MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monroe County, Wisconsin
Survey Area Data: Version 12, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

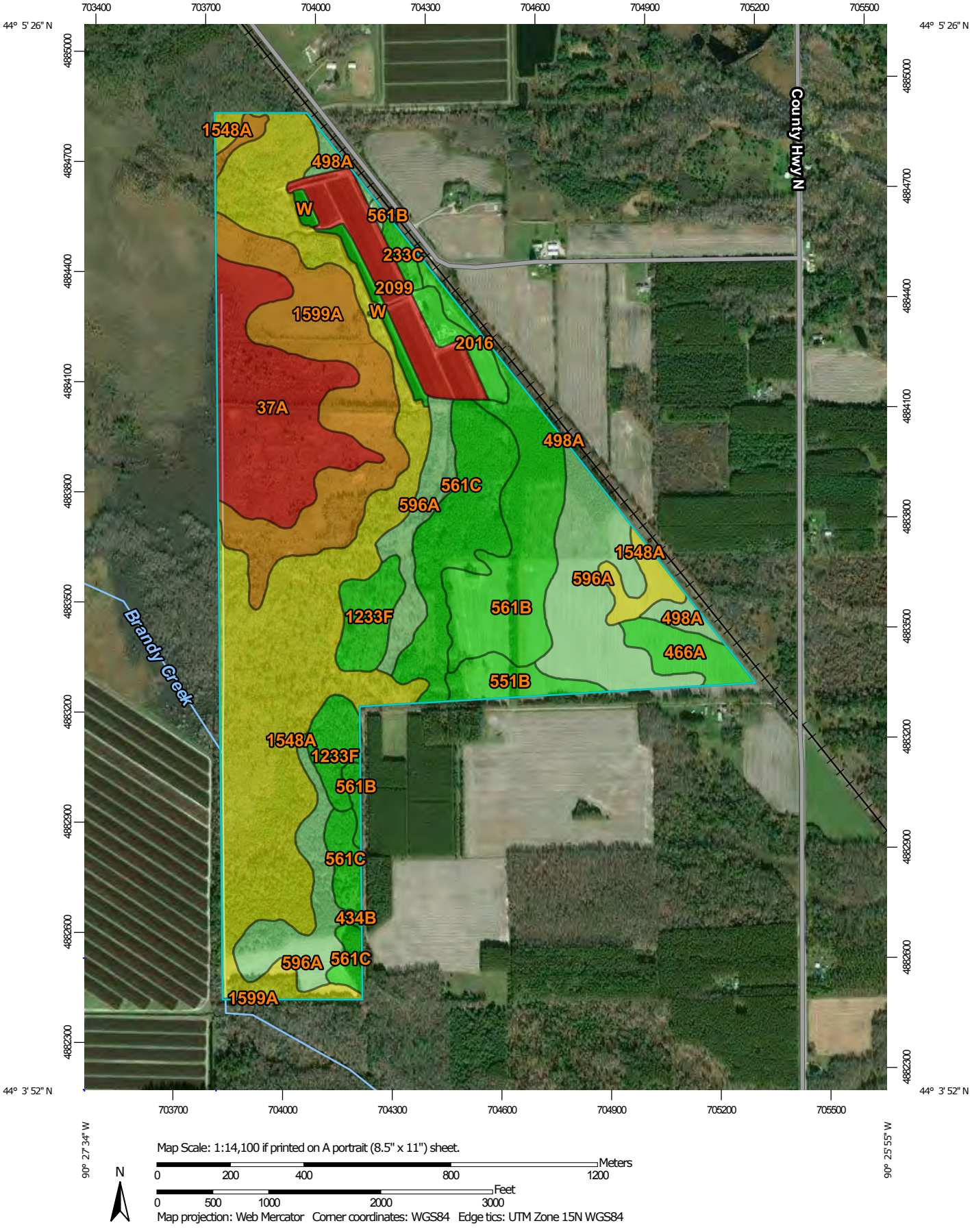
Date(s) aerial images were photographed: Aug 10, 2011—Nov 7, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
17A	Dawsil mucky peat, lake plain, frequently ponded, 0 to 1 percent slopes	6.1	0.3%
37A	Loxley peat, pediment, frequently ponded, 0 to 1 percent slopes	191.8	8.7%
233C	Boone sand, 6 to 15 percent slopes	2.6	0.1%
434B	Bilson sandy loam, 1 to 6 percent slopes	8.0	0.4%
448A	Sooner silt loam, 0 to 3 percent slopes	32.9	1.5%
466A	Bilmod sandy loam, lake terrace, 0 to 3 percent slopes	127.5	5.8%
498A	Hoop sandy loam, loamy substratum, 0 to 3 percent slopes	296.1	13.5%
551B	Impact sand, 2 to 6 percent slopes	44.9	2.0%
556A	Mindoro sand, 0 to 3 percent slopes	38.5	1.8%
561B	Tarr sand, 1 to 6 percent slopes	101.9	4.6%
561C	Tarr sand, 6 to 15 percent slopes	72.2	3.3%
596A	Tint sand, lake plain, 0 to 3 percent slopes	260.2	11.9%
1233F	Boone-Tarr sands, 15 to 50 percent slopes	17.8	0.8%
1548A	Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes	300.5	13.7%
1599A	Ponycreek-Dawsil, frequently ponded, complex, lake plain, 0 to 1 percent slopes	474.0	21.6%
2016	Pits, quarry, soft bedrock	5.7	0.3%
2022	Pits, siliceous sand	2.3	0.1%
2099	Psammaquents, nearly level	148.0	6.7%
W	Water	62.4	2.8%
Totals for Area of Interest		**2,193.4**	**100.0%**

Figure 6


90° 27' 34" W
90° 25' 55" W
703400
703700
704000
704300
704600
704900
705200
705500
44° 5' 26" N
44° 3' 52" N
4885000
4884700
4884400
4884100
4883800
4883500
4883200
4882900
4882600
4882300
County Hwy N
Brandy Creek
1548A
498A
W
561B
233C
2099
1599A
W
2016
37A
498A
561C
596A
1548A
596A
1233F
561B
498A
466A
551B
1548A
1233F
561B
561C
434B
596A
561C
1599A
Map Scale: 1:14,100 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0
200
400
800
1200
Feet
0
500
1000
2000
3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines

- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points

- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monroe County, Wisconsin
Survey Area Data: Version 12, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 10, 2011—Nov 7, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
37A	Loxley peat, pediment, frequently ponded, 0 to 1 percent slopes	100	43.8	10.4%
233C	Boone sand, 6 to 15 percent slopes	0	2.5	0.6%
434B	Bilson sandy loam, 1 to 6 percent slopes	0	0.4	0.1%
466A	Bilmod sandy loam, lake terrace, 0 to 3 percent slopes	0	8.8	2.1%
498A	Hoop sandy loam, loamy substratum, 0 to 3 percent slopes	3	5.0	1.2%
551B	Impact sand, 2 to 6 percent slopes	0	8.1	1.9%
561B	Tarr sand, 1 to 6 percent slopes	0	38.7	9.2%
561C	Tarr sand, 6 to 15 percent slopes	0	36.4	8.7%
596A	Tint sand, lake plain, 0 to 3 percent slopes	6	60.2	14.3%
1233F	Boone-Tarr sands, 15 to 50 percent slopes	0	17.1	4.1%
1548A	Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes	42	119.6	28.4%
1599A	Ponycreek-Dawsil, frequently ponded, complex, lake plain, 0 to 1 percent slopes	90	51.0	12.1%
2016	Pits, quarry, soft bedrock	0	5.7	1.3%
2022	Pits, siliceous sand	0	0.1	0.0%
2099	Psammaquents, nearly level	100	19.2	4.6%
W	Water	0	4.7	1.1%
Totals for Area of Interest			**421.2**	**100.0%**

Wetla

Concord Ave
Co. Hwy N
Cranberry Bog
Wetland 8 (E2K)
Wetland 5 (E1K)
Wetland 7 (T5K)
Wetland 6 (T5/S3K)
Wetland 4 (T5/S3K)
Wetland 3 (T3/5K)
Wetland 2 (T5K)
Wetland 1 (T3/5K)
Google Earth
© 2018 Google
N
5000 ft

Wetlan

Wetland

Wetland 5
(E1K)
SP 5-W
Wetland 4
(T5/S3K)
SP 4-U
SP 4-W
SP 5-U
Wetland 3
(T3/5K)
SP 3-U
SP 3-W
Wetland 2
(T5K)
SP 2-W
SP 2-U
Google Earth
© 2018 Google
N
1000 ft

Wetlan

Cranberry Bog
Concord Ave
Co Hwy N
Wetland 7 (T5K)
SP 8-U
SP 8-W
SP 9-U
SP 7-U
SP 7-W
Wetland 6 (T5/S3K)
SP 6-W
SP 6-U
Wetland 8 (E2K)
SP 10-W
SP 10-U
N
2000 ft
Google Earth
© 2018 Google

Appendix A
Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 6/28/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 1-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 1, T18N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): none Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Tint sand, lake plaine, 0 to 3 percent slopes (596A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Vegetation and soil are significantly disturbed as sample pont is adjacent to a soybean field. This area appears to be periodically plowed.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 16

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
See Photos 1-3

VEGETATION– Use scientific names of plants. Sampling Point: 1-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	20	Yes	FAC
2. *Pinus strobus*	20	Yes	FACU
3. *Populus tremuloides*	5	No	FAC
4.			
5.			
6.			
7.			
	45	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	5	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	5	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Rubus idaeus*	90	Yes	FAC
2. *Coronilla varia*	5	No	UPL
3. *Poa pratensis*	5	No	FACU
4. *Schedonorus arundinaceus*	5	No	FACU
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	105	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	120	x 3 =	360
FACU species	30	x 4 =	120
UPL species	5	x 5 =	25
Column Totals:	155 (A)		505 (B)

Prevalence Index = B/A = 3.26

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 1-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 2/1	100					Sandy	
8-16	10YR 6/1	100					Sandy	white sand
16-22	7.5YR 5/1	98	7.5YR 5/8	2	C	M	Sandy	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ? Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 6/28/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 1-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 1, T18N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Poneycreek cmplex, lake plain, 0 to 3 percent slopes (1548A) NWI classification: T3/5K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ? Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 16
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 12

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
See Photos 1- 3.

VEGETATION– Use scientific names of plants. Sampling Point: 1-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Populus tremuloides*	40	Yes	FAC
2. *Pinus strobus*	10	No	FACU
3. *Rhamnus cathartica*	5	No	FAC
4.			
5.			
6.			
7.			
	55	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	70	Yes	FAC
2. *Populus tremuloides*	20	Yes	FAC
3. *Pinus strobus*	10	No	FACU
4.			
5.			
6.			
7.			
	100	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Onoclea sensibilis*	25	Yes	FACW
2. *Rhamnus cathartica*	10	Yes	FAC
3. *Scirpus cyperinus*	10	Yes	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	45	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	25	x 2 =	50
FAC species	145	x 3 =	435
FACU species	20	x 4 =	80
UPL species	0	x 5 =	0
Column Totals:	200 (A)		575 (B)

Prevalence Index = B/A = 2.88

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 1-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 2/1	100					Mucky Sand	
8-14	7.5YR 5/2	100					Sandy	
14-20	7.5YR 6/1	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/12/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 2-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 1, T18N, R1W

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Tint sand, lake plain, 0 to 3 percent slopes (596A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 2-U is the upland sample point for Wetland 2

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 2-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Pinus strobus*	50	Yes	FACU
2. *Pinus banksiana*	20	Yes	FACU
3. *Quercus rubra*	15	No	FACU
4.			
5.			
6.			
7.			
	85	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Pinus strobus*	5	Yes	FACU
2. *Quercus alba*	2	Yes	FACU
3. *Rhamnus cathartica*	2	Yes	FAC
4. *Comptonia peregrina*	2	Yes	UPL
5.			
6.			
7.			
	11	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Quercus rubra*	3	Yes	FACU
2. *Fragaria virginiana*	2	Yes	FACU
3. *Monarda punctata*	2	Yes	UPL
4. *Euphorbia corollata*	2	Yes	UPL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	9	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 10 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 10.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	2	x 3 =	6
FACU species	97	x 4 =	388
UPL species	6	x 5 =	30
Column Totals:	105 (A)		424 (B)

Prevalence Index = B/A = 4.04

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)
The Herb Stratum had 40% reindeer lichen (Cladonia rangiferina).

SOIL

Sampling Point 2-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 4/3	100					Sandy	silty sand
4-12	10YR 4/4	100					Sandy	silty sand
12-22	10YR 7/1	100					Sandy	white sand

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/12/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 2-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 1, T18N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Poneycreek complex, lake plain, 0 to 3 percent slopes (1548A) NWI classification: T5K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 2-W is located in Wetland 2.
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 12

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
See Photo # 4

VEGETATION– Use scientific names of plants. Sampling Point: 2-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	60	Yes	FAC
2. *Pinus strobus*	25	Yes	FACU
3. *Populus tremuloides*	20	No	FAC
4.			
5.			
6.			
7.			
	105	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	50	Yes	FAC
2. *Populus tremuloides*	15	No	FAC
3. *Acer rubrum*	15	No	FAC
4. *Pinus strobus*	5	No	FACU
5.			
6.			
7.			
	85	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Rhamnus cathartica*	5	Yes	FAC
2. *Osmunda spectabilis*	1	No	OBL
3. *Rubus idaeus*	1	No	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	7	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	1	x 1 =	1
FACW species	0	x 2 =	0
FAC species	166	x 3 =	498
FACU species	30	x 4 =	120
UPL species	0	x 5 =	0
Column Totals:	197 (A)		619 (B)

Prevalence Index = B/A = 3.14

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 2-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
1-7	10YR 2/1	100					Mucky Sand	
7-10	10YR 6/1	60					Sandy	
	10YR 2/1	40						
10-18	10YR 6/1	60					Sandy	
	10YR 7/1	40						
18-22	10YR 6/1	70	10YR 6/6	2	C	M	Sandy	Prominent redox concentrations
	10YR 7/1	28						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ? Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

1 inch of peat on the soil surface (0 Horizon)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 7/12/2018

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 3-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 1, T18N, R1W

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Boone-Tarr sands, 15 to 30 percent slopes (1233F) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 3-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Quercus rubra*	60	Yes	FACU
2. *Pinus strobus*	40	Yes	FACU
3. *Quercus alba*	10	No	FACU
4.			
5.			
6.			
7.			
	110	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Pinus strobus*	50	Yes	FACU
2. *Rhamnus cathartica*	5	No	FAC
3.			
4.			
5.			
6.			
7.			
	55	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Carex pensylvanica*	20	Yes	UPL
2. *Quercus alba*	5	No	FACU
3. *Rhamnus cathartica*	1	No	FAC
4. *Acer rubrum*	1	No	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	27	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	7	x 3 =	21
FACU species	165	x 4 =	660
UPL species	20	x 5 =	100
Column Totals:	192 (A)		781 (B)

Prevalence Index = B/A = 4.07

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 3-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-14	10YR 6/6	100					Sandy	
14-22	10YR 6/2	100					Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Soil was dry. Soil was moistened for color match

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/12/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 3-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 1, T18N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes (1548A) NWI classification: T3/5K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 18

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
SP 3-W is in Wetland 3.
See Photos # 5-7.

VEGETATION– Use scientific names of plants. Sampling Point: 3-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Pinus strobus*	70	Yes	FACU
2. *Rhamnus cathartica*	5	No	FAC
3.			
4.			
5.			
6.			
7.			
	75	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Pinus strobus*	20	Yes	FACU
2. *Rhamnus cathartica*	20	Yes	FAC
3. *Vaccinium myrtilloides*	10	Yes	FACW
4.			
5.			
6.			
7.			
	50	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Osmundastrum cinnamomeum*	80	Yes	FACW
2. *Rhamnus cathartica*	5	No	FAC
3. *Pteridium aquilinum*	5	No	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1. *Rubus idaeus*			FAC
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 3-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 2/1	100					Mucky Sand	
6-10	10YR 3/2	100					Sandy	
10-22	10YR 7/2	60					Sandy	
	10YR 7/1	40						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 6/28/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 4-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Boone-Tarr sands, 15 to 50 percent slopes (1233F) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
4-U is the upland sample point for Wetland 4

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 4-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Quercus alba*	60	Yes	FACU
2. *Acer rubrum*	50	Yes	FAC
3. *Pinus strobus*	30	Yes	FACU
4.			
5.			
6.			
7.			
	140	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Vaccinium myrtilloides*	80	Yes	FACW
2. *Pinus strobus*	20	No	FACU
3. *Rhamnus cathartica*	5	No	FAC
4.			
5.			
6.			
7.			
	105	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Pteridium aquilinum*	5	Yes	FACU
2. *Osmundastrum cinnamomeum*	2	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	7	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	82	x 2 =	164
FAC species	55	x 3 =	165
FACU species	115	x 4 =	460
UPL species	0	x 5 =	0
Column Totals:	252 (A)		789 (B)

Prevalence Index = B/A = 3.13

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 4-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	7.5YR 2.5/2	100					Peat	
1-3	10YR 2/1	100					Mucky Sand	
3-7	10YR 3/2	100					Sandy	
7-10	10YR 4/3	60					Sandy	
	7.5YR 4/4	40						
10-14	10YR 5/3	98	7.5YR 5/6	2	C	M	Sandy	Prominent redox concentrations
14-22			10YR 6/2	100	D	M	Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 6/28/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 4-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Ponycreek, lake plain, 0 to 3 percent slopes (1548A) NWI classification: T5/S3K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 4-W is located in Wetland 4.
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- X Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ? Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 20
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 9

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Other: tress with buttressed tree roots

VEGETATION– Use scientific names of plants. Sampling Point: 4-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Quercus rubra*	30	Yes	FACU
2. *Acer rubrum*	20	Yes	FAC
3. *Pinus strobus*	20	Yes	FACU
4.			
5.			
6.			
7.			
	70	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Vaccinium myrtilloides*	30	Yes	FACW
2. *Rhamnus cathartica*	10	Yes	FAC
3. *Pinus strobus*	10	Yes	FACU
4.			
5.			
6.			
7.			
	50	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Osmundastrum cinnamomeum*	60	Yes	FACW
2. *Rhamnus cathartica*	10	No	FAC
3. *Athyrium angustum*	10	No	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 57.1% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	90	x 2 =	180
FAC species	50	x 3 =	150
FACU species	60	x 4 =	240
UPL species	0	x 5 =	0
Column Totals:	200 (A)		570 (B)

Prevalence Index = B/A = 2.85

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 4-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	7.5YR 2.5/2	100					Peat	
3-7	10YR 2/1	100					Mucky Sand	
7-9	10YR 2/2	100					Mucky Sand	
9-16	10YR 6/2	100					Sandy	
16-20	10YR 6/1	100					Sandy	
20-24	7.5YR 6/1	98	10YR 6/6	2	C	M	Sandy	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ? 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 6/29/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 5-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Boone-Tarr sands, 15 to 50 percent slopes (1233F) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 5-U is the upland sample point for Wetland 5

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Sample point is located on hillside adjacent and to the south of Wetland 5.

VEGETATION– Use scientific names of plants. Sampling Point: 5-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Quercus alba*	40	Yes	FACU
2. *Quercus rubra*	30	Yes	FACU
3. *Pinus resinosa*	15	No	FACU
4. *Pinus strobus*	10	No	FACU
5. *Acer rubrum*	10	No	FAC
6.			
7.			
	105	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	40	Yes	FAC
2. *Vaccinium angustifolium*	10	No	FACU
3. *Vaccinium myrtilloides*	5	No	FACW
4.			
5.			
6.			
7.			
	55	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Carex pensylvanica*	70	Yes	UPL
2. *Acer rubrum*	10	No	FAC
3. *Quercus alba*	5	No	FACU
4. *Rhamnus cathartica*	5	No	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	5	x 2 =	10
FAC species	65	x 3 =	195
FACU species	110	x 4 =	440
UPL species	70	x 5 =	350
Column Totals:	250 (A)		995 (B)

Prevalence Index = B/A = 3.98

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 5-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 2/1	50					Sandy	
	10YR 7/1	50						
5-20	10YR 4/6	100					Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ? Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 6/29/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 5-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): drainage way Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Ponycreekcomplex, lake plain, 0 to 3 percent slopes (1548A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Vegetation observed was characteristic of an Emergent/Wet Meadow (E2K) and is noted as such in this report.
Hydrology is naturally problematic as it is seasonal.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 18
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 14

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
See Photo # 8

VEGETATION– Use scientific names of plants. Sampling Point: 5-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Pinus strobus*	20	Yes	FACU
2. *Pinus resinosa*	10	Yes	FACU
3. *Picea mariana*	5	No	FACW
4.			
5.			
6.			
7.			
	35	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	20	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	20	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Carex lacustris*	75	Yes	OBL
2. *Scirpus cyperinus*	25	No	OBL
3. *Geum aleppicum*	30	Yes	FAC
4. *Acer rubrum*	20	No	FAC
5. *Lysimachia ciliata*	15	No	FACW
6. *Rubus idaeus*	15	No	FAC
7.			
8.			
9.			
10.			
11.			
12.			
	180	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	100	x 1 =	100
FACW species	20	x 2 =	40
FAC species	85	x 3 =	255
FACU species	30	x 4 =	120
UPL species	0	x 5 =	0
Column Totals:	235 (A)		515 (B)

Prevalence Index = B/A = 2.19

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 5-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 2/1	100					Mucky Sand	
5-10	10YR 6/2	100					Sandy	
10-14	10YR 6/2	98	10YR 6/6	2	C	M	Sandy	Prominent redox concentrations
14-21	10YR 5/1	60					Sandy	
	10YR 6/2	40						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ? Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- X Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/13/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 6-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Boone-Tarr sands, 15 to 50 percent slopes (1233F) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 6-U and 7-U are upland sample points for Wetland 6

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 6-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	40	Yes	FAC
2. *Quercus alba*	20	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	60	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	70	Yes	FAC
2. *Vaccinium angustifolium*	10	No	FACU
3.			
4.			
5.			
6.			
7.			
	80	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Carex pensylvanica*	50	Yes	UPL
2. *Pteridium aquilinum*	15	Yes	FACU
3. *Symphyotrichum laeve*	5	No	FACU
4. *Quercus alba*	1	No	FACU
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	71	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1. *Rubus idaeus*	2	No	FAC
2.			
3.			
4.			
	2	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	112	x 3 =	336
FACU species	51	x 4 =	204
UPL species	50	x 5 =	250
Column Totals:	213 (A)		790 (B)

Prevalence Index = B/A = 3.71

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 6-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 2/2	100					Sandy	
4-7	10YR 3/4	80					Sandy	
	10YR 2/2	20						
7-15	10YR 3/4	100					Sandy	
15-24	10YR 5/4	100					Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ? Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/13/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 6-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Ponycreek complex, lake plaine, 0 to 3 percent slopes (1548A) NWI classification: T5/S3K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 6-W and 7-W are wetland sample points for Wetland 6
Hydrology is naturally problematic as it is seasonal.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 18
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 12

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 6-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	10	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	10	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	95	Yes	FAC
2. *Vaccinium myrtilloides*	70	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	165	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Lycopodiella inundata*	20	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	20	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1. *Rubus idaeus*	5	Yes	FAC
2.			
3.			
4.			
	5	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	70	x 2 =	140
FAC species	110	x 3 =	330
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	200 (A)		490 (B)

Prevalence Index = B/A = 2.45

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 6-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 2/1	100					Muck	
2-6	10YR 2/2	100					Mucky Sand	
6-12	10YR 5/4	60					Sandy	
	5YR 3/4	40						
12-22	10YR 5/3	93	7.5YR 5/6	5	C	M	Sandy	Prominent redox concentrations
			7.5YR 4/6	2	C	M		Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ? Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ? 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 7/18/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 7-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Tint sand, lake plain, 0 to 3 percent slopes (596A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 6-U and 7-U are upland sample points for Wetland 6

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 7-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Quercus rubra*	20	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	20	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	40	Yes	FAC
2. *Comptonia peregrina*	20	Yes	UPL
3. *Pinus strobus*	10	No	FACU
4.			
5.			
6.			
7.			
	70	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Phleum pratense*	30	Yes	FACU
2. *Rhamnus cathartica*	20	Yes	FAC
3. *Pteridium aquilinum*	15	Yes	FACU
4. *Quercus alba*	10	No	FACU
5. *Asclepias syriaca*			UPL
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	75	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.3% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	60	x 3 =	180
FACU species	85	x 4 =	340
UPL species	20	x 5 =	100
Column Totals:	165 (A)		620 (B)

Prevalence Index = B/A = 3.76

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 7-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 3/1	100					Sandy	
10-14	10YR 3/3	100					Sandy	
14-22	10YR 5/4	100					Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/18/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 7-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-ponycreek complex, lake plain, 0 to 3 percent slopes NWI classification: T5/S3K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 6-W and 7-W are located in Wetland 6
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 16
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 12

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 7-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	15	Yes	FAC
2. *Pinus strobus*	2	No	FACU
3.			
4.			
5.			
6.			
7.			
	17	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	80	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	80	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Carex lacustris*	80	Yes	OBL
2. *Osmundastrum cinnamomeum*	5	No	FACW
3. *Rubus idaeus*	5	No	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 7-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 2/2	100					Peat	
2-10	10YR 2/1	100					Mucky Sand	
10-18			7.5YR 5/1	100	D	M	Sandy	
18-22			7.5YR 5/1	98	D	M	Sandy	
			7.5YR 6/6	2	C	M		Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ? 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ? Polyvalue Below Surface (S8) (**LRR K, L**)
- ? Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 7/18/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 8-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): convex Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Tint sand, lake plain, 0 to 3 percent slopes (596A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 8-U is the upland sample point for Wetland 7

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION– Use scientific names of plants. Sampling Point: 8-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	60	Yes	FAC
2. *Quercus rubra*	50	Yes	FACU
3. *Pinus strobus*	10	No	FACU
4.			
5.			
6.			
7.			
	120	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Vaccinium angustifolium*	50	Yes	FACU
2. *Acer rubrum*	20	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	70	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Carex pensylvanica*	20	Yes	UPL
2. *Pteridium aquilinum*	5	Yes	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	25	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.3% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	80	x 3 =	240
FACU species	115	x 4 =	460
UPL species	20	x 5 =	100
Column Totals:	215 (A)		800 (B)

Prevalence Index = B/A = 3.72

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 8-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 3/1	100					Sandy	
6-20	10YR 3/4	100					Sandy	
20-22	10YR 6/1	93	10YR 5/6	7	C	M	Sandy	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ? Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Soil was dry. It was moistened for color match

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 7/18/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 8-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes (1548A) NWI classification: T5K

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 8-W is located in Wetland 7
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- X Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 20
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 14

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
SP 8-W is in Wetland 7
Other: trees with buttressed roots
See Photo # 9

VEGETATION– Use scientific names of plants. Sampling Point: 8-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	80	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	80	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	10	Yes	FAC
2. *Pinus strobus*	2	No	FACU
3.			
4.			
5.			
6.			
7.			
	12	=Total Cover	
Herb Stratum (Plot size: 5 ft. radius)			
1. *Acer rubrum*	20	Yes	FAC
2. *Rubus idaeus*	20	Yes	FAC
3. *Maianthemum canadense*	10	No	FACU
4. *Rhamnus cathartica*	10	No	FAC
5. *Cornus canadensis*	10	No	FAC
6. *Osmundastrum cinnamomeum*	5	No	FACW
7.			
8.			
9.			
10.			
11.			
12.			
	75	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	5	x 2 =	10
FAC species	150	x 3 =	450
FACU species	12	x 4 =	48
UPL species	0	x 5 =	0
Column Totals:	167 (A)		508 (B)

Prevalence Index = B/A = 3.04

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 8-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	5YR 4/4	100					Peat	
1-6	10YR 2/2	100					Mucky Sand	
6-14	7.5YR 5/1	100					Sandy	
14-20	7.5YR 5/1	98	10YR 6/6	2	C	M	Sandy	Prominent redox concentrations
20-22	7.5YR 5/1	95	10YR 6/6	5	C	M	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- X Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Sand City/County: Monroe County Sampling Date: 7/18/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 9-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): drainage way Local relief (concave, convex, none): concave Slope %:

Subregion (LRR or MLRA): LRR K Lat: Long: Datum:

Soil Map Unit Name: Tint sand, lake plain, 0 to 3 percent slopes (596A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology X significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation , Soil , or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area**
Hydric Soil Present?	Yes	No X	**within a Wetland?** **Yes** **No** X
Wetland Hydrology Present?	Yes	No X	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)
SP 9-U is located in a disturbed area with sedges scattered throughout.
Hydrology is naturally problematic as it is seasonal

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- Surface Water (A1)
- High Water Table (A2)
- Saturation (A3)
- Water Marks (B1)
- Sediment Deposits (B2)
- Drift Deposits (B3)
- Algal Mat or Crust (B4)
- Iron Deposits (B5)
- Inundation Visible on Aerial Imagery (B7)
- Sparsely Vegetated Concave Surface (B8)
- Water-Stained Leaves (B9)
- Aquatic Fauna (B13)
- Marl Deposits (B15)
- Hydrogen Sulfide Odor (C1)
- Oxidized Rhizospheres on Living Roots (C3)
- Presence of Reduced Iron (C4)
- Recent Iron Reduction in Tilled Soils (C6)
- Thin Muck Surface (C7)
- Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- Surface Soil Cracks (B6)
- Drainage Patterns (B10)
- Moss Trim Lines (B16)
- Dry-Season Water Table (C2)
- Crayfish Burrows (C8)
- Saturation Visible on Aerial Imagery (C9)
- Stunted or Stressed Plants (D1)
- Geomorphic Position (D2)
- Shallow Aquitard (D3)
- Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	No X	Depth (inches):
Water Table Present?	Yes	No X	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes	No X	Depth (inches):

Wetland Hydrology Present? **Yes** **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
See Photo # 11

VEGETATION– Use scientific names of plants. Sampling Point: 9-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1. *Rhamnus cathartica*	60	Yes	FAC
2. *Spiraea tomentosa*	5	No	FACW
3.			
4.			
5.			
6.			
7.			
	65 =Total Cover		
Herb Stratum (Plot size: 5 ft. radius)			
1. *Cyperus esculentus*	20	Yes	FACW
2. *Fragaria virginiana*	20	Yes	FACU
3. *Scirpus cyperinus*	15	Yes	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	55 =Total Cover		
Woody Vine Stratum (Plot size: 30 ft. radius)			
1. *Rubus idaeus*	40	Yes	FAC
2.			
3.			
4.			
	40 =Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	15	x 1 =	15
FACW species	25	x 2 =	50
FAC species	100	x 3 =	300
FACU species	20	x 4 =	80
UPL species	0	x 5 =	0
Column Totals:	160 (A)		445 (B)

Prevalence Index = B/A = 2.78

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 9-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/4	100					Sandy	
12-15	10YR 3/4	50					Sandy	
	10YR 5/1	50						
15-20	10YR 5/1	100					Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Soil was dry. It was moistened for color matching

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/25/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 10-U

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): none Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Bilmond sandy loam, lake terrace, 0 to 3 percent slopes (466A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 10-U is the upland sample point for Wetland 8.
Vegetation and soil is significantly disturbed as it is in a soy bean filed.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Soy beans at the upland sample point were dark green in color and healthy.

VEGETATION– Use scientific names of plants. Sampling Point: 10-U

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
Herb Stratum (Plot size: 5 ft. radius)			
1. *Glycine max*	70	Yes	UPL
2. *Digitaria ischaemum*	1	No	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	71 =Total Cover		
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	1	x 4 =	4
UPL species	70	x 5 =	350
Column Totals:	71 (A)		354 (B)

Prevalence Index = B/A = 4.99

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point 10-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 3/2	100					Sandy	sandy loam
10-20	10YR 5/3	70					Sandy	sandy loam
	7.5YR 5/4	30						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Valley Junction Mine City/County: Monroe County Sampling Date: 7/25/18

Applicant/Owner: Valley Sand, LLC State: WI Sampling Point: 10-W

Investigator(s): Kerry Ingraham Section, Township, Range: Section 36, T19N, R1W

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope %: ____

Subregion (LRR or MLRA): LRR K Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Hoop sandy loam, loamy substratum, 0 to 3 percent slopes (498A) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation X, Soil X, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
SP 10-W is located in Wetland 8
Vegetation and soil is significantly disturbed as it is in a cropped agriculture field planted with soybeans.
It is naturally problematic as the sample point is in a depression in the soy bean field adjacent to a ditched wetland to the east. East of the ditched wetland are railroad tracks with forest and emaergent wetlands to the east of the tracks.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- X Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- X Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
SP 10-W is in Wetland 8
See Photo # 10

VEGETATION– Use scientific names of plants. Sampling Point: 10-W

Tree Stratum (Plot size: 30 ft. radius)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft. radius)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
Herb Stratum (Plot size: 5 ft. radius)			
1. *Phalaris arundinacea*	70	Yes	FACW
2. *Cyperus esculentus*	50	Yes	FACW
3. *Glycine max*	5	No	UPL
4. *Galium obtusum*	5	No	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	130 =Total Cover		
Woody Vine Stratum (Plot size: 30 ft. radius)			
1.			
2.			
3.			
4.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	125	x 2 =	250
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	5	x 5 =	25
Column Totals:	130 (A)		275 (B)

Prevalence Index = B/A = 2.12

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)
The sample point is in a depression. The soybeans in this area are few in number, light green in color, and stunted

SOIL

Sampling Point 10-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/2	97	7.5YR 4/6	3			Sandy	
8-14	10YR 5/3	60	7.5YR 5/4	10	C	M	Loamy/Clayey	Faint redox concentrations
	10YR 3/2	30						
14-22	10YR 5/3	70	7.5YR 5/4	10	C	M	Loamy/Clayey	Faint redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- X Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

Appendix B
Site Photographs

Site Photographs

Photo: #1
Wetland 1
Sample
Point (SP)
1-W
T3/5K

Photo: #2
facing north
at SP 1-U

Photo: #3
Wetland 1, facing south toward old fence row on southern boundary (T3/5K)

Photo: #4
Wetland 2, facing west at SP 2-W (T5K)

Photo: #5
Wetland 3,
SP 3-W
(T3/5K)

Photo: #6
SP 3-U

Photo: #7
Wetland 3, wetland boundary near transect 3; break in upland/ wetland vegetation (T3/5K)

Photo: #8
Wetland 5, facing northwest at SP 5-W (E1K)

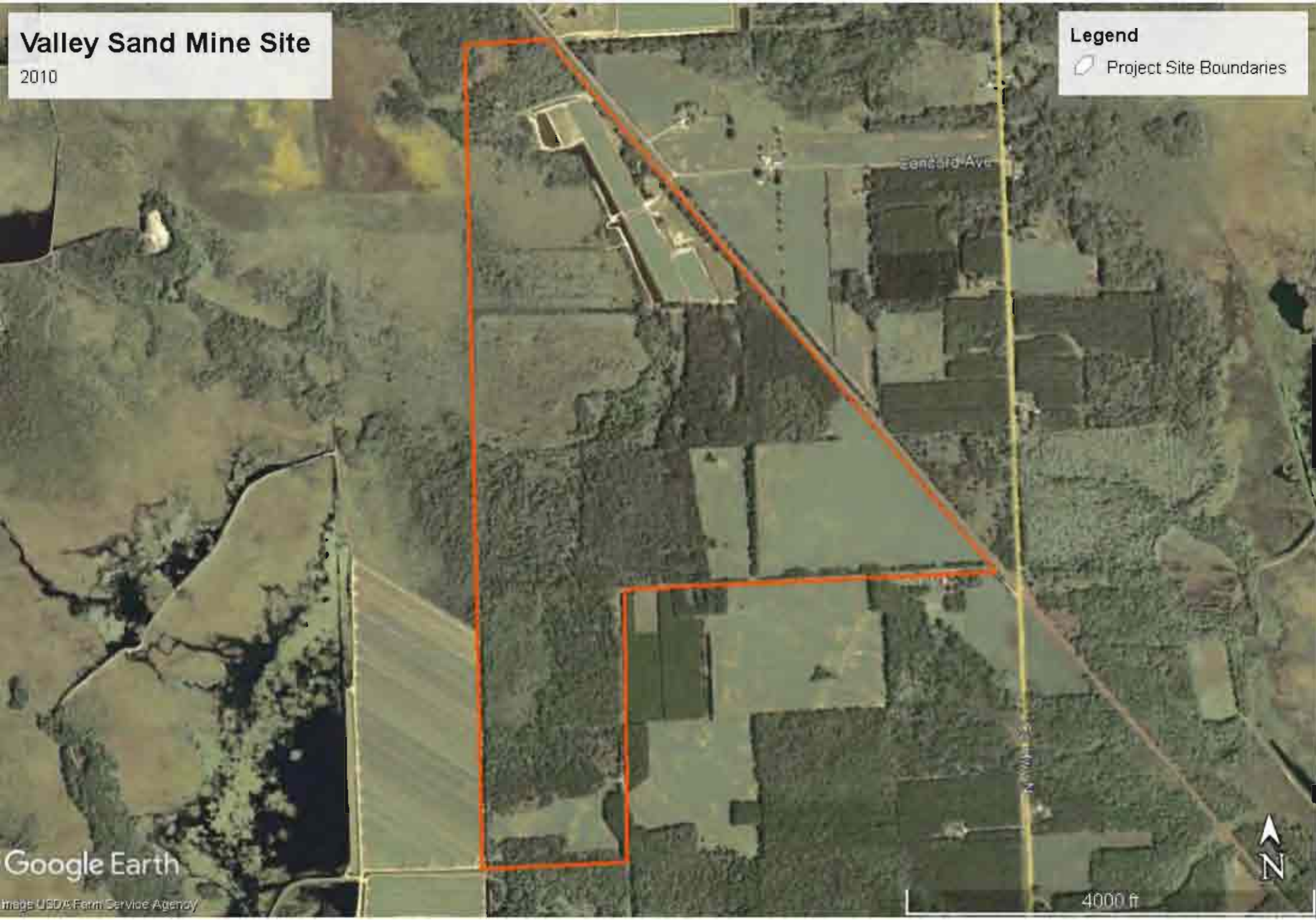
Photo: #9
Wetland 7, facing north along berm, forest (T5K) wetland transitioning to sedge meadow (E2H) to the west; cranberry bogs lie to the east of the berm

Photo: # 10
Wetland 8, facing southwest to wetland basin and SP 10-W

Photo: #11
Facing north at SP 9-U; This area was investigated for presence of wetland indicators; dominant veg. was hydric but had no hydric soil or hydrology indicators.

Appendix C
Historic Aerial Photographs


Valley Sand Mine Site
2013
Legend
Project Site Boundaries
Concord Ave
N Hwy 395
Google Earth
4000 ft
N

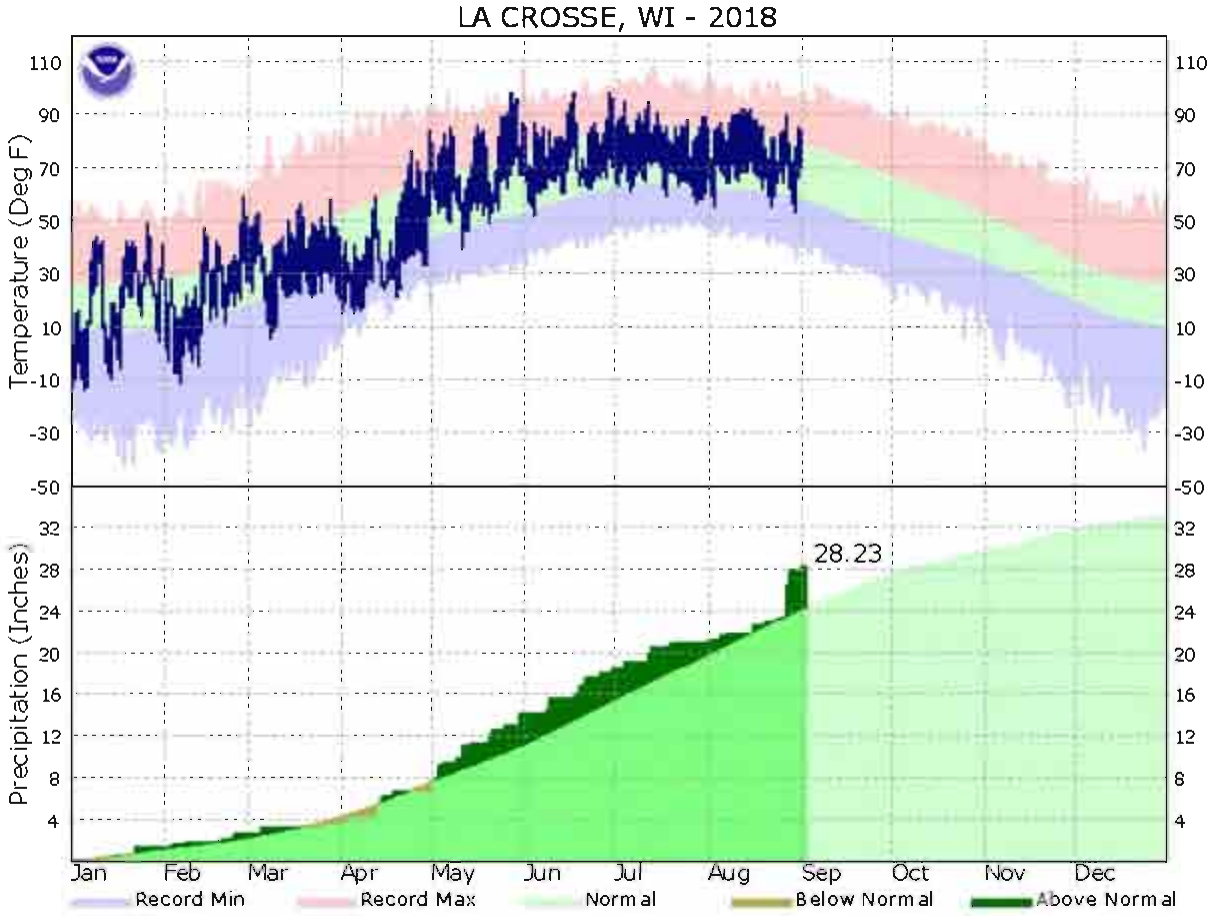

Valley Sand Mine Site
2010
Legend
Project Site Boundaries
Concord Ave
Google Earth
Image USDA Farm Service Agency
4000 ft
N


Valley Sand Mine Site
2005
Legend
Project Site Boundaries
Concord Ave
N
4000 ft
Google Earth


Valley Sand Mine Site
1999
Legend
Project Site Boundaries
Somerset Ave
Google Earth
Image U.S. Geological Survey
4000 ft
N


Valley Sand Mine Site
1939
Legend
Project Boundary

Appendix D
Climate Summary Data


LA CROSSE, WI - 2018
Temperature (Deg F)
110
90
70
50
30
10
-10
-30
-50
Precipitation (Inches)
32
28
24
20
16
12
8
4
28.23
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Record Min
Record Max
Normal
Below Normal
Above Normal

Appendix E
NRCS Monroe County Soil Report

United States Department of Agriculture

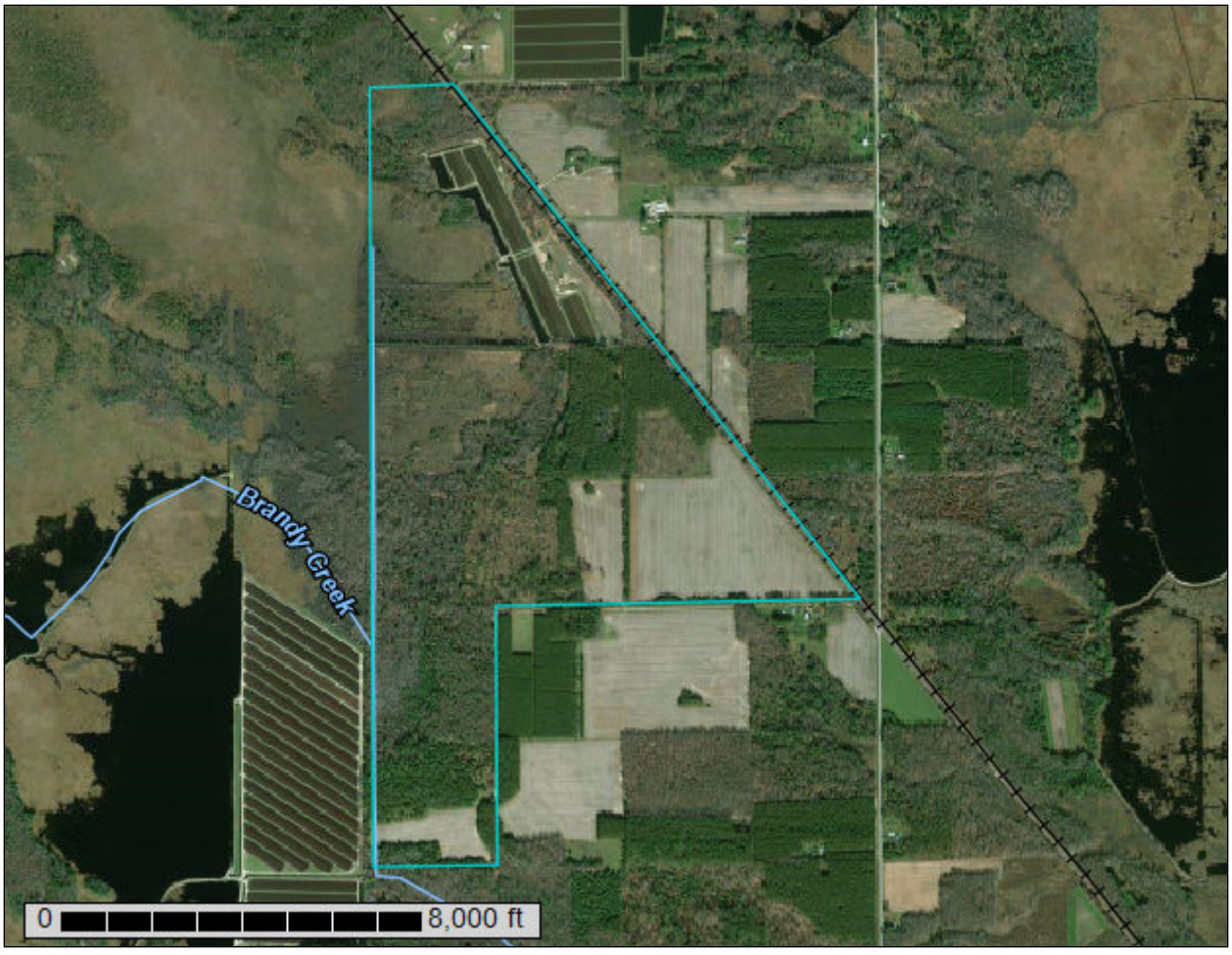
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Monroe County, Wisconsin

Valley Sand



August 16, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

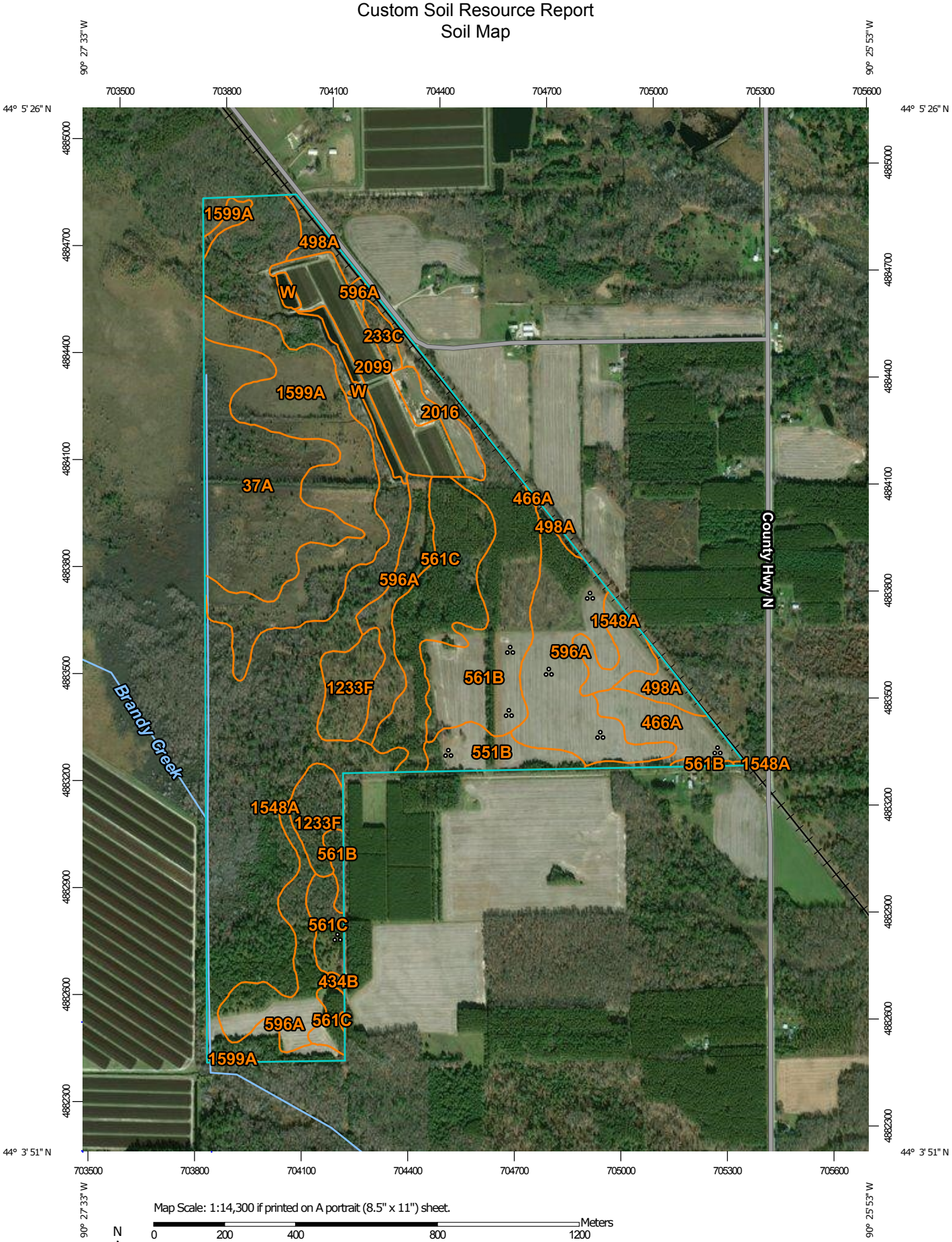
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monroe County, Wisconsin
Survey Area Data: Version 12, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 10, 2011—Nov 7, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
37A	Loxley peat, pediment, frequently ponded, 0 to 1 percent slopes	42.7	9.8%
233C	Boone sand, 6 to 15 percent slopes	2.6	0.6%
434B	Bilson sandy loam, 1 to 6 percent slopes	0.4	0.1%
466A	Bilmod sandy loam, lake terrace, 0 to 3 percent slopes	11.9	2.7%
498A	Hoop sandy loam, loamy substratum, 0 to 3 percent slopes	8.9	2.0%
551B	Impact sand, 2 to 6 percent slopes	9.6	2.2%
561B	Tarr sand, 1 to 6 percent slopes	43.9	10.0%
561C	Tarr sand, 6 to 15 percent slopes	36.9	8.4%
596A	Tint sand, lake plain, 0 to 3 percent slopes	61.9	14.2%
1233F	Boone-Tarr sands, 15 to 50 percent slopes	17.3	4.0%
1548A	Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes	120.4	27.5%
1599A	Ponycreek-Dawsil, frequently ponded, complex, lake plain, 0 to 1 percent slopes	50.8	11.6%
2016	Pits, quarry, soft bedrock	5.7	1.3%
2022	Pits, siliceous sand	0.1	0.0%
2099	Psammaquents, nearly level	19.2	4.4%
W	Water	4.7	1.1%
Totals for Area of Interest		**437.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the

landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present

or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Monroe County, Wisconsin

37A—Loxley peat, pediment, frequently ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t801
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Loxley, pediment, and similar soils: 94 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Loxley, Pediment

Setting

Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Herbaceous organic material

Typical profile

Oi - 0 to 4 inches: peat
Oa1 - 4 to 10 inches: muck
Oa2 - 10 to 16 inches: muck
Oa3 - 16 to 52 inches: muck
Oe - 52 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 25.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Frequently flooded, organics (G089XY010WI)
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

Minor Components

Dawsil

Percent of map unit: 3 percent
Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

Ponycreek

Percent of map unit: 2 percent
Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Citypoint, deep

Percent of map unit: 1 percent
Landform: Fens on rock pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

233C—Boone sand, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1lmwx
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Boone and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boone

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy slope alluvium over siliceous sandy residuum weathered from sandstone

Typical profile

Ap - 0 to 8 inches: sand
Bw - 8 to 21 inches: sand
C - 21 to 35 inches: sand
Cr - 35 to 60 inches: weathered bedrock

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: About 35 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Tarr

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Elevasil

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

434B—Bilson sandy loam, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lmxh
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Bilson and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bilson

Setting

Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium over stratified sandy and loamy alluvium

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 32 inches: sandy loam
2C1 - 32 to 38 inches: stratified sand to loamy sand
2C2 - 38 to 60 inches: stratified sand to sandy loam

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Mod AWC, adequately drained (G105XY005WI)
Hydric soil rating: No

Minor Components

Elevasil

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Bilmod

Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Merimod

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Gosil

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

466A—Bilmod sandy loam, lake terrace, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2qqzx
Elevation: 340 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Bilmod, lake terrace, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bilmod, Lake Terrace

Setting

Landform: Lake terraces on glacial lakes (relict)
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium over stratified sandy and loamy alluvium

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt1, Bt2 - 9 to 24 inches: sandy loam
2BC - 24 to 32 inches: loamy sand
2C1 - 32 to 46 inches: stratified sand to loamy sand
2C2 - 46 to 60 inches: stratified sand to sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 42 to 66 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Mod AWC, adequately drained (G105XY005WI)
Hydric soil rating: No

Minor Components

Bilson

Percent of map unit: 4 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tintson, lake terrace

Percent of map unit: 3 percent
Landform: Lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hoop, loamy substratum

Percent of map unit: 3 percent
Landform: Depressions on lake terraces on glacial lakes (relict), drainageways on lake terraces on glacial lakes (relict)

Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: No

498A—Hoop sandy loam, loamy substratum, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2qcwp
Elevation: 340 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Hoop, loamy substratum, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoop, Loamy Substratum

Setting

Landform: Depressions on lake terraces on glacial lakes (relict), drainageways on lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Parent material: Loamy alluvium over stratified loamy and/or sandy alluvium

Typical profile

Ap - 0 to 9 inches: sandy loam
BE,Bt1-Bt3 - 9 to 33 inches: fine sandy loam
2C - 33 to 60 inches: stratified sand to loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D

Forage suitability group: Mod AWC, high water table (G089XY004WI)
Hydric soil rating: No

Minor Components

Bilmod, lake terrace
Percent of map unit: 5 percent
Landform: Lake terraces on glacial lakes (relict)
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lows, lake terrace
Percent of map unit: 3 percent
Landform: Depressions on lake terraces, drainageways on lake terraces, glacial lakes (relict)
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: Yes

Tintson, lake terrace
Percent of map unit: 2 percent
Landform: Lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

551B—Impact sand, 2 to 6 percent slopes

Map Unit Setting
National map unit symbol: 2rhz1
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition
Impact and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Impact

Setting
Landform: Pediments, stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Siliceous sandy alluvium

Typical profile

Ap - 0 to 8 inches: sand
A,AB - 8 to 15 inches: sand
Bw - 15 to 36 inches: sand
C - 36 to 60 inches: sand

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Tarr

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Bilson

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Gosil

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

561B—Tarr sand, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lmxy
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Tarr and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tarr

Setting

Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy pedisediment over sandy residuum

Typical profile

Oe,A - 0 to 6 inches: sand
Bw1, Bw2 - 6 to 34 inches: sand
C - 34 to 62 inches: sand

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Bilson

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tint

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Boone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Impact

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

561C—Tarr sand, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1lmxz
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Tarr and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tarr

Setting

Landform: Pediments
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 6 inches: sand
Bw1, Bw2 - 6 to 34 inches: sand
C - 34 to 62 inches: sand

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Boone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Gosil

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tint

Percent of map unit: 1 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

596A—Tint sand, lake plain, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t80c
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Tint, lake plain, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tint, Lake Plain

Setting

Landform: Pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: sand
E - 5 to 9 inches: sand
Bw1 - 9 to 17 inches: sand
Bw2 - 17 to 24 inches: sand
BC - 24 to 34 inches: sand
C1 - 34 to 38 inches: sand
C2 - 38 to 79 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.03 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Other vegetative classification: Pinus/Vaccinium-Gaylussacia (PVGy)
Hydric soil rating: No

Minor Components

Majik, cool

Percent of map unit: 8 percent
Landform: Stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Rubus (PVRh)
Hydric soil rating: No

Ponycreek, lake plain

Percent of map unit: 6 percent
Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Tarr, lake plain

Percent of map unit: 1 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Gaylussacia (PVGy)
Hydric soil rating: No

1233F—Boone-Tarr sands, 15 to 50 percent slopes

Map Unit Setting

National map unit symbol: 1lmyt
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Boone and similar soils: 55 percent
Tarr and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boone

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 3 inches: sand
E,Bw - 3 to 21 inches: sand
C - 21 to 35 inches: sand
Cr - 35 to 60 inches: weathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: About 35 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained with limitations (G105XY003WI)
Hydric soil rating: No

Description of Tarr

Setting

Landform: Hills
Landform position (two-dimensional): Footslope, backslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 6 inches: sand
Bw1, Bw2 - 6 to 34 inches: sand
C - 34 to 62 inches: sand

Properties and qualities

Slope: 15 to 45 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained with limitations (G105XY003WI)
Hydric soil rating: No

Minor Components

Elevasil

Percent of map unit: 13 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Rock outcrop, sandstone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

1548A—Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t807
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Majik, cool, and similar soils: 55 percent
Ponycreek, lake plain, and similar soils: 35 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Majik, Cool

Setting

Landform: Stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 6 inches: sand
E - 6 to 9 inches: sand
Bw1 - 9 to 16 inches: sand
Bw2 - 16 to 20 inches: sand
Bw3 - 20 to 25 inches: sand
BC - 25 to 31 inches: sand
C - 31 to 79 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.03 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Low AWC, high water table (G105XY001WI)
Other vegetative classification: Pinus/Vaccinium-Rubus (PVRh)
Hydric soil rating: No

Description of Ponycreek, Lake Plain

Setting

Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oa - 0 to 4 inches: muck
A - 4 to 6 inches: mucky sand
Bg - 6 to 29 inches: sand
C - 29 to 79 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Forage suitability group: Low AWC, high water table (G089XY001WI)
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Minor Components

Dawsil, lake plain

Percent of map unit: 7 percent
Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

Tint, lake plain

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Gaylussacia (PVGy)
Hydric soil rating: No

1599A—Ponycreek-Dawsil, frequently ponded, complex, lake plain, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t805
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Ponycreek, lake plain, and similar soils: 45 percent
Dawsil, lake plain, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ponycreek, Lake Plain

Setting

Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oa - 0 to 4 inches: muck
A - 4 to 6 inches: mucky sand
Bg - 6 to 29 inches: sand
C - 29 to 79 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Forage suitability group: Low AWC, high water table (G089XY001WI)
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Description of Dawsil, Lake Plain

Setting

Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Herbaceous organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oe1 - 0 to 8 inches: mucky peat
Oe2 - 8 to 20 inches: mucky peat
Oa - 20 to 40 inches: muck
C - 40 to 79 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Frequently flooded, organics (G089XY010WI)
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

Minor Components

Majik, cool

Percent of map unit: 10 percent
Landform: Stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Rubus (PVRh)

Hydric soil rating: No

Loxley, pediment

Percent of map unit: 5 percent
Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

2016—Pits, quarry, soft bedrock

Map Unit Composition

Pits, quarry, soft bedrock: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

2022—Pits, siliceous sand

Map Unit Composition

Pits, siliceous sand: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Siliceous Sand

Setting

Parent material: Siliecous sand from sandstone

Interpretive groups

Land capability classification (irrigated): None specified
Other vegetative classification: Not Assigned (other map units) (Noth)
Hydric soil rating: No

2099—Psammaquents, nearly level

Map Unit Setting

National map unit symbol: 2fjbr
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 120 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Psammaquents and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Psammaquents

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Ponded
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: Yes

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Appendix 6

High Capacity Well Construction Reports

Well Construction Report For WISCONSIN UNIQUE WELL NUMBER MX544

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **GEBHARDT, EDDIE**
Telephone Number: **608-378-4724**
Mailing Address: **BOX 225**
City: **WARRENS**
State: **WI**
Zip Code: **54666**
County of Well Location: **Monroe**
County Well Permit No.: **W**
Well Completion Date: **01/15/1999**

1. Well Location: [X] Town [ ] City [ ] Village of **LINCOLN**
Fire # (if available)
Grid or Street Address or Road Name and Number
Subdivision Name | Lot # | Block #

Well Constructor (Business Name): **BRIAN HEEG**
License #: **355**
Facility ID Number (Public Wells)
Address: **5069 E CTY F**
Public Well Plan Approval # W--
City: **AUBURNDALE**
State: **WI**
Zip Code: **54412**
Date of Approval (mm/dd/yyyy): **08/12/1998**
Hicap Permanent well #: **2595**
Common Well #: **001**
Specific Capacity: **4.7** gpm/ft

Gov't Lot # | or **SE** 1/4 of **NE** 1/4 of
Section **36** T **19** N; R **1** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type: [ ] Replacement [X] New [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?: **IRRIGATION**

3. Well serves # of homes and or **CRANBERRY OPERA** (e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [X] Yes [ ] No
Property? [X] Yes [ ] No

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:
1. Landfill
2. Building Overhang
3. Septic [ ] Holding Tank [ ]
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. Shoreline [ ] Swimming Pool [ ]
9. Downspout/Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain [ ] Cast Iron or Plastic [ ] Other
14. Building Sewer [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
15. Collector or Street Sewer: [ ] Sanitary units in. diam. [ ] Storm [ ] =< 6 [ ] > 6
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
23. Other Manure Storage
24. Ditch
25. Other NR 812 Waste Storage

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
14.75	0	41
12	41	130
8.5	130	240

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation----------
[X] ---2. Rotary - Air----------
[ ] ---3. Rotary - Air and Foam----------
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia------
[ ] 7. Dual Rotary
[X] 8. Temp. Outer Casing **16** in. dia. depth (ft)
Removed? [X] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc		From (ft.)	To (ft.)
--S-	SAND	0	12
--N-	SANDSTONE	12	115
-SN-	SOFT SANDSTONE	115	125
-HN-	FIRM SANDSTONE	125	240

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
12	ST STEEL ASTM A53 0.375 WALL SAWHILL USA WELDED JT	0	41
9	ST STEEL ASTM A53 .325 WALL US STEEL WELDED JOINT WITH PACKER	34	130

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
10 ft. below ground surface

10. Pump Test
Pumping Level **105** ft. below surface
Pumping at **450** GPM for **2** hours

11. Well is: [X] Above Grade **24** in. [ ] Below Grade
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **TREMIE PUMP**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
CEMENT	0	41	18

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [ ] No If no, explain: **NONE**

13. Signature of the Well Constructor or Supervisory Driller: **BH** Date signed: **02/18/1999**
Signature of Drill Rig Operator (Mandatory unless same as above) Date signed

Make additional comments on reverse side about geology, additional screens, water quality, etc.
Variance issued [ ] Yes [X] No

Well Construction Report For WISCONSIN UNIQUE WELL NUMBER RK500

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A
(R 8/00)

Property Owner: **WHISKEY CREEK CRANBERRY CO**
Telephone Number: **608-343-4959**
Mailing Address: **25507 CO EW**
City: **WARRENS**
State: **WI**
Zip Code: **54666**
County of Well Location: **Monroe**
County Well Permit No.: **W**
Well Completion Date: **08/26/2003**

1. Well Location: [X] Town [ ] City [ ] Village of **LINCOLN**
Fire # (if available)
Grid or Street Address or Road Name and Number
Subdivision Name | Lot # | Block #

Well Constructor (Business Name): **HEEG WELL DRLG LLC**
License #: **6704**
Facility ID Number (Public Wells)
Address: **5069 CTY F**
Public Well Plan Approval #: W--**4210063**
City: **AUBURNDALE**
State: **WI**
Zip Code: **54412**
Date of Approval (mm/dd/yyyy): **05/11/1999**
Hicap Permanent well #: **2809**
Common Well #: **002**
Specific Capacity: **5** gpm/ft

Gov't Lot # or **SE** 1/4 of **SW** 1/4 of
Section **25** T **19** N; R **1** [ ] E [X] W
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type: [ ] Replacement [X] New [ ] Reconstruction
Lat/Long Method: **GPS008**
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?

3. Well serves # of homes and or **CRANBERRY OPERA** (e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [X] Yes [ ] No
Property? [X] Yes [ ] No

[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:

1. Landfill
400 2. Building Overhang
400 3. Septic [ ] Holding Tank [ ]
400 4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. Shoreline [ ] Swimming Pool [ ]
9. Downspout/Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain [ ] Cast Iron or Plastic [ ] Other
14. Building Sewer [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
15. Collector or Street Sewer: [ ] Sanitary units in. diam. [ ] Storm [ ] =< 6 [ ] > 6
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
23. Other Manure Storage
24. Ditch
25. Other NR 812 Waste Storage

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
15	0	40
12	40	100
10	100	260

Upper Enlarged Drillhole / Lower Open Bedrock
[ ] ---1. Rotary - Mud Circulation---
[X] ---2. Rotary - Air---
[ ] ---3. Rotary - Air and Foam---
[ ] ---4.Drill-Through Casing Hammer
[ ] ---5. Reverse Rotary
[ ] ---6. Cable-tool Bit in. dia---
[ ] 7. Dual Rotary
[X] 8. Temp. Outer Casing **16** in. dia. **14** depth (ft)
Removed? [X] Yes [ ] No
If no, why not?

8. Geology

Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
IQS- SAND	0	14
IHN- FIRM SANDSTONE	14	56
OSN- SOFT SANDSTONE	56	70
IHN- FIRM SANDSTONE	70	260

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
12	ST STEEL ASTMA53 SAWHILL WELDED	0	40
10	ST STEEL ASTMA53 SAWHILL WEDED WITH PACKER	36	100

Dia. (in.)	Screen type, material & slot size		

9. Static Water Level
ft. above ground surface
10 ft. below ground surface

10. Pump Test
Pumping Level **100** ft. below surface
Pumping at **450** GPM for **2** hours

11. Well is: [X] Above Grade **24** in. [ ] Below Grade
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method
Method: **TREMIE PUMPED**

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
CEMENT	0	40	19

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?
[ ] Yes [ ] No If no, explain:

13. Signature of the Well Constructor or Supervisory Driller: **BH** Date signed: **08/26/2003**
Signature of Drill Rig Operator (Mandatory unless same as above) Date signed

Make additional comments on reverse side about geology, additional screens, water quality, etc.

Variance issued [ ] Yes [X] No

Appendix 7

NRCS Custom Soil Resource Report

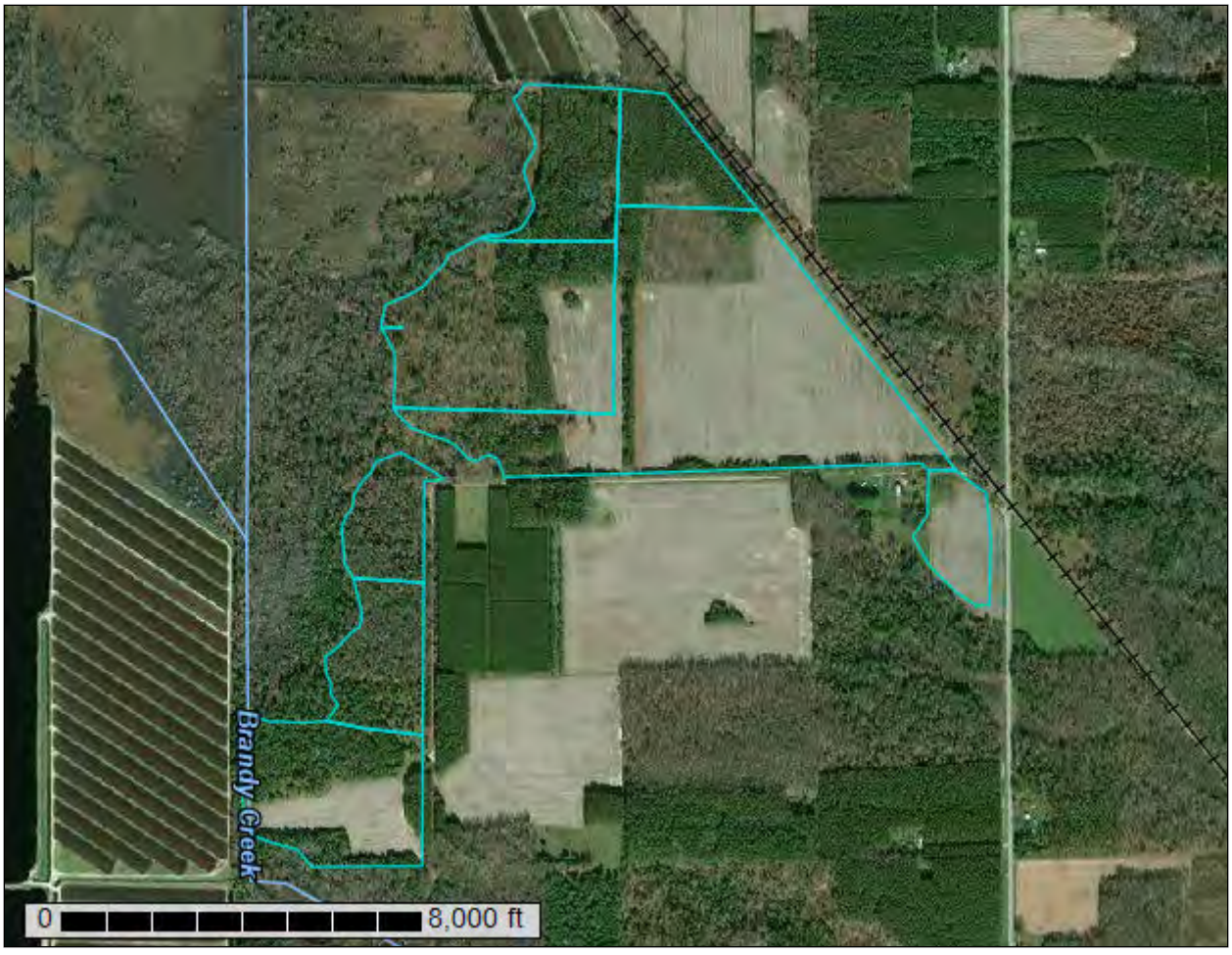
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Monroe County, Wisconsin



September 13, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

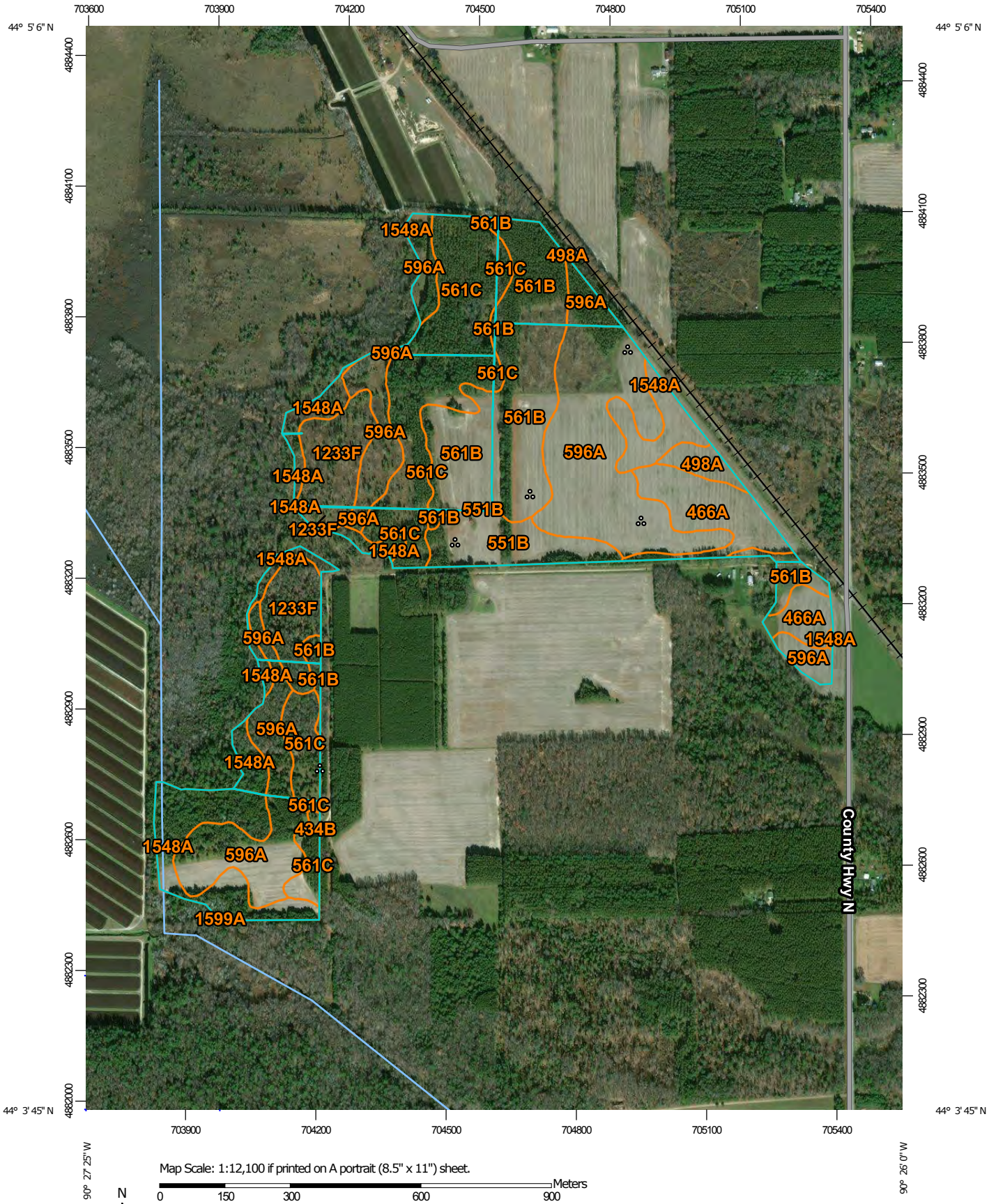
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:12,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monroe County, Wisconsin
Survey Area Data: Version 12, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 10, 2011—Nov 7, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
434B	Bilson sandy loam, 1 to 6 percent slopes	0.2	0.1%
466A	Bilmod sandy loam, lake terrace, 0 to 3 percent slopes	13.6	6.8%
498A	Hoop sandy loam, loamy substratum, 0 to 3 percent slopes	2.5	1.3%
551B	Impact sand, 2 to 6 percent slopes	9.9	5.0%
561B	Tarr sand, 1 to 6 percent slopes	36.1	18.1%
561C	Tarr sand, 6 to 15 percent slopes	35.0	17.6%
596A	Tint sand, lake plain, 0 to 3 percent slopes	59.0	29.6%
1233F	Boone-Tarr sands, 15 to 50 percent slopes	16.6	8.4%
1548A	Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes	26.1	13.1%
1599A	Ponycreek-Dawsil, frequently ponded, complex, lake plain, 0 to 1 percent slopes	0.0	0.0%
Totals for Area of Interest		**199.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a

particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Monroe County, Wisconsin

434B—Bilson sandy loam, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lmxh
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Bilson and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bilson

Setting

Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium over stratified sandy and loamy alluvium

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 32 inches: sandy loam
2C1 - 32 to 38 inches: stratified sand to loamy sand
2C2 - 38 to 60 inches: stratified sand to sandy loam

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Mod AWC, adequately drained (G105XY005WI)
Hydric soil rating: No

Minor Components

Elevasil

Percent of map unit: 4 percent
Landform: Hills

Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Bilmod

Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Merimod

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Gosil

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

466A—Bilmod sandy loam, lake terrace, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2qqzx
Elevation: 340 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Bilmod, lake terrace, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bilmod, Lake Terrace

Setting

Landform: Lake terraces on glacial lakes (relict)
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Loamy alluvium over stratified sandy and loamy alluvium

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt1, Bt2 - 9 to 24 inches: sandy loam
2BC - 24 to 32 inches: loamy sand
2C1 - 32 to 46 inches: stratified sand to loamy sand
2C2 - 46 to 60 inches: stratified sand to sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 42 to 66 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Mod AWC, adequately drained (G105XY005WI)
Hydric soil rating: No

Minor Components

Bilson

Percent of map unit: 4 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tintson, lake terrace

Percent of map unit: 3 percent
Landform: Lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hoop, loamy substratum

Percent of map unit: 3 percent
Landform: Depressions on lake terraces on glacial lakes (relict), drainageways on lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: No

498A—Hoop sandy loam, loamy substratum, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2qcwp
Elevation: 340 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Hoop, loamy substratum, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hoop, Loamy Substratum

Setting

Landform: Depressions on lake terraces on glacial lakes (relict), drainageways on lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Parent material: Loamy alluvium over stratified loamy and/or sandy alluvium

Typical profile

Ap - 0 to 9 inches: sandy loam
BE,Bt1-Bt3 - 9 to 33 inches: fine sandy loam
2C - 33 to 60 inches: stratified sand to loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Forage suitability group: Mod AWC, high water table (G089XY004WI)
Hydric soil rating: No

Minor Components

Bilmod, lake terrace

Percent of map unit: 5 percent
Landform: Lake terraces on glacial lakes (relict)
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lows, lake terrace

Percent of map unit: 3 percent
Landform: Depressions on lake terraces, drainageways on lake terraces, glacial lakes (relict)
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: Yes

Tintson, lake terrace

Percent of map unit: 2 percent
Landform: Lake terraces on glacial lakes (relict)
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

551B—Impact sand, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2rhz1
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Impact and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Impact

Setting

Landform: Pediments, stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Siliceous sandy alluvium

Typical profile

Ap - 0 to 8 inches: sand
A,AB - 8 to 15 inches: sand
Bw - 15 to 36 inches: sand
C - 36 to 60 inches: sand

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Tarr

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Bilson

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Gosil

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

561B—Tarr sand, 1 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lmxy
Elevation: 680 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Tarr and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tarr

Setting

Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy pedisediment over sandy residuum

Typical profile

Oe,A - 0 to 6 inches: sand
Bw1, Bw2 - 6 to 34 inches: sand
C - 34 to 62 inches: sand

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Bilson

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tint

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Boone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Impact

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

561C—Tarr sand, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1lmxz
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Tarr and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tarr

Setting

Landform: Pediments
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 6 inches: sand
Bw1, Bw2 - 6 to 34 inches: sand
C - 34 to 62 inches: sand

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Hydric soil rating: No

Minor Components

Boone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Gosil

Percent of map unit: 2 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tint

Percent of map unit: 1 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

596A—Tint sand, lake plain, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t80c
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Tint, lake plain, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tint, Lake Plain

Setting

Landform: Pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: sand
E - 5 to 9 inches: sand
Bw1 - 9 to 17 inches: sand
Bw2 - 17 to 24 inches: sand
BC - 24 to 34 inches: sand
C1 - 34 to 38 inches: sand
C2 - 38 to 79 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.03 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained (G105XY002WI)
Other vegetative classification: Pinus/Vaccinium-Gaylussacia (PVGy)
Hydric soil rating: No

Minor Components

Majik, cool

Percent of map unit: 8 percent
Landform: Stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Rubus (PVRh)
Hydric soil rating: No

Ponycreek, lake plain

Percent of map unit: 6 percent
Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Tarr, lake plain

Percent of map unit: 1 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Gaylussacia (PVGy)
Hydric soil rating: No

1233F—Boone-Tarr sands, 15 to 50 percent slopes

Map Unit Setting

National map unit symbol: 1lmyt
Elevation: 700 to 1,400 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Boone and similar soils: 55 percent
Tarr and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boone

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 3 inches: sand
E,Bw - 3 to 21 inches: sand
C - 21 to 35 inches: sand
Cr - 35 to 60 inches: weathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: About 35 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained with limitations (G105XY003WI)
Hydric soil rating: No

Description of Tarr

Setting

Landform: Hills
Landform position (two-dimensional): Footslope, backslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy slope alluvium over sandy residuum

Typical profile

Oe,A - 0 to 6 inches: sand
Bw1, Bw2 - 6 to 34 inches: sand
C - 34 to 62 inches: sand

Properties and qualities

Slope: 15 to 45 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Forage suitability group: Low AWC, adequately drained with limitations (G105XY003WI)
Hydric soil rating: No

Minor Components

Elevasil

Percent of map unit: 13 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Rock outcrop, sandstone

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

1548A—Majik, cool-Ponycreek complex, lake plain, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t807
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Majik, cool, and similar soils: 55 percent
Ponycreek, lake plain, and similar soils: 35 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Majik, Cool

Setting

Landform: Stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 6 inches: sand
E - 6 to 9 inches: sand
Bw1 - 9 to 16 inches: sand
Bw2 - 16 to 20 inches: sand
Bw3 - 20 to 25 inches: sand
BC - 25 to 31 inches: sand
C - 31 to 79 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.03 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Low AWC, high water table (G105XY001WI)
Other vegetative classification: Pinus/Vaccinium-Rubus (PVRh)
Hydric soil rating: No

Description of Ponycreek, Lake Plain

Setting

Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oa - 0 to 4 inches: muck
A - 4 to 6 inches: mucky sand
Bg - 6 to 29 inches: sand
C - 29 to 79 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Forage suitability group: Low AWC, high water table (G089XY001WI)
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Minor Components

Dawsil, lake plain

Percent of map unit: 7 percent
Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

Tint, lake plain

Percent of map unit: 3 percent
Landform: Pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Gaylussacia (PVGy)
Hydric soil rating: No

1599A—Ponycreek-Dawsil, frequently ponded, complex, lake plain, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t805
Elevation: 720 to 1,440 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 110 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Ponycreek, lake plain, and similar soils: 45 percent
Dawsil, lake plain, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ponycreek, Lake Plain

Setting

Landform: Depressions on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oa - 0 to 4 inches: muck
A - 4 to 6 inches: mucky sand
Bg - 6 to 29 inches: sand
C - 29 to 79 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: A/D
Forage suitability group: Low AWC, high water table (G089XY001WI)
Other vegetative classification: Not Assigned (wet mineral soils) (Nmin)
Hydric soil rating: Yes

Description of Dawsil, Lake Plain

Setting

Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Herbaceous organic material over siliceous sandy alluvium derived from sandstone

Typical profile

Oe1 - 0 to 8 inches: mucky peat
Oe2 - 8 to 20 inches: mucky peat
Oa - 20 to 40 inches: muck
C - 40 to 79 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Frequently flooded, organics (G089XY010WI)
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

Minor Components

Majik, cool

Percent of map unit: 10 percent
Landform: Stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Pinus/Vaccinium-Rubus (PVRh)

Hydric soil rating: No

Loxley, pediment

Percent of map unit: 5 percent
Landform: Fens on pediments
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Not Assigned (acid organic soils) (Naor)
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Appendix 8
WDNR Endangered Resources Review, ERR Log #18-129;
NHI Bald Eagle Nest Locations by Township

State of Wisconsin / DEPARTMENT OF NATURAL RESOURCES

Scott Walker, Governor
Daniel L. Meyer, Secretary

101 S. Webster St.
Box 7921
Madison, WI 53707-7921
Telephone 608-266-2621
FAX 608-267-3579
TTY 608-267-6897

February 25, 2018

Nancy Benz
Summit Envirosolutions, Inc.
1210 E. 115th St.
Burnsville, WI 55337

SUBJECT: Endangered Resources Review (ERR Log # 18-129)
Proposed Valley Junction Mine, Monroe County, WI (T18N R01W S01, T19N R01W S35, T19N R01W S36, T18N R01W S02)

Dear Nancy Benz,

The Bureau of Natural Heritage Conservation has reviewed the proposed project described in the Endangered Resources (ER) Review Request received February 20, 2018. The complete ER Review for this proposed project is attached and follow-up actions are summarized below:

Required Actions: 1 species
Recommended Actions: 1 species
No Follow-Up Actions: 0 species
Additional Recommendations Specified: Yes

This ER Review may contain Natural Heritage Inventory data (http://dnr.wi.gov/topic/NHI), including specific locations of endangered resources, which are considered sensitive and are not subject toWisconsin's Open Records Law. Information contained in this ER Review may be shared with individuals who need this information in order to carry out specific roles in the planning, permitting, and implementation of the proposed project. **Specific locations of endangered resources may not be released or reproduced in any publicly disseminated documents.**

The attached ER Review is for informational purposes and only addresses endangered resources issues. **This ER Review does not constitute DNR authorization of the proposed project and does not exempt the project from securing necessary permits and approvals from the DNR and/or other permitting authorities.**

Please contact me at 608-264-8968 or via email at anna.rosslers@wi.gov if you have any questions about this ER Review.

Sincerely,

Anna Rossler
Endangered Resources Review Program

cc: Becky Roth

Endangered Resources Review for the Proposed Valley Junction Mine, Monroe County
(ER Log # 18-129)

Section A. Location and brief description of the proposed project

Based on information provided by the ER Review Request form and attached materials, the proposed project consists of the following:

Location	Monroe County - T18N R01W S01, T19N R01W S35, T19N R01W S36, T18N R01W S02
Project Description	The proposed project is a nonmetallic mine and industrial sand processing facility, including a transload spur parallel to the current Union Pacific Railroad line. Prior to site disturbance, erosion control and stormwater BMPs will be installed. After construction of wet and dry sand processing plants (approx. 20 acres) on the northeast edge of the site, excavation of industrial sand and contemporaneous reclamation will take place in eleven phases (See Figure 10). Phases will range from 9 to 24 acres (total of approx. 197 acres), and will be reclaimed per theNon-Metallic Mining Reclamation plan to a final land use of wetlands surrounding a lake.
Project Timing	4th Quarter 2018- 2038
Current Habitat	Over 300 acres of the project property are to be left undisturbed, including the mapped wetlands and buffers, and areas without mineable resource (See Figures 7 and 10). Of the 197 acres proposed to be excavated and reclaimed, current land uses are: agricultural cropland, 40%; conifer plantations, 20%; mixed deciduous forest (red maple, beech, black oak), 40%.
Impacts to Wetlands or Waterbodies	Wetlands will be left undisturbed, with a minimum 75-foot buffer, and best management practices installed to avoid impacts to waters of the state. Wetlands on the west side of the mine property are adjacent to Unnamed Stream #5024205, which flows into Brandy Creek 7500). Brandy Creek is not a designated Outstanding Resource Water, Exceptional Resource Water, Priority Navigable Waterway, or Impaired Water.
Property Type	Private
Federal Nexus	No

It is best to request ER Reviews early in the project planning process. However, some important project details may not be known at that time. Details related to project location, design, and timing of disturbance are important for determining both the endangered resources that may be impacted by the project and any necessary follow-up actions. Please contact the ER Review Program whenever project plans change or new details become available to confirm if results of this ER Review are still valid.

Section B. Endangered resources recorded from within the project area and surrounding area

	Group	State Status	Federal Status
Karner Blue Federal High Potential Range	Other	NA	HPR
Blanding's Turtle *(Emydoidea blandingii)*	Turtle~	SC/P	SOC

For additional information on the rare species, high-quality natural communities, and other endangered resources listed above, please visit our Biodiversity (http://dnr.wi.gov/topic/EndangeredResources/biodiversity.html) page. For further definitions of state and federal statuses (END=Endangered, THR=Threatened, SC=Special Concern), please refer to the Natural Heritage Inventory (NHI) Working List (http://dnr.wi.gov/topic/nhi/wlist.html).

Section C. Follow-up actions

Actions that need to be taken to comply with state and/or federal endangered species laws:

• **Karner Blue Federal High Potential Range - Other**

State Status: NA **Federal Status:** HPR

Impact Type	Impact possible
Required Measures	Surveys,Other
Description of Required Measures	The project is located within the Karner Blue Butterfly (KBB) High Potential Range (HPR). The wild lupine (Lupinus perennis) is the host plant for this species. Suitable habitat includes but is not limited to pine barrens/plantations, oak savannas, sand prairies, utility and road right-of-ways, abandoned agricultural fields, and semi-closed canopy forests. Non-suitable habitat includes but is not limited to wetlands, routinely mowed areas, active agricultural fields, and dense forests. Suitable habitat may be present at the project site. Therefore, the following surveys need to be conducted in all suitable habitat within the KBB HPR. Please be aware that in the southeast branch of the project, only the southeast quarter of that branch is in the KBB HPR. Survey Methods Wild lupine surveys will need to be conducted by a qualified botanist from green-up to July 31 and prior to any ground disturbance at the site. If lupine is not present on the site, then no further action for the butterfly is necessary. Lupine survey forms can be found at the WDNR KBB HCP website. If lupine is identified at the project site, additional surveys will be required to determine the presence of the Karner Blue Butterfly. These surveys must be conducted by a certified surveyor during the two peak flight periods (roughly late May - late June and mid July - late August). If KBBs are not present on site, then no further action for the butterfly is necessary. Both wild lupine and KBB survey results should be submitted to the Endangered Resources Review Program. WDNR Habitat Conservation Plan Coordinator Becky Roth can assist you with questions concerning surveys (Rebecca.Roth@wisconsin.gov, (608) 220-6209). If the Karner Blue Butterfly is present on or near the site, please coordinate with the U.S. Fish and Wildlife Service (612-725-3548 x2201) or the WDNR HCP Coordinator (DNRKarnerBlue@wisconsin.gov) on measures to avoid impacts to the butterfly. If avoidance of all occupied habitat is not possible and the project may result in take of the butterfly, the applicant can become a partner to the Wisconsin Statewide KBB Habitat Conservation Plan (HCP).

Actions recommended to help conserve Wisconsin's Endangered Resources:

• **Blanding's Turtle (*Emydoidea blandingii*) - Turtle~**

State Status: SC/P **Federal Status:** SOC

Impact Type	Impact possible
Recommended Measures	Time of year restriction,Exclusion Fencing,Other
Description of Recommended Measures	Since suitable habitat for the Blanding's Turtle may be present within the project site, the following measures can voluntarily be implemented to avoid impacts. Otherwise if a turtle is found, please carefully move it to suitable habitat outside the project area. Overwintering areas – Blanding's turtles typically overwinter in wetlands or water bodies with standing water at least three feet deep. Because this species can be found in these wetlands and water bodies throughout the year, impacts to these wetlands and water bodies should be avoided at all times. Non-overwintering areas – For wetlands / water bodies shallower than three feet at the deepest point, conduct work outside of the Blanding's turtle's active season (March 5 – November 15). The installation and maintenance of exclusion fencing using the WDNR Amphibian and Reptile Exclusion Fencing Protocol is an avoidance option that can be used during this period as long as the exclusion fencing is installed between November 16 and March 4. Work can then be conducted within the fenced area at any time of year as long as the fencing is maintained. Upland nesting habitat – Avoid work in suitable upland nesting habitat (sandy and/or well-drained soils) within 275 m (900 ft) of a wetland or water body during the Blanding's turtle's nesting period (May 20 – October 15). The installation and maintenance of exclusion fencing using the WDNR Amphibian and Reptile Exclusion Fencing Protocol is an avoidance option that can be used during this period as long as the exclusion fencing is installed between October 16 and May 19. Work can then be conducted within the fenced area at any time of year as long as the fencing is maintained.

Remember that although these actions are not required by state or federal endangered species laws, they may be required by other laws, permits, granting programs, or policies of this or another agency. Examples include the federal Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, State Natural Areas law, DNR Chapter 30 Wetland and Waterway permits, DNR Stormwater

permits, and Forest Certification.

Additional Recommendations

Several wetlands and stream are present within the project site and we strongly recommend implementing erosion and runoff prevention measures during the course of the project.

Please note that erosion control netting (also known as erosion control blankets, erosion mats or erosion mesh netting) used to prevent erosion during the establishment of vegetation can have detrimental effects on local snake and other wildlife populations. Plastic netting without independent movement of strands can easily entrap snakes moving through the area, leading to dehydration, desiccation, and eventually mortality. Netting that contains biodegradable thread with the “leno” or “gauze” weave (contains strands that are able to move independently) appears to have the least impact on snakes and should be used in areas adjacent to or near any waterbody.

If erosion matting will be used for this project, use the following matting (or something similar): American Excelsior “FibreNet” or “NetFree” products; East Coast Erosion biodegradable jute products; Erosion Tech biodegradable jute products; ErosionControlBlanket.com biodegradable leno weave products; North American Green S75BN, S150BN, SC150BN or C125BN; or Western Excelsior “All Natural” products.

No actions are required or recommended for the following endangered resources: None

Section D. Next Steps

1. Evaluate whether the **'Location and brief description of the proposed project'** is still accurate. All recommendations in this ER Review are based on the information supplied in the ER Review Request. If the proposed project has changed, please contact the ER Review Program to determine if the information in this ER Review is still valid.
2. Determine whether the project can incorporate and implement the ‘**Follow-up actions**’ identified above:
    - 'Actions that need to be taken to comply with state and/or federal endangered species laws' represent the Department's best available guidance for complying with state and federal endangered species laws based on the project information that you provided and the endangered resources information and data available to us. If the proposed project has not changed from the description that you provided us and you are able to implement all of the 'Actions that need to be taken to comply with state and/or federal endangered species laws', your project should comply with state and federal endangered species laws. Please remember that if a violation occurs, the person responsible for the taking is the liable party. Generally this is the landowner or project proponent. For questions or concerns about individual responsibilities related to Wisconsin’s Endangered Species Law, please contact the ER Review Program.
    - If the project is unable to incorporate and implement one or more of the 'Actions that need to be taken to comply with state and/or federal endangered species laws' identified above, the project may potentially violate one or more of these laws. Please contact the ER Review Program immediately to assist in identifying potential options that may allow the project to proceed in compliance with state and federal endangered species laws.
    - 'Actions recommended to help conserve Wisconsin’s Endangered Resources’ may be required by another law, a policy of this or another Department, agency or program; or as part of another permitting, approval or granting process. Please make sure to carefully read all permits and approvals for the project to determine whether these or other measures may be required. Even if these actions are not required by another program or entity for the proposed project to proceed, the Department strongly encourages the implementation of these conservation measures on a voluntary basis to help prevent future listings and protect Wisconsin’s biodiversity for future generations.
3. If federally-protected species or habitats are involved and the project involves federal funds, technical assistance or authorization (e.g., permit) and there are likely to be any impacts (positive or negative) to them, consultation with USFWS will need to occur prior to the project being able to proceed. If no federal funding, assistance or authorization is involved with the project and there are likely to be adverse impacts to the species, contact the USFWS Twin Cities Ecological Services Field Office at 612-725-3548 (x2201) for further information and guidance.

Section E. Standard Information to help you better understand this ER Review

Endangered Resources (ER) Reviews are conducted according to the protocols in the guidance document Conducting Proposed

Endangered Resources Reviews: A Step-by-Step Guide for Wisconsin DNR Staff.

How endangered resources searches are conducted for the proposed project area: An endangered resources search is performed as part of all ER Reviews. A search consists of querying the Wisconsin Natural Heritage Inventory (NHI) database for endangered resources records for the proposed project area. The project area evaluated consists of both the specific project site and a buffer area surrounding the site. A 1 mile buffer is considered for terrestrial and wetland species, and a 2 mile buffer for aquatic species. Endangered resources records from the buffer area are considered because most lands and waters in the state, especially private lands, have not been surveyed. Considering records from the entire project area (also sometimes referred to as the search area) provides the best picture of species and communities that may be present on your specific site if suitable habitat for those species or communities is present.

Categories of endangered resources considered in ER Reviews and protections for each: Endangered resources records from the NHI database fall into one of the following categories:

- Federally-protected species include those federally listed as Endangered or Threatened and Designated Critical Habitats. Federally-protected animals are protected on all lands; federally-protected plants are protected only on federal lands and in the course of projects that include federal funding (see Federal Endangered Species Act of 1973 as amended).

- Animals (vertebrate and invertebrate) listed as Endangered or Threatened in Wisconsin are protected by Wisconsin's Endangered Species Law on all lands and waters of the state (s. 29.604, Wis. Stats.).

- Plants listed as Endangered or Threatened in Wisconsin are protected by Wisconsin's Endangered Species Law on public lands and on land that the person does not own or lease, except in the course of forestry, agriculture, utility, or bulk sampling actions (s. 29.604, Wis. Stats.).

- Special Concern species, high-quality examples of natural communities (sometimes called High Conservation Value areas), and natural features (e.g., caves and animal aggregation sites) are also included in the NHI database. These endangered resources are not legally protected by state or federal endangered species laws. However, other laws, policies (e.g., related to Forest Certification), or granting/permitting processes may require or strongly encourage protection of these resources. The main purpose of the Special Concern classification is to focus attention on species about which some problem of abundance or distribution is suspected before they become endangered or threatened.

- State Natural Areas (SNAs) are also included in the NHI database. SNAs protect outstanding examples of Wisconsin's native landscape of natural communities, significant geological formations, and archeological sites. Endangered species are often found within SNAs. SNAs are protected by law from any use that is inconsistent with or injurious to their natural values (s. 23.28, Wis. Stats.).

Please remember the following:

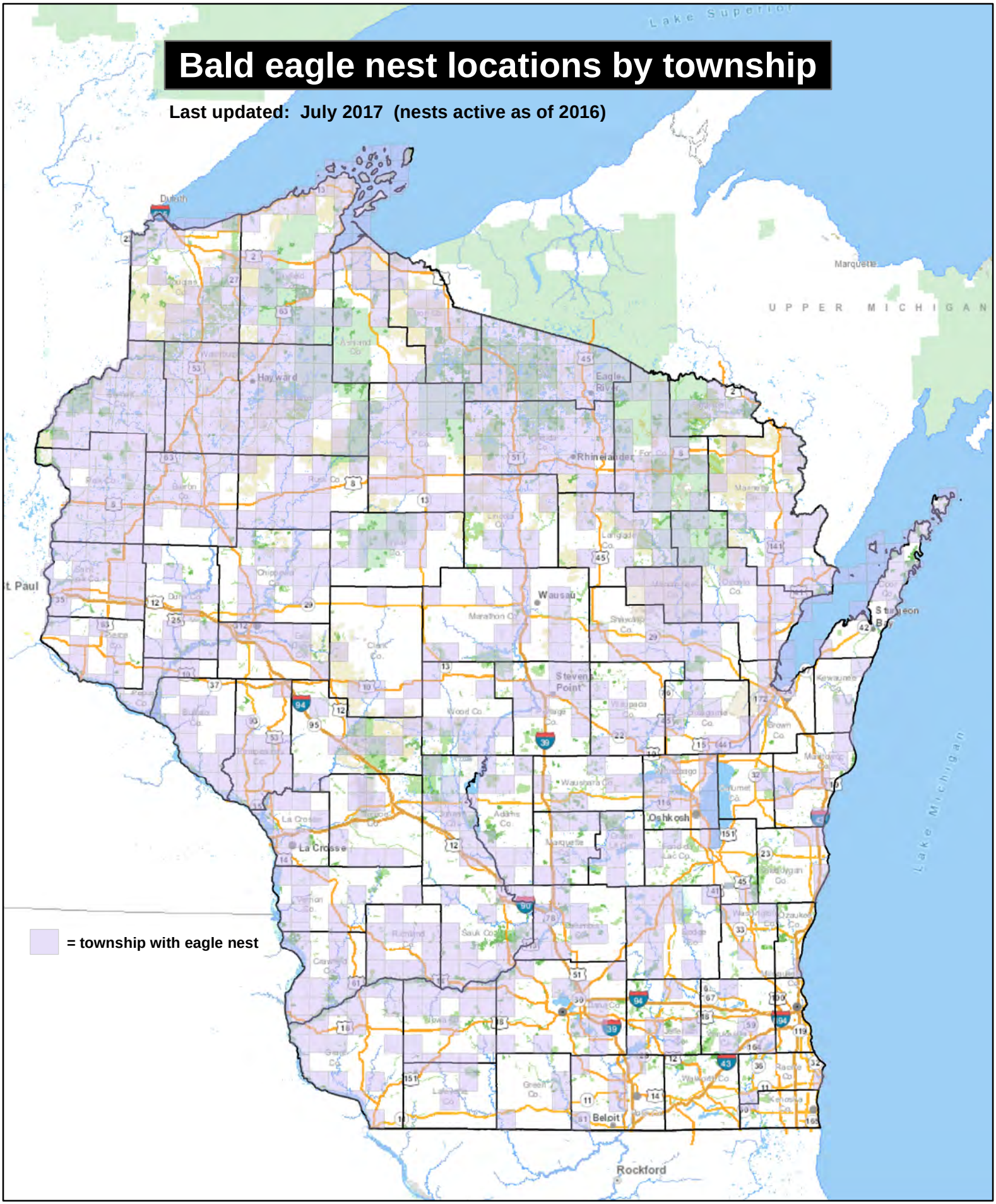
1. This ER Review is provided as information to comply with state and federal endangered species laws. By following the protocols and methodologies described above, the best information currently available about endangered resources that may be present in the proposed project area has been provided. However, the NHI database is not all inclusive; systematic surveys of most public lands have not been conducted, and the majority of private lands have not been surveyed. As a result, NHI data for the project area may be incomplete. Occurrences of endangered resources are only in the NHI database if the site has been previously surveyed for that species or group during the appropriate season, and an observation was reported to and entered into the NHI database. As such, absence of a record in the NHI database for a specific area should not be used to infer that no endangered resources are present in that area. Similarly, the presence of one species does not imply that surveys have been conducted for other species. Evaluations of the possible presence of rare species on the project site should always be based on whether suitable habitat exists on site for that species.

2. This ER Review provides an assessment of endangered resources that may be impacted by the project and measures that can be taken to avoid negatively impacting those resources based on the information that has been provided to ER Review Program at this time. Incomplete information, changes in the project, or subsequent survey results may affect our assessment and indicate the need for additional or different measures to avoid impacts to endangered resources.

3. This ER Review does not exempt the project from actions that may be required by Department permits or approvals for the project. Information contained in this ER Review may be shared with individuals who need this information in order to carry out specific roles in the planning, permitting, and implementation of the proposed project.

Bald eagle nest locations by township

Last updated: July 2017 (nests active as of 2016)



Appendix 9

Wisconsin Department of Transportation (WisDOT) Erosion Control Matrices;
WDNR Conservation Practice Standards for Stormwater(NRCS Best Management Practices)

CHANNEL EROSION CONTROL MATRIX
(Concentrated Flow Application)

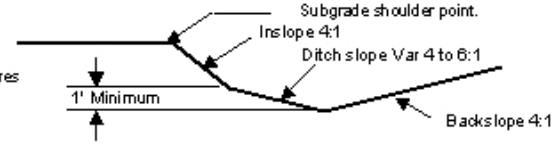
TYPE OF EROSION CONTROL DEVICE	PERMISSIBLE SHEAR LBS/S.F.	DITCH GRADE															REMARKS
		< 2%			2% - 4%			4% - 6%			6% - 9%*			9% - 12%*			
		Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			Max. Length (ft.)			
		300	600	1200	300	600	1200	300	600	1200	300	600	1200	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.																	

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	
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.

Wet Detention Pond
(1001)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A permanent pool of water with designed dimensions, inlets, outlets and storage capacity, constructed to collect, detain, treat and release stormwater runoff.

II. Purposes

The primary purposes of this practice are to improve water quality and reduce peak flow.

III. Conditions Where Practice Applies

This practice applies to urban sites where stormwater runoff pollution due to particulate solids loading and attached pollutants is a concern. It also applies where increased runoff from urbanization or land use change is a concern. Site conditions must allow for runoff to be directed into the pond and a permanent pool of water to be maintained.

This standard establishes criteria for ponds to detain stormwater runoff, although some infiltration may occur. In some instances, detention ponds may present groundwater contamination risks, and this standard sets criteria for determining when liners may be necessary to address risks to groundwater. Where the detention pond will be discharging to an infiltration practice, see WDNR Conservation Practice Standards 1002-1004.

Application of this standard is not intended to address flood control. Modifications to the peak flow criteria or additional analysis of potential flooding issues may be needed or required by local authorities. For ponds used during the construction period, see WDNR Conservation Practice Standard 1064, Sediment Basin.

This practice provides a method to demonstrate that a wet detention pond achieves the total suspended solids (TSS) reduction and peak flow control required by NR 151.12, Wis. Adm. Code, for post-construction sites. Pollutant loading models such as SLAMM, P8, DETPOND or equivalent methodology may also be used to evaluate the efficiency of the design in reducing TSS.

IV. Federal, State and Local Laws

The design, construction and maintenance of wet detention ponds shall comply with all federal, state and local laws, rules or regulations. The owner/operator is responsible for securing required permits. This standard does not contain the text of any federal, state or local laws governing wet detention ponds.

The location and use of wet detention ponds may be limited by regulations relating to stormwater management, navigable waters (Ch. 30, Wis. Stats.), floodplains, wetlands, buildings, wells and other structures, or by land uses such as waste disposal sites and airports. The pond embankment may be regulated as a dam under Ch. 31, Wis. Stats., and further restricted under NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

V. Criteria

The following minimum criteria apply to all wet detention pond designs used for the purposes stated in Section II of this standard. Use more restrictive criteria as needed to fit the conditions found in the site assessment.

A. Site Assessment – Conduct and document a site assessment to determine the site characteristics that will affect the placement, design, construction and maintenance of the pond. Document the pond design. Items to assess include:

1. At the pond site, on a site map:

    a. Identify buildings and other structures, parking lots, property lines, wells, wetlands, 100-year floodplains, surface

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

drains, navigable streams, known drain tile, roads, and utilities (both overhead and buried) showing elevation contours and other features specified by the applicable regulatory authority.

b. Show location of soil borings and test pits on site map, characterize the soils, *seasonally high groundwater level*[1], and *bedrock* conditions to a minimum depth of 5 feet below the proposed bottom of the pond or to bedrock, whichever is less. Conduct one test pit or boring per every 2 acres of permanent pool footprint, with a minimum of two per pond. Include information on the soil texture, color, structure, moisture and groundwater indicators, and bedrock type and condition, and identify all by elevation. Characterize soils using both the USDA and USCS classification systems.

Note: USCS characterization is used for soil stability assessment while USDA soil characterization identifies the soil's potential permeability rate.

c. Investigate the potential for *karst features* nearby.

2. In the watershed, on a watershed map:

a. Identify predominant soils, the drainage ways, navigable streams and floodways, wetlands, available contour maps, land cover types and known karst features. Identify the receiving surface waters, or whether the drainage basin drains directly to groundwater.

b. Show channels and overland flow before and after development, contours, and property lines.

c. Refer to the Tc (time of concentration) flow paths and subwatershed boundaries used in runoff calculations.

B. Pond Design – Properly designed wet detention ponds are effective at trapping smaller particles, and controlling peak flows (see App. C, Figures 1-3).

1. Water Quality – Pollutant reduction (TSS and phosphorus) is a function of the permanent pool area and depth, the outlet structure and the active storage volume. The following criteria apply:

a. Permanent Pool – The elevation below which runoff volume is not discharged and particles are stored.

i. Design ponds to include a permanent pool of water. The surface area of the permanent pool is measured at the invert of the lowest outlet. The minimum surface area of the permanent pool must address the total drainage area to the pond.

Note: Use App. A for the initial estimate of the permanent pool area based on drainage area. Prorate values for mixed land uses.Use Equation 1 to solve for q_o and iterate as needed.

ii. The permanent pool surface area is sized based on the particle size and the peak outflow during the 1-yr., 24-hour design storm using Equation 1:

$$\mathbf{S_a = 1.2 * (q_o / v_s)}$$ [Equation 1(a)]

or

$$\mathbf{q_o = (v_s * S_a) / 1.2}$$ [Equation 1(b)]

Where:

$\mathbf{S_a}$ = Permanent pool surface area measured at the invert of the lowest outlet of the wet detention pond (square feet)

$\mathbf{q_o}$ = Post-construction peak outflow (cubic feet/second) during the 1-yr., 24-hour design storm for the principal outlet

$\mathbf{v_s}$ = Particle settling velocity (feet/second)

1.2 = EPA recommended safety factor

iii. Particle settling velocities (v_s) shall be based on representative particle sizes for the desired percent TSS reduction.

- 80% (3 micron): $\mathbf{v_s} = 1.91 \times 10^{-5}$ ft./sec.
- 60% (6 micron): $\mathbf{v_s} = 7.37 \times 10^{-5}$ ft./sec.
- 40% (12 micron): $\mathbf{v_s} = 2.95 \times 10^{-4}$ ft./sec.

Note: Particle settling velocities were calculated assuming a specific gravity of 2.5, a water temperature of 50 degrees Fahrenheit (10 degrees C) and a kinematic viscosity of 0.01308 $cm.^2/sec.$ (Pitt, 2002). The calculations also assume discrete and quiescent settling conditions per Stoke's Law.

b. Active Storage Volume – Volume above the permanent pool that is released slowly to settle particles. Calculate the volume with the following method:

Use a hydrograph-producing method, such as the one outlined in Natural Resources Conservation Service, Technical Release 55 (TR-55), to determine the storage volume for detention ponds. This can be accomplished by using App. B where:

$\mathbf{q_o}$ = Peak outflow during the 1-yr., 24-hour design storm for the principal outlet calculated using Equation 1 (see V.B.1.a.ii).

$\mathbf{q_i}$ = Calculated post-construction peak inflow or runoff rate during the 1-yr., 24-hour design storm.

$\mathbf{V_R}$ = Calculated volume of runoff from the 1-year, 24-hour design storm for the entire contributory area.

$\mathbf{V_S}$ = The required active storage volume determined using App. B.

Note: This method may require iterative calculations.

c. Safety – Include a safety shelf (or aquatic shelf) that extends a minimum of 8 ft. from the edge of the permanent pool waterward with a slope of 10:1 (horizontal:vertical) or flatter. The maximum depth of the permanent pool of water over the shelf shall be 1.5 ft.

d. Depth – The average water depth of the permanent pool shall be a minimum of 3 ft., excluding the safety shelf area and sediment storage depth.

e. Length to Width – Maximize the length to width ratio of the flow path to prevent short-circuiting and dead zones (areas of stagnant water). See Section VII, Considerations D and N for options to prevent short circuiting.

f. Sediment Storage – After all construction has ceased and the contributory watershed has been stabilized, one of the following applies:

i. A minimum of 2 ft. shall be available for sediment storage (for a total of 5 ft. average depth, excluding the safety shelf area). For ponds greater than 20,000 sq. ft., 50% of the total surface area of the permanent pool shall be a minimum of 5 ft. deep. For ponds less than 20,000 sq. ft., maximize the area of 5 ft. depth.

ii. Modeling shows that for 20 years of sediment accumulation, less than 2 ft. sediment storage is needed (not to be less than 0.5 feet).

iii. A minimum of 4 ft. shall be available for sediment storage if the contributory area includes cropland not stabilized by any other practice, such as strip cropping, terraces and conservation tillage.

For information on sediment storage in forebays, see Section VII, Consideration C.

Note: Municipalities that use sand in the winter may consider increasing the sediment storage depth.

g. Side Slopes Below Safety Shelf – All side slopes below the safety shelf shall be 2:1 (horizontal:vertical) or flatter as required to maintain soil stability, or as required by the applicable regulatory authority.

h. Outlets – Wet detention ponds shall have both a principal outlet and an emergency spillway.

i. Prevent Damage – Incorporate into outlet design trash accumulation preventive features, and measures for preventing ice damage and scour at the outfall. Direct outlets to channels, pipes, or similar

conveyances designed to handle prolonged flows.

ii. Principal Water Quality Outlet – Design the outlet to control the proposed 2-yr., 24-hour discharge from the pond within the primary principal outlet without use of the emergency spillway or other outlet structures. If a pipe discharge is used as the primary principal outlet, then the minimum diameter shall be 4 inches. Where an orifice is used, features to prevent clogging must be added.

iii. Backward Flow – Any storm up to the 10-yr., 24-hour design storm shall not flow backward through the principal water quality outlet or principal outlet. Flap gates or other devices may be necessary to prevent backward flow.

iv. Emergency Spillway – All ponds shall have an emergency spillway. Design the spillway to safely pass peak flows produced by a 100-yr., 24-hour design storm routed through the pond without damage to the structure. The flow routing calculations start at the permanent pool elevation.

v. Peak Flow Control – Design the peak flow control to maintain stable downstream conveyance systems and comply with local ordinances or conform with regional stormwater plans where they are more restrictive than this standard. At a minimum:

a) The post-development outflow shall not exceed pre-development peak flows for the 2-yr., 24-hour design storm.

b) Use a hydrograph-producing method such as TR-55 for all runoff and flow calculations.

c) When pre-development land cover is cropland, use the runoff curve numbers in Table 1, unless local ordinances are more restrictive**.**

d) For all other pre-development land covers, use runoff curve numbers from TR-55 assuming "good hydrologic conditions."

e) For post-development calculations, use runoff curve numbers based on proposed plans.

Note: Local ordinances may require control of larger storm events than the 2-yr., 24-hour storm. In these cases, additional or compound outlets may be required.

Table 1 - Maximum Pre-Development Runoff Curve Numbers for Cropland Areas

Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	55	69	78	83

2. Other Pond Criteria

a. Inflow Points – Design all inlets to prevent scour during peak flows produced by the 10-yr., 24-hr. design storm, such as using half-submerged inlets, stilling basins and rip-rap. Where infiltration may initially occur in the pond, the scour prevention device shall extend to the basin bottom.

b. Side Slopes **–** All interior side slopes above the safety shelf shall be 3:1 (horizontal:vertical), or flatter if required by the applicable regulatory authority.

c. Ponds in Series – To determine the overall TSS removal efficiency of ponds in series, the design shall use an *approved model* such as DETPOND or P8, that can track particle size distribution from one pond to the next.

d. Earthen Embankments – Earthen embankments (see App. C, Figure 3) shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.

i. Vegetation – Remove a minimum of 6 in. of the parent material (including all vegetation, stumps, etc.) beneath the proposed base of the embankment.

ii. Core Trench or Key-way – For embankments where the permanent pool is ponded 3 ft. or more against the embankment, include a core trench or key-way along the centerline of the embankment up to the permanent pool elevation to prevent seepage at the joint between the existing soil and the fill material. The core trench or key-way shall be a minimum of 2 ft. below the existing grade and 8 ft. wide with a side slope of 1:1 (horizontal:vertical) or flatter. Follow the construction and compaction requirements detailed in V.B.2.d.iii below for compaction and fill material.

iii. Materials – Construct all embankments with non-organic soils and compact to 90% standard proctor according to the procedures outlined in ASTM D-698 or by using compaction requirements of USDA Natural Resources Conservation Service, Wisconsin Construction Specification 3. Do not bury tree stumps, or other organic material in the embankment. Increase the constructed embankment height by a minimum of 5% to account for settling.

iv. Freeboard – Ensure that the top of embankment, after settling, is a minimum of 1 vertical foot above the flow depth for the 100-yr., 24-hr. storm.

v. Pipe Installation, Bedding and Backfill – If pipes are installed after construction of the embankment, the pipe trench shall have side slopes of 1:1 or flatter. Bed and backfill any pipes extending through the embankment with embankment or equivalent soils. Compact the bedding and backfill in lifts and to the same standard as the original embankment.

vi. Seepage – Take measures to minimize seepage along any conduit buried in the embankment. Measures such as anti-seep collars, sand diaphragms or use of bentonite are acceptable.

vii. Exterior side slopes shall be 2:1 (horizontal:vertical) or flatter, with a minimum top width of the embankment of 4 ft., or 10 ft. if access for maintenance is needed. The embankment must be designed for slope stability.

e. Topsoil and Seeding – Spread topsoil on all disturbed areas above the safety shelf, as areas are completed, to a minimum depth of 4 inches. Stabilize according to the permanent seeding criteria in WDNR Conservation Practice Standard 1059, Seeding for Construction Site Erosion Control.

f. Liners – Use the Liner Flowchart in App. D to determine when a liner is needed. For types of liners, see the Liner Flowchart and specifications in App. D. If a liner is used, provide a narrative that sets forth the liner design and construction methods.

Note: Some municipalities have wellhead protection areas and all municipalities have source water protection areas delineated by WDNR. Consult with the local community about when a liner will be needed if located within one of these areas.

g. Depth to Bedrock – The separation distance from the proposed bottom of a wet detention pond to bedrock will determine which of the following apply:

i. If the separation distance is a minimum of 5 ft. and the soil beneath the pond to bedrock is 10% fines or more, refer to the Liner Flowchart to determine if a liner may be needed for reasons other than proximity to bedrock;

ii. If the separation distance is a minimum of 3 ft. and the soil beneath the pond to bedrock is 20% fines or more, refer to the Liner Flowchart to determine if a liner may be needed for reasons other than proximity to bedrock;

iii. If conditions in (i) or (ii) are not met, then a Type B liner is required at a minimum. Refer to the Liner

Flowchart to determine if a Type A liner may be needed for reasons other than proximity to bedrock (see liner specifications in App. D);

iv. If blasting in bedrock is performed to construct a wet detention pond in bedrock, then a Type A liner is required (see liner specifications in App. D) and an engineering design must be conducted.

h. Separation from Wells – Wet detention ponds shall be constructed 400 feet from community wells (NR 811, Wis. Adm. Code) and 25 feet from non-community and private wells (NR 812, Wis. Adm. Code).

Note: The 25 foot setback from non-community and private wells is a final construction distance. This may not be sufficient to prevent running over the well with heavy equipment during construction of the pond.

i. Wetlands – For wet detention ponds that discharge to wetlands, use level spreaders or rip-rap to prevent channelization, erosion and reduce sedimentation in the wetlands.

j. Off-site runoff – Address off-site runoff in the design of a wet detention pond.

k. Aerators/Fountains – If an aerator or fountain is desired for visual and other aesthetic effects (aerators designed to mix the contents of the pond are prohibited) they must meet one of the first two items (i – ii), and items (iii) and (iv) below.

i. Increase the surface area of the wet detention pond beyond the area needed to achieve compliance with a stormwater construction site permit. The increase in surface area is equal to or greater than the *area of influence* of the aerator/fountain. Use an aerator/fountain that does not have a *depth of influence* that extends into the sediment storage depth (see App. E, Figure 4).

ii. For wet detention ponds where the surface area is no more than required to meet the stormwater construction site permit conditions, the depth of influence of the device cannot extend below the sediment storage elevation. Include in the design an automatic shut-off of the aerator/fountain as the pond starts to rise during a storm event. The aerator/fountain must remain off while the pond depth returns to the permanent pool elevation and, further, shall remain off until such time as required for the design micron particle size to settle to below the draw depth of the pump. (See V.B.1.a.iii for the design micron particle sizes that correlate with a TSS reduction.)

iii. Aerator/fountains are not allowed in wet detention ponds with less than a 5 ft. permanent pool designed depth.

iv. Configure the pump intake to draw water primarily from a horizontal plane so as to minimize the creation of a circulatory pattern from bottom to top throughout the pond.

VI. Operation and Maintenance

Develop an operation and maintenance plan that is consistent with the purposes of this practice, the wet detention pond's intended life, safety requirements and the criteria for its design. The operation and maintenance plan will:

A. Identify the responsible party for operation, maintenance and documentation of the plan.

B. Require sediment removal once the average depth of the permanent pool is 3.5 ft. At a minimum, include details in the plan on inspecting sediment depths, frequency of accumulated sediment removal, and disposal locations for accumulated sediment (NR 500, Wis. Adm. Code).

C. Include inlet and outlet maintenance, keeping embankments clear of woody vegetation, and providing access to perform the operation and maintenance activities.

D. Identify how to reach any forebay, safety shelf, inlet and outlet structures.

E. Address weed or algae growth and removal, insect and wildlife control and any landscaping practices.

F. If a liner is used, show how the liner will be protected from damage during sediment removal or when the liner is undergoing repair.

G. Prohibit excavation below the original design depth unless geotechnical analysis is completed in accordance with V.A.1.b & c.

VII. Considerations

Consider the following items for all applications of this standard:

A. Additional conservation practices should be considered if the receiving water body is sensitive to temperature fluctuations, oxygen depletion, excess toxins or nutrients.

B. To prevent nuisance from geese, consider not mowing around the pond perimeter. To maximize safety and pollutant removal, consider spreading topsoil along the safety shelf to promote plant growth.

C. For ease of maintenance, a sediment forebay should be located at each inlet (unless inlet is < 10% of total inflow or an equivalent upstream pretreatment device exists) to trap large particles such as road sand. The storage volume of the sediment forebay should be consistent with the maintenance plan, with a goal of 5%-15% of the permanent pool surface area. The sediment forebay should be a minimum depth of 3 ft. plus the depth for sediment storage.

D. The length to width ratio of the flow path should be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the pond, including the permanent pool and forebay.

E. Consider providing additional length to the safety shelf, above or below the wet pool elevation, to enhance safety.

F. To prevent damage or failure due to ice, all risers extending above the pond surface should be incorporated into the pond embankment.

G. The use of underwater outlets should be considered to minimize ice damage, accumulation of floating trash or vortex control.

H. Watershed size and land cover should be considered to ensure adequate runoff volumes to maintain a permanent pool.

I. Aesthetics of the pond should be considered in designing the shape and specifying landscape practices. Generally, square ponds are aesthetically unappealing.

J. If downstream flood management or bank erosion is a concern, consider conducting a watershed study to determine the most appropriate location and design of stormwater management structures, including consideration of potential downstream impacts on farming practices and other land uses.

K. For wet detention ponds with surface area more than 2 acres or where the fetch is greater than 500 feet, consider reinforcing banks, extending the safety shelf, vegetating the safety shelf or other measures to prevent erosion of embankment due to wave action.

L. To prevent failure, consider reinforcing earthen emergency spillways constructed over fill material to protect against erosion.

M. All flow channels draining to the pond should be stable to minimize sediment delivery to the pond.

N. Baffles may be used to artificially lengthen the flow path in the pond. In some designs, a circular flow path is set up in a pond even when the inlet and outlet are next to each other and no baffles are used. Then the flow path can be calculated using the circular path.

O. Consider using low fertilizer inputs on the embankments and collecting the clippings.

P. Consider providing a method to facilitate dewatering during accumulated sediment removal.

Q. Consider using backflow preventers to minimize fish entrapment.

R. Consider providing a terrestrial buffer of 10-15 feet around the pond if it has low or no embankments.

S. Consider a hard surface for the bottom of the forebay to ease sediment removal.

T. Use of algaecides, herbicides or polymers to control nuisance growths or to enhance sedimentation must receive a permit under NR 107, Wis. Adm. Code. Contact the appropriate DNR specialist.

U. Consider additional safety features beyond the safety shelf where conditions warrant them.

V. Consider vegetative buffer strips along drainage ways leading to the detention pond to help filter pollutants.

W. After the site assessment is complete, review and discuss it with the local administering agency at a pre-design conference to determine and agree on appropriate pond design for the site.

X. Design so that the 10-yr., 24-hour design storm does not flow through the emergency spillway. The 10-yr. design criteria protects the embankment from premature failure due to frequent or long-duration flows through the emergency spillway.

Y. Where practical, construct the emergency spillway on original grade.

Z. Conduct a groundwater boring to 15 feet below the pond and consider the historic "mottling marks" in assessing groundwater levels.

AA. For partially or fully submerged inlet pipes, consider using pipe ties or some other method to keep pipes from dislodging during frost movement.

BB. Consider employing a geotechnical engineer if stability of the embankment is a concern and to justify slopes steeper than 2.5:1.

CC. Assess potential environmental hazards at the site from previous land uses. The assessment should use historical information about the site to determine if the potential for environmental hazard exists, e.g., contaminated soils, contaminated groundwater, abandoned dumps or landfills. Contaminated areas can be located by reviewing the Bureau of Remediation and Redevelopment Tracking System (BRRTS), the DNR Registry of Waste Disposal Sites in Wisconsin and the Solid and Hazardous Waste Information System (SHWIMS) available through the WDNR website.

DD. Consider direct and indirect impacts to area wetland hydrology and wetland hydroperiod due to area hydrologic modifications that result from routing wetland source waters through a wet detention pond or releasing the discharge from a wet detention pond directly into a wetland.

EE. Consider conducting more than one test pit or boring per every 2 acres of permanent pool footprint, with a minimum of two per pond, if more are needed to determine the variability of the soil boundary or to identify perched water tables due to clay lenses. For the soils analysis, consider providing information on soil thickness, groundwater indicators—such as soil mottle or redoximorphic features—and occurrence of saturated soil, groundwater or disturbed soil.

FF. Where the soils are fine, consider groundwater monitoring if the groundwater table is less than 10 feet below the bottom of the wet pond because the water table may fluctuate seasonally. Other impacts on the groundwater table elevation may be from seasonal pumping of irrigation wells or the influence of other nearby wells. Monitoring or modeling may be necessary in these situations to identify the groundwater elevation.

GG. For additional guidance on seepage control for embankments, consult sections V.B.1.c and V.B.1.e(2) of NRCS Conservation Practice Standard 378, Pond, particularly if a wet detention pond's embankment is considered to be a dam.

VIII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

IX. References

Center for Watershed Protection, *Stormwater BMP Design for Cold Climates*, December 1997.

R. Pitt and J. Voorhees, *The Design and Use of Detention Facilities for Stormwater Management Using DETPOND*, 2000.

United States Department of Agriculture, Natural Resources Conservation Service, Conservation Practice Standard 378, *Pond*, July 2001.

United States Department of Agriculture, Natural Resources Conservation Service, *Engineering Field Handbook.*

United States Department of Agriculture, Natural Resources Conservation Service, *Ponds – Planning, Design, Construction*, Agriculture Handbook 590, revised September 1997.

United States Department of Agriculture, Natural Resources Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*.

United States Department of Agriculture, Natural Resources Conservation Service, *Wisconsin Field Office Technical Guide, Section IV*.

United States Department of Commerce, Weather Bureau, *Rainfall Frequency Atlas of the United States, Technical Paper 40*.

University of Wisconsin – Extension, *The Wisconsin Storm Water Manual, Part Four: Wet Detention Basins*, Publication No. G3691-P.

Wisconsin State Legislature, Revisor of Statutes Bureau, *Wisconsin Administrative Code*; for information on the codes of state agencies, including WDNR, see http://www.legis.state.wi.us/rsb/code.htm.

X. Definitions

Approved Model (V.B.2.c) – A computer model that is used to predict pollutant loads from urban lands and has been approved by the applicable regulatory authorities. SLAMM and P8 are examples of models that may be used to verify that a detention pond design meets the desired total suspended solids reduction.

Area of Influence (V.B.2.k.i) – The area of influence of an aerator/fountain is a function of the circular area of impact of the return water and the mixing area of the pump, whichever is greater.

Bedrock (V.A.1.b) – Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Depth of Influence (V.B.2.k.i) – The depth of influence of an aerator/fountain is a function of the impact depth of the return water and the draw depth of the pump, whichever is greater.

Karst Feature (V.A.1.c) – An area or surficial geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater. May include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps, swallets, fracture trace (linear feature, including stream segment, vegetative trend and soil tonal alignment), Karst pond (closed depression in a karst area containing standing water) or Karst fen (marsh formed by plants overgrowing a karst lake or seepage area).

Seasonally high groundwater level (V.A.1.b) – The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Appendix A—Calculation of Preliminary Permanent Pool Surface Area for TSS Reduction [1]

		80%	60%
Land Use/Description/Management[2]	Total Impervious (%)[3]	Minimum Surface Area of the Permanent Pool (% of Watershed Area)	Minimum Surface Area of the Permanent Pool (% of Watershed Area)
Residential • < 2.0 units/acre (>1/2 acre lots) (low density • 2.0 - 6.0 units/acre (medium density) • > 6.0 units/acre (high density)	8 - 28 >28 -41 >41 - 68	0.7 0.8 1.0	0.3
Commercial/Office Park/Institutional/Warehouse/Industrial/Manufacturing/Storage[4] (Non-retail related business, multi-storied buildings, large heavily used outdoor parking areas, material storage, or manufacturing operations	<60 60-80 80-90 >90	1.8 2.1 2.4 2.8	0.6
Parks/Open Space/Woodland/Cemeteries	0-12	0.6	0.2
Highways/Freeways (Includes right-of-way area) • Typically grass banks/conveyance • Mixture of grass and curb/gutter • Typically curb/gutter conveyance	<60 60-90 >90	1.4 2.1 2.8	1.0

[1] Multiply the value listed by the watershed area within the category to determine the minimum pond surface area. Prorate for drainage areas with multiple categories due to different land use, management, percent impervious, soil texture, or erosion rates. For example, to achieve an 80% TSS reduction, a 50 acre (residential, 50% imperviousness) x 0.01 (1% of watershed from table) = 0.5 acre + 50 acres (office park, 85% imperviousness) x 0.024 (2.4% of watershed) = 1.2 acre. Therefore 0.5 acre + 1.2 acre = 1.7 acres for the minimum surface area of the permanent pool.

[2] For offsite areas draining to the proposed land use, refer to local municipalities for planned land use and possible institutional arrangements as a regional stormwater plan.

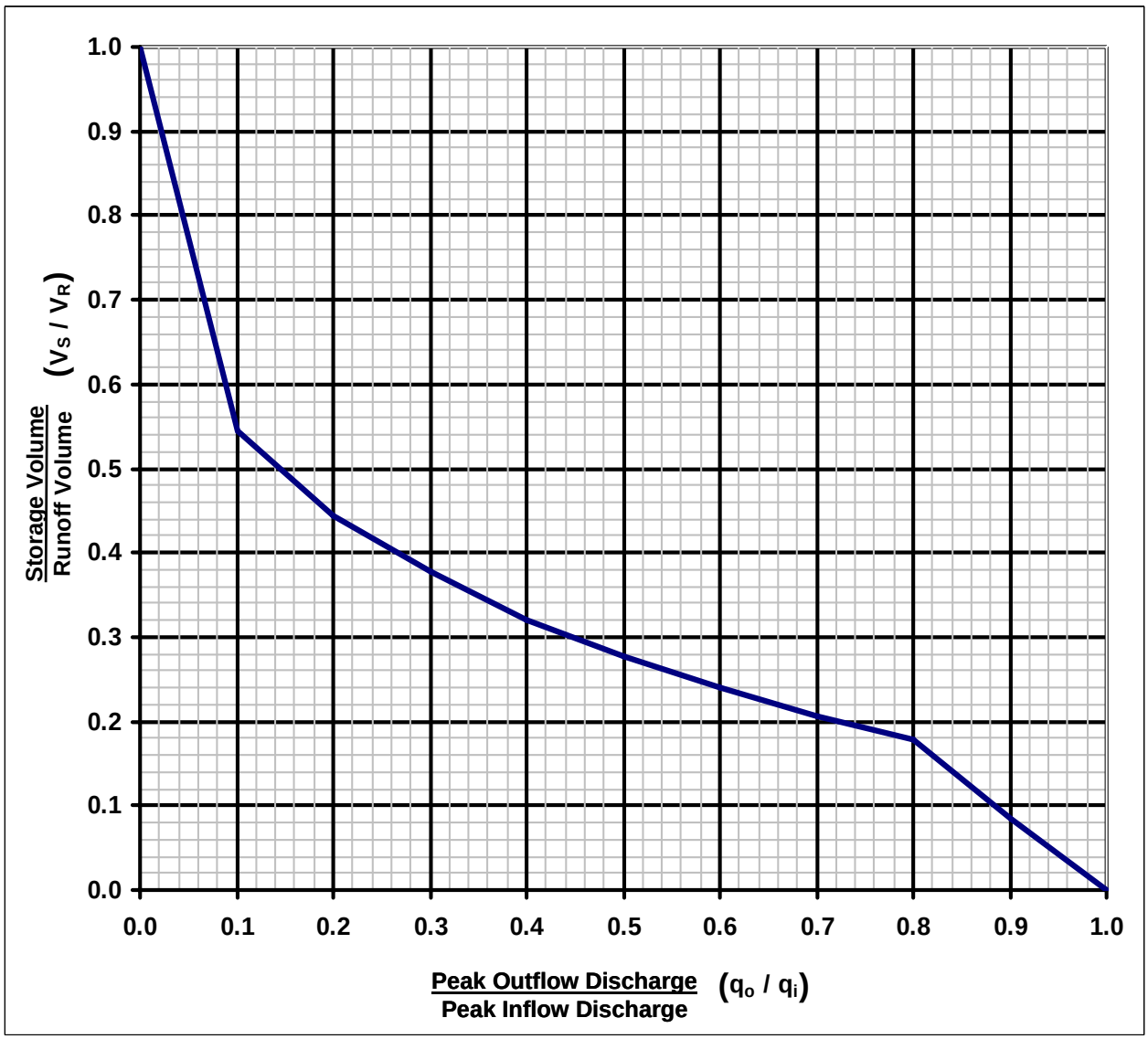
[3] Impervious surfaces include rooftops, parking lots, roads, and similar hard surfaces, including gravel driveways/parking areas.

[4] Category includes insurance offices, government buildings, company headquarters, schools, hospitals, churches, shopping centers, strip malls, power plants, steel mills, cement plants, lumber yards, auto salvage yards, grain elevators, oil tank farms, coal and salt storage areas, slaughter houses, and other outdoor storage or parking areas.

Source: This table was modified from information in "The Design and Use of Detention Facilities for Stormwater Management Using DETPOND" by R. Pitt and J. Voorhees (2000).

Appendix B

Approximate Detention Basin Routing for Type II Storms



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. 1986. NRCS Bulletin No. WI-210-8-16 (Sept. 12, 1988) amended the TR-55 routing graph for Type II storms to include flows outside the original range.

Appendix B (cont'd.)

Rainfall Quantities:

Table 2 provides a summary of the 1-year, 24-hour rainfall totals using NRCS mandated TP-40, which has not been updated since 1961. Table 3 provides a summary of more current data from the Rainfall Frequency Atlas of the Midwest published in 1992. Local requirements may dictate the use of one dataset over the other.

Table 2 – Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[1]	
Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette
[1]TP – 40: Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.	

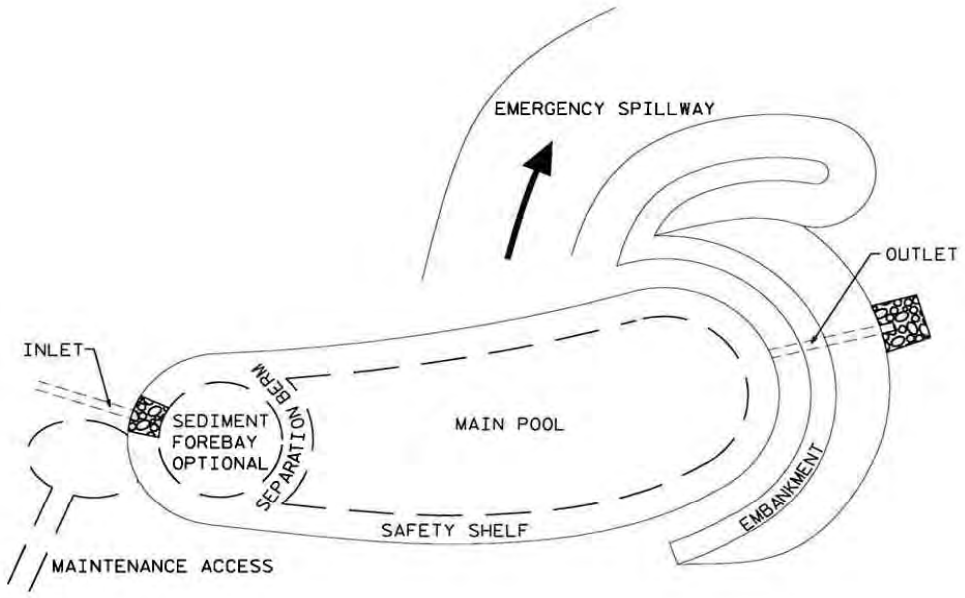
Table 3 - Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[2]		
Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowoc, Fond du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha
[2]Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.		

Appendix B (cont'd.)

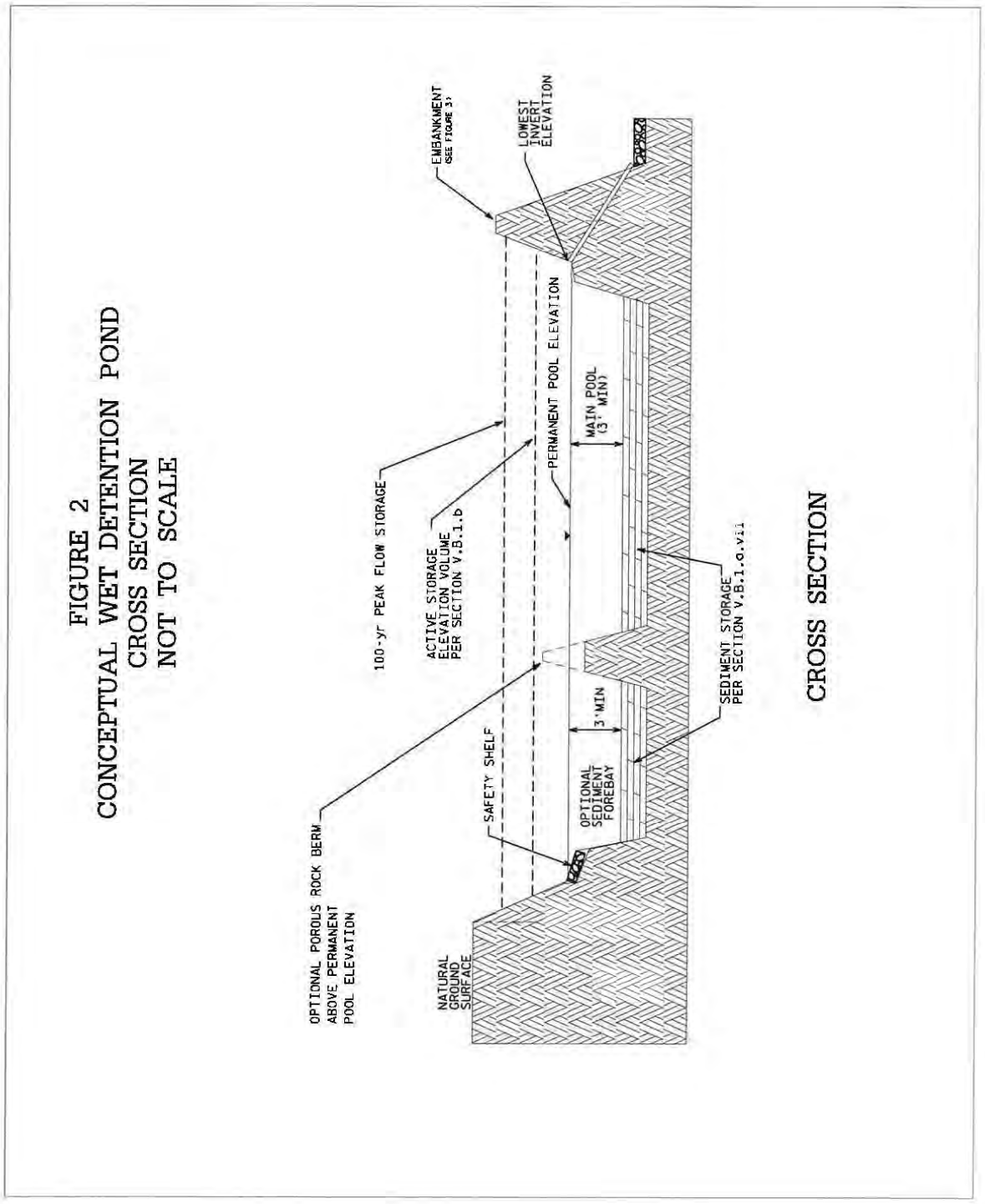
Table 4 – Runoff for Selected Curve Numbers and Rainfall Amounts[1]											
Runoff Depth in Inches for Curve Number of:											
Rainfall (inches)	50	55	60	65	70	75	80	85	90	95	98
1.9	0.00	0.01	0.04	0.11	0.20	0.33	0.50	0.72	1.01	1.39	1.68
1.96	0.00	0.01	0.05	0.12	0.23	0.36	0.54	0.77	1.06	1.44	1.73
2.1	0.00	0.02	0.08	0.16	0.28	0.43	0.62	0.87	1.18	1.58	1.87
2.15	0.00	0.03	0.09	0.18	0.30	0.46	0.66	0.91	1.22	1.63	1.92
2.18	0.00	0.03	0.10	0.19	0.31	0.47	0.68	0.93	1.25	1.65	1.95
2.2	0.00	0.04	0.10	0.19	0.32	0.48	0.69	0.94	1.27	1.67	1.97
2.21	0.00	0.04	0.10	0.20	0.32	0.49	0.69	0.95	1.28	1.68	1.98
2.22	0.00	0.04	0.10	0.20	0.33	0.49	0.70	0.96	1.28	1.69	1.99
2.23	0.01	0.04	0.11	0.20	0.33	0.50	0.71	0.97	1.29	1.70	2.00
2.25	0.01	0.04	0.11	0.21	0.34	0.51	0.72	0.98	1.31	1.72	2.02
2.3	0.01	0.05	0.12	0.23	0.36	0.54	0.75	1.02	1.35	1.77	2.07
2.4	0.02	0.07	0.15	0.26	0.41	0.59	0.82	1.10	1.44	1.87	2.17
2.5	0.02	0.08	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
2.6	0.03	0.10	0.20	0.34	0.50	0.71	0.96	1.26	1.62	2.06	2.37
[1]NRCS TR-55, Equations 2-1 to 2-4 used to determine runoff depths.											

Appendix C—Pond Geometry

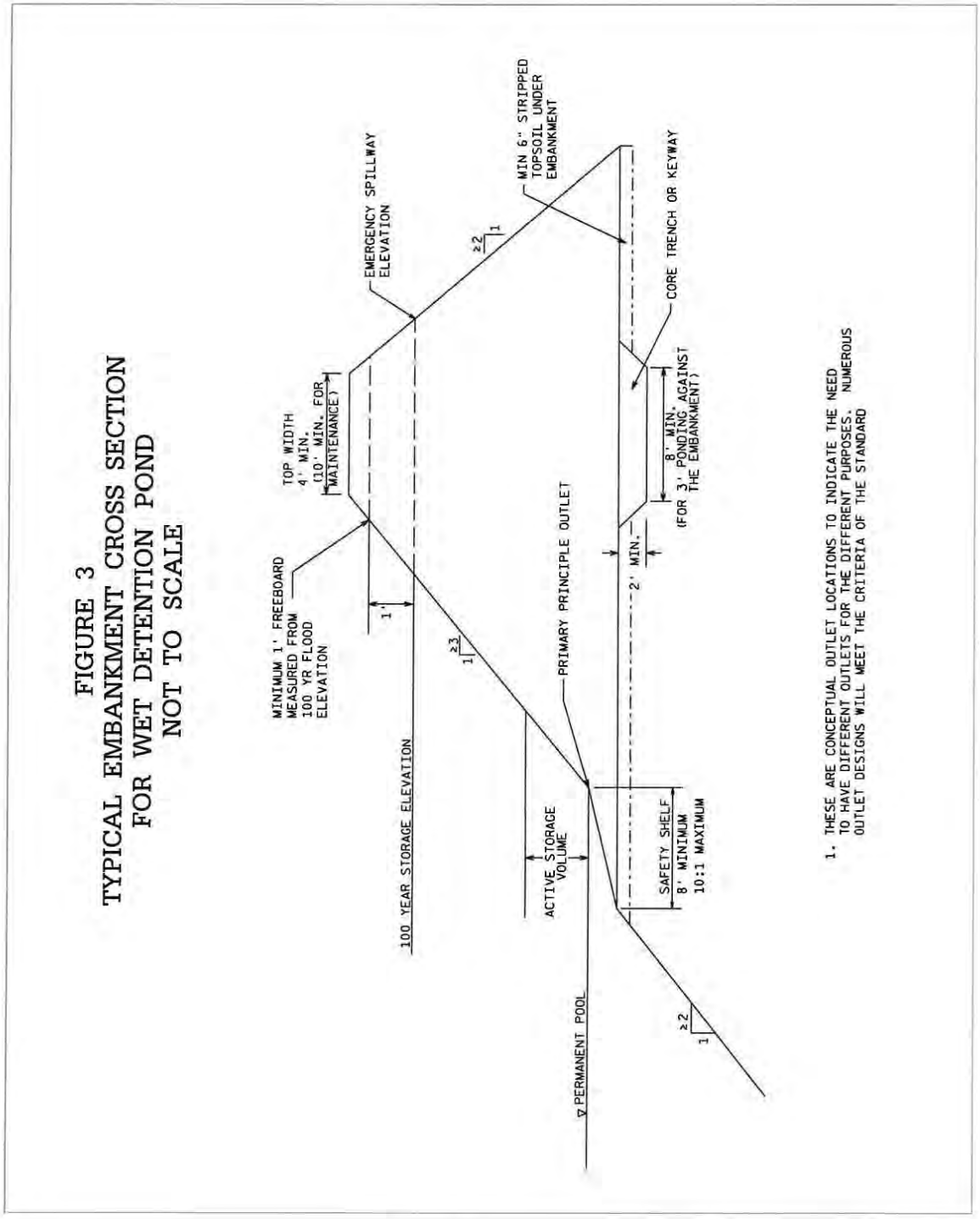
FIGURE 1
CONCEPTUAL WET DETENTION POND
PLAN VIEW
NOT TO SCALE



Appendix C—Pond Geometry (cont'd.)



Appendix C—Pond Geometry (cont'd.)



Appendix D—Pond Liner Design, Decision Flowchart

Pond Liner Design Specifications for Three Levels of Liners

A. Type A Liners—for sites with the highest potential for groundwater pollution. They include:
- Clay (natural soil, not bentonite)
- High Density Polyethylene (HDPE)
- Geosynthetic Clay Liners (GCL)

1. Clay liner criteria (essentially the same as the clay below landfills but not as thick):
   a. 50% fines (200 sieve) or more.
   b. An in-place hydraulic conductivity of 1×10^{-7} cm./sec. or less.
   c. Average liquid limit of 25 or greater, with no value less than 20.
   d. Average PI of 12 or more, with no values less than 10.
   e, Clay installed wet of optimum if using standard Proctor, and 2% wet of optimum if using modified Proctor.
   f. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 300, Clay Liners.
   g. Minimum thickness of two feet.
   h. Specify method for keeping the pool full or use of composite soils below liner.
2. HDPE liner criteria:
   a. Minimum thickness shall be 60 mils.
   b. Design according to the criteria in Table 3 of the NRCS 313, Waste Storage Facility technical standard.
   c. Install according to NRCS Wisconsin Construction Specification 202, Polyethylene Geomembrane Lining.
3. GCL liner criteria:
   a. Design according to the criteria in Table 4 of NRCS 313, Waste Storage Facility technical standard.
   b. Install according to NRCS Wisconsin Construction Specification 203, Geosynthetic Clay Liner.

B. Type B Liners—for sites with medium potential for groundwater pollution or where need for a full pool level is high. They include:
- All liners meeting Type A criteria
- Clay
- HDPE
- Polyethylene Pond Liner (PPL)

1. Clay liner criteria:
   a. 50% fines (200 sieve) or more.
   b. An in-place hydraulic conductivity of 1×10^{-6} cm./sec. or less.
   c. Average liquid limit value of 16 or greater, with no value less than 14.
   d. Average PI of 7 or more with no values less than 5.
   e. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
   f. Minimum thickness of two feet.
   g. Specify method for keeping the pool full or use of composite soils below liner.
2. HDPE liner criteria:
   a. Minimum thickness shall be 40 mils.
   b. All other criteria same as for Type A HDPE liner.
3. PPL liner criteria:
   a. Minimum thickness shall be 30 mils.
   b. All other criteria same as for Type A HDPE liner.

C. Type C Liners—for sites with little potential for groundwater pollution or where the need for a full pool is less important. They include:
- All liners meeting Type A or B criteria
- Silts and clays
- HDPE (<40 mil)
- PPL (20-24 mil)
- PVC (30-40 mil)
- EPDM (45 mil)

1. Silt/Clay liner criteria:
   a. 50% fines (200 sieve), or 20% fines and a PI of 7.
   b. Soil compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
   c. Minimum thickness of two feet.
   d. Specify method for keeping the pool full or use of composite soils below liner.

D. Liner Elevation—All liners must extend above the permanent pool up to the elevation reached by the 2-yr., 24-hour storm event.

E. For synthetic liners, follow the manufacturers' recommendations for installation.

Appendix E—Aerators/Fountains

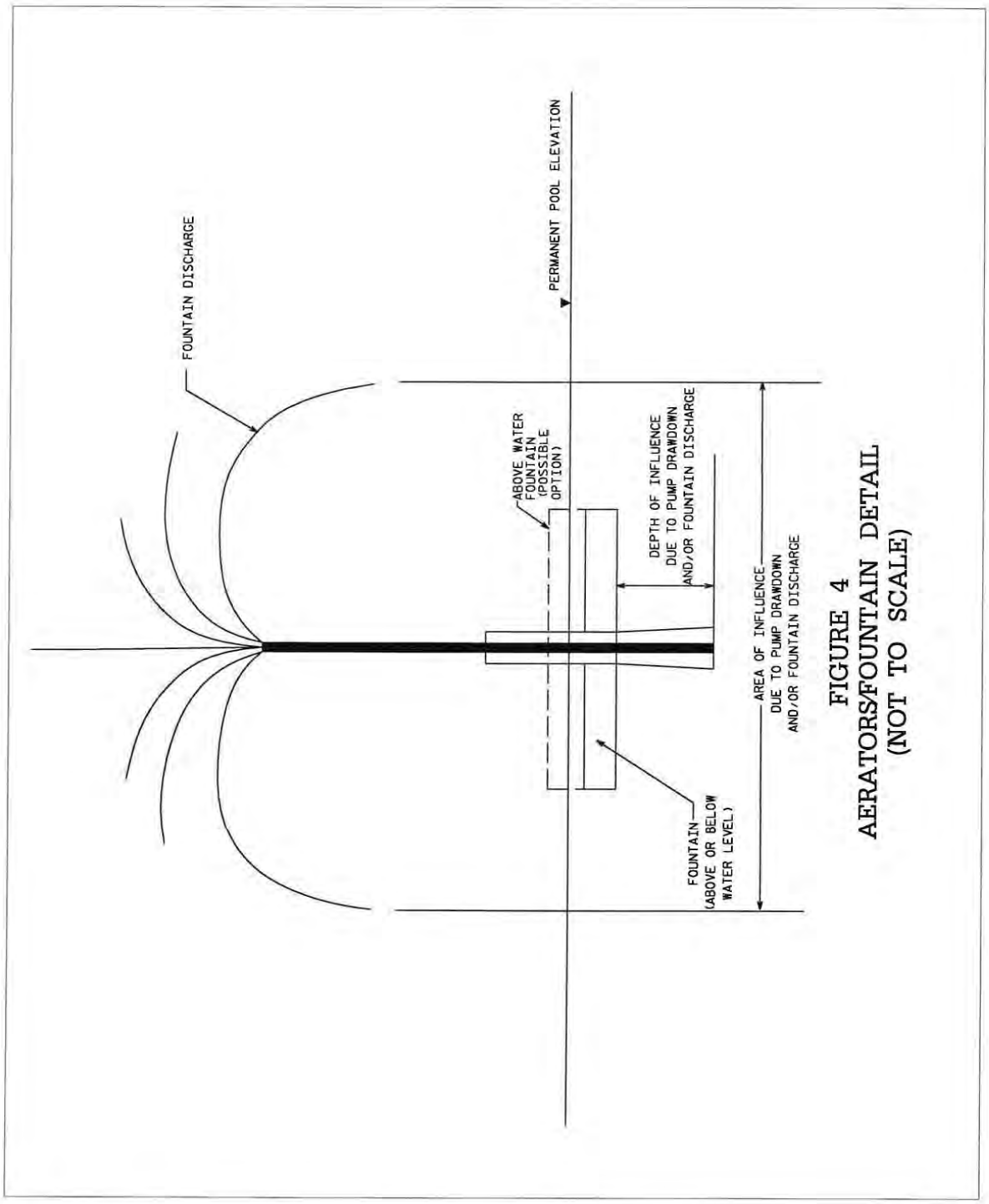
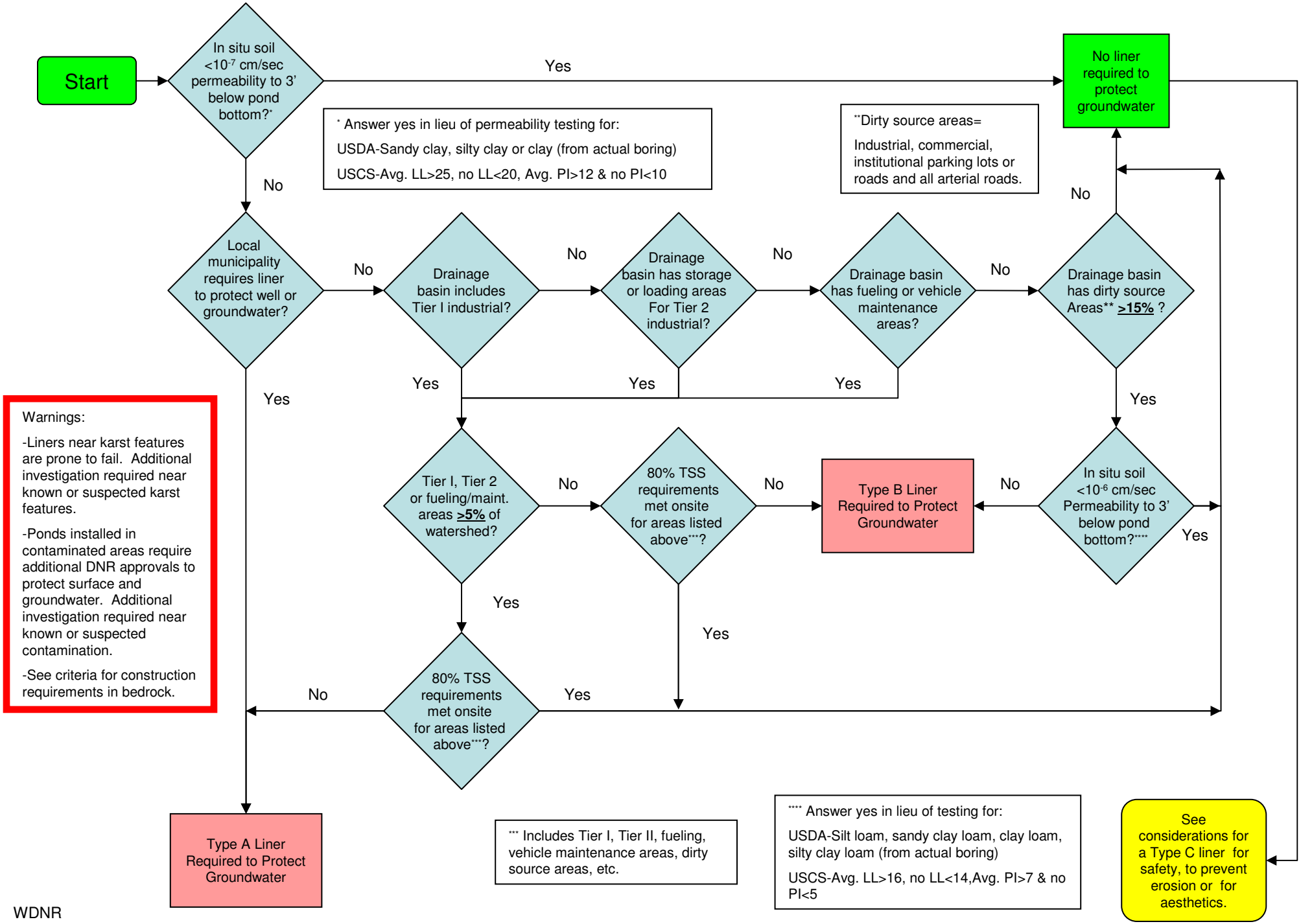


FIGURE 4
AERATORS/FOUNTAIN DETAIL
(NOT TO SCALE)

Appendix D - Liner Flow Chart for Wet Detention Ponds



WDNR
10/07

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

CONSERVATION PRACTICE STANDARD

SITE EVALUATION FOR STORM WATER INFILTRATION

1002

DEFINITION

This standard defines site evaluation procedures to:

(1) Perform an initial screening of a *development site*[1] to determine its suitability for infiltration,

(2) Evaluate each area within a development site that is selected for infiltration, and

(3) Prepare a site evaluation report.

PURPOSE

(1) Protect groundwater from surface water pollution sources,

(2) Identify areas suitable for infiltration,

(3) Establish methods to a) characterize the site, and b) screen for exclusions and exemptions under ch. NR 151, Wis. Adm. Code,

(4) Establish requirements for siting an *infiltration device* and the selection of *design infiltration rates*,

(5) Define requirements for a site evaluation report documenting that appropriate areas are selected for infiltration and that an appropriate design infiltration rate is used, and

CONDITIONS WHERE PRACTICE APPLIES

This standard is intended for development sites being considered for storm water infiltration devices. Additional site location requirements may be imposed by other storm water infiltration device technical standards.

Be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration devices. This standard does not contain the text of federal, state or local laws. Note that infiltration devices are commonly regulated as plumbing when in connection with a piping system, see ch. SPS 382, Wis. Adm. Code. This technical standard enables state and local authorities to implement infiltration requirements with uniformity.

CRITERIA

The site evaluation consists of four steps (Steps A – D) for locating the optimal areas for infiltration and establishing the design infiltration rate for properly sizing infiltration devices (below, and Figure 1).

To avoid costly redesigns, it is recommended to complete Step A before the preliminary plat, and Step B before the final plat or Certified Survey Map (CSM) is approved. For regional infiltration devices, and for devices constructed on public right-of-ways, public land, or jointly owned land, Step C should be completed before the final plat or final CSM approval.

Infiltration devices distributed around a development will usually better sustain the existing hydrology, and can improve the lifespan of devices, compared to a single *regional device*. Information collected in Step A may be used to explore the potential for multiple *infiltration areas* versus a regional device.

[1] Words in the standard that are shown in italics are described in the Definitions section. The words are italicized the first time they are used in the text. Conservation Practice Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI at (608) 441-2677.

Step A. Initial Site Screening

Step B. Preliminary Field Verification of the Initial Site Screening

Step C. Establishment of Design Infiltration Rate

Step C.1. Field Evaluation of Specific Infiltration Areas

Step C.2. Infiltration Rate Exemption

Step C.3. Infiltration Rate Determination

Infiltration Option 1 – Infiltration Rate Not Measured, *Soil Compaction* Mitigated

Infiltration Option 2 – Infiltration Rate Measured with In-Field Device, Soil Compaction Mitigated

Infiltration Option 3 – Infiltration Rate Not Measured, Soil Compaction Not Mitigated

Step D. Soil and Site Evaluation Report

Figures and Attachments:

Figure 1. Site Evaluation for Infiltration Flow Chart

Figure 2. Example Bioretention Basin Section

Figure 3. Example Bioretention Basin Section with Underdrain Section

Figure 4. Example *Infiltration Basin* Section

Attachment 1. Hydrologic Condition Form

Attachment 2. Soil and Site Evaluation Form

Record information for Steps B and C as noted in Step D. Prepare a single report for the infiltration evaluation.

Step A. Initial Site Screening

The purpose of Step A is to use existing available information to determine if installation is limited by s. NR 151.124 (3)(a) or (4), Wis. Adm. Code, and where field work is needed for Step B.

A wetland determination or delineation may be needed to identify boundaries of wetlands within or near the site, but is not required as part of the soil evaluation.

The initial screening may be conducted without fieldwork to determine the following:

(See a list of references and resources in the Considerations section).

(1) Site topography and slopes greater than 20%,

(2) Site soil infiltration capacity characteristics as defined in NRCS County soil surveys or other relevant source,

(3) *Soil parent material* obtained from published soil descriptions,

(4) *Hydrologic condition* based on the c*ondition values* for the current and two previous months' rainfall (Attachment 1),

(5) Soil map unit, depth to groundwater and depth to restrictive features; use seasonally high groundwater information where available,

(6) Distance to sites listed on the Wisconsin Remediation and Redevelopment Database (WRRD) sites within 500 feet from the perimeter of the development site,

(7) Known presence of endangered species habitat,

(8) Location of rivers, streams, lakes, and floodplains,

(9) Location of mapped wetlands, hydric soil and potentially hydric soil based on the Wisconsin Wetland Inventory (WWI), which can be accessed via the WDNR Surface Water Data Viewer,

(10) Areas prohibited from installation of storm water infiltration devices by s. NR 151.124(3)(a) and (4)(a), Wis. Adm. Code, including, but not limited to, setbacks from *direct conduits to groundwater* such as wells, sinkholes, and *karst features* due to the potential for groundwater contamination,

(11) Areas exempt from the requirement to install storm water infiltration devices by ss. NR 151.124 (3)(b) and (4)(c) Wis. Adm. Code,

(12) Potential impact to utilities, and

(13) Potential impact to adjacent property.

Step B. Preliminary Field Verification of the Initial Site Screening

The purpose of Step B is to field-verify information from Step A for all potential areas of the development site considered suitable for infiltration. Evaluate the areas for depth to groundwater, depth to *bedrock*, and soil texture to verify any exemption and exclusion found in Step A. *Soil borings* are acceptable for Step B.

Sandy loams, loams, silt loams, silts and all clay textural classifications are assumed to meet the *percent fines* limitations of a filtering layer in s. NR 151.002(14r), Wis. Adm. Code, for both 3 and 5 foot soil layers. *Coarse sand* does not meet s. NR 151.002(14r), Wis. Adm. Code, limitations for a 3 foot soil layer consisting of 20% fines. Other sand textures and loamy sands may require the percent fines level be verified with a sieve analysis.

Step C. Establishment of Design Infiltration Rate

The purpose of Step C is to determine if locations identified for infiltration devices are suitable for infiltration and to provide the required information to design the device.

Test pits are required for Step C. If a backhoe is unable to excavate a test pit to the required depth, then soil borings may be used to evaluate the depth below that which the backhoe is able to reach. It is expected that a medium-sized backhoe can reach at least 15 feet below grade. Information from soil borings and monitoring well logs may supplement data from test pits. Refer to Attachment 2 for a soil and site evaluation form.

Step C.1. Field Evaluation of Specific Infiltration Areas.

Construct the minimum number of test pits for each infiltration device as defined in Table 1. Local agencies may require additional test pits for soil evaluation.

Excavate test pits to a depth of at least 5 feet below the *native soil interface* elevation (Figures 2 – 4) or to a *limiting layer*, such as bedrock or groundwater. If no limiting layer is encountered, continue excavation to 5 feet below the native soil interface even if *perched conditions* are encountered. For example, if the native soil interface of an infiltration device is 8 feet below the *existing grade*, a test pit at least 13 feet deep will be needed (8 feet plus 5 feet).

Follow *OSHA* safety protocol for designing and entering test pits. To avoid entering test pits, soil may also be examined from the surface as it is excavated.

Complete morphological soil profile description using the NRCS Field Book for Describing and Sampling Soils, (latest edition). Soil profile descriptions are to be made by a professional meeting the Qualifications (see Step D). Document the test pits using the Soil Test Pit Evaluation form in Attachment 1.

Table 1. Evaluation Requirements to Proposed Infiltration Devices [Note 1]

Infiltration Device (Technical Standard [Note 2, Note 3]**)**	**Tests Required**	**Minimum Number of Test Pits Required** [Note 4, Note 5]
Rain Garden	Soil texture evaluation or infiltration test	N/A
Infiltration Trenches (1007)	Test pits	1 test pit/100 linear feet of trench with a minimum of 2 test pits, and sufficient to determine / confirm variability
Vegetated Swale (1005)	Test pits	1 test pit/ 500 linear feet of swale with a minimum of 2 test pits, and sufficient to determine / confirm variability
Bioretention Systems (1004)	Test pits	1 test pit or a number sufficient to assess infiltration potential, and sufficient to determine / confirm variability
Surface Infiltration Basins (1003)	Test pits	2 test pits then an additional test pit /10,000 square feet and sufficient to determine / confirm variability
Subsurface Dispersal Systems (N/A) greater than 15 feet in width	Test pits	2 test pits then an additional test pit /10,000 square feet and sufficient to determine / confirm variability
Permeable Pavement Systems (1008)	Test pits	2 test pits then an additional test pit /10,000 square feet and sufficient to determine / confirm variability

[Note 1] Maintain trench safety requirements; test pit evaluations can be made from the surface without entering the pit.

[Note 2] Technical standards refer to the corresponding WDNR design technical standard containing design criteria for this practice.

[Note 3] Where initial site borings show uniform soils throughout the site, the professional meeting the Qualifications (see Step D) may reduce the number of test pits, provided information from both test pits and soil borings confirm a uniform soil condition across the proposed device location.

Note 4 Test pits are optimally located within 10 feet of the footprint perimeter, and not within the footprint.

Note 5 If a backhoe is unable to excavate a test pit deep enough from the existing surface to reach 5 feet below the native soil interface, then soil borings may be used to evaluate the depth below the which the backhoe is unable to reach. It is expected that even a medium sized backhoe can reach at least 15 feet below grade.

Step C.2. Infiltration Rate Exemption.

To determine if a site is eligible for exemption from infiltration under s. NR 151.124(4)(c), Wis. Adm. Code, use a scientifically credible field test method unless the least permeable soil horizon within five feet below the native soil interface is one of the following: sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, or clay. Take at least three infiltration tests at the optimal infiltration location per the criteria obtained in Step B, and distribute tests so that they best represent the area being tested (see Step C.3. Infiltration Option 2 for infiltration test methods). Conduct tests within the native soil layer being evaluated for exemption. For a site to be exempt from infiltration requirements, at least two-thirds of tests are to have a measured infiltration rate of less than 0.6 in/hr. Use the infiltration rate from actual field measurements to request an exemption to infiltration requirements; correction factors do not apply.

Step C.3. Infiltration Rate Determination.

The purpose of this step is to determine a design infiltration rate (Infiltration Options 1 – 3).

Use Infiltration Options below to determine the design infiltration rate. Examples calculate the *static infiltration rate.*

Note that *soil compaction mitigation* reduces the soil density and promotes infiltration.

Infiltration Option 1 – Infiltration Rate Not Measured, Soil Compaction Mitigated

Using information from soil test pits, select the design static infiltration rate from Table 2 based on soil texture of the least permeable soil horizon within 5 feet below the native soil interface. See Example 1.

Table 2. Design Static Infiltration Rates for Soil Textures Receiving Storm Water [Note 1]

Soil Texture	Design Static Infiltration Rate Without Measurement (Inches/Hour) [Note 2]
Coarse sand or coarser	3.60
Loamy coarse sand	3.60
Sand	3.60
Loamy sand	1.63
Sandy loam, fine sand, loamy sand, very fine sand, and loamy fine sand	0.50
Loam	0.24
Silt loam	0.13
Sandy clay loam	0.11
Clay loam	0.03
Silty Clay loam	0.04 [Note 3]
Sandy clay	0.04
Silty clay	0.07
Clay	0.07

[Note 1] These infiltration rates are not to be used to request exemption from infiltration requirements.

[Note 2] Infiltration rates represent the lowest value for each textural class presented in Table 2 of Rawls, 1998.

[Note 3] Infiltration rate is an average based on Rawls, 1982 and Clapp & Hornberger, 1978.

Table 2 assumes separation from the native soil interface to a limiting layer such that mounding of water will not reach the native soil interface. A regulatory authority may require a mounding analysis when concerned that mounding may impair the function of the device or have an adverse impact to property. See Considerations section for more information.

Where adverse soil structure is present, such as moderate to strong platy soil structure, compacted or cemented soil horizons, or massive soil conditions with high bulk density reduce the design static infiltration rates per judgment of an individual meeting the Qualifications in Step D.

Example 1.

(1) Calculate the design static infiltration rate (F_{static}) where the native soil interface is 4 feet below existing grade (Table E1).

Table E1. Observed Soil Conditions for Example 1

Soil Depth Below Existing Grade (Inches)	Soil Texture	Infiltration Rate Note 1 (Inches/Hour)
0 – 12	Silt Loam	0.13
12 – 24	Sandy Loam	0.50
24 – 72	Loam	0.24
72 – 130	Silt Loam	0.13
130 – 180	Loam	0.24

Note 1 Infiltration rates are from Table 2.

Solution 1.

(1) F_{static} = the soil texture with the lowest infiltration rate within 5 feet below the native soil interface

(2) Solve for F_{static}: Add 5 feet to the depth of the native soil interface (4 feet) for a total of 9 feet of depth. The soil texture with the lowest infiltration rate from 4 feet to 9 feet (48 to 108 inches) below existing grade is silt loam, for which Table E1 shows an infiltration rate of 0.13 in/hr.

(3) F_{static} = 0.13 in/hr.

Infiltration Option 2 – Infiltration Rate Measured with In-Field Device, Soil Compaction Mitigated

Conduct two field infiltration tests within each soil test pit at the native soil interface as required in Table 1 and calculate a geometric mean infiltration rate.

Select infiltration measurement location(s) representative of the site being tested. Conduct the infiltration tests at the native soil interface elevation of the proposed infiltration device. If the infiltration rate is measured with a *Double-Ring Infiltrometer*, use the requirements of ASTM D3385 for the field test, except that the test period may be reduced to 2 hours and may be a falling head test (WDNR 2010). Record at least 5 water depth measurements spaced throughout the test period to determine the lowest infiltration rate that occurs during the test. An infiltration test may be conducted over a period of less than 2 hours only if water is depleted during testing due to a high infiltration rate (e.g., > 10 in/hr). In this case, graph the infiltration rate change with respect to time using the measured data points to project the infiltration rate out to 2 hours.

Infiltration testing is used to determine the lowest infiltration rate under a saturated soil condition during **non-frozen soil conditions**. Infiltration test results may not be representative due to macro pores (e.g., soil cracks, worm holes); therefore, avoid areas with macro pores. If cracks in soil are due to dry soil, do not test until soil has taken on adequate moisture to eliminate the soil cracks.

The geometric mean of infiltration test results should be used. However, it may be appropriate to group certain test results where an infiltration trend is apparent and assign different geometric mean rates accordingly. Grouping of results may be done based on soil type or spatial reasons to provide representative results. Where an infiltration rate is too low to measure, a rate of 0.03 in/hr may be used to calculate a geometric mean of the dataset (the dataset's values must be greater than zero to calculate a geometric mean).

To calculate the static infiltration rate,

(1) Determine the ratio of textural infiltration rates (R) by dividing the textural infiltration rate (Table 2) at the native soil interface by the lowest textural infiltration rate (Table 2) within 5 feet below the native soil interface.

(2) Use this ratio to select the appropriate correction factor (*A*) from Table 3. The correction factor is based on compaction mitigation occurring, and adjusts the measured infiltration rates for the occurrence of less permeable soil horizons below the surface and the potential variability in the subsurface soil horizons throughout the infiltration site.

(3) Next, divide the geometric mean of the measured infiltration rates by the correction factor (*A*) to obtain the static infiltration rate.

Table 3. Correction Factors for Measured Infiltration Rates at Infiltration Devices Note 1

Ratio of Textural Infiltration Rates (*R*)	Correction Factor (*A*)
1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

Note 1 Washington State Department of Ecology, 2001.

Example 2.

(1) Calculate the static design infiltration rate (F_{static}) for an infiltration device having Double-Ring Infiltrometer measurements with a geometric mean (G) infiltration rate of 1.45 in/hr.

(2) The infiltration device native soil interface is 4 feet (48 inches) below existing grade. No groundwater or redoximorphic features were encountered.

Table E2. Observed Soil Conditions for Example 2

Soil Depth Below Existing Grade (Inches)	Soil Texture	Infiltration Rate Note 1 (Inches/Hour)
0 – 12	Silt Loam	0.13
12 – 84	Sandy Loam	0.50
84 – 180	Loam	0.24

Note 1 Infiltration rates are from Table 2.

Solution 2.

(1) Calculate *R*, the ratio of textural infiltration rates = T_N / T_L

Where:

T_N = Textural infiltration rate at the native soil interface (Table 2, sandy loam)

T_L = Lowest textural infiltration rate within 5 feet below the native soil interface (Table 2, loam)

(2) *R* = 0.50 in/hr (sandy loam) / 0.24 in/hr (loam) = 2.08

(3) From Table 3, the correction factor (*A*) for 2.08 is 3.5.

(4) Calculate F_{static}, the static infiltration rate = *G* / *A*

Where:

G = the geometric mean of the measured infiltration rate = 1.45 in/hr

A = the correction factor from Table 3 based on *R*.

(5) F_{static} = 1.45 in/hr / 3.5 = 0.41 in/hr

Infiltration Option 3 – Infiltration Rate Not Measured, Soil Compaction Not Mitigated

Notice: **This section is not applicable where soil compaction mitigation actions will be implemented at an infiltration device (see Definitions).**

Mitigating soil compaction is important, as both topsoil and subsoils can become compacted during construction. It is best to avoid compacting areas, primarily during construction, in the first place, especially areas where infiltration devices will be located. However, construction of an infiltration device can lead to soil compaction, so appropriate actions should be taken to mitigate potential compaction. Soil compaction mitigation actions will vary based on the site and type of infiltration device. Individual infiltration design standards include actions to avoid and mitigate soil compaction. Where actions are not taken to mitigate soil compaction, apply the correction factor (*B*) from Table 4 in this section to further reduce the design infiltration rate of the infiltration device.

Table 4. Static Infiltration Rate Correction Factor for Incidental Soil Compaction Note 1

Compacted Soil Type		Correction Factor (*B*)
Sand	Coarse Sand or Coarser	0.9
	Loamy Coarse Sand	
	Sand	
	Loamy Sand	
Loam	Sandy Loam	0.4
	Loam	
	Silt Loam	
	Sandy Clay Loam	
Clay	Clay Loam	0.2
	Silty Clay Loam	
	Sandy Clay	
	Silty Clay	
	Clay	

Example 3.

(1) Calculate the static infiltration rate (F_{static}) where soil compaction mitigation is not performed. Observations from the test pit indicate that the soil texture with the lowest permeability within 5 feet below the native soil interface is sandy loam.

Solution 3:

(1) $F_{static} = T_L * B$

Where:

T_L = Lowest textural infiltration rate (Table 2) within 5 feet below the native soil interface

B = the correction factor from Table 4

(2) F_{static} = 0.5 in/hr (Table 2 for sandy loam) * 0.4 (Table 4 correction factor for sandy loam)

F_{static} = 0.2 in/hr

Note that if a vegetated swale is proposed, a dynamic infiltration rate is used.

$F_{dynamic} = F_{static} * 0.5$

Step D – Soil and Site Evaluation Report

Include the site information required in Steps B and C in the Soil and Site Evaluation Report. Complete the single report prior to the *construction plan* submittal for regulatory approval. Include the following in the report:

(1) The date the information was collected.

(2) A legible site plan/map that is presented on paper that is no less than 8 ½ X 11 inches in size and:

(a) Is drawn to scale,

(b) Includes a site location map,

(c) Include a north arrow,

(d) Includes a permanent vertical and horizontal reference point,

(e) Illustrates the entire development site,

(f) Shows all areas of planned filling and/or cutting if known,

(g) Shows the percent and direction of land slope for the site or contour lines,

(h) Highlights areas with slopes over 20%,

(i) Shows all floodplain information (elevations and locations) that is pertinent to the site,

(j) Shows the locations of the soil borings and test pits,

(k) Shows the location by site grid and elevations of existing surface and bottom of all test pits/borings included in the report,

(l) Shows location of wetlands within the entire development site as field delineated and surveyed,

(m) Shows location of private wells within 100 feet of the development site, and public wells within 400 feet of the development site, and

(n) Shows location of karst features within 1,000 feet downgradient and 100 feet upgradient of the development site.

Write soil profile descriptions in accordance with the descriptive procedures, terminology and interpretations found in the Field Book for Describing and Sampling Soils, USDA, NRCS (latest edition). Thaw frozen soil material prior to conducting evaluations for soil color, texture, structure and consistency. In addition to the data determined in Steps B and C, include the following information for each soil horizon or layer of the soil profiles:

(1) Thickness, in inches or decimal feet,

(2) Munsell soil color notation,

(3) Soil mottle or redoximorphic feature color, abundance, size and contrast,

(4) USDA soil textural class with rock fragment modifiers,

(5) Soil structure, grade size and shape,

(6) Soil consistence, root abundance and size,

(7) Soil horizon boundary, distinctness and topography,

(8) Occurrence of saturated soil, groundwater, bedrock or disturbed soil,

(9) Bedrock type, weather-fractured or unfractured, and elevation,

(10) Proposed native soil interface elevation, and

(11) Seasonal and current groundwater elevations.

QUALIFICATIONS

Site Evaluation

Complete Steps A and B by a Licensed Professional with experience in soil investigations, interpretation, and classification acceptable to the authority having jurisdiction.

Soil Evaluation

Complete Step C by a Licensed Professional Soil Scientist, or Licensed Professional Geologist as licensed by the Wisconsin Department of Safety and Professional Services (DSPS) with experience in soil investigations, interpretation, and classification or other licensed professional with 5 years of experience acceptable to the authority having jurisdiction until December 31, 2022.

After January 1, 2023 complete Step C by a Licensed Professional Soil Scientist or Licensed Professional Geologist as licensed by the DSPS.

CONSIDERATIONS

Additional recommendations relating to design that may enhance the use of, or avoid problems with this practice but are not required to insure its function are as follows:

(1) As part of the permitting process, the development site should be checked to determine the potential for *cultural resources*. If cultural resources are known or suspected to be on site, include their location on relevant permit applications.

(2) If a site is suspected of having contaminated soil or other materials from its prior land use, historic fill or other reason, then an evaluation to characterize the potential contamination may be warranted (an Environmental Site Assessment may be justified). New fill should be evaluated for contamination before it is brought to a new site. DNR guidance publications WA-1820 “Waste Soil Determinations and Identifying Clean Soil” (http://dnr.wi.gov/news/input/Guidance.html) and RR-060 “Management of Contaminated Soils and Other Solid Wastes” (http://dnr.wi.gov/files/PDF/pubs/rr/RR060.pdf) were developed to assist generators, regulators and property owners to manage waste properly.

(3) The permitting process requirements for development sites vary across the state and may also vary within a municipality depending on the number of lots being developed. The timing of Steps A, B, and C may need to be adjusted for the type of approval process.

(4) Be aware that any activity that will result in a discharge of fill material to a wetland will require a permit under s. 381.36 Wis. Stats. Wetlands are defined in s 23.32 Wis. States and Ch. NR 103, Wis. Adm. Code.

(5) Resources available for completing Steps A and C:

(a) USDA-NRCS Web Soil Survey, websoilsurvey.sc.egov.usda.gov/

(b) Sites listed in the Wisconsin Remediation and Redevelopment Database (WRRD), including GIS tool, http://dnr.wi.gov/topic/Brownfields/WRRD.html

(c) Floodplain areas as regulated under s. 87.30, Wis. Stats. and chs. NR 30, 31, and 116, Wis. Adm. Code.

(d) NRCS Climate Analysis for Wetlands Tables (WETS Tables, see Attachment 1), https://www.wcc.nrcs.usda.gov/climate/navigate_wets.html

(e) Endangered species habitat as shown on National Heritage Inventory County maps, http://dnr.wi.gov/topic/nhi.

(f) Access points and road setbacks as determined by county or municipal zoning plans.

(g) Existing reports concerning the groundwater and bedrock. Examples include: Publications from USGS, NRCS, Regional Planning Commissions, WDNR, DATCP, WisDOT, UW system or WGNHS.

(h) The Drinking Water and Groundwater pages of the WDNR http://dnr.wi.gov/topic/DrinkingWater/

(i) The Wisconsin Grain Size Database http://wgnhs.uwex.edu/maps/data

(j) WDNR Surface Water Data Viewer http://dnr.wi.gov/topic/surfacewater/swdv/

(k) Occupational Safety and Health Administration www.osha.gov

(l) WDNR's Process to Assess and Model Grass Swales guidance. Steps for "modified" Double Ring infiltrometer test are given within this guidance. http://dnr.wi.gov/topic/stormwater/standards/ms4_modeling.html

(6) If a karst feature is located within the site, a Karst Inventory Form from the Wisconsin Geological and Natural History Survey should be filled out (https://wgnhs.uwex.edu/water-environment/karst-sinkholes/).

(7) Groundwater monitoring wells, constructed as per ch. NR 141, Wis. Adm. Code, can be used to determine the *groundwater level*. GeoProbes may be used for groundwater levels, provided that groundwater levels have reached a steady state condition. Large sites considered for infiltration basins may need to be evaluated for the direction of groundwater flow.

(8) Consider conducting a groundwater mounding analysis to verify that the *highest anticipated groundwater level* does not approach the native soil interface. The infiltration rate into saturated soil in this case may be at or near zero. This standard requires that limiting layers within 5 feet below the native soil interface of an infiltration device be considered in the design infiltration rate. It is also possible for a limiting layer more than 5 feet below the native soil interface to affect an infiltration device where lateral movement is limited. Increased mounding height, and therefore the potential for increased infiltration device drawdown time, are more likely to occur under the following conditions: shallow depth to groundwater or limiting layer, increased infiltration device size, decreased device length/width ratio, the presence of low-hydraulic conductivity material, thin aquifer thickness, and shallow water table gradient. It is also appropriate to conduct a mounding analysis in locations where mounding may impact basements or adjacent property. Refer to http://dnr.wi.gov/topic/stormwater/standards/gw_mounding.html for mounding calculation guidance.

(9) Ch. NR 151, Wis. Adm. Code provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.

(10) One or more areas within a development site may be selected for infiltration. A development site with many areas suitable for infiltration is a good candidate for a dispersed approach to infiltration. It may be beneficial to contrast regional devices with onsite devices for sites that receive runoff from one lot or a single source area within a lot, such as rooftop or parking lot.

(11) Consider conducting a soil evaluation to a depth of 15 feet below the existing grade as standard protocol, unless bedrock or groundwater is reached, and deeper if this area will be 'cut,' or lowered, from existing grade

(12) In some situations, adding fill to a location to increase the separation distance between the proposed bottom of an infiltration device and a limiting layer may make a location suitable for infiltration.

(13) The authority having jurisdiction will decide if a proposed alternative infiltration test method is acceptable for new devices and existing swales. Discuss the proposed plan with the authority before detail design.

(14) The Modified Philip Dunne infiltration test is suitable for assessment of required maintenance because accumulation of fine particles limit the infiltration rate in these practices.

(15) Devices located on or near final slopes of ≥20% may be unstable. Consider a slope stability calculation.

(16) No construction sediment should enter the infiltration device. This includes sediment from site grading as well as construction activities. Avoid stockpiling soils and vehicle travel on the infiltration area. If possible, delineate and protect from compaction areas selected for infiltration during grading and construction. This will help to preserve the infiltration rate and extend the life of the device. Where compaction occurs, follow mitigation requirements as outlined in design technical standards.

(17) *Class V injection wells* are not addressed in this document; see http://dnr.wi.gov/topic/wells/uiw.html for details on these types of wells.

(18) In projects which involve piping of storm water, consult plumbing code in ch. SPS 382, Wis. Adm. Code.

(19) Storm water infiltration devices may fail prematurely if there is:

(a) An inaccurate estimation of the design infiltration rate,

(b) An inaccurate estimation of the seasonal high water table or bedrock,

(c) Excessive compacting or sediment loading during construction, or

(d) No pretreatment for post-development runoff and lack of maintenance.

(20) Consider vegetation species and root depth and their potential to enhance the infiltration rate.

REFERENCES

Ahmed F., and J.S. Gulliver. (2010). Manual for the Modified Philip-Dunne (MPD) Infiltrometer. St. Anthony Falls Laboratory (http://www.safl.umn.edu).

Ahmed, F., J.S. Gulliver, and J.L. Nieber. (2015). Field infiltration measurements in grassed roadside drainage ditches: Spatial and temporal variability. *Journal of Hydrology*, 530:604-611.

ASTM D 3385 – 88, 1988. Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometers.

Ch. NR 30, Wis. Adm. Code

Ch. NR 31, Wis. Adm. Code

Ch. NR 116, Wis. Adm. Code

Ch. NR 103, Wis. Adm. Code

Ch. NR 141, Wis. Adm. Code

Ch. NR 151, Wis. Adm. Code

Ch. NR 811, Wis. Adm. Code (line 71)

Ch. NR 812, Wis. Adm. Code (line 71)

Ch. NR 815, Wis. Adm. Code (line 552)

Ch. SPS 382, Wis. Adm. Code Design, Construction, Installation, Supervision, Maintenance and Inspection of Plumbing.

Clapp, R.W. and G.M., Hornberger. 1978. Empirical equations for some hydraulic properties. Water Resources Research 14:601-604.

Ferguson, B.K., 1994. Storm water Infiltration, CRC Press Inc.

Finnemore, E. J., 1993. Estimation of Ground-Water Mounding Beneath Septic Drain Fields. Groundwater, Vol. 31 No. 6, pp. 884-889.

Finnemore, E.J., 1995. A program to calculate Ground-Water Mound Heights. Groundwater, Vol. 33, No. 1.

Hantush, M. S., 1967. Growth and Decay of Groundwater-Mounds in Response to Uniform Percolation. Water Resources Research, Vol. 3, No. 1, pp. 227-234.

Lowndes, M., 2000. "Infiltration Basins and Trenches" The Wisconsin Storm water Manual, G3691-3.

Munsell Color (Firm), 2010. Munsell soil color charts: with genuine Munsell color chips. Grand Rapids, MI:Munsell Color.

Rawls, W.J., D.L. Brakensiek and K.E. Saxton, 1982. Estimation of Soil Water Properties, Transactions of the American Society of Agricultural Engineers Vol. 25, No. 5 pp. 1316 –1320 and 1328.

Rawls, W.J., Gimenez, and Grossman, R., 1998. Use of Soil Texture, Bulk Density and Slope of Water Retention Curve to Predict Saturated Hydraulic Conductivity, ASAE, Vol. 41(2), pp. 983-988.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and Soil Survey Staff. 2012. Field book for describing and sampling soils, Version 3.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.

Washington State Department of Ecology, 2001. Storm Water Management Manual for Western Washington, Publication Numbers 99-11 through 99-15.

Wisconsin Department of Natural Resources, Memorandum: Process to Assess and Model Grass Swales for ss. NR 151.13(2) and NR 216.07(6), WIs. Adm. Code, November 24, 2010. http://dnr.wi.gov/topic/stormwater/documents/GrassSwales080424.pdf.

DEFINITIONS

Aquiclude: A geological material through which zero water flow occurs.

Aquitard: Compacted layer of clay, silt or rock that attenuates water flow underground.

Bedrock: A consolidated rock, or weathered in place parent material larger than 2 mm in size and greater than 50 percent of the soil profile.

Bioretention systems: An infiltration device consisting of an excavated area that is back-filled with an engineered soil, covered with a mulch layer or erosion control mat and planted with a diversity of woody and herbaceous vegetation. Storm water directed to the device percolates through the engineered soil, where it is treated by a variety of physical, chemical and biological processes before infiltrating into the *native soil* and/or discharges through an underdrain.

Class V injection well: Any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Any infiltration device that has a subsurface pipe distribution system is considered to be an injection well. See ch. NR 815, Wis. Adm. Code or http://dnr.wi.gov/topic/Wells?UIW.html for compliance criteria.

Condition value: A value based on NRCS Climate Analysis for Wetlands Tables (WETS Tables) to denote if the month was dry (1), normal (2), or wet (3) compared to the past 20 years of that same month. Using this data, a month is dry when its total rainfall is less than the 30th percentile, wet when its total rainfall exceeds the 70th percentile, and normal when total rainfall is from the 30th to 70th percentile.

Construction plan: A map and/or plan describing the built-out features of an individual lot.

Coarse sand: Soil material that contains 25% or more very coarse and coarse sand, and <50% any other one grade of sand.

Cultural resources: Historic state resources, including archaeological sites (e.g., Indian mounds, rock art, logging camps), burial mounds, historic structures, and submerged resources.

Design infiltration rate: A velocity (in/hr), based on soil structure and texture, at which precipitation or runoff enters and moves into or through soil. The design rate is used to size an infiltration device or

system. Rates are selected based on soil texture or in-field infiltration rate measurements with appropriate correction factors. See also: static infiltration rate, dynamic infiltration rate.

Development site: The entire area planned for development, irrespective of how much of the site is disturbed at any one time or intended land use. It can be one lot or multiple lots.

Direct conduits to groundwater: Wells, sinkholes, swallets, fractured bedrock at the surface, mine shafts, non-metallic mines, tile inlets discharging to groundwater, quarries, or depressional groundwater recharge areas over shallow fractured bedrock.

Double-Ring Infiltrometer: A device that directly measures infiltration rates into a soil surface. The Double-Ring Infiltrometer requires a fairly large test pit excavated to depth of the proposed infiltration device and preparation of a soil surface representative of the bottom of the infiltration area.

Dynamic infiltration rate: The infiltration rate accounting for flowing water conditions (multiply static infiltration rate by 0.5), typically used for vegetated swales and filter strips.

*Existing grade: S*lope of the site prior to modification.

Geometric mean: The *n* root of the product of *n* values. For example, the geometric mean of 0.5, 0.65, and 0.71 inches/hour is:

$$\sqrt[3]{0.5 \times 0.65 \times 0.71} = \sqrt[3]{0.23075} = 0.61 \text{ inches/hr}$$

High groundwater level: The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Highest anticipated groundwater level: The sum of the calculated mounding effects of the discharge and the seasonal *high groundwater level*.

Hydrologic condition: For the purposes of this standard, a hydrologic condition (H) is based on the NRCS Climate Analysis for Wetlands Tables (WETS Tables) and calculated as follows:

$$H = (C_t \times 3) + (C_{t-1} \times 2) + (C_{t-2})$$

Where:

C_t = Condition value for month *t*

Infiltration areas: Areas within a development site that are suitable for installation of an infiltration device.

Infiltration basin: An open impoundment created either by excavation or embankment with a flat densely vegetated floor. It is situated on permeable soils and temporarily stores and allows a designed runoff volume to infiltrate the soil.

Infiltration device: A structure or mechanism engineered to facilitate the entry and movement of precipitation or runoff into or through the soil. Examples of infiltration devices include irrigation systems, rain gardens, infiltration trenches, bioretention systems, infiltration grassed swales, infiltration basins, subsurface dispersal systems and infiltration trenches.

Infiltration trench: An excavated trench that is usually filled with coarse, granular material in which storm water runoff is collected for temporary storage and infiltration. Other materials such as metal pipes and plastic domes are used to maintain the integrity of the trench.

Karst feature: An area or surficial geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps, or swallets.

Licensed Professional Hydrogeologist: A hydrogeologist licensed by the Wisconsin Department of Safety and Professional Services.

Licensed Professional Soil Scientist: A soil scientist licensed by the Wisconsin Department of Safety and Professional Services.

Limiting layer: A limiting layer can be bedrock, an *aquitard*, *aquiclude* or the seasonal high groundwater

table, but it does not include a perched water layer (water above an aquitard) or soil with redoximorphic features. A clayey soil aquitard may exist within a few feet below grade, but still have a suitable layer for infiltration within 5 feet below the *proposed grade*.

Native soil interface: The surface at which storm water runoff is proposed to infiltrate. This surface is below an engineered soil layer (see Figures 2-4).

OSHA: Occupational Safety and Health Administration, a government agency to assure safe and healthy working conditions for working men and women (www.osha.gov).

Percent fines: Percentage of given sample of soil which passes through a #200 sieve.

Perched conditions: A soil moisture regime where saturated soil (i.e., wet soil) is located above unsaturated soil (i.e., moist soil).

Permeable pavement system: A pavement system that allows movement of storm water through the pavement surface and into a base/subbase reservoir designed to achieve water quality and quantity benefits.

Proposed grade: The proposed final design elevation and grade of the development. This is the top of topsoil, walkways, planting beds, roads, and parking areas.

Rain garden: A shallow, vegetated depression that captures storm water runoff and allows it to infiltrate.

Regional device: An infiltration system that receives and stores storm water runoff from multiple structures. Infiltration basins are the most commonly used regional infiltration devices.

Soil borings: For the purposes of this standard, soil borings are drilled, bored, cored or dug holes in the ground to obtain data from an unmixed soil sample, such as from a hollow stem auger or split spoon sampler. Mixed soil samples, such as those from a power auger, are not acceptable.

Soil compaction: An increase in bulk density of the soil. The more pressure per unit area exerted on soil, the greater the increase in bulk density, which leads to a decrease in infiltration. Also known as “soil structure degradation.”

Soil compaction mitigation: Taking action to decrease bulk density of the soil, which might be accomplished by a combination of mechanical, vegetative and/or chemical means. Example of compaction mitigation include: deep tilling, deep ripping, soil amendment and establishment of deep-rooted vegetation.

Soil parent material: The unconsolidated material, mineral or organic, from which the *solum* develops.

Solum: The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons.

Static infiltration rate: Infiltration rate as measured for standing water.

Subsurface dispersal system: An exfiltration system that is designed to discharge storm water through piping below the ground surface, but above the seasonal high groundwater table (subject to the applicable requirements of ch. NR 815, Wis. Adm. Code).

Test pit: An excavation, typically using a backhoe, to examine soil composition, texture, steady state and seasonal high groundwater levels, and bedrock proximity.

Vegetated swale: A constructed storm water conveyance system designed to achieve water quality and quantity benefits.

Figure 1:

Site Evaluation for Infiltration Flow Chart

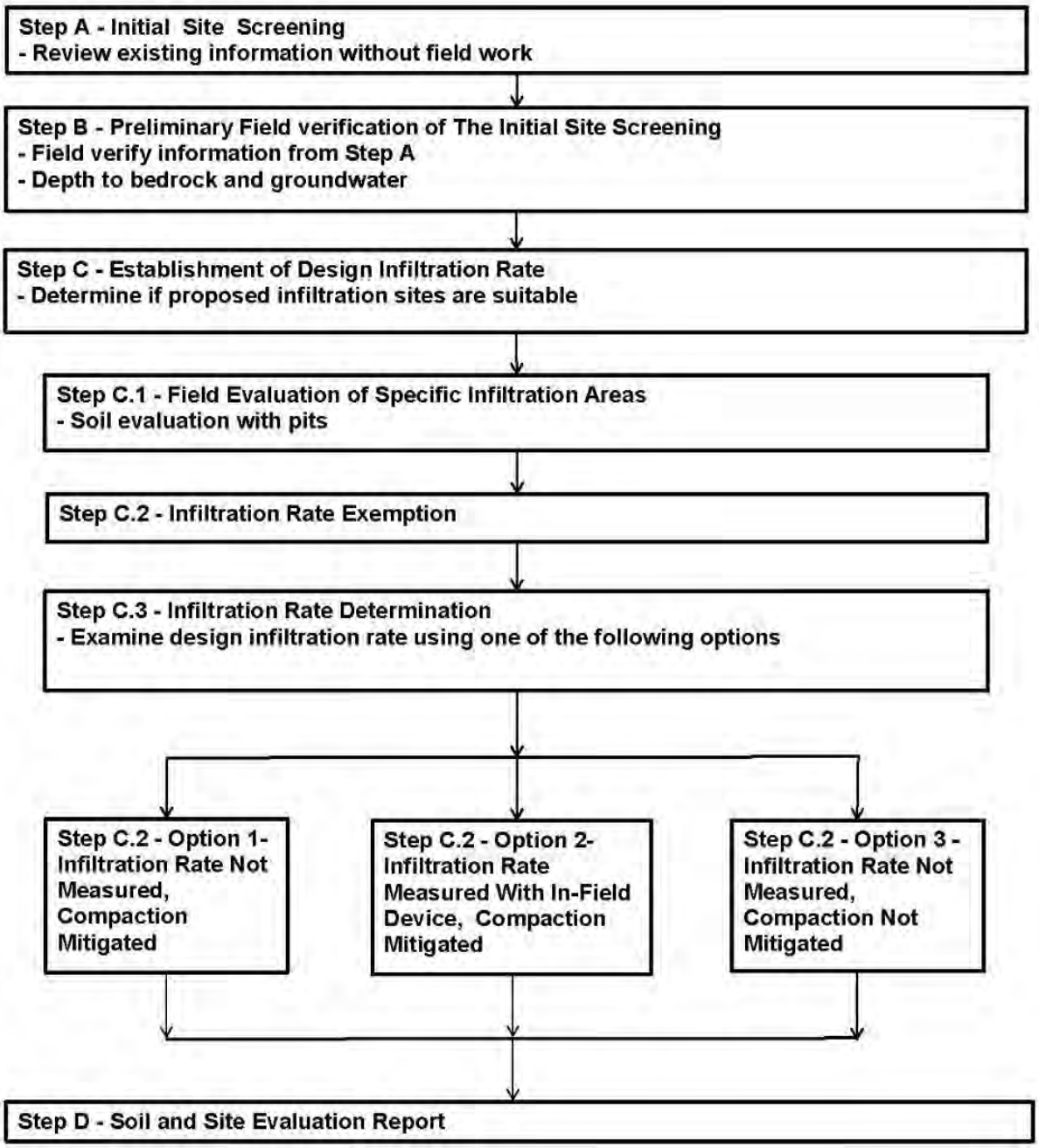
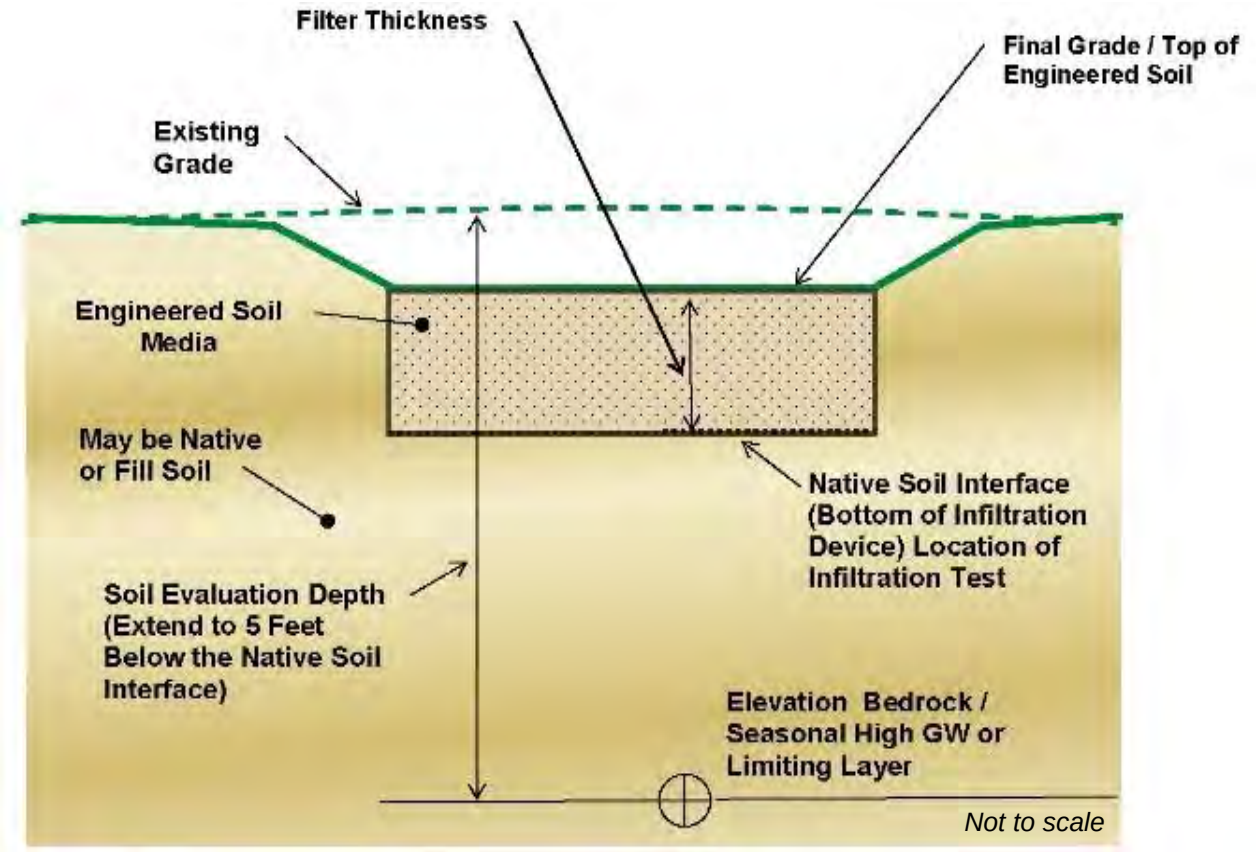


Figure 2:

Example Bioretention Basin Section



Note 1 NR 151 and SPS 382 require a minimum separation distance from the native soil interface and seasonal high groundwater/bedrock.

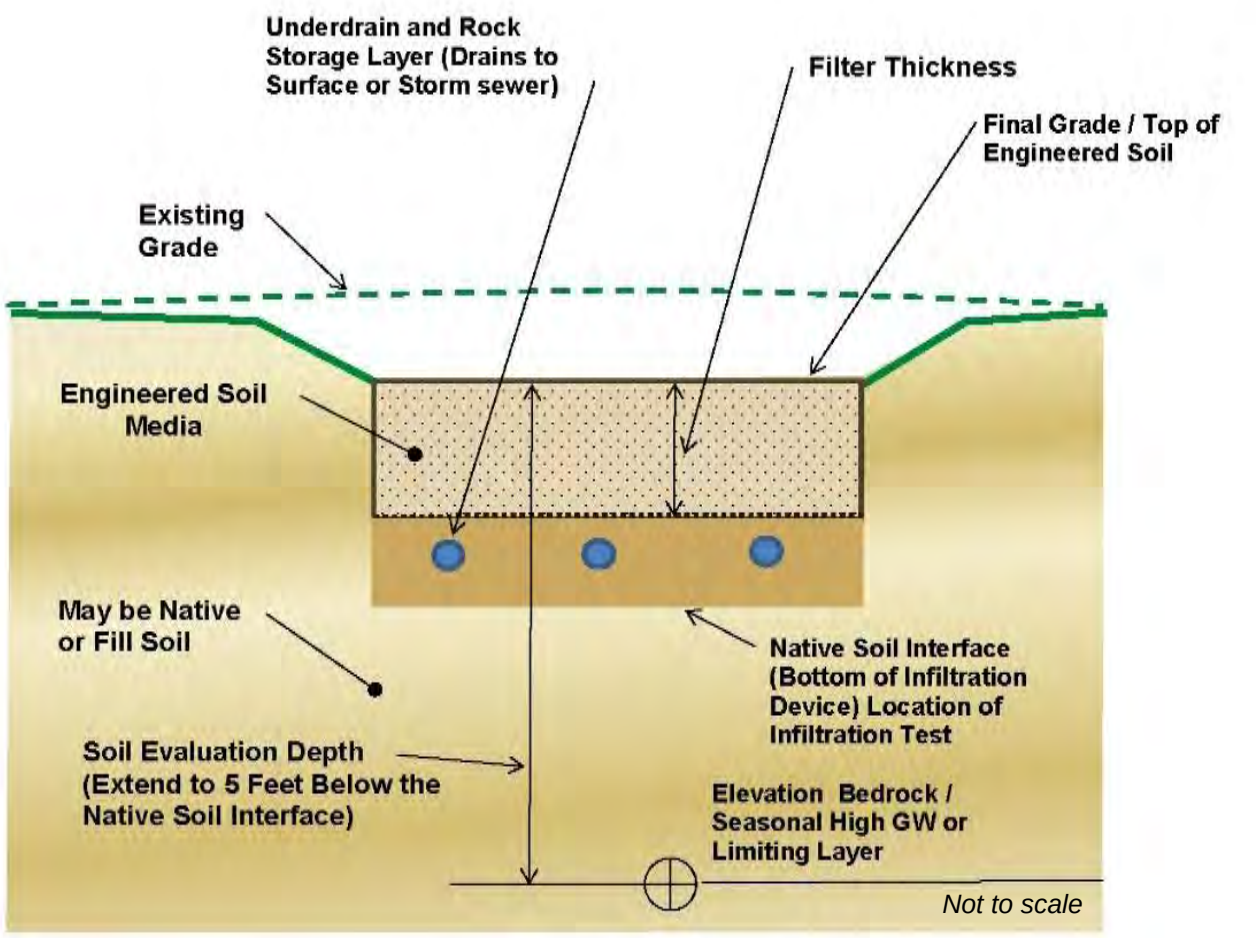
Note 2 Soil evaluation depth shall extend at least 5 feet below the native soil interface, unless seasonal high groundwater or bedrock is reached.

Note 3 Refer to Technical Standard 1004 Bioretention for Infiltration for additional design details.

Note 4 Location of infiltration testing is at the native soil interface.

Figure 3:

Example Bioretention Basin with Underdrain Section



Note 1 NR 151 and SPS 382 require a minimum separation distance from the native soil interface and seasonal high groundwater/bedrock.

Note 2 Soil evaluation depth shall extend at least 5 feet below the native soil interface, unless seasonal high groundwater or bedrock is reached.

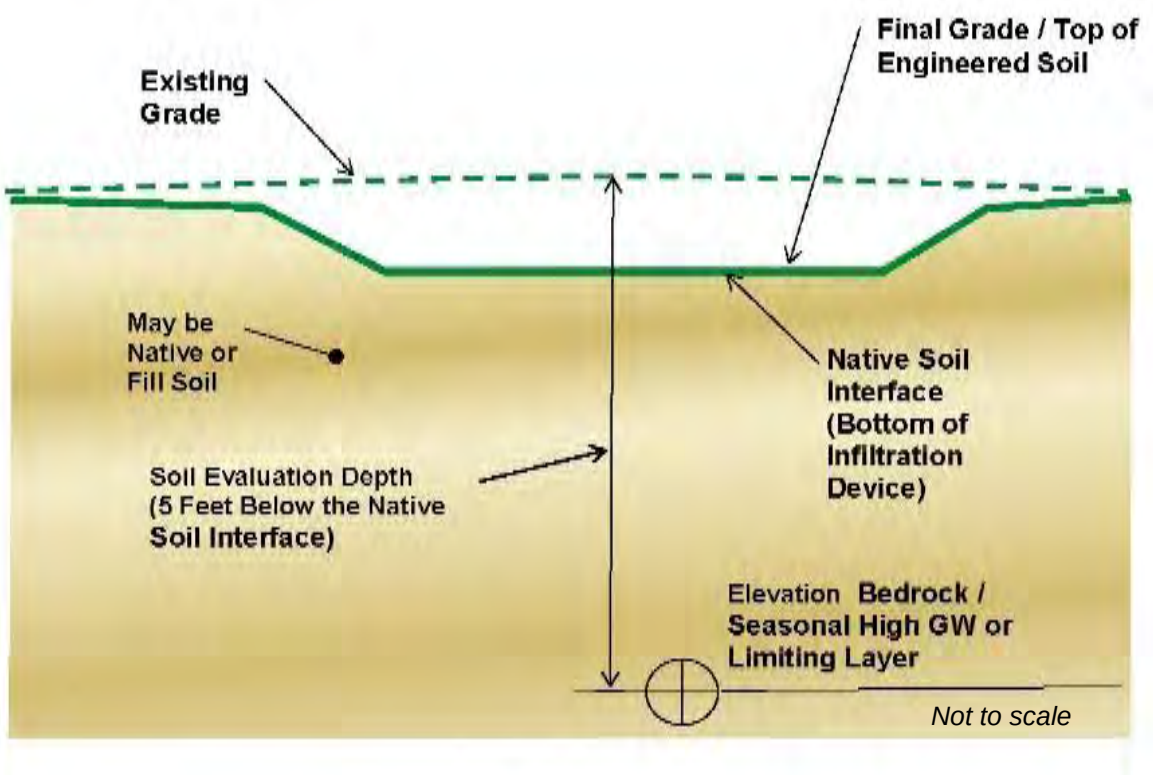
Note 3 Refer to Technical Standard 1004 Bioretention for Infiltration for additional design details.

Note 4 Underdrain and rock storage is not part of filter layer.

Note 5 Location of infiltration testing is at the native soil interface.

Figure 4:

Example Infiltration Basin Section



Note 1 NR 151 and SPS 382 require a minimum separation distance from the native soil interface and seasonal high groundwater/bedrock.

Note 2 Soil evaluation depth shall extend at least 5 feet below the native soil interface, unless seasonal high groundwater or bedrock is reached.

Note 3 Soil amendment, such as compost, may be tilled into the top 1-2 feet of soil.

Note 4 Refer to Technical Standard 1003 Infiltration Basin for additional design details.

Note 5 Location of infiltration testing is at the native soil interface.

Attachment 1:

Hydrologic Condition Form. This optional table may be used to calculate the hydrologic condition to fulfil Step A.(4). See next page for example.

Month	30% chance will have		Average Monthly Rainfall	Current Year Rainfall	Condition Note 1	Condition Value Note 2	Weight Value Note 5	Product of Condition Value and Weight Value
	Less than	More than						
(current)								
(current – 1)								
(current – 2)								
							SUM: Note 5	

Note 1 Condition:
Where "Current Year Rainfall" < "30% Chance Will Have Less Than," Condition is *Dry*
Where "Current Year Rainfall" > "30% Chance Will Have More Than," Condition is *Wet*
Where neither of the above statements (Dry, Wet) is true, Condition is *Normal*

Note 2 Condition Value:
Where Condition is Dry, Condition Value is *1*
Where Condition is Normal, Condition Value is 2
Where Condition is Wet, Condition Value is *3*

Note 3 Given numbers.

Note 4 **Where the sum is 6 to 9**, the hydrologic condition is *drier than normal*. Ensure the infiltration test site is thoroughly pre-wetted prior to conducting infiltration tests, and consider postponing infiltration tests until *normal* or *wetter than norma*l conditions occur. Testing during drier than normal conditions may produce misleading results that may ultimately compromise the integrity of the device.

Where the sum is 10 to 14, the hydrologic condition is *normal*. Infiltration testing during these conditions is recommended.

Where the sum is 15 to 18, the hydrologic condition is *wetter than norma*l. Infiltration testing during these conditions is acceptable.

Hydrologic condition Example. The following information demonstrates how to obtain and use information to calculate hydrologic condition using WETS tables. Refer to https://www.wcc.nrcs.usda.gov/climate/wets_defs.html for more information on WETS tables, examples, and definitions, and to https://www.wcc.nrcs.usda.gov/climate/navigate_wets.html for navigating to climate data, including WETS tables.

This example is for Dane County, Charmany Farm, May 2017, using data from 1997-2017; data from USDA Agricultural Applied Climate Information System (AgACIS) is on the following page.

Month	30% chance will have Note 1		Average Monthly Rainfall Note 1	Current Year Rainfall Note 2	Condition Note 3	Condition Value Note 4	Weight Value Note 5	Product of Condition Value and Weight Value
	Less than	More than						
(current) MAY	3.53	5.42	4.65	3.79	Normal	2	3	6
(current – 1) April	3.02	5.18	4.36	4.21	Normal	2	2	4
(current – 2) March	1.51	3.01	2.49	3.15	Wet	3	1	3
							SUM: Note 6	11 (*Normal*)

`Note 1 Information obtained from WETS tables. Navigate to USDA climate data (see link above), and select (1) Location » nearest the site, (2) Product » WETS, (3) Options » Year Range: past 20 years, Thresholds: 24, 28, 32, (4) View » Go.

Note 2 Information obtained from monthly climate summaries. Navigate to USDA climate data (see link above), and select (1) Location » nearest the site, (2) Product » Monthly summarized data, (3) Options » Year Range: current year; Variable: Precipitation; Summary: Sum; Allowable missing days: 1, (4) View » Go.

Note 3 Condition:
Where "Current Year Rainfall" < "30% Chance Will Have Less Than," Condition is *Dry*
Where "Current Year Rainfall" > "30% Chance Will Have More Than," Condition is *Wet*
Where neither of the above statements (Dry, Wet) is true, Condition is *Normal*

Note 4 Condition Value:
Where Condition is Dry, Condition Value is *1*
Where Condition is Normal, Condition Value is 2
Where Condition is Wet, Condition Value is *3*

Note 5 Given numbers.

Note 6 **Where the sum is 6 to 9**, the hydrologic condition is *drier than normal*. Ensure the infiltration test site is thoroughly pre-wetted prior to conducting infiltration tests, and consider postponing infiltration tests until *normal* or *wetter than normal* conditions occur. Testing during drier than normal conditions may produce misleading results that may ultimately compromise the integrity of the device.

Where the sum is 10 to 14, the hydrologic condition is *normal*. Infiltration testing during these conditions is recommended.

Where the sum is 15 to 18, the hydrologic condition is *wetter than normal*. Infiltration testing during these conditions is acceptable.

(A)

WETS Station: CHARMANY FARM, WI

Requested years: 1997 - 2017

Month	Avg Max Temp	Avg Min Temp	Avg Mean Temp	Avg Precip	30% chance precip less than	30% chance precip more than	Avg number days precip 0.10 or more	Avg Snowfall
Jan	26.9	11.8	19.3	1.49	0.95	1.80	4	9.1
Feb	31.5	15.6	23.6	1.78	1.23	2.11	5	10.5
Mar	43.2	25.2	34.2	2.49	1.51	3.01	5	5.1
Apr	57.4	36.8	47.1	4.36	3.02	5.18	7	1.1
May	68.5	48.3	58.4	4.65	3.53	5.42	9	0.0
Jun	77.8	58.4	68.1	5.36	3.27	6.49	8	-
Jul	82.1	63.0	72.5	4.25	2.75	5.11	6	-
Aug	-	-	-	4.19	2.45	5.09	7	-
Sep	73.6	53.0	63.3	3.29	2.30	3.91	5	-
Oct	60.2	41.0	50.6	2.62	1.70	3.15	5	0.1
Nov	46.8	-	-	2.26	1.30	2.75	4	1.1
Dec	31.5	17.6	24.6	2.28	1.41	2.76	5	11.9
Annual:					35.11	41.63		
Average	-	-	-	-	-	-	-	-
Total	-	-	-	39.01			71	-

GROWING SEASON DATES

Years with missing data:	24 deg = 2	28 deg = 2	32 deg = 2
Years with no occurrence:	24 deg = 0	28 deg = 0	32 deg = 0
Data years used:	24 deg = 19	28 deg = 19	32 deg = 19
Probability	24 F or higher	28 F or higher	32 F or higher
50 percent *	Insufficient data	Insufficient data	Insufficient data
70 percent *	Insufficient data	Insufficient data	Insufficient data

* Percent chance of the growing season occurring between the Beginning and Ending dates.

(B)

Monthly Total Precipitation for CHARMANY FARM, WI

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	2.75	1.61	3.15	4.21	3.79	6.00	10.89	M	M	M	M	M	M
Mean	2.75	1.61	3.15	4.21	3.79	6.00	10.89	M	M	M	M	M	M

(A) WETS table and (B) current year monthly rainfall output from USDA Agricultural Applied Climate Information System (AgACIS) for use in hydrological determination example, previous page. Data used in the hydrologic condition form is outlined in red. Dates are circled in blue.

1002-CPS-23
Division of Industry Services
P. O. Box 2658
Madison, Wisconsin 53701
Scott Walker, Governor
Laura Gutierrez, Secretary

Attachment 2:

SOIL AND SITE EVALUATION – STORM

In accordance with SPS 382.365, 385, Wis. Adm. Code, and WDNR Standard 1002

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent of slope, scale or dimensions, north arrow, and BM referenced to nearest road *Please print all information* Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)]	County Parcel I.D. Reviewed by: Date:

Property Owner	Property Location Govt. Lot ¼ ¼ S T N R E (or) W
Property Owner' Mail Address	Lot # / Block # / Subd. Name or CSM #
City State Zip Code Phone Number	☐ City ☐ Village ☐ Town Nearest Road

Drainage area _____ ☐ sq .ft ☐ acres Test site suitable for (check all that apply): ☐ Site not suitable; ☐ Bioretention; ☐ Subsurface Dispersal System; ☐ Reuse; ☐ Irrigation; ☐ Other _____	Hydraulic Application Test Method ☐ Morphological Evaluation ☐ Double Ring Infiltrometer ☐ Other: (specify) _____	Soil Moisture Date of soil borings: _____ USDA-NRCS WETS Value: ☐ Dry =1; ☐ Normal = 2; ☐ Wet = 3.

☐ #OBS. ☐ Pit ☐ Boring Ground surface elevation. _____ ft. Elevation of limiting factor _____ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr

Comments:

☐ #OBS. ☐ Pit ☐ Boring Ground surface elevation. _____ ft. Elevation of limiting factor _____ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr

Comments:

Name (Please Print) Signature Credential Number

Address Date Evaluation Conducted Telephone Number

☐ #OBS. ☐ Pit ☐ Boring Ground surface elevation. __________ ft. Elevation of limiting factor __________ ft. Page ___ of ____

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr

Comments:

☐ #OBS. ☐ Pit ☐ Boring Ground surface elevation. __________ ft. Elevation of limiting factor __________ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr

Comments:

☐ #OBS. ☐ Pit ☐ Boring Ground surface elevation. __________ ft. Elevation of limiting factor __________ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr

Comments:

☐ #OBS. ☐ Pit ☐ Boring Ground surface elevation. __________ ft. Elevation of limiting factor __________ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App Rate Inches/Hr

Comments:

Overall Site Comments:

Infiltration Basin

(Acre-Feet)
(1003)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

An infiltration basin is defined as an open impoundment (greater than 15 feet wide in its minimum dimension) created either by excavation or embankment with a flat, densely vegetated floor dedicated to the infiltration of runoff through the ground surface.

II. Purpose

The practice may be applied as part of a structural stormwater management practice system to support one or more of the following purposes:

- Reduce stormwater pollutants
- Increase discharge to groundwater
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of runoff.

III. Conditions Where Practice Applies

The infiltration basin practice applies to urban areas where increased pollutant loadings, thermal impacts, or increased runoff volumes are a concern and the area is suitable for infiltration. (See NR 151.12(5) (c) 5 and 6 and WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002).)

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration basins. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Screening criteria located in the WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) shall be followed. In addition, the following site location criteria shall be met.

1. Building location – The basin shall not be *hydraulically connected*[1] to foundations or pavements, or cause negative impacts to structures. These negative impacts could include: water in basements and foundation instability.

2. 20% Slopes - Infiltration shall not cause seepage, contribute to hill slope failure or increase erosion on down gradient slopes. A minimum horizontal setback distance of 200 feet shall be maintained from down gradient slopes greater than 20% unless slope stability calculations demonstrate that the slope is stable under saturated conditions at a shorter distance from the practice. Note: Berms constructed as part of the practice are not included in this separation distance.

B. Design

1. Bypass/Dewatering – The basin shall be designed with a maintenance draw down capability. An example of this device is shown on Figure #3.

   When infiltration cells are used, a *draw down device* shall be provided for each cell.

2. Pretreatment Practices – Space must be allotted for pretreatment prior to infiltration to remove the following percentage of total suspended solids, on an average annual basis, based on the following land uses.

   a. 60% for residential (and associated roads)

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

b. 80% for commercial, industrial, institutional (and associated roads)

3. Infiltration Rates - See WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) for design infiltration rates.

4. Dimensions

   a. Depth – Depth is a function of the maximum draw down time of 24 hours (for the infiltration portion of the practice only), using the design infiltration rate, with a not to exceed depth of 24 inches.

      The maximum depth of 24 inches applies to all infiltration cells within the practice.

   b. *Target Stay-on Depth* – The target stay-on depth shall meet the requirements of NR 151. (See Consideration L.)

   c. Effective Infiltration Area – The maximum depth along with the storage volume of water to be infiltrated can be used to determine the preliminary *effective infiltration area* necessary for the infiltration basin. (See Consideration L.)

   d. Slopes

      1. Longitudinal Slope – If used, the longitudinal slope shall not exceed 1% (0% longitudinal slope is recommended). If any longitudinal slope is specified, "infiltration cells" as described in V.B.4.f. shall be required.

      2. Lateral Slopes in the effective infiltration area shall be 0%.

Example: (This example is a continuation of the 20 acre mixed land use example presented in "Technical Note for Sizing Infiltration Basins and Bioretention Devices to Meet State of Wisconsin Stormwater Infiltration Performance Standards." See Consideration L. for reference.)

This example assumed an average pre-development curve number of 75 for the pre-development soil condition in the drainage basin, sandy loam soils at the infiltration site and a post-development curve number of 70 for the pervious areas in the drainage basin. From that example, the preliminary effective infiltration area is 8,930 square feet or 0.2 acres. Therefore, the storage volume (SV) at a one-foot maximum depth (MD) is 0.2 acre-ft or 8,930 cu. ft.

Calculate the dimensions of the basin. Assume a rectangular basin with a length to width ratio of 3:1
SV=MD * L * W substitute L=3W
SV=MD * $3W^2$.
Solve for W:
8,930 cu. ft. = 1 X $3W^2$ 2,977 = W^2
W = 55 ft
L= 3W so L = 164 ft

If using a longitudinal slope, it is still required that the maximum depth, at any point in the basin, not exceed 24 inches (or in this case 12 inches due to the soil type). This slope results in a 3D triangle of infiltration volume versus the cubic volume created by a basin with a flat floor.

To correct for this and to provide the required infiltration volume, the preliminary effective infiltration area originally calculated must be divided by 0.5. This will correct for the triangle of lost volume created by the sloped floor of the basin, the maximum depth and the water surface.

8,930 sq. ft. / 0.5 = 17,860 sq. ft.
The new W and L are now W = 77ft. and L = 3W = 231ft.

Note: The surface area calculated is the minimum effective infiltration area and does not include slopes or setbacks. Additional site area will be needed to account for berms and slopes.

e. Side Slopes – All side slopes for interior and exterior berms shall have a 4:1 slope (horizontal: vertical) or flatter.

f. Infiltration Cells – To maximize the effective infiltration area utilized and to prevent channelized flow, the effective infiltration area shall be subdivided into multiple smaller "cells" using *level spreaders* (example shown in Figure 1 & 2). These "cells" shall be used if a longitudinal slope is specified or if the length of the flow path exceeds 300 linear feet.

The effective infiltration area shall be divided such that as a downstream cell reaches the depth of its level spreader, the elevation of the water in that cell does not exceed the downstream toe of slope from the next upstream level spreader. The height of any level spreader shall not exceed the maximum ponding depth.

Example (continued)

Given: MD = 12 inches, SA = 17, 860 sq. ft., longitudinal slope = 1%. W = 77 ft. L = 231 ft.

With a length of 231 feet and a slope of 1% we know the basin rises 2.3 feet along its length from the outlet to the toe of the pre-treatment area. Given a 12-inch maximum depth of water in the practice for infiltration, the basin needs to be divided into multiple cells with each cell a maximum 300 feet length or a maximum of 12 inches of depth in each cell.

As this example has a longitudinal slope of 1% the maximum cell is 100 feet in length (100 * 1% = 1 feet which is the maximum depth). Had this basin had no longitudinal slope on the floor, a cell up to 300 feet long could have been utilized.

The first level spreader should be located 100 feet upstream from the outlet structure. This leaves us with 131 feet to the pretreatment area. At 1% slope, the height of the level spreader should be 1.3 feet, which is greater than allowed. So the second level spreader should be 1 foot in height, with the third being 100 more feet upstream with a height of 0.43 feet.

Note: To improve the aesthetics of the basin, the second and third cells may be evened out to two cells of 66 feet each and level spreader heights of 0.66 feet.

5. Basin Inlets and Cell Dividers / Level Spreader – The design shall evenly spread the outflow from the pretreatment device or between cells across the width of the basin. The pretreatment discharge pipes and stone trench shown in Figures 1 & 2 (plan and profile view) provide an example of level spreaders.

6. Basin Outlets – The infiltration basin outlet shall safely convey stormwater

from the basin through all of the following mechanisms. An example of outlet pipes is shown in Figures 3 & 4 (front and side view)

a. Draw Down Device – A means shall be provided to quickly remove standing water from the basins for maintenance and winter diversion.

b. Emergency Spillway – A means shall be provided to release discharge in excess of the infiltration volume safely into the downstream stormwater conveyance system. The spillway shall be designed for a 100 year 24-hour storm event.

c. Freeboard – One foot of freeboard above the flow depth in the spillway shall be provided.

7. Maintenance Access – Provide a 12 foot wide access route, with a 6:1 slope, to the floor of the basin for sediment and debris removal.

8. Embankment Construction – Embankments shall conform with WDNR Conservation Practice Standard Wet Detention Basin (1001). A basin embankment may be regulated as a dam under ch. 31 Stats., and further restricted under ch. NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

C. Construction

1. Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.

2. An assessment of the active erosion in the drainage area to the infiltration basin shall be performed to determine when to bring the infiltration basin on-line. The basin shall be brought on-line when the area draining to the basin has achieved 90% build out of all lots in any of the first 3 years or 75% build out in any subsequent year. By 5 years from the start of construction in the drainage area, all infiltration basins shall be brought on-line. Build out means that the lot has been fully developed and stabilized from erosion. If the infiltration basin area is to also provide peak flow control for the fully built out 5-year, 24-hour event or greater, then a bypass device to divert those flows into the practice will be allowed until the infiltration basin is brought fully on-line. Erosion and sediment control practices shall be implemented for the remaining 10-25% of the undeveloped lots with the goal of preventing any sediment from reaching the infiltration basin.

3. During construction one of the following methods shall be used:

a. No disturbance – The infiltration area shall be fenced off to prevent heavy equipment access during development.

b. Compaction Mitigation – If the active infiltration area is graded the effects of compaction shall be mitigated using the following methods:

(1) Incorporate soil additives consisting of two inches of compost mixed into two inches of topsoil.

(2) The soil mix (V.C.3.b.1) shall be incorporated into the existing soil using a chisel plow or rotary device with the capability of reaching to 12 inches below the existing surface.

(3) The compost component shall meet the following WDNR Specification S100 Compost.

4. The basin shall be constructed to the grades, elevations, and specifications in the plan. After grading and top soiling, the elevation of the basin shall be surveyed for conformance to design specifications.

D. Vegetation Cover

1. Establishment – Cover crops need to be applied in conjunction with the initial seeding of permanent vegetation. When establishing turf type grass, use the criteria contained in the DNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059). Sod shall not be used.

   If turf grass is utilized, the basin cannot be used for recreational purposes due to compaction concerns.

2. Native Seeding – Native vegetation shall be established in conformance with recommendations from a qualified native nursery in the area. If trees are to be used, species shall be selected that will not interfere with the function of the basin, or cause maintenance problems. Section IX References, lists sources that provide suggested seed mixtures.

   Native (prairie) seeding shall be completed in the fall (as dormant seeding prior to first snowfall) or in the spring (between May 1 and June 20), or plugs shall be used.

3. Fertilizer – Soil testing shall be used to determine proper applications for nutrients and liming. Fertilizer application shall conform to the criteria located in NRCS Conservation Practice Technical Standard, Critical Area Planting (342) or WDNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059).

4. Mulch – Mulch shall conform to the criteria located in WDNR Conservation Practice Standard Mulching for Construction Sites (1058).

VI. Considerations

A. Pretreatment Options - See WDNR Conservation Practice Technical Standards Wet Detention Basin (1001), Ditch Check (1062), and Vegetated Infiltration Swale (1005) for guidance. Estimates of pollutant reduction by proprietary devices should be based on monitoring using the EPA Environmental Testing Verification protocol.

B. Well Locations - If well locations in relation to the basin are a concern, the site should be evaluated for the direction of ground water flow.

C. Multiple Uses - Basins can be used for both infiltration and peak shaving as shown on Figure 1 and 2. However, another option is to include a *flow splitter* or diversion prior to pretreatment. By limiting the inflow into a BMP, a flow splitter can enhance the longevity of the BMP by reducing the volumetric rate of treatment, erosion or scour, and vegetation damage. Flow splitters need to be designed to address site conditions and flows.

D. Drainage Area Size – The drainage area should be between 5 and 50 acres. If the drainage area is more than 50 acres, multiple basins should be provided.

E. Regulatory Caps - Ch. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.

F. Native Vegetation - The use of prairie grass or other deep-rooted plants is encouraged because these plants can increase the infiltration capacity of the basin. Dense vegetation will also reduce soil erosion on the basin floor.

G. Level Spreader - Since it is often difficult to construct a level spreader, a combination of a berm and stone trench is recommended. Other methods to disperse flows include irrigation practices such as ridge and furrow irrigation systems. Refer to American Society of Agricultural Engineering Standards for guidelines on construction of irrigation dispersal systems.

H. Tracked vehicles should be used during construction to lessen compaction.

I. The final grading should be conducted by the landscape contractor so that the drainage area can be stabilized first.

J. Snow should not be placed in the effective infiltration area. It may be placed on the

pretreatment area or areas draining into the pretreatment area.

K. Internally Drained Watersheds – There are unique considerations for watersheds that are closed basins which are internally drained. Infiltration basins constructed in internally drained watersheds shall meet the requirements of NR 151 and this standard. Storms with a recurrence interval greater than a 2-year 24-hour storm must also be considered in the design and engineering judgment may determine that criteria such as draw down time and maximum depth may be exceeded for these larger storms. Infiltration basins in internally drained watershed may have different needs for plants, pretreatment, safety, maintenance or other characteristic that must be considered during design and construction.

L. The DNR has created a technical note that may be used to size infiltration basins. The "Technical Note for Sizing Infiltration Basins and Bioretention Devices To Meet State Of Wisconsin Stormwater Infiltration Performance Standards" contains an approved method to determine the target stay-on depth and 12 design charts that can be used to size these basins for a variety of conditions. In addition, the technical note contains a reference to an approved infiltration model (RECARGA) that can also be used to determine effective infiltration area requirements. Other models may be used if approved. The Technical Note can be accessed at: http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post

VII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

VIII. Operations and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, intended life of the components, safety requirements, and the criteria for the design. There may be state and local laws that require adequate O&M of public and private facilities and the identification of responsible parties. At a minimum, the plan shall include:

A. Inspection Intervals – At minimum, quarterly inspections shall occur. Inspection shall include spreader and overflow spillway for indication of failure. Note the condition of vegetation as part of inspection. If standing water is observed over 50% of the basin floor 3 days after rainfall, the basin is clogged and measures should be undertaken to unclog it. (See section VIII.C).

B. Native Vegetation - Maintenance of Native Vegetation – Mowing (cutting) or burning shall be used to maintain the vegetation.

1. Establishment - The first mowing of newly planted seed shall occur once it reaches a height of 10 to 12 inches.
2. Mowing
   a. Mowing shall reduce the height of plants to 5 to 6 inches.
   b. After establishment, if burning cannot be accommodated, mowing shall occur once in the fall (after November 1). The area shall be mowed to a height of 5 to 6 inches.
3. Burning
   a. Routine Maintenance - Beginning the second year, burning shall occur in the early spring (prior to May 1st) or in the late fall (after November 1st)
   b. Burning shall be done two consecutive years and then up to three years can pass before the next burning.
   c. Under no circumstances shall burning occur every other year.

C. Restoration Procedures – these include removing the top 2 to 3 inches, chisel plowing and adding topsoil and compost. If deep tilling is used, the basin shall be drained and the soils dried to a depth of 8 inches. If the basin was planted in turf grass and clogging again occurs after these restoration procedures have been used, the owner /operator shall replant with prairie

style vegetation using the soil preparation method recommended by the native nursery in the area.

D. Trash shall be removed as quickly as possible once observed.

E. Pretreatment – If wet detention is used, see WDNR Conservation Practice Technical Standard Wet Detention Basin (1001) for operations and maintenance requirements.

F. Winter Maintenance – All draw down devices in the pond shall be opened during winter months to discourage infiltration of runoff water containing high levels of chlorides. If this practice is an enclosed basin, the use of chloride deicers shall be limited in the area draining to the basin to reduce the chance of exceeding the limits in ch. NR 140.

IX. References

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3-85 – 3-91. Minneapolis.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications for Highway and Structure Construction. Section 630, Seeding.

X. Definitions

Draw down device (V.B.1): A draw down device can consist of any device that allows for the dewatering of the infiltration basin or the infiltration cells down to the ground elevation. Examples include removable weir plates (shown in Figure 3), pipes with valves, weirs with removable stop logs.

Effective infiltration area (V.B.4.c.): An effective infiltration area means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.

Flow Splitter (VI.C): A flow splitter is a device used to direct a fraction of runoff into the BMP facility while bypassing excess flows from larger storm events.

Hydraulically connected (V.A.1.): Two entities are said to be hydraulically connected if a surface or subsurface conduit exists between the two such that water is transmitted from one entity to the other.

Level spreader (V.B.4.f): A level spreader is a device used to disperse concentrated flows back over a wide area, dissipating the energy of the runoff and promoting sheet flow. Common types of level spreaders include vegetated, earthen or stone berms, weirs and stone trenches.

Target Stay-on Depth (IV.B.4.b.): The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal.

Technical Note August 2015

For Sizing Infiltration Basins and Bioretention Devices to meet State of Wisconsin Stormwater Infiltration Performance Standards

Introduction

This technical note includes several tools approved by the Wisconsin Department of Natural Resources to design infiltration basins and bioretention devices capable of meeting the state of Wisconsin stormwater infiltration performance standards contained in ss. NR 151.12(5)(c) and NR 151.24(5), Wis. Adm. Code. The purpose of this technical note is to describe where these tools can be found and how they are used. The Department of Natural Resources recognizes the existence of other models that estimate stormwater infiltration. These other models and tools may also be used to meet the state of Wisconsin infiltration performance standards if approved by the Department of Natural Resources.

The tools included in this technical note are:

- a chart for determining target stay-on depth;
- RECARGA, an infiltration model that can be used to determine the required effective infiltration area for infiltration basins and bioretention devices;
- a set of design charts, developed using RECARGA, which can be used to determine the required effective infiltration area for infiltration basins.

The University of Wisconsin-Madison Department of Civil Engineering developed the RECARGA model. The University of Wisconsin and Department of Natural Resources staff developed the other design charts included in this technical note.

To design an infiltration basin or bioretention device, one or more conservation practice standards must be used in conjunction with this technical note. These conservation practice standards include other important requirements relating to siting, dimensions, construction, operation and maintenance of infiltration practices. The applicable conservation practice standards include:

- DNR Conservation Practice Standard 1002, Site Evaluation for Stormwater Infiltration [PDF 183KB]
- DNR Conservation Practice Standard 1003, Infiltration Basin [ZIP 901KB]
- DNR Conservation Practice Standard 1004, Bioretention for Infiltration [PDF]
- Wisconsin Department of Natural Resources Specification S100, Compost [PDF 90KB]

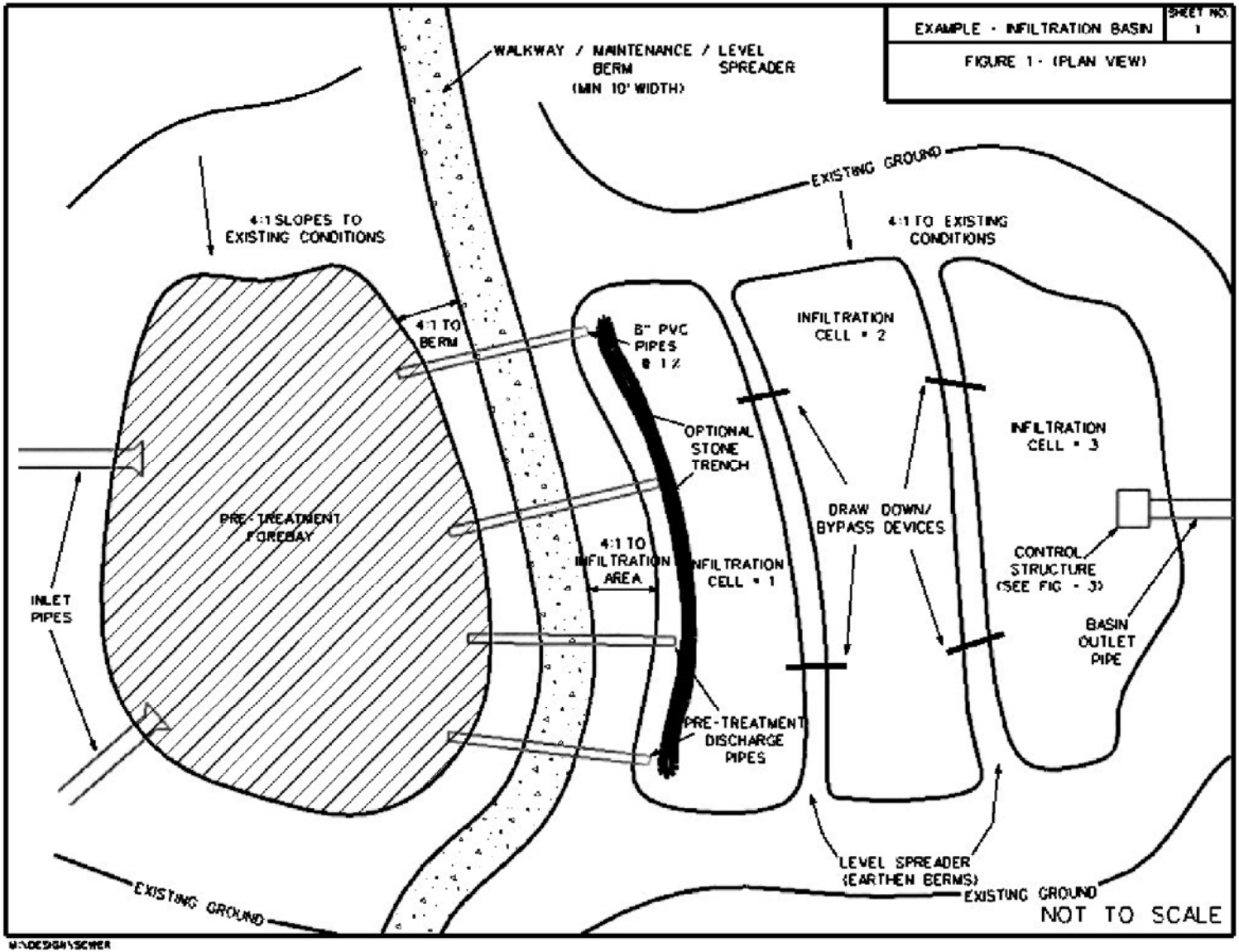
The designer will use Parts 2 and 3 of this technical note and the DNR Conservation Practice Standard 1003 to determine the required effective infiltration area for an infiltration basin. Part 5 of this technical note may also be used. To determine the effective infiltration area for a bioretention device, the designer will use Parts 2, 4 and 5 of this technical note in conjunction with DNR Conservation Practice Standard 1004. In addition, DNR Conservation Practice Standards 1002 and S100 apply to both devices.

This technical note also cross-references several digital files that can be used to size infiltration basins and bioretention devices. A list of these digital files is shown in Table 1. Note that some of the digital files will be used in designing both infiltration basins and bioretention devices while others are specific to only one of these practices.

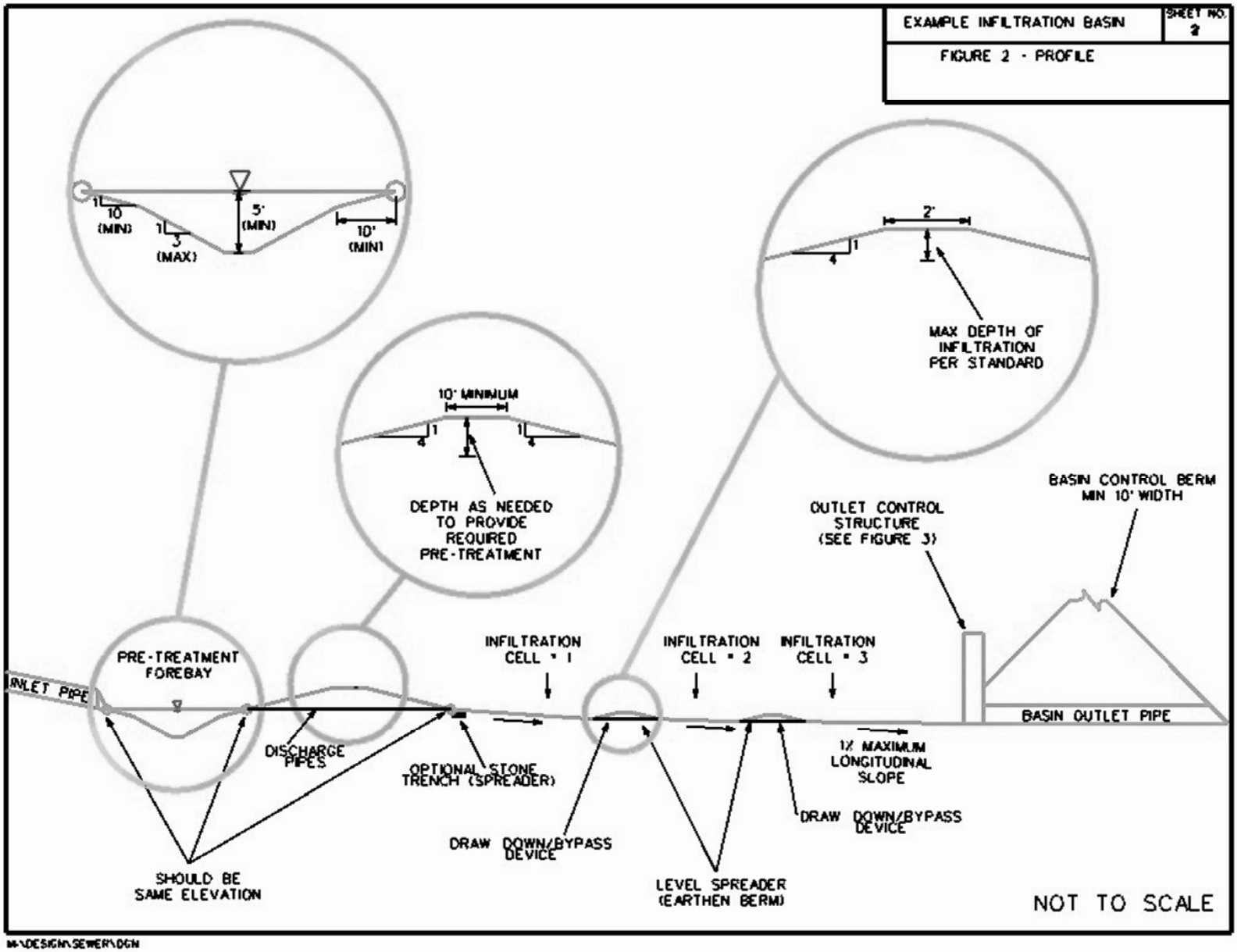
File Content	Applicability
Technical note text [PDF 298KB]	Infiltration Basins, Bioretention Devices
Target Stay-on Depth [Excel 22KB]	Infiltration Basins, Bioretention Devices
Infiltration Basin Nomographs • Set of 12 [Zip 150KB], or • download the 12 graphs separately:	

Pond Depth	silt loam	loam	sand loam	loamy sand	sand	
3"	[Excel 55KB]					Infiltration Basins
6"		[Excel 55KB]	[Excel 55KB]	[Excel 55KB]	[Excel 55KB]	
12"			[Excel 55KB]	[Excel 55KB]	[Excel 55KB]	
18"				[Excel, 55KB]	[Excel 54KB]	
24"				[Excel 54KB]	[Excel 54KB]	

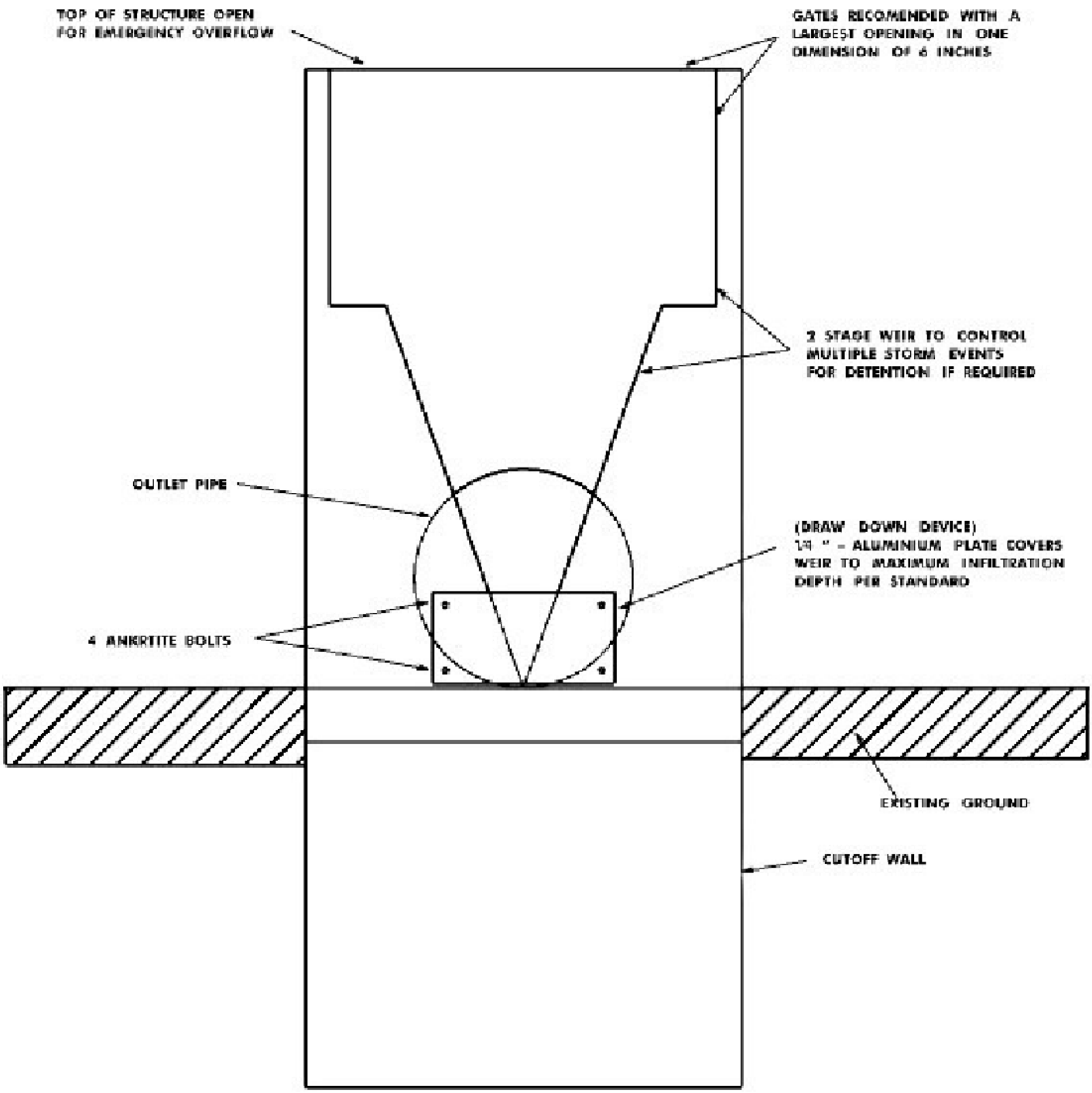
RECARGA v. 2.3 * [ZIP 20MB] - **READ ME FIRST** [PDF]	Infiltration Basins, Bioretention Devices
RECARGA User's Manual v. 2.3 [PDF]	Infiltration Basins, Bioretention Devices



M:\DESIGN\SCHEER


EXAMPLE INFILTRATION BASIN
SHEET NO. 2
FIGURE 2 - PROFILE
10' (MIN)
3 (MAX)
5' (MIN)
10' (MIN)
2'
MAX DEPTH OF INFILTRATION PER STANDARD
10' MINIMUM
DEPTH AS NEEDED TO PROVIDE REQUIRED PRE-TREATMENT
BASIN CONTROL BERM MIN 10' WIDTH
OUTLET CONTROL STRUCTURE (SEE FIGURE 3)
PRE-TREATMENT FOREBAY
INLET PIPE
INFILTRATION CELL # 1
INFILTRATION CELL # 2
INFILTRATION CELL # 3
BASIN OUTLET PIPE
DISCHARGE PIPES
OPTIONAL STONE TRENCH (SPREADER)
1% MAXIMUM LONGITUDINAL SLOPE
DRAW DOWN/BYPASS DEVICE
DRAW DOWN/BYPASS DEVICE
SHOULD BE SAME ELEVATION
LEVEL SPREADER (EARTHEN BERM)
NOT TO SCALE
M:\DESIGN\SEWER\DGN

EXAMPLE INFILTRATION BASIN OUTLET STRUCTURE	SHEET NO 3
FIGURE 3 - FRONT VEIW	



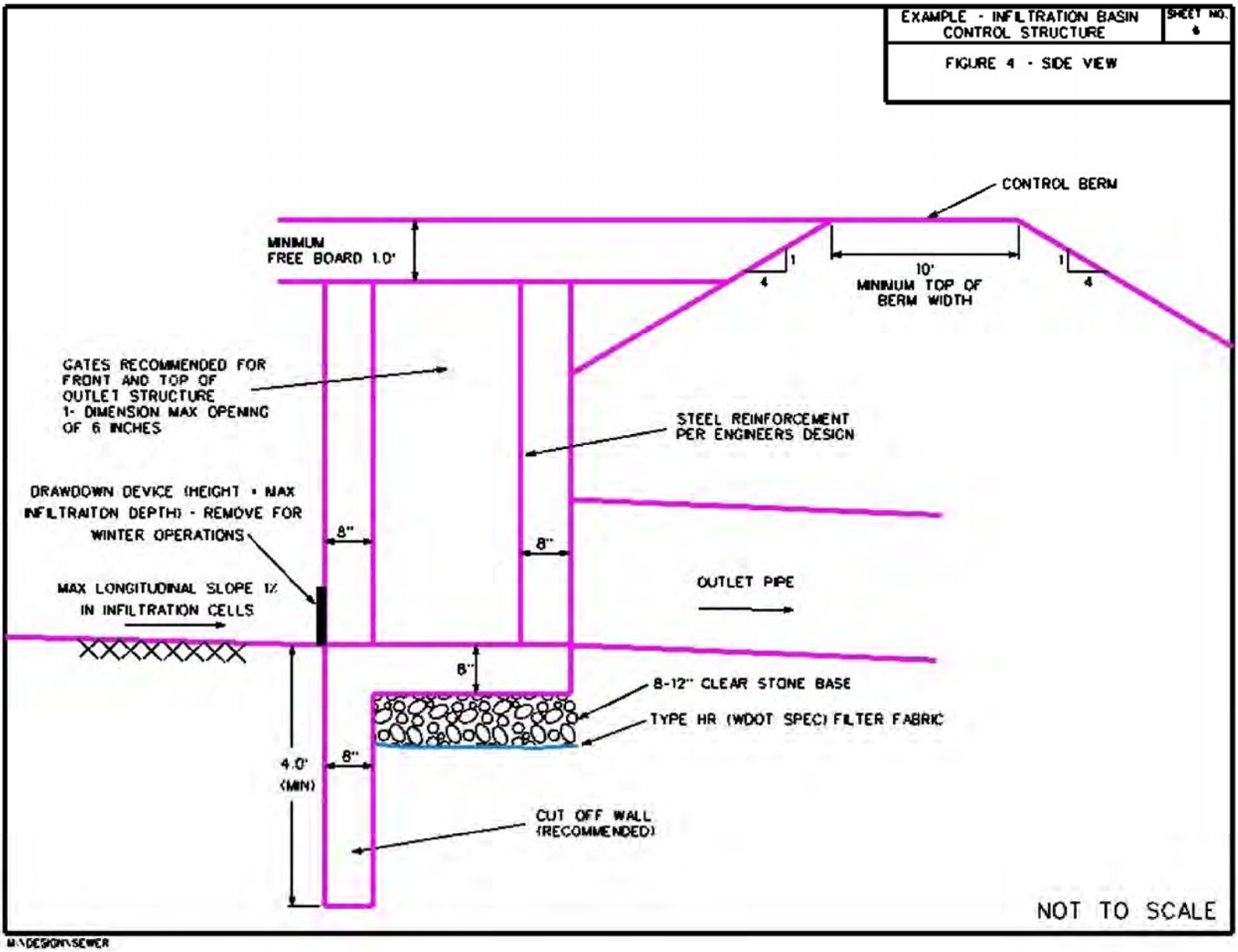
NOT TO SCALE

M:\DESIGN\SEWER

EXAMPLE - INFILTRATION BASIN CONTROL STRUCTURE

SHEET NO. 6

FIGURE 4 - SIDE VIEW

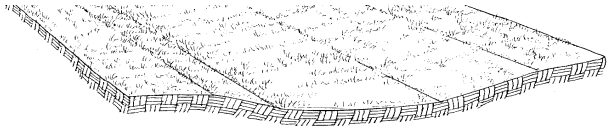


M:\DESIGN\SEWER

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
CONSERVATION PRACTICE STANDARD
VEGETATED SWALE
CODE 1005

I. DEFINITION

Vegetated swales are constructed storm water conveyance systems designed to achieve water quality and quantity benefits.



II. PURPOSES

The purposes of this practice are to filter and trap pollutants, improve water quality, attenuate peak flow, and/or promote infiltration while limiting groundwater contamination.

III. CONDITIONS WHERE PRACTICE APPLIES

This standard applies to new vegetated swales. Refer to WDNR Guidance[1] for evaluation of existing swale systems. Swales are intended to treat relatively flat drainage areas with contributory areas generally less than 5 acres. Swales are not suitable in areas of steep longitudinal slope or areas with erodible soils without measures to reduce flow velocities and protect against erosion.

Vegetated swales are best suited for use:

A. In low- to medium-density residential areas with 7 units per acre or fewer;

B. In non-residential areas where infiltration of runoff is allowable under ch. NR 151, Wis. Adm. Code;

C. Along roads and drainage easements;

D. In meeting the swale treatment option in chs. NR 151 (subchapter IV, Transportation Facility Performance Standards), Wis. Adm. Code;

E. With other control practices, such as filter strips, wet detention ponds, and bioretention devices.

IV. FEDERAL, STATE, AND LOCAL LAWS

Users of this standard shall be aware of potentially applicable Federal, State, and local laws, rules, regulations, or permit requirements governing vegetated swales. This standard does not contain the text of Federal, State, or local laws.

---

[1] *See most current modeling guidance for municipalities at http://dnr.wi.gov/topic/stormwater/standards/ms4_modeling.html.*

V. CRITERIA

Vegetated swales may be used independently or as a component of a storm water conveyance/storage system, and in either case shall be designed in accordance with the following:

A. **Site Assessment**

1. To receive credit toward meeting NR 151 performance standards or Total Maximum Daily Load (TMDL) allocations, conduct and document a site assessment in accordance with WDNR Conservation Practice Standard "Site Evaluation for Stormwater Infiltration" (1002).
2. For transportation projects (III.D) not required to meet NR 151 performance standards or TMDL allocations, conduct a site assessment of sufficient detail to establish site-specific design factors, including but not limited to soil types and depth to seasonal high groundwater.

B. **Site Layout –** In the site layout, identify vegetated swale location in relation to and in consideration of buildings, water supply wells, karst geology, lot boundaries, site topography, drainage patterns, and existing or proposed public rights-of-way, easements, as well as other environmental and regulatory items of concern. Chapter NR 151 Wis. Adm. Code specifies required minimum separation distances.

1. If a swale accepts runoff from more than one property, locate the swale in a permanent legally-established drainage easement granting access for maintenance, or in a public right-of-way.
2. Do not *hydraulically connect*[2] swales to foundations and do not locate swales where they cause negative impacts to structures.
3. Do not locate swales such that overflow from the swale could cause flooding of existing or proposed buildings, roads, or adjacent properties during storm events (refer to applicable regulatory requirements for drainage design).
4. Identify how and where runoff from each drainage area will enter the swale, either as *sheet flow* from the side of the swale, or from a concentrated source such as a pipe or curb cut. Describe the flow path of runoff from source areas through pre-treatment devices and into swales. Examples include:
    a. Sheet flow from road surface to road shoulder, to *vegetated filter strip* for pre-treatment prior to a vegetated swale.
    b. Upstream pre-treatment device, such as a wet detention pond, discharging through a pipe into a vegetated swale.
5. If swales are located such that the bottom of the swale is at or below the seasonally high groundwater level, set the infiltration rate for that portion of the swale to zero in the model.
6. In site plans, identify which swales are designed in accordance with this Standard.

C. **Modeling Parameters –** Use an *approved model* to quantify infiltration volume and/or pollutant load reduction provided by vegetated swales. The swales used in the models are those that meet the criteria of this standard. When modeling, do not include segments of the swale that do not meet velocity and depth requirements in section V.D. When modeling, do not combine swale segments that have significantly different flow depths, flow velocities, or infiltration rates unless the most conservative values are applied to all segments (steepest slope, narrowest bottom width, lowest infiltration rate, etc.). The modeling parameters are defined below.

1. Average swale length to outlet (feet) is used if the analysis incorporates particulate pollutant reductions due to filtering or settling.
    a. If a swale conveys runoff from an upstream point source to a downstream discharge point with little additional runoff added to the swale between the upstream and downstream points, the 'average swale length to outlet' is defined as the total swale length.

[2] *Words in the standard that are shown in italics are described in Definitions Section IX. The words are italicized the first time they are used in this text.*

b. If a swale network conveys runoff from a drainage area with multiple defined point source inputs or sheet flow, then the 'average swale length to outlet' is defined as the total of half of each swale segment length in the drainage area served by swales divided by the number of swale segment lengths.

$$\mathbf{SL_{avg} = [(SS_1/2) + (SS_2/2) + \ldots + (SS_n/2)] / n}$$

Where:

SL_{avg} = Average Swale Length to Outlet (feet)

SS_n = Swale Segment Length

n = Number of Swale Segment Lengths

2. *Design infiltration rate* (inches/hour) is the dynamic infiltration rate of the swale (one-half of the static infiltration rate to account for flowing water). See Section V.I.4. for equation.
3. Rainfall (inches) data that is used in the analysis shall be appropriate for the site as determined by the *administering authority*.
4. Total swale length (feet) is the total length of all swales in the drainage area developed in accordance with this standard. Exclude culvert lengths from total swale length.
5. Swale densities (feet/acre) are the total swale length divided by the treated drainage area. Calculate swale densities for each drainage area.
6. Swale geometry includes side slopes, longitudinal slopes, and bottom width (V.E.) of the typical swale in the drainage area being analyzed. Swales with significant variations in width, longitudinal slope, bottom width, and/or drainage area along their length should be divided into segments and modeled in series to account for these variations.
7. Swale retardance factor describes the type and height of the grass which is then used to determine the Manning's *n* value used in the equations provided in HEC-15 (September 2005) and as extended by Kirby and others (2005). Vegetated swales typically have a retardance factor represented by Retardance Class C or D.
8. Total Tributary Drainage Area (acres) is the drainage area served by the swale including the area of the swale.
9. Vegetation height (inches) is the typical height of vegetation in the swale. Pollutant reduction varies with the vegetation height, type, and density.

D. **Velocity and Depth** – The maximum velocity of runoff into and through a vegetated swale shall not cause the swale system to become unstable (such as through erosion, sediment resuspension, scour, etc.), and shall allow adequate residence time for infiltration.

1. For the 2-year, 24-hour design storm, do not exceed 1.5 feet per second peak flow velocity, and do not exceed a 12-inch flow depth. For design storms greater than the 2-year, 24-hour, velocities shall be non-erosive for finished grade soil with *established vegetation*.
2. Select Manning's roughness coefficients, "*n*", consistent with the type of vegetation, mowing height, and depth of flow as determined using HEC-15. Attachment 1 illustrates the variation in Manning's *n* values for various flow depths.
3. If allowed by the regulatory authority, install ditch checks as necessary to reduce velocities, extend detention time, or retain a design volume. Refer to WDNR Conservation Practice Standard "Ditch Checks" (1062) for design requirements.
4. Design ditch checks so standing water drains within 24 hours after a rainfall/runoff event. If using wet-tolerant vegetation, standing water must drain within 48 hours of the rainfall/runoff event.

E. **Swale Geometry**[3]

1. Design swales with side slopes no steeper than three horizontal to one vertical (3:1) for trapezoidal or triangular swale cross sections, except for roadways, where a slope as steep as 2.5:1 is allowed because the ratio of contributing drainage area from highways to swale length is typically low. Use flatter side slopes if possible to reduce erosion and increase infiltration.
2. Design the bottom width of swales with trapezoidal cross section to be no more than 8 feet wide to minimize channelization. If widths greater than 8 feet are needed, use a triangular cross-section with shallow side slopes (as flat as 20:1) with appropriate erosion control matting (refer to WDNR Conservation Practice Standard "Channel erosion mat" (1053)), or length-wise dividers so that the maximum bottom width of any given cell is 8 feet.
3. Design the longitudinal slope of the swale to be between 0.5% and 4%. Slopes less than 1% with infiltration rates below 0.13 inches/hour must be planted with wet-tolerant vegetation. Ditch checks may be used to mitigate for steeper slopes (refer to WDNR Conservation Practice Standard "Ditch Checks" (1062) for design requirements).

F. **Vegetation**

1. Plant swales with native vegetation or turf grass.
2. Provide site-specific planting information with project plans and specifications for establishment of *dense vegetation*.
3. Use a companion or cover crop if needed to establish native vegetation. Care should be taken with proper selection of companion or cover crop since many seed mixes are already formulated to address this issue.
4. Select vegetation that is tolerant of road salt and wetness, depending on swale location.
5. Install a planting medium that can support the selected vegetation.
6. To maintain typical swale vegetation, design swales to drain and to have no standing water within 24 hours after a rainfall/runoff event. If sump pump discharges to a swale are expected, use wet-tolerant vegetation. If wet-tolerant vegetation is established, standing water must drain within 48 hours of the rainfall/runoff event.

G. **Construction**

1. Prepare a construction erosion and sediment control plan**.**
2. Where swales are proposed in filled areas, specify in the plans that fill used in the swale area is a soil type consistent with the infiltration rate assumed in the modeling.
3. If possible, construct swales off-line. Bring swales on-line after the vegetation is established and the contributing watersheds are fully stabilized. The swale shall be brought on-line when the area draining to the basin has achieved 90% *build out* of all lots in any of the first 3 years or 75% build out in any subsequent year. By 5 years from the start of construction in the drainage area, all vegetated swales shall be brought on-line.
4. Where swales cannot be constructed off-line, such as in the case of a road ditch or construction conveyance channel that is intended to serve as an infiltration practice post-construction, follow one of these approaches:
    a. Construct and stabilize the swale as early in the construction process as possible to allow the vegetation to become established before receiving large quantities of runoff. Install and maintain effective erosion and sediment controls to prevent swales from receiving construction site sediment, which is difficult to remove from an established swale without destroying the vegetation (refer to WDNR Conservation Practice Standards "Channel Erosion Mat" (1053) and "Seeding for Construction Site Erosion Control" (1059) for further guidance).

[3] *This standard does not set forth criteria for the analysis of site hydrology, system hydraulic analysis for large flows, or channel stability. See References, Section X.*

b. If grading plan provides sufficient elevation, temporarily leave swales one foot above finished grade to protect the infiltration capacity. Excavate to final grade once the site is stabilized. Protect and vegetate the swale as specified in V.G.4.c. below.

c. Construct the swales as part of the overall grading plan, but do not finish the swales until the rest of the construction is completed and the contributing watershed has been stabilized by following these steps:

i. Stabilize adjacent construction areas. After the tributary areas are stabilized, remove any sediment that entered the swale during construction.

ii. Stabilize the swale following compaction mitigation or addition of necessary soil amendments.

iii. If the swale infiltration capacity has been reduced due to silt or clay sediment, excavate the top 1 foot of soil and replace with *engineered soils* or appropriate native soils that provide infiltration characteristics to meet the modeling requirements.

iv. Refer to WDNR Conservation Practice Standards "Channel Erosion Mat" (1053), "Mulching for Construction Sites" (1058), and "Seeding for Construction Site Erosion Control" (1059).

5. During construction there may be a delay between the initial road construction and installation of utilities outside of the swales. To address compaction and sediment deposition from utility installation, follow one of these approaches:

a. Complete swale construction immediately following road completion, and then protect the swales as aggressively as possible during utility installation, using construction fencing, biologs, etc.

b. Stabilize the swales following road construction using topsoil, temporary seeding, and erosion control matting (refer to WDNR Conservation Practice Standards "Channel Erosion Mat" (1053) and "Seeding for Construction Site Erosion Control" (1059) for further guidance). Following utility installation, complete the swale stabilization. This may entail sediment removal, compaction mitigation, soil amendments, installing erosion control matting a second time, and seeding with the permanent seed mix.

c. Avoid placing utility easements within the swale boundary.

6. To address swale compaction, use one of the following options:

a. Avoid swale compaction during and after construction. Keep vehicles and equipment with ground pressure equal to or greater than 5 pounds per square inch (PSI) out of swales at all times.

b. Mitigate swale compaction by one or more of the following methods:

i. Use a chisel plow or rotary tillage device, to incorporate four inches of compost per WDNR Specification "S100 Compost," to a depth of 12 inches below the surface. Keep vehicles and equipment with ground pressure equal to or greater than 5 PSI out of swales after mitigation is completed. Refer to Section V.I. to determine appropriate infiltration rate.

ii. After topsoil placement, *subsoil* (deep till) the bottom of the swale to a depth of 20 inches below the surface to loosen the soil and mix soil layers. See definition of "subsoil" for more detail. Keep vehicles and equipment with ground pressure equal to or greater than 5 PSI out of swales after mitigation is completed. Refer to Section V.I. to determine appropriate infiltration rate.

c. If swale compaction is not avoided or mitigated as described in items V.G.6.a or V.G.6.b, refer to Sections V.I.3 and V.I.4 (also see example in Attachment 6) to determine the appropriate infiltration rate.

H. **Pre-treatment –** As with other infiltration devices, vegetated swales require pre-treatment of storm water to remove sediment from source areas listed in s. NR 151.124(7) Wis. Adm. Code. Pre-treatment is intended to prevent clogging of the infiltration system and protect groundwater. For vegetated swales,

many contaminants are mitigated in the soil column, and vegetation prevents clogging. Therefore, the pre-treatment options below are intended to protect swale vegetation, mainly to allow for settling of larger particles that could smother vegetation.

The area of any pre-treatment practice does not count toward the *effective infiltration area*. For vegetated swales, pre-treatment can be accomplished through the use of the following practices (see Attachment 2 for pre-treatment diagrams):

1. *Vegetated Filter Strip* – Vegetated filter strips can pre-treat sheet flow. Use level spreaders, grading, and shaping to convert concentrated flow to sheet flow before reaching filter strips. Design vegetated filter strips for a maximum flow depth of ½ inch, and a slope not steeper than 3:1, except for roadways, where a slope as steep as 2.5:1 is allowed because the ratio of contributing drainage area from highways to swale length is typically low. Use flatter side slopes if possible to reduce erosion and increase infiltration. Determine if the filter strips satisfy the following pre-treatment requirements:
    a. Ten or more feet of filter strip flow length is sufficient for pre-treatment of sheet flow runoff into swales.
    b. If there is less than five feet of filter strip flow length, the filter strip does not count toward pre-treatment, and an alternate pre-treatment method must be used.
    c. For filter strip flow length five feet or greater, but less than ten feet, use the procedure in Attachment 3 to account for the deficient filter strip flow length.
    d. Filter strips are not an adequate pre-treatment measure when receiving runoff from more than 100 feet of flow from impervious and/or non-vegetated areas.
2. Vegetated Swale – Vegetated swales can pre-treat concentrated flow from point sources such as pipes and curb cuts. When calculating the effective infiltration area, subtract the pre-treatment swale area (multiply 80 feet of swale length by the swale wetted perimeter (see Attachment 4)) from the total infiltration area.[4]
3. *Sedimentation Device* – Sedimentation devices can accept sheet flow and/or concentrated flow for pre-treatment. Design the sedimentation device to capture at least a 100-micron particle size, which equates to approximately 10% *NURP* total suspended solids reduction.
4. Other Device – To the extent technically and economically feasible, minimize the level of pollutants infiltrating to groundwater though use of pre-treatment devices for the pollutants of concern.

I. **Infiltration –** To meet the infiltration performance standards of s. NR 151.124 Wis. Adm. Code, a swale must meet the following:

1. Effective Infiltration Area – Use the following equation to calculate the area that can be counted toward requirements in s. NR 151.124 Wis. Adm. Code :

$$\mathbf{A = P * L}$$

Where:

A = effective infiltration area in square feet

P = wetted perimeter (at one-inch flow depth) in feet

L = length of vegetated swale in feet

See Attachment 4 for calculation methodology. Pre-treatment areas do not count toward the effective infiltration area. Vegetated swales receiving runoff from source areas identified in s. NR 151.124(7) Wis. Adm. Code cannot be counted toward the effective infiltration area unless the water is effectively pre-treated prior to entering the swale.

[4] *The 80-foot length of swale is based on a Stokes' law calculation using approximately 1 foot flow depth, 1.5 feet per second flow velocity, and 100-micron particle size, and applies for each drainage area of 5 acres or smaller.*

2. Infiltration Volume – Use an approved model to quantify the volume of water infiltrated and the resulting pollutant reduction to surface water.
3. Static Infiltration Rate – The design infiltration rate is a function of the static infiltration rate. Use one of these approaches to determine the static infiltration rate:
   a. Use WDNR Conservation Practice Standard "Site Evaluation for Stormwater Infiltration" (1002) to determine static infiltration rate; except that if conducting site-specific infiltration tests at design bottom elevation of the swale, the WDNR modified (2-hour) double-ring infiltrometer test[5] may be used.
   b. If sod grown in muck soils is used for vegetated swales, use a static infiltration rate of no more than 0.05 inches per hour.
   c. If imported topsoil is used, use the infiltration rate commiserate with the textural class of the topsoil and use the WDNR Conservation Practice Standard "Site Evaluation for Stormwater Infiltration" (1002).
   d. If incidental soil compaction of a swale will not be addressed as described in V.G.6.a or V.G.6.b, determine the static infiltration rate as specified in V.I.3.a. and apply the appropriate multiplier from Table 1 below (see example in Attachment 6):

Table 1. Static Infiltration Rate Multiplier for Incidental Soil Compaction

Compacted Soil Type		Multiplier
Sand	Coarse Sand or Coarser	0.9
	Loamy Coarse Sand	
	Sand	
	Loamy Sand	
Loam	Sandy Loam	0.4
	Loam	
	Silt Loam	
	Sandy Clay Loam	
Clay	Clay Loam	0.2
	Silty Clay Loam	
	Sandy Clay	
	Silty Clay	
	Clay	

[5] *For more detail regarding the WDNR modified (2-hour) double-ring infiltrometer test procedure, see "Process to Assess and Model Grass Swales" (WDNR 2010)* http://dnr.wi.gov/topic/stormwater/documents/GrassSwales080424.pdf

4. *Design Infiltration Rate* – Use the following equation to calculate the design infiltration rate for swales:

$$K_{swale} = ½ * K_{static}$$

Where:

K_{swale} = design infiltration rate in inches per hour

K_{static} = static infiltration rate in inches per hour determined in accordance with WDNR Conservation Practice Standard "Site Evaluation for Stormwater Infiltration" (1002)

½ = safety factor to account for the dynamic nature of a swale through which water is moving, compared to the static nature of an infiltration test in which water is ponded

VI. CONSIDERATIONS

The following considerations are intended to enhance the use of this practice, or to address special cases that may arise in the implementation of the practice.

A. Swales should be designed to have hydraulic capacities that meet applicable local government or state agency requirements for conveying runoff from large storms, and they should also be designed as part of a *major storm water management system* as defined in this standard.

B. The number and length of swales is dictated by the topography and amounts of runoff from the contributing area. For a given depth of flow, the width of a swale depends on the rate and velocity of flow through the swale.

C. Establishment of deep-rooted vegetation will enhance infiltration.

D. Underdrains may be added to swales with less than 1% slope to reduce the duration of standing water. Plant wet-tolerant vegetation if the drawdown time exceeds 24 hours. If using underdrains, refer to WDNR Conservation Practice Standard "Bioretention for Infiltration" (1004) for guidance. Model areas with underdrains separately to determine appropriate surface water pollutant removal credit.

E. Swale performance may change over time due to site-specific conditions, such as vegetation characteristics, maintenance, sediment deposition, compaction, etc. Follow the most recent WDNR guidance that specifically addresses evaluation of existing swales.

F. Conduct soil tests to determine the amount of fertilizer needed to establish or maintain dense vegetation.

G. Excavation hoes, light equipment with turf-type tires, marsh equipment, or wide-track loaders that have ground pressure equal to or less than 5 PSI should be used to construct swales and minimize compaction. Heavier equipment may require compaction mitigation.

H. Public education is recommended to inform local residents of the swales' purpose and to discourage dumping of leaves or parking within swales or on the edge of swales.

I. Vegetated swales are not suitable for treating chlorides. Chloride de-icer use within source areas tributary to a swale can be reduced or eliminated by using alternative de-icers or clean sand.

J. To protect groundwater, if site information indicates compliance with a preventative action limit (in accordance with ch. NR 140 Wis. Adm. Code) is not achievable, a vegetated swale may not be installed or shall be modified to prevent infiltration to the maximum extent practicable.

VII. PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, locations, size and elevations of all components of the practice to allow for certification of construction upon completion.

VIII. OPERATION AND MAINTENANCE

Prepare a site-specific annual inspection and maintenance plan for the swales that addresses the following:

A. Identify the responsible party.

B. Limit off-street parking or other activities that may cause rutting or soil compaction in swales and repair as needed.

C. Inspect swales annually to detect and remedy nuisance conditions such as standing water, weeds, woody growth, and trash dumping. Limit the use of pesticides and fertilizer if swale is used for water quality control.

D. State the proper vegetation type and design height for dense vegetation in the maintenance plan, and maintain the specified height when mowing or cutting.

E. Remove sediment when infiltration rates are impeded, sediment accumulation is visible, or if standing water exists for 48 hours after a rainfall/runoff event. Avoid compaction of the soil in the swale during the sediment removal process. After sediment removal, repair any damaged or eroded areas by filling with topsoil that meets appropriate infiltration requirements. If compaction occurs, restore the swale infiltration capacity by mitigating for compaction as described in V.G.6.b. Mitigation practices can include subsoiling or chisel plowing as described in V.G.6.b. Reseed as needed to reestablish vegetation.

F. Implement erosion control measures if erosion during construction or maintenance becomes severe enough to prevent establishment of vegetation. Refer to WDNR Conservation Practice Standards "Channel Erosion Mat" (1053), "Mulching for Construction Sites" (1058), and "Seeding for Construction Site Erosion Control" (1059) for further guidance.

IX. DEFINITIONS

Administering Authority (V.C.3.): State and/or local units of government with stormwater management regulatory authority.

Approved Model (V.C.): A computer model with an infiltration component that adequately accounts for the hydraulic nature of swales and that has been approved by the applicable regulatory authority. Examples include SLAMM, P-8, and RECARGA.

Build Out (V.G.2): Build out means that the lot has been fully developed and stabilized from erosion.

Dense Vegetation (V.F.2.): A stand of 3 to 12-inch high grassy vegetation that uniformly covers at least 90% of a representative 1 square yard plot.

Design Infiltration Rate (V.C.2.): A velocity, based on soil structure and texture, at which precipitation or runoff enters and moves into or through soil. The design rate is used to size an infiltration device or system. Rates are selected to be minimal rates for the different types of soils. Selection of minimal rates will provide a robust design and maximize the longevity of the device.

Effective Infiltration Area (V.H.): The area of the infiltration system that is used to infiltrate runoff. Does not include the area used for pre-treatment.

Engineered Soil (V.G.4.c.iii.): A prescribed mixture of soil meeting the most recent version of WDNR Conservation Practice Standard "Bioretention for Infiltration" (1004) or most recent guidance regarding engineered soil.

Established Vegetation (V.D.1): A uniform perennial vegetative cover of at least 70% density.

Hydraulically Connected (V.B.2.): Two entities are considered to be hydraulically connected if a surface or subsurface link exists between them such that water is transmitted from one entity to the other.

Major Storm Water Management System (VI.A): The storm water management facilities that are intended to convey and/or store runoff in excess of the capacity of the minor system. The minor system is designed to function frequently to prevent nuisance flooding and is sized for a smaller storm than the major system, generally a 10-year storm. The major system is primarily designed to function infrequently to prevent flooding of buildings and ponding of runoff in locations where it could promote harmful infiltration and inflow to sanitary sewers. The major system is generally designed for a 100-year storm. It consists of the components of the minor system, such as overland flow, swales, curbs and gutters, storm sewers, and detention/retention basins, and also includes the entire roadway cross section and associated swales or overland flow paths ultimately discharging to receiving streams.

NURP (V.H.3.): NURP stands for Nationwide Urban Runoff Program and in this document refers to the NURP particle size distribution. See Attachment 5 and the USGS website (http://www.usgs.gov/) for more information.

Sedimentation Device (V.H.3.): Examples of sedimentation devices that could be used for swale pre-treatment may include wet detention ponds (Wisconsin DNR Conservation Practice Standard #1001), proprietary sedimentation devices, catch basins, and hydrodynamic devices.

Sheet flow (V.B.4): A maximum ½-inch depth of flow evenly spread over the filter strip width, for runoff events using the average annual rainfall as defined in s. NR 151.002 Wis. Adm. Code.

Stabilized (V.G.4.b): A uniform perennial vegetative cover has been established with a density of at least 70% vegetative cover (for unpaved areas, such as the swale).

Subsoil (V.G.6.b.2.): A form of deep tillage to break up the soil layers and reduce compaction, which can improve infiltration, drainage, and root penetration. If the swale is to be subsoiled, conduct the following:

1. After topsoil placement, use equipment capable of exerting necessary penetration force to drag tines, shanks or claws through the soil to a depth of approximately 20 inches to loosen the soil and mix the soil layers. Subsoil the swale three times to mix the topsoil and base soil. Do not pull the shanks through previous channels, but instead create multiple channels in the swale.
2. Use at least one shank behind each vehicle track or rear wheel to mitigate compaction.
3. If soils are saturated, delay operations until the soil moisture is less than or equal to “field capacity,” which is the amount of water retained in the soil after it has been saturated and allowed to drain freely.
4. Schedule a 50-foot long test section to demonstrate the subsoil process prior to completing the balance of the work.
5. Finish grading the surface (prior to seed preparation) with tracked equipment with a track pressure no greater than 5 PSI to minimize compaction.

Vegetated Filter Strip (V.B.4.a.): Vegetated filter strips (grassed filter strips, filter strips, and grassed filters) are vegetated surfaces designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils.

X. REFERENCES[6]

Brach, John, *Protecting Water Quality in Urban Areas: Best Management Practices for Minnesota*, Minnesota Pollution Control Agency, Division of Water Quality, October 1989.

Burton, G. Allen, and R. Pitt, *Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists, and Engineers*, 1st ed., CRC Press: Boca Raton, FL, USA (pp. 451–453), 2002.

[6] *Methods for hydraulic analysis and channel stability are well documented and are therefore not included in this standard. For more background, see open channel hydraulics texts such as Open Channel Hydraulics, Chow, 1988; Open Channel Flow, Henderson, 1966; and Open-Channel Hydraulics, French, 1985.*

Center for Watershed Protection, *Better Site Design: A Handbook for Changing Development Rules in Your Community*, Center for Watershed Protection, Ellicott City, Maryland, August 1998.

Clapp, Roger B. and G.M. Hornberger. *Empirical Equations for Some Hydraulic Properties.* Water Resources Research Vol. 14, No. 4 (pp. 601-604). August 1978.

Claytor, Richard A., and Schueler, Thomas R., *Design of Stormwater Filtering Systems*, Center for Watershed Protection, Silver Spring, Maryland, December 1996.

Horner, Richard R., *Biofiltration Systems for Storm Runoff Water Quality Control*, December 1988.

Kirby, Jason T.; Durrans, S. Rocky; Pitt, Robert; and Johnson, Pauline D., *Hydraulic Resistance in Grass Swales Designed for Small Flow Conveyance*, Journal of Hydraulic Engineering, January 2005.

Livingston, Eric H. , "Lessons Learned About Successfully Using Infiltration Practices," Proceedings of National Conference on Tools for Urban Water Management & Protection, Chicago, Illinois, United States Environmental Protection Agency, February 7-10, 2000.

Lowndes, Mary Anne, "Grassed Swales," *The Wisconsin Storm Water Manual: Technical Design Guidelines for Storm Water Management Practices*, Gary D. Bubenzer, Series Editor, UW-Extension, 2000.

Maryland Department of the Environment, Water Management Administration, *2000 Maryland Stormwater Design Manual,* Volumes I and II, 2000.

Minton, Gary R. *Stormwater Treatment Biological, Chemical, and Engineering Principals*, Sheridan Books, Inc., 2005.

NR 140, Wisconsin Administrative Code, http://docs.legis.wisconsin.gov/code/admin_code/nr/100/140.pdf

NR 151, Wisconsin Administrative Code, http://docs.legis.wisconsin.gov/code/admin_code/nr/100/151.pdf

Pitt, Robert and Voorhees, John, SLAMM for Windows-Source Loading and Management-Version 10, 2015.

Pitt, Robert, S. Chen, S. Clark, J. Lantrip, C. K. Ong, and J. Voorhees; *Infiltration Through Compacted Urban Soils and Effects on Biofiltration Design*, published in *Stormwater and Urban Water Systems,* Vol. 11 (edited by W. James). CHI. Guelph, Ontario, 2003.

Rawls, Walter J., D.L. Brakensiek and K.E. Saxton. *Estimation of Soil Water Properties, Transactions of the American Society of Agricultural Engineers* Vol. 25, No. 5 (pp. 1316-1320 and 1328). 1982.

Rawls, Walter J., D. P. Giménez, and R. Grossman. *Use of Soil Texture, Bulk Density and Slope of Water Retention Curve to Predict Saturated Hydraulic Conductivity,* ASAE, Vol. 41(2), (pp. 983-988). 1998.

Schueler, Thomas R., *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*, Department of Environmental Programs, Metropolitan Washington Council of Governments, July 1987.

Schueler, Thomas R., *Design of Stormwater Wetland Systems. Metropolitan Washington Council of Governments.* Washington. D. C., 1992.

USDA-Agricultural Research Service, *Stability Design of Grass-Lined Open Channels*, Agriculture Handbook No. 667, September 1987.

USDA-SCS. 1988. National Engineering Field Manual. Natural Resources Conservation Service. Washington, DC.

USDA-SCS, *National Engineering Handbook*, Section 4 – Hydrology, March 1985.

USDA-Natural Resources Conservation Service, *Grassed Waterway Conservation Practice Standard*, Code 412, June 1993.

U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No. 15 (HEC-15), Third Edition, *Design of Roadside Channels with Flexible Linings*, September 2005.

Washington State Department of Ecology, *Stormwater Management Manual for the Puget Sound Basin (The Technical Manual)*, Washington State Department of Ecology, February 1992.

Wisconsin Department of Natural Resources, Memorandum: *Process to Assess and Model Grass Swales for ss. NR 151.13(2) and NR 216.07(6), Wis. Adm. Code*, November 24, 2010. http://dnr.wi.gov/topic/stormwater/documents/GrassSwales080424.pdf

Wisconsin Department of Natural Resources, *Bioretention for Infiltration*, Conservation Practice Standard (1004), 2014. http://dnr.wi.gov/topic/stormwater/documents/Bioretention1004.pdf

Wisconsin Department of Natural Resources, *Channel Erosion Mat*, Conservation Practice Standard (1053), 2004. http://dnr.wi.gov/topic/stormWater/documents/dnr1053-ChannelErosionMat.pdf

Wisconsin Department of Natural Resources, *Ditch Checks,* Conservation Practice Standard (1062), 2006. http://dnr.wi.gov/topic/stormWater/documents/Ditch_Check_1062_v2.pdf

Wisconsin Department of Natural Resources, *Mulching for Construction Sites,* Conservation Practice Standard (1058), 2003. http://dnr.wi.gov/topic/stormWater/documents/MulchingForConstructionSites_1058.pdf

Wisconsin Department of Natural Resources, *S100 Compost*, Conservation Practice Specification, 2004. http://dnr.wi.gov/topic/stormwater/documents/SpecificationS100Compost.pdf

Wisconsin Department of Natural Resources, *Seeding for Construction Site Erosion Control,* Conservation Practice Standard (1059), 2003. http://dnr.wi.gov/topic/stormWater/documents/SeedingForConstructionSiteErosionControl_1059.pdf

Wisconsin Department of Natural Resources, *Site Evaluation for Stormwater Infiltration,* Conservation Practice Standard (1002), 2004. http://dnr.wi.gov/topic/stormwater/documents/techstd1002.pdf

Wisconsin Department of Natural Resources, *Wet Detention Pond,* Conservation Practice Standard (1001), 2007. http://dnr.wi.gov/topic/stormwater/documents/WetPondStd1001.pdf

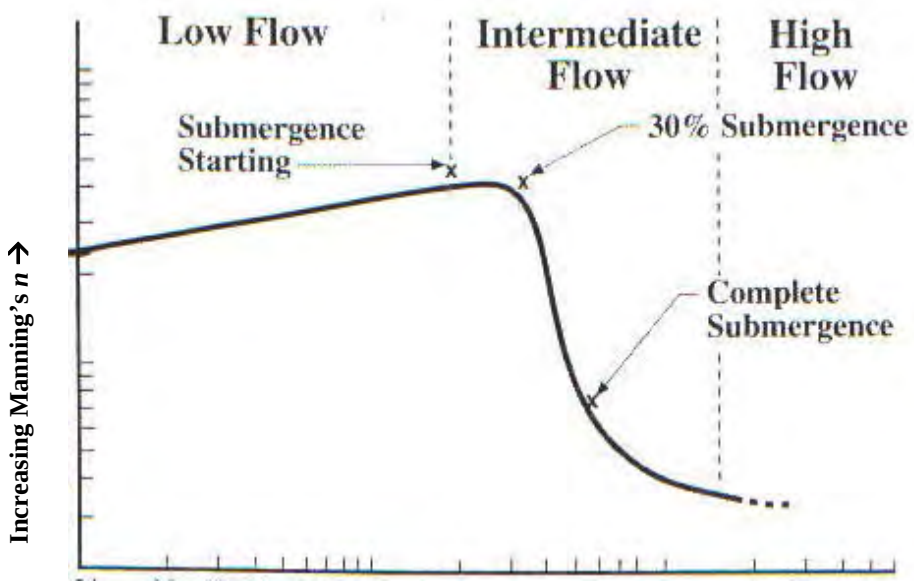
Attachment 1:

Illustration of the Change of Manning's *n* Values with Flow Depth

Vegetated Swale (1005)

Manning's *n*, the roughness coefficient, varies with the type and height of vegetation and the depth of flow. Typically, vegetation creates a significant flow resistance at lower flows when the grass remains erect and the water surface is below the top of the vegetation. Vegetated infiltration swales are designed to convey runoff from smaller more frequent storm events and thus at lower flow depths than typically encountered using the typical design-storm methodology (i.e. 2-year or 10-year storm). Figure 1 shows a variation of Manning's n with flow depth. Figure 1 assumes dense turf type vegetation mowed to a height of 4-inches. For design, calculate Manning's *n* values using equations in HEC-15.

Figure 1: Manning's *n* Under Different Flow Depths



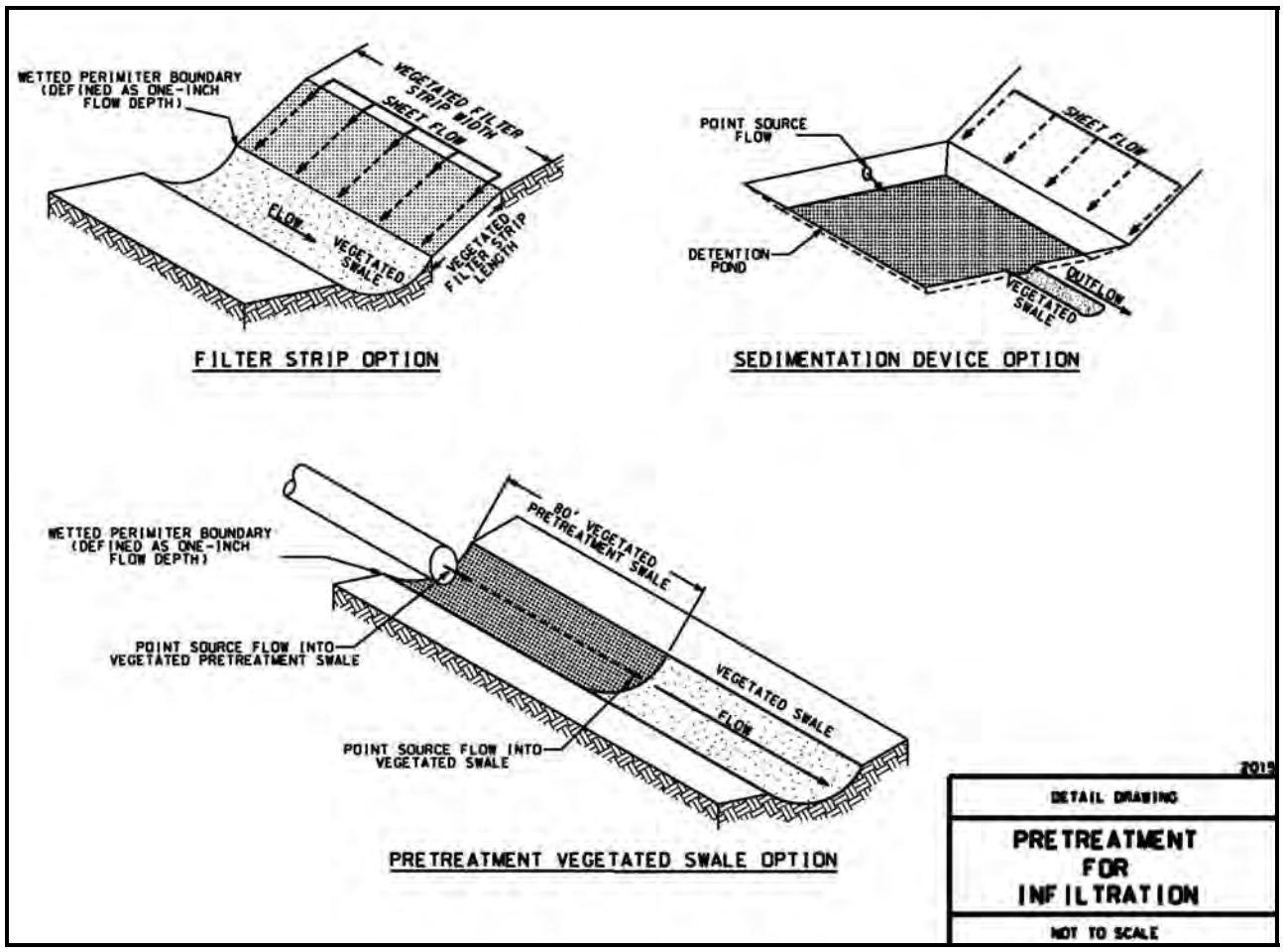
Modified from: Minton 2005

Research has shown that Manning's *n* can be related to the product of the flow velocity and the hydraulic radius. This relationship is further dependent again on the type and height of vegetation. Currently, data does not exist for native prairie vegetation.

Attachment 2:

Pre-Treatment Options for Swales

Vegetated Swale (1005)



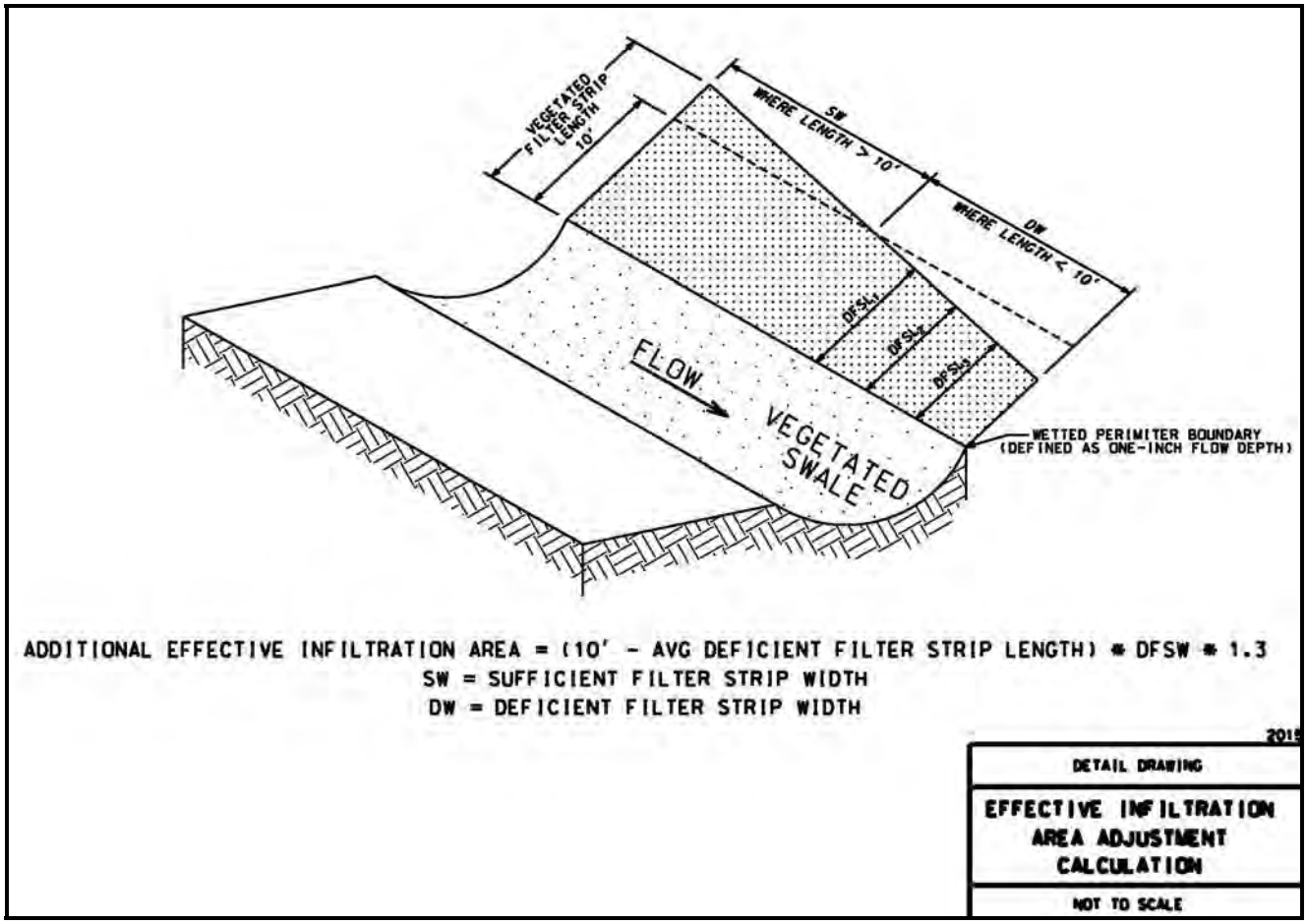
Note: The 80-ft length of vegetated pretreatment swale is based on a Stokes' Law calculation using approximately 1 foot flow depth, 1.5 feet per second flow velocity, and 100-micron particle size, and applies for each drainage area of 5 acres or smaller.

Attachment 3:

Deficient Filter Strip Length

Vegetated Swale (1005)

Use this method to address pre-treatment in situations where there is insufficient filter strip flow length (greater than five feet and less than ten feet).



The Additional Effective Infiltration Area (AEIA) required to compensate for using filter strips less than 10 feet (and at least 5 feet) in length can be calculated using the figure above for reference and the following steps:

1. Determine the deficient filter strip width (DFSW) in feet. This is the cumulative width of filter strip where the filter strip flow path length is less than 10 feet (but at least 5 feet).
2. Determine the average filter strip length (DFSL) in feet in the DFSW. Use a minimum of three distances within any deficient segment of filter strip. One measurement must include the shortest filter strip flow path length in the DFSW.
3. Calculate the Additional Effective Infiltration Area (AEIA) required to compensate for the deficient filter strip. Use the equation:

AEIA = (10 feet – Avg. DFSL) * DFSW * 1.3

The AEIA is the area of swale or other infiltration area that does not count toward the site's effective infiltration area. A maximum of 80 feet of swale length would not be considered "effective infiltration area" for each drainage area (up to five acres) served by swales. Filter strips are not an adequate pre-treatment measure when receiving runoff from more than 100 feet of flow from impervious and/or non-vegetated areas.

Attachment 4:

Calculation of Effective Infiltration Area

Vegetated Swale (1005)

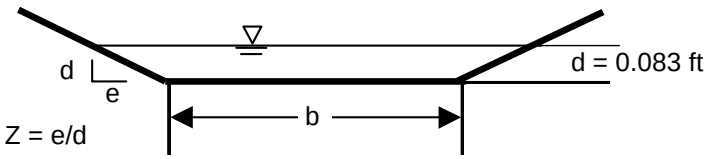
The effective infiltration area as outlined in ch. NR 151 Wis. Adm. Code is defined as the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms, or pre-treatment. The area of infiltration is calculated for a swale based on the wetted perimeter of the swale. However, the swale is rarely flowing at capacity under the numerous smaller rainfall events that dominate an average year, so the wetted perimeter at the design capacity of the swale (typically a 2-year or 10-year storm) is not appropriate. The effective infiltration area is determined as follows:

Effective Infiltration Area (ft^2) = Wetted Perimeter (ft) * Length of Vegetated Infiltration Swale (ft)

For the purpose of ch. NR 151 Wis. Adm. Code, the wetted perimeter will be calculated at a 1-inch (0.083 feet) depth of flow. The 1-inch depth of flow is intended to simulate the water quality volume. Wetted perimeter can be calculated as outlined below.

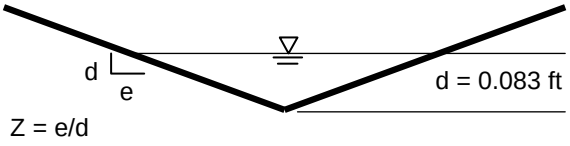
Trapezoidal Channel Cross section:

Wetted Perimeter, p
$p = b + 2d (Z^2 + 1)^{1/2}$



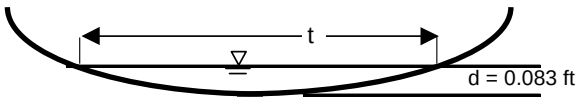
Triangular Channel Cross section:

Wetted Perimeter, p
$p = 2d (Z^2 + 1)^{1/2}$



Parabolic Channel Cross section

Wetted Perimeter, p	Top Width of flow, t	Cross-sectional Area of flow, a
$p = t + (8 d^2) / (3 t)$	$t = a / (0.67 d)$	$a = 2/3 (t d)$



Attachment 5:

NURP Particle Size Distribution

Vegetated Swale (1005)

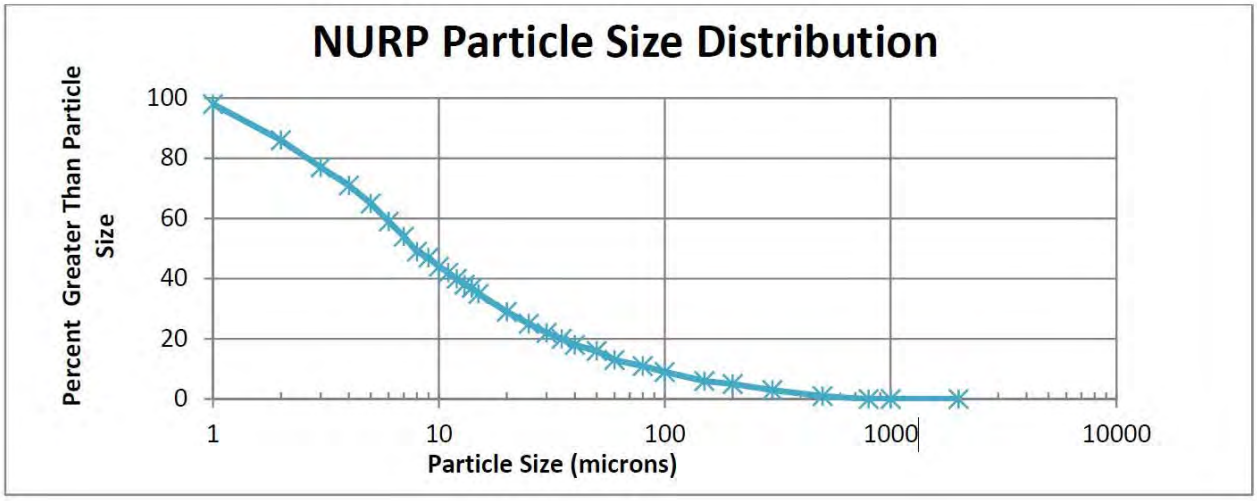


Image Source: Burton, A.G., and Pitt, R., 2002

Attachment 6:

Example

Infiltration Rates for Compacted Soils

Vegetated Swale (1005)

If an infiltration rate is needed for modeling a proposed vegetated swale in which incidental soil compaction will not be avoided or mitigated in accordance with V.G.6.a or V.G.6.b, follow the steps below:

1. Follow WDNR Conservation Practice Standard "Site Evaluation for Stormwater Infiltration" (1002) [7] to obtain an infiltration rate.

   Example: for Sandy Loam, $K_{std1002}$ = 0.5 in/hr

2. Select a multiplier from the table below corresponding to compacted soil type.

   *Example: for Sandy Loam, **M** = 0.4*

Compacted Soil Type		Multiplier
Sand	Coarse Sand or Coarser	0.9
	Loamy Coarse Sand	
	Sand	
	Loamy Sand	
Loam	Sandy Loam	0.4
	Loam	
	Silt Loam	
	Sandy Clay Loam	
Clay	Clay Loam	0.2
	Silty Clay Loam	
	Sandy Clay	
	Silty Clay	
	Clay	

3. Apply the multiplier from step 2 to the infiltration rate obtained in step 1. This is the static infiltration rate adjusted for incidental compaction.

   Example: $K_{static} = M * K_{std1002}$

   K_{static} = 0.4 * 0.5 in/hr*

4. Follow V.I.4 to account for infiltration of flowing water (divide the adjusted infiltration rate from step 3 by two). This is the design/dynamic infiltration rate to use in post-construction storm water modeling and calculations.

   Example: $K_{swale} = ½ * K_{static}$

   K_{swale} = ½ * (0.4 * 0.5 in/hr)*

   K_{swale} = 0.1 in/hr*

[7] *If conducting site-specific infiltration tests at design bottom elevation of the swale, the WDNR modified (2-hour) double-ring infiltrometer test may be used.*

Attachment 7:

Technical Note for Infiltration in Compacted Soils

Vegetated Swale (1005)

The table below documents the approach used for developing multipliers for unmitigated incidental compaction in swales. This approach is intended to serve as a placeholder until the WDNR Conservation Practice Standard "Site Evaluation for Infiltration" is revised to address infiltration rates in compacted soils.

Soil Type[8]		Infiltration Rate, inches/hour		Ratio	Compaction Multiplier[9]
		Table 2 Site Evaluation for Infiltration 1002[10]	Pitt Compaction Measurements[11](*) or Extrapolation		
Sand	Coarse Sand or Coarser	3.6	3.26	0.91	0.9
	Loamy Coarse Sand	3.6	3.26	0.91	
	Sand	3.6	3.26*	0.91	
	Loamy Sand	1.63	1.467	0.90	
Loam	Sandy Loam	0.5	0.22*	0.44	0.4
	Loam	0.24	0.11	0.46	
	Silt Loam	0.13	0.014*	0.11	
	Sandy Clay Loam	0.11	0.0242	0.22	
Clay	Clay Loam	0.03	0.0066*	0.22	0.2
	Silty Clay Loam	0.04[12]	0.01	0.23	
	Sandy Clay	0.04	0.01	0.25	
	Silty Clay	0.07	0.002	0.03	
	Clay	0.07	<0.002*	0.03	

[8] *Use sandy loam infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.*

[9] *Multipliers were developed from a ratio of the compacted soil infiltration rates from the Pitt, R. et al 2003 research and WDNR Conservation Practice Standards "Site Evaluation for Infiltration" (1002) Table 2 infiltration rates, then simplified into three categories.*

[10] *Infiltration rates represent the lowest value for each textural class presented in Table 2 of Rawls, 1998.*

[11] *Compacted soils data from Table 8 (Standard Compaction) of Pitt, R. et al 2003.*

[12] *Infiltration rate in Conservation Practice Standards "Site Evaluation for Infiltration" (1002) Table 2 is an average based on Rawls, 1982 and Clapp & Hornberger, 1978.*

Non-Channel Erosion Mat

(1052)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combinations of material and with varying life spans.

II. Purpose

The purpose of this practice is to protect the soil surface from the erosive effect of rainfall and prevent *sheet erosion* [1] during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation. This practice applies to both *Erosion Control Revegetative Mats (ECRM*) and *Turf-Reinforcement Mats* (*TRM*).

III. Conditions Where Practice Applies

This standard applies to erosion mat selection for use on erodible slopes.

This standard is not for channel erosion; for channel applications reference WDNR Conservation Practice Standard (1053) Channel Erosion Mat.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum allowable standards for design, installation and performance requirements. Only Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) approved mats will be accepted for use in this standard.

Slope and slope length shall be taken into consideration. This information can be found in the Slope Erosion Control Matrix located in the PAL.

To differentiate applications Erosion mats are organized into three Classes of mats, which are further broken down into various Types.

A. **Class I**: A short-term duration (minimum of 6 months), light duty, organic mat with photodegradable plastic or biodegradable netting.

   1. **Type A** – Use on erodible slopes 2.5:1 or flatter.

   2. **Type B** – Double netted product for use on erodible slopes 2:1 or flatter.

B. **Class I, Urban**: A short-term duration (minimum of 6 months), light duty, organic erosion control mat for areas where mowing may be accomplished within two weeks after installation.

   1. **Urban, Type A** – Use on erodible soils with slopes 4:1 or flatter.

   2. **Urban, Type B** – A double netted product for use on slopes 2.5:1 or flatter.

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

C. **Class II**: A long-term duration (three years or greater), organic erosion control revegetative mat.

1. **Type A** – Jute fiber only for use on slopes 2:1 or flatter for sod reinforcement.

2. **Type B –** For use on slopes 2:1 or greater made with plastic or biodegradable net.

3. **Type C** – A woven mat of 100% organic fibers for use on slopes 2:1 or flatter and in environmentally and biologically sensitive areas where plastic netting is inappropriate.

D. **Class III**: A permanent 100% synthetic ECRM or TRM. Either a soil stabilizer Type A or Class I, Type A or B erosion mat must be placed over the soil filled TRM.

1. **Type A** – An ECRM for use on slopes 2:1 or flatter.

2. **Type B or C** – A TRM for use on slopes 2:1 or flatter.

3. **Type D** – A TRM for use on slopes 1:1 or flatter.

E. **Material Selection**

1. For mats that utilize netting, the netting shall be bonded to the parent material to prevent separation of the net for the life of the product.

2. For urban class mats the following material requirements shall be adhered to:

a. Only 100% organic biodegradable netted products are allowed, including parent material, stitching, and netting.

b. The netting shall be stitched with biodegradable thread/yarn to prevent separation of the net from parent material.

c. All materials and additive components used to manufacture the anchoring devices shall be completely biodegradable as determined by ASTM D 5338.

d. Mats with photodegradable netting shall not be installed after September 1st.

F. **Installation**

1. ECRMs shall be installed after all topsoiling, fertilizing, liming and seeding is complete.

2. The mat shall be in firm and intimate contact with the soil. It shall be installed and anchored per the manufacturer's recommendation.

3. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.

4. At time of installation, document the manufacturer and mat type by retention of material labels and manufacturer's installation instructions. Retain this documentation until the site has been stabilized.

VI. Considerations

A. Urban mats may be used in lieu of sod.

B. Documentation of materials used, monitoring logs, project diary and weekly inspection forms, including erosion and stormwater management plans, should be turned over to the authority charged with long term maintenance of the site.

VII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat

2. Installation Sequence

3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Erosion mat shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

D. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm Printed copies are no longer distributed.

Field Code Changed

X. Definitions

Sheet and Rill Erosion (II): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Erosion Control Revegetative Mats (ECRM) (II): erosion control revegetative mats designed to be placed on the soil surface.

Turf-Reinforcement Mats (TRM) (II): turf-reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved Type A soil stabilizer.

Channel Erosion Mat

(1053)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A protective soil cover of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combination of materials and with varying life spans.

II. Purpose

The purpose of this practice is to protect the channel from erosion or act as turf reinforcement during and after the establishment of grass or other vegetation in a channel. This practice applies to both *Erosion Control Revegative Mats* (*ECRM*[1]) and *Turf-Reinforcement Mats* (*TRM*).

III. Conditions Where Practice Applies

This standard applies where runoff channelizes in intermittent flow and vegetation is to be established. Some products may have limited applicability in projects adjacent to navigable waters.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. To complete the shear calculations, a 2 year, 24 hour storm event shall be used to calculate depth of flows for an ECRM. For sizing a TRM, use the depth of flow corresponding to the maximum design capacity of the channel.

Only mats listed in the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be accepted for use in this standard.

To differentiate applications WisDOT organizes erosion mats into three classes of mats, which are further broken down into various Types.

A. **Class I**: A short-term duration (minimum of 6 months), light duty, organic ECRM with plastic or biodegradable netting.

   1. **Type A** – Only suitable for slope applications, not channel applications.

   2. **Type B** – Double netted product for use in channels where the calculated (design) shear stress is 1.5 lbs/ft^2 or less.

B. **Class II**: A long-term duration (three years or greater), organic ECRM.

   1. **Type A** – Jute fiber only for use in channels to reinforce sod.

   2. **Type B** – For use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Made with plastic or biodegradable mat.

   3. **Type C** – A woven mat of 100% organic material for use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Applicable

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

for use in environmentally sensitive areas where plastic netting is inappropriate.

C. **Class III**: A permanent 100% synthetic ECRM or TRM. Class I, Type B erosion mat or Class II, Type B or C erosion mat must be placed over a soil filled TRM.

1. **Type A** – An ECRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

2. **Type B** – A TRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

3. **Type C** – A TRM for use in channels where the calculated (design) shear stress of 3.5 lbs/ft^2 or less.

4. **Type D** – A TRM for use in channels where the calculated (design) shear stress of 5.0 lbs/ft^2 or less.

D. **Installation**

1. ECRM shall be installed after all topsoiling, fertilizing, liming, and seeding is complete.

2. Erosion mats shall extend for whichever is greater: upslope one-foot minimum vertically from the ditch bottom or 6 inches higher than the design flow depth.

3. The mat shall be in firm and continuous contact with the soil. It shall be anchored, overlapped, staked and entrenched per the manufacturer's recommendations.

4. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.

5. At time of installation, document the manufacturer and mat type by saving material labels and manufacturer's installation instructions. Retain this documentation until the site is stabilized.

VI. Considerations

A. Erosion mats shall be selected so that they last long enough for the grass or other vegetation to become densely established.

B. Consider using Class II, Type C mats adjacent to waterways where trapping small animals is to be avoided.

C. Class III TRM may be appropriate as a replacement for riprap as a channel liner. Check the shear stress criteria for the channel to determine mat applicability.

D. Once a gully has formed in a channel, it is difficult to stabilize due to loss of soil structure. Even when the gully is filled with topsoil and reseeded, the soil has a tendency to dislodge in the same pattern. If gully formation continues to be a problem the design should be reevaluated, including other mat classes or riprap.

E. It may be difficult to establish permanent vegetation and adequate erosion protection in a channel with continuous flow. Consider riprap or planting wetland species with an ECRM.

F. Documentation of materials used, monitoring logs, project diary, and weekly inspection forms including erosion and stormwater management plans, should be provided to the authority charged with long term maintenance of the site.

G. Channel cross sections may be parabolic, v-shaped or trapezoidal. The use of "V" channels is generally discouraged due to erosion problems experienced.

H. To help determine the appropriate channel liner, designers can refer to the design matrix in the back of the WisDOT PAL. However, for channels not conforming to the typical section shown in the channel matrix or having a depth of flow greater than 6 inches (150 mm), the designer will need to design

for an appropriate channel liner. One way to do this is to use the "tractive force" method presented in FHWA's Hydraulic Engineering Circular (HEC) No. 15. This method requires that the calculated maximum shear stress of a channel is not to exceed the permissible shear stress of the channel liner. To use this method, permissible shear stress values are stated next to each device listed in the channel matrix.

VII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat
2. Installation sequence
3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Erosion mats shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

D. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm.

X. Definitions

Channel Erosion: The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

Erosion Control Revegative Mats (*ECRM)* (II): Erosion control revegetative mats are designed to be placed on top of soil.

Turf-Reinforcement Mats (*TRM)* (II): Turf-reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved soil stabilizer Type A (as classified in the WisDOT PAL)

checks shall be removed once the final grading and channel stabilization is applied.

C. Sediment deposits shall be removed when deposits reach 0.5 the height of the barrier. Removal of sediment may require replacement of stone. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

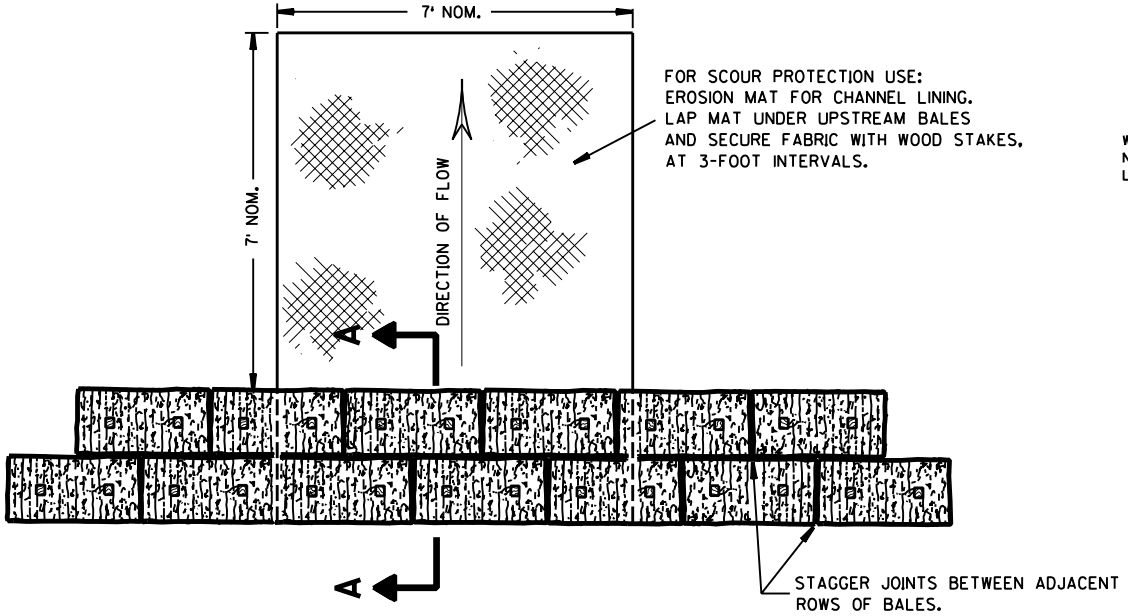
WisDOT "Erosion Control Product Acceptability List" is available online at: http://www.dot.wisconsin.gov/business/engrserv/pal.htm Printed copies are no longer distributed.

X. Definitions

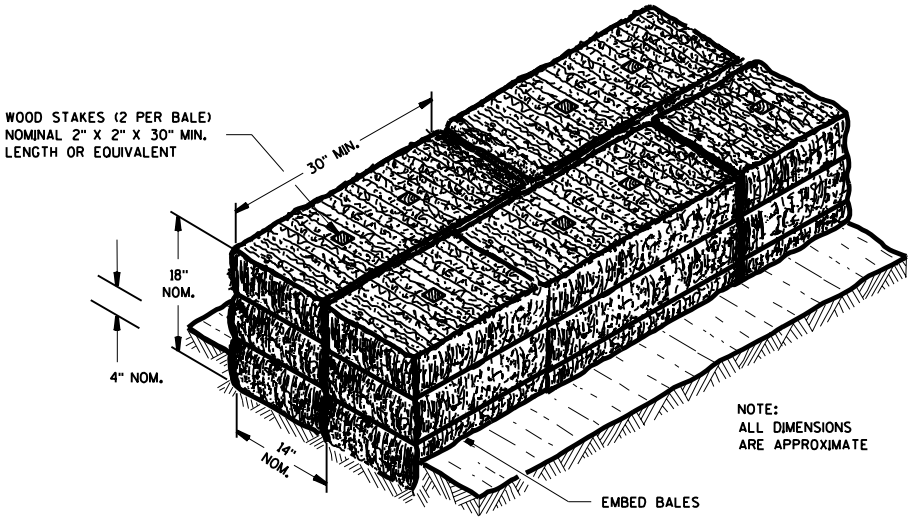
D_{50} (V.C.1): The particle size for which 50% of the material by weight is smaller than that size.

Ditch Checks (I) Are commonly referred to as temporary check dams. Stone ditch checks refer to those made out of either stone or rock.

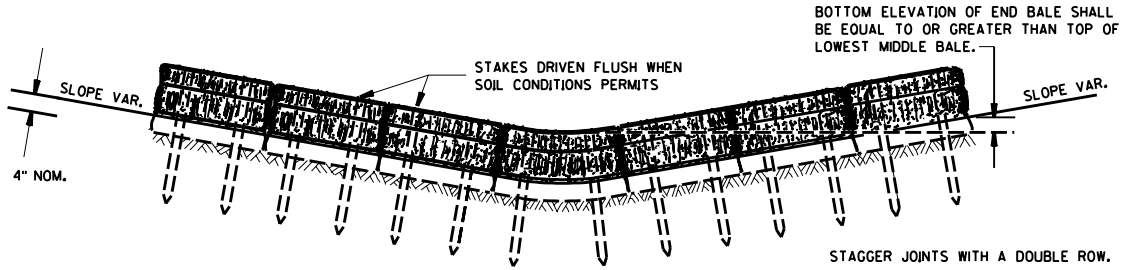
Figure 1



PLAN VIEW



SECTION A-A



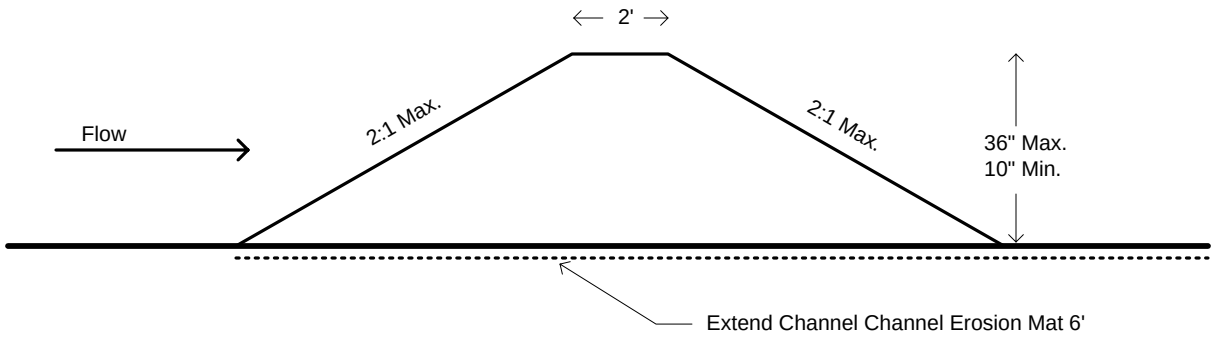
FRONT ELEVATION

TEMPORARY DITCH CHECK USING EROSION BALES ①

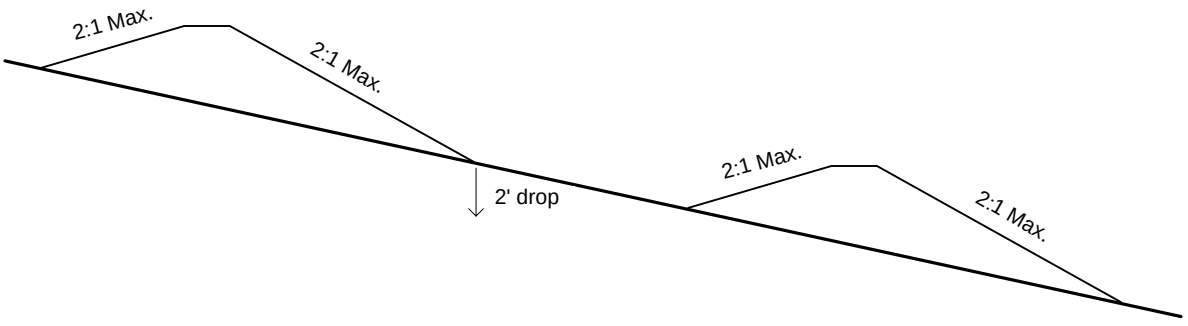
This drawing based on Wisconsin Deptartment of Transportation Standard Detail Drawing 8 E 8-3.

TYPICAL INSTALLATIONS OF EROSION BALES / TEMPORARY DITCH CHECKS

Figure 2. Stone Ditch Check



Side View



Side View

Not to Scale

WDNR

Sediment Trap
(1063)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A *temporary*[1] sediment control device formed by excavation and/or embankment to intercept sediment-laden runoff and to retain the sediment.

II. Purposes

To detain sediment-laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment traps are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment traps shall be constructed at locations accessible for clean out. Sediment traps are designed to be in place until the contributory drainage area has been *stabilized*.

The contributory drainage area shall be a maximum of five acres. For concentrated flow areas smaller than one acre, ditch checks may be installed; refer to WDNR conservation practice standard Ditch Check (1062).

For larger drainage areas and/or for sediment basins requiring an engineered outlet structure refer to WDNR conservation practice standard Sediment Basin (1064) or Wet Detention Basin (1001).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of sediment traps. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. **Timing** – Sediment traps shall be constructed prior to disturbance of up-slope areas and placed so they function during all phases of construction. Sediment traps shall be placed in locations where runoff from disturbed areas can be diverted into the traps.

B. **Sizing Criteria** – Properly sized sediment traps are relatively effective at trapping medium and coarse-grained particles. To effectively trap fine-grained particles, the sediment trap must employ a large surface area or polymers.

The specific trapping efficiency of a sediment trap varies based on the surface area, depth of dead storage, and the particle size distribution and concentration of sediment entering the device.

1. Surface Area – The minimum surface area of a sediment trap shall be based on the dominant textural class of the soil entering the device. The surface area calculated below represents the surface for the permanent pool area (if wet) or the surface area for the dead storage. This surface area is measured at the invert of the stone outlet (see Figure 1).

   a. For coarse textured soils (loamy sand, sandy loam, and sand):

$$A_{s\ (coarse)} = 625 * A_{dr}$$

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

b. For medium textured soils (loams, silt loams, and silt):

$$A_{s\ (medium)} = 1560 * A_{dr}$$

c. For fine textured soils (sandy clay, silty clay, silty clay loam, clay loam, and clay):

$$A_{s\ (fine)} = 5300 * A_{dr}$$

For the equations above:

A_s = surface area of storage volume in square feet
A_{dr} = contributory drainage area in acres

Note: The equations above were derived using a representative particle distribution for detached sediment for each textural class. Sediment traps designed based on this standard will achieve 80% reduction of suspended solids for the drainage area.

d. The surface area of sediment traps used in areas with fine to medium sized soils can be reduced when used in conjunction with water applied polymers. When employing polymers, size the surface area for controlling fine particles using the criteria for medium soils (V.B.1.b.) and when controlling medium sized particles use the sizing equation contained in (V.B.1.a.) for coarse soils. See WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051) for criteria governing the proper use and selection of polymers.

2. Depth – The depth of the sediment trap measured from the sediment trap bottom to the invert of the stone outlet, shall be at least three feet to minimize re-suspension and provide storage for sediment.

3. Shape – The sediment trap shall have a length to width ratio of at least 2:1. The position of the outlet to the inlet shall be as such to minimize short-circuiting of the water flow path.

4. Side Slopes – Side slopes shall be no steeper than 2:1.

Note: A sediment trap sized with the surface area equations above, a three-foot depth, and 2:1 side slopes will generally result in an 80% sediment reduction. Slopes flatter than 2:1 will require larger surface areas to provide adequate storage.

C. **Embankment –** Embankments of temporary sediment traps shall not exceed five feet in height measured from the downstream toe of the embankment to the top of the embankment. Construct embankments with a minimum top width of four feet, and side slopes of 2:1 or flatter. Earthen embankments shall be compacted.

Where sediment traps are employed as a perimeter control, the embankments shall have stabilization practices place prior to receiving runoff.

D. **Outlet –** Sediment traps shall be constructed with both a principal and emergency spillway. The stone outlet of a sediment trap shall consist of a stone section of embankment (stone outlet) located at the discharge point. The stone outlet section provides a means of dewatering the basin back to the top of the permanent storage between storm events, and also serves as a non-erosive emergency spillway for larger flow events.

1. Outlet Size – The size of the outlet shall depend on the contributory drainage area and desired outflow. The length of the stone outlet / weir outlet can be calculated based on the size of the drainage area found in Table 1. Refer to section IX References for the equation used to calculate flow through a stone outlet or gabion.

Table 1 Weir Length

Drainage Area (acres)	Weir Length (feet)
1	4.0
2	6.0
3	8.0
4	10.0
5	12.0

The emergency spillway (top of the weir) shall be sized to adequately pass the 10-year 24-hour storm without over topping the sediment trap. The crest of the spillway shall be at least one foot below the top of the embankment. The minimum weir lengths provided in Table 1 are adequate to pass the 10 year event.

Note: The weir length has little effect on overall treatment efficiency provided the sizing criteria in Section V.B. is adhered too.

The stone outlet shall have a minimum top width of 2 feet and a maximum side-slope of 2:1.

Discharge from the sediment basin shall be safely conveyed to a stormwater facility, drainage way, or waterbody. The discharge velocity shall be below the velocity to initiate scour unless appropriate stabilization methods are employed.

2. Stone Size – Stone shall consist of angular well graded 3 to 6 inch clear washed stone.

3. Keyway Trench – The stone outlet shall be protected from undercutting by excavating a keyway trench across the stone foundation and up the sides to the height of the outlet. See Figure 1. Underlying with geotextile fabric is optional.

E. Provide access for cleanout and disposal of trapped sediment.

VI Considerations

A. Sediment traps generally require excessive surface areas to settle clay particles and fine silts. If these conditions exist on the site consider using a sediment basin (DNR Conservation Practice Standard Sediment Basin 1064) or adding polymer to the sediment trap. See WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051) for criteria governing the use of polymers

B. To improve trapping efficiency, filter fabric can be placed on the up-slope side of the stone outlet / gabion and anchored with stone. When fabric is utilized to enhance filtering, more frequent maintenance is required to prevent clogging. When using fabric, a monofilament type fabric shall be used (such as WisDOT Type FF). The apparent opening size of the fabric, not the stone size, will dictate the flow rate through the outlet therefore outlet lengths need to be calculated since values in Table 1 are based on stone. When calculating the size of the outlet a clogging factor of 50% should be used for the fabric.

C. Consider possible interference with construction activities when locating sediment traps.

D. Provisions should be made for protecting the embankment from failure caused by storms exceeding the 10-year design requirement. Consider a stabilized and non-erosive emergency spillway bypass.

E. In general, groundwater impacts from temporary sediment traps that have storage areas in contact with groundwater are not a major concern. However, sediment trap contact with groundwater should be avoided in areas with karst features, fractured bedrock, or areas of significant groundwater recharge.

F. Sediment trapping is achieved primarily by settling within the pool formed by the trap. Sediment trapping efficiency is a function of surface area, depth of pool, and detention time. If site conditions permit, a length to width ratio greater than 2:1 will increase efficiency.

G. If site conditions prevent the sediment trap from having a three-foot depth, then an equivalent storage volume must be created through increasing the surface area.

H. For sediment traps in place longer than 6 months, consider outlets constructed of two types of stone. A combination of coarse aggregate and riprap (WisDOT light riprap classification) should be used to provide stability. A one-foot layer of one inch washed stone then should be placed on the up-slope face to reduce drainage flow rate.

VII Plans and Specifications

A. Plans and specifications for installing sediment traps shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

   1. Location and spacing of sediment traps

   2. Schedules and sequence of installation and removal

   3. Standard drawings and installation details

   4. Rock gradation

B. All plans, standard detail drawings, or specifications shall include a schedule for installation, inspection, maintenance, and identify the responsible party.

VIII Operation and Maintenance

Sediment Traps shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period. Sediment may need to be removed more frequently.

A. Deposits of sediment shall be removed when they reach a depth of one foot.

B. If the outlet becomes clogged it shall be cleaned to restore flow capacity.

C. Recommend provisions for proper disposal of the sediment removed from the trap.

D. Maintenance shall be completed as soon as possible with consideration given to site conditions.

E. Sediment traps shall be removed and the location stabilized after the disturbed area draining to the sediment trap is stabilized and no longer susceptible to erosion.

IX References

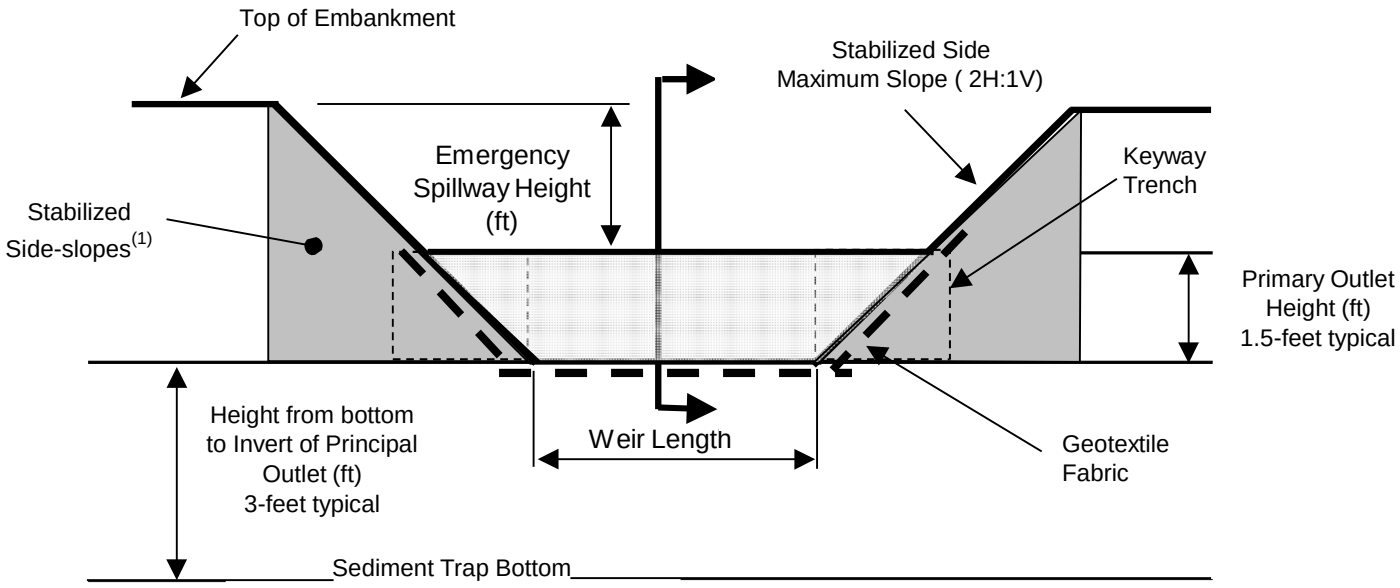
C. McIntyre, G. Aron, J. Willenbrock, and M. Deimler. Report No. 10: Analysis of flow through porous media as applied to gabion dams regarding the storage and release of storm water runoff. NAHB/NRC Designated Housing Research Center at Penn State, Department of Civil Engineering; August 1992.

X Definitions

Stabilized (III): Means that all land disturbing construction activities at the construction site have been completed and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures or that employ equivalent stabilization measures.

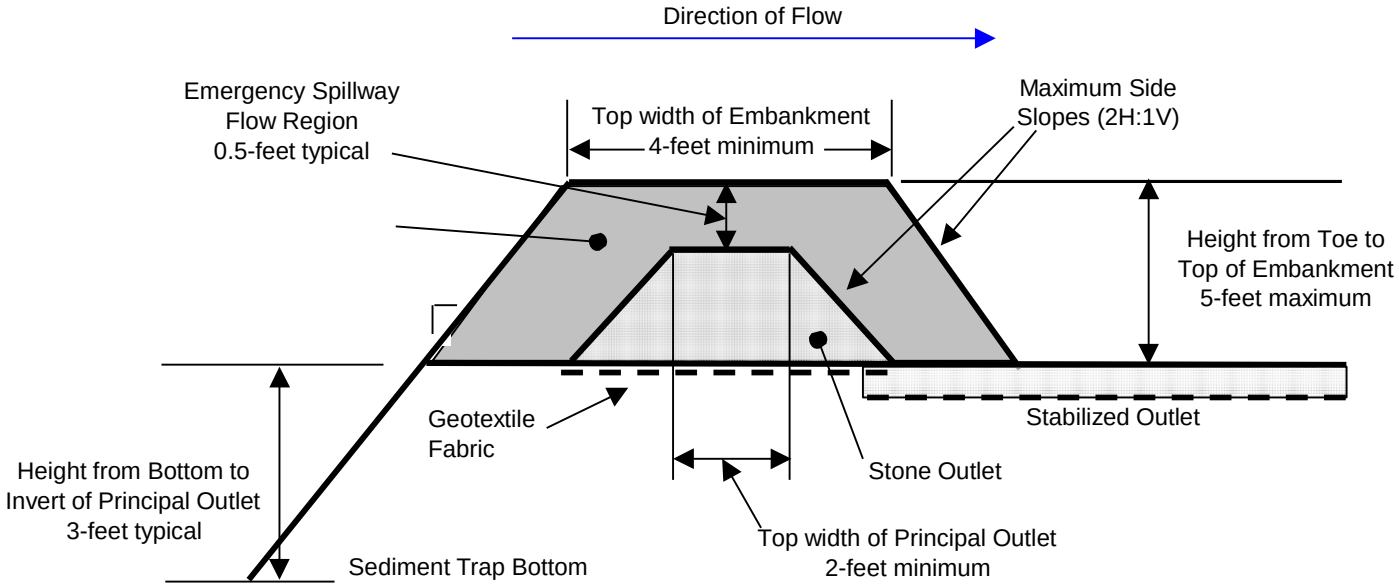
Temporary (I): An erosion control measure that is in place for the duration of construction or until the site is stabilized.

Figure 1: Sediment Trap Outlet Detail



Cross-section View of Principal Outlet

Notes: (1) Side-slopes and faces of earthen embankment around outlet shall be armored with riprap or stabilized with erosion mat sufficient to handle flows from the 10-year storm.



View A - A of Principal Outlet