

USDA Soil Basics

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OBJECTIVES

- Define and describe allowable methodology for determination of soil textures
- Describe DOH reference and proper use of United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) methodology

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NOTE

Additional information on certain slides will be found in the “NOTES” section and will only be visible in the “normal” view in PowerPoint

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Basics:

- Soil Color - the dominant morphological feature used to predict the SHWT
- Matrix – dominant (background) color(s) of soil horizon (can be ≥ 1 color)
- Mottle – splotch of color, opposite of matrix

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Information Used to Determine Wet Season Water Table Elevation

See Florida Administrative Code
Rule 64E-6.006(2)

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The following information shall be used in determining the wet season water table elevation

- (a) U.S. Department of Agriculture Soil Conservation Service soils maps and soil interpretation records
- (b) Evaluation of soil color and the presence or absence of mottling
- (c) Evaluation of impermeable or semi-permeable soil layers

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- (d) Evaluation of onsite vegetation
- (e) An onsite evaluation of the property which has used the above referenced sources of information and which has considered the season of the year when the evaluation was performed, historic weather patterns, and recent rainfall events

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Seasonal High Water Tables

- Wettest Season High Water Table: the elevation of the ground water table during that period of time each year when it is expected to be at its highest level
- USDA NRCS term is Seasonal High Saturation

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REFERENCE MATERIALS

- County soil surveys and the information contained therein, plus any other soil interpretation records available through USDA NRCS
- This includes the Web Soil Survey

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Redoximorphic Features

- Redoximorphic (Redox) Features – specific features formed from oxidation-reduction reactions used to predict seasonal high water tables
- Caused by the presence of water and minerals in the soil

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Redoximorphic Features

- Formerly called “mottling” (see site evaluation form)
- A term that USDA NRCS defines as a color change being that has been caused by the presence of water

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Redoximorphic Features

- The regulation therefore uses any types of redoximorphic features
- This would actually be any soil-based feature used to determine an estimated seasonal high water table
- Water tables above the ground surface are estimated by other methods

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Impermeable Layer

- Evaluation of impermeable or semi-permeable layers existing with the natural undisturbed soil or fill material
- A semi-permeable or impermeable layer can also be created when fill material has been placed either on top of a natural soil, or natural soil has been removed and replaced by fill material

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Impermeable Layers

- Could be caused by the placement of the fill itself (compaction)
- Caused by dissimilar soil textures
- Caused by poor drainage
- Could also include effects from artificial drainageways

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Onsite Vegetation

- Observation of surrounding plant ecological communities to determine the natural vegetation of the area
- Vegetation has differing nutrient and water requirements, an evaluation of the vegetation gives evidence of water levels based on the species of plants in the area

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Onsite Vegetation

- Natural vegetation is present due to water/nutrient availability in the area, not the other way around
- Vegetation that has been planted in the surrounding area usually not as useful as an indicator

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SHWT Evaluation

- All required sources of information must be used
- Must consider things like:
 1. drought or excessively wet time
 2. is it the dry season or wet season
 3. Recent weather patterns from past few days to weeks prior to site evaluation

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Example

- Evaluation performed three weeks after the last significant rainfall in a “normal rainfall” year
- Observed water table was at 30 inches
- Need to document information, i.e. “no rainfall in this area in three weeks”

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Evidentiary Value

- Given a different weight of evidence when compared to a site if the observed water table was at 30 inches one day after significant rainfall during a normal rainfall year
- Include information in the site evaluation remarks section to help validate the SHWT determination

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DOH Questioning Soil Profiles/SHWT Estimation of Non-departmental Evaluators

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Per Florida Statute:

- Section 381.0065(4)(n)
- The department shall accept evaluations submitted by professional engineers and such other persons as meet the expertise established by this section or by rule unless the department has a reasonable scientific basis for questioning the accuracy or completeness of the evaluation

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Meaning

- Site evaluation must be complete and accurate
- Conclusions must be validated and justified by facts found in the evaluation
- Cannot assume information that is not presented

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QUESTIONS?

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SOIL DEFINED BY USDA NRCS

- Soil is the collection of dynamic natural bodies, at or near the earth's surface, made up of earthly materials and supports or is capable of supporting plant growth
- For the purpose of soil survey investigations, the soil is usually described to a depth of *80 inches*, or to hard bedrock, whichever comes first

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EXCLUSIONS TO THE DEFINITION

- Potting soil
- Sediments at bottom of lakes, seas, oceans, etc.
- Fill material

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Essential Element in the Definition

- Landforms (hills, slopes, flatwoods)
- Soil Genesis (formation of soil)
- Soil Material (sands/clays)
- Soil Horizons
- Soil Morphology (observable characteristics of the soil within soil horizons, including description of kind and arrangement of the soil horizons)

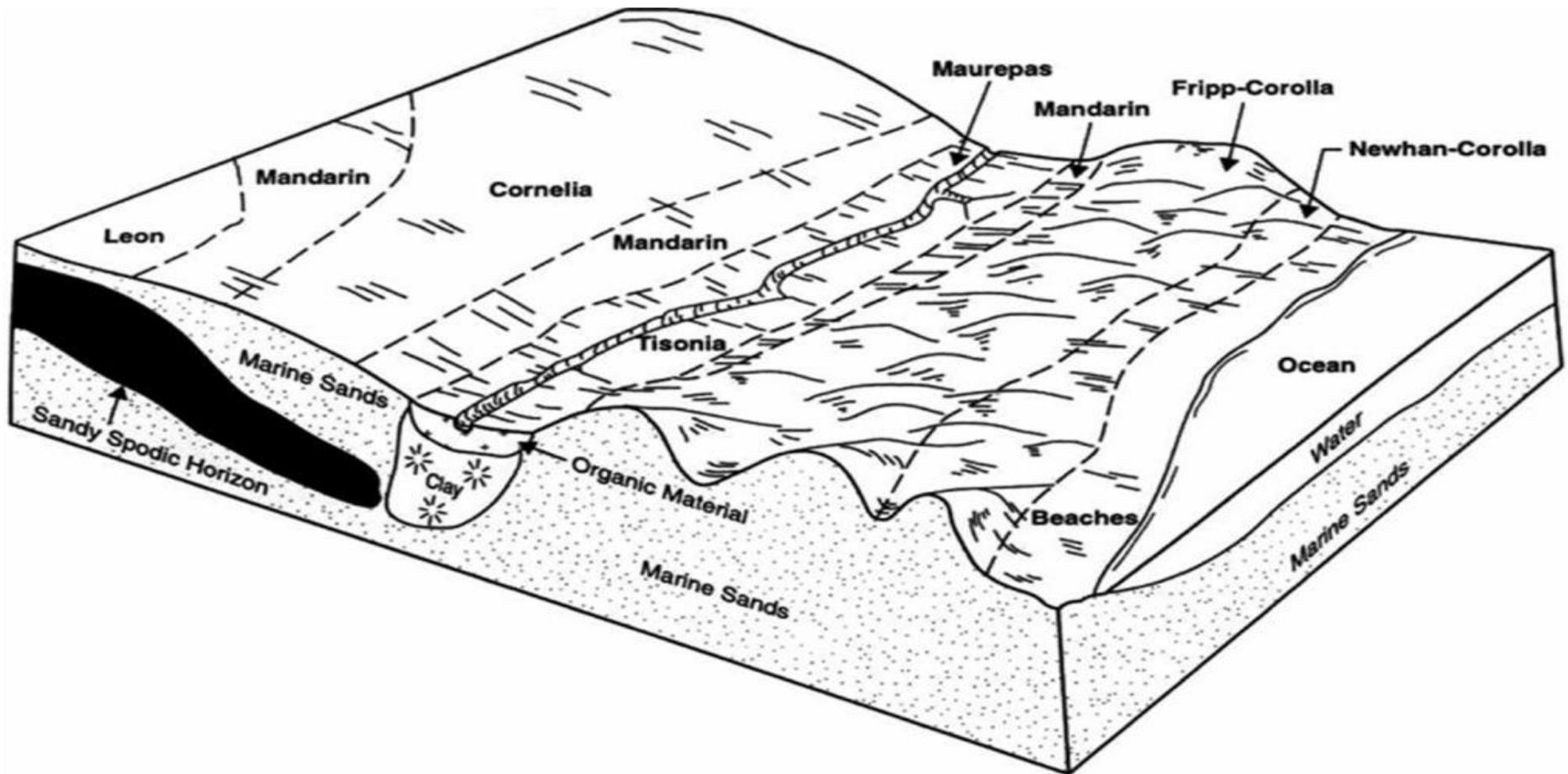
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Landforms/Topographic Relief

Whole Landscape Hydrology



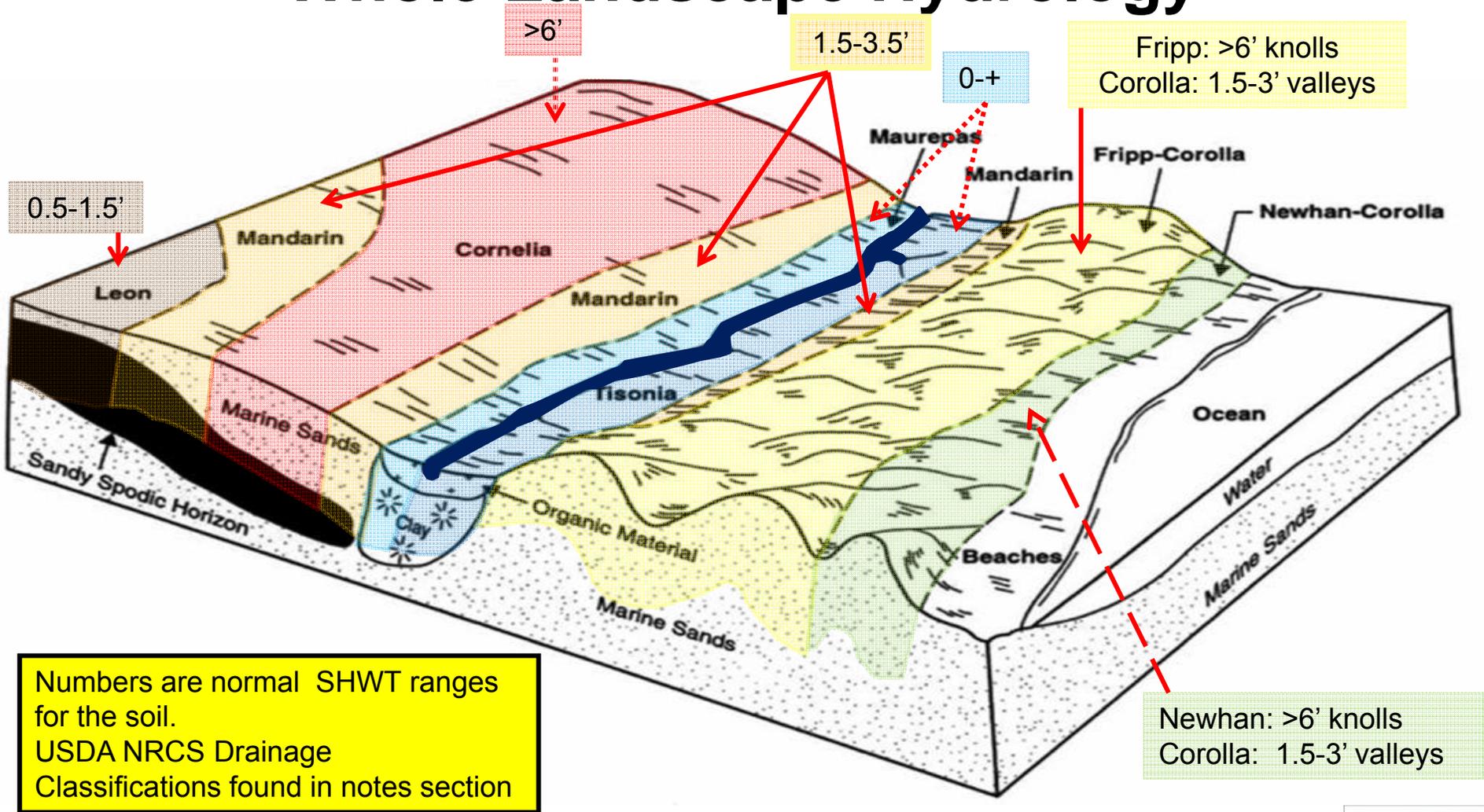
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Landforms/Topographic Relief

Whole Landscape Hydrology



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- When determining the SHWT of the site in question, one must consider the **ENTIRE LANDSCAPE HYDROLOGY**
- Look around the site
- Use the soil surveys for clues to validate SHWT determination, especially where no observable redox features can be found

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Soil Horizons

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Generally:

- Areas of brighter, more colorful soils (redder) are better drained
- Areas of less colorful, darker soils (grays) are more poorly drained

Soil Horizons in Flatwoods area

Higher landscape position,
better drainage, redder soil
colors

Lower landscape position,
poorer drainage, gray/black
colors

Gradual Transition area over distance

30 feet

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So, does landscape
position have
anything to do with
SHWT ?

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Anthropogenic Soils

- Anthropogenic: something caused by humans
- Areas of soil that have been manipulated by man (filled, soil removal, mixed, etc.)
- Try and determine the amount of time that the fill material has been on site

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Anthropogenic Soils

- May be able to use Google Earth's historic imagery feature to look back to approximately 1994
- Could also use other aerial photography sites like Florida Aerial Photography at <http://ufdc.ufl.edu/aerials>

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Soil Horizons

- Soil has natural organization and is biologically active
- This inherent organization results from climatic and biological forces altering the properties of the materials of the earth's surface (Sprecher. 2000)

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- Because these soil-forming forces exert progressively less influence with depth, they result in more or less horizontal layers that are termed “soil horizons”
- Individual layers are distinguishable from adjacent layers by a distinctive set of properties produced by the soil-forming processes

- The characteristics and vertical sequence of these horizons vary in natural patterns across the landscape
- Some characteristics can change over a few feet
- Many soils are similar over large areas
- Individual kinds of soils are distinguished by their specific sequence of horizons, or “soil profile”

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Soil Horizon Change

- Horizon designation changes when:
- Change in soil color
- Change in soil texture
- Change in soil structure (we don't discuss structure of soil)
- Any combination of above

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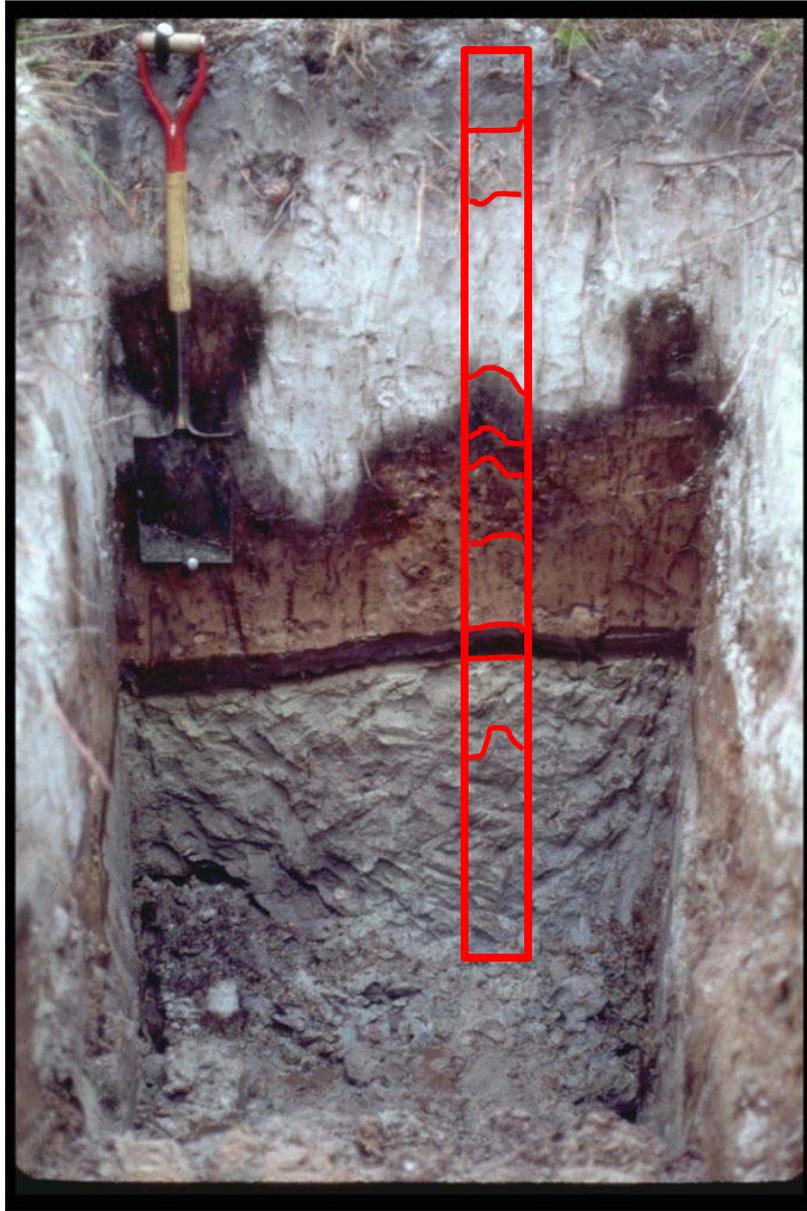
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Soil Profile

- Individual kinds of soils are distinguished by their specific sequence of horizons, or “soil profile”
- Soil profile is determined by using soil auger or other digging device to reveal soil horizon information

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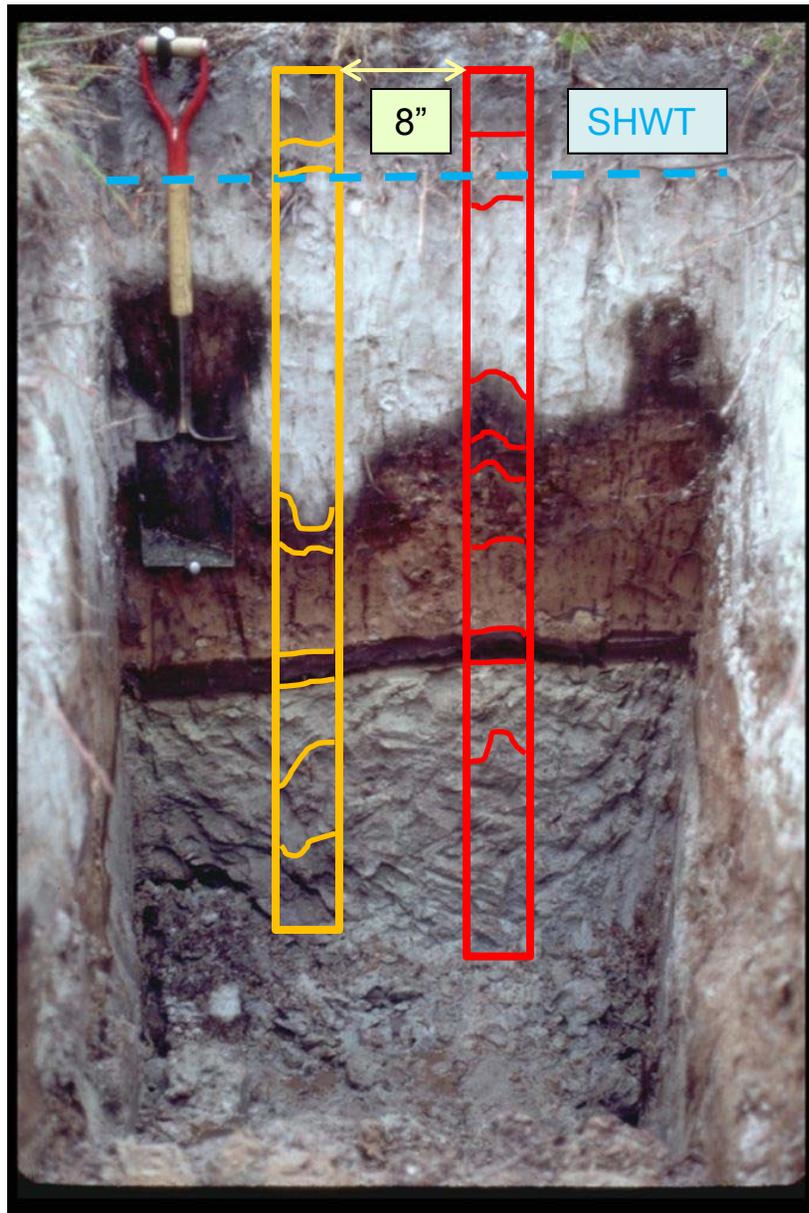
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- Soil Horizons exposed in a pit (soil profile)
- The matrix color is the dominant color in each layer
- Horizons have color, texture, thickness and soil structure

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- Soil profile changes within one foot
- Seasonal high water table would not change in this short distance
- Observe area behind the shovel

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USDA Horizon Designations

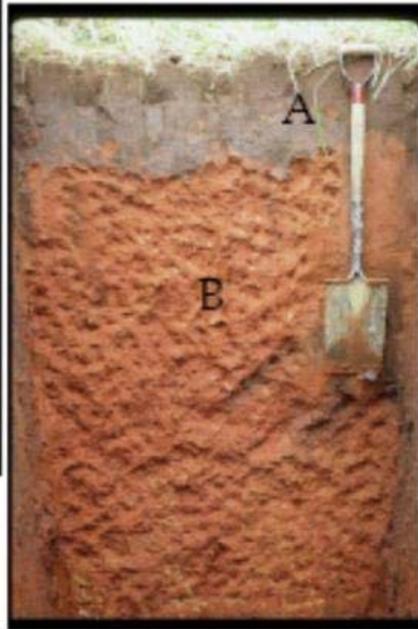
- USDA NRCS describe horizons by:
- Alphabetic or alpha-numeric symbol for the type of layer
- Upper and lower boundary depth
- Munsell notation and texture
- Example: A1 -- 0 to 9 inches;(10YR 2/1) fine s
- DOH notation is a little different

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Soils in Florida



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Master Horizons

All master horizons are
designated by a capital letter

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Major Horizon Designations



- O Horizon – Surface organic layer
- A Horizon – Surface mineral layer
- E Horizon- Leached layer
- B Horizon- Subsoil
- C Horizon- Underlying material
- R Horizon- Bedrock

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Major Horizon Designations

- O Horizon – Organic horizon, the surface layer in extreme wet soils comprised of organic matter
- Muck, mucky peat and peat are O horizons

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Major Horizon Designations

- A Horizon - topsoil or surface layer
- Surface layer in a mineral soil
- Characterized by accumulation of organic matter and/or loss of materials (e.g., clays) to deeper layers

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Major Horizon Designations

- E Horizon - a subsurface layer, the leached layer
- Materials are removed (leached) from this layer and deposited in the B horizon
- Not found in every soil
- Often lighter than layers above or below
- *Always followed by a B horizon*

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Major Horizon Designations

- B Horizon - the subsoil layer, characterized by accumulation of clays or other materials such as aluminum, iron and organic matter and greater structural development
- Can occur directly under an A horizon (e.g. a spodic layer)
- Have not formed in all soils

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Major Horizon Designations

- C Horizon - the underlying material, unconsolidated parent material little influenced by soil-forming processes (not much going on)
- R Horizon – bedrock, normally limestone in Florida

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Soil Horizonation

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O Horizon-
(Sapric/Muck)
Most highly
decomposed plant
materials of the O
horizon category



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O Horizon
(Fibric/Peat)-
formerly called
“root mat” and is
least decomposed
of the O horizon
category



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A Horizon-
Topsoil
layer, color
is from
organic
material

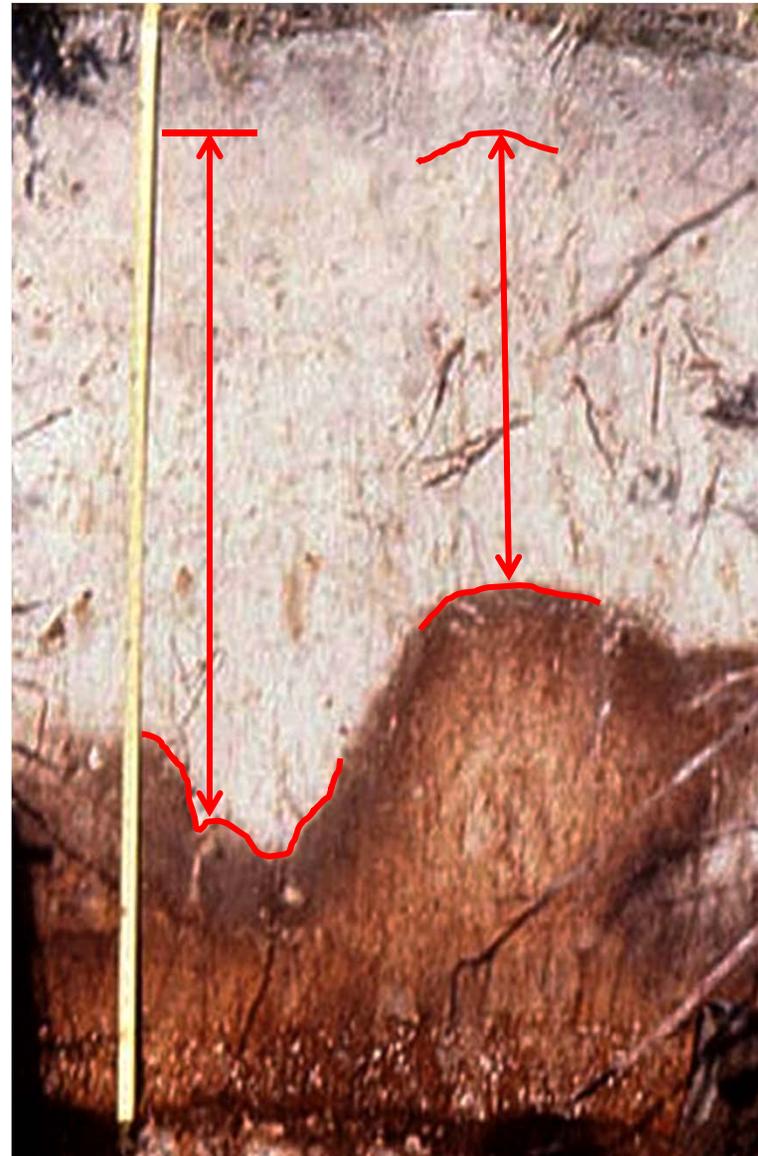


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- E horizon-
leached layer
between the A
horizon and B
horizon
- Note E horizon is
lighter in color
than the A
(upper)
or B
(Lower)
horizon

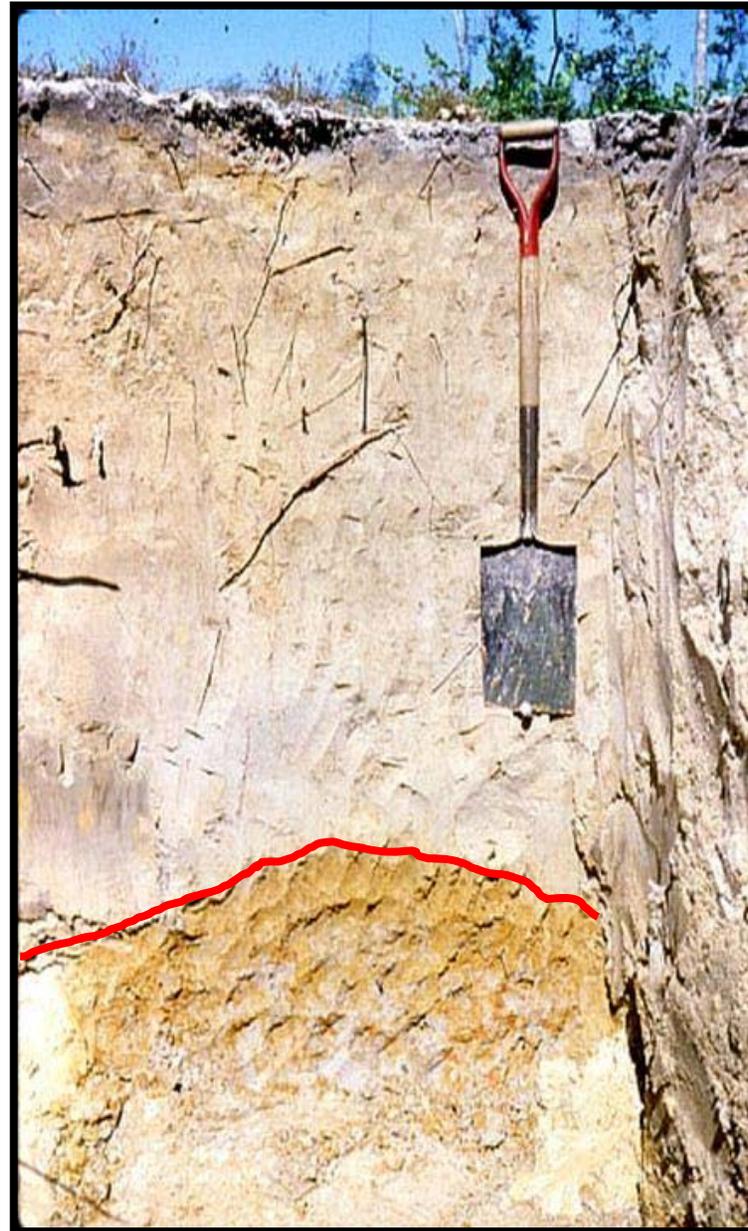


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B horizon –
Increase in clay
particles and color
(iron) in this slide

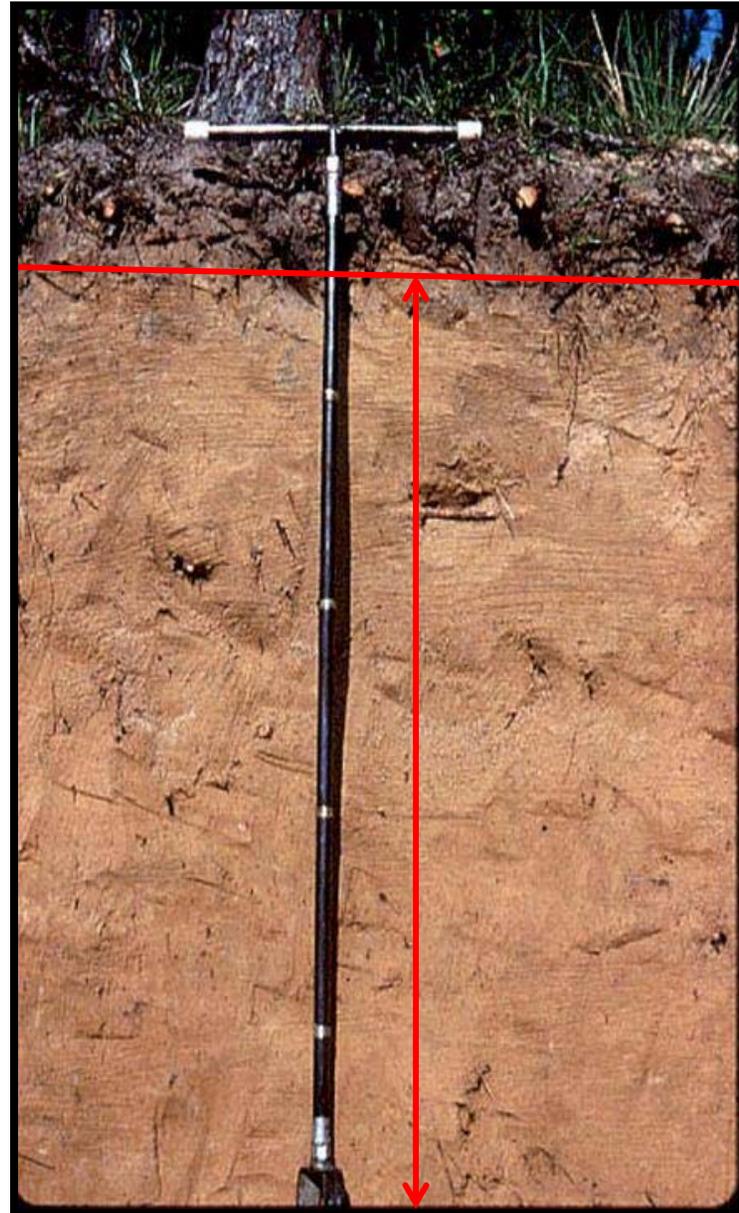


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C horizon - the underlying material, unconsolidated parent material little influenced by soil-forming process

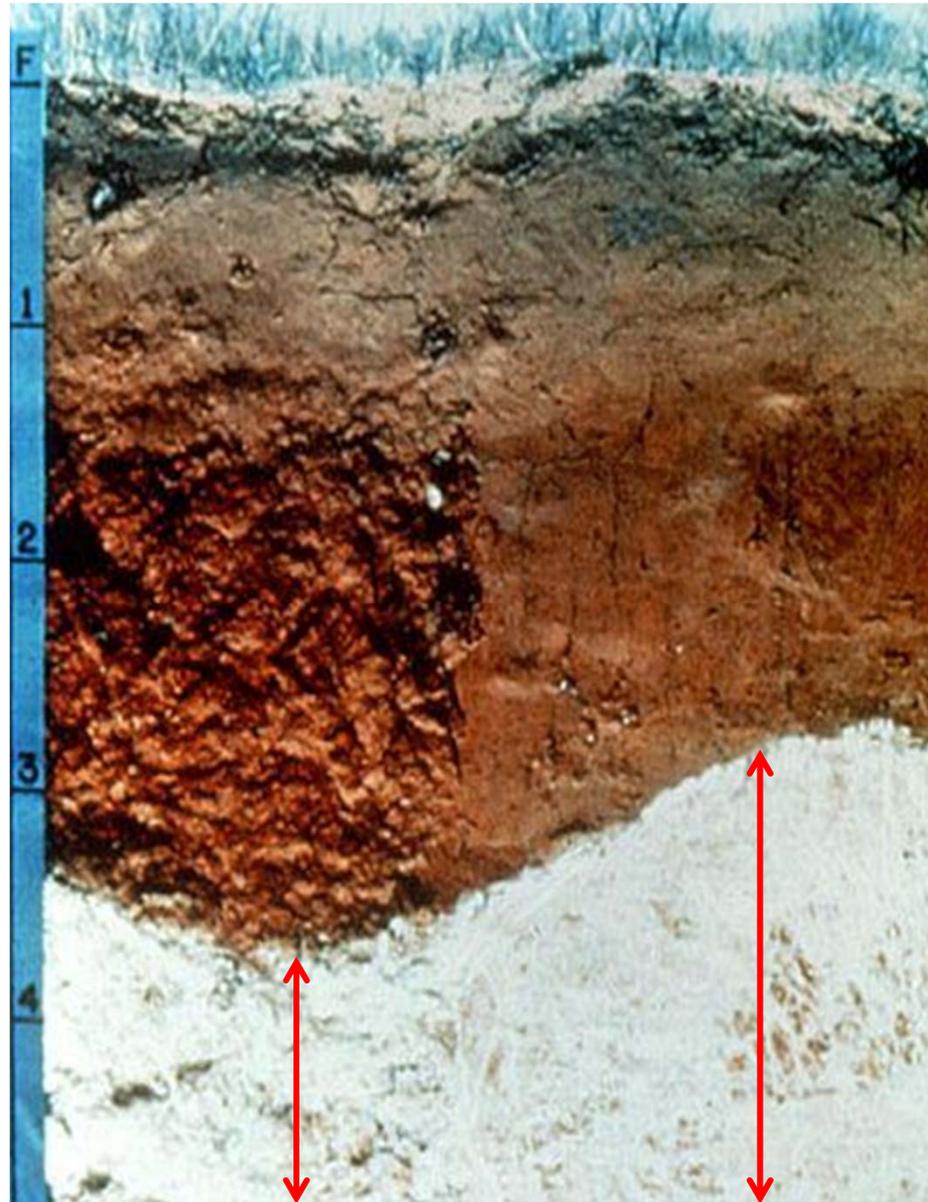


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R horizon –
Rock, in Florida
mostly limestone



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Notes on soil horizon designation in older soil surveys

- Before about 1981, soil surveys and other documents contained profile descriptions that used a slightly different group of horizon designations
- Following is a list of some old designations and their equivalent designations in the new system

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Old

New

O1

O_i or O_e

O2

O_a or O_e

A1

A

A2

E

A3

AB or EB

AC

AC

B1

AB or BA

B2

B or B_w

B3

BC or CB

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- Horizon numbering in the old system is the same as in the new system, however the inclusion of numbers in old master horizon designation makes interpretation somewhat confusing
- Consider the following example:

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Old

New

A11

A1

A12

A2

A21

E1

A22

E2

B21t

Bt1

B22t

Bt2

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QUESTIONS?

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Subhorizon-specific part of a horizon

- Subhorizon: identifiable layers that clearly differ in properties from adjacent layers
- A change in horizon designation would occur when a change in the color, texture or structure happens, or if a combination of any of the three happens

Horizon Subscripts

**a.k.a. Subhorizon suffixes
(know the ones in **RED**)**

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Subhorizon Suffixes

- **a** – (O horizon only-Oa) highly decomposed organic material; sapric material (muck)
- **b** - (A horizon only-Ab) buried layer
- **e** – (O horizon only-Oe) not fully decomposed organic matter; Hemic material (mucky peat)

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Subhorizon Suffixes

- **g** – *dominance of gley (gray) colors due to wetness (lack of oxygen, reduction of Fe) (e.g. Cg); this includes all low chroma (chroma ≤ 2) colors*
- **h** - (B horizon only-Bh) subsoil accumulation of organic acids and aluminum (spodic layer) *NOTE: Not an organic layer by definition, must be sandy*

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Subhorizon Suffixes

- **i** – (O horizon only, Oi); least broken down organic material, Fibric material (Peat)
- **k** - accumulation of calcium carbonate (CaCO_3)
- **m** - cementation - hard – indurated

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Subhorizon Suffixes

- **p-** This symbol is used to indicate tillage or a disturbance of the surface layer by mechanical means, pasturing, or similar uses
- A disturbed organic horizon is designated Op
- A disturbed mineral horizon is designated Ap even though clearly once an E, B, or C horizon

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Subhorizon Suffixes

- q - silica accumulation - very weathered or old soil
- r - soft or weathered bedrock. C horizon only (Cr)
- **t** - subsoil *accumulation of clay particles*, B horizon only (Bt)

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Subhorizon Suffixes

- v – B horizon only, plinthite (soft iron nodules) accumulation; (Btv)
- w- subsoil this is more intensely developed than others in color or structure, without clay accumulation or spodic development, B horizon only (Bw)

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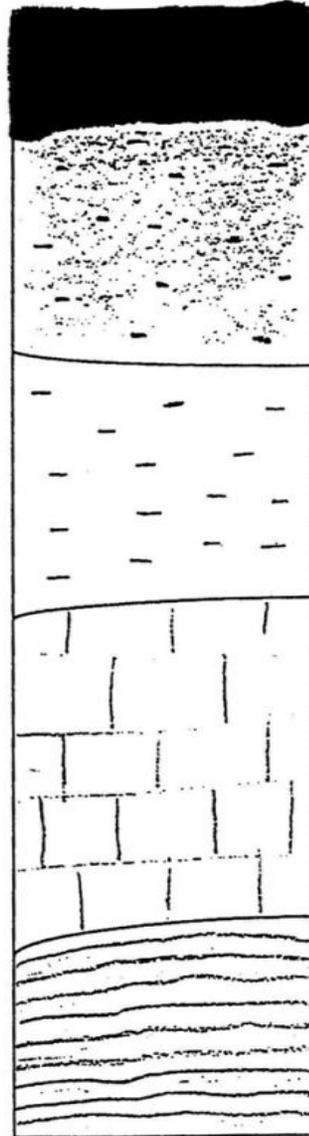
A--Topsoil. Mineral horizon colored dark by organic matter.

AE--Transitional horizon. Has characteristics similar to both the A and E horizons.

E--Horizon of maximum leaching, or loss of substances such as clay particles.

Bt or Bh--Horizon of maximum soil development, usually the accumulation of organic acids or of clay particles

C--Horizon of geologic material that is relatively unaltered by soil forming processes.



Surface layer.

Subsurface layer.

Subsurface layer.

Subsoil layer.

Substratum or underlying layer.

Classic Soil Profile

Representative Profile Schematic

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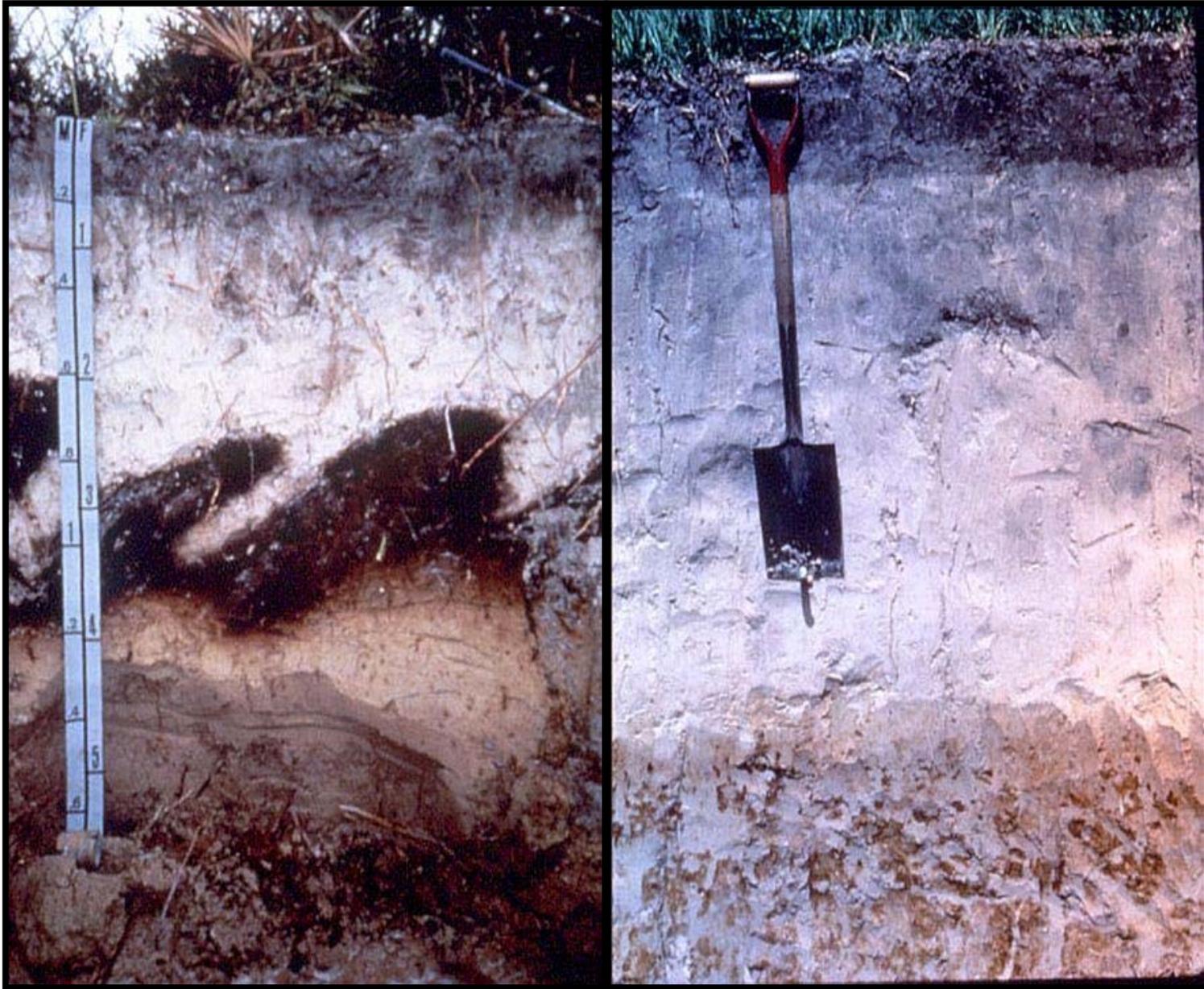


Examples of Horizons in Florida Soils

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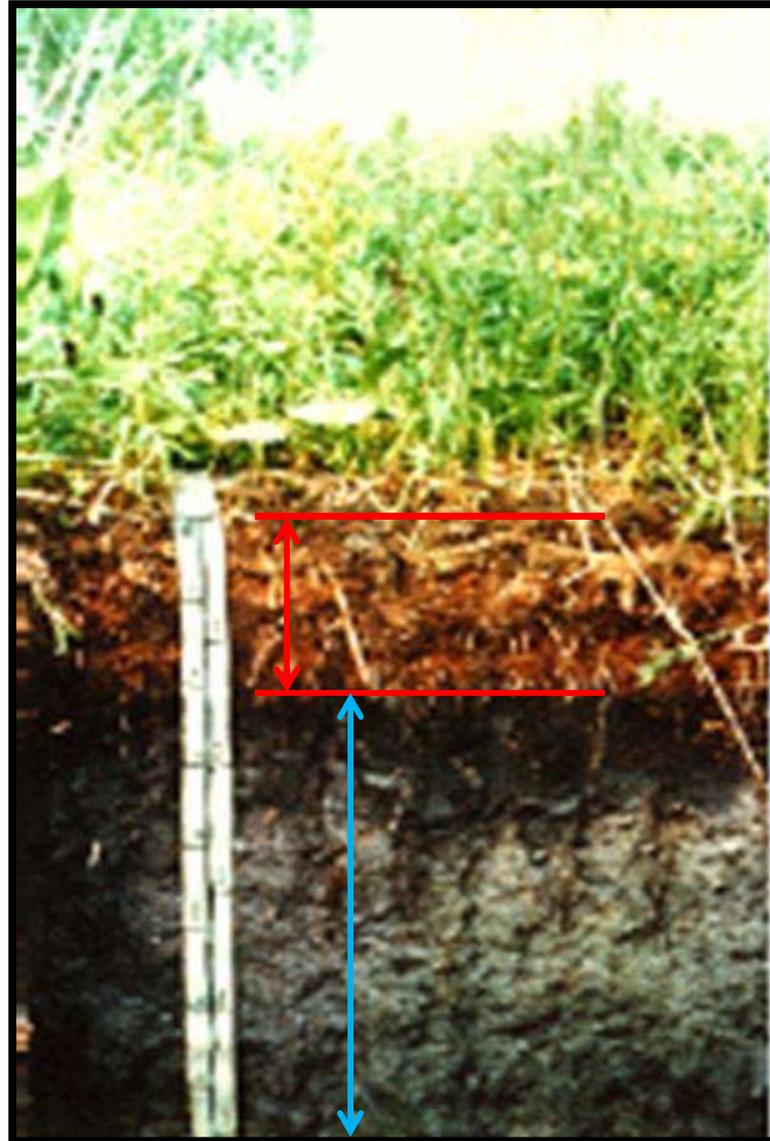


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Terra Ceia muck-muck has two layers and different colors



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Soil Horizons in a “spodosol”

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A, AE, E horizons

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E and Bh horizon interface

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End of presentation QUESTIONS?

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