Field Indicators for Identifying Hydric Soils in New England V3.0

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Hydric Soils 101

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 (59 Fed. Reg. 35680, 7/13/94).

Waterlogging Process – microbes use up O2, Water retards O2 diffusion.

Variable depending on factors, as little as 2 days to 1-2 weeks.

Soil temp. at 50 cm above biological zero (4C).

Major portion of rooting zone, generally 6" in sandy soils, 12" loamy soils.

Hydric Soils 101

- The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation.
- Soils that are sufficiently wet because of artificial measures are included in the concept of hydric soils (artificial drainage does not alter hydric soil status). Also, soils in which the hydrology has been artificially modified are hydric if the soil, in an unaltered state, was hydric.

Basic Hydric Soil Features

1. High OM in surface layer (wooded areas).
2. Black mineral surface horizons (A).
3. Gray subsoil colors.
4. Redoximorphic features near surface.
5. Hydrogen sulfide odor in some.

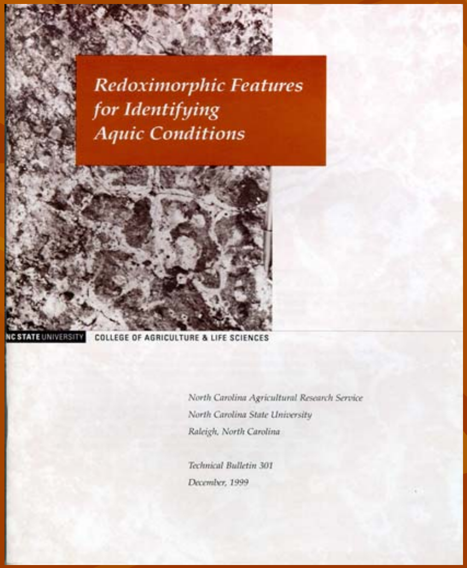
Meets Indicator: V. Mineral Histic

Review of Terminology

- Organic Soil Material – usually formed under wet conditions and contain 12 to 18 % OC dry weight depending on clay content.
- Histic Epipedon – consist of organic soil material 8 to 16 in. thick.
- Histosol – Soil order, organic soil material > 16 inches thick.
- Mucky mineral modifier – mineral soil texture with 5 to 12 % OC (depending on clay).

Redoximorphic Features

- Formerly called "mottles", new term relates the color patterns to a process (oxidation, reduction, and movement caused by saturated conditions).
- Concentrations, depletions, pore linings, nodules, depleted/gleyed/reduced matrixes.



Order from NCSU by contacting: Rhonda_Thrower@ncsu.edu

Formation of Redoximorphic Features

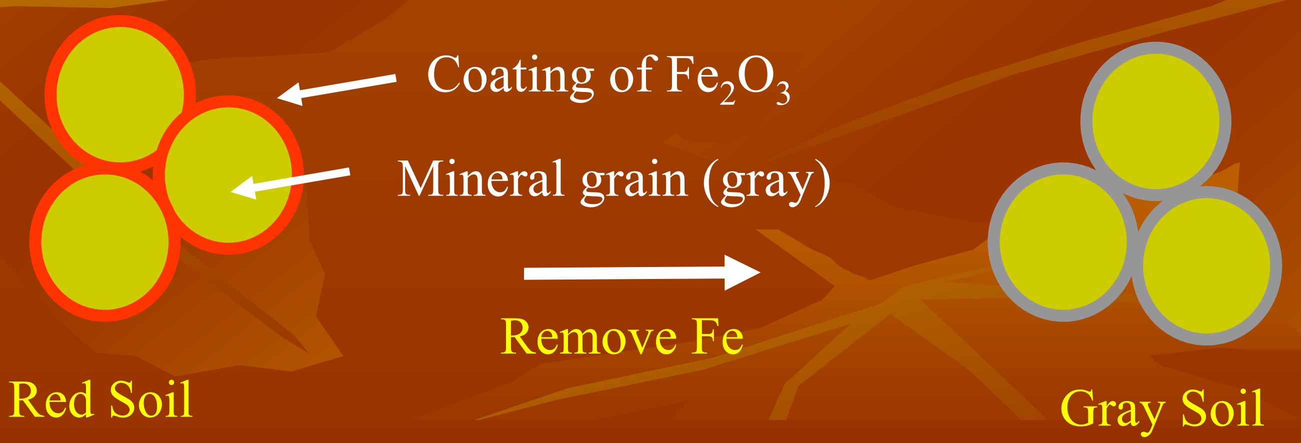
- Anaerobic conditions
  - soil is saturated so almost all pores are filled with water; absence of oxygen
- Prolonged anaerobiosis
  - changes the chemical processes in the soil
- Reduction of Fe and Mn oxides
  - results in distinct soil morphological characteristics
    - most are readily observable changes in soil color

Oxidation/Reduction Sequence

Redox Potential	Element	Reaction
+350 mV	Oxygen	$O_2 \longrightarrow H_2O$
+220 mV	Nitrogen	$NO_3^- \longrightarrow NO_2^-, N_2, NH_4^+$
+200 mV	Manganese	$Mn^{+4} \longrightarrow Mn^{+2}$
+120 mV	Iron	$Fe^{+3} \longrightarrow Fe^{+2}$
-150 mV	Sulfur	$SO_4^{-2} \longrightarrow H_2S$
-250 mV	Carbon	$CO_2 \longrightarrow CH_4$

Soil Color and Oxidation/Reduction

- In subsoil horizons, Fe and Mn oxides give soils their characteristic brown, red, and yellow colors
- When reduced, Fe and Mn are mobile and can be stripped from the soil particles
- Leaves the characteristic mineral grain color
  - usually a neutral gray



Redox Interpretation Problems

Redoximorphic features do not occur in all soils

- Low amounts of soluble Organic Carbon
- High pH
- Cold temperatures
- Low amounts of Fe
- Aerated groundwater

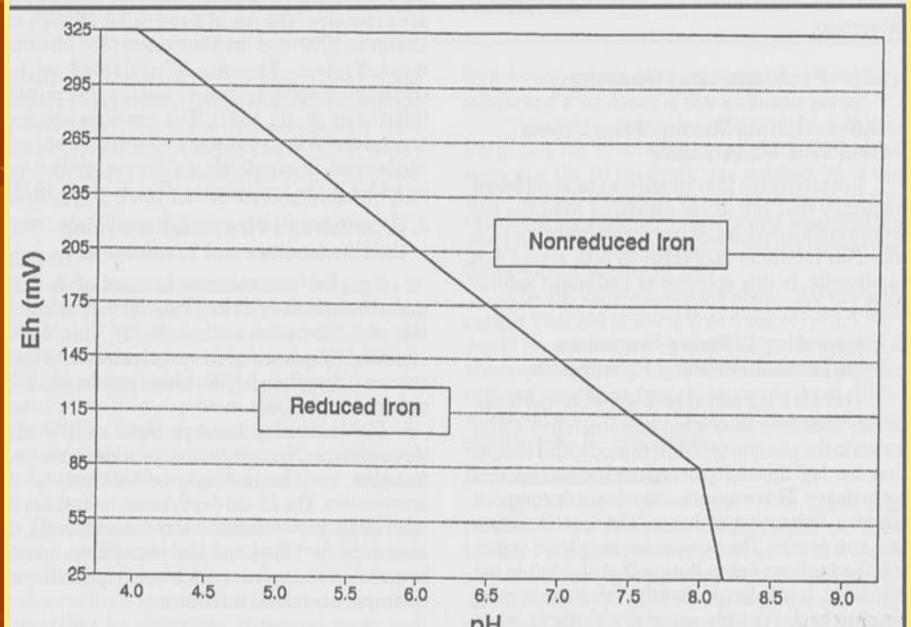


Figure 13. The pH dependency of iron redox potential.

Redox Examples

Redox depletion along dead root channel, surrounded by a redox concetration.

Ap – 0-9 in, 10YR 2/1, sil

Bw – 9-17 in, sil,

2.5Y5/3 matrix with M3P 10YR 5/6 concentrations & C2D 2.5Y 6/2 depletions.

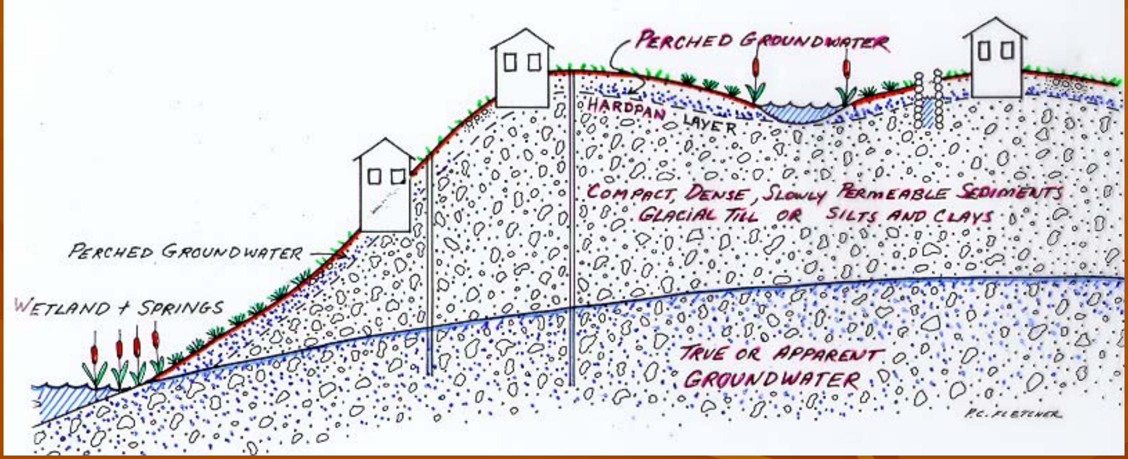
Bg – 17-24 in, sil, 2.5Y 6/1 with F1D 2.5Y 5/4.

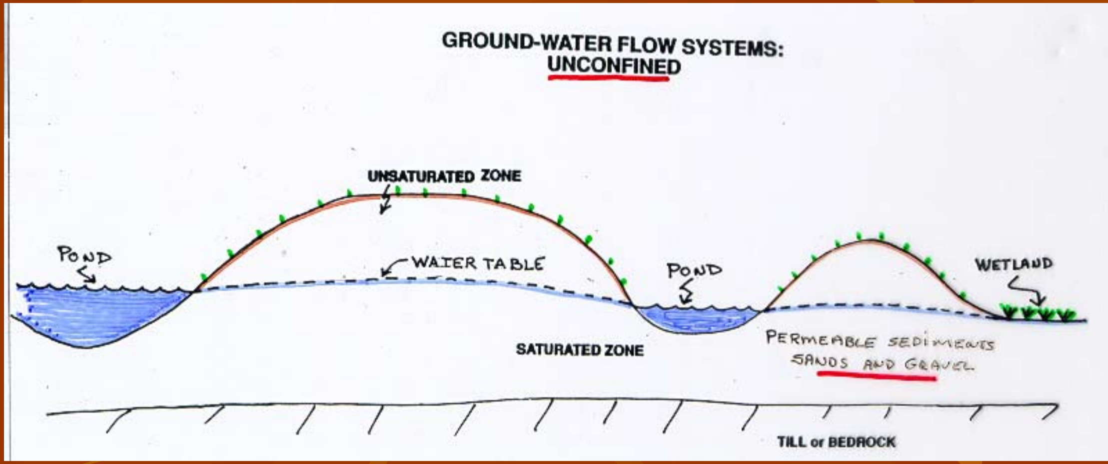
Hydric Soil Delineation Procedure

1. Review reference maps prior to site visit.
2. Start in presumed wetland area first to confirm there are hydric soils (**never dig on the line**).
3. Locate soil test pit near the 5’ vegetative plot.
4. Dig a good hole (at least 1’ diameter down to at least 20”)!

Dig as Deep as Possible

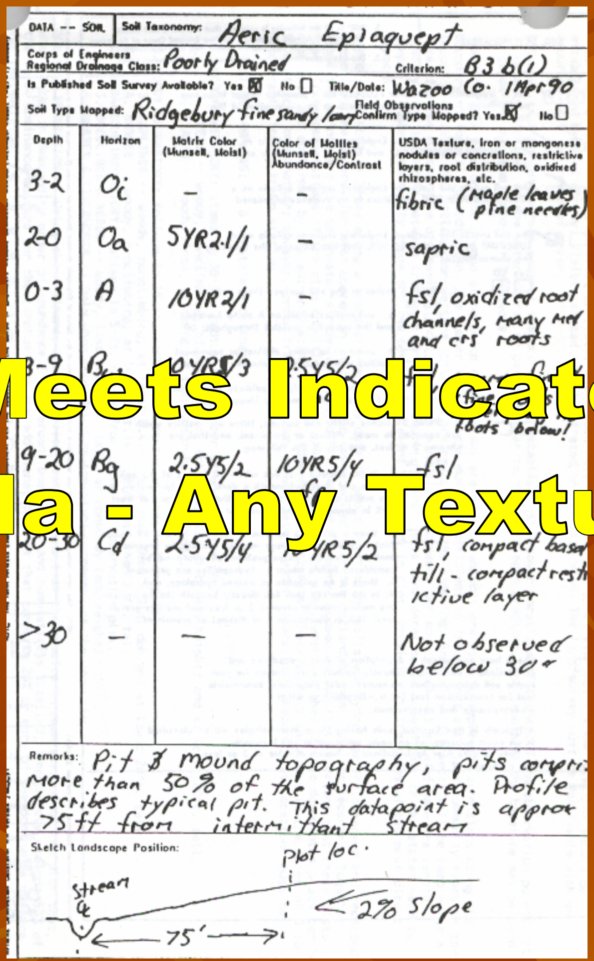
- Determine hydrologic setting of site.
- Look for restrictive layers (till, silts) if wetland is sloping.
- Connect wetness from bottom of pit to surface.
- Better description!





Hydric Soil Delineation Procedure

5. Describe the soil profile as detailed as possible (color, texture, redox, horizons, depths, etc.).
6. Document hydrology and other features.
7. Use indictors or other document to determine if the soil is hydric.
8. Repeat for the upland.



DATA -- SOIL | Soil Taxonomy: Aeric Epiaquept

Corps of Engineers Regional Drainage Class: Poorly Drained | Criterion: B3b(1)

Is Published Soil Survey Available? Yes ☒ No ☐ | Title/Date: Wazoo Co. 1Mar90

Soil Type Mapped: Ridgebury fine sandy loam | Field Observations Confirm Type Mapped? Yes ☒ No ☐

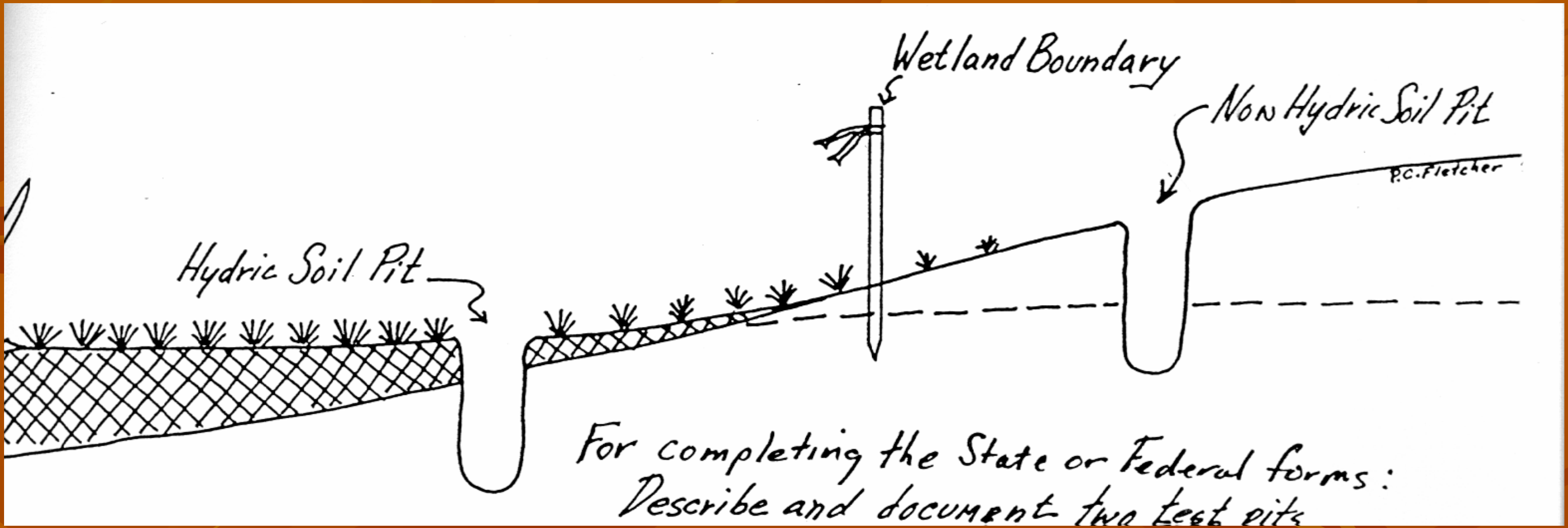
Depth	Horizon	Matrix Color (Munsell, Moist)	Color of Mottles (Munsell, Moist) Abundance/Contrast	USDA Texture, iron or manganese nodules or concretions, restrictive layers, root distribution, oxidized rhizospheres, etc.
3-2	Oi	–	–	fibric (maple leaves pine needles)
2-0	Oa	5YR2.1/1	–	sapric
0-3	A	10YR2/1	–	fsl, oxidized root channels, many med and crs roots
3-9	B[illegible]	10YR5/3	2.5Y5/2 [illegible]	fsl [illegible] roots below!
9-20	Bg	2.5Y5/2	10YR5/4 [illegible]	fsl
20-30	Cd	2.5Y5/4	[illegible]YR5/2	fsl, compact basal till - compact restrictive layer
>30	–	–	–	Not observed below 30"

Remarks: Pit & mound topography, pits compri[se] more than 50% of the surface area. Profile describes typical pit. This datapoint is approx 75ft from intermittant stream

Sketch Landscape Position:

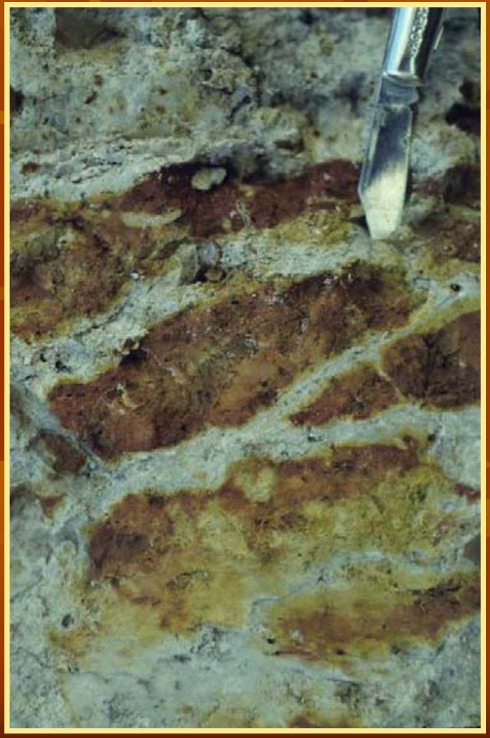
Meets Indicator XIa - Any Texture

Hydric Soil Delineation Procedure



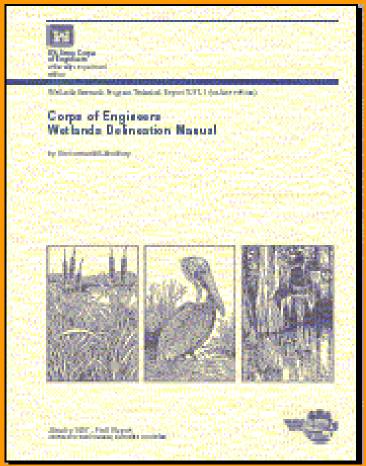
9. Build a model for the morphology of the hydric and upland soils.
10. Use a Dutch auger to core areas from the wetland to the upland (fill in holes).
11. Try to locate flag where there is a change in landform, vegetation, soils, and hydrology.

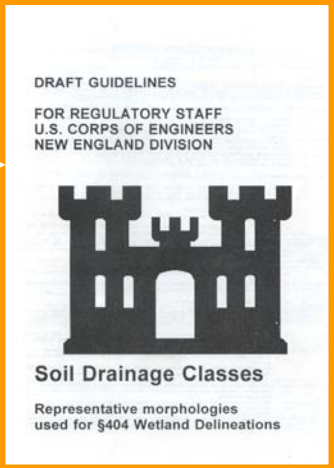
Field Indicators
for
Identifying Hydric Soils
in
New England



NEW ENGLAND INDICATORS: A HISTORY LESSON

- 87 Manual used soil drainage classes in the criteria for a hydric soil.
- Drainage classes were mainly an agricultural term without soil morphology.
- In the 1980's the NE office of the ACOE with assistance of the NRCS (Pete Fletcher) attempted to establish drainage class criteria for all of NE Document available at: http://nesoil.com/properties/drainageclasses.htm.





NEW ENGLAND INDICATORS: A HISTORY LESSON

- Team of COE, EPA, NRCS traveled throughout NE to examine soils and data.
- Although some success was reached, the final drainage class criteria were still confusing.
- In 1992 the drainage class contingent merged into the NETCHS with the goal of establishing hydric soil indicators (like those being developed at the time at the federal level) to identify hydric soils in NE.

New England Hydric Soil Technical Committee

- Federal Agencies (NRCS, ACOE, EPA, USFWS)
- State Agencies (NH DES, CTDEP, Maine Dept of Ag)
- University Personnel (UCONN, URI, UMASS, UNH)
- Private Sector (Consultants)

Peter Fletcher (Chair), Retired from USDA - Natural Resources Conservation Service
Stephen Gourley, USDA - Natural Resources Conservation Service - Vermont
James Gove, Gove Environmental Services
Peter Hammen, New Hampshire Dept. of Environmental Services
Wayne Hoar, USDA - Natural Resources Conservation Service - Maine
Joseph Homer, USDA - Natural Resources Conservation Service – New Hampshire
Steven Hundley, USDA - Natural Resources Conservation Service – New Hampshire
Kenneth Kettenring, New Hampshire Dept. of Environmental Services
Rebekah Lacey, New England Interstate Water Pollution Control Commission
Ruth Ladd, US Army Corps of Engineers
Raymond Lobdell, Lobdell and Associates
Harvey Luce, University of Connecticut
Wende Mahaney, US Fish and Wildlife Service
Joseph Noel, Maine Association of Professional Soil Scientists
Thomas Peragallo, Peragallo Associates
Jeff Peterson, Vanasse Hangen Brustlin
Sidney Pilgrim, University of New Hampshire
David Rocque, Maine Dept. of Agriculture, Food and Rural Resources
Matthew Schweisberg, US Environmental Protection Agency
Michael Sheehan, US Army Corps of Engineers
Lori Sommer, New Hampshire Dept. of Environmental Services
Mark Stolt, University of Rhode Island
Steven Tessitore, Connecticut Dept. of Environmental Protection
James Turenne, USDA – Natural Resources Conservation Service – Rhode Island
Peter Veneman, University of Massachusetts, Amherst
Thomas Villars, USDA – Natural Resources Conservation Service - Vermont
Michael Whited, USDA – Natural Resources Conservation Service
David Wilkinson, USDA – Natural Resources Conservation Service - Maine

Field Indicators for Identifying Hydric Soils in New England

- Only region-wide publication not based on National indicators.
- Recognized by the ACOE to conform to results obtained using the 1987 Manual (see letter).
- ACOE encourages its usage throughout NE.
- Published through the New England Interstate Water Pollution Control Commission.

Field Indicators Features

- Dynamic document –changes made as a result of new data, agreed to by the NETCHS.
- Hierarchal key – starts with wettest soils (few morphologies) to the dry-end of hydric soils.
- Looks for a combination of soil morphologies at certain depths to determine if the soil meets the definition of a hydric soil.
- If a soil meets an indicator it can be considered a hydric soil. If no indicators are met it does <u>NOT</u> mean the soil is non-hydric (professional judgment).

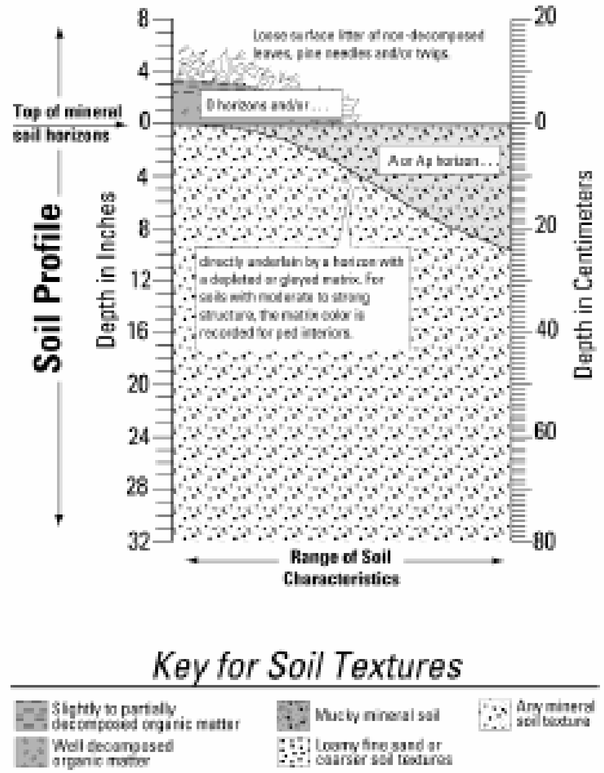
Field Indicators Features

VI. DEPLETED OR GLEYED MATRIX. Within 10 inches of the ***top of the mineral soil material*** and directly underlying an ***A*** or ***Ap horizon*** (or, if they are not present, an ***O horizon***), is a horizon with a ***depleted*** or ***gleyed matrix*** (for soils with ***moderate*** to ***strong structure***, the ***matrix color*** is recorded for ***ped interiors***); or

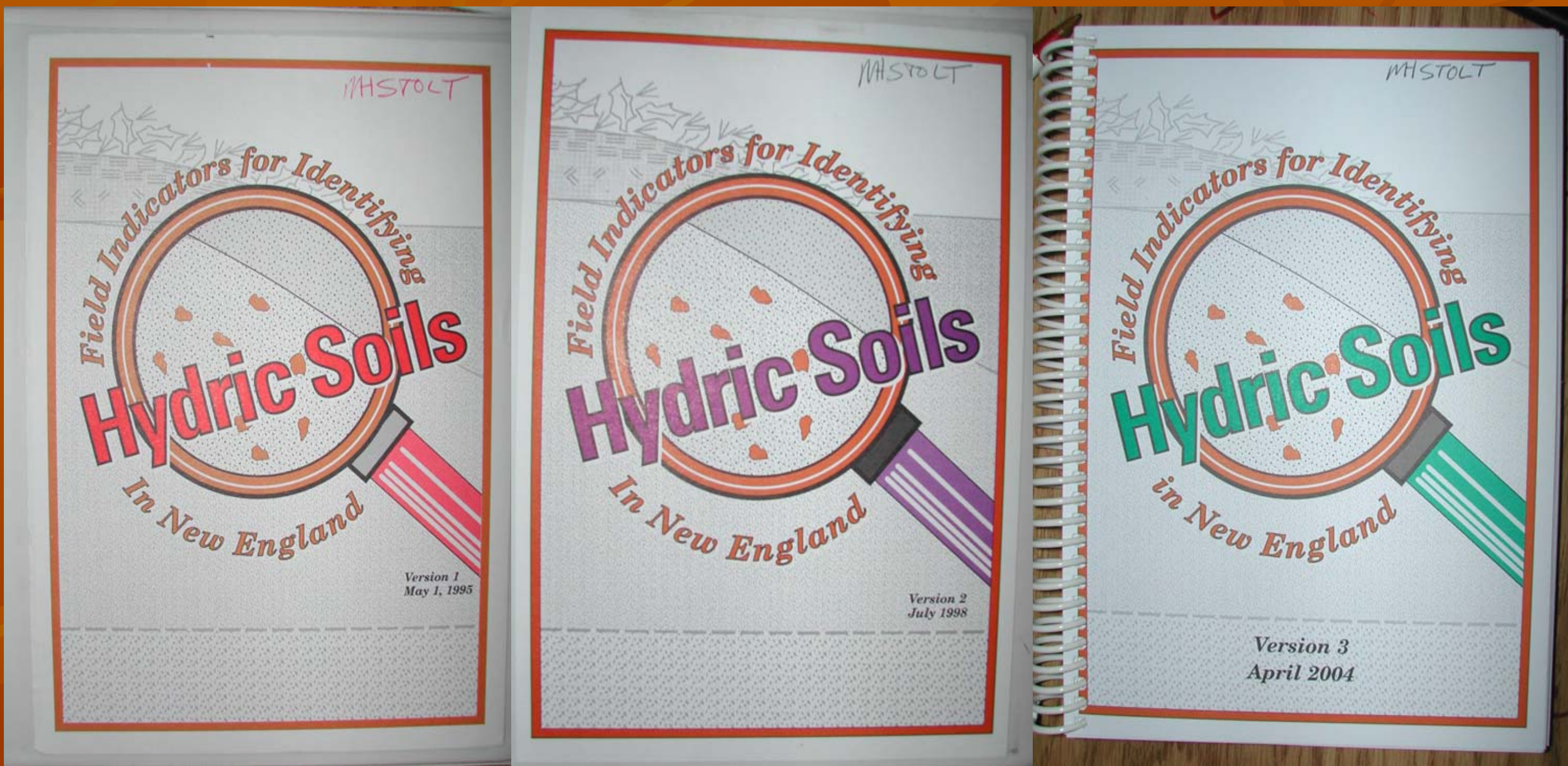
USER NOTE: An ***E horizon*** usually has low chroma colors as a result of an eluvial process and only qualifies as a ***depleted*** or ***gleyed matrix*** if it has 2 percent or more ***redoximorphic concentrations***. For soils with ***E horizons***, refer to Indicators IX.A, IX.B, and IX.C.

*Terms or phrases in **bold italics** are defined in the **Glossary of Terms***

VI. Depleted or Gleyed Matrix



Three Versions 1995, 1998, and 2004



What’s changed from Version II to Version III

General Changes

- The term “Aquic Conditions” removed
  - Make consistent with hydric soil definition
- Numbering scheme
  - From previous four major groups (I, II, III, IV A, B, C, etc.) to
  - I, II, II, IV, V, etc., so now there are 13 indicators, some of which have subdivisions
  - Each indicator has been given a short name for ease of reference (ie. X. “Sandy with Redox”)

General Changes

- No indicators in Version II were dropped
  - Some remain unchanged
  - Others have minor modifications
  - There is 1 new indicator for “dark” soils
- New information
  - Supplement prepared by Dave Rocque that discusses hydric soil identification in a less technical manner
  - Problem soil information greatly expanded

General Changes

- Introductory cautionary note was added
  - Mimics note in National Indicators
  - These are not all-inclusive (we don’t have all the answers) therefore further research & validation is needed.

KEY TO HYDRIC SOIL INDICATORS

Version 3 – April 2004

CAUTION: The field indicators in this book should not be considered all-inclusive. Although an attempt has been made to list the most relevant indicators, there are cases (see Problem Soils discussion on p. 54) where hydric soils exist that do not meet any of the currently listed indicators. Therefore, not meeting one of the indicators does not preclude a soil from being determined as hydric. In addition, there are rare occasions when a soil has one or more relevant field indicators but is not a hydric soil. Field indicators will continue to be revised as problem areas and exceptions to these keys become known or additional interpretation tools are developed. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, the assistance of an experienced soil or wetland scientist may be needed to determine whether the soil is hydric.

Technical Changes
Definitions, etc.

- "mineral soil surface" →
  "top of the mineral soil surface"
  - Mineral soil not always at the surface
- "partially decomposed organic…" →
  "slightly decomposed"
  - Oi (fibric) included in indicators that rely on organic layers

Technical changes made to blend with National Indicators, reflect changes in Soil Taxonomy, and as a result of research and data.

Technical Changes
Definitions, etc.

- “organic streaking” → “stripped matrix”
  - Some argue more accurately called a partially stripped matrix
  - Process not totally understood but seem to be areas of carbon depletions
- Depleted Matrix
  - E horizons (Eg) with concentrations are now included
    - also – depleted matrix and gleyed matrix are considered to be redoximorphic features

Depleted Matrix

Depleted Matrix - A ***depleted matrix*** makes up more than 50% of the horizon or subhorizon from which iron has been removed or transformed by processes of reduction and often translocation to create colors of low chroma and high value. ***A*** and ***E horizons*** may have low chromas and high values and may therefore be mistaken for a ***depleted matrix***; however, they are excluded from the definition, unless, in the case of an ***E horizon***, it has 2 percent or more ***redoximorphic concentrations***. In some places the ***depleted matrix*** may change color upon exposure to air (***reduced matrix***); this phenomenon is included in the concept of ***depleted matrix***.

- The following combinations of value and chroma identify a ***depleted matrix***:
- 1. Matrix value 4 or more and chroma 1 with or without other ***redoximorphic features***; or
- 2. Matrix value 6 or more and chroma 1 or 2 with or without other ***redoximorphic features***; or
- 3. Matrix value 4 or 5 and chroma 2 or less with 2 percent or more ***redoximorphic features***. When features are faint, extra care and professional judgment should be exercised as to whether or not they are an indication of a hydric soil.
- For ***matrix color*** matching those on the color pages labeled "Gley," refer to ***gleyed matrix*** definition.

Step-by-Step Comparison
Flooding & Organic Surface Layers

Version II	Version III	Comments
I	I - Ponded or Flooded	No change
II	II - Tidal	No change
III A	III - Histosols	No change
III B	IV - Histic epipedon	No change User note requires redox features in mineral material below. Includes depleted matrix and gleyed matrix as redox features
III C	V - Mineral Histic	Includes fibric Depleted matrix can include E

Step-by-Step Comparison
Flooding & Organic Surface Layers

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I	I - Ponded or Flooded	No change
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III C	V - Mineral Histic	Includes fibric Depleted matrix can include E

Step-by-Step Comparison

Loamy Soils

Version II	Version III	Comments
III D	VI - Depleted or Gleyed Matrix	No change except E horizon can qualify
III E	VII - Depleted Below Dark Surface	No change except E horizon can qualify
	VIII - Dark Mineral Soils	New Indicator for soils with low value (≤ 4) e.g. Cabot

Step-by-Step Comparison

Spodosols

Version II	Version III	Comments
III F 1 a 5% redox in E Bs with any redox	IX A 1- Spodosols 2% redox in E Bh, Bhs, Bs with 2%	Lowered redox requirement in E, raised it in Spodic.
III F 1 b 5% redox in E Dark Bh, Bhs directly underlain by a horizon with any redox.	IX A 2 2% redox in E Bh, Bhs directly underlain (but within 20”) by a horizon with 2% redox.	Lowered redox requirement in E, raised it in Spodic. Sets a maximum depth of 20”. Dark Bh / Bhs is redundant
III F 2 (shallow E) (i.e. Bh(s) starts ≤ 6”) 5% redox below Bh / Bhs	IX B (shallow E) Ap now explicitly included 2% redox below Bh or Bhs	Max. depth of 20”

Step-by-Step Comparison, Spodosols, cont.

II F 3 a E with 5% or streaking underlain by Spodic with any redox	IX C 1 E with 2% or stripped matrix underlain by Spodic with 2% redox	All IX C now allows **Ap** <u>or</u> A
II F 3 b (No E horizon) Bh / Bhs underlain with 5% redox	IX C 2 (No E horizon) Bh / Bhs underlain with 2% redox	Max. depth of 20”
III F 3 c (No E horiz.) Bs with 5%	IX C 3 (No E horizon) Bs with 2%	

5% threshold for redox now 2% *

Former any amount of redox now 2%

A <u>or</u> Ap’s allowed

Max. depth of 20”

Step-by-Step Comparison
Sandy Soils

III G 1 5% redox under thin (4 – 8”) organic or mucky A	X A - Sandy w/ Redox 2% redox under thin organic or mucky A	Sandy soils do not require dominant sandy texture.
III G 2 5% redox, chroma ≤ 3 under dark A, Ap or O	X B 2% redox, chroma ≤ 3 under dark A, Ap or O	Use sandy indicators for sandy layers, loamy indicators for loamy layers.
III G 3 5% redox, chroma ≤ 3 under thick, very dark Ap	X C 2% redox, chroma ≤ 3 under thick, very dark Ap	

5% threshold for redox now 2%*

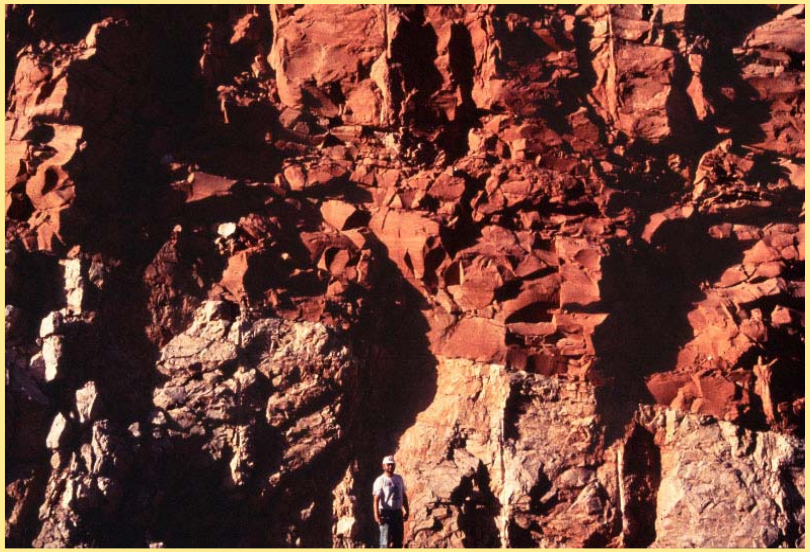
Don’t average texture in upper 20”

Step-by-Step Comparison
Any texture

III H 1 Dark A, 10% depletions in B, ≤ 20” to depleted / gleyed matrix	XI A – Any Texture Now 5% depletions in B	Intent is for loamy soils
III H 2 a & b (combined into 1) Thick, very dark Ap, 20 or 10% dep. in B, ≤ 20” to depleted / gleyed matrix, and redox ≤ 6”	XI B Thick, very dark Ap, 5% dep. in B, ≤ 20” to depleted / gleyed matrix	Intent is that the layer with depletions is continuous to the d / g matrix
III I 1 & 2 (combined into 1) Very dark A, 3 chroma B w/ 10% redox & ≤ 24” to depletions & ≤ 6” 5% conc. (2% concretions)	XII Very dark A, 3 chroma B w/ 10% redox & ≤ 18” to 2% depletions & ≤ 6” 2% redox features	

XIII. Problem Soils
Expanded Information

- STATSGO generated maps on NEIWPCC www site
- General guidance on identifying hydric soil in problem situations
- Established subcommittees to set up monitoring sites and investigate indicators
- Contact information provided for sub-committee Chairs
- "Supplement" has additional info on Problem Hydric Soils



Problem Hydric Soils

Soils that do not exhibit typical morphology associated with wetness due to geologic or anthropogenic influences.

- Soils formed in Dark Parent Materials
- Disturbed Soils
- Soils formed in Red Parent Materials
- Other's in RI: Calcareous areas (?), saprolitic rocks, coastal soils, thick loess, spodosols, and sandy soils.

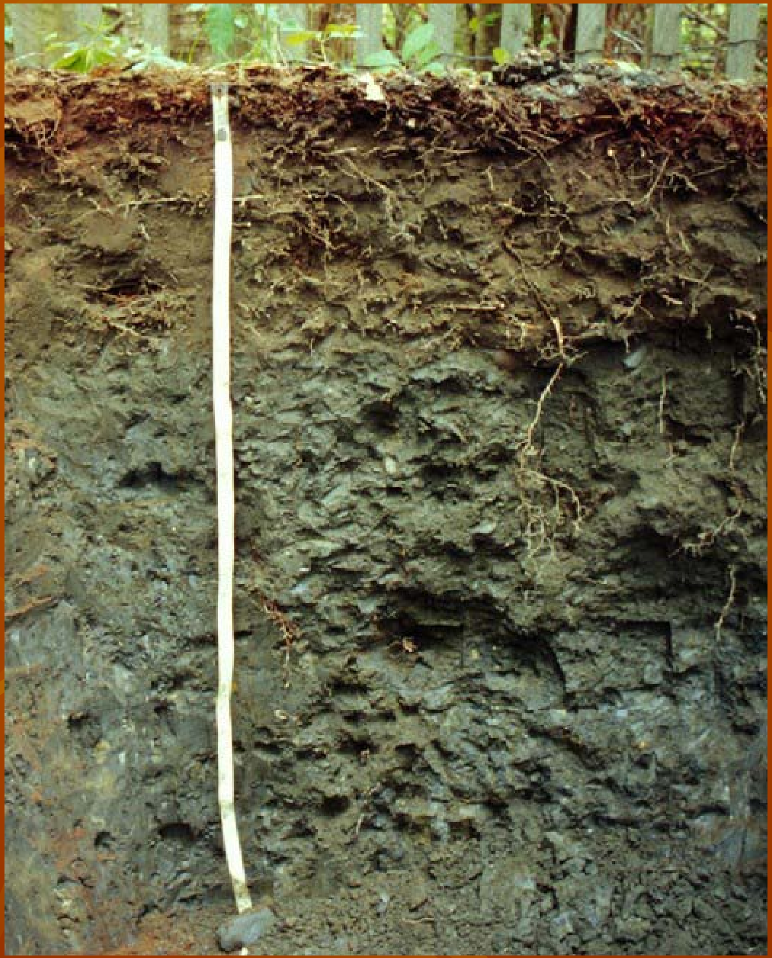
Dark (lithochomic) Soils

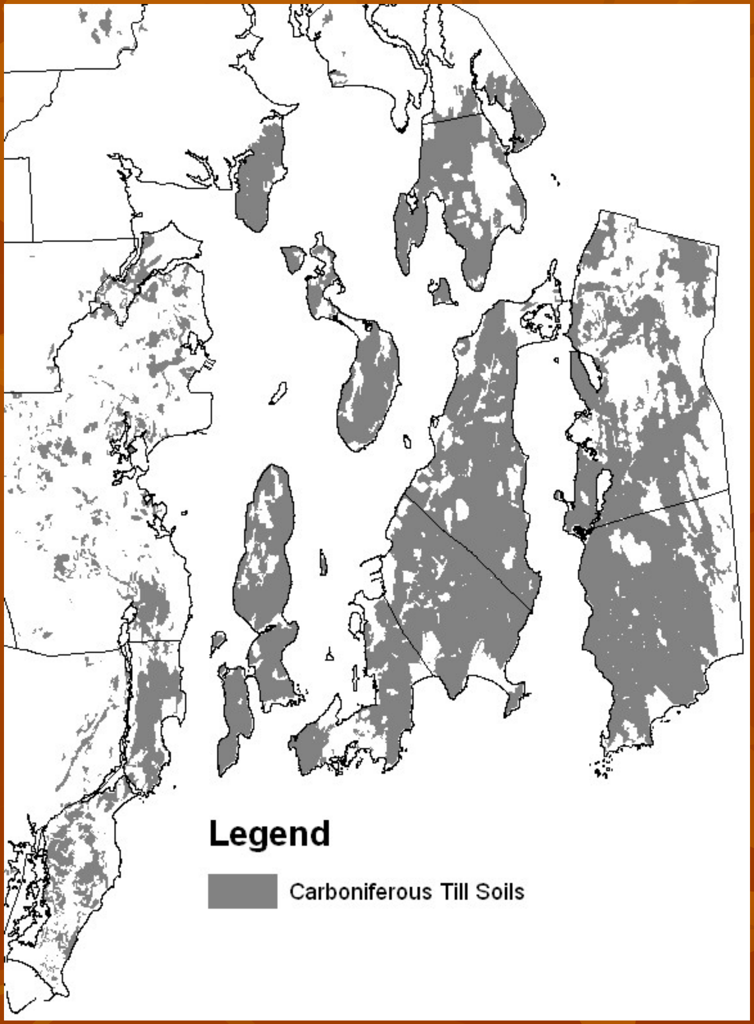
- Considered “problem soils” because dark colors are associated with the bedrock and not always due to wetness.
- Carbon can mask iron colors.
- Upland soils can be mistaken for hydric.
- Dark till subcommittee set up to monitor and develop an indicator.

> **VIII. DARK MINERAL SOILS.** Soils with a matrix chroma of 2 or less that extends to a depth of 20 inches below the *top of the mineral soil material*, and that have a *dark A* or *Ap horizon* (with or without an *O horizon*) that is directly underlain by a horizon with a matrix value of less than 4, and within 12 inches of the *top of the mineral soil material* or directly underlying an *A or Ap horizon*, whichever is shallower, 2 percent or more *redoximorphic features* that extend to:
>
> A. a depth of 20 inches below the *top of the mineral soil material*; or
>
> B. a *depleted* or *gleyed matrix*, whichever is shallower; or

Indicator developed during the dark till tour. Field tested on several sites successfully!

Carboniferous Soils (Dark Tills)





Spodosols

Spodosols

- Can be difficult to describe and key out.
- Occur in both upland and wetlands.
- Have high iron content.
- Occur extensively in NNE (northern bias).
- Not mapped in RI…Yet!
- Bathtub ring effect.
- Working on a mesic indicator for spodosols.

Disturbed Soils

- Occur throughout the landscape.
- Cut (excavated) areas.
- Filled areas.
- When was the fill placed, was it wet fill or formed in place, were the soil hydric prior, are they still?
- Is it a violation!
- Not mapped to series level in RI.

Anthropogenic Soils

Excavated soil – old sand and gravel pit mined down to water table – now a hydric soil/wetland.

Soccer field with fill over buried hydric soils, tray left still hydric, tray right (higher elevation) non-hydric.

Landscape Transect Approach

- Soils occur as a continuum on the landscape
- Describe a known "wet"soil
- Describe a known "upland"soil
- Use judgment to discern the boundary

What Next?

- **Begin Work on Version 4.**
- **Monitor problem soil areas 3 locations along representative transects – develop guidelines and indicators if possible.**
  - Validate indicators
  - Develop new indicators

Help Wanted

We need your help to identify representative locations and monitor the soils and hydrology:

1. Looking for sites that can be monitored for several years (wells, Eh meter, etc.).
2. Any sites where indicators don’t work.
3. Any accessible sites where you have data.
4. Any recommendations/changes/clarifications we can make with V 4.0.

Questions

Thank You