DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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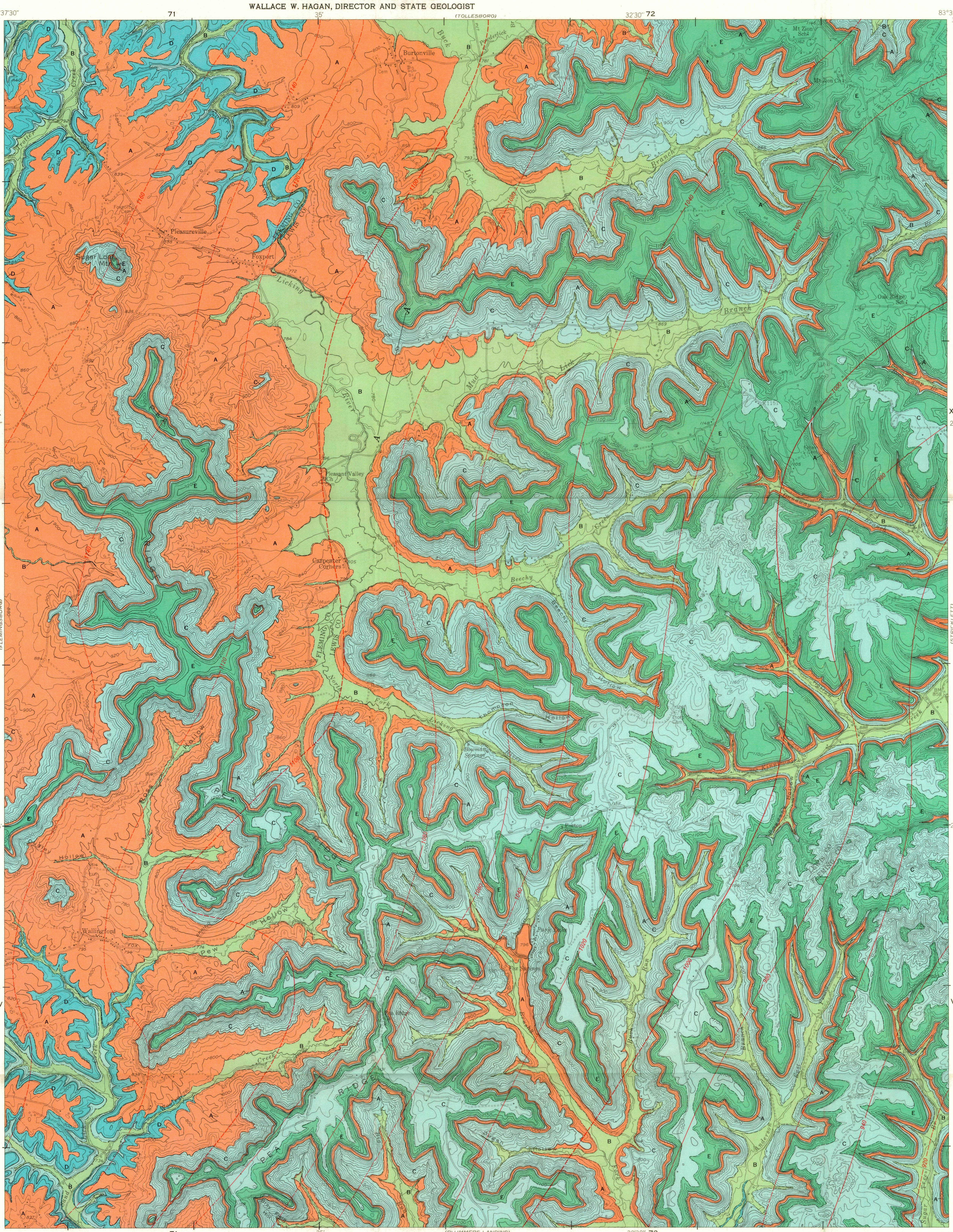
MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-460

SYSTEM	SERIES	FORMATION AND MEMBER	MAP UNIT	LITHOLOGY	THICKNESS, IN FEET	DESCRIPTION
QUATERNARY		Alluvium	B		0–15	Sand, silt, clay, and gravel; locally derived, medium permeable; surface runoff rapid, lowlands subject to flooding particularly along North Fork Licking River; highly susceptible to erosion, particularly gullying. Soil mantles thin porous alluvium.
CARBONIFEROUS, MISSISSIPPIAN	Lower Mississippian	Borden Formation: Siltstone member	E		60+ (Borden Formation 400+)	Siltstone, medium-gray to greenish-gray, moderately indurated, irregularly bedded; weathers to large light-buff blocky slabs; iron stained along fractures and bedding planes; gradational into underlying shale, contact placed at base of lowest siltstone bed. Remnants cap highest hills in southeastern part of quadrangle.
		Borden Formation: Shale member	C		100–220	Silty shale and shaly siltstone; light-gray to buff, moderately indurated, indistinctly bedded; contains nodules and lenses of ironstone; slightly calcareous; hackly to indistinct fracture; weathers to very argillaceous yellow clay soil of low permeability. Fossils include abundant blue-gray worm trails, common *Taonurus*, and very rare poorly preserved brachiopods. Lower contact gradational, with thin, evenly bedded very fine grained sandstone beds becoming progressively more abundant northeastward. Shale thins by laterally grading northeastward into sandstone. Contact placed at top of highest sandstone bed of underlying unit. Forms gullied knobs and rounded hills capping broad divides. Surface drainage fair, numerous ponds in natural depressions.
		Borden Formation: Sandstone member	E		60–140	Sandstone, very light brown to buff, very fine to fine-grained, moderately cemented; sand grains are subangular quartz, rare mica plates and pyrite; clayey matrix, porous and permeable; distinctly evenly bedded in units up to 2 feet thick; massive lower part, thin-bedded upper part. *Taonurus* very abundant on bedding planes. Weathers to angular blocks up to 4 feet in length which slump into and choke drainage in the valley heads. Locally interbedded with shale of underlying unit. Unit forms prominent ledge or rim of the uplands.
					15–20	Clay shale, green with bands of dark-reddish-brown, ½-inch beds, blocky to conchoidal fracture, moderately indurated; weathers to medium-brown clayey soil; poor porosity and permeability. Unit and underlying formation form topographic recess above bench.
		Sunbury Shale	C		15–20	Shale, black, fissile, highly carbonaceous; contains rare pyrite specks and crystals; breaks into thin even plates ¼ inch or less in thickness; weathers to light-brown clayey soil. Contains abundant conodonts.
DEVONIAN OR MISSISSIPPIAN (?)		Bedford Shale	A		20–60	Shale and siltstone: Shale, grayish-yellow to greenish-gray, thin- and irregularly bedded; weathers to yellow clayey soil. Siltstone, gray to greenish-gray, thin-bedded; ripple marks common with crestline trends varying from east-west to N. 50° W.; siltstone more abundant in northeastern part of quadrangle. Formation contains abundant crystals and nodular masses of pyrite. Worm trails and animal borings common along bedding planes. Not stable on steep slopes, tends to form slides and slumps particularly along basal contact.
DEVONIAN	Upper Devonian	Ohio Shale	C		140–200	Shale, dark-gray to black, thin- and evenly bedded, fissile, highly carbonaceous, moderately indurated, rarely pyritic; weathers to light-grayish-brown chips. Locally greenish-gray clayey shale 1 to 5 feet thick occurs near base. Springs are common near base; water is generally sulphurous; rock has low porosity but is permeable where highly fractured or jointed. Contains abundant conodonts and very rare small brachiopods. Rests unconformably on Bisher(?) Limestone or on Crab Orchard Formation; thins southwestward. Relatively resistant to erosion, forms distinct topographic bench at upper contact and steep slopes along valley walls.
SILURIAN	Middle Silurian	Bisher(?) Limestone	D		0–10	Limestone, gray to reddish-brown, varies from finely crystalline to coarse-grained sandy limestone, lenticular crossbeds 3 to 5 feet thick, ferruginous; weathers to reddish-brown soil. In places the unconformity at top marked by a punky ferruginous zone along which springs are profuse (i.e. along north side Beechy Creek valley). Unit present in outcrop only in southeastern quarter of quadrangle; elsewhere it has been removed by post-Silurian pre-Late Devonian erosion.
	Lower and Middle Silurian	Upper part of Crab Orchard Formation	A		80–150	Shale, greenish-gray, clayey, thin- and evenly bedded, blocky to conchoidal fracture, very plastic when moist. Locally upper part contains thin (½ to 2 inches thick) interbeds of silty limestone with rare fossil (crinoid) fragments; in places banded and mottled with light-reddish-brown streaks. Has low porosity and permeability but absorbs some water. This is an expansive shale that falls within the critical category of FHA classification (Lambe, 1960) and develops a swell index of 4100 psf.
		Lower part of Crab Orchard Formation and Brassfield Formation	A, D		50–55	Limestone and shale: Limestone, greenish-gray, weathers bright reddish brown and yellowish brown, coarsely to finely crystalline, dolomitic in part, locally oölitic with hematite in upper part. Even beds up to 10 inches thick; thicker beds break into large slabs up to 4 feet long. Crossbedded bioclastic limestone and large 1- to 2-foot ripple marked beds in upper part. Chemical weathering moderate producing a reddish-brown soil. Lower part of unit predominantly limestone, upper part limestone interbedded with green clay shale. Bedding planes frequently marked with X-like impressions 4 to 6 inches long. Crinoids and brachiopods common particularly in oölitic beds. Angular "cog wheel" crinoid beads up to 1 inch in diameter and brachipods are typical of upper part. Cavities of fossils sometimes filled with petroleum or petroleum residues. Basal beds form conspicuous bench along lower valley slopes. Shale, greenish-gray, clayey, thin-bedded, blocky to conchoidal fracture; glauconite pellets locally abundant; low porosity and permeability but absorbs water becoming very plastic when wet.
ORDOVICIAN	Upper Ordovician	Sedimentary rocks	C		30–35 (70+)	Shale, greenish-gray, thin- and evenly bedded, calcareous, hackly fracture, moderately indurated, sparsely fossiliferous. Forms lower valley slopes in northwestern and southwestern parts of quadrangle. This and underlying unit included in Richmond Group by Perry (1925).
			D		35+	Limestone, light- to medium-gray, thin and irregularly bedded, argillaceous, fossiliferous; weathers to slabs 1 to 3 inches thick and up to 18 inches in length. Brachiopods and bryozoans common. Unit forms ledges and riffles along stream beds.



Base by U.S. Geological Survey, 1951

The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions

TRUE NORTH
MAGNETIC NORTH
1°
APPROXIMATE MEAN DECLINATION, 1965

SCALE 1:24 000

1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION

Geology mapped in 1962

INTERPRETATION OF FOUNDATION AND EXCAVATION CONDITIONS

This map has been prepared to show some of the kinds of information useful to engineers and land-use planners that can be derived by interpretation of general geologic maps. Some of the uses of interpretive maps are well-known in the geologic profession; they are indispensable tools in the modern search for oil and ore deposits; they are the first essential step in unraveling the story of the earth on which we live. Less well-known is the fact that topographic and geologic maps contain many of the basic data needed for planning most engineering construction jobs. Any manmade structure should be adapted to the topographic and geologic environment shown on these maps. Moreover, most construction jobs must be based on knowledge of the soils and waters, which also are intimately related to this same environment. The topographic map shows the shape of the land—the hills and valleys, the streams and swamps, the manmade features such as roads and towns. The geologic map shows the kinds and shapes of the rock bodies that form the land surface and that lie beneath it. These are the facts around which the construction engineer must build.

General geologic maps, prepared primarily for scientific purposes, do not show, as such, all the facts that are needed for engineering plans. Still, the facts that are on the map or in the descriptive text that accompany them are useful for preliminary studies, if properly interpreted. How some of these facts can be interpreted is demonstrated by the accompanying map on which formations or parts of them are combined according to gross similarity in engineering properties rather than geologic age. The interpretation was made primarily from the basic data contained in the report on the Geology of the Burtonville quadrangle, Kentucky, Map GQ-396 by Robert Morris (1965). This interpretation is published in the hope that it will aid in the appreciation of the value of general geologic maps for special purposes.

EXPLANATION

A

Poor foundation material, easily excavated
(Shale)

Bedford Shale, upper part of Crab Orchard Formation, and upper part of the lower part of the Crab Orchard Formation and the Brassfield Formation

Expansive clay shale; landslides and slumps are common where valley slopes are steep or excavated cuts are oversteepened; structural failures of Fox Springs Road east of Wallingford are caused by flowage of water-saturated shale. There the shale, which is several feet thick, overlies resistant limestone of the Brassfield Formation; permeability low to very low

B

Fair to good foundation material, easily excavated
(Alluvium)

Sand, silt, clay, and gravel; unconsolidated, poorly stratified flood-plain alluvium and terrace deposits; medium to low permeability; lowlands subject to flooding; highly susceptible to erosion, particularly gullying; stable on gentle slopes, but steep cuts require retaining walls; give rise to thin, porous soil mantle with rapid surface drainage

Explanation for the broad flood plain along the North Fork Licking River southeast of Foxport and its engineering significance: The structure contours show that the bedrock formations have a gentle regional dip to the east-southeast. As an indirect result of this dip the limestone strata exposed in the northwest part of the quadrangle form a barrier which restricts the flow of the North Fork Licking River during flood stage, thereby causing periodic shallow but widespread flooding of the valley bottom. Suspended material that settles from the impounded water is added to the alluvium during each high-water stage. The alluvium consists mainly of clay sized particles derived from the Crab Orchard Formation and therefore, in this area, has engineering properties similar to the upper part of the Crab Orchard Formation

C

Generally good foundation material, moderately difficult to excavate
(Shale and shaly siltstone)

Shale member of the Borden Formation, Sunbury Shale, Ohio Shale, and Ordovician shale

Hard fissile shale and argillaceous siltstone; stands in fairly steep excavated slopes; very low permeability with internal drainage along fractures. Spring and seepage zones characteristically occur near base of Ohio Shale where it overlies the Crab Orchard Formation and shale at top of Crab Orchard Formation is perpetually moist and plastic; construction along this interface requires special design to control drainage or conduct water away from the Crab Orchard

D

Excellent foundation material, difficult to excavate
(Limestone)

Bisher(?) Limestone, lower part of the lower Crab Orchard Formation and Brassfield Formation, and Ordovician limestone

Foundation will support heavy loads except where sinkholes may be present; removal requires blasting and heavy power equipment; permeability low with internal drainage along joints and fractures

E

Excellent foundation material, difficult to excavate
(Sandstone and siltstone)

Sandstone and siltstone members of the Borden Formation

Foundation will support heavy loads except where excavated to lowermost few feet of unit; removal requires blasting and heavy power equipment; will stand in vertical and near vertical cuts; permeability moderate to low and seepage may occur along face of steep cuts

Contact

Dashed where approximately located; short dashed where inferred or gradational; dotted where concealed

1000

Structure contours

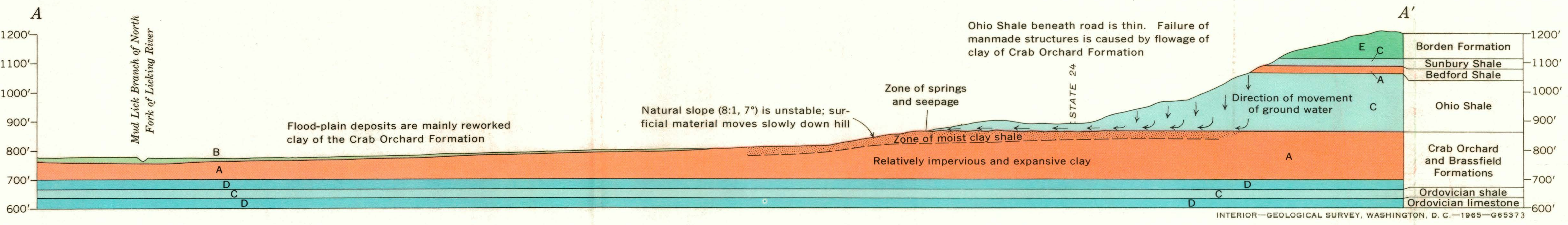
Drawn on base of Sunbury Shale. Dashed where datum above land surface. Contour interval 20 feet

REFERENCES CITED

Lambe, T. W., 1960, The character and identification of expansive soils, Fed. Housing Adm. Tech. Studies Rept., FHS-701.

Morris, R. H., 1965, Geology of the Burtonville quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-396.

Perry, E. S., 1925, Geological map of Lewis County, Kentucky: Kentucky Geol. Survey, ser. 6.



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CROSS SECTION SHOWING VARIATIONS IN GROUND STABILITY RELATED TO TOPOGRAPHY, LITHOLOGY, AND GROUND WATER

SCALE 1:4000
500 0 500 FEET

MAP SHOWING FOUNDATION AND EXCAVATION CONDITIONS IN THE BURTONVILLE QUADRANGLE, KENTUCKY

By

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1965