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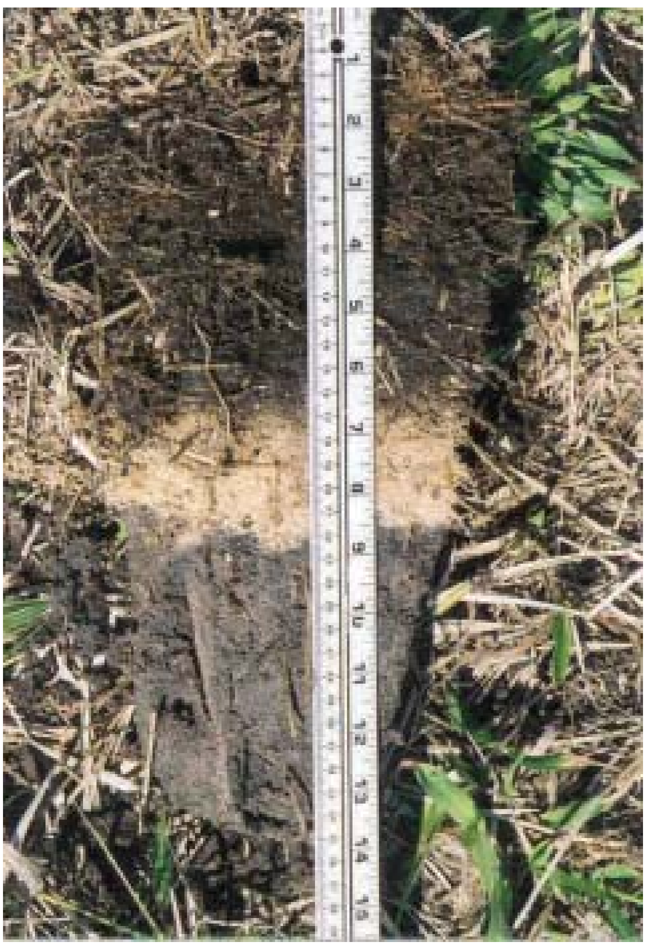
Wetland Science Institute

Soil Survey Division

Field Indicators of Hydric Soils in the United States

Guide for Identifying and Delineating Hydric Soils, Version 5.01, 2003



In cooperation with the National Technical Committee for Hydric Soils

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Cover

Live roots are discounted when determining the fiber content of a soil. The soil on the left has muck (sapric soil material) starting at a depth of 2 cm and extending to a depth of about 16 cm. The soil on the right has mucky peat (hemic soil material) to a depth of about 8 cm. If indicator S2 (2.5 cm mucky peat or peat) or indicator S3 (5 cm mucky peat or peat) is not a concern, morphologies below 8 cm would determine the hydric status of this soil. Scale is cm (left) and inches (right) for both profiles.

Foreword

Field Indicators of Hydric Soils in the United States has been developed by soil scientists of the Natural Resources Conservation Service (NRCS) in cooperation with the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, various Regional, State, and local agencies, universities, and the private sector. The editors recognize the efforts of the many individuals without which this guide could not have been developed. Included herein are the hydric soil indicators approved for use by the NRCS and the National Technical Committee for Hydric Soils when identifying, delineating, and verifying the presence of hydric soils in the field.

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Introduction

Field Indicators of Hydric Soils in the United States (hereafter referred to as Indicators) is a guide to help identify and delineate hydric soils in the field (fig. 1). Indicators are not intended to replace or relieve the requirements contained in the definition of a hydric soil. The list of Indicators is considered to be dynamic; changes and additions are anticipated annually. The section *To Comment on the Indicators* provides guidance to recommend changes, deletions, and additions. Any modifications to the Indicators must be approved by NRCS and the National Technical Committee for Hydric Soils. To properly use the Indicators, a basic knowledge of soil landscape relationships and soil survey procedures is necessary.

The indicators are designed to be regionally specific. Each indicator provides the Land Resource Regions (LRRs) or the Major Land Resource Areas (MLRAs) in which it can be used. The geographic extent of LRRs (fig. 2) and MLRAs are defined in USDA Agriculture Handbook 296 (USDA, SCS, 1981). LRR specific Indicators are listed in appendix A and described in section Field Indicators of Hydric Soils. The indicators are used to identify the hydric soil component of wetlands; however, some hydric soils do not have any of the currently listed indicators. Therefore, the absence of any listed indicator does not exclude the soil from being classed as hydric. Such soils should be studied and their characteristic morphologies identified for inclusion in this guide.

Concept

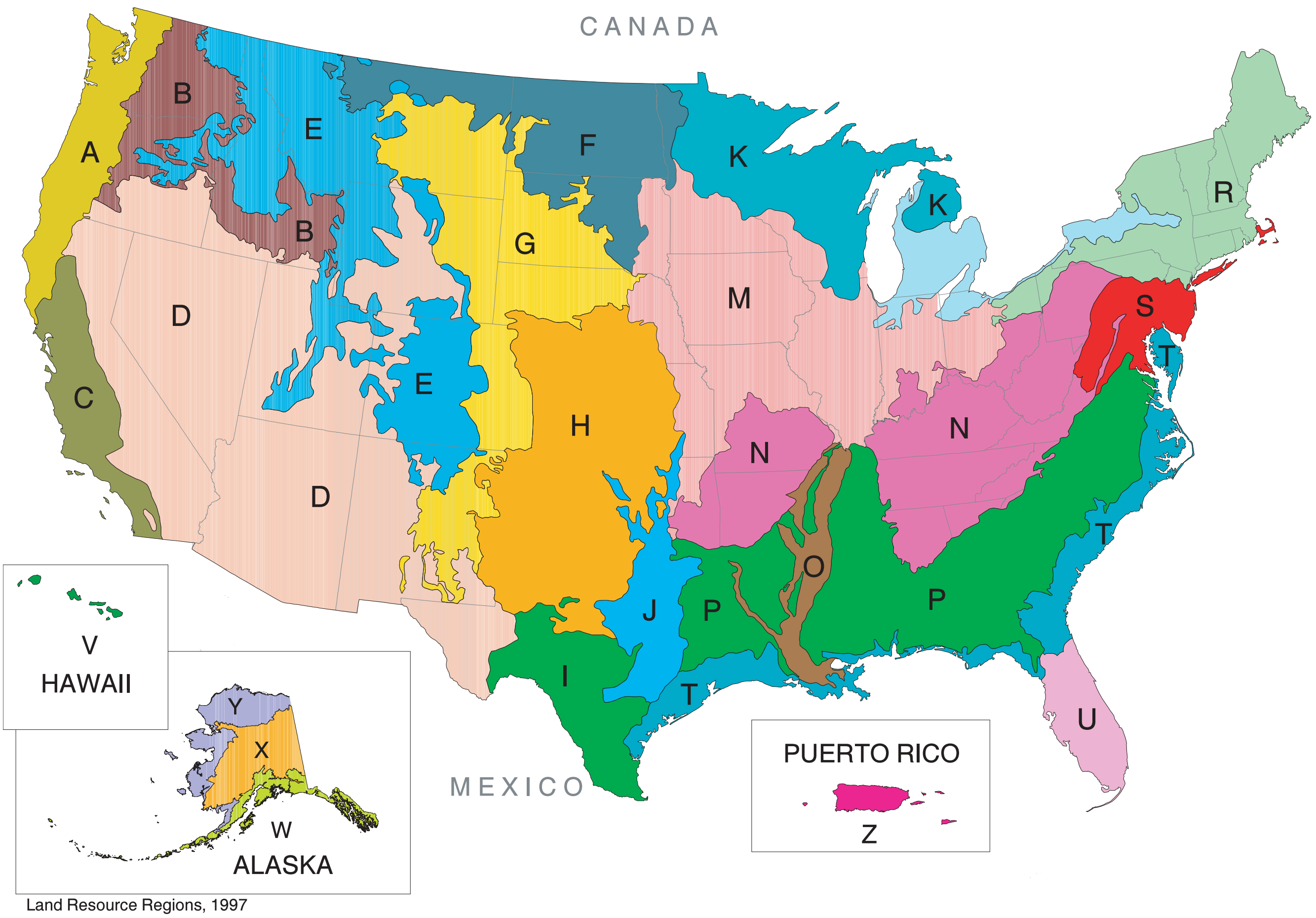
Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil (Federal Register, July 13, 1994).

Nearly all hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation, or both, for more than a few days. Saturation or inundation when combined with microbial activity in the soil causes a depletion of oxygen. This anaerobiosis promotes biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, and/or accumulation of iron and other reducible elements. These processes result in characteristic morphologies that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils.

Figure 1. The field indicators are to be used to delineate hydric soils. The soil on the right is hydric that has the Indicator S6 Stripped Matrix starting at a depth of about 14 cm, and the soil on the left is nonhydric with the Stripped Matrix starting at a depth of about 18 cm.

Hydric soil indicators are formed predominantly by the accumulation or loss of iron, manganese, sulfur, or carbon compounds. The presence of hydrogen gas (rotten egg odor) is a strong indicator of a hydric soil, but this indicator is found in only the wettest sites containing sulfur. Although indicators related to iron/manganese (Fe/Mn) depletions or concentrations are common, they cannot form in materials that contain low amounts of Fe/Mn. Soil formed in such materials may have low chroma colors that are not related to saturation and reduction. For such soil, features related to accumulations of organic carbon should be used. These features are identified in this guide to handle soil that may have had low amounts of Fe/Mn and where hydrogen sulfide gas is not detected. Some of these carbon accumulation features, such as Indicators A1 Histosols, A2 Histic Epipedon, and A3 Black Histic are often used to identify hydric soils. Because they are maximum expressions of anaerobiosis, they are rarely used for delineation purposes.

Figure 2. USDA Land Resource Regions map of specific Indicators.



LRR symbol	LRR name	LRR symbol	LRR name
A	Northwestern Forest, Forage, and Specialty Crop Region	N	East and Central Farming and Forest Region
B	Northwestern Wheat and Range Region	O	Mississippi Delta Cotton and Feed Grains Region
C	California Subtropical Fruit, Truck, and Specialty Crop Region	P	South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region
D	Western Range and Irrigated Region	Q	Pacific Basin Region
E	Rocky Mountain Range and Forest Region	R	Northeastern Forage and Forest Region
F	Northern Great Plains Spring Wheat Region	S	Northern Atlantic Slope Diversified Farming Region
G	Western Great Plains Range and Irrigated Region	T	Atlantic and Gulf Coast Lowland Forest and Crop Region
H	Central Great Plains Winter Wheat and Range Region	U	Florida Subtropical Fruit, Truck Crop, and Range Region
I	Southwest Plateaus and Plains Range and Cotton Region	V	Hawaii Region
J	Southwestern Prairies Cotton and Forage Region	W	Southern Alaska Region
K	Northern Lake States Forest and Forage Region	X	Interior Alaska Region
L	Lake States Fruit, Truck, and Dairy Region	Y	Arctic and Western Alaska Region
M	Central Feed Grains and Livestock Region	Z	Caribbean Region

Cautions

Some hydric soils have morphologies that are difficult to interpret or seem inconsistent with the landscape, vegetation, or hydrology. Such soils include those formed in grayish or reddish parent materials; soils that have high pH or low organic matter content; Mollisols and Vertisols; soils that have relict redoximorphic features; and disturbed soils, such as cultivated soils and filled areas.

Soil that is artificially drained or protected, for instance, by levees, is hydric if the soil in its undisturbed state would meet the definition of a hydric soil. This soil should also have at least one of the Indicators.

Morphological features of hydric soils indicate that saturation and anaerobic conditions have existed under either contemporary or former (recent) hydrologic regimes. Features that do not reflect contemporary or recent hydrologic conditions of saturation and anaerobiosis are relict features. Typically, contemporary and recent hydric soil morphologies have diffuse boundaries; relict hydric soil features have sharp boundaries. 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.

Procedure

To document a hydric soil, first remove all loose leaf matter, needles, bark, and other easily identified plant parts to expose the surface. Dig a hole and describe the soil profile to a depth of at least 50 cm (20 in). Using the completed soil description specify which Indicators have been matched.

Deeper examination of soil may be required where field indicators are not easily seen within 50 cm (20 in) of the surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations. For example, examination to less than 50 cm (20 in) may suffice in soils that have a surface horizon of organic material or mucky mineral material because these shallow organic accumulations only occur in hydric soils. Conversely, depth of excavation is often greater than 50 cm (20 in) in Mollisols because the upper horizons of these soils mask the effect of organic material and often contain no visible redoximorphic features. In many sites making exploratory observations to a meter or more is necessary. These observations should be made with the intent of documenting and understanding the variability in soil properties and hydrologic relationships on the site.

Depths used in the Indicators are measured from the muck or mineral soil surface unless otherwise indicated. All colors refer to moist Munsell colors (fig. 3).

Soil colors specified in the Indicators do not have decimal points listed; however, colors do occur between Munsell chips. Soil colors should not be rounded to qualify as meeting an indicator. For example, a soil matrix that has a chroma between 2 and 3 should be listed as having a chroma of 2+. This soil material does not have a chroma 2 and would not meet any indicator that requires a chroma 2 or less.

Particular attention should be paid to changes in topography over short distances (microtopography). Small changes in elevation may result in repetitive sequences of hydric/nonhydric soils. The delineation of individual areas of hydric and nonhydric soils may be difficult.

Often the dominant condition (hydric/nonhydric) is the only reliable interpretation. The shape of the local landform can greatly affect the movement of

Figure 3. Indicator F6 Redox Dark Surface. The left is moist and the right is dry. Most commonly moist soil colors are to be used when identifying and delineating hydric soils.

water through the landscape. Significant changes in parent material or lithologic discontinuities in the soil can affect the hydrologic properties of the soil. After exploratory observations have been made sufficient to understand the soil-hydrologic relationships at the site, subsequent excavations may then be shallower if identification of appropriate indicators allows.

To Comment on the Indicators

The Indicators are revised and updated as field data are collected to improve our understanding of hydric soil processes (fig. 4). Revisions, additions, and other comments regarding field observations of hydric soil conditions that cannot be documented using the presently recognized Indicators are welcome; however, any modifications and additions must be approved by NRCS and NTCHS. Guidelines for requesting changes to field indicators are as follows:

1. **Adding indicators or changing existing indicators**—Minimally, the following should accompany all requests for additions and changes to existing hydric soil indicators in *Field Indicators of Hydric Soils in the United States*:

Figure 4. Proper installation of the right kinds of monitoring devices is important to obtain approval of changes and additions to the hydric soil indicators.

   (a) Detailed pedon descriptions of at least three pedons that document the addition or change and detailed pedon descriptions of three neighboring nonhydric pedons.
   (b) Detailed vegetative data collected to represent the vegetation of the six pedons.
   (c) Saturation/inundation data and redox potential (Eh) data for a duration that captures the saturation cycle (dry-wet-dry) of at least one of the hydric pedons and one of the nonhydric pedons. Precipitation and in situ soil-water pH data from the same sites should also be provided. Monitoring instrumentation should be installed according to the Hydric Soil Technical Standard in Technical Note 11 (http://soils.usda.gov/soil_use/hydric/hstn.htm).

2. **Adding a test indicator**—Minimally, the following should accompany all requests for adding a test indicator to *Field Indicators of Hydric Soils in the United States*:
   (a) Detailed pedon descriptions of at least three pedons that document the test indicator and detailed pedon descriptions of three neighboring nonhydric pedons.
   (b) Detailed vegetative data collected to represent the vegetation of the six pedons.

3. All requests involving 1 and 2 above additionally require a short written plan that
   (a) Identifies the problem,
   (b) Explains the rationale for the request, and
   (c) Provides the following:
      – person responsible and point of contact (e–mail and mail addresses and phone number)
      – timeline for supporting data and final report to be delivered to NTCHS
      – timeline needed for final NTCHS decision
      – partners involved in project

Requests and data should be sent to:
Wade Hurt, Chair
NTCHS Field Indicator Subcommittee
P.O. Box 110290
University of Florida
Gainesville, FL 32611-0290
e-mail: Wade_Hurt@mail.ifas.ufl.edu

Field Indicators of Hydric Soils

Field Indicators of Hydric Soils in the United States is structured as follows:
1. Alpha-numeric listing
2. Short name
3. Applicable Land Resource Regions (LRRs)
4. Description of the field indicator
5. User notes

For example, A1 indicates the first indicator for all soils; Histosol or Histel is the short name; the indicator is for use in all LRRs; classifies as a Histosol except Folists is the field indicator description; and helpful user notes are added.

All soils

All soils refers to soils that have any USDA soil texture. Unless otherwise indicated, all mineral layers above any of the Indicators have dominant chroma 2 or less, or the layer(s) with dominant chroma of more than 2 is less than 15 cm (6 in) thick. Also, unless otherwise indicated, nodules and concretions are not considered to be redox concentrations. Use the following Indicators regardless of texture.

A1. Histosol *(for use in all LRRs)* **or Histel** *(for use in LRRs with permafrost)*. **Classifies as a Histosol (except Folist) or as a Histel (except Folistel).**

Histosol User Notes: A Histosol has 40 cm (16 in) or more of the upper 80 cm (32 in) as organic soil material (fig. 5). Organic soil material has an organic carbon content (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. The material includes muck (sapric soil material), mucky peat (hemic soil material), or peat (fibric soil material). See glossary for definition of muck, mucky peat, peat, and organic soil material. See figure 37 (organic soil material) in the glossary for organic carbon requirements. Histels are similar to Histosols except they are underlain by permafrost.

A2. Histic Epipedon. *For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.* **A histic epipedon.**

Histic Epipedon User Notes: Most histic epipedons are surface horizons 20 cm (8 in) or more thick of organic soil material. Aquic conditions or artificial drainage are required. See Soil Taxonomy, (USDA, NRCS, Soil Survey Staff 1999). Slightly lower organic carbon contents are allowed in plowed soils (ibid.). See glossary for definitions. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

A3. Black Histic. *For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.* **A layer of peat, mucky peat, or muck 20 cm (8 in) or more thick starting within the upper 15 cm (6 in) of the soil surface having hue 10YR or yel-lower, value 3 or less, and chroma 1 or less** (fig. 6).

Black Histic User Notes: Unlike indicator A2 this indicator does not require proof of aquic conditions or artificial drainage. See glossary for definitions of peat, mucky peat, and muck. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

Figure 5. Indicator A1 Histosols. Muck (sapric soil material) is more than 80 cm thick. Scale is feet (R) and m (L).

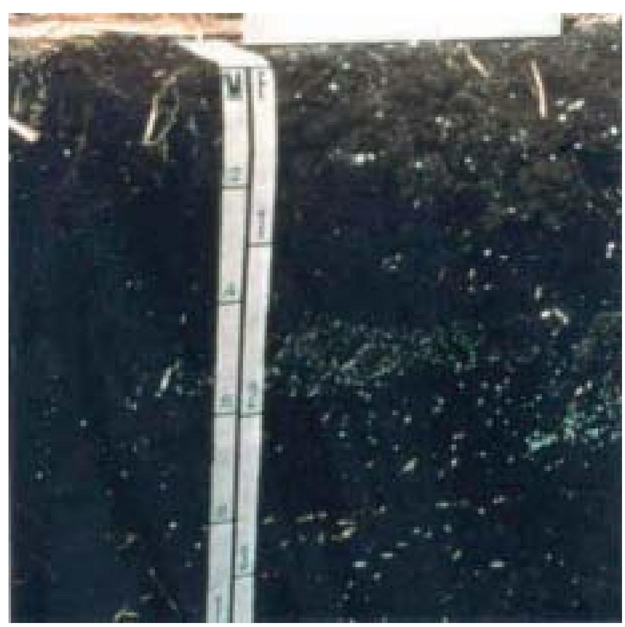


Figure 6. Indicator A3 Black Histic. Proof of aquic conditions is not required. Scale is inches (R) and cm (L).

A4. Hydrogen Sulfide. *For use in all LRRs.* **A hydrogen sulfide odor within 30 cm (12 in) of the soil surface.**

Hydrogen Sulfide User Notes: The rotten egg smell indicates that sulfate-sulfur has been reduced, and therefore the soil is anaerobic. In most hydric soils the sulfidic odor is only present when the soil is saturated and anaerobic.

A5. Stratified Layers. *For use in LRRs F, K, L, M, N, O, P, R, S, T, and U; for testing in LRRs V and Z.* **Several stratified layers starting within the upper 15 cm (6 in) of the soil surface. One or more of the layers has value 3 or less with chroma 1 or less, and/or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have value 4 or more and chroma 2 or less.**

Stratified Layers User Notes: Use of this indicator may require assistance from a trained soil scientist that has local experience. The minimum organic carbon content of at least one layer of this indicator is slightly less than required for Indicator A7 Mucky Modified Mineral Texture: at least 70 percent of soil material is covered, coated, or similarly masked with organic matter. An undisturbed sample must be observed. Individual strata are dominantly less than 2.5 cm (1 in) thick. A hand lens is an excellent tool to aid in the identification of this indicator. Many alluvial soils have stratified layers at greater depths; these are not hydric soils. Many alluvial soils have stratified layers at the required depths, but lack chroma 2 or less; these do not fit this indicator. Stratified layers occur in any type soil material (figs. 7 and 8).

Figure 7. Indicator A5 Stratified Layers is sandy. Scale is inches.

Figure 8. Indicator A5 in loamy material. Scale is inches (R) and cm (L).

A6. Organic Bodies. *For use in LRRs P, T, U, and Z.* **Presence of 2 percent or more organic bodies of muck or a mucky modified mineral texture, approximately 1 to 3 cm (0.5 to 1 in) in diameter, starting within 15 cm (6 in) of the soil surface** (figs. 9, 10, and 11).

Organic Bodies User Notes: The percent organic carbon in organic bodies is the same as that in the Muck or Mucky Texture Indicators. This indicator includes the indicator previously named *accretions* (Florida Soil Survey Staff, 1992). Many organic bodies do not have the required amount of organic carbon and are not indicative of hydric soils. The content of organic carbon should be known before this indicator is used. Organic bodies of hemic (mucky peat) or fibric (peat) soil materials, or both, do not qualify as this indicator. Material consisting of partially decomposed root tissue does not qualify as the indicator.

Figure 10. Indicator A6 Organic Bodies. From the soil in figure 9, the individual organic bodies are 1 to 3 cm in diameter. Scale is inches (upper) and cm (lower).

Figure 9. Indicator A6 Organic Bodies. The mucky organic bodies layer occurs between 0 and 10 cm. Indicator S7 Dark Surface is also present. Scale is inches (R) and cm (L).

Figure 11. Indicator A6 Organic Bodies. The organic bodies are approximately 1 to 3 cm in diameter; sometimes they are smaller. Scale is inches.

A7. 5 cm Mucky Mineral. *For use in LRRs P, T, U, and Z.* **A mucky modified mineral surface layer 5 cm (2 in) or more thick starting within 15 cm (6 in) of the soil surface** (fig. 12).

5 cm Mucky Mineral User Notes: *Mucky* is a USDA texture modifier for mineral soil. The organic carbon content is at least 5 percent and ranges to as high as 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky fine sand that has at least 5 percent organic carbon, but not more than about 12 percent organic carbon. Another example is mucky sandy loam that has at least 7 percent organic carbon, but not more than about 14 percent organic carbon. See the glossary for the definition of mucky modified mineral texture. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

A8. Muck Presence. *For use in LRRs U, V, and Z.* **A layer of muck that has a value 3 or less and chroma 1 or less within 15 cm (6 in) of the soil surface** (fig. 13).

Muck Presence User Notes: The presence of muck of any thickness within 15 cm (6 in) is the only requirement. Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm (6 in). Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition such that plant parts cannot be identified. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Then examine for decomposed organic soil material. Generally, muck is black and has a greasy feel; sand grains should not be evident. Hydric soil indicator determinations are made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decision-making process for Mucky Peat, Peat, Organic Bodies, or Histic Indicators. See the glossary for the definition of muck. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

Figure 12. Indicator A7 5 cm Mucky Mineral about 10 cm thick. Indicator S7 Dark Surface is also present. Scale is inches (R) and cm (L).

Figure 13. Indicators A8 Muck Presence and S7 Dark Surface. Muck is less than 1 cm thick and the dark surface is 18 cm thick. Scale is inches (R) and cm (L).

A9. 1 cm Muck. *For use in LRRs D, F, G, H, P, and T; for testing in LRRs I, J, and O.* **A layer of muck 1 cm (0.5 in) or more thick with value 3 or less and chroma 1 or less starting within 15 cm (6 in) of the soil surface.**

1 cm Muck User Notes: Unlike Indicator A8 Muck Presence, there is a minimum thickness requirement of 1 cm. Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm (6 in). Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Then examine for decomposed organic soil material. Generally, muck is black and has a greasy feel; sand grains should not be evident. Hydric soil indicator determinations are made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decisionmaking process for Mucky Peat, Peat, Organic Bodies, or Histic Indicators. See the glossary for the definition of muck. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

A10. 2 cm Muck. *For use in LRRs M and N; for testing in LRRs A, B, C, E, K, L, S, W, X, Y, and Z.* **A layer of muck 2 cm (0.75 in) or more thick with value 3 or less and chroma 1 or less starting within 15 cm (6 in) of the soil surface.**

2 cm Muck User Notes: This Indicator requires a minimum muck thickness of 2 cm. Normally this expression of anaerobiosis is at the soil surface; however, it may occur at any depth within 15 cm (6 in). Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Then examine for decomposed organic soil material. Generally, muck is black and has a greasy feel; sand grains should not be evident. Hydric soil indicator determinations are made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decisionmaking process for Mucky Peat, Peat, Organic Bodies, or Histic Indicators. See the glossary for the definition of muck. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

Sandy soils

Sandy soils refers to those soils that have a USDA texture of loamy fine sand and coarser. Unless otherwise indicated, all mineral layers above any of the Indicators have dominant chroma 2 or less, or the layer(s) with dominant chroma of more than 2 is less than 15 cm (6 in) thick. In addition, unless otherwise indicated, nodules and concretions are not considered to be redox concentrations. Use the following sandy Indicators for sandy mineral soil materials:

S1. Sandy Mucky Mineral. *For use in all LRRs except W, X, and Y.* **A mucky modified sandy mineral layer 5 cm (2 in) or more thick starting within 15 cm (6 in) of the soil surface.**

Sandy Mucky Mineral User Notes: *Mucky* is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 percent and ranges to as high as 14 percent for sandy soils. The percent-age requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky fine sand that has at least 5 percent organic carbon, but not more than about 12 percent organic carbon. See the glossary for the definition of mucky modified mineral texture. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

S2. 2.5 cm Mucky Peat or Peat. *For use in LRRs G and H.* **A layer of mucky peat or peat 2.5 cm (1 in) or more thick with value 4 or less and chroma 3 or less starting within 15 cm (6 in) of the soil surface underlain by sandy soil material.**

2.5 cm Mucky Peat and Peat User Notes: Mucky peat (hemic soil material) and peat (fibric soil material) having at least 12 to 18 percent organic carbon. Organic soil material is called peat if virtually all of the plant remains are sufficiently intact to permit identification of plant remains. Mucky peat is an intermediate stage of decomposition between peat and highly decomposed muck. To determine if mucky peat or peat, or both, are present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Next examine for undecomposed to partly decomposed organic soil material. See the glossary for the definitions of mucky peat and peat.

S3. 5 cm Mucky Peat or Peat. *For use in LRRs F and M.* **A layer of mucky peat or peat 5 cm (2 in) or more thick with value 3 or less and chroma 2 or less starting within 15 cm (6 in) of the soil surface underlain by sandy soil material.**

5 cm Mucky Peat and Peat User Notes: Mucky peat (hemic soil material) and peat (fibric soil material) have at least 12 to 18 percent organic carbon. Organic soil material is called peat if virtually all of the plant remains are sufficiently intact to permit identification of plant remains. Mucky peat is an intermediate stage of decomposition between peat and highly decomposed muck. To determine if mucky peat or peat, or both, are present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called a leaf/root mat. Next examine for undecomposed to partly decomposed organic soil material. See the glossary for the definitions of mucky peat and peat.

S4. Sandy Gleyed Matrix. *For use in all LRRs except W, X, and Y.* **A gleyed matrix that occupies 60 percent or more of a layer starting within 15 cm (6 in) of the soil surface** (fig. 14).

Sandy Gleyed Matrix User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the gley page (Gretag/Macbeth, 2000). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more. The gleyed matrix only has to be present within 15 cm (6 in) of the surface. Soils with gleyed matrices are saturated for a significant duration; this is why no thickness of the layer is required. See the glossary for the definition of gleyed matrix.

S5. Sandy Redox. *For use in all LRRs except V, W, X, and Y.* **A layer starting within 15 cm (6 in) of the soil surface that is at least 10 cm (4 in) thick and has a matrix with 60 percent or more chroma 2 or less with 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings** (fig. 15).

Sandy Redox User Notes: Distinct and prominent are defined in the glossary. Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas, 1994). Included within this concept of redox concentrations are iron/manganese bodies as soft masses with diffuse boundaries. The iron/manganese masses are 2 to 5 mm and have value 3 or less and chroma 3 or less; most commonly they are black. Iron/manganese masses should not be confused with concretions and nodules associated with plinthitic (USDA, NRCS, Soil Survey Staff, 1999) or relict concretions. Common to many redox concentrations (USDA, NRCS, 2002) are required.

S6. Stripped Matrix. *For use in all LRRs except V, W, X, and Y.* **A layer starting within 15 cm (6 in) of the soil surface in which iron/manganese oxides and/or organic matter have been stripped from the matrix exposing the primary base color of soil materials. The stripped areas and translocated oxides and/or organic matter form a diffuse splotchy pattern of two or more colors. The stripped zones are 10 percent or more of the volume; they are rounded and approximately 1 to 3 cm (0.5 to 1 in) in diameter.**

Figure 14. Indicator S4 Sandy Gleyed Matrix. The gleyed matrix begins at the soil surface. Scale is inches (R) and cm (L).

Stripped Matrix User Notes: This indicator includes the indicator previously named *polychromatic matrix* (Florida Soil Survey Staff, 1992) as well as the term *streaking* (Environmental Laboratory, 1987) (app. B). Common to many (USDA, Soil Survey Division Staff, 1993) areas of stripped (uncoated) soil materials 1 to 3 cm (0.5 to 1 in) in size is a requirement. Commonly the splotches of color have value 5 or more and chroma 1 and/or 2 (stripped) and chroma 3 and/or 4 (unstripped). The matrix may lack the 3 and/or 4 chroma material. The mobilization and translocation of the oxides and/or organic matter is the important process and should result in splotchy coated and uncoated soil areas (figs. 16, 17, and 18).

Figure 16. Indicator S6 Stripped Matrix. The matrix stripped of iron oxides begins below a depth of about 10 cm. Scale is inches (R) and cm (L).

Figure 15. Indicator S5 Sandy Redox. The redox masses occur below a depth of about 10 cm. Scale is inches.

Figure 17. Indicator S6 Stripped Matrix. The matrix stripped of organic matter begins beneath the surface layer. Scale is inches.

S7. Dark Surface. *For use in LRRs N, P, R, S, T, U, V, and Z.* **A layer 10 cm (4 in) or more thick starting within the upper 15 cm (6 in) of the soil surface with a matrix value 3 or less and chroma 1 or less. At least 70 percent of the visible soil particles must be covered, coated, or similarly masked with organic material. The matrix color of the layer immediately below the dark layer must have chroma 2 or less** (fig. 19).

Dark Surface User Notes: The organic carbon content of this indicator is slightly less than required for mucky. An undisturbed sample must be observed. A 10X or 15X hand lens is an excellent tool to aid this decision. Many wet soils have a ratio of about 50 percent soil particles that are covered or coated with organic matter and about 50 percent uncoated or uncovered soil particles, giving the soil a salt and pepper appearance. Where the percent of coverage is less than 70 percent, a Dark Surface indicator is not present.

S8. Polyvalue Below Surface. *For use in LRRs R, S, and T; for testing in LRRs K and L.* **A layer with value 3 or less and chroma 1 or less starting within 15 cm (6 in) of the soil surface underlain by a layer(s) where translocated organic matter unevenly covers the soil material forming a diffuse splotchy pattern. At least 70 percent of the visible soil particles in the upper layer must be covered, coated, or masked with organic material. Immediately below this layer, the organic coating occupies 5 percent or more of the soil volume and has value 3 or less and chroma 1 or less. The remainder of the soil volume has value 4 or more and chroma 1 or less.**

Polyvalue Below Surface User Notes: This indicator describes soils with a very dark gray or black surface or near-surface layer less than 10 cm (4 in) thick underlain by a layer where organic matter has been differentially distributed within the soil by water movement (figs. 19 and 20). The mobilization and translocation of organic matter results in splotchy coated and uncoated soil areas as described in the Sandy Redox and Stripped Matrix Indicators except that for S8 the whole soil is in shades of black and gray. The chroma 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator includes the indicator previously termed streaking (Environmental Laboratory, 1987) (app. B).

Figure 18. Indicator S6 Stripped Matrix. Close up of oval stripped areas showing the associated decomposing roots.

Figure 19. Indicator S7 Dark Surface. The dark surface is 15 cm thick. The material below 15 cm meets the intent of Indicator S8 Polyvalue Below Surface. Scale is inches.

S9. Thin Dark Surface. *For use in LRRs R, S, and T; for testing in LRRs K and L.* **A layer 5 cm (2 in) or more thick entirely within the upper 15 cm (6 in) of the surface, with value 3 or less and chroma 1 or less. At least 70 percent of the visible soil particles in this layer must be covered, coated, or masked with organic material. This layer is underlain by a layer(s) with value 4 or less and chroma 1 or less to a depth of 30 cm (12 in) or to the spodic horizon, whichever is less.**

Thin Dark Surface User Notes: This indicator describes soils with a very dark gray or black near-surface layer at least 5 cm (2 in) thick underlain by a layer where organic matter has been carried downward by flowing water (fig. 20). The mobilization and translocation of organic matter results in an uneven distribution of organic matter in the eluvial (E) horizon. The chroma 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator commonly occurs in hydric Spodosols; however, a spodic horizon is not required.

Figure 20. Indicator S8 Polyvalue Below Surface (R) and Indicator S9 Thin Dark Surface (L). Organic matter has been mobilized and translocated. A spodic horizon is not required but commonly occurs in soils with these indicators. Scale is inches.

S10. Alaska Gleyed. *For use in LRRs W, X, and Y.* **Dominant hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with value 4 or more in the matrix, within 30 cm (12 in) of the mineral surface, and underlain by hue 5Y or redder in the same type of parent material.**

Alaska Gleyed User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the gley page (Gretag/Macbeth. 2000). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with value 4 or more. Color comparison to underlying material must be based on material of the same type or lithology.

Loamy and clayey soils

Loamy and clayey soils refers to those soils with USDA textures of loamy very fine sand and finer. Unless otherwise indicated, all mineral layers above any of the Indicators have dominant chroma 2 or less, or the layer(s) with dominant chroma of more than 2 is less than 15 cm (6 in) thick. Also, unless otherwise indicated, nodules and concretions are not considered to be redox concentrations. Use the following loamy and clayey Indicators for loamy or clayey mineral soil materials:

F1. Loamy Mucky Mineral. *For use in all LRRs except N, R, S, V, W, X, and Y, those using A7, and MLRA 1 of LRR A.* **A mucky modified loamy or clayey mineral layer 10 cm (4 in) or more thick starting within 15 cm (6 in) of the soil surface.**

Loamy Mucky Mineral User Notes: *Mucky* is a USDA texture modifier for mineral soils. The organic carbon is at least 8 percent, but can range to as high as 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky sandy loam that has at least 8 percent organic carbon, but not more than about 14 percent organic carbon. See the glossary for the definition of mucky modified mineral texture. See figure 37 (organic soil material) in the glossary for organic carbon requirements.

F2. Loamy Gleyed Matrix. *For use in all LRRs except W, X, and Y.* **A gleyed matrix that occupies 60 percent or more of a layer starting within 30 cm (12 in) of the soil surface.**

Loamy Gleyed Matrix User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the gley pages (Gretag/Macbeth. 2000). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with value 4 or more. The gleyed matrix only has to be present within 30 cm (12 in) of the surface. Soils with gleyed matrices are saturated for a significant duration; this is why no thickness of the layer is required (figs. 21 and 22). See glossary for the definition of gleyed matrix.

Figure 21. Indicator F2 Loamy Gleyed Matrix. The gleyed matrix begins at a depth of about 18 cm. Indicator F3 Depleted Matrix also occurs between the gleyed matrix and the surface layer.

F3. Depleted Matrix. *For use in all LRRs except W, X, and Y.* **A layer with a depleted matrix that has 60 percent or more chroma 2 or less that has a minimum thickness of either:**

a. 5 cm (2 in) if 5 cm (2 in) is entirely within the upper 15 cm (6 in) of the soil, or

b. 15 cm (6 in) and starts within 25 cm (10 in) of the soil surface.

Depleted Matrix User Notes: Redox concentrations including iron/manganese soft masses or pore linings, or both, are required in soils with matrix colors of 4/1, 4/2, and 5/2 (fig. 23). A, E and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. Redox concentrations are not required for soils with matrix value 5 or more and chroma 1 or value 6 or more and chroma 2 or 1 (fig. 24). See glossary for the complete definition of depleted matrix. The low chroma matrix must be caused by wetness and not a relict or parent material feature.

Figure 22. Indicator F2 Loamy Gleyed Matrix. The gleyed matrix starts at the soil surface. Scale is inches.

F4. Depleted Below Dark Surface. *For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.* **A layer with a depleted matrix that has 60 percent or more chroma 2 or less starting within 30 cm (12 in) of the soil surface that has a minimum thickness of either:**

- **a. 15 cm (6 in),**
- **b. 5 cm (2 in) if the 5 cm (2 in) consists of fragmental soil material (see glossary).**

The layer(s) above the depleted matrix has value 3 or less and chroma 2 or less.

Depleted Below Dark Surface User Notes: This indicator often occurs in Mollisols, but also applies to soils that have umbric epipedons and dark colored ochric epipedons. For soils that have dark colored epipedons greater than 30 cm (12 in) thick, use Indicator F5. Redox concentrations including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas depleted matrix; however, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. See glossary for the definition of depleted matrix.

F5. Thick Dark Surface. *For use in all LRRs except W, X, and, Y; for testing in LRRs W, X, and Y.* **A layer at least 15 cm (6 in) thick with a depleted matrix that has 60 percent or more chroma 2 or less (or a gleyed matrix) starting below 30 cm (12 in) of the surface. The layer(s) above the depleted or gleyed matrix has hue N and value 3 or less to a depth of 30 cm (12 in) and value 3 or less and chroma 1 or less in the remainder of the epipedon.**

Thick Dark Surface User Notes: The soil has a black or very dark gray surface layer 30 cm (12 in) or more thick (figs. 25 and 26). The dark subsoil has value 3 or less, and chroma 1 or less. Below the dark colored epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions.

Figure 23. Indicator F3 Depleted Matrix. The chroma is 2 below a depth of about 15 cm. Redox concentrations are present. Scale is inches.

Figure 24. Indicator F3 Depleted Matrix. The chroma is 1 within a depth of about 10 to 15 cm. Redox concentrations are absent. Scale is inches.

Figure 25. Indicator F5 Thick Dark Surface. A depleted matrix is below the mollic epipedon. Scale is inches.

Figure 26. Indicator F5 Thick Dark Surface. Deep observation is often necessary.

Redox concentrations including iron/manganese soft masses or pore linings, or both, are required in soils that have matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may be mistaken for a depleted matrix. They are excluded, however, from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. See glossary for the definition of depleted matrix.

F6. Redox Dark Surface. *For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.* **A layer at least 10 cm (4 in) thick entirely within the upper 30 cm (12 in) of the mineral soil that has:**

- **a. matrix value 3 or less and chroma 1 or less and 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings, or**
- **b. matrix value 3 or less and chroma 2 or less and 5 percent or more distinct or prominent redox concentrations as soft masses or pore linings.**

Redox Dark Surface User Notes: Redox concentrations in high organic matter mineral soils with a dark surface are often difficult to see (figs. 27 and 28). The organic matter masks some or all of the concentrations that may be present. Careful examination is required to see what are often brownish mottles in the darkened materials. In some instances, drying of the samples makes the concentrations (if present) easier to see. Dried colors, if used, need to have matrix chromas of 1 or 2, and the redox concentrations need to be distinct or prominent.

In soils that are wet because of subsurface saturation, the layer immediately below the dark epipedon should have a depleted or gleyed matrix. Soils that are wet because of ponding or shallow, perched layer of saturation may not always have a depleted/gleyed matrix below the dark surface. This morphology has been observed in soils that have been compacted by tillage and other means. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark colored epipedon when applying this indicator. Redox concentrations including iron/manganese soft masses or pore linings, or both, are required in soils that have matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may, therefore, be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present.

Figure 27. Indicator F6 Redox Dark Surface. Prominent redox concentrations as soft masses and pore linings are present. Below the dark epipedon is indicator F4 Depleted Dark Surface. Scale is cm.

Figure 28. Indicator F6 Redox Dark Surface. Often, as in this soil, the redox concentrations are small (fine).

F7. Depleted Dark Surface. *For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.* **Redox depletions, with value 5 or more and chroma 2 or less, in a layer at least 10 cm (4 in) thick entirely within the upper 30 cm (12 in) of the mineral soil that has:**

- **a. matrix value 3 or less and chroma 1 or less and 10 percent or more redox depletions, or**
- **b. matrix value 3 or less and chroma 2 or less and 20 percent or more redox depletions.**

Depleted Dark Surface User Notes: Care should be taken not to mistake mixing of an E or calcic horizon into the surface layer as depletions. The pieces of E and calcic horizons are not redox depletions. Knowledge of local conditions is required in areas where E and/or calcic horizons may be present. In soils that are wet because of subsurface saturation, the layer immediately below the dark surface should have a depleted or gleyed matrix. Redox depletions should have associated microsites with redox concentrations that occur as Fe pore linings or masses within the depletion(s) or surrounding the depletion(s).

F8. Redox Depressions. *For use in all LRRs except W, X, and Y; for testing in LRRs W, X, and Y.* **In closed depressions subject to ponding, 5 percent or more distinct or prominent redox concentrations as soft masses or pore linings in a layer 5 cm (2 in) or more thick entirely within the upper 15 cm (6 in) of the soil surface** (fig. 29).

Redox Depressions User Notes: This indicator occurs on depressional landforms, such as vernal pools, playa lakes, rainwater basins, grady ponds, and potholes; but not microdepressions on convex or plane landscapes.

F9. Vernal Pools. *For use in LRRs C and D.* **In closed depressions subject to ponding, presence of a depleted matrix in a layer 5 cm (2 in) thick entirely within the upper 15 cm (6 in) of the soil surface.**

Vernal Pools User Notes: Most often soils pond water for two reasons: they occur on landscape positions that collect water and they have a restrictive layers(s) that prevents water from moving downward through the soil. Normally this indicator occurs at the soil surface. Redox concentrations including iron/manganese soft masses or pore linings, or both, are required in soils that have matrix colors of 4/1, 4/2, and 5/2. A, E, and calcic horizons may have low chromas and high values and may, therefore, be mistaken for a depleted matrix; however, they are excluded from the concept of depleted martix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present.

F10. Marl. *For use in LRR U.* **A layer of marl that has a value 5 or more starting within 10 cm (4 in) of the soil surface** (fig. 30).

Marl User Notes: Marl is a limnic material deposited in water by precipitation of $CaCO_3$ by algae as defined in Soil Taxonomy (USDA, NRCS, Soil Survey Staff. 1999). It has a Munsell value 5 or more and reacts with dilute HCl to evolve CO_2. Marl is not the carbonatic substrate material associated with limestone bedrock. Some soils have materials with all the properties of marl except they lack the required Munsell value. These soils are hydric if the required value is present within 10 cm (4 in) of the soil surface. Normally this indicator occurs at the soil surface.

Figure 29. Indicator F8 Redox Depressions. This soil has mainly iron redox concentrations in the upper part and iron/manganese in the lower part. Scale is cm (L) and inches (R).

F11. Depleted Ochric. *For use in MLRA 151 of LRR T.* **A layer(s) 10 cm (4 in) or more thick that has 60 percent or more of the matrix with value 4 or more and chroma 1 or less. The layer is entirely within the upper 25 cm (10 in) of the soil surface.**

Depleted Ochric User Notes: This indicator is applicable on accreting deltaic areas of the Mississippi River.

F12. Iron/Manganese Masses. *For use in LRRs N, O, P, and T; for testing in LRR M.* **On flood plains, a layer 10 cm (4 in) or more thick with 40 percent or more chroma 2 or less, and 2 percent or more distinct or prominent redox concentrations as soft iron/manganese masses and diffuse boundaries. The layer occurs entirely within 30 cm (12 in) of the soil surface. Iron/manganese masses have value 3 or less and chroma 3 or less; most commonly they are black (fig. 31). The thickness requirement is waived if the layer is the mineral surface layer.**

Iron/Manganese Masses User Notes: These iron/manganese masses are usually small (2 to 5 mm) and have a value and chroma 3 or less. They can be black.

Figure 30. Indicator F10 Marl. This indicator is known to occur only in south Florida. Scale is feet.

The low matrix chroma is because of wetness and is not a relict or parent material feature. Iron/manganese masses should not be confused with the larger and redder iron nodules associated with plinthite (USDA, NRCS, 2002) or with concretions that have sharp boundaries. This indicator occurs on flood plains of rivers, such as the Apalachicola, Congaree, Mobile, Savannah, and Tennessee Rivers.

F13. Umbric Surface. *For use in LRRs P and T.* **In depressions and other concave landforms, a layer 25 cm (10 in) or more thick starting within 15 cm (6 in) of the soil surface in which the upper 15 cm (6 in) must have value 3 or less and chroma 1 or less, and the lower 10 cm (4 in) of the layer must have the same colors as above or any other color that has a chroma 2 or less** (fig. 32).

Umbric Surface User Notes: Thickness requirements may be slightly less than those required for an umbric epipedon. Microlows are not considered to be concave landforms. Umbric surfaces on higher landscape positions, such as side slopes dominated by Humic Dystrudepts, are excluded.

F14. Alaska Redox Gleyed. *For use in LRRs W, X, and Y.* **A layer that has dominant matrix hue 5Y with chroma 3 or less, or hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with 10 percent or more redox concentrations as pore linings with value and chroma 4 or more. The layer occurs within 30 cm (12 in) of the soil surface.**

Alaska Redox Gleyed User Notes: Presence of 10 percent redox concentrations as pore linings in a dominantly gleyed matrix (hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more); or hue 5Y with chroma 3 or less is required. Pore linings must have value and chroma 4 or more.

F15. Alaska Gleyed Pores. *For use in LRRs W, X, and Y.* **Presence of 10 percent hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more in the matrix or along channels containing dead roots or no roots within 30 cm (12 in) of the soil surface. The matrix has dominant chroma 2 or less.**

Alaska Gleyed Pores User Notes: Presence of 10 percent gleyed root channels within a low chroma matrix is required.

Figure 31. Indicator F12 Iron/Manganese Masses in a 40 percent depleted matrix. Scale is inches.

Figure 32. Indicator F13 Umbric Surface. This umbric surface is about 20 cm thick. Scale is inches.

F16. High Plains Depressions. *For use in MLRAs 72 and 73 of LRR H; for testing in other MLRAs of LRR H.* **In closed depressions subject to ponding, a mineral soil that has chroma 1 or less to a depth of at least 35 cm (13.5 in) and a layer at least 10 cm (4 in) thick within the upper 35 cm (13.5 in) of the mineral soil that has either:**

a. **1 percent or more redox concentrations as nodules or concretions, or**
b. **redox concentrations as nodules or concretions with distinct or prominent corona.**

High Plains Depressions User Notes: This indicator is for closed depressions (FSA *playas*) in western Kansas, southwestern Nebraska, eastern Colorado, and southeastern Wyoming. It occurs in soils such as the Ness and Pleasant series. The matrix color of the 35 cm (13.5 in) layer must be a chroma 1 or less; chroma 2 matrix colors are excluded; value is usually 3. The nodules/concretions are rounded, hard to very hard, range in size from less than 1 mm to 3 mm, and most commonly are black or reddish black. The corona usually are reddish brown, strong brown, or yellowish brown. The nodules/concretions can be removed from the soil, and the corona (halos) will occur as coatings on the concentration or will remain attached to the soil matrix. Use of 10X to 15X magnification aids in the identification of these features.

Test Indicators of Hydric Soils

The Indicators listed before this section should be tested for use in LRRs other than those listed. Other Indicators for testing are listed below. This list of test indicators is not extensive. Users of the Indicators are encouraged to submit descriptions of other soil morphologies they think indicative of hydric soils along with supporting data for inclusion in subsequent versions of *Field Indicators of Hydric Soils in the United States*.

All soils

TA1. Playa Rim Stratified Layers. *For testing in LRR D.* **Stratified layers starting within the upper 15 cm (6 in) of the soil surface. At least one layer has value 3 or less and chroma 1 or less or it has value 2 or more and chroma 2 or less with 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings. The upper 15 cm (6 in) has dominant chroma 2 or less.**

Playa Rim Stratified Layers User Notes: Unlike the Indicator A5 Stratified Layers, this indicator does not require continuous chroma 2 or less. Thin layers of chroma 3 or higher may occur as long as the upper 15 cm (6 in) is dominantly chroma 2 or less. A minimum amount of organic carbon is not required. A layer that has redox concentrations is substitutional for the dark layer. This indicator occurs on sparsely vegetated playas and playa rims adjacent to nonvegetated playas.

TA2. Structureless Muck. *For testing in MLRAs 141, 143, 144b, 145, and 146 of LRR R.* **Starting within 15 cm (6 in) of the soil surface on concave positions or in depressions, a layer of muck 2 cm (0.75 in) or more thick that has no soil structure.**

Structureless Muck User Notes: Nonhydric muck horizons have low moisture content and are usually fluffy or have weak to moderate structure. Hydric muck horizons are usually wet and amorphous or, if dry, then are hard and difficult to rewet.

TA3. Coast Prairie Redox. *For use in MLRA 150A of LRR T.* **A layer starting within 15 cm (6 in) of the soil surface that is at least 10 cm (4 in) thick and has a matrix chroma 3 or less with 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings, or both.**

Coast Prairie Redox User Notes: These hydric soils occur mainly on depressional landforms and portions of the intermound landforms on the Lissie Formation. Redox concentrations occur mainly as iron dominated pore linings (Vepraskas, 1994). Common to many redox concentrations are required. Chroma 3 matrices are allowed because they may be the color of stripped sand grains or because few to common sand size reddish chert particles occur and may prevent obtaining chroma 2 or less.

Sandy soils

TS1. Iron Staining. *For testing in LRRs W, X, and Y.* **A continuous zone, 3 cm (1 in) or more thick, of iron staining that has value 4 or more and chroma 6 or more within 15 cm (6 in) of the soil surface. The zone is immediately below a horizon in which iron/manganese oxides have been removed from the matrix and exposed the primary base color of the silt and sand grains.**

TS2. Thick Sandy Dark Surface. *For testing in LRR F.* **A layer at least 15 cm (6 in) thick with a depleted matrix that has 60 percent or more chroma 2 or less or a gleyed matrix starting below 30 cm (12 in) of the soil surface. The layer(s) above the depleted or gleyed matrix has hue N and value 3 or less; or hue 10YR or yellower with value 2.5 or less and chroma 1 to a depth of 30 cm (12 in) and chroma 1 or less in the remainder of the epipedon.**

TS3. Dark Surface 2. *For testing in LRR G.* **A layer 10 cm (4 in) or more thick starting within 15 cm (6 in) of the soil surface with matrix value 2.5 or less and chroma 1 or less. At least 70 percent of the soil material is covered, coated, or masked with organic material. The matrix color of the layer immediately below the dark surface must have value 4 or more and chroma 2 or less.**

TS4. Sandy Neutral Surface. *For testing in LRR M.* **A layer at least 10 cm (4 in) thick with a depleted matrix that has 60 percent or more chroma 2 or less or a gleyed matrix starting within 30 cm (12 in) of the soil surface. The layer(s) above the depleted or gleyed matrix has hue N and value 3 or less.**

TS5. Chroma 3 Sandy Redox. *For testing in LRRs F, G, H, K, L, M, and R.* **A layer starting within 15 cm (6 in) of the soil surface that is at least 10 cm (4 in) thick and has a matrix chroma 3 or less with 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings, or both.**

Chroma 3 Sandy Redox User Notes: Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas, 1994). Included within this concept as redox concentrations are iron/manganese bodies as soft masses that have diffuse boundaries. The iron/manganese masses are 2 to 5 millimeters and have a value 3 or less and a chroma 3 or less; commonly they are black. Iron/manganese masses should not be confused with the larger and redder iron nodules associated with plinthitic soils or relict concretions (USDA, NRCS, Soil Survey Staff, 1999). Common to many redox concentrations are required.

Loamy and clayey soils

TF1. ? cm Mucky Peat or Peat. *For testing in LRRs F, G, H, and M.* **A layer of mucky peat or peat ? cm thick with value 4 or less and chroma 3 or less starting within 15 cm (6 in) of the soil surface.**

? cm Mucky Peat or Peat User Notes: Testing from 1994 indicates that the diagnostic thickness for mucky peat and for peat is 1 to 5 cm. Further testing is needed to find the definitive thickness.

TF2. Red Parent Material. *For testing in LRRs that have red parent material.* **In parent material with a hue of 7.5YR or redder, a layer at least 10 cm (4 in) thick with a matrix value 4 or less and chroma 4 or less and 2 percent or more redox depletions or redox concentrations as soft masses or pore linings, or both. The layer is entirely within 30 cm (12 in) of the soil surface. The minimum thickness requirement is 5 cm (2 in) if the layer is the mineral surface layer.**

Red Parent Material User Notes: This indicator was developed for use in areas of red parent material, such as Triassic/Jurassic sediment in the Connecticut River valley, Permian red beds in Kansas, clayey red till and associated lacustrine deposits around the Great Lakes, and Jurassic sediments associated with *hogbacks* on the eastern edge of the Rocky Mountains. This indicator also occurs on Red River flood plains, such as the Chattahoochee, Congaree, Red, and Tennessee Rivers. Redox features most noticeable in red material include redox depletions and soft manganese masses that are black or dark reddish black (fig. 33).

TF3. Alaska Concretions. *For testing in W, X, and Y.* **Within 30 cm (12 in) of the soil surface redox concentrations as nodules or concretions greater than 2 mm in diameter that occupy more than approximately 2 percent of the soil volume in a layer 10 cm (4 in) or more thick with a matrix chroma 2 or less.**

TF4. 2.5Y/5Y Below Dark Surface. *For testing in LRRs F, M, N, P, S, and T.* **A layer at least 15 cm (6 in) thick with 60 percent or more hue 2.5Y or yellower, value 4 or more, and chroma 1; or hue 5Y or yellower, value 4 or more, and chroma 2 or less starting within 30 cm (12 in) of the soil surface. The layer(s) above the 2.5Y/5Y layer has value 3 or less and chroma 2 or less.**

2.5Y/5Y Below Dark Surface User Notes: Further testing is required to investigate whether these colors below a Mollic epipedon are indicative of wetness.

TF5. 2.5Y/5Y Below Thick Dark Surface. *For testing in LRRs D, F, and M.* **A layer at least 15 cm (6 in) thick with 60 percent or more hue 2.5Y or yellower, value 4 or more, and chroma 1; or hue 5Y or yellower, value 4 or more, and chroma 2 or less starting below 30 cm (12 in) of the soil surface. The layer(s) above the 2.5Y/5Y layer has hue N and value 3 or less; or has hue 10YR or yellower with value 2.5 or less and chroma 1 or less to a depth of 30 cm (12 in) and value 3 or less and chroma 1 or less in the remainder of the epipedon.**

Figure 33. Indicator TF2 Red Parent Material that has common to many redox depletions and soft masses of iron/manganese.

TF6. Calcic Dark Surface. *For testing in LRRs F, G, and M.* **A layer with an accumulation of calcium carbonate ($CaCO_3$) or calcium carbonate equivalent occurs within 40 cm (16 in) of the soil surface. It is overlain by a layer(s) that has value 3 or less and chroma 1 or less. The layer of $CaCO_3$ accumulation is underlain by a layer within 75 cm (30 in) of the surface 15 cm (6 in) or more thick having 60 percent or more by volume of at least one of the following:**

a. **depleted matrix,**
b. **gleyed matrix, or**
c. **hue 2.5Y or yellower, value 4, and chroma 1.**

Calcic Dark Surface User Notes: This indicator is the soil taxonomy criterion that separates Aeric Calciaquolls from Typic Calciaquolls, with an additional requirement of black or very dark gray surface layer. In the Midwest, the hydric/nonhydric boundary has generally been accepted as the line between Aeric and Typic Calciaquolls. Typic Calciaquolls (Vallers series and others) are documented to occur on upland plant communities on convex slopes (evaporative rims of potholes). Further documentation is needed to determine what soil morphological features can be used to separate hydric Typic Calciaquolls from nonhydric.

TF7. Thick Dark Surface 2/1. *For testing in all LRRs except LRRs O, P, T, and U.* **A layer at least 15 cm (6 in) thick with a depleted matrix that has 60 percent or more chroma 2 or less (or a gleyed matrix) starting below 30 cm (12 in) of the soil surface. The layer(s) above the depleted or gleyed matrix has hue 10YR or yellower, value 2.5 or less, and chroma 1 or less to a depth of 30 cm (12 in) and value 3 or less and chroma 1 or less in the remainder of the epipedon.**

Thick Dark Surface 2/1 User Notes: The soil has a black surface layer 30 cm (12 in) or more thick. The dark subsoil has value 3 or less and chroma 1. Below the mollic (umbric) epipedon is a depleted matrix or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions. Further testing is needed to determine if cumulic soil that has surface hue of 10YR or yellower is hydric. Testing notes need to indicate on what landscape position this indicator fails. It may be necessary to limit this indicator to concave landscapes.

TF8. Redox Spring Seeps. *For testing in LRR D.* **A layer that has value 5 or more and chroma 3 or less with 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings** (fig. 34). **The layer is at least 5 cm (2 in) thick and is within the upper 15 cm (6 in) of the soil surface.**

Redox Spring Seeps User Notes: This indicator is similar to Indicator F9 Vernal Pools. However, to more fully correlate hydric soils to wetland vegetation, chroma 3 is included in this indicator as well as the redox concentrations portions of the depleted matrix concept. This indicator is not unique to depressional landscapes; therefore, that requirement is dropped. As inferred, this indicator may occur in seeps and flow-through areas adjacent to springs and upslope end of drainageways as well as depressional seeps surrounded by uplands.

TF9. Delta Ochric. *For testing in LRR O.* **A layer 10 cm (4 in) or more thick that has 60 percent or more of the matrix with value 4 or more and chroma 2 or less, but has no redox concentrations. This layer occurs entirely within the upper 30 cm (12 in) of the soil surface.**

Figure 34. Indicator TF8 Redox Spring Seeps with prominent redox concentrations. Scale is cm.

Delta Ochric User Notes: This indicator is applicable in accreting areas of the Mississippi River Delta.

TF10. Alluvial Depleted Matrix. *For testing in LRRs M, N, and S.* **On frequently flooded flood plains, a layer with a matrix that has 60 percent or more chroma 3 or less with 2 percent redox concentrations as soft iron masses, starting within 15 cm (6 in) of the soil surface and extending to a depth of more than 30 cm (12 in).**

TF11. Reduced Vertic. *For testing in all LRRs that have Vertisols and Vertic intergrades.* **In Vertisols and Vertic intergrades, a positive reaction to alpha-alpha-Dipyridyl that**

a. **is the dominant (60%or more) condition of a layer at least 4 inches thick within the upper 12 inches (or at least 2 in thick within the upper 6 in) of the mineral or muck soil surface,**
b. **occurs for at least 7 continuous days and 28 cumulative days, and**
c. **occurs during a normal (within 16–84% of probable precipitation) or drier season and month.**

Please follow the procedures and note the considerations in Hydric Soil Technical Note 8 (use of alpha-alpha-Dipyridyl).

Reduced Vertic User Notes: The time requirements for this indicator were identified from research in MLRA 150A in LRR T (Gulf Coastal Prairies); these or slightly modified time requirements may be found to identify wetland Vertisols and Vertic Intergrades in other parts of the Nation. These soils generally have a thick, dark surface horizon, but Indicators F4, F5, and F6 are often lacking; possibly due to masking of redoximorphic features by organic carbon. These soils are a special case of the Problem Soils with thick, dark A horizons listed in the 1987 Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987).

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Unless otherwise noted the following references include definitions of terms used throughout this document and have additional information concerning the terms in the glossary of this document.

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Glossary

Marked with an asterisk (*), these terms, as defined in this glossary, may have definitions that are slightly different from the definitions in the referenced materials. The definitions are to assist users of this publication and are not intended to add to or replace definitions in the referenced materials.

A Horizon. A mineral horizon that formed at the surface or below an O horizon where organic material is accumulating. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Accreting areas. Landscape positions where soil material accumulates through deposition from higher elevations or upstream positions more rapidly than is being lost through erosion.

Anaerobic. A condition in which molecular oxygen is virtually absent from the soil.

Anaerobiosis. Microbiological activity under anaerobic conditions.

Aquic conditions. Conditions in the soil represented by depth of saturation, occurrence of reduction, and redoximorphic features. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

***Artificial drainage.** The use of human efforts and devices to remove free water from the soil surface or from the soil profile. The hydrology may also be modified by the use of levees and dams to prevent water from entering a site (fig. 35).

Biologic zero. The soil temperature, at a depth of 50 cm, below which the growth and function of locally adapted plants are negligible.

Figure 35. The presence of artificial drainage does not alter the hydric status of a soil.

Calcic horizon. An illuvial horizon in which carbonates have accumulated to a significant extent. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Calcium carbonate. Chemical formula of $CaCO_3$. Calcium carbonate effervesces when treated with cold hydrochloric acid.

$CaCO_3$ equivalent. This is the acid neutralizing capacity of a soil expressed as a weight percentage of $CaCO_3$ (molecular weight of $CaCO_3$ equals 100).

Closed depressions. A low-lying area surrounded by higher ground with no natural outlet for surface drainage.

COE. United States Army Corps of Engineers.

Common. When referring to redox concentrations or depletions, or both, common represents 2 to 20 percent of the observed surface.

Concave landscapes. A landscape whose surface curves downward.

***Covered, coated, masked.** These terms describe all of the redoximorphic processes by which the color of soil particles are hidden by organic material, silicate clay, iron, aluminum, or some combination of these.

***Depleted matrix.** A depleted matrix is the volume of a soil horizon or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create colors of low chroma and high value. A, E and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. In some places the depleted matrix may change color upon exposure to air (reduced matrix), this phenomena is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

- Matrix value 5 or more and chroma 1 with or without redox concentrations as soft masses and/or pore linings, or
- Matrix value 6 or more and chroma 2 or 1 with or without redox concentrations as soft masses and/or pore linings, or
- Matrix value 4 or 5 and chroma 2 and has 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings, or

- Matrix value 4 and chroma 1 and has 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings.

Diffuse boundary. Used to describe redoximorphic features that grade gradually from one color to another (fig. 36). The color grade is commonly more than 2 mm wide. Clear is used to describe boundary color gradations intermediate between sharp and diffuse.

Distinct[1]. Readily seen, but contrast only moderately with the color to which compared. The contrast is distinct if the:

1. delta hue = 0, and
   a. delta value ≤2 and delta chroma >1 to <4, or
   b. delta value >2 to <4 and delta chroma <4;
2. delta hue = 1, and
   a. delta value ≤1 and delta chroma >1 to <3, or
   b. delta value >1 to <3, delta chroma <3; or
3. delta hue = 2, and
   a. delta value = 0 and delta chroma >0 to <2, or
   b. delta value >0 to <2 and delta chroma <2.

[1]If the mottle and matrix both have values of ≤3 and chromas of ≤2, the color contrast is Faint, regardless of the difference in hue.

Figure 36. These redox concentrations exist as pore linings and have diffuse boundaries.

E horizon. A mineral horizon in which the main dominant process is loss of silicate clay, iron, and/or aluminum, leaving a concentration of sand and silt particles. See Soil Taxonomy (1999) for complete definition.

EPA. U.S. Environmental Protection Agency.

Faint. Evident only on close examination. The contrast is faint if the:

1. delta hue = 0, delta value ≤2, and delta chroma ≤1; or
2. delta hue = 1, delta value ≤1, and delta chroma ≤1; or
3. delta hue = 2, delta value = 0, and delta chroma = 0; or
4. delta hue = ≥ 3 and both colors have values ≤3 and chromas ≤2.

Fe/Mn concretions. Firm to extremely firm, irregularly shaped bodies of iron and manganese masses that have sharp to diffuse boundaries. When broken in half, concretions have concentric layers. See Vepraskas (1994) for complete description.

Fe/Mn nodules. Firm to extremely firm irregularly shaped bodies that have sharp to diffuse boundaries. When broken in half, nodules do not have visibly organized internal structure. See Vepraskas (1994) for complete description.

Few. When referring to redox concentrations, depletions, or both, few represents less than 2 percent of the observed surface.

Fibric. See Peat.

Fragmental soil material. Soil material that consists of 90 percent or more rock fragments. Less than 10 percent of the soil consists of particles 2 mm or smaller.

Frequently flooded or ponded. A frequency class in which flooding or ponding is likely to occur often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).

FWS. U.S. Department of Interior, Fish and Wildlife Service.

***g.** A horizon suffix indicating the horizon is gray because of wetness, but not necessarily gleyed. All gleyed matrices (definition below) should have the suffix **g**; however, all horizons that have the **g** suffix are not gleyed. For example, a horizon with the color 10YR 6/2 that is at least seasonally wet, with or without other redoximorphic features, should have the **g** suffix.

Glauconitic. A mineral aggregate that contains micaceous mineral resulting in a characteristic green color, such as glauconitic shale or clay.

***Gleyed matrix.** Soils that have a gleyed matrix have the following combinations of hue, value, and chroma and the soils are not glauconitic:
1. 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more and chroma 1; or
2. 5G with value 4 or more and chroma 1 or 2; or
3. N with value 4 or more; or
4. (for testing only) 5Y, value 4 or more, and chroma 1.

In some places the gleyed matrix may change color upon exposure to air (reduced matrix). This phenomenon is included in the concept of gleyed matrix.

***Hemic.** See Mucky peat.

Histic epipedon. A thick (20–60 cm [8–24 in]) organic soil horizon that is saturated with water at some period of the year unless artificially drained and that is at or near the surface of a mineral soil.

Histels. Organic soils that overly permafrost and show evidence of cryoturbation. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Histosols. Organic soils that have organic soil material in more than half of the upper 80 cm (32 in), or that are of any thickness if overlying rock or fragmental materials have interstices filled with organic soil materials. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Horizon. A layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by soil forming processes. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Hydric soil criteria.
1. All Histels except Folistels and all Histosols except Folists, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Historthels, and Histoturbels great groups, and Cumulic or Pachic subgroups that are:
   a. somewhat poorly drained with a water table equal to 0.0 foot from the surface during the growing season, or
   b. poorly drained or very poorly drained and have either:
      (1) water table equal to 0.0 foot during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches, or for other soils; or
      (2) water table at less than or equal to 0.5 foot from the surface during the growing season if permeability is equal to or greater than 6 inches per hour in all layers within 20 inches; or
      (3) water table at less than or equal to 1 foot from the surface during the growing season, if permeability is less than 6 inches per hour in any layer within 20 inches; or
3. Soils that are frequently ponded for long or very long duration during the growing season or
4. Soils that are frequently flooded for long or very long duration during the growing season.

Hydric soil definition (1994). 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.

Hydrogen sulfide odor. The odor of H_2S, which is similar to rotten eggs.

Hydromorphic. Features in the soil caused or formed by water.

Layer(s). A horizon, subhorizon, or combination of contiguous horizons or subhorizons that share property(s) referred to in the Indicators.

Lithologic discontinuity. Occurs in a soil that has developed in more than one type of parent material. Commonly determined by a significant change in particle-size distribution, mineralogy, and other properties that indicate a difference in material from which the horizons formed.

Land Resource Region (LRR). These geographic areas are characterized by a particular pattern of soils, climates, water resources, and land use. Each LRR has a different letter of the alphabet (A–Z). LRRs are defined in USDA Agriculture Handbook 296.

Many. When referring to redox concentrations and/or depletions, many represents more than 20 percent of the observed surface.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions, formed primarily under freshwater lacustrine conditions. Complete definition in description USDA NRCS, Soil Taxonomy (1999).

Matrix. The dominant soil volume that is continuous in appearance and envelopes microsites. When three colors exist, such as when a matrix, depletions, and concentrations are present, the matrix may represent less than 50 percent of the total soil volume.

MLRA. Major Land Resource Areas. Geographically associated divisions of land resource regions. defined in USDA Agriculture Handbook 296.

Mollic epipedon. A mineral surface horizon that is relatively thick, dark colored, humus rich, and has high base saturation. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Mollisols. Mineral soils that have a mollic epipedon. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

***Muck.** A sapric organic soil material in which virtually all of the organic material is decomposed, not allowing for identification of plant forms. Bulk density is normally 0.2 g/cm^3 or more. Muck has <1/6 fibers after rubbing, and sodium pyrophosphate solution extract color has lower value and chroma than 5/1, 6/2, and 7/3.

***Mucky modified texture.** A USDA soil texture modifier; for example, mucky sand. Mucky modified mineral soil that has 0 percent clay and between 5 and 12 percent organic carbon. Mucky modified mineral soil that has 60 percent clay and between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon.

***Mucky peat.** A hemic organic material with decomposition intermediate between that of fibric and sapric organic material. Bulk density is normally between 0.1 and 0.2 g/cm^3. Mucky peat does not meet fiber content (after rubbing) or sodium pyrophosphate solution extract color requirements for either fibric or sapric soil material.

Nodules. See Fe/Mn nodules.

NRCS. Natural Resources Conservation Service (formerly Soil Conservation Service).

NTCHS. National Technical Committee for Hydric Soils.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic soil material. Soil material that is saturated with water for long periods or artificially drained and, excluding live roots, has an organic carbon content of 18 percent or more with 60 percent or more clay, or 12 percent or more organic carbon with 0 percent clay. Soil that has an intermediate amount of clay has an intermediate amount of organic carbon. If the soil is never saturated for more than a few days, it contains 20 percent or more organic carbon. Organic soil material includes *Muck, *Mucky Peat, and *Peat (fig. 37).

***Peat.** A fibric organic soil material that has virtually all of the organic material allowing for identification of plant forms. Bulk density is normally <0.1 g/cm^3. Peat has 3/4 or more fibers after rubbing, or 2/5 or more fibers after rubbing and sodium pyrophosphate solution extract color of 7/1, 7/2, 8/2, or 8/3.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. See USDA, NRCS, Soil Taxonomy (1999) for a complete description of plinthite.

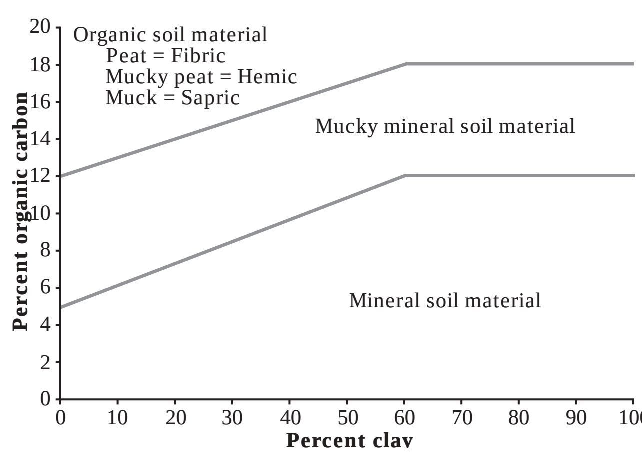
Ponding. Standing water in a closed depression that is removed only by percolation, evaporation, or transpiration. Duration is greater than 7 days.

Pore linings. Zones of accumulation that may be either coatings on a pore surface or impregnations of the matrix adjacent to the pore. See Vepraskas (1994) for complete description.

Prominent. Contrasts strongly with the color to which compared. Color contrasts that are not faint or distinct are prominent.

Redox concentrations. Bodies of apparent accumulation of Fe/Mn oxides. Redox concentrations include soft masses, pore linings, nodules, and concretions. For the purposes of the Indicators, nodules and concretions are excluded from the concept of redox concentrations unless otherwise specified by specific Indicators. See Vepraskas (1994) for complete discussion.

Figure 37. Percent organic carbon required for organic soil material, mucky mineral soil material, and mineral soil material as it related to percent clay content.



Redox depletions. Bodies of low chroma (2 or less) having value 4 or more where Fe/Mn oxides have been stripped or where both iron and manganese oxides and clay have been stripped. Redox deletions contrast distinctly or prominently with the matrix. See Vepraskas (1994) for complete description.

Redoximorphic features. Features formed by the processes of reduction, translocation, or oxidation of Fe and Mn oxides. Formerly called mottles and low chroma colors (fig. 38). See Vepraskas (1994) for complete description.

Reduced matrix. Soil matrices that have low chroma and high value, but whose color changes in hue or chroma when exposed to air. See Vepraskas (1994) for complete description.

***Reduction.** For the purpose of the Indicators, when the redox potential (Eh) is below the ferric/ferrous iron threshold as adjusted for pH. In hydric soils, this is the point when the transformation of ferric iron (Fe^{+++}) to ferrous iron (Fe^{++}) occurs (fig. 39).

Relict features. Soil morphological features that do not reflect recent hydrologic conditions of saturation and anaerobiosis (fig. 40). See Vepraskas (1994) for complete description.

***Sapric.** See Muck.

Saturation. When the soil water pressure is zero or positive, most all the soil pores are filled with water.

Sharp boundary. Used to describe redoximorphic features that grade sharply from one color to another. The color grade is commonly less than 0.1 millimeter wide (fig. 40).

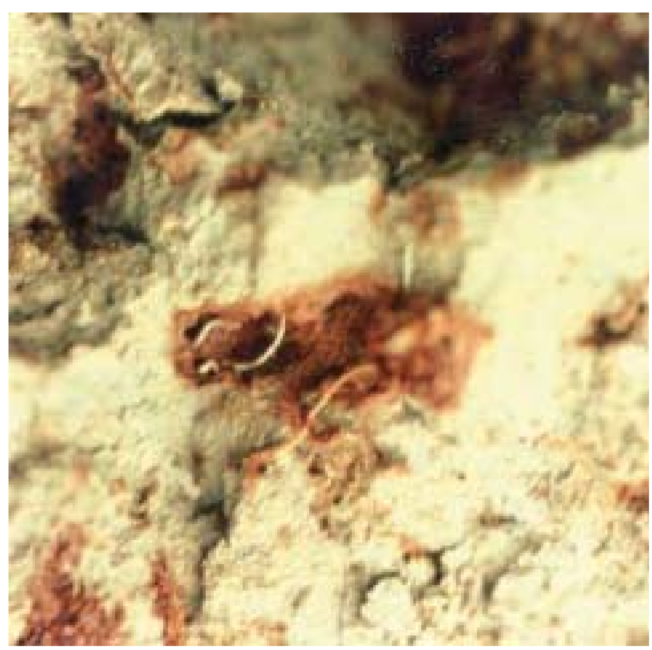
Figure 38. Redoximorphic features as required in many of the Indicators. These redox concentrations occur as pore linings along root channels and ped faces.

Soft masses. Redox concentrations that are not hard, frequently within the matrix, and whose shape is variable.

Soil texture. The weight proportion of the soil separates for particles less than 2 mm.

Figure 39. Reduction would probably occur in this salt marsh throughout the year. The Indicator A4 Hydrogen Sulfide would most likely occur here.

Figure 40. Sharp boundaries, such as those shown here, may indicate these redoximorphic features are relict.



Spodic horizon. A mineral soil horizon that is characterized by the illuvial accumulation of amorphous materials composed of aluminum and organic carbon with or without iron. The spodic horizon has a certain minimum thickness and minimum quantity of oxalate extractable carbon plus aluminum or specific color requirements, or both.

Umbric Epipedon. A thick, dark mineral surface horizon that has base saturation of less than 50 percent. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Vertisol. A mineral soil with 30 percent or more clay in all layers. This soil expands and shrinks depending on moisture content and contains slickensides or wedge-shaped peds. See USDA, NRCS, Soil Taxonomy (1999) for complete definition.

Wetland. An area that has hydrophytic vegetation, hydric soils, and wetland hydrology, per the FSA Manual and the U.S. Corps of Engineers, 1987 Wetlands Delineation Manual (fig. 41).

Within. When referring to specific indicator depth requirements, within means not beyond in depth, for example, less than or equal to 15 cm.

Figure 41. If the area this soil represents has hydrophytic vegetation and wetland hydrology, it would be a wetland. This soil has the Indicator F2 Loamy Gleyed Matrix.

Appendix A
Indicators by Land Resource Region (LRR)

LRR	Indicators
A	A1, A2, A3, A4, A10, S1, S4, S5, S6, F1 (except MLRA 1), F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
B	A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
C	A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F9, TF2, TF7.
D	A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F9, TA1, TF2, TF5, TF7, TF8.
E	A1, A2, A3, A4, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
F	A1, A2, A3, A4, A5, A9, S1, S3, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS2, TS5, TF1, TF2, TF4, TF5, TF6, TF7.
G	A1, A2, A3, A4, A9, S1, S2, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS3, TS5, TF1, TF2, TF6, TF7.
H	A1, A2, A3, A4, A9, S1, S2, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F16 (MLRAs 72 & 73 only), TS5, TF1, TF2, TF7.
I	A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
J	A1, A2, A3, A4, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
K	A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS5, TF2, TF7.
L	A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, TS5, TF2, TF7.
M	A1, A2, A3, A4, A5, A10, S1, S3, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F12, TS4, TS5, TF1, TF2, TF4, TF5, TF6, TF7, TF10.
N	A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, S7, F2, F3, F4, F5, F6, F7, F8, F12, TF2, TF7, TF10.
O	A1, A2, A3, A4, A5, A9, S1, S4, S5, S6, F1, F2, F3, F4, F5, F6, F7, F8, F12, TF2, TF9.
P	A1, A2, A3, A4, A5, A6, A7, A9, S4, S5, S6, S7, F2, F3, F4, F5, F6, F7, F8, F12, F13, TF2.
R	A1, A2, A3, A4, A5, S1, S3, S4, S5, S6, S7, S8, S9, F2, F3, F4, F5, F6, F7, F8, TA2, TF2, TF7.
S	A1, A2, A3, A4, A5, A10, S1, S4, S5, S6, S7, S8, S9, F2, F3, F4, F5, F6, F7, F8, TF2, TF4, TF10.
T	A1, A2, A3, A4, A5, A6, A7, A9, S4, S5, S6, S7, S8, S9, F2, F3, F4, F5, F6, F7, F8, F 11 (MLRA 151 Only), F12, F13, TA3 (MLRA 150a 0nly)
U	A1, A2, A3, A4, A5, A6, A7, A8, S4, S5, S6, S7, F2, F3, F4, F5, F6, F7, F10, F13.
V	A1, A2, A3, A4, A5, A8, S4, S5, S6, S7, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.
W	A1, A2, A3, A4, A10, S10, F4, F5, F6, F7, F8, F14, F15, TS1, TF2, TF3, TF7.
X	A1, A2, A3, A4, A10, S10, F4, F5, F6, F7, F8, F14, F15, TS1, TF2, TF3, TF7.
Y	A1, A2, A3, A4, A10, S10, F4, F5, F6, F7, F8, F14, F15, TS1, TF2, TF3, TF7.
Z	A1, A2, A3, A4, A5, A6, A7, A8, S4, S5, S6, S7, F2, F3, F4, F5, F6, F7, F8, TF2, TF7.

Appendix B
Indicator Correlations

Source: U.S. Corps of Engineers Wetland Delineation Manual 1987. Technical Report, Y–87–1. Environmental Laboratory, U.S. Army Engineers Waterways Experiment Station. Vicksburg. MS.

Soils	Regional Indicators
Non-sandy soils:	
a. Organic soils (Histosols)	A1 Histosol
b. Histic Epipedon	A2 Histic Epipedon
	A3 Black Histic
c. Sulfidic material	A4 Hydrogen Sulfide
d. Aquic or peraquic moisture regime	————
e. Reducing soil conditions	TF11 Reduced Vertic
f (1). Gleyed soils (gray color)	F2 Loamy Gleyed Matrix F14 Alaska Redox Gleyed F15 Alaska Gleyed Pores
f (2). Soils that have bright mottles and/or low matrix chroma	F3 Depleted Matrix F9 Vernal Pools F11 Depleted Ochric F16 High Plains Depressions TF8 Redox Spring Seeps TF9 Delta Ochric TF10 Alluvial Depleted Matrix
g. Soil appearing on the hydric soils list	————
h. Iron and manganese concretions	F12 Iron/Manganese Masses TF3 Alaska Concretions
Not listed in the 1987 manual	A5 Stratified Layers A6 Organic Bodies A7 5 cm Mucky Mineral A8 Muck Presence A9 1 cm Muck A10 2 cm Muck F1 Loamy Mucky Mineral F4 Depleted Below Dark Surface F5 Thick Dark Surface F6 Redox Dark Surface F7 Depleted Dark Surface F10 Marl F13 Umbric Surface

Appendix B: Indicator Correlations—Continued

1987 Manual	Regional Indicators
Not listed in 1987 manual—Continued	TA1 Playa Rim Strat. Layers TA2 Structureless Muck TF1 ? cm Mucky or Peat TF2 Red Parent Material TF4 Y Below Dark Surface TF5 Y Below Thick Dark Surface TF6 Calcic Dark Surface TF7 Thick Dark Surface 2/1 TS2 Thick Sandy Dark Surface TF7 Thick Dark Surface 2/1 TF11 Reduced Vertic
Sandy soils:	
a. Organic soils (Histosols)	A1 Histosol
b. Histic epipedon	A2 Histic Epipedon A3 Black Histic
c. Sulfidic material	A4 Hydrogen sulfide
d. Aquic or peraquic moisture regime	________
e. Reducing soil conditions	________
f. Iron and manganese concretions	________
g. High organic matter content in the surface horizon	A6 Organic Bodies A7 5 cm Mucky Mineral A8 Muck Presence A9 1 cm Muck A10 2 cm Muck S1 Sandy Mucky Mineral S2 2.5 cm Mucky or Peat S3 5 cm Mucky Peat or Peat S7 Dark Surface TA2 Structureless Muck TS2 Thick Sandy Dark Surface
h. Streaking of subsurface horizons by organic matter	S6 Stripped Matrix S8 Polyvalue Below Surface
i. Organic pan	S9 Thin Dark Surface
j. Soils appearing on the hydric soils list	________

Appendix B: Indicator Correlations—Continued

1987 Manual	Regional Indicators
Not listed in the 1987 manual	A5 Stratified Layers S4 Sandy Gleyed Matrix S10 Alaska Gleyed TA1 Playa Rim Stratified Layers TS1 Iron Staining TS4 Sandy Neutral Surface
Problem soils	
Sandy soils	A5 Stratified Layers S5 Sandy Redox S6 Stripped Matrix S8 Polyvalue Below Surface S9 Thin Dark Surface TA1 Playa Rim Stratified Layers TS5 Chroma 3 Sandy Redox
Soils with thick dark A horizons	F4 Dep. Below Dark Surface F5 Thick Dark Surface F6 Redox Dark Surface F7 Depleted Dark Surface F13 Umbric Surface F16 High Plains Depressions TF4 Y Below Dark Surface TF5 Y Below Thick Dark Surface TF6 Calcic Dark Surface TS2 Tk. Sandy Dark Surface TF7 Thick Dark Surface 2/1 TF11 Reduced Vertic
Soils with red parent material	F8 Redox Depressions F9 Vernal Pools F12 Iron/Manganese Masses TA3 Coast Prairie Redox TS1 Iron Staining TF2 Red Parent Material TF8 Redox Spring Seeps
Soils with low chroma parent material	S4 Sandy Gleyed Matrix S10 Alaska Gleyed F10 Marl TS4 Sandy Neutral Surface