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SURFICIAL GEOLOGY OF THE CALDWELL QUADRANGLE ESSEX AND MORRIS COUNTIES, NEW JERSEY

OPEN FILE MAP OFM 66

Pamphlet containing table 1 accompanies map

INTRODUCTION

Surficial deposits in the Caldwell quadrangle include artificial fill, alluvial, alluvial-fan, swamp, talus, and stream-terrace deposits, all of postglacial age; glaciolacustrine and glaciofluvial deposits of late Wisconsinan and Illinoian age; and till of late Wisconsinan and Illinoian age. Postglacial deposits are generally less than 30 feet thick. Glaciofluvial sand and gravel deposits are generally less than 25 feet thick. The glaciolacustrine deposits include stratified sand, gravel, silt, and clay and are as much as 200 feet thick. Till is as much as 110 feet thick.

The accompanying map and sections show the surface extent and subsurface relations of these deposits. The composition and thickness of the deposits, and the glacial and postglacial events they record, are described in the *Description of Map Units*. Well and boring data used to construct bedrock-surface-elevation contours and to infer the subsurface distribution of the deposits are provided in table 1 (in pamphlet). The chronologic relationships of the deposits are shown in the *Correlation of Map Units*. The glacial aquifers and the history of river drainage and glacial erosion in the quadrangle and adjacent areas are briefly described in the two sections below.

GLACIAL AQUIFERS

Surficial deposits in the quadrangle yield ground water to domestic, industrial, and public-supply wells in several areas and affect the movement of water and pollutants from the land surface into lakes, streams, and underlying bedrock and glacial aquifers. Yields and screened intervals for wells tapping glacial deposits are provided in table 1 in the Passaic River, Whippany River, and Canoe Brook valleys, in East Hanover, Livingston, Florham Park, and Millburn, about 20 public-supply wells, and numerous domestic wells in East Hanover, draw water from glaciolacustrine sand and gravel laid down either in front of advancing late Wisconsinan ice (unit Qpc) or during retreat of the Illinoian glacier (unit Qss), with yields of as much as 1670 gallons per minute. These glaciolacustrine sands occur in the subsurface only and are overlain by till (unit Qt) and, in places, glaciolacustrine silt and clay (units Qpcl, Qtsl, and Qpmtl). These overlying sediments are less permeable than the sand and act as confining or semiconfining layers. When first drilled, some wells tapping the confined sands flowed at the surface, although pumpage has now reduced the piezometric surface significantly (Meisler, 1976; Hoffman and Quinlan, 1994). The buried lacustrine deposits are continuous within the yellow area shown in figure 1, although the Illinoian sediments are generally restricted to the buried pre-Illinoian bedrock valleys (fig. 1). The continuity of the confined sand beds, however, is interrupted where they thin, pinch out, or were eroded away and replaced by silt and clay (for example, between wells 351 and 341 on section EE'). The hydrology of this aquifer system is discussed in detail in Vermuele (1905), Thompson (1932), Vecchioli and others (1967), Nichols (1968), Meisler (1976), Hoffman and Quinlan (1994), and Hoffman and others (in review).

In the Passaic River and Rockaway River valleys north of the yellow area in figure 1, the preadvance lacustrine deposits (units Qpc and Qss) were completely eroded during the late Wisconsinan advance. The water-producing beds in this area instead are glaciolacustrine sand and gravel laid down in lacustrine fans (unit Qpmtf) and deltas (unit Qpmd) during the late Wisconsinan retreat. They are not as continuous as the aquifers to the south and are tapped by fewer wells. Most of the productive beds are fan deposits (Qpmtf). Where the fans crop out, chiefly in a belt along the base of Second Watchung Mountain, they are unconfined. Elsewhere, they are confined or semi-confined by overlying lake-bottom silt and clay (unit Qpmtl).

On and east of Second Watchung Mountain the glacial deposits generally are too thin, impermeable, or have insufficient saturated thickness, to be productive aquifers. A single public-supply well (well 455) taps unconfined glaciolacustrine sand and gravel of unit Qmn near Orange Reservoir in the valley of the West Branch of the Rahway River.

Hydraulic conductivities of the surficial deposits may be estimated from statewide glacial aquifer-test data on file at the N. J. Geological Survey (Mennel and Canace, 2002) and published aquifer-test and laboratory data summarized by Stanford (2000). Sand and gravel deposits (units Qss, Qpc, Qpmf, Qpmd, Qsm, Qrw, Qeb, Qsc, Qsp, Qwc, and parts of Qal and Qrt) are highly permeable, having estimated hydraulic conductivities that range from 10^1 to 10^3 feet per day (ft/d). Sandy till and silty sand till (parts of Qt and Qry) are also permeable, having estimated hydraulic conductivities from 10^{-1} to 10^1 ft/d. Silt and clay lake-bottom deposits (parts of units Qpmtl, Qpcl, Qtsl) are of low permeability, having estimated hydraulic conductivities of 10^{-3} to 10^{-1} ft/d. Fine sand and silt lake-bottom, alluvial, and wetland deposits (parts of units Qpmtl, Qpcl, Qtsl, Qal, Qac, and Qs) and sandy silt till (Qb, parts of units Qr and Qry) are somewhat more permeable, having estimated hydraulic conductivities of 10^{-2} to 10^{0} ft/d. Swamp deposits (Qs) and fill (af, afl) have variable hydraulic conductivities that depend on the clay and silt content of the material. Peat with little mineral soil, and fill composed of sand, cinders, gravel, demolition debris, slag, and trash, may be highly permeable.

PREGLACIAL DRAINAGE AND GLACIAL EROSION

The topography of the bedrock surface is contoured at an interval of 50 feet from water-well, test-boring, and geophysical-survey data, including data from Vermeule (1905), Thompson (1932), Nichols (1968), Canace and others (1993) and Hoffman and others (in review). Contours are shown where the bedrock-surface topography varies significantly from the land-surface topography. West of Second Watchung Mountain, and in the East Branch of the Rahway River valley in the southeast corner of the map, the rock surface is contoured at elevations of 200 feet and below. In the West Branch of the Rahway River valley between First and Second Watchung Mountains the rock surface is contoured at elevations of 300 feet and below.

West of Second Watchung Mountain the rock surface defines a pre-Illinoian fluvial drainage system that has been significantly modified by glacial scour during both the Illinoian and late Wisconsinan advances. The fluvial system is part of a pre-Illinoian drainage network buried beneath Illinoian and late Wisconsinan glacial deposits in the central Passaic River basin (Nichols, 1968; Hoffman and Quinlan, 1994; Hoffman and others, in review). This drainage network formerly exited the basin through a notch within the Short Hills Gap in Second Watchung Mountain (fig. 1). This gap is now filled with Illinoian and late Wisconsinan glacial deposits (Stanford, 1993), and the postglacial drainage now exits the basin at Little Falls, where the rock surface is at an elevation of about 160 feet. The bedrock surface in the Short Hills notch is at an elevation of about 70 feet, based on geophysical and well data (Ghatge and Hall, 1991; Stanford, 1991). Thus, any rock surface below an elevation of 70-80 feet to the west of the Short Hills Gap has been overdeepened by glacial scour. The buried valley along the line of section EE', named the Millburn Valley by Nichols (1968), contains Illinoian till on its floor south of the Interstate 280 area and is deepened to an elevation as low as 20 feet, indicating as much as 50-60 feet of scour during the Illinoian glaciation. North of the Whippany River-Interstate 280 area, the rock surface is as low as 40 feet below sea level, Illinoian deposits are absent, and the rock is directly overlain by late Wisconsinan till. Here, the rock surface has been overdeepened at least 120 feet, chiefly during the late Wisconsinan advance, and no vestiges of the preglacial fluvial valley remain.

Elsewhere in the quadrangle there is no evidence of significant scour. The rock surface beneath the lower Canoe Brook valley defines a tributary to the pre-Illinoian fluvial valley draining to the Short Hills notch, and is filled with Illinoian deposits. The southwesterly trend of the headwater reaches of Canoe Brook and Bear Brook on Second Watchung Mountain are reflex of this pre-Illinoian drainage pattern. Canoe Brook now defines a barbed pattern as it drains into the postglacial Passaic, reflecting the northward drainage rerouting due to closure of the Short Hills Gap.

In the valley of the West Branch of the Rahway River, deposition of till and, south of Northfield Avenue, lacustrine sand and gravel of unit Qsm, caused the postglacial stream to shift slightly east of its preglacial alignment. The same eastward shift likely occurred in the Peckman River valley in the north end of this valley, based on rock-surface elevation in the adjacent Orange quadrangle (Stanford, 2001).

DESCRIPTION OF MAP UNITS

Postglacial Deposits--These include man-made fill; talus (Qta), stream deposits in fans (Qalf), terraces (Qts), and modern channels and floodplains (Qal), and wetland deposits in swamps (Qs). They were all deposited since retreat of the late Wisconsinan glacier about 18,000 yrs B. P. (years before present).

ARTIFICIAL FILL--Artificially emplaced sand, gravel, silt, clay, and rock fragments, and man-made materials including cinders, ash, brick, concrete, wood, slag, asphalt, metal, glass, and trash. Color variable but generally dark brown, gray, or black. As much as 20 feet thick. Many small areas of fill are not mapped. Some areas of fill are inferred from the extent of swamps and alluvial deposits shown on Salisbury (1895) and on manuscript geologic and topographic maps (dated 1880-1900) on file at the N. J. Geological Survey.

af TRASH FILL--Trash mixed with and covered by sand, silt, clay, and gravel. As much as 60 feet thick. In solid-waste landfills.

Qal ALLUVIUM--Sand, silt, clay, pebble-to-cobble gravel; dark brown, brown, reddish-brown, gray; moderately to well sorted, stratified to massive. Contains variable amounts of organic matter, demolition debris, and trash. As much as 20 feet thick. Adjacent to unit Qst in Troy Meadows and Hatfield Swamp, alluvium is thin (1-3 feet) and is underlain by stream-terrace sand.

Qalf ALLUVIAL FAN DEPOSITS--Pebble-to-cobble gravel, sand, minor silt; brown to yellowish-brown; moderately sorted, stratified. As much as 20 feet thick (estimated).

Qst STREAM TERRACE DEPOSITS--Fine-to-coarse sand, pebbly sand, pebble gravel, minor silt; brown, yellowish-brown, light gray; moderately to well sorted, stratified. As much as 40 feet thick in the Pine Brook area, generally less than 15 feet thick elsewhere. Forms terraces with surfaces 5-10 feet above the modern floodplain along the Passaic, Whippany, and Rockaway Rivers, and along the West Branch of the Rahway River in South Mountain Reservation. In the area of Pine Brook, Troy Meadows, and Hatfield Swamp, the stream terrace deposits form, in part, a shallow-water delta laid down in the Totowa stage of glacial Lake Passaic (see below) shortly after deglaciation.

Qs SWAMP AND MARSH DEPOSITS--Peat and organic silt, clay, and fine sand; black, dark brown, and gray. As much as 20 feet thick.

Qta TALUS--Angular chips, flagstones, and cobbles of basalt, with little or no matrix material. Forms apron at base of a cliff in South Mountain Reservation. As much as 10 feet thick (estimated). Many small talus deposits on the east slopes of Riker Hill, Hook Mountain, and the Watchung Mountains are not mapped.

Glacial Deposits--These include till and stratified sediments. Till is a poorly sorted, nonstratified sediment containing gravel clasts and boulders, deposited directly from glacial ice (units Qr, Qry, Qb). The stratified sediments are generally well sorted. They include sand and gravel laid down by glacial meltwater in river plains (Qwc, Qeb) and in glacial-lake deltas and fans (Qs, Qpc, Qsp, Qpmf, Qpmd, Qsm, Qwc). The stratified sediments also include silt, clay, and fine sand deposited on the bottoms of glacial lakes (Qsl, Qpcl, Qpmtl) and moderately to poorly sorted sand and gravel deposited in ice-walled basins and ponds (Qsc). All of these deposits are of late Wisconsinan age except Qss, Qsl, and Qb, which are of probable Illinoian age.

Illinoian deposits are preserved beneath late Wisconsinan deposits in the yellow area in figure 1, where they are inferred from drillers' logs. They include till (Qtb), which rests directly on the bedrock surface, and overlying sand and gravel (Qss) and silt, fine sand, and clay (Qsl). In the Short Hills Gap (fig. 1), water-well records indicate that Illinoian till fills the gap to an elevation of 150-200 feet (Stanford, 1991). Thus, during retreat of Illinoian ice, a lake filled the central Passaic basin to an elevation of about 150-200 feet. Units Qss and Qsl, which rise no higher than about 140 feet, are deltaic, lacustrine-fan, and lake-bottom sediments laid down in this lake. An alternate interpretation of these deposits is that the Short Hills notch was not filled with Illinoian deposits during the Illinoian retreat, or during the following interglacial period, or during the late Wisconsinan advance, permitting fluvial drainage through the notch at all three times (Stone and others, 2002). In this scenario, the stratified deposits above the Illinoian till and below the late Wisconsinan advance-stage lacustrine deposits (unit Qpc) are glaciofluvial and interglacial fluvial sediments (the Wharton alluvial deposits and Florham Park outwash deposits of Stone and others, 2002). However, the interbedding of sand and gravel with thick clay and silt in these deposits, and their range in elevation from 40 feet (30 feet below the rock floor of the notch) to 150 feet, favor a lacustrine depositional setting. Also, it is unlikely, given the well data in the Short Hills Gap, and the widespread distribution of Illinoian till in the subsurface west and north of the gap, that the notch was open. Thus, the "Wharton" and "Florham Park" deposits are not mapped here.

The Illinoian deposits have not been dated in this region. Weathering characteristics, soil development on outcropping deposits, and correlation to tills in Long Island and southern New England, indicate that they predate the last interglacial period about 125,000 years ago (Stone and others, 2002), and likely were deposited during the late Illinoian glaciation about 150,000 years ago. Following retreat of Illinoian ice there was a long period of erosion until arrival of late Wisconsinan ice.

The orientation of striations, distribution of till, and provenance of erratics in till, indicate that late Wisconsinan ice advanced toward the southwest across the Caldwell quadrangle. This ice was on the west side of an advancing lobe channeled between the Palisades Ridge to the east and the Highlands to the west (Salisbury, 1902; Stanford and Harper, 1991). The Watchung Mountains impeded ice flow, and ice to the west of First Watchung Mountain (hereafter referred to as the "Passaic lobe") did not advance as far to the south as ice to the east of First Watchung (hereafter referred to as the "Hackensack lobe").

Till was deposited discontinuously on the bedrock surface. It is thickest on the east- and northeast-facing slopes of the Watchung ridges and Riker Hill, which faced the advancing ice, and where it forms drumlins or contributes to the streamlined shape of bedrock ridges on the west slope of Second Watchung Mountain. It is also thick in the southern part of the quadrangle on and west of Second Watchung Mountain, in and adjacent to the terminal moraine. It is thin and patchy on the tops of the Watchung ridges. The late Wisconsinan till includes two varieties: a reddish-brown silty sand to sandy silt till (Rahway Till, Qr) derived from the local red sandstone bedrock, and a yellow to reddish-yellow sandy silt till (Rahway Till, yellow phase, Qry) derived from local basalt. The yellow till overlies red till in places west of First Watchung Mountain.

The Passaic lobe advanced to a limit a few miles south of the southern edge of the quadrangle. The Hackensack lobe advanced about 15 miles farther south, to Perth Amboy. The ice front began to retreat from this position before 20,000 yrs B. P., and had likely retreated north of the Caldwell quadrangle by 18,000 yrs B. P. (Stanford and Harper, 1991). The retreating ice margin maintained the two-lobe form that it had during advance. Recessional ice margins are marked by ice-contact glaciolacustrine deposits and till ridges (fig. 1). The retreating ice margin dammed east- or north-draining valleys, including the central Passaic basin, to form the glacial lakes in which most of the recessional deposits were laid down. Glacial-stream deposits were laid down in two valleys after lakes drained. Details of the history of glacial lakes and glacial streams are provided in the following description of map units. Names of the lakes and lake stages (except for the Totowa stage of Lake Passaic) follow those of Stone and others (2002).

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 the lake floor and in the distal parts of deltas and margins of fans. 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 fans may be deformed locally by collapse, slumping, or shoving by glacial ice. Bedding in lake-bottom deposits is generally horizontal, laminated to thin-bedded, and undeformed. Nongravel sediment is yellowish-brown, light reddish-brown, and light gray. Sand consists chiefly of quartz, feldspar, mica, and fragments of gray and red-brown sandstone and mudstone, gray gneiss, and basalt. Gravel is chiefly white-to-gray gneiss, gray mudstone and sandstone, and reddish-brown mudstone and sandstone, with some white quartz, purple and gray quartzite, and basalt.

GLACIAL LAKE PASSAIC DEPOSITS--Deltaic, lake-bottom, and lacustrine-fan deposits laid down in glacial Lake Passaic. Lake Passaic filled the central Passaic River basin between Second Watchung Mountain and the Highlands. It includes four stages: one advance-phase stage and three recessional stages. When the Hackensack lobe of the advancing late Wisconsinan glacier blocked Millburn Gap (fig. 1), the Chatham stage of Lake Passaic flooded the Passaic basin west of Second Watchung Mountain. This stage was controlled by a spillway at an elevation between 250-300 feet on a divide in the valley between First and Second mountains south of Millburn Gap. The exact elevation of this spillway is unknown because it has been buried by later deposits. This spillway drained down the Blue Brook valley ("Blue Brook spillway" in fig. 1). When Millburn Gap was blocked by the Hackensack lobe, the margin of the Passaic lobe was likely no farther south than the Pine Brook area. Chatham-stage deposits (Qpc, Qpcl) occur in the subsurface, beneath till and recessional lacustrine deposits, only south of this area. With continued advance, the Hackensack lobe moved across Blue Brook valley onto Second Watchung Mountain and blocked the Blue Brook spillway. At this time Lake Passaic rose to the Moggy Hollow stage. Deposition of the terminal moraine then filled the Short Hills Gap to an elevation of 375-380 feet, holding the lake at the Moggy Hollow stage during deglaciation. The Moggy Hollow stage (units Qpmf, Qpmd, Qpmtl) was controlled by a spillway at an elevation of 340 feet near Far Hills, 22 miles southwest of Caldwell. Elevation of this lake level at this stage in the Caldwell quadrangle was 370 to 390 feet. A lower lake level, the Great Notch stage (unit Qpgt), was established when the retreating ice front uncovered Great Notch, a gap in First Watchung Mountain 5 miles northeast of Caldwell. The Great Notch spillway is at an elevation of about 305 feet, and the elevation of the lake level at this stage in the Caldwell quadrangle ranges from 295 to about 305 feet. The Great Notch stage lowered when the gap through First Watchung Mountain at Paterson was deglaciated. For a short time after this lowering, a lacustrine-fan deposit in Totowa, about 6 miles northeast of Caldwell, dammed the Passaic basin upstream of that point, holding in a short-lived lake (the Totowa stage) with a spillway at an initial elevation of about 190 feet. Erosion lowered this outlet and soon breached this dam.

Qpmf **Deltaic deposits**--Fine-to-coarse sand and pebble-to-cobble gravel; minor silt. As much as 100 feet thick. Includes two deltas (at Caldwell and along Canoe Brook, fig. 1) deposited in the Moggy Hollow stage of Lake Passaic.

Qpmd **Lacustrine-fan deposits**--Fine-to-coarse sand and pebble-to-cobble gravel; minor silt, very fine sand, and clay. As much as 110 feet thick. Deposited in the Moggy Hollow stage of Lake Passaic.

Qpmtl **Lake-bottom deposits**--Silt, clay, fine sand. As much as 140 feet thick. Deposited chiefly during the Moggy Hollow stage. Uppermost parts may have been laid down in the Great Notch stage. In the area north of Interstate 280 and the Whippany River, the uppermost part of the deposit includes silt and fine sand laid down in the Totowa stage.

Qpgt **Beach deposits**--Fine-to-coarse sand and pebble-to-cobble gravel. As much as 10 feet thick. Formed by wave action reworking till along the shore of the Great Notch stage of Lake Passaic. One small deposit mapped in Livingston; others likely present but now obscured by urbanization.

Qpc **Deltaic and lacustrine-fan deposits**-- Fine-to-coarse sand, pebble gravel, minor cobble gravel, silt, and clay. As much as 60 feet thick. Deposited in Chatham stage of Lake Passaic. In subsurface only. Contact with Qpcl is interfingered or gradational and is inferred from well records.

Qpcl **Lake-bottom deposits**--Silt, clay, fine sand. As much as 80 feet thick. Deposited in Chatham stage of Lake Passaic. Contact with Qpc is interfingered or gradational and is inferred from well records.

GLACIAL LAKE VERONA DEPOSITS--Deltaic and lacustrine-fan deposits laid down in Lake Verona. This lake occupied the north-draining Peckman River valley and was controlled by a spillway at an elevation between 400-420 feet on the drainage divide at the head of the valley at Pleasantdale in West Orange. It lowered slightly to the Moggy Hollow stage of Lake Passaic when the north end of Second Watchung Mountain at Little Falls, just northeast of North Caldwell, was deglaciated, and then drained when the Moggy Hollow stage lowered to the Great Notch stage (see above).

Qvw Fine-to-coarse sand, minor silt and pebble-to-cobble gravel. As much as 65 feet thick.

SOUTH MOUNTAIN DEPOSIT--Deltaic and lacustrine-fan deposits laid down in an ice-dammed lake in the valley of the West Branch of the Rahway River. This lake formed when the Hackensack lobe retreated from the valley but continued to abut First Watchung Mountain south of Millburn (fig. 1). The spillway was at the point of abutment, at an elevation of about 340 feet. The lake drained when Millburn Gap was deglaciated.

Qsm Fine-to-coarse sand, pebble-to-cobble gravel. As much as 120 feet thick.

PRE-ADVANCE STRATIFIED DEPOSITS--Deltaic and lacustrine-fan sand and gravel. In subsurface only, beneath late Wisconsinan till. Laid down in small proglacial ponds that were dammed and then overrun by the advancing ice. Exposed in streambanks along Cub Brook and Bear Brook; elsewhere inferred from water-well records.

Qsp Fine-to-coarse sand, pebble-to-cobble gravel. As much as 20 feet thick.

ICE-CONTACT DEPOSITS-- These form hummocky ridges and knolls above the level of adjacent lakes or fluvial plains. They may have been deposited in ice-walled basins, ponds, and channels, or by glacial pushing and deformation of previously deposited sediment.

Qsc Pebble-to-cobble gravel and fine-to-coarse sand, locally sandy, cobbly diamicton; moderately sorted; variably stratified. As much as 100 feet thick.

ILLINOIAN LACUSTRINE DEPOSITS--Deltaic, lacustrine-fan, and lake-bottom deposits laid down in a glacial lake occupying the central Passaic basin during Illinoian retreat. This lake was controlled by a spillway across Illinoian till in the Short Hills Gap at an elevation between 150-200 feet. This spillway is now buried beneath late Wisconsinan deposits. Depending on the elevation of the spillway, this lake drained either when the gaps through the Watchungs at Little Falls and Paterson were deglaciated or when the spillway was lowered by erosion such that the lake bottom became exposed.

Qls **Deltaic and lacustrine-fan deposits**--Fine-to-coarse sand, pebble gravel, minor cobble gravel, silt, and clay. As much as 60 feet thick. In subsurface only. Contact with Qpcl is interfingered or gradational and is inferred from well records. Contact with Qpc or Qpcl is picked at first report of coarser sand and gravel beneath fine sand, silt, or clay.

Qtsl **Lake-bottom deposits**--Silt , clay, fine sand. As much as 50 feet thick. In subsurface only. Contact with overlying unit Qsl is picked at reported color change to redder or more yellow-color (indicating surface exposure and weathering), or at reported change to coarser grain size.

Glacial Stream Deposits--These are stratified and generally well-sorted. They include sand and gravel forming plains and terraces in the East Branch and West Branch of the Rahway River valleys (fig. 1). The West Branch valley was exposed after the lake it contained drained when Millburn Gap was deglaciated. The East Branch valley in this area did not contain a glacial lake. Color and sand and gravel composition similar to that of glacial-lake deposits.

Qrw WEST BRANCH DEPOSIT--Pebble-to-cobble gravel, fine-to-coarse sand. As much as 25 feet thick.

Qeb EAST BRANCH DEPOSIT--Pebble gravel, some cobble gravel, fine-to-coarse sand. As much as 25 feet thick.

Till--Poorly sorted, nonstratified sediment deposited directly by glacial ice or by sediment flows from glacial ice. Sediment is matrix-supported and is generally compact below the soil zone due to consolidation by the weight of overlying ice. The matrix may show a coarse subhorizontal platy structure. Three tills are distinguished on the basis of color, grain size, and age. The terminal moraine (Qtmr) is distinguished by surface morphology and is composed of Rahway Till. The late Wisconsinan tills are in gradational contact with each other.

Qr **Qrt** RAHWAY TILL--Reddish-brown, light reddish-brown, reddish-yellow silty sand to sandy silt (locally clayey silt in lowlands west of Second Watchung Mountain) containing some to many (2-15% by volume) subrounded and subangular pebbles and cobbles and few (<1%) subrounded boulders. Matrix is compact, nonsticky, nonplastic to slightly plastic, nonjointed, and may have subhorizontal fissility. Gravel clasts include chiefly red and gray sandstone and siltstone, gray gneiss, and a little white quartz, purple quartzite, and basalt. Boulders are chiefly gneiss and some basalt; a very few are quartzite and gray and red sandstone. As much as 80 feet thick. Unit Qrt delineates areas where Qr is discontinuous and generally less than 15 feet thick. Small, thin deposits of clay and silt of unit Qpmtl overlie Rahway Till on some low flat areas in lowlands west of Second Watchung Mountain.

Qtmr TILL OF THE TERMINAL MORAINE--Rahway Till, as in unit Qr, forming ridge-and-basin topography of the terminal moraine. As much as 120 feet thick.

Qry **Qryt** RAHWAY TILL, YELLOW PHASE--Reddish-yellow, yellow, gray, very pale brown silty sand, sandy silt, and silt with some to many (2-15% by volume) subangular and subrounded pebbles and cobbles and few to some (<1-5%) subrounded boulders. Matrix is compact, nonsticky to slightly sticky, slightly plastic, nonjointed, and may have subhorizontal fissility. Gravel clasts include chiefly gray (weathering reddish-yellow) basalt and gray gneiss, and some gray and red sandstone and siltstone and purple quartzite. Boulders are chiefly gneiss and basalt; a very few are quartzite and sandstone. As much as 110 feet thick in drumlins, generally less than 40 feet thick elsewhere. Unit Qryt delineates areas where Qry is discontinuous and generally less than 15 feet thick. On steep slopes Qryt includes thin rubbles of angular basalt cobbles and flagstones with little or no till cover. These rubbles were formed by both postglacial mechanical weathering and glacial-deformation of finely jointed basalt.

Qb BERGEN TILL--Reddish-brown to reddish-yellow sandy clayey silt to sandy clay. Gravel content and composition similar to Rahway till. Matrix is compact, moderately plastic and very plastic, and weakly jointed. Gneiss, sandstone, and mudstone clasts have weathering rinds or are fully decomposed. As much as 25 feet thick. In subsurface only, generally on bedrock surface in yellow area in figure 1. Exposed in steep slope on south side of till ridge near Cedar Ridge Country Club; elsewhere inferred from well records.

MAP SYMBOLS

Contact--Long-dashed where approximately located, short-dashed where gradational or featheredged, dotted where reconstructed to the base-map topography in excavated areas.

Drumlin--Line along crest, symbol on summit.

Striation--Observation at dot.

Till ridge--Line on crest, barbs on gentle slope. Asymmetric ridges, 10 to 60 feet high, with gentle north slopes, composed of till. Formed along active recessional ice margins.

Esker--Ridges of sand and gravel deposited in ice-walled channels or subglacial tunnels. Arrows show inferred flow direction of meltwater.

Meltwater channel--Line in base of channel, arrow indicates flow direction.

Scarp cut by postglacial streams--Line at top, ticks on slope.

Excavation perimeter--Outlines quarries and former sand and gravel pits. Topography within these areas may differ from that on the base map.

Former quarry

Former sand and gravel pit

Spillway for glacial lake--Symbol in spillway area, arrow indicates direction of drainage.

470e **Well with log in table 1**--Location accurate within 100 feet.

47□ **Well with log in table 1**--Location accurate within 500 feet.

Elevation of bedrock surface in well or boring--From Nichols (1968). Shown only where other data are sparse.

Elevation of bedrock surface in well or boring--From N. J. Geological Survey files

Elevation of bedrock surface from seismic survey--From Hoffman and others (in review).

Elevation of bedrock surface from seismic survey--From Canace and others (1993).

Qpc **Subsurface unit exposed**--Observed in 2002-2003.

50 **Elevation of bedrock surface**--Contour interval 50 feet. Shown at and below bedrock-surface elevation of 200 feet to the west of Second Watchung Mountain and east of First Watchung Mountain, and below bedrock-surface elevation of 300 feet in the valley between First and Second Watchung Mountains.

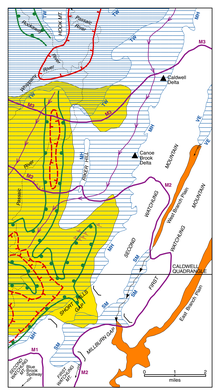
Bedrock outcrop--Many small outcrops on the Watchung Mountains, Riker Hill, and Hook Mountain, within units Qrt and Qry, are not shown.

Well on section--Most wells are projected to line of section. In these cases, depths of contacts on the section may not exactly match those reported in well logs.

Body of water--Shown where underlying surficial deposit is uncertain.

(Qal) **Alluvial lag**--Silt, sand, and clay alluvium interspersed with lags of cobbles and small boulders winnowed from underlying till or bedrock.

Thermokarst basin--Line on rim, pattern within basin. Chiefly on stream-terrace sand, formed from melting of ground ice.



pre-Illinoian fluvial valley
Illinoian glacial overdeepening
late Wisconsinan glacial overdeepening
Chatham-stage and Illinoian deposits in subsurface
gaps in Watchung Mountains
late Wisconsinan recessional features:
glacial lake, symbol on shoreline
tunnel channel
delta
till ridge
glaciofluvial ice-contact deposits
glaciofluvial outwash plain
glaciofluvial valley train
Chatham-stage and Illinoian spillway
ice margin, symbol on former glacier

Figure 1.--Geomorphic and glacial features in the Caldwell quadrangle and vicinity. Abbreviations on glacial-lake sheorelines are: MH=Moggy Hollow stage of Lake Passaic, TW=Totowa stage of Lake Passaic, VE=Lake Verona, SM=South Mountain lake, ice margins are: M1=southernmost late Wisconsinan ice margin, M2=last ice margin before draining of South Mountain lake, M3=ice margin during deposition of Caldwell delta.

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SURFICIAL GEOLOGY OF THE CALDWELL QUADRANGLE ESSEX AND MORRIS COUNTIES, NEW JERSEY

by
Scott D. Stanford

2005

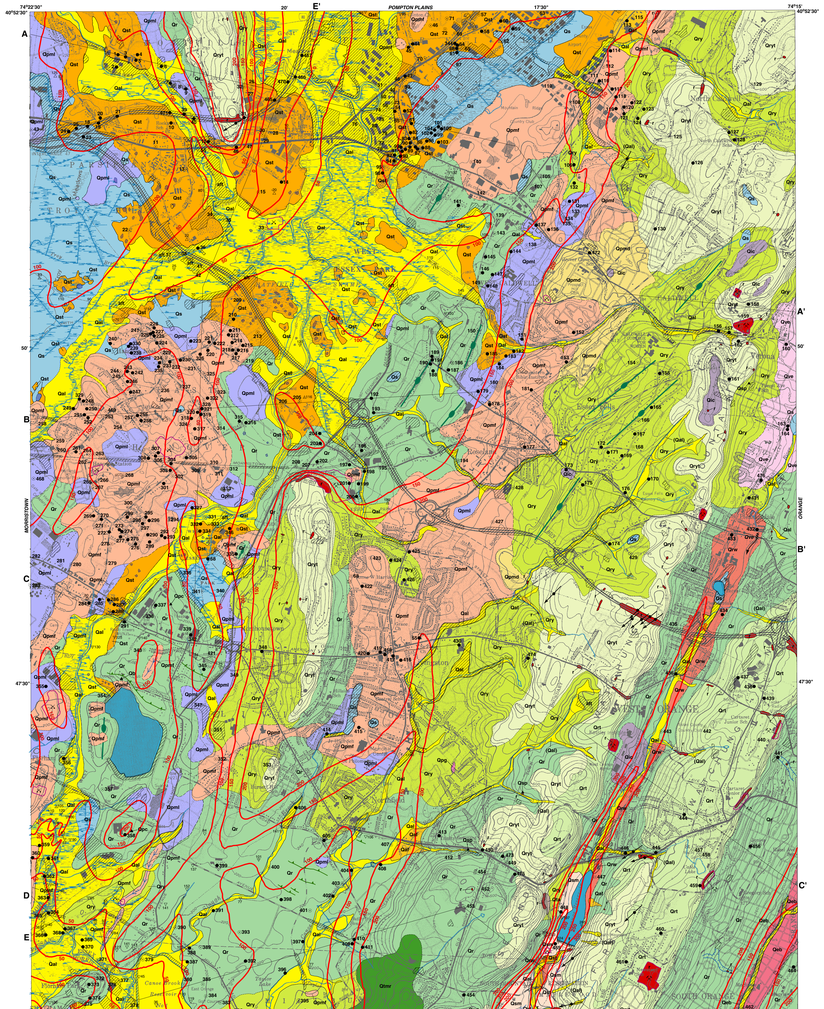
SCALE 1:24 000

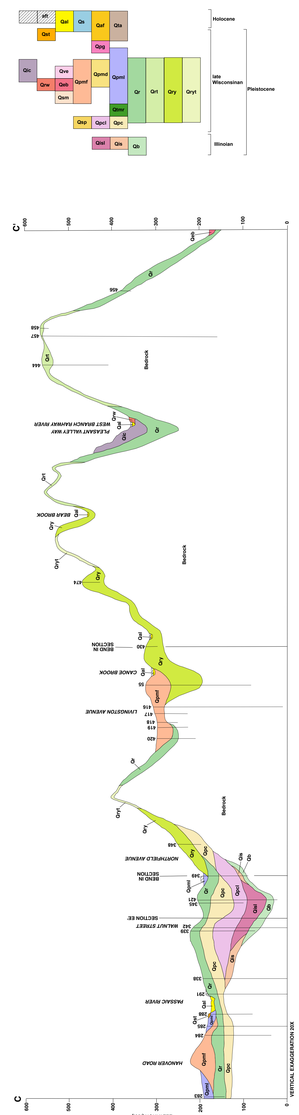
1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
500 0 500 1000 1500 2000 METRES
0 1 KILOMETER

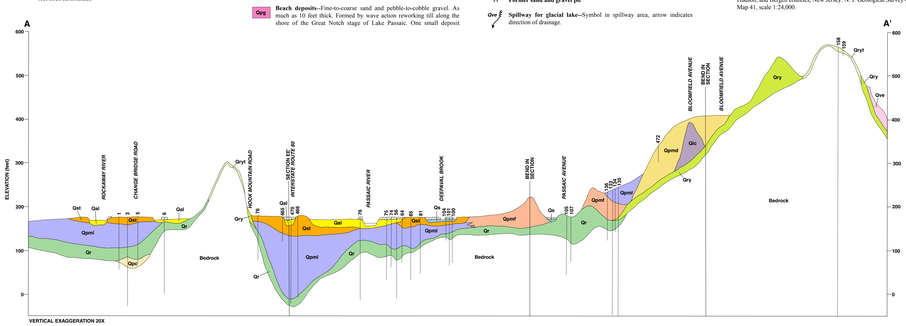
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

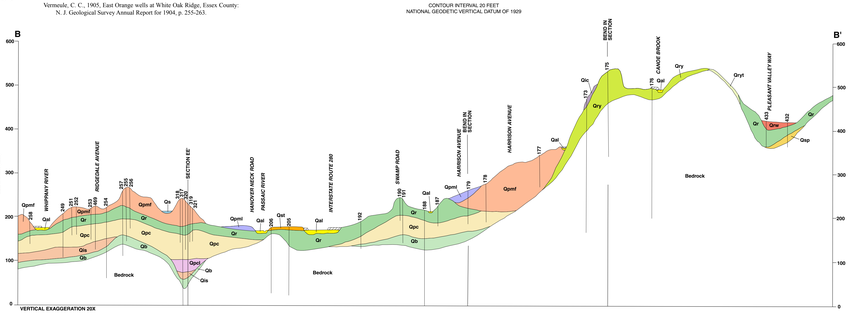
APPROXIMATE MEAN DECLINATION, 1998

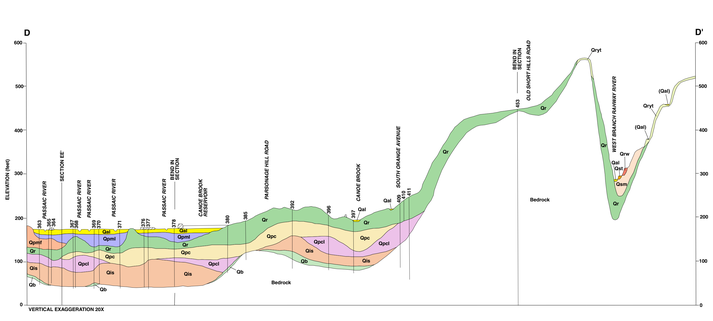
LOCATION IN NEW JERSEY











Surficial Geology of the Caldwell Quadrangle
Essex and Morris Counties, New Jersey

New Jersey Geological Survey
Open-File Map 66
2005

pamphlet to accompany map

Table 1.--Selected well and boring records.

Well No.	Identifier[1]	Depth to bedrock or driller's log with depth and description[2]	
1	25-11619	0-70	clay (Qst thin over Qpml)
		70-100	hardpan (Qr)
		100-120	red shale
2	25-14507	0-5	fill (af)
		5-18	silty sand (Qal)
		18-54	clay (Qpml)
		54-88	hardpan and stones (Qr)
		88-107	silty sand and gravel (Qpc)
		107-125	red shale
3	26-1710	0-14	sandy ground (Qst)
		14-70	clay (Qpml)
		70-90	hardpan (Qr)
		90-109	sand (Qpc)
		109-114	quick sand (Qpc)
		114-196	red shale and sandstone
		196-203	gray shale
4	25-13302	0-16	sand (Qst)
		16-86	clay (Qpml)
		86-104	hardpan, stones (Qr)
		104-111	silty water-bearing sand (Qpc)
		111-148	red shale
5	25-1430	0-5	fill
		5-9	sand (Qst)
		9-58	clay (Qpml)
		58-95	hardpan, stones, and some boulders (Qr)
		95-106	sand and gravel (Qpc), yield 30 gpm
6	25-13808	0-8	clay (Qal)
		8-27	boulders, gravel (Qr)
		27-164	gray and red shale
		164-175	trap rock
7	25-11532	0-6	fill (af)
		9-37	clay (Qal over Qpml)
		37-44	hardpan and stones (Qr)
		44-77	red shale
		77-88	trap rock
8	25-11345	0-4	fill
		4-18	sandy (Qst)
		18-33	clay (Qpml)
		33-41	water-bearing silty sand (Qr)
		41-54	fractured rock

		54-130	trap rock
9	25-10170	0-18	sand (Qst)
		18-37	clay (Qpml)
		37-40	sand and gravel (Qr)
		40-47	porous trap rock
10	25-3935	0-12	yellow clay (Qst over Qpml)
		12-22	gray clay (Qpml)
		22-30	coarse sand (Qpmf)
		30-35	sand with light gravel (Qpmf)
		35-40	reddish clay with sand (Qpmf)
		40-55	sand, getting finer, with a lot of water (Qpmf)
		55-65	very coarse sand and light gravel (Qpmf)
		65-75	coarse sand and gravel, water 2 feet above ground (Qpmf)
		75-80	reddish brown sand, not as coarse (Qpmf or Qr)
		80-86	reddish brown sand with less water (Qpmf or Qr)
		at 86	rock (red shale)
		production well at site screened 54-90, yield 350 gpm	
11	25-22543	0-22	brown sand, gravel with some large stones (Qst)
		22-38	brown silty fine sand with small layers of clay (Qst grading to Qpml)
		38-44	slab of gray traprock (probably Qpml)
		44-61	water-bearing light brown silty sand, gravel (Qr or Qpmf)
		61-125	red, gray, brown shale
12	25-17473	0-189	trap rock
13	25-36977	abbreviated log	
		0-11	brown silt, little sand (Qst)
		11-15	gray clay, little silt (Qst)
		15-21	black-brown sand, little silt (Qst)
		21-40	gray clay with fine sand seams (Qpml)
		40-62	brown silt, some fine rock fragments (Qpml)
14	25-15778	0-27	water-bearing sand (Qst)
		27-72	silty fine sand (Qst grading to Qpml)
		72-94	clay (Qpml)
		94-101	silt (Qpml)
		101-152	clay (Qpml)
		152-158	hardpan and stones (Qr)
		158-161	silty sand and gravel (Qr)
		161-167	hardpan and stones (Qr)
		167-174	water-bearing sand and gravel containing considerable silt (Qr or Qpc)
		174-176	red sandstone
15	25-13857	0-42	fine sand (Qst)
		42-158	clay with layers of silty sand (Qpml)
		158-169	water-bearing silty sand, gravel (Qr)
		169-372	red and gray shale
16	26-4072	0-3	fill
		3-23	sandy (Qst)
		23-36	clay, hardpan, stones (Qr)
		36-149	traprock
		149-191	red shale and sandstone
17	25-14782	0-7	fill
		7-23	sandy (Qst)
		23-85	clay, hardpan and stones (Qpml over Qr)
		85-192	red shale with sandstone
18	I-80 boring L-16	0-3	muck (Qs)
		3-8	organic silt with wood (Qs)
		8-18	silty gray clay with wood (Qs over Qpml)
		18-60	gray clay with silt (Qpml)
		60-63	sand, silt, clay, trace gravel (Qr)
		63-71	compact fine-to-medium sand, silt, gravel, trace clay (Qr)
		71-76	compact fine-to-medium sand, silt, gravel (Qr)

19	I-80 boring L-17	0-8	fine brown sand (Qst)
		8-55	gray clay (Qpml)
		55-79	brown clay, gravel (Qr or Qpml)
		79-100	sandy brown clay, trace silt (Qr or Qpml)
		100-106	coarse brown sand, gravel (Qr or Qpc)
		106-106.5	shale
20	I-80 boring 22-2	abbreviated log	
		0-11	fine-to-coarse brown sand, gravel, trace silt (Qst)
		11-56	gray silty clay and clayey silt (Qpml)
		56-108	red to gray clayey silt, gravel (Qpml)
		108-114	brown-gray silt, sand, gravel, till (Qr)
21	I-80 boring L-18	0-8	medium-grained brown sand (Qst)
		8-15	silt, trace fine sand (Qst)
		15-18	gray clay (Qpml)
		18-47	silty gray clay (Qpml)
		47-68	light brown, gray clay (Qpml)
		68-77	sand, gravel (Qr or Qpmf)
22	25-26367	0-20	dark brown to yellow brown silty very-fine-to-medium sand (Qst)
		20-50	gray silty clay, trace sand, varved, mottled, low plasticity (Qpml)
		50-63	dark reddish gray silty clay, sandy, sand content increases with depth (Qpml)
		63-76	dark reddish gray clayey sandy silt, trace gravel (Qr)
23	I-80 boring 18-1	abbreviated log	
		0-9	brown clay and peat (Qs)
		9-64	gray, brown silty clay, trace gravel (Qpml)
		64-89	brown, gray sand, silt, gravel, clay (Qr)
		89-94	red brown silt, varved sand (Qpc or weathered rock)
24	I-80 boring 19-8	abbreviated log	
		0-10	fine brown sand (Qst)
		10-85	gray clay and silt, trace gravel and sand (Qpml)
		at 85	rock
25	I-80 boring L-15	abbreviated log	
		0-8	muck and organic silt with wood (Qs)
		8-18	silty gray clay with wood (Qs over Qpml)
		18-60	gray clay with silt (Qpml)
		60-76	compact fine-to-medium sand, silt, clay, trace gravel (Qr)
26	25-12953	0-11	sand (Qst)
		11-33	clay (Qpml)
		33-41	hardpan, stones (Qr)
		41-99	shale with red sandstone
27	25-22195	0-29	sand with some gravel (Qst)
		29-64	gray clay (Qpml)
		64-125	red and gray shale
28	25-16366	215	
29	NJGS files	0-11	yellow clay (Qst)
		11-16	sand (Qst)
		16-20	clay (Qst)
		20-32	sand (Qst)
		32-75	black clay (Qpml)
		75-160	gray clay (Qpml)
		160-177	gray clay, small cobbles (Qpml over Qpmf)
		177-197	sand, gravel (Qpmf)
		197-206	black clay (Qpmf)
		206-224	sand, gravel (Qpmf)
		224-530	shale
30	25-16336	0-26	coarse sand, water bearing (Qst)
		26-104	silty fine sand (Qst grading to Qpml)
		104-196	clay (Qpml)

		196-215	water-bearing sand, gravel (Qpmf)
		at 215	shale
		screened 201-215, yield 50 gpm	
31	I-80 boring	0-6	silty brown sand, gravel (Qry)
	HM-1	6-12	trap rock
32	25-9063	0-8	sand (Qst)
		8-18	hardpan and stones (Qr)
		18-50	red shale
33	25-22518	0-43	sand and gravel (Qal over Qst)
34	25-34334	abbreviated log	
		0-52	garbage fill (aft)
		52-72	medium sand, some fine sand (Qst)
		72-77	fine sand and silt (Qst grading to Qpml)
		77-87	silty clay (Qpml)
35	25-34331	abbreviated log	
		0-60	garbage fill (aft)
		60-62	fine-to-medium sand (Qal)
		62-70	fine-to-medium sand, trace clay (Qal over Qst)
		70-75	fine-to-medium sand, trace silt and clay (Qst)
		75-77	silt with trace clay (Qpml)
36	25-7902	0-13	sand, gravel (Qal over Qst)
		13-154	dry gray clay (Qpml)
		at 154	rock
37	25-26376	abbreviated log	
		0-14	fill (aft)
		14-23	black silty clay and garbage (aft over Qal)
		23-89	brown to gray silty clay (Qpml)
		89-104	reddish brown medium-to-coarse sand and gravel (Qpmf)
38	25-34243	0-30	silt, fine-to-medium sand, garbage (aft)
		30-35	silty fine sand (Qal)
		35-40	silty fine sand and silty clay in bottom 2 feet (Qal over Qpml)
39	I-80 boring	0-6	silt, sand (Qal)
	Rr-2	6-10	medium-grained gray sand , trace gravel (Qal)
		10-18	silt, varved clay (Qpml)
		18-21	silt, clay, gravel, trace sand (Qr)
		21-35	compact silt, trace sand, gravel (Qr)
		35-40	trap rock
40	I-80 boring	0-7	fine-to-coarse sand, gravel, clay (Qal)
	Rr-7	7-17	silt, trace clay (Qpml)
		17-31	gray, brown silt with gravel, trace sand, clay (Qr)
		31-35	compact silt, sand, gravel, boulders (Qr)
		at 35	rock
41	25-26388	0-15	fill (aft)
		15-26	dark gray clayey silt and silty clay (Qal)
		26-39	dark gray silty clay, varved (Qpml)
		39-58	very dark grayish brown to dark reddish brown sand, silty sand with occasional clay layers (Qpml)
42	25-34244	0-7	fill, wood, plastic (aft)
		7-12	organic clay and peat (Qal)
		12-17	gray to brown silt (Qal)
		17-27	medium gray sand (Qst)
		27-32	fine gray sand (Qst)
		32-33.5	fine gray sand and clay (Qst grading to Qpml)
43	25-19937	0-4	fill, sandy brown clay (Qpml)
		4-38	gray clay (Qpml)
		38-41	silty red sand (Qpml or Qr)

		41-42	red hardpan (Qr)
		42-62	hard red shale
44	26-3992	0-65	hardpan (Qst over Qpmf?)
		65-74	gravel (Qpmf), yield 30 gpm
45	26-2830	0-2	fill
		2-41	hardpan and stones with some large boulders (Qst over Qpmf?)
		41-52	water-bearing silty sand (Qpmf)
		52-59	clay (Qpmf)
		59-66	water-bearing sand and gravel (Qpmf), yield 30 gpm
46	26-4690	0-118?	sand, clay (Qst over Qpml)
		118?-250	red shale
47	26-13707	0-9	fill (af)
		9-32	tan, brown sand (Qst)
		32-40	dark gray stiff inorganic clay (Qpml)
48	26-1674	0-93	clay and hardpan (Qst over Qpml over Qr?)
		93-140	gray slate
		140-150	sandstone
49	26-6624	0-11	hardpan and gravel (af)
		11-23	fine silty [sand?] water bearing (Qal)
		23-78	gray clay (Qpml)
		78-82	water-bearing heaving sand and gravel (Qpmf)
		82-86	choice water-bearing sand and gravel (Qpmf), yield 35 gpm
50	26-15144	0-44	clay (Qal over Qpml)
		44-91	sand (Qpml over Qpmf)
		91-95	gravel (Qpmf)
		95-100	shale
51	26-348	0-88	sand, clay to hardpan (Qal over Qpml over Qr or Qpmf)
		88-162	red and gray rock
52	26-2535	0-18	sand (Qst)
		18-55	gray clay (Qpml)
		55-72	hardpan (Qr)
		72-150	red sandstone
53	26-3081	0-33	sandy (Qst)
		33-83	clay (Qpml)
		83-88	water-bearing silty sand and gravel (Qr or Qpmf)
		88-132	gray to red shale
54	26-1975	0-28	water-bearing sand (Qst)
		28-61	clay (Qpml)
		61-85	hardpan (Qr)
		85-103	red and gray shale
55	26-3016	0-125	started in sand and gravel, went into hardpan and boulders with a few strata of sand (Qpmf over Qry)
56	26-2265	0-10	sand (Qst)
		10-70	clay (Qpml)
		70-100	hardpan (Qr)
		100-185	red rock
57	25-27432	0-84	sand and gravel (Qst over Qpmf)
		84-250	shale
58	26-2884	0-20	clay (Qst over Qpml)
		20-104	sand, gravel (Qpmf)
		104-140	red rock
59	26-4207	0-20	overburden (af over Qs over Qst?)
		20-35	gray clay (Qpml)

		35-50	sand granite [gravel?] (Qpmf)
		50-60	sand, gravel (Qpmf)
		60-275	gray and red shale
60	26-3008	0-22	sandy (Qst)
		22-46	clay (Qpml)
		46-64	hardpan with some large stones (Qr or Qpmf)
		64-76	water-bearing sand and gravel (Qpmf)
		76-99	hardpan (Qr)
		99-112	soft shale
		112-212	red and gray shale
61	26-2503	90	
62	26-3025	0-2	fill (af)
		2-6	black muck (Qs)
		6-11	sandy (Qst)
		11-38	clay (Qpml)
		38-61	hardpan and stones (Qr or Qpmf)
		61-66	water-bearing silty sand and gravel (Qr or Qpmf)
		66-101	red and gray shale
63	26-1-657	0-9	sandy (Qst)
		9-41	clay (Qpml)
		41-76	hardpan and large stones (Qr)
		76-285	red and gray shale
64	26-2367	0-10	sand (Qst)
		10-60	clay (Qpml)
		60-80	sand (Qpmf or Qr)
		80-137	shale
65	26-4266	0-14	sandy (Qst)
		14-54	clay (Qpml)
		54-87	hardpan, stones, and some boulders (Qr)
		87-120	red shale with sandstone
66	26-4372	0-14	sandy (Qst)
		14-58	clay (Qpml)
		58-89	hardpan and stones (Qr)
		89-141	red shale with sandstone beds
67	26-2247	0-10	sand (Qst)
		10-40	clay (Qpml)
		40-70	sand (Qr)
		70-129	shale
68	U. S. Army	abbreviated log	
	Corps of	0-7	gray and brown silt, trace sand and clay (Qs over Qst)
	Engineers	7-16	brown silty sand (Qst)
	boring	16-35	brown sandy clay (Qpml)
	P-10-4	35-51	brown clayey sand (Qpml)
69	26-2938	0-27	sandy (Qst)
		27-51	clay (Qpml)
		51-73	hardpan with some boulders (Qr or Qpmf)
		73-89	water-bearing silty sand and gravel (Qpmf)
		89-97	soft shale
		97-161	firm red shale
70	26-3921	0-16	sandy (Qst)
		16-31	clay (Qpml)
		31-62	hardpan and stones (Qr or Qmpf)
		62-80	water-bearing heaving sand (Qpmf)
		80-85	choice water-bearing sand and gravel (Qpmf), yield 30 gpm
71	26-2716	0-17	sandy (Qst)
		17-38	clay (Qpml)
		38-74	hardpan and stones (Qr or Qpmf)

		74-93	water-bearing sand and gravel (Qpmf), yield 30 gpm
72	26-4731	0-20	fine gray sand (Qst)
		20-30	gray clay with fine sand (Qpml)
		30-40	gray clay, some fine sand (Qpml)
		40-50	fine sand (Qpml)
		50-60	fine silty sand (Qpml)
		60-70	fine sand (Qpml grading to Qmpf)
		70-80	sand, gravel (Qpmf)
		80-90	brown fine-to-medium sand, quite silty (Qpmf or Qr)
		90-95	fine brown sand, quite silty (Qpmf or Qr)
		screened 75-95, yield 146 gpm	
73	26-2745	0-4	fill (af)
		4-7	clay (Qal)
		7-32	sandy (Qst)
		32-79	clay (Qpml)
		79-89	water-bearing sand and gravel (Qpmf), yield 30 gpm
74	26-1597	0-74	gray clay (Qal over Qpml)
		74-84	hardpan (Qr)
		84-115	red rock
75	26-4089	0-4	fill (af)
		4-19	sandy (Qal over Qst)
		19-61	clay (Qpml)
		61-90	hardpan and stones (Qr)
		90-101	soft gray shale
		101-146	firm red and gray shale with sandstone
76	26-2071	0-11	fill (af)
		11-19	clayey sand (Qal)
		19-52	clay (Qpml)
		52-81	hardpan (Qr)
		81-89	soft shale
		89-191	gray and red shale
77	26-4312	0-6	fill (af)
		6-34	sandy (Qal over Qst)
		34-67	clay (Qpml)
		67-74	hardpan and stones (Qr or Qpmf)
		74-80	water-bearing sand and gravel (Qpmf), yield 15 gpm
78	26-2686	0-3	fill (af)
		3-19	sandy (Qal over Qst)
		19-47	clay (Qpml)
		47-71	hardpan with some large boulders (Qr)
		71-83	red sandstone
79	26-3030	0-3	fill (af)
		3-18	sand (Qal over Qst)
		18-52	clay (Qpml)
		52-74	hardpan and stones (Qr)
		74-130	gray and red shale
80	26-2810	0-31	sandy (Qal over Qst)
		31-69	clay (Qpml)
		69-75	water-bearing sand and gravel (Qpmf), yield 20 gpm
81	26-6225	0-2	fill
		2-14	gray silty water-bearing sand (Qst)
		14-57	gray dense clay (Qpml)
		57-66	water-bearing silty sand and gravel (Qr or Qpmf)
		66-130	red shale and sandstone
82	26-2021	0-20	sand (Qst)
		20-55	gray clay (Qpml)
		55-80	hard pan (Qr)
		80-100	red rock

83	26-1383	0-88	clay and sand (Qst over Qpml)
		88-98	red rock
84	26-4799	0-18	sandy (Qst)
		18-41	gray clay (Qpml)
		41-56	hardpan and stones (Qr)
		56-130	red shale and sandstone
85	26-2892	0-22	sandy (Qst)
		22-72	clay (Qpml)
		72-74	silty sand (Qpml)
		74-79	hardpan with stones (Qr)
		79-104	gray shale
		104-144	red shale with some sandstone
86	26-5409	0-28	sandy (Qst)
		28-45	gray clay (Qpml)
		45-53	hardpan and stones with some large boulders (Qr)
		53-120	red shale and sandstone
87	26-5029	0-26	sandy (Qst)
		26-43	gray clay (Qpml)
		43-51	hardpan and stones (Qr)
		51-130	red shale and sandstone
88	26-5562	0-13	brown clay (Qst)
		13-17	gray silty fine sand (Qst)
		17-43	gray clay (Qpml)
		43-47	reddish brown hardpan and stones (Qr)
		47-115	red shale with sandstone beds
89	26-4157	0-17	sandy (Qst)
		17-45	clay (Qpml)
		45-54	hardpan and stones (Qr)
		54-61	water-bearing silty sand (Qr)
		61-130	red and gray shale and sandstone
90	26-4155	0-21	sandy (Qst)
		21-36	clay (Qpml)
		36-55	hardpan and stones (Qr)
		55-57	water-bearing silty sand and gravel (Qr)
		57-60	gray shale
91	26-4156	0-3	fill
		3-21	sandy (Qst)
		21-44	clay (Qpml)
		44-55	hardpan and stones (Qr)
		55-61	water-bearing sand and gravel (Qpmf or Qpc), yield 20 gpm
92	26-5163	0-2	fill
		2-17	brown sand (Qst)
		17-38	gray clay (Qpml)
		38-49	hardpan with some large stones (Qr)
		49-55	water-bearing sand and gravel (Qpmf or Qpc), yield 15 gpm
93	26-1312	0-74	gray clay (Qst over Qpml)
		74-147	red rock
94	26-2945	0-2	fill
		2-18	sandy (Qst)
		18-31	clay (Qpml)
		31-44	hardpan with stones (Qr)
		44-53	water-bearing sand and gravel (Qpmf or Qpc)
		screened 48-53, yield 25 gpm	
95	26-4748	0-41	sandy (Qst)
		41-54	gray clay (Qpml)
		54-59	water-bearing sand and gravel (Qpmf), yield 12 gpm

96	26-4431	0-10	sandy soil (Qst)
		10-25	sand (Qst)
		25-60	clay (Qpml)
		60-65	red hardpan (Qr)
		65-161	red sandstone and gray slate
97	26-3725	0-19	sandy (Qst)
		19-41	clay (Qpml)
		41-57	hardpan and stones (Qr)
		57-64	silty water-bearing sand and gravel (Qr or Qpmf)
		64-92	gray shale
		92-140	red shale
98	26-1805	0-8	sand (Qst)
		8-42	clay (Qpml)
		42-52	hardpan (Qr)
		52-131	red shale
99	26-2496	0-2	fill (af)
		2-17	sandy (Qst)
		17-39	clay (Qpml)
		39-44	hardpan (Qr)
		44-56	red shale
100	26-4261	0-14	sandy (Qst)
		14-31	clay (Qpml)
		31-49	hardpan and stones (Qr)
		49-105	red shale with sandstone
101	26-4270A	0-17	sandy (Qst)
		17-41	clay (Qpml)
		41-53	hardpan and stones (Qr)
		53-110	red shale
102	26-2544	0-2	fill (af)
		2-41	clay (thin Qst over Qpml)
		41-47	hardpan (Qr)
		47-110	red shale
103	26-24465	0-7	red-brown clayey silt (thin Qst over Qpml)
		7-40	cobble, boulders with brown fine-to-coarse sand and thin layers of brown clayey silt (Qpmf or Qr)
104	26-4184	0-2	fill (af)
		2-12	clay (Qpml)
		12-23	sandy (Qpmf or Qpml)
		23-46	hardpan and stones (Qr)
		46-56	red shale with sandstone
105	26-1438	0-50	clay and cobblestones (Qr)
		50-135	trap
106	26-3771	0-24	sand and large stones (Qry)
		24-42	hardpan with large stones (Qry)
		42-49	water-bearing sand and gravel quite silty (Qry)
		49-72	trap rock
107	26-1296	0-60	clay and boulders (Qr)
		60-100	trap rock
108	26-1740	0-32	fill, then hardpan (Qpmf over Qry)
		32-135	trap rock
109	26-22471	0-12	green-black sand and gravel (Qal over Qpmf)
		12-53	clayey silt with some grayish-black gravel (Qry)
110	26-16830	0-17	brown fine-to-coarse gravel and silty sandy clay (Qpmf)
		17-49	as above with some cobbles (Qpmf)

		49-54	fine-to-coarse red sand, gravel, hard and dry (Qr)
		54-67	same as above, but with moisture (Qr)
		67-80	bedrock, little water
111	26-2553	0-15	clay (Qpmf)
		15-62	hardpan (Qry)
		62-205	trap rock
112	26-40	0-54	earth, some boulders (Qpmf over Qry)
		54-85	rock, gray shale
113	26-2870	0-72	stratified drift (Qaf over Qpmf), yield 12 gpm
114	26-1701	0-5	yellow sandy clay (Qpmf)
		5-17	boulders, small cobbles, sandy hardpan (Qpmf)
		17-24	sandy hardpan (Qpmf)
		24-28	coarse gravel (Qpmf)
		28-30	gray hardpan (Qry)
		30-186	blue to black trap
		186-202	red to gray shale
		202-300	gray trap
115	26-575	0-15	boulders (Qaf)
		15-85	hardpan (Qpmf over Qry)
		85-100	hard gray rock
		100-142	softer gray rock
116	26-1081	0-50	clay and hardpan with some sand at 30 (Qpmf over Qry)
		50-200	trap rock
117	26-1808	0-30	hardpan (Qpmf over Qry)
		30-240	trap
118	26-2119	0-18	dirt (Qpmf over Qry)
		18-123	trap rock
119	26-4368	0-6	dirt and clay (Qpmf over Qry)
		6-200	conglomerate (basalt)
120	26-1109	0-45	hardpan and boulders (Qpmf over Qry)
		45-102	trap rock
121	26-1035	0-45	hardpan (Qpmf over Qry)
		45-175	trap rock
122	26-3678	0-45	hardpan and boulders (Qpmf over Qry)
		45-136	trap rock
123	26-586	0-5	dirt (Qry)
		5-202	trap rock
124	26-1036	0-7	dirt (Qry)
		7-160	trap rock
125	26-1130	0-4	dirt (Qry)
		4-174	trap rock
		174-180	red rock, not sandstone
126	26-4271	2	
127	26-29459	0-28	boulders, large gravel, silts and sands, brown (Qry)
128	26-23132	0-40	medium-to-fine sand and coarse gravel, some cobbles and boulders (Qry)
129	26-842	4	
130	26-1295	0-16	hardpan and boulders (Qry)
		16-155	trap rock

131	26-1640	0-84	topsoil, stones, boulders, hardpan (thin Qpml over Qry)
132	26-4270	0-15	boulders (Qry)
		15-70	dirty gravel (Qry)
		70-82	pan (Qry)
		82-135	trap rock
133	26-1547	abbreviated log	
		0-30	brownish yellow sandy clay with rock fragments (Qpml)
		30-49	same as above with larger fragments (Qr)
		49-53	fragments of brown shaly sandstone and gray diabase (Qr)
		53-67	brown sandy clay with some gravel, large diabase fragments (Qr)
		67-209	basalt
		209-218	sandstone
		218-305	basalt
134	46-209	0-7	clay, brown, few pebbles (Qpml)
		7-40	till, sandy and bouldery, little clay (Qr or Qpmf)
		40-65	sand, coarse to very coarse with fine gravel, well sorted, water bearing (Qpmf)
		65-74	sand, medium to coarse, very well sorted, water bearing (Qpmf)
		74-80	till, sandy, yellowish brown, little clay (Qry)
		80-98	till, clayey, compact, reddish brown (Qr)
		98-104	shale, reddish brown
135	46-208	0-75	clay, hardpan (Qpml over Qpmf and Qr)
		75-360	trap
136	26-3060	0-66	hardpan, clay, stones and some large boulders (Qpmf over Qr)
		66-116	mix of trap rock and gray shale
137	26-2961	0-49	hardpan, stones, and large boulders (thin Qpml over Qr)
		49-63	sand and gravel (Qpc?)
		63-68	silty water-bearing sand and gravel (Qpc?)
		68-78	fractured trap
		78-131	firm trap with shale layers
138	26-5868	0-21	hardpan, clay, some large stones (thin Qpml over Qr)
		21-29	water-bearing silty sand (Qr)
		29-46	hardpan and stones (Qr)
		46-51	weathered trap rock
139	26-22	0-40	earth and boulders (Qr)
		40-58	gravel, sand (Qpc)
		58-204	red rock
140	26-1091	0-74	clay and boulders (Qpmf over Qr)
		74-305	red and gray sandstone
141	26-5188	0-2	fill
		2-12	hardpan and stones (Qr)
		12-26	gray clay (Qpml)
		26-38	hardpan and stones (Qr)
		38-105	red shale with beds of red sandstone
142	26-4267	0-4	fill
		4-57	hardpan, stones with some large boulders (thin Qpmf over Qr)
		57-131	red shale with sandstone beds
143	26-3928	0-56	hardpan, stones, and clay (Qr)
		56-115	soft red shale with sandstone beds
144	26-3172	0-61	hardpan and stones (Qr)
		61-68	water-bearing silty sand and stones (Qr)
		68-84	red and gray shale
		84-134	trap rock
145	26-4468	0-49	hardpan and stones (Qr)
		49-130	red shale with sandstone beds

146	26-818	0-80	hardpan and boulders (Qr), yield 30 gpm
147	26-367	0-76	clay, boulders, hardpan (Qr)
		76-172	red rock
		172-250	trap
148	26-261	0-30	clay (Qpml)
		30-50	sand (Qr or Qpmf)
		50-84	gravel (Qr or Qpc)
		84-158	red rock
149	26-41	0-18	open well
		18-75	red dirt and gravel (Qr)
		75-181	red shale
150	26-2919	0-60	boulders and gravel (Qr), yield 5 gpm
151	26-6615	0-80	sand (Qpml over Qpmf)
		80-275	trap rock
152	26-2964	0-70	hardpan and gravel (Qpmf)
		70-180	trap rock
153	46-200	0-45	sand, clay, boulders (Qpmf)
		45-68	water-bearing gravel (Qpmf)
		68-81	sand, clay, boulders (Qpmf or Qry)
		81-94	water-bearing gravel (Qpmf or Qpc)
		94-97	sand, clay, boulders (Qry)
		screened 43-94, yield 627 gpm	
154	26-276	0-39	hardpan and boulders (Qry)
		39-40	red clay (Qry)
		40-62	yellow clay and hardpan (Qry)
		62-71	red to brown clay and hardpan (Qb or weathered basalt)
		71-240	trap rock
		240-244	traces of red clay or red shale
		244-372	trap rock
155	26-2806	0-38	earth, hardpan (Qry)
		38-395	trap rock
156	26-2290	0-39	clay and boulders (Qry)
		39-285	trap rock
		285-320	red rock
		320-370	sandstone
157	26-28135	abbreviated log	
		0-20	brown sand, gravel, boulders, some silt (Qry)
158	26-7978	0-10	overburden (Qry)
		10-35	hardpan, broken trap
		35-270	trap rock
		270-790	red sandstone and red and gray shale
159	26-17087	0-8.5	brown to reddish brown fine-to-medium sand, some gravel and some silt--till material (Qry)
		8.5-9	basalt bedrock
160	26-26928	0-8	brown silty fine sand (Qve)
		8-15	brown coarse-to-fine sand, gravel, cobbles (Qve)
		15-32	brown medium-to-fine sand (Qve)
161	26-2214	0-35	sand and clay (Qry)
		35-165	trap rock
		165-300	red sandstone
162	26-1673	0-3	dirt (Qry)

		3-125	trap
		125-190	reddish rock
		190-200	sandstone
163	26-13030	0-13	clay (Qve)
		13-18	boulder, red rock (Qve or Qr)
		18-65	sand and clay, small gravel (Qve or Qr)
		65-500	trap rock
164	26-15029	abbreviated log	
		0-35	brown sand and clay (Qve)
		35-55	brown fine-to-coarse sand (Qve)
		55-65	brown sand and clay (Qve or Qr)
		65-67	broken rock
		67-75	rock, well flows
165	26-3260	0-90	hardpan (Qry)
		90-578	trap rock
		578-600	unknown [no recovery]
166	26-550	0-104	clay (Qry)
		104-221	trap
167	26-3758	0-25	clay and boulders (Qry)
		25-50	sand (Qps)
		50-75	hardpan and boulders (Qb?)
		75-205	trap rock
168	26-5235	0-50	gravel, sand (Qry)
		50-60	gravel, hardpan (Qry)
		60-100	sand, boulders (Qry)
		100-110	sand (Qps?)
		110-467	trap rock
		467-598	red shale
169	26-1985	0-84	sandy clay (Qry)
		84-99	broken trap rock
\		99-196	trap rock
170	46-20	0-19	hardpan, boulders (Qry)
		19-37	coarse brown sand, heavy gravel, boulders very dense (Qry or weathered basalt)
		37-38	decayed rock
		at 38	dense trap rock
171	26-3058	0-90	hardpan and some boulders (Qry)
		90-192	trap rock
172	26-4037	0-80	hardpan and cobblestones (Qry)
		80-90	broken trap
		90-115	broken loose trap
		115-400	trap rock
173	26-3375	0-70	hardpan and boulders (Qry)
		70-240	trap rock
		240-303	red sandstone
174	NJGS files	0-40	clay and silt, some fine sand, gray to brown (Qry)
		40-44	coarse sand and gravel (weathered basalt or Qps)
		at 44	basalt
175	26-2689	0-68	hardpan and very bad boulders (Qry)
		68-195	trap rock
176	25-5477	0-28	overburden (Qry)
		28-192	trap rock
		192-212	running, granulated trap
		212-300	trap rock

177	26-30246	0-5	brown medium-to-fine sand, and cobbles, and boulders (Qpmf)
		5-20	grayish brown medium-to-fine sand and cobbles (Qpmf)
		20-75	brown medium-to-fine sand and gravel and cobbles (Qpmf)
178	26-4804	0-10	soil and overburden (Qpmf)
		10-85	glacial drift, very clean gravel (Qpmf), yield 100 gpm
179	26-1421	0-60	hardpan and boulders (Qpml over Qpmf)
		60-75	fine sand (Qpmf)
		at 75	coarse sand (Qpmf), yield 20 gpm
180	26-4122	0-30	sandy hardpan and boulders (Qpmf)
		30-55	sand, gravel (Qpmf)
		55-69	sandy hardpan (Qr)
		69-305	trap rock
181	46-203	0-60	clay, boulders (Qpmf over Qry)
		60-62	wash, partly rounded trap pebbles (Qps?)
		62-480	trap
		480-494	red sandstone and shale
		494-565	trap
182	46-206	abbreviated log	
		0-31	boulders, sand, clay (Qst over Qr)
		31-37	broken trap, sand with water (Qr)
		37-60	boulders, clay (Qr)
		60-66	fine-to-coarse sand, boulders, clay (Qr)
		66-76	sand, gravel, with little clay (Qpc or weathered basalt)
		76-364	basalt
183	26-1910	0-8	clay (Qst over Qpml)
		8-10	sand, gravel (Qpmf)
		10-30	real fine sand (Qpmf)
		30-60	hardpan (Qr)
		60-69	hardpan, large boulders, streaks of sand, gravel (Qr over Qpc?)
		69-76	coarse sand, large gravel (Qpc)
		76-78	yellow clay (Qpc)
		78-82	coarse sand and gravel (Qpc)
		82-92	yellow clay (Qpcl)
		at 92	rock
		screened 61-89, yield 457 gpm	
184	46-204	0-3	clay (Qpml)
		3-5	nested boulders (Qpmf)
		5-13	boulders, clay, some sand (Qpmf)
		13-42	clay, some sand (Qpmf and Qpml)
		42-49	boulders, clay (Qr)
		49-64	loose rock, sand (Qr over Qpc)
		64-92	gravel and sand, water bearing (Qpc)
		at 92	fine brown sand (Qpc)
		screened 72-92, yield 410 gpm	
185	46-205	0-45	brown sandy clay (Qst over Qpml)
		45-106	fine grained sand, small amount of clay, few pebbles (Qpml over Qpmf)
		106-120	red sandstone
		120-423	trap
186	26-1082	0-100	hardpan, boulders, etc. (Qr)
		100-102	coarse gravel (Qpc), yield 20 gpm
187	26-4484	0-41	hardpan, clay, and stones (Qr)
		41-50	water-bearing sand and gravel (Qpc), yield 30 gpm
188	26-4743	0-9	gray clay (Qr)
		9-23	sand, gravel (Qr)
		23-29	sand, gravel, brown clay (Qr)
		29-49	sand, gravel, brown clay, hard (Qr)
		49-51	fine brown sand (Qpc)
		51-66	sand, gravel (Qpc)

		66-73	hardpan, brown (Qb?)
		73-93	hardpan with red clay (Qb)
		93-450	red sandstone
189	26-2684	0-25	old well
		25-100	sand in various forms (Qpc)
		100-115	red hardpan (Qb)
		115-163	red sandstone
190	26-2848	0-39	hardpan with stones (Qr)
		39-47	water-bearing sand (Qpc)
		47-53	choice water-bearing sand and gravel (Qpc), yield 8 gpm
191	26-6043	0-39	hardpan, lenses of sand and gravel with some large boulders (Qr)
		39-59	water-bearing silty sand with some stones, sand and gravel (Qpc)
		59-66	clay (Qpcl)
		66-83	water-bearing silty sand and gravel (Qis or Qpc)
		83-89	hardpan with some large stones (Qb)
		89-101	red sandstone
192	26-2736	0-29	sandy clay, hardpan, boulders (Qr)
		29-41	sandy hardpan and rocks, some layers of sand (Qr over Qpc)
		41-58	clay and hardpan (Qb)
		58-65	red sandstone with some shale
193	26-2647	0-27	brownish clay, some fine sand, rocks and boulders (Qr)
		27-32	sand and gravel (Qpc)
		32-43	clay, some sand (Qpcl)
		43-51	sandy clay (Qpcl)
		51-60	clay (Qpcl)
		60-61	sand, gravel (Qb or Qis)
		61-74	clay with some gravel (Qb)
		74-462	red sandstone and shale
194	26-17982	0-87	sand, clay (Qr over Qpc)
		87-323	shale
195	26-4164	0-30	sand and gravel (Qr)
		30-104	gravel (Qpc?)
		104-107	clay, sand, and stones (Qb?)
		107-389	shale and sandstone, black, red, and gray
196	26-5189	0-34	existing well
		34-40	water-bearing sand and gravel (Qpc), yield 15 gpm
197	26-29818	0-65	coarse to fine sand to gravel, large cobbles to boulders (Qr over Qpc)
198	26-830	0-10	yellow clay and boulders (Qr)
		10-13	hardpan and boulders (Qr)
		13-15	yellow clay, sand, and gravel (Qr)
		15-22	coarse sand and gravel (Qpc?)
		22-35	yellow hardpan (Qpcl or Qry)
		35-59	brown hardpan (Qpcl or Qr)
		59-85	red hardpan (Qr or Qb)
		85-242	red, brown rock and shale
199	26-884	0-78	clay and boulders (Qr)
		78-350	sandstone
200	26-841	0-97	hardpan and cobbles (Qr)
		97-255	red sandstone
		255-275	gray shale
		275-405	red sandstone
201	26-21892	0-35	glacial till--sand, gravel, and boulders (Qr)
		35-53	boulders, gravel, sand (Qr or Qpc)
		53-72	glacial till--boulders, sand, lime, and clay (Qb?)
202	26-462	0-17	yellow clay and boulders (Qr)

		17-26	hardpan (Qr)
		26-28	blue gray and brown gravel (Qr)
		28-34	hardpan (Qr)
		34-42	sand and gravel (Qpc?)
		42-49	hardpan (Qb?)
		49-444	gray and red shale
203	26-7708	0-28	red-brown clay, sand, gravel, cobbles (Qr)
		28-34	brown medium coarse sand and gravel (Qpc)
		34-40	red shale, sandstone
204	26-4942	0-6	yellowish brown clay (Qr)
		6-18	grayish brown sticky clay (Qr)
		18-30	grayish brown clay and boulders (Qr)
		30-40	reddish sandy hardpan with large rocks (Qr)
		40-500	red and gray shale
205	25-17294	0-42	hardpan, clay, stones (Qr)
		42-156	red sandstone with lenses of red and gray shale
206	25-17295	0-12	hardpan and stones (Qr)
		12-59	trap rock
		59-150	red sandstone
207	25-30670	0-61	silty clay, clayey silt, some sand, with cobbles and small boulders (Qr)
		61-79	shale
208	26-23446	abbreviated log	
		0-57	brown silty sand to silty clay with some gravel, trace cobbles (Qr)
		57-59	red-brown sandstone
209	25-12425	0-8	sandy (Qst)
		8-23	clay (Qpml)
		23-41	hardpan with stones (Qr)
		41-51	water-bearing silty sand and gravel (Qpc)
		51-57	fractured traprock
210	25-15711	0-15	clay (Qst over Qpml)
		15-50	fine sand (Qpmf)
		50-57	coarser sand (Qpmf), yield 20 gpm
211	26-3040	0-21	clay (Qpmf)
		21-36	silty sand with some gravel (Qpmf)
		36-51	hardpan and stones (Qr)
		51-55	choice water-bearing sand and gravel (Qpc), yield 10 gpm
212	25-13467	0-3	fill
		3-11	sand (Qpmf)
		11-22	clay (Qpmf)
		22-43	hardpan and stones (Qr)
		43-52	silty sand and gravel (Qr over Qpc)
		52-56	choice sand and gravel (Qpmf), yield 15 gpm
		at 56	rock
213	25-13383	0-8	sandy (Qst)
		8-19	clay (Qpml)
		19-37	hardpan, gravel, and large stones (Qr)
		37-42	water-bearing sand and gravel (Qpc)
		42-53	traprock
214	25-8394	0-18	sand (Qpmf)
		18-45	hardpan (Qr)
		45-55	fine sand (Qpc)
		55-58	gray hardpan (Qb or weathered basalt)
		58-118	trap
215	25-9721	0-41	sand (Qpmf)
		41-45	fractured traprock

216	25-11555	0-30	sandy soil (Qpmf)
		30-50	hardpan (Qr)
		50-65	gray rock
217	25-7919	0-45	fine sand (Qpmf)
		45-52	hardpan (Qr)
		52-130	hard trap rock
218	25-9418	0-13	sandy clay (Qpmf)
		13-53	hardpan (Qr)
		53-73	trap rock
219	25-9808	0-23	clay (Qr)
		23-37	silty water-bearing sand (Qpc)
		37-83	trap rock
220	25-10996	0-35	hardpan (Qpmf over Qr)
		35-70	very fine sand (Qpc)
		at 70	coarse gray sand (Qpc), yield 8 gpm
221	25-28441	abbreviated log	
		0-45	brown and white fine sand, little silt, little gravel (Qpmf)
222	25-39939	abbreviated log	
		0-30	brown fine-to-coarse sand and silty sand with gravel (Qpmf)
		30-36	brown fine silty sand with clay (Qr or Qpmf)
223	25-12859	0-13	clay (Qpml)
		13-51	silty water-bearing sand and gravel (Qpmf)
		51-58	choice water-bearing sand and gravel (Qpmf), 25 gpm
224	25-12687	0-86	sand and gravel (Qpmf, probably over Qr and Qpc), yield 25 gpm
225	25-14001	0-20	hardpan (Qpmf over Qr)
		20-95	sand (Qpc), yield 30 gpm
226	25-13973	0-15	clay and hardpan (Qpmf over Qr)
		15-62	sand (Qpc), yield 20 gpm
227	25-13986	0-15	old well
		15-91	sand (Qpc), yield 10 gpm
228	25-10090	0-38	hardpan and stones (Qpmf over Qr)
		38-45	water-bearing sand and gravel (Qpc), yield 20 gpm
229	25-9410	0-19	silty sand (Qpmf)
		19-36	clay (Qr)
		36-40	water-bearing sand and gravel (Qpc), yield 30 gpm
230	25-13123	0-30	hardpan (Qpmf over Qr)
		30-95	very fine sand (Qpc)
		at 95	coarse gray sand (Qpc), yield 20 gpm
231	25-8405	0-28	sand (Qpmf)
		28-57	sand and gravel with clay mixture (Qr)
		57-68	water-bearing silty sand and gravel (Qpc)
		68-72	clean water-bearing sand and gravel (Qpc), yield 15 gpm
232	25-11752	0-75	clay, then sand (Qpmf over Qr over Qpc), yield 20 gpm
233	25-10069	0-67	sand, coarse sand (Qpmf over Qr over Qpc), yield 20 gpm
234	25-11727	0-26	hardpan and some clay (Qpmf over Qr)
		26-49	silty water-bearing sand and gravel (Qpc)
		49-57	choice water-bearing sand and gravel (Qpc), yield 15 gpm
235	25-11636	0-22	hardpan (Qpmf over Qr)
		22-46	water-bearing silty sand (Qpc)
		46-52	heavy gravel with some large boulders (Qpc)

		52-56	water-bearing choice sand (Qpc), yield 8 gpm
236	25-10640	0-15	hardpan (Qpmf over Qr)
		15-35	sand (Qpc)
		35-70	trap rock (anomalous bedrock-surface elevation, not contoured)
237	25-7450	0-82	sand and gravel (Qpmf over Qr over Qpc), yield 18 gpm
238	25-14389	0-20	clay, boulders (Qpml over Qr)
		20-94	sand (Qpc), yield 75 gpm
239	25-18267	0-34	hardpan (Qpml over Qr)
		34-49	sand, gravel (Qpc)
		49-132	hardpan, boulders (Qpc or Qis over Qb?)
		screened 65-84, yield 900 gpm	
240	25-11467	0-15	hand dug well
		15-41	clay (Qpml)
		41-58	hardpan (Qr)
		58-91	heaving water-bearing sand (Qpc)
		91-106	reddish hardpan (Qis or Qb)
		106-111	water-bearing sand and gravel (Qis), yield 10 gpm
241	25-7176	0-50	boulders, hardpan, gravel (Qpmf over Qr over Qpc), yield 15 gpm
242	25-12956	0-5	sandy (Qpmf)
		5-17	hardpan, stones (Qr)
		17-41	clay (Qpcl)
		41-61	water-bearing silty sand and gravel (Qis)
		61-92	hardpan (Qis or Qb)
		92-97	water-bearing sand and gravel (Qis), yield 30 gpm
243	25-12955	0-13	sandy (Qpmf)
		13-41	clay (Qr over Qpcl)
		41-67	water-bearing sand and gravel (Qis)
		67-84	hardpan and stones mixed with red clay (Qb)
		84-93	red shale
244	25-3857	0-15	clay (Qpmf over Qr)
		15-63	sand (Qpc over Qis), yield 75 gpm
245	25-6798	0-50	hardpan with large stones (Qpmf over Qr)
		50-98	heaving sand (Qpc over Qis)
		98-100	water-bearing gravel (Qis), yield 25 gpm
246	25-15-116	0-30	open well
		30-125	sand (Qpc over Qis), yield 8 gpm
247	25-10407	0-13	clay (Qpmf over Qr)
		13-80	sand and gravel, water-bearing from 46 (Qpc over Qis), yield 13 gpm
248	25-11378	0-25	hardpan (Qpmf over Qr)
		25-50	sand gravel (Qpc), yield 20 gpm
249	25-23784	0-5	medium brown sand and gravel (Qpmf)
		5-15	stiff gray clay (Qpml)
		15-55	red-brown till (Qr)
		55-100	medium-to-fine brown sand and gravel (Qpc)
250	25-10931	0-30	hardpan with small boulders (Qpmf over Qr)
		30-60	gravel (Qr over Qpc)
		60-114	heaving sand (Qpc)
		114-117	sandstone
251	25-8855	0-40	hardpan and boulders (Qpmf over Qr)
		40-61	sand and water (Qpc), yield 15 gpm
252	25-8856	0-45	hardpan and boulders (Qpmf over Qr)
		45-64	sand and water (Qpc), yield 15 gpm

253	25-4976	0-12	hardpan (Qpmf over Qr)
		12-71	sand and gravel (Qpc), yield 18 gpm
254	25-13852	0-36	hardpan and stones (Qpmf over Qr)
		36-58	silty sand (Qpc)
		58-69	clay (Qpcl)
		69-91	heaving sand (Qis)
		91-103	red clay to firm shale (Qb)
		103-157	red shale
255	25-11018	0-45	hardpan (Qpmf over Qr)
		45-120	sand (Qpc), yield 12 gpm
256	25-9444	0-70	hardpan and some boulders (Qpmf over Qr)
		70-90	fine sand (Qpc)
		at 90	coarse gray sand, water (Qpc or Qis), yield 15 gpm
257	25-11336	0-33	sand and heavy gravel (Qpmf)
		33-67	hardpan with large stones (Qr)
		67-98	heaving sand (Qpc)
		98-121	red clay to rock (Qb)
		121-150	shale
258	25-13854	0-30	hardpan, stones with some boulders (Qpmf over Qr)
		30-51	choice water-bearing sand and gravel (Qpc), yield 38 gpm
259	25-28129	0-7	brown fine silty clay (Qpmf and Qpml)
		7-60	cobbles, gravel, boulders (Qpmf over Qr)
		60-62	brown medium-to-coarse sand, gravel, some red clay (Qpc)
		62-72	brown medium-to-coarse sand, some gravel (Qpc)
260	25-9752	0-109	sand, gravel, boulders (Qpmf over Qr over Qpc), yield 15 gpm
261	25-13436	0-15	hardpan (Qpmf)
		15-20	sand (Qpmf)
		20-60	hardpan and boulders (Qr)
		60-80	sand (Qpc)
		80-90	red hardpan (Qb)
		90-150	red sandstone
262	25-10748	0-80	gravel and hardpan (Qpmf over Qr over Qpc)
		80-356	red sandstone with streaks of gray slate
263	25-28780	0-6	crushed stone, some silt, trace weathered shale (fill?)
		6-11	red weathered shale (fill?)
		11-12	boulder (Qpmf)
		12-17	white medium-to-coarse sand, trace red weathered shale (Qpmf)
		17-19	boulder (Qpmf)
		19-24	medium-to-coarse gray brown sand and fine gravel, some silt (Qpmf)
		24-54	cobbles and boulders, very coarse sand and fine gravel (Qpmf)
		54-70	red dense clay (Qr)
		70-76	brown clay (Qpcl)
		76-81	yellow clay (Qpcl)
		81-84	gray clay (Qpcl)
		84-87	soft gray clay (Qpcl or weathered shale)
		87-128	red and gray shale
264	25-27508	0-7	brown clayey sand (Qpmf)
		7-17	brown medium sand, some fine gravel (Qpmf)
		17-36	brown silty clay, boulder at 35 (Qpml over Qr)
		36-45	brown clayey fine sand with some fine-to-medium gravel (Qr)
		45-50	brown fine-to-medium sand (Qpc)
		50-70	red-brown to gray-brown clay to sandy clay (Qpcl)
		at 70	pieces of decomposed shale
265	25-26473	0-22	brown medium-to-fine sand and gravel, some cobbles (Qpmf)
		22-47	brown fine-to-medium sand (Qpmf)
		47-58	brown silty fine sand some gravel (Qr)

		58-73	red brown clayey silt and trace fine sand (Qpcl)
		73-87	brown medium-to-coarse sand and gravel (Qis)
		87-91	weathered shale
266	25-35354	0-4	fill
		4-45	coarse-to-medium sand (Qpmf)
		45-65	sands, medium and fine (Qpmf)
		65-70	sandy clay (Qr)
267	25-36560	0-44	red silty clay with layers of cobbles about every 5 feet (Qpmf and Qpml)
		at 44	rock (Qr?)
268	25-32196	0-125	sand, gravel, cobbles (Qpmf over Qr)
		125-605	red shale
269	25-9355	0-40	dead sand (Qpmf)
		40-70	hard pan (Qr)
		70-80	fine sand, water (Qpc)
		80-88	red hardpan (Qb)
		88-175	red sandstone
270	25-9411	0-31	sandy clay and some stones (Qpmf)
		31-56	hardpan (Qr)
		56-62	water-bearing sand and gravel (Qpc), yield 20 gpm
271	25-7777	0-65	sand, hardpan, and gravel (Qpmf over Qr over Qpc), yield 10 gpm
272	25-10852	0-20	sandy clay (Qpmf)
		20-45	sand (Qpmf)
		45-55	red hardpan (Qr)
		55-150	red sandstone
273	25-9888	0-15	fine sand and clay (Qpmf)
		15-50	hardpan and boulders (Qr)
		50-70	sandstone
274	25-9900	0-40	sandy clay and boulders (Qpmf over Qr)
		40-58	sand, then red hardpan (Qpc over Qb)
		58-107	red sandstone then gray rock
275	25-11569	0-23	sandy (Qpmf)
		23-36	clay (Qpml)
		36-62	hardpan (Qr)
		62-70	soft gray shale
		70-88	gray shale turning red
276	25-9852	0-67	sand and gravel (Qpmf over Qr)
		67-115	red rock
277	25-11423	0-50	boulders and hardpan (Qpmf over Qr)
		50-100	red shale
278	25-13925	0-20	sand (Qpmf)
		20-40	sand and gravel (Qpmf)
		40-65	gray hardpan (Qr)
		65-135	mixture of shale and slate
279	25-11784	0-15	sand (Qpmf)
		15-54	hardpan (Qr)
		54-110	red sandstone
280	25-8413	0-5	earth (Qpml)
		5-10	dark clay (Qpml)
		10-65	fine sand (Qpmf, probably over Qr)
		65-82	coarse sand (Qpc)
		82-105	red rock
		105-189	blue and brown rock
281	NJGS files	abbreviated log	

		0-34	brown clay (Qpml)
		34-38	brown clay mixed with boulders (Qr)
282	25-11066	0-15	clay (Qpml)
		15-50	fine sand (Qr over Qpc)
		50-65	red hardpan (Qb)
		65-118	red sandstone
283	25-39589	0-9	brown coarse-to-fine gravel (fill?)
		9-19	gray clay (Qpml)
		19-25	gray sandy silt with gravel (Qr)
		25-30	gray silt with gravel (Qr)
		30-44	brown fine-to-medium sand with gravel and silt (Qr)
284	25-13363	0-15	topsoil then sand (Qpmf)
		15-45	hardpan and boulders (Qr)
		45-65	sand (Qpc)
		65-150	red sandstone
285	25-14012	0-10	overburden(Qpml)
		10-24	sand (Qpmf)
		24-60	sand, gravel (Qr over Qpc)
		60-400	blue, brown, red, gray shale
286	25-10677	0-15	hardpan (thin Qst-Qpml over Qr)
		15-50	sand (Qpc)
		50-60	red hardpan (Qb)
		60-100	red sandstone
287	25-13844	0-15	old open well
		15-45	sand (Qpc)
		45-55	red hardpan (Qb)
		55-115	red sandstone
288	25-11257	0-45	clay and sand, fine sand (Qpml-Qr over Qpc)
		45-60	gray rock--not trap
		60-100	red sandstone
289	25-13384	0-31	sandy (Qpmf)
		31-47	hardpan and gravel (Qr)
		47-52	clay (Qpcl)
		52-66	water-bearing sand and gravel, very silty (Qpc)
		66-105	red shale
290	21-11700	0-2	fill
		2-24	clay (Qpmf)
		24-59	hardpan and stones (Qr)
		59-66	water-bearing silty sand and gravel (Qpc)
		66-81	shale and sandstone
291	25-12755	0-2	fill
		2-6	brown clay (Qr)
		6-11	gray clay (Qr)
		11-29	brown clay with stone (Qr)
		29-32	dirty sand, some clay (Qpc)
		32-39	hard yellowish white clay with some sand layers (Qpc or weathered shale)
		39-301	brown and gray shale
292	25-13572	0-38	original well
		38-52	silty sand and gravel (Qr)
		52-62	hardpan and stones (Qr)
		62-75	water-bearing silty sand and gravel (Qpc)
		75-92	red shale streaked with sandstone
293	25-10875	0-90	sand, gravel (Qpmf over Qr over Qpc)
		90-145	red rock
294	25-11492	0-105	sandy soil then red hardpan and boulders (Qpmf over Qr over Qpc over Qb)
		105-150	red sandstone

295	25-13875	0-17	sandy (Qpmf)
		17-21	clay (Qpml)
		21-52	hardpan and stones (Qr)
		52-59	silty water-bearing sand and gravel (Qpc)
		59-71	hardpan and stones (Qb)
		71-118	red shale
296	25-9889	0-57	sand and gravel (Qpmf over Qr)
		57-69	hardpan (Qb)
		69-116	red and gray shale
297	25-9291	0-60	dead sand and clay (Qpmf over Qr)
		60-72	hardpan (Qb)
		72-128	red sandstone
298	25-13587	0-17	sandy (Qpmf)
		17-61	gravel, sand, and boulders (Qpmf over Qr)
		61-67	hardpan (Qr)
		67-73	water-bearing silty sand and gravel (Qpc)
		73-100	red shale
299	25-9126	0-66	gravel and large stones (Qpmf over Qr)
		66-75	fractured shale
		75-90	firm red shale
300	25-12175	0-87	sand and gravel (Qpmf over Qr)
		87-300	red shale
301	25-9493	0-30	hardpan and clay (Qpmf over Qr)
		30-50	sand (Qpc)
		50-106	hardpan (Qb)
		106-140	sandstone
302	25-6500	0-30	gravel and boulders (Qpmf over Qr)
		30-78	sand (Qpc)
		78-142	red rock
303	25-9119	0-29	hardpan (Qpmf over Qr)
		29-42	sand and large stones (Qpc)
		42-51	water-bearing choice sand and gravel (Qpc), yield 15 gpm
304	25-8444	0-60	hardpan and boulders (Qpmf over Qr)
		60-115	fine sand (Qpc)
		115-130	red hardpan (Qb)
		130-180	red sandstone
305	25-12686	0-30	sandy soil (Qpmf)
		30-60	hardpan and boulders (Qr)
		60-147	fine sand (Qpc)
		147-185	red sandstone
306	25-11521	0-70	hardpan and boulders (Qpmf over Qr)
		70-120	fine sand (Qpc)
		120-126	red hardpan (Qb)
		126-175	red sandstone
307	25-11216	0-70	clay, then hardpan and boulders (Qpmf over Qr)
		70-90	fine sand (Qpc)
		90-123	hardpan and boulders (Qb)
		123-170	red sandstone
308	25-11098	0-60	hardpan and gravel, fine sand at 60 (Qpmf over Qr over Qpc)
		60-88	coarse sand with water (Qpc), yield 15 gpm
309	25-30798	0-110	brown fine-to-coarse sand, gravel, cobbles, boulders, layers of clay (Qpmf over Qr)
310	25-31815	0-20	clay, silt, few cobbles, little gravel (Qpmf over Qr)

		20-48	fine-to-coarse sand, gravel, few small boulders, cobbles (Qpc)
		48-74	very fine sand, silt, few small boulders, trace clay (Qpcl)
		74-78	red-brown till (Qb)
		at 78	bedrock (probable boulder, not bedrock)
311	25-35172	0-35	red-brown silt and clay (Qpmf over Qr)
		35-62	fine sand and gravel (Qpc)
		62-82	gray silt and clay, trace fine sand (Qpcl)
312	25-17114	0-45	hardpan and clay (Qr)
		45-60	sand and gravel (Qpc)
		60-134	hardpan, boulders (Qb)
		134-170	red and brown rock
		170-190	gray shale
		190-453	black granite, white granite (basalt?)
		453-610	red shale
313	25-14708	0-15	gumbo (Qpml)
		15-35	clay (Qpml)
		35-45	small gravel (Qpmf)
		45-60	clay and gravel, some water (Qr)
		60-70	coarse sand, clay, and gravel (Qpc)
		70-80	clay and sand (Qpc)
		80-95	clay (Qpcl)
		95-111	red clay (Qb)
		111-115	gravel (Qis)
		115-120	sand (Qis)
		120-387	red and gray shale
		387-494	trap rock
		494-643	red shale and sandstone
314	25-10046	0-30	clay (Qr)
		30-58	sand and gravel (Qpc), yield 15 gpm
315	25-12132	0-37	clay with some large stones (Qr)
		37-49	choice water-bearing sand and gravel (Qpc)
		49-61	hardpan with some boulders (Qb)
		61-67	red clay (Qb or weathered shale)
		67-110	trap rock
316	25-12183	0-55	sand and gravel (Qr over Qpc)
		55-80	water-bearing sand (Qpc)
		80-86	choice water-bearing sand and gravel (Qpc), yield 15 gpm
317	25-14246	0-25	clay (Qpmf)
		25-30	hardpan (Qpmf)
		30-56	sand (Qpmf)
		56-75	hardpan (Qr)
		75-130	sand (Qpc)
		130-160	yellow silt (Qpcl)
		160-175	dirty sand (Qis)
		175-201	hardpan (Qb)
		201-270	red sandstone
318	25-10290	0-63	sand and gravel (Qpmf)
		63-77	hardpan and stones (Qr)
		77-100	water-bearing sand and gravel (Qpc), yield 12 gpm
319	25-9186	0-76	hardpan with large stones (Qpmf over Qr)
		76-82	water-bearing sand and gravel (Qpc), yield 16 gpm
320	25-10027	0-79	hardpan and stones (Qpmf over Qr)
		79-105	water-bearing silty sand and gravel (Qpc)
		105-108	water-bearing choice sand and gravel (Qpc), yield 15 gpm
321	25-10678	0-50	hardpan (Qpmf over Qr)
		50-78	fine sand (Qpc)
		at 78	coarse sand with water (Qpc), yield 4 gpm

322	25-10203	0-55	sand and gravel (Qpmf over Qr)
		55-80	water-bearing sand (Qpc)
		80-86	choice water-bearing sand and gravel (Qpc), yield 15 gpm
323	25-10408	0-31	clay (Qpmf over Qr)
		31-57	hardpan (Qr)
		57-82	silty water-bearing sand and gravel (Qpc)
		82-95	hardpan (Qb)
		95-148	gray and red shale
324	25-15-128	0-60	sand and clay (Qpmf over Qr)
		60-100	hardpan mixed with gravel (Qr)
		100-130	heaving sand (Qpc)
		130-168	clay mixed with gravel (Qpcl over Qis)
		168-171	water-bearing gravel (Qis), yield 20 gpm
325	25-7295	0-57	hardpan (Qpmf over Qr)
		57-62	sand (Qpc)
		62-66	water-bearing sand and gravel (Qpc), yield 20 gpm
326	25-14143	0-10	silt, clayey, yellow brown, with some sand and fine gravel (Qpmf)
	OEP 1 of Vecchioli and others (1967)	10-50	sand, fine-to-medium, yellow brown, well sorted, with thin layer of till at 20 feet and layer of brown silt at 30 feet (Qpmf)
		50-60	till, clayey, brown (Qr)
		60-62	clay, grayish brown, sandy in part (Qr)
		62-70	sand, clayey, poorly sorted (Qr)
		70-90	till, sandy, mostly very poorly sorted medium-to-coarse sand with pebbles, little to no clay (Qr)
		90-100	till, clayey, dark gray, very angular rock fragments (Qr)
		100-112	till, clayey, yellow to light brown, highly weathered, very angular rock fragments (Qb)
		112-119	shale, gray, hard
327	25-9640	0-60	fine sand (Qpml over Qpmf over Qr)
		60-85	coarse sand, no water (Qpc)
		85-131	mud, coarse sand, no water (Qpcl over Qis)
		131-270	red sandstone
328	25-9846	0-40	clay hardpan (Qpmf over Qr)
		40-110	quicksand (Qpc)
		110-147	sand, gravel (Qis), yield 12 gpm
329	OEP 3 of Vecchioli and others (1967)	0-5	sand, medium, very poorly sorted, with gravel, brown (Qpmf)
		5-10	till, very clayey, brown (Qr)
		10-16	silt, clayey, with gravel, dark brownish gray (Qr)
		16-25	sand, very coarse, and fine gravel, poorly sorted, water-bearing (Qpc)
		25-55	sand, coarse to very coarse, with some gravel, fair to poorly sorted, water-bearing (Qpc)
		55-60	sand, medium-to-coarse, well-sorted, water-bearing (Qpc)
		60-70	sand, fine-to-medium, well sorted, water-bearing (Qpc)
		70-110	sand, coarse, well sorted, water-bearing, very coarse to granule size between 105-110 feet (Qis)
		110-120	till, sandy, with some clay (Qb)
		120-125	shale, red and gray, highly weathered
		screened 94-104, yield 245 gpm	
330	OEP 2 of Vecchioli and others (1967)	0-10	sand, medium, very clayey, brown (Qpml)
		10-20	clay, gray, slightly silty and sandy (Qr)
		20-25	sand, very fine, brown, silty (Qpc)
		25-50	sand, coarse, silty, some gravel, fair sorting (Qpc)
		50-80	sand, medium, fair sorting, water-bearing (Qpc)
		80-114	till, clayey, brown to rust (Qb)
		114-118	sand, coarse, fair sorting, water-bearing (Qis)
		118-125	shale, red to brown, highly weathered at top
		screened 62-72, yield 280 gpm	
331	25-15-183	0-8	yellow brown clay (Qal)
		8-10	brown sand (Qal)
		10-18	fine-to-medium gray sand and gravel (Qal)

		18-44	smooth textured gray clay--changing to brown clay with increasing depth (Qpml)
		44-55	cemented sand and gravel and gray clay (Qr)
		55-72	soft sandy brown clay, some gravel (Qpcl)
		72-74	gray rock (hard clay in Qpcl?)
		74-106	soft sandy brown clay, some gravel, color becomes redder as depth increases (Qpcl over Qisl)
		106-114	stiff red clay with gravel--hardpan (Qb)
		114-116	red shale
332	25-2191	0-13	fine light reddish brown sand with clay binder (Qst)
		13-35	soft, sticky gray sandy clay (Qpml)
		35-45	gray sandy clay, some gravel (Qpml)
		45-52	gray clay-bound silt (Qpml)
		52-59	cemented fine gravel and sand, angular (Qr)
		59-86	gray clay with sand and fine gravel, traces of red clay as depth increases (Qpcl over Qisl)
		86-87	cemented sand and gravel (Qis)
		87-95	dirty, rounded medium sand and gravel (Qis)
		95-98	medium-to-fine sand, clean (Qis)
		98-106	dirty rounded medium sand and gravel (Qis)
		106-115	red-brown clay with gray (Qb over weathered shale)
		115-119	red-brown shale
333	25-1831	0-5	fill
		5-10	black muck (Qal)
		10-52	gray sandy clay, trace reddish clay (Qpml)
		52-76	gray sandy clay with some mixed gravel, small amount of water (Qr)
		76-110	red clay with some fine-to-medium gravel (Qpcl over Qis-Qisl)
		110-116	disintegrated ledge and reddish clay, some fine gravel (Qb over weathered shale)
		at 116	red shale
334	45-341	0-6	yellow clay (Qst)
		6-43	soft gray and brown clay (Qpml)
		43-53	gray sandy clay, some gravel (Qr)
		53-57	fine angular gray gravel, sand (Qpc)
		57-65	gray sandy clay, some gravel (Qpcl)
		65-76	soft gray clay and gravel (Qpcl)
		76-89	shift [to] reddish gray clay (Qisl)
		89-94	red clay with sand and gravel (Qisl over Qis)
		94-96	red shale or boulders (Qis)
		96-106	very dirty sand and gravel, red-brown, clayey, heaves with water (Qis)
		106-112	soft red clay with sand and gravel (Qb)
		at 112	ledge--red shale
335	25-25959	0-80	decomposed red shale (Qr over Qpcl over Qisl-Qb)
		80-400	red shale
336	25-34020	0-5	fill
		5-20	fine sand with some clay (Qal over Qpml)
		20-32	glacial till (Qr)
		32-60	silty sand and gravel (Qpc)
		60-75	fine sand (Qpc)
337	25-30910	0-60	brown coarse-to-fine sand, little silt, little fine-to-medium gravel (Qr over Qpc)
		60-63	brown silty clay (Qpcl)
338	25-1677	0-18	sand (Qr)
		18-30	sand and gravel (Qr)
		30-35	red sand and gravel (Qr)
		35-42	coarse gravel (Qpc)
		42-44	sand and some gravel (Qpc)
		44-48	sand and clay (Qpc)
		48-54	red sand, clay and gravel (Qis)
		54-59	sand and gravel (Qis)
		59-67	fine mucky sand (Qb or Qis)
		67-200	blue rock, brown, red rock

339	25-15-422	0-10	fill with small boulders
		10-21	soft sandy clay mixed with gravel (Qr)
		21-29	muddy coarse sand and gravel (Qpc)
		29-35	coarse red sand and gravel (Qpc)
		35-48	medium red sand (Qpc)
		48-50	brownish yellow clay (Qpcl)
		50-100	reddish brown clay (Qpcl)
		100-126	brown clay (Qisl)
		126-142	red hardpan (Qb)
		142-143	red sandstone
340	25-2192	0-24	gray clay (Qs over Qpml)
		24-30	fine sand with gray clay (Qpml)
		30-32	sand (Qpmf)
		32-38	sand and gravel with clay binder (Qr)
		38-40	hard clay (Qr)
		40-79	silty sand and brown clay (Qpcl)
		78-88	red hardpan (Qb)
		88-93	brown shale
341	25-21771	0-3	fill rock
		3-11	black muck (Qs)
		11-22	gray soft clay (Qpml)
		22-45	gray-brown soft clay (Qpml)
		45-67	soft brown clay (Qpml)
		67-78	brown silty clay (Qpml)
		78-83	brown hardpan with rocks (Qr)
		83-87	red silty clay (Qpcl)
		87-124	hard, sandy hardpan (Qisl?)
		124-128	red hardpan (Qb)
		128-506	red and gray shale
342	25-4412	0-5	sand and gravel (Qr)
		5-8	boulders (Qr)
		8-32	yellow sand (Qpc)
		32-135	clay (Qpcl over Qisl)
		135-156	clay and fine sand (Qisl)
		156-170	soft red rock (Qb over weathered shale)
		170-190	red rock (red and blue rock to 450 in adjacent well 25-4151)
343	25-12454	0-24	clay and boulders (Qr)
		24-37	sandy clay with rocks (Qr over Qpc)
		37-48	reddish soft clay (Qpcl)
		48-57	reddish clay, hard (Qisl)
		57-68	hardpan (Qb)
		68-75	red shale
344	26-705	0-98	clay, sand, boulders (Qst over Qpml over Qr)
		98-137	sandstone
345	25-13584	0-28	brown sandy clay (Qr)
		28-36	sand, gravel (Qpc)
		36-48	brown clay (Qpcl)
		48-51	fine clay sand (Qpcl)
		51-66	gray-brown clay (Qpcl)
		66-67	medium brown sand (Qis)
		67-80	brown sand with clay seam (Qis)
		80-83	sand, gravel (Qis)
		83-90	red sandy clay (Qisl)
		90-100	sand and gravel with clay (Qis)
		100-102	yellowish brown clay (Qisl)
346	U. S. Army	abbreviated log	
	Corps of	0-4	dark brown organic sandy silt (Qst)
	Engineers	4-8	yellow brown silty medium-to-coarse sand (Qst)
	boring	8-10	gray lean clay (Qpml)
	P-10-9	10-51	gray to brown fat clay, slightly sandy (Qpml)

347	25-13643	0-23	yellowish brown clay, hardpan, boulders (Qpml over Qr)
		23-82	brown sandy clay, some boulders (Qpcl)
		82-89	yellow brown sandy clay (Qisl)
		89-103	reddish brown silty clay (Qisl)
		103-126	yellowish brown clay (Qisl)
		126-135	red hardpan (Qb)
		135-136	red shale
348	25-39161	abbreviated log	
		0-35	gray-brown silty clay and medium-to-fine sand with gravel and boulders (Qry)
		35-52	brown medium-to-fine sand (Qpc)
349	25-13620	0-9	hard clay, boulders, fill (af over Qpml)
		9-15	gray clay, small boulders (Qpml over Qry)
		15-28	brown sandy clay, hardpan (Qr)
		28-35	sandy hardpan, softer (Qr)
		35-46	hardpan, boulders--large (Qr)
		46-60	soft light brown clay with small gravel (Qpcl)
		60-70	soft light brown clay, some water (Qpcl)
		70-75	dry seamy clay, streaks of fine sand (Qpcl)
		75-89	fine yellow sandy clay (Qisl)
		89-99	fine red soupy sand and gravel (Qis)
		95-102	red hardpan (Qb)
		102-105	red shale
350	25-41409	0-80	overburden (Qry over Qpc)
		80-285	traprock
		285-390	red shale
		390-400	gray shale
351	25-13677	0-16	sandy clay, rocks (Qry)
		16-36	hardpan, red sand and gravel rocks (Qr)
		36-41	brown sand, gravel, hardpan (Qr over Qpc?)
		42-44	dirty sand and gravel (Qpc)
		44-56	sand, gravel, hardpan (Qpc)
		56-71	hardpan (Qpcl?)
		71-82	hardpan, sand, gravel, clay (Qis?)
		82-95	red clay (Qisl or Qb)
		95-99	red shale
352	25-13678	0-34	clay, boulders, stones (Qpmf thin on Qry)
		34-49	reddish sandy clay with water-bearing sand layers (Qpcl)
		49-63	reddish fine sandy clay (Qpcl)
		63-73	sand and gravel, dirty (Qis)
		73-81	yellowish sand and gravel, clay (Qis)
		81-118	reddish brown silty clay, some gray and white (Qisl)
353	25-4768	0-11	clay and boulders (Qry)
		11-30	hard gray rock
		30-85	very hard trap rock
		85-189	red argillite rock
354	25-42909	abbreviated log	
		0-35?	reddish brown medium-to-fine sand, little to some clayey silt, trace fine gravel (Qr)
		35?-64?	reddish brown silty clay, trace fine sand (Qpcl)
		64-66	brown silty clay, trace fine sand (Qpcl)
355	OEP 7 of Vecchioli and others (1967)	0-2	sand, clayey, with few pebbles (Qpml)
		2-10	clay, dark-gray, with some sand (Qpml)
		10-20	clay, dark-gray, interbedded with silt, dark, reddish-gray (Qpml)
		20-29	silt, dark-gray, interbedded with sand, very fine, grayish-brown, and thin lenses of dark-gray clay (Qpml)
		29-37	shale, sandy, red, extremely weathered at top to moderately weathered at base
356	25-14167	0-5	fill (af)
	OEP 8 of	5-29	clay and silt, dark gray and dark reddish gray with few pebbles at 5-10 (Qal)

	Vecchioli	29-40	till, reddish-brown, compact, silty and pebbly (Qr)
	and others	40-42	sand, medium, with little gravel, silty, reddish-brown, weathered (Qis or Qb)
	(1967)	42-50	till, silty, clayey, sandy, some gravel, reddish brown (Qb)
		50-55	shale and sandstone
357	25-13088	0-89	sand, gravel, clay (Qr over Qpc-Qpcl), yield 24 gpm
358	25-36407	0-45	overburden (Qr over Qpc)
		45-100	red sandstone
359	25-17364	0-20	till, clayey, yellow-brown to brown (Qal over Qr)
		20-30	sand, medium, silty (Qpc)
		30-50	till, clayey, yellow-brown, brown, rust colored, boulders, cobbles at 38 feet, 50 feet, crystalline pebbles and shale pebbles highly to moderately weathered (Qb)
		50-57	sand, all sizes, slightly clayey (Qis)
		57-71	till, sandy and pebbly, some clay in upper few feet, some pebbles highly weathered (Qb or Qis)
		71-103	sand, medium-to-coarse, with gravel, very little silt, clay, fairly well to poorly sorted, water-bearing (Qis)
		103-110	sand, medium-to-coarse, well sorted with little silt, few pebbles (Qis)
		110-120	sand, coarse to very coarse, gravel, water-bearing, thin lenses of clay, red sand (Qis)
		120-125	shale, red, highly weathered
		screened 85-123, yield 1000 gpm	
360	25-31304	0-80	sand, silt (Qpmf over Qr over Qpc)
		80-100	sand, gravel (Qis, Qb)
		100-140	sand (Qis)
		140-304	shale
		304-375	limestone (probably gray shale)
361	25-7096	0-43	clay (Qal over Qpml)
		43-53	gravel, boulders (Qr)
		53-75	sand, gravel with clay streaks (Qpc)
		75-123	sand, gravel (Qpc over Qis)
		at 123	rock
		screened 81-121, yield 1080 gpm	
362	25-7097	0-20	clay with streaks of sand (Qal over Qpml)
		20-30	clay with small stones (Qpml)
		30-47	sand, clay, boulders (Qr)
		47-128	sand, gravel, boulders (Qpc over Qis)
		128-130	clay, rock lenses (Qb)
		screened 75-130, yield 1080 gpm	
363	25-7098	0-24	clay with streaks of fine sand (Qal over Qpml)
		24-40	sandy clay (Qpml)
		40-54	sand, some clay and boulders (Qr)
		54-74	sandy clay (Qpcl)
		74-119	sand with streaks of clay (Qis)
		119-123	red clay (Qb)
		at 123	rock
		screened 93-123, yield 1080 gpm	
364	25-37062	0-3	fill (af)
		3-26	brown fine-to-coarse sand (Qal)
		26-50	brown fine-to-coarse sand, some silty clay and cobbles (Qpml over Qpmf)
		50-70	silt and clay, some fine-to-medium gravel, some fine sand (Qr)
		70-76	silt and clay, some fine-to-medium gravel, few cobbles (Qr)
		76-90	clay and silt, some fine-to-medium gravel, trace fine sand (Qpcl)
		90-95	fine sand, trace fine-to-medium gravel (Qis)
		95-97	silt and fine-to-medium sand (Qis)
		97-100	coarse-to-medium sand, trace fine-to-coarse gravel (Qis)
		100-111	fine-to-medium sand, trace fine-to-medium gravel (Qis)
		111-117	coarse-to-medium sand, trace fine-to-coarse gravel (Qis)
		117-125	coarse-to-medium sand, trace silt and fine sand (Qis)
		125-127	fine-to-medium sand, some clay (Qis or Qb)
		screened 95-125, yield 1090 gpm	

365	25-34201	0-15	brown and black fine-to-coarse sand, trace silt, trace gravel (Qal)
		15-25	brown silty clay and fine-to-medium gravel (Qpml over Qpmf)
		25-30	fine-to-coarse sand, trace gravel, trace silt and clay (Qpmf)
		30-35	fine-to-medium gravel and coarse sand (Qpmf)
		35-40	coarse sand, trace fine sand and gravel (Qpmf)
		40-45	brown very fine-to-fine sand, trace silty clay (Qpmf over Qr)
		45-55	same, with cobbles (Qr)
		55-65	coarse sand and fine gravel, trace silt (Qr)
		65-70	fine-to-medium sand, some silty clay (Qpc)
		70-85	clayey silt, trace fine-to-coarse sand, trace gravel (Qpcl)
		85-95	brown medium sand, little clay and silt (Qis)
		95-115	brown coarse sand, trace fine gravel, trace fine-to-medium sand (Qis)
		115-128	red-brown fine sand, trace coarse sand, trace fine gravel, trace silt (Qb)
		128-130	red-brown weathered shale
366	25-37061	0-3	loam (Qal)
		3-15	brown and black fine-to-coarse sand, trace silt, trace gravel (Qal)
		15-25	brown silty clay and fine-to-medium gravel (Qpml over Qpmf)
		25-30	fine-to-coarse sand, trace gravel, trace silt and clay (Qpmf)
		30-35	fine-to-medium gravel and coarse sand (Qpmf)
		35-40	coarse sand, trace fine sand and gravel (Qpmf)
		40-45	brown very fine-to-fine sand, trace silty clay (Qr)
		45-55	brown very fine-to-fine sand, trace silty clay, cobbles (Qr)
		55-65	coarse sand and fine gravel, trace silt (Qpc)
		65-70	fine-to-medium sand, some silty clay (Qpc)
		70-85	clayey silt, trace fine-to-coarse sand, trace gravel (Qpcl)
		85-95	brown medium sand, little clay and silt (Qis)
		95-115	brown coarse sand, trace fine gravel, trace fine-to-medium sand (Qis)
		115-128	red-brown fine sand, trace coarse sand, trace fine gravel, trace silt (Qis)
		128-130	red-brown weathered shale
		screened 96-126, yield 892 gpm	
367	25-34200	0-15	brown silty clay and fine-to-coarse sand, some fine-to-coarse gravel (Qal)
		15-60	brown silty clay, some fine-to-coarse sand, some fine-to-coarse gravel, increasing sand and decreasing silty clay with depth, cobbles throughout (Qpml over Qr)
		60-65	brown fine-to-coarse sand and fine-to-coarse gravel, little silt (Qpc)
		65-70	brown medium-to-coarse sand and fine-to-coarse gravel, little silt (Qpc)
		70-115	brown fine-to-coarse sand, little to some fine-to-medium gravel, trace to little silt (Qpc-Qpcl over Qis, all other nearby wells report silt and clay in this interval)
		115-125	yellow-brown fine-to-medium sand, little silt (Qis)
		125-130	brown fine-to-coarse sand, little silt (Qis)
		130-132	red-brown weathered shale
368	25-37060	0-3	loam (Qal)
		3-15	brown silty clay, fine-to-coarse sand (Qal)
		15-50	brown silty clay, some fine-to-coarse sand and gravel, cobbles throughout (Qpml over Qr)
		50-60	silt, some clay (Qpcl)
		60-75	silt and clay, trace fine sand and fine gravel (Qpcl)
		75-82	silt and clay, some fine gravel, fine sand (Qpcl)
		82-90	clay, some fine sand, some fine gravel (Qpcl)
		90-94	clay, some silt, trace fine sand (Qpcl)
		94-98	silt, some fine sand, trace fine-to-medium gravel (Qis)
		98-115	fine-to-medium sand, little silt, trace fine gravel (Qis)
		115-125	fine-to-coarse sand, trace fine-to-medium gravel, trace silt (Qis)
		125-130	coarse-to-medium sand, trace fine-to-medium gravel, trace silt (Qis)
		130-133	silt and clay, trace fine sand (Qb)
		screened 95-125, yield 1280 gpm	
369	25-24573	0-6	fill
		6-17	gray clay (Qal over Qpml)
		17-21	gray clay with gravel (Qpml)
		21-46	sandy gray clay (Qpml)
		46-58	sandy gray clay with stones (Qr)
		58-66	gray silty sand (Qpc)
		66-76	brown sandy clay (Qpcl)

		76-113	brown sandy clay with hard layers (Qpcl)
		113-117	sand and some gravel (Qis)
		117-121	fine-to-coarse sand with some gravel (Qis)
		121-132	fine-to-coarse sand with gravel and stones (Qis)
		132-135	coarse sand and gravel (Qis)
		135-138	red hardpan and shale (Qb)
		screened 116-140, yield 1005 gpm	
370	25-51419	0-5	clay, trace silt, trace sand, fine, gray-brown, soft, dry (Qal)
		5-10	clay, some silty sand, fine-to-coarse, trace gravel, fine-to-medium, soft, brown, moist (Qal)
		10-20	clay, trace silt, gray, medium dense, dry to moist (Qpml)
		20-40	clay, little silty sand, fine, trace gravel, fine-to-medium, with some broken pieces of cobbles, gray-brown, soft to medium dense, moist to wet (Qpml over Qr)
		40-45	glacial till, clay, little silty sand, fine-to-coarse, trace silt, brown, loose, wet (Qr)
		45-53	silt, some sand, fine-to-coarse, trace gravel, fine-to-coarse, brown, medium hard, wet (Qpc)
		53-60	sand, fine-to-coarse, trace gravel, fine-to-coarse, trace silt, brown, loose, wet (Qpc)
		60-70	silty sand, fine-to-medium, some clay, trace gravel, fine-to-coarse, brown, medium hard, wet (Qpc over Qpcl)
		70-75	silty clay, trace sand, fine-to-medium, trace gravel, fine-to-medium, loose (Qpcl)
		75-90	gravel, fine-to-coarse, trace sand, fine-to-coarse, trace silt, poorly sorted, occasional cobbles, brown, loose, wet (Qis)
		90-95	silty sand, fine-to-coarse, trace gravel, fine, loose (Qis)
		95-110	sand, fine-to-coarse, little gravel, fine-to-medium, trace silt, brown, loose, wet (Qis)
		110-115	silty sand, fine-to-coarse, trace gravel, fine, loose (Qis)
		115-123	gravel, fine-to-medium, and sand, fine-to-coarse, little silt, brown, loose, wet (Qis)
		at 123	bedrock, gray shale and sandstone
371	25-23347	0-40	sandy gray clay (Qal over Qpml)
		40-47	sandy gray clay with some small cobbles (Qr)
		47-52	gray clay with boulders and small cobbles (Qr)
		52-60	silty sand (Qpc)
		60-75	brown silty sand (Qpc)
		75-80	silty sand, some gravel (Qis)
		80-85	sand and gravel, some coarse gravel (qis)
		85-90	brown silty sand (Qis)
		90-95	silty sand (Qis)
		95-100	sand and gravel (Qis)
		100-108	sand and gravel, some fine silt (Qis)
		108-130	sand and gravel (Qis)
		130-132	red shale
		screened 116-132, yield 150 gpm	
372	Allen well of Thompson (1932)	140	
373	25-4114	0-5	large cobble stones and clay (Qr)
		5-25	very fine sand (Qpc)
		25-58	very fine dirty sand mixed with clay (Qpc)
		58-315	trap rock
		315-320	blue shale rock
		320-407	red shale rock
374	25-17379	0-30	clay, layers of sand, gravel, with boulders (Qr)
		30-75	hardpan with layers or slabs of red shale from 65-75 (Qpc or Qb over shale)
		75-90	tight red hardpan, chips appear to be red shale (Qb or shale)
		90-177	gray traprock, hard
375	25-31595	0-30	sandy overburden (Qr)
		30-340	shale rock

376	25-36137	abbreviated log	
		0-17	clay, brown and gray (Qal over Qpml)
		17-22	pebble gravel (Qr)
		22-25	fine sand and gravel, brown (Qr)
		25-31	clay, sand and gravel (Qr)
		31-35	sand and gravel, little clay, brown (Qr)
		35-48	gravel, broken rock, hard, brown clay (Qr)
		48-67	sand and gravel (Qpc)
		67-72	clay, reddish brown (Qpcl)
		72-80	more sand, less clay (Qis)
		80-134	coarse-to-fine sand and gravel, little clay (Qis)
		screened 107-137, yield 500 gpm	
377	25-12852	0-10	solid clay (Qal over Qpml)
		10-46	rocks, dirty sand, and clay (Qr)
		46-67	coarse sand and gravel (Qpc)
		67-71	solid clay (Qpcl)
		71-135	sand gravel (Qis)
		135-136	red shale
		screened 105-135, yield 602 gpm	
378	45-260	0-30	gray clay (Qal over Qpml)
		30-37	light brown clay, little sand (Qpml)
		37-48	coarse gravel, large stones, little brown clay (Qr)
		48-50	fine sand, some stones, little clay (Qr)
		50-54	coarse sand, large stones, some clay (Qpc)
		54-59	dark gray clay, some stones (Qpcl)
		59-63	coarse stone [sand?] gravel, stone, some clay (Qpc)
		63-68	clean coarse sand, stone, probably water (Qpc)
		68-70	brown clay, fine sand, now water (Qpcl)
		70-77	sand, coarse gravel, clay at times (Qis)
		77-120	sand and little gravel, fairly coarse, water (Qis)
		120-135	sand, gravel at times, conglomerate composed of sand, rottenstone (Qis over bedrock?)
		screened 60-135, yield 1481 gpm	
379	East Orange 9 of Thompson (1932)	0-25	clay and loam (Qal over Qpml)
		25-50	hardpan (Qr)
		50-55	red clay (Qpcl)
		55-75	sand and gravel (Qpc)
		75-85	red clay (Qpcl)
		85-100	sand and gravel (Qis)
		100-102	rock
380	well 15 of Vermeule (1905)	0-6	loam (Qr)
		6-15	dark clay (Qr)
		15-45	hardpan (Qr)
		45-51	fine sand (Qpc)
		51-65	coarse sand (Qpc)
		65-77	fine sand (Qpc)
		77-94	clay (Qpcl)
		94-105	soft shale (Qb or weathered rock)
		at 105	hard sandstone
381	well T18 of Thompson (1932)	0-8	yellow clay (Qal)
		8-20	brown clay, gravel, and boulders (Qr)
		20-40	sand, gravel, brown clay, boulders (Qr)
		40-45	sand, gravel, boulders (Qpc)
		45-65	sand and clay (Qpcl)
		65-80	blue and red sandstone
382	well 9 of Vermeule (1905)	0-20	clay and loam (Qr)
		20-50	hardpan (Qr)
		50-70	sand and gravel (Qpc)
		70-80	red clay (Qpcl)
		80-90	sand and gravel (Qis)
		at 90	sandstone

383	well 8 of	0-15	clay and loam (Qr)
	Vermeule	15-48	hardpan (Qr)
	(1905)	48-50	red clay (Qpcl)
		50-68	sand and gravel (Qpc)
		68-85	red clay (Qpcl)
		85-90	sand and gravel (Qis)
		at 90	sandstone
384	well 7 of	0-25	clay and loam (Qr)
	Vermeule	25-65	sand and gravel (Qpc)
	(1905)	65-75	red clay (Qpcl)
		85-95	sand and gravel (Qis)
		at 95	sandstone
385	well 6 of	0-15	loam (Qr)
	Vermeule	15-27	fine sand (Qr)
	(1905)	27-53	hardpan (Qr)
		53-65	fine gravel (Qpc)
		65-70	fine sand (Qpc)
		70-74	dark clay or shale (Qb or weathered shale)
		74-81	red shale
		81-89	coarse sandstone
386	well 14 of	0-10	clay and loam (Qry)
	Vermeule	10-30	hardpan (Qr)
	(1905)	30-38	red clay (Qpcl)
		38-65	sand and gravel (Qpc)
		65-85	red clay (Qpcl)
		85-98	sand and gravel (Qis)
		at 98	sandstone
387	45-6	69	
388	25-16313	0-5	brown silt and sand, some boulders (Qr)
		5-12	brown silt and sand, some clay, small cobbles and boulders (Qr)
		12-30	fine-to-coarse sand and silt, some cobbles Qr)
		30-35	fine brown silt and sand, some clay (Qpc)
		35-45	brown sand to coarse gravel, some boulders and cobbles (Qpc)
		45-55	fine brown sand to coarse gravel, some boulders and cobbles (Qpc)
		55-60	fine brown silt and sand, some cobbles (Qpc)
		60-76	fine brown silt, some cobbles (Qpcl)
		76-81	red hardpan with layers of red clay (Qb)
		81-235	red and gray shale
389	well 13 of	0-15	clay and loam (Qal over Qr)
	Vermeule	15-25	sand and gravel (Qpc)
	(1905)	25-75	red clay (Qpcl)
		at 75	sandstone
390	well 16 of	0-12	loam (Qr)
	Vermeule	12-21	fine gravel (Qpc)
	(1905)	21-47	sand and gravel (Qpc)
		47-60	fine sand and gravel (Qpc)
		60-85	fine sand (Qpc)
		85-89	gravel (Qis or Qb)
		89-101	red sandstone
391	25-19136	0-10	brown silty sand with boulders (Qr)
		10-30	fine-to-coarse sand, small cobbles, some boulders (Qpc or Qr)
		30-35	fine brown silty sand, some clay (Qpc or Qr)
		35-45	brown sand, coarse gravel, some small cobbles (Qpc)
		45-55	fine brown sand, some cobbles (Qpc)
		55-60	fine brownish silty sand, some small cobbles (Qpc)
		60-75	fine brown sand, some cobbles
		75-81	red hardpan with thin layers of red clay in it (Qb)
		81-140	red shale
		140-175	gray shale
		175-295	red shale

392	25-24339	0-24	hard-packed sand and gravel, no water (Qr)
		24-50	silty sand and gravel, very little water (Qpc)
		50-95	hard-packed sand and gravel, some small cobbles, very little water (Qis?)
		95-101	red hardpan, some clay (Qb)
		101-110	red shale
		110-114	gray shale
		114-137	red shale
393	East Orange 14 of Thompson (1932)	0-15	muck and soil (Qr)
		15-32	gravel and boulders (Qr)
		32-50	fine gray sand (Qpc)
		50-60	sand (Qpc)
		60-85	hardpan (Qpcl?)
		85-95	fine gravel (Qis)
		95-110	fine sand (Qis)
		110-120	gravel (Qis)
		120-140	hardpan (Qb)
		140-220	sticky red clay (weathered shale)
		220-260	red shale
		260-280	blue shale
394	25-7102	0-10	boulders (Qry)
		10-21	sand and gravel with streaks of clay (Qpc)
		21-30	clay (Qpcl)
		30-84	hardpan, clay, and gravel (Qpcl over Qis?)
		84-105	sand and gravel with streaks of clay (Qis)
		105-125	sand and gravel (Qis)
		125-130	clay (Qb?)
		at 130	weathered rock
		screened 80-120, yield 760 gpm	
395	well 4 of Vermeule (1905)	0-43	hard pan and clay (Qry)
		43-75	fine sand (Qpc)
		75-76	red clay (Qpcl)
		76-80	fine red sand, with water to the bottom (Qpc)
		80-82	gravel (Qis)
396	26-1712	0-22	clay, gravel, boulders (Qr)
		22-39	sand, gravel (Qpc)
		39-43	red sand (Qpc)
		43-52	fine sand (Qpc)
		43-63	sandy clay (Qpcl)
		63-81	red clay, fine sand (Qpcl)
		81-87	red clay (Qpcl)
		87-97	sand, stones, clay (Qis)
		97-100	stones (Qis)
		100-110	sand, gravel, stone (Qis)
		110-118	sand, gravel, clay (Qb)
		118-121	blue clay (weathered shale?)
		screened 91-112, yield 1670 gpm	
397	26-1713	0-21	clay, sand, gravel, stones (Qr)
		21-29	sand, mud, stones (Qr)
		29-33	coarse sand (Qpc)
		33-50	fine sand (Qpc)
		50-75	very fine sand (Qpc)
		75-87	red clay (Qpcl)
		87-109	sand, gravel, stones, clay (Qis)
		109-115	sand, gravel, stones (Qis)
		115-119	yellow clay (Qb or weathered shale)
		119-121	blue clay (weathered shale)
		screened 30-115, yield 1110 gpm	
398	26-2607	0-59	hardpan and boulders (Qr)
		59-76	dirty sand and gravel (Qpc)
		76-85	very fine sand (Qpc)
		85-122	hardpan (Qis over Qb)
		122-171	red shale

399	25-3053	0-127	hardpan, boulders, clay, silt (Qr over Qpc over Qpcl)
		127-284	sandstone
400	25-16384	0-9	brown hardpan, boulders (Qr)
		9-16	sand, gravel, boulders, some cobbles (Qr or Qpc)
		16-22	sand, gravel, boulders, small cobbles (Qr or Qpc)
		22-43	sand, gravel, small to large cobbles (Qpc)
		43-46	sand, gravel, small cobbles (Qpc)
		46-59	fine sand with layers of gray clay, some brown silt, small cobbles (Qpcl)
		59-64	fine sand, gravel, no water (Qis)
		64-78	fine sand, coarse gravel (Qis)
		78-83	fine sand, silt, no water (Qis)
		83-92	red hardpan, layer of clay (Qb)
		92-97	fine red sand, clay (Qb)
		97-284	red shale and sandstone, gray from 214-242
401	East Orange 1 of Thompson (1932)	0-10	loam (Qr)
		10-40	hardpan (Qr)
		40-50	gravel and clay (Qr or Qpc)
		50-80	hardpan (Qpcl or Qis)
		80-90	clay and gravel (Qis)
		90-130	blue clay (Qisl or weathered shale)
		130-160	red clay (weathered shale)
		160-270	red and gray shale and sandstone
402	26-1714	0-37	boulders, gravel, clay (Qr)
		37-64	sand, gravel, boulders (Qpc)
		64-66	fine sand (Qpc)
		66-71	medium-to-coarse sand, gravel, and boulders (Qis)
		71-72	clay, boulders (Qis)
		72-89	coarse sand, gravel, and boulders (Qis)
		89-103	medium-to-coarse sand, gravel, and boulders (Qis)
		screened 71-102, yield 700 gpm	
403	East Orange 2 of Thompson (1932)	0-10	loam (Qr)
		10-45	hardpan (Qr)
		45-65	clay (Qpcl)
		65-82	gravel (Qis)
		82-95	gravel and clay (Qis)
		95-110	sandy clay (Qb?)
		110-120	clay (Qb or weathered shale)
		120-150	blue clay (weathered shale)
		150-205	red clay and shale, red sandstone
404	26-4476	0-5	fine sand (Qal)
		5-7	coarse gravel, some cobbles (Qal)
		7-25	hardpan with small cobbles (Qr)
		25-30	hard-packed sand and gravel, small cobbles (Qpc)
		30-50	sand and gravel, some small cobbles (Qpc)
		50-60	sand and gravel (Qpc)
		60-70	sand and gravel, fine to coarse (Qpc)
		70-85	gravel, fine-to-coarse (Qis?)
		85-94	gravel (Qis)
		94-100	sand, gravel, reddish brown (Qis)
		100-115	sand, light red (Qis)
		115-119	coarse gravel (Qis or Qb)
		119-270	red shale, quite soft
		270-282	blue shale
		282-285	red slate
		285-320	basalt
405	26-19124	abbreviated log	
		0-28	brown silt, fine sand, some clay and gravel (Qr)
		28-29	shale
406	25-20463	0-12	yellow sand and clay (Qal over Qr)
		12-35	yellow clay, sand, small stones, trap rock stones (Qry)
		35-55	fine sand, very hard-packed (Qpc)
		55-63	red clay, sand, and stones (Qb)

		63-68	gray and red clay, sand and stones (Qb)
		68-457	red sandstone and shale
407	East Orange 3 of Thompson (1932)	0-8	loam (Qr)
		8-30	hardpan (Qr)
		30-40	gravelly hardpan (Qpc)
		40-50	hardpan (Qpc)
		50-60	gravel (Qpc)
		60-85	hardpan (Qpcl or Qis)
		85-100	gravel and clay (Qis or Qb)
		100-135	red clay (weathered shale)
		135-145	soft shale and sandstone
408	26-4700	0-10	fine sand (Qal over Qr)
		10-20	fine light brown sand (Qr)
		20-50	sand, fine-to-coarse, light brown, some water (Qpc)
		50-72	gravel, gray, some small cobbles (Qpc)
		72-77	fine light brown sand (Qpc)
		77-79	gray hard-packed gravel (Qis or Qb)
		79-172	basalt, sandstone from 133-153
409	26-5987	0-30	gravel and sand (Qr)
		30-46	gravel (Qr)
		46-92	clay (Qpcl)
		92-150	trap rock
410	26-30589	0-48	till--clay, trace coarse-to-fine sand and gravel, trace cobbles and boulders (Qr)
411	26-2885	0-45	hardpan and boulders (Qr)
		45-140	trap rock
412	26-164	0-42	clay, mud, boulders (Qr)
		42-143	trap
		143-146	sandstone
		146-153	trap
413	26-555	0-46	yellow hardpan (Qr over Qry)
		46-60	clay (Qps)
		60-95	hard very fine sand (Qps)
		95-130	soft trap rock
		130-150	trap rock
414	25-16303	0-5	yellow sticky clay (Qpml)
		5-18	sand, gravel, clay (Qpmf)
		18-32	hardpan, reddish brown (Qr)
		32-456	shale
415	26-1240	0-21	clay, sand, boulders (Qpmf)
		21-281	red and gray argillite
416	26-958	0-22	hardpan, boulders (Qpmf over Qry)
		22-298	brown sandstone, slate
417	26-29620	0-20	red-brown medium-to-fine sand, trace silt, trace coarse-to-fine gravel (Qpmf)
		20-75	red-brown siltstone
418	26-21166	abbreviated log	
		0-9	fill
		9-18	brown clay, silt, fine sand, trace gravel (Qpmf)
		18-48	red sandstone
419	26-22850	0-5	fill
		5-21	green-gray silty fine sand (Qpmf)
		21-37	brown coarse-to-fine sand, gravel, boulders (Qpmf)
		37-41	very tight gray clay (Qr)
		41-52	gray shale
		52-70	red sandstone

420	26-14333	0-35	sand, some gravel (Qpmf)
		35-40	boulders (Qr)
		40-50	clay (Qr)
		50-90	red shale
421	25-12455	0-29	clay with rocks and boulders (Qr)
		29-40	reddish sandy clay (Qpc)
		40-43	boulders in sandy clay (Qpc)
		43-60	very sandy clay (Qpc)
		60-67	brown sand and gravel (Qpc)
		67-75	yellowish sand and gravel with a soft clay mixed in the formation (Qpc)
		75-112	yellow clay (Qpcl)
		112-158	reddish clay (Qisl)
		158-166	brown hard clay (Qisl)
		166-177	red hardpan (Qb)
		177-181	red shale with clay seams
422	45-340	0-36	red clay with gravel (Qpmf)
		36-50	red hardpan (Qr)
		50-372	sandstone
423	26-1096	60	
424	45-342	0-13	sand and clay (Qry)
		13-18	boulders (Qry)
		18-22	clay and boulders (Qry)
		22-47	sandy clay (Qpcl)
		47-50	gravel (Qis or Qb)
		50-60	red clay (Qb)
		60-441	red and gray argillite
425	26-25396	0-12	brown clay, silt, trace medium-to-fine sand (Qry)
		12-44	weathered siltstone
426	26-1095	0-4	fill
		4-63	clay and stone (Qry)
		63-384	red and blue sandstone and shale
427	26-19459	0-49	sand and gravel (Qpmf)
		49-460	basalt
428	26-6601	0-78	sand and gravel (Qry)
		78-85	weathered brown rock
		85-500	green, gray, reddish brown rock
429	26-14139	0-4	overburden (Qry)
		4-15	sand and brown clay (Qry)
		15-42	brown clay, some rocks (Qry)
		42-55	broken rock
		55-420	trap
		420-700	sandstone
430	26-21071	0-24	clayey brown sand with cobbles and boulders--till (Qry)
431	26-2857	0-82	clay (Qry over Qr)
		82-600	trap rock
		600-1050	red shale
432	26-4340	0-29	hardpan and stones (Qrw over Qr)
		29-42	water-bearing sand and gravel (Qsp)
		42-51	trap rock
		screened 35-50, yield 50 gpm	
433	26-22584	0-5	overburden sand and clay (Qrw)
		5-18	sandy loam, brown (Qrw)
		18-54	rocks and boulders (Qr)
434	26-4954	0-30	sand and gravel (Qrw over Qr)
		30-200	granite (basalt)

435	26-846	0-10	hardpan (Qr)
		10-72	hard-set sand, almost a sandstone (Qr over Qsp or weathered sandstone)
		72-128	red sandstone
436	26-11687	abbreviated log	
		0-4	fill
		4-32	brown, gray fine-to-medium sand and gravel (Qal over Qrw)
		32-37	gray gravel, some clayey silt, trace fine sand (Qr)
437	26-15089	abbreviated log	
		0-11	red-brown silty sand to silty clay, trace gravel (Qr)
		at 11	basalt rock
438	26-10885	0-30	till (Qr)
		30-32	weathered diabase
439	26-29421	0-8	red-brown sand, some silt and clay, basalt chips (Qr)
		8-17	fractured basalt
440	26-1787	4	
441	26-4781	0-15	red hardpan (Qr)
		15-400	red shale and red sandstone
442	26-990	0-8	earth (Qr)
		8-115	trap
443	26-3045	0-14	yellow brown clay and boulders (Qr)
		14-25	sandy clay with boulders (Qr)
		25-52	sand and gravel, some clay, drills hard (Qr)
		52-74	sand and gravel, cemented (Qsp?)
		74-85	clay with some sand and gravel (Qsp?)
		at 85	decayed rock
444	26-6560	0-25	hardpan and stones (Qr)
		25-150	trap rock
445	26-5158	0-3	clay (Qr)
		3-350	trap rock
446	26-8100	0-33	red shale drift (Qr)
		33-350	black trap
447	26-4433	0-13	dirt (Qrw)
		13-68	trap rock
448	26-11544	0-20	red clay with gravel and sand (Qsm over Qr)
		20-30	red clay, broken rocks (Qr)
		30-35	alyer of rock and clay, red-brown (Qr)
		35-50	softer sand and gravel (Qr or Qsp)
		50-53	rock, hard, black
		53-65	red clay and black rock and gravel (weathered shale)
		65-100	black and brown broken rock with a little clay (weathered shale)
		100-107	clay and rock (weathered shale)
		107-200	brown and black sandstone
449	26-158	0-2	gravel (Qr)
		2-150	trap rock
450	26-26131	0-2	gray silty clay and rock fragments (Qr)
		2-5	fractured gray basalt
		5-28	hard gray basalt
451	26-732	0-46	hardpan (Qr)
		46-102	trap rock
452	26-1143	0-35	hardpan (Qr)
		35-150	trap rock

453	26-2327	0-32	trap rock
		32-44	sandstone and trap rock
		44-79	red sandstone
		79-654	hard trap rock
		654-819	red rock
454	22-8468	0-78	overburden (Qr)
		78-256	hard trap rock
		256-503	red shale and sandstone
455	26-3701	abbreviated log	
		0-126	fine-to-coarse sand, grit, gravel, and boulders (Qsm)
		126-130	blue-gray rock
		screened 74-125, yield 1404 gpm	
456	NJGS files	0-8	red clay, sand, gravel (Qr)
		8-14	red sand and coarse gravel (Qr or Qsp)
		14-16	soft sandstone
		16-21	sandstone rock
457	26-1283	0-4	dirt (Qr)
		4-265	trap
		265-406	sandstone
458	26-30418	abbreviated log	
		0-16	reddish brown clayey medium-to-fine sand, some gravel (Qr)
459	26-1607	0-7	dirt (Qr)
		7-165	trap rock
		165-750	red sandstone
460	26-1080	0-11	fill (Qr)
		11-172	trap
461	26-1048	0-8	[overburden] (Qr)
		8-380	trap rock
		380-602	red rock
462	26-2780	0-22	red clay, some sand and gravel (Qeb over Qr)
		22-200	shale
463	26-3643	0-31	reddish hardpan (Qeb over Qr)
		31-500	red shale
464	26-3807	0-5	topsoil and fill
		5-25	red hardpan (Qr)
		25-174	red sandstone
465	I-80 boring 27	0-4	fine-to-medium red-brown sand (Qst)
		4-9	fine-to-medium brown sand and coarse gravel (Qst)
		9-19	fine brown sand, trace silt (Qst)
		19-25	fine brown sand, layers of medium-to-coarse brown sand (Qst)
		25-49	fine brown sand, trace silt (Qst grading to Qpml)
		49-51	gray silt (Qpml)
		51-54	gray silt and clay (Qpml)
		54-55	gray silt (Qpml)
466	I-80 boring 28	0-1	water
		1-7	soft muck and silt (Qal)
		7-38	fine gray silty sand (Qst)
		38-43	fine gray silty sand and some clay (Qst grading to Qpml)
		43-47	gray clay, some silt (Qpml)
		47-67	fine gray clayey sand and some silt (Qpml)
		67-176	fine gray sand, clay and silt in layers (Qpml)
		176-181	medium gray sand, gravel, some clay (Qr)
467	I-80 boring	0-8	sand and clay (Qal)
		8-25	sand and gravel (Qst)

		25-40	sandy silt (Qst grading to Qpml)
		40-79	silty clay (Qpml)
		79-81	fine sand (Qpml)
		81-155	silty clay (Qpml)
		155-173	clay, sand, and gravel (Qr)
		at 173	rock fragments
468	Gate of	0-8	clay (Qpml)
	Heaven	8-40	till (Qr)
	cemetery	40-60	fine sand (Qpc)
	well of	60-88	sand and gravel (Qis)
	Vecchioli	88-130	coarse sand (Qis)
	and others	130-157	till (Qb)
	(1967)	157-162	rock
469	NJGS files	0-48	sand and clay (Qpmf over Qr)
	25-15-117	48-81	fine sand and a little clay (Qpc)
		81-100	sand and gravel (Qis)
470	I-80 boring	0-2	vegetation and sandy silt (Qal)
	L-19	2-45	fine gray sand (Qal over Qst)
		45-47	gray silt with a trace of clay (Qpml)
		47-55	gray clay (Qpml)
		55-71	gray silt (Qpml)
		71-75	layers of clay and silt, 2 to 4 inches thick
		75-83	silt
		83-95	clay, trace of silt (Qpml)
		95-100	gray silt (Qpml)
		100-104	silt, lenses of gray clay (Qpml)
		104-149	gray clay (Qpml)
		149-187	gray clay, some gravel (Qpml)
		187-195	fine-to-coarse brown sand, trace of silt and gravel (Qr)
		195-198	compact fine brown sand and gravel (Qr)
		at 198	refusal (shale)
471	I-80 boring	0-3	gray and brown silty clay, trace fine sand (Qal)
	22	3-8	gray sandy clay (Qst)
		8-13	brown clay and fine silty sand (Qst)
		13-25	fine silty sand, varved layer of fine sand (Qst)
		25-31	red clayey sand and gravel (Qst over Qpml)
472	NJGS files	0-12	brown sand, gravel, and boulders (Qpmd)
		12-16	very fine brown sand (Qpmd)
		16-40	brown sand, gravel, small boulders, and trace of clay (Qpmd)
473	NJGS files	0-4	yellow and gray clay, some boulders (Qr)
		4-15	red clay, sand, gravel (Qr)
		15-17	brown sand, clay, gravel (Qr)
		17-21	soft rock
474	NJGS files	0-10	brown clay, sand, and gravel (Qry)
		10-40	compact brown sand, clay, gravel, and boulders (Qry, note that rock is at a depth of 6 and 7 feet in borings 100 feet to south)
475	NJGS files	0-3	loam, clay, gravel (Qr)
		3-22	red clay, sand, gravel, and boulders (Qr)
476	NJGS files	0-3	gray clay, gray silty sand (Qve)
		3-4	fine-to-medium brown sand (Qve)
		4-9	brown clay, sand, gravel (Qve)
		9-14	gray sand, gravel (Qve)
		14-20	brown and red clay, sand, gravel (Qr)
		20-25	compact brown sand and gravel (Qr)

[1]Identifiers of the form 26-xxxx and 25-xxxx are well permit numbers issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation. Identifiers of the form xx-xx-xxx are N. J. Atlas Sheet grid coordinates of well logs in the Bureau

of Water Allocation files that do not have a permit number, or that have an incorrect or indecipherable permit number. Identifiers of the form "NJGS files, xx-xx-xxx", are entries in the N. J. Geological Survey permanent note collection. Identifiers of the form "NJGS files" or "I-80 boring" or "U. S. Army Corps of Engineers boring" are wells or engineering test borings on file at the N. J. Geological Survey. Identifiers followed by a reference, for example, "East Orange 1 of Thompson (1932)" are from the cited publication.

[2]A number without a log is the depth, in feet below land surface, to bedrock reported for wells where the surficial material is either not identified or identified only as "overburden" or "glacial fill". For wells and borings with logs of the surficial materials, the depth (in feet below land surface) and driller's or logger's description, or the description contained in the cited publication, is provided. Inferred map units and comments are in parentheses. All descriptions are reproduced as they appear in the original source, except for minor format, punctuation, and spelling changes. Bracketed words and queried depths indicate inferences where information is not clearly stated on the log. Logs identified as "abbreviated" have been condensed for brevity. Many bedrock descriptions have been condensed; these are not identified as abbreviated. For wells completed in surficial materials, the screened interval and yield (in gallons per minute, gpm) are reported beneath the log. If no screened interval is reported, the well is reported to be cased to the total depth drilled, with no screen. Map units are inferred from the known extent of materials at the surface and from known depositional settings, in addition to the drillers' descriptions.