United States Department of Agriculture
Natural Resources Conservation Service

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The Hydric Soil Technical Standard

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Hydric Soil Technical Note 11

Hydric Soils Technical Standard and Data Submission Requirements for Field Indicators of Hydric Soils

Hydric Soils Technical Note 11: Hydric Soils Technical Standard and Data Submission Requirements for Field Indicators of Hydric Soils

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PURPOSE: This document describes the Technical Standard for Hydric Soils (HSTS), which provides a quantitative method to determine if a soil meets the definition of a hydric soil. The HSTS is primarily used to: 1) Identify a hydric soil when field indicator may not be present (e.g., wetland restoration, mitigation, creation, construction); 2) Evaluate the current functional hydric status of a soil (e.g., changes in hydrology); and 3) Propose changes in existing hydric soil indicators (e.g., expanding geographic area of application, revision to technical requirements).

The following sections describe the HSTS and provide guidance regarding the collection and submission of data to the National Technical Committee for Hydric Soils (NTCHS) to validate that a site has met the HSTS. The submission of clear, concise data to the NTCHS promotes technical accuracy, transparency, and efficient decision making in support of hydric soil and wetland resource management. This document describes the minimum data necessary; however, the NTCHS may request additional supporting data depending on specific circumstances.

TECHNICAL STANDARD: The HSTS was developed and approved by the NTCHS and provides a method to demonstrate that a soil currently meets the definition of a hydric soil. Hydric soils are defined as soils "formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register 1994). As a result, the HSTS requires proof of 1) anaerobic conditions and 2) soil saturation for at least 14 consecutive days for most soils, or for 7 consecutive days for a total of 18 annual days for Vertisols in Louisiana and Texas 3) during normal rainfall periods when soil microbes are active. The following section presents the technical requirements for anaerobic conditions and soil saturation.

1) Anaerobic conditions - The HSTS provides for three methods to document anaerobic conditions in the soil.

a) *Indicators of Reduction in Soils (IRIS) tubes*

A minimum of three of five Indicators of Reduction in Soil (IRIS) tubes must have 30 percent or more removed from a zone 15 cm (6 in) or more thick. The zone of removal must begin within 15 cm (6 in) of the soil surface for all soil textures.

b) *Oxidation-reduction potential (Eh) measurements using platinum electrodes*

A minimum of three of five platinum electrodes must have measurements of Eh=175 mv at pH 7. Eh is adjusted for pH on a line with a slope of negative 60 (Figure 1). Soil pH measurements must be collected in-situ each time an Eh measurement is made at the location of one of the five platinum electrodes. Electrodes should be installed at 25 cm (10 in) for most soils, 12.5 cm (5 in) in sandy textured soils, and 10 cm (4 in) in soils that are flooded or ponded and typically do not saturate to greater depths.

Purpose

1. Identify a hydric soil when a field indicator may not be present
   - Problem soil (soils that are hydric but lack an indicator)
   - Wetland restoration or creation (young soils)
2. Evaluate the current functional hydric soil status of a soil
3. Propose additions or changes to existing hydric soil indicators

Hydric Soil Definition

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.

Anaerobic Conditions

1. Indicator of Reduction in Soils (IRIS) Tubes
2. Oxidation-Reduction Potential (Eh) Measurements Using Platinum Electrodes
3. Alpha-Alpha-Dipyridyl Dye
   - Liquid dye
   - Strips

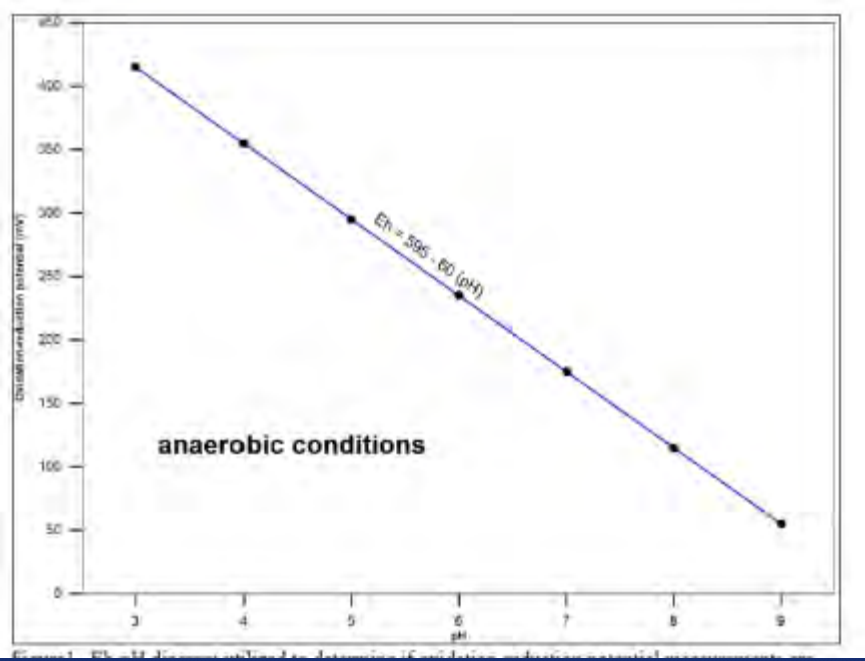
IRIS tubes

Minimum of 3 of 5 tubes must have 30% iron removed from a zone 15 cm or more thick. The zone of removal must begin within 15 cm of the surface for all soil textures.

Eh measurements

A minimum of 3 of 5 platinum electrodes must have Eh measurements of <175 mv at pH 7. Eh threshold is adjusted for pH on a line with a slope of -60. pH measurements are required when using Eh measurements.

Eh Threshold for Anaerobic Conditions



- Installation depth
  - 12.5 cm in sandy textured soils
  - 10 cm in soils that are flooded or ponded and typically do not saturate
  - 25 cm for all other soils

Alpha-Alpha-Dipyridyl Dye

A positive reaction to dye must occur within 60% or more of a layer in least 2 of 3 samples.

Alpha-Alpha-Dipyridyl Requirements

- Reaction must occur
  - within a 5 cm layer in upper 10 cm in soils that inundate but don't saturate
  - a 6.25 cm layer of the upper 12.5 cm in sandy textured soils
  - 10 cm of the upper 30 cm in all other soils

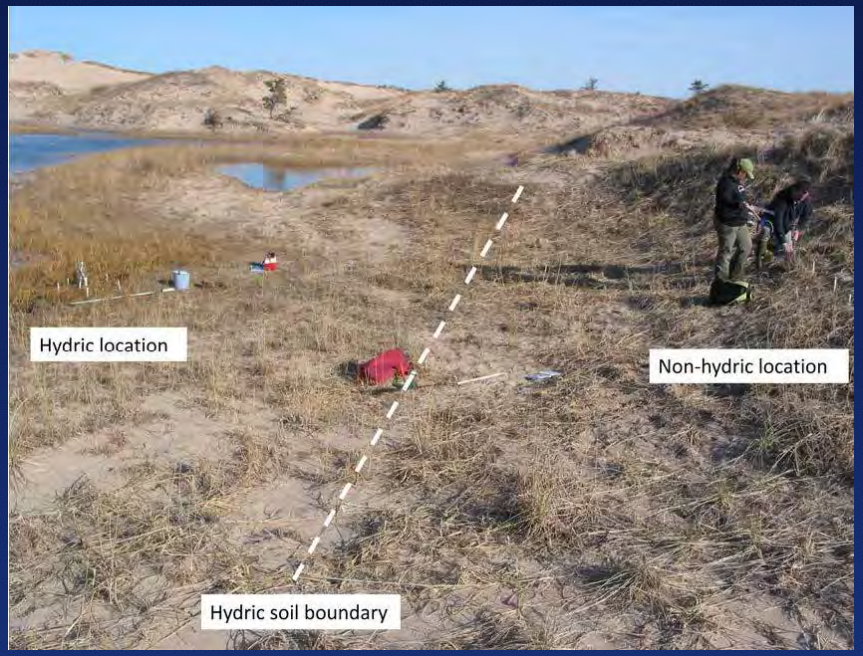
Saturated Conditions

- Saturation measures at 25 cm for 14 consecutive days with a piezometer or shallow well in most soils.
  - Vertisols in LA and TX require saturation for at least 7 consecutive and 18 cumulative days.

On-site Precipitation Data

- On-site precipitation data is needed to evaluate whether the data was collected in a normal, wetter than normal, or drier than normal year.

Data Requirements



- Should utilize data collected at paired hydric/nonhydric locations to demonstrate that hydric conditions exist within the hydric location and are absent in the nonhydric location.

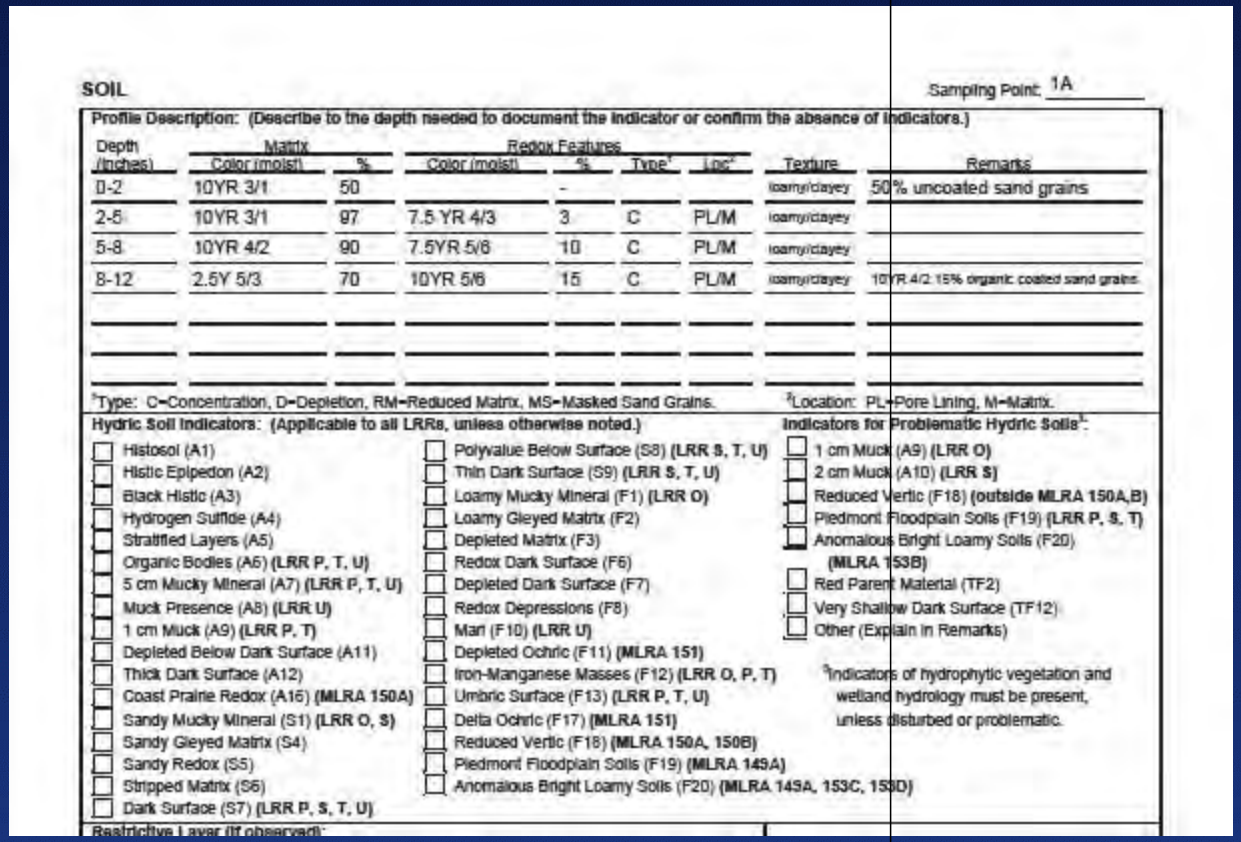
Replicates

- A minimum of three paired hydric/nonhydric study areas at different locations are required for consideration of additions or changes to Field Indicators.

Data Requirements at Each Location

- Soil description
- Evidence that the soil meets or fail the HSTS
- Analysis of rainfall normality

Soil Description



SOIL

Sampling Point: 1A

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 3/1	50		-			loamy/clayey	50% uncoated sand grains
2-5	10YR 3/1	97	7.5 YR 4/3	3	C	PL/M	loamy/clayey	
5-8	10YR 4/2	90	7.5YR 5/6	10	C	PL/M	loamy/clayey	
8-12	2.5Y 5/3	70	10YR 5/6	15	C	PL/M	loamy/clayey	10YR 4/2 15% organic coated sand grains

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

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) (LRR P, T, U)
- ☐ 5 cm Mucky Mineral (A7) (LRR P, T, U)
- ☐ Muck Presence (A8) (LRR U)
- ☐ 1 cm Muck (A9) (LRR P, T)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) (MLRA 150A)
- ☐ Sandy Mucky Mineral (S1) (LRR O, S)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (LRR P, S, T, U)
- ☐ Polyvalue Below Surface (S8) (LRR S, T, U)
- ☐ Thin Dark Surface (S9) (LRR S, T, U)
- ☐ Loamy Mucky Mineral (F1) (LRR O)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) (LRR U)
- ☐ Depleted Ochric (F11) (MLRA 151)
- ☐ Iron-Manganese Masses (F12) (LRR O, P, T)
- ☐ Umbric Surface (F13) (LRR P, T, U)
- ☐ Delta Ochric (F17) (MLRA 151)
- ☐ Reduced Vertic (F18) (MLRA 150A, 150B)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 149A)
- ☐ Anomalous Bright Loamy Soils (F20) (MLRA 149A, 153C, 153D)

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) (LRR O)
- ☐ 2 cm Muck (A10) (LRR S)
- ☐ Reduced Vertic (F18) (outside MLRA 150A,B)
- ☐ Piedmont Floodplain Soils (F19) (LRR P, S, T)
- ☐ Anomalous Bright Loamy Soils (F20) (MLRA 153B)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

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

Restrictive Layer (if observed):

Soil Description

Table 1. Example of soil descriptions at paired hydric (H) and adjacent nonhydric (N) sites examining high chroma sandy soils in Michigan, USA (NRCS 2010; Berkowitz and Sallee 2011). All redox concentrations were distinct or prominent; PL = pore lining, M = matrix. Note that the example provides data from one paired hydric/nonhydric location; multiple locations are required for hydric soil field indicator development or revision (Berkowitz and Noble 2014).

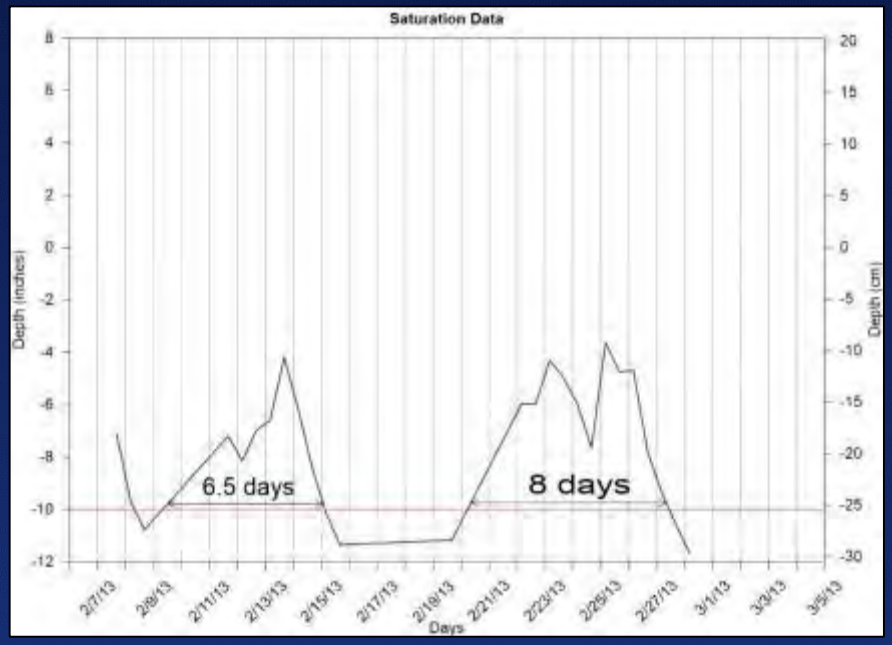
Site	Layer	Depth (cm)	Matrix color	Matrix (%)	Redox (%)	Type and location	Texture	Field indicator
High chroma1(H)	1	0-10	10YR 4.5/2	100			Sandy	None
	2	10-20	10YR 4.5/3	97	3	PL/M	Sandy	
	3	20-50	10YR 5/3	97	3	PL/M	Sandy	
High chroma1(N)	1	0-10	10YR 6/3	100			Sandy	None
	2	10-50	10YR 5/3	100			Sandy	

Photographs

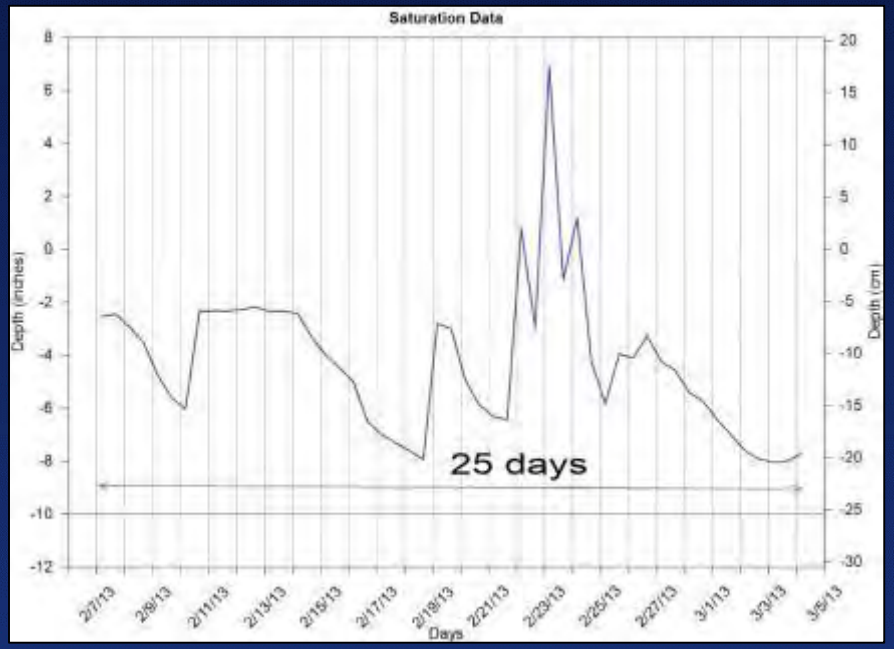
Evidence the Soil Meets HSTS

- For most soil saturation must occur for 14 consecutive days.

Does not meet HSTS



Meets HSTS



Anaerobic Conditions

- Must also meet anaerobic conditions threshold measured by IRIS tubes, alpha-alpha dipyridyl, or direct measurements of Eh for 14 consecutive days when the soils are also saturated.

Iris Tube Evaluation

IRIS Tubes

Table 2. Example of IRIS tube data from one paired hydric (H)/non-hydric (N) study location.

Site	Tube#	Installation date	Removal date	# Days	% Removed	Zone of Removal (cm)		>30% Removal	Notes
						Top	Length		
H	H1	2/1/2013	3/15/2013	42	95	10	35	Yes	
H	H2	2/1/2013	3/15/2013	42	50	18	27	No	removal begins below 15 cm
H	H3	2/1/2013	3/15/2013	42	70	10	35	Yes	
H	H4	2/1/2013	3/15/2013	42	45	12	33	Yes	
H	H5	2/1/2013	3/15/2013	42	20	12	33	No	<30% removal
Hydric Site 1								3/5	Meets Anaerobic Conditions Criteria
N	N1	2/1/2013	3/15/2013	42	10	20	10	No	<30% removal
N	N2	2/1/2013	3/15/2013	42	20	25	20	No	<30% removal
N	N3	2/1/2013	3/15/2013	42	25	25	20	No	<30% removal
N	N4	2/1/2013	3/15/2013	42	30	28	17	No	removal begins below 15 cm
N	N5	2/1/2013	3/15/2013	42	15	25	20	No	<30% removal
Nonhydric Site 1								0/5	Fails Anaerobic Conditions Criteria

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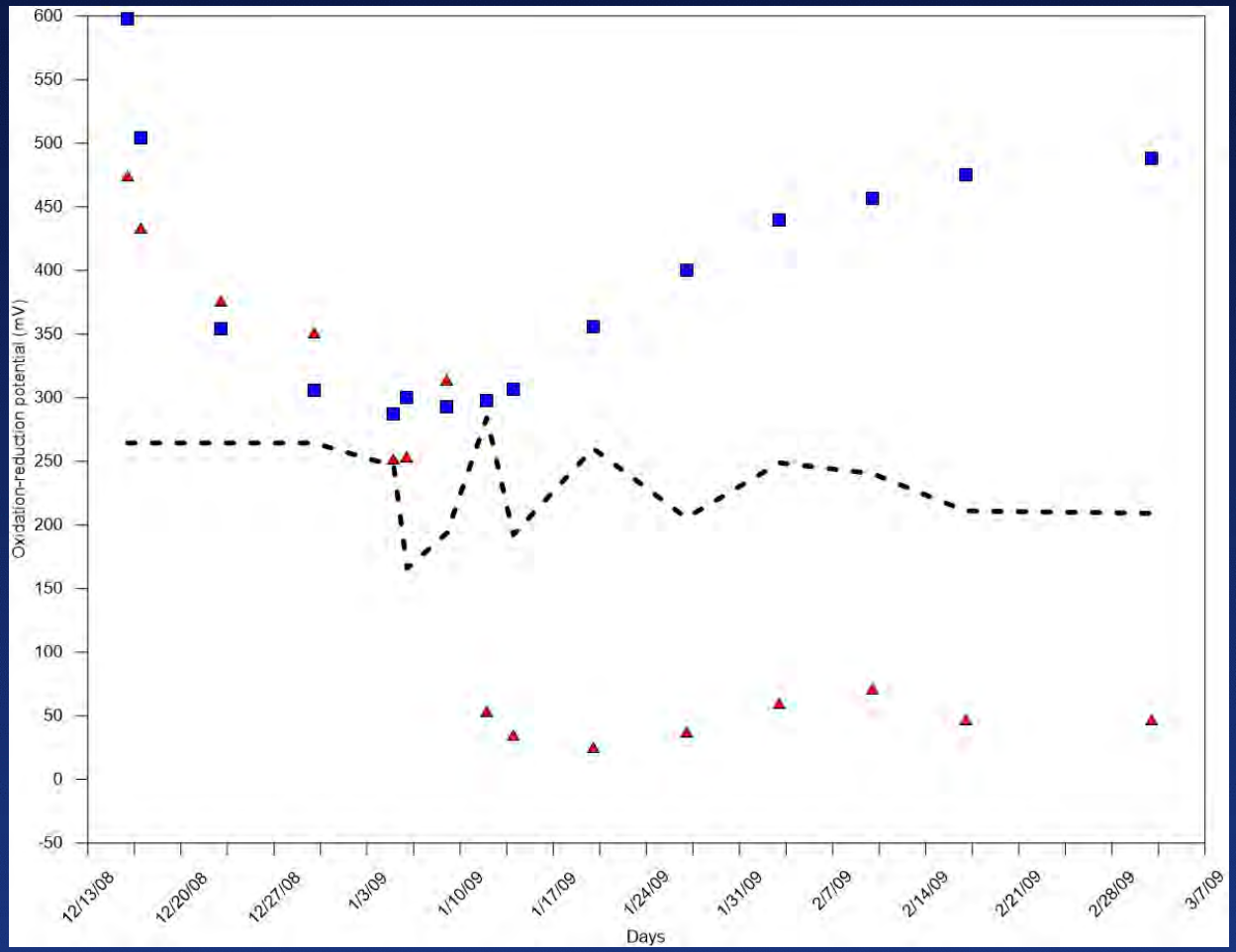
Alpha-alpha-dipyridyl Dye

Alpha-alpha-dipyridyl Dye

Table 3. Example of summary data indicating anaerobic conditions, saturated conditions, and HSTS results collected at paired hydric and nonhydric study locations.

	Parameter			Summary		
Study Area	**IRIS Tubes with >30% Removal**	**αα-dipyridyl dye reaction**	**Consecutive Days of Saturation**	**Anaerobic Conditions**	**Saturated Conditions**	**HSTS**
Hydric site 1	4/5	Yes	26	Yes	Yes	Yes
Nonhydric site 1	1/5	No	5	No	No	No
Hydric site 2	5/5	Yes	89	Yes	Yes	Yes
Nonhydric site 2	2/5	No	15	No	Yes	No
Hydric site 3	3/5	Yes	37	Yes	Yes	Yes
Nonhydric site 3	0/5	No	8	No	Yes	No

Direct Measurements of Eh



Sample Data for Eh

Table 4. Example of data from five Pt electrodes at paired hydric (H) and non-hydric (N) study sites. One of the five probes at N1 displayed anaerobic conditions and would fail to meet the anaerobic conditions requirements of the HSTS; H1 displayed three of five probes with anaerobic conditions. H1 would meet the anaerobic conditions requirement of the HSTS for that date. *Reference electrode type: Ag/AgCl correction factor +197

Date	Site	Replicate Probe #	Reading (mV)	Reference Probe Correction* (mV)	Soil pH	Required for Reduction (595-60*(pH))	Reduced
01/28/09	N1	1	176	373	6.2	223	No
01/28/09	N1	2	302	499	6.2	223	No
01/28/09	N1	3	163	360	6.2	223	No
01/28/09	N1	4	70	267	6.2	223	No
01/28/09	N1	5	306	503	6.2	223	No
01/28/09	H1	1	33	230	5.51	264.4	Yes
01/28/09	H1	2	95	292	5.51	264.4	No
01/28/09	H1	3	-15	182	5.51	264.4	Yes
01/28/09	H1	4	-89	108	5.51	264.4	Yes
01/28/09	H1	5	154	351	5.51	264.4	No

Direct Antecedent Rainfall Evaluation Method (DAREM)

- Obtain 30th and 70th percentile from NRCS WETS tables
- Document monthly on-site rainfall measurements
- 1=drier than normal; 2=normal; 3=wetter than normal
- Weight by month and multiply
- Add three months prior to measurements
- 6-9=dry; 10-14=normal;15-18=wet

Normal Precipitation Analysis

Prior Month	Name	WETS 30th percentile	WETS 70th percentile	Measured Rainfall	Condition	Condition Value	Month Weight	Score	Result
Baldwin Co.		Weather station							
3rd	Sept	2.89	7.04	5.01	Normal	2	1	2	
2nd	Oct	1.08	3.74	3.2	Normal	2	2	4	
most recent	Nov	3.24	6.25	0.89	Dry	1	3	3	**Dry**
Month examined	Dec						**Total**	**9**	
Baldwin Co.		Weather station							
3rd	Oct	1.6	4.11	4.28	Wet	3	1	3	
2nd	Nov	3.15	6.2	1.47	Dry	1	2	2	
most recent	Dec	4.03	6.53	8.82	Wet	3	3	9	
Month examined	Jan						**Total**	**14**	**Normal**

When HSTS is Reliable

- If HSTS is met during wetter than normal period, study must be extended to ensure that the site will also meet standard during normal year
- If HSTS is no met during dryer than normal period, study must be extended to ensure site will not meet standard during normal year

Summary

- The HSTS provides a quantitative method for evaluating whether a soil meets the definition of a hydric soil through the evaluation of the occurrence of saturated and anaerobic conditions under normal precipitation.
- The HSTS will not identify hydric soils that formed under conditions of saturation, ponding, or flooding but no longer exhibit these characteristics due to hydrologic alteration.

Summary

- The HSTS can be used to:
  - Identify young hydric soils or problematic hydric soils where field indicators are not present
  - Evaluate the functional hydric soil status
  - With replication propose changes to existing field indicators or additional indicators

HSTS Tech. Note 11 Location

- http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/