PAL Erosion control Matrices

CHANNEL EROSION CONTROL MATRIX

(Concentrated Flow Application)

TYPE OF EROSION CONTROL DEVICE	PERMISSIBLE SHEAR LB/S.F.	DITCH GRADE															REMARKS
		< 2%			2% - 4%			4% - 6%			6% - 9% *			9% - 12% *			
		Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			
		300	600	1200	300	600	1200	300	600	1200	300	600	1200	300	600	1200	
Seed with properly anchored mulch	0.6																Anchor mulch per specifications.
Sod ditch checks with seed and mulch	N/A					C											Install one ditch check for every 1 foot of drop. Sod stakes required.
Temporary ditch checks (hay bales or approved manufactured alternatives lisited in the WisDOT PAL)	N/A																Install one ditch check for every 2 feet of drop. Maximum 200' spacing. Not recommended for slopes less than 1%.
Sod ditch liner	1.0																Upstream end must be buried. Additional sod stakes required.
Double netted light duty (WisDOT Class I Type B) erosion mat	1.5																Only mat type products allowed.
Sod reinforced with a double netted jute (WisDOT Class II Type A) erosion mat	1.5																Upstream end must be buried. Additional sod stakes required. Two bid items needed.
Stone or rock ditch checks, or Rock-Filled Filter Bags	N/A																Use No. 2 coarse aggregate, railroad ballast, or breaker run. Install one ditch check for every 2 feet of drop. Use in conjunction with a channel lining.
Medium duty coconut erosion mat (WisDOT Class II Type B or C)	2.0																
Heavy duty synthetic (WisDOT Class III Type A) erosion mat or turf reinforcement mat (WisDOT Class III Type B)	2.0																Germination may be a problem with Class III Type A mats. An ECRM is required for initial erosion protection for Class III Type B mats.
Heavy duty synthetic turf reinforcement (WisDOT Class III Type C) mat	3.5																An ECRM is required for initial erosion protection. Contact manufacturer if higher shears are needed.
Riprap ditch checks	N/A																Place top of downstream ditch check level with bottom of upstream ditch check. Use in conjunction with a channel lining.
Heavy duty synthetic turf reinforcement (Class III Type D) mat	5																An ECRM is required for initial erosion protection. Contact manufacturer if higher shears are needed.
Light riprap	4																Outfalling, overtopping and scour need to be addressed. Use 2' minimum ditch depth.
Medium riprap	5																
Heavy riprap	8																
Riprap measures apply to all ditch types. Use of these measure requires engineering judgement and design.																	

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(Concentrated Flow Application)

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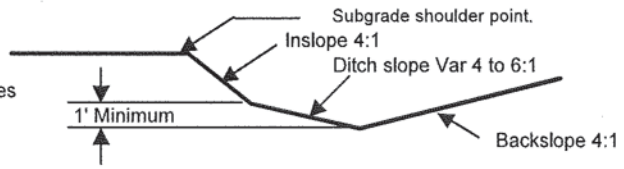
		< 2%			2% - 4%			4% - 6%			6% - 9% *			9% - 12% *			
		Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			
		300	600	1200	300	600	1200	300	600	1200	300	600	1200	300	600	1200	
Grouted rip rap	N/A	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Address outfalling, overtopping and scour. Line with Grotextile fabric Type "HR", (see Chap. 10, Const. Detail and special provision). Use 2' minimum ditch depth.
Articulated Concrete Block Type A	5	●	●	●	●	●	●	●	●	●	●						ACBs apply to all ditch types. Use of these measures requires engineering judgement and design.
Articulated Concrete Block Type B	10	●	●	●	●	●	●	●	●	●	●	●	●	●			
Articulated Concrete Block Type C	15	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Articulated Concrete Block Type D	20	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Articulated Concrete Block Type E	30	●	●	●	●	●	●	●	●	●	●	●	●				

Standard Ditch Section

Erosion control for ditches not conforming to the typical at right, that complies with FDM procedures 11-15-1 Figures 6 & 7, should be designed according to FDM Chapter 13.



KEY

Effective range of device for Sandy or Clayey Soil: ●●●●●●●

Device applicable, may not be cost effective: ●●●●●●●

" C " effective for clayey soil only

Not applicable. Use in conjunction with other BMPs:

ECRM - Erosion control revegetation mat. All Class I and II mats are ECRMs.
TRM - Turf reinforcement mat.
FDM - WisDOT Facilities Development Manual
BMP - Best Management Practice
PAL - See Note 6

* For ditch grades over 9% special design considerations may be required.
** Soils that are not sandy should be treated as clay soils.

NOTES

1) Ditch flow rates used to develop bar chart are based on a 60 ft. right of way from pavement centerline and a 2-Yr. rainfall event for temporary liners or a 25-Yr. rainfall event for permanent (Class III mat or riprap) liners. If the drainage area extends outside the 60 foot right of way or unusual flows are expected, use the shear stress column values to determine the suitablity of a liner. See FDM procedures in Chapter 10 and in Section 13-30-10.
2) Erosion mats shall extend upslope 1.0 ft. min. vertically from the ditch bottom or 6" higher than the design flow depth. There shall be no joints within 18" of the low point.
3) Cost shall be a consideration in the selection of these devices.
4) Add sediment traps at the bottom of channel slopes.
5) Refer to FDM Chapter 10 for any channels exceeding the limits shown.
6) Approved materials for erosion products are referenced from the Wisconsin Department of Transportation Erosion Control Product Acceptability Lists (PAL), found at the web site: http://www.dot.wisconsin.gov/business/engrserv/pal.htm
7) On long or steep channels that require a higher class mat, use the appropriate lower class mat for the first 300 ft to 600 ft of the channel.
8) Effective erosion control involves minimizing the amount of time soil is exposed and the selection of a combination of practices, and not reliance on just one practice.

SLOPE EROSION CONTROL MATRIX

TYPE OF EROSION CONTROL	SLOPE																					REMARKS
	6:1 or flatter (7)			4:1			3:1			2.5:1			2:1			1:1					
	SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH			SLOPE LENGTH					
	0 - 30'	30 - 60'	60 - 120	0 - 30'	30 - 60'	60 - 120	0 - 30'	30 - 60'	60 - 120	0 - 30'	30 - 60'	60 - 120	0 - 30'	30 - 60'	60 - 120	0 - 30'	30 - 60'	60 - 120				
Seed with properly anchored mulch																						
Single netted light duty (WisDOT Class I Type A) erosion mat																						
Light duty single netted 100% biodegradeable (WisDOT Urban Type A) erosion mat																						Use only 100% biodegradeable anchors for urban mats.
Light duty double netted 100% biodegradeable (WisDOT Urban Type B) erosion mat																						Use only 100% biodegradeable anchors for urban mats.
Bonded Mulch (WisDOT Type A Soil Stabilizer)																						May be applied over Class III Type B, C, or D mats in place of erosion control revegetation mats.
Polymer (WisDOT Type B Soil Stabilizer)	Used in conjunction with other BMPs effective up to a 2:1 slope. Not effective in sand. When used alone effective up to a 3:1 slope. Stand alone use appropriate for earthen stock piles, temporary, and late season applications																					
Double netted light duty (WisDOT Class I Type B) erosion mat																						
Sod																						
Medium duty coconut erosion mat (WisDOT Class II Type B or C)																						
Sod reinforced with a double netted jute (WisDOT Class II Type A) erosion mat																						Sod stakes required. Two bid items needed.
Heavy duty synthetic erosion control revegetation mat (WisDOT Class III Type A)																						Germination may be a problem with Class III Type A mats
Riprap																						Angle of repose must be considered, see FDM Chapter 13.
Heavy duty synthetic turf reinforcement (WisDOT Class III Type B or C) mat																						A soil stabilizer or ECRM will be required for initial erosion protection.
Heavy duty synthetic turf reinforcement (WisDOT Class III Type D) mat																						A soil stabilizer or ECRM will be required for initial erosion protection.
Slope paving or grouted riprap																						Consider clear zone requirements. Only use in limited circumstances such as overflow areas near bridges.

SLOPE EROSION CONTROL MATRIX

Benches	Consider benches when cuts exceed 20', bench at approximately 15' vertical intervals to collect and drain water. Treat benches as channels (ditches). Adjust elevations to provide drainage. Consider flumes at transitions.
Intercepting embankments	Used to intercept runoff from abutting lands. Flumes may be necessary to direct runoff.
Silt fence	Used at toe of slopes to intercept and detain small amounts of sediment. Use only WisDOT approved silt fence as listed in the PAL.
Temporary ditch checks or Erosion bales	Used at toe of slopes to intercept and detain small amounts of sediment.
Slope drains/flumes	May be necessary on slopes (see channel matrix for design guidance).
Sediment traps	Used to trap sediment laden runoff. Could be used at the inlet or outlet end of slope drain.

KEY:

Not applicable. Use in conjunction with other BMPs: ⊗

Effective range of device for Sandy or Clayey Soil:

Device applicable, may not be cost effective:

* Soils that are not sandy should be treated as clay soils.

ECRM - Erosion control revegetation mat. All Class I and II mats are ECRMs.
TRM - Turf reinforcement mat.
FDM - WisDOT Facilities Development Manual
PAL - See Note 5

NOTES

1) Cost shall be a consideration in the selection of these devices.
2) Designers should review FDM Chapter 10 prior to selection of erosion mats.
3) Install intercepting ditches to limit slope lengths to 15' vertical intervals. (See FDM Chapter 10)
4) Refer to FDM Chapter 10 for any slopes exceeding the limits shown.
5) Approved materials for erosion products are referenced from the Wisconsin Department of Transportation Erosion Control Product Acceptability Lists (PAL), found at the web site: http://www.dot.wisconsin.gov/business/engrserv/pal.htm
6) On steeper slopes that require a higher class mat, use the appropriate lower class mat or seed and mulch for the first 30 ft to 60 ft of the slope.
7) Unless project conditions require otherwise, seed and mulch all slopes that are flatter than a 5% grade, regardless of length. If practicable, bench the slopes.
8) Effective erosion control involves minimizing the amount of time soil is exposed and the selection of a combination of practices, and not reliance on just one practice.

Seeding Plan

WORKING DRAFT - NON-METALLIC MINE RECLAMATION - POST MINING LAND USE

CATEGORY OF POST MINING LAND USE	SUB-CATEGORY		LAND COVER		DEVELOPMENT DENSITY/INTENSITY		PUBLIC ACCESS/USE
Wildlife Habitat/Conservancy	Terrestrial		Grassland/Prairie		No Residential,		No Public Use -vs-
	Mixed		Grassland/Prairie/Forest Savannah		Commercial, or		Defined Public Use
	Aquatic		Wet/Sedge Meadow		Industrial		
			Shallow ponded/Deep Ponded		Development		
Agricultural	Ag Production		Cultivated cropland; Row Crop		No Development		No Public Use -vs-
			Cultivated Cropland; Forage Based		▪Non-Irrigated		Defined Public Use
			Pasture		▪Irrigated		
			Other				
Forest	Forest Production		Even aged species		No Development		No Public Use -vs-
			Mixed aged species		Low Density		Defined Public Use
Residential	Ag/Forest Residential				Low Density		Defined Dev. Plan
	Res Subdivision				Med. Density		
					High Density		
Commercial	Light				Low Intensity		Defined Dev. Plan
	Heavy				Med. Intensity		
					High Intensity		
Industrial	Light				Low Intensity		Defined Dev. Plan
	Heavy				Med. Intensity		
					High Intensity		
Institutional	Public Inst.						
	Private Inst.						
Any other land use category that may currently or potentially apply to the subject mine site, as defined in an approved comprehensive plan or zoning ordinance.							

MIX 1 - PASTURE

Common Name	Scientific Name	Lb./Ac.*	Price/Lb.	Price
Timothy	*Phleum pratense*	4	$ 1.50	$ 6.00
Tall Fescue	*Festuca arundinaceae*	5	$ 1.50	$ 7.50
Canada Wild Rye	*Elymus canadensis*	3	$ 12.00	$ 36.00
Agricultural Rye	*Secale cereale*	4.5	$ 1.00	$ 9.00
Alfalfa**	*Medicago sativa*	10	$ 4.00	$ 40.00
Alsike Clover**	*Trifolium hybridum*	4.5	$ 2.00	$ 9.00
	Total	**31 lbs.**	**Total**	**$ 107.50**

MIX 2 – STABILIZATION/WILDLIFE/GRAZING (Mix 3 would be suitable too)

Common Name	Scientific Name	Lb./Ac.*	Price/Lb.	Price
Agricultural Rye	*Secale cereale*	4	$ 1.00	$ 4.00
Timothy	*Phleum pratense*	2	$ 1.50	$ 3.00
Tall Fescue	*Festuca arundinaceae*	3	$ 1.50	$ 4.50
Switchgrass	*Panicum virgatum*	1	$ 13.50	$ 13.50
Big Bluestem	*Andropogon gerardi*	1	$ 10.50	$ 10.50
Canada Wild Rye	*Elymus canadensis*	3	$ 12.00	$ 36.00
Alsike Clover**	*Trifolium hybridum*	4	$ 2.00	$ 8.00
Red Clover**	*Trifolium repens*	4	$ 2.00	$ 8.00
Alfalfa**	*Medicago sativa*	5	$ 4.00	$ 20.00
	Total	**27 lbs.**	**Total**	**$ 107.50**

MIX 3 – NATIVE MIX FOR WILDLIFE/PASSIVE RECREATION

Common Name	Scientific Name	Unit	Unit/Ac.*	Price/Unit	Price
Big Bluestem	*Andropogon gerardi*	lb.	1	$ 10.50	$ 10.50
Canada Wild Rye	*Elymus canadensis*	lb.	3	$ 12.00	$ 36.00
Switchgrass	*Panicum virgatum*	lb.	1	$ 13.50	$ 13.50
Indiangrass	*Sorghastrum nutans*	lb.	3	$ 16.00	$ 48.00
Purple Prairie Clover**	*Dalea purpurea*	oz.	2	$ 4.50	$ 9.00
Canada Tick Trefoil**	*Desmodium canadensis*	oz.	5	$ 20.75	$ 103.75
New England Aster	*Aster novae angliae*	oz.	0.2	$ 48.75	$ 9.75
Purple Cone Flower	*Echinacea purpurea*	oz.	4	$ 4.50	$ 18.00
Dotted Mint**	*Monarda punctata*	oz.	4	$ 51.25	$ 205.00
Bergamot**	*Monarda fistulosa*	oz.	5	$ 25.75	$ 128.75
Yellow Coneflower	*Ratibida pinnata*	oz.	3	$ 4.50	$ 13.50
Blackeyed Susan	*Rudbeckia hirta*	oz.	0.5	$ 3.00	$ 1.50
Blue Vervain	*Verbena hastada*	oz.	1	$ 6.75	$ 6.75
		Total	**~9.5 lbs.**	**Total**	**$ 604.00**

MIX 4 – WET SOILS/POND EDGE/WEDLAND AREA

Common Name	Scientific Name	Unit	Unit/Ac.*	Price/Unit	Price
Canada Wild Rye	*Elymus canadensis*	lb.	3	$ 12.00	$ 36.00
Switchgrass	*Panicum virgatum*	lb.	1	$ 13.50	$ 13.50
Timothy	*Phleum pratense*	lb.	2	$ 1.50	$ 3.00
Blue Joint Grass	*Calamagrotis canadensis*	oz.	3.2	$ 56.25	$ 180.00
Annual Oats	*Avena sativa*	lb.	8	$ 2.00	$ 16.00
Alsike Clover**	*Trifolium hybridum*	lb.	1	$ 2.00	$ 2.00
Red Clover**	*Trifolium repens*	lb.	1	$ 2.00	$ 2.00
Culver's Root	*Veronicastrum virginicum*	oz.	2	$ 77.00	$ 154.00
Canada Tick Trefoil**	*Desmodium canadensis*	oz.	5	$ 20.75	$ 103.75
Blackeyed Susan	*Rudbeckia hirta*	oz.	0.2	$ 3.00	$ 0.60
Smooth Aster	*Aster laevis*	oz.	2	$ 48.75	$ 97.50
New England Aster	*Aster novae angliae*	oz.	0.6	$ 30.75	$ 18.45
Joe Pye Weed	*Eupatorium maculatum*	oz.	1	$ 36.00	$ 36.00
		Total	**~17 lbs.**	**Total**	**$ 662.80**

* Seeding rates assume broadcast seeding and may be multiplied by 0.5 to approximate rates if drilled.

** Denotes legumes, which must be inoculated according to the seed provider's instructions prior to seeding.

Pricing for native species found at Agrecol in 2012.

http://www.agrecol.com