Wetland Restoration

Technical Training and Certification Program

Minnesota Wetland Professional Certification Program

BOARD OF WATER AND SOIL RESOURCES

Technical Training and Certification Program

BWSR Wetland Section | www.bwsr.state.mn.us/wetlands

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Agenda

2024 Wetland Restoration - Hutchinson, MN

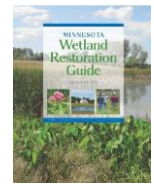
Day One - May 15, 2024

Topic	Speaker
Introductions & Housekeeping	
Intro Wetlands	Demmer
Planning Considerations	Deans
Break	
Site Assessment - Engineering	Peter
Site Assessment - Vegetation	Shaw
Lunch & Travel to Site	
Site Assessment Field Visit	Peter, Shaw, Carlson
End of Day	

Day Two - May 16, 2024

Wetland Restoration Design	Deans
Sed Mix Selection, Site Prep, and Seeding	Voigt, Shaw
Break	
Monitoring	Demmer, Meyer, Carlson
Lunch & Travel to Site	
Site Field Visit	Peter, Shaw, Carlson
End of Day	

MN Wetland Restoration Guide



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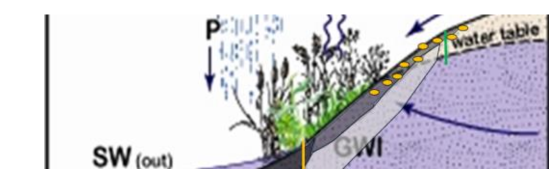

Introduction to the HGM Classes of MN Wetlands

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What is a Wetland?

Definition: Those areas inundated or saturated by surface or ground **water** at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of **vegetation** typically adapted to life in saturated **soil** conditions.

Hydrology + Vegetation + Soil = Wetland

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3 Parameters of a Wetland

- 3 Parameters of a wetland
  - Hydrology- frequency and duration of movement of water through a landscape
  - Soil- organic and mineral surfaces which often exhibit characteristics that it has been in saturated conditions
  - Vegetation- plant community and prevalence of species that have made adaptations to live in saturated conditions

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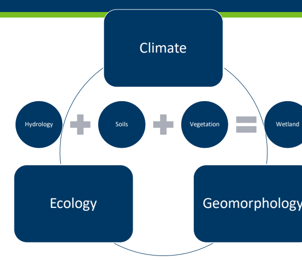
Key factors

- Climate
- Ecology
- Hydrology
- Geomorphology
- Soil
- Plant Communities
- Wetlands



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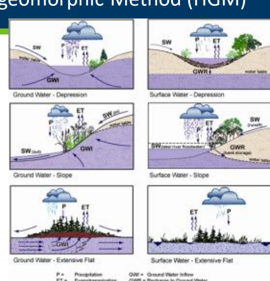
Hydrogeomorphic Method (HGM)

- Assesses functional conditions of a specific wetland referenced to data collected from wetlands across a range of physical conditions

- Established Classes based on geomorphic, hydrology and hydraulic functions of palustrine wetlands



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HGM Classes

- RIVERINE
- DEPRESSION
- SLOPE
- MINERAL SOIL FLATS
- ORGANIC SOIL FLATS
- ESTUARINE FRINGE
- LACUSTRINE FRINGE

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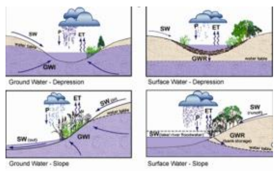
HGM Subclasses

- Determined by:
  - Hydrology Input:
    - Groundwater
    - Surface water
  - Hydrology Output
    - Surface
    - Ground



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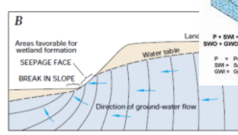
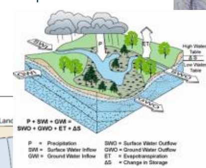
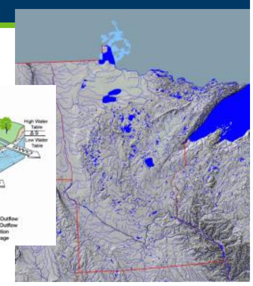
Parameters of HGM

- **Geomorphology**- landscape position, surface shape
- **Hydrology**- water source and output
- **Hydraulics**- hydrodynamics







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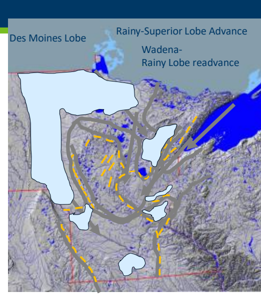
In MN, geomorphology is result of glacial geology

Recent Glacial Geology of MN



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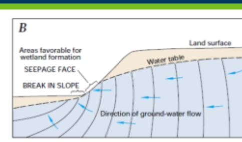
Hydraulics- how water moves



- Uni-directional
- Bi-directional
  - Estuarine and lacustrine fringe

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Hydrology of HGM Classes

HGM Class (subclass)	Hydrology Inputs	Hydrology Outputs	Hydraulics
RIVERINE	surface flow precipitation groundwater	surface flow evapotranspiration	unidirectional
DEPRESSIONAL- surface	surface flow precipitation	groundwater recharge evapotranspiration	unidirectional
DEPRESSIONAL- ground	groundwater precipitation	intermittent surface flow evapotranspiration groundwater recharge	unidirectional
SLOPED- surface	surface flow precipitation	surface flow evapotranspiration groundwater recharge	unidirectional
SLOPED- ground	groundwater surface water precipitation	surface flow evapotranspiration	unidirectional
MINERAL SOIL FLATS	precipitation intermittent surface flow	evapotranspiration intermittent surface flow	unidirectional
ORGANIC SOIL FLATS	groundwater precipitation	intermittent surface flow Evapotranspiration	unidirectional
ESTUARINE FRINGE	surface flow tidal exchange precipitation	tidal exchange surface flow Evapotranspiration	bidirectional
LACUSTRINE FRINGE	surface flow groundwater precipitation	return flow to lake surface flow evapotranspiration	bidirectional

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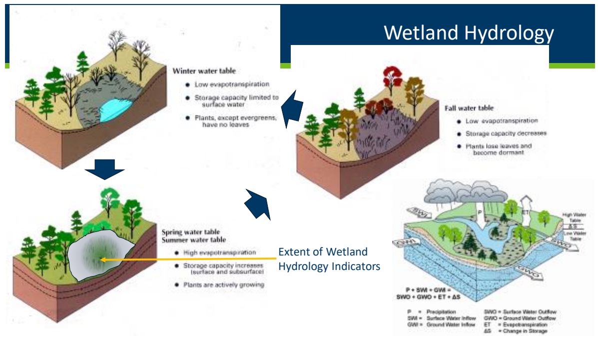
Wetland Hydrology



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Different water levels leave different evidence

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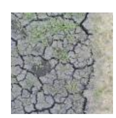
Hydrology Indicator Groups

Group A – direct observation of *water*



Group B – evidence of *flooding/ponding*

Group C – evidence of *current or recent saturation*.

Group D – *Landscape and veg. characteristics* that indicate contemporary wetland conditions.

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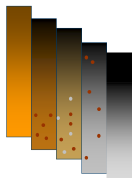
Hydric Soil Development

Hydric soils indicators develop in **anaerobic** conditions by the process of :

1. **Reduction** and Re-oxidation of Iron
2. **Organic Matter** Accumulation

Foundation of the Field Indicator Manual.



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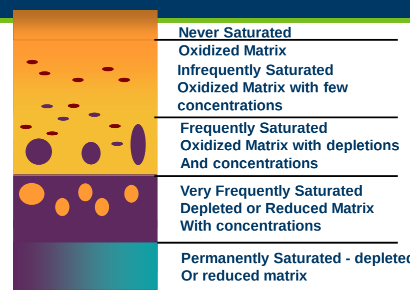
Hydric Soil Development and Duration under Aquic Conditions



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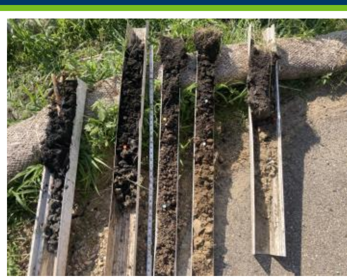
Hydric Soil Developed in Inundated Conditions



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Hydric Soil Developed in Saturated Conditions

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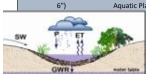
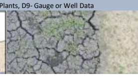
Common Indicators for Depression Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Depression	Seasonally Flooded	A1- Surface Water, B1- Water Marks, B3- Drift Deposits, B8- Sparsely Vegetated Concave Surface, B6- Surface Soil Cracks, C2-Dry-Season Water Table, D2- Geomorphic Position	A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, F8- Redox Depression, S1- Sandy Mucky Mineral, S5- Sandy Redox
Depression	Saturated	A2- High Water Table, A3- Saturation, B2- Sediment Deposits, C3- Oxidized Rhizospheres along living roots, C7- Thin Muck Surface, C9- Saturation Visible on Aerial Imagery, D2-Geomorphic Position, D5- FAC-neutral Test	A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, F8- Redox Depression, S1- Sandy Mucky Mineral, S5- Sandy Redox
Depression	Semi permanently flooded (up to 6")	A1- Surface Water, A2- High Water Table, B1- Water Marks, B7- Inundation Visible on Aerial Imagery, B14- True Aquatic Plants, D9- Gauge or Well Data	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, A11- Depleted Below Dark Surface, A12- Thick Dark Surface





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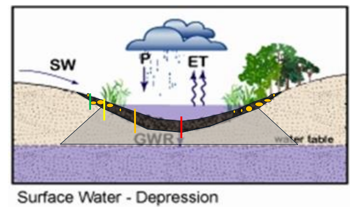
Cross Section of Hydric Soils in Depression Wetlands

- Histosol
- Thick dark surface
- Depleted below dark surface
- Redox dark surface



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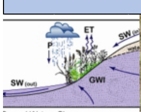
Common Indicators for Sloped Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Sloped	Saturated	A2- High Water Table, A3- Saturation, B8-Sparsely Vegetated Concave Surface, B15- Marl Deposits, C7- Thin Muck Surface, C9- Saturation Visible on Aerial Imagery, D2-Geomorphic Position, D5- FAC-neutral Test	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, S1- Sandy Mucky Mineral, S3- 2" Mucky Peat, S5- Sandy Redox



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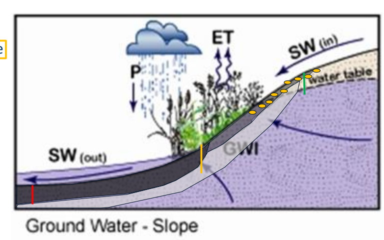
Cross Section of Hydric Soils in Sloped Wetlands

- Histosol
- Depleted below dark surface
- Redox Dark Surface



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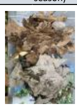
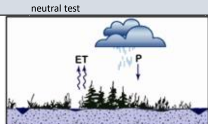
Common Indicators for Mineral Flat Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Mineral Flat	All regimes except permanently flooded (Saturated most of growing season)	A2- High Water Table, A3- Saturation, , B5- Iron Deposits, B9- Water-Stained Leaves, B10- Drainage Patterns, C2- Dry-Season Water Table, D2- Geomorphic Position, D3- Shallow Aquitard, D4- Microtopographic Relief, D5- FAC-neutral test	A11- Depleted Below Dark Surface, A12- Thick Dark Surface, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, S1- Sandy Mucky Mineral, S3- 2" Mucky Peat, S5- Sandy Redox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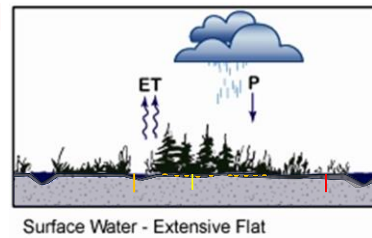
Cross Section of Hydric Soil in Mineral Flat Wetlands

- Depleted Below dark Surface
- Loamy mucky mineral
- Redox Dark Surface



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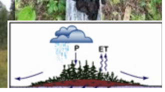
Common Indicators for Organic Flat Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Organic Flat	All regimes except permanently flooded (Saturated most of growing season)	A2- High Water Table, A3- Saturation, , B5- Iron Deposits, B9- Water-Stained Leaves, B10- Drainage Patterns, C2- Dry-Season Water Table, D2- Geomorphic Position, D3- Shallow Aquitard, D4- Microtopographic Relief, D5- FAC-neutral test	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, F1- Loamy Mucky Mineral, S1- Sandy Mucky Mineral, S3- 2" Mucky Peat
Organic Flat	Saturated	A2- High Water Table, A3- Saturation, C2- Dry-Season Water Table, D1- Stunted or Stressed Plants, D5- FAC-neutral test	A1- Histosol, A2- Histic Epipedon, A3- Black Histic



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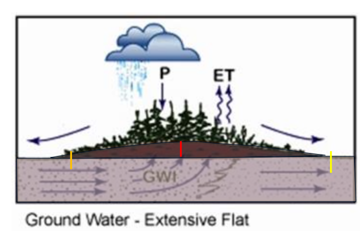
Cross Section of Hydric Soils in Organic Flat Wetland

- Histosol
- Histic Epipedon
- Loamy mucky mineral



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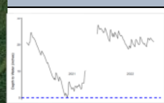
Common Indicators for Lacustrine Fringe Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Lacustrine Fringe	Semi permanently to permanently flooded (up to 8.2')	A1- Surface Water, A2- High Water Table, B1- Water Marks, B7- Inundation Visible on Aerial Imagery, B14- True Aquatic Plants, D9- Gauge or Well Data	A1- Histosol, A2- Histic Epipedon, A3- Black Histic, A11- Depleted Below Dark Surface, A12- Thick Dark Surface



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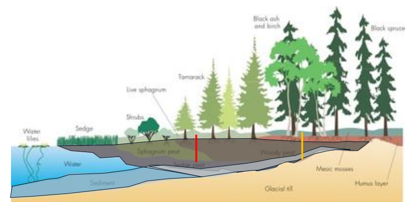
Cross Section of Hydric Soils in Lacustrine Fringe

- Histosol
- Thick Dark Surface



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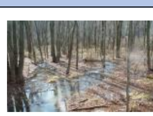
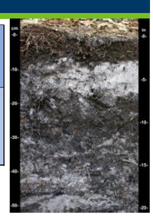
Common Indicators for Riverine Wetlands

HGM Class	Typical Water Regimes	Hydrology Indicators Common to Water Regime	Soil Indicators Common to Water Regime
Riverine	Temporary Flooded	B1- Water Marks, B2- Sediment Deposits, D3- Drift Deposits, B8- Sparcely Vegetated Concave Surface, B10- Drainage Patterns, C20 Dry Season Water Table, D2- Geomorphic Position	A5- Stratified Layers, F1- Loamy Mucky Mineral, F3- Depleted Matrix, F6- Redox Dark Surface, F8- Redox Depression, S1- Sandy Mucky Mineral, S5- Sandy Redox



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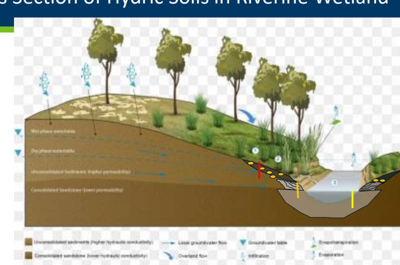
Cross Section of Hydric Soils in Riverine Wetland

- Redox dark surface
- Stratified Layers
- Depleted or Gleyed Matrix



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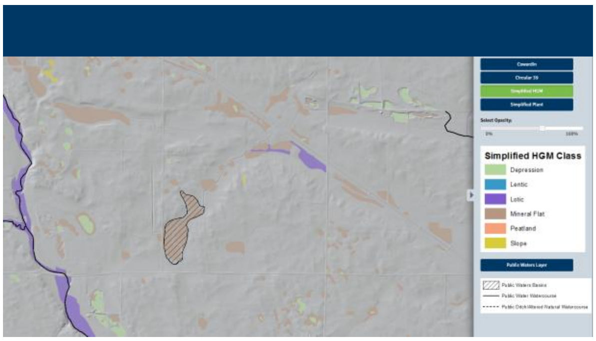

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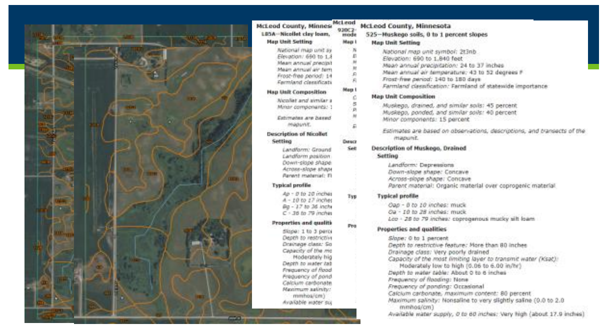

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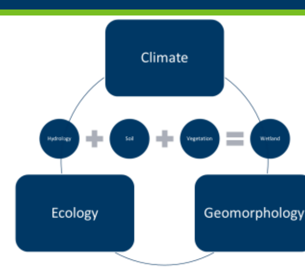
Main points to consider

- HGM Class and subclasses are based on geomorphology, hydrology and hydraulics
- Hydrology indicators provide evidence of water regimes
- But…hydrology is the shortest-term evidence of wetland indicators
- Soil indicators correlate with hydrology indicators and provide further evidence of water regimes
- Water regimes correlate with plant communities…



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Wetland Restoration Overview – Planning Considerations

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Wetlands in MN

- Wetlands cover 8.7 million Acres
- 9.7 million acres of Wetlands have been drained or filled

Source: BWSR Wetland Restoration Guide (U. of MN, 1984)

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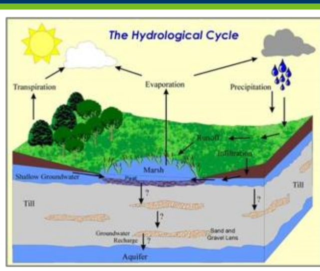
Hydrologic Cycle of Typical MN Pothole Wetland



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Wetland Benefits

- Erosion Control
- Flood Control
- Ground water recharge & Discharge
- Water quality
- Rare Species Habitat
- Recreation
- Wildlife Habitat

Source: BWSR Wetland Restoration Guide (U. of MN, 1984)

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What does Altered Wetland Mean?

- Decreases the input or increases the output

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Effectively Drained

- A condition where ground or surface water has been removed

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Restoration vs Creation vs Enhancement

- Wetland Restoration
- Wetland Creation
- Wetland Enhancement

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What NRCS Practice Standard Number am I??

	A. 657	B. 658	C. 659
Wetland Creation	A	B	C
Wetland Enhancement	A	B	C
Wetland Restoration	A	B	C

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What NRCS Practice Standard Number am I??

A. 657 B. 658 C. 659

Wetland Creation	A	B	C
Wetland Enhancement	A	B	C
Wetland Restoration	A	B	C

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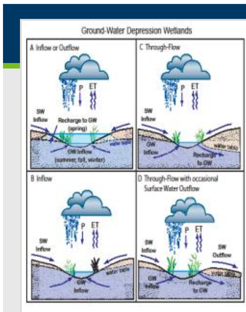
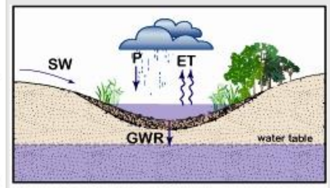
Depressional Wetland





Surface Water - Depression

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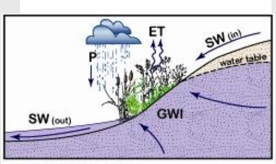
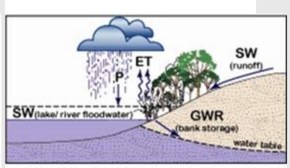
Sloped Wetlands

- Ground Water Supported
- Surface Water Supported



Ground Water - Slope



Surface Water - Slope

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Why is it important to know the type of Wetland?

- Influences how they were drained
- How to restore them

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Example

- Surface Water Supported Wetland



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Wetlands Farmed Under Natural Conditions

- Hydrology has not been manipulated
- Hydrophytic vegetation has been removed
- Often mapped by NRCS as a “W”

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Wetlands Farmed under Natural Conditions

- Restoration is achieved by re-establishing hydrophytic vegetation

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Drained and Altered Wetlands

- Hydrology has been manipulated
- Often mapped by NRCS as a “FW” and “PC”


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Drained and Altered Wetlands

- Restoration should address both hydrology and vegetation

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Common Restoration Strategies

- Tile Blocks
- Outletting Incoming Drainage Tile
- Rerouting Tile and Ditch Systems
- Removing, Relocating, and Installing Drainage Lift Stations
- Sediment/Vegetation Removal
- Ditch Blocks and Fills
- Earthen Embankments
- Wetland Outlets

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Statewide Wetland Restoration Strategy

- Developed in 2009
- Prioritize Restorations
- Improve coordination
- Design and Produce Better Wetland Restorations

Source: MN Wetland Restoration Guide

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Project Goals

- Targeted Wildlife
- Improve downstream water quality
- Flood Control
- Groundwater Protection
- Increased Landscape Diversity
- Targeted plant communities
- Specific management objectives

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Goals & Objectives

Source: MN Wetland Restoration Guide

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Goals

Objectives

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Considerations for Goals & Objectives

- Identify general goals
- Be realistic
- Be consistent with
  - Programs
  - Agencies
  - Sponsoring Organizations

Source: MN Wetland Restoration Guide

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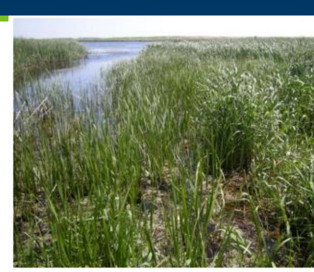
Restoring to Historic Conditions



Source: MN Wetland Restoration Guide

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Measurable Outcomes

Goal	Objective(s)	Outcome(s)
Provide high quality wildlife habitat and plant diversity	High interspersion of plant community types achieved by implementing a diverse seeding and management plan Selective shallow scraping to remove sediment and create deeper water regimes	At least 3 different plant community types composed of 12 or more native plant species Scraped areas with normal water depths from 0.5 to 2.5 feet during the growing season At least 3 nesting pair of waterfowl utilize the site each year
Improve flood conditions in downstream lake by attenuating floodwater	Establish dense upland and wetland vegetation to slow and intercept flood waters	At least 90% areal coverage of vegetation and at least 30% coverage by shrubs and trees
Restore seasonally flooded wet meadow	Break drainage tile to restore natural hydrology Establish diverse native vegetation in wetland and upland project areas	Surface water present in 50% of the basin for at least 14 consecutive days from May until June. At least 8 or more dominant native plant species in upland and wetland plant communities
Provide breeding habitat for amphibians	Construct earthen embankment across drainage ditch and install water control structure	At least 6 inches of surface water in 50% of the basin until June 1.

62

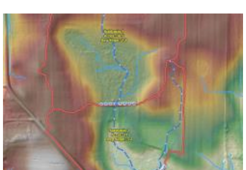
Recap

Type of Wetland

Goals

Objectives

63



Engineering Site Assessments for Wetlands

USDA MASWCD BWSR

Technical Training and Certification Program

May 2024

64

65

First glance

What are the first aspects of a site you should look for?

What has not changed over the years?

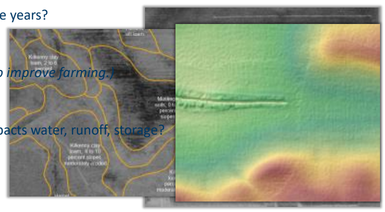
- SOILS

What <u>has</u> changed? *(-Likely, to improve farming.)*

- HYDROLOGY

What else hasn't changed; impacts water, runoff, storage?

- TOPOGRAPHY



66

Investigation role

You don't have to have all the answers but know what questions to ask.

The line from site assessment (i.e. what's possible and feasible) to design (what will actually work) is blurry!

67

PROGRAM RULES

68

C3softworks games

https://bravozone.us

ID: 0097

You'll need to enter your name (first name is fine)

- *Questions are 30 sec.*
- *Have EFH Fig 14-34 ready*

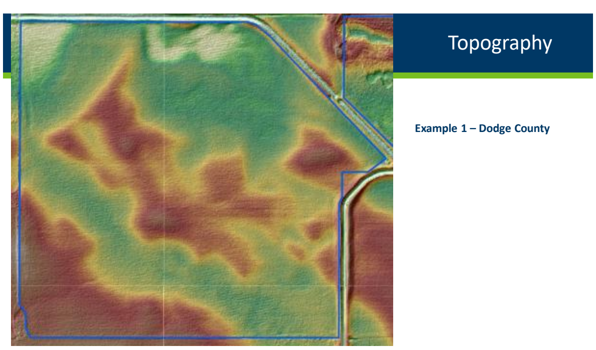
69


Example 1 – Dodge County
3_Jackson_Binder.pdf
2_Freeborn_Binder.pdf
1_Dodge_Binder.pdf

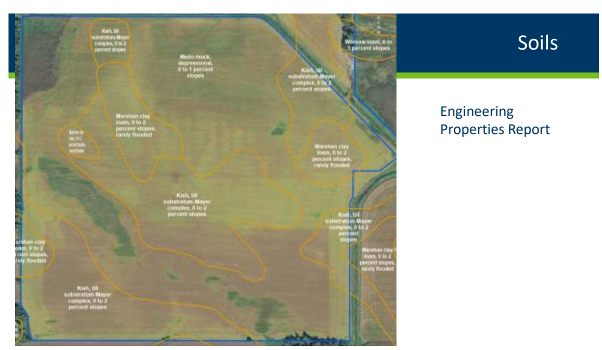
74


Example 1 – Dodge County
July 27, 2019 photo
5.4" rain
11
0.85
0.09
0.89
0.47
2.53
0.40
0.00
0.00
0.00
0.00
0.20
S

75


Topography
Example 1 – Dodge County

76


Soils
Engineering Properties Report

77

78

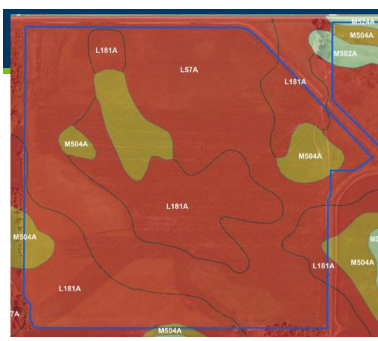
NWI

Example 1 – Dodge County

NWI Circular 39 layer

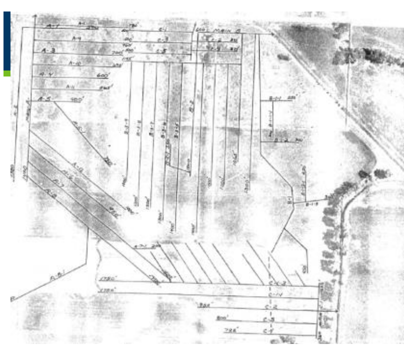
- Seasonally Flooded Basin
- Shallow Marsh

79



Soils - Hydric

80



Tile Maps

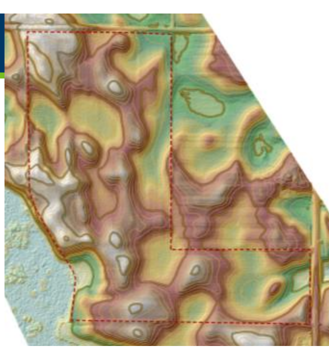
- Cut off neighbor's outlet
- Flows leaving easement (i.e. damage)
- Receive water in areas we didn't expect
- Drain otherwise restorable areas

81

82

Example 2 – Freeborn County

83

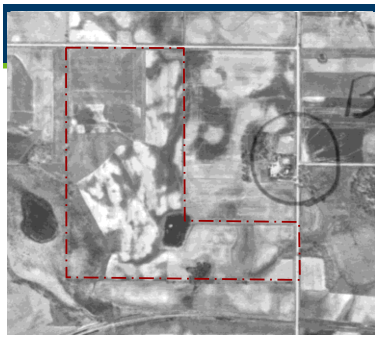


Example 2 – Freeborn County

84

Example 2 – Freeborn County

85

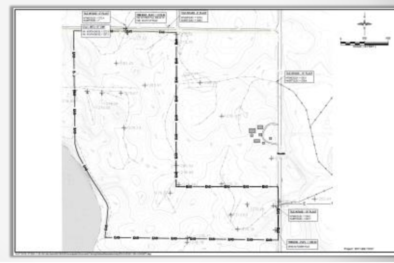


Example 2 – Freeborn County

August 1938
May 1951

86

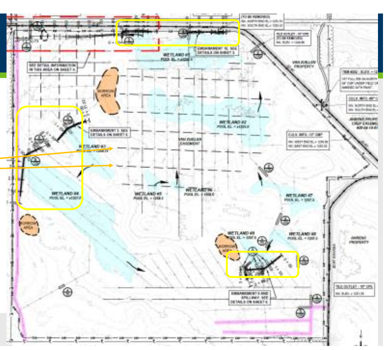
work in small groups



87

#1 -Dodge Co site

- 5 embankments (w/ spillways)
- Tile breaks (ripped)
- One new side inlet



88

#2 -Freeborn Co site

89

#2- Freeborn Co. site

South / East

Design Totals:

- 4 embankments
- 1275 LF tile breaks
- 515 CY scrapes

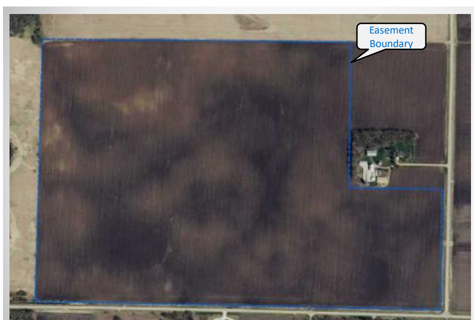
90

Design Example

Example 3 – Jackson County

Site assessment today, design tomorrow

91



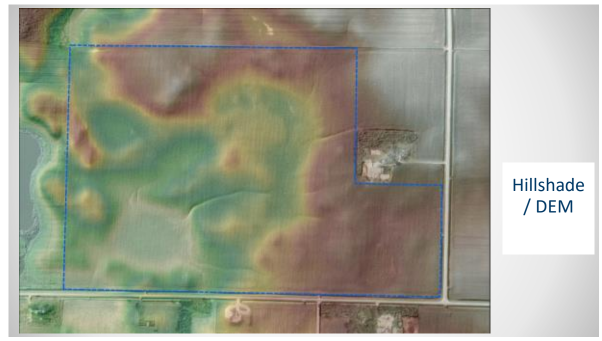
92

1938

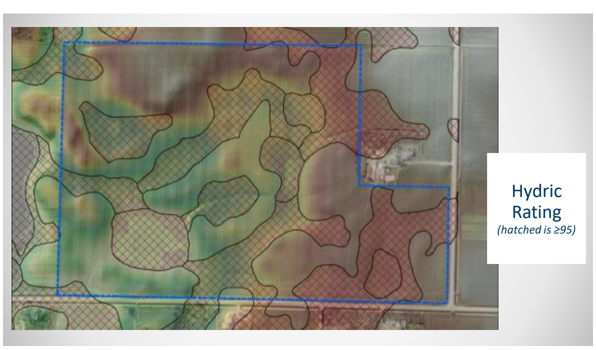
93


1954

94


Hillshade / DEM

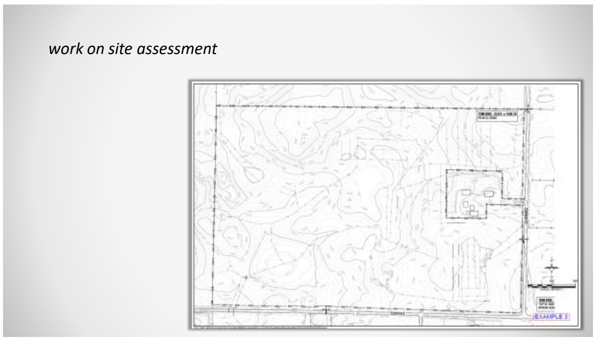
95


Hydric Rating
(hatched is ≥95)

96


Prelim Tile Map

97


work on site assessment

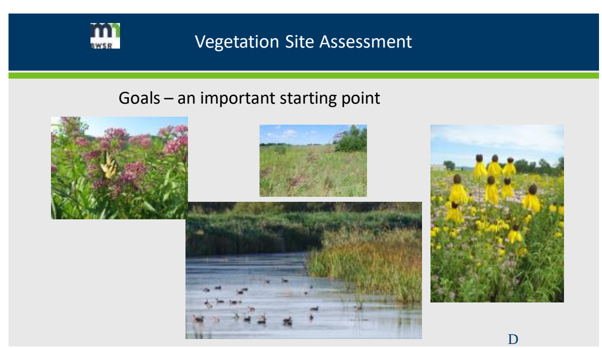
98


Identify restoration potential on #3 example
This is a different RIM restoration

99


Wetland Site Assessment - Vegetation
2024
BOARD OF WATER AND SOIL RESOURCES
Optional Tagline Goes Here | mn.gov/websiteurl
D

100


Vegetation Site Assessment
Goals – an important starting point
D

101

Vegetation Site Assessment

Potential Vegetation Goals – Project Scale

D

102

Vegetation Site Assessment

Potential Vegetation Goals – Project Scale

- Restore to historic plant communities
- Stabilize soils
- Restore plant diversity
    - Restore a resilient plant community
    - Benefit at-risk wildlife
    - Benefit game species
    - Benefit overall wildlife biodiversity
- Meet mitigation performance standards or other program requirements
- Landowner goals

D

103

Vegetation Site Assessment

D

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Site Assessment

Site Assessment Table

Site Assessment Table

Information	Importance for Restoration Plan Development	Comments
Site History	Historical landuse can have a big influence on the potential for native seedbank and soil health, as well as the presence of weeds.	
Surrounding Landuse and Stressors	Surrounding landuses can cause sedimentation, the introduction of pollutants, nutrients or pesticides, as well as the introduction of aggressive species.	
Topography	Site contours will help determine potential areas of nutrient and pollutant concentrations as well as planting zones, seed mixes, and other planting strategies.	
Geology and Soils Information	Geology and soils influence erosion potential as well as nutrient levels, infiltration rates and seeding zones.	
Hydrology	The flow of water, areas of concentrated flow, depth to groundwater influence restoration strategies and appropriate seed mixes and other plant materials.	
Existing Vegetation/Seedbank	Existing native or invasive species plants or seed influences the planning of site preparation, planting, and maintenance strategies.	
Unique Natural Resources	Fens, seeps, rare species, nesting locations and rock outcrops are all examples of unique natural resources that should be noted as part of the site assessment.	
Wildlife Specific Opportunities	Opportunities such as connections that can be made between habitats and opportunities to maximize habitat for specific species should be incorporated into the restoration plan.	
Other Opportunities		

D

105

Site Assessment

Site
Assessment
Table

Site Assessment Table	
Information	Importance for Restoration Plan Development
Site History	Historical landuse can have a big influence on the potential for native seedbank and soil health, as well as the presence of weeds.

D

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Site History

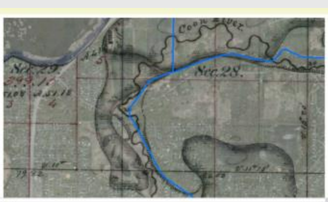
•Site History

- General history (photos, land survey, vegetation)
- Agriculture (types, duration, and intensity) (Landowner)
- Hydrology alteration (Landowner/Engineers)
- Previous restoration (Landowner/Conservation District)
- Site management (Landowner/Conservation District)

D

107

Site Hisory



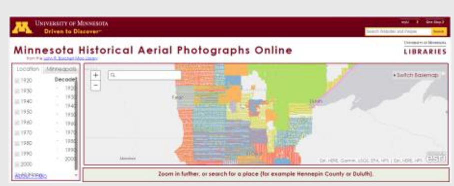
1855 public land survey map overlaying recent aerial imagery

The Public Land Survey System (state.mn.us)

D

108

Site History



MHAPO (umn.edu)

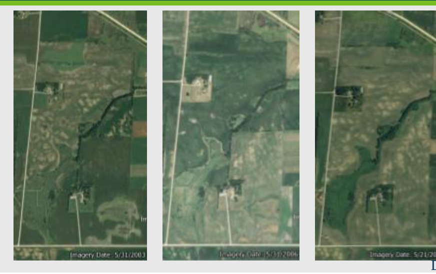
109

Site History

D

110

Site History – Field Site



D

111

Site Assessment

Site
Assessment
Table

Surrounding Landuse and Stressors	Surrounding landuses can cause sedimentation, the introduction of pollutants, nutrients or pesticides, as well as the introduction of aggressive species.

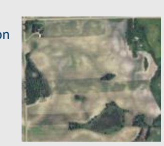
D

112

Surrounding Landuse and Stressors

•Surrounding Landuse and Stressors

- Adjacent or nearby Native plant communities
- Surrounding Agriculture (types, duration, and intensity)
- Surrounding Industry
- Surrounding Nutrient Sources
- *Chemical use
- Surrounding Hydrology alteration



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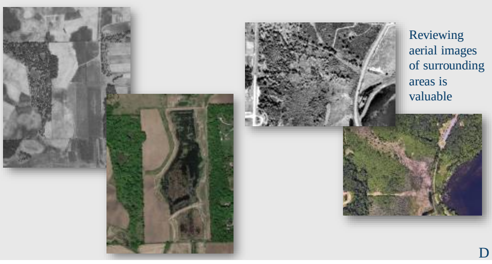
113

Surrounding Landuse and Stressors



Reviewing aerial images of surrounding areas is valuable

D

114

Surrounding Landuse and Stressors

Potential Site Stressors

- -Water Fluctuations
- -High Nutrients
- -Sediment
- -Pollutants
- -Invasive Plants
- -Herbivores

D

115

Surrounding Land use and Stressors

Potential Site Stressors

D

116

Surrounding Land use and Stressors

Is reed canary grass present in or around the site?

D

117

Surrounding Landuse and Stressors

Are cattails present or a risk?

D

118

Surrounding Landuse and Stressors

Surrounding landuse can be positive. Surrounding reference sites can be valuable for understanding restoration potential and as a seed source.

D

119

Site Assessment

Site
Assessment
Table

Topography	Site contours will help determine potential areas of nutrient and pollutant concentrations as well as planting zones, seed mixes, and other planting strategies.

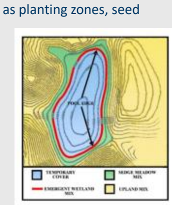
D

120

Topography

•Topography

Site contours will help determine potential areas of nutrient and pollutant concentrations as well as planting zones, seed mixes, and other planting strategies.



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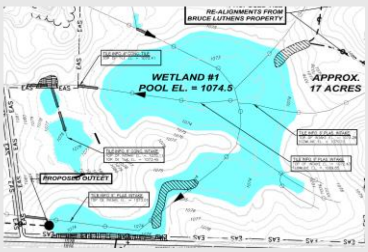
121

Topography



D

122

Geology and Soils

Site Assessment Table

Geology and Soils Information	Geology and soils influence erosion potential as well as nutrient levels, infiltration rates and seeding zones.	

K

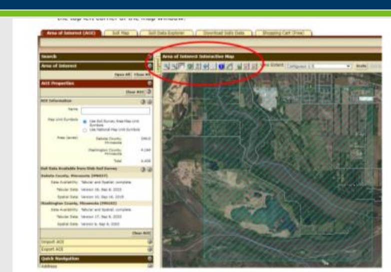
123

Geology and Soils

K

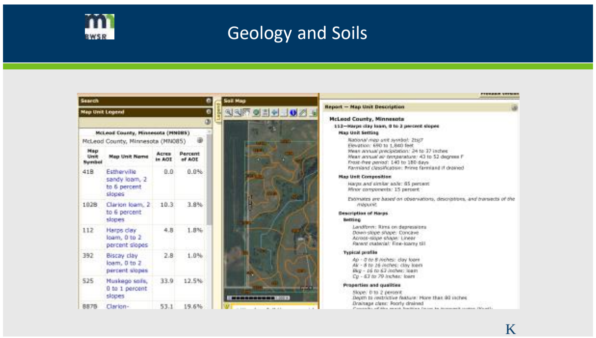
124

Geology and Soils

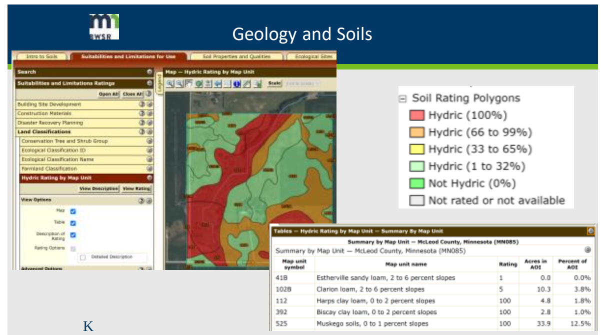


K

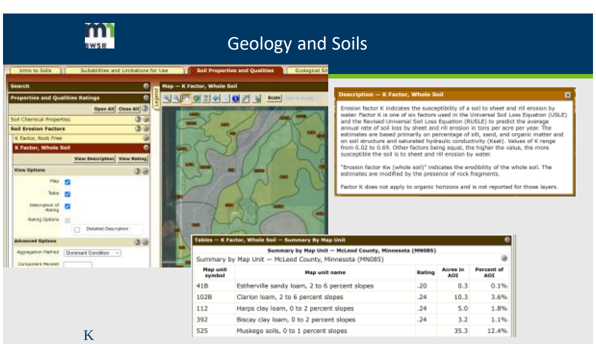
125



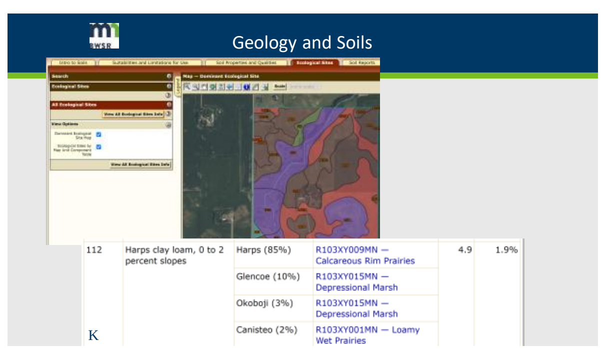
126



127



128



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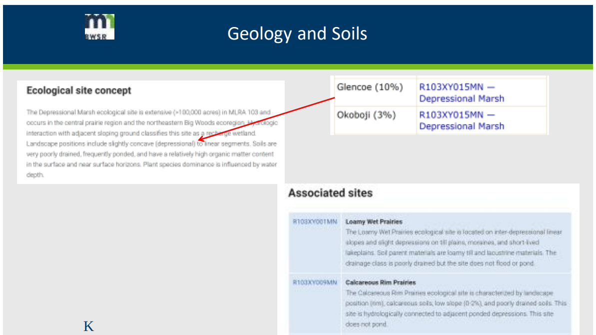

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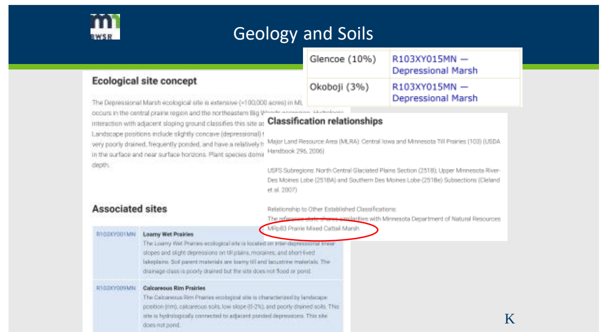

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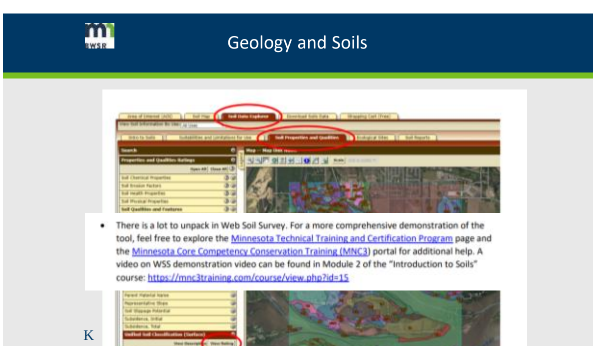
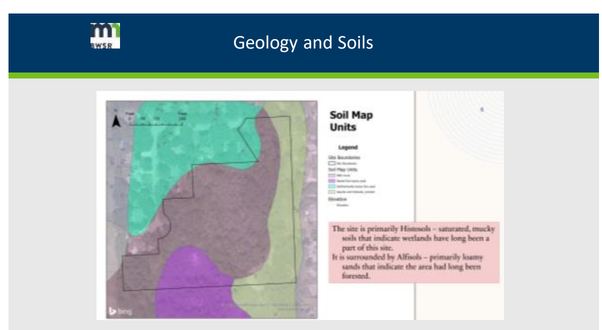
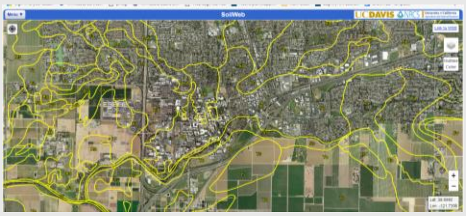


132



133

Geology and Soils



K

134

Hydrology

Site Assessment Table

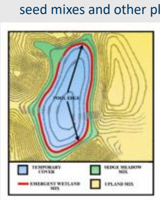
Hydrology	The flow of water, areas of concentrated flow, depth to groundwater influence restoration strategies and appropriate seed mixes and other plant materials.

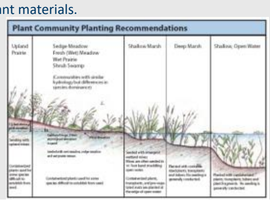
D

135

Hydrology

•Hydrology
The flow of water, areas of concentrated flow, depth to groundwater influence restoration strategies and appropriate seed mixes and other plant materials.





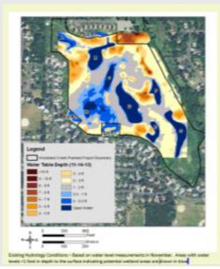
136

Hydrology

- Pool elevation - seed a narrow band of emergent mix (10 feet wide) straddling pool elevation. Seed will germinate and plants will grow into emergent zone
- Pool elevation to 1-2 feet in elev. above pool (or saturated soils) - seed wet meadow mix
- Pool elevation plus 1-2 feet and higher - seed an upland mixes

137

Hydrology



138

Existing Vegetation and Seedbank

Site Assessment Table

Existing Vegetation/Seedbank	Existing native or invasive species plants or seed influences the planning of site preparation, planting, and maintenance strategies.

139

Existing Vegetation and Seedbank





140

Existing Vegetation and Seedbank

141

Existing Vegetation and Seedbank



142

Existing Vegetation and Seedbank

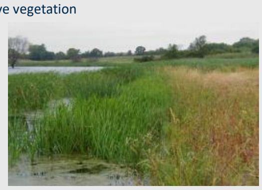



143

Existing Vegetation and Seedbank

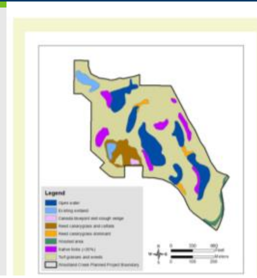
Assessing Existing Vegetation

-Early successional weeds
-Invasive vegetation
-Native vegetation



144

Existing Vegetation and Seedbank



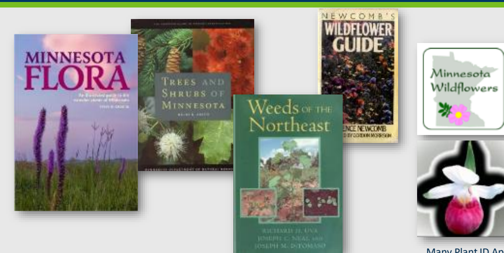
145

Existing Vegetation and Seedbank

K

146

Existing Vegetation and Seedbank



K

Many Plant ID Apps

147

Existing Vegetation and Seedbank

K

148

Existing Vegetation and Seedbank

Cropping duration and frequency, soil types and connection to natural wetlands influences seedbank

Beltrami County Wetland Restoration

149

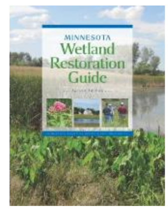
Existing Vegetation and Seedbank

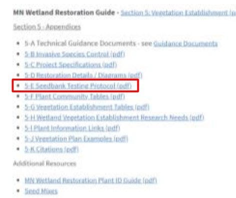
Benefits:
Good method to maximize the Use of local species.

Limitations:
Some species are not common from seedbank. It can be difficult to find seedbank layers where sediment accumulation has occurred.

150

Existing Vegetation and Seedbank




MN Wetland Restoration Guide - Section 5: Vegetation Establishment (pdf)

Section 5 - Appendices

- 5-A Technical Guidance Documents - see Guidance Documents
- 5-B Invasive Species Control (pdf)
- 5-C Project Specifications (pdf)
- 5-D Restoration Details / Diagrams (pdf)
- 5-E Seedbank Testing Protocol (pdf)
- 5-F Plant Community Tables (pdf)
- 5-G Vegetation Establishment Tables (pdf)
- 5-H Wetland Vegetation Establishment Research Needs (pdf)
- 5-I Plant Information Links (pdf)
- 5-J Vegetation Plan Examples (pdf)
- 5-K Citations (pdf)

Additional Resources

- MN Wetland Restoration Plant ID Guide (pdf)
- Seed Mixes

151


APPENDIX
5E Seed Bank Testing Protocol

Seed Bank Composition of Wetlands – Seed Emergence Methodology
Developed by Jeff Lee of Barr Engineering

- Field collection of soil samples
- Grow and document seedlings over the course of four months

152

Unique Natural Resources

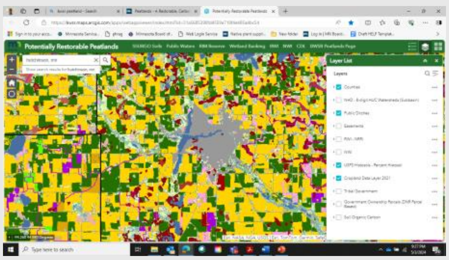
Site Assessment Table

Unique Natural Resources	Fens, seeps, rare species, nesting locations and rock outcrops are all examples of unique natural resources that should be noted as part of the site assessment.

Peatlands - A Restorable, Carbon-Rich Resource | MN Board of Water, Soil Resources (state.mn.us)

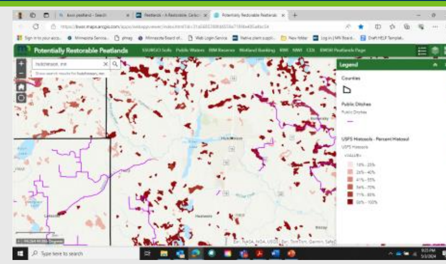
153

Unique Natural Resources



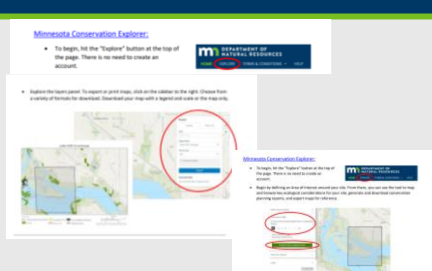
154

Unique Natural Resources



155

Unique Natural Resources



156

Wildlife Specific Opportunities

Site Assessment Table

Wildlife Specific Opportunities	Opportunities such as connections that can be made between habitats and opportunities to maximize habitat for specific species should be incorporated into the restoration plan.

157

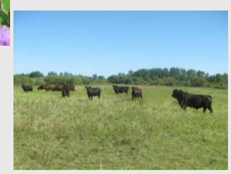
Wildlife Specific Opportunities

•Wildlife Specific Opportunities

Opportunities such as connections that can be made between habitats and opportunities to maximize habitat for specific species should be incorporated into the restoration plan.


158

Wildlife Specific Opportunities


159

Other Opportunities

Site Assessment Table

Other Opportunities	

Incorporate Landowner Preferences, as able
Cultural Resources
Timelines

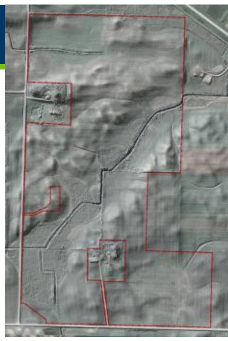
160

Vegetation Site Assessment

Questions?



161



Field Site – Banking Site

½ mi. wide x 1 mi. tall

294 ac.

162

1940
1955

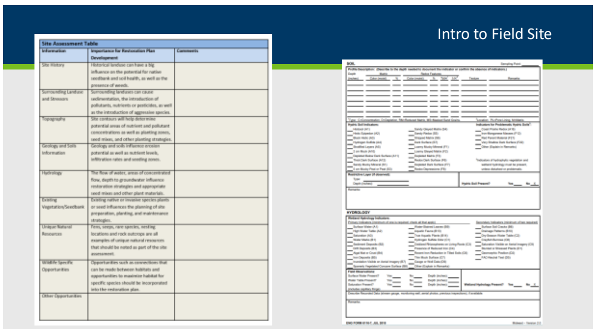
163

North
Half

164

South
Half

165



Site Assessment Table		
Information	Importance for Restoration Plan Development	Comments
Site History	Historical landuse can have a big influence on the potential for native seedbank and soil health, as well as the presence of weeds.	
Surrounding Landuse and Stressors	Surrounding landuses can cause sedimentation, the introduction of pollutants, nutrients or pesticides, as well as the introduction of aggressive species.	
Topography	Site contours will help determine potential areas of nutrient and pollutant concentrations as well as planting zones, seed mixes, and other planting strategies.	
Geology and Soils Information	Geology and soils influence erosion potential as well as nutrient levels, infiltration rates and seeding zones.	
Hydrology	The flow of water, areas of concentrated flow, depth to groundwater influence restoration strategies and appropriate seed mixes and other plant materials.	
Existing Vegetation/Seedbank	Existing native or invasive species plants or seed influences the planning of site preparation, planting, and maintenance strategies.	
Unique Natural Resources	Fens, seeps, rare species, nesting locations and rock outcrops are all examples of unique natural resources that should be noted as part of the site assessment.	
Wildlife Specific Opportunities	Opportunities such as connections that can be made between habitats and opportunities to maximize habitat for specific species should be incorporated into the restoration plan.	
Other Opportunities		

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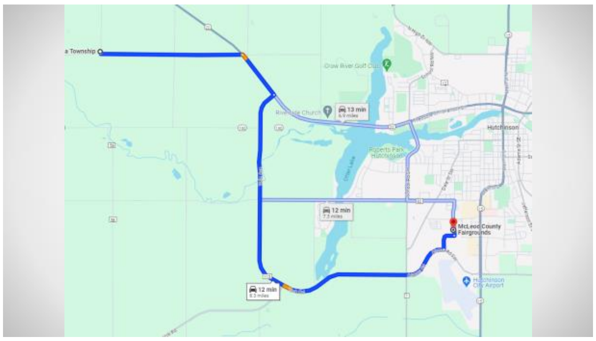
a Township
13 min
6.9 miles
Hutchinson
12 min
7.3 miles
McLeod County Fairgrounds
12 min
8.3 miles
Hutchinson City Airport

170