KENTUCKY GEOLOGICAL SURVEY
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DRAFT GEOLOGIC QUADRANGLE

NEW RICHMOND QUADRANGLE, KY.

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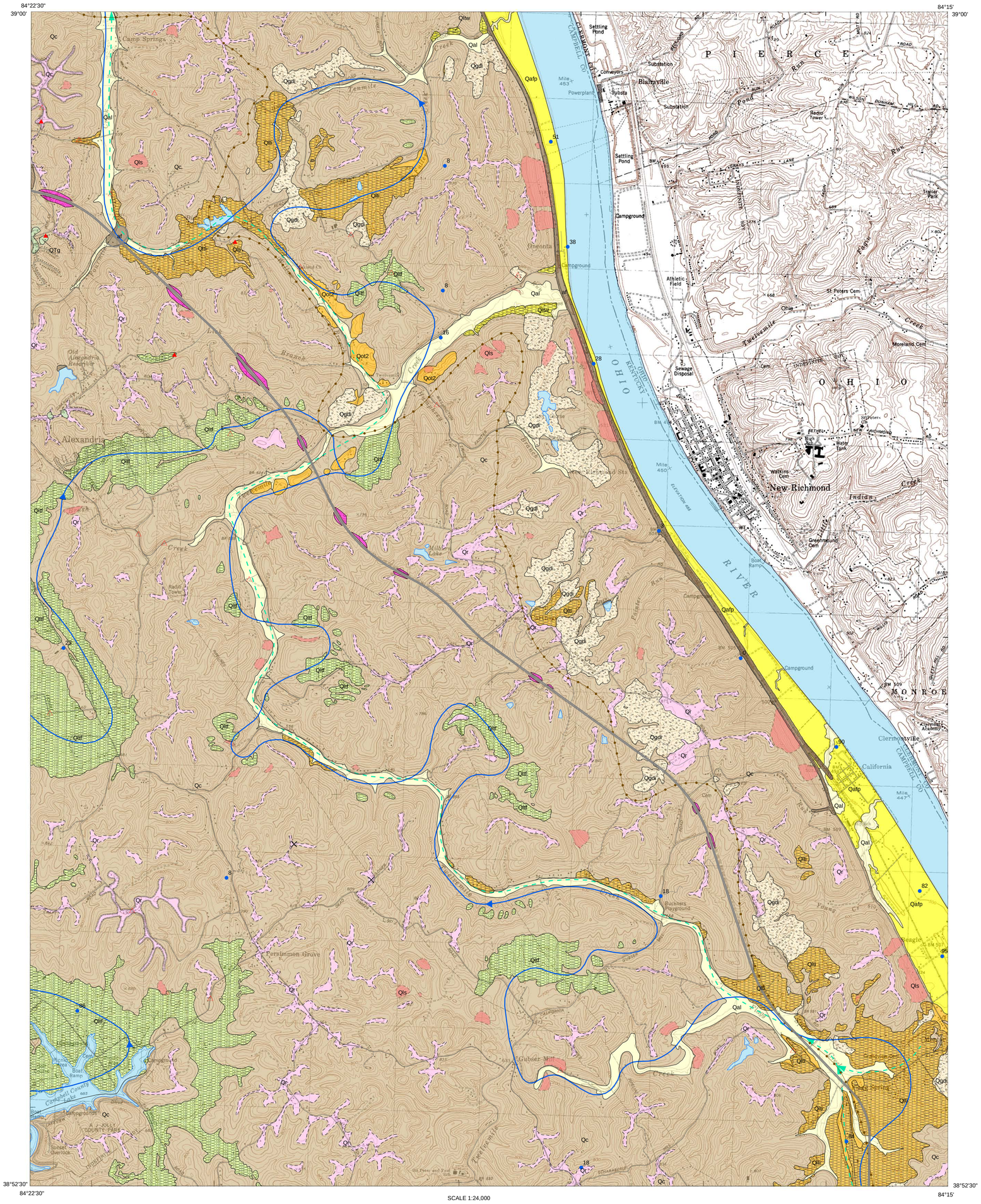
Contract Report 42



SCALE 1:24,000

NAD 1983, Kentucky State Plane Single Zone, feet projection

Topographic base from the Kentucky Geography Network, Kentucky Raster Graphics (KRGs). ftp://ftp.kymartian.ky.gov/krg/

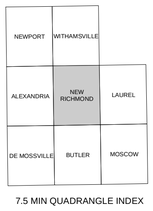
Original coordinate system UTM, zone 16, NAD 1927

5,000 2,500 0 5,000 10,000 Feet

0.5 0.25 0 0.5 1 Miles

0.5 0.25 0 0.5 1 Kilometers

CONTOUR INTERVAL 20 FEET



7.5 MIN QUADRANGLE INDEX

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ACKNOWLEDGMENTS

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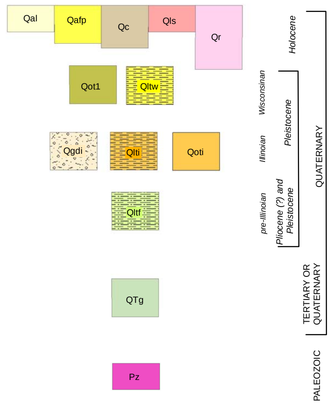
Field mapping was completed by Matthew M. Crawford from May 2010 to May 2011. Subsurface information was compiled from data on file at the Kentucky Geological Survey.

SURFICIAL GEOLOGIC MAP OF THE NEW RICHMOND QUADRANGLE, KENTUCKY

By
Matthew M. Crawford

2011

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qls **Landslide deposits (Holocene)**
Unconsolidated, complex deposits of colluvial soil and weathered rock derived from gravity-related processes including slumps, translational slides, earthflows, and creep. Processes can occur where water contributes to a plane of weakness within colluvial slopes or along stream banks; commonly at the soil-bedrock interface. Large amounts of water, especially after large storm events, increases the soil's pore water pressure adding to the load on the slope. Slope disturbance or modification in addition to natural erosion also contributes to landslides. Slide ages range from active to historic non-active. Unit mapped from 1-meter resolution LiDAR data.

Qal **Alluvium, modern tributary (Holocene)**
Unconsolidated silt, gravel, clay and sand deposited in modern stream channel tributaries of the Ohio River; occupies narrow valley bottoms and small floodplains. Deposits are generally less than 20 feet thick except near floodplains along the Ohio River. Unit rests on glacial deposits or Ordovician bedrock.

Qafp **Alluvium, river floodplain (Holocene)**
Unconsolidated clay, sand, and gravel along the Ohio River. Thicknesses generally range from 20 to 50 feet. Clay, yellowish, sandy. Sand; brown, fine and coarse. Clay and sand mixed and interlayered. Pea-size gravel mixed with the sand and clay at different intervals.

Qc **Colluvium (Holocene)**
Unconsolidated, heterogeneous deposit covering hillsides and shoulders of ridges. Generally steeper than 10 degrees and dominantly ranges from 10 to 25 degrees. Grain size ranges from fine silty-clay loam to silt, flaggy limestone and shale fragments present. Thickness of colluvial soils ranges, but is typically thicker at the toe of the slope. Clayey (predominantly illite) parts can become sticky and plastic when wet. Areas where thin, soil horizons are indistinguishable. Unit primarily derived from the bedrock of the Kope Formation and is the parent material of the USDA-NRCS Eden Soil Series.

Qr **Residual soil (Holocene-Pleistocene)**
Unconsolidated silt to silty-clay loam derived from weathering of underlying bedrock; primarily occurs on ridgetops and slope shoulders. Slopes generally are less than 12 degrees. In some areas unit is mixed with overlying loess. Blocky to fine-granular structure, stiff. Areas with more loess the soils are light-brown to orange, commonly sticky. These soils formed from limestone bedrock residuum interbedded with shale and primarily is the parent material of the USDA-NRCS Faywood, Nicholson, and Rossmoyne Soil Series.

Qltw **Lacustrine deposits (Pleistocene)**
Clay, silt, and sand, generally calcareous: Clay and fine silt, medium-gray, weathers dark yellowish orange; coherent, sticky when wet, locally finely laminated; make up most of deposit. Coarse silt and very fine to medium sand, pale-grayish-orange to dark-yellowish-orange, friable, as interbeds 1/2 inch to 3 inches thick. Unit includes sequences of sharply defined beds as much as 3 inches thick, each of which grades upward from coarse silt at base to clay at top. Leached to depths of 3 to 5 feet. Present in Kentucky along lower courses of Tenmile and Twelvemile Creeks underlying narrow terrace remnants at maximum elevations of a little under 540 feet. Description from Lacustrine or slackwater deposits (Wisconsinan) of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975).

Qot1 **Alluvium, outwash (Pleistocene)**
Silt, sand, clay, and gravel, generally calcareous: Silt and clay, light-greenish-gray; readily weather yellowish orange and yellowish brown, generally sandy, locally pebbly. Sand, reddish-orange, fine, silty, friable, locally leached and oxidized to depths of 12 or more feet; contains thin laminae of clayey silt. Gravel, of local types of limestone and igneous and metamorphic rocks, present as scattered pebbles as much as 3 inches in diameter in bodies of silt, clay, and sand. Maximum elevation of deposit about 545 feet. Composition laterally variable: silt and clay predominate at Clermontville on Ohio shore and near Camp Meacham on Kentucky shore; sand forms most of deposit near mouths of Indian Creek and Pond Run in Ohio. On Pond Run about 600 feet upstream from its entrance into the Ohio River valley, basal zone of outwash incorporates jumbled mass of locally derived limestone slabs as much as 12 inches across in a sandy silt matrix. Description from Glacial outwash (Wisconsinan) of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975).

Qlti **Lacustrine deposits (Pleistocene)**
Clay, silt, sand, and gravel: Almost entirely clayey silt and silty clay, medium- to brownish-gray; calcareous where fresh but mostly leached and weathered to light greenish gray or pale yellowish brown and moderate brown; shows lamination where fresh; locally contains small pebbles. Weathered deposits along toeslopes are fine-grained, clayey, stiff soil; resembles residual soil at top of hills. Best preserved in head reaches of creeks, where it forms moderately to sharply dissected valley fill. Unit as mapped locally includes small patches of drift, outwash, and alluvium. Observed exposure of reddish-orange sand (outwash?), with gray streaks; friable with quartz pebbles; 8 feet thick (see photo). Unit very poorly exposed; rests on bedrock and Illinoian drift and outwash. Description modified from Lacustrine deposits (Illinoian) of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975).

EXPLANATION

- Contact
- Gradational contact
- Gradational contact inferred
- Concealed contact
- Approximate southwestern limit of Illinoian glacial drift (From Gibbons and others, 1975)
- Pre-Illinoian courses of the ancestral Licking River and one of its tributaries (From Gibbons and others, 1975)
- Illinoian glacial bypass channel of the Ohio River (From Gibbons and others, 1975)
- 23 KGS database, number indicates depth to bedrock in feet
- Landform observation and soil probe Sample taken for grain size analysis
- Landform observation

Figure 1. Slackwater deposits, lacustrine terrace (Qlti). Exposure of reddish-orange sand (lense of outwash?), friable with quartz pebbles. 8 feet thick.

Figure 2. Residual soil (Qr). Silt to silty-clay loam covering ridgetops and gently sloping shoulders. Many places soil is mixed with coarse silt, soft, sticky light-brown to orange loess.

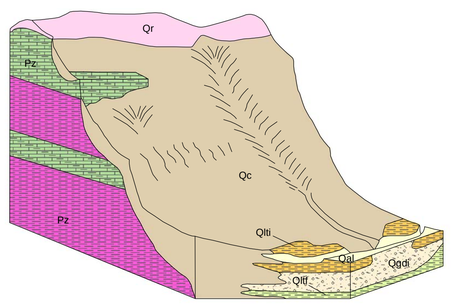


Figure 3. General diagrammatic model of the surficial deposits and geomorphology of the New Richmond quadrangle. Residual soil and colluvium mantle the hillsides and glacial lacustrine, outwash, and drift occupy the valleys. The green color Pz represents stratigraphy that contains more limestone and the purple more shale Modified from Wysocki and others, 2000.

Qoti **Alluvium, outwash (Pleistocene)**
Gravel and conglomerate, sand and sandstone, minor silt and clay: Gravel and conglomerate, in freshly exposed outwash commonly travertine-cemented, roughly bedded; composed dominantly of pebbles, cobbles and boulders of local types of limestone with scattered, mostly small clasts of exotic rocks including chert, quartz, quartzite, and igneous and metamorphic rocks; gravel of the most intensely weathered outwash is loose, mostly of pebble size, and composed entirely of exotic rocks left after limestone was removed by leaching. Sand and sandstone, pale-grayish-orange to moderate-yellowish-orange, coarse to fine, mostly poorly sorted, commonly laminated and crosslaminated, friable at most outcrops but firmly cemented by travertine at some. In Kentucky, sand and gravel of unit support well to poorly defined terraces typically at elevations of 550 to 620 feet, near junction of Willow Branch and Twelvemile Creek; terraces at concordant levels in Flagg Spring area are underlain mostly by pebble and cobble gravel. Unit poorly exposed at most localities, rests on bedrock and Illinoian drift. Description from Glacial outwash (Illinoian) of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975).

Qdgi **Glacial drift (Pleistocene)**
Silt, clay, sand, gravel, and conglomerate: Combination of lacustrine deposits and outwash. Silt, clay, and sand, medium-light-gray to light-olive-gray, weathering dark yellowish brown, light brown, or pale grayish orange. Gravel has same composition as Illinoian outwash gravel and is similarly leached. Igneous and metamorphic pebbles and cobbles abundant in sandy lenses. Weathering of feldspar-bearing exotic clasts in drift varies from slight discoloration of surface to thorough decomposition of rocks. Drift generally unconsolidated and without evident bedding or sorting. Along Ky. Highway 8 about half a mile from north boundary of quadrangle, drift includes masses as much as 15 feet across of rudely bedded travertine-cemented limestone conglomerate. Intricate interlensing of bedded and nonbedded material indicates that both were deposited at ice front, nonbedded material directly from the ice as till, bedded material in the space between the ice and the valley wall to form kame terrace deposit. Small patches of outwash and lacustrine deposits locally included in unit. Unit poorly exposed at most localities; rests on bedrock and Illinoian outwash and lacustrine deposits. Description modified from Glacial drift (Illinoian) of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975).

Qltf **Lacustrine and fluvial deposits (Pleistocene)**
Clay, silt, gravel, and sand of ancestral Licking River system, light-brownish-gray, weather moderate yellowish brown and light brown; dominantly slightly silty clay with locally abundant gravel and rare to sparse fine quartz sand. Clay (the Claryville Clays of Durrell, in Durrell and others, 1961, p. 68-73), mostly of lacustrine origin, plastic when wet; calcareous where fresh, but generally leached to depths of more than 7 feet; thinly bedded to laminated; includes thin beds of moderately indurated limonitic siltstone. Weathered deposits along toeslopes are fine-grained, clayey, stiff soil; resembles residual soil at top of hills. Locally abundant gravel at or near base of unit marks main paleochannels and is of two distinct types. Gravel of the ancestral Licking River (see explanation) is lithologically diverse: it includes rounded pebbles of white and darker colored quartz, subangular pebbles and cobbles of brown chert, chips and slabs of iron-stained siltstone and very fine grained sandstone, and angular to subangular fragments of bleached porous chert. Gravel of the major tributary that entered the ancestral Licking River near the present confluence of Twelvemile Creek and Willow Branch is lithologically simple: it consists almost entirely of angular to subangular fragments of brown chert and pebbles of pale-yellow silicified limestone or dolomite; rounded quartz pebbles are locally present but nowhere common. Fluvial deposits are in part preglacial, possibly as old as Pliocene. Lacustrine deposits resulted from blocking of the ancestral Licking River system downstream (to the north) during Kansan of possibly Nebraskan Glaciation (Durrell and others, 1961, p. 70). Prior to filling and abandonment, the Licking River had cut its channel down to an elevation of about 625 feet in this segment. Unit soft, easily eroded. New neighborhoods near Alexandria and west of the AA Highway (KY 9) have highly modified these deposits. Description modified from Lacustrine and fluvial deposits (Pre-Illinoian) of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975).

QTg **Upland gravel (Tertiary or Quaternary)**
Silt, sand, and clay, grayish-orange, dark-yellowish-orange, and moderate-yellowish-brown, noncalcareous, without evident bedding. Sand, more abundant in lower part of unit, mainly quartz with minor chert and scarce white mica; grains are subrounded to angular, mostly iron stained, but about 5 percent are unstained, frosted grains uncommon. Unit soft, easily eroded, poorly exposed, lacking distinct topographic expression. Mapped outcrops locally cap uplands around headwaters of Fourmile Creek near west boundary of quadrangle. Small outcrops east of Persimmon Grove shown by outcrop symbol only. Extensively preserved to west in Alexandria quadrangle (Gibbons, 1971). Description from High-level silt and sand deposits of Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975). Mapped area in the northwest part of the quadrangle has been masked by neighborhood development. Small amounts of gravel, rounded quartz pebbles, were observed on the side of Poplar Ridge Rd.

af **Artificial fill, engineered fill (Modern)**
Material designed and deposited for construction of roads, railroads, buildings and engineered structures. Map units are delineated only when they are large enough to be shown as polygons at the scale of 1:24000.

Pz **Bedrock (Paleozoic)**
Shale and limestone; interbedded. Shaley bedrock along valley slopes and stream bottoms and more resistant limestone toward ridgetops. Only mapped as roadcuts along the AA Highway (KY 9). Natural bedrock exposures at the tops of ridges or exposed in stream beds not mapped.

GEOLOGIC SUMMARY

GEOLOGIC SETTING

The New Richmond 7.5-min quadrangle is located in Campbell County, Kentucky and lies along the Ohio River in the Outer Bluegrass Region of the state. Ordovician bedrock geology in the quadrangle consists of, in ascending order, the Point Pleasant Tongue of the Clays Ferry Formation, Kope Formation, and Fairview Formation. The Point Pleasant is limestone and shale and is rarely exposed, cropping out along streams of major tributary valleys. The Kope consists of approximately 75 percent shale and is 230 to 250 ft thick, primarily cropping out along river valleys and the lower parts of hills. The Fairview is interbedded limestone and shale that occurs as a more resistant rock on hills and ridgetops This map shows the distribution of surficial, engineering soils above bedrock and the relationship between surficial deposits and the underlying bedrock.

GEOMORPHOLOGY AND SURFICIAL DEPOSITS

The units described on this map reflect natural processes collectively operating as a dynamic geomorphic system (Newell, 1978). The primary mechanisms of sediment transport and deposition in this area are flowing water (alluvial and glaciofluvial processes) and gravity/mass-movement (colluvial processes), which are complexly interrelated. The map units in this area have been delineated based on the primary process generating the deposit or material. Soil survey maps and existing bedrock geologic maps served as the initial guide to mapping and these areas were modified through field identification, geomorphic setting, and well data. Delineation and identification of all maps units is restricted by the map scale of 1:24,000.

Fluvial deposits of the pre-glacial Licking River are prevalent in the New Richmond quadrangle, complexly occurring with glacial and glaciofluvial deposits of Wisconsinan, Illinoian, and pre-Illinoian ages (Luft, 1980). The ancestral pre-Illinoian course of the Licking River runs northwest through the quadrangle. Most of this course also served as the glacial bypass for the Ohio River because of the southward Illinoian glacial advance. The present course of the Licking River flows north 5 to 10 miles west of these paleo river courses. The southwestern limit of Illinoian glacial drift also runs northwest-southeast through the quadrangle, approximately less than a mile northwest of the paleo river courses.

This map shows the distribution of lacustrine deposits (Qwala), glacial outwash (Qwo, Qio), glacial drift (Qd) and glaciofluvial deposits (QTd) that were mapped on the Geologic Map of the New Richmond quadrangle by Gibbons, A.B. and others (1975) geologic mapping by the U.S. Geological Survey in cooperation with the Kentucky Geological Survey. The distribution of these deposits are mainly the same as the Gibbons map but modified where not present or where can be extended. The remaining surficial deposits include alluvium (Qal), residual soil (Qr), colluvium (Qc) and landslide deposits (Qls). The distributions of these deposits are based on field observation, Natural Resource Conservation Service soil data, and high resolution elevation data (LiDAR).

The alluvial deposits (Qal) occupy the broad Ohio River Valley and parts of smaller tributary valleys. The glacial influence is apparent by the misfit alluvial streams Residual soil (Qr) mapped primarily occurs on ridges and hilltops. This soil locally includes loess that overlies or is mixed with the residuum. The Kope shale weathers easily, slumping and producing colluvial soils (Qc) of variable thickness. Composition of the colluvium ranges from clayey (predominantly illite) and silty to coarse with abundant limestone slabs.

HAZARDS

Landslides have been a problem in the northern Kentucky area for decades. The natural geology and topography of many parts of northern Kentucky are susceptible to landslides. Just across the Ohio River in Cincinnati, where the geology and slopes are similar more money is spent per capita to repair landslides than in any other city in the United States (Ohio Valley Landslides LLC, 2007). Landslides typically occur on steep slopes in the colluvium or along the colluvial-bedrock contact. Other surficial deposits in the area are prone to landslides as well. Pleistocene glaciation in the region produced soft clayey lake deposits, outwash, glacial drift, and other fluvial deposits that fail and can damage roads or other

The most common types of landslides are small, thin translational slides and thick rotational slumps on steeper slopes. Less frequent block slides occur in unconsolidated glacial deposits. In a translational slide, thin layers of colluvium move downslope along the underlying bedrock contact. Rotational slides typically occur within thicker colluvial slopes, artificial fill, and lake deposits where scarps and slide boundaries are more evident but the failure plane is more difficult to identify. Shaley colluvium associated with the Kope Formation slumps easily and is susceptible to movement when not properly drained or the slope is steepened. Areas within existing landslides generally seem to be more susceptible to further slope movement than colluvial slopes that have no disturbance (Agnello, 2009). Landslide movement in colluvium is most common during the spring and winter when there typically is a higher level of precipitation (Agnello, 2009). Many landslides are associated with some type of human disturbance, such as improper drainage or steepening the slope to build a road, home, or other structure.

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