



**Mn/DOT Seeding Manual
2007 Edition**

**Office of Environmental Services
Erosion Control Engineering Unit**



Mn/DOT Seeding Manual

The seeding manual entails methods used to establish and maintain both general and native seed mixtures for roadside plantings throughout the state of Minnesota. The manual provides a basic guide to the seed mixtures that Mn/DOT typically specifies and the methods for placement. For detailed seeding and mulch recommendations, refer to the individual Mn/DOT district seeding recommendations.

Seed Mixtures

The seed mixtures described in Mn/DOT's 2005 Standard Specifications for Construction will be specified and used on construction projects. These mixtures have higher rates of cover crop to provide quicker erosion control and are also generally more cost effective. All A-series (1995), and B-series (2000) mixtures should no longer be specified.

The seed mixtures have been numbered in such a manner that all mixtures in the 100's are temporary cover, 200's are general seed mixtures, and 300's are native seed mixtures.

Wetland Restoration

Wetland restoration seeding uses the BWSR Seed mixes. BWSR has also developed a number of mixes for use on RIM and CREP projects. They can be found at BWSR's website under "native seed mix recommendations". The file is a PDF file. The BWSR URL can be found at: <http://www.bwsr.state.mn.us/wetlands/publications/nativewetveg.pdf> . For wetland seeding on Mn/DOT projects using seed mixes from the 300 series that fit the moisture level of the area should be specified.

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Basic Seed Mixture Design Information

The following recommendations are intended to provide general guidance for the areas in which mixtures listed should be used. Note that within each mixture tabulation, at the end of this manual, there is a brief description of the mix and what it was developed for.

The seeding rates listed are for roadside establishment and initial erosion control. The rates are somewhat higher than rates used for seeding parkland fields and other non-roadside areas.

Table 1. Recommended Seed Mixtures

	Purpose	Mixture	Seeding Rate (lbs/acre)	Maintenance
Temporary	Winter Wheat	100	100	N/A
	Spring/Summer Cover	110	100	N/A
	1 to 2 years of Cover	150	40	N/A
	2 to 5 years of Cover	190	60	N/A
General	Sandy Roadside	240	75	Mow up to 3 times per year
	General Roadside	250	70	Mow up to 3 times per year
	Commercial Turf	260	100	Mow a minimum of once per 2 weeks
	Residential Turf	270	120	Mow a minimum of once per 2 weeks
	Agricultural Area Roadside	280	50	Mow up to 3 times per year
Native	Ponds & Wet Area- Tall Grasses	310	82	To reduce weed establishment, mow 2 to 3 times (30 days apart) during 1 st year with the mower deck about 6"-8" off the ground. Mow one time during the 2 nd year before weeds set their seeds. Burn or mow once every 3 to 5 years following the initial 2 years of maintenance to remove dead plant material and stimulate new seed.
	Sandy/dry Areas- Short Grasses	330	84.5	
	Sandy/dry Areas- Mid-height Grasses	340	84.5	
	General Roadside	350	84.5	
	Sedge/Prairie Meadow	325	84	
	Floodplain	328	88	

Season of Planting

The season of planting for seed mixtures runs from spring to early summer and from fall until the ground freezes. **Table 2** lists the general dates when seeding of various Mn/DOT mixes should occur. Seasons can be extended based on the current weather patterns, such as frequent low intensity rainfalls with cooler than average temperatures.

**Table 2
SEASON OF PLANTING**

Seed Mixture Number	Spring	Fall
100	---	Aug. 1 – Oct. 1
110	May 1 – Aug. 1	---
150, 190	April 1 - July 20.	July 20 – Oct. 20
240, 250, 260, 270	April 1 - June 1	July 20 - Sept. 20
280	April 1 – Sept. 1	---
310, 325, 328, 330, 340, 350	April 15 – July 20	Sept. 20 – Oct. 20

For the portion of Minnesota north of, and including US Highway 2, the Season of Planting for Mixtures 150 through 280 shall be April 15 through September 20.

Dormant Seeding

When dormant seeding, it is important to note different species are dormant at different times of the year. Dormant seeding for warm-season grasses occurs in early fall as they require 65 °F and above sustained soil temperatures and moisture to germinate. Cool-season grasses will germinate at colder temperatures, a soil temperature at a depth of 1” at or below 40 °F. Cool-season grasses generally germinate in a shorter period of time. Many forbs will not germinate at all the first year when seeded in the spring as they require a freeze/thaw period (winter) to germinate. Thus, forbs may not appear until the following spring. Dormant seeding is somewhat risky due to factors such as weather, snow cover, predation, and soil erosion. However, plantings do appear to contain more diversity of cool-season grasses and forbs when installed in the fall.

Snow Seeding

Seeding on top of the snow is considered snow seeding and usually performed due to contract constraints. When this is done the seed will melt through the snow and germinate when it reached the correct temperature in the spring. Mulch can also be placed over the snow on top of the seeded site. Snow seeding can be done during the thawing days in February and March.

Seed Mixtures

Mixture: 150			
Common Name	Bulk Rate		% of Mix Component
	Kg/ha	lb/ac	
Rye-grass, perennial	16.8	15	37.5
Wheat-grass, slender	5.6	5	12.5
Red clover	11.2	10	25.0
Alfalfa, vernal	11.2	10	25.0
GRAND TOTALS:	44.8	40	100.0
For: 1-2 Year Temporary Stabilization			

Mixture: 190			
Common Name	Bulk Rate		% of Mix Component
	Kg/ha	lb/ac	
Red Clover	6.7	6	10.0
Alsike Clover	4.7	4.2	7.0
Alfalfa, creeping	10.7	9.6	16.0
Brome grass, smooth	8.1	7.2	12.0
Rye-grass, perennial	16.8	15	25.0
Wheat-grass, slender	3.4	3	5.0
Vetch, hairy	16.8	15	25.0
GRAND TOTALS:	67.2	60	100.0
<i>For: 2-5 Years Roadside Stabilization</i>			

Mixture: 240			
Common Name	Bulk Rate		% of Mix Component
	Kg/ha	lb/ac	
Brome grass, smooth	10.9	9.7	13.0
Bluegrass, Kentucky “Certified Park”	22.6	20.2	27.0
Bluegrass, Canada	10.9	9.7	13.0
Switch grass	2.1	1.9	2.5
Wheat-grass, slender	3.4	3.0	4.0
Fescue, Hard “Reliant II”	5.9	5.3	7.0
Rye-grass, perennial	16.8	15.0	20.0
Dropseed, sand	2.1	1.9	2.5
Bluestem, little *	2.9*	2.6*	3.5*
Red clover	5.9	5.3	7.0
Prairie clover, purple	0.5	0.4	0.5
GRAND TOTALS:	84	75	100.0
* Bulk with 50% PLS minimum			
<i>For: Sandy- Roadside</i>			

Mixture: 250			
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Brome grass, smooth	11.0	9.8	14.0
Bluegrass, Kentucky “Certified Park”	22.7	20.3	29.0
Bluegrass, Canada	11.0	9.8	14.0
Switch grass	2.4	2.1	3.0
Wheat-grass, slender	3.1	2.8	4.0
Rye-grass, perennial	16.5	14.7	21.0
Timothy	2.4	2.1	3.0
Redtop	2.4	2.1	3.0
Alfalfa, creeping	4.7	4.2	6.0
White Clover	2.4	2.1	3.0
GRAND TOTALS:	78.6	70	100.0
<i>For: General Roadside excluding sandy sites</i>			

Mixture: 260			
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Bluegrass, Kentucky “Certified Park”	35.8	32	32.0
Bluegrass, Canada	11.2	10	10.0
Bluegrass, Kentucky - Low Maintenance ¹	33.6	30	30.0
Fescue, hard	9.0	8	8.0
Rye-grass, perennial	22.4	20	20.0
GRAND TOTALS:	112	100	100.0
<i>For: Commercial Turf</i>			
¹ Any accepted low maintenance Kentucky Bluegrass EXCEPT “Park”.			

Mixture: 270			
Common Name	Bulk Rate		% of Mix Component
	kg/ac	lb/ac	
Bluegrass, Kentucky - Elite	33.6	30	25.0
Bluegrass, Kentucky - Improved	33.6	30	25.0
Bluegrass, Kentucky - Low Maintenance	33.6	30	25.0
Red fescue, creeping	10.8	9.6	8.0
Rye-grass, perennial	22.8	20.4	17.0
GRAND TOTALS:	134.4	120	100.0
<i>For: Residential Turf</i>			

Mixture: 280			
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Alfalfa, creeping	16.8	15	30.0
Brome grass, smooth	11.2	10	20.0
Redtop	3.4	3	6.0
Rye-grass, perennial	16.8	15	30.0
Switch grass	2.2	2	4.0
Timothy	2.2	2	4.0
Wheat-grass, slender	3.4	3	6.0
GRAND TOTALS:	56	50	100.0
<i>For: Agricultural Roadsides</i>			

Mixture: 310			
Common Name	PLS Rate		% of Mix Component
	kg/ha	lb/ac	
Bluestem, big	2.8	2.5	25.0
Indian grass	2.8	2.5	25.0
Wild-rye, Virginia	2.2	2.0	20.0
Switch grass	0.6	0.5	5.0
Blue-joint grass	0.3	0.25	2.5
Green bulrush	0.3	0.25	2.5
Wool grass	0.3	0.25	2.5
Giant bur reed	0.3	0.25	2.5
Cordgrass, prairie	1.7	1.5	15.0
Grass Totals:	11.3	10.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Winter Wheat*	62.7	56.0	80.0
Rye-grass, annual	12.5	11.2	16.0
Wheatgrass, slender	3.1	2.8	4.0
Cover Crop Totals:	78.3	70	100.0
Wet Forbs Mixture (Table 3876-6)	2.2	2.0	100.0
GRAND TOTALS:	91.8	82.0	100.0
*Oats to be substituted for spring plantings			
<i>Purpose: Native mix for wetter areas. Infiltration ponds, dry ponds, wet ditches. Tall height.</i>			

Mixture: 325			
Common Name	PLS Rate		% of Mix Component
	kg/ha	lb/ac	
Bluestem, big	1.7	1.5	15.0
Fringed brome	1.7	1.5	15.0
Wheat grass, slender	1.7	1.5	15.0
Virginia wild-rye	1.7	1.5	15.0
Switch grass	0.6	0.5	5.0
Fowl bluegrass	1.7	1.5	15.0
Indian grass	1.7	1.5	15.0
Prairie cord grass	0.6	0.5	5.0
Grass Totals:	11.4	10.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Blue-joint grass	0.22	0.2	10.0
Bottlebrush sedge	0.34	0.3	15.0
Tussock sedge	0.22	0.2	10.0
Fox sedge	0.22	0.2	10.0
Reed manna grass	0.22	0.2	10.0
Fowl manna grass	0.22	0.2	10.0
Green bulrush	0.22	0.2	10.0
Wool grass	0.22	0.2	10.0
Soft-stem bulrush	0.34	0.3	15.0
Sedge Totals:	2.22	2.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Winter Wheat*	61.6	56	80.0
Rye-grass, annual	12.3	11.2	16.0
Wheatgrass, slender	3.1	2.8	4.0
Cover Crop Totals:	77	70	100.0
Wet Forbs Mixture (Table 3876-6)	2.2	2.0	100.0
GRAND TOTALS:	92.8	84.0	100.0
*Oats to be substituted for spring plantings			
<i>Purpose: Native sedge/prairie meadow mix. Reaches a height of 915 mm to 1220 mm (36 to 48 inches). Developed for use on hydric soils and for wetland restoration.</i>			

Mixture: 328			
Common Name	PLS Rate		% of Mix Component
	kg/ha	lb/ac	
Bluestem, big	2.2	2	12.5
Brome, fringed	2.2	2	12.5
Wild-rye, Virginia	4.4	4	25.0
Switchgrass	1.1	1	6.3
Bluegrass, fowl	5.5	5	31.3
Indian grass	2.2	2	12.5
Grass Totals:	17.6	16.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Winter Wheat*	61.6	56.0	80.0
Rye-grass, annual	12.3	11.2	16.0
Wheatgrass, slender	3.1	2.8	4.0
Cover Crop Totals:	77	70	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Milkweed, marsh	0.33	0.3	15.0
Prairie clover, purple	0.33	0.3	15.0
Tic-trefoil, showy	0.33	0.3	15.0
Sunflower, early	0.33	0.3	15.0
Black-eyed Susan	0.55	0.5	25.0
Vervain, blue	0.33	0.3	15.0
<i>Economy Forbs Totals:</i>	2.2	2.0	100.0
GRAND TOTALS:	96.8	88.0	100.0
*Oats to be substituted for spring plantings			
<i>Purpose: Native mix for infiltration ponds, dry ponds, temporary wet ditches. Tall height.</i>			

Mixture: 330			
Common Name	PLS Rate		% of Mix Component
	kg/ha	lb/ac	
Gramma, sideoats	3.4	3.0	21.5
Gramma, blue	2.8	2.5	18.0
Bluestem, little	3.9	3.5	25.0
June grass	1.1	1.0	7.0
Dropseed, sand	1.1	1.0	7.0
Wild-rye, Canadian	3.4	3.0	21.5
Grass Totals:	15.7	14.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Winter Wheat*	62.7	56.0	80.0
Rye-grass, annual	12.5	11.2	16.0
Wheatgrass, slender	3.1	2.8	4.0
Cover Crop Totals:	78.3	70	100.0
Dry Forbs Mixture (Table 3876-6)	0.6	0.5	100.0
GRAND TOTALS:	94.6	84.5	100.0
*Oats to be substituted for spring plantings			
<i>Application: Native mix for Sandy/dry areas. Short height.</i>			

Mixture: 340			
Common Name	PLS Rate		% of Mix Component
	kg/ha	lb/ac	
Bluestem, big	3.3	3.0	21.5
Bluestem, little	2.8	2.5	18.0
Wild-rye, Canadian	2.2	2.0	14.0
Grama, sideoats	2.2	2.0	14.0
Switch grass	0.6	0.5	4.0
Dropseed, sand	0.6	0.5	3.5
Bluegrass, Canada	3.4	3.0	21.5
June grass	0.6	0.5	3.5
Grass Totals:	15.7	14.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Winter Wheat*	62.7	56.0	80.0
Rye-grass, annual	12.5	11.2	16.0
Wheatgrass, slender	3.1	2.8	4.0
Cover Crop Totals:	78.3	70	100.0
Dry Forbs Mixture	0.6	0.5	100.0
GRAND TOTALS:	94.6	84.5	100.0
*Oats to be substituted for spring plantings			
<i>Application: Native mix for Sandy/Dry areas. Mid-height.</i>			

Mixture: 350			
Common Name	PLS Rate		% of Mix Component
	kg/ha	lb/ac	
Bluestem, big	3.4	3.0	21.5
Indian grass	2.8	2.5	18.0
Bluestem, little	2.8	2.5	18.0
Grama, sideoats	3.4	3.0	21.5
Wild-rye, Canadian	2.2	2.0	14.0
Switch grass	1.1	1.0	7.0
Grass Totals:	15.7	14.0	100.0
Common Name	Bulk Rate		% of Mix Component
	kg/ha	lb/ac	
Winter Wheat*	62.7	56.0	80.0
Rye-grass, annual	12.5	11.2	16.0
Wheatgrass, slender	3.1	2.8	4.0
Cover Crop Totals:	78.3	70	100.0
Mesic Forbs Mixture	0.6	0.5	100.0
GRAND TOTALS:	94.6	84.5	100.0
*Oats to be substituted for spring plantings			
<i>Application: Native mix for general roadside areas.</i>			

Mixture: Dry Forbs²		
Common Name	Botanical Name	% of Mix
Leadplant	<i>Amorpha canescens</i>	10.0
Butterfly Milkweed	<i>Asclepias tuberosa</i>	2.0
Heath Aster	<i>Aster ericoides</i>	4.0
Stiff tickseed	<i>Coreopsis palmate</i>	2.0
Yarrow	<i>Achillea millefolium</i>	2.0
Long-leaved bluets	<i>Hedyotis longifolia</i>	1.0
Round-headed Bushclover	<i>Lespedeza capitata</i>	3.0
Rough blazingstar	<i>Liatris aspera</i>	4.0
Dotted blazingstar	<i>Liatris punctata</i>	3.0
Wild lupine	<i>Lupinus perennis</i>	5.0
White prairie clover	<i>Dalea candidum</i>	5.0
Purple prairie clover	<i>Dalea purpureum</i>	16.0
Prairie rose	<i>Rosa arkansana</i>	1.0
Black-eyed susan	<i>Rudbeckia hirta</i>	18.0
Gray goldenrod	<i>Solidago nemoralis</i>	3.0
Upland goldenrod	<i>Solidago ptarmicoides</i>	1.0
Stiff goldenrod	<i>Solidago rigida</i>	2.0
Showy goldenrod	<i>Solidago speciosa</i>	2.0
Hoary vervain	<i>Verbena stricta</i>	14.0
Golden Alexander	<i>Zizea aurea</i>	2.0
	Total:	100.0
Rate: 0.5 lb/acre bulk		
² Acceptable origin and variety for all Dry Forbs are MN Certified (YT), MN wild-type. Minimum percent purity is 80% and minimum percent Germination is 40% for all Dry Forbs.		

³
Mixture: Wet Forbs

Common Name	Botanical Name	% of Mix
Fragrant giant hyssop	<i>Agastache foeniculum</i>	2.0
Water plantain	<i>Alisma subcordatum</i>	4.0
Meadow garlic	<i>Allium canadense</i>	1.0
Canada anemone	<i>Anemone Canadensis</i>	1.0
Marsh milkweed	<i>Asclepias incarnata</i>	2.0
Panicled aster	<i>Aster simplex</i>	3.0
New England aster	<i>Aster novaeangliae</i>	3.0
Red-stalked aster	<i>Aster puniceus</i>	3.0
Flat-topped aster	<i>Aster umbellatus</i>	1.0
Canada tick trefoil	<i>Desmodium glutinosum</i>	1.0
Joe-pye weed	<i>Eupatorium maculatum</i>	17.0
Boneset	<i>Eupatorium perfoliatum</i>	10.0
Grass-leaved goldenrod	<i>Solidago graminifolia</i>	2.0
Sneezeweed	<i>Helenium autumnale</i>	1.0
Giant sunflower	<i>Helianthus giganteus</i>	2.0
Common ox-eye	<i>Heliopsis helianthoides</i>	1.0
Great St. John's wort	<i>Hypericum pyramidalatum</i>	2.0
Wild iris	<i>Iris versicolor</i>	1.0
Tall blazingstar	<i>Liatris pycnostachya</i>	8.0
Wild bergamot	<i>Monarda fistulosa</i>	1.0
White prairie clover	<i>Dalea candidum</i>	1.0
Purple prairie clover	<i>Dalea purpureum</i>	2.0
Mountain mint	<i>Pycnanthemum virginianum</i>	1.0
Black-eyed susan	<i>Rudbeckia hirta</i>	6.0
Stiff goldenrod	<i>Solidago rigida</i>	2.0
Tall meadow rue	<i>Thalictrum dasycarpum</i>	2.0
Blue vervain	<i>Verbena hastata</i>	14.0
Ironweed	<i>Veronia fasciculate</i>	1.0
Culver's root	<i>Veronicastrum virginicum</i>	3.0
Golden Alexander	<i>Zizea aurea</i>	2.0
	Total:	100.0

Rate: 2 lbs/acre bulk

³
Acceptable origin and variety for all Wet Forbs are MN Certified (YT), MN wild-type. Minimum percent purity is 80% and minimum percent Germination is 40% for all Wet Forbs.

Establishing General Seed Mixtures

General Recommendations

Seeding general mixtures can be accomplished using a number of different methods from mechanical means to hydroseeding. One key to a successful establishment is preparing the soil bed. Immediately before seeding, the soil should be tilled to a minimum depth of 3". The tillage will help improve seed-to-soil contact as well as increase the amount of initial infiltration giving the seeds moisture to begin establishment.

Temporary Erosion Control

Immediately after seeding, within 24 hours, mulch should be applied to protect and enhance seed germination. In most cases on slopes 1:3 (Vertical:Horizontal) and flatter Mn/DOT Type 1 mulch (see specification below) at 90% soil coverage is applied. This generally requires about 2 tons per acre of straw mulch. If mulch applications are placed too heavily, it can hinder germination or smother new seedlings. In areas with weed concerns, it is recommended to use high quality weed free mulch such as MCIA Certified Weed Free mulch, Mn/DOT Type 3. See Native Grass section for example Mn/DOT Type 3 specification.

On slopes that are temporary in nature, have limited access, or are stockpiles, consider using Mn/DOT Type 6 Hydraulic Soil Stabilizer (see specification below) at 2100 lbs/acre.

On slopes that are steeper than 1:3 or in ditch bottoms it is recommended that the seeding be covered with an erosion control blanket. The erosion control blanket should contain netting on both sides and be composed of straw, a straw/coconut blend, or wood fibers. Under more strenuous conditions such as slopes steeper than 1:2, ditch bottoms experiencing flow velocities greater than 7 feet/second or ditch grades 5% or more specialized treatments not covered in this manual should be used.

Generic Specification Examples:

Mn/DOT Type 1 Mulch – This mulch shall consist of grain straw, hay, cuttings of agricultural grasses and legumes. The material shall be free of seed bearing stalks of noxious grasses or weeds as defined by the rules and regulations of the Minnesota Department of Agriculture. In addition, mulch shall not contain the following species: cattail, reed canary grass, birds-foot trefoil or crown vetch. At the time of delivery the mulch shall be in an air-dried condition.

Mn/DOT Type 6 Hydraulic Soil Stabilizer – Type 6 shall be a blend of 40 to 60% recycled paper and 40 to 60% wood cellulose fibers by weight. The fibers shall contain no germination or growth inhibiting factors. It shall not contain nor be processed from sawdust or pulverized newspaper. It shall be dyed an appropriate color to allow visual metering of its application, and shall have the property of becoming dispersed and suspended when agitated in water. It shall contain 2.5 to 5% tackifier by weight. The tackifier shall be incidental to the Type 6 hydromulch material. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover that readily absorbs water and allows infiltration to the underlying soil. Moisture content shall not exceed 15% at the time of delivery. When washed on a 850µm sieve at least 50% shall be retained on the sieve.

Fertilizer

Fertilizer is based on 3 main ingredients as a percentage of the bag plus minerals and inert material making up the remainder. These 3 ingredients are Nitrogen (N), Phosphorus (P), and Potassium (K) and are shown as an N:P:K ratio. This ratio is also known as the fertilizer analysis. It is always recommended to take soil tests to determine the existing soil fertility in order to choose an appropriate fertilizer analysis based on the soil deficiencies. Depending on the site and the situation fertilizer selection can be one of four types; Type 1: a Commercial fertilizer, Type 2: a Phosphorous Free fertilizer, Type 3: a Slow Release Nitrogen fertilizer, and Type 4: a Natural Based fertilizer from organic material. The fertilizer type chosen will depend on the site, proximity to ditches, surface waters... Immediately before seeding, broadcast and work into the top inch of soil the fertilizer at the appropriate application rate, then seed. Prior to mulching firm up the seed bed with a cultipacker or other approved soil firming equipment.

Seeding Methods

Method 1. Drop Seeding Onto Tilled Sites - This is the "standard" method for seeding on prepared sites such as those on construction projects.

- A) Site Preparation** - The site should be prepared by loosening topsoil to a minimum depth of 3 inches.
- B) Fertilizer** – Use a fertilizer analysis based on a soil test or a general recommendation is a 10-10-10 (NPK) commercial grade analysis at 200 lbs/acre.
- C) Seed Installation** - Seed should be installed with a drop seeder that will accurately meter the types of seed to be planted, keep all seeds uniformly mixed during the seeding and contain drop seed tubes for seed placement

(Brillion-type). The drop seeder should be equipped with a cultipacker assembly to ensure seed-to-soil contact.

D) Seeding Rates - Rates are specified in the mixture tabulation for the specified mix.

E) Packing – If the drop seeder is not equipped with a cultipacker, the site should be cultipacked following the seeding to ensure seed-to-soil contact.

F) Mulch - The site should be mulched and disc-anchored following cultipacking. The standard mulch is Mn/DOT Type 1 at a rate of 2.0 tons/acre. Also see temporary erosion control for additional information.

Method 2. Hydroseeding - Hydroseeding is an acceptable method for establishing the general mixtures when it is done correctly. However, it is imperative that the site is prepared and finished properly. Mn/DOT generally uses hydroseeding on steep slopes or other areas inaccessible to a drop seeder such as wetland edges and ponds. Hydroseeding is not recommended if the extended weather patterns are hot and dry and the soil surface is dry and dusty. The seed-water slurry should be applied within one hour after the seed is added to the hydroseeder tank.

A) Site Preparation - The site should be prepared by loosening topsoil to a minimum depth of 3 inches. It is critical that the seedbed be loosened to a point that there are a lot of spaces for seed to filter into cracks and crevices otherwise it may end up on the surface and wash away with the first heavy rain.

B) Fertilizer - Either use a fertilizer analysis based on a soil test or a general recommendation is a 10-10-10 (NPK) commercial grade analysis at 300 lbs/acre.

C) Seed Installation - Seed should be installed by hydro-seeding it evenly over the entire site. A fan-type nozzle should be used with approximately 500 gallons of water per acre. It is recommended to add approximately 75 pounds of hydromulch per 500 gallons of water for a visual tracer to ensure uniform coverage.

D) Seeding Rates - Rates are specified in the mixture tabulation for the specified mix.

E) Harrowing - The site should be harrowed, cultipacked or raked following seeding.

F) Mulch - The site should be mulched following harrowing using one of the following methods (as per plans or special provisions):

- Mn/DOT Type 1 mulch at a rate of 2.0 tons per acre with disc anchoring.
- Mn/DOT Hydraulic Soil Stabilizer or Bonded Fiber Matrix on inaccessible sites.

NOTE: When seeding in conjunction with a hydraulic soil stabilizer (bonded fiber matrixes (BFM's), hydro-mulches, etc., it is recommended that a two-step operation be used. Seed should be placed first and the hydraulic soil stabilizer be applied afterwards. This is to ensure that seed comes into direct contact with the soil.

Method 3. Broadcast Seeding - Broadcast seeding is performed either with mechanical “cyclone” seeders, by hand seeding or by any other method that scatters seed over the soil surface. It is essential that steps be taken to ensure good seed to soil contact when broadcast seeding is used.

A) Site Preparation - The site should be prepared by loosening topsoil to a minimum depth of 3 inches. It is critical that the seedbed be loosened to a point that there are spaces for seed to filter into cracks and crevices otherwise it may end up on the surface and wash away with the first heavy rain.

B) Fertilizer - Use a fertilizer analysis based on a soil test or a general recommendation is a 10-10-10 (NPK) commercial grade analysis at 200 lbs/acre.

C) Seed Installation - Seed should be installed by broadcasting it evenly over the entire site. Several types and sizes of broadcast seeders are available for use, ranging from fertilizer-type spreaders to power spreaders mounted on all terrain vehicles. Seed should be mixed thoroughly prior to seeding and should be mixed occasionally in the spreader to prevent separation and settling.

D) Seeding Rates - Rates are specified in the mixture tabulation for the specified mix.

E) Harrowing - The site should be harrowed or raked following seeding.

F) Packing - The site should be cultipacked following harrowing.

G) Mulch - The site should be mulched following packing using one of the following types of mulch (as per plans or special provisions):

- Mn/DOT Type 1 mulch at a rate of 2.0 tons per acre followed by disc anchoring.
- Mn/DOT Hydraulic Soil Stabilizer or Bonded Fiber Matrix on inaccessible sites.

Method 4. Interseeding Into Existing Vegetation or Mulch - This method is generally used for sites that did not establish well or if a temporary mulch was applied to the site. An interseeder drill can be used to plant the seed without removing or tilling the existing vegetation or mulch.

A) Site Preparation For Existing Vegetation- The site should be prepared by mowing existing vegetation to a height of 4-6 inches. The area can then be directly planted using an interseeding drill.

NOTE: Sites that contain significant weed infestations may require weed control measures before planting. After

mowing, a herbicide application with glyphosate should be used. Addition of a surfactant and/or addition of 2,4-D to the mix often results in a more complete kill, especially with unwanted broad-leaved species. Recommended herbicide rates are 2.0 quarts/acre of glyphosate and 1.0 - 2.0 quarts/acre 2,4-D. Seeding can be performed 7-10 days after herbicide application. Other broadleaf herbicides can also be used such as Trimec, Transline, Stinger, etc. Follow the label directions.

- B) Fertilizer** - Use a fertilizer analysis based on a soil test or a general recommendation is a 22-5-10 (NPK) commercial grade analysis at 200 lbs/acre.
- C) Seed Installation** - The seed mixture should be installed with a seed drill that will accurately meter the seed to be planted and keep all seeds uniformly mixed during the drilling. The drill should contain a legume box for small seeds, and it should be equipped with disc furrow openers and packer assembly to compact the soil directly over the drill rows. Maximum row spacing should be 8 inches. The inter-seeder drill must be out-fitted with trash rippers that will slice through the vegetative mat and make a furrow into the underlying soil approximately 1 inch wide by 1/2 to 1 inch deep. These furrows shall be directly in line with the drill seed disc openers. Fine seed should be drop-seeded onto the ground surface from the fine seed box drill seeding should be done whenever possible at a right angle to surface drainage.
- D) Seeding Rates** - Rates are specified in the mixture tabulation for the specified mix.
- E) Harrowing** - Harrowing is not required when using this seeding method.
- F) Packing** - Cultipacking the site is recommended to ensure seed-to-soil contact.
- G) Mulch** - Mulch is not required when using this seeding method unless a 90% soil coverage rate is not maintained.

Establishing Native Grasses and Forbs

General Recommendations - Seeding should take place soon after any final grading, contouring or other major site work is completed to minimize soil erosion and invasion by weedy species. Consequently, this work should be done just before the time of year when the seeds should be planted. Seeding natives can be done with good results in the spring or fall. If seeding over dead vegetation, the best results are in the fall, the freeze/thaw cycle will allow better seed to soil contact. Fall seeding allows stratification for the seeds that may need to over winter to germinate. Seeding native grasses and forbs (wildflowers) can be accomplished using a number of different methods. However, due to the complexity of seed sizes, textures and densities, a great deal of care needs to be taken to ensure that the site is well prepared and that seed is placed properly. A number of different types of drills may be used to place seed, but be aware that many "older style" drills will clog easily with fluffy seeds. Some drills will not distribute the seed evenly due to the varying size and weight of the seed. Broadcast seeding and hydroseeding also work well, but remember that natives cannot be seeded exactly the same as turf grasses. There are several general "rules of thumb" to keep in mind when seeding natives:

- Native seeds prefer a firm seedbed. An overly soft seedbed risks the chance of seeds being planted too deep.
- Large and/or fluffy seeds should be buried approximately 1/4 inch deep.
 - Seed should be lightly covered with soil. Harrowing or raking works well.
- Small and/or fine seeds (most forbs) should be scattered over the soil surface.

Native Grass and Forb Mixtures –Seed mixtures 310 through 350 are native/forb mixtures, these mixtures consist of warm-season native grasses, cool-season native grasses, native forbs (wildflowers) and annual or short-term cover crops. The mixtures have a higher cover crop rate to provide increased erosion protection. A deliberate attempt has been made to have a large number of different grasses and forbs as it has been shown that diverse plantings are more resistant to drought, floods, and pathogens than monotypic or low diversity plantings. The inclusion of a diverse mixture of forbs is greatly beneficial to wildlife and the forbs occupy niches that would otherwise be occupied by weeds such as thistle. The native legumes also fix nitrogen, which is made available to other plants in the system through fungal interactions between plants. Cool-season native grasses tend to establish quickly and will decrease over time on sites where warm-season species would normally dominate. Warm-season native grasses tend to be slower to establish, but are extremely hardy and long-lived. Warm-season grasses also tend to stay standing over the winter and provide the best snow filtering capabilities and wildlife habitat.

In addition to planting a large diversity of species, we recommend using local ecotype plant materials. The origin of local ecotypes can be guaranteed by purchasing "Yellow Tag" certified native seeds. The Minnesota Crop Improvement Association (MCIA) works with local seed producers to certify that the origin of their products is local (see below for specification). NOTE: Seed certified to be Zone 1 (northern Iowa ecotype) is acceptable for use in southern Minnesota, seed certified to be of eastern ND and SD origin is acceptable for use in Western MN, and seed certified to be of Western WI origin is acceptable for use in eastern MN.

Generic Specification Example:

MCIA Yellow Tag Certified Seed Requirements – Native species shall have their origin documented by

the Minnesota Crop Improvement Association (MCIA). This level of certification is at the “Yellow Tag” level according to the MCIA Quality Control program. Documentation verifying the origin of this seed shall be provided to the Engineer/Project Manager at least 30 days prior to the installation date. In the event that certain species may not be available as certified, those species may be supplied by a MCIA Certified Approved Collector/Producer along with documentation demonstrating the origin of those materials. All substitutions are subject to the approval of the Engineer/Project Manager.

Cover/nurse Crops – Cover crops provide a quick short-term vegetative cover while the permanent native species are establishing. A cover crop reduces the soils erosion potential and moderates the native seedlings microclimate during establishment. Typical cover crops in Mn/DOT’s native mixes include oats/winter wheat, annual rye grass and slender wheatgrass. Winter wheat is substituted for oats during fall plantings. The annual rye grass provides good cover in early spring but does not do well in late spring and summer. It also does well dormant seeded.

Temporary Erosion Control - It is recommended to protect a new seeding by covering it with mulch or an erosion control blanket. In general, slopes that are 1:3 (vertical : horizontal) and flatter should be mulched with a clean grain straw or native grass mulch and disc anchored following seeding. Mulching should attempt to achieve 90% coverage of the exposed soil surface. This generally requires about 2 tons per acre of straw mulch. It is also recommended to use a high quality weed free mulch such as MCIA Certified Weed Free mulch (see below for specification) or a native grass (prairie) mulch.

On slopes that are steeper than 1:3 it is recommended that the seeding be covered with an erosion control blanket. Generally, straw blankets containing double netting (Straw 2S) perform best with native plantings.

If seeding is being done in a ditch or swale that will receive moderate water flows for periods of time, it is recommended that a straw/coconut blanket be used to cover it. Other more severe situations such as very steep slopes and/or channels exposed to high water velocities will require more specialized treatments that are not covered in this manual.

NOTE: Mulches derived from pasture hay containing reed canary grass, smooth brome and other introduced forage species may contain enough seed of those species to ruin your native grass and forb planting. They are not recommended for use with native plantings.

Generic Specification Example:

Mn/DOT Type 3 (MCIA Certified Weed Free Mulch) - This mulch shall consist of clean grain straw and be certified by the Minnesota Crop Improvement Association (MCIA) to be free of noxious weed seeds, seed bearing stalks, and/or other reproductive propagules as defined by rules and regulations of the Minnesota Department of Agriculture. Documentation verifying that the mulch has passed MCIA field inspection shall accompany the material upon delivery to the job site. At the time of delivery, the mulch shall be in an air dried condition.

Fertilizer – It is always recommended to take soil tests to determine the existing soil fertility in order to choose an appropriate fertilizer and lime based on the soil deficiencies. Lime and fertilizer suggestions based on soil tests are the same as for cool-season grasses. Lime is not necessary if soil pH is 5.5 or higher. If phosphorous and potassium levels are low it is recommended to use a 0-10-20 NPK analysis slow release fertilizer applying 60 pounds per acre (see below for specification). Nitrogen is not recommended when establishing warm-season grasses because it leads to increased weed competition. However established stands will respond positively to 40 to 60 pounds of N per acre.

Generic Specification Example:

Fertilizer (Type 3 - Slow Release) - The fertilizer used for this project shall be a commercial grade of **slow release complete fertilizer** applied at a rate of 60 lbs/acre at the time of preparing the seed bed for seeding. The fertilizer shall contain a 0-10-20 (NPK) analysis.

Seeding Into Agricultural Fields - Many fields that have been row cropped will have some amount of herbicide residue present, depending on what the crop was and what type of herbicide was used on the site to control weeds. Leaving the site fallow, or planting a temporary cover for a season before planting, will help reduce herbicide residue. Fields that have been treated with Atrazine in the last two years should be left fallow a season prior to planting.

Inoculants - A number of inoculants are available in the marketplace. Native legumes form an association with nitrogen fixing bacteria of the genus *Rhizobium*. The *Rhizobial* bacteria occupy nodules on the plant roots. Most legume seed comes with bacterial inoculant in the form of a fine powder. Usually this inoculum is already dead or is not the right species for the native legume and the majority of the nodulation that actually occurs is from *Rhizobia* already present in the soil. Extremely disturbed soils may contain no *Rhizobia* at all. More information on *Rhizobia* is available at the University of Minnesota website: <http://www.rhizobium.umn.edu/>. Another form of inoculum that is available are various

mycorrhizal fungi. Most mycorrhizal inoculants that are available are ecto-mycorrhizae, which are for woody species. The type of mycorrhizae that associate with prairie species are endo-mycorrhizae, specifically vesicular arbuscular mycorrhizae (VA mycorrhizae). To our knowledge, no good commercial sources for VA mycorrhizae are available at this time for prairie species. The soil can be tested to see if there is already mycorrhizae present, whether the soil is toxic or has the proper soil properties to enhance colocation.

Seed Treatments - Be aware that seeds of many native species require specialized treatments such as cold/moist stratification, scarification, etc. Many of these species go through such treatments naturally if seeded in the fall.

Origin Requirements: It is preferred that seed of all native grasses and forbs be “certified” to be of MN (or regional) origin and of wild ecotype, except for fowl bluegrass, slender wheat grass, and fringed brome, which may be of MN, ND, MT or Canadian origin. These species should be available as Minnesota origin in a few years. The origin certification program is administered by the Minnesota Crop Improvement Association (MCIA). Documentation accompanying origin certification should include the “yellow tag” if species are being supplied individually and/or a document from MCIA indicating origin. On labels affixed to bags of seed it is common to show the species, germination, purity, lot number, and under origin “YT” or yellow tag with the geographic origin (i.e., Hennepin Co., MN).

Seed Texture and Size

Seed texture and size of native seed is highly variable. Some native seed such as Switchgrass is very small while other native seed such as Canada Wild rye has long awns.

If a drill or drop seeder is used, the seed mixture ingredients should be ordered such that the seed is packaged separately based seed size and texture. Fluffy seed should be placed in the native seed box that contains picker fingers. Fine seed should be placed in the fine seed box. Cereal grains, such as oats and winter wheat, used for a cover crop should be placed in the grain seed box that contains flutes.

If a broadcast seeder is used, the seed mixture may either be ordered mixed or as separate ingredients. During installation, the operator should be aware that fluffy seed will have a tendency to bridge or “ball up” in the seeder. Fine seed has a tendency to “pour through” the seeder. Therefore, an effective agitator is required in the seed box. Mixing heavier seed such as sideoats grama, wheat and oats will also help “weigh down” the lighter fluffy seed.

If a hydroseeder is used, the seed is usually ordered as a mixture. The hydroseeder has a vigorous agitator in the tank.

Seeding Methods

Method 1. Drop Seeding Onto Tilled Sites – This is the “standard” method for seeding native species on prepared sites such as those on construction projects.

A) Site Preparation – The site should be prepared by loosening topsoil to a minimum depth of 3 inches.

B) Fertilizer – If not basing the fertilizer application on soil test results, the fertilizer used should be a commercial grade slow release complete fertilizer applied at a rate of 300 lbs/acre at the time of preparing the seed bed for seeding. The fertilizer should contain 10-20-20 (NPK) analysis.

C) Seed Installation – Seed should be installed with a drop seeder that will accurately meter the types of seed to be planted and keep all seeds uniformly mixed during planting (Trillion-type). The seeder should contain a minimum of three seed boxes; a fine seed box, a box for large/fluffy seeds, and a box for cool season or grains. It should be equipped with drop tubes and a packer assembly to compact the soil directly over the seed. All seeding should be done at a right angle to surface drainage.

D) Seeding Rates – Rates are specified in the mixture tabulation for the specified mix.

E) Harrowing – The site should be lightly harrowed or raked following seeding if the seeder does not contain a cultipacker.

F) Packing – Cultiacking the site following harrowing is recommended to ensure a firm seed bed.

G) Mulch – The site should be mulched and disc-anchored following packing using one of the following types of mulch (as per plans or special provisions):

- Mn/DOT Type 3 (MCIA certified weed free mulch) at a rate of 2.0 tons per acre.
- Prairie hay/mulch (Mn/DOT Type 7 or 8) at a rate of 2.0 tons per acre.

Method 2. Drill Seeding Into Temporary Cover Crops – This method involves two separate seeding operations. First, a temporary cover crop is planted on the entire site to stabilize the soil and control erosion. Second, the native seed mixture is installed the following fall or the next spring (during one of the optimum seeding dates) using either an interseeder type drill or by lightly disking down the temporary cover and seeding into it. The interseed method greatly reduces the erosion potential and reduces soil disturbance. Using this method allows for some early weed control before

the native mixture is installed. This method is used for various reasons such as when a site is ready for seeding at a time of year that is not optimum for seeding a permanent seed mixture, the soils need to be stabilized rapidly for erosion control, or a field needs to be left fallow due to residual herbicide.

I. Establishment of Temporary Cover Crop

- A) Site Preparation** – The new site should be prepared for the temporary seeding by loosening topsoil to a minimum depth of 3 inches.
- B) Fertilizer** – The fertilizer used should be a commercial grade of slow release complete fertilizer applied at a rate of 300 lbs/acre at the time of preparing the seed bed for seeding. The fertilizer should contain 10-20-20 (NPK) analysis
- C) Seed Installation** – Temporary cover crops of oats, winter wheat, or combinations of the above may be installed using a standard grain drill or broadcast. Planting depth should be 1/4 to 1/2 inch.
- D) Seeding Rates** – The temporary cover crop of oats or winter wheat should be seeded at a rate of 80 lbs/acre.
- E) Harrowing** – The site should be harrowed or raked following installation of the temporary cover crop.
- F) Packing** – Packing is not required after installing the temporary cover crop.
- G) Mulch** – The site should be mulched and disc-anchored following packing using one of the following types of mulch (as per plans or special provisions):
 - Mn/DOT Type 3 (MCIA certified weed free mulch) at a rate of 2.0 tons per acre.
 - Clean grain straw at a rate of 2 tons per acre.
 - Prairie hay/mulch (Mn/DOT Type 7 or 8) at a rate of 2.0 tons per acre.

II. Establishment of the Native Mixture - The native mixture can be established into the areas previously seeded with a temporary cover crop by one of two methods; 1) interseeding using a no-till drill, or 2) by lightly tilling the area with a disc and seeding using one of the other acceptable seeding methods.

- A1) Site Preparation for Interseeding** - No tillage is necessary for installation of the native seed mixture. The site may require mowing if the temporary cover has grown taller than 12 inches and is still actively growing (winter wheat may require this). This will stop the rapidly growing cover crop from reaching maturity and shading out the establishing native vegetation. Optimal height for existing vegetation to be drilled into is 4-6 inches. No other site preparation is necessary.
- A2) Site Preparation with Light Tillage** - The area seeded with a temporary cover crop should be prepared by lightly disking to incorporate some of the mulch and temporary cover crop into the soil surface. Approximately 50% of the soil surface should be visible through the mulch or plant debris. Much of the existing cover should be left in place for its mulch value.
- B) Fertilizer** - The fertilizer used should be a commercial grade of slow release complete fertilizer applied at a rate of 300 lbs/acre at the time of preparing the seed bed for seeding. The fertilizer should contain 10-20-20 (NPK) analysis. The rate is reduced by half the normal recommendation because the initial half of the fertilizer was applied with the cover crop.
- C1) Seed Installation By Interseeding** - The native seed mixture should be installed with a seed drill that will accurately meter the types of seed to be planted and keep all seeds uniformly mixed during the drilling (Truax-type). The drill should contain a minimum of two seed boxes; a fine seed box and a box for large/fluffy seeds, and it should be equipped with disc furrow openers and packer assembly to compact the soil directly over the drill rows. Maximum row spacing should be 8 inches. The inter-seeder drill must be out-fitted with trash rippers which will slice through the vegetative mat and make a furrow into the underlying soil approximately 1 inch wide by 1/2 to 1 inch deep. These furrows shall be directly in line with the drill seed disc openers. Fine seed can be drop-seeded onto the ground surface from the fine seed box, and large/fluffy seed should be placed to obtain a final planting depth of 1/4 to 1/2 inch. All drill seeding should be done at a right angle to surface drainage.
- C2) Seed Installation By Drilling Lightly Tilled Sites** - The native mixture should be installed with a seed drill that will accurately meter the types of seed to be planted and keep all seeds uniformly mixed during the drilling (Truax-type). The drill should contain a minimum of two seed boxes; a fine seed box and a box for large/fluffy seeds, and it should be equipped with disc furrow openers and packer assembly to compact the soil directly over the drill rows. Maximum row spacing should be 8 inches. Fine seed should be drop-seeded onto the ground surface from the fine seed box, and large/fluffy seed should be placed to obtain a final planting depth of 1/4 to 1/2 inch. All drill seeding should be done at a right angle to surface drainage.
- D) Seeding Rates** - Rates are specified in the mixture tabulation for the specified mix. When using the 300 series mixtures, reduce the cover crop component from 70 lbs/acre to 35 lbs/acre.
- E) Harrowing** - Harrowing is not necessary when seeding the native mixture.
- F) Packing** - Packing the site is recommended to ensure a firm seed bed.
- G) Mulch** - Mulch may not be required with installation of the native mixture, depending on existing site conditions. The site should be mulched to achieve 90% ground coverage (10% bare ground). If this condition already exists mulch is not required.

Method 3. Drill Seeding Into Existing Vegetation - This method entails killing the existing vegetation with herbicide and using an interseeder drill to install the seed.

- A) Site Preparation** - The site should be prepared by mowing existing vegetation to a height of 4-6 inches in late April/early May or in late August/early September. The grass should be allowed to re-grow or "flush" before herbicide application with glyphosate, this may take 1-3 weeks depending on weather conditions. Addition of a surfactant and/or addition of 2,4-D to the mix often results in a more complete kill, especially with unwanted broad-leaved species. Recommended herbicide rates are 2.0 quarts/acre of glyphosate and 1.0 - 2.0 quarts/acre 2,4-D. Fall site preparation to control smooth brome grass may require higher glyphosate rates. Seeding can be performed 7-10 days after herbicide application. NOTE: Sites that contain significant weed infestations may require other types of weed control during preparation to ensure that the planting is a success.
- B) Fertilizer** - Fertilizer is not required when using this seeding method.
- C) Seed Installation** - The native seed mixture should be installed with a seed drill that will accurately meter the types of seed to be planted and keep all seeds uniformly mixed during the drilling (Truax-type). The drill should contain a minimum of two seed boxes; a fine seed box and a box for large/fluffy seeds, and it should be equipped with disc furrow openers and packer assembly to compact the soil directly over the drill rows. Maximum row spacing should be 8 inches. The inter-seeder drill must be out-fitted with trash rippers which will slice through the vegetative mat and make a furrow into the underlying soil approximately 1 inch wide by 1/2 to 1 inch deep. These furrows shall be directly in line with the drill seed disc openers. Fine seed should be drop-seeded onto the ground surface from the fine seed box, and large/fluffy seed should be placed to obtain a final planting depth of 1/4 to 1/2 inch. All drill seeding should be done at a right angle to surface drainage.
- D) Seeding Rates** - Rates are specified in the mixture tabulation for the specified mix.
- E) Harrowing** - Harrowing is not required when using this seeding method.
- F) Packing** - Packing the site is recommended to ensure a firm seed bed.
- G) Mulch** - Mulch is not required when using this seeding method.

Method 4. Broadcast Seeding - Broadcast seeding is performed either with mechanical "cyclone" seeders, by hand seeding or by any other method that scatters seed over the bare soil surface. The most desirable aspect of broadcast seeding is that there is no row effect such as that which results from drill seeding. This lends a more natural appearance to the planting. However, broadcast seeding may not be desirable if the weather is hot and dry and/or the soil moisture is content is low. It is essential that steps be taken to ensure good seed to soil contact when broadcast seeding is used.

- A) Site Preparation** - The site should be prepared by loosening topsoil to a minimum depth of 3 inches. It is critical that the seed bed be loosened to a point that there are spaces for seed to filter into cracks etc., otherwise it may end up on the surface and wash away with the first heavy rain.
- B) Fertilizer** - If used, the fertilizer used should be a commercial grade of slow release complete fertilizer applied at a rate of 100 lbs/acre at the time of preparing the seed bed for seeding. The fertilizer should contain 0-10-20 (NPK) analysis.
- C) Seed Installation** - Seed should be installed by broadcasting it evenly over the entire site. Several types and sizes of broadcast seeders are available for use, ranging from fertilizer-type spreaders to power spreaders mounted on all terrain vehicles. Seed should be mixed thoroughly prior to seeding and should be mixed occasionally in the spreader to prevent separation and settling.
- D) Seeding Rates** - Rates are specified in the mixture tabulation for the specified mix.
- E) Harrowing** - The site should be harrowed or raked following seeding.
- F) Packing** - The site should be packed using a culti-packer or equivalent following harrowing.
- G) Mulch** - The site should be mulched and disc-anchored following packing using one of the following types of mulch (as per plans or special provisions):
 - Mn/DOT Type 3 (MCIA certified weed free mulch) at a rate of 2.0 tons per acre.
 - Prairie hay/mulch (Mn/DOT Type 7 or 8) at a rate of 2.0 tons per acre.
 - Mn/DOT Hydraulic Soil Stabilizer or Bonded Fiber Matrix on inaccessible sites.

Method 5. Hydroseeding - Hydroseeding is an acceptable method for establishing natives when it is done correctly. However, it is imperative that the site is prepared and finished properly. Mn/DOT generally uses hydroseeding on steep slopes or other areas inaccessible to a seed drill such as wetland edges and ponds. Hydro-seeding native grasses and forbs is not recommended if the extended weather patterns are hot and dry and the soil surface is dry and dusty. The seed-water mixture should be applied within one hour after the seed is added to the hydro-seeder tank.

- A) Site Preparation** - The site should be prepared by loosening topsoil to a minimum depth of 3 inches. It is critical that the seedbed be loosened to a point that there are a lot of spaces for seed to filter into cracks etc., otherwise it may end up on the surface and wash away with the first heavy rain.
- B) Fertilizer** - If used, the fertilizer used should be a commercial grade of slow release complete fertilizer applied at a

rate of 300 lbs/acre at the time of preparing the seed bed for seeding. The fertilizer should contain 10-20-20 (NPK) analysis.

C) Seed Installation - Seed should be installed by hydro-seeding it evenly over the entire site. A fan-type nozzle should be used with approximately 500 gallons of water per acre. It is recommended to add approximately 75 pounds of hydromulch per 500 gallons of water for a visual tracer to ensure uniform coverage.

D) Seeding Rates - Rates are specified in the mixture tabulation for the specified mix.

E) Harrowing - The site should be harrowed or raked following seeding.

F) Packing - The site should be packed using a culti-packer or equivalent following harrowing.

G) Mulch - The site should be mulched and disc-anchored following packing using one of the following types of mulch (as per plans or special provisions):

- Mn/DOT Type 3 (MCIA certified weed free mulch) at a rate of 2.0 tons per acre.
 - Prairie hay/mulch (Mn/DOT Type 7 or 8) at a rate of 2.0 tons per acre.
 - Mn/DOT Hydraulic Soil Stabilizer or Bonded Fiber Matrix on inaccessible sites.

NOTE: When seeding in conjunction with a hydraulic soil stabilizer (bonded fiber matrixes (BFM's), hydro-mulches, etc., it is recommended that a two-step operation be used. Seed should be placed first and the hydraulic soil stabilizer be sprayed on afterwards. This is to ensure that seed comes into direct contact with the soil.

Maintenance Requirements

General Seed Mixtures 240, 250 and 280

Year 1

Maintenance after Spring or Early Summer Seeding:

- 1) Mowing during early Fall may be necessary if weed infestation or shading becomes a problem.
- 2) Weed Control – mowing should help control annual weeds. Spot spray thistles etc.
- 3) If plants are growing slowly, you can apply fertilizer (20-10-10 analysis) as necessary over the top to improve growth.

Maintenance after Fall or Dormant Seeding:

- 1) Mowing in May or June may be necessary if weed infestation becomes a problem.
- 2) Weed Control – mowing should help control annual weeds. Spot spray thistles etc.

Long Term

Maintenance:

- 1) Can mow 3 times per year as desired.
- 2) Spot spray weeds as needed.

General Seed Mixtures 260 and 270

Year 1

- 1) Provide water if necessary to aid establishment
- 2) After turf grasses reach a height of 6 inches, initially mow to a height of 2 to 3 inches.

Long Term

- 1) Fertilize and water as needed.
- 2) Mow a minimum of once every 2 weeks.

Native Grass and Forb Mixtures (310, 330, 340, 350, 325, 328)

Year 1

Establishment (spring seeding):

- 1) Prepare site - Late April - May.
- 2) Seed - May 1 – June 1.

Maintenance:

- 1) Mow (6-8 inches) – every 30 days after planting until September 30.
- 2) Weed Control - mowing should help control annual weeds. Spot spray thistles etc.

Establishment (fall seeding):

- 1) Prepare site - Late August - early September.
- 2) Seed - late September to freeze-up.

Maintenance (following season):

- 1) Mow (6-8 inches) – once in May, June and July.
- 2) Weed Control - mowing should keep annual weeds down. Spot spray thistles etc.

Evaluation:

- 1) Cover crop growing within 2 weeks of planting (except dormant plantings).
- 2) Seedlings spaced 1-6 inches apart in drill rows.
- 3) Native grass seedlings may only be 4-6 inches tall.
- 4) If there is a flush of growth from foxtail etc., mow as necessary.

Year 2**Maintenance:**

- 1) Mow (6-8 inches) one time between June 1 - August 15 before weeds set seed.
- 2) Weed Control - mowing should keep annual weeds down. Spot spray thistles etc.
- 3) Some sites may not require much maintenance the second year.

Evaluation:

- 1) Cover crop will be gone unless winter wheat was used in a fall planting.
- 2) Grasses forming clumps 1-6 inches apart in drill rows, but still short.
- 3) Some flowers should be blooming (black-eyed Susans, bergamot etc.).
- 4) If there is a flush of growth from foxtail etc., mow site.

Year 3**Maintenance:**

- 1) Mow only if necessary.
- 3) Weed Control - Spot spray thistles, etc.
- 4) Sites usually do not require much maintenance the third year.

Evaluation:

- 1) Planting should begin looking like a prairie - tall grasses, flowers etc.

Long-term**Maintenance:**

- 1) Weed Control - Spot spray thistles etc.
- 2) Burning (3-5 year rotation) alternate spring and fall if possible.
- 3) Haying (3-5 year rotation) late summer or early fall. Alternate with burning (may substitute for burning).
- 4) Burning two years in a row will really "clean up" rough-looking sites.

**GRASS REQUIREMENTS
GERMINATION, PURITY, AND ACCEPTABLE VARIETIES**

Trade Name	Scientific Name	Acceptable Varieties	Purity Minimum %	Germination Minimum %
Bentgrass, seaside	<i>Agrostis palustrus</i>	--	98	90
Redtop	<i>Agrostis stolonifera</i>	--	92	85
Oats	<i>Avena sativa</i>	--	99	85
Brome, smooth	<i>Bromus inermis</i>	Lincoln, Carlton, Sac, Signal, Manchar	90	85
ReGreen™	<i>Elymus trachycaulus</i> <i>x Triticum aestivum</i>	--	95	90
Fescue, hard	<i>Festuca ovina</i> <i>var. duriuscula</i>	Durar, Scaldis, Reliant II, Warwick, Aurora	95	85
Fescue, red	<i>Festuca rubra</i>	Wintergreen, Dawson, Pen Lawn, Cindy	97	85
Fescue, sheep's	<i>Festuca sp.</i>	--	95	85
Ryegrass, perennial	<i>Lolium perene</i>	--	99	90
Ryegrass, annual	<i>Lolium italicum</i>	--	99	90
Timothy	<i>Phleum pratense</i>	--	99	85
Bluegrass, Canada	<i>Poa compressa</i>	Common, Reubens, Talon	95	82
Bluegrass, Kentucky-Elite	<i>Poa pratensis</i>	Adelphi, Aspen, Columbia, Estate, Eclipse, Fylking, Jefferson, Merit, Midnight, Midnight II, Monopoly, NuGlade, Parade, Rambo, Touchdown, Victa	95	82
Bluegrass, Kentucky-Improved	<i>Poa pratensis</i>	Baron, Odyssey, Rugby II, Shamrock	95	82
Bluegrass, Kentucky-Low Maintenance	<i>Poa pratensis</i>	America, Aquila, Caliber, Certified Park, Challenger, Impact, Kenblue, Nassau, Newport, Nugget, Ram I, South Dakota, Sydsport	95	82
Bluegrass, Kentucky-Park	<i>Poa pratensis</i>	Certified Park only	95	82
Bluegrass SD Common	<i>Poa pratensis</i>	98/85	98	85
Alkali grass	<i>Puccinella distans</i>	Fult's, Salty	95	85
Wheat, winter	<i>Triticum aestivum</i>	--	99	85

LEGUME REQUIREMENTS

GERMINATION, PURITY, AND ACCEPTABLE VARIETIES

Trade Name	Scientific Name	Acceptable Varieties	Purity Minimum %	Germination Minimum %
Alfalfa, creeping	<i>Medicago sativa</i>	Rambler, Victoria, Teton, Travois, Spredor 2	99	85
Alfalfa, perennial	<i>Medicago sativa</i>	Vernal	99	85
Alfalfa, annual	<i>Medicago sativa</i>	Nitro, Condor, El Grande, Maricopa, Mesa, Prestige, Tulane, Westar, Beacon, Coronado, Mecca, Sundor	99	85
Clover, alslike	<i>Trifolium hybridum</i>	--	99	85
Clover, red	<i>Trifolium pratense</i>	Lakeland, Arlington	99	85
Clover, white	<i>Trifolium repens</i>	----	99	85

Germination values determined by test shall include dormant seed for legumes.

**NATIVE GRASS REQUIREMENTS
GERMINATION, PURITY, AND ACCEPTABLE VARIETIES**

Trade Name	Scientific Name	Acceptable Origin And Varieties	Purity Minimum %	Germination Minimum %
Bluestem, big	<i>Andropogon gerardi</i>	MN Certified (YT), Bison	85	70 (tz)
Gramma, sideoats	<i>Bouteloua curtipendula</i>	MN Certified (YT)	85	70
Gramma, blue	<i>Bouteloua gracilis</i>	MN, SD, ND wild-type	80	70
Brome, fringed	<i>Bromus ciliata</i>	MN, MT, Canada wild-type	85	70
Brome, Kalm's	<i>Bromus kalmii</i>	MN wild-type	85	70
Hairy wood chess	<i>Bromus purgans</i>	MN wild-type	85	70
Buffalo grass	<i>Buchloe dactyloides</i>	MN, ND, SD, NE wild-type	85	70
Blue-joint grass	<i>Calamagrostis canadensis</i>	MN Certified (YT), MN wild-type	85	70 (tz)
Sedge, bottle-brush	<i>Carex comosa</i>	MN wild-type	85	60 (tz)
Sedge, tussock	<i>Carex stricta</i>	MN wild-type	85	60 (tz)
Sedge, fox	<i>Carex vulpinoidea</i>	MN wild-type	85	60 (tz)
Wild rye, Canadian	<i>Elymus canadensis</i>	MN Certified (YT)	85	70
Bottle brush grass	<i>Elymus hystrix</i>	MN wild-type	85	70
Wheat grass, slender	<i>Elymus trachycaulus</i>	MN, ND, SD, Canada wild-type, Revenue	85	70
Wild rye, Virginia	<i>Elymus virginicus</i>	MN, WI, IA, Canada wild-type	85	70
Wheat grass, western	<i>Elytrigia smithii</i>	MN, ND, SD wild-type, Rodan	85	70
Manna grass, reed	<i>Glyceria grandis</i>	MN Certified (YT), MN wild-type	85	70 (tz)
Manna grass, fowl	<i>Glyceria striata</i>	MN Certified (YT), MN wild-type	85	70 (tz)
Common rush	<i>Juncus effusus</i>	MN wild-type	85	60 (tz)
June grass	<i>Koeleria macrantha</i>	MN, ND, SD wild-type	85	70
Switch grass	<i>Panicum virgatum</i>	MN Certified (YT), Dakotah	95	70
Bluegrass, fowl	<i>Poa palustris</i>	MN, ND, Canada wild-type	90	70 (tz)
Bluestem, little	<i>Schizachyrium scoparium</i>	MN Certified (YT),	85	70
Bulrush, green	<i>Scirpus atrovirens</i>	MN wild-type	85	60 (tz)
Wool grass	<i>Scirpus cyperinus</i>	MN wild-type	85	60 (tz)
Bulrush, soft-stem	<i>Scirpus validus</i>	MN Certified (YT), MN wild-type	85	60 (tz)
Indian grass	<i>Sorghastrum nutans</i>	MN Certified (YT)	85	70 (tz)
Cordgrass, prairie	<i>Spartina pectinata</i>	MN Certified (YT), MN wild-type, Red River	85	70 (tz)
Dropseed, rough	<i>Sporobolus asper</i>	MN, IA Certified (YT), MN wild-type	90	70 (tz)
Dropseed, sand	<i>Sporobolus cryptandrus</i>	MN, ND, SD wild-type	95	70 (tz)
Dropseed, prairie	<i>Sporobolus heterolepsis</i>	MN Certified (YT), MN wild-type	90	70 (tz)
Needle grass, green	<i>Stipa viridula</i>	MN, ND, SD wild-type, Lodorm	90	80 (tz)

Note: (tz) means that the acceptance may be by a tetrazolium test for viability. YT denotes Yellow tag origin certification by the MCIA.

NATIVE FORB SPECIES GERMINATION, PURITY, AND ACCEPTABLE VARIETIES

Trade Name	Scientific Name	Acceptable Origin And Varieties	Purity Minimum %	Germination Minimum %
Hyssop, fragrant-giant	<i>Agastache foeniculum</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Onion, prairie	<i>Allium stellatum</i>	MN Certified (YT), MN, ND, SD wild-type	80	40 (tz)
Anemone, Canada	<i>Anemone canadensis</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Milkweed, marsh	<i>Asclepias incarnata</i>	MN Certified (YT), MN wild-type	80	60 (tz)
Milkweed, butterfly	<i>Asclepias tuberosa</i>	MN Certified (YT), MN wild-type	80	60 (tz)
Aster, sky-blue	<i>Aster azureus</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Aster, heath	<i>Aster ericoides</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Aster, smooth-blue	<i>Aster laevis</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Aster, large-leaved	<i>Aster macrophyllus</i>	MN Certified (YT), MN wild-type	60	40 (tz)
Aster, New England	<i>Aster novae-angliae</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Aster, upland-white	<i>Aster ptarmicoides</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Aster, swamp	<i>Aster puniceus</i>	MN Certified (YT), MN wild-type	60	40 (tz)
Aster, silky	<i>Aster sericeus</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Milkvetch, Canada	<i>Astragalus canadensis</i>	MN Certified (YT), MN wild-type	90	70 (tz)
Partridge pea	<i>Chamaecrista fasciculata</i>	MN Certified (YT), MN wild-type	90	70 (tz)
Tic-seed, stiff	<i>Coreopsis palmata</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Prairie clover, white	<i>Dalea candidum</i>	MN Certified (YT), MN wild-type	90	70 (tz)
Prairie clover, purple	<i>Dalea purpureum</i>	MN Certified (YT), MN wild-type	90	70 (tz)
Tick-trefoil, showy	<i>Desmodium canadense</i>	MN Certified (YT), MN wild-type	90	70 (tz)
Coneflower, narrow-leaved	<i>Echinacea angustifolia</i>	MN Certified (YT), MN, ND, SD wild-type	80	50 (tz)
Joe-pye weed	<i>Eupatorium maculatum</i>	MN Certified (YT), MN wild-type	60	50 (tz)
Boneset	<i>Eupatorium perfoliatum</i>	MN Certified (YT), MN wild-type	60	50 (tz)
Ox-eye, common	<i>Heliopsis helianthoides</i>	MN Certified (YT), MN wild-type	80	60 (tz)
Iris, blue-flag	<i>Iris virginica-shrevii</i>	MN Certified (YT), MN wild-type	80	60 (tz)
Bushclover, round-headed	<i>Lespedeza capitata</i>	MN Certified (YT), MN, ND, SD wild-type	80	50 (tz)
Blazingstar, rough	<i>Liatris aspera</i>	MN Certified (YT), MN wild-type	80	50 (tz)

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NATIVE FORB SPECIES (CON'T) GERMINATION, PURITY, AND ACCEPTABLE VARIETIES

Trade Name	Scientific Name	Acceptable Origin And Varieties	Purity Minimum %	Germination Minimum %
Blazingstar, dotted	<i>Liatrix punctata</i>	MN Certified (YT), MN, ND, SD wild-type	80	50 (tz)
Blazingstar, tall	<i>Liatrix pycnostachya</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Lobelia, great-blue	<i>Lobelia siphilitica</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Monkey flower	<i>Mimulus ringens</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Bergamot, Wild	<i>Monarda fistulosa</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Bee balm, spotted	<i>Mondarda punctata</i>	MN Certified (YT), MN wild-type	70	40 (tz)
Beardtongue, foxglove	<i>Penstemon digitalis</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Penstemon, showy	<i>Penstemon grandiflorum</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Coneflower, columnar	<i>Ratibida columnifera</i>	MN Certified (YT), MN, ND, SD wild-type	80	50 (tz)
Coneflower, grey-headed	<i>Ratibida pinnata</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Black-eyed Susan's	<i>Rudbeckia hirta</i>	MN Certified (YT), MN wild-type	80	60 (tz)
Golden-glow, wild	<i>Rudbeckia laciniata</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Brown-eyed Susan	<i>Rudbeckia triloba</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Goldenrod, grass-leaved	<i>Solidago graminifolia</i>	MN Certified (YT), MN wild-type	70	40 (tz)
Goldenrod, stiff	<i>Solidago rigida</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Goldenrod, showy	<i>Solidago speciosa</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Spiderwort, prairie	<i>Tradescantia bracteata</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Spiderwort, Ohio	<i>Tradescantia ohiensis</i>	MN Certified (YT), MN, WI, IA wild-type	80	50 (tz)
Vervain, blue	<i>Verbena hastata</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Vervain, hoary	<i>Verbena stricta</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Ironweed	<i>Veronia fasciculata</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Culver's root	<i>Veronicastrum virginianum</i>	MN Certified (YT), MN wild-type	80	40 (tz)
Vetch, American	<i>Vicia americana</i>	MN Certified (YT), MN, Canada wild-type	80	60 (tz)
Alexander's, heart-leaved	<i>Zizea aptera</i>	MN Certified (YT), MN wild-type	80	50 (tz)
Alexander's, golden	<i>Zizea aurea</i>	MN Certified (YT), MN wild-type	80	50 (tz)

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