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# CAPSTONE: Soil Survey Study

## 1. Overview and Scope

In this lesson, high school students will learn about the parent material (geologic) state factor that contributed to the formation of particular soils in the local area. The lesson will culminate in a field trip during which the students will conduct a careful investigation of the prominent rocks, minerals and soils within the local area. I anticipate that prior to this lesson; the students will have studied other Earth science topics, including topography, climate and atmosphere, hydrologic processes, ecosystems and biodiversity, plate tectonics, rock and mineral classifications, rock forming cycle, and geologic time scale. For this lesson, students will concentrate their efforts on identifying the parent materials that exist in the local area, and how those materials likely contributed to the compositions and other characteristics of local soils. The students will read several short articles on various processes involved in soil formation and will participate in a series of classroom lectures and discussions to learn about the natural, as well as the human processes that influenced the formation and compositions of the soils, and that likely continue to impact the present soil state. The soil survey will include an exercise/research element that allows students to principally identify the parent materials (geologic origins) and certain physical and chemical properties of local soils, as well as ascertain the topographic settings, the causes and effects of weathering and erosion, and the possible human influences on soils.

Two sites will serve as the study areas for the soil surveys – Loft Mountain, along Skyline Drive in Shenandoah National Park, vicinity coordinates N 38° 15' 40.9828" W 78° 39' 24.1853"; and Albemarle County near US Highway 29 and Boulders Road, vicinity coordinates N 38° 9' 33.6147" latitude, W 78° 25' 5.4621 longitude. The Loft Mountain site is superb for introducing the students to near-pristine outcrops of weathered rock formations. Students will observe natural weathering features caused by wind, water and gravity, in some cases. They will also observe and annotate the types of biota (flora) that exist in this region. The Albemarle County study site offers a pronounced contrast in topography, biota and soil types. Students will observe both natural weathering and erosion features, as well as the effects of human activity on the landscape, particularly how that activity contributes to erosion and possible alterations in biota and biodiversity.

Students will attempt to draw correlations between state factors that influence the types of soils found at both sites, and differentiate the effects and results of natural and human-induced processes on the parent material and soils found at the Loft Mountain and Albemarle County sites. Students will use the opportunity to observe and report on some of the issues surrounding natural and anthropogenic impact upon the environment. They will formulate their own thoughts and ideas about the Critical Zone in their region, and consequently determine for themselves the extent that human activity has had, and may potentially have on the Critical Zone.

## 2. Audience

High school 11$^{th}$ and 12$^{th}$ grade levels. This study is intended as part of an advanced Earth science class that expands upon other science and mathematics curriculum currently taught in high school. This particular instruction requires students to apply some algebra, chemistry, physics and computer science skills. The expectation is that students have already received instruction in Algebra I and II, Chemistry I, Physics I, a basic Earth science course (or geology, if available) and a basic computer science class in grades 9 and 10. Students who have not undertaken any of these courses prior to attempting this lesson may have difficulty comprehending some concepts.

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## 3. About the Lesson

This lesson will span three one-hour class periods, and will include a one-day field trip to the two soil study sites. For the purpose of preparing the students for the field trip and soil survey, the first two lessons will include a discussion of compositions and characteristics of rocks and formations, topographic landforms, and soils of the local area. I intend to devote the first two lesson periods toward discussion of assigned readings from the relevant textbook chapter(s), as well as from selected scientific articles and web sources. I expect the students to obtain a firm grasp of the parent material as a state factor of soil formation. Students should gain from the readings and discussions an understanding of the physical, chemical and biological processes that influence the Critical Zone as they relate to the two study sites. [The advanced readings should challenge the students to apply some degree of critical thinking to our discussions.]

During the third lesson, we will conduct a map survey of the two study sites, along with a discussion of geomorphology and biodiversity of the area. The field trip will serve as the practical exercise, during which we will travel to and traverse the Loft Mountain and Albemarle County/Boulders Road study sites. There, students will make observations of the topography, geology, flora and fauna, and soils. They will work in groups of three to four individuals, collecting representative samples and making field observations based on what they learned in the classroom.

The construct of this lesson should enable students to compare the content of the lesson(s) contained in the textbook to recent scientific and open-source readings, and from that comparison form their own thoughts and opinions about soil formation and the Critical Zone, natural processes, and effects of human perturbation. Ultimately, the students should be able to determine the state factors and key processes involved in soil formation, the importance of soil to the local ecosystem, and the effects of natural and anthropogenic influences on the Critical Zone. In subsequent lessons (beyond this lesson), the level of difficulty will increase, whereby students will conduct similar analyses of soils, but they will analyze more closely the mineral and organic components, and other characteristics such as pH level, water content, salinity and the like.

## 4. Learning Objectives – What students will learn in this lesson

By the end of the Critical Zone lesson, students should be able to:

- define the Critical Zone and why it is important to life on Earth
- recognize the contribution of parent material as an essential state factor of soil formation
- understand the twelve soil classifications, and recognize the specific characteristics of particular soils within the local area
- access the Web Soil Survey and compare the reports to field observations
- differentiate between bedrock and surficial geologic maps and apply them to understanding the Critical Zone each of the two study sites
- Find remotely sensed imagery, specifically aerial photographs for each study site
- list some anthropogenic impacts on the Critical Zone at each study site

## 5. Schedule

The following chart lists what is due for the Critical Zone lessons. As students work their way through the reading materials and engage in discussions for the Critical Zone lessons they will eventually apply their knowledge and observation skills during and following a field survey of soils at two different sites. The Critical Zone lesson will require three class periods and one field trip to complete. (Based on minimum of one contact hour per period)

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| Critical Zone, Periods 1 & 2 | | | |
|---|---|---|---|
| **REQUIREMENT** | **LOCATION** | **Graded** | **% Total Grade** |
| **Readings:**<br>Earth Science Textbook: Chapters related to landforms and geology<br><br>Nelson, W. (1962) Geology and Mineral Resources of Albemarle County. *Virginia Division Of Geology And Mineral Resources*, **Bulletin 77**, 103 pp. [Read: pp 1 – 7; 12 – 14; 22 – 27; 43 – 48; and 60 – 63; focus on Catoctin Formation, Charlottesville formation, and greenstone].<br><br>Daniels, D. and Leo, G. (1985) Geologic Interpretation of the Basement Rocks of the Atlantic Coastal Plain. *USGS Open File Report 85-655*, U.S. Geological Survey, Reston, Virginia, 48pp. [Read pp. 1 – 4; 14 – 24]<br><br>Eaton, L., et. al. (2003) Quaternary deposits and landscape evolution of the central Blue Ridge of Virginia. *Geomorphology,* **56**, 139 – 154.<br><br>Sherwood, W., et. al. (2010) Soils, geomorphology, landscape evolution, and land use in the Virginia Piedmont and Blue Ridge. *The Geological Society of America Field Guide 16*, 31 – 50. | Home | No | |
| **Discussion:** Refer to Discussion Questions for Period 1 & 2 Readings | Classroom | Yes; Participation | 25% |

| Critical Zone, Period 3 | | | |
|---|---|---|---|
| **REQUIREMENT** | **LOCATION** | **Graded** | **% Total Grade** |
| * Map Database<br>http://ngmdb.usgs.gov/Prodesc/proddesc_93560.htm<br><br>**Readings:**<br><br>Southworth, S., et al. (2009), Geologic Map of the Shenandoah National Park Region, *USGS Open File Report 2009-1153*, U.S. Geological Survey, Reston, Virginia, 103pp. [Read pp. 8 – 22; 84 –87; access map at following website: http://pubs.usgs.gov/of/2009/1153/pdf/ofr2009-1153.pdf ] | Class | No | |

| Critical Zone, Field Trip & Report | | | |
|---|---|---|---|
| **REQUIREMENT** | **LOCATION** | **Graded** | **% Total Grade** |
| Field trip participation<br><br>Soil survey report: 5 to 7 pages with site maps, parent material and topography descriptions, soil descriptions, natural and human influences, and references | Study sites | Yes | 35%<br><br>40% |
| | | | 100% |

## 6. Materials

Much of the discussion for the second and third periods of the lesson would benefit from access to computers and the internet, therefore, the instructor should arrange for use of the school's computer facility for at least two full class periods. If computers are unavailable, then the instructor may opt to obtain geologic maps and print soil surveys associated with the two study sites and provide these to students for the designated periods. The instructor should also provide the articles listed periods 1 and 2 in the Schedule for student use during the designated lessons. For the field trip, students should each carry a day pack with rain gear, change of socks, water bottle, sunscreen and light snack. Each student should also have a small notebook and mechanical pencil and eraser for note taking and drawing. The instructor should provide maps – a 1:63360 photocopy of each study site will suffice [recommend using Map 11 Appalachian Trail, Shenandoah National Park South District. Published by Potomac Appalachian Trail Club, revised October 2009]. The instructor should also provide each group with a compass and protractor for use at both sites, and a spade, trowel; and 3 – 4 buckets for use at Study Site 2.

## 7. Lesson Outline

### Periods 1 & 2

These two periods comprise an instructor-led discussion of assigned articles and online readings. The instructor should provide the following list of topics, as a handout, as well as the scientific articles at least two days before the start of this lesson to give students the opportunity to read and respond to questions:

Topics for Discussion

1. Overview of the Critical Zone and the five state factors of soil formation.

2. Focused discussion of parent materials and topography.

3. Soil, its basic composition, and how it forms; incorporate samples of local and regional soils for comparative analysis and discussion.

4. The three primary rock types and the processes involved in their formation; provide hand samples of local rock types, or images if available.

5. Weathering and erosion, and how these processes relate to soil formation; include natural effects and human-induced effects.

6. The relationships between parent material, topography and soil formation, and what processes, either natural or human-generated contributed to each.

## Period 3

This period will encompass a map survey of the areas of interest. The instructor should point out to students:

* coordinates of each location
* general topographic features
* geologic history and advent of human habitation
* distances, elevations and slopes of key landforms
* distinctive soils in each area
* subsurface (bedrock) and surface geologic formations

This period is best taught using automation equipment and access to the internet in order to display the maps of the survey site locations and accompanying reports. If not available, then paper geologic maps will suffice. The instructor should access the following websites (if automation is available) to demonstrate the contents and utility of these sites to the students:

NRCS Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/

ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Taxonomy/maps.pdf

http://soils.usda.gov/technical/classification/osd/index.html

http://soils.usda.gov/technical/classification/scfile/index.html

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## Field Trip

The instructor will have a certain degree of latitude in terms of dividing the students into groups of three to four, and setting tasks prior to the start of the field trip. While at the National Park Visitor Center, the students would benefit from a short, comprehensive discussion about the day's work ahead, a map orientation, and a safety briefing. Since digging is not permitted in the park, the students will only need their day packs, compasses, protractors and notebooks. Once at Study Site 1, the students can set to work identifying the topographic features in the immediate and surrounding area; identifying likely parent materials; weathering, erosion and deposition features; soils and soil characteristics; and description of biota. Once the instructor is satisfied that the students have obtained all the data that they will need to write the portion of the report for Site 1, the group should move to Site 2 and repeat the process. Since digging is permitted at Site 2, the instructor can have students clear debris and soil surfaces to better observe and identify the soil horizons and other features.

## 8. Report

As described in the schedule, the report should be 5 to 7 pages in length and include, at a minimum:

* site maps – each survey site, with a marker that accurately plots the site location

*detailed descriptions of parent materials – short explanation of rock type, major minerals, age of formation, weathering and erosion evidence

* topography – descriptions should include local and surrounding terrain features, slope estimates, presence of water sources, deposition features

* soil descriptions – field observations in concert with USDA/NRCS data

* natural and human influences – a short, comprehensive explanation of natural and/or human effects contributing to weathering, erosion, deposition, mineral input/sources

* references

The instructor should introduce the students to the following websites, as well. Students should become familiar with these sites to help prepare their reports.:

http://soils.usda.gov/education/:

* Soil Facts: http://soils.usda.gov/education/facts/

* Concepts (Handout): ftp://ftp-fc.sc.egov.usda.gov/NSSC/Educational_Resources/concepts2.pdf

* The Twelve Orders of Soil Taxonomy: http://soils.usda.gov/technical/soil_orders/

* Technical Classifications: http://soils.usda.gov/technical/classification/osd/index.html

## 9. Grading Rubric

### Discussion Participation

Students receive credit for discussion participation based on similar standards as the written products. Things I will look for during discussion periods include:

Consistency in response(s) – student addresses the question being asked, and offers a cogent, coherent response that either answers the question, or adds to the discussion flow.

Stays on topic – student response adds to the discussion and stays on topic, without deviating or drawing discussion toward a different topic.

Demonstrates interest and self-initiative – student needs no prompting and is ready to respond; and offers additional, complementary information, backed by source or reference.

Expresses opinions and ideas in a clear and concise manner with obvious connection to topic – these are student's own opinions and ideas related to the topic, to include creative approaches to solutions or way ahead.

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| Report Rubric | | | |
|---|---|---|---|
| Points / Area of Focus | 1 – 2 | 3 – 4 | 5 - 6 |
| Content/Accuracy | Content not clear, not accurate, and/or important content is irrelevant, missing, or misrepresented, and/or insufficient detail, and/or inaccurate or ineffective management of quantitative information. | Small omissions or inadequacies in content, but primarily a full coverage task requirements and audience needs. Some minor inaccuracies, but mostly accurate. May include some irrelevant details or omit important details. Explanations and descriptions are almost always clear and precise. Quantitative information accurate, expressed with reasonable supporting plots. | Content is fully compliant with the requirements of the task and the needs of the audience; everything is accurate; level of detail is suited to the needs of the task and readers. Explanations and descriptions of content are clear and precise. Quantitative information, if relevant, is accurate, expressed with appropriate visuals, and well integrated into the text. |
| Analysis/Problem-solving/Conclusions | Remains at a low cognitive level. Analysis superficial; overreliance on descriptive and narrative modes; little or no relation between conclusions and evidence; fails to address alternative points of view or counter evidence. | Attains a high cognitive level appropriate to the assignment. Thorough analysis, though not entirely insightful or original; conclusions clearly and adequately supported by evidence; alternative points of view or counter-evidence raised, but lacking. | Attains highest cognitive level that is appropriate to the assignment. Insightful, original analysis; conclusions superbly supported by evidence clearly explained; consideration of alternative points of view or counter-evidence as relevant. |
| Organization/structure | Points are not clear or the sequence of points is illogical or inadequate to the needs of the task or audience. | Points are clear. In general, points establish a logical line of reasoning. | Points are clear and logically arranged; content well-developed; analysis meets the task and audience needs. |
| Style | Language is awkward, hard to read. The reader must backtrack to decipher the writer's meaning, or the reader cannot grasp the meaning. Language is overly wordy; or inappropriate in tone. Source citations missing or inaccurate. | Style is adequate, but lacks polish and directness. Some language is imprecise but is generally understandable. | Words are precise; language is concise, without wordiness; writer's tone is appropriate to the audience and purpose; sentences well-constructed; transitions lead smoothly from one idea to the next. Active voice predominates. Sources, as relevant, are appropriately cited. |
| Grammar (Correctness) | Departures cause irritation to the reader or cause the reader to lose focus. | A few departures, but not enough to disturb the reader. | Few if any departures from Edited Standard English grammar, punctuation, & usage. |

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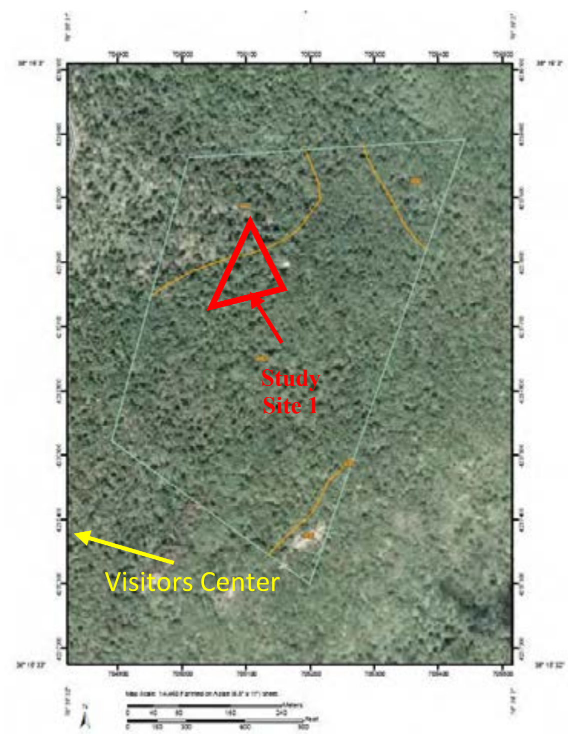
**Report: Shenandoah Region and Albemarle County, Virginia Soils Study**

This field study provides observations and analyses of soils at two separate sites – Loft Mountain along Skyline Road, Shenandoah National Park; and Albemarle County, vicinity intersection of Highway 29 (Seminole Trail) and Boulders Road (see map insets). The Albemarle County site is situated approximately twelve miles to the east and south of the Loft Mountain site.




Map 1: Loft Mountain, Shenandoah National Park, Virginia


Map 2: Albemarle County, Virginia, vicinity intersection of Highway 29 and Boulders Road

(Maps retrieved on 5 and 8 December 2012 from http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx )

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## <u>Soil Study Site 1: Loft Mountain Map</u>

Image from USGS TNM 2.0 National Map Viewer: http://viewer.nationalmap.gov/viewer/

Study Site 1 on Loft Mountain can be accessed from the Visitor Center parking area located west and south of the study site location. Portions of the exposed soil located within the red triangle can be easily and safely accessed and studied. The area is dominated by various loams, as classified by the NRCS, to include Cataska-Hartleton, Hartleton-Cataska, Lew, Myersville-Catoctin, and Tusquitee. The specific loam of interest, which is substantially exposed in the area depicted on the map, is the Lew very stony silt loam.

**Soil Characteristics**


Lew very stony silt loam (44D) [Smith: 2 Sep 2012]


Lew very stony silt loam (44C) [Smith: 2 Sep 2012]

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| Albemarle County, Virginia (VA003) | | | |
|---|---|---|---|
| **Map Unit Symbol** | **Map Unit Name** | **Acres in AOI** | **Percent of AOI** |
| 44C | Lew very stony silt loam, 7 to 15 percent slopes | 8.6 | 15.2% |
| 44D | Lew very stony silt loam, 15 to 25 percent slopes | 42.2 | 75.1% |
| 60C | Myersville-Catoctin very stony silt loams, 7 to 15 percent slopes | 0.0 | 0.0% |
| 60E | Myersville-Catoctin very stony silt loams, 25 to 60 percent slopes | 5.4 | 9.6% |
| **Totals for Area of Interest** | | **56.2** | **100.0%** |

USDA, Natural Resources Conservation Service. Custom Soil Resource Report for Albemarle County, Virginia. Retrieved on 5 December 2012 from: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

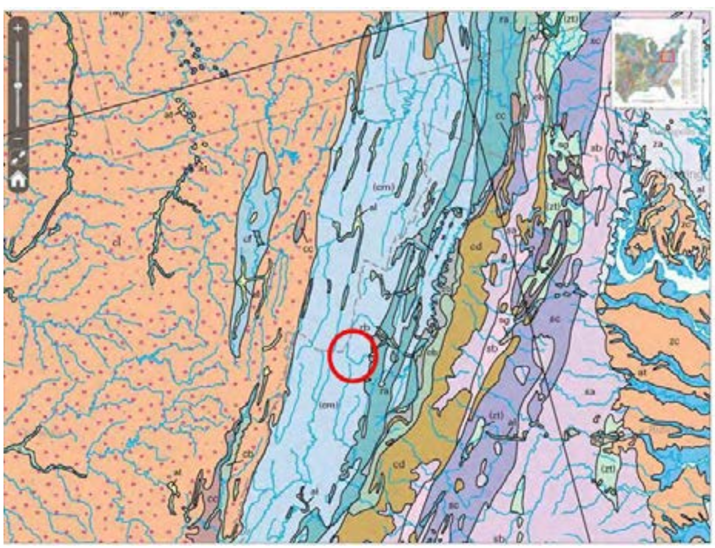
The NRCS classifies Lew soil as "[f]ine-loamy, mixed, active, mesic Ultic Hapludalfs," which means the Lew is an Alfisol. The soil at the study site is characterized by a thin, black organic layer covered in places by colluvium comprised of small- to medium-sized (0.5 – 2 centimeter), angular to sub-angular rock fragments (channers). The top, organic, O layer, is directly underlain by a slightly thicker, coarse silt loam A layer and is interspersed with mostly angular to sub-angular greenstone channers of similar size covering the top layer. The rock fragment size and distribution appears to increase with depth, within the B horizon, at approximately 70 centimeters below the surface. The origin, or parent material of this soil is described as "colluvial material weathered from greenstone or other basic rocks," indicating metamorphic rock of basaltic origin. [Although digging is not permitted in the park, students can identify the various layers along slide areas and uprooted trees.] The greenstone is also present in alluvial and fluvial depositional formations east of the Shenandoah ridgeline. Several outcrops of these rocks are readily exposed to weathering in several locations.

The NRCS indicates that Lew soil forms along slopes and on hills, as well as significant deposits in alluvial plains, all of which would indicate weathering of parent material at higher elevations, coupled with downhill flow and accumulation over time. (Data retrieved on 7 December 2012 from https://soilseries.sc.egov.usda.gov/OSD_Docs/L/LEW.html )

The Lew soil is "mesic," indicating the mean annual soil temperature can range between 8° and 15° C. The Lew soil is of the Alfisol order. Alfisols comprise approximately 13.9 percent of total land area in the U.S., however, in the state of Virginia, Alfisols appear to occupy slightly less land area. (see respective maps at http://www.cals.uidaho.edu/soilorders/alfisols.htm ) The typical pedon for Lew is "extremely stony silt loam – forested." Lew soil is generally "well-drained, and moderately permeable." Lew soils are considered suitable mainly for forestry.

**Geology: Surficial and Bedrock Materials**

**Surface Map** (Soil survey Site 1 depicted by red circle below)



Fullerton, D.S., Bush, C.A., and Pennell, J.N., 2003, Map of surficial deposits and materials in the eastern and central United States (east of 102 degrees west longitude): U.S. Geological Survey, Geologic Investigations Series Map I-2789, scale 1:2500000

In accordance with the map legend, the surficial lithologies in the vicinity of the soil study site include the following:

(cm) – Colluvium, decomposition residuum, and solution residuum

ra – Cherty, clayey to sandy solution residuum

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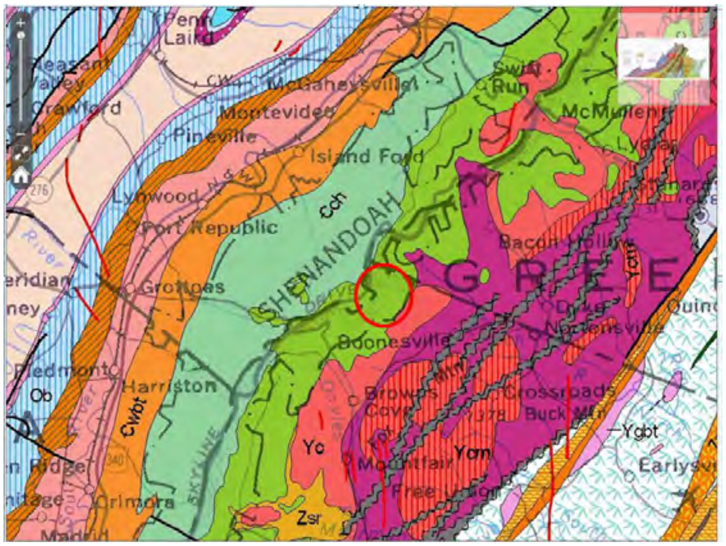
**Bedrock Map** (soil survey Site 1 denoted by the red circle below).




(Retrieved from: Virginia Division of Mineral Resources, 2003, [Geologic map of Virginia [A 1993 digital rendition of this product with legend is available]]: Virginia Division of Mineral Resources, scale 1:500000.)

In accordance with the map legend, the bedrock lithology in the vicinity of the soil study site includes the following:

CZc – Catoctin Formation, metabasalt

**Soil Study Site 2: Albemarle County, vicinity US 29 and Boulders Road**

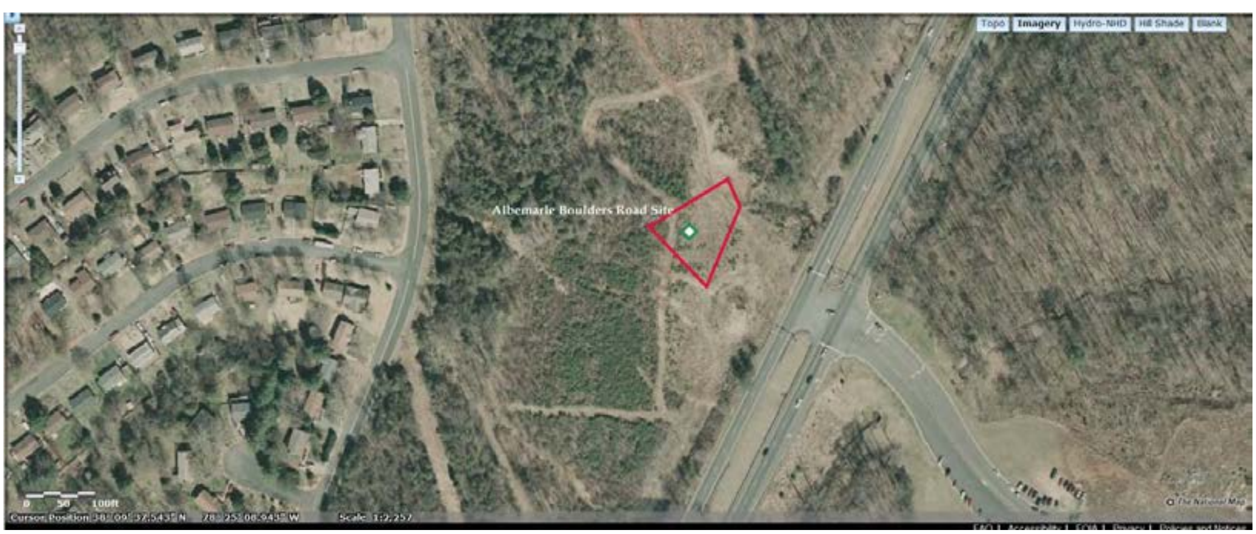



Image from USGS TNM 2.0 National Map Viewer: http://viewer.nationalmap.gov/viewer/

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Study Site 2 Study Site 2 is situated in a newer housing development area in which ongoing construction and movement of heavy equipment restricts access to some parts of the site. Portions of the exposed soil located within the red triangle can be safely accessed and studied. The area is dominated by various loams, as classified by the NRCS, to include Chester, Glenelg, Hayesville, and Udorthents. The specific loam of interest, which is substantially exposed throughout the area, is the Chester loam.

**Soil Characteristics**

View of B and upper C horizons
[Smith: 9 Sep 2012]

View of B horizon with pen as reference scale
[Smith: 9 Sep 2012]

| Albemarle County, Virginia (VA003) | | | |
|---|---|---|---|
| **Map Unit Symbol** | **Map Unit Name** | **Acres in AOI** | **Percent of AOI** |
| 14D | Chester loam, 15 to 25 percent slopes | 2.7 | 35.4% |
| 34D | Glenelg loam, 15 to 25 percent slopes | 2.4 | 30.9% |
| 36C | Hayesville loam, 7 to 15 percent slopes | 2.3 | 29.3% |
| 88 | Udorthents, loamy | 0.3 | 4.4% |
| **Totals for Area of Interest** | | **7.8** | **100.0%** |

USDA, Natural Resources Conservation Service. Custom Soil Resource Report for Albemarle County, Virginia. Retrieved on 8 December 2012 from: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

The NRCS classifies Chester soil as "[f]ine-loamy, mixed, semiactive, mesic Typic Hapludults." The soil at the study site is characterized by a very thin, dark gray organic layer directly underlain by a much wider yellowish-red, silty to coarse loam. The clay composition appears to increase below the first seven to eight inches. There are some large pebbles and rocks (note green pen adjacent large rock fragment in photo) scattered throughout the mid to lower sections of the B horizon. The origin, or parent material of this soil is described as "[r]esiduum weathered from mica schist" indicating metamorphic origin. The parent material is visible and readily accessible within the C horizon, and one can obtain clean surface using a rock hammer in order to better analyze the mineral composition of the samples.

The separate horizons are easy to differentiate by making fresh vertical cuts through the outer surface of the exposure using a spade or machete. This rock type is also present along the Shenandoah ridge, along with other varieties of metamorphic rocks to include granitoids and gneisses. The lower portion of the B horizon and visible portion of the C horizon contained several large examples of mica schist, as well as what appear to be quartz-rich granitoid rocks.

The NRCS indicates that Chester soil forms along slopes and on hills, as well as significant deposits in alluvial plains, all of which would indicate weathering of parent material at higher elevations, coupled with downhill flow and accumulation over time. (Data retrieved on 4 September 2012 from https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CHESTER.html)

The Chester soil is "mesic," indicating the mean annual soil temperature can range between 8° and 15° C. The Chester soil is of the Ultisol order. Ultisols comprise approximately 9.2 percent of total land area. In the state of Virginia, however, Ultisols appear to occupy much greater land area compared to Alfisols. (see http://www.cals.uidaho.edu/soilorders/orders.htm )

The NRCS site notes that the typical pedon for Chester loam is a "silt loam" associated with "a hardwood forest of oak, hickory and tulip poplar at an elevation of 400 feet." The Chester loam typically includes an E horizon of 4 to 8 inch thickness, and a soil A horizon that can range from 0 to 4 inches. Chester soil displays "moderately high to high" hydraulic conductivity, and is generally well-drained. Chester loams are considered suitable mainly for forestry and construction.

**Geology: Surficial and Bedrock Materials**

**Surface Map** (Soil survey Site 2 depicted by red circle below)

Fullerton, D.S., Bush, C.A., and Pennell, J.N., 2003, Map of surficial deposits and materials in the eastern and central United States (east of 102 degrees west longitude): U.S. Geological Survey, Geologic Investigations Series Map I-2789, scale 1:2500000

In accordance with the map legend, the surficial lithologies in the vicinity of the soil study site include the following:

cb – Resistant block or resistant-boulder colluviums and rock waste

cd – Crystalline boulder alluvium

(cm) – Colluvium, decomposition residuum, and solution residuum

ra – Cherty, clayey to sandy solution residuum

zb – Decomposition residuum on sand and gravel beneath high stream terraces and in alluvial fans

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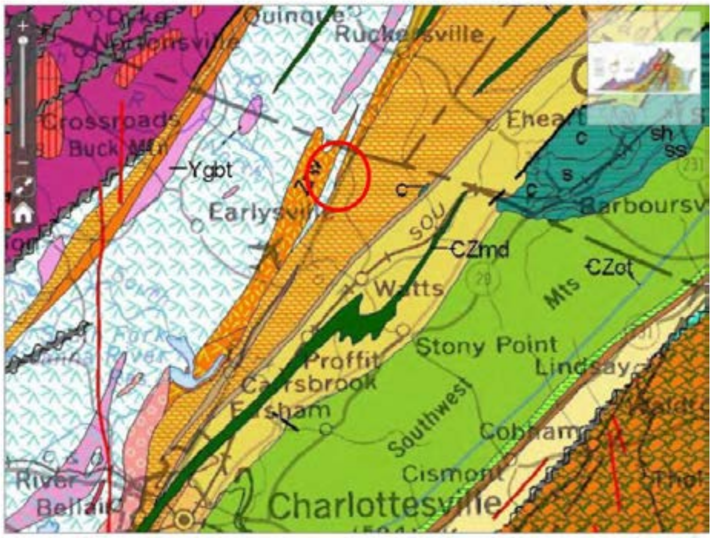
**Bedrock Map** (soil survey Site 2 denoted by the red circle below).




Virginia Division of Mineral Resources, 2003, Digital representation of the 1993 geologic map of Virginia [The original 1993 map is available]: Virginia Division of Mineral Resources, Publication 174, scale 1:500000.

In accordance with the 1993 map legend, the bedrock lithologies in the vicinity of the soil study site, all members of the Blue Ridge Basement Complex, include the following:

ybg – Porphyroblastic biotite-plagioclase augen gneiss (Middle Proterozoic (Grenville Age) Plutonic Rocks)

zlm – Metagraywacke (Lynchburg Group, Blue Ridge Anticlinorium, Stratified Rocks)

zrw – White oak alkali feldspar granite (Robertson River Igneous Suite, Late Proterozoic Igneous Rocks)

**Biomes, Biodiversity and Human Perturbation**

Both study sites are situated within the temperate broadleaf forest biome (Campbell and Reece (2007)), or temperate mixed forest (Raven (1992)). Specific topography, water resources and human land use activities, to name a few, further define these study sites. Both sites underwent significant deforestation starting in the mid-1700s, however, such human perturbation ceased in the Site 1 area by 1930. Site 2 continues to undergo deforestation and land clearing for agricultural, commercial development and habitation purposes. As a result, the biomes that exist today are vastly different from those which existed prior to the arrival of colonists in the late 17th Century. As Campbell and Reece point out, "[l]ogging and land clearing for agriculture and urban development destroyed virtually all the original deciduous forests of North America." (1171) The present day forests are those that recovered or were replanted following deforestation. As such, the biome of today likely contained significantly different biota in the past.

Urban development appears to be the human activity that has most affected the soil near Study Site 2, particularly in the soil's ability to resist erosion. Natural vegetation and upper soil layers have been removed to facilitate housing construction, and natural drainage systems have been replaced by road networks, building foundations, sidewalks and sewer conduits. An added consequence of construction has been the exposure of parent material and bedrock to mechanical and chemical weathering, and subsequent erosion of these materials.

Human perturbation in the natural conditions of soil biodiversity has resulted in the disruption of some species' habitats. Most notably, the larger macrofauna that once inhabited the area have migrated to less (human) populated areas. By comparison, human restoration activities in and around Study Site 1 have resulted in improved drainage and reduced erosion. Although there is no way to definitively determine the original micro- and macrofaunal populations of the local area, the effects of human perturbation of the soil and associated ecosystem have been vastly reduced.

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