Maryland Envirothon SOILS Exam Guidance Information

(revised 2024)

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 points)

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

Part B – Soil Profile Features (36 points)

1) Major Soil Horizons (4 points)
2) Current Topsoil Thickness (2 points)
3) Topsoil Structure (1 point)
4) Soil Color – Topsoil and Subsoil/Substratum (4 points)
5) Soil Drainage (6 points)
6) Soil Depth (4 points)
7) Rock Fragments (1 point)
8) Soil Texture (6 points) (includes tie breaker question)
9) Soil Permeability (4 points)
10) Soil Reaction (pH) (2 points)
11) Topsoil Color with Munsell Color Book (1 point)
12) Compaction (1 point)

Part C – Soil and Site Interpretations (32 points)

Agricultural Suitability

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

Soil Health

8) Soil Color Interpretation (1 point)

9) Compaction Interpretation (1 point)
10) Structure Interpretation (1 point)
11) Nutrient Management Needs (5 points)

Wildlife Suitability

12) Wildlife habitat

Urban Suitability

13) Suitability for Septic Tank Absorption Fields (2 points)
14) Suitability for Lawns (2 points)
15) Suitability for Dwellings with Basements (2 points)

Section II: Soil Survey Use (24 points)

Training Scorecard
Soils & Land Use Station

Section I: Landscape and Soil Profile Features (76 points total)

Part A – Landscape Features (8 points total)

Consider the immediate area around the soil pit, mark the box to select your answer.

1. Position (2 points)

□ Upland
□ Upland depression
□ Drainageway
□ Terrace
□ Floodplain

2. Parent Material (2 points)

□ Residuum
□ Colluvium
□ Recent alluvium
□ Old alluvium
□ Coastal Plain sediments

3. Slope Characteristics (2 points)

Slope Class	Piedmont-Appalachian	Coastal Plain	Letter Designation
□ Nearly level	0-3%	0-2%	A
□ Gently sloping	3-8%	2-5%	B
□ Strongly sloping	8-15%	5-10%	C
□ Moderately steep	15-25%	10-15%	D
□ Steep	25-50%	15-25%	E
□ Very steep	50+%	25+%	F

4. Surface Stoniness or Rockiness (2 points)

□ None
□ Very stony (less than 30 ft. apart)
□ Rock outcrop (2 exposures within 100 ft)

Part B – Soil Profile Features (36 points total)

Examine the soil profile in the pit and the soil samples provided, mark the box to select your answer, or write your answer in the space provided.

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1. Check the major soil horizons visible in this profile (check all that are present): (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 points)

□ 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 colors due to wetness)
□ Yellowish brown or red, some redox depletions (gray colors due to wetness)
□ Dominantly gray immediately below the topsoil, with redox concentrations (brownish red accumulations of iron)

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
□ 10 to less than 20 inches
□ 20 to less than 40 inches
□ 40 to less than 72 inches
□ no redox depletions to 72 inches

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. Depth to Bedrock

□ Very shallow (less than 10 inches)
□ Shallow (10 to less than 20 inches)
□ Moderately deep (20 to less than 40 inches)
□ Deep (40 to less than 60 inches)
□ Very deep (60 inches or greater)

b. Effective Rooting Depth

□ Very shallow (less than 10 inches)
□ Shallow (10 to less than 20 inches)
□ Moderately deep (20 to less than 40 inches)
□ Deep (40 to less than 60 inches)
□ Very deep (60 inches or greater)

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

□ Less than 15% gravel
□ 15-35% gravel
□ Greater than 35% gravel OR very stony or rock outcrop

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 (coarse texture)
□ Moderately rapid, 2.0-6.0 in/hr (moderately coarse texture)
□ Moderate, 0.6-2.0 in/hr (medium texture)
□ Moderately slow, 0.2-0.6 in/hr (moderately fine texture)
□ Slow, <0.2 in/hr (fine texture)

b. Subsoil – B Horizon

□ Rapid, > 6.0 in/hr (coarse texture)
□ Moderately rapid, 2.0-6.0 in/hr (moderately coarse texture)
□ Moderate, 0.6-2.0 in/hr (medium texture)
□ Moderately slow, 0.2-0.6 in/hr (moderately fine texture)
□ Slow, <0.2 in/hr (fine texture or fragipan is present)

10. Soil Reaction (2 points)
Using the pH test kit, what is the pH of the soil in the sample box? _____

11. Topsoil Color (1 point)
Using the Munsell Soil Color Book, what is the color of the soil in the sample box?

_____
Hue **Value / Chroma**

12. Compaction (1 point)
Use the wire flag to determine if the topsoil layer is compacted in the designated area

□ Little to no compaction (good). Wire flag enters soil easily to a depth of 6 inches or more with little or no resistance
□ Some compaction (fair). Wire flag penetrates 4-6 inches into the soil with a lot of wiggling and moderate force
□ Compacted (poor). Wire flag penetrates 2-4 inches into the soil with force

Part C – Soil and Site Interpretations (32 points total)

Use your determinations from Landscape and Soil Profile Features (Parts A and B) to answer questions about soil and site interpretations. Mark the box to select your answer.

Agricultural Suitability

1. Past Soil Erosion (2 points)

Past Soil Erosion = Original topsoil thickness (from information sign) minus current topsoil thickness

□ Slight (less than 3 inches of the original soil lost)
□ Moderate (≥3-8 inches of the original soil lost)
□ Severe (greater than 8 inches 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 points)

□ None
□ Flooding or ponding (Occasional or Frequent)
□ Slope (Gently sloping or greater)
□ Past erosion (Severe)
□ Effective rooting depth (less than 40 inches deep)
□ Drainage (less than 40 inches to redox depletions, gray colors due to wetness)
□ Coarse textures (Topsoil and Subsoil)
□ Very stony or Rock outcrop

4. Land Capability Class (3 points)

□	I	No limiting factors and nearly level
□	II	Gently sloping, or Moderately well drained, or Moderately deep effective rooting depth
□	III	Strongly sloping, or Somewhat poorly drained, or Poorly drained, or Shallow effective rooting depth, or Coarse textures
□	IV	Moderately steep, or Very poorly drained, or Occasionally flooded
□	V	Nearly level and very stony surface or rock outcrop, or frequently flooded
□	VI	Steep, or Gently sloping through steep and very stony surface or rock outcrop
□	VII	Very steep, or Very shallow effective rooting depth
□	VIII	Swamp, tidal marsh, coastal beach, areas with >90% rock outcrop, or urban land

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

□	Drainage	Moderately well, Somewhat poorly, Poorly, or Very poorly drained AND Land Capability Class less than or equivalent to IV
□	Irrigation	Excessively well drained or Effective rooting depth less than 20 inches AND Land Capability Class less than or equivalent to IV
□	Contour farming	Gently sloping AND Land Capability Class equivalent to II, III, or IV
□	Contour strip-cropping	Strongly sloping or Moderately steep AND Land Capability Class less than or equivalent to IV
□	Grassed waterway	Drainageway 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
□	Cover crops	Land Capability Class less than or equivalent to IV
□	Permanent vegetation	Land Capability Class V, VI, VII, or VIII

6. Is this a Hydric soil, i.e., poorly 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 color, it indicates this soil's health is: (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; Any color that doesn't meet criteria for Good or Poor
□ Poor – Soil is bright to dull colored, no organic matter is visible in the topsoil layer; Value > 4 AND Chroma >4

9. Looking at the compaction in the topsoil, it indicates this soil's health is: (1 point)

□ Good – Little to no compaction, root growth unrestricted
□ Fair – Some compaction, root growth somewhat restricted
□ Poor – Compacted, root growth restricted, roots may be growing laterally

10. Looking at the structure/aggregation of the topsoil layer, it indicates this soil's health is: (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 based on the soil test results on the information sign.

Crop to be grown (from information sign): _____

Soil Test Results (from information sign):

pH _____

Magnesium _____ Phosphorus _____ Potassium _____

Mark all that are needed: (5 points)

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

Wildlife Suitability

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

□ Wetland wildlife
□ Upland wildlife

Urban Suitability

13. Suitability for Septic Tank Absorption Fields: (2 points)
Check the appropriate suitability based on the most limiting soil property

	Soil Properties					Suitability: (check one)
More Limiting ↓	**Slope**	**Flooding**	**Depth to Bedrock**	**Depth to Redox Features**	**Subsoil Permeability**	
	Nearly level, gently sloping	None	> 72 inches	> 72 inches	Moderately rapid, moderate	□ Slight
	Strongly sloping	Rare	40-72 inches	40-72 inches	Moderately slow	□ Moderate
	Moderately steep to very steep	Frequent, Occasional	< 40 inches	< 40 inches	Slow, Rapid	□ Severe

14. Suitability for Lawns: (2 points)
Check the appropriate suitability based on the most limiting soil property

	Soil Properties					Suitability: (check one)
More Limiting ↓	**Slope**	**Topsoil Texture**	**Rock Fragments in/on Surface**	**Past Erosion**	**Depth to Redox Depletions**	
	Nearly level, gently sloping	Moderately coarse, Medium	< 15% gravel	Slight	> 24 inches	□ Slight
	Strongly sloping	Moderately Fine, Coarse	15-35% gravel	Moderate	12-24 inches	□ Moderate
	Moderately steep to very steep	Fine	> 35% gravel, or Very stony, or Rock outcrop	Severe	< 12 inches	□ Severe

15. Suitability for Dwellings with Basements: (2 points)
Check the appropriate suitability based on the most limiting soil property

	Soil Properties				Suitability: (check one)
More Limiting ↓	**Slope**	**Flooding**	**Depth to Redox Depletions**	**Depth to Bedrock**	
	Nearly level, gently sloping	None	> 72 inches	> 72 inches	□ Slight
	Strongly sloping	---	40-72 inches	40-72 inches	□ Moderate
	Moderately steep to very steep	Rare, Frequent, Occasional	< 40 inches	< 40 inches	□ Severe

Section II: Soil Survey Use (24 points total)

Using Web Soil Survey (WSS)

Use Web Soil Survey to answer questions about specific soil types on a property. Questions will be about specific soil properties and suitability of the soil for various land uses.

Link to Web Soil Survey:
https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm?TARGET_APP=Web_Soil_Survey_application_hujyifhbzlyd04iqbovjbnmj

Soils & Land Use Exam Guidance

(page number refers to the topic discussion in the 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. The area to be evaluated is provided on the information sign and by the station proctor.

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

1. Position (p. 11) – Requires understanding of landscape positions and the ability to differentiate them in the field

- □ Upland – Usually level, rolling, or complex slopes; Unaffected by stream activity
- □ Upland depression– Concave landforms; Surface water is slowed or sometimes ponded and may have a thick dark surface because of wetness. Some depressions on the Coastal Plain are Delmarva Bays or "whale wallows".
- □ Drainageway – At the head of drainageways the land slopes towards the site from at least three directions directing surface water flow towards the site; Water flowing over the site may only be present during or following a storm and may not be confined to a channel; Soil may have a thick topsoil layer due to the accumulation of depositional materials.
- □ Terrace – Above zone of current flooding; Soil usually has gravel lines or coarse sands in the profile indicating sorting by water; Parent material is older alluvium and shows more soil development (i.e., higher clay content in the subsoil than in the topsoil layer). In the Piedmont and Appalachian region, terraces have rock fragments with rounded edges
- □ Floodplain – Area near a stream that floods when stream overtops its banks. Information sign will indicate flooding frequency, which can be none, rare, occasional, or frequent; Floodplains have a flooding frequency of rare, occasional or frequent. Parent material is recent alluvium.

2. Parent Material (p. 8) – Requires knowledge of the characteristics of five major soil parent materials and the ability to differentiate them in the field. Soil profiles may contain multiple parent materials.

- □ Residuum – soils formed in place from the weathering of bedrock (bedrock may not be visible in the exposed soil profile
- □ Colluvium – material that has moved downslope by gravity and water; Generally located on lower parts of slopes; Soil material and angular to subrounded coarse fragments are unsorted and disoriented. In the Piedmont and Appalachian region, it is common to find colluvium parent materials over residuum; in this situation, check both parent materials on the scorecard.
- □ Recent alluvium – Fresh or recent deposits moved by water; Occurs in floodplain positions or an upland depression with ≥20 inches depositional material; Soils formed in recent alluvium tend to have poorly developed soil profiles
- □ Old alluvium – Rounded, water-worn coarse fragments in the soil profile; Occurs on stream terraces; Soils tend to have a developed profile (i.e., higher clay content in the subsoil relative to the topsoil layer), never or rarely flood, and no fresh mineral deposits
- □ Coastal Plain sediments – Series of water-deposited sediments left by previous geologic events occurring on the Coastal Plain region; May have a wind-blown silty cap (loess) over the water-deposited sediments

3. Slope Characteristics (p. 13) – Requires the ability to use clinometers or Abney levels to determine slope percentage and identify the appropriate slope class based on the physiographic province of the state. Guidance to the appropriate physiographic providence will be provided in training and/or by the site proctor.

Slope Class	Piedmont-Appalachian	Coastal Plain	Soil Survey Letter Designation
Nearly level	0-3%	0-2%	A
Gently sloping	3-8%	2-5%	B
Strongly sloping	8-15%	5-10%	C
Moderately steep	15-25%	10-15%	D
Steep	25-50%	15-25%	E
Very steep	>50%	>25%	F

4. Surface Stoniness or Rockiness (p. 32) – Must be able to recognize stoniness or rock outcrops and assess quantities present at the site to determine significance

□ None – Less than listed below

□ Very stony (less than 30 ft. apart) – Stones exposed on soil surface are ≥10 inches in diameter and are less than 30 feet apart within the designated area to be judged; Does not include gravel or cobbles; Tillage of intertilled crops impractical, hay or pasture is possible; Land Capability Class of V or greater

□ Rock outcrop (2 exposures within 100 ft) – Two or more bedrock exposures less than 100 feet apart within the designated area to be judged; Tillage of intertilled crops impractical, hay or pasture is possible; Land Capability Class of V or greater; Commonly found in limestone valleys

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

1. Major Soil Horizons (p. 19) – Requires knowledge of characteristics of major soil horizons and the ability to differentiate them in the field. Students will be asked to identify the major soil horizons visible in the soil profile. Possible options are O, A, E, B, C, R. Soil profiles may contain multiple major soil horizons.

2. Current Topsoil Thickness – Requires measuring the thickness of the topsoil horizon(s) to the nearest inch. In crop land, the topsoil is the A horizon(s). In forested or grass areas, the topsoil includes the O horizon (if present) and any A horizon(s).

3. Topsoil Structure (p. 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 box with “single grain, massive, or platy” but if entire layer is granular check the “granular” box. Type of structure and strength of expression are used as a criterion for soil health.

□ Granular

□ Blocky

□ Single grain, massive, or platy

4. Soil Color (p. 23) – Soil color can be influenced by organic matter content, drainage condition, parent material, and erosion condition. Requires assessment of the moist color of freshly broken, uncrushed, unsmoothed peds from the topsoil (A horizon) and subsoil and substratum (B and/or C Horizons).

a. Topsoil (A Horizon) – Identify the dominant color of the soil when moist, uncrushed.

- □ Brown or dark brown – typical topsoil color; darker color indicates increased organic matter
- □ Reddish brown – could indicate an eroded soil surface and a subsoil that is closer to the surface; colors may be inherited from the soil parent material
- □ Gray or grayish brown – usually indicates poor drainage condition, usually has a gray subsoil below
- □ Black – indicates high organic matter content; soil may be very poorly drained; typical Munsell color value ≤3 and chroma = 1

b. Subsoil and Substratum (B and/or C Horizon) – Iron compounds are usually responsible for subsoil and substratum colors. Generally, these colors reflect the drainage class of the soil. Gray colors (redox depletions) indicate the soil is saturated for periods of time and iron coatings have been removed from the soil. The presence of gray colors (redox depletions) and the depth in the profile indicates the seasonal high water table of the soil.

- □ Yellowish brown or red, no redox depletions (gray colors due to wetness) – Usually well drained condition, oxygen is readily available; some gray colors may be due to parent material
- □ Yellowish brown or red, some redox depletions (gray colors due to wetness)
- □ Dominantly gray immediately below the topsoil, with redox concentrations (brown, red, or orange colors due to accumulations of iron) – These colors indicate wetter conditions than the above colors; describes poorly drained or very poorly drained soils; dominantly gray colors start directly below the surface layer.

5. Soil Drainage (p. 37) – Requires the ability to recognize redox depletions (gray soil colors due to wetness), measure the depth the colors first appear below the surface, identify the appropriate depth class, and identify the appropriate natural drainage class. The exact depth to redox depletions may be needed for urban interpretations.

a. Depth to Redox Depletions – Identify the appropriate depth class describing the depth where redox depletions first appear below the surface.

- □ Directly under a thick, black colored surface
- □ 0 to less than 10 inches
- □ 10 to less than 20 inches
- □ 20 to less than 40 inches
- □ 40 to less than 72 inches
- □ no redox depletions to 72 inches

b. Natural Soil Drainage Class

□ Excessively well drained – No redox depletions (gray colors due to wetness) above 40 inches AND all coarse textured soils or soils that are shallow to bedrock with a porous profile (>35% rock fragments in the subsoil and/or substratum) on steep slopes

□ Well drained – no redox depletions (gray colors due to wetness) above 40 inches

□ Moderately well drained – redox depletions (gray colors due to wetness) between 20 and 40 inches

□ Somewhat poorly drained - redox depletions (gray colors due to wetness) between 10 and 20 inches

□ Poorly drained – redox depletions (gray colors due to wetness) are directly below the surface layer

□ Very poorly drained – very dark or black, thick surface layer indicating high organic matter, gray subsoil soil immediately below the dark surface layer; Site is usually ponded for part of the year

6. Soil Depth (p. 35) – Requires the ability to identify bedrock and/or root restricting layers and the depth that they occur. Depth to root restrictions and bedrock can impact available rooting depth for crops and suitability for basements and septic systems.

a. Depth to Bedrock – Depth to bedrock. This includes hard, unweathered bedrock and bedrock that has started to weather and fracture but is still difficult to dig with a shovel, restricts root growth, and has limited water holding capacity.

□ Very shallow (less than 10 inches)

□ Shallow (10 to less than 20 inches)

□ Moderately deep (20 to less than 40 inches)

□ Deep (40 to less than 60 inches)

□ Very deep (60 inches or greater)

b. Effective Rooting Depth – Identify the depth to a layer that restricts root growth, such as bedrock, fragipan (hardpan), permanent high water table, or significant layer of coarse gravel and sand (>60% gravel). The information sign will provide guidance on depth to these restrictions. Sometimes roots can still be found growing in bedrock fractures, along prism faces of fragipans, below the designated permanent water table, or in layers of coarse gravel and sand. For this question, ignore these roots (if they are present), the effective rooting depth is the depth of the top of the root restricting layer.

□ Very shallow (less than 10 inches)

□ Shallow (10 to less than 20 inches)

□ Moderately deep (20 to less than 40 inches)

□ Deep (40 to less than 60 inches)

□ Very deep (60 inches or greater)

7. Rock Fragments (p. 32) – Refers to rock fragments in the topsoil layer or on the soil surface. Rock fragments are greater than 2mm diameter. Requires visually estimating the percentage of rock fragments exposed in the soil profile face and/or on the surface and selecting the appropriate volume range. If site is very stony or has rock outcrops, that would also be indicated in Question 4 of Part A. Representative samples of varying gravel contents will be available for reference during the training session.

□ Less than 15% gravel
□ 15-35% gravel
□ Greater than 35% gravel OR very stony OR rock outcrop

8. Soil Texture (p. 28) – Requires the ability to determine soil texture by feel on both topsoil and subsoil horizons and place in one of the five broad textural groups. USDA texture classes are provided on the exam for further guidance. Texture samples may be provided, or a depth increment may be designated for extraction of textures samples. Organic matter in topsoil horizons may increase feeling of smoothness. Percent clay in the subsoil is used as a tie breaker question if needed.

□ Coarse – sandy, 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

9. Soil Permeability (p. 34) – For the MD Envirothon, permeability is primarily dependent upon the textural group. Texture groups are determined in Question 8 or Part B and the correlation to permeability classes is given on the exam. Permeability is determined for both the topsoil and subsoil horizons.

Caution: Texture 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. Soils developed from limestone have moderate permeability in the subsoil even though the subsoil texture is fine or moderately fine.

□ 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, or fine or moderately fine textures in limestone soils
□ Moderately slow, 0.2-0.6 in/hr – Moderately fine textures
□ Slow, <0.2 in/hr – Fine textures, or fragipan is present

10. Soil Reaction (p. 37) – Requires the ability to properly use the Hellige-Truog or other test kits as demonstrated in the training session to determine pH on a soil sample. The proctor will give instructions on the sample to be used for testing pH. pH should be estimated to the nearest tenth (i.e., 5.7). In most cases, a 1 to 1.5 pH unit range is allowed for full credit.

11. Topsoil Color with Munsell Soil Color Book (p. 27) – Visually determine the color of the topsoil by using the standardized soil color charts. Soil color should be determined on a moistened freshly broken ped face (not crushed or rubbed samples). Select the chip that most closely matches the soil and record the Hue, Value, and Chroma (e.g., 10YR 4/3 or 7.5YR 5/6). Topsoil color is used as a criteria for evaluating soil health.

12. Compaction – Use a wire flag to infer compaction within the topsoil. The degree of compaction in the topsoil is related to soil health and plant growth. More compaction typically indicates poor soil health. There will be an area designated at the site to complete this test. In areas with rock fragments in the surface horizon or dense roots (forested area), it may be difficult to evaluate compaction with just the wire flag. Make sure to trying to insert the wire flag multiple times. If rocks and/or roots are interfering, evaluate compaction by looking at the root growth patterns and structure in the exposed soil profile.

- □ Little to no compaction (good) – Wire flag enters soil easily to a depth of 6 inches or more with little or no resistance
- □ Some compaction (fair) – Wire flag penetrates 4-6 inches into the soil with a lot of wiggling and moderate force
- □ Compacted (poor) – Wire flag penetrates 2-4 inches into the soil with force

Part C: Soil and Site Interpretations – These responses are based on the landscape features and soil properties observed and measured in Parts A and B.

Agricultural Suitability

1. Past Soil Erosion (p. 45) – The appropriate class is determined by measuring the thickness of the existing topsoil layer (Part B, Question 2) and comparing it to the original topsoil thickness given on the information sign. The difference between the original thickness and the current measured thickness is the amount of soil lost due to erosion (or gained if current topsoil thickness, is greater than original thickness, this would be due to deposition of soil material. Class criteria are included on the exam.

- □ Slight – less than 3 inches of the original soil lost (no mixing of subsoil into the topsoil layer)
- □ Moderate – 3-8 inches of the original soil lost (some subsoil may be mixed into surface, but the topsoil is still darker than the subsoil)
- □ Severe – greater than 8 inches of the original soil lost (surface layer and subsoil layer are similar in color)

2. Potential Future Erosion (p. 46) – Emphasizes the significance of future erosion potential if the site is cultivated for agricultural purposes or disturbed in timber harvest operations or urban uses. For the MD Envirothon, potential future erosion is based strictly on slope class (Part A, Question 3).

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

3. Major Limiting Factors – Identify the major factors limiting crop growth. Check all that apply, based on information determined earlier and information provided on the information sign. Criteria for each major limiting factor is given on the exam.

- □ None – No major limiting factors, all other options should be blank; Land Capability Class I
- □ Flooding or ponding – Limiting factor when flooding or ponding is occasional or frequent; Flooding and ponding frequency will be noted on the information sign
- □ Slope – Limiting factor when gently sloping or steeper (Part A, Question 3)
- □ Past Erosion – Limiting factor when past erosion is severe (Part C, Question 1)
- □ Effective rooting depth – Limiting factor when effective rooting depth is less than 40 inches (Part B, Question 6a)
- □ Drainage – Limiting factor when redox depletions (gray colors due to wetness) occur less than 40 inches deep (Part B, Question 5a); This includes very poorly, poorly, somewhat poorly, and moderately well drained soils (Part B, Question 5b)
- □ Coarse Textures – Limiting factor when the topsoil and subsoil textures are both coarse (Part B, Question 8a and 8b); Coarse textures have rapid permeability and low or very low water holding capacity
- □ Very stony or Rock outcrop – Limiting factor if site is very stony or has rock outcrop (Part A, Question 4)

4. Land Capability Class (p. 47) – The technical criteria for Land Capability Class and Subclass are provided in soil survey reports and can be quite complex. For the MD Envirothon, only the major Land Capability Class is required and is determined based on the criteria listed on the exam. Caution: carefully follow all the criteria, paying close attention to the use of “and” and “or”.

- □ I – No major limiting factors and nearly level
- □ II – Gently sloping, or moderately well drained, or moderately deep effective rooting depth
- □ III – Strongly sloping, or somewhat poorly drained, or poorly drained, or shallow effective rooting depth, or coarse textures
- □ IV – Moderately steep, or very poorly drained, or occasionally flooded
- □ V – Nearly level and very stony or rock outcrop, or frequently flooded
- □ VI – Steep, or gently sloping through steep and very stony or rock outcrop
- □ VII – Very steep, or very shallow effective rooting depth
- □ VIII – Swamp, tidal marsh, coastal beach, areas with >90% rock outcrop, or urban land

5. Best Management Practices (p. 57) – There are many BMPs that can be used to control erosion and improve water quality. For this question, use drainage class (Part B, Question 5b), slope (Part A, Question 3), and Land Capability Class (Part C, Question 4) to select the needed BMPs for the soil and site. Criteria are given on the exam. Check all that apply.

- □ Drainage – Needed for moderately well, somewhat poorly, poorly, or very poorly drained soils with a Land Capability Class ≤IV
- □ Irrigation – Needed for excessively well drained soils with a Land Capability Class ≤IV or soils with an effective rooting depth less than 20 inches and Land Capability Class ≤IV
- □ Contour Farming – Needed at sites that are gently sloping and are Land Capability Class II, III, or IV
- □ Contour strip-cropping – Needed at sites that are strongly sloping or moderately steep and have a Land Capability Class ≤IV
- □ Grassed waterway – Needed at sites located in a drainageway which conveys concentrated surface water runoff and have a Land Capability Class ≤IV
- □ No-till farming – Needed at sites with a Land Capability Class ≤IV
- □ Cover crops – Needed at sites with a Land Capability Class ≤IV
- □ Permanent vegetation – Needed at sites with Land Capability Class V, VI, VII, or VIII

6. Hydric Soil (p. 52) – Hydric soils are soils that form in wetlands and are poorly and very poorly drained. Based on the drainage class of the soil (Part B, Question 5b) determine if the soil is hydric.

7. Prime Farmland (p. 53) – Prime Farmland identifies land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. For the MD Envirothon, Prime Farmland is based on Land Capability Class (Part C, Question 4). Sites with Land Capability Class I or II are Prime Farmland.

Soil Health (p. 66)

8. Soil Health Indicated by Soil Color – The color of the topsoil layer can be used to infer organic matter content which is related to soil health. Healthy soils are dark in color and rich in organic matter. Use the Munsell Color Notation (Part B, Question 11) to indicate the soil health.

- □ 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; Any color that doesn't meet criteria for Good or Poor
- □ Poor – Soil is bright to dull colored, no organic matter is visible in the topsoil layer; Value > 4 AND Chroma >4

9. Soil Health Indicated by Compaction – Compaction of the topsoil layer indicates poor soil health and root growth. Evaluate how easily a wire flag can be inserted into the soil to infer the amount of compaction at the site (Part B, Question 12). Note: if the soil has rock fragments or dense roots (forested area) that prevents using the wire flag, look at the root growth patterns and soil structure in the exposed soil profile to evaluate compaction.

- □ Good – Little to no compaction, root growth unrestricted
- □ Fair – Some compaction, root growth somewhat restricted
- □ Poor – Compacted, root growth restricted, roots may be growing laterally

10. Soil Health Indicated by Topsoil Structure – Soil structure or aggregation is the result of biological, chemical, and physical processes in the soil or occurring at the surface. The type of structure and how well the peds or aggregates hold together is related to soil health. Good soil structure is important for water and air movement and root growth. Assess the soil health based on the structure of the topsoil horizon (Part B, Question 3).

□ 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 Needs (p. 64) – Requires basic knowledge of types of crops (legumes vs. non-legumes), soil test results, and when nutrients and lime should be applied. The type of crop to be planted at the site and the soil test results will be indicated on the information sign. Disregard what might actually be growing on the site. Legume crops such as soybeans, alfalfa, and clovers are capable of fixing their own nitrogen, so they do not require the addition of nitrogen fertilizer. All other crops, such as corn, small grains, and grasses for hay or pasture require supplemental nitrogen for optimum productivity. Soil test levels for magnesium, phosphorus, and potassium will be reported as VL = Very Low, L = Low, M = Medium, H = High, or VH = Very High. These nutrients are 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. For this question, use the pH test values given on the information sign, it may be different than what was measured. Check all of the soil amendments that are needed.

□ Lime – Needed if pH < 6.5

□ Nitrogen – Needed for all non-legume crops

□ Magnesium – Needed if soil test levels are VL, L, or M

□ Phosphorus (phosphate) – Needed if soil test levels are VL, L, or M

□ Potassium (potash) – Needed if soil test levels are VL, L, or M

Wildlife Suitability

12. Suitability for Wildlife Habitat – Determine the wildlife habitat that would be most suitable for the site based on the soil drainage class (Part B, Question 5b).

□ Wetland wildlife – best suited on very poorly and poorly drained soils (hydric soils)

□ Upland wildlife – best suited on somewhat poorly, moderately well, well, and excessively well drained soils

Urban Suitability

13. Suitability for Septic Tank Absorption Fields – Requires the ability to apply site and soil properties to determine the suitability of the site for a septic tank absorption field. Properties to consider are slope (Part A, Question 3), flooding (information sign), depth to bedrock (Part B, Question 6b), depth to redox depletions (Part B, Question 5a), and subsoil permeability (Part B, Question 9b). The most limiting level of any of the soil properties dictates the overall suitability.

Caution: Since the soil pits often cannot be dug to 72 inches for safety, assume the conditions observed at the bottom of the exposed profile also represent conditions below 72 inches unless given specific guidance on the information sign and/or from the proctor.

14. Suitability for Lawns – Requires the ability to apply site and soil properties to determine the suitability of the site for a residential lawn. Properties to consider are slope (Part A, Question 3), topsoil texture (Part B, Question 8a), rock fragments in/on the surface (Part B, Question 7), past erosion (Part C, Question 1), depth to redox depletions (Part B, Question 5a). The most limiting level of any of the soil properties dictates the overall suitability.

15. Suitability for Dwellings with Basements – Requires the ability to apply site and soil properties to determine the suitability of the site for a septic tank absorption field. Properties to consider are slope (Part A, Question 3), flooding (information sign), depth to redox depletions (Part B, Question 5a), and depth to bedrock (Part B, Question 6b). The most limiting level of any of the soil properties dictates the overall suitability.

Section II: Soil Survey Use (p. 53)

This portion of the exam is intended to expose the participant to the soil survey report and how to find information. Participants will use Web Soil Survey or hard-copy soil survey reports. The participants are given a scenario and a list of the soil map units at a site. They will use the soil survey to answer the questions about the soil map units at the site. The questions may be related to soil interpretations or specific soil properties.

Link to Web Soil Survey:
https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm?TARGET_APP=Web_Soil_Survey_application_hujyifhbzlyd04iqbovjbnmj