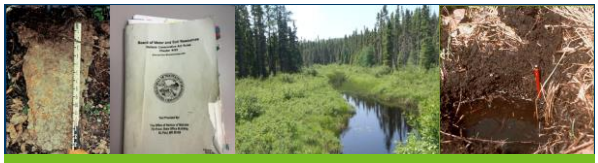

MN Wetland Professional Certification Program
Wetland Delineation Methods

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Agenda

Day 1 (9-5)

- Introductions
- 3 parameters of a Wetland
- Wetland Delineation Methods
- Critical Definitions of Wetlands
- Wetland Classification systems
- Wetland Functions
- Wetland Hydrology Indicators
- Top of Data Sheet & Hydrology Indicators Field Exercise

Day 2 (9-5)

- Quiz
- Web Resources for Wetland Professionals
- Antecedent Precipitation Exercise
- Offsite Hydrology Methods
- Soil Concepts
- Hydric Soil Indicators
- Web Soil Survey Exercise
- Soil Texture Lab & Field Exercise along Landform

Day 3 (9-5)

- Wetland Vegetation
- Vegetation Sampling Plot Field Exercise
- Submitting Wetland Delineation Reports
- Wetland Delineation Field Exercise & Class summary

2

MWPCP Class Portal

3

MWPCP CORE CURRICULUM

1) **Wetland Conservation Act (WCA)-** MN Rule Chapter 8420 and underlying Statute, Agency Guidance
2) **Purpose-** No net loss; increase quantity, quality & biological diversity; avoid, minimize, replace
3) **Scope-** What WCA Regulates & does NOT regulate
4) **Other Regulatory Programs-** Section 404 of the Clean Water Act, MN Public Waters Program, NRCS Swampbuster
5) **Local Government Unit (LGU)-** Determining the LGU & LGU Duties
6) **Technical Evaluation Panel (TEP)-** TEP members, procedures, meetings, recommendations, and findings of fact.
7) **Critical Definitions-** Important WCA and delineation manual definitions
8) **Wetland Classification Systems-** Circular 39, Cowardin, Eggers & Reed, Hydrogeomorphic method
9) **Wetland Ecology & Functional Assessment-** Understanding wetland functions and values, assessment methods
10) **Wetland Delineation-** USACE 1987 Manual and Regional Supplements & guidance documents
    a) **Vegetation-** Plant ID, plant communities, definition of a hydrophyte, National Wetland Plant List, plant indicator status, determining hydrophytic vegetation, problematic vegetation
    b) **Soil-** Definition of hydric soil, key physical properties, textural divisions, Web Soil Survey, Field Indicators of Hydric Soils
    c) **Hydrology** - Hydrology technical standard, hydrology indicators, antecedent precipitation, offsite aerial imagery review

1) **Application Procedures-** General WCA application requirements, determining a complete application, file management
2) **Noticing Requirements-** Notice of Application, Notice of Decision, timelines
3) **Boundary and Type Applications-** Required report components, site review
4) **No-Loss Criteria-** Activities with no permanent loss or impact to wetlands
5) **Exemption Standards-** Impacts to wetlands that do not require replacement
6) **Replacement plans-** Purpose & requirement, application requirements, approval conditions, special considerations, sequencing, replacement standards
7) **Wetland Banking** – Purpose, bank types, actions eligible for credit, establishing a wetland bank, restoration construction methods, certification and deposit of credits, replacement for public road projects, monitoring and corrective actions, withdrawals and transfers
8) **Enforcement & Appeals-** Enforcement procedures, Agency Roles in violations, restoration methods, voluntary restorations, appeal process

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Science first, then apply policy

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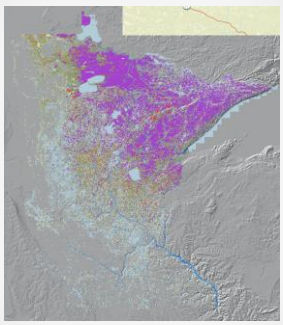

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Pop Quiz

According to the 2019 Minnesota update of the National Wetland Inventory, how many acres of wetlands are in MN?

A) 6.3 million acres

B) 10.5 million acres

C) 12.2 million acres

D) 24.4 million acres

7



Three Parameters of a Wetland

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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

9

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

10

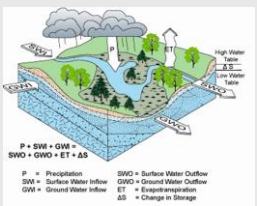
Hydrology

…"inundated or saturated by surface or ground water at a frequency and duration"

- Technical standard of 14 or more consecutive days of flooding or ponding;
- Water table 12 in. or less below soil surface;

11

Hydrology



- Inputs
  - Precipitation
  - Surface water inflow
  - Groundwater inflow
- Outputs
  - Surface water outflow
  - Groundwater outflow
  - Evapotranspiration

12

Hydrology Indicators

Evidence that there is continuing hydrology and confirms that an episode of inundation/saturation occurred recently.

Wetland hydrology indicators are divided into two categories:

- Primary – provide stand-alone evidence of a current or recent hydrologic event; and
- Secondary – provide evidence of recent hydrology when supported by one or more other hydrology indicators.

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Soil

"…sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions"

14

Hydric Soil

- A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding **long enough** during the **growing season** to develop anaerobic conditions in the **upper part**.

15

Hydric Soil Indicators

Based on key physical properties: color & texture

And the depth & thickness where they are found

16

Vegetation

"…sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions"

Wetland Indicator Status	Definition
Obligate Wetland (OBL)	Almost always occur in wetlands
Facultative Wetland (FACW)	Usually occur in wetlands, but may occur in non-wetlands
Facultative (FAC)	Occur in wetlands and non-wetlands
Facultative Upland (FACU)	Usually occur in non-wetlands, but may occur in wetlands
Obligate Upland (UPL)	Almost never occur in wetlands

National Wetland Plant List, 2016, V3.3
http://rsgisias.crrel.usace.army.mil/NWPL/

17

Hydrophytes

Adaptations to saturated environment:

- morphological (multiple trunks, floating leaves)
- physiological (metabolic pathways)
- reproductive (floating seedlings)

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Dominance Tests

Methods to determine dominance of hydrophytic vegetation:

- Rapid test
- Dominance test (50/20)
- Prevalence Index
- Morphologic adaptations

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Rapid Test Example

Hydrophytic Vegetation?

20

Quiz

- What are the three parameters that define a wetland?

Hydrology + Vegetation + Soil = Wetland

21

Basic Overview of Wetland Delineation

22

3-Parameter/ Indicator Approach

1. **Soils** –Longest term evidence, Historic conditions, may not reflect current condition.
2. **Hydrology** –Current condition, shortest term evidence but heavily influenced by recent climate conditions
3. **Vegetation** – Somewhere between

The 87 Manual requires 3 parameters because one source typically gives the answer in all situations

23

87 Manual and Regional Supplements

24

Wetland Delineation Types

Routine – Qualitative Data
- Indicator based (veg, soil, hydro)
- Representative sample points
- Estimate and interpret data
- 3-Types of delineations

Comprehensive – Quantitative Data
- Systematic sampling
- Precise measurements

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Wetland Delineation Types

ROUTINE

Level 1 - Onsite Inspection Unnecessary

Level 2 - Onsite Inspection Necessary

Level 3 - Combination of Levels 1 and 2

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Wetland Delineation Types

Routine Level 1

Use when exact wetland boundary **not necessary**

Proposed Shed

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Routine Level 1

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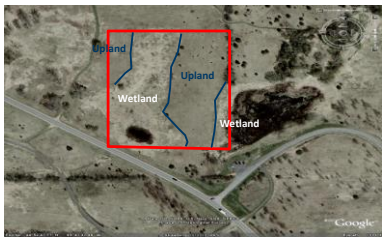
Routine Level 1



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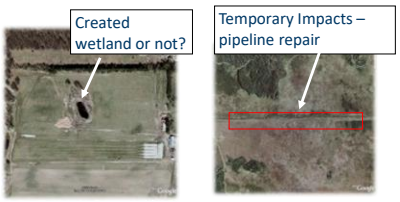
Routine Level 1 Examples



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Wetland Delineation Types

Routine Level 2

- Use when an accurate boundary is critical
- Need a formal boundary approval
- Most used and focus of class

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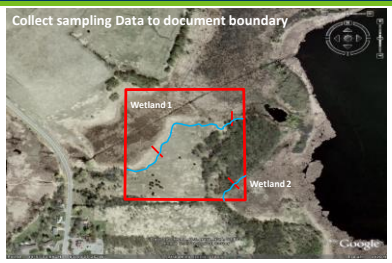
Routine 2



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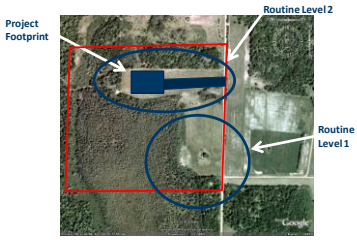
Routine Level 3

Combination of Levels 1 and 2



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Routine Level 3

34

Wetland Delineation Types

Comprehensive Delineation Method

- Complex, requiring rigorous documentation and coordination
- Quantitative Measurements of:
  - Hydrology
  - Vegetation
  - Soils
- Combine with other methods

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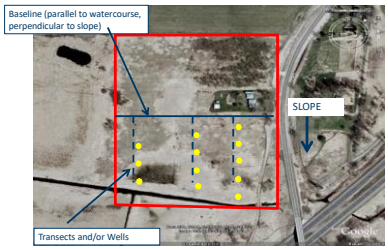
Comprehensive Delineation



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Routine Level 2 Process

1. Research data sources
   - Know site before visit
   - Saves time and effort
2. Field visit and data collection
   - Data collection
   - Preponderance of evidence
3. Delineate wetland boundary
   - Document indicators of wetland/non-wetland decision
   - Only after multiple informal observations

37

Offsite Resources = Data Sources

- Aerial Photos (current and historic)
- Soil map (Web Soil Survey)
- Topographic\LiDAR
- NWI Map (updated version in MN)
- DNR Public Waters Map

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Routine Level 2 Process

- **Field Visit and Data Collection**
- Use preliminary map to make a plan
- Recon site and make informal observations and samples
- Make notes about general characteristics
  - Plant Communities
  - Topographic changes-Landscape position
  - Changes in soils
  - Precipitation conditions (wet-dry)
- Delineate Wetland Boundary

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Field Equipment

40

Sample Points

1. Top section of data sheet
   - Documents sample location and landscape setting
   - Site conditions Wet-Dry
2. Vegetation
   - ID species to determine if plant community is hydrophytic
   - Record comments on changes in vegetation
3. Soil
   - Describe soil and determine if it is hydric
   - Record comments on changes in soil

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Sample Points

4. Topography
   - Record changes in topography
     - Abrupt
     - Gradual
     - Geomorphic position
5. Other notable remarks and observations
   - Basis for delineation line (sharp topo/veg break)
   - Hydrology inputs and outputs

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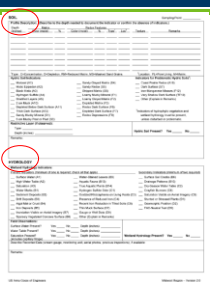
It's all about the documentation!



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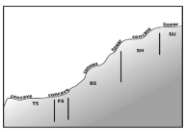
It's all about the documentation!



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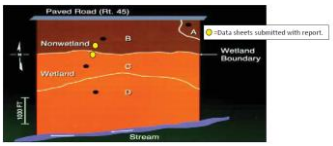
Sampling Location Should Be Representative

- Representative of soil changes (from upland to wetland)
- Representative of vegetation changes
- Representative of hydrology indicator changes
- Representative of landscape changes



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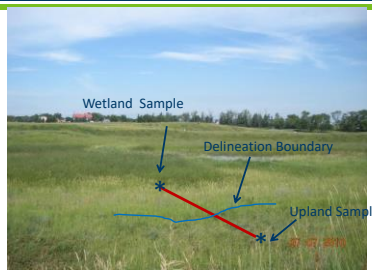
Routine Level 2 Sampling Transects



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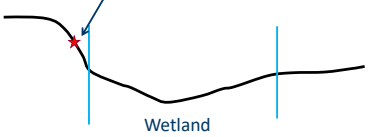
Sample location is important!

Good data collection cannot compensate for poor sampling location choices.

47

Common Errors – The "safe" approach

Choosing sampling location in area with the clearest boundary while ignoring the "tough" area.



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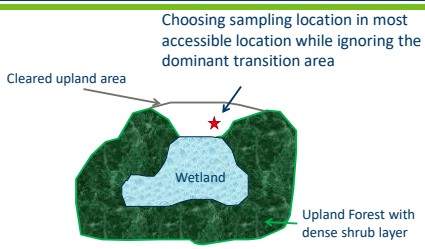
Common Errors – The "lazy" approach



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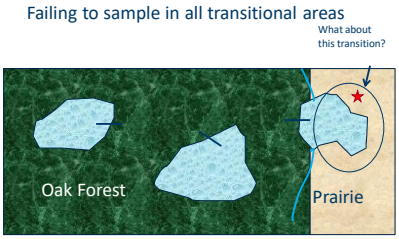
Common Errors – The "anti-community" approach



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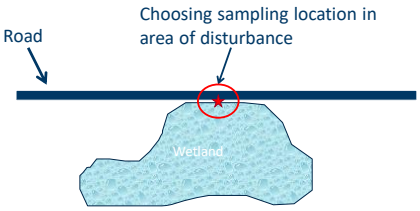
Common Errors – The "disturbed" approach



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Make a Plan:

- Examining your offsite mapping before heading to the field.
- Do an initial site reconnaissance before settling on a sampling location.
- In tough areas, do "preliminary" sampling to help determine where you should do your "official" representative sampling (i.e. full data sheets).

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- BWSR Wetland Delineation page

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Wetland Classification Systems

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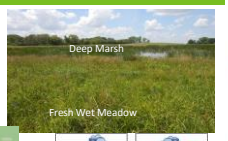
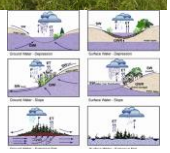
Wetland Classification Systems in MN

- Circular 39
- Cowardin et al.
- Eggers & Reed
- Hydrogeomorphic Method





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Why Classify Wetlands?

- To establish a consistent organizational structure for:
  - Understanding functions
  - Inventory/mapping
  - Scientific study and tracking
  - Regulation

Most systems use

- Vegetation (emergent or forested?)
- Hydrology (standing water or saturation?)
- Water depth (6 inches or 3 feet?)

Some use

- hydrologic source (surface or groundwater fed)
- geomorphic position (position on the landscape).

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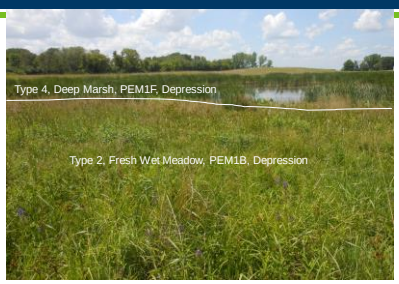
Wetland Classification Systems



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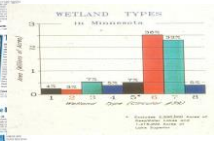
Circular 39



Developed in 1956 for wildlife habitat (waterfowl)

Used in Minnesota Wetland Conservation Act

Based on hydrology and vegetation
let's also apply landscape position

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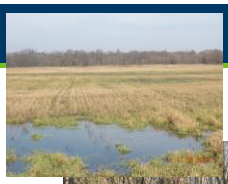
Type 1



Seasonally flooded basins

Landscape position: depressional basins, floodplains

Hydrology: Seasonally Flooded, dry for much of growing season

Vegetation: Highly Variable plant communities

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Type 2

Inland fresh meadow

Landscape position: depressions, lake fringes

Hydrology: saturated, without standing water for most of the growing season

Vegetation: grasses, sedges, rushes, or broadleaf plants

60

Type 3

Inland shallow marshes

Landscape position: lake fringe, seep areas of on irrigated land

Hydrology: flooded up to 6" in depth

Vegetation: Grasses, bulrushes, cattails, arrowhead

61

Type 4

Deep marsh

Landscape position: shallow basins, lake fringe

Hydrology: 6" to 3' of near permanent surface water with open water components

Vegetation: Cattails, reeds, spike rush, bulrushes, pondweeds, duckweeds, water lilies, wild rice

62

Type 5

Inland open water

Landscape position: shallow basins, lake fringe

Hydrology: <6' deep

Vegetation: pondweeds, water milfoils, fringed by emergent vegetation

63

Type 6

Shrub swamps

Landscape position: sloped, along river and lake fringes

Hydrology: Saturation with seasonal shallow inundation

Vegetation: Shrub swamps dominated with willow, dogwood and alder as well as grasses/forbs.

64

Type 7

Wooded swamps

Landscape position: mineral flats, sloped

Hydrology: saturated with seasonal inundation for short periods

Vegetation: Forested, often dominated with tamarack, black ash, spruce, red maple, balsam fir, cedar

65

Type 8

Bogs

Landscape Position: organic flats, lake fringe

Hydrology: permanently saturated

Vegetation: Herbaceous strata dominated by sphagnum moss, leatherleaf, Labrador tea, sedges, black spruce and tamarack trees

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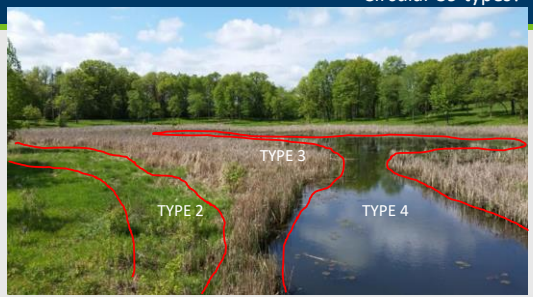
Circular 39 types?



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Cowardin Classification System

- Created in 1979
- Includes wetlands and other aquatic habitats (streams, lakes, etc.)
- Used for NWI maps
- Nationwide system

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Cowardin System

Hierarchy uses symbols to describe System, Class, plant community, hydrology and modifiers

Examples of common symbols:

Systems:
P = Palustrine, L= Lacustrine, R = Riverine

Palustrine Classes:
EM = Emergent, SS = Scrub shrub, FO = Forested

Plant Community:
EM: Persistent=1, Non persistent=2
SS & FO: Broad-leaved deciduous=1, Needle-leave deciduous= 2, Broad-leaved evergreen=3, Needle-leaved evergreen=4

Water regime modifiers:
C = Seasonally flooded, A = Temporarily Flooded, B= Seasonally Saturated D= Continuously Saturated F=semi-permanently flooded, H=permanently flooded

Special Modifiers:
b = Beaver, d = Partially Drained/Ditched, f = Farmed, x = Excavated

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Cowardin System - NWI

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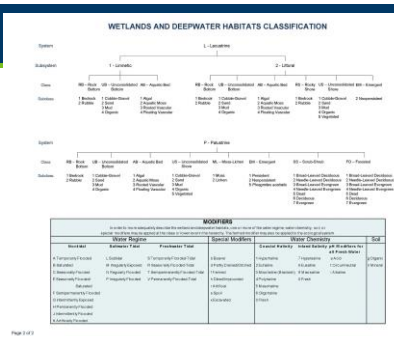

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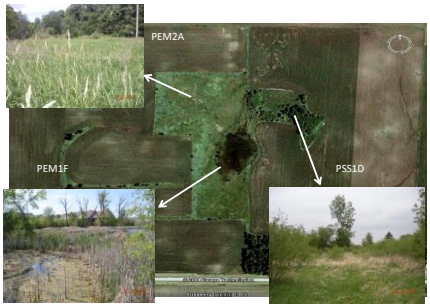

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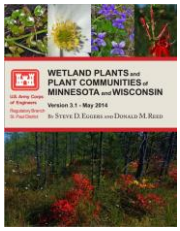
Eggers & Reed Classification System

Primarily based on plant communities, but includes "typical" associated hydrologic regimes

- **Shallow, Open Water**
- **Deep Marsh**
- **Shallow Marsh**
- **Sedge Meadow**
- **Fresh (Wet) Meadow**
- **Wet/Wet-Mesic Prairie**
- **Calcareous Fen**
- **Open Bog/Coniferous Bog**
- **Shrub-Carr/Alder Thicket**
- **Hardwood Swamp/Coniferous Swamp**
- **Floodplain Forest**
- **Seasonally Flooded Basin**



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Eggers & Reed Classification System

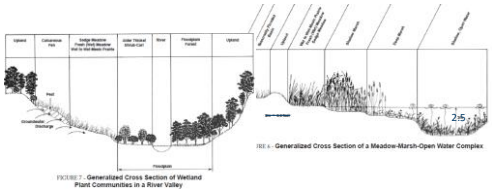

FIGURE 7. Generalized Cross Section of Wetland Plant Communities in a River Valley

FIG 6 - Generalized Cross Section of a Meadow-Marsh-Open Water Complex

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Shallow, Open Water

Hydrology: permanently inundated, Water depths less than 8.2 feet (2.5 meters)

Vegetation: Dominated by submergent, floating and floating-leaved species

75

Deep Marshes

Hydrology: **semi-permanently inundated** by 6 inches to 3 feet or more of water during the growing season

Vegetation: Dominated by herbaceous emergent, submergent, floating and floating-leaved species

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Shallow Marshes

Hydrology: Soils saturated to the surface to inundated up to 6 inches of water for a significant portion of most growing seasons

Vegetation: Wild rice, reed canary grass and bur reed

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Fresh (Wet) Meadows

Hydrology: Water table often drop below 12 inches after early portion of growing season

Vegetation: Dominated by grasses, such as reed canary grass and redtop, and/or forbs such as giant goldenrod and marsh aster

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Sedge Meadows

Hydrology: Saturated soils most of the growing season.

Vegetation: Dominated by sedges, primarily *Carex,* but also woolgrass and other sedge family members, Canada blue-joint grass may be subdominant, can have floating mat (Sedge Mat) when fringing deeper hydrologic regimes

79

Wet to Wet-Mesic Prairies

- Hydrology: Saturated soils most of the growing season
- Vegetation: Dominated by native prairie grasses, often with a rich diversity of hydrophytic prairie forbs such as Prairie cord-grass, big bluestem, gayfeather, green bulrush, mountain mint, sawtooth sunflower, New England aster, white lady-slipper, etc.

80

Seasonally Flooded Basins

Hydrology: seasonally flooded, Typically ponded for a few weeks early in the growing season then drying out

Vegetation: Mudflats left by receding water are colonized by annuals such as smartweeds

Condition shown is in May -- cropped corn field. By mid- to late growing season, annual species such as wild millet (FACW) and smartweeds (FACW-OBL) would dominate

81

Shrub-Carr and Alder Thickets

Hydrology: saturated to seasonally flooded

Vegetation: Native willows, dogwoods and/or alders dominate. Disturbed sites may have non-native buckthorns.

82

Hardwood and Coniferous Swamps

Hydrology: saturated, may be seasonally inundated

Vegetation: Black Ash, Tamarack/Black Spruce, no continuous sphagnum moss

83

Calcareous Fens

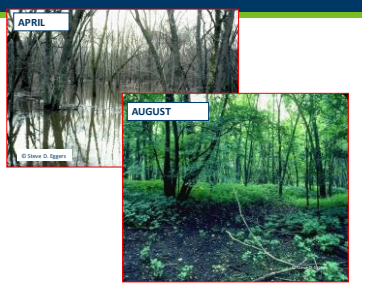
- Hydrology: upwelling groundwater discharge continuously saturates organic soils, Specific soil and water chemistry (CaCo)
- Vegetation: Rarest wetland type in MN. Supports disproportionate number of T & E species: sterile sedge, beaked spikerush, hardstem bulrush, Grass of Parnassus, Kalm's lobelia, white lady-slipper, Riddell's goldenrod

84

Floodplain Forests

Hydrology: seasonally inundated, relatively well-drained for most of the growing season

Vegetation: silver maple, American elm, river birch, green ash, black willow, box elder, eastern cottonwood



85

Open and Coniferous Bogs

Hydrology: saturated, with acidic, peat soils low in nutrients

Vegetation: tamarack, black spruce, continuous mat of *Sphagnum* moss, bog sedge, wire-grass sedge, cottongrass, leatherleaf, labrador tea and unique flora not found in any other habitat. Many orchid species.

86

Eggers & Reed?

87

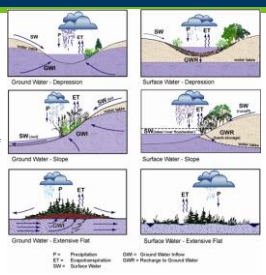
Hydrogeomorphic Method

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

- Developed by Brinson (1993), modified by Smith et al. (1995)
- Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the NRCS (2008 NRCS Technical Note No. 190-8-76)

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

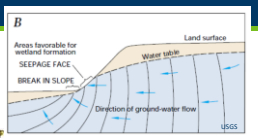
- RIVERINE, DEPRESSIONAL, SLOPE, MINERAL SOIL FLATS, ORGANIC SOIL FLATS, ESTUARINE FRINGE, LACUSTRINE FRINGE

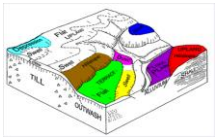


88

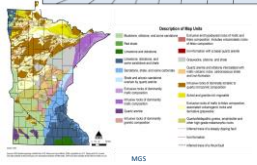
Parameters of HGM

- Geomorphology- landscape position
- Hydrology- water source and output
- Hydraulics- hydrodynamics





USGS

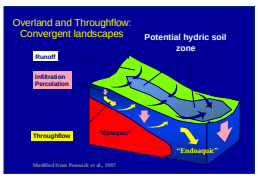


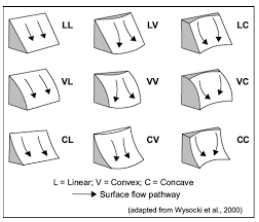
MGS

89

Landscape Position- surface shape

- Convex- surface curves outward
- Concave- surface curves inward
- Linear- flat, one dimensional surface



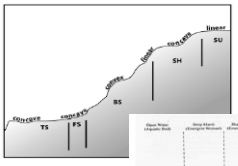


90

Landscape Position- slope processes

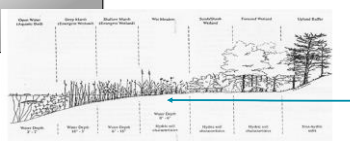
Landscape position:

- Summit
- Shoulder
- Backslope
- Foot slope
- Toe slope



Slope processes:

- Erosional- summit, shoulder, backslope
- Depositional- foot slope, toe slope



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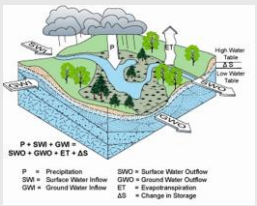
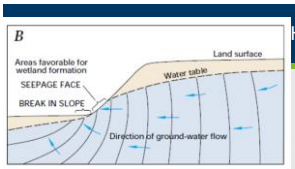
Hydrology



- Inputs
  - Precipitation
  - Surface water inflow
  - Groundwater inflow
- Outputs
  - Surface water outflow
  - Groundwater outflow
  - Evapotranspiration

92

Hydraulics- how water moves



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

93

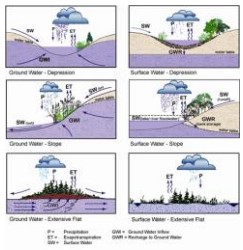
HGM Classes

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

94

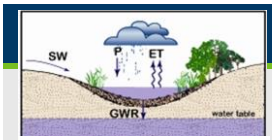
HGM Subclasses

- Influenced by:
  - Groundwater input
  - Surface water input
  - Hydrology Outputs
    - Surface
    - Ground



95

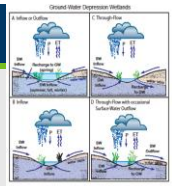
Depressional- surface



- Landscape position- concave, foot slope/toe slope, closed contours
- Hydraulics- unidirectional
- Water source- surface flow and precipitation, seasonal
- Outputs- Evapotranspiration, groundwater recharge

96

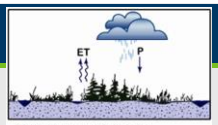
Depressional- groundwater



- Landscape position- concave, foot and toe slopes, closed contours
- Hydraulics- unidirectional
- Water source- groundwater and precipitation, *seasonal*
- Outputs- Evapotranspiration, groundwater recharge, intermittent overland flow

97

Mineral Soil Flats

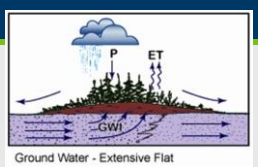


Surface Water - Extensive Flat

- Landscape position- relic land bottoms and floodplains, intergrades to multiple other classes (sloped, riverine, lacustrine)
- Hydraulics- vertical groundwater fluctuations
- Water source- precipitation, no groundwater interaction
- Outputs- evapotranspiration, saturated "seepage" flow

98

Organic Soil Flats



Ground Water - Extensive Flat

- Landscape position- summit (interfluves- broad "plateau" between drainage systems, depressions filled with organics, vertical accretion of organics
- Hydraulics- precipitation, unidirectional groundwater
- Water source- precipitation, groundwater
- Outputs- saturated overland seepage, evapotranspiration

99

Riverine

- Landscape position- floodplains and riparian corridors, often intergrade to sloped or depressional
- Hydraulics- unidirectional, surface overbank flow, groundwater, interflow (both surface and ground) from adjacent uplands
- Water source- precipitation, groundwater
- Outputs- overland surface flow (perennial flow not required), evapotranspiration

100

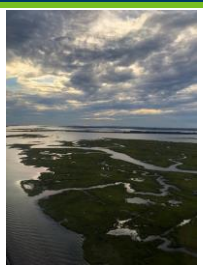
Lacustrine Fringe

- Landscape position- adjacent to lakes, toe slope, often intergrade to sloped
- Hydraulics- bidirectional (inflow from adjacent uplands and lake)
- Water source- precipitation, groundwater
- Outputs- return flow to lake, saturated surface seepage, evapotranspiration

101

Estuarine Fringe

- Landscape position- along coasts and estuaries, often intergrade to riverine
- Hydraulics- bidirectional (tidal flow)
- Water source- surface via frequent tidal flooding, precipitation
- Outputs- tidal exchange, saturated overland flow, evapotranspiration



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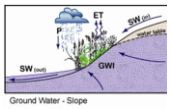
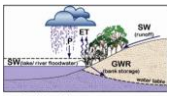
Sloped

- Landscape position- linear or convex, predominately found at foot and toe slope, can be found on back slope and shoulder slope, often intergrades to other classes (mineral flat, riverine, depression)
- Hydraulics- unidirectional
- Water source- groundwater, surface runoff, precipitation
  Outputs-



Ground Water - Slope



Surface Water - Slope

103

HGM Class (subclass)	Hydrology Inputs	Hydrology Outputs	Hydraulics
RIVERINE	surface flow precipitation groundwater	surface flow evapotranspiration	bidirectional (both surface and ground)
DEPRESSIONAL- surface	surface flow precipitation	groundwater recharge evapotranspiration	unidirectional
DEPRESSIONAL- ground	groundwater precipitation	intermittent surface flow evapotranspiraton 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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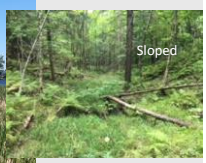
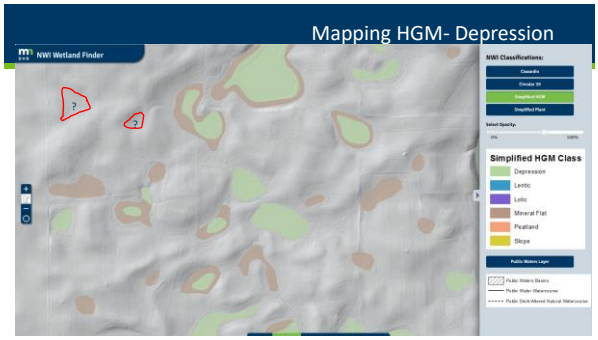
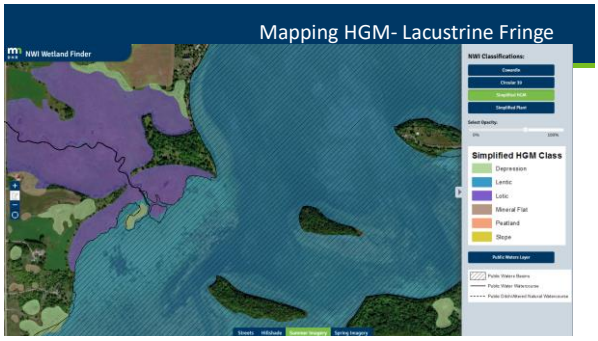
HGM?



105


Mapping HGM- Depression
NWI Wetland Finder
NWI Classifications:
Simplified HGM Class
Depression
Lentic
Lotic
Mineral Flat
Peatland
Slope

106


Mapping HGM- Lacustrine Fringe
NWI Wetland Finder
NWI Classifications:
Simplified HGM Class
Depression
Lentic
Lotic
Mineral Flat
Peatland
Slope

107


NWI Wetland Finder
NWI Classifications:
Simplified HGM Class
Depression
Lentic
Lotic
Mineral Flat
Peatland
Slope

108

Wetland Classification Systems in Minnesota

Circular 39
- Based on hydrology and vegetation

Cowardin
- Based on hierarchy system, class, veg, water regime, special modifiers

Eggers & Reed
- Based on plant communities & "typical" associated hydrologic regimes

Hydrogeomorphic Method
- Based on landscape position, water source, hydraulics

Type 3, PEM1F, shallow marsh, DEPRESSION-surface

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Critical Definitions for Wetland Delineation

110

Critical Definitions

- Wetlands
- Deepwater Aquatic Habitat
- Semipermanently and permanently flooded
- Growing Season
- Disturbed (Atypical Situations)
- Naturally Problematic (Problem Areas)
- Normal Environmental Conditions
- Normal Circumstances

111

Two-Step Process

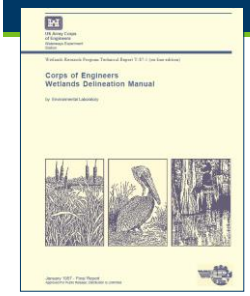
Step 1: Delineate Wetlands, if Present, Within a Site

Every Data Sheet
- Normal Circumstances?
- Normal Environmental Conditions?
- Disturbed (Atypical Situations)?
- Problem Area (Naturally Problematic)?

Step 2: Apply regulations, policy and guidance

112

Definitions



113

Chapter 5- Difficult Wetland Situations

- Atypical situations
  - Agricultural Land (NE/NC, Midwest)
  - Silviculture (NC/NE)
- Problem areas
  - Problematic vegetation
  - Problematic soil
  - Seasonal hydrology
- Procedural problems
  - Wetland/non-wetland mosaics

114

What is a Wetland?

"Wetlands are sometimes wet areas where people meet to argue."

Greg Larson

115

- Technical definition:

Those areas that are 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 for life in saturated soil conditions.

116

Deepwater Habitat

Deepwater aquatic habitats are areas that are permanently inundated at mean annual water depths >8.2 ft or permanently inundated areas less than or equal to 8.2 ft that do not support rooted-emergent or woody plant species

They have the follow diagnostic characteristics:

1) vegetetation- no rooted-emergent or woody pant species are present in these permanently inundated areas
2) Soil- the sustrate technically is not defined as a soil if the mean water depth is >8.2 ft or if it will not support rooted emergent or woody plants

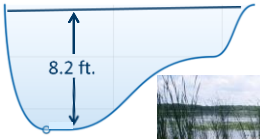
117

Limits of wetland (depth)- Deepwater Habitat

Important Considerations for Wetlands

- Must be capable of supporting rooted, emergent vegetation.
- Must have soil.

If the water is too deep or fast flowing, cannot support rooted vegetation and soil cannot form (unconsolidated bottom).



118

permanently and semipermanently flooded areas

- 2009 Rule language:
- Subp. 51. **Permanently and semipermanently flooded area of a ~~type 3, 4, or 5~~ wetland.** "Permanently and semipermanently flooded area of a ~~type 3, 4, or 5~~ wetland" means the portion of a ~~type 3, 4, or 5~~ wetland below the level where the water has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly the point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial.

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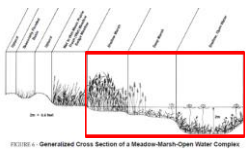
Permanently and Semipermanently flooded areas- Circular 39 & Eggers & Reed

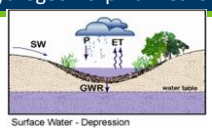
Circular 39	Eggers & Reed
1	Seasonally Flooded Basins
1	Floodplain Forests
2	Sedge Meadows
2	Fresh (wet) Meadows
2	Wet to Wet-Mesic Prairies
2	Calcareous Fens
3	Shallow Marsh
4	Deep Marsh
5	Shallow, Open Water
6	Shrub-Carr
6	Alder Thicket
7	Hardwood Swamp
7	Coniferous Swamp
8	Open Bog
8	Coniferous Bog



120

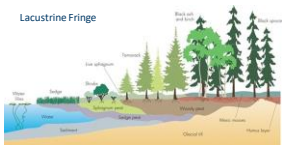
permanently and semipermanently flooded areas- Hydrogeomorphic Method

HGM Class	Typical Water Regimes
Mineral Flat	All regimes except permanently flooded (Saturated most of growing season)
Organic Flat	All regimes except permanently flooded (Saturated most of growing season)
Organic Flat	Saturated
Sloped	Saturated
Riverine	Temporary Flooded
Lacustrine Fringe	Semi permanently to permanently flooded (up to 8.2')
Depression	Seasonally Flooded
Depression	Saturated
Depression	Semi permanently flooded (up to 6")



Surface Water - Depression

Lacustrine Fringe



121

Permanently and Semipermanently Flooded areas- Cowardin

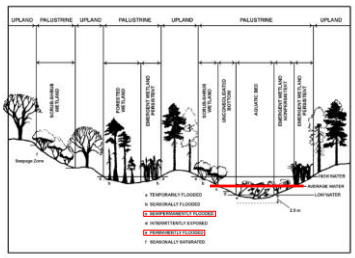


Figure 6. Distinguishing features and examples of habitats in the Palustrine System.

- Depression

122

Lacustrine Fringe

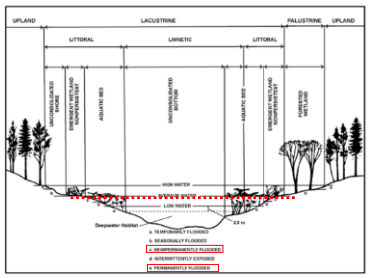


Figure 5. Distinguishing features and examples of habitats in the Lacustrine System.

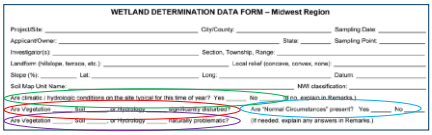
123

Mapping flooded areas

- C water modifier or deeper

124

Data Sheets



WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: _____ City/County: _____ Sampling Date: _____

Applicant/Owner: _____ State: _____ Sampling Point: _____

Investigator(s): _____ Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____

Slope (%): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

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

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

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

125

Why do we care about Growing Season?

Growing season dates are needed to:

- Evaluate and interpret certain wetland hydrology indicators
- Analyze recorded data to determine if wetland hydrology criterion is met

126

Indicators of Start of the Growing Season

1. **Soil temperature at 12 inches is 41° F. or higher**

Use a compost thermometer for each site

Research & Outreach Centers | College of Food, Agricultural and Natural Resource Sciences (umn.edu)

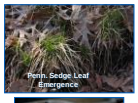
https://www.mda.state.mn.us/protecting/soilprotection/soiltemp

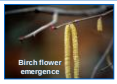
2. "Green-up" indicator

127

"Green-Up" Indicator for Start of Growing Season

Two or more species of non-evergreen plants show active growth in a wetland or surrounding area with similar elevation and aspect





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Start of Growing Season

April site visit:

Two species of non-evergreen plants – reed canary grass and lake sedge – have new, green, aerial leaf/stem growth

Meets the "green-up" indicator for the start of the growing season

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End of Growing Season

- woody deciduous species lose their leaves

and/or

- the last herbaceous plants cease flowering and their leaves die back

130

Normal Circumstance

- Those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions

HISTORY: In early years of implementing the Section 404 regulatory program, wetland identification was based on vegetation – there were no delineation manuals/3-parameter approach. Cases arose where wetland vegetation was removed (plowed under, burned off, herbicided, etc.) in an attempt to evade wetland regulations. Corps/EPA then adopted the approach of determining whether the area in question would support dominance by wetland vegetation under normal circumstances.

131

Normal Environmental Conditions vs. Normal Circumstances

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: _____ City/County: _____ Sampling Date: _____

Applicant/Owner: _____ State: _____ Sampling Point: _____

Investigator(s): _____ Section, Township, Range: _____

Landform: (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____

Slope (%): _____ Datum: _____

Soil Map Unit: _____ NWI classification: _____

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

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

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

Normal Environmental Conditions?

Normal Circumstances?

132

Normal Environmental Conditions vs. Normal Circumstances

- **Short-term:** "normal environmental conditions" refers to the climatic conditions of the current year and growing season
- **Long-term:** "normal circumstances" refers to the multiple-year/decades-long condition of the site

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Normal Circumstances

WETLAND DETERMINATION DATA FORM – Midwest Region

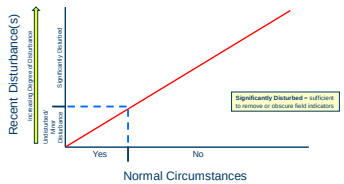
Project/Site: _____ City/County: _____ Sampling Date _____
Applicant/Owner: _____ State: _____ Sampling Point: _____
Investigator(s): _____ Section, Township, Range: _____
Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____
Slope (%): _____ Lat: _____ Long: _____ Datum: _____
Soil Map Unit Name: _____ NWI classification: _____
Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No _____ (If no, explain in Remarks.)
Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____
Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

If "Yes", data collection is based on current conditions.

If "No", data collection is based on conditions that would exist in absence of recent disturbance(s).

134

Relationship of Normal Circumstances and Recent Disturbance(s)



135

Normal Circumstances

- The full range of pristine to highly disturbed conditions may constitute the normal circumstances
- The long-term condition of a site including any authorized or other legal alterations, such as highways, dams, and other relatively permanent infrastructure and development
- The extent, duration and relative permanence of the physical alteration(s) are key
- Maintenance is a factor – if a physical alteration (e.g., ditch system) is abandoned and wetlands reestablish, the NC is wetlands
- The conditions indicated by the soils and hydrology normally present on a site, in cases where the vegetation has been altered or removed

Extent and Relative Permanence Test

136

Not Normal Circumstances

Recent, unauthorized fill that buried natural vegetation and native soils, and altered hydrology

137

Normal Circumstances - Hydrology

Example A: Ditch legally constructed in 1950s and maintained since = ditch is established as **Normal Circumstances**. Partially drained is the normal circumstance for hydrology.

Example B: Ditch constructed last year; unauthorized side casting of fill materials in wetlands = **NOT Normal Circumstances**

138

Normal Circumstances

Authorized wetland fill meets the "extent and relative permanence test" -- establishes a new Normal Circumstance

3. Physical alteration(s) is legally established, maintained and represents the long-term condition of the site; OR is a newly-authorized physical alteration (e.g., a permitted fill, new concrete dam).....**Normal Circumstances**

139

Normal Circumstances – Soils

- **Normal plowing** (e.g., 8- to 9-inch depth) is not considered a "significant" disturbance to soils if does not remove or obscure field indicators of hydric soils
  - -- Examples: A1, A12
  - -- However, other field indictors (e.g., F8, some S indicators (sandy)) would be obscured or difficult to determine
- "Deep ripping" or other methods that disturb and mix soil layers at depths greater than normal plowing are **NOT Normal Circumstances**

140

Normal Circumstances - Vegetation

Removal of natural vegetation and replacement with a planted crop = NOT Normal Circumstances

IGNORE the planted crop for purposes of the hydrophytic vegetation determination

When natural vegetation has been removed, focus on soils and hydrology. If a site has wetland hydrology and hydric soils, it would support dominance by hydrophytes under normal circumstances.

141

Normal Circumstances - Vegetation

- Removing, manicuring, planting, cropping, or other means of altering vegetation that is more than minor = NOT Normal Circumstances

Overgrazed to the extent that alteration of vegetation is more than minor – including the extreme case shown above where vegetation has been removed = NOT Normal Circumstances

142

Normal Circumstances - Vegetation

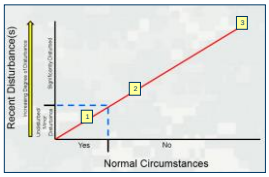
Light grazing of a sedge meadow – minor disturbance of natural vegetation = Normal Circumstances

Example of an unimproved pasture = no interseeding, planting, etc.

143

Normal Circumstances - Vegetation

What about moderate grazing sufficient to result in a shift of the plant community to species more tolerant of grazing ("increasers") at the expense of other plant species ("decreasers")[see Table 10 in Midwest Supplement for examples]. Most cases: NOT Normal Circumstances. Follow Midwest Supplement guidance.



KEY:

1 Light Grazing – Sedge Meadow

2 Moderate Grazing

3 Overgrazed – Exposed Soils

144

Normal Circumstances - Vegetation

Natural vegetation removed and replaced by manipulated/manicured vegetation (seeding, mowing, fertilizing, selective herbicide applications) = NOT Normal Circumstances

145

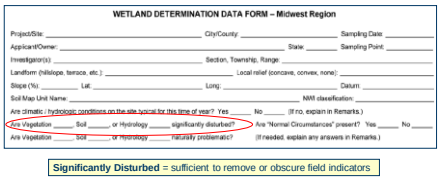
Disturbed (Atypical Situations)

- **One or more parameters altered or absent due to recent human activities or natural event**

Filling, artificial drainage, stream channelization, mechanized land clearing, levee construction, mowing, cropping, plowing, logging, change in river course, high-capacity groundwater well pumping, tree farms, etc.

146

Degree of Disturbance(s)



WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: _____ City/County: _____ Sampling Date: _____

Applicant/Owner: _____ State: _____ Sampling Point: _____

Investigator(s): _____ Section, Township, Range: _____

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Slope (%): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

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

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

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

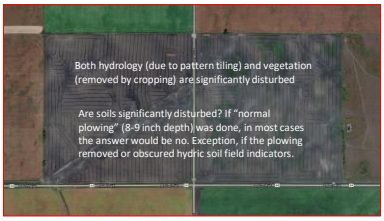
Significantly Disturbed = sufficient to remove or obscure field indicators

147

Disturbed (Atypical)

148

Disturbed (Atypical)



149

Problem Areas (Naturally Problematic)

- **One or more parameters are absent due to normal seasonal or annual variability, or permanently due to the nature of the soils or plant species**
  - Seasonal wetlands
  - Prairie potholes
  - Red clay parent materials
  - FACU-dominated wetlands
  - Inter-dunal swales

150

Problem Areas

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: _____ City/County: _____ Sampling Date: _____

Applicant/Owner: _____ State: _____ Sampling Point: _____

Investigator(s): _____ Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____

Slope (%): _____ Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

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

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

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

151

Seasonal Wetlands

152

Problem Areas

Wetlands dominated by non-hydrophytic species like white pine, a Facultative Upland species

153

Problem Areas and Normal Circumstances

- **EXAMPLE:** Vernal pools are naturally dry outside of the first few weeks of the growing season = **Normal Circumstances**

154

Problem Areas and Normal Circumstances

Project/Site: _____ City/County: _____ Sampling Date: _____
Applicant/Owner: _____ State: _____ Sampling Point: _____
Investigator(s): _____ Section, Township, Range: _____
Landform: (hillslope, terrace, etc.) _____ Local relief (concave, convex, none): _____
Slope (%): _____ Lat: _____ Long: _____ Datum: _____
Soil Map Unit Name: _____ NWI classification: _____
Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (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.)

Prairie pothole wetland in a drought year

155

Normal Circumstances?

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Wetland Functions

BOARD OF WATER AND SOIL RESOURCES

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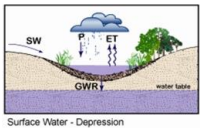
Overview

- Wetland Functions
- Wetland Values

- Hydrogeomorphic Method
- Functional Assessments
  - MN Routine Assessment Method (MNRAM)
  - Floristic Quality Assessment (FQA)



Surface Water - Depression

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Wetland Functions & Values

Wetland Functions: in scientific assessments means natural processes

Wetland Value: wetland goods and services providing monetary or social welfare benefit.

159

Values

Food Production

Wild Rice

Cranberries

160

Values

More than a billion people make a living from wetlands across the world.

- Fishing
- Eco-tourism
- Farming
- Drinking water

Source: www.worldwildlife.org
Photos: www.ramsar.org

161

Values

Recreation, Aesthetics, Education

162

Values

Hunting, Fishing, Bird watching, photography

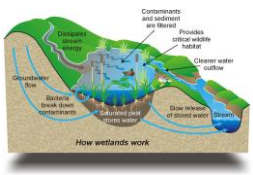
www.nps.org

Mud Duck Boats

163

Wetland Functions

- Act as a natural "filter" to maintain water quality
- Facilitates infiltration recharging groundwater
- Stabilize base flow
- Decreases fluid velocity during high flow events which decreases turbidity
- Storm water retention (i.e. storage)
- Provides habitat
- Shoreline protection



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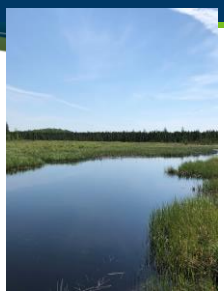
Functions

Water Quality

165

Functions

Floodwater Retention



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Functions

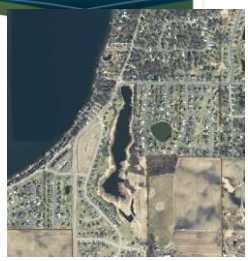
Habitat

- Many insects, reptiles and amphibians rely on wetlands to complete their life cycle.
- Some mammals are semi-aquatic: beavers, muskrat, mink, otters.
- Many birds feed and nest in wetlands.
- Fish rely on wetlands for breeding, feeding and shelter.

167

Functions

Sediment Trap



168

Functions

Groundwater Recharge

169

Functions

Carbon Storage

Although wetlands only account for 5-8% of earths terrestrial landscape they may provide carbon sinks of about 300 to 700 billion tons of carbon. Peatland wetlands make up the majority of carbon sinks.

170

Functional Assessment Methods

- MN Routine Assessment Method (MNRAM)
  - Numeric model for assessing wetland functions and some values

Comprehensive General Guidance

for

Minnesota Routine Assessment Method (MnRAM) Evaluating Wetland Function, Version 3.4 (beta)

9/15/2010

- Floristic Quality Assessment
  - Vegetation based ecological condition assessment method

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MnRAM (MN Routine Assessment Method)

- Developed by interagency work group shortly after WCA passed.
  - Refined in 2010
- Assessment tool that uses numeric model to rank both Functions and values

- BWSR no longer supports Access database version
- Excel version 3.2 and text version using the Comprehensive Guidance Document for explanations, definitions and ranking formulas for each function

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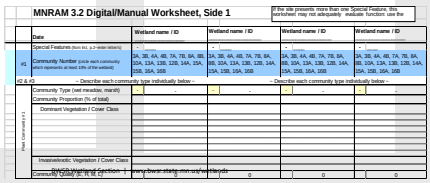
Method

Determine vegetative diversity and integrity:

- List plant communities of each wetland
  - Dominant vegetation
  - Cover class


MNRAM 3.2 Digital/Manual Worksheet, Side 1

If the site presents more than one Special Feature, this worksheet may not adequately evaluate function: use the

	Date	Wetland name / ID	Wetland name / ID	Wetland name / ID	Wetland name / ID
	Special Features (from loc. p.2--wide-ranging)				
All	Community Number (circle each community which represents at least 10% of the wetland)	3A, 3B, 4A, 4B, 7A, 7B, 8A, 8B, 10A, 13A, 13B, 15B, 16A, 16B, 20B, 16A, 16B	3A, 3B, 4A, 4B, 7A, 7B, 8A, 8B, 10A, 13A, 13B, 15B, 16A, 16B, 15A, 15B, 16A, 16B	3A, 3B, 4A, 4B, 7A, 7B, 8A, 8B, 10A, 13A, 13B, 15B, 16A, 16B, 15A, 15B, 16A, 16B	3A, 3B, 4A, 4B, 7A, 7B, 8A, 8B, 10A, 13A, 13B, 15B, 16A, 16B, 15A, 15B, 16A, 16B
4D & 4S	-- Describe each community type individually below --			-- Describe each community type individually below --	
Plant Community 1	Community Type (wet meadow, marsh)				
	Community Proportion (% of total)				
	Dominant Vegetation / Cover Class				
	Invasive/exotic Vegetation / Cover Class				
	Community Quality (A, B, C, D)				

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

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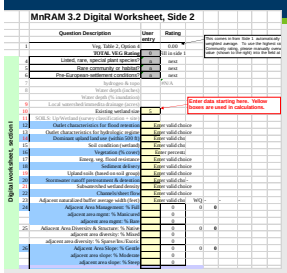
Method


MnRAM 3.2 Digital Worksheet, Side 2

	Question Description	User entry	Rating
1	Veg. Table 2, Option B		0.000
	TOTAL VEG. Rating	0	0 to rule 1
4	Listed, rare, special plant species	n	ranst
5	Rare community or habitat	n	ranst
6	Pre-European settlement conditions	n	ranst
7	hydrogeo & topo		ANs A
8	Water depth (cm/hrs)		
9	Water depth (% inundation)		
10	Local watershed/stormwater drainage (acres)		
11	Existing wetland size	0	
12	SOILS: Up/Wetland (survey classification + hydric)		
13	Outlet characteristics for flood attenuation		Enter valid choice
14	Outlet characteristics for hydrologic export		Enter valid choice
15	Dominant upland land use (within 500 ft)		Enter valid choi
16	Soil condition (wetland)		Enter valid choi
16	Vegetation (% cover)		Enter percent
17	Emerg. veg. flood resistance		Enter valid choice
18	Sediment deltas		Enter valid choice
19	Upland soils (based on soil groups)		Enter valid choice
20	Stormwater runoff pretreatment & detention		Enter valid choi
21	Subwatershed wetland density		Enter valid choice
22	Channelized/short flow		Enter valid choice
23	Adjacent naturalized buffer average width (feet)		Enter valid choi
24	Adjacent Area Management: % Fully	0	0
	adjacent area organic % Mucky/peat	0	
	adjacent area organic % Boggy	0	
25	Adjacent Area Diversity & Structure: % Native	0	0
	adjacent area diversity: % Mixed	0	
	adjacent area diversity: % Sparse/less Native	0	
26	Adjacent Area Slope: % Gentle	0	0
	adjacent area slope: % Moderate	0	
	adjacent area slope: % Steep	0	

Enter data starting here. Yellow boxes are used in calculations.

Digital (work sheet_ section 1

Assign rating based on series of questions for each wetland using Comprehensive Guidance

MnRAM Comprehensive General Guidance

MnRAM Guidance on Selected Questions

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

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Method

Functional index score

Outcome Numeric ranking:

- Exceptional
- High
- Medium
- Low

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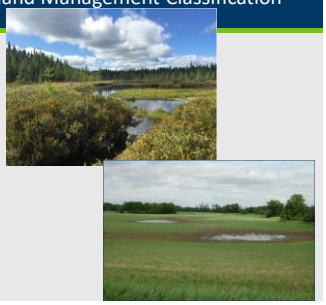
Wetland Management Classification

Functional index score can then be used to classify management

- Wetland Management Classification System

Results are **classification recommendations:**

- Preserve, Manage 1, Manage 2, Manage 3



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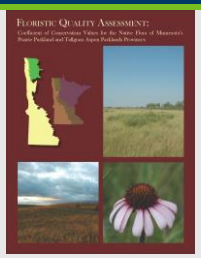
Floristic Quality Assessment

- Vegetation condition assessment to measure the quality of a native plant community
- Developed by the MN Pollution Control Agency
  - 2007, Statewide C-values
  - Efforts to regionalize C-values underway
- Intended to compliment functional assessments such as MNRAM



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FQA Key Concepts

- Key concepts:
  - Species conservatism- tolerance to degradation
    - Coefficients of Conservatism (C-value)
  - Floristic Quality Index
    - Species richness and mean C-values
- Sampling methods
  - Rapid FQA
  - Full Method

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FQA Key Concepts

- Coefficients of Conservatism
  - Numeric rating of an individual species fidelity in relationship to disturbance
  - C-values range from 0-10
    - 0= most tolerant, found in wide variety of plant communities
    - 10= least tolerant, found in narrow range of plant communities
    - Non-native species = 0
      - Reed Canary Grass (introduced) C=0
      - Ostrich Fern (FAC, NCNE) C=5
      - Pink lady slipper C=9

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Sampling Methods Overview

- FQA Sampling Protocol:
  - Map Assessment Area
  - Determine Plant community types
  - Conduct timed meander (rapid) or plot-based sampling
  - Conduct shoreland sampling (if necessary)
  - Make Areal cover estimations
  - Calculations

- Full FQA -Plot-based sampling
- Rapid FQA- Timed meander rules
  - Areal cover in cover classes for each species

180

- Determining the Assessment Area
- Define plant communities
  - Eggers & Reed
  - MN DNR Native Plant Communities Classification Guide
    - Laurentian Mixed Forest, Eastern Broadleaf Forest, Prairie Parkland and Tallgrass Aspen Parklands

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Metrics

Variables:

- Number of species = Species Richness
- Mean C-value
- Mean C-value (weighted) (wC)
  - $wC = \sum pC$

- Floristic Quality Index
  - Integral measurement of FQA
    - $FQI = \bar{C}\sqrt{S}$
    - mean C value
    - S= number of species (i.e. species richness)
  - Both stand alone indices
- Greater the FQI, the closer the condition is to a natural state

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Review

- Functions- natural processes
  - Water quality, flood retention, habitat, groundwater recharge, carbon storage
- Values- provide monetary or social welfare benefit
  - Wild rice, recreation, education, aesthetics, fishing

- HGM- landscape position, hydrology, hydraulics
  - Depressional, sloped, riverine, mineral flats, organic flats, lacustrine and estuarine fringe
- MNRAM- Numeric model for assessing wetland functions and some values
- FQA- Vegetation based ecological condition assessment method

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Wetland Functional Assessment

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

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Hydrology Indicators

Minnesota Wetland Professional Certification Program

185

Hydrology

…"inundated or saturated by surface or ground water at a frequency and duration"

- Technical standard of 14 or more consecutive days of flooding or ponding;
- Water table 12 in. or less below soil surface;

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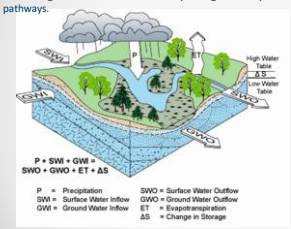
Hydrology

Wetlands gain and lose water constantly through a variety of pathways.



- Inputs
  - Precipitation
  - Surface water inflow
  - Groundwater inflow
- Outputs
  - Surface water outflow
  - Groundwater outflow
  - Evapotranspiration

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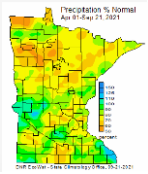
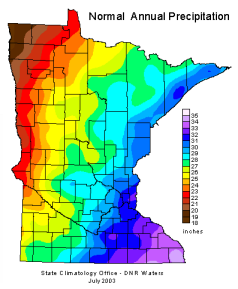
Precipitation

- Average Annual precipitation varies significantly from one side of the state to the other
- A difference of 14 inches from Houston to Kittson counties





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Hydrology Indicators

Evidence that there is continuing hydrology and confirms that an episode of inundation/saturation occurred recently.

Wetland hydrology indicators are divided into two categories:
Primary – provide stand-alone evidence of a current or recent hydrologic event; and
Secondary – provide evidence of recent hydrology when supported by one or more other hydrology indicators.

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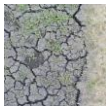
Hydrology Indicator Groups

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.

190

Land Resource Regions

- **Regions dictate which indicators are used and how they are used**

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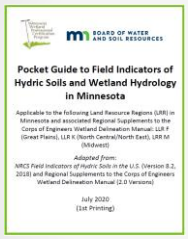
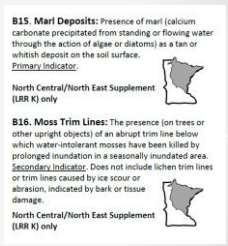
Flipbook





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Group A Indicators

direct observation of *water*

193

A1: Surface water

Category:
Primary

Direct, visual observation of surface water during a site visit.

194

A2: High water table

Category: Primary

Water table 12 in. (30 cm) or less below the surface in a soil pit, auger hole, or shallow monitoring well.

195

A3: Saturation

Category: Primary

Visual observation of saturated soil conditions 12 in. or less from the soil surface as indicated by water **glistening** on the surfaces and broken interior faces of soil samples.

196

Group B Indicators

evidence of ponding or flooding – past or present

197

B1: Water Marks

Category: Primary

Water marks are discolorations or stains on the bark of woody vegetation, rocks, bridge supports, buildings, fences, or other fixed objects as a result of inundation.

198

B2: Sediment Deposits

Category: Primary

Sediment deposits are thin layers or coatings of fine-grained mineral material or organic matter remaining on tree bark, plant stems or leaves, rocks, and other objects after surface water recedes

199

B3: Drift Deposits

Category: Primary

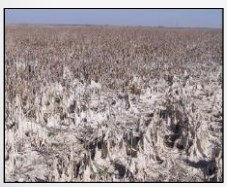
Drift deposits consist of rafted debris that has been deposited on the ground surface or entangled in vegetation or other fixed objects.

200

B4: Algal mat or crust

Category: Primary

This indicator consists of a mat or dried crust of algae, perhaps mixed with other detritus, left on or near the soil surface after dewatering.



201

B5: Iron deposits

Category: Primary

General Description: This indicator consists of a thin orange or yellow crust or gel of oxidized iron on the soil surface or on objects near the surface.

202

B6: Surface soil cracks

Category: Secondary

Water destroys the soil structure which facilitates the cracking. Surface soil cracks consist of shallow cracks that form when fine-grained mineral or organic sediments dry and shrink

203

B7: Inundation on aerial imagery

Category: Primary

One or more recent aerial photographs or satellite images that show the site to be inundated during the growing season.

204

B8: Sparsely vegetated concave surface

Category: Primary. (Secondary in LRR F)

On concave land surfaces, the ground surface is either unvegetated or sparsely vegetated due to long-duration ponding during the growing season.

Sparsely vegetated concave surfaces should contrast with vegetated slopes and convex surfaces in the same area. Less than 5% ground cover.

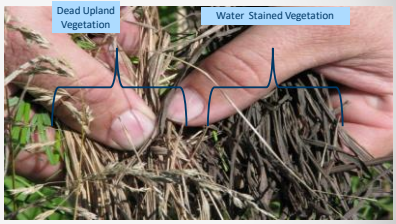
Secondary

205

B9: Water-stained leaves

Category: Primary

Water-stained leaves are fallen or recumbent dead leaves that have turned grayish or blackish in color due to inundation for long periods.



206

B10: Drainage patterns

Category: Secondary

Flow patterns visible on the soil surface or eroded into the soil, low vegetation bent over in the direction of flow, absence of leaf litter or small woody debris due to flowing water

207

B13: Aquatic fauna

Category: Primary

Presence of live individuals, diapausing insect eggs or crustacean cysts, or dead remains of aquatic fauna,

Either on the soil surface or clinging to plants or other emergent objects.

208

B14: True aquatic plants

Category: Primary

Presence of live individuals or dead remains of true aquatic plants.

Require water for support, or desiccate in the absence of standing water

209

B15: Marl deposits

Category: Primary

Presence of marl on the soil surface.

Found mainly in calcareous fens, seeps, or white cedar swamps in areas underlain by limestone bedrock.

210

B16: Moss Trim Lines

Category: Secondary

Moss trim lines on trees or other upright objects in seasonally inundated areas.

Formed when water-intolerant mosses growing on tree trunks and other upright objects are killed by prolonged inundation.

211

Group C Indicators

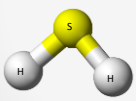
evidence of soil saturation – past or present

212

C1: Hydrogen sulfide odor

Category: Primary

A hydrogen sulfide (rotten egg) odor within 12 in. of the soil surface.

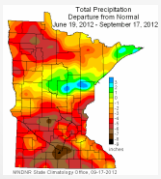


213

C2: Dry season water table

Category: Secondary

Visual observation of the water table between 12 and 24 in. (30 and 60 cm) below the surface during the normal dry season or during a drier-than-normal year.



214

C3: Oxidized rhizospheres along living roots

Category: Primary. In LRR F Secondary in tilled areas

Presence of a layer containing iron-oxide coatings or plaques on the surfaces of living roots and/or iron-oxide coatings or linings on soil pores immediately surrounding living roots within 12 inches of the soil surface.

Secondary

215

C6: Recent iron reduction in tilled soils

Category: Primary

Redox concentrations as pore linings or soft masses in the tilled surface layer of soils cultivated within the last two years.

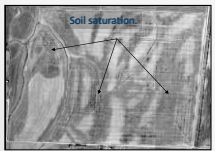
Must be within the plow layer

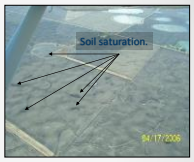
216

C9: Saturation visible on aerial imagery

Category: Secondary

One or more recent aerial photographs or satellite images indicate soil saturation. Saturated soil signatures must correspond to field-verified hydric soils, depressions or drainage patterns, differential crop management, or other evidence of a seasonal high water table.





217

Group D Indicators

landscape and vegetation characteristics that indicate contemporary wet conditions

218

D1: Stunted or stressed plants

Category: Secondary

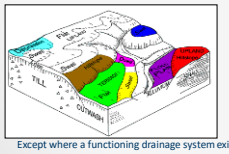
In agricultural or planted vegetation located in a depression, swale, or other topographically low area, this indicator is present if a majority of individuals of the same species growing in the potential wetland are clearly of smaller stature, less vigorous, or stressed compared with individuals growing in nearby drier landscape situations.

219

D2: Geomorphic position

Category: Secondary

This indicator is present if the area in question is located in a localized depression, linear drainageway, concave position within a floodplain, at the toe of a slope, on the low-elevation fringe of a pond or other water body, or in an area where groundwater discharges.



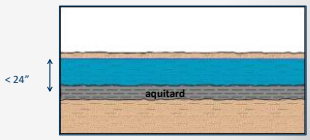
Except where a functioning drainage system exists*

220

D3: Shallow Aquitard

Category: Secondary

Presence of an aquitard within 24 in. of the soil surface that is potentially capable of perching water within 12 in. of the surface.



221

D4: Microtopographic relief

Category: Secondary

Microtopographic features that occur in areas of seasonal inundation or shallow water tables:

- Hummocks
- Tussocks
- Flark-and-strang topography

- Microhighs < 36 in. above the base soil level

222

D5: FAC – neutral test

Category: Secondary

The plant community passes the FAC-neutral test:

1. Compile list of dominant plant species across all strata
2. Drop any with FAC (FAC, FAC-, FAC+)
3. >50 % of remaining dominant species are FACW and/or OBL

If it's an equal number of each, then use non-dominant

*This indicator uses the longer term nature of plants

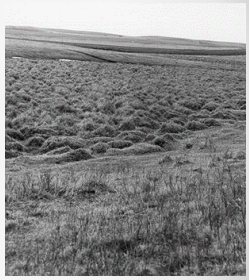
Herb stratum	(Plot size:)	0	= Total Cover	
1.	*Andropogon gerardii*	40	Y	FAC
2.	*Solidago gigantea*	12	Y	FACW
3.	*Bromus inermis*	10	N	FACU
4.	*Sonchus arvensis*	10	N	FACU
5.	*Cirsium arvense*	8	N	FACU
6.	*Phalaris arundinacea*	5	N	FACW
7.	*Melilotus officinalis*	5	N	FACU
8.				
9.				

223

Indicator D7: Frost-heave hummocks

Category: Secondary

This indicator consists of hummocky microtopography produced by frost action in saturated wetland soils.



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Hydrology Indicators

Take home message

- Wetland hydrology is dynamic
- Indicators prove current or recent evidence of hydrology
- Proof = minimum of 1 Primary or 2 Secondary
- Lack of indicator(s) does not confirm absence of wetland hydrology! CH 5 (Difficult Wetland Situations) is a "must read"

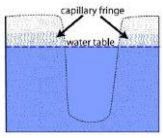
225

Hydrology Indicators?

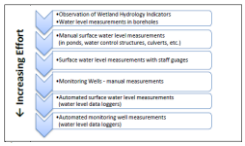
226

Methods to monitor hydrology

- Observation of indicators
- Staff gauges
- Open boreholes

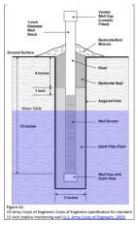


- Monitoring wells
  - Manual measurements
  - Automated measurements



227

Design and location of monitoring wells

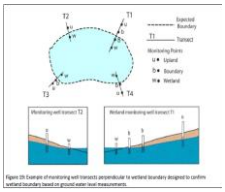


Monitoring wells

- Screen, Riser, Sand Pack, Bentonite seal

Well location

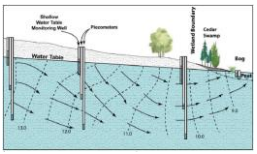
- Depends on the question:
  - Single well will tell if hydrology is present
  - Complex sites require transects based on landscape position, etc.
    - Professional judgement



228

Piezometers

- Used to measure depth-specific head measurements
  - Measure vertical component
    - Hydrostatic pressure or "head"
  - May provide automated measurements
- Not typically used for standard wetland investigations



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Interpreting Hydrology

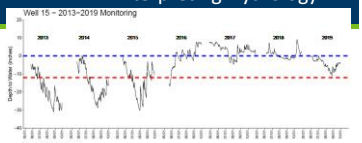
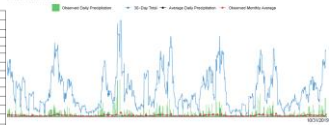


Table 1: Summary of Wetland Success Criteria for Phase I

Success Criteria	Phase I		
	Wet Meadow	Hardwood Swamp	Shallow Marsh
Duration			
Growing Seasons	5	4	5
Hydrology			
Hydrology (depth to water table)	Surface to -12"	Surface to -12"	+6" to -12"
Hydroperiod (duration within zone)	Meets duration	Meets duration	Meets duration
Vegetation			
Wetland Indicator (% FAC or wetter)	41/52 = 79%	39/51 = 76%	20/22 = 91%
Species Composition (Native Richness)	39/52 = 75%	39/51 = 76%	19/22 = 86%
Invasive Cover (% non-native)	2%	9%	2%
FQAI/MFQA	20.2/36.7	20.0/23.4	16.9/19.7
Tree Coverage (trees per acre)	N/A	26.48	N/A



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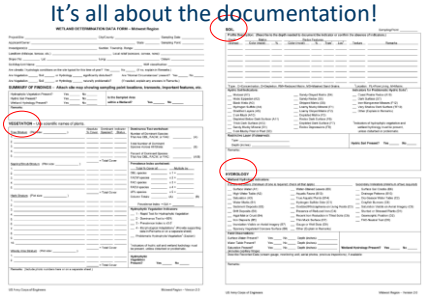
It's all about the documentation!



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