

Maryland Envirothon SOILS Exam

Guidance Information

(revised 2017)

Objective: To test students' knowledge and awareness of basic soil science and its application in wise land-use planning and therefore conserving, protecting and enhancing the soil resource base. This is accomplished through a practical hands-on type of exam requiring the ability to make basic soil property observations, apply these observations to make suitability interpretations and the ability to use soil survey reports. This guide contains an outline, example scorecard and guidance information to the scorecard.

Outline to Soils Exam:

Section I. Landscape and Soil Profile Features (76 points)

Part A. Landscape Features (8 pts.)

1. Position (2 pts.)
2. Parent Material (2 pts.)
3. Slope Characteristics (2 pts.)
4. Surface Stoniness or Rockiness (2 pts.)

Part B. Soil Profile Features in Pit (35 pts.)

1. Major Soil Horizons (4 pts.)
2. Topsoil Layer – O and A horizon(s) thickness (2 pts.)
3. Topsoil Structure (1 pt.)
4. Soil Color - Topsoil and Subsoil/Substratum (4 pts.)
5. Soil Drainage (6 pts.)
6. Soil Depth (4 pts.)
7. Rock Fragments (1 pt.)
8. Soil Texture (6 pts.) and Tie Breaker
9. Soil Permeability - Topsoil and Subsoil (4 pts.)
10. Soil Reaction - pH (2 pts.)
11. Topsoil Color with Munsell Book (1pt.)

Part C. Soil and Site Interpretations (33 pts.)

Agricultural Suitability

1. Past Soil Erosion (2 pts.)
2. Potential Future Erosion (2 pts.)
3. Major Limiting Factors (2 pts.)
4. Land Capability Class (3 pts.)
5. Best Management Practices (4 pts.)
6. Hydric Soil (2 pts.)
7. Prime Farmland (2 pts.)

Soil Health

8. Munsell Soil Chart Notation (1 pts.)
9. Pin Flag – Compaction (2 pts.)
10. Structure/Aggregation of Topsoil (1 pts.)
11. Nutrient Management Needs (5 pts.)

Urban Suitability

12. Suitability for Septic tank Absorption Field (2pts.)
13. Suitability for Lawns (2 pts.)
14. Suitability for Dwellings with Basements (2 pts.)

Wildlife Suitability

15. Wildlife Habitat (1 pts.)

Section II. Soil Survey Use (15 pts.)

Section III. Fifth Issue Related to Soils (9 pts.)

**- Maryland Envirothon
Soil/Land Use Station
Training Scorecard**

SECTION I: Landscape and Soil Profile Features (76 points)

Part A – Landscape Features (8 points total)

Considering the immediate area around the soil pit, mark a for your answer.

1. Position (2 points)

- Upland
- Upland depression or drainage way
- Terrace
- Floodplain

2. Parent Material (2 points)

- Residual
- Colluvium
- Recent alluvium
- Old alluvium
- Coastal plain sediments

3. Slope Characteristics (2 points)

<u>Slope Class</u>	<u>Piedmont-Appalachian</u>	<u>Letter Designation</u>
<input type="checkbox"/> Nearly level	0 – 3 %	A
<input type="checkbox"/> Gently sloping	3 – 8 %	B
<input type="checkbox"/> Strongly sloping	8 – 15 %	C
<input type="checkbox"/> Moderately steep	15 – 25 %	D
<input type="checkbox"/> Steep	25 – 50 %	E
<input type="checkbox"/> Very Steep	50 + %	F

4. Surface Stoniness or Rockiness (2 points)

- None
- Very stony (less than 30 ft. [9.8 m] apart)
- Rock outcrop (2 exposures within 100 ft. [32.8 m])

Part B – Soil Profile Features (35 points total)

From the examination of the soil profile in the pit and other soil samples provided, mark a for your answer or write your answer in the space provided.

1. Check the major soil horizons visible in this profile: (4 points)

- O A E B C R

2. What is the current topsoil thickness, O and/or A horizon(s)? (2 points)

_____ inches

3. What is the topsoil structure? (1 point)

- Granular
 Blocky
 Single grain, massive or platy

4. Soil Color (2 points each column)

a. Topsoil – A Horizon

- Brown or dark brown
 Reddish brown
 Gray or grayish brown
 Black

b. Subsoil and Substratum – B and/or C horizon

- Yellowish brown or red, no redox depletions (gray mottling/wetness)
 Yellowish brown or red, some redox depletions (gray mottling/wetness)
 Dominantly gray, with redox concentrations (brownish red mottling/wetness)

5. Soil Drainage (3 points each column)

a. Depth to redox depletions

- Directly under a thick black colored surface
 0 to less than 10 inches [0-<25 cm]
 10 to less than 20 inches [25-<51 cm]
 20 to less than 40 inches [51-<102 cm]
 40 to less than 72 inches [102-<183 cm]
 72 inches [183 cm] or greater

b. Natural soil drainage class

- Excessively well drained
 Well drained
 Moderately well drained
 Somewhat poorly drained
 Poorly drained
 Very poorly drained

6. Soil Depth (2 points each column)

a. Effective rooting depth

- Very shallow (less than 10 inches [<25 cm])
 Shallow (10 to less than 20 inches [25-<51 cm])
 Moderately deep (20 to less than 40 inches [51-<102 cm])
 Deep (40 to less than 60 inches [102-<152 cm])
 Very deep (60 inches [152 cm] or greater)

b. Depth to bedrock

- Very shallow (less than 10 inches [<25 cm])
 Shallow (10 to less than 20 inches [25-<51 cm])
 Moderately deep (20 to less than 40 inches [51-<102 cm])
 Deep (40 to less than 60 inches [102-<152 cm])
 Very deep (60 inches [152 cm] or greater)

7. Rock Fragments - What is the percentage of rock fragments in and on the surface layer? (1 point)

- Less than 15% gravel
- 15 – 35% gravel
- Greater than 35% gravel OR very stony, rock outcrops

8. Soil Texture (3 points each column)

a. Topsoil – A horizon

- Coarse – sand, loamy sand
- Moderately coarse – sandy loam
- Medium – loam, silt loam, sandy clay loam
- Moderately fine – silty clay loam, clay loam
- Fine – clay, silty clay, sandy clay

b. Subsoil – B horizon

- Coarse – sand, loamy sand
- Moderately coarse – sandy loam
- Medium – loam, silt loam, sandy clay loam
- Moderately fine – silty clay loam, clay loam
- Fine – clay, silty clay, sandy clay

c. **Percent clay in subsoil** (used for tie breaker) _____ %

9. Soil Permeability (2 points each column)

a. Topsoil – A horizon

- Rapid (> 6.0 in/hr [>15 cm/hr])
(Coarse texture)
- Moderately rapid (2.0-6.0 in/hr [5-15 cm/hr])
(Moderately coarse texture)
- Moderate (0.6-2.0 in/hr [1.5-5 cm/hr])
(Medium texture)
- Moderately slow (0.2-0.6 in/hr [0.5-1.5 cm/hr])
(Moderately fine texture)
- Slow (<0.2 in/hr [<0.5 cm/hr])
(Fine texture)

b. Subsoil – B horizon

- Rapid (> 6.0 in/hr [>15 cm/hr])
(Coarse texture)
- Moderately rapid (2.0-6.0 in/hr [5-15 cm./hr]) (Moderately coarse texture)
- Moderate (0.6-2.0 in/hr [1.5-5 cm/hr])
(Medium texture)
- Moderately slow (0.2-0.6 in/hr [0.5-1.5 cm/hr])
(Moderately fine texture)
- Slow (<0.2 in/hr [<0.5 cm/hr])
(Fine texture or fragipan present)

10. Soil Reaction (2 points)

Using the pH test kit, what is the pH of the soil in the sample bag? _____

11. Topsoil Color (1 point)

Using the Munsell Soil Color Book, what is the color notation of the soil in the sample box?

Hue Value/Chroma

Part C – Soil and Site Interpretations (33 points total)

Using the determinations from Landscape and Soil Profile Features (Parts A and B), mark a for your answer.

Agricultural Suitability

1. **Past Soil Erosion** = Original topsoil thickness (from information sign) minus current topsoil thickness. (2 points)

- Slight (less than 3 inches [8 cm] of the original soil lost)
- Moderate (3 – 8 inches [8-20 cm] of the original soil lost)
- Severe (greater than 8 inches [20 cm] of the original soil lost)

2. **Potential future erosion if cultivated or disturbed** (2 points)

- Slight (nearly level)
- Moderate (gently sloping)
- Severe (strongly sloping – very steep)

3. **Major limiting factors (check all that apply)** (2 pts.)

- None
- Flooding or ponding (Occasional or Frequent)
- Slope (Gently sloping or greater)
- Past erosion (Severe)
- Effective rooting depth (less than 40 inches [51 cm] deep)
- Drainage (less than 40 inches [51 cm] to redox depletions, gray mottles/wetness)
- Coarse textures (Topsoil and subsoil)
- Very stony or rock outcrop

4. **Land Capability Class (check one)** (3 points)

- I No limiting factors, nearly level
- II Gently sloping, or moderately well drained, or moderately deep
- III Strongly sloping, or somewhat poorly drained, or poorly drained, or shallow, or coarse textures
- IV Moderately steep, or very poorly drained, or occasionally flooded
- V Nearly level and very stony, rock outcrop, or frequently flooded
- VI Steep, or gently sloping through steep with a very stony surface or rock outcrop
- VII Very steep with or without a very stony surface or rock outcrop, or very shallow soils
- VIII Swamp, tidal marsh, coastal beach, rock outcrop or urban land

5. **Best management practice(s) needed at this site** (check all that apply and use drainage class, slope and Land Capability Class as criteria) (4 points)

- Drainage *Moderately well, somewhat poor, poorly drained or very poorly drained AND Land Capability Class less than or equivalent to IV)*
- Irrigation *Excessively well drained AND Land Capability Class less than or equivalent to IV*
- Contour farming *Gently sloping AND Land Capability Class equivalent to II, or III, or IV*
- Contour strip-cropping *Strongly sloping or moderately steep AND Land Capability Class less than or equivalent to IV*
- Grassed waterway *Drainage way or swale which conveys concentrated runoff AND Land Capability Class less than or equivalent to IV*
- No-till farming *Land Capability Class less than or equivalent to IV*
- Permanent vegetation *Land Capability Class V, VI, VII or VIII*
- Cover crops *Land Capability Class less than or equivalent to IV*

6. Is this a Hydric soil, i.e. poorly drained or very poorly drained? (2 points)

- Yes
- No

7. Is this Prime Farmland, i.e. Land Capability Class I or II? (2 points)

- Yes
- No

Soil Health

8. Using the Munsell Soil Color Book Notation for the topsoil layer, would it indicate this soil's health to be: (1 point)

Good

Soil is dark brown or black in color; organic matter is visible in the topsoil layer.

Value ≤ 3 and chroma ≤ 3

Fair

Soil is somewhat dark in color; little organic matter is visible in the topsoil layer.

Value = 3 or 4 and chroma = 4
Value = 4 and chroma = 3

Poor

Soil is bright to dull colored; no organic matter is visible in the topsoil layer.

Value > 4 and chroma > 4

9. Using the pin flag to measure compaction in the designated area, would it indicate this soil's health to be: (2 points)

Good

Wire flag enters soil easily to a depth below the topsoil layer; unrestricted root penetration

Fair

Wire flag enters soil, but requires force to reach a depth below the top soil layer; root growth restricted.

Poor

Wire flag enters soil with force, but does not penetrate through the topsoil layer; roots growing laterally

10. Looking at the structure/aggregation of the topsoil layer, would it indicate this soil's health to be: (1 point)

Good

Soil is granular, soft and crumbly, held together with many fine roots. Looks like cottage cheese.

Fair

Soil is blocky and firmer with some fine roots.

Poor

Soil is single grain, massive or platy and hard to break apart. It has few or no fine roots..

11. Determine any nutrient management needs, from the soil test results on the information sign.

Crop to be grown (from information on sign): _____

Soil test results (from information on sign):

Magnesium

Phosphorus

Potassium

Mark the following if needed: (1 point each = 5 points)

- Lime (based on topsoil pH from information on sign)
- Nitrogen
- Magnesium
- Phosphorus (phosphate)
- Potassium (potash)

Urban Suitability

12. Suitability for Septic Tank Absorption Fields (check the appropriate suitability with the most limiting soil property) (2 points)

MORE LIMITING ↓	SOIL PROPERTIES				SUITABILITY	
	Slope	Flooding	Depth to Bedrock	Depth to redox depletions	Subsoil Permeability	Check One:
	Nearly level, gently sloping	None	> 72 in. >183 cm.	> 72 in. >183 cm.	Moderately rapid or moderate	<input type="checkbox"/> Slight
	Strongly sloping	Rare	40-72 in. 102-183 cm.	40-72 in. 102-183 cm.	Moderately slow	<input type="checkbox"/> Moderate
	Moderately steep to very steep	Frequent, Occasional	<40 in. <102 cm.	<40 in. <102 cm.	Slow or rapid	<input type="checkbox"/> Severe

13. Suitability for Lawns (check the appropriate suitability with the most limiting soil property) (2 points)

MORE LIMITING ↓	SOIL PROPERTIES				SUITABILITY	
	Slope	Soil Surface Texture	Rock Fragments in/on Surface	Past Erosion	Depth to redox depletions	Check One:
	Nearly level, gently sloping	Mod. coarse, medium	Less than 15% gravel	Slight	>24 in. >61 cm.	<input type="checkbox"/> Slight
	Strongly sloping	Mod. fine, coarse	15 – 35% gravel	Moderate	12-24 in. 30-61 cm.	<input type="checkbox"/> Moderate
	Moderately steep to very steep	Fine	Greater than 35% gravel OR very stony, rock outcrops	Severe	<12 in. <30 cm.	<input type="checkbox"/> Severe

14. Suitability for Dwellings With Basements (check the appropriate suitability with the most limiting soil property) (2 points)

MORE LIMITING ↓	SOIL PROPERTIES				SUITABILITY
	Slope	Flooding	Depth to redox depletions	Depth to Bedrock	Check One:
	Nearly level, gently sloping	None	> 72 in. >183 cm.	> 72 in. >183 cm.	<input type="checkbox"/> Slight
	Strongly sloping	-----	40-72 in. 102-183 cm.	40-72 in. 102-183 cm.	<input type="checkbox"/> Moderate
	Moderately steep to very steep	Rare, Frequent, Occasional	<40 in. <102 cm.	<40 in. <102 cm.	<input type="checkbox"/> Severe

Wildlife Suitability

15. Which wildlife habitat is this soil best suited for? (1 point)

- Wetland wildlife
- Upland wildlife

SECTION II: Soil Survey Use *(15 points total)*

Section II: Soil Survey Use

(15 points total)

Circle the correct answer(s) or write the appropriate response in the space provided.

You have just purchased a piece of property in ?? County. You would like to build a house on the property as well as do some farming and develop some areas to attract wildlife. Answer the following questions, using the soil survey report, to help you decide where the most appropriate places are to do these things on your property.

Section III: Fifth Issue – “Current Issue” is an important topic in today’s world. As a conservation planner working for the Natural Resources Conservation Service, you are to answer the following questions pertaining to soil resource concerns.

(9 points total)

Guidance to Soil Exam (page number indicates location in Maryland Envirothon Soil Study Guide)

Section I. Landscape and Soil Profile Features - This section pertains to the exposed soil profile and the area to be evaluated as provided by the information sign or the pit proctor.

Part A. Landscape Features – based on area surrounding the soil pit

1. Position (page 11) - requires understanding of kinds of landscape positions and the ability to differentiate in field.
 - **Upland:** usually level, rolling or convex, unaffected by stream activity
 - **Upland depression or drainageway:** concave landforms or at the heads of drainage ways, surface water retarded, sometimes ponded, usually thick dark surface (black), at least three sides are sloping to the bottom, parent material may be accumulated depositional material, may not be poorly drained.
 - **Terrace:** above zone of current flooding, usually gravel lines or coarse sands in profile, older alluvium parent material
 - **Floodplain:** near stream, has flood frequency, recent alluvium parent material

2. Parent Material (page 8) - requires knowledge of characteristics of 5 major types and ability to differentiate in field. Soil profiles may contain multiple types.
 - **Residual:** soils formed in place from bedrock (bedrock may not be present in profile)
 - **Colluvium:** generally located on lower part of slopes, moved down slope by gravity and water, soil material and angular coarse fragments, maybe subrounded.
 - **Recent alluvium:** fresh or recent deposits, floodplain position or an upland depression with ≥ 20 inches depositional material, poorly developed profile in the recent alluvial material.
 - **Old alluvium:** water worn (rounded) coarse fragments in the soil profile, stream terrace position, should have a developed profile, never or rarely flooded, no fresh materials
 - **Coastal Plain sediments:** on coastal plain region, can have silty cap (loess)

3. Slope Characteristics (page 13) - requires the ability to use clinometers or Abney levels to determine slope percentage and place in appropriate class based on physiographic province of the State. Guidance to appropriate physiographic province will be provided in training and/or by site proctor. The participant may need to know the exact percentage of slope for urban interpretations.

<u>SLOPE CLASS</u>	<u>COASTAL PLAIN</u>	<u>PIEDMONT OR MOUNTAIN</u>	<u>SOIL SURVEY LETTER SYMBOL</u>
Nearly level	0 to 2%	0 to 3%	A
Gently sloping	>2 to 5%	>3 to 8%	B
Strongly sloping	>5 to 10%	>8 to 15%	C
Moderately steep	>10 to 15%	>15 to 25%	D
Steep	>15 to 25%	>25 to 50%	E
Very steep	>25%	>50%	F

4. Surface Stoniness or Rockiness (page 32) - must be able to recognize stoniness or rock outcrops and assess quantities present to determine significance.
 - **None:** less than listed below
 - **Very stony:** tillage of intertilled crops impracticable, hay or pasture possible, no better than class V, stones exposed on soil surface that are ≥ 10 inches in diameter and are less than 30 feet apart, not gravel or cobble
 - **Rock outcrop:** bedrock exposures, intertilled crops impracticable, hay or pasture possible, no better than class V, two or more bedrock exposures less than 100 feet apart within designated area to be judged, commonly found in limestone valleys

Part B. Soil Profile Features - based on exposed soil profile in the pit and provided samples

1. Major soil horizons (page 19) - requires knowledge of characteristics of major soil horizon and ability to differentiate in field. Will be asked to circle soil horizons visible in the profile (wall of the pit). Possible horizons are O, A, E, B, C, R.
2. Current Topsoil layer thickness - requires measurement to nearest inch of the A horizon(s) in cropland or of any O horizons plus A horizon(s) in forested or grass areas.
3. Topsoil Structure (page 33) – identify most limiting type or kind of structural peds in topsoil layer, i.e. if upper part is granular but lower part is platy check the block with “single grain, massive, or platy” but if entire layer is granular check the “granular” block. Type of structure and strength of expression are used as a criterion for soil health.
4. Soil Color (page 23) - influenced by organic matter content, drainage condition, or eroded condition. Requires assessment of color of both the A horizon and subsoil and substratum horizons.

Topsoil (A-horizon)--dominant moistened color of horizon

- **Brown or dark brown:** normal
- **Reddish brown:** eroded soil surface, subsoil closer to surface, inherited from parent material
- **Gray or grayish brown:** usually poor drainage condition and usually gray below
- **Black:** high organic matter content could be very poorly drained

Subsoil and Substratum (B and/or C horizons) -- from bottom of surface layer to bottom of pit (look at as a whole), mainly iron compound coatings responsible for color, generally these colors reflect the drainage class of the soil. The more gray colors (redox depletions) and the higher in the soil profile, the wetter the condition of the soil (saturation), which is indicating the seasonal high water table in the soil profile.

- **Yellowish brown or red, no redox depletions (gray mottling due to wetness):** usually well drained condition, oxygen readily available, some gray colors may be due to parent material
 - **Yellowish brown or red, some redox depletions (gray mottling due to wetness)**
 - **Gray, some redox concentrations (brown mottling):** these colors indicate a wet condition, wetter than the above colors; only for poorly drained or very poorly drained soils and should be directly under surface layer.
5. Soil Drainage (page 37) - soil color is a good indicator; based on entire profile. Requires ability to recognize redox depletions (gray soil colors attributable to wetness), measure the depth these colors first appear below the surface, place in appropriate depth class and place the profile into its appropriate natural drainage class.
 - **Excessively drained:** all coarse textures or shallow to bedrock porous profiles on steep slopes; no redoximorphic features (mottles due to wetness)

- **Well drained:** no redoximorphic features (mottles due to wetness) above 40"
 - **Moderately well drained:** redoximorphic features (mottles due to wetness) between 20-40"
 - **Somewhat poorly drained:** redoximorphic features (mottles due to wetness) between 10-20"
 - **Poorly drained:** redoximorphic features (mottles due to wetness) are dominantly directly below the surface layer
 - **Very poorly drained:** low-lying and concave or depressions, very dark or black, thick surface layer (high organic matter), gray subsoil, usually ponded
6. Soil Depth (page 35) - root restricting or affecting basements or septic systems interpretations. Both effective rooting depth and depth to bedrock is required. Criteria for both depth classes are given on exam. Effective rooting depth is the same as depth to bedrock unless a fragipan (hardpan), sustained (permanent) high water table, or significant layer of coarse gravel and sand (greater than 60% gravel) occurs above bedrock. Information sign and/or proctor will provide guidance as to depth to these restrictions.
- **Very deep:** >60"
 - **Deep:** 40-60"
 - **Moderately deep:** 20-40"
 - **Shallow:** 10-20"
 - **Very shallow:** <10"
7. Rock Fragments (page 32) refers to rock fragments in the topsoil layer or on the soil surface, which are greater than 2 mm in size. They affect suitability for lawns. It is determined by visually estimating percentage exposed in profile face and/or on the soil surface, by extracting a sample from topsoil layer, segregating ≤ 2 mm soil material from > 2 mm rock fragment into two distinct piles and estimating relative volume of each. Select appropriate volume range: Less than 15% gravel, 15 – 35% gravel, greater than 35% gravel
8. Soil Texture (page 28) - requires the ability to determine texture by feel on both topsoil and subsoil horizons and place in one of the 5 broad textural groups. USDA textural classes are provided on exam for further guidance. Texture samples may be provided or a depth increment may be designated for extraction of texture samples from the profile.
- Topsoil (A-horizon)**--organic matter may increase feeling of smoothness
- **Coarse:** sand, loamy sand, very gritty, none to very little ribbon, poorly formed stable ball (if at all)
 - **Moderately coarse:** sandy loam, fine sandy loam, gritty, some ribboning, stable ball
 - **Medium:** loam, silt loam, sandy clay loam, maybe gritty or smooth, good ribbon (>2"), (if real gritty then must be sticky also)
 - **Moderately fine:** clay loam, silty clay loam, smooth, excellent ribbon, sticky
 - **Fine:** clay, sandy clay, silty clay, hard to work up, very sticky, long ribbon (>3")
- Subsoil (B horizon)**—see individual textural group information above
- **Coarse**
 - **Moderately coarse**
 - **Medium**
 - **Moderately fine**
 - **Fine**

9. Soil Permeability (page 34) - is required on both the topsoil and subsoil layers and is primarily dependent upon textural group of each of these layers. Textural groups are given on exam and correlated to respective permeability rates. **Caution** - textural group defines permeability unless the soil contains a fragipan (hardpan) or it is formed in a limestone or similar parent material where structure is strongly expressed. Soils with fragipans have slow permeability in the subsoil regardless of texture and soils developed from limestone have moderate permeability although subsoil texture may be in the "fine" textural group.
- **Rapid:** >6.0 in./hr., coarse textures
 - **Moderately rapid:** 2.0-6.0 in./hr., moderately coarse textures
 - **Moderate:** 0.6-2.0 in./hr., medium textures
 - **Moderately slow:** 0.2-0.6 in./hr., moderately fine textures
 - **Slow:** <0.2 in./hr., fine textures or fragipan present
10. Soil Reaction (page 37) - requires the ability to properly use Hellige -Truog or other test kits as demonstrated in training session to determine pH on both topsoil and subsoil layers. More precise information may or may not be provided by proctor for sampling locations. pH should be estimated to the nearest tenth, i.e. 5.7. In most cases, a 1 to 1 1/2 pH range, bracketing the measured pH, is allowed for full credit.
11. Topsoil Color with Munsell Book (page 27) is used as a criterion for determining soil health. Determine by visually comparing a moistened broken ped face (not crushed or rubbed) to the standard soil color charts. Select chip that most closely matches soil and document Hue, Value and Chroma (example 10YR 4/3 or 7.5YR 5/6)

Part C. Soil and Site Interpretations - these responses are based on landscape features and soil property decisions made in the preceding Parts A and B.

Agriculture Suitability

1. Past Soil Erosion (page 45) - The appropriate class is determined by measuring the thickness of existing topsoil layer, A horizon(s) in cropland or O horizon plus A horizon(s) in forested or grass areas, and comparing this measured thickness to the original topsoil thickness given on the information sign. This is determined by subtracting the measured thickness from the original thickness. The answer could be a loss of topsoil due to erosion or an increase of topsoil due to a deposition of soil material. Class criteria are included on the exam.
 - **None to slight:** <3" original soil lost (no mixing of subsoil)
 - **Moderate:** 3-8" original soil lost (some subsoil layer mixed with surface, but still darker than subsoil)
 - **Severe:** >8" original soil lost (surface layer and subsoil layer similar in color)
2. Potential Future Erosion (page 46) - is included to emphasize the significance of future erosion potential on the site if cultivated for agricultural purposes, or otherwise disturbed in timber harvest operations, or in other urban related uses. For this exam it is based strictly on slope class determined in question Part A. #3.
 - **Slight**-- nearly level slopes (0 to 2% or 0 to 3%)
 - **Moderate**-- gently slopes (2 to 5% or 3 to 8%)
 - **Severe**-- strongly sloping to very steep (>5% or >8%)

3. Major limiting factors - can check more than one; limiting to crop growth. Check all that apply, based on previous determinations and information provided on the information sign. Limiting criteria for each factor are given on the exam.
 - **None:** Land Capability Class I
 - **Flooding or ponding:** check if occasional or frequent; will be noted on pit information sign
 - **Slope:** check for any >2%
 - **Past Erosion:** check only if severe
 - **Effective rooting depth:** check for any <40" deep
 - **Drainage:** check when redox depletions, gray mottles due to wetness are found <40" deep, this includes all drainage classes except well and excessively drained
 - **Permeability:** check if rapid or slow
 - **Available water capacity:** check if all coarse textures
 - **Stoniness or rock outcrop:** check if found at soil pit site
4. Land Capability Class (page 47) - while technical criteria for Land Capability Class and subclass as provided in soil survey reports, can be quite complex, only the major Land Capability Class is requested based upon criteria listed on the exam. **Caution** - carefully heed the meaning of the words, "and" and "or" in these criteria.
5. Best Management Practices (page 57) - while there are numerous BMP's available for erosion control and water quality improvement, this question uses drainage class, slope, and Land Cap. Class to identify needed BMP's for the soil and site. Criteria are given on the exam.
 - **Drainage:** would be needed for moderately well drained, or somewhat poorly drained, or poorly drained, or very poorly drained soils, and Land Cap. Class \leq IV.
 - **Irrigation:** would be needed for excessively well drained soils and Land Cap. Class \leq IV.
 - **Contour farming:** gently sloping soils and Land Cap. Class II
 - **Contour stripcropping:** strongly sloping or moderately steep soils and Land Cap. Class \leq IV.
 - **Grassed waterways:** site is located in a drainageway or swale which conveys concentrated runoff and Land Cap. Class \leq IV
 - **No-till Farming:** Land Cap. Class \leq IV
 - **Permanent vegetation:** Land Cap. class V, VI, VII, or VIII
 - **Cover crops:** Land Cap. Class \leq IV
6. Hydric Soil (page 52) - is included to illustrate relationship to poorly drained and very poorly drained soils, as identified in question Part B #5, and possible wetland implications.
7. Prime Farmland (page 52) - based on Land Capability Classification; check if Land Cap. Class is I or II from answer above.

Soil Health (page 66)

8. Munsell Soil Chart Notation – the color of the topsoil layer can be used to infer organic matter content which is related to soil health. The darker the soil color the higher the organic matter content, the better the health of the soil.
 - **Good:** Soil is dark brown or black in color; organic matter is visible in the topsoil layer. Value \leq 3 and chroma \leq 3.
 - **Fair:** Soil is somewhat dark in color; little organic matter is visible in the topsoil layer. Value = 3 or 4 and chroma = 4; Value = 4 and chroma = 3

- **Poor:** Soil is bright to dull colored; no organic matter is visible in the topsoil layer. Value > 4 and chroma > 4
9. Pin Flag – Compaction – the amount of compaction of the topsoil layer is related to soil health and root growth. The more compaction the worst the health of the soil is. Insertion of a pin flag, into the topsoil, can infer the amount of compaction.
- **Good:** Wire flag enters soil easily to a depth below the topsoil layer; unrestricted root penetration.
 - **Fair:** Wire flag enters soil, but requires force to reach a depth below the topsoil layer; root growth restricted.
 - **Poor:** Wire flag enters soil with force, but does not penetrate through the topsoil layer; roots growing laterally.
10. Structure/Aggregation of Topsoil – the amount of aggregation/structure of the topsoil layer is related to soil health. The more aggregation and fine roots in the layer the better the soil health.
- **Good:** Soil is granular, soft and crumbly, held together with many fine roots. Looks like cottage cheese.
 - **Fair:** Soil is blocky and firmer with some fine roots.
 - **Poor:** Soil is single grain, massive or platy and hard to break apart. It has few or no fine roots.
11. Nutrient Management (page 64) - requires basic knowledge of types of crops (legumes vs. non legumes), soil test results, and when nutrients as well as lime should be applied. Legume crops such as soybeans, alfalfa, and clovers do not require nitrogen. All other crops such as corn, small grains, and grasses for hay or pasture require supplemental nitrogen for optimum productivity. Recommendations are given for the crop indicated on information sign irrespective of what might actually be growing on the site. Soil tests for magnesium, phosphorus, and potassium will be given on information sign as VL = Very low, L = Low, M = Medium, H = High or VH = Very high. These nutrients are needed or recommended if the soil test is VL, L or M. Lime is recommended if the pH of the topsoil layer is less than 6.5.
- **Lime:** check if pH <6.5
 - **Nitrogen:** check if anything other than legumes
 - **Phosphorus (Phosphate):** check if not high or very high
 - **Potassium (Potash):** check if not high or very high
 - **Magnesium:** check if not high or very high

Urban Suitability

12. Suitability for Septic Tank Absorption Fields - requires the ability to apply soil properties, determined from exposed soil profile and site in previous parts of the exam, to arrive at a suitability rating for this use. Soil features include slope, flooding, depth to bedrock, depth to redox features (wetness), and subsoil permeability. The most limiting level of any of the five soil properties dictates the overall degree of suitability. Example, if the site were nearly level, no flooding, with bedrock > 72 inches, depth to redox depletions (gray colors/wetness) in the 40 - 72 inch range and slow permeability, the suitability would be SEVERE because of the slow permeability. **Caution** - since many soil pits, for safety purposes are seldom excavated to a depth of 72 inches or more, it is presumed that conditions evident at the bottom of the exposed profile, i.e. at 60 inches for example, also represent conditions at > 72 inches unless specific guidance to the contrary is provided on the information sign or by the proctor.

13. Suitability for Lawns - is similar in format to suitability for septic tank absorption fields except that key soil properties are different as are some criteria depth ranges, i.e. depth to redox depletions (wetness). This suitability rating also requires the estimation of % rock fragment (gravel) by volume in the surface layer. Representative samples of varying gravel contents should be carefully evaluated during training sessions for reference. Soil properties include slope, soil surface texture, rock fragments in or on surface, past erosion, and, depth to redox depletions (gray colors/wetness)
14. Suitability for dwellings with basements - is similar in format to other suitability questions except soil features and criteria change. Again, soil features determined in earlier portion of exam are used to arrive at an overall suitability. Soil features include slope, flooding, depth to bedrock, depth to redox depletions (gray colors/wetness).

Wildlife Suitability

15. Suitability for Wildlife habitat – based on the drainage class of the soil.

Section II. Soil Survey Use (page 53) - this portion of exam is intended to expose the participant to the soil survey report and how to find soils information contained in it. The participant will be given a real-life scenario and a soils map with a legend of the mapping units. They will be required to use the report to find the answers to questions related to the soil map. Some questions may be related to soil interpretations others to specific soil properties. In most cases the questions will be the same across the county or state but responses will change depending upon the soil survey area. An example of a scenario is: *“You have just purchased a piece of property in ??????? County. The following is the soils map and soil legend for the property you just purchased. You’re unsure of what you want to do. You may want to develop it, do some farming, or change some areas to attract wildlife. Using the soil survey, answer the following questions to help you decide where the most appropriate places are to do these things on your property.”*

NOTE: Although the “official” soil surveys for Maryland are all on the NRCS Web Soil Survey internet site (<http://websoilsurvey.nrcs.usda.gov/app/>), for the contest, soil survey information reports will be provided to the students for answering questions.

Section III. Fifth Issue as Related to Soils - this portion of the exam consists of general knowledge questions of the current Fifth Issue subject as it is related to soils. The questions are usually taken from reference materials posted on the State Envirothon web page or from handouts provided by the soil instructors.