WRP Technical Note SG-DE-4.1
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Using the NRCS Hydric Soil Indicators with Soils with Thick A Horizons

PURPOSE: The purpose of this technical note is to assist hydric soil determination in soils with thick A horizons using the *Field Indicators of Hydric Soils in the United States* (Natural Resources Conservation Service (NRCS) 1998); hereafter referred to as *"NRCS Indicators."* Official interpretation of the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory (1987), hereafter referred to as the "*1987 Manual*") allows appropriate NRCS indicators to be used under rules of the "Problem Areas" section.

DISCLAIMER: This technical note does not presume to prescribe policy for the U.S. Army Corps of Engineers. Its purpose, rather, is to explain some technical resources in the discipline of hydric soils.

NRCS INDICATORS: *NRCS Indicators* helps resolve some of the soils problems in the *1987 Manual*. The NRCS list includes six indicators to identify hydric soils with thick, dark A horizons (indicators F4, F5, F6, F7, F13, and F16). Indicators F4, F6, and F7 are for use in all states except Alaska; F5 is for all of the United States except Alaska and the southeastern U.S.; indicator Fl3 is for land resource regions (LRRs) P and T (south Atlantic gulf slope and coastal plain); F16 is for two major land resource areas (MLRAs) in the western High Plains. Indicator F3 will also be discussed for comparative purposes.

GENERAL RULES FOR USING THE *NRCS INDICATORS*: Two differences between *NRCS Indicators* and the *1987 Manual* apply to all of the indicators and a third difference to most of the indicators.

First, *NRCS Indicators* is not an exhaustive list of all morphologies found in hydric soils. Therefore, a soil may still be hydric even if no NRCS indicator is found. The list of indicators in the *1987 Manual* does not include this explicit disclaimer; instead, use of the "Problem Area" section of the manual is required when listed indicators are lacking.

Second, *NRCS Indicators* and the *1987 Manual* provide different instructions on how to use the color charts. The *1987 Manual* instructs that soil chromas be read to the nearest Munsell color chip; for example, a soil chroma of 2.2 is read as chroma 2. *NRCS Indicators* does not allow rounding soil chromas to the nearest chip. For example, if an NRCS indicator requires soil chroma to be "2 or less," then a soil chroma of 2.2 would be higher than the threshold and would not be included in the concept of that indicator.

Third, the *1987 Manual* places no color limits on the A horizon. Most of the NRCS indicators, however, require that Munsell chroma of the A horizon be 2 or less except for an oxidized layer within the A horizon for those cases where drainage and plowing may have altered the natural soil profile. Therefore, NRCS includes the following statement at the beginning of the lists of indicators: ***"unless***

otherwise indicated, all mineral layers above any of the Indicators have dominant chroma of 2 or less, or the layer(s) with dominant chroma of more than 2 is less than 15 cm (6 in.) thick."

Use of indicators F3-F5 requires understanding of the terms "gleyed matrix" and "depleted matrix."

GLEYED MATRIX: The gleyed matrix is similar to the "gleyed soils" indicator of the *1987 Manual* (page 31, paragraph 44.f.(l)). The main difference between gleyed matrix indicators of the *1987 Manual* and the 1998 *NRCS Indicators* is changes in the gley color charts (Kollmorgen Corporation) from the 1975 edition to the 1994 edition (see Figure 1). These changes are inconsequential because all differences between editions of the color charts are also covered under the *1987 Manual* indicator of matrix chroma of 1 or less in unmottled soils (¶ 4.f(2)(a)).

DEPLETED MATRIX: *NRCS Indicators* uses the term "depleted matrix" to describe soil layers with light gray colors due to long-term saturation. The depleted matrix is very similar to, but more precise than, the *1987 Manual* indicator: "soils with bright mottles and/or low matrix chroma" (pages 31-32, paragraph 44.f(2)). Figure 1 summarizes the differences. Three differences require discussion.

High-Value vs Low-Value Colors at 10 in. The *1987 Manual* indicator "Soil Colors" (paragraph 44.f) requires that low chroma colors be "in the horizon immediately below the A horizon or 10 in. (whichever is shallower)." This wording leaves open the possibility of mistaking upland soils as hydric when they have value/chroma combinations of 3/1 or 2/1 without mottles. The NRCS depleted matrix explicitly requires high-value colors.

Mottle Contrast. The *1987 Manual* places no requirements on mottle colors. *NRCS Indicators* requires "distinct" or "prominent" visual contrast between Fe concentrations and the gray matrix; that is, mottles must be easily seen rather than just "faint." The quantitative distinctions between these terms are presented in Figure 2. Verbal definitions of "faint," "distinct," and "prominent" follow:

- **Faint.** Evident only on close examination. 1) If difference in hue = 0, difference in value ≤ 2, and difference in chroma ≤ 1, the contrast is faint; or 2) If difference in hue = 1, difference in value ≤ 1, and difference in chroma ≤ 1, the contrast is faint.
- **Distinct.** Readily seen, but contrasts only moderately with the color to which compared; a class of contrast intermediate between faint and prominent. 1) If difference in hue = 0, difference in value < 4, and difference in chroma > 1 and < 4, the contrast is distinct; or 2) If difference in hue = 0, difference in value > 2 to < 4, and chroma < 4, the contrast is distinct; or 3) If difference in hue = 1, difference in value > 1 to < 3, and difference in chroma > 1 to < 3, the contrast is distinct; or 4) If difference in hue = 2, difference in value ≥ 0 to < 2, and difference in chroma ≥ 0 to < 2, the contrast is distinct.
- **Prominent.** Contrasts strongly with the color to which compared. 1) If difference in hue = 0, difference in value ≥ 4, or difference in chroma ≥ 4, the contrast is prominent; or 2) If difference in hue = 1, difference in value ≥ 3, or difference in chroma ≥ 3, the contrast is prominent; or 3) If difference in hue = 2, difference in value ≥ 2, or difference in chroma ≥ 2, the contrast is prominent; or 4) If difference in hue ≥ 3, the contrast is prominent.

Gleyed Matrix comparisons: *1987 Manual* and *NRCS Indicators*		
	***1987 Manual* (¶ 44.f.1)**	**NRCS 1998 Gleyed Matrix**
Percent soil volume with gleyed matrix	> 50 percent	≥ 60 percent
Gley chart edition	1975	1994
Gleyed Hues	N, 5Y and yellower, greener, or bluer	N, 10Y and greener or bluer
Munsell Values	4 or more	4 or more
Soil changes color on exposure to air	Not specified; fits concept of "Reducing soil conditions."	Fits Gleyed Matrix and Depleted Matrix
Low Chroma Colors comparisons: *1987 Manual* (¶ 44.f.2) and NRCS Depleted Matrix		
	***1987 Manual* (¶ 44.f.2)**	**NRCS 1998 Depleted Matrix**
Matrix value/chroma when mottles are mandatory	4/2, 5/2, 6/2, 7/2, 8/2 (matrix values of 3 or less are A horizon colors)	4/1, 4/2, 5/2
Matrix value/chroma when mottles are optional	4/1, 5/1, 6/1, 7/1, 8/1	5/1, 6/1, 7/1, 8/1, 6/2, 7/2, 8/2
Percent soil volume with gray background	> 50 percent	≥ 60 percent
Mottle abundance	Few, common, or many	Common or many
Mottle contrast	Faint, distinct, or prominent	Distinct or prominent
Kind of mottles	Concentrations or depletions	Only concentrations

Figure 1. Contrast between the *1987 Manual* and the *NRCS Indicators* regarding gleyed matrix and depleted matrix. This table is sized so that it can be photocopied and put into the 6-ring binder for the Munsell soil color charts.

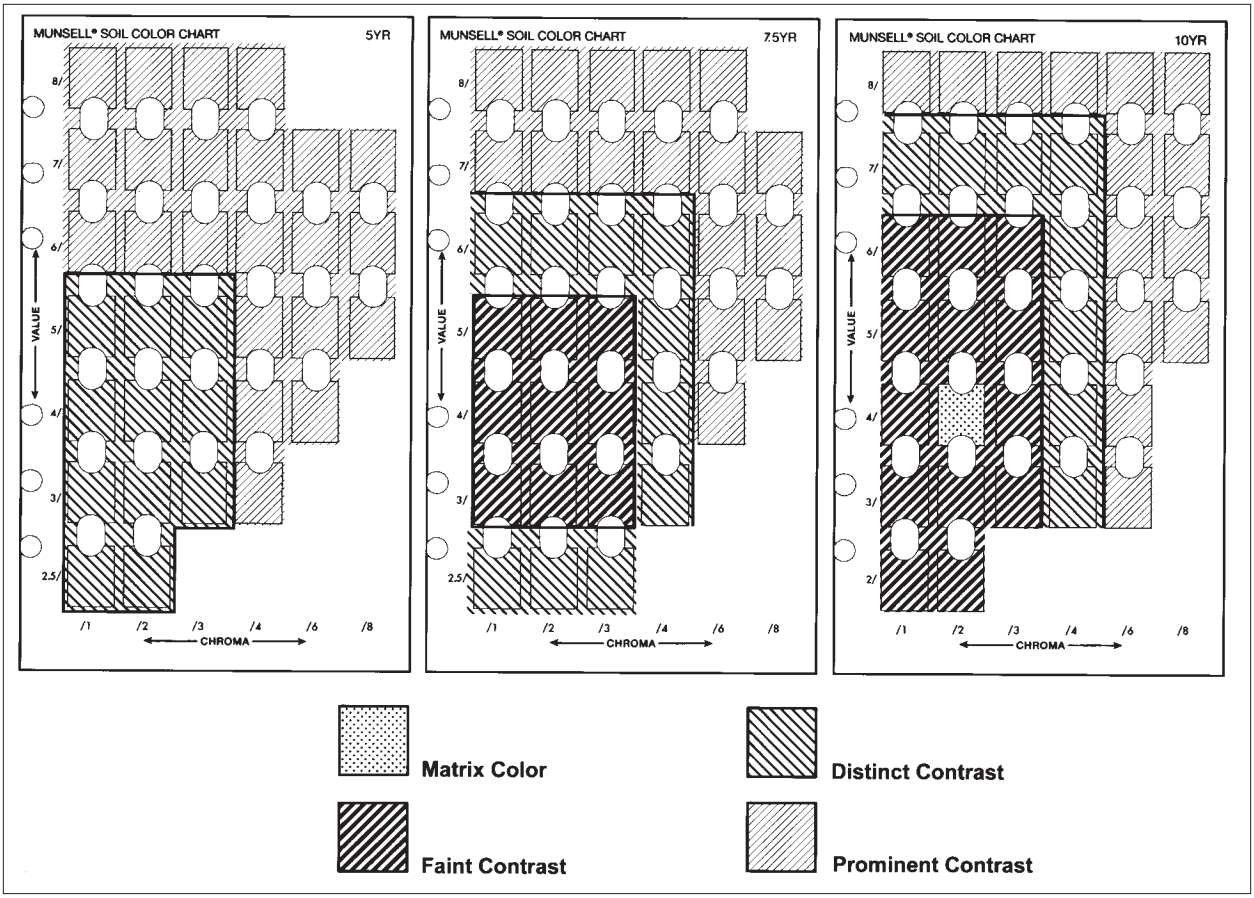

Figure 2. Faint, distinct, and prominent contrast as defined for the NRCS Indicators. All contrasting colors are with respect to the 10YR 4/2 color chip (matrix color). For example, features with colors that fall into the range of dark cross-hatching have faint contrast with respect to the 10YR 4/2 matrix. The 7.5YR color chart displays color contrast with a change of one page in Hue with respect to the 10YR 4/2 matrix, and the 5YR page displays color contrast with a change of two pages in Hue with respect to the 10YR 4/2 matrix.

- **Mottle Abundance.** The *1987 Manual* places no requirements on number of mottles whereas the *NRCS Indicators* requires that mottle abundance be at least 2 percent in the depleted matrix.

RESOLVING THE APPARENT GAP BETWEEN 3-VALUE AND 4-VALUE MATRIXES:

Versions 3.3 and earlier of *NRCS Indicators* have been interpreted to require that A horizon values be 3 or less and that depleted matrix values be 4 or more. This left a gap between 3-value and 4-value colors with no hydric soil indicators, for instance, in AB or AE horizons. This unintentional omission was corrected in Version 4.0 of *NRCS Indicators*, which stipulates that soil value should be read to the nearest color chip. Consequently, values of 3.5 or less are evaluated as if they were values of 3 or less; values greater than 3.5 are evaluated as if they were 4 or more.

The practical application of this change is that we can now apply *NRCS Indicators to* transitional AE or AB horizons. For example, an AB horizon between 8 and 15 in. with value/chroma of 3.2/1 would

be evaluated with Mollisol indicators, such as F6 or F7. A horizon between 8 and 15 in. with value/chroma of 3.8/1 would be evaluated with the depleted matrix indicator, F3.

***NRCS INDICATORS* OVERVIEW: THREE CLASSES OF THICK, DARK SURFACE HORIZON:** Soils with thick, dark surfaces can be divided into three classes when discussing the *NRCS Indicators:*

a. Mottles missing in the A horizon, nationwide applicability.

b. Mottles present in the A horizon, nationwide applicability.

c. Regional applicability.

MOTTLES MISSING IN THE A HORIZON: INDICATORS F4 AND F5. Indicators F4 and F5 are for soils with thick, dark surface layers; iron segregations are not required in the thick, dark surface. These soils must have at least 6 in. of depleted or gleyed matrix below the dark epipedon. The depth to the top of the depleted matrix varies between indicators. Indicator F3 is discussed below, too, because it forms a continuum with F4 and F5.

Thick, dark A horizons provide contradictory information about anaerobic conditions in the upper part of the soil. On the one hand, a thick A horizon can reduce information about anaerobic conditions near the soil surface when water table depth is inferred from colors below the **"A."** So, the thicker the A horizon, the more uncertainty that anaerobic conditions are present in the upper part of the soil. On the other hand, dark colors can result from anaerobic conditions because of the high carbon accumulation in wetlands.

NRCS Indicators combines these two morphologies (darkness of A horizon, and thickness of A horizon) into the sequence of F3 through F5. F3 addresses the shallowest **A** horizons, which have the least stringent darkness requirements. F5 addresses the thickest **A** horizons and has the most stringent darkness requirements. F4 is intermediate (Figure 3).

A horizon < 6 in. thick. If the A horizon is less than 6 in. thick to the depleted matrix, then the **A** horizon can have chroma higher than 2 *(NRCS Indicator* F3; see Figure 3):

> "Unless otherwise indicated . . . the layer(s) [above the Depleted or Gleyed Matrix] with dominant chroma of more than 2 is less than 15 cm (6 in.) thick" *(NRCS Indicators,* 1998, page 13, beginning of "Loamy and Clayey Soils" section).

A horizons from 6 to 10 in. thick. If the depleted matrix starts between 6 and 10 in. of the soil surface, then the A horizon must be 3/2 or darker[1] *(NRCS Indicators F2* and F3). The NRCS allows for the rare exception when the surface of the dark colored **A** horizon may have chroma greater than 2

[1] "Or darker" in this technical note means "or with either (a) same value and lower chroma, (b) same chroma and lower value, or (c) both chroma and value are lower." Neutral colors of same or lower value are included.

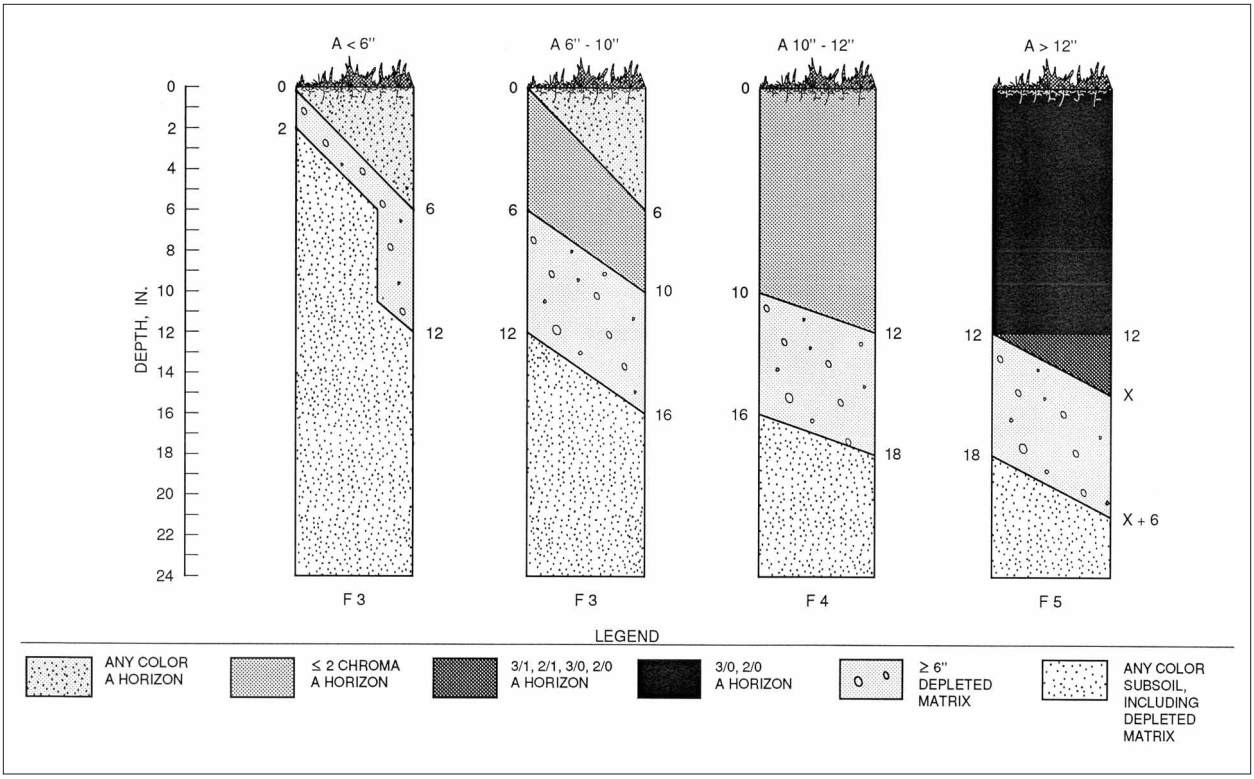

Figure 3. Depth and color requirements for NRCS Indicators F3, F4, and F5.

(such as might result from plowing), so long as the thickness of this higher chroma subhorizon (Al) is less than 6 in. (discussed above).

A horizon from 10 to 12 in. thick. If the A horizon is between 10 and 12 in. deep to the depleted matrix, then all of the A must be 3/2 or darker; no higher chroma layers are allowed (NRCS indicator F4; see Figure 3).

A horizons > 12 in. If the A horizon (and any very dark B horizons) are more than 12 in. thick to the depleted or gleyed matrix, then

a. The top 12 in. must be N 3/0 or darker.

b. Any more epipedon between 12 in. and the depleted or gleyed matrix must be 3/1 or darker.

This is described by NRCS indicator F5. There is no maximum thickness. See Figure 3.

SUMMARY OF INDICATORS F3-F5. The thicker the unmottled A horizon, the darker it must be to indicate shallow anaerobic conditions. A depleted matrix must be below.

MOTTLES PRESENT IN THE A HORIZON: INDICATORS F6 AND F7. F6 and F7 are for dark surfaces with either redox concentrations or redox depletions in the upper 12 in. of the dark A horizon. F6 is for concentrations; F7 is for depletions (Figure 4). Percent abundance of the mottles

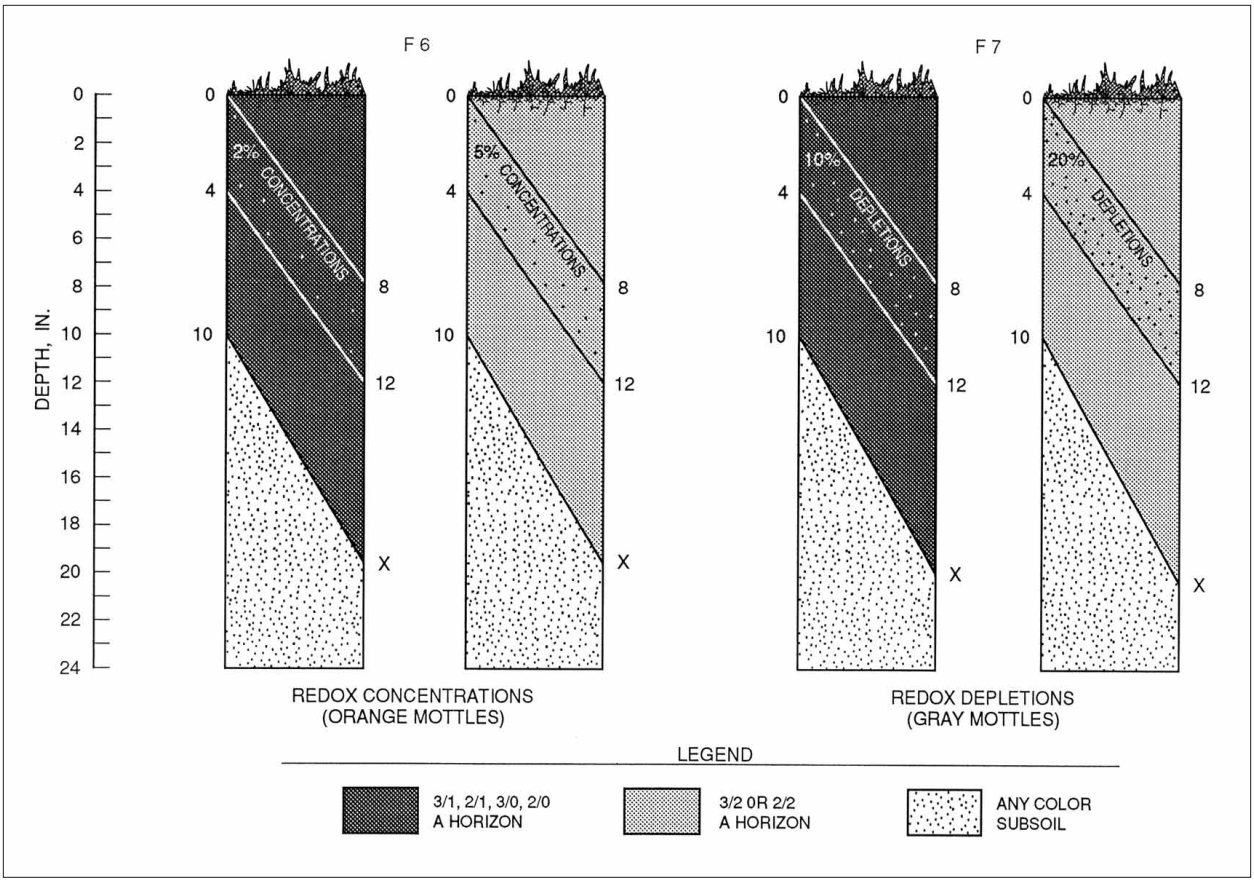

Figure 4. Depth and color requirements for NRCS Indicators F6 and F7.

depends on whether the dark colors are 1 chroma or 2 chroma. In both cases the dark surfaces may be 12 or more inches thick. The A horizon must contain redox mottles within the dark matrix; not all of the A horizon has to be mottled, but there must be a zone of at least 4 in. of mottling above 12 in. within the A horizon. Shallower and thicker zones of mottling, of course, are allowed. There is no requirement for depleted or gleyed matrixes below the dark surface.

F6 requires 2-percent iron concentrations if the matrix color is 3/1 or darker. It requires 5-percent iron concentrations if the matrix color is 3/2 or 2/2. There must be at least 4 in. of these colors in the upper 12 in. of the dark epipedon. The *1987 Manual* places no such restrictions on the abundance of mottles required if chroma is 2 or less; mottles just need to be present (paragraph 44.f(2)(a)).

F7 requires 10-percent iron depletions if the matrix color is 3/1 or darker. It requires 20-percent iron depletions if the matrix color is 3/2 or 2/2. There must be at least 4 in. of these colors in the upper 12 in. of the dark epipedon. The *1987 Manual* places no such restrictions on the abundance of mottles required if chroma is 2 or less; mottles just need to be present (paragraph 44.f(2)(a)).

With F6 and F7, it is not necessary to dig deeper than 12 in. to hunt for a depleted matrix. It is unlikely that a soil would form visible iron segregations within the surface 12 in. and not have evidence of reduction below the epipedon. If one ever found a soil that met the requirements for F6 or F7 but had

a 3-chroma matrix from 12 to 18 in., then it would be necessary to hunt for an explanation: perhaps the water table is perched; more likely deep plowing brought lighter-colored materials to shallower depths, and these were mistaken for redox segregations.

The NRCS definition of F6 and F7 allows mottling within the A horizon to be used as a hydric soil indicator for thinner A horizons (as thin as 4 in.), even with high chroma subsoils. This would not be hydric according to the *1987 Manual* unless the soil could be identified as a different kind of problem soil.

THICK, DARK A HORIZONS THAT ARE REGIONALLY UNIQUE:

Fl3: Thick A Horizons in the Humid East. Many wet soils in the Atlantic and Gulf coastal plains and the lower Mississippi River valley have thick, dark surface horizons that result from arrested decomposition of organic matter. The A horizons become thinner upslope of most of these soils.

Indicator F13 requires a layer at least 6 in. thick with value/chroma of 3/1 or darker[1] within the upper 12 in. (Figure 5). An oxidized A subhorizon with higher chroma is allowed above 6 in. Below the dark layer there must be at least 4 in. with chroma of 2 or less, and any value. Consequently, several different morphologies are covered:

- 3/1 or darker all the way to 10 in.
- 3/1 or darker to 6 in. and 3/2 or 2/2 from 6 to 10 in.
- 3/1 or darker to 6 in. and 4/2 or lighter gray from 6 to 10 in.
- 3/2 or 3/3 on top but not deeper than 6 in.; at least 6 more inches of 3/1 or darker; and 4 more inches of 4/2 or lighter gray below.
- 3/2 or 3/3 on top but not deeper than 6 in.; at least 10 more inches of 3/1 or darker below.

This indicator is restricted to depressions. It can be used in LRRs P and T (South Atlantic and Gulf slopes and coastal plains; NRCS 1998, p. 4).

F16: High Plains depressions. Indicator F16 is written for wetlands that fit the Food Security Act definition of "playas" in the west-central High Plains, in MLRAs 72 and 73 in LRR H. The indicator is limited to depressional positions that pond water. The indicator (Figure 5) describes soils that have value/chroma of 3/1 or darker in the top 13.5 in. At least 4 in. of that layer has to have nodules or concretions. The nodules must occupy at least 1 percent of the volume of the 4-in. layer; or the nodules may occupy less than 1 percent if they are surrounded by a distinct halo of iron mass (red or orange mottle).

SUMMARY: *NRCS Indicators* is a significant improvement on the *1987 Manual* with respect to the problematic soils with thick, dark **A** horizons. They should be used whenever A horizons extend below 10 in. It will take some practice to gain confidence with them; experience with *NRCS*

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[1] 3/1, 2/1, N 3/0, or N 2/0.

Indicators for sandy soils in the southeast coastal plain, however, has shown that the community of wetland scientists can quickly learn to use indicators more sophisticated than those in the *1987 Manual.*

POINT OF CONTACT: For additional information, contact Dr. Steve Sprecher (601-634-3957, *sprechs1@mail.wes.army.mil*). This technical note should be cited as follows:

> Sprecher, S. (1999). "Using the NRCS hydric soil indicators with Soils with thick A horizons," *WRP Technical Notes Collection* (TN WRP SG-DE-4.1). U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/wrp*

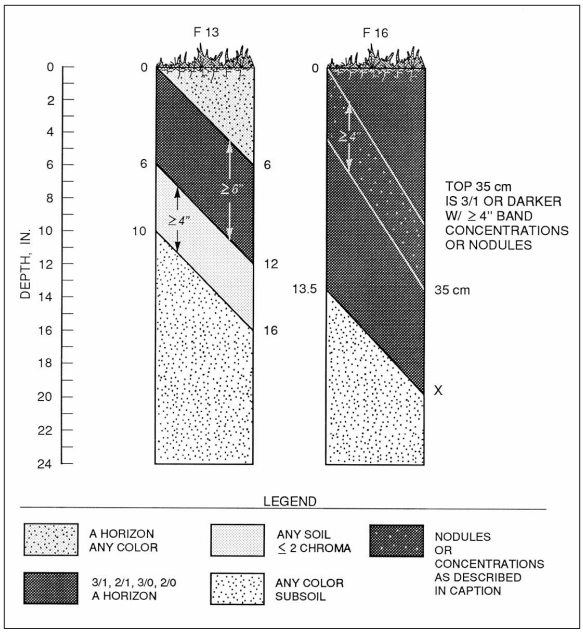

Figure 6. Depth and color requirements for NRCS Indicators F13 and F16.

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