DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TABLE 1. Physical Properties and Engineering Characteristics of Non-consolidated Materials, Fairfax County, Virginia

Open File 79-1221
(Table 1 of 3B)

Surface Materials Map Unit	Surface Materials Map Symbol	Description of Material	Unified Soil Classification 1/	Total Unit Weight (kilograms force per cubic meter)	Drainage and Natural Moisture Characteristics		Suitability as Compacted Material	Excavation Properties	Erodibility	Shear Strength and Compressibility Characteristics	Allowable Bearing Pressure (kilograms force per square centimeter)	Slope Stability	Road Performance Characteristics
					Surface Drainage	Internal Drainage and Natural Moisture							
Artificial Fill	1	Includes large graded areas of engineered highway and railroad fills, trash fills, gravel pits, and areas of major earthwork, such as airfields and dams. Highway and railroad fills are locally derived heterogeneous mixtures of soil and rock moved a short distance from borrow pits and cut sections, and compacted. Trash fills include household refuse, tree stumps, bed springs, etc., commonly mixed with earth materials and not compacted, at places to thicknesses of 10m. Gravel pits generally have heterogeneous mixtures of uncompacted soil, at places with trash. In urban areas fill of variable composition and thickness overlies natural materials at many places.	Variable	Engineered earth fills: 1450-1900. Sedimentation ponds: 1300-1600. Gravel pits: 1300-2100. Uncontrolled trash fills: 800-2400.	Engineered fills generally well drained. Trash fills and gravel pits commonly poorly drained.	Permeability usually low to very low in engineered fills, and usually low in trash fills, gravel pits, and sedimentation ponds. Fine-grained soils in engineered fills generally have natural moisture content near plastic limit. Fine-grained soils in gravel pits and trash fills have highly variable natural moisture contents, but are commonly very wet. Sedimentation ponds commonly extremely wet.	Engineered fills commonly suitable. Natural materials in gravel pits commonly suitable, but trash and wet fill are not usable. Trash fills and sedimentation pond materials unsuitable because of presence of stumps, boulders, bed springs, etc.	Engineered fills commonly can be excavated with light power equipment. In gravel pits and sedimentation ponds, wet soils can make excavation difficult. Trash fills with stumps, boulders, bed springs, etc., are difficult to excavate with light power equipment.	Engineered fills made of silty materials derived from residuum and saprolite commonly highly erodible; engineered fills of Coastal Plain deposits generally have sufficient clay binder to prevent serious erosion. Gravel pits and trash fills commonly highly erodible.	Engineered fills typically have stiff or stronger fine-grained soils and compact coarse-grained soils. Sedimentation ponds commonly have very soft soils, with extremely high compressibility characteristics. Gravel pits contain highly variable fill material near surface, but natural soils are typically strong and have low compressibility. Trash fills commonly have highly compressible materials such as bed springs, tree limbs, tin cans, etc.	Engineered fills: 2 and higher. Trash fills and sedimentation ponds: none commonly, requiring excavation and recompaction or removal, generally at least 1 where compacted with T-99 specifications, and organics removed. Gravel pit materials: highly variable, none to 3, natural materials generally having highest values.	Utility excavations in engineered fills of clay-rich soils typically stable to depths of 2m; granular soils stable at angles less than 30 degrees. Long permanent slopes typically stable at angles of 25 degrees, and steeper at places. Utility excavations in gravel pits and trash fills commonly unstable at depths greater than 1.3m. Long permanent slopes typically stable at angles of 25 degrees, and steeper in places. Utility excavations in sediment ponds commonly unstable at depths greater than 1-1.3m. Long permanent slopes commonly unstable at slope angles greater than 15 degrees.	Engineered fills generally perform well. Trash fills and sediment ponds commonly unsuitable as road foundations, and must be removed and replaced or recompacted. Gravel pits commonly perform well upon recompaction of previously dumped granular soils.
Alluvium	2	Highly variable deposits of sand, silt, clay, gravel, and boulders which have been transported and deposited by streams or rivers on valley bottoms or in lowlands. Areas of alluvium are subject to periodic flooding. Deposits are typically well to poorly graded, and commonly less than 6m thick. Commonly has layers 0.3-1m thick that change abruptly vertically and laterally. Generally tends to become coarser with increasing depth, and sometimes has organic layers near the surface. Fine-grained deposits are commonly strongest near the ground surface and become weaker with depth, apparently because of desiccation. Alluvium of streams draining the Piedmont was derived primarily from crystalline bedrock and saprolite. Fine-grained fractions commonly are very micaceous. Pebbles are commonly quartz. Iron-cemented boulders are occasionally found at the base of the alluvium. Alluvium of streams draining the Triassic Lowland commonly has reddish-brown pebbles and fragments derived from the surrounding sedimentary rocks, and is very sandy at base. At many sites adjacent to diabase, alluvium is very clay-rich and highly plastic. Alluvium in or near the channels of streams in upland areas of the Piedmont and Triassic Lowland is commonly dried and oxidized to some extent, and lighter colored and less rich in organics than that in the lowlands. Alluvium of streams draining the Coastal Plain commonly is derived from the sands, silts, clays, and gravels of the Coastal Plain sediments and Upland gravel deposits. Pebbles are typically well rounded quartz, quartzite, and chert. Many boulders are present near the Fall Line; further from the Fall Line, in swampy areas, the alluvium may contain weak organic material.	SM,SW,CL, ML,CH,OH, (SP,GM,OL, Pt)	1750-2100	In swales and lowlands water commonly at surface because of low relief, proximity to water table and fine-grained matrix.	Permeability highly variable laterally and vertically. Single-sized sands that occur in buried channels commonly have medium to high permeability. Silty sands and finer grained soils generally have low permeabilities. Soils commonly very wet or saturated near surface in swales and lowlands.	Commonly too wet to be used economically. Highly organic and clay-rich deposits generally unsuitable.	In swales and lowlands commonly difficult to excavate and ensure stability because groundwater near surface and soils weak. Iron oxide-cemented boulders occasionally in Piedmont and Coastal Plain.	Few problems, because of low relief, except where active stream erosion takes place.	Very soft to stiff clays, silts, and organic clays and silts usually soft to medium; commonly slightly overconsolidated as much as 0.2 kgf/cm² near surface; organic and very weak clays can undergo major long-term deformation, even under very light surcharge; possibility of settling under no additional surcharge at sites underlain by organic soils. Loose to medium compact sands. Occasional cemented boulders in uplands. Effective friction angle of clays about 20 degrees; sands, 30 degrees.	Fine-grained: none ordinarily. Coarse-grained: 2. Alluvium is generally unsuitable for heavy structures, commonly requiring piles to underlying geologic units, or displacement type of pile in soft sediments.	Utility excavations can fail on vertical slopes exceeding 1.3m height. Temporary excavations normally stable at 45 degrees; steeper slopes should be braced. Permanent long slopes generally stable at 35 degrees, but sometimes must be flatter.	High ground-water table throughout much of unit; organic-rich and very soft soils susceptible to densification and differential settlement, even with no embankment load.
Terrace Alluvium	3	Sand, gravel, silt, and clay deposited by water in abandoned river valley of ancestral Potomac River (Hybla Valley) and Mason Neck or along modern streams as terraces above present day flood plains. In Hybla Valley and Mason Neck it is commonly 15-25m thick, but can exceed 40m. Individual layers there range in thickness from 0.3-7m and can persist for long distances along the former direction of flow of the ancestral Potomac River. Outside Hybla Valley and Mason Neck, maximum thickness is about 5m. In the Coastal Plain, soils near the ground surface are often very fine-grained, wet, weak, and rich in organic material; it has occasional peat beds up to 7m thick. Outside the Coastal Plain, strata are typically coarser in texture and better drained.	SM,SW,CL, ML,CH,OH, (OL,SP,Pt)	1600-1900	In Coastal Plain, water commonly at surface because of proximity to water table, low relief, and fine-grained matrix; generally well drained outside Coastal Plain.	Permeability similar to Alluvium in Coastal Plain, generally higher outside Coastal Plain. Commonly very wet or nearly saturated in Hybla Valley and Mason Neck, drier outside Coastal Plain.	Commonly too wet to be used economically in Hybla Valley and Mason Neck; commonly suitable outside Coastal Plain.	Difficulties common in Coastal Plain, because ground water near surface, and soils weak. Few problems outside Coastal Plain.	Same as above.	Same as above, except there are no cemented boulders.	Same as above.	Same as above.	Same as above.
Colluvium and Lag Gravel	4	Colluvium consists of a loose, heterogeneous mass of fine-grained soil, saprolite, and coarse angular rock fragments, that accumulate as a result of mass wasting, generally on hillsides or at the base of hillslopes. Deposits are poorly sorted and crudely stratified with angular quartz fragments at many places. Lag gravel has materials similar to colluvium, but is a residual accumulation of coarse fragments remaining near the surface after the finer material has been removed by erosion or chemical weathering. Commonly less than 3m, but locally as much as 7m thick. Although not shown on the map, the lower parts of most upland slopes (beneath the line of contraflexure along the slope) in the Piedmont have thin colluvium 1-1.7m thick. This colluvium generally has a very silty matrix. Colluvium in the Triassic Lowland is typically thinner than in the Piedmont, with a silty to clayey silt matrix. In the Coastal Plain the colluvium is usually sand and gravel, with a plastic clay matrix, and thickness of 1.7-3 m is common. Locally, landslide deposits are associated with colluvium.	Outside Coastal Plain :ML,MH,SP Coastal Plain :SP,SM,SC, GP,GC,SP	1300-1900	Usually fairly well drained to well drained at upper parts of slope; seeps fairly commonplace at toes of slopes.	Permeability usually low outside Coastal Plain; commonly very low to low in Coastal Plain because of clay matrix. Natural moisture content highly variable, but many deposits above plastic limit at toes of slopes.	Locally suitable, but variability in properties at a given site makes control difficult; highly micaceous colluvium in Piedmont may be difficult to compact.	Typically few problems but can be very wet. Usually easy to drain excavations by removal of seepage water.	Silty deposits in Piedmont and Triassic Lowland typically very erodible.	Soft to stiff clays and silts; commonly normally to slightly overconsolidated; soft to medium consistency soils subject to very large deformations; highly micaceous, silty deposits subject to significant long-term deformations under normal foundation loadings. Effective friction angle commonly from 25 degrees to 30 degrees; may be considerably lower in clay-rich deposits of Coastal Plain.	Fine-grained: none to 1. Coarse-grained: 1 to 2. Generally unsuitable for heavy structures; sometimes can be excavated economically to underlying stronger units, where spread footings can be used.	Utility excavations can occasionally fail on vertical slopes exceeding 2-2.7m height, but normally stable. Outside Coastal Plain, susceptible to creep extending to depth of about 1m or greater on slopes exceeding 15 to 20 degrees. Retaining walls highly susceptible to frost damage on all slopes, but especially on slopes exceeding 17 degrees (30 percent).	Shallow ground-water table at many sites; outside Coastal Plain, micaceous and silty soils are very susceptible to frost heaving and weakening.
Upland Gravel	5	Consists primarily of rounded to subrounded gravel and cobbles of quartz, quartzite, and chert, with interstitial sand, silt, and clay. Moderately-to well-sorted. As much as 15 m thick, averaging about 10 m. Typically has lenses of silt and clay commonly less than 1.7 m but as much as 3 m thick, not usually continuous for large lateral distances. Iron oxide and clay cementation can form hardpan at depths from 0.3-3 m below the ground surface.	SM,SC,SW, CL,ML,(SP, GC,CH)	1900-2200	Hardpan can retain water at or near surface each spring and for many weeks after a rainy season; seeps common at contact with underlying Potomac Group sediments.	Permeability low and internal drainage generally slow above hardpan, generally much higher permeability and better drained below hardpan. Some local perched water tables, generally easily drained. Fine-grained soils commonly near plastic limit, and coarse-grained generally drained of free water, except in former channels. Seeping channels commonly cut into Potomac Group deposits beneath; some of these channels have single-sized coarse sands, and high permeability.	Commonly excellent source of fill, readily compacted.	Generally few excavation problems, but has some iron oxide-cemented layers near contact with Potomac Group. Usually easy to drain excavations by removal of seepage water.	Sands easily eroded where disturbed.	Clays and silts normally stiff to very stiff, rarely medium; typically overconsolidated 1.3 kgf/cm², rarely less, sometimes higher. Coarse-grained deposits range from medium to very compact, typically compact. Effective friction angle of clays about 25 degrees, sands 30 degrees to 38 degrees.	Fine-grained: commonly 1.5 to 2.5, can be 1 or less, or as high as 3. Coarse-grained: commonly 2 to 3, can be 1.5, or as high as 4. Commonly good for heavy structures on spread footings, and generally good for H-piles; large boulders can cause driving problems.	Utility excavations on vertical slopes deeper than 1.3 m commonly require bracing where saturated. Long permanent slopes generally stable at 35 degrees, but occasionally must be flatter.	Generally very good performance; drainage problems where hardpan retains water at surface.
Potomac Group, Predominantly Sand	6	An interbedded sequence of fine to coarse, locally pebbly sand, with some silt and clay layers and lenses. Sand and gravelly sand beds much more abundant than clay and silt-clay beds. Sand and gravel beds commonly many meters thick, but can range from less than 0.3m to greater than 50m. Clay and silt-clay beds typically much less than 3m thick. Areal extent of thin beds often very limited, but thick beds can persist for many hundreds of feet. Matrix of sand typically contains 35 percent silt and clay. Unweathered sands, at depths greater than 10 ft (3m), are normally very compact. Clay and silt-clay beds can comprise as much as 30 percent of this unit. Occasionally has joints and thin weak zones of shearing extending into unweathered materials.	SM,SP,SW, (GM,CL,CH)	2000-2200	Typically dry at surface within a few days after a rainy season, except where underlain by clay-rich sediments. Seeps on hillsides at many places.	Typically low, but medium in sand filled channels. Very low in strata containing highly plastic clays. Many local perched water tables. Coarse-grained deposits normally near plastic limit.	Sand-rich facies commonly very good as source of fill, providing it can be excavated easily and no fine-grained material present. Uppermost, weathered 3-5m is usually good source of fill; has sufficient clay binder to resist erosion.	Generally few excavation problems in weathered zone, but unweathered material may be difficult to excavate with light power equipment where matrix has highly plastic clay, or where unweathered fine-grained materials are encountered. Occasional iron-cemented layers to 0.3m thick. Usually easy to drain excavations by removal of seepage water, except in broad valleys and lowlands, where ground-water table is near the surface.	Generally has sufficient clay matrix to prevent serious erosion.	Weathered zone medium compact to compact; unweathered compact to very compact. Unweathered commonly overconsolidated 10-15 kgf/cm²; weathered can be normally consolidated, but usually retains some overconsolidation. Peak effective friction angle of 30 degrees to 35 degrees; residual effective friction angle commonly 22 degrees to 30 degrees (5 degrees to 8 degrees less than peak).	Unweathered coarse-grained: 3 to 6, as high as 8. Weathered coarse-grained: higher than 1.5. Unweathered normally very good for heavy structures, high bearing capacity for piles and caissons.	Temporary excavations normally stable at slopes of 60 degrees to depths of 3m, except where saturated; temporary excavations in unweathered sands commonly stable at steeper slopes, to greater depths. Sands with no clay matrix and jointed sands can be unstable at depths less than 3m. Long permanent slopes in unweathered zone should be designed using shear strength greatly reduced from peak values; possibility of joints and weathered, softened zones should be considered in design of permanent slopes.	Generally very good performance, except where fine-grained strata encountered.
Potomac Group, Predominantly Clay	7	An interbedded sequence of silt and clay with some sand and gravel lenses. Commonly sandy or silty clay, but may be massive clay. Ranges in thickness from less than 0.3 m to greater than 50 m. Areal extent of thin beds usually very limited, but thick beds can persist for many hundreds of meters. Primary clay mineralogy is montmorillonite, secondary is kaolinite. Unweathered clay normally hard, but commonly is weakened and has many soft zones within upper 3 m, caused by shearing and interaction with ground water. Thin soft seams can extend much deeper. Sand and silt beds may comprise as much as 30 percent of this unit.	CL,CH,ML, MH,(SM,SP, SW)	Weathered - 1600 Unweathered - 2100	Water retained at surface until removed by runoff or by evaporation. Water can be retained indefinitely in flat areas. Surface runoff generally good; however, on rolling topography small seeps present on many slopes.	Very low except in sandy strata; water may occupy joints and fractures near the surface; fractures may extend to great depths. Surface drainage important to presence of water in joints and fractures. Natural moisture content of unweathered zones generally near plastic limit, in weathered zones usually above plastic limit.	Difficult or impossible to compact properly owing to highly plastic clays with high shrink-swell potential.	Generally few problems in upper 3 m, but shear zones and joints occasionally cause wall instability, especially if water present in fractures and if fractures are permitted to open; drainage of joints and fractures may be insignificant if drainage initiated during construction period. Difficult to excavate with light power equipment, especially in unweathered zones.	Undisturbed highly plastic clays are extremely erodible; weather to thin chips, 1 cm square by 0.3 cm thick. Possibly dispersive.	Weathered zone soft to very stiff; unweathered very stiff to hard. Unweathered commonly overconsolidated 10-15 kgf/cm²; weathered can be normally consolidated, but usually retains some overconsolidation. Peak effective friction angle of 20 degrees to 30 degrees; residual friction angle commonly 15 degrees to 25 degrees (5 degrees less than peak).	Unweathered fine-grained: 2 to 5, higher where sandy. Weathered fine-grained: 0 to 2. Both weathered and unweathered subject to shrink-swell problems, if foundations not at least 4 ft (1.3 m) beneath ground surface; corrective drainage measures should be taken, and nearby trees removed. Unweathered normally good for heavy structures, with high bearing capacity for piles. Unweathered suitable for caissons, where not fractured and jointed.	Temporary excavations generally stable in vertical cuts to depths of 2.3 m, but occasional adversely oriented joints can cause large blocks to fall from wall. Water in joints can cause instability, and positive measures should be taken to protect critical excavations. Long permanent slopes can be unstable at angles as low as 10 degrees and possibly less in weathered and jointed zones. Possibility of jointed and sheared zones should be considered in design of all slopes. Residual parameters, or at least strength values greatly reduced from peak values, should always be used for design of permanent slopes.	Performance commonly poor, because of swelling characteristics and impermeability of clay. Swelling causes curbs to be misaligned and streets to heave differentially, and weakening of clay due to swelling results in low CBR values. Highly plastic clays amenable to lime stabilization.

[1] Soils in parentheses are present in secondary amounts.