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U. S. GEOLOGICAL SURVEY
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INTRODUCTION

Surficial deposits in the Orange quadrangle include artificial fill and alluvial, estuarine, and swamp sediments of postglacial age, and glacial sediments of late Wisconsinan age. The glacial sediments include stratified sand, gravel, silt, and clay deposited in glacial lakes and by glacial streams, and till deposited by glacial ice. The stratified glacial sediments are as much as 250 feet thick. Till is as much as 60 feet thick. The postglacial deposits are generally less than 20 feet thick.

The surficial deposits are delineated on the accompanying map and cross sections and are described below. The postglacial and glacial events they record are also discussed. A brief summary of the hydrologic and engineering characteristics of the deposits is also provided. Well and test-boring data used to draw bedrock-surface contours and to infer the subsurface distribution of the deposits are plotted on the map, and selected logs are listed in table 1. Table 2 lists the composition of gravel clasts in the glacial deposits. Figure 1 shows the extent of glacial lakes and ice margins in the quadrangle and adjacent areas. The chronologic relationships of the deposits are shown in the "Correlation of Map Units".

HYDROLOGIC AND ENGINEERING CHARACTERISTICS

Surficial deposits in the Orange quadrangle convey water from the surface to underlying bedrock and to surface-water bodies. They also provide support for foundations, and are the material within which excavations for underground structures and road and railroad cuts are made. Before the 1970s they were mined for sand, gravel, and clay at a few places. The extent of larger recent sand and gravel pits are shown on the map; locations of smaller pits are shown in Merrill and others (1902) and Darton and others (1908). Urbanization now precludes further extraction.

Hydraulic conductivities of the surficial deposits can be estimated from statewide glacial aquifer-test data on file at the N. J. Geological Survey (www.state.nj.us/dep/njgs/geodata/dgs01-4.htm) and published aquifer-test and laboratory data summarized by Stanford and Witte (in press). Sand and gravel deposits (units Qbn, Qwt1, Qwt2, Qbd, Qve, Qah, Qdw, Qyn, Qpr, Qst, and parts of Qal) are highly permeable, having estimated hydraulic conductivities between 10^1 and 10^3 feet per day (ft/d). Silt and clay lake-bottom deposits (parts of units Qbnl, Qwt1, Qvel, and Qdwl) are of low permeability, having estimated hydraulic conductivities of 10^{-5} to 10^{-3} ft/d. Fine sand and silt lake-bottom and alluvial deposits (parts of units Qbnl, Qvel, Qwt1, Qdwl, and Qal) and sandy silt till (units Qr, Qry) are somewhat more permeable, having estimated hydraulic conductivities of 10^{-3} to 10^{-1} ft/d. Salt-marsh and swamp deposits (Qm and Qs) and fill have variable hydraulic conductivities that depend on the clay and silt content of the material. Salt-marsh and swamp peats with little mineral soil, and fill composed of sand, cinders, gravel, demolition debris, slag, and trash, may be highly permeable.

The strength of the surficial materials depends on their grain size, compaction, and water content. Salt-marsh, swamp, and alluvial deposits (units Qm, Qs, and Qal) are of low strength because they have not been subject to water or sediment loads greater than those at present, and have been continuously saturated or moist since their time of deposition, and so are noncompact. They also may contain significant amounts of organic matter, which is weaker than mineral soil. Construction on these materials generally requires the use of pilings to transfer loads to the underlying bedrock or till, or the excavation of the natural material and replacement with engineered fill of greater strength. Lake-bottom deposits that underlie units Qm, Qal, Qpt, and Qs (units Qbnl, Qdwl, and parts of Qwt1) are similarly of low strength because they have been continuously saturated since deposition.

Sand and gravel (units Qbn, Qwt1, Qwt2, Qve, Qdw, Qyn, Qbd, Qah, Qst, Qpt) are coarser-grained and, where they crop out, better-drained than the lake-bottom, alluvial, and wetland deposits and thus are of greater strength. Most till (Qr, Qry) in the quadrangle was deposited beneath glacial ice and so has been consolidated by the weight of the ice. Artificial fill consists of a variety of materials, including uncompacted trash and demolition debris, and compacted engineered fills composed of sand, silt, and gravel. Uncompacted fill, and fill containing wood, decomposable material, or void space, is subject to settlement. Fill placed on top of salt-marsh, alluvial, or swamp deposits is also subject to settlement because the underlying materials are highly compressible.

Data on the density, grain size, and Atterberg limits for the surficial materials are provided by Rogers and others (1951).

DESCRIPTION OF MAP UNITS

Postglacial Deposits--These include man-made fill, sediment deposited in salt marshes (Qm), in freshwater swamps (Qs), and in river floodplains and channels (Qal, Qpt, Qst). They were all deposited after glacial retreat.

After glacial Lake Bayonne lowered to the Hackensack level (see below), and after the sediment dams for lakes Delawanna and Paramus that blocked the Passaic Valley at Kearny and Rutherford (fig. 1) were eroded, the Passaic River cut a channel into the deltaic sand in the valley between Newark and Paterson. This sediment was redeposited as a terrace (Qpt) on the valley bottom. Draining of Lake Hackensack caused the Passaic to cut its channel into the terrace sand and to deposit sandy alluvium (included in unit Qal) along its present channel and on the drained Lake Bayonne-Hackensack lake bottom. This alluvial sand is now covered by salt-marsh deposits and fill in the salt marsh east of Kearny (hereafter referred to as the "Kearny Meadows") (section EE'). Similarly, draining of glacial lakes Verona, Watsessing, and Yantacaw exposed deltaic deposits to erosion by the Peckman, Second, and Third rivers, resulting in the deposition of small stream terraces (Qst) along those rivers.

As the erosion of the deltas was completed the sediment load in the streams declined. The terraces themselves were then incised and the modern floodplain and channel sediments (Qal) were laid down. In the Kearny meadows, alluvial deposition was gradually replaced by salt-marsh sedimentation (Qm) as sea level rose and flooded the former lake plain. Most of the salt-marsh sediment has been deposited within roughly the past 3000 years (Newman and others, 1969).

Landfilling on the wetland and alluvial deposits began shortly after permanent European settlement in the 1600s. The earliest fills were likely along the Newark and Harrison waterfronts. Large-scale filling for transportation, industrial facilities, and residential development occurred during the early twentieth century. Much of the original salt marsh, most former river floodplains, and virtually all of the original freshwater swamps have been filled.

ARTIFICIAL FILL--Artificially emplaced sand, gravel, silt, clay, and rock fragments; and man-made materials including cinders, ash, brick, concrete, wood, slag, metal, glass, and trash. Color variable but generally dark brown, gray, or black. As much as 60 feet thick but generally less than 20 feet thick. Mapped only where it covers salt-marsh, alluvial, or swamp deposits, and where it occurs in distinct landforms visible on 1:12,000-scale aerial photographs. Fill is also present in all urban areas as a layer generally less than 10 feet thick. The extent of fill is based, in part, on the extent of swamps, alluvial deposits, and salt marshes shown in Salisbury (1895), N. J. Geological Survey (1889, 1906), Merrill and others (1902), and Darton and others (1908).

Qm **SALT-MARSH DEPOSITS**--Organic silt and clay, and peat; black, dark brown, and gray. As much as 15 feet thick.

Qal **ALLUVIUM**--Sand, silt, pebble-to-cobble gravel, minor clay; dark brown, gray, reddish-brown. Contains variable amounts of organic matter. As much as 25 feet thick. Extent of alluvium beneath artificial fill is based, in part, on mapping by Salisbury (1895), Merrill and others (1902) and Darton and others (1908). Many small deposits of alluvium along streams and in valley bottoms in urban areas, now covered by fill, are not mapped.

Qs **SWAMP DEPOSITS**--organic silt and clay, and peat; black, dark brown, and gray. As much as 10 feet thick (estimated). Except for the small swamp in Eagle Rock Reservation, the deposits are inferred from historical maps (N. J. Geological Survey, 1889, 1903) and are now entirely covered by fill.

Qpt **LOWER PASSAIC TERRACE DEPOSITS**--Fine-to-coarse sand, some silt and pebble gravel; light reddish-brown, light gray, very pale brown. Moderately to well-sorted; stratified. As much as 40 feet thick.

Qst **STREAM TERRACE DEPOSITS**--Fine-to-coarse sand and pebble-to-cobble gravel, some silt; reddish-brown to brown. Moderately sorted; stratified. As much as 15 feet thick (estimated).

Glacial Deposits--These include till--a poorly sorted, nonstratified sediment containing gravel clasts and boulders, deposited directly from glacial ice (Qr, Qry), and sorted, stratified sediments. The stratified sediments include sand and gravel laid down by glacial meltwater in river plains (Qeb, Qbd), and in glacial-lake deltas and fans (Qbn, Qdw, Qwt1, Qwt2, Qyn, Qah, Qpr); and varved silt, clay, and fine sand deposited on the bottoms of glacial lakes (Qbnl, Qwt1, Qvel, Qdwl, Qhkl).

Before these deposits were laid down the underlying bedrock surface was shaped by glacial erosion. The topography of the bedrock surface (plotted at 50-foot contour interval on the geologic map at and below the 200-foot elevation) shows elongate northeast-southwest-trending troughs that extend to nearly 300 feet below sea level in the Kearny meadows, and to nearly 100 feet below sea level in the Passaic Valley. The troughs shallow both northward and southward (Stanford and others, 1990) and are closed to an elevation reaching just below sea level, indicating that they are products of glacial scour, not filled preglacial valleys.

The bedrock valley extending southwestward from Nutley to Orange may be, in part, a preglacial fluvial valley. Deposition of stratified sediments in glacial Lake Watsessing and deposition of the Bloomfield Moraine (unit Qrb) blocked the valley during deglaciation. When stream drainage was reestablished, the Second River was diverted eastward from its former valley at Bloomfield, and the Third River was diverted northeastward at Bloomfield into the Nutley-Bloomfield segment of the former valley.

Till is generally thin (less than 35 feet thick) throughout most of the broad upland areas between the valleys, indicating that the topography of these uplands is the product primarily of glacial erosion rather than deposition. The northeast-southwest-trending streamlined ridges indicated by the bedrock topography east of First Watchung Mountain were produced chiefly by differential glacial erosion of the northeast-southwest striking beds of sandstone and siltstone in this area. Where till exceeds 40 feet in thickness (wells 8, 10, 20, 37, 148, 167, 187) deposition of till contributed to the streamlining.

The distribution and composition of till reflect ice-flow directions during the late Wisconsinan glaciation. Regionally, striation and drumlin orientations indicate that late Wisconsinan ice advanced southerly to southwesterly across northeastern New Jersey as a lobe channeled between the Watchung Mountains on the west and the Palisades Ridge on the east, and centered on the Hackensack Valley (Salisbury, 1902; Stanford and Harper, 1991). The Orange quadrangle is located on the west side of this lobe. East of First Watchung Mountain ice flowed southwesterly, whereas on and west of First Mountain, striations demonstrate a more westerly flow imparted as ice from the east overtopped the ridges. This ice had traversed extensive outcrops of red sandstone and siltstone to the northeast in the Hackensack Valley and it deposited primarily reddish-brown silty sand till (Qr), reflecting the red sandstone source rocks. Yellowish-brown silty till (Qry) was deposited on Second Watchung Mountain and on First Mountain north of Cedar Grove Reservoir. The yellow color and higher silt content of this till reflect the incorporation of weathered basalt as ice traversed First Mountain.

Late Wisconsinan ice reached its southernmost position at Perth Amboy, about 20 miles south of Belleville, about 21,000 yrs B.P. (radiocarbon years before present), based on radiocarbon dates of organic material in bogs in western New Jersey (Harmon, 1968; Cotter and others, 1986) and on organic sediments beneath till on Long Island (Sirkin, 1986). A continuous terminal moraine was deposited at the position of maximum advance. As the ice front retreated, a series of glacial lakes formed, dammed to the south by the moraine (Stanford and Harper, 1991). One of these, Lake Bayonne, occupied the Newark Bay and Hackensack Meadows lowlands (fig. 1) and had an outlet over the moraine at Perth Amboy. This outlet was gradually lowered by erosion, and therefore the level of Lake Bayonne steadily declined. In the Orange quadrangle a delta deposited in Lake Bayonne at Newark records a lake level of about 30 feet above sea level. Adjusting for postglacial rebound of Earth's surface in response to release of the weight of the glacier, this elevation indicates that the spillway at Perth Amboy had been eroded to about 25 feet below sea level (using the rebound rate of 3.5 feet per mile to the north from Stanford and Harper [1991]). Deposits in Lake Bayonne include deltaic and lacustrine-fan sand and gravel (Qbn), and lake-bottom silt, clay, and fine sand (Qbnl).

Continued erosion of the outlet at Perth Amboy, and along the Arthur Kill to the north, uncovered diabase bedrock at an elevation of 30 feet below sea level in the Arthur Kill about 15 miles south of Belleville. The diabase halted further downcutting and formed the stable spillway for Lake Hackensack. An auxiliary spillway was also established across diabase in the Kill van Kull between Bayonne and Staten Island. In the Orange quadrangle, Lake Hackensack occupied the lowest parts of the Kearny meadows. The upper parts of the lake-bottom silt and clay deposit underlying the meadows were likely laid down in Lake Hackensack (Qhkl). The lake drained eastward into the Hudson Valley when the retreating ice front uncovered Sparkill Gap, a deep gap through the Palisades Ridge, about 20 miles northeast of Belleville.

As the ice front retreated eastward into the Second River Valley, deposition of a glaciofluvial deposit (Qeb) by meltwater draining down the East Branch of the Rahway River Valley was succeeded by deposits laid down in glacial Lake Watsessing (Qwt1, Qwt2, Qwt1.) (fig. 1). This lake was initiated when the ice front retreated eastward from the Rahway-Second River divide and water was impounded in the east-draining valley. Earlier, higher stages of Lake Watsessing (combined as stage 1 in fig. 1) were controlled by an initial spillway into the Rahway basin at an elevation of about 190 feet, succeeded by 2 or 3 spillways into the Elizabeth River basin at elevations between 165 and 175 feet. Sand and gravel deposited in this lake stage (Qwt1) do not clearly show lakeshore features and so cannot be tied to a particular spillway. However, both of the Qwt1 deposits rise to elevations above 180 feet and so were probably laid down when the 190-foot spillway was active. With continued eastward retreat of the ice margin, a lower spillway at an elevation of about 110 feet was uncovered in what is now Branch Brook Park. It drained southerly into Lake Bayonne in the Passaic Valley (fig. 1). A broad but thin delta (Qwt2) was deposited in this shallow lake stage (stage 2 in fig. 1). When continued retreat uncovered the Second River Valley between Newark and Belleville, this lake drained.

The Bloomfield Moraine (Qrb) was deposited concurrently with Qwt2 and with the Lake Bayonne deltaic deposit (Qbn) in north Newark. This moraine, which is composed of both till and sand and gravel, represents a significant stillstand of the receding ice margin and appears to correlate to the Silver Lake and Ogdensburg-Culvers Gap moraines farther west in the state (Stanford, 1993). Moraine deposits may overlie deltaic sediment in places (sections BB', CC', well 128), suggesting that the ice margin may have readvanced a short distance during or prior to deposition of the moraine.

During, or shortly after, deposition of the Bloomfield Moraine, the receding ice margin on First Mountain uncovered Great Notch, a gap in the mountain at an elevation of about 300 feet. This allowed glacial Lake Passaic, a large lake that filled the Passaic basin between Second Mountain and the Highlands, to drop from a high stage (the Moggy Hollow stage, fig. 1) to the Great Notch stage (fig. 1) (Salisbury and Kummel, 1895; Stone and others, 1989). This was a drop of about 75 feet in lake level and it likely produced a large initial flood down the Third River Valley, which drains the Great Notch spillway, followed by a steady spillway discharge until the gap through First Mountain in Paterson was uncovered, at which time the lake drained. This flood and subsequent discharge cut channels into the upland downstream from Great Notch. The main channel is particularly evident along Third River between Grove and Broad streets. A slightly smaller channel, formed either as an overflow channel during the initial flood or as an earlier channel when the ice front was a little farther west, descends through Yanticaw Brook Park in Montclair. Where the slope of the valley flattens near Brookdale, a plain of sand and gravel was deposited. This glaciofluvial deposit (Qbd) extends downvalley to Bloomfield, where it overlies lake-bottom sediments of Lake Watsessing (sections BB', CC').

As the ice front receded eastward from the Bloomfield Moraine, several additional glacial lakes formed. In the Passaic Valley the Lake Bayonne delta filled the valley in the reach south of the junction of Second River to an elevation of about 50 feet. This delta formed the dam for glacial Lake Delawanna (fig. 1), which filled the Passaic Valley between Belleville and Passaic as the ice front retreated eastward. Deltaic sand and gravel (Qdw) were deposited in this lake in the Clifton-Passaic area and in Belleville, and lake-bottom silt, fine sand, and clay (Qdwl) accumulated in the Lyndhurst-Belleville reach of the valley (section DD').

The Third River Valley downstream from Bloomfield drains northeasterly and so was dammed by the retreating ice margin to form glacial Lake Yantacaw (fig. 1). This lake was controlled by a spillway at an elevation of about 110 feet just north of Hendricks Field in Belleville, with southward drainage into the Second River Valley. Deposits in Lake Yantacaw are chiefly sand and silt deltaic sediments (Qyn).

A small easterly draining valley near Athenia was similarly dammed, forming glacial Lake Athenia (fig. 1). Deltaic sand and gravel (Qah) largely fill this lake basin.

Continued northeasterly retreat of the ice margin out of the Orange quadrangle left a delta in the Delawanna section of Clifton as a dam across the Passaic Valley at an elevation of about 35 feet just north of the present crossing of Route 3. Lake Paramus (fig. 1) formed in the Passaic and Saddle River valleys north of this dam. A small part of a glacial Lake Paramus delta (Qpr) occupies the extreme northeastern corner of the quadrangle.

In the north-draining Peckman River Valley, between First and Second mountains in the northwestern part of the quadrangle, the northward-retreating ice margin dammed the valley to create glacial Lake Verona (fig. 1). Lake Verona was controlled by a spillway at an elevation of about 400 feet on the West Branch Rahway River-Peckman River divide. Deltaic sand and gravel (Qve) and lake-bottom silt and clay (Qvel) were deposited in this lake, which was more than 200 feet deep in places. When the retreating ice margin uncovered the north end of Second Mountain in North Caldwell, Lake Verona became an arm of the Moggy Hollow stage of Lake Passaic, which was at a nearly identical elevation as Lake Verona. This lake then lowered to the Great Notch stage when Great Notch was deglaciated, and drained completely when the gap in First Mountain at Paterson was uncovered (fig. 1).

Glacial-Lake Deposits--These are stratified and generally well-sorted. They include sand and gravel laid down in deltas and lacustrine fans; and clay, silt, and fine sand laid down on lake-bottom plains and in the lower parts of deltas. Bedding in the deltas includes inclined foreset beds of sand, pebbly sand, and minor pebble-to-cobble gravel, overlain at the surface of some deltas by horizontal topset beds of sand and pebble-to-cobble gravel. Lacustrine fans contain gently dipping beds of sand and pebble-to-cobble gravel. Bedding in deltas and lacustrine fans may be deformed locally by collapse, slumping, or pushing by glacial ice. Bedding in lake-bottom deposits is generally horizontal, laminated to thin-bedded, and undeformed. Nongravel sediment is light reddish-brown, reddish-brown, yellowish-brown, and light gray. Sand composition is chiefly quartz, feldspar, mica, and fragments of sandstone, mudstone, gneiss, quartzite, and basalt. Gravel consists chiefly of clasts of red and gray sandstone and mudstone, and a little gray gneiss, white-to-yellow quartz, purple-to-gray quartzite and quartzite-conglomerate and, in the Lake Verona deposits, dark-gray basalt.

Qhkl **GLACIAL LAKE HACKENSACK LAKE-BOTTOM DEPOSITS**--Silt, clay, minor fine sand. As much as 40 feet thick (estimated). Lower contact is an approximate timeline marking the transition from the Lake Bayonne level to the Lake Hackensack level, not a physical discontinuity.

Qpr **GLACIAL LAKE PARAMUS DEPOSITS**--Fine-to-coarse sand, minor pebble gravel. As much as 40 feet thick (estimated).

Qah **GLACIAL LAKE ATHENIA DEPOSITS**--Fine-to-coarse sand and pebble-to-cobble gravel. As much as 65 feet thick.

Qyn **GLACIAL LAKE YANTACAW DEPOSITS**--Fine-to-coarse sand, silt, minor pebble-to-cobble gravel and clay. As much as 40 feet thick.

GLACIAL LAKE DELAWANNA DEPOSITS--Include deltaic and lacustrine-fan sediment (Qdw) in the Clifton and Passaic area, and a small deposit in Belleville; and lake-bottom sediment (Qdwl) in the Passaic Valley between Newark and Lyndhurst, beneath terrace deposits and alluvium (section DD'), and locally beneath deltaic deposits (sections AA', BB', CC').

Qdw Fine-to-coarse sand and pebble-to-cobble gravel, minor silt. As much as 70 feet thick.

Qdwl Silt, fine sand, clay. As much as 60 feet thick.

GLACIAL LAKE BAYONNE DEPOSITS--Include deltaic and lacustrine-fan sediment in Newark and Harrison (Qbn) and lake-bottom sediment (Qbnl) beneath alluvium in the Passaic Valley at Newark (section DD') and beneath salt-marsh deposits in the Kearny Meadows (section EE').

Qbn Fine-to-coarse sand and pebble-to-cobble gravel, some silt. As much as 80 feet thick.

Qbnl Silt, clay, fine sand. As much as 220 feet thick.

GLACIAL LAKE WATSESSING DEPOSITS--Include deltaic and lacustrine-fan sediment deposited in an upper lake stage (Qwt1) and a lower stage (Qwt2), and lake-bottom sediment (Qwt1.) deposited in both lake stages.

Qwt2 Fine-to-coarse sand and some pebble gravel and silt. As much as 40 feet thick.

Qwt1 Fine-to-coarse sand, pebble gravel, minor cobble gravel. As much as 80 feet thick.

Qwtl Silt, fine sand, clay. As much as 50 feet thick.

GLACIAL LAKE VERONA DEPOSITS--Include deltaic and lacustrine-fan sediment (Qve) and lake-bottom sediment (Qvel).

Qve Fine-to-coarse sand, pebble-to-cobble gravel, some silt. As much as 140 feet thick.

Qvel Silt, clay, fine sand. As much as 90 feet thick.

Glacial-Stream Deposits--Stratified, generally well-sorted gravel and sand forming valley-bottom plains and terraces in valleys not occupied by glacial lakes. Bedding is generally horizontal; varying from massive, thick beds in cobble gravel to cross-beds and thin horizontal beds in sand to pebbly sand. Nongravel sediment is reddish-brown, brown, and light-gray. Sand is chiefly quartz, feldspar, mica, and fragments of red-brown sandstone and mudstone, gray gneiss, and gray to purple quartzite. Gravel is chiefly reddish-brown sandstone and siltstone, and some gray-to-brown mudstone and sandstone, gray gneiss, white-to-yellow quartz, and purple-to-gray quartzite-conglomerate.

Qbd **BROOKDALE DEPOSIT**--Pebble-to-cobble gravel and fine-to-coarse sand. As much as 40 feet thick.

Qeb **EAST BRANCH DEPOSIT**--Pebble-to-cobble gravel and fine-to-coarse sand, some silt. As much as 40 feet thick.

Till and Related Deposits--Poorly-sorted, nonstratified sediment deposited directly by glacial ice or by sediment flows from glacial ice.

Qr, Qrt **RAHWAY TILL**--Reddish-brown to light-reddish-brown silty sand to sandy clayey silt containing some to many subrounded and subangular pebbles and cobbles and few subrounded boulders. Generally compact below the soil zone. May show a coarse subhorizontal fissile structure. Gravel clasts include chiefly red sandstone and siltstone, some gray sandstone and mudstone, and minor white-to-yellow quartz, gray-to-purple quartzite-conglomerate and gray gneiss. Dark-gray basalt is common on and west of First Mountain. Boulders are chiefly gneiss and gray quartzite; basalt boulders are common on and west of First Mountain. As much as 60 feet thick. Unit Qrt delineates areas where Qr is discontinuous and generally less than 10 feet thick. Contacts with unit Qry are gradational and Qry may underlie Qr in places on and west of First Mountain.

Qry, Qryt **RAHWAY TILL, YELLOW PHASE**--Reddish-yellow, yellow, very pale-brown sandy silt to silt with some to many subangular to subrounded pebbles and cobbles and few subrounded boulders. Gravel clasts include chiefly dark-gray basalt, with some red-brown sandstone and siltstone and minor gray sandstone and mudstone, gray gneiss, and gray-to-purple quartzite-conglomerate. Boulders are chiefly gneiss, quartzite, and basalt. As much as 40 feet thick. Unit Qryt delineates areas where Qry is discontinuous and generally less than 10 feet thick.

Qrb **BLOOMFIELD MORAINE DEPOSIT**--Till as in unit Qr interbedded with fine-to-coarse sand and pebble-to-cobble gravel. As much as 70 feet thick. Forms irregular ridges that stand 20 to 40 feet above adjacent delta and terrace surfaces in Newark, Belleville, and Bloomfield. Some of these ridges are elongated in a northwest-southeast direction, suggesting that they were deposited along one or more recessional ice margins (fig. 1, margins M2 and M3).

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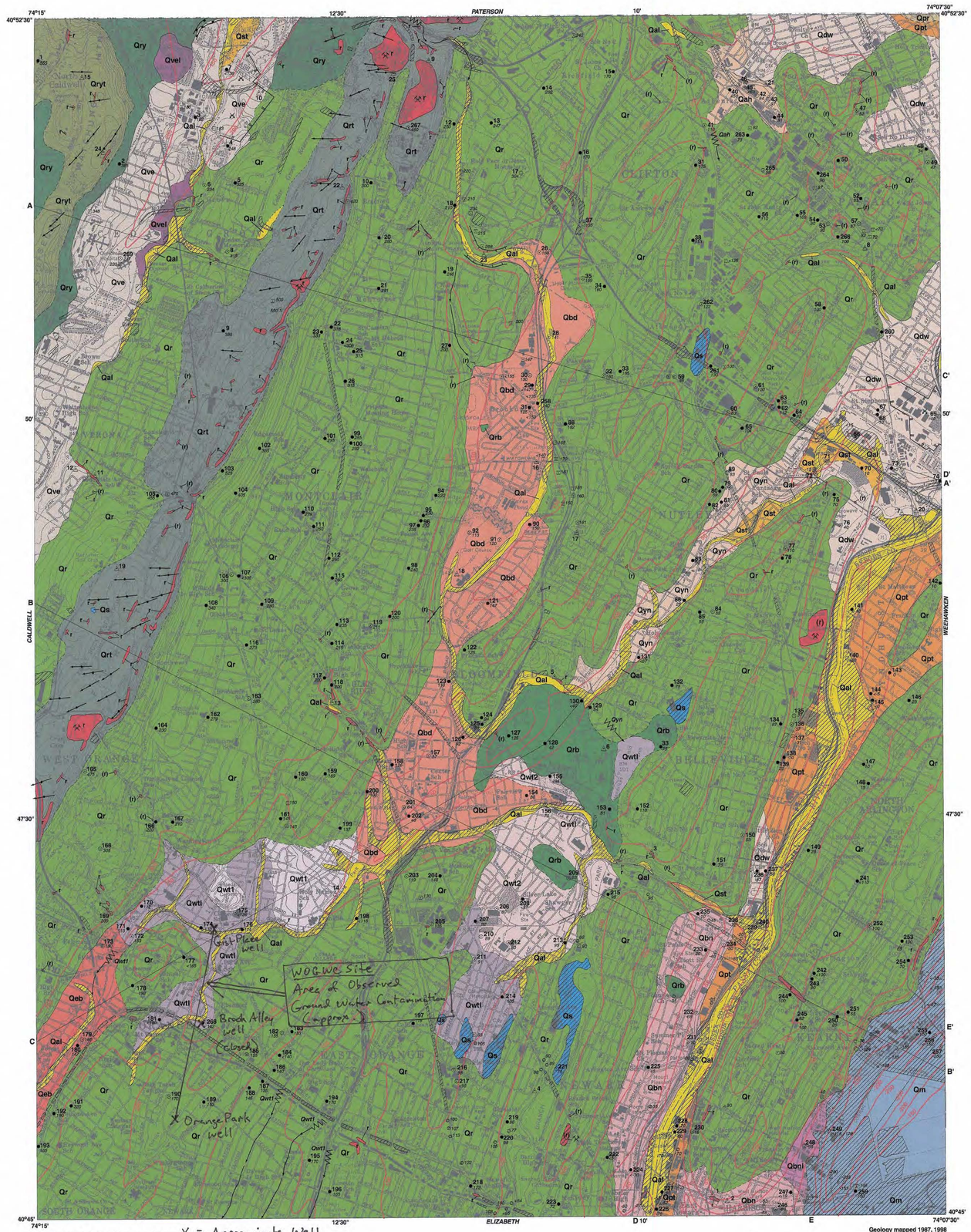


Base map from U. S. Geological Survey, 1955
Photorevised 1981

X = Approximate Well Locations (GVG Dec. 2010)

Geology mapped 1987, 1998

The interpretations presented here are provisional pending peer review. There may be changes prior to publication.

APPROXIMATE MEAN DECLINATION, 1999

SCALE 1:24 000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

LOCATION IN NEW JERSEY

MAP SYMBOLS

Contact--Solid where well-defined by landforms; dashed where approximate, gradational, or feather-edged; dotted where covered by fill or water, or where removed by excavation. Some contacts are modified from Salisbury (1895), Merrill and others (1902), Darton and others (1908), and unpublished manuscript maps of H. B. Kummel and R. D. Salisbury on file at the N. J. Geological Survey.

Striation--Observation at dot. Flagged data are from Salisbury (1902, p. 555, 561) and are approximately located.

Elevation of bedrock surface in well or boring--Data from Lovegreen (1974). Values are inferred from a bedrock topography map with contour interval of 20 feet.

Elevation of bedrock surface in well or boring--Data from Parrillo (1959).

Elevation of bedrock surface in well or boring--Data from Herpers and Barksdale (1951).

Elevation of bedrock surface in well or boring--Data from files of the N. J. Geological Survey.

Well with log in table 1--Location judged to be accurate to within 100 feet. Elevation of bedrock surface in italics.

Well with log in table 1--Location judged to be accurate to within 500 feet. Elevation of bedrock surface in italics.

Elevation of bedrock surface--Contour interval 50 feet. Shown only at and below bedrock surface elevation of 200 feet.

Large bedrock outcrop--May be partly covered by fill or structures. Many small outcrops on First and Second Watchung Mountain not shown.

Former bedrock outcrop--Shown on unpublished manuscript maps of R. D. Salisbury and H. B. Kummel (on file at the N. J. Geological Survey) but no longer exposed.

Well with log in table 1--On sections, projected to line of section.

Depth to bedrock in well or boring--On sections, projected to line of section. Dot indicates bedrock surface penetrated, no dot indicates bedrock not reached.

Spillway of glacial lake--Arrow shows direction of drainage.

Site of pebble lithology count--Data in table 2.

Excavation scarp--Line at top, ticks on slope. Delineates extent of former sand and gravel pits.

Scarp cut by meltwater--Line at top, ticks on slope. Delineates channel along Third River cut by drainage from the Great Notch spillway.

Scarp cut by postglacial stream--Line at top, symbols on slope.

Former sand and gravel pit

Former quarry

Active quarry

Meltwater channel--Arrow shows direction of flow.

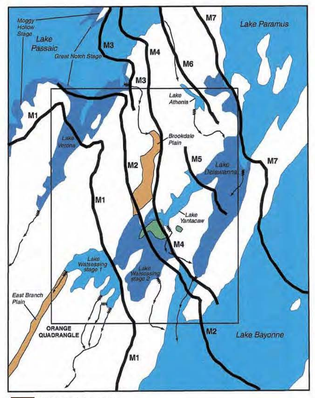
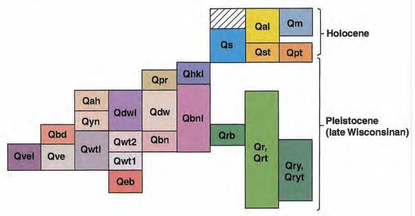


Figure 1.--Recessional ice margins, glacial lakes, and glaciofluvial and moraine deposits in the Orange quadrangle and adjacent areas. Ice-margin abbreviations are: M1=last margin before drop of Lake Watsessing from high to low stage. M2=last margin before Lake Verona was replaced by the Moggy Hollow stage of Lake Passaic. Outer ridges of Bloomfield Moraine, and deltas, were deposited in lower stage of Lake Watsessing in Bloomfield and in Lake Bayonne in Newark and Harrison. M3=last ice margin before Great Notch was deglaciated and Moggy Hollow stage of Lake Passaic fell to the Great Notch stage. M4=last ice margin before formation of lakes Yantacaw and Delawanna. Inner ridges of Bloomfield Moraine were deposited, and deposition of deltas in lower stage of Lake Watsessing and in Lake Bayonne continued. Brookdale glaciofluvial plain was laid down by discharge from the Great Notch spillway. M5=last ice margin before lowering of Lake Yantacaw to the Lake Delawanna level. Deposition of the Brookdale plain continued on the newly exposed floor of Lake Watsessing (low stage). M6=last ice margin before draining of Great Notch stage. Deltaic sediments were deposited in Lake Athenia. M7=last ice margin before lowering of Lake Delawanna to Lake Paramus.

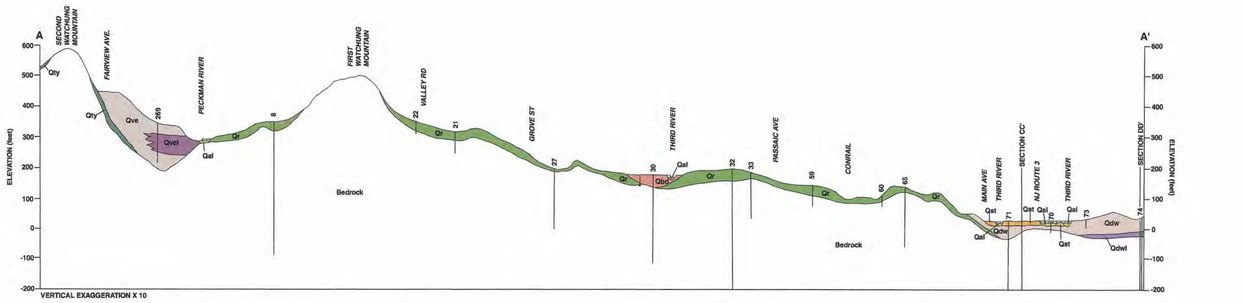
CORRELATION OF MAP UNITS

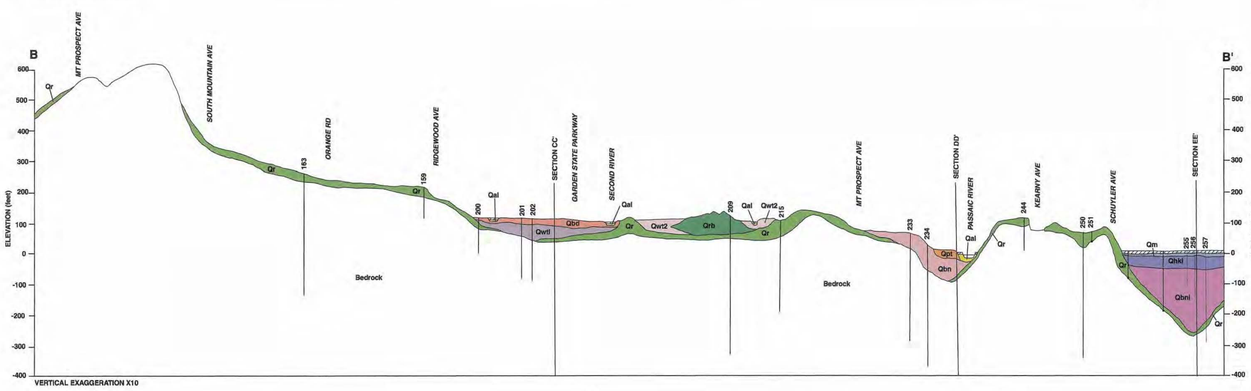


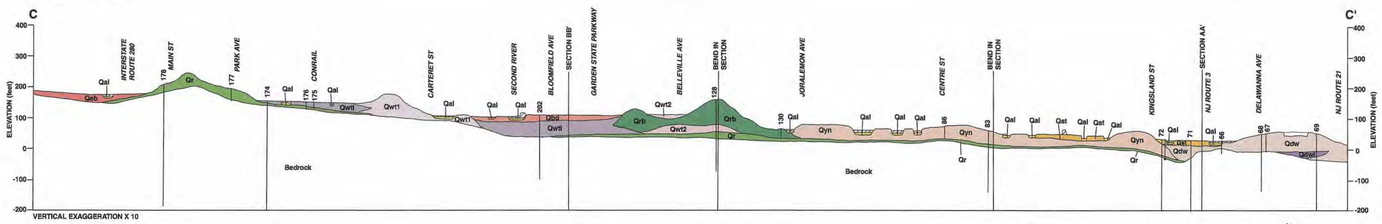
SURFICIAL GEOLOGY OF THE ORANGE QUADRANGLE, ESSEX, PASSAIC, HUDSON, AND BERGEN COUNTIES, NEW JERSEY

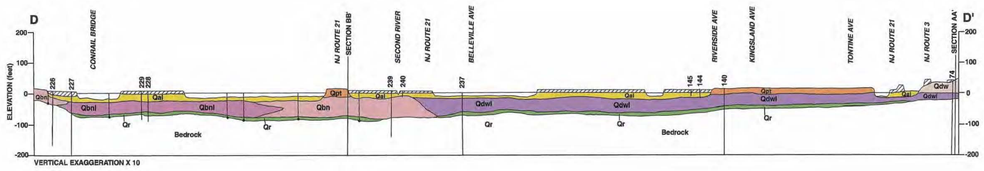
by
Scott D. Stanford
2001

Prepared in cooperation with the
U. S. GEOLOGICAL SURVEY
NATIONAL GEOLOGIC MAPPING PROGRAM









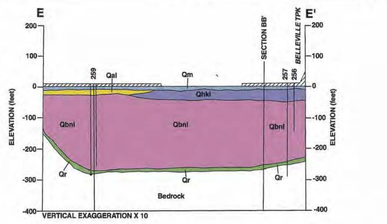


Table 1.--Selected Well and Boring Logs

Well No.	Identifier[1]	Driller's Log Depth[2]	Description
1	26-1828	0-4 4-195	overburden (Qry) trap rock (basalt)
2	26-4811	abbreviated log 0-26 26-42 42-100 100-398 398-430	brown silty fine sand with little to some clay and occasional thin zones of fine-to-coarse gravel (Qr) reddish-brown clayey silty fine-to-coarse sand with little fine gravel; well graded (Qr) red-brown silty clay, little sand (weathered shale or pro-advance lacustrine deposits) red-brown soft shale, siltstone, and sandstone basalt
3	26-390	0-77 77-80 80-99 99-105	silt and fine sand (Qva) water, dirty sand and gravel (Qva or Qr) hard sand and gravel (Qr) broken trap (basalt)
4	26-4749	0-20 20-32 32-373	clay (Qva) gravel (Qva or Qr) gray trap rock (basalt)
5	26-4283	0-35 35-147	overburden, boulders (Qr) trap (basalt)
6	26-1848	0-16 16-110	overburden (Qr) trap (basalt)
7	26-19547	abbreviated log 0-34	brown fine-to-medium sand, little to some silt (Qva)
8	26-3909	0-55 55-290 290-430	hardpan (Qr) trap (basalt) red rock (shale)
9	NJGS files	abbreviated log 0-12 12-15	red sand, gravel, trace of clay and small boulders (Qr) rock
10	26-3689	0-30 30-61 61-361	clay (Qr) hardpan (Qr) red rock
11	26-3453	0-30 30-233	broken trap rock overburden (Qr over basalt) red sandstone
12	26-5234	0-2 2-80	topsoil (Qr) red sandstone
13	26-1464	0-23 23-100	overburden (Qr) red sandstone
14	26-3411	0-8 8-250	dirt (Qr) shale
15	26-6096	abbreviated log 0-12 12-15	red-brown medium-to-fine sand, little to some silt, little coarse-to-fine gravel (Qr) red-brown shale and sandstone
16	26-6942	0-16 16-20 at 20	brown-red silt, clay, cobbles, gravel, sand, brick, and glass (fill) red decomposed shale, cobbles, silt, clay, trace sand (Qr) refusal (possible bedrock)
17	BWA files 26-2-828	0-10 10-217	clay, dirt (Qr) red rock
18	26-5858	abbreviated log 0-5 5-11	red-brown silty sand with gravel (Qr) red fractured sandstone
19	26-3501	0-10 10-165	hardpan (Qr) red sandstone
20	26-1164	0-70 70-260	earth, clay, gravel (Qr) red rock
21	26-3092	0-20 20-29 29-45 45-71	clay (Qr) hardpan (Qr) red sandstone red shale
22	26-23231	abbreviated log 0-24 24-28	reddish-brown silty sand with shale cobbles (Qr) reddish-brown shale
23	26-4597	0-4 4-7 7-300	light-gray fine sand with some gray clay (Qr or fill) red hardpan (Qr) red shale
24	26-5575	abbreviated log 0-24	red-brown medium-to-fine sand and silt, little gravel, a few boulders (Qr)
25	26-136	0-17 17-157	red earth (Qr) red shale
26	26-7625	0-15 15-19	silty clay and fine sandy till (Qr) red shale
27	26-3256	0-4 4-200	dirt (Qr) red shale
28	26-28962	0-29 29-300	clay, sand, and gravel (Qsl over Qbd) red shale and sandstone
29	26-28546	0-23	silty sand and gravel, cobbles (Qbd)
30	26-25205	0-40 40-290	overburden, lots of gravel (Qbd) sandstone
31	26-1462	0-45 45-201	glacial fill (Qbd over Qr) red rock
32	26-1730	0-38 38-430	clay (Qr) red shale
33	26-2395	0-15 15-150	hardpan (Qr) red rock
34	26-4825	0-20 20-300	red clay (Qr) red rock
35	26-4390	0-16 16-335	hardpan (Qr) sandstone
36	26-2811	0-21 21-110	overburden (Qbd over Qr) red sandstone
37	26-593	0-55 55-207	sandy hardpan (Qr) shale
38	26-20644	0-3 3-17 17-23	gray-red medium-to-fine sand, little silt (fill or Qr) red-brown fine-to-medium sand and coarse-to-fine gravel, little silt, trace cobbles (Qr) very fractured rock
39	26-20349	0-8 8-38	red-brown silty medium-to-fine sand, some coarse-to-fine gravel, trace cobbles (Qr) hard red sandstone
40	26-20213	abbreviated log 0-62	red-brown fine-to-medium sand, some gravel, trace silt (Qdh)
41	26-24590	0-14 14-43	brown soil, silt, and sand (Qr) sandstone
42	26-421	0-46 46-605	sand and gravel (Qsh) sandstone and shale
43	26-27868	abbreviated log 0-29 29-33 33-70	red-brown well-sorted medium sand with a trace of gravel (Qsh) gray-red to brown silty fine sand to clayey silt (Qr) bedrock
44	26-3211	0-39 39-270	sand (Qsh) red rock
45	26-14493	abbreviated log 0-17 17-60	red-brown fine sand, some gravel, little silt (Qsh) red-brown sandy to clayey till with boulders (Qr)
46	26-27723	0-62	sand, gravel, cobbles, and boulders (Qsh)
47	BWA files 26-2-933	0-33 33-48 48-200	sand (Qr or fill or weathered sandstone) clay with pieces of red sandstone (Qr or weathered sandstone) red sandstone
48	26-2123	0-21 21-500	hardpan (Qr) red rock
49	26-3195	0-18 18-205	hardpan (Qr) red shale
50	26-3614	0-20 20-300	shale (possibly Qr) red rock
51	26-3941	0-23 23-242	sandy hardpan (Qr) sandstone
52	26-6148	abbreviated log 0-15 15-39	red-brown medium-to-fine sand, some clay, some gravel and shale fragments and boulders (Qr) competent shale
53	BWA files 26-2-966	0-18 18-292	hardpan (Qr) red rock
54	26-2231	0-20 20-500	red hardpan (Qr) red shale
55	26-3584	0-17 17-108	hardpan (Qr) red shale
56	26-3403	0-5 5-210	dirt (Qr) shale
57	26-7931	abbreviated log 0-6 6-8 8-10	brown, black fine-to-coarse sand, some gravel and silty clay and wood (fill) red fine sand and clay, some fine-to-medium pebbles (Qr) red shale
58	26-3583	0-20 20-180	red clay (Qr) red shale
59	26-20504	abbreviated log 0-26 26-73	red-brown fine-to-medium sand, gravel and silty clay (Qr) red shale
60	26-19881	abbreviated log 0-27 27-35	red-brown fine-to-coarse sand, little to some silt and gravel (Qr) red-brown weathered sandstone
61	26-26436	0-12 12-60	red sand and gravel (Qr) red shale
62	26-22693	0-18	red-brown silty clay, some coarse-to-fine gravel, little coarse-to-fine sand, trace cobbles (Qr)
		18-28	sandstone
63	26-667	0-35 35-102	dead sand (Qr) red rock
64	26-3547	0-8 8-143	hardpan (Qr) red shale and sandstone
65	26-3662	0-16 16-190	sand, clay, gravel, and boulders (Qr) sandstone
66	26-27752	0-5 5-20 20-40	gravel, soil, brick fill brown medium-to-fine sand with some gravel and an occasional boulder or two (Qdw) red shale
67	26-3844	0-21 21-47 47-50 50-55	hardpan, sand and gravel (Qdw) silty sand (Qdw) water-bearing sand (Qdw) red shale
68	26-3727	0-21 21-37 37-59 59-186	clayey silty sand (Qdw) hardpan and stones (Qdw) silty water-bearing sand with few stones (Qdw) red shale and sandstone
69	26-4566	0-15 15-79 79-91 91-400	fill clay (Qdw over Qdwl) gravel (Qdw) red rock
70	26-10121	0-22 22-27	red-brown fine-to-medium sand, some gravel (Qdw) decomposed sandstone (possibly Qr)
71	26-4208	0-56 56-300	overburden (Qst over Qdw) red sandstone and shale
72	26-3347	0-55 55-448	hardpan (Qm over Qr) sandstone and red shale
73	26-5440	0-30	brown medium-to-fine sand, trace fine gravel, trace silt (Qdw)
74	26-1315	0-60 60-304	sand and clay (Qdw over Qdwl) red rock
75	26-22186	0-6 6-7 7-28	red fine-to-coarse sand and gravel (Qr) weathered sandstone red sandstone
76	26-4692	0-10 10-500	boulders and dirt (Qdw over Qr) sandstone
77	26-3908	0-8 8-212	hardpan (Qr) red sandstone
78	26-3704	0-19 19-158	hardpan (Qr) sandstone
79	26-3070	0-25 25-150	red hardpan (Qr) red sandstone
80	26-3099	0-11 11-165	hardpan (Qr) red rock
81	26-798	0-26 26-209	gravelly hardpan (Qr) red rock
82	26-3265	0-41 41-200	red hardpan (Qr) red sandstone
83	26-3668	0-20 20-45 45-50 50-200	hardpan and clay (Qzn) fine sand (Qzn) red hardpan (Qr) red sandstone
84	26-3168	0-18 18-22 22-117	hardpan (Qr) gravel (Qr) sandstone
85	26-3144	0-40 40-125	hardpan and clay with many boulders (Qr) red sandstone
86	26-23010	abbreviated log 0-29 29-35 at 35	brownish-red silty fine sand with trace coarse sand and clay (Qzn) reddish-brown fine-to-coarse sand with layers of clayey silt and gravel (Qzn) refusal (possible bedrock)
87	26-4766	0-4 4-18 18-30 30-33 33-405	red clay (Qr) clay and silt (Qr) sand, gravel (Qr) rotten sandstone red to brown sandstone
88	26-4983	0-7 7-101	hardpan and stones (Qr) red shale and sandstone
89	26-28626	0-4 4-31	red-brown silty medium-to-fine sand and rock fragments (Qr) sandstone
90	26-4764	0-6 6-12 12-27	clay (fill?) clay and gravel (Qbd) loam, sand and gravel (Qbd or Qr)
91	26-1852	0-40 40-353	hardpan (Qbd) red sandstone
92	26-954	0-42 42-400	hardpan (Qbd) red sandstone
93	26-5852	abbreviated log 0-7 7-11 11-15	white, tan clay, sand, rock fill dark brown organic silty clay (Qsl) gray and red-brown coarse-to-fine sand, little medium-to-fine gravel (Qbd)
94	26-4134	0-20 20-300	overburden, hardpan (Qr) sandstone
95	26-3791	0-10 10-100	earth (Qr) red shale
96	26-3839	0-8 8-110	earth (Qr) red shale
97	26-239	0-5 5-166	earth and clay (Qr) red shale and sandstone
98	26-3258	0-10 10-181	overburden (Qr) red sandstone
99	26-3975	0-32 32-134	hardpan (Qr) sandstone
100	26-30286	0-8 8-25	brown silty gravel (Qr) red sandstone and shale
101	26-3460	0-30 30-150	red hardpan (Qr) red sandstone
102	26-3132	0-35 35-200	red hardpan (Qr) red sandstone
103	26-4373	0-15 15-220	hardpan (Qr) red rock
104	26-3499	0-15 15-227	hardpan (Qr) red sandstone
105	26-7866	0-5 5-190 190-460	overburden (Qr) trap rock (basalt) red sandstone
106	26-7965	0-20 20-21	red sandy silt till (Qr) red shale
107	26-8739	0-19 at 19	red silty clay till (Qr) refusal on rock
108	26-3231	0-10 10-169	dirt (Qr) red rock
109	26-106	0-20 20-505	dirt (Qr) red shale
110	NJGS files	0-11 11-16	red fine sand, some gravel, trace of silt and clay (Qr) rock
111	26-3688	0-21 21-300	hardpan (Qr) red rock
112	26-4041	0-25 25-30 30-205	sand (Qr) gravel (Qr) red rock
113	26-5407	0-5 5-165	overburden (Qr) red shale
114	26-6858	0-5 5-150	hardpan (Qr) red shale and sandstone
115	26-1166	0-10 10-151	till (Qr) red rock
116	26-171	0-26 26-191	earth (Qr) red shale
117	26-3687	0-9 9-300	clay (Qr) red shale
118	26-142	0-17 17-200	hardpan (Qr) red rock
119	26-4827	0-34 34-402	sand, gravel, clay (Qr) red sandstone
120	26-3735	0-35 35-150	red clay and hardpan (Qr) red sandstone
121	26-24674	0-6 6-24 24-28 28-32	silt, gravel, trace sand (Qbd) conglomerate with large gravel, silt, sand (Qbd) fine silt, sand, graded gravel (Qr) brownstone
122	26-3385	0-15 15-403	overburden--dirt (Qr) red rock
123	26-11371	0-3 3-12 12-17	yellow silty sand with trace cobbles (Qbd) red silty sand to sandy silt till (Qr) red shale
124	26-29859	0-26 26-60	cobbles and gravel (Qbd) red sandstone
125	26-20002	abbreviated log 0-21 21-51	brown clayey sand and cobbles (Qbd) light-brown mudstone
126	26-4763	0-12 12-16 16-28 28-380	soil and clay (fill) black loam (Qsl?) gravel and sandy loam (Qbd) red sandstone and shale
127	26-3626	0-25 25-102	hardpan (Qrb) sandstone
128	26-4258	0-80 80-100 100-128 128-238	red clay and hardpan (Qrb) fine sand (Qvst or Qrb) red hardpan (Qt or Qrb) red sandstone
129	26-4576	0-7 7-26 26-34 34-350	fill clay (Qr) broken rock (Qr?) red rock
130	NJGS files	0-9 9-30	cinders, wood, sand and gravel fill red clay, sand, gravel, and boulders (Qrb)
131	26-5496	abbreviated log 0-23	red-brown clayey silt with trace coarse-to-fine gravel and trace coarse-to-fine sand (Qr)
132	26-3091	0-25 25-45 45-107	clay (Qr) hardpan (Qr) red sandstone
133	U. S. Army Corps of Engineers boring DC-48	abbreviated log 0-12 12-19 19-45 45-401	red-brown clayey silt with trace sand and gravel (Qrb) red-brown gravelly sand, little silt (Qvst or Qrb) brown silty sand, little fine-to-medium gravel (Qrb) red-brown sandstone
134	26-28177	0-20 20-32	red-brown medium-to-fine silty sand, some gravel (Qr) rock
135	26-1663A	0-18 18-144	overburden (Qr) red rock
136	26-3759	0-23 23-223	hardpan and boulders (Qr) sandstone
137	26-21991	0-9 9-19 19-53	brown silty sand (Qrt) reddish-brown silty sand with some chunks and chips of rock (Qr) red shale
138	26-8379A	0-40 40-300	overburden (Qr) red shale and sandstone
139	26-817	0-8 8-250	hardpan (Qr) red shale
140	26-3956	0-10 10-20 20-70 70-92 92-195 195-232	fill sand (Qsl) clay (Qdwl) fine sand (Qdwl or Qdw) red sandstone gray shale
141	26-29436	0-20	sand and clay (fill over Qsl)
142	26-784	0-22 22-140	sandy hardpan (Qr) red rock
143	26-603	0-20 20-151	sand (Qrt) red sandstone
144	26-4836	0-6 6-20	red fine sand, some silt (Qrt) red silt, trace fine sand and clay (Qrt or Qdwf)
145	26-4878	0-8 8-18	silt (Qrt) clay (Qdwf)
146	26-3393	0-22 22-79	(length of casing, no log of materials, probable Qr) shale
147	26-7553	0-16 16-40	stony hardpan (Qr) stony red hardpan (Qr)
148	26-11492	0-62 62-200	sand (Qr) red sandstone
149	26-4615	0-12 12-100	hardpan and stones (Qr) red and brown sandstone and shale
150	26-9110	0-27 27-36	brown medium-to-fine sand, trace medium-to-fine gravel, trace clayey silt (Qr) sandstone
151	26-16499	abbreviated log 0-25 25-50	reddish-brown silty medium-to-fine sand, some pebbles and rock fragments (Qr) reddish-brown sandstone
152	26-1711	0-45 45-200	red hardpan (Qr) red sandstone
153	26-3569	0-49 49-450	hardpan (Qrb) red shale
154	26-4130	0-6 6-30 30-154	miscellaneous fill red hardpan (Qbd over Qrb) red sandstone
155	26-5280	abbreviated log 0-13 13-25	reddish-brown medium-to-fine sand, little medium-to-fine gravel (Qwt) reddish-brown medium-to-fine sand, trace medium-to-fine gravel, trace silt (Qrb?)
156	26-2353	0-20 20-512	hardpan (thin Qbd over Qr) sandstone
157	26-3371	0-73 73-150	hardpan (Qbd over Qwtl) red shale
158	26-5607	0-4 4-9	sandstone gravel and sandstone cobbles (Qbd) red shale and sandstone
159	26-3068	0-31 31-97	red sand, gravel, some clay (Qr) red rock
160	26-3120	0-31 31-102	red sandy clay and gravel (Qr) red rock
161	26-3741	0-44 44-122	sandy red clay (Qr) red rock
162	26-5031	0-21 21-400	red overburden (Qr) red sandstone
163	26-3929	0-21 21-152	hardpan (Qr) red sandstone
164	26-3229	0-98	red rock
165	26-4419	0-4 4-200	overburden (Qr) red sandstone
166	26-8825	abbreviated log 0-13 13-20 20-23	silty sand, clay, rocks--fill gray, yellow-brown, red sand, gravel, clay and boulder (Qr) red clay and shale (probable bedrock)
167	26-3904	0-30 30-40 40-50 50-225	hardpan and boulders (Qr) sand and gravel (Qr) red hardpan (Qr) red sandstone
168	26-1663A	0-25 25-150	overburden (Qr) red rock
169	26-7807	0-3 3-250	overburden (Qr) shale
170	26-2441	0-58 58-505	hardpan, boulders (Qr) red shale
171	26-3315	0-25 25-67 67-150	clay and sand (Qvstl) coarse sand and gravel (Qsh) red shale
172	26-5561	0-17 17-125	hardpan with layers of gray clay (Qwtl) brown sandstone and red shale
173	NJGS files	0-9 9-14	brown fine sand, some gravel and boulders (Qsh) rock
174	26-4322	0-6 6-17 17-500	fill red clay and stones (Qwtl or Qr) red shale and sandstone
175	26-11532	0-13 13-24	red-brown silty clay (Qwtl) red-brown coarse-to-fine sand, trace clayey silt, trace medium-to-fine gravel (Qwt1)
176	NJGS files	0-7 7-13 13-26 at 26	sand, gravel, cinder fill red silty sand, coarse gravel (Qwtl over Qr) red fine-to-coarse silty sand, gravel and boulders (Qr) refusal (possible bedrock)
177	NJGS files	abbreviated log 0-35	red fine-to-medium sand, silt, clay, gravel, and boulders (Qr)
178	26-1645	0-20 20-400	clay and boulders (Qr) Newark Group (sandstone bedrock)
179	26-39	0-8 8-40 40-350	fill and clay sandy clay, hardpan (Qsb over Qt) red and brown shale
180	26-2160	0-3 3-8 8-33 33-500	fill sand (Qsh) sand and clay (Qsh over Qr) red shale
181	26-5132	abbreviated log 0-22 22-25	gray to reddish-gray silty clay, laminated in places (Qwtl) reddish-brown medium-to-fine sand, trace silt (Qr)
182	26-44	0-15 15-357	red hardpan (Qr) brown shale
183	26-1087	0-32 32-254	glacial fill (Qr) red rock
184	26-4910	0-10 10-30	decomposed red shale (Qr or fill) red sand with harder layers of shale, some boulders (Qr)
185	26-1353A	0-30 30-150	clay (Qr) shale
186	BWA files 26-12-721	0-40 40-150	hardpan (Qr) red rock
187	26-1350A	0-40 40-210	gravelly hardpan (Qr) red rock
188	26-1729	0-30 30-150	fill and clay (Qr) shale
189	26-1196	0-37 37-392	earth, dirt, clay (Qr) red rock
190	26-3440	0-19 19-21 21-28 28-551	red hardpan, boulders (Qr) red hardpan and broken shale (Qr) red hardpan and broken shale (Qr on bedrock) red and brown shale
191	26-3673	0-22 22-150	red hardpan (Qr) red sandstone
192	26-6996	abbreviated log 0-11 11-18	red-brown coarse-to-fine sand and coarse-to-fine gravel, trace clayey silt (Qr) red shale
193	26-3807	0-25 25-174	red hardpan (Qr) red sandstone
194	26-5773	0-4 4-10 10-12	fill--coarse broken rock silty sand, small boulders (Qr) reddish-brown shale and sandstone
195	26-4517	0-8 8-305	hardpan (Qr) red rock
196	26-8576	abbreviated log 0-18 18-46	red-brown medium-to-very-fine sand and silt, little coarse-to-fine gravel (Qr) red shale and sandstone
197	26-4192	0-12 12-350	hardpan (Qr) red sandstone
198	26-8383	0-5 5-17	asphalt, road stone (fill) brown clay, trace medium-to-fine sand, medium-to-fine gravel, trace some small cobbles (Qr)
199	26-3710	0-28 28-96	red clay, gravel, sand (Qr) red rock
200	26-916	0-8 8-20 20-30 30-115	fill dead sand (Qr) sand with water (Qr) red sandstone
201	26-253	0-56 56-200	fill (Qbd over Qwtl) red sandstone
202	26-1463	0-67 67-205	sand, gravel, clay (Qbd over Qwtl) red rock
203	26-921	0-3 3-11 11-478	fill clay and gravel (Qr) red sandstone
204	26-3734	0-12 12-227	hardpan (Qr) red sandstone
205	26-1762	0-15 15-404	clay (Qr) red shale
206	26-1621	0-35 35-395	hardpan and dead sand (Qwt2) red sandstone
207	26-4763	abbreviated log 0-10 10-28 28-400	clay and silt (Qwtl) sand and gravel and clay (Qr) red sandstone
208	26-8906	0-18	red-brown medium-to-fine sand, little silt, trace medium-to-fine gravel (Qwt2)
209	26-3344	0-67 67-500	soil, sand and gravel (Qrb) red sandstone
210	26-105	0-26 26-247	earth (Qwtl) red rock
211	26-3036	0-12 12-24 24-110	fill clay, quite sandy (Qwtl) red sandstone
212	26-11260	0-7 7-16 16-27 27-31 31-33	yellow-brown medium-to-fine sand, trace silt (fill and Qwt2) red-brown fine sandy silt (Qwtl) red-brown fine sandy silt, little medium-to-fine gravel (Qwtl) red-brown silty clay, little fine sand, trace rock fragments (Qr) red-brown sandstone
213	26-5599	abbreviated log 0-9 9-11 11-15	concrete, stone, sand, silt fill brown silt and clay, little medium-to-fine sand (Qsl) brown coarse-to-fine sand, some silt, trace coarse-to-fine gravel and cobbles (Qwt2)
214	26-5205	0-10 10-11	gray silt and clay (Qwtl) red shale
215	26-2599	0-50 50-300	hardpan and boulders (Qr) red sandstone
216	26-17289	0-22	red-brown medium-to-fine sand, trace clay silt, some fine gravel (Qr)
217	26-12283	abbreviated log 0-25	dense reddish-brown silty fine-to-medium sand and some fine-to-coarse gravel (Qr)
218	26-27047	0-11 11-24	red-brown silt, some clay and fine sand, abundant rock fragments to boulder size (Qr) red-brown shale
219	26-27116	0-10 10-20 20-24 24-30	fill brown silt (Qr) boulders (Qr) sandstone
220	26-26644	0-12 12-19	red medium-to-coarse sand (Qr) red sandstone and shale
221	26-4894	0-25 25-450	fine sand, clay, broken red shale (Qr) red rock
222	NJGS files	abbreviated log 0-20	red sand, clay, and gravel (Qr)
223	26-10895	0-18 18-275	overburden (Qr) rock
224	26-27357	0-55	red-brown silts and sands with large cobbles and slabs of broken shale, grading to fine, medium, and coarse red-brown sand (Qbn)
225	26-27700	0-10 10-15 15-25	reddish-brown fine silt (Qbn) dark-brown silt, small cobbles (Qbn) red shale
226	26-4008	0-88 88-174	sand, gravel, boulders (Qrt over Qbn) red rock
227	26-5159	0-20 20-35 35-68 68-75 75-400	fill gravel and larger stones (Qsl or Qrt) sand and clay (Qbsl) red clay (Qbsl or Qr) red shale
228	26-30049	0-15 15-18 18-40 40-50 50-65 65-70 70-80 80-95	gray-black cinders, wood, glass, fine-to-medium sand, trace silt (fill) gray-black silty clay, trace peat (Qsl) gray-brown sand, gravel (Qsl over Qbn) red-brown silt, trace clay(Qbnl) red sandy silt (Qbnl) red silt, trace gravel (Qr) red silt, trace sand (Qr) red shale
229	26-30047	0-10 10-17 17-53 35-67 67-70 70-88	black sand, silt, gravel, cinders, brick (fill) black-gray silt, clay, sand, organic fibers (Qsl) red-brown sand, gravel, silty clay (Qsl over Qbn and Qbnl) red-brown fine sand, silt, clay (Qbnl) boulders (Qr) red shale
230	26-2638	0-2 2-697	earth and clay (Qr) red shale
231	26-28832	0-23	reddish-brown silty sand some coarse gravel (Qbn)
232	26-22228	0-6 6-88 88-91	fill red-brown fine sandy silt (Qbn) red-brown shale
233	26-8608	0-40 40-350	overburden (Qbn) red rock
234	26-911	0-80 80-400	earth, clay (Qbn) red rock
235	26-3064	0-45 45-300	hardpan and sand and gravel (Qbn over Qr) red sandstone
236	26-4332	0-5 5-25 25-55 55-62 62-200	fill red hardpan (Qdw) fine sand (Qdw) red hardpan (Qr) red sandstone
237	26-327	0-20 20-60 60-70 70-206	boulders (Qdw) sand (Qdw) red hardpan (Qr) red sandstone
238	26-214	0-6 6-46 46-52 52-63 63-82 82-83	fill hardpan (Qsl over Qbn) boulders (Qbn) hardpan (Qbn) sand and gravel (Qbn) red rock
239	26-5139	0-20 20-86 86-148	overburden with gravel (Qsl over Qbn) sand, clay, gravel (Qbn) red rock
240	26-15706	abbreviated log 0-6 6-8 8-20	black-brown sand, silt, brick, cinders, sandstone fragments (fill) black fine sand and organic silt with peat (Qm) fine-to-medium sand, some fine-to-medium gravel (Qbn)