Research Report

ENGINEERING GEOGNOSY OF BOYD COUNTY

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OF
BOYD COUNTY

INTRODUCTION

Engineering soils and geologic maps are proving to be invaluable tools of engineers, industrial leaders, community planners, and administrators during the preliminary stages of planning and site selection for major construction projects and the development of plans to use nature's basic resource--the land. Quantitative engineering data for soils and geological formations, and the interpretation of these data, are important factors to consider in the best land-use plans and in providing stable foundations and proper usage of earth materials for highways, buildings, and other earth structures. Engineering soils and geologic maps can be used to great advantage by planners and engineers to 1) make soil and geological reconnaissance surveys, 2) organize and check field surveys, 3) correlate and predict performances of soil and geological materials, and 4) locate construction material and resource deposits.

Recognizing the need and demand for this type of information, the Research Division of the Kentucky Department of Highways has undertaken a pilot study to report the engineering geognosy of a selected area in Kentucky. The area reported herein is located in the vicinity of Ashland.

This report discusses the engineering properties and behavior of unconsolidated surficial deposits and consolidated bedrock materials in Boyd County, Kentucky. It is based mainly on an interpretation of engineering test data retrieved and summarized from Kentucky Department of Highways' design and construction plans for routes I 64, KY 3, and US 60, which pass through the area; a soils report *(1)* prepared by the Soil Conservation Service for the city of Ashland; and published geologic reports and maps *(2, 4, 5)*. Engineering soils and geologic maps and interpretations presented in this report should be viewed from a standpoint of rapidly providing generalized engineering information of the different soil and rock materials in the subject area. For important earthwork and foundation engineering purposes and for detailed and specific data, it is recommended that the soil and rock materials at a particular site be explored and tested thoroughly.

AREA UNDER CONSIDERATION

The area under consideration, lying between latitudes 38° 14′N and 38° 30′N and longitudes 82° 34′W and 82° 49′W, is located in the northern part of the Eastern Coal Field, a major physiographic and geologic division of Kentucky. On the eastern and northeastern sides, the area, comprising approximately 159 square miles, is bounded by the Big Sandy and Ohio Rivers, respectively. Another sizeable river passing through the area is the Little Sandy. One metropolitan area, Ashland, with a population in excess of 31,000, is located on the relatively broad flood plain of the Ohio River and lies in the northeastern portion of the area. Many small towns and villages are located along the rivers passing through the area, and homes are scattered in the hill sections. Most of the hills are wooded, and much of the flood plains is open farm and pasture land.

PHYSICAL FEATURES AND GEOLOGY OF THE AREA

Topography of the area consists of steep, mountainous uplands of the Cumberland (Allegheny) Plateau and flood plain lowlands of the Ohio River and its tributaries. The area is a maturely dissected plateau exhibiting a dendritic drainage pattern with irregular, narrow, winding ridges, and deep, narrow valleys. Maximum elevation of the area is on the order of 1000 feet while the minimum elevation occurring along the flood plain of the Ohio River is about 500 feet. Surface drainage is either directly into the Ohio River or indirectly into it through the Big and Little Sandy Rivers and many small branches and streams which emerge from the hills. Deep channels have been cut into the sediments of the Ohio River flood plain by these streams.

Prior to Pleistocene time, the Ohio River drainage system cut wide, deep valleys into the Cumberland Plateau and drained northward toward the Great Lakes *(2)*. With the advancement of the Illinoian Ice Sheet, the Ohio River drainage system was blocked and forced to cut a new valley along the southern edge of the glacier to the Mississippi River, hence forming its present course. The Wisconsin Ice Sheet of the late Quaternary Period (Pleistocene Epoch) did not reach the Ohio River, but it did give rise to the formation of outwash plains along the Ohio River. When the Wisconsin Ice Sheet melted and retreated northward, the Ohio River valley was filled with glacial outwash materials -- gravels, sands, silts, and clay -- to a depth of several feet. During the Recent Epoch (Quaternary Period), or the time since the last withdrawal of the Wisconsin Ice Sheet, several feet of alluvium consisting of sands, silts, and clays have been deposited by the Ohio River over the glacier outwash material. The deposits of unconsolidated gravels, sands, silts, and clays thin out as they overlap onto the hill slopes lying south of the Ohio River.

Just south of the city of Ashland there is a section of an old plain where the hills are flat and do not rise above elevation 700 feet *(2)*. This area consists of both terraces and abandoned valley sections. The deposits in this gradation plain contain sand, gravel, quartz, and chert boulders, which, according to Phalen *(3)* are residual materials from the remains of older crystalline rocks of the Blue Ridge located east of Ashland. According to McFarland *(2)* the old valley floors contain pre-Illinoian drift, possibly the Jerseyan.

Rocks underlying the area are near-horizontal beds of sandstones, siltstones, shales, coals, limestones, and underclays *(4, 5)*. These rocks, representing the Conemaugh, Monogahela and Breathitt Formations (Pennsylvanian Age), dip eastward off the flanks of the Cincinnati Arch about 35 feet per mile. Thin residual soils cover the steep hill slopes.

DESCRIPTION OF EARTH MATERIALS

The map shown in Figure 1 is an adaptation of the geologic maps *(4, 5,)* of the Ashland and Boltsfork Quadrangles and sections of the Catlettsburg, Burnaugh, Argillite, and Rush Quadrangles. Correlation between map units and geological units is shown on the stratigraphic column in Figure 2.

Based on origin and position, the unconsolidated surficial materials, which are geologically much younger than the underlying bedrock material, have been broadly divided into river deposited alluvium, glacial terrace deposits, and residual deposits consisting of clayey soils underlain by sandstones and shales and soils derived from clays and semi-plastic shales associated with coal beds. Engineering data presented in Table 1 were obtained from Kentucky Department of Highways' design and construction records. Hole locations are by latitude and longitude and are shown on the map in Figure 1. Engineering data in Table 2 were taken from a soils report prepared by the Soil Conservation Service for the city of Ashland *(1)* . General sample locations for this data are shown in Figure 1.

The underlying (consolidated) sedimentary bedrock materials consist of interlayed shales, siltstones, limestones, sandstones, and coals. Table 3 summarizes the general engineering properties and behavior of the soil and rock units. The limitations of these materials for community and recreational development and for light industrial building of three stories or less are shown in Table 4.

UNCONSOLIDATED SURFICIAL MATERIALS

ALLUVIUM -- Alluvial deposits consisting of a matrix of clay with sand, silt, and gravel are geologically the most recent materials formed by the deposition of sediments from the many streams and rivers in the area (see Figure 1). These deposits make up the flood plains of both the large and small streams, extending well up to their heads. These alluvial soils of the bottom lands are composed of lensing and interfingering layers which often change drastically in thickness, gradation, density, and water content. Along the Big and Little Sandy Rivers, this material ranges up to 70 feet thick. Along tributaries, the thickness of the material is shallower, varying from 6 to 12 feet. The soils of the alluvial deposits classify by the textural, AASHO, and Unified Systems (Tables 1 and 2) predominantly as clays, A-7-6 or A-6, and CL, respectively. However, in a few locations, the soils classify as sandy clays and sandy clay loams, A-4, and SC and ML. On the average, the alluvial soils consist of about 47 percent clay, 27 percent silt, and 26 percent fine and coarse sand.

These alluvial deposits, except for the uppermost portion of the deposits, are "normally consolidated" and are highly compressible under heavy loads. Since these soils are normally consolidated, they will show a progressive increase in shear strength with increasing depth. Generally, the consistency will range from very soft near ground surface to firm to stiff at lower depths. Unconfined compressive strength will range from 0.25 to 2.00 tons per square foot. Undrained shear strength values can be determined using the plasticity index, Table 2, and a relationship presented by Bishop *(6)* .

In the top portion of the alluvial deposits, a slightly stiff surface crust has developed as a result of atmospheric drying and the effects of vegetation. This thin crust, five to ten feet thick, is "overconsolidated". An indicator of the overconsolidated nature of the crust is color. Usually a brownish or yellowish color of a soil indicates it has been exposed at one time above the water table and has been subjected to desiccation.

On exposure to the atmosphere, dark colored soils are oxidized and turn yellowish or brownish. Consequently, moderately high bearing pressures with only slight settlement can be adopted for narrow foundations in the surface crust, provided stresses induced by the weight of the structures are not transmitted to the more compressible, underlying layers.

In order to prevent damaging differential settlements and bearing-capacity failures for structures with high bearing pressures, or in the case of wide or deep foundations, it will be necessary to adopt lower bearing pressures. In the thick deposits along the Ohio, Big Sandy, and Little Sandy Rivers, consideration should be given to the use of raft foundations with moderate contact pressures. For very high bearing pressures, it will probably be necessary to transmit the induced loads through the compressible material to bedrock using a pile foundation. Care should be exercised to insure that the pile tips rest on firm bedrock and not on highly compressible blue shale and clays. In order to prevent frost heave, the bottoms of foundations should be located at a minimum depth of 30 inches.

The water table in low lying areas is within a few feet of the surface in the wet season. Basements in these areas need a properly designed pumping system to prevent flooding and to drain sewers, or provision should be made to waterproof the outside of the basement with an impervious membrane, such as asphalt. During application of the waterproofing material, continuous pumping may be necessary in order to keep the foundation dry and allow the material to set. For construction requiring excavations, some means may be required for lowering the water table. Since the alluvial soils usually contain a high percentage of clay material and the permeability of the soils is moderate, pumping from sumps can be used with little or no trouble.

Slopes of excavations will stand almost vertically in the alluvial material. An estimate of heights these slopes can stand without failure can be calculated using a relationship presented elsewhere *(7)*.

The alluvial soils may be used for fill construction with a slope ratio as much as 2::1 if compacted to maximum unit weight and optimum moisture content (AASHO Designation: T 99). These soils will perform from fair to good as subgrades for highways. Gullying of the fill slopes can occur from normal rainfall, and the side slopes should be covered at least with sod; the upper surface of slopes should be adequately drained. Generally, when the moisture content is properly controlled, the alluvial soils will compact readily with either sheepsfoot or pneumatic-tired rollers. Since these recompacted soils do not drain rapidly and may absorb water by capillarity with a resulting loss in strength, pavement design should be based on the saturated strength of the soils. Compressibility and expansion of these soils in the compacted state varies from medium to low. Potential frost action which can result in frost heave varies from slight to very high.

The location of highway embankments on the alluvial deposits may require settlement and stability analyses, especially where locally occurring thick, soft, wet foundation soils exist. These deposits, under moderate to heavy loads, are subject to considerable settlement and shear failures; when loaded too rapidly, excessive pore pressures may develop in the foundation material, resulting in a bearing capacity failure. It is estimated that at least one year may be required for most of the settlement to occur in these deposits; and even after this time, long-term settlements, which can damage pavements and buildings, may occur. Where practical, the unsuitable soils may be removed and replaced with better materials, or the foundation may be stabilized.

TERRACE DEPOSITS – A small portion of the area around Ashland contains terrace deposits which appear to be remnants of Pre-Illinoian Glacial Drift. These deposits generally classify by the textural, Unified, and AASHO classification systems as fine sandy loam, clay, or loam; ML, CL, SC, or SM; and A-4 or A-6, respectively. Depth to bedrock in these deposits generally ranges from 4 to 14 feet, but the depth may be as much as 45 feet.

The terrace deposits will make good foundation material and sustain moderate to heavy loads. These outwash plains, underlain by gravel, tend to have good drainage. These materials are compressible and, for structures located on these deposits, differential settlement and stability should be investigated. For highway purposes, these materials will make from fair to poor subgrades and subbases. These soils can be compacted using either sheepsfoot or pneumatic-tired rollers.

RESIDUAL SOILS -- The largest portion of the area is covered by residual soils. These include clayey soils, underlain by sandstone and shales of the Monongahela and Conemaugh Formations, and clays and semi-plastic shales associated with coal beds of the Breathitt Formation. Generally the residual soils are thin with depth to bedrock usually on the order of one to six feet. Development of a well defined profile in these soils has been prevented by washing on the steep slopes. In many places, rocks are exposed, and most often, the exposed rocks are sandstone with smaller outcroppings of shale. Textural, Unified, and AASHO classifications (Tables 1 and 2) representative of the clayey soils underlain by sandstones and shales are clay, CL and ML, and A-4 and A-6, respectively. For the clays and the semi-plastic shales associated with coal beds, representative soil classifications are clay and sandy clay, CL, ML, and SM-SC, and A-4 and A-6. On the average, the clayey soils consist of about 42 percent clay, 27 percent silt, and 31 percent fine and coarse sand. The clays associated with the coal beds consist of about 42 percent clay, 25 percent silt, and 33 percent fine and coarse sand.

The clayey soils underlain by sandstones and shales will make fair to poor subgrade material for highways (see Tables 3 and 4), mainly because of the moderate shrink-swell potential. They have a low bearing capacity and are subject to heaving when exposed to frost action. The clays and semi-plastic clays associated with coal beds will make poor subgrades for highways and should not be used. These soils have a low bearing capacity, high shrink-swell potential, and are subject to frost heaving. These soils will make poor foundations. Major engineering problems which are encountered in areas containing residual soils result generally from the undesirable characteristics of the underlying bedrock materials, and any site investigation should concentrate on these bedrock materials.

CONSOLIDATED BEDROCK MATERIALS

Bedrock materials (Pennsylvanian Age) in the area, from younger to older deposits, consist of interbedded sandstones and shales of the Monongahela Formation, and interbedded coals, underclays, sandstones, siltstones, and shales of the Breathitt Formation. A stratigraphic section of these materials is shown in Figure 2.

The shales vary widely in character and include fire clays, clay shales, silty shales, and sandy shales. In consistency, the shales vary from hard to very soft and are relatively impermeable. The soft shales have a very low CBR value and are undesirable as subgrade material. In many locations, this weathered, softened shale occurs just below the soil and may be as thick as six feet. When intact and unweathered, the hard shales will support moderate to heavy loads; however, on exposure to water or frost they are liable to softening. They will not stand in cliffs *(4)* unless capped with more resistant materials; these shales will stand in most cuts on slopes of 2::1. Some landslides have occurred in the shales and shaley siltstones of the Conemaugh Formation, especially where steep slopes exist.

Sandstones and siltstones in the area usually contain enough calcareous cementation to stand in steep cliffs when excavated. These sandstones cemented with calcareous material (calcium carbonate) are relatively resistant to weathering and will serve as excellent foundations. Some of the sandstones are cemented with a clayey material; on exposure to frost or water these sandstones are liable to softening. Clayey-cemented sandstones are less resistant to weathering than calcareous cemented sandstones and usually show a weathered zone of from one to three feet near exposed outcrops. However, these sandstones will support moderate to heavy loads. Some sandstones are uncemented and friable. Apparently the existence of these sandstones in the friable state has resulted from the dissolution of the calcareous cementing agent, forming irregular, random pockets of loose sand within the sound rock.

Consequently, great care should be exercised in exploratory drilling in these sandstones. In determining the thickness and extent of these friable sandstones, rotary core drilling is preferred over percussion drilling. Where the sandstones are more than a few feet thick, generally some blasting is required prior to their removal. The friable sandstones can be moved without blasting. Where hard sandstones overlie softer shales, rockfalls may be caused by shale weathering out from under the sandstones.

Underclays, plastic and semi-plastic shales, and associated coal beds of the Breathitt Formation are the weakest and least competent exposed rocks in the area. These materials are practically impermeable. They are unstable even at slopes of 3::1; and only when they are thin and capped at the top and bottom with more resistant materials will they stand vertically. Consequently, certain engineering problems are associated with this geologic formation *(4)*.

The majority of landslides in the area occur along the underclays of the Breathitt Formation. They are most prevalent in and near the outcrops of Princess Coal Beds 6 and 7, as evidenced by the many failures of roads that cross these coal beds. In hillside excavations for houses along these beds, many small landslides have occurred. The most significant factor in causing landslides is ground water, which seeps down through the more permeable silts and sandstones until it reaches the impermeable underclays. It migrates along the top of the underclays, and its presence is indicated in the form of intermittent springs or seepage zones. Many road failures have occurred where the road was located directly on the underclays. The underclays, when wet, tend to flow outward from underneath pavements. Subsidence of buildings and other structures are common in the southern section of Ashland *(4)*. This subsidence is a result of cave-ins of existing workings over the Princess No. 6 coal bed. Additional loading may put the coal workings in a state of incipient instability.

Failures of highway embankments can be prevented or minimized by removing the underlying clays and replacing with material that has a higher bearing strength. Where this may be impracticable, the foundation may be stabilized using vertical sand drains. It is essential that ground water which seeps along the underclays be intercepted by drains and conducted away from the highway embankments. Where embankments are to be in contact with outcrops of the underclays -- potential seepage zones, a drainage blanket of proper design should be interjected between original ground line and the bottom of the embankment. Slopes of highway cuts in the Breathitt Formation should be at least at a ratio of 3::1, in the Monongahela and Comenaugh Formations 2::1 slopes can be used. Terraced slopes can be used in these formations to control rock falls. Retaining walls with a properly designed backwall drainage system can be used to control oversteepened slopes. Before new buildings are planned or constructed, all land above the Princess No. 6 coal bed should be thoroughly explored for mined-out areas.

COAL WORKINGS

Coal layers vary in thickness from a fraction of an inch to four feet and have been mined for domestic and industrial use since the region was first settled. The most important coal producing beds are the Princess Nos. 5, 6, and 7 *(4)* . The Princess No. 7 coal has been mined extensively, and much of the readily available coal has been extracted. Princess Nos. 5 and 6 coals have also been mined to the point where there is little or no usable coal remaining.

FLOODS

Flooding could present a serious problem to the Ashland area, especially those areas not protected by the city flood wall. The peak flood *(8)* recorded in this area was in January 1937, when the Ohio River reached a gauge height of 73.6 feet with a discharge of 690,000 cfs. This compares to a mean annual flood of gauge height 54 feet and discharge of 428,000 cfs., a 25-year flood of gauge height 68 feet and discharge of 621,000 cfs., and a 50-year flood of gauge height 71 feet and discharge of 663,100 cfs.

Smaller streams could cause some flood damage, but the magnitude of the flood would be rather insignificant when compared to that of the Ohio River.

HYDROLOGIC CONDITIONS

ALLUVIUM DEPOSITS OF THE OHIO RIVER

Most wells drilled in these deposits are adequate for a modern domestic supply and will usually produce as much as 500 gallons per minute. Compound horizontal wells could be constructed that would yield more than the reported maximum. Water from these deposits is very hard.

ALLUVIUM OF STREAMS TRIBUTARY TO THE OHIO RIVER

Nearly all wells are dug in these deposits; most of these wells are adequate for a minimum domestic supply, producing about 100 gallons per day. A few wells are adequate for a modern domestic supply, yielding as much as 500 gallons per day. Water from these dug wells is moderately hard and contains noticeable amounts of iron. Screened, drilled wells probably can be developed where the alluvium is sandy and the saturated thickness is several feet.

CONEMAUGH AND BREATHITT FORMATIONS

All drilled wells in the valley bottoms will produce 100 gallons per day, and many yield more than 500 gallons per day. Yields of more than 500 gallons per day are also normal for almost half the wells drilled on hillsides, with smaller yields from the tops of these hills. Although coal seams supply water to a few wells, most common aquifers in these formations are sandstones. Water in this area is characteristically very hard, has a noticeable iron content, and is salty at depths about 100 feet below the valley bottoms.

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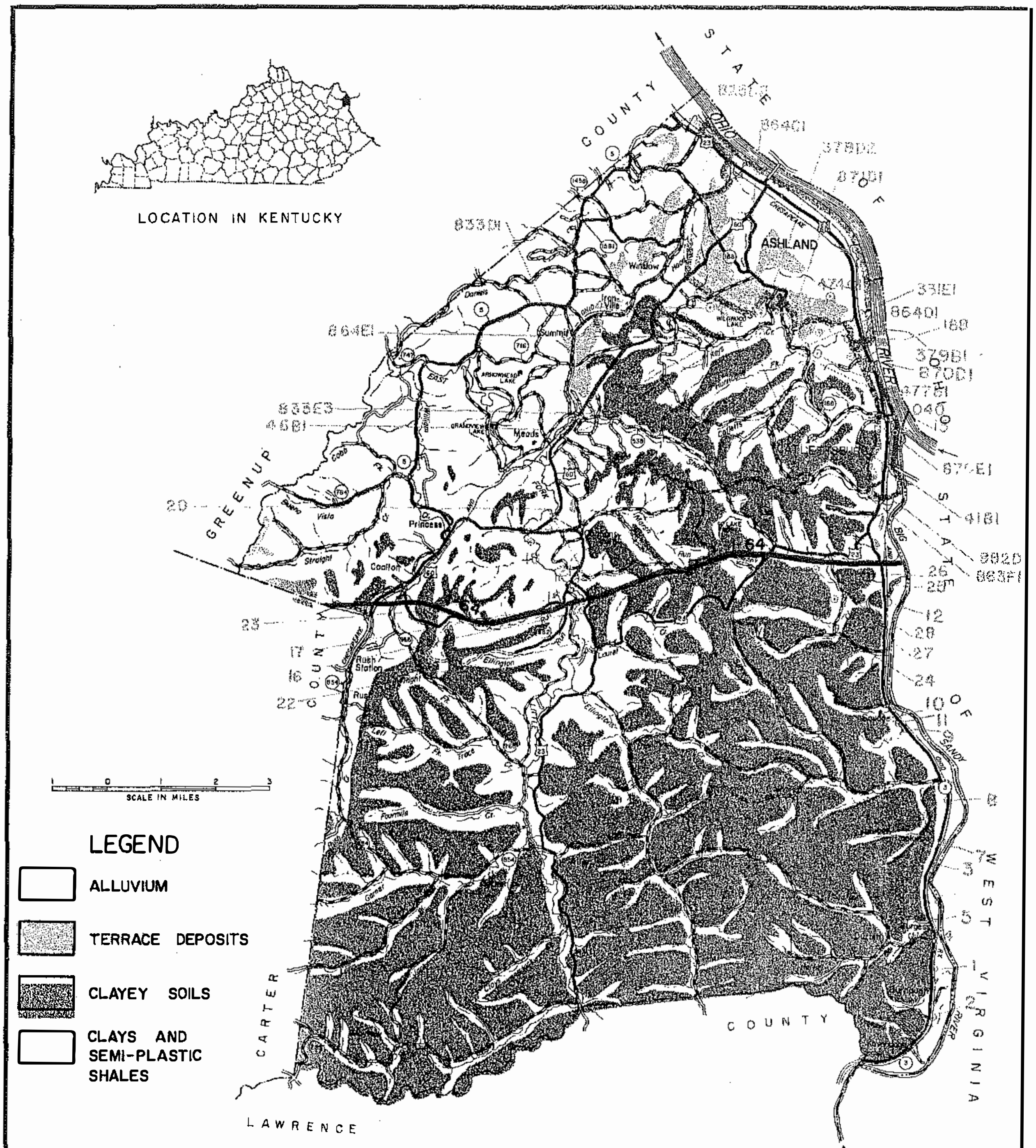

FIGURE I

GENERALIZED SOIL MAP
BOYD COUNTY
KENTUCKY

SYSTEM	SERIES	MAP UNITS	FORMATION	LITHOLOGY	THICKNESS (FEET)	DESCRIPTION
QUATERNARY		ALLUVIAL SOILS	ALLUVIUM		0-70	GRAVEL, SAND AND SILT
TERTIARY (?) AND QUATERNARY	PLIOCENE(?) AND PLEISTOCENE	TERRACE DEPOSITS	TERRACE DEPOSITS		0-45	SAND, SILT AND GRAVEL
CARBONIFEROUS PENNSYLVANIAN	UPPER PENNSYLVANIAN	RESIDUAL CLAYEY SOILS	MONOGAHELA FORMATION			SHALE, SANDSTONE & SILTSTONE THIN TO THICK BEDS 65 % SHALE 25 % SANDSTONE 10 % SILTSTONE
			CONEMAUGH FORMATION		160-600	SILTSTONE, SANDSTONE, SHALE AND LIMESTONE THIN TO THICK BEDS 40 % SILTSTONE 35 % SANDSTONE 15 % SHALE 10 % LIMESTONE
	MIDDLE PENNSYLVANIAN	RESIDUAL CLAYS AND SEMI-PLASTIC SHALES	BREATHITT FORMATION		290-455	SANDSTONE, SHALE, SILTSTONE LIMESTONE, COAL & UNDERCLAYS THIN TO MEDIUM BEDS 35 % SANDSTONE 25 % SHALE 10 % SILTSTONE 5 % LIMESTONE 25 % COAL & UNDERCLAYS

FIGURE 2 GENERALIZED COLUMNAR SECTION

TABLE 1. ENGINEERING SOIL TEST DATA

Map Unit	Underlying Material	Sample Number	Classification: Textural	Classification: AASHO	Classification: Unified	Depth To Bedrock (feet)	Depth (feet): Top	Depth (feet): Bottom	Maximum Dry Density (lbs/cu ft)	Optimum Moisture Content (percent)	Liquid Limit	Plasticity Index	California Bearing Ratio	Specific Gravity	Grain Size Distribution: Coarse Sand	Grain Size Distribution: Fine Sand	Grain Size Distribution: Silt	Grain Size Distribution: Clay	Grain Size Distribution: Colloids	Field Moisture Equivalent (percent)	Volume Change from Field Moisture Equivalent (percent)	Shrinkage Limit	Shrinkage Ratio
Alluvium	Shale	1	Clay	A-7	CL	6	0	1	106.6	19.9	43.0	21.0	6.5	2.73	2.9	12.8	26.7	6	33.9	27.0	6.9	22.9	1.68
			Clay	A-7	CH		1	2	102.4	21.3	58.3	34.6	3.0	2.77	2.0	6.9	19.8	71.3	44.9	30.3	17.0	20.6	1.76
			Clay	A-6	CL		2	6	116.7	14.2	34.0	16.0	5.0	2.76	9.0	21.8	34.5	53.7	25.2	22.0	8.4	17.5	1.86
		2	Clay	A-7	CL		0	1.5	106.6	19.9	43.0	21.0	6.5	2.73	2.9	12.8	26.7	57.6	33.9	27.0	6.9	22.9	1.68
			Clay	A-7	CH		1.5	3.5	102.4	21.3	58.3	34.6	3.0	2.77	2.0	6.9	19.8	71.3	44.9	30.3	17.0	20.6	1.76
			Sandy clay loam	A-6	CL		3.5		122.2	11.5	25.2	11.0	17.0	2.71	5.6	41.9	22.0	30.5	23.6	18.4	0.0	20.6	1.74
		3	Clay	A-7	CL		0		108.5	18.2	41.0	21.4	7.5	2.77	0.3	20.5	26.9	52.3	35.5	25.3	4.5	22.6	1.68
	Sandstone	4	Clay	A-7	CL	5	0	3	106.6	19.9	43.0	21.0	6.5	2.73	2.9	12.8	26.7	57.6	33.9	27.0	6.9	22.9	1.68
			Clay	A-7	CH		3	5	102.4	21.3	58.3	34.6	3.0	2.77	2.0	6.9	19.8	71.3	44.9	30.3	17.0	20.6	1.76
		5	Clay	A-7	CL		0	4	108.5	18.2	41.0	21.4	7.5	2.77	0.3	20.5	26.9	52.3	33.5	25.3	4.5	22.6	1.68
			Clay	A-7	CH		4		109.8	17.8	54.2	34.3	2.0	2.77	1.0	4.9	18.8	75.3	48.8	26.7	9.0	21.5	1.72
		6	Clay	A-7	ML-CL		0	1	101.7	19.1	42.6	17.1	9.5	2.62	1.4	19.2	40.8	38.6	18.2	29.3	13.1	20.3	1.46
			Clay	A-7	CL		1	5	108.5	18.2	41.0	21.4	7.5	2.77	0.3	20.5	26.9	52.3	33.5	25.3	4.5	22.6	1.68
			Clay	A-4	CL		5	7	115.6	14.1	24.3	8.0	13.5	2.69	0.3	42.5	24.5	32.9	23.6	19.5	0.0	20.0	1.72
	Sandstone boulders	7	Clay	A-7	ML-CL		0	6	101.7	19.1	42.6	17.1	9.5	2.62	1.4	19.2	40.8	38.6	18.2	29.3	13.1	20.3	1.46
			Clay	A-7	CL				108.5	18.2	41.0	21.4	7.5	2.77	0.3	20.5	26.9	52.3	33.5	25.3	4.5	22.6	1.68
			Clay	A-7	CH				109.8	17.8	54.2	34.3	2.0	2.73	1.0	4.9	18.8	75.3	48.8	26.7	9.0	21.5	1.72
			Clay	A-7	CH		6	8	109.8	17.8	54.2	34.3	2.0	2.73	1.0	4.9	18.8	75.3	48.8	26.7	9.0	21.5	1.72
			Clay	A-7	CL		8		109.1	19.4	49.0	29.0	3.5	2.58	2.2	4.3	30.7	62.8	40.0	25.9	17.7	16.2	1.82
		8	Sandstone boulders				0	2															
			Clay	A-6	CL		2	3.5	110.8	16.8	33.9	17.0	9.5	2.72	2.7	11.2	33.8	52.3	29.6	23.0	0.0	23.1	1.67
			Clay	A-7	CL				109.1	18.6	44.6	24.0	4.0	2.72	4.7	9.2	22.9	63.2	41.7	26.0	0.0	26.9	1.67
			Clay	A-6	CL		3.5		112.4	17.4	37.0	19.0	4.1	2.74	2.4	2.5	27.7	67.4	35.8	24.0	4.1	21.5	1.72
		9	Sandy clay loam	A-6	CL		0	4	118.6	13.0	26.0	13.0	13.6	2.74	0.6	57.7	10.1	31.6	22.6	18.4	0.0	21.0	1.71
		10	Clay	A-6	CL		0	3	108.3	17.0	37.0	18.0	8.0	2.68	0.7	24.5	29.1	45.7	31.7	24.0	0.0	33.1	1.42
			Clay	A-6	CL		3	4.5	107.8	18.8	39.0	18.0	3.5	2.81	0.5	9.7	27.5	62.3	35.9	25.4	1.8	21.9	1.73
		11	Clay	A-7	ML-CL		0	1	92.9	22.5	44.2	16.2	11.5	2.59	1.5	27.2	34.7	36.6	8.2	33.0	0.0	38.9	1.29
			Clay	A-6	CL		1	3	108.3	17.0	37.0	18.0	8.0	2.68	0.7	24.5	29.1	45.7	31.7	24.0	0.0	33.1	1.42
			Clay	A-6	CL		3	5	107.8	18.8	39.0	18.0	3.5	2.81	0.5	9.7	27.5	62.3	35.9	26.4	1.8	21.9	1.73
		12	Clay	A-6	CL		0		108.0	17.6	28.0	17.0	7.0	2.73	0.5	10.7	39.6	49.2	30.4	25.6	0.2	25.5	1.51
		13	Clay	A-6 or A-7	ML-CL		0	2	106.9	16.6	41.0	14.3	5.6	2.61	13.8	12.7	29.3	44.2	27.1	28.7	1.3	27.5	1.52
			Clay	A-6	CL		2		112.8	15.1	33.3	13.0	4.5	2.71	17.2	14.7	25.7	42.4	28.5	23.1	7.9	18.7	1.90
		14	Clay	A-4 or A-6	CL		0	1	116.3	16.6	31.1	12.2	4.5	2.66	6.0	32.2	22.2	39.6	20.8	21.3	0.0	22.7	1.66
			Clay	A-7	ML-CL		1		107.1	20.1	42.7	18.0	3.5	2.70	2.4	20.6	22.0	55.0	29.5	27.9	8.6	22.8	1.67
	Wet loose sand at 40 feet and shale at 50 feet	16	Clay	A-4	ML-CL		0	10			31.0	9.1		2.63	0.7	35.3	28.0	36.0	18.0	24.1	0.6	23.7	1.62
		16	Clay	A-6	ML-CL		0	6	109.0	17.2	34.0	11.8	4.7	2.72	0.4	32.0	26.4	41.2	22.6	24.0	0.0	26.1	1.59
		17	Clay	A-4 or A-6	ML-CL		0	6			32.2	11.3		2.70	4.2	31.4	24.8	39.8	20.8	22.9	0.0	21.8	1.70
	Sandstone	18	Clay	A-6	CL		0	5	116.4	14.5	33.8	14.9	4.7	2.67	10.8	32.4	25.0	35.9	17.8	21.3	0.0	26.6	1.56
			Clay shale				5	11															
			Clay shale with seams of mud and sandstone				11	21															
			Hard shale				21	31															
			Hard, weathered coarse sandstone				31	41															
	Sandstone	19	Clay	A-4	ML	4	0	4	111.6	16.6	25.9	3.9	4.7	2.63	7.5	35.3	24.0	33.0	14.0	23.0	5.6	19.8	1.73
Residual clayey soils underlain by siltstones, sandstones, and shales of the Monongahela and Conemaugh Formations	Sandy shale	25	Clay loam	A-7	ML-CL or MH-CH	2	0	2	99.9	22.1	49.6	19.7			2.8	1.2	25.9	27.3	42.8	33.9		27.2	1.53
	Clayey sandstone	26	Sandy loam	A-4 or A-6	ML-CL	1	0	1	111.4	16.4	36.0	11.8			6.7	20.4	25.0	19.8	28.1	26.7		22.6	1.67
	Sandy shale	27	Sandy loam	A-4 or A-6	ML-CL	9	0	6	100.1	19.1	34.3	9.8			5.8	41.2	30.5	13.8	8.7	26.5		28.8	1.55
			Sandy loam	A-4 or A-6	CL		6	7	110.6	16.9	29.2	10.1			5.6	26.4	25.2	16.1	26.7	22.1		24.2	1.60
			Sandy loam	A-7	CH		7	9	99.3	21.4	53.2	28.7			2.2	29.4	26.9	13.7	27.8	20.7		27.3	1.60
	Sandstone	28	Sandy loam	A-4 or A-6	ML-CL				100.1	19.1	34.3	9.8			5.8	41.2	30.5	13.8	8.7	26.5		28.8	1.55
			Sandy loam	A-6	CL				114.8	15.0	32.9	12.8			5.3	42.7	18.4	11.0	22.6	23.0		26.5	1.55
			Sandy loam	A-7	CL				102.1	19.3	42.2	24.4			2.7	14.5	19.6	17.1	46.1	21.8		23.8	1.61
			Sandy loam	A-4	ML				114.9	12.4	22.9	3.6			10.6	49.5	18.2	9.3	12.5	22.3			
			Sandy loam	A-4	CL				121.4	11.8	26.0	9.9			6.3	21.7	34.0	20.6	17.4	20.7		28.5	1.51
Residual clays and semiplastic shales underlain by coals, underclays, sandstones, siltstones, limestones, and shales of the Breathitt Formation	Clayey shale	20	Clay	A-6	ML-CL	0.5	0	0.5	111.4	16.4	35.0	11.8			6.7	20.4	26.0	47.0		25.7		22.6	1.67
		21	Clay	A-6	ML-CL	6	0	6	107.3	18.0	34.7	11.9			6.2	19.5	32.6	41.6		25.4		22.6	1.66
	Sandstone	22	Clay	A-6	CL	3	0	3	116.4	14.5	33.8	14.9			10.8	32.4	25.0	35.9		21.3		26.6	1.56
	Clayey shale	23	Clay	A-4 or A-6	ML-CL		0	3	104.2	18.4	34.4	9.3			4.6	14.5	39.2	41.6		28.3		30.9	1.45
			Clay	A-6 or A-7	ML	4	3	4	105.7	20.0	39.8	12.0			4.7	26.6	30.7	38.0		31.6		32.8	1.40
	Clayey shale	24	Clay	A-7	ML-CL	5	0	4	100.1	21.1	46.9	18.7			4.0	29.0	19.9	47.1		34.4		32.0	1.42
			Clay	A-6	ML-CL		4	5	103.7	19.0	38.0	12.2			3.3	34.1	16.5	46.1		30.1		27.8	1.51

TABLE 2. SUMMARY OF SOIL CHARACTERISTICS

Map Unit	Parent Material	Sample Number	Classification			Depth to Bedrock (feet)	Depth (inches)	Depth to Water Table (feet)	Percent Passing				Permeability (inches/hour)	Available Water Capacity (inches/inch of soil)	Reaction (pH Value)	Shrink-Swell Potential	Corrosivity	
			Textural	AASHO	Unified				No. 4	No. 10	No. 40	No. 200					Uncoated Steel	Concrete
Alluvium	Sandstones or shales	41B1, 41D1, 41E1	Gravelly loam	A-4	SM	5-9	0-13	4	75- 65	65- 75	60- 70	40- 50	2.00-6.30	0.13-0.16	4.5-5.5	Low	Low	Low
			Clay loam	A-4	SM or SC		13-36		80- 90	75- 85	65- 75	40- 50	0.63-2.00	0.17-0.19	4.5-5.0	Low	Moderate	Moderate
			Clay loam	A-4	SM or SC		36-50		70- 80	65- 76	45- 55	35- 45	0.63-2.00	0.16-0.17	4.5-5.0	Low	Moderate	Moderate
	Sandstones or shales	46B1	Loam	A-4	SM	6-12	0-12	1-2	100	90-100	80- 90	40- 50	2.00-6.30	0.15-0.18	5.1-5.5	Low	Low	Low
			Sandy clay loam	A-4 or A-6	SC or CL		12-23		100	90-100	80- 90	45- 55	0.63-2.00	0.17-0.19	4.5-5.0	Low	Moderate	Moderate
			Loam	A-4	SM		23-60		90-100	85- 95	75- 85	35- 45	2.00-6.30	0.15-0.17	4.5-5.0	Low	Moderate	Moderate
	Sandstones or shales	477B1	Loam	A-4	ML or CL	6-12	0-12	4+	100	90-100	90- 95	50- 60	2.00-6.30	0.16-0.18	5.6-6.0	Low	Low	Low
			Clay loam	A-6	ML or CL		12-50		100	95-100	90- 95	65- 75	0.63-2.00	0.18-0.20	5.1-5.5	Low	Low	Low
			Loam	A-4	SM or SC		50-72		90-100	90- 95	75- 85	40- 50	2.00-6.30	0.15-0.17	4.5-5.0	Low	Moderate	Moderate
		379B1	Silt loam	A-4	ML	8-12	0- 8	5-8	100	90-100	85- 95	70- 80	0.53-2.00	0.20-0.22	5.6-6.0	Low	Low	Low
			Silty clay loam	A-6	CL		6-36		100	90-100	85- 95	75- 85	0.63-2.00	0.18-0.20	5.1-5.6	Low	Low	Low
			Silty clay loam	A-6 or A-4	CL or ML		36-48		90-100	85- 95	80- 90	65- 75	0.63-2.00	0.17-0.19	4.5-5.0	Low	Moderate	Moderate
	Sandstones or shales	188	Fine sandy loam	A-4	SM or ML	6-10	0-30	1-2	95-100	90-100	70- 80	40- 60	2.00-6.30	0.15-0.17	5.1-5.5	Low	Low	Low
			Fine sandy loam	A-4	SM		30-60		95-100	90-100	65- 75	40- 50	2.00-6.30	0.13-0.15	4.5-5.0	Low	Moderate	Moderate
Terrace deposits	Sandstones or shales	378C1, 378D2	Fine sandy loam	A-4	ML	4-9	0- 6	3-5	100	90-100	85- 95	50- 60	2.00-6.30	0.15-0.18	5.1-5.5	Low	Low	Low
			Clay loam	A-6	ML or CL		6-36		100	90-100	85- 95	65- 75	0.63-2.00	0.17-0.19	4.5-5.0	Low	Low	Low
			Loam	A-4 or A-6	SC or SM		36-60		95-100	90- 95	85- 95	35- 45	2.00-6.30	0.15-0.17	4.5-5.0	Low	Moderate	Moderate
	Sandstones or shales	474C1	Fine sandy loam	A-4	SM	8-14	0-14	6+	100	90-100	80- 90	40- 50	2.00-6.30	0.14-0.17	5.1-5.5	Low	Low	Low
			Sandy clay loam	A-4 or A-6	SC or CL		14-28		100	90-100	80- 90	45- 55	0.63-2.00	0.15-0.18	4.5-5.0	Low	Moderate	Moderate
			Clay loam	A-6	CL		28-50		100	90-100	80- 90	55- 65	0.63-2.00	0.17-0.19	4.5-5.0	Low	Moderate	Moderate
			Sandy loam	A-2 or A-4	SM		50-72		90-100	86- 95	60- 70	30- 40	2.00-6.30	0.13-0.15	4.5-5.0	Low	Moderate	Moderate
Residual clayey soils underlain by siltstones, sandstones, and shales of the Monongahela and Conemaugh Formations		870D1, 870E1, 871F1	Fine sandy loam	A-2	SM	1.5-3.5	0-10	None	95-100	95-100	90- 95	25- 35	6.30-20.0	0.12-0.14	4.5-5.0	Low	Moderate	Moderate
			Fine sandy loam	A-2	SM		10-25		95-100	95-100	90- 95	25- 35	6.30-20.0	0.13-0.15	4.5-5.0	Low	Moderate	Moderate
			Sandy loam	A-2	SM		25-36		85- 95	80- 90	75- 85	20- 30	6.30-20.0	0.12-0.14	4.5-5.0	Low	Moderate	Moderate
		882C1, 882D1	Silt loam	A-4	ML	1.5-3.5	0-11	3-4	95-100	90- 95	80- 90	75- 85	0.63-2.00	0.19-0.21	4.5-5.0	Moderate	Moderate	Moderate
			Silty clay	A-7	CL or CH		11-30		95-100	90- 95	80- 90	80- 90	0.20-0.63	0.16-0.18	4.5-5.0	High	Moderate	Moderate
			Silty clay	A-7	CL or ML		30-38		95-100	75- 90	65- 75	60- 70	0.20-0.63	0.14-0.16	4.0-5.0	High	High	High
		833D2, 833E3	Silt loam	A-4 or A-6	ML	3-6	0- 4	4-6	95-100	90-100	85- 95	80- 90	0.63-2.00	0.17-0.19	5.1-5.5	Moderate	Moderate	Moderate
			Silty clay	A-7	CH		4-18		100	100	100	95-100	0.20-0.63	0.15-0.17	5.1-5.5	High	Low	Low
			Clay	A-7	CH		18-36		100	100	100	95-100	0.06-0.20	0.14-0.16	5.1-6.0	High	Low	Low
			Silty clay	A-6	CL or ML		36-48		95-100	90- 95	85- 90	65- 75	0.06-0.20	0.13-0.15	6.1-6.5	High	Low	Low
		825D2	Silty clay loam	A-4 or A-6	ML	2-4	0-10	1.5-3	100	100	90-100	80- 90	0.63-2.00	0.16-0.18	4.5-5.0	Moderate	Moderate	Moderate
			Silty clay	A-7	MH or CH		10-26		100	100	90-100	80- 90	0.06-0.20	0.13-0.17	4.0-5.0	High	High	High
			Silty clay loam	A-7	ML or CL		26-40		95-100	95-100	80- 90	75- 85	0.06-0.20	0.13-0.15	4.0-5.0	High	High	High
Residual claya and semiplastic shales underlain by coals, underclays, sandstones, siltstones, limestones, and shales of the Breathitt Formation		331E1	Silt loam	A-4	ML or CL	3.5-6	0-12	4+	95-100	80- 90	70- 80	65- 75	0.63-2.00	0.20-0.22	4.6-5.0	Low	Low	Low
			Silty clay loam	A-6 or A-7	ML or CL		12-36		95-100	80- 90	70- 80	70- 80	0.20-0.63	0.18-0.20	4.5-5.0	Moderate	Moderate	Moderate
			Silty clay loam	A-7	MH or CH		36-50		80- 85	70- 80	60- 70	55- 65	0.20-0.63	0.14-0.16	4.5-5.0	Moderate	Moderate	Moderate to High
		40F1	Silty loam	A-4	ML	4-9	0-12	6+	85- 90	75- 85	60- 70	45- 55	0.63-2.00	0.20-0.22	5.1-5.5	Low	Low	Low
			Silty clay loam	A-4	ML or CL		12-28		80- 85	65- 75	55- 65	55- 65	0.63-2.00	0.20-0.22	4.5-5.0	Low	Moderate	Moderate
			Silty clay loam	A-6	ML or CL		28-50		75- 80	60- 70	55- 65	50- 60	0.68-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
		40F1	Silt loam	A-4	ML	1.5-3.5	0- 8	4+	90-100	85- 90	75- 85	55- 65	0.68-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
			Silty clay loam	A-4 or A-6	ML or CL		8-19		90-100	85- 90	75- 85	60- 70	0.83-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
			Silty clay loam	A-4 or A-6	ML or CL		19-36		85- 95	70- 80	60- 70	60- 60	0.63-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
		863F1	Silt loam	A-4	ML	1.5-3.5	0-10	3-4	95-100	90- 95	80- 90	75- 85	0.63-2.00	0.19-0.21	4.5-5.0	Moderate	Moderate	Moderate
			Silty clay	A-7	CL or CH		10-28		95-100	90- 95	80- 90	80- 90	0.20-0.63	0.16-0.18	4.5-5.0	High	Moderate	Moderate
			Silty clay	A-7	CL or ML		28-34		95-100	75- 90	65- 75	60- 70	0.20-0.63	0.14-0.16	4.5-5.0	High	High	High
		863F1	Silt loam	A-4	ML	1.5-3.5	0- 8	4+	90-100	85- 90	75- 85	55- 65	0.63-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
			Silty clay loam	A-4 or A-6	ML or CL		8-19		90-100	65- 90	75- 85	60- 70	0.63-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
			Silty clay loam	A-4 or A-6	ML or CL		19-36		85- 95	70- 80	60- 70	50- 60	0.63-2.00	0.16-0.18	4.5-5.0	Low	Moderate	Moderate
			Silt loam	A-4	ML	1.5-3.5	0-10	4+	90-100	85- 90	75- 85	55- 65	0.63-2.00	0.18-0.20	4.5-5.5	Low	Moderate	Moderate
			Silty clay loam	A-4 or A-6	ML or CL		10-23		90-100	85- 90	75- 85	60- 70	0.63-2.00	0.18-0.20	4.5-5.0	Low	Moderate	Moderate
			Silty clay loam	A-4 or A-6	ML or CL		23-30		85- 95	70- 80	60- 70	50- 60	0.63-2.00	0.16-0.18	4.5-5.0	Low	Moderate	Moderate

TABLE 3. GENERALIZED ENGINEERING INTERPRETATION OF SOIL AND ROCK UNITS

Map Unit	Relative Suitability						Building Foundation	Sand and Gravel	Topsoil
	Roadways		Foundations	Rolled Earth Dams					
	Fills	Subgrades		Homogeneous Embankment	Core	Shell			
Alluvium	Good to fair, slopes of 2:1 can be used and should be protected by sod, low shrink-swell	Fair to poor, low CBR's	Fair to poor, subject to long-term settlements	Good to fair	Good to fair	Cannot be used	Good to fair, will sustain moderate to heavy loads, shear strength increases with increasing depth; top portion overconsolidated, lower portion normally consolidated; allowable bearing pressure about one to two tons per square foot, limited by considerations of overall settlement which can occur in these soils; depth to bedrock ranges from six to twelve feet in tributary areas, along the Ohio River material may be as thick as 70 feet and along Big and Little Sandy Rivers material may be as thick as 50 feet; compacted fill has allowable bearing pressure equivalent to natural soil if compaction is controlled	Unsuited, contains fine material	Good in upper foot, contains some gravel
Terrace deposits	Good to fair, slopes of 2:1 can be used and should be protected by sod, low shrink-swell	Fair to poor	Fair to poor, subject to long-term settlements	Good to fair	Good to fair	Cannot be used	Good to fair; will sustain moderate to heavy loads; top portion overconsolidated, bottom portion normally consolidated; allowable bearing pressure about one to two tons per square feet, depth to bedrock ranges from eight to fourteen feet, but may be as thick as 45 feet	Unsuited, contains fine material	Good in upper foot, contains some gravel
Residual clayey soils underlain by siltstones, sandstones, and shales of the Monogahela and Conemaugh Formations	Fair to poor, slopes of 2:1 can be used and should be protected by sod, moderate shrink-swell	Good to poor	Fair to poor, subject to long-term settlements and ground water seepage	Fair	Good to fair	Cannot be used	Fair to poor, allowable bearing pressure about 0.5 to two tons per square foot, clayey materials subject to swell with access to water and long-term settlements, depth to bedrock ranges from three to six feet Shales will sustain moderate to heavy loads when dry, allowable bearing pressure may be as much as ten tons per square foot when shales are not exposed to water or weathering; sandstones and siltstones are excellent foundation materials and will sustain heavy loads, allowable bearing pressure on the order of 20 tons per square foot; calcareous cementing medium of sandstone subject to dissolution, forming random pockets of loose sand, rotary core drilling preferred to expose these pockets; sandstones are somewhat weather resistant and may be underlain by weaker shales.	Unsuited, contains fine material	Good to poor in upper foot
Residual clays and semiplastic soils underlain by coals, underclays, sandstones, siltstones, limestones, and shales of the Breathitt Formation	Fair to poor, highway fills should not be located on underclays and shales without adequate drainage, high shrink-swell	Fair to poor	Poor, subject to long-term settlements and ground water seepage	Fair to poor	Good to poor	Cannot be used	Poor, allowable bearing pressure about 0.5 to one ton per square foot; subject to long-term settlements, swelling and frost heave; depth to bedrock about three to six feet; deep shales may have an allowable bearing capacity of ten tons per square foot when dry, but bearing strength decreases when wet or exposed to weathering; subsidence of buildings due to cave-ins of many mined-out areas in the southern part of the city of Ashland has occurred	Unsuited, contains clayey material	Fair to poor in upper foot, high clay content

TABLE 3. GENERALIZED ENGINEERING INTERPRETATION OF SOIL AND ROCK UNITS

Map Unit	Ground Water Conditions	Permeability in Natural State	Permeability when Compacted	Compressibility when Compacted and Saturated	Shearing Strength when Compacted and Saturated	Workability as a Construction Material	Potential Frost Action	Slope Stability in Open Cuts	Erosion Resistance
Alluvium	Severe, seasonal high water table in low areas is within two feet of surface, flood hazard exists in low areas	Moderate	Semipervious to impervious	Medium to low	Good to fair	Good to fair, easily moved with power and hand equipment	Slight to very high	Cut slopes stand steeply to near vertical	Moderate to slight, subject to scouring in overflow areas
Terrace deposits	Moderate, seasonal high water table is usually more than six feet from surface	Moderate to moderately rapid	Semipervious to impervious	Good to fair	Good to fair	Good to fair, easily moved with power and hand equipment	Slight to very high	Cut slopes stand steeply to near vertical	Moderate to slight
Residual clayey soils underlain by siltstones, sandstones, and shales of the Monogahela and Conemaugh Formations	Moderate, seasonal high water table varies from four to six feet from surface	Very slow to rapid, siltstones and sandstones are pervious, shales are impervious	Semipervious to impervious	High to low	Good to poor	Fair to poor, easily moved with power and hand equipment Siltstones and sandstones require blasting before removal, shales and sandy shales can usually be removed without blasting	Slight to very high	Cut slopes stand steeply to near vertical Cut slopes in shales will not stand in cliffs unless capped with more resistant materials; stable in slopes of 2:1; where hillsides are steep, some landslides are present in shales; cut slopes in sandstones stand nearly vertical, except where uncemented and friable, and should be terraced to prevent rockfalls	Slight on steep slopes and when not covered with vegetation
Residual clays and semiplastic soils underlain by coals, underclays, sandstones, siltstones, limestones, and shales of the Breathitt Formation	Severe, seasonal high water table is usually within one to three feet of surface, in wet season soils may become waterlogged, intermittent springs and seepage zones present along outcrops of underclays	Moderately slow to moderate, underclays and plastic and semiplastic shales are impervious, sandstones pervious	Semipervious to impervious	Medium	Fair to poor	Good to poor, easily moved with power and hand equipment, plastic and semiplastic shales and underclays can usually be removed with power equipment	Medium to very high	Cut slopes in underclays, plastic to semiplastic shales, and coal beds are unstable at 3:1; numerous landslides prevalent along underclays where slopes are steep; shales capped by sandstone tend to weather, resulting in rockfalls; cuts should be terraced	Slight on steep slopes and when not covered with vegetation

TABLE 4. GENERALIZED SOIL LIMITATIONS FOR COMMUNITY DEVELOPMENT, RECREATIONAL USES, AND LIGHT INDUSTRIAL BUILDINGS

Map Unit	Community Development						
	Sewage Effluent	Sewage Lagoons	Homesites or Small Buildings with Small Basements	Streets and Parking Lots	Lawns and Landscaping	Sanitary Fills	Cemeteries
Alluvium	Severe, seasonal high water table, flood hazard on lower areas	Moderate to severe, permeability too rapid	Moderate to severe, Seasonal high water table, flood hazard on lower areas	Moderate to severe, seasonal high water table, flood hazard on lower areas	Moderate to severe, slight to some areas, seasonal high water table, coarse fragments present in some areas	Severe in most areas, seasonal high water table, flood hazard on lower areas	Slight to severe, seasonal high water table, flood hazard on lower areas
Terrace deposits	Moderate to severe, sloping	Severe, sloping	Moderate, sloping	Severe, sloping	Moderate to severe, sloping	Moderate to severe, sloping	Moderate to severe, sloping
Residual clayey soils underlain by siltstones, sandstones, and shales of the Monongahela and Conemaugh Formations	Severe, steep slopes and shallow depth to bedrock	Severe, steep slopes, rapid permeability, and shallow depth to bedrock	Moderate to severe, steep slopes, shallow depth to bedrock, shrink-swell and soil stability unfavorable in some areas, and stoney	Severe, steep slopes	Severe, steep slopes, shallow depth to bedrock and danger of erosion on steep slopes	Severe, steep slopes and shallow depth to bedrock	Severe, steep slopes and shallow depth to bedrock
Residual clays and semiplastic shales underlain by coals, underclays, sandstones, siltstones, limestones, and shales of the Breathitt Formation	Severe, steep slopes, slow permeability and shallow depth to bedrock	Severe, steep slopes and shallow depth to bedrock	Moderate to severe, high shrink-swell potential, steep slopes, and shallow depth to bedrock	Severe, high shrink-swell potential and steep slopes	Moderate to severe, steep slopes, shallow depth to bedrock, and danger of erosion on steep slopes	Moderate to severe, steep slopes, shallow depth to bedrock, and slow permeability	Moderate to severe, steep slopes, shallow depth to bedrock, and slow permeability

Map Unit	Recreational Uses							Light Industrial Buildings
	Camp Sites		Picnic and Play Areas	Athletic Fields	Golf Fairways	Paths and Trails	Access Roads	
	Tents	Trailers						
Alluvium	Moderate to severe, seasonal high water and flood hazard on lower areas	Moderate to severe, seasonal high water and flood hazard on lower areas	Slight to severe, seasonal high water table and flood hazard on lower areas	Slight to severe, seasonal high water table, flood hazards on lower areas, and sloping	Moderate to severe, seasonal high water table, flood hazard on lower areas, and sloping	Moderate, seasonal high water, and flood hazard on lower areas	Moderate to severe, flood hazard on lower areas	Moderate to severe, poorly drained
Terrace deposits	Moderate to severe, sloping	Severe, sloping	Moderate to severe, sloping	Severe, sloping	Moderate to severe, sloping	Slight to moderate	Moderate, sloping	Moderate
Residual clayey soils underlain by siltstones, sandstones, and shales of the Monongahela and Conemaugh Formations	Severe, steep slopes	Severe, steep slopes	Severe, steep slopes	Severe, steep slopes	Severe, steep slopes	Severe, steep slopes	Severe, steep slopes	Severe, steep slopes
Residual clays and semiplastic shales underlain by coals, underclays, sandstones, siltstones, limestones, and shales of the Breathitt Formation	Moderate to severe, steep slopes	Severe, steep slopes	Moderate to severe, steep slopes	Severe, steep slopes	Moderate, steep slopes	Slight to moderate, steep slopes	Slight to moderate, steep slopes	Severe, steep slopes