2021 Massachusetts Envirothon
Soils Questions for the Petersham Natural Resource Challenge
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(CDC and State COVID-19 guidelines for group gatherings, wearing of face coverings, and social distancing should be followed)

Your team has been hired as the school's environmental consultant to review the adequacy of its site plan for obtaining the required approvals from the town's planning board, health department and conservation commission in order to build a new school. Prior to submitting its site plan, it is your job to identify any environmental or human health issues concerning the proposed location of the school building and its supporting services.

Using the GIS mapping application, suggested resources, and any other available resources, answer the following questions as a part of your assessment and recommendations.

QUESTION #1
(15 pts)

Most of the proposed school complex is on soils mapped as a Woodbridge-Paxton association, 3 to 15 percent slopes, extremely stony. Based on the soil map, what would be some of the soil-based limitations that may be encountered in building the structure, septic system, and grass fields on this site? What soil properties affect these soil limitations?

- **Possible Resources:**
  - Provided Envirothon Map
  - Web soil survey: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
  - Soil Web: https://casoilresource.lawr.ucdavis.edu/gmap/

- **Scoring: 1 out of 15 rating, with one being the least amount of knowledge and 15 the greatest**
  - 1-3 points – no answer or incorrect answer
  - 4-6 points – some knowledge - identify 1 limitation, no mention of soil properties
  - 7-9 points – average - identify 1 or 2 limitation with at least one soil property to support

- 10-12 points – above average - identify 2 or more limitations with at least one soil property to support each
- 13-15 points – lots of knowledge - identify 3 or more limitations with multiple soil properties to support each

QUESTION #2
(20 pts)

The following two soil descriptions represent soils that would be found at the school complex site. Use these descriptions to answer the following questions.

- Would you anticipate finding a seasonal high water table within 100 cm of the soil surface in either site? (5 pts)
- At what depth? (5 pts)
- Which site would have a higher water infiltration rate and water holding capacity and why? (5 pts)
- Incorporate these answers into your assessment of the proposed complex. (5 pts)

Site 1 – Septic system site:

Oe—0 to 5 centimeters (0.0 to 2.0 inches); black (10YR 2/1) moderately decomposed plant material; very friable; many very fine to fine roots throughout; pH 4.8, abrupt wavy boundary.

A—5 to 12 centimeters (2.0 to 4.7 inches); very dark brown (7.5YR 2.5/3) cobbly fine sandy loam; weak medium subangular blocky structure; friable; many very fine and coarse roots throughout; pH 4.8, clear broken boundary.

Bw1—12 to 43 centimeters (4.7 to 16.9 inches); dark yellowish brown (10YR 4/4) stony fine sandy loam; weak medium subangular blocky structure; friable; few very fine to coarse roots throughout; pH 5.2, clear wavy boundary.

Bw2—43 to 66 centimeters (16.9 to 26.0 inches); dark yellowish brown (10YR 4/4) cobbly sandy loam; friable; few very fine to medium roots throughout; pH 5.2; clear wavy boundary.

2BC—66 to 89 centimeters (26.0 to 35.0 inches); dark yellowish brown (10YR 4/4) and dark grayish brown (2.5Y 4/2) gravelly loamy sand; weak coarse subangular blocky structure; friable; few very fine to fine roots throughout; 5 percent fine distinct brown (7.5YR 4/4), moist, iron-manganese masses; pH 5.4.

2Cd—89 to 120 centimeters (35.0 to 47.2 inches); gray (2.5Y 5/1) loamy sand; structureless massive; firm; few very fine roots in cracks and few fine roots in cracks; silt coats; pH 5.4.

Site 2 – Sports field site:

Oe—0 to 5 centimeters (0.0 to 2.0 inches); dark reddish brown (5YR 2.5/2) moderately decomposed plant material; very friable; pH 5.2, abrupt wavy boundary.

A1—5 to 12 centimeters (2.0 to 4.7 inches); black (7.5YR 2.5/1) highly organic gravelly sandy loam; weak medium subangular blocky; very friable; pH 5.1, clear wavy boundary.

A2—12 to 20 centimeters (4.7 to 7.9 inches); very dark brown (7.5YR 2.5/2) very gravelly sandy loam; moderate medium subangular blocky; very friable; 5, pH 5.0, clear wavy boundary.

Bw1—20 to 31 centimeters (7.9 to 12.2 inches); dark brown (7.5YR 3/4) stony coarse sandy loam; weak medium subangular blocky structure; friable; pH 5.3, clear wavy boundary.

Bw2—31 to 48 centimeters (12.2 to 18.9 inches); brown (7.5YR 4/4) very gravelly loamy coarse sand; weak medium subangular blocky structure; friable; pH 5.3, gradual wavy boundary.

BC1—48 to 90 centimeters (18.9 to 35.4 inches); dark yellowish brown (10YR 4/4) very gravelly loamy coarse sand; structureless single grain; loose, pH 5.2, gradual wavy boundary.

BC2—90 to 100 centimeters (35.4 to 39.4 inches); olive brown (2.5Y 4/4) very gravelly coarse sand; structureless single grain; loose, pH 5.3, abrupt irregular boundary.

C—100 to 112 centimeters (39.4 to 44.1 inches); olive brown (2.5Y 4/3) very gravelly coarse sand; structureless single grain; loose; pH 5.3.

- **Possible Resources:**
  - 2020-21 MA Envirothon Video presentations MA Soils 2 MA Soils in the Field

QUESTION #3
(15 pts)

Based on the soil maps and the above soil descriptions, what are the soil parent materials present on this site and how will the various parent materials and landforms affect runoff and groundwater movement?

- **Possible Resources:**
  - 2020-21 MA Envirothon Video presentations MA Soils 1
- **Scoring: 1 out of 15 rating, with one being the least amount of knowledge and 15 the greatest**
  - 1-3 points – no answer or incorrect answers to both
  - 4-6 points – very little information – one correct parent material and/or landform
  - 7-9 points – average – identify both parent materials and landforms
  - 10-12 points – above average – correctly identify both parent materials, landforms and discuss water movement
  - 13-15 points – lots of knowledge – correctly identify both parent materials, landforms and demonstrate thorough understanding of water movement. Integrate your answer into the assessment of the school complex proposal

QUESTION #4
(15 pts)

Soils are a resource in themselves as well as a consideration in planning and design for development.

- Consider how the proposed school complex development would alter the existing soils on the site.
- Discuss how the soil types and landforms would influence the design proposals for the school complex.

- **Scoring: 1 out of 15 rating, with one being the least amount of knowledge and 15 the greatest**
  - 1-3 points – no answer or very briefly addressed
  - 4-6 points – very little information – one part of question addressed
  - 7-9 points – both parts of question addressed
  - 10-12 points – above average – both parts of question addressed with examples
  - 13-15 points – lots of knowledge – both parts of question thoroughly addressed with multiple examples

QUESTION #5
(15 pts)

What are some of the practices that should be implemented during and after construction to maintain and improve healthy, resilient soils on the site? How would a highly functioning soil versus a highly degraded soil impact the site in the long term?

- **Possible Resources:**
  - Soil Conservation BMP to Build Resilience and Protect Water Quality with Joel Betts https://www.youtube.com/watch?v=jB5lWOcwLIc
  - Soil Health NRCS https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/
- **Scoring: 1 out of 15 rating, with one being the least amount of knowledge and 15 the greatest**
  - 1-3 points – no answer or very briefly addressed
  - 4-6 points – very little information – one healthy soils practice identified
  - 7-9 points – average – 1 to 2 practices identified and long-term impacts addressed
  - 10-12 points – above average – 2 or more practices identified and long-term impacts thoroughly addressed
  - 13-15 points – lots of knowledge – 2 or more practices identified. A thorough understanding of soil health and resiliency demonstrated through discussion.