DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PROFESSIONAL PAPER 1344
TABLE 3

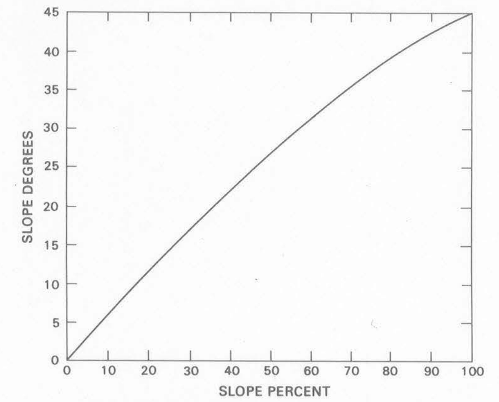
Surface materials map unit (pl. 1)	Description of parent bedrock	Weathered profile	Unified Soil Classification[1] of saprolite and B horizon	Total unit weight (kgf/m³)	Drainage and natural-moisture characteristics		Suitability as compacted material	Excavation properties	Susceptibility to erosion	Shear strength and compressibility characteristics	Allowable bearing pressure (kgf/cm²)	Slope stability	Road-performance characteristics
					Surface drainage	Internal drainage and natural moisture							
Hornfels h	Thermally metamorphosed shale, siltstone, sandstone, and conglomerate; entirely recrystallized adjacent to diabase, and gradually decreasing in metamorphic grade away from diabase. Altered zone commonly extends 100–300 m from contact with diabase and may extend 1,000–1,500 m. Rocks commonly gray, green, or mauve. Arkosic sandstone may be altered to rocks which look like granite; siltstone and shale may be altered to massive, fine-grained rocks, commonly spotted with epidote and other minerals such as hematite and malachite. Metamorphosed rocks retain layering and bedding, and are stronger and tougher than parent rock. Sheets, joints, and fractures variable; may be highly fractured at various orientations near contact, with breaks as close together as 2.5–5 cm.	Weathered profile generally similar to sedimentary rock from which derived, except depth of weathering commonly decreases significantly near diabase contact. B horizon (or residuum) may contain much clay and be as thick as 1.3 m, but generally is much thinner sandy clay. Beneath B horizon, weathered rock commonly has many platy fragments. Depth to unweathered rock averages about 1.5 m, but may vary from 0 to 5 m.	B horizon: CH, MH-CH, ML-CL, CL. Saprolite (residuum): ML, ML-CL.	1,750 and higher, generally increasing with depth to unweathered rock.	Moderately well drained to poorly drained, depending largely on clay content of saprolite (residuum).	Permeability generally low to very low in B horizon, and low to medium in saprolite (residuum). After rainy period, water near ground surface commonly perched above contact of weathered-unweathered rock.	Saprolite (residuum) highly variable, but commonly only marginally suitable, especially where high in clay or contains many rock fragments. Highly plastic clay of B horizon unsuitable.	Saprolite (residuum) easy to excavate using light power equipment; weathered rock may be difficult to excavate using power equipment. Generally increasingly difficult to excavate with power equipment as diabase contact is approached.	Saprolite generally not highly erodible, except where clay content is low. B horizon generally not very susceptible.	Clay medium to stiff, silt stronger. Effective friction angle of fine-grained materials probably greater than 20°, even for clay; coarse-grained effective friction angle much higher. Compressibility highly variable; medium-stiff clay may compress significantly under moderate loads.	1 or more for shallow footings above unweathered rock. Highly plastic, swelling clay and erosion tubes may lower this value.	Highly variable, depending on degree of alteration and parent bedrock; at places material more fractured than parent bedrock and requires flatter slopes than unaltered rock; at places more massive than parent bedrock.	Perched water near ground surface and presence of plastic clays commonly result in poor performance.
Phyllite ph	Phyllite, metasiltstone, schistose phyllite, and phyllitic slate. Some quartz veins and pods. Compressive strength of rocks highly variable, depending on rock type. Structures vary from foliated to fissile, locally schistose, locally thin to thick bedded (few centimeters to meters thick). Steeply dipping foliation and cleavage are dominant planar elements. Where fissile, rock splits along 0.2-0.5-cm-thick planes. Shear zones and joints commonly parallel to foliation. Shear zones generally contain unweathered or slightly weathered rock, but may contain soft soil. Cross joints vary in spacing and development, commonly closely spaced. Fan joints common at apices of folds. Rocks typically break into elongate blocks. Locally, complex structures and parent rocks change abruptly laterally, perpendicular to bedding.	Near ground surface, typically silt containing some clay, micaceous at places, commonly containing many hard-rock slivers, chips, and fragments. Saprolite of this texture varies from 0 to at least 10 m deep, possibly much thicker. Saprolite varies from medium consistency to stronger and typically has many slightly opened parting planes, locally containing abundant quartz fragments. Depth to unweathered rock varies from 0 to 30 m, averaging about 10 m. Thickness of saprolite and depth to unweathered rock greatest on hilltops. Rock outcrops most common on very steep slopes, in stream valleys, and near major streams. Saprolite consistency and saprolite-weathered rock contact may be highly variable at a specific site. Shear zones relatively common, especially parallel to foliation plane in highly foliated rocks. Shear zones commonly contain slickensided material much weaker than surrounding weathered rock or seprolite; may contain clays at residual friction-angle strength condition.	Saprolite: ML, SM, (ML-CL).	1,300 and higher, lowest in saprolite immediately beneath B horizon; generally increases gradually with depth from saprolite to unweathered rock.	Normally well drained to very well drained, except at toe of slopes or on flat ground.	Permeability throughout weathered profile typically medium; possibly higher. Water collects at contact of weathered-unweathered rock. Natural-moisture content of saprolite near ground surface commonly 10 percent less than plastic limit; degree of saturation increases with depth. Plastic limit of silty soil near surface averages about 25 percent.	Saprolite generally acceptable as compacted fill, but ease of compaction and strength and compressibility of compacted material commonly quite dependent on compaction moisture content. Highly micaceous soils especially sensitive to compaction control. Wet soils easily dried. Soils compacted by T–99 (American Society for Testing and Materials, 1978) specifications suitable for homes and light two-story structures.	Saprolite at ground surface on hilltops generally easy to excavate, using light power equipment, to depths at least 2–3 m. Increasingly difficult with increasing depth. Some quartzite beds and quartz veins require blasting.	Saprolite highly erodible, especially where micaceous and wherever remolded.	Medium or stronger consistency where soil disturbed by roots and other organic activity, or by frost action (rarely deeper than 1.7 m), and beneath shallow covering of colluvium (Colluvium and lag gravel unit, pl. 1, table 1). Strength increases gradually with depth, commonly to stiff consistency at 7–m depth. Peak effective friction angle commonly about 25°–35°; residual effective friction angle about 20°–25°, possibly less in sheared zones. Apparent preconsolidation stress commonly slightly greater than existing overburden stress at top of saprolite, but increases rapidly with depth. Apparent preconsolidation stress less than apparent preconsolidation stress in overlying Coastal Plain sediments at some places, especially in western areas. Soils commonly extremely compressible in virgin part of consolidation curve and highly compressible at loadings less than preconsolidation stress.	Commonly 1–2 for spread footings at shallow depths in saprolite; values typically increase rapidly with depth.	Temporary vertical slopes in saprolite commonly stable to depths of at least 2 m, but parting planes, shear zones, and aplite dikes make slopes unstable at unpredictable localities or depths. Permanent long slopes rarely unstable at angles less than 27°–30° in saprolite, weathered rock, or unweathered rock; stability depends almost entirely on defects such as joints and shear zones. Unweathered rock commonly stable at much higher angles.	Soils generally well drained internally, but silty, micaceous soils extremely susceptible to frost heaving and softening where surface drainage poor. Can be stabilized by cement at many places.
Gneiss, schist, and meta-graywacke[2] gsm	Massive to well-foliated rocks, in well-defined thin to thick beds 1 cm to many meters thick. Rocks include schistose gneiss, granofels, impure quartzite, metagraywacke, pelitic schist, mica schist, phyllonite, and veins and pods of quartz. Gneissic rocks and granofels (gneiss association) may include large blocks (larger than a house) of exotic rocks. Included blocks may have physical properties much different from adjacent rock. Gneiss typically jointed; joints dip steeply, commonly at least 1 m apart. Also typically has subhorizontal and some randomly oriented joints. Joints commonly offset 0.25–1 cm. Gneiss has widespread weak shear zones parallel to foliation, especially near Fall Line, 1 cm-1 m thick and continuous for great distances. Gneiss also has many aplite dikes, 1 cm-1 m thick, highly shattered in some places. Schist and metagraywake associations, typically interbedded, have much better developed bedding and foliation than gneiss. Dominant planar element in schist and metagraywacke commonly metamorphic foliation, commonly steeply dipping. Schist and metagraywacke have many small isoclinal folds and many shear zones parallel to foliation; shear zones generally highly micaceous and 1 cm-1 m thick. Shear zones generally contain unweathered or slightly weathered rock, but may contain soft soil. Joints in schist and metagraywacke commonly irregular and at many orientations; locally intensely developed but may be 1 m or more apart. Locally, structures and parent rocks of all rocks types commonly change abruptly laterally. Veins and pods of quartz common, 0.5 cm-0.3 m thick.	Saprolite typically highly micaceous silt containing some sand and clay; contains none to many parting planes. Massive saprolite forms on massive rocks; parting planes develop on highly foliated bedrock. Parting planes may be open slightly near ground surface. Saprolite varies from 0 to at least 20 m thick, and consistency varies from medium to stronger. Saprolite commonly at least 7–10 m thick, far from main streams. Physical properties typically change erratically vertically and laterally (based on Standard Penetration Test data). Depth to unweathered rock 0–50 m, averaging about 15 m. Depth of saprolite and weathered rock greatest on hilltops. Saprolite-weathered rock contact highly variable locally; may vary vertically as much as 10 m within 0.7–m distance in steeply dipping beds of mica schist and quartzite, because of highly variable weathering susceptibility. Shear zones relatively common, especially parallel to foliation plane in highly foliated rocks. Shear zones commonly contain slickensided material much weaker than surrounding weathered rock or seprolite; may contain clays at residual friction-angle strength condition.	Saprolite: ML, SM (MH)	Same as "Phyllite."	Same as "Phyllite."	Same as "Phyllite," except natural-moisture content of saprolite near ground surface commonly 5–10 percent less than plastic limit.	Same as "Phyllite."	Same as "Phyllite."	Same as "Phyllite."	Same as "Phyllite," except peak effective friction angle of highly plastic clay in some dikes probably about 20°. Clay-coated, continuous joints present at some places beneath clay-bearing Coastal Plain sediments. Joints have peak effective friction angles as low as 10°, and very small or no cohesion intercept on strength envelope.	Same as "Phyllite."	Same as "Phyllite," except friction angle may be much lower where saprolite and weathered rock beneath Coastal Plain sediments have clay-coated, continuous, planar joints. Permanent long slopes may be unstable at low angles, depending on joint orientation, clay coating, and shear zones.	Same as "Phyllite."

[1]The following letters indicate certain soil characteristics. First letter: G, gravel; S, sand; M, silt; C, clay; O, organic; Pt, peat. Second letter: W, well graded; P, poorly graded; M, silty; C, clayey; L, low plasticity; H, high plasticity. The materials are described in terms of major and minor occurrences; minor occurrences are in parentheses.

[2]Gneiss, schist, and metagrawacke are shown separately on "Preliminary bedrock map of Fairfax County, Va." (Drake and Froelich, 1977).

PHYSICAL PROPERTIES AND ENGINEERING CHARACTERISTICS OF WEATHERED MATERIAL DERIVED FROM METAMORPHIC ROCKS, FAIRFAX COUNTY, VIRGINIA

TYPICALLY HAS SAPROLITE AND WEATHERED ROCK CONSISTING OF FLAT, PLATY FRAGMENTS



RELATIONSHIP BETWEEN SLOPE DEGREES AND SLOPE PERCENT