DEPARTMENT OF INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PRELIMINARY SURFACE MATERIALS MAP OF THE ANNANDALE QUADRANGLE, VIRGINIA

INTRODUCTION

The surface materials of Annandale Quadrangle include: unconsolidated deposits of waterlaid sand, gravel and clay; saprolite (weathered bedrock); fresh bedrock; artificially moved or disturbed ground; and soil. Except for alluvium in modern drainages, the unconsolidated deposits are found mostly in the southeastern third of the map area. Fresh rock outcrops comprise less than 1% of the total area, artificially moved or disturbed ground less than 10%. About 56% of the area is mantled by saprolite. Soil is present above most of the surface materials, but is not shown on this map.

The Surface Materials Map is based on published smaller scale maps (see list of references), unpublished logs from water well and foundation borings, and new field work. The position of some contact lines between control points was projected on the basis of relevent structure contour and isopach maps. The scale of the Surface Materials Map precludes its use for specific site planning; rather, it should be used as a regional planning tool.

Accompanying the map are a cross section, showing the subsurface extension of surface materials, and three tables giving general characteristics and engineering properties of the surface materials in and near Annandale quadrangle.

POSSIBLE USES OF THE MAP

The Surface Materials Map can be used to delineate the distribution and general physical characteristics of the unconsolidated deposits which underlie the soil zone and which overlie fresh bedrock. When used in conjunction with the cross section and the Base of Saprolite Map (Froelich, 1975b), the general direction of water flow and subsurface position of aquifers may be inferred. From the Surface Materials Map and the Thickness of Overburden Map (Froelich, 1975b) the volume of Overburden can be defined. When a slope or Landforms Map (Rogers, 1975) is superimposed on the Surface Materials Map, slide-prone areas may be delineated by outlining significant slopes where clay crops out.

MAP UNITS

Unit 1 -- Artificial fill, sediment pond fill, and distorbed ground. These materials are locally derived mixtures of soil, saprolite, rock, gravel, sand, and clay which have been moved a short distance from artificial cuts and borrow pits made during construction. Artificially changed ground has a wide range of properties. In general, it is less stable and has less bearing strength than the undisturbed parent material. It is readily eroded and provides a major source of sediment to streams until stabilized by vegetation and rip-rap.

Unit 2 -- Alluvium -- These deposits include water-transported sand, silt, clay, gravel and boulders in modern floodplains. They are generally fairly well sorted, micaceous and consist predominantly of quartz and material derived from nearby outcrops. Thick deposits, as in the Cameron Run floodplain, are natural water storage areas. Alluvial areas are generally poorly drained and subject to flooding.

Unit 3 -- Terraces and colluvium -- Nearly level terraces composed of mixtures of sand, gravel, and clay occur at higher elevations adjacent to Unit 2. The material is moderately to poorly sorted, with subangular to rounded fragments. Similar unconsolidated mixtures with higher proportions of angular quartz, are found in many upland parts of the quadrangle; they are either moving slowly downhill in response to gravity (colluvium), or are residual (lag) deposits left when other material is removed by erosion or chemical solution.

Unit 4 -- Upland gravel deposits -- Deeply dissected deposits of sand and gravel with interstitial clay and silt cover much of the upland areas. Within the deposits are locally thin beds of clay and silt interbedded with the sheet-like deposits of sand and gravel. Most of the pebbles and cobbles are composed of quartz and quartzite, with rare fragments of chert, red sandstone, and various crystalline rocks. Many areas of Unit 4 contain impermeable hardpans and iron crusts. Upland gravel has been removed extensively for use as aggregate.

Unit 5, 5a and 5b -- Unconsolidated sands and clays -- Interbedded pebbly sand and silty clay beds of Unit 5 occur beneath Unit 4 in the southeastern part of the quadrangle. This unit is progressively thicker and contains a higher proportion of clay beds to the southeast.

Two major environmental concerns associated with Unit 5 are: 1) aquifers and their outcrop areas, and 2) slide-prone areas. The most sensitive zones related to aquifers are where the porous sand and gravel beds (5b) receive rain and runoff water at or near the surface. Landslides in the Annandale area occur where clay beds (5a) occur on significant slopes, (either natural or aritficial). The clay contains montmorillonite, a mineral which swells when wet and shrinks when dry. In some areas the removal of impermeable hardpans during mining of Unit 4 has resulted in destabilization of underlying swelling clay beds by recurrent wetting and drying.

Unit 6a, 6b, 6c, 6d and 6e -- Saprolite -- Saprolite is a residual deposit of soft, red-brown to gray, earthy, porous material derived by weathering and decomposition of crystalline rock; most of the constituent minerals other than quartz are altered to clays. Saprolite retains the structure and volume of the original rock, but density is commonly half that of the parent rock. As saprolite characteristics are directly related to parent bedrock, the saprolite is divided into 5 units (6a through 6e) on this basis. Selected physical properties of different types of saprolite are described in table 1, and some engineering characteristics are compared in tables 2 and 3.

Unit 7 - Fresh bedrock--Unaltered hard metamorphic or igneous bedrock with less than 10 feet of overburden.

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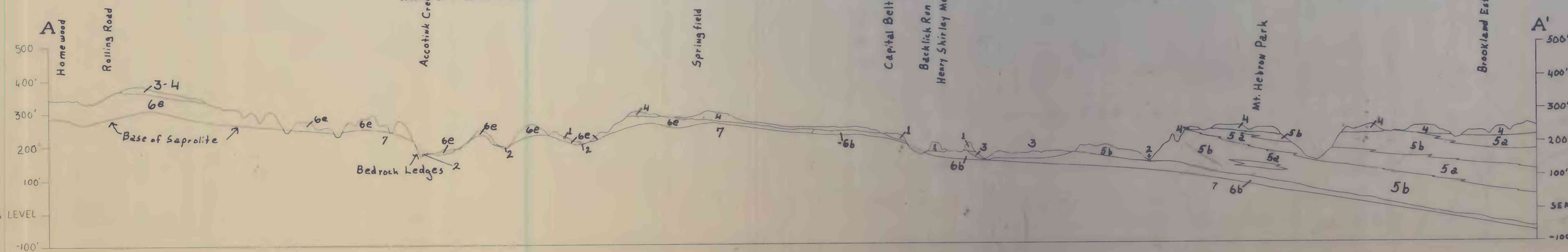
SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION



PRELIMINARY SURFACE MATERIALS MAP OF ANNANDALE QUADRANGLE, VIRGINIA

BY

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1975

EXPLANATION

See Columns 1 & 2 of Table 1

Table 1: Characteristics of Surface Materials, Annandale, Virginia

Surface Materials Map Symbol	Name of Unit	Preliminary Geologic Map Symbol	Grain Size Description	Color	Predominant Mineralogy	Topographic Form	Maximum Thickness of Unit in Feet	Permeability	Mode of Occurrence	Rippability	Special Problems	Uses and Possible Uses
1	Artificially Changed Ground	[illegible]	[illegible]	Variable	Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Alluvium	[illegible]	[illegible]	[illegible]	Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Terraces and Colluvium	[illegible]	[illegible]	[illegible]	Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Upland Gravel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5a	Clay & Silt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Poor	[illegible]	[illegible]	[illegible]	[illegible]
5b	Sand and Gravel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]
6	Undifferentiated	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Variable	[illegible]	[illegible]	[illegible]	[illegible]
6a	Saprolite	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6b		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
6c		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
6d		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
6e		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
7	Fresh Bedrock	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
x	Outcrop											

[1]Unified Soil Classification [2]Distribution of particle sizes in Surface Materials [3][illegible]

Unified Soil Classification

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

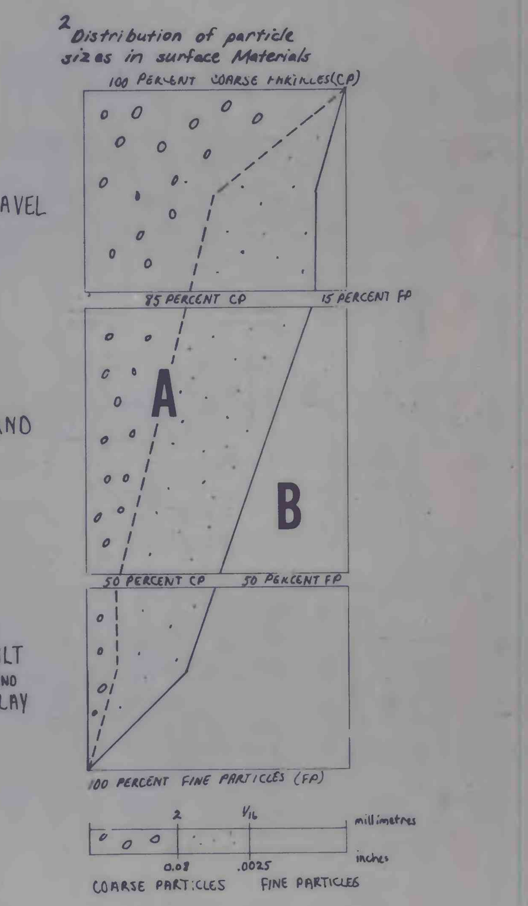

Table 2: Selected Engineering Properties of Overburden and Bedrock, Surface Materials Map, Annandale quadrangle.

Unit		Special Conditions	Total Unit Weight PCF	Shear Strength Cohesive KSF	Effective Friction Angle Ø	Allowable Bearing Pressure TSF	Penetration Rate BPF
1	Artificial Fill	Local overburden mixed with rock	130	-	30°	1.5-2.0 Needs special study	10-20
2	Alluvium	Organic clay	120	0.3	23°	0.75	5-10
		Silty sand	130	-	30°	2-2.5	
3,4	Gravel Deposits	Clay and silt	130	1-2	25°	1-2	5-30
		Sand and gravel	130	-	30°-36°	2-4	10-200
5a	Unconsolidated Sands and Clays*	Plastic clay	130	2.5-5	25°	2.5-4	25-40
		Sandy clay	130	4-6	30°	3-4.5	30-100
5b		Silty to gravelly sand	130-135		33°-36°	4-8	30-100+
6a-e	Saprolite (decomposed rock)	Near surface micaceous, unstructured	140	-	30°	3-4	50 100
		Undisturbed, compact, retains rock structure	140	-	36°	5	-
7	Bedrock	Highly jointed, weathered, schistose gneiss	170	0.5-5 ksi	45°	10	-
		Moderately jointed sound gneiss	170	5.0-15.0 ksi		30-60	-

Where shear strength in KSF is listed the material is expected to perform as a cohesive soil. Where no shear strength is listed the material is expected to perform as a cohesionless soil.

PCF - Pounds per cubic foot; KSF - Kips per square foot.

KIP - A unit of weight equal to 1000 pounds used to express a deadweight load.
TSF - Tons per square foot; ksi - kips per square inch.
BPF - No. of blows of 300-350 lb. hammer falling 18 in. needed to drive 3 1/2 in. casing 1 ft.

Modified from Table 7, Soil properties for design, final report, subsurface investigation, v.1, Mueser and others, 1967. (Approximately 10 miles north of Annandale quadrangle, Virginia.)

*Due to probable differences in plasticity characteristics, the values given for Connecticut Avenue kaolinitic clay may not be representative of Annandale quadrangle montmorillonitic clay. The swelling potential of the clays in Annandale quadrangle should be considered also in engineering designs.

Table 3 -- Engineering Properties of Saprolite (Decomposed Rock)

Engineering tests of saprolite on:		Unit 6a or 6b	Unit 6b Sheared	Unit 6b Massive
Depth range (in feet)		35.8-55.6	10.9-25.5	15.6-35.8
Average natural water content		17.2-24.5%	20.9-31.2%	16.5-42.3%
Direct Shear Tests	Normal stress (TSF)	0.51-2.51	0.51-3.01	0.51-2.0
	Shear stress (TSF)	0.79-2.22	0.47-2.74	0.58-1.51
Triaxial & Unconfined Compression Tests	Deviator stress (TSF)	0.67-1.67	0.98-3.87	0.48-1.79
	Confining tests	0.0-2.0	0.0-2.0	1.47
	Existing overburden stress (TSF)	3.2	1.1	1.4
Consolidation Tests	Estimated preconsolidation stress (TSF)	11.7	10	13
	Swelling index (Cs)	0.009-0.056	0.04	0.115
	Compression index (Ci)	0.0174	0.55	0.520

TSF - Tons per square foot
Modified from Table 7, Soil properties for design, final report, subsurface investigation, v. 1, Mueser and others, 1967. (Approximately 10 miles north of Annandale quadrangle, Virginia.)

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