout:** Comply with [Iowa DOT Materials I.M. 491.11](#).
2. **Non-shrink Grout:** Comply with [Iowa DOT Materials I.M. 491.13](#).

PART 3 - EXECUTION**3.01 INSTALLATION OF STEPS**

- A. Prepare Subgrade:** In fill areas, construct and compact subgrade to 95% of maximum Standard Proctor Density.
- B. Forming:** Comply with [Iowa DOT Article 2403.03, B](#).
- C. Concrete:** Comply with [Section 6010, 3.02](#). Deposit concrete for the full depth of the steps in one operation.
- D. Reinforcing Steel:** Comply with [Iowa DOT Section 2404](#). Provide a minimum 2 inches of cover on all reinforcing steel.

3.02 INSTALLATION OF RAIL**A. General:**

- 1. Install rail continuously with no gaps or breaks along the length specified in the contract documents.
- 2. Use welded connections between rail components. Grind connections to remove sharp or abrasive edges and to remove other irregularities.

- B. Handrail:** Install the top rail between 34 inches and 38 inches above the nose of the step tread. Maintain a consistent height above the step treads. Install the bottom rail midway between the nose of the step and the top rail.

C. Safety Rail:

- 1. **Rails:** Install the top rail a minimum of 42 inches above the finished grade. Install the bottom rail a maximum of 4 inches above finished grade.
- 2. **Pickets:** Locate pickets in the center of the top and bottom rails and space evenly between posts. Provide a maximum clear opening between pickets of 4 inches.

- D. Posts:** Install posts at a maximum spacing of 8 feet. Attach handrail posts in one of following two ways.

1. Bolted Connection:

- a. Weld anchor plate to the bottom of the handrail posts.
- b. Layout location and drill four 7/16 inch holes for anchor bolts at each post attachment point. Drill holes with a carbide drill bit; do not core drill anchor bolt holes.
- c. Apply adhesive anchoring material according to manufacturer's published recommendations and install threaded rod or anchor bolts.

2. Grouted Connection:

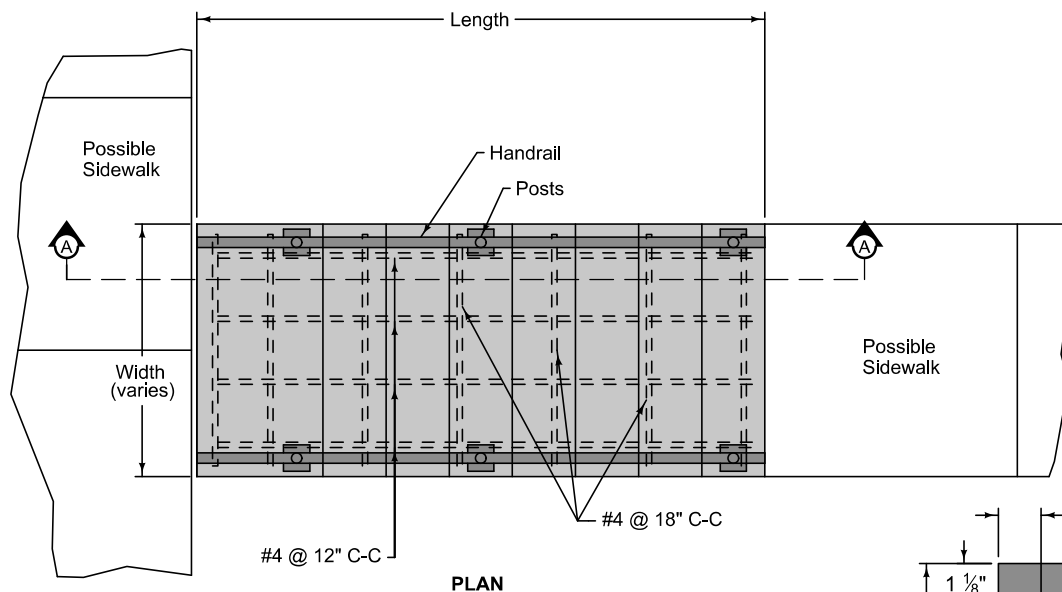
- a. Form a 6 inch deep hole in the concrete curb 1 inch larger than the outside diameter of the post. Alternatively, hole may be core drilled in hardened concrete.
- b. After the concrete hardens, set handrail posts into holes and temporarily secure.
- c. Fill the void between the post and holes with non-shrink or polymer grout.

3.03 PAINTING

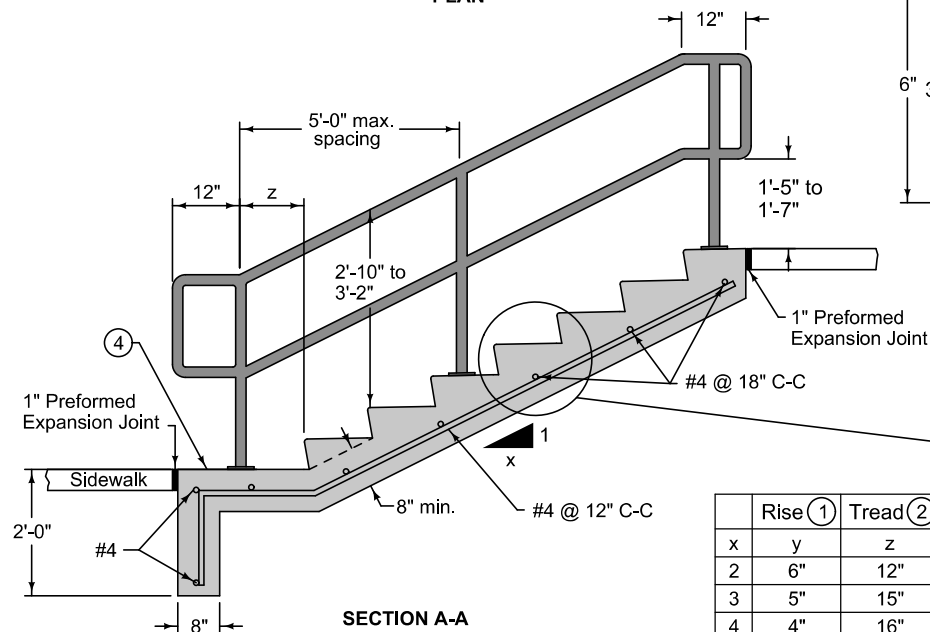
Do not paint hot dipped galvanized or aluminum handrail or safety rail.

- A. Mix paint and/or primer to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to paint unless such procedure is specifically described in manufacturer's product instructions.
- B. Shop coat handrail, safety rail, posts, pickets, and anchor plates with primer following fabrication.
- C. Apply two field coats of paint upon completion of installation.

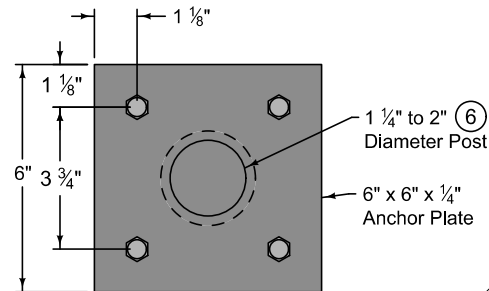
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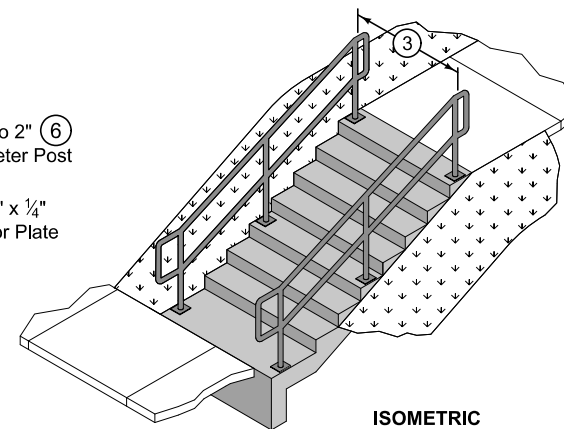
PLAN



SECTION A-A



ANCHOR PLATE DETAIL



ISOMETRIC

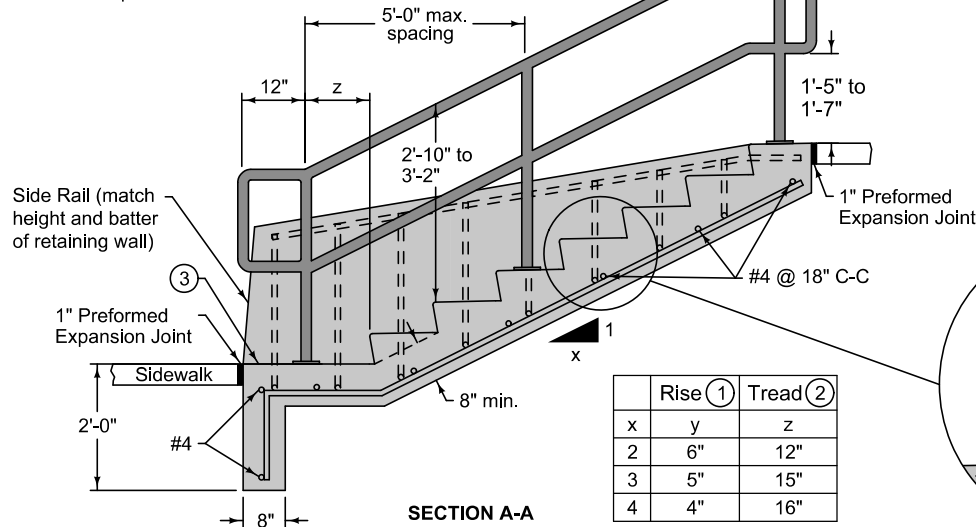
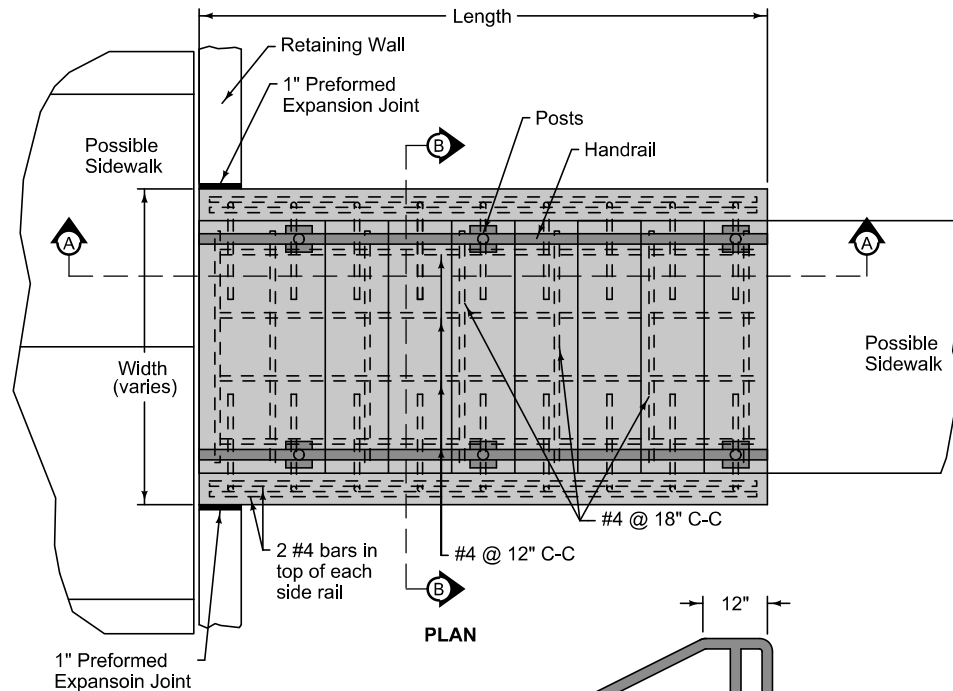
Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

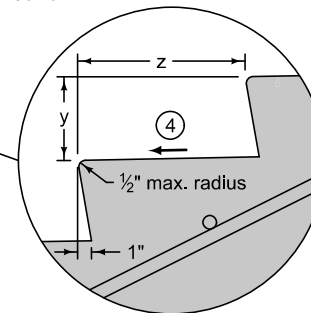
- ① Minimum riser height is 4 inches. Maximum riser height is 7 inches.
- ② Minimum tread depth is 11 inches.
- ③ Match existing sidewalk width.
- ④ Construct cross slope of landing to match adjacent sidewalk.
- ⑤ Slope tread 1% minimum to 2% maximum in any direction.
- ⑥ Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.

	Rise ①	Tread ②
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"

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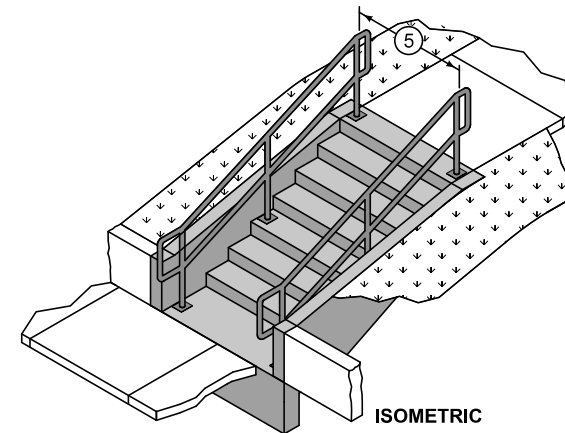
	Rise ①	Tread ②
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"



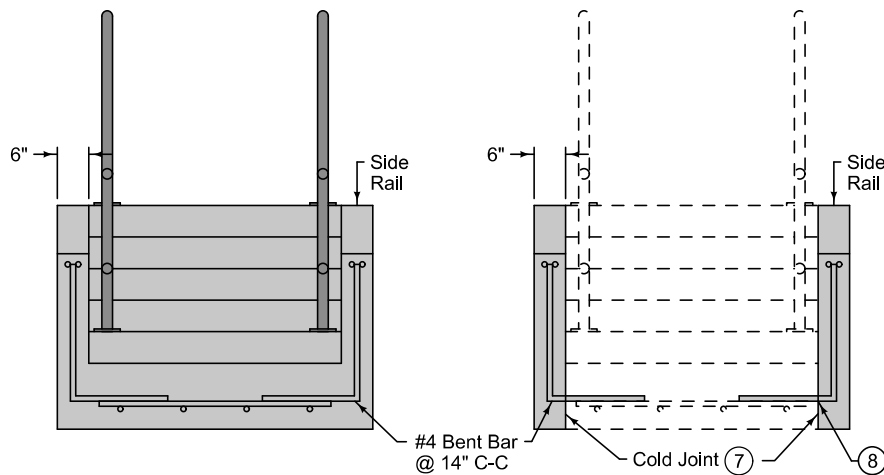
Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

- ① Minimum riser height is 4 inches. Maximum riser height is 7 inches.
- ② Minimum tread depth is 11 inches.
- ③ Construct cross slope of landing to match adjacent sidewalk.
- ④ Slope tread 1% minimum to 2% maximum in any direction.
- ⑤ Match existing sidewalk width.

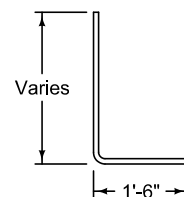


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SECTION B-B
(Side Rails and Stairs Formed and
Constructed Monolithically)

ALTERNATE SECTION B-B
(Side Rails and Stairs Formed
and Constructed Separately)

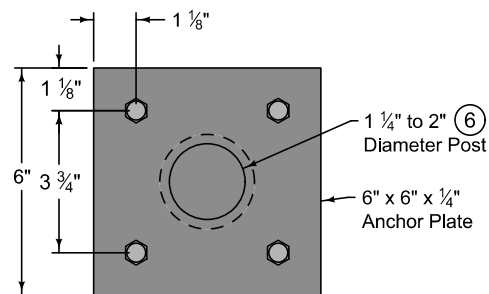


BENT BAR

Provide a minimum of 2 inches of cover for all reinforcing.

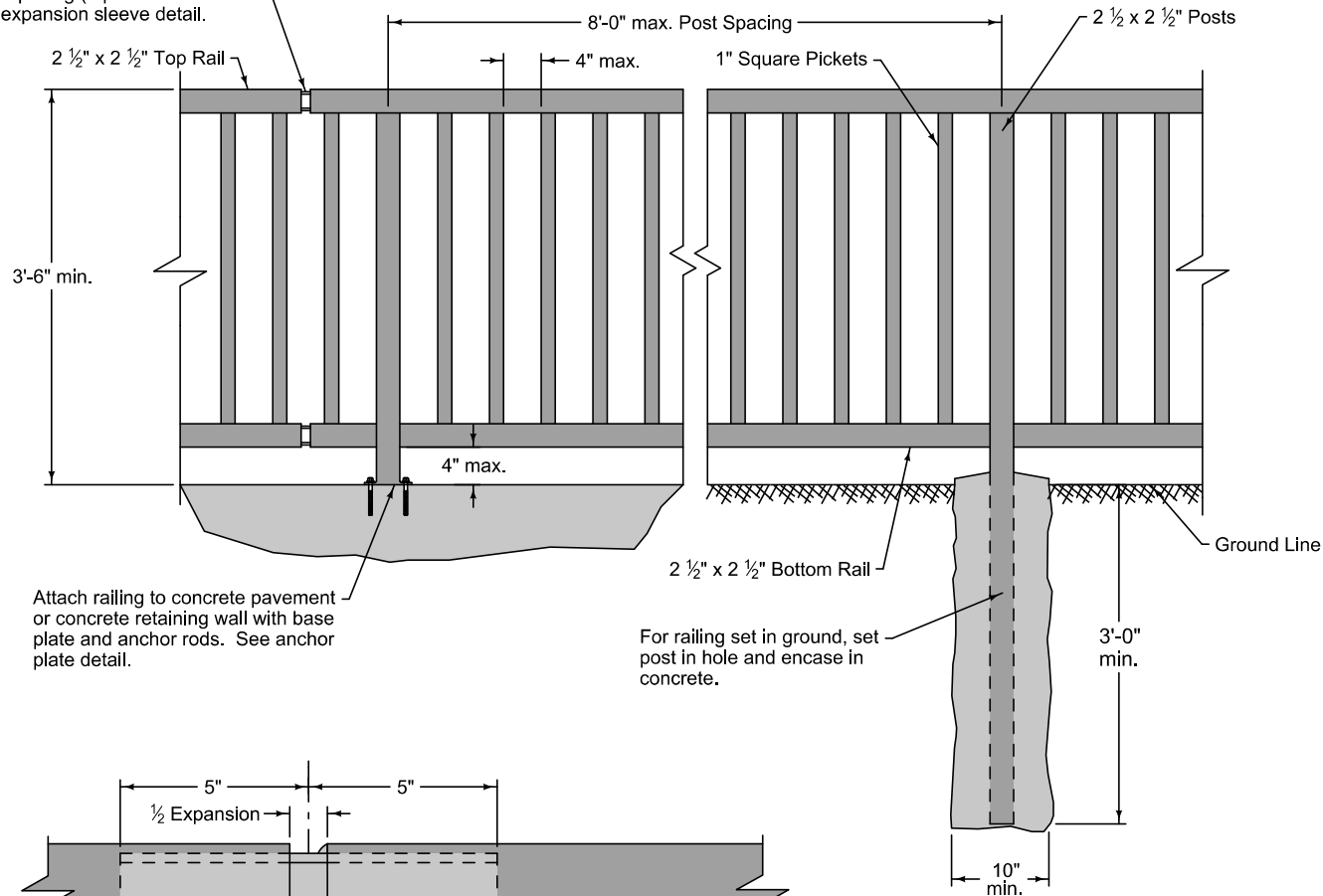
Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

- ⑥ Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.
- ⑦ Upon approval of Engineer, side rails may be formed and constructed separately from the stairs. Seal the cold joint between the side rail and stairs according to Section 7010.
- ⑧ If side rails and stairs are constructed separately, dowel bar substitutes may be used for the bent bars connections between the side rails and the stairs.



ANCHOR PLATE DETAIL

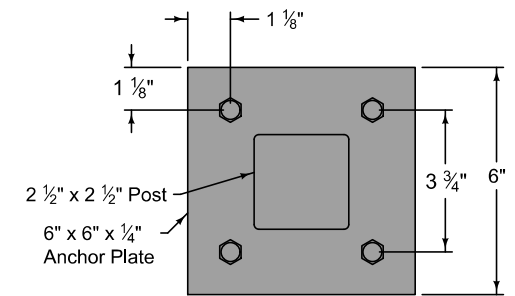
Provide expansion joint at 48'-0" max. spacing (top and bottom rail). See expansion sleeve detail.



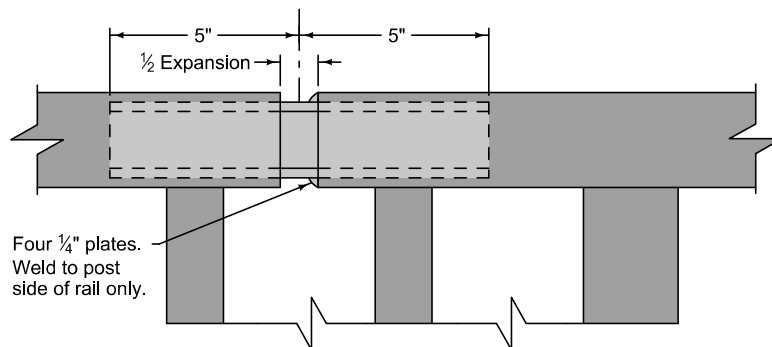
Weld all components with 1/4 inch fillet welds. Grind welds and connections as required to provide a smooth surface, free of burrs.

Field paint safety rail after installation as specified in the contract documents.

- ① Detail shown is for top rail. Expansion joint for bottom rail is similar.



ANCHOR PLATE DETAIL



EXPANSION SLEEVE DETAIL

①

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