Surficial deposits in the Morristown quadrangle include artificial fill, alluvial, swamp, eolian, and stream-terrace deposits, all of postglacial age; glacial deposits of late Wisconsinan and Illinoian age; and weathered-rock material and hillslope deposits that range from middle to late Pleistocene in age. Postglacial deposits are generally less than 30 feet thick. Glacial deposits include glaciolacustrine and glaciofluvial deposits and till. 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 300 feet thick. Till is as much as 150 feet thick. The weathered-rock material and hillslope deposits are generally less than 40 feet thick but weathered gneiss may be as much as 100 feet thick and weathered conglomerate may be as much as 200 feet

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. 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 numerous domestic, industrial, and public-supply wells 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. These wells withdraw water from glaciolacustrine sand and gravel laid down either in front of advancing late Wisconsinan ice (unit Qpc) or during the Illinoian glaciation (unit Qis). These glaciolacustrine sands occur in the subsurface and are overlain by till (units Qr, Qn, Qb, Qf) and, in places, glaciolacustrine silt and clay (units Opcl, Qisl, and Opml). 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 potentiometric surface significantly (Meisler, 1976; Hoffman and Quinlan, 1994). The buried lacustrine deposits are continuous over nearly all of the quadrangle within the limit of late Wisconsinan glaciation (margin M2 on fig. 1). They are absent only in the far northeastern corner, in the Troy Meadows area, where they were either not

deposited or were entirely eroded by late Wisconsinan ice. Illinoian glaciolacustrine sediments are generally contained within buried pre-Illinoian fluvial valleys (fig. 1), and the late Wisconsinan glaciolacustrine sediments tend to be thicker within these buried valleys. Most large-capacity wells are located within these buried valleys owing to the thicker saturated sands there. The continuity of the confined sand beds is interrupted where they thin, pinch out, or are replaced by silt and clay. To the west and south, the confined sands, particularly those of unit Qpc, are in contact with outcropping sand and gravel of unit Qpmd and, north of the Morristown area, with sandy till of unit Qtmn. Precipitation and infiltration of surface water into these deposits are important sources of recharge for the confined sands. The hydrology of this aquifer system is discussed in detail in Vecchioli and Nichols (1966), Vecchioli and others (1967), Nichols (1968), Meisler (1976), Hoffman and Quinlan (1994), and Hoffman and others (in review).

Hydraulic conductivities of the surficial deposits may be estimated from aquifertest data on file at the N. J. Geological Survey (Mennel and Canace, 2002) and published aguifer-test and laboratory data summarized by Stanford (2000). Sand and gravel deposits (units Qis, Qpc, Qpmf, Qpmd, Qsu, Qmt, and parts of Qe, Qal and Qst) 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 Qr, Qn, Qtmn, Qtmr, and Qf), and silty sand weathered rock and colluvium (parts of Qwg, Qwc, and Qcg) are also permeable, having estimated hydraulic conductivities from 10⁻¹ to 10² ft/d. Silt and clay lake-bottom deposits (parts of units Qpml, Qpcl, Qisl), clayey silt till (parts of Qr, Qb), and clayey silt weathered rock and colluvium (parts of Qwb, Qws, Qcs, and Qcb) are of low ibility, having estimated hydraulic conductivities of 10° to 10° ti/d. Fine sand-and-silt lake-bottom, alluvial, and wetland deposits (parts of units Qpml,

Qcb) are somewhat more permeable, having estimated hydraulic conductivities of 10⁻³ to 10⁻¹ ft/d. Swamp deposits (Qs) and fill 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

Qpcl, Qisl, Qal, Qst, and Qs), sandy silt till (parts of Qr, Qn, Qtmr, Qtmn, Qb,

Qf), and sandy silt weathered rock and colluvium (parts of Qwg, Qwb, Qcg, and

The topography of the bedrock surface is contoured at 50-foot interval from water-well, test-boring, and geophysical-survey data, including data from Thompson (1932), Vecchioli and Nichols (1966), Vecchioli and others (1967), Nichols (1968), Ghatge and Hall (1989), Canace and others (1993) and Hoffman and others (in review). Contours are shown where the bedrock-surface topography varies significantly from modern topography, generally at bedrocksurface elevations of less than 400 feet in the northern half of the quadrangle and less than 300 or 250 feet in the southern half.

The rock surface defines a pre-Illinoian fluvial drainage system that has been modified by glacial scour, chiefly during the Illinoian glaciation. 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, about 3 miles east of Chatham. This gap is now filled with Illinoian and late Wisconsinan glacial deposits (Stanford, 1991), and the postglacial drainage now exits the basin at Little Falls, about 8 miles northeast of Troy Hills, 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 surfaces below an elevation of 70-80 feet to the west of the Short Hills Gap have been overdeepened by glacial scour. The Chatham, East Hanover, and Florham Park buried valleys (fig. 1) all contain sizable areas with rock-surface elevations below 70 feet, some deepening to elevations as low as 30 feet, indicating as much as 40-50 feet of scour during the Illinoian glaciation. The rock surface in these overdeepenings is directly overlain by Illinoian till (sections EE', CC'), indicating that Illinoian ice was in contact with the bedrock and so was

Elsewhere in the quadrangle there is no evidence of significant scour. West of section EE', Illinoian till is in contact with the rock surface in most of the Cedar Knolls, Chatham, and Troy Hills buried valleys, but the rock-surface elevations do not show significant scour. In places within the buried valleys, Illinoian till overlies Illinoian lacustrine deposits (sections AA', CC') that rest on the bedrock surface. This stratigraphy indicates that Illinoian ice was advancing into a lake and overrode the sediments laid down in front of the glacier. The ice was buoyed by the lake water, and by the pore water within the sediment, and so was not erosive. Similarly, late Wisconsinan ice advanced into a deep lake in the Morristown quadrangle (the Chatham and Moggy Hollow stages of Lake Passaic, see below). Like the Illinoian ice, the late Wisconsinan glacier was buoyed and overrode, instead of eroding, the earlier Illinoian and proglacial lacustrine deposits that covered the bedrock surface. Late Wisconsinan ice was in contact with the bedrock surface only in the far northeast corner of the quadrangle, beneath the eastern Troy Meadows (sections AA', EE'). This area is at the west edge of a late Wisconsinan glacial scour trough that extends to the northeast beneath the Great Piece Meadow in the Caldwell and Pompton Plains quadrangles (Stanford, 2005). This scour feature was eroded during the late Wisconsinan advance, before lakes were impounded and the glacier margin was

buoyed off the bedrock surface (see lake history, below). DESCRIPTION OF MAP UNITS

Postglacial Deposits--These include man-made fill, stream deposits in terraces (Qst), and modern channels and flood plains (Qal, Qcal), wetland deposits in swamps (Qs), and windblown sediments (Qe). They were 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 and on manuscript geologic and topographic maps (1880-1900) on file at the N. J. Geological Survey.

TRASH FILL--Trash mixed and covered with sand, silt, clay, and gravel. As much as 30 feet thick. In solid-waste landfills.

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 15 feet thick. Adjacent to unit Qs in Troy and Black Meadows, alluvium is thin (1-3 feet) and is underlain by swamp and marsh deposits.

STREAM-TERRACE DEPOSITS--Fine-to-coarse sand, pebbly sand, pebble-to-cobble gravel, minor silt; brown, yellowish-brown, light gray; moderately to well sorted, stratified. As much as 15 feet thick. Forms terraces with surfaces 5-15 feet above the modern flood plain along the Whippany River, Loantaka and Great brooks, and in Troy Meadows. In Troy Meadows the stream-terrace deposits are, in part, a shallow-water delta laid down in the Totowa stage of glacial Lake Passaic by Troy Brook and the Whippany River (see below) shortly after deglaciation. Some of the stream terrace deposits along the Whippany River in the Morristown area, and along Loantaka Brook, may have been deposited in the Great Notch stage of Lake Passaic (see

SWAMP AND MARSH DEPOSITS--Peat and organic silt, clay, and minor fine sand; black, dark brown, and gray. As much as 15 feet thick.

ALLUVIUM AND COLLUVIUM, UNDIVIDED--Interbedded colluvium as in units Qcg and Qcs, and alluvium consisting of dark brown to yellowish-brown or reddish-brown silty sand to sandy silt with angular to subangular pebble-to-cobble gravel or shale-chip gravel. As much as 15 feet thick. In valley bottoms on uplands outside the late Wisconsinan glacial limit.

EOLIAN DEPOSITS--Fine sand and silt, yellowish-brown to very pale brown. As much as 5 feet thick. Deposited in sheets on valley sides to the south and east of broad expanses of lake-bottom and stream-terrace deposits in the Great Brook and Loantaka Brook valleys. Deposited shortly after draining of the Moggy Hollow stage of Lake Passaic.

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, Qn, Qtmr, Qtmn, Qf, Qb). The stratified sediments are generally well sorted. They include sand and gravel laid down by glacial meltwater in river plains (Qmt) and in glacial-lake deltas and fans (Qis, Qpc, Qpmf, Qpmd, Qsu). The stratified sediments also include silt, clay, and fine sand deposited on the bottoms of glacial lakes (Qisl, Qpcl, Qpml). All of these deposits are of late Wisconsinan age except Qis, Qisl, Qf, and Qb, which are of probable Illinoian age.

Illinoian deposits crop out in the northwest corner of the quadrangle and are preserved beneath late Wisconsinan deposits within the limit of late Wisconsinan glaciation (margin M2 in fig. 1), where they are reported from drill holes and observed in a few excavations. Illinoian ice advanced to a limit (M1 in fig. 1) several miles south of the late Wisconsinan limit in the uplands north of Morris Plains but did not advance beyond the late Wisconsinan limit east of there. The Illinoian deposits include till (Qb, Qf), which generally rests directly on the bedrock surface, sand and gravel (Qis) and silt, fine sand, and clay (Qisl). In a few places, Illinoian till overlies units Qis and Qisl, which in turn rest on

bedrock. In the Short Hills Gap (3 miles east of Chatham), water-well records lake with a surface elevation of about 370 feet in the Morristown area, about 10 indicate that Illinoian till fills the gap to an elevation of 150-200 feet (Stanford, feet higher than the Moggy Hollow stage of Lake Passaic in the area. Lake 1991). Since the Short Hills Gap was the drain for the central Passaic basin in Whippany is proposed to have been dammed by deposits of the Moggy Hollow pre-Illinoian time (see section on preglacial drainage), a glacial lake formed delta in Morristown that formerly extended across the Whippany River valley. when the gap was blocked. When Illinoian ice covered the gap, a lake at an Exposures and well logs in the Morris Plains delta, however, show that the elevation similar to the Moggy Hollow stage of Lake Passaic (see below) filled contact of topset gravels with foreset sand, which marks the lake surface, is at the basin, with a lake elevation of about 360-370 feet in the Morristown an elevation of 360 feet, not 370 feet (section CC'), and so is consistent with the quadrangle. Parts of units Qis and Qisl in the Cedar Knolls buried valley, and in Moggy Hollow stage. Thus, Lake Whippany is not recognized as a separate the western ends of the Chatham and Troy Hills buried valleys, rise to elevations of about 300 feet and may have been deposited in this lake. When Illinoian ice

receded from the Short Hills Gap, the 360-foot lake lowered to about 150-200

feet, which is the elevation of the top of the sediment dam filling the gap. Parts

of units Qis and Qisl in the central and eastern areas of the quadrangle, which

rise no higher than about 160 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

(units Qpc, Qpcl) 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 30 feet (40 feet below the

rock floor of the notch) to 300 feet, favor a lacustrine depositional setting. Also,

it is unlikely, given the well data for 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

The Illinoian deposits in this region have not been dated. 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 a long period of erosion preceded arrival of

The regional orientation of striations and distribution of till indicate that late

Wisconsinan ice advanced toward the southwest and west across the Morristown

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). The

As the Passaic lobe entered the quadrangle, it advanced into the Chatham stage

of Lake Passaic (see below) and overran proglacial lacustrine deposits and

earlier Illinoian sediments. The elevation of the Chatham stage in the

Morristown quadrangle ranged from 250 to 320 feet, giving water depths of as

much as 200 feet in front of the advancing ice. As the ice front reached its

farthest extent (M2 in fig. 1), Lake Passaic rose to the Moggy Hollow stage,

which was at least 50 feet higher than the Chatham stage. The Moggy Hollow

stage was maintained during deposition of the terminal moraine and recession of

the glacier from the quadrangle. Till was deposited as a continuous sheet

between 20 and 70 feet thick on the overrun sediment. In a few places the till,

and underlying lacustrine sediment, are shaped into small drumlins with long

axes parallel to ice flow (symboled on map). The late Wisconsinan till includes

two varieties: a reddish-brown silty sand, sandy silt, and clayey silt till (Rahway

Till, Qr) derived from the local red shale and sandstone bedrock and overrun

The Passaic lobe advanced to a limit along the western edge of the quadrangle

(M2 in fig. 1). After reaching this limit, the ice front receded about two miles in

the Lake Passaic basin south and east of Morris Plains, and less than about half

about one mile in the Lake Passaic basin while depositing lacustrine-fan and

deltaic sediments. After this readvance the ice margin stabilized and deposited

the terminal moraine, a 0.5-0.75-mile-wide belt of till with ridge-and-basin

surface morphology. The moraine was deposited over a relatively long period,

The ice front began to retreat from the terminal moraine before 20,000 yrs B. P.,

and had retreated north of the Morristown quadrangle by 18,000 yrs B. P.

(Stanford and Harper, 1991). Retreat of the ice margin from the terminal

moraine was relatively rapid, because there are few recessional ice-margin

features north and east of the moraine. During retreat the glacier laid down

lacustrine-fan and lake-bottom deposits in the Moggy Hollow stage of Lake

Passaic. A belt of lacustrine-fan deposits extending from Madison to Florham

Park, and another belt a mile to the east, mark the positions of subglacial tunnel

channels that conducted meltwater from the glacier out into the lake. The fan

deposits were laid down on the lake floor at the mouths of the tunnels or, where

the deposits form narrow, sharp-crested ridges (symboled on map), within the

tunnels. Elsewhere the fan deposits are in detached, single bodies and may have

been deposited by ephemeral tunnel channels. Till ridges with gentle north

slopes and steep south slopes (symboled on map), and overrun fan deposits,

suggest minor readvances during retreat. Details of the history of lake stages

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). Lake elevations are based on

Glacial-Lake Deposits--These are stratified and generally well sorted. They

include sand and gravel laid down in deltas and lacustrine fans; and clay, silt,

and fine sand laid down on lake-bottom plains and in the basal 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 conglomerate, gray quartzite, and

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 (4 miles east of Chatham), the Chatham stage of Lake Passaic

flooded the central 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.

This spillway drained into the Raritan basin down the Blue Brook valley in the

Roselle and Chatham quadrangles. When Millburn Gap was blocked by the

Hackensack lobe, the margin of the Passaic lobe was likely no farther south than

the northern Troy Meadows area. Chatham-stage deposits (Qpc, Qpcl) occur in

the subsurface, beneath till and recessional lacustrine deposits, only south and

west 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.

elevation of 375-380 feet, holding the lake at the Moggy Hollow stage during

deglaciation. The Moggy Hollow stage (units Qpmf, Qpmd, Qpml) was

controlled by a spillway at an elevation of 340 feet near Far Hills, 11 miles

southwest of Morristown. Elevation of the lake level at this stage in the

Morristown quadrangle was 355 to 375 feet. A lower lake level, the Great Notch

stage, was established when the retreating ice front uncovered Great Notch, a

gap in First Watchung Mountain 10 miles east of Troy Hills. The Great Notch

spillway is at an elevation of about 305 feet, and the elevation of the lake level

at this stage in the Morristown quadrangle ranges from 290 to about 300 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, 9 miles northeast of Troy Hills, dammed the Passaic basin

spillway at an initial elevation of about 190 feet. Erosion lowered this outlet and

soon breached this dam. In the Morristown quadrangle the Totowa stage was

restricted to a shallow lake in the Troy Meadows and Black Meadows lowland,

with a lake level between 180 and 170 feet.

upstream of that point, holding in a short-lived lake (the Totowa stage) with a

Deposition of the terminal moraine then filled the Short Hills Gap to an

an uplift gradient of 2.1 feet/mile to the N21°E for Lake Passaic (Stone and

perhaps as long as 1000 years, during which the ice margin shifted only slightly

a mile along the mountain escarpment north of Morris Plains. It then readvanced

derived from gneiss and overrun lacustrine sediments.

within the moraine belt.

lacustrine sediments; and a yellowish-brown silty sand till (Netcong Till, Qn),

Morristown quadrangle lies within the western half of the Passaic lobe.

late Wisconsinan ice.

Deltaic deposits--Fine-to-coarse sand and pebble-to-cobble gravel, minor silt. As much as 100 feet thick. Includes deltas at Morris Plains and along the front of the terminal moraine between Morristown and Madison. The Morris Plains delta includes pebble-to-cobble gravel topset beds as much as 40 feet thick (section CC'); topset gravels elsewhere are generally less than 30 feet thick. Deposited in the Moggy Hollow stage of Lake Passaic.

Lacustrine-fan deposits--Fine-to-coarse sand and pebble-to-cobble gravel, minor silt, very fine sand, and clay. As much as 60 feet thick. Deposited in the Moggy Hollow stage of Lake Passaic.

Lake-bottom deposits--Silt, clay, fine sand. As much as 90 feet thick. **Qpml** Deposited chiefly during the Moggy Hollow stage. Uppermost parts may have been laid down in the Great Notch stage. In the Troy Meadows and Black Meadows area the uppermost part of the deposit may include silt and fine sand laid down in the Totowa stage.

Deltaic and lacustrine-fan deposits--Fine-to-coarse sand, pebble gravel, minor cobble gravel, silt, and clay. As much as 120 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.

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 rcords. UNCORRELATED LACUSTRINE DEPOSITS--Deltaic sand and gravel

deposited in two small impoundments dammed by the retreating ice margin on the terminal moraine above the Lake Passaic level east of Tabor. Deposited as the ice front receded from the moraine.

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

ILLINOIAN LACUSTRINE DEPOSITS--Deltaic, lacustrine-fan, and lakebottom deposits laid down in Illinoian glacial lakes. Deposits in the subsurface beneath late Wisconsinan deposits were laid down in a glacial lake occupying the central Passaic basin. This lake was controlled at first by the spillway at Moggy Hollow, probably slightly higher than the 340-foot elevation of the late Wisconsinan spillway. During Illinoian retreat, the lake was controlled by a much lower 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 lakebottom became exposed. The Qis deposit along New Jersey Route 10 in the northwest corner of the quadrangle was laid down in an ice-dammed lake that filled the valley southwest of Tabor. The spillway for this lake was across the divide just to the south of the deposit, at an elevation of about 700 feet.

Deltaic and lacustrine-fan deposits--Fine-to-coarse sand, pebble gravel, minor cobble gravel, silt, and clay. As much as 100 feet thick. Contact with Qisl is interfingered or gradational and is inferred from well records. Contact with Qpc or Qpcl in subsurface is picked at first report of coarser sand and gravel beneath fine sand, silt, or clay.

Lake-bottom deposits--Silt, clay, fine sand. As much as 80 feet thick. In subsurface only. Contact with Qpcl in subsurface is picked at report of color change to redder or more yellow color (indicating surface exposure and weathering), or at report of change to coarser grain size. Glacial Stream Deposit--Weakly stratified and moderately sorted cobble-to-

boulder gravel and sand forming a plain in the valley between Tabor and Morris Plains. Sediment was deposited by meltwater draining from the terminal moraine on the east side of the valley, and from two meltwater channels that discharged at the north end of the plain (fig. 1). The western channel is the sluiceway for water draining from glacial Lake Denville in the Rockaway basin, just north of the quadrangle (Stanford, 1989). This sluiceway carried a significant discharge until the retreating ice front uncovered the Rockaway valley at Boonton, 4 miles northeast of Tabor.

MELTWATER TERRACE DEPOSIT--Cobble-to-boulder gravel, pebble-to-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. Four tills are distinguished on the basis of color, grain size, and age. The Rahway Till (Qr) is a reddish-brown sandy silt till of late Wisconsinan age, derived from erosion of red shale and sandstone bedrock. The Netcong Till (Qn) is a yellowish-brown silty sand till of late Wisconsinan age, derived from erosion of gneiss bedrock. The Bergen (Qb) and Flanders (Qf) tills are Illinoian counterparts to the Rahway and Netcong tills, respectively. The terminal moraine is distinguished by surface morphology and is composed of Rahway Till (Qtmr) and Netcong Till (Qtmn). The late Wisconsinan tills are in gradational contact with each other. Formal definition of the till units is in Stone and others (2002).

RAHWAY TILL--Reddish-brown, light reddish-brown, reddishyellow, yellowish-brown silty sand to clayey sandy silt, locally clayey silt containing some to many (2 to 15% by volume) subrounded and subangular pebbles and cobbles and few (<2%) subrounded boulders. Matrix is compact, nonsticky to slightly sticky where clayey, nonplastic to slightly plastic where clayey, nonjointed, and may have subhorizontal fissility. Gravel clasts include chiefly red and gray sandstone and siltstone, gray gneiss, and a little white quartz, purple conglomerate and quartzite, and basalt. Boulders are chiefly gneiss with some conglomerate; a very few are gray and red sandstone and basalt. As much as 80 feet thick. Unit Qtmr delineates segments of the terminal moraine composed of Rahway Till. Small, thin deposits of clay and silt of unit Qpml overlie Rahway Till on some low flat areas in lowlands east of the terminal moraine. Only the larger of these deposits are mapped.

NETCONG TILL--Yellowish-brown, very pale brown (oxidized) to grayish-brown and brown (unoxidized) silty sand to sandy silt with many subrounded to subangular pebbles and cobbles, and some to many boulders. Matrix is generally compact, nonplastic, nonsticky, nonjointed, and may have subhorizontal fissility. As much as 80 feet thick. Gravel is chiefly gray-to-white gneiss and gray mudstone and sandstone, with some purple conglomerate and quartzite. Boulders are chiefly gneiss and purple conglomerate. Unit Qtmn delineates segments of the terminal moraine composed of Netcong Till.

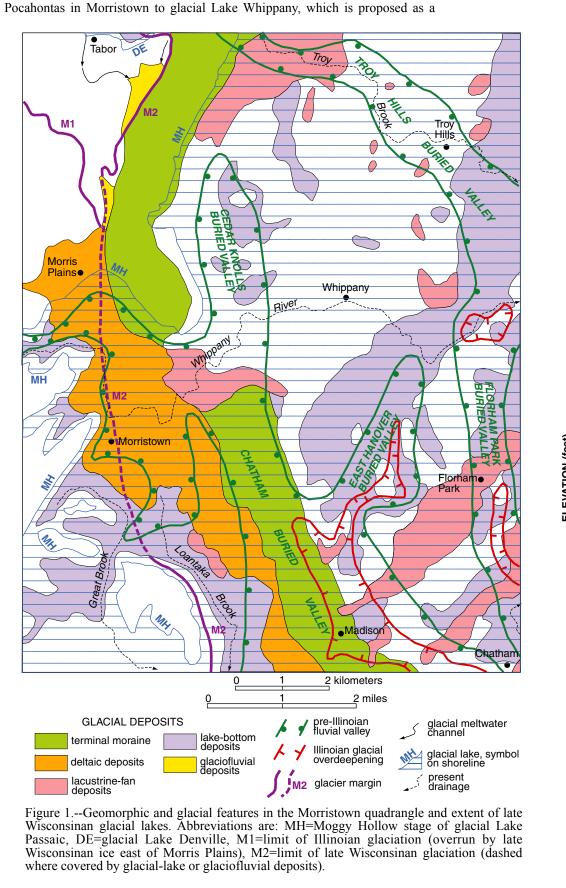
BERGEN TILL--Reddish-brown to reddish-yellow sandy clayey silt to sandy clay. Gravel content and composition similar to Rahway till. Matrix is compact, moderately sticky and plastic, and weakly jointed. Gneiss, sandstone, and mudstone clasts have weathered rinds or are fully decomposed. As much as 50 feet thick. In subsurface only, generally on bedrock surface. Exposed in cuts beneath late Wisconsinan till west of Whippany; elsewhere inferred from well

FLANDERS TILL--Brown, yellowish-brown silty sand to sandy clayey silt with some to many subrounded to subangular pebbles and cobbles and few to some boulders. Till matrix is generally compact, nonplastic, nonsticky, nonjointed, but may have a weak to moderate subhorizontal fissility. Gravel is chiefly gneiss, with some gray and red mudstone and sandstone and purple conglomerate and quartzite. Boulders are chiefly gneiss with some purple conglomerate. Gneiss clasts have weathered rinds generally greater than 0.25 inch thick. Some mudstone clasts are also deeply weathered or decomposed. As much as 40 feet thick. Crops out in northwest corner of quadrangle and occurs in subsurface in the western part of the Troy Hills buried valley (section AA'), where it is inferred from well records.

Hillslope Deposits--Nonstratified, poorly sorted sediment deposited at the foot

VERTICAL EXAGGERATION 20)

of hillslopes by downslope movement of material on the slopes. Deposited Stone and others (2002) assign deposits in Morris Plains and west of Lake primarily under cold-climate conditions during the middle and late Pleistocene.



GNEISS COLLUVIUM--Yellowish-brown silty sand to sandy clayey silt with some to many angular to subangular gneiss pebbles and cobbles, and, adjacent to unit Qf, a few purple conglomerate and gray mudstone pebbles and cobbles. Gneiss clasts are unweathered at surface but are partially weathered at depth. As much as 40 feet thick Overlies eroded remnants of units Qf and Qis within the area of Illinoian glaciation (M1 in fig. 1).

angular sandstone pebbles and cobbles. As much as 15 feet thick

BASALT COLLUVIUM--Yellowish-brown to brown clayey silt with some angular basalt pebbles and cobbles. As much as 15 feet thick

SHALE AND SANDSTONE COLLUVIUM--Reddish-brown to brown clayey silt to silty sand with few to some shale chips and

Weathered Bedrock Material--Nonstratified, poorly sorted sediment formed by mechanical and chemical weathering of bedrock. Owing to their variable thickness, these units are not shown on sections.

WEATHERED GNEISS--Yellowish-brown, yellow, very pale brown, reddish-yellow silty clayey sand with few to many angular pebbles and cobbles of gneiss. Clasts range from unweathered to fully decomposed. Generally less than 20 feet thick but may be as much as 100 feet thick. Qwgt indicates areas where weathered material is thin or absent and fractured outcrop abundant.

WEATHERED BASALT--Reddish-yellow to yellowish-brown clayey sandy silt to clayey silt with many angular pebbles and cobbles of basalt. Most clasts have thin weathered rinds. As much as 20 feet **Qwbt** thick. Qwbt indicates areas where weathered material is thin or absent and fractured rock rubble abundant.

WEATHERED SHALE AND SANDSTONE--Reddish-brown, brown, vellowish-brown silt to silty sandy with many shale chips or angular pebbles and cobbles of sandstone. As much as 20 feet thick. Qwst **Qwst** indicates areas where weathered material is thin or absent and outcrop or shale-chip rubble abundant.

WEATHERED CONGLOMERATE--Reddish-brown fine-to-coarse

sand to silty sand with many rounded white to purple quartz and conglomerate pebbles and subangular to angular red sandstone pebbles and cobbles. Sandstone clasts are partially decomposed. As much as 200 feet thick. MAP SYMBOLS

- Contact--Long-dashed where approximately located, short-dashed where gradational or feather-edged, dotted where concealed by water or removed by excavation.

Drumlin--Line along crest, symbol on summit. 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 recessional ice margins. ✓ Esker--Line on crest. Ridges of sand and gravel deposited in subglacial tunnels.

Spillway of glacial lake--Symbol in spillway, arrowed line shows direction of drainage. Meltwater channel--Line in base of channel, arrow indicates flow

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

☆ Former quarry

X Former sand-and-gravel, or clay, pit--Clay pits indicated by "c" **★c** following symbol. Well with log in table 1--Location accurate within 100 feet.

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. 140 Elevation of bedrock surface, from seismic or resistivity survey--From Ghatge and Hall (1989).

Elevation of bedrock surface, from seismic survey--From Canace

Subsurface unit exposed--Observed in 1990, 2003-2004.

To Elevation of bedrock surface, from seismic survey--From Nichols

Elevation of bedrock surface--Contour interval 50 feet. Includes top surface of weathered bedrock. Shown at bedrock-surface elevations of 400 feet and lower in the northern half of the quadrangle and at 250 feet and lower in the southern half of the quadrangle.

Bedrock outcrop--Some small outcrops within units Qwg, Qwb, and Qws are not shown. Outcrop is also abundant in areas mapped as Qwgt, Qwbt, and Qwst.

projection, depths of contacts on section may not be identical to those Alluvial lag--Silt, sand, and clay alluvium interspersed with lags of

Well on sections--Projected to line of section in most cases. Owing to

cobbles and small boulders winnowed from underlying unit Qmt. Thermokarst basin--Line on rim, pattern within basin. Chiefly on stream-terrace sand, formed from melting of ground ice. May contain

thin peat deposits. **Topographic features of the terminal moraine**

> **Narrow ridge**--Line on crest. **Broad ridge**--Line on crest.

Scarp--Line at top, balls on slope.

⊗ Basin--Line on perimeter, pattern within basin. Most are seasonally wet and contain thin peat deposits. Large moraine basins containing peat deposits are mapped as unit Qs.

Kettle--Line on perimeter. Developed on permeable substrate (generally unit Qpmd under thin till) and so does not retain water and does not contain peat. REFERENCES

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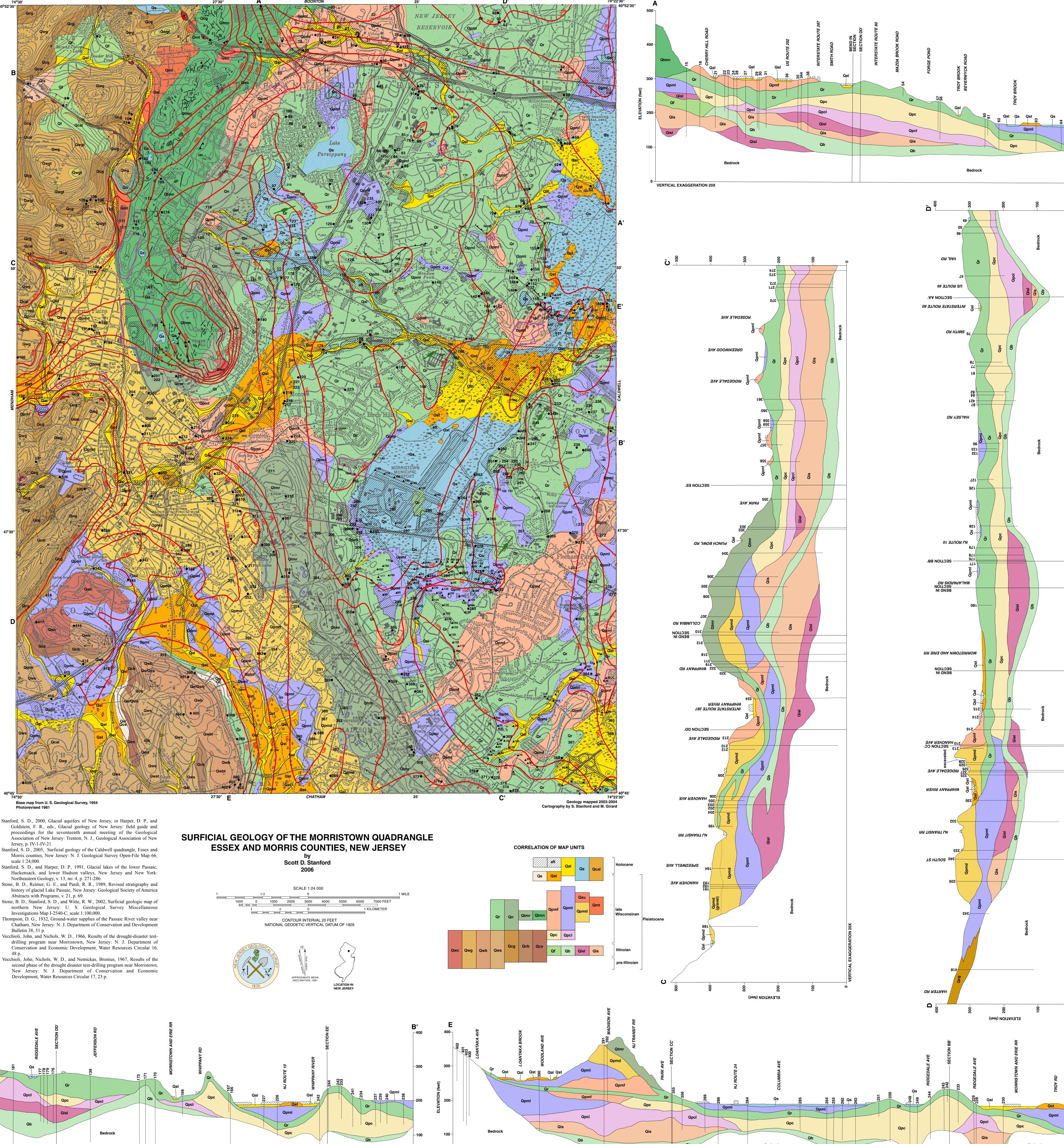
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Prepared in cooperation with the

U. S. GEOLOGICAL SURVEY

NATIONAL GEOLOGIC MAPPING PROGRAM



SURFICIAL GEOLOGY OF THE MORRISTOWN QUADRANGLE

ESSEX AND MORRIS COUNTIES. NEW JERSEY

Pamphlet containing table 1 accompanies map

OPEN-FILE MAP OFM 67

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

New Jersey Geological Survey Open-File Map 67 2006

pamphlet to accompany map

Table 1.--Selected well and boring records.

Well No.	Identifier ¹	Depth to b	edrock or driller's log with depth and description ²
1	25-28337	0-70 70-100	clay and boulders (Qcg over Qwg) granite
2	25-3129	>100	(Qf over Qwg)
3	25-14171	0-40 41-116 116-118 118-123 yield 34 g	fine silt (Qs over lake-bottom sediment of glacial Lake Denville gray clay (lake-bottom sediment of glacial Lake Denville) boulders (Qcg or Qwg?) large gravel (Qwg?) pm
4	25-23374	abbreviate 04 4-36	d log fill (af) brown silt, sand, gravel, boulders (Qal over Qwg)
5	25-15539	0-49 49-158	overburden with boulders (Qis over Qcg) granite
6	25-24143	5	
7	25-40385	0-25	glacial till (Qf over Qwg)
8	25-12908	0-5 5-23 23-272	boulders, gravel, and sandy clay (Qf) sand stone (Qwg?) gray granite
9	25-3167	0-9 9-30 30-150	earth and clay (Qcg) sand and gravel (Qwg or Qmt) granite rock
10	25-3168	0-6 6-12 12-35 35-150	top soil and clay (Qcg) boulders (Qcg or Qmt) sand and gravel (Qmt or Qwg) granite rock
11	25-3169	0-8 8-36 36-195	clay (Qcg) sand and gravel (Qmt or Qwg) granite rock
12	P42 Canace and others, 1993	abbreviate 0-72 72-78	d log fine-to-coarse brown sand, gravel, boulders (Qtmn) fractured gray rock and sandy decomposed rock (Qwg)
13	25-30560	0-50 50-60 60-80 80-120	brown silt, sand and boulders (Qtmn) medium-to-fine sand and boulders (Qtmn) brown coarse sand and gravel (Qtmn) coarse sand and boulders (Qtmn)

14	25-13422	0-2	loam (Qtmn)
		2-8	clean sand (Qtmn) muddy sand and clay (Qtmn)
		8-67 67-69	coarse sand (Qtmn)
		69-70	silty sand and clay (Qtmn)
		70-80	clean sand (Qpc or Qtmn)
		80-81	boulder
15	25-11377	0-43	sand, gravel, small boulders (Qpmf over Qr)
		43-75 75-79	fine sand, silt with clay (Qpml) coarse sand (Qis)
		79-90	fine sand, silt (Qisl)
		90-96	coarse sand (Qis)
		96-110	sand and fine gravel (Qis)
		110-125	coarse sand and gravel (Qis or Qf)
		125-155	clean sand and gravel (Qis or Qf)
		155-188 188-196	sand and gravel, not so clean (Qis or Qf) sandy clay (Qisl)
		196-200	broken granite rock
			61-171, yield 350 gpm
16	25-11584	160	
17	25-11585	0-50	gravel with very little sand (Qpmf over Qr)
		50-90	sand and gravel mix (Qpc)
		90-105	clean coarse sand (Qpc)
		105-160	sand and gravel (Qis or Qf)
		scieened i	40-160, yield 831 gpm
18	25-11750	0-150	sand, gravel, boulders (Qpmf over Qr, Qpc, Qf?)
		150-178	sand and very coarse gravel (Qis)
19	25-13421	0-1.5	fill
	Vecchioli	1.5-38	sand, very fine- to fine-grained, silty, gray, with some medium- and coarse-
	and Nichols, 1966, area 4,	38-50	grained sand from 5 to 15 feet, few boulders from 16 to 18 feet (Qpmf) till, yellowish brown (Qn)
	test well 1	50-52	sand, fine-grained, gray, with fine to coarse gravel, poorly sorted (Qpc)
		52-69	sand, fine-grained, silty, gray (Qpcl)
		69-86	till, yellowish brown (Qf or Qis)
		86-151	sand, coarse and very-coarse grained, silty, with fine to coarse gravel, poorly sorted gravel (Qis)
		151-162	till, yellowish brown, pebbles and cobbles highly weathered (Qf)
		162-199	sand, fine- to coarse-grained, with some fine to coarse gravel and few
			cobbles, poorly sorted in part, thin to thick lenses of sandy till at 175 feet, 190 feet and 194 feet (Qis)
		199-209	till, yellowish brown (Qf)
		209-211	sand, coarse-grained, with gravel and cobbles (Qis)
		211-213	sand, fine-grained, silty, yellowish brown, very compact (Qisl)
		screened 1	91-199, yield 260 gpm
20	25-618	0-70	clay (Qpmf over Qn)
		70-73	sand (Qpc)
		73-169	conglomerate
21	area 4, other	0-53	clay and small stones (Qpmf over Qr)
	well 2, Vecchioli and	53-120 120-124	sand and gravel, water-bearing (Qpc) gray clay (Qpcl)
	Nichols, 1966	124-155	sand and gravel, uniform, water-bearing
	, , , , , , , , , , , , , , , , , , , ,		0-118, yield 500 gpm
22	25-17228	0-5	gray sandy clay (Qal)
		5-10	brown sand streaks of gray clay (Qal)
		10-30	brown sand and boulders (Qpmf)
		30-70	boulders, brown sand and gravel, streaks of clay (Qr)
		70-101 101-104	boulders, sand and gravel (Qpc) weathered rock (probably Qb)
		104-107	rock (boulder?)
		107-10/	

23	25-18850	0-18 18-34 34-59 59-100 100-116 116-119 119-127 screened 10	fine silty sand (Qal) clay with sand, gravel (Qpmf) sand, gravel, hardpan, boulders (Qr) sandy clay with some sand layers (Qpc and Qpcl) sandy clay with stones (Qb) sand and gravel (Qb or Qis) sand and gravel with some clay (Qb or Qis) 17-127, yield 910 gpm
24	P41 Canace and others, 1993	0-30 30-42 42-80 screened 60	gray clay, sand (Qpmf) brown clay, sand (Qr) water-bearing sand, gravel with boulders (Qpc0 0-80, yield 750 gpm
25	25-12508	0-12 12-18 18-56 56-58 58-207	fine sand (Qtmn) hardpan (Qtmn) cobbles, boulders (Qtmn) boulders (Qtmn) rock
26	25-7546	0-15 15-17 17-36	clay (Qwg) loose rock (Qwg) granite rock
27	N 25-4-574	0-28 28-73 73-103 103-133 133-145 145-173 173-179 at 179	clay and fine sand, mixed (Qal over Qpmf) hardpan, clay and boulders (Qr) fine sand with a little clay (Qpcl) coarse sand to coarse gravel (Qis) fine sand and clay (Qis-Qisl) hardpan with large boulders (Qb) reddish brown clay (Qisl) soft brownstone (Qisl or bedrock)
28	P34 Canace and others, 1993	0-3 3-5 5-8 8-34 34-44 44-50 50-89 89-102 102-136 136-139 139-145 145-190 screened 57	clay (Qal) gravel (Qal or Qpmf) sand and gravel (Qpmf) blue clay (Qpmf) sand, gravel, clay, boulders (Qr) blue clay (Qpcl) sand, gravel, boulders (Qpc) blue clay and boulders (Qb) yellow clay and boulders (Qb) red clay and boulders (Qb) sand and gravel (Qis) red clay (Qisl) 7-87 and 140-145, yield 600 gpm
29	25-18849	0-25 25-34 34-86 86-92 92-95 95-98 98-110 110-113 113-134 134-139 screened 11	brown sandy clay (Qpmf) gray sand and clay (Qpmf) gray hardpan, boulders, sandy streaks (Qr) coarse sand, little clay and gravel (Qpc) hardpan (Qis?) coarse sand with clay (Qis) hardpan, sand and clay (Qb) clay (Qb) hardpan, sandy (Qb or Qis) hardpan, sand and gravel (Qb or Qis) 19-139, yield 900 gpm
30	25-7381	0-37 37-50 50-58 58-63 63-144 screened 10	sandy clay (Qpmf) hardpan (Qr) gravel, some sand and clay (Qr) hardpan, gravel with some sand and gray clay (Qr) gray sandy clay, some gravel (Qpc, Qpcl) 05-141, yield 600 gpm
31	P132 Canace and others, 1993	0-4 4-6 6-10	yellow clay (Qpmf) fine brown sand (Qpmf) sandy brown clay (Qpmf)

		10-20 20-30 30-37 37-41 41-94 94-99 99-105 105-127 127-129 129-137 137-138 138-141 141-151 screened 11	sandy brown clay, gravel (Qpmf over Qr) clay, boulders (Qr) brown sand (Qpc) clay, boulders (Qr) hardpan, boulders, clay (Qr) coarse sand (Qpc) clay, boulders (Qb or Qis) coarse gray sand, gravel (Qis) hardpan (Qis) coarse gray sand (Qis) hardpan (Qis) boulders (Qis) boulders (Qis) brown clay (Qisl) 0-140, yield 745 gpm
32	25-31975	0-82 yield 50 gp	gravel, sand (Qpmf) om
33	P37 Canace and others, 1993	abbreviated 0-7 7-45	log fine silty brown sand, trace clay (Qpmf) brown sand, gravel, boulders (Qr)
34	P38 Canace and others, 1993	abbreviated 0-81	log brown silt, fine-to-medium sand and gravel (Qpmf over Qr)
35	45-33	0-31 31-33 33-51 51-57 57-71 71-73 73-89 89-94 94-96 96-129 129-137 137-143 screened 51	hardpan and clay (Qpmf) fine blue sand (Qpmf) blue clay gumbo (Qr?) fine sand (Qpc) gravel (Qpc) fine sand (Qpc) clay (Qpcl) sand (Qis) red sand (Qis) red clay (Qisl) sand and gravel (Qis) red clay, hardpan (Qb) -77, yield 500 gpm
36	25-22542	abbreviated 0-53	log brown coarse-to-fine sand, some gravel (Qpmf)
37	25-33909	0-50 50-75	dirt, clay, boulders (Qr) pea gravel (Qpc)
38	P60 Canace and others, 1993	0-136 136-158	no log (Qpmf over Qr) water-bearing sand, flows at 12 gpm (Qpc)
39	25-36273	0-17 17-43 43-63 63-80 80-100	boulders and till (Qr) till and sand (Qr over Qpc) sand and gravel (Qpc) boulder till (Qb) sand and gravel (Qis)
40	25-29415	abbreviated 0-124 124-144 144-150	log sandy silt, gravel-till (Qr) sand and gravel (Qpc) till (Qb)
41	25-25492	0-38 38-48 48-79 79-108 108-127 127-147	gray-brown clay and silt (Qr) brown silt, sand, gravel, cobbles-till (Qr) brown coarse-to-medium sand and gravel, trace silt (Qpc) brown coarse sand and gravel, cobbles, boulders-till (Qb) brown coarse sand, trace silt (Qis) brown coarse sand and gravel, cobbles, silt-till (Qis?)
42	25-29416	abbreviated	log

		screened 6	0-85, yield 1100 gpm
		94-96	shale
		89-94	sandy clay, gravel, large stones (Qb)
		77-80 80-89	clay, boulders (Qb or Qpc) fine-to-coarse sand, gravel, boulders, clay (Qb or Qpc)
		68-77	very-fine-to-coarse sand, gravel, stones, boulders (Qpc)
	-	11-68	clay, boulders (Qr)
 51	25-17118	0-11	overburden (Qr)
		93-98	rock
		77-93	red clay (Qpcl)
		58-72 72-77	sand, gravel (Qpc) red clay, sand, gravel (Qpc)
		52-58	sand, gravel with red clay (Qpc)
	others, 1993	49-52	coarse sand (Qpc)
	Canace and	20-49	hardpan (Qr)
50	P29	0-20	clay, boulders (Qr)
		80-85	sticky red hardpan (Qb)
		75-80	sticky yellow clay, water-bearing gravel (Qpcl over Qb)
		70-75	streaks of yellow clay, trace sand (Qpcl)
		60-65 65-70	sand, gravel, less water (Qpc) water-bearing sand, less flow (Qpc)
		50-60	clean water-bearing sand (Qpc)
		40-50	sand with coarse water-bearing gravel (Qpc)
		25-40	sand, fine gravel (Qpc)
		15-20 20-25	sand (Qpc) sand, overburden (Qpc)
		10-15	hard gravelly clay, boulders (Qr)
19	25-3664	0-10	clean yellow clay (Qr)
		106-107	red rock
		100-106	dirty gravel (Qb)
		80-100	water-bearing sand (Qpc)
		78-80	coarse sand, very clean gravel (Qpc)
		71-78	loose sand (Qpc)
		5-68 68-71	very tough sand, gravel (Qr) boulders (Qr)
18	25-6004	0-5	clay (Qr)
			-
		yield 60 g	
		103-105 105-118	hardpan (Qb) hardpan, rock (Qb over bedrock)
		85-103 103 105	sand, gravel (Qpc)
	others, 1993	81-85	hardpacked stones (Qpc)
	Canace and	75-81	sand, gravel (Qpc)
17	P57	0-75	hardpan, boulders (Qr)
		screened 7	0-100, yield 525 gpm
		At 100	red shale
		80-100	water-bearing sand, gravel (Qpc)
		65-80	clay with sand, gravel (Qr over Qpc)
46	25-12718	0-20 20-65	clay with large stones (Qr) clay with small stones (Qr)
16	25 12710	0.20	alary with large stop (On)
	20 .0002	23-75	sandstone (probably Qr)
45	25-40082	0-23	red-brown silty sand (Qr)
		At 65	fine-to-coarse sand (Qpc)
14	25-6690	0-65	hardpan and boulders (Qpmf over Qr)
		25-60	sand, gravel (Qpc or Qr)
		15-25	fine sand (Qpc or Qr)
13	23-23131	5-15	soil, boulders (Qr) clay (Qr)
3	25-23151	0-5	soil boulders (Or)
		119-140	reddish brown fine-to-medium sand, silt layers (Qpc)
		0-119	sandy silt, gravel, boulders, brown to reddish brown (C

52	25-15809	no log, rock screened 55	k at 76 i-70, yield 263 gpm	
53	25-41450	0-40	brown medium-to-fine sand, trace brown clay, silt, grav	vel, cobbles (Qr)
54	P72 Canace and others, 1993	0-26	fine-to-medium brown sand, gravel, boulders, trace cla	y (Qr)
55	P76 Canace and others, 1993	0-11 11-26	brown silt, clay with boulders, trace gravel (Qr) medium-to-coarse brown sand, silt, gravel, boulders (Q	r)
56	25-27258	abbreviated 0-45 45-60 60-65 65-90 90-110 cased to 85	log brown sand, gravel, boulders (Qr) coarse brown sand (Qpc) medium-to-coarse brown gravel (Qpc) brown sand and gravel (Qpc) fine brown sand and clay (Qpcl) , yield 890 gpm	
57	25-40965	abbreviated 0-30 30-50 50-85 screened 70	log brown sand, gravel, stone, boulders (Qr) brown sand, coarse gravel (Qr or Qpc) brown sand and gravel (Qpc) 0-95, yield 1809 gpm, static level 2.72 feet above land	surface
58	25-13417 Vecchioli and Nichols, 1966, area 2, OEP test hole	0-11 11-20 20-26 26-47 47-52	silt and clay, laminated with few fine gravel, yellowish clay, slightly silty, trace fine gravel, grayish brown (Qrayler of the gravel, thinly interbedded, brownish-gray; sand silty clay, laminated in part (Qr or Qpml) till, brown (Qr) shale, sandy, reddish brown	r or Qpml)
59	25-1081	0-5 5-40 40-45 cased to 45	clay (Qpml or Qr) clay, boulders (Qr) gravel (Qpc) , yield 10 gpm	
60	Vecchioli and Nichols, 1966, area 2, other test hole	0-23 23-50 50-84 at 84	clay mixed with sand (Qr) gravel, sand, well flows 100 gpm, water rises 10 feet al (Qpc) clay, hardpan (Qpcl over Qb) red shale	bove land surface
61	25-11106	0-23 23-26 26-30 30-47 At 47 screened 27	clay and fine sand (Qr or Qpml) water-bearing sand and gravel (Qpc) water-bearing sand and clay (Qpc) water-bearing fine-to-medium sand and gravel (Qpc) clay, hardpan (Qb?) 247, yield 835 gpm	
62	25-12635	0-22 22-50 50-61 61-80 At 80 screened 55	clay (Qpml) clay, mixed with stones (Qr) water-bearing sand (Qpc) water-bearing coarse sand, gravel (Qpc) red shale i-80, yield 327 gpm	
63	P114 Canace and others, 1993	0-50 50-80 at 80	no log sand (Qpc) rock	
64	25-13416 Vecchioli and Nichols, 1966, area 2 OEP test hole 2	0-3 3-11 11-20 20-33 33-39	till, yellowish brown (soil on Qst) silt and clay, laminated, sandy in part, light gray (Qpm clay, laminated, silty in part, yellowish brown (Qpml) silt, laminated, clayey in part, brownish gray with few brownish gray clay and very fine sand, and few small g clay, laminated, silty, yellowish brown, trace fine grave	laminae of gravel (Qpml)

		39-58 58-64 64-69	little fine to very coarse gravel at 35-39 feet (Qpml) silt and clay, laminated yellowish brown, with partings sand, some fine gravel, little medium gravel (Qpml) till, brown (Qr) shale	s of very fine-grained
65	25-15804	0-30 30-43 43-45 45-55 55-73 73-75 75-85 85-105 105-112 112-120	hardpan, boulders (Qr) hardpan (Qr) gravel (Qpc) water-bearing gravel (Qpc) fine gravel with weathered rock (Qpc) sand (Qpc) light gray clay (Qpcl) brown sand (Qis or Qpcl) red sand, soft red shale (Qb) red shale	
66	P119 Canace and others, 1993	0-45 45-60 60-65 at 65 screened 45	clay (Qr) water-bearing sand, gravel (Qpc) fine sand (Qpc or Qb) red shale 6-65, yield 250 gpm	
67	P121 Canace and others, 1993	0-45 45-60 60-65 at 65 screened 45	clay (Qr) water-bearing sand, gravel (Qpc) fine sand (Qpc or Qb) red shale 6-65, yield 370 gpm	
68	25-9131	0-5 5-15 15-20 20-70 at 70 screened 40	clay (Qr) clay, sand (Qr) gravel, sand, clay (Qr) water-bearing sand and gravel (Qpc) red shale 0-70, yield 650 gpm	
69	25-15805	0-30 30-38 38-65 65-68 68-76	sand, clay (Qr) fine sand (Qpc) fine sand, gravel (Qpc) sand with red shale (Qpc or Qb) hard red shale	
70	25-10864	0-33 33-40 cased to 40	hardpan, clay (Qr) water-bearing sand, gravel (qpc) , yield 15 gpm	
71	25-13413 Vecchioli and Nichols, 1966, area 2, OEP test well	abbreviated 0-10 10-12 12-15 15-90 90-125 125-126 126-133 screened 75	till, yellowish brown (Qr) very-fine-to-coarse sand, some fine gravel (Qpc) till, yellowish brown (Qr) fine-to-coarse sand, some gravel (Qpc) till, yellowish brown, some gravel is moderately to ver medium-to-coarse sand, silty, clayey, with fine-to-medi shale 0-89, yield 258 gpm	
72	25-15036	0-30 30-60 60-80 80-120	hardpan, boulders (Qr) yellow clay (Qpcl) red clay (Qisl) red sandstone	
73	25-7953	0-30 30-91 91-101 101-140	hardpan, boulders (Qr) hardpan (Qpe?) soft to hard red shale (Qb?) red shale	
74	25-27259	abbreviated 0-30 30-100	log brown sand, stones, gravel, boulders (Qr) brown sand, gravel (Qpc)	

75	25-18318	0-12 12-28	silty brown sand with boulders (Qr) hardpan with small cobbles (Qr)	-
		28-34	sandy hardpan (Qr)	
		34-37	water-bearing coarse gravel (Qpc)	
		37-42	small boulders with loose sand, small cobbles (Qpc)	
		42-66	soft silty sand with small cobbles (Qpc)	
		66-84	silty sand, gravel (Qpc)	
		84-88	water-bearing sand, gravel (Qpc)	
		88-103	water-bearing silty sand (Qpc)	
		screened 7	'8-103, yield 1002 gpm	
 5	25-37615	0-40	clay and boulders (Qr)	•
		40-45	sand, gravel, boulders (Qpc)	
		45-60	sand, gravel, clay, boulder (Qpc)	
		60-81	boulder, clay, little gravel (Qpc)	
		81-89	large gravel (Qpc)	
		89-93	clay and gravel (Qpc)	
		93-97 97-102	boulders, gravel and sand (Qpc) clay and gravel (Qb)	
			60-100, yield 100 gpm	
	25 41974	0-40	vallary brown and arrayal trops silt (On)	-
	25-41874	40-94	yellow brown sand, gravel, trace silt (Qr) brown silt, gravel, fine sand, clay (Qr over Qpc)	
		94-101	reddish brown clay with rock fragments and weathered	l rock (Ob over
		<i>y</i>	bedrock)	. 10011 (20 0 / 01
 }	25-11876	0-58	clay (Qr)	-
		58-80	coarse sand (Qpc)	
		at 80	red shale	_
	25-41875	0-20	fine brown stiff silty clay (Qr)	
		20-80	reddish brown silt, some medium to coarse gravel and	
		80-104	yellow brown fine-to-medium sand and gravel, some of	
		at 104	reddish brown clay with rock and rock fragments (Qb	over bedrock)
	25-30920	abbreviate	<u> </u>	
		0-12	red brown clayey silt with a little sand and gravel (Qr)	
		12-47 47-50	brown coarse-to-fine sand, little gravel and silt (Qpc) brown clayey silt, little sand (Qpcl)	
				-
	25-41876	0-20	reddish brown silty clay, trace fine sand and coarse gr	
		20-70	yellow brown clayey fine sand, trace medium gravel ((-
		70-78 78-109	grayish brown silty medium-to-coarse sand, trace clay, yellow brown clayey fine sand, trace silt, cobbles (Qb	
		at 109	reddish brown silty clay some weathered rock	0. QP0)
	25-7034	0-5	clay (Qr)	
		5-50	clay, boulders (Qr)	
		50-58	dirty sand (Qpc)	
		58-81 81-96	sand, gravel (Qpc) clay, gravel (Qb or Qpc)	
			52-81, yield 300 gpm	
	25-6488	0-4	fill	-
3	20 0 100	4-38	boulders (Qr)	
		38-77	hardpan (Qr)	
		77-95	water-bearing coarse sand (Qpc)	
		95-99	clay (Qb or Qpcl)	
		At 99	red rock	
		screened 7	'6-95, yield 100 gpm	-
1	25-14192	0-18	gray clay (Qr)	
		18-60 60-80	clay (Qr) sand, gravel (Qpc)	
			55-80, yield 430 gpm	
	25-41276	0-5	aray elay (Or)	-
	23-12/0	5-10	gray clay (Qr) fine sand and gravel (Qpc)	

		10-48 48-90 90-92 92-97 97-550	gravel, cobbles and sand (Qpc) boulders, gravel, and sand (Qpc) gray silt (Qpcl) red clay (Qb) red and gray shale
86	25-42737	0-12 12-55 55-80 80-90 90-95	clayey silt (Qr) glacial till (Qr) coarse gravel (Qpc) fine-to-coarse sand (Qpc) clay, weathered shale
87	25-42736	0-12 12-45 45-70 70-80 80-105	clayey silt (Qr) glacial till (Qr) medium-to-coarse silty clay with little clay (Qpc) coarse gravel (Qpc) clay, weathered shale
88	25-43968	abbreviated 0-45 45-91	brown clayey silty sand and gravel (Qr) gravel, cobbles, medium-to-fine sand, boulders at base (Qpc)
89	25-7589	0-4 4-43 43-60 60-73 73-92 adjacent pro	yellow clay, boulders (Qr) gray clay, boulders (Qr) medium gravel, coarse sand (Qpc) yellow clay (Qb?) red shale oduction well (25-7620) screened 55-65, yield 715 gpm
90	25-13418 Vecchioli and Nichols, 1966, area 3, OEP test hole 1	0-60 60-62 at 62	till, brown, few boulders (Qb) gravel, fine, and very coarse sand (Qpc) boulders (Qpc)
91	25-3093	0-45 45-50	clay, small stones (Qr) sand (Qpc), yield 50 gpm
92	25-1080	0-10 10-40 40-43 cased to 55	gravel (Qr) clay, boulders (Qr) gravel (Qpc) , yield 10 gpm
93	25-12151	0-15 15-41 41-53 53-62 62-139	hand-dug well clay (Qr) hardpan with some stones (Qr) soft gray shale gray and red shale
94	25-1219	0-40 40-50 cased to 50	clay, boulders (Qr) sand (Qpc) , yield 10 gpm
95	25-1081	0-5 5-40 40-45 cased to 45	clay (Qr) clay, boulders (Qr) gravel (Qpc) , yield 10 gpm
96	25-1109	0-10 10-40 40-47 cased to 47	clay (Qr) clay, boulders (Qr) sand, gravel (Qpc) , yield 12 gpm
97	25-13259	0-48 48-63 63-65 65-92 92-112 112-114	clay (Qpml over Qr) fine sand, silt (Qpc, Qpcl) clay (Qpcl) sand, gravel (Qis) fine brown sand with clay (Qis, Qisl) red silt, soft red shale (Qb on rock)

98	25-1126	0-30	hardpan (Qr)	
		30-40	sand (Qpc)	
		cased to 40), yield 10 gpm 	
99	25-22472	0-50	sand, gravel (Qr)	
		50-93	fine sand (Qpc)	
		93-98	gravel (Qpc), yield 7 gpm	
100	25-1234	0-22	clay (Qr)	
		22-32	boulders (Qr)	
		32-42	sand (Qpc) 2, yield 10 gpm	
			., yield 10 gpiii	
101	25-15238	70		
102	25-24496	0-95	sand, gravel (Qtmn over Qpmd)	
		cased to 88	3, yield 25 gpm	
103	N 25-3-964	0-100	boulders and sand (Qtmn over Qpmd)	
104	25-617	0-124	clay, hardpan and rock (Qtmn)	
		124-134	granite gneiss	
105	25-585	0-140	clay and hardpan (Qtmn)	
		140-151	granite gneiss	
106	25-21011	0-50	clay (Qcg over Qwg)	
		50-120	granite	
107	25-24869	0-39	mud and water (Qcg)	
		39-100	granite	
108	25-21274	0-39	clay, stones, sand (Qcg)	
		39-98	granite	
109	25-24168	0-37	clay, sand, gravel (Qcg)	
		37-399	granite	
110	25-2195	abbreviated	l log	
		0-44	yellowish brown sandy clay and boulders (Qmt over C	
		44-87	yellowish brown sandy clay, a couple of beds of sand Qpmd)	and gravel (Qpml
		87-91	broken rock	
111	25-695	0-18	dirt and stones (Qmt)	
		18-33	gravel and stones (Qmt)	
		33-83	sand, stones, and clay (Qtmn)	
		83-174	granitic rock	
112	25-9272	abbreviated	l log	
		0-63	fine-to-coarse sand, boulders, stones (Qtmn)	
		63-103	coarse sand and gravel (Qpmd)	
		103-107 screened 87	fine sand, some small gravel (Qpmd) 7-107, yield 518 gpm	
112	25 4274	abbrovist-	l log	
113	25-4274	abbreviated 0-40	fine sand with clay (Qtmn)	
		40-77	sand, gravel, clay, boulders (Qtmn)	
		77-101	sand (Qpmd)	
		101-105 screened 58	clay (Qpml) 8-102, yield 500 gpm	
114	25 4271	abbraviat-	l log	
114	25-4271	abbreviated 0-63	sand, gravel, clay, boulders, hardpan (Qtmn)	
		63-96	coarse sand and gravel (Qpmd)	
		96-109	dirty sand (Qpmd)	
		screened 76	6-108, yield 1000 gpm	

115	25-3477	0-20 20-30 30-51 51-71 screened 38	hardpan and boulders (Qtmn) sand and clay (Qtmn) clean sand, some gravel, makes water (Qpmd) fine sand, reddish clay from 66-66.5 (Qpmd) 8-70, yield 850 gpm
116	25-4273	abbreviated 0-77 77-101 101-105	l log sand, clay, gravel, boulders (Qtmn) sand (Qpmd) clay (Qpml)
117	25-731	0-30 30-85 85-135	sand and boulders (Qmt) gravel (Qtmn) granite
118	25-13345	0-80 80-145 At 145 cased to 14	yellow clay (Qtmn) dirty sand (Qpmd) clean sand (Qpmd) 15, yield 20 gpm
119	25-21288	0-55 55-165 screened 10	hardpan and boulders (Qn) sand, gravel (Qpc) 60-165, yield 40 gpm
120	45-317	0-35 35-60	clay and hardpan (Qn) water-bearing gravel stratum (Qpc)
121	45-316	0-35 35-60	clay and hardpan (Qn) water-bearing gravel stratum (Qpc)
122	25-21431	0-3 3-20 20-40 40-55 55-134 screened 10	fill gray clay (Qs over Qpml) gray clay with sand (Qn) gray clay, sand, gravel (Qn) gravel, sand (Qpc) 96-134, yield 948 gpm
123	25-15806	0-20 20-70 70-125 125-165 165-176	hardpan and boulders (Qr) brown sand (Qpc) sand, fine, wet but no water (Qpc) clay (Qpcl) red shale rock
124	P128 Canace and others, 1993	0-1 1-3 3-15 15-17 17-50 50-60 60-170 170-196 196-198	fill black muck (Qs) clay (Qpml) sand and gravel (Qr) hardpan and boulders (Qr) brown sand and gravel (Qpc) yellow hardpan (Qpcl) tan clay and sand (Qb) red rock
125	25-17949	0-35 35-40 40-61 61-75	hardpan (Qr) gravel (Qpc) clay (Qpcl) red rock
126	25-13419 Vecchioli and Nichols, 1966, area 3, OEp test hole 2	0-6 6-19 19-22 22-36 36-40 40-58 58-69 69-99	clay and silt, laminated, yellowish brown, trace fine gravel (Qpml over Qr) till, brown (Qr) clay, silty, with silt and clayey silt, brownish gray, trace sand to fine gravel (Qr) till, brown to yellowish brown, some crystalline pebbles moderately weathered (Qr) sand, interbedded fine-to-medium and fine-to-coarse sand, little silt (Qpc) till, yellowish brown, crystalline pebbles moderately to very weathered (Qb) sand, very-fine-grained, silty, yellowish brown (Qisl) till, brown to yellowish brown, crystalline pebbles very weathered to extremely weathered (Qb)

		99-100 100-109	sand, medium- to very-coarse-grained, silty, little clay, gray shale	poorly sorted (Qb)
127	25-39652	0-26 26-46	glacial till (Qr) fine sand, boulders (Qpc)	
128	25-13420 Vecchioli and Nichols, 1966, area 3 OEP test hole 3	0-3 3-8 8-10 10-29 29-70 70-95 95-110	clay (Qpml) till, brown (Qr) sand, very-fine to coarse grained, poorly sorted, silty (till, brown (Qr) sand, fine-to-coarse grained (Qpc) till, brown (Qb) reddish brown shale	(Qr)
129	25-13904	0-30 30-80 80-100 100-247	open well sand (Qpc) red sandstone very soft gray rock	
130	25-28560	0-100 100-200	overburden with layers of clay, hardpan, and sand (Qr red shale	over Qpc)
131	25-41520	90		
132	25-39088	abbreviated 0-33 33-58	log gray to reddish brown clay (Qpml) gray to brown clayey sand with gravel and boulders (Qr)
133	25-39092	abbreviated 0-29 29-57	log reddish brown to gray clay (Qpml) reddish brown, brown, gray silty and to sandy silt wit (Qr)	th gravel and boulders
134	25-39091	abbreviated 0-22 22-57	log red-brown to gray clay (Qpml) gray to brown clayey silty sand with gravel and bould	lers (Qr)
135	25-37073	0-90 90-250	clay with layers of fine sand (Qpml over Qr over Qpc) red shale	
136	25-33384	90		
137	25-1340	0-55 55-60 cased to 60	boulders, clay (Qr) sand (Qpc) , yield 20 gpm	
138	25-36770	0-12 12-43	brown hardpan (Qr) brown sand and gravel (Qpc)	
139	25-12558	0-70 70-100 100-193	clay and boulders (Qr) sand and clay (Qpc) red sandstone	
140	25-21923	0-31 31-76 76-115 115-165	hardpan and gravel with some large boulders (Qr) light brown clayey sand and gravel (Qpc) light brown clay (Qpcl) red shale	
141	25-37779	0-35 35-60 60-86	clay, boulders, cobbles, sand (Qr) sand and cobbles (Qpc) cobbles, some clay and till (Qpc, Qpcl, Qb)	
142	25-40188	0-12 12-57 57-58 58-84 84-88	clay, sand, gravel (Qr) sand, gravel, cobbles (Qpc) silty clay (Qpcl) gravel, sand, boulders (Qpc or Qis) till (Qb)	
143	25-37421	0-47	sand, gravel, boulders (Qr)	

		47-90	sand and gravel (Qpc)
144	N 25-14-236	0-10 10-14 14-65 65-80 80-96 96-130 130-410	clay (Qr) boulders (Qr) sandy clay (Qpc) clay and gravel (Qpc or Qis) coarse sand and gravel (Qpc or Qis) clay (Qpcl or Qisl) red shale
145	25-25950	abbreviated 0-20 20-55 55-60 60-108 108-121 121-126 126-129 129-133	log yellow, brown sandy clay (Qr) brown sandy clay with gravel and stones (Qr) fine brown silty sand with clay (Qpc or Qr) sand and gravel with a little clay (Qpc) sandy red clay quite sticky (Qb) light brown silty sand and clay with layers of gray shale red clay with layers of red soft shale soft red shale
146	25-42793	0-5 5-27 27-62	clay (Qr) sand and gravel (Qr or Qpc) sand, gravel, boulders (Qpc)
147	25-28144	0-50 50-65 65-200	clay and gravel mixed (Qr over Qpc) red hardpan (Qb) red shale
148	25-21574	0-59 59-68 68-89 89-92 92-130	hardpan, large stones, clay (Qr) fine silty sand (Qpc) water-bearing sand and gravel with fine sand (Qpc) hardpan, large stones (Qb) brown and gray shale
149	25-22730	0-3 3-50 50-54 cased to 54	gray clay (Qpml) hardpan (Qr) sand, gravel (Qpc) , yield 25 gpm
150	25-19957	0-28 28-34 34-51 51-57 57-61	existing well silty sand (Qr) hardpan and stones (Qr) heaving water-bearing sand and gravel (Qpc) choice water-bearing sand and gravel (Qpc)
151	25-14808	0-10 10-30 30-55 cased to 55	clay and boulders (Qr) hardpan (Qr) sand (Qpc) , yield 50 gpm
152	25-14402	0-10 10-53 cased to 53	hardpan and boulders (Qr) sand and gravel , yield 50 gpm
153	25-14983	0-28 28-41 41-52 cased to 52	hardpan, stones, boulders (Qr) clay (Qpcl) water-bearing sand and gravel , yield 20 gpm
154	P136 Canace and others, 1993	0-5 5-15 15-52 52-59 59-61 61-64 64-68 68-88 88-94 94-100	fill, boulders (Qr) clay (Qr) stones, gravel (Qr) sand, gravel (Qpc) stones (Qpc) sand, gravel (Qpc) sand, trace clay (Qpc) coarse sand (Qpc) sand, gravel (Qpc) hard shale

155	25-19609	0-41	old well
		41-67	water-bearing silty sand (Qpc)
		67-71	water-bearing sand, gravel (Qpc)
		cased to 71	, yield 12 gpm
156	25-24012	0-14	hardpan and stones (Qr)
		14-38	sand and gravel with large stones and boulders (Qpc)
		38-46	fine sand (Qpc)
		46-65	water-bearing sand and gravel (Qpc)
		cased to 65	, yield 15 gpm
157	25-13420	abbreviated	log
	Vecchioli	0-4	brown clay (Qr)
	and Nichols,	4-43	yellowish brown till (Qr)
	1966, area 2, OEP test hole	43-50	sand (Qpc)
	3	50-59 59-63	till (Qpc or Qr) sand (Qpc)
	3	63-70	till (Qb)
		70-75	reddish brown shale
158	25-9725	0-48	sand, gravel (Qr over Qpc)
100	20 3720		, yield 35 gpm
159	25-15974	0-20	hardpan and clay (thin Qpmf over Qr)
		20-60	sand (Qpc)
			, yield 60 gpm
160	25-13311	0-10	sand, gravel, clay (Qr)
		10-113	sand and gravel (Qpc)
		113-120	soft shale
161	25-9838	>50	
		screened 43	5-50 in gravel (Qpc), yield 110 gpm
162	25-7655	0-15	fine sand (Qst)
		15-75	clay (Qpml)
		75-80	red hardpan (Qr)
		80-110	red sandstone
163	25-8517	0-75	sand then hit clay (Qst over Qpml)
		75-80	fine sand (Qpml)
		80-85	red hardpan (Qr)
		85-100	red sandstone
164	25-9973	0-21	sand (Qst)
		21-81	clay (Qpml)
		81-85	hardpan (Qr)
		85-103	red shale
165	25-38637	0-26	clay, sand, gravel (Qr)
		26-50	sand, gravel (Qpc)
166	N 25-14-261	60	
167	25-25580	abbreviated	log
107	20 20000	0-21	red-brown silty sand, cobbles (Qr)
		21-54	fine-to-coarse sand, gravel, trace silt (Qpc or Qr)
168	25-21078	0-20	overburden (Qr)
	,	20-41	sand (Qpc)
		41-90	red clay (Qb)
		90-600	red and gray shale
169	25-37196	abbreviated	log
/		0-48	brown sand, silt, gravel, till (Qr)
		48-58	gray shale rock
170	25 9054	0.80	alay and hardnen (Or aver Oh)
170	25-8954	0-80	clay and hardpan (Qr over Qb)

		80-400	red sandstone
171	25-11890	0-45 45-500	hardpan (Qr over Qb) red rock
172	25-5374	0-58 58-400	clay and sand (Qr over Qb?) red and gray rock
173	25-7875	0-20 20-45 45-543	fill sand and gravel, no water (Qr over Qpc?) red and gray rock
174	25-11704	0-50 50-69 69-97 screened 58	hardpan and cobbles (Qr) sand and gravel (Qpc) no samples, well flows (Qpc or Qpcl) 8-78, yield 550 gpm
175	25-17606	0-8 8-41 41-64 64-66	clay, fill boulders, sand, gravel (Qr over Qpc) sand, gravel (Qpc) rotten rock and yellow clay (Qpcl?)
176	25-3527	0-58 58-88 88-138 138-141 141-144	brown clay and boulders (Qr) sand and gravel (Qpc) clay and boulders (Qpcl, Qisl, Qis?) sand and gravel (Qis) hardpan to top of rock (Qb)
177	25-48	abbreviated 0-20 20-53 53-115 115-134 screened 84	log clay (Qr) mix of hard sandy clay, rocks stones (Qr) fine-to-coarse sand with clay (Qpc, Qpcl, Qisl) clay, sand, stones, clay, gravel (Qb?) 1-116, yield 1000 gpm
178	25-25562	abbreviated 0-65 65-95 95-124 124-137 137-140 140-141	log gray sandy clayey hardpan with gravel (Qr) sand and gravel with some silt and clay (Qpc) sandy clay (Qpcl, Qisl) clay with sand and gravel (Qis?) red hardpan with layers of red clay (Qb) red shale
179	25-25834	abbreviated 0-91 91-115 115-138 138-140 140-143	log sandy gray clay to silty sand and gravel, hardpan (Qr over Qpc) light brown fine sand and clay (Qpcl or Qisl) yellow silty sand and clay (Qisl) red hardpan (Qb) red shale
180	25-42939	abbreviated 0-46	log red brown clayey silt, trace sand and gravel (Qr)
181	25-13372	0-20 20-31 31-310 310-384	boulders and clay (Qr) sand and clay (Qpc, Qpcl) red clay, sand and gravel (Qis, Qisl, Qb over Qwc) conglomerate rock
182	25-13594	0-34 34-90 90-100	sandstone and boulders (Qn) sand and gravel (Qpc) rock
183	25-3898	0-100 100-136	dead sand (Qtmn over Qpmd) red shale
184	25-14440	0-25 25-47 47-70 70-81	sand and boulders (Qpmd) sand and clay, gravel (Qpmd) clay (Qpml) sand and granite, trace of clay (Qwg)

cased to 81, yield >20 gpm

185	25-13068	0-38 38-68 68-80	gravel and boulders (Qpmd) sand (Qpmd) brown granite
186	25-21376	14	
187	25-14142	11	
188	25-14116	abbreviated 0-112 112-171	log clay, sand, and stones (Qpmd over Qwg) soft and hard rock
189	25-8493	abbreviated 0-142 142-145	log sand, clay, gravel, stones (Qpmd over Qwg) weathered rock
190	25-13667	0-27 27-76 76-99 99-106 106-112	sand, gravel, large boulders (Qpmd topsets) sand with few stones (Qpmd foresets) clay (Qpml) conglomerate rock water-bearing sand and gravel (Qwc)
191	25-33204	0-34 34-60 60-95 95-130 130-131	gravel and large rocks, coarse sand (Qpmd topsets) fine-to-medium sand, fine sand (Qpmd) fine silty sand, small clay streaks (Qpmd over Qpml) silt and clay (Qpml) rock
192	25-27106	abbreviated 0-15 15-25 25-46 46-78 78-133 133-134 134-137	log hardpan with large boulders and cobbles (Qpmd topsets) sand and gravel (Qpmd topsets) silty sand and gravel (Qpmd) gray silty fine sand, some gravel and clay (Qpmd) gray silt and clay (Qpml) hardpan with hard clay (Qwg?) granite
193	25-33621	abbreviated 0-40 40-55 55-78 78-127 127-130 130-132	log gravel and large rocks, coarse sand (Qpmd topsets) fine-to-medium sand (Qpmd) fine sand and silt, small clay streaks (Qpmd) gray silty clay (Qpml) fine-to-medium sand (Qwg?) very tough drilling (gneiss bedrock)
194	25-26159	abbreviated 0-21 21-42	log brown sand and gravel (Qpmd topsets) brown-gray medium-to-fine sand (Qpmd)
195	25-17798	93	
196	25-13488	0-12 12-46 46-57 57-141	hard clay (Qwg) sand, stone and clay (Qwg) rotten dark brown granite gray granite
197	25-15132	0-25 25-150 150-157 cased to 15	sand (Qpml) clay (Qpml) sand (Qwg?) 7, yield 15 gpm
198	25-8387	abbreviated 0-9 9-81 81-88 88-91 91-104	log sand and boulders (Qal) gray clay (Qpml) gray sandy hardpan, boulders (Qcg?) brown coarse sand and gravel (Qcg?) yellow sandy hardpan (Qwg?)

		104 124	vallavy so ak	
		104-134	yellow rock	-
199	25-27154	0-13	silty clay (Qpmd or Qr)	
		13-27	rocks and gravel (Qpmd or Qr)	
		27-36	clay silt (Qpmd or Qr)	
		36-50	sand and gravel (Qpmd)	-
200	25-29531	>134		-
201	25-41021	0-22	red-brown silty sand and gravel, little clay, some cobb	
		22-50	red-brown sand and gravel, coarse gravel and cobbles	(Qpmd)
202	25-35190	0-21	red-brown clayey silt with some sand, trace fine grave graded sand (Qr)	l, grading to well
		21-69	brown well graded sand (Qpmd)	
		69-71	red brown clayey fine sand with some gravel (Qpmd)	_
203	25-1890	abbreviated	l log	
		0-28 28-54	reddish brown hardpan and boulders (Qr) fine sand with clay (Qpmd)	
		54-75	fine-to-coarse sand (Qpmd)	
		75-93	grayish fine dirty soupy sand (Qpml)	
		93-111	red hardpan (Qb)	
		111-119	reddish brown hard clay (Qisl)	
		119-153	red clay (Qisl)	
		153-162	reddish brown sandy hardpan (Qb)	
		162-170	cemented sand (Qis)	
		170-203 203-207	reddish brown clay (Qisl) brown rock	
20.4	25.26056	-1. l: -4	11	-
204	25-26056	abbreviated 0-7	_	
		7-14	silty brown clay with some cobbles (Qr?) silty brown sand, gravel (Qpmd)	
		14-35	silty fine-to-medium sand (Qpmd)	
		35-50	brown silt with layers of silty clay and some small gra	vel (Qpml)
		50-64	brown silt and some medium sand with small pebbles	
205	25-43340	0-25	silty till (Qr)	-
		25-60	fine-to-coarse sand (Qpmd)	
		60-80 80-82	fine-to-medium sand with silt and clay lenses (Qpmd of fine-to-coarse sand (Qis?)	over Qpml)
206	25-13244	abbreviated	1 log	-
		0-28	brown hard pan (Qr)	
		28-33	clean sand and gravel (Qpmd)	
		33-45	fine brown sand (Qpmd)	
		45-55 55-90	brown hard pan very sandy large stones (Qr) sand and gravel (Qpmd)	
		90-93	fine-to-medium sand with clay (Qpmd, Qpml)	
		93-110	hard pan, small stones (Qb)	
			5-85, yield 100 gpm	
207	25-13998	0-40	sand and clay (Qtmr)	-
		40-190	sand and clay and boulders (Qtmr over Qpmd)	
		190-400	soft red sandstone	
208	25-37534	abbreviated	i log	-
		0-73	sand and gravel (Qpmd)	
209	25-23858	>125		•
210	25-14092	abbreviated	l log	-
		0-105	brown to gray sand (Qpmd)	
		105-110	hard pan (Qr)	
		110-132	gray clay (Qpml)	
		132-134	sand and gravel (Qis?)	
		134-149	red and brown clay (Qb over Qisl)	
		149-177 177-320	red clay (Qisl) red and gray shale	
		111-320	iou una giuy siiaio	

211	25-31696	abbreviated 0-42 42-45	log tan and brown sand and gravel (Qpmd) decomposed red shale (probably Qpml or Qr)
212	25-42108	abbreviated 0-25 25-47 47-75	log brown medium-to-coarse sand (Qpmd) brown, white medium-to-fine sand (Qpmd) brown fine sand (Qpmd)
213	25-35081	abbreviated 0-68 68-70	log coarse brown sand and gravel (Qpmf) brown silt (Qpmd)
214	25-14162 Vecchioli and others, 1967, OEP test hole 15	0-5 5-20 20-26 26-58 58-72 72-89 89-100	medium sand (Qal) sandy silty till (Qr) clayey silt with some gravel (Qr) brown silty clayey sandy till (Qr) very fine to very coarse sand (Qpc) very compact, brown, silty clayey sandy till (Qb) shale, extremely weathered
215	N 25-14-182	0-28 28-70 70-95 95-96 96-152	yellow sand and clay (Qst over Qr) blue clay (Qr over Qpc, Qpcl) red clay (Qb) sand (Qb, Qis) red rock
216	25-14161 Vecchioli and others, 1967, OEP test hole 16	0-2 2-4 4-11 11-13 13-20 20-27 27-41 41-45 45-48 48-68 68-94 94-128 128-143 143-148 screened 75	fill yellowish brown silty fine sand (Qal) silty clayey sandy brown till (Qr) brown clayey silt (Qr) silty sandy brown till (Qr) coarse sand (Qpc) silty sandy brown till (Qr) fine gravel, water-bearing (Qpc) sandy silty gravelly brown till (Qr) fine sand, little coarse sand (Qpc) medium-to-coarse sand , little fine sand, water-bearing (Qpc) laminated brown clayey silt (Qpcl) silty clayey sandy brown till, very weathered (Qb) shale i-85, yield 105 gpm
217	25-19683	0-19 19-66 66-98 98-125 cased to 12	hardpan and stones (Qr) clay (Qpcl) water-bearing heaving sand (Qis) water-bearing sand and gravel (Qis) 5, yield 15 gpm
218	25-19787	0-4 4-28 28-57 57-69 69-130 cased to 13	clay (Qst or Qr) hardpan and stones (Qr) clay (Qpcl) silty sand (Qis) water-bearing heaving sand and gravel (Qis) 0, yield 15 gpm
219	25-12627	0-22 22-46 46-68 68-128 cased to 12	hardpan (Qst) clay (Qpml) hardpan and stones (Qr) silty water-bearing sand and gravel (Qpc) 8, yield 30 gpm
220	25-21158	abbreviated 0-20 20-60 60-70 70-75 75-135	log brown sand and boulders (Qr) brown sand and gravel (Qpc) brown sand and some gray clay (Qpcl) reddish brown clay (Qisl) gray to brown to reddish brown sand, a little gravel (Qis)

221	25-5031	0-15	sand and boulders (Qst over Qr)
		15-65 65-95	sand and gravel (Qpc) sand, gravel, and clay (Qpc over Qpcl)
		95-107	yellow clay (Qisl)
		107-132	coarse sand and gravel (Qis)
		132-140 140-150	yellow clay (Qisl) very fine sand (Qis)
			08-128, yield 320 gpm
222	25-19030	0-50	sand (Qr over Qpc)
		50-123 cased to 12	gravel (Qpc, Qis) 3, yield 15 gpm
223	25-14231	>70	
224	25-13744	0-20	sand (Qpmf)
224	23-13744	20-45	gray clay (Qr?)
		45-65	sand, gravel (Qpc)
		cased to 61	, yield >20 gpm
225	25-13911	0-45	sand, gravel, clay (Qtmr)
		45-55 55-90	sand, gravel (Qpc) sand (Qpc)
		90-95	sand, gravel (Qpc or Qis)
		cased to 95	, yield 7 gpm
226	25-22516	abbreviated	8
		0-20 20-75	brown sand and gravel (Qal over Qst)
		20-75 75-85	gray clay (Qpml) gray clay, brown sand and stones (Qr)
		85-90	muddy sand and gravel (Qpc)
		90-100	gray slate
227	25-11349	0-38	fill and clay (Qst over Qpml)
		38-41 41-65	brown sand (Qpmf) gravel (Qpmf)
		65-75	slate
		screened 56	5-67, yield 120 gpm
228	25-14205	0-65	clay (Qpml over Qr over Qpcl)
		65-115 screened 85	sand and gravel (Qis) 5-115, yield 1500 gpm
229	25-13672	>130	
		screened 10	00-110 in gravel (Qis?), yield 484 gpm
230	Vecchioli	0-30	till (Qr)
	and others, 1967, N. J.	30-120	sand and gravel (Qpc, Qis)
	P&L test	120-130 130-135	till (Qb) rock
	well 4		
231	N 25-14-365	0-7	yellow clay (Qpml)
		7-40	hardpan (Qr)
		40-60 60-90	fine sand (Qpc) coarse sand and gravel (Qpc or Qis)
		90-130	coarse sand, water (Qpc or Qis)
		130-157	clay and gravel mixed (Qb)
		157-303	varicolored shale and sandstone
232	25-26394	0-8	fill
		8-17	wood, sand, some gravel and stones (Qal)
		17-33 33-35	soft gray clay and fine sand (Qpml) coarse sand and cobbles (Qr?)
		35-67	gray clay (Qpcl)
		67-102	sand, stone, gravel, cobbles, some clay balls (Qis)
233	25-3988	0-25	sand, gravel, and stone (Qr)

		25-92 screen 82-9	sand and gravel, water (Qpc) 2, yield 60 gpm	
234	25-32834	0-50 50-77	clay, gravel (Qr) gravel (Qpc)	
235	25-25615	0-27 27-72	brown fine silty sand with some clay and some cobble brown fine-to-medium sand with some gravel, some sil clay (Qpc)	
236	25-25616	0-25 25-67	brown fine silty sand with trace of clay and trace of col brown fine-to-medium sand with some gravel, some sil (Qpc)	
237	25-31350	0-12 12-24 24-75	brown sand, clay (Qr) stones (Qr) fine brown sand and stones (Qpc)	
238	25-40823	0-50 50-70	brown fine sand, trace clay, silt, fine gravel (Qr) brown coarse-to-fine sand, trace silt, trace gravel and co	obbles (Qpc)
239	25-29364	abbreviated 0-40 40-64	log red-brown silty sand and gravel (Qr) red-brown medium-to-coarse sand and gravel (Qpc)	
240	25-29362	abbreviated 0-62	log brown, red-brown silty sand and gravel (Qr)	
241	25-43888	0-25 25-92	clay and sand (Qr) sand and gravel (Qpc)	
242	25-40790	0-10 10-18 18-40	fill brown clayey till (Qr) brown medium-to-fine sand, some coarse-to-fine gravel	, trace cobbles (Qpc)
243	25-34045	0-13 13-100 100-122	brown, light brown varved silt, clayey silt, clay (Qr?) light red brown coarse-to-fine sand, little gravel, little s brown-gray medium-to-fine sand, trace silt (Qpc)	silt (Qpc)
244	25-43889	abbreviated 0-11 11-100 100-125 125-126	log clay and gravel (Qr) sand and gravel (Qpc) sand, gravel and clay (Qpc, Qb?) clay, red shale	
245	25-13563	abbreviated 0-23 23-101 101-106	log clay, gravel, boulders (Qr) sand and gravel (Qpc) blue and red shale	
246	25-34051	0-18 18-122	brown fine-to-coarse sand and gravel, shale fragments, brown coarse-to-fine sand, trace gravel and silt (Qpc)	some silt (Qr)
247	25-34054	abbreviated 0-30 30-41 41-47 47-50	log gray-brown fine-to-coarse sand and gravel, some silt (Q gray-brown fine-to-coarse sand and silt, trace fine gravered-brown clayey silt and coarse-to-fine sand (Qb or Q) red-brown weathered shale (anomalous depth to rock, to see the same state of the same same same same same same same sam	el, wet (Qr or Qpc) pcl)
248	25-40812	abbreviated 0-12 12-50 50-85 85-140 at 140	log brown sand and silt, trace gravel (Qr) brown-gray sand, little silt (Qpc) brown sand and gravel, little silt (Qpc) brown-gray sand, little gravel (Qpc) siltstone	
249	25-13476 Vecchioli and Nichols,	abbreviated 0-28 28-40	log yellowish brown till (Qr) brown silt and fine sand (Qpcl, Qpc)	

	1966, area 1 OEP test well	40-136 136-141 screened 11	medium-to-coarse sand (Qpc) reddish gray shale 3-123, yield 360 gpm
250	25-13679 Vecchioli and Nichols, 1966, area 1 OEP test well	abbreviated 0-4 4-23 23-50 50-56 56-120 120-125 screened 10	log gray clay (Qs) brown till (Qr) coarse sand (Qpc) gravel (Qpc) coarse sand (Qpc) reddish brown siltstone 00-110, yield 350 gpm
251	25-15311	0-4 4-15 15-35 35-42 cased to 42	fill clay (Qr) hardpan and boulders (Qr) sand (Qpc) , yield 50 gpm
252	25-13477	abbreviated 0-1 1-31 31-35 35-44 44-48 48-50 50-61	log swamp muck (Qs) brown till (Qr) sand (Qpc) brown till (Qr) medium-to-coarse sand (Qpc) brown till (Qb) reddish brown shale
253	25-11113	108	
254	25-11341	0-40 40-85 85-95 95-111 111-168	gravel, boulders (Qr) sand and gravel (Qpc) sand (Qpc) red clay (Qb) red rock
255	25-11342	0-45 45-75 75-97 97-143	gravel and boulders (Qr) sand, gravel (Qpc) red clay (Qb) red rock
256	25-11114	0-50 50-120 120-150	gravel, boulders (Qr) sand (Qpc) red rock
257	25-11329	0-40 40-87 cased to 87	gravel, boulders (Qr) sand, gravel (Qpc) , yield 18 gpm
258	25-11330	0-50 50-92 92-95 95-141	gravel, boulders (Qr) sand, gravel (Qpc) red rock clay (Qb) red rock
259	25-11343	0-50 50-60 60-68 68-108	gravel, boulders (Qr) sand, gravel (Qpc) red clay (Qb) rock
260	25-11331	0-50 50-90 90-100 100-145	gravel and boulders (Qr) sand, gravel (Qpc) clay (Qb) red rock
261	25-12326	0-21 21-53 53-79 79-84 84-90	clay and stones (Qr) sand and heavy gravel (Qpc) water-bearing silty sand and gravel (Qpc) clay (Qpcl) water-bearing sand and gravel (Qpc)

		90-141	red shale
262	Vecchioli	abbreviated	log
	and Nichols,	0-10	brown silty clay (Qr)
	1966, area 1	10-15	brown silty clayey sand (Qr)
	other well	15-127	medium-to-very-coarse sand, fine gravel (Qpc)
	1	127-130	red shale
263	25-14182	0-5 5-7	brown sand fill
		7-16	topsoil (Qs) dark gray clay (Qs over Qpml)
		16-21	brown and gray clay (Qpml)
		21-30	clay and silty fine sand (Qpml)
		30-38	gray clay, gravel, stones (Qr)
		38-64	stone, medium-to-coarse gravel (Qpc)
		64-121	sand, gravel, stones (Qpc)
		121-124	dirty very coarse sand, gravel, large stones (Qpc or Qb
		screened 82	2-118, yield 1557 gpm
264	25-14181	abbreviated	_
		0-2 2-4	fill topsoil (Qs)
		4-11	gray clay (Qs)
		11-24	silty gray sand (Qst or Qpml)
		24-31	silty gray clay (Qpml)
		31-124	gravel, stones, sand (Qpc)
		124-128	slate
		screened 75	i-122, yield 1500 gpm
265	25-13653	abbreviated	-
	Vecchioli	0-3	swamp muck
	and Nichols,	3-10	brownish gray clay (Qr)
	1966, area 1 OEP test well	10-37 37-39	brown till (Qr) silt and fine sand (Qpc)
	3	39-108	coarse sand with some gravel (Qpc)
	3	108-116	pebbly till (Qb or Qpc)
		116-124	sand and gravel (Qpc or Qis)
		124-129	reddish brown shale
		screened 99	0-108, yield 330 gpm
266	Vecchioli	abbreviated	5
	and Nichols,	0-7	brown clay, little fine gravel (Qr)
	1966, area 1 OEP test well	7-39	brown till, few boulders (Qr)
	4	39-74 74-89	medium-to-coarse sand, some fine gravel (Qpc) yellowish brown till (Qb)
	·	89-98	brown till (Qb)
		screened 60	0-70, yield 315 gpm
267	25-13475	abbreviated	log
	Vecchioli	0-1	swamp muck
	and Nichols,	1-31	brown till (Qr)
	1966, area 1	31-35	fine-to-coarse sand, some silt, little clay (Qpc)
	OEP test hole	35-44	brown till (Qr)
	1	44-48 48-50	medium-to-very-coarse sand (Qpc) brown till (Qb)
		50-61	reddish brown shale
268	25-14981	0-4	topsoil and fill
200	23-14701	4-60	clay (Qr)
		60-65	hardpan (Qr)
		65-75	sand (Qpc)
		cased to 75	, yield 20 gpm
269	24-42455	0-15	medium sand (Qr?)
		15-29	fine-to-medium sand (Qpc)
		29-45	fine-to-medium sand with cobble (Qpc)
		45-62	medium sand (Qpc)
270	25-35985	0-8	clay (Qr?)

		8-50	fine sand and gravel (Qpc)
271	25-14872	0-5	topsoil and hardpan (Qpml)
		5-15	clay (Qpml)
		15-25	sand and clay (Qr?)
		25-35	fine sand (Qpc)
		35-55	gravel and sand (Qpc)
		55-58	red hardpan (Qb)
		58-78	red shale
272	25-7639	0-40	sand and gravel (Qpmf)
		40-49	clay (Qpml or Qr)
		49-55	dirty sand (Qr?)
		55-62	clay (Qpcl)
		62-80	clay and sand (Qpcl)
		80-90 90-272	clay (Qpcl or Qb) red shale rock
273	25-28444	abbreviated	log
213	23-20444	0-28	silt and sand (Qpmf)
		28-40	gray silty clay (Qpml)
		40-67	till-cobbles and gravel, fine-to-medium sand and silt (Qr)
274	25-4586	0-33	hardpan (Qpmf over Qr)
		33-77	sand and gravel (Qpc)
		cased to 77	, yield 20 gpm
275	25-43101	0-12	gray-brown clay, trace medium-to-fine sand (Qr)
		12-55	brown coarse-to-fine sand, trace clay and gravel (Qpc)
276	25-14873	0-10	clay (Qpml)
		10-30	hardpan and clay (Qr)
		30-80	sand and gravel (Qpc)
		80-100	gravel and clay (Qpc or Qis)
		100-110	sand and clay (Qpcl or Qis)
		110-125	red hardpan (Qr)
		125-135	red shale
277	25-1830	abbreviated	_
		0-12 12-26	gray clay (Qpml) boulders, clay, hardpan (Qr)
		26-47 47-94	red hardpan (Qr) sand with some clay and gravel (Qpc)
		94-109	sandy clay (Qpcl)
		109-120	reddish fine sandy clay (Qb?)
		120-128	red shale
278	25-2193	0-5	black dirt (Qs)
	Vecchioli	5-25	brownish gray clay (Qpml)
	and Nichols,	25-43	brown hardpan (Qr)
	1966, area 1	43-47	sand and gravel, clay binder (Qpc or Qr)
	other well	47-109	medium and coarse sand (Qpc)
	7	109-118	red hardpan (Qr)
		118-121	brown hardpan (Qr)
		at 121 screened 10	red rock 0-110, yield 210 gpm
270	25 12422		
279	25-12423	0-6	sand and gravel fill
	Vecchioli	6-11	hardpan and boulders (Qr)
	and Nichols,	11-23	clay, hardpan and boulders (Qr)
	1966, area 1	23-53	cemented sand, seams of hardpan and bouders (Qr, Qpc)
	other well	53-77	medium sand (Qpc)
	1	77-88	clay (Qpcl)
		88-101 101 103	sand, some gravel (Qis)
		101-103 screened 67	sandy clay with some gravel (Qb?) -103, yield 735 gpm
280	25-20415	abbreviated	log
		0-27	boulders, rock, sand (Qr)

		27-45 45-73 73-102 102-143 screened 86	sandy clay and gravel (Qr) hard brown clay (Qpcl) clay and stones (Qis?) clayish sand and gravel (Qis?) 6-136, yield 876 gpm
281	25-35724	0-48 48-51	red brown glacial till (Qr) red brown coarse-to-fine sand (Qpc)
282	25-14163 Vecchioli and others, 1967, OEP test hole 6	0-60 60-67 67-76 76-78 78-84	silty sandy dense brown till (Qr) very-fine-to-fine sand, silty, brown (Qpc) clayey sandy yellowish brown till (Qb) clay with shale fragments reddish brown shale
283	25-14148 Vecchioli and others, 1967, OEP test hole 5	abbreviated 0-10 10-25 25-33 33-65 65-81 81-85 85-87 87-91	log yellow-brown till (Qr) very fine silty clayey brown sand, some pebbles (Qr) brown clayey till (Qr) sand and gravel (Qpc) sand and silt (Qpc, Qpcl) reddish brown clayey silt with shale fragments (Qb) coarse sand (Qis) gray and red shale
284	25-14150 Vecchioli and others, 1967, OEP test hole 4	abbreviated 0-20 20-47 47-124 124-130 screened 11	log dark gray clay (Qpml) clayey brown till (Qr) coarse sand and gravel (Qpc) red and gray shale 0-120, yield 300 gpm
285	Vecchioli and Nichols, 1966, area 1 other test hole 2	0-12 12-27 27-35 35-60 60-87 87-118 118-145	no log clay (Qpml) boulders (Qr) gravel and fine sand (Qpc) fine sand and clay (Qpc, Qpcl) gray rock red rock
286	Vecchioli and Nichols, 1966, area 1 other test hole 1	0-11 11-35 35-38 38-55 55-65 65-70 70-71 71-75 75-77	brown clay (Qr) brown hardpan with boulders (Qr) brown clay (Qr) sand (Qpc) sand and clay lenses (Qpc, Qpcl) hardpan (Qb) sand (Qis) sandy hardpan (Qb) rock
287	25-9086	abbreviated 0-10 10-20 20-43 43-49 49-65 65-70 70-80 80-108 108-140	log brownish red silty sand with gravel (fill?) very clayey coarse sand (Qpml?) brown clay with coarse sand (Qpml) brown clay with coarse sand and gravel (Qr) silty fine-to-coarse sand (Qpc) silty gravel (Qb?) gray clay with shale fragments (Qb or Qws) gray shale soft red shale
288	25-6558	0-40 40-80 80-120 120-132 screened 10	clay and stones (Qr) red clay and stones (Qr) sand and gravel (Qpc) sandy clay (Qpcl) 09-119, yield 222 gpm
289	25-15953	0-5 5-8	red clay (Qpml) black muck (Qpml)

		8-71 71-78 78-88 screened 71	red clay, gravel, boulders (Qr) fine-to-medium sand (Qpc) coarse sand and small gravel (Qpc) -88, yield 150 gpm	
290	25-38780	abbreviated 0-6 6-10 10-17 17-27 27-41	log fill black peat brown and gray varved clay (Qpml) reddish brown clay (Qpml) reddish brown silty clayey sand and gravel, cobbles a	nd boulders (Qr)
291	Hoffman and others, in review, W885	>62 screened 51	-62, yield 200 gpm	
292	25-43287	0-5 5-36 36-57 57-130	fill clay, sand, gravel, boulders (Qr) decomposed red shale (probably Qpcl) red shale	
293	25-8244	90		
294	25-42452	abbreviated	log brown sand, gravel, trace silt (Qr over Qpc)	
295	25-28315	abbreviated 0-35 35-45 45-75 75-106	log glacial moraine-clayey silty sand with gravel, cobbles decomposed red shale red shale blue-gray hard shale	, boulders (Qr)
296	N 25-14-514	0-17 17-26 26-36 36-44 44-49 49-56 56-76 76-80	clay with small stones (Qpml over Qr) coarse gray sand with stones (Qpc) coarse brownish gray sand with trace clay (Qpc) hard brown clay and grit (Qr or Qpcl) fine brown sandy clay with grits (Qr or Qpcl) light brown clay with grits (Qpcl) reddish brown clay and grits (Qpcl or Qb) red shale	
297	N 25-14-514	abbreviated 0-28 28-38 38-64 64-71	log gray and brown clay, sand, stones, grit (Qr) hard brown clay, grit (Qr) coarse gray sand and gravel, artesian water conditions hard red clay changing to hard shale	(Qpc)
298	25-4167	abbreviated 0-23 23-98 98-133 at 133 screened 10	sand, gravel, boulders (Qr) sand and gravel (Qpc) yellow water-bearing sand (Qpc or Qis) sand and clay (Qb or Qisl) 07-132, yield 350 gpm	
299	25-4053	>133 screened 11	good water- bearing sand at 114 (Qpc or Qis) 3-133, yield 220 gpm	
300	25-34901	abbreviated 0-37 37-65 65-90 90-100 100-130	log brown clay and gravel (Qr) sand and gravel (Qpc) sand with clay (Qpcl) hard red clay with sand and gravel (Qb) brown and red shale	
301	25-26582	>80		
302	25-34058	0-110 110-122 122-135	gravel/sand/clay (Qtmr over Qpc over Qpcl) sand (Qis?) rock	

		135-470	shale
303	25-22434	0-90	boulders, silt (Qtmr)
		90-142	fine sand, silt (Qpc, Qpcl)
		142-171	red and gray clay (Qisl)
		171-175 175-300	gravel and coarse sand, water (Qis) hard red shale
304	25-10487	0-71 71-165	clay, gravel, boulders (Qtmr) sand, gravel, some clay (Qpc, Qpcl)
		165-205	coarse sand (Qis)
		205-220	dirty sand, some gravel (Qb?)
		220-271	coarse sand and gravel
		screened 24	1-271, yield 236 gpm
305	25-18982	0-50	sand and large gravel (Qtmr)
		50-130 130-160	clay and sand (Qpml)
		160-189	sand (Qis) sand and gravel (Qis)
		189-210	sand (Qis)
		210-218	hard red clay (Qb)
		218-231	sand and gravel (Qis)
		screened 22	1-231, yield 20 gpm
306	25-9253	abbreviated	log
		0-50	brown clay and boulders (Qtmr)
		50-120	brown clay and stones (Qtmr, Qpcl)
		120-171	sand and gravel (Qis)
		171-173 173-185	red shale (Qb?) gray like hardpan or rotten rock (Qb?)
		185-188	red shale
307	25-29037	abbreviated	log
		0-63	boulders, gravel, clay (Qtmr)
		63-80	fine sand (Qpmd)
		80-101	gravel (Qpmd)
		101-123	brown clay, gravel (Qpml)
		123-170 170-183	brown clay (Qpml) gravel with silty clay (Qis)
		183-195	gray and brown sand and clay (Qis, Qisl)
		195-214	rocks and clay (Qb)
		214-237	sand (Qis)
		screened 21	5-235, yield 350 gpm
		adjacent we	ll 25-28597 shows >321 to rock
308	25-30478	abbreviated	log
		0-62	reddish brown clayey sand with gravel (Qtmr)
		62-81	sand and gravel (Qpmd)
		81-140 140-200	gray to reddish brown silty clay (Qpml) sand (Qis)
		200-201	gray weathered shale (Qb?)
309	25-15313	0-120	red sand and gravel (Qtmr over Qpmd)
		120-183	clay (Qpml)
		183-202	sand (Qis)
		202-228	sand and gravel (Qis or Qb)
		228-245 245-253	gray shale hard gray rock
310	25-13613	0-47	hardpan with cobbles and boulders (Qtmr)
		47-90	dirty sand and gravel (Qpmd)
		90-150	clay (Qpml)
		150-202 202-207	hardpan (Qb or Qis) clay (Qisl)
		207-217	sand (Qis)
		217-224	clay (Qisl)
			1-216, yield 22 gpm
311	N 25-14-423	0-250	clay and hardpan (Qtmr over Qpmd, Qpml)

		250-270 270-300 300-885	same, streaks of sand (Qis?) quick sand (Qis) gray and red rock	
312	25-13047	150		
313	25-13680	0-38 38-92 92-140 140-185 185-207 207-262	hardpan and stones (Qpmd, topset gravel) sand and gravel (Qpmd) clay (Qpml) hardpan and stones (Qb or Qr) water-bearing sand and gravel, quite silty (Qis or Qpml gray and red shale and sandstone	f)
314	25-13070	0-60 60-100 100-175	sand, gravel (Qpmd) sand (Qpmd) red clay (Qpml)	
315	25-34663	abbreviated 0-35 35-80 80-205 205-224 224-275 275-292 292-299 screened 2'	l log brown clay and gravel (Qtmr) sand (Qpmd) sand and gravel (Qpmf) brown clay and gravel (Qr) fine sand and clay (Qpml) fine sand and gravel (Qis) brown clay and gravel (Qb) 72-282, yield 257 gpm	
316	25-16215	0-18 18-90 90-190 190-200 200-235 235-238 screened 22	gravel , clay, boulders (Qtmr) gravel, clay, small stones (Qtmr over Qpmd) fine dirty sand (Qpml) sand and gravel (Qpmf) sand (Qpmf) sand, mixed with clay (Qr?) 23-233, yield 15 gpm	
317	25-38674	0-42 42-215	sand, gravel, boulders (Qpmd, topset gravel) sand, some silt, some layers of gravel and boulders (Qpmf)	pmd over Qpml over
318	25-19279	0-240 240-580	silt, clay, sand and gravel (Qpmd over Qpml over Qpm shale	nf)
319	25-29269	abbreviated 0-12 12-55 55-90	l log brown silty clayey sand (Qr) sand and gravel (Qpmd) fine sand, silt, clay (Qpml)	
320				
	25-30965	abbreviated 0-30 30-75 75-115 115-120		
321	25-14488	0-30 30-75 75-115	l log brown sandy silt, boulders (Qr) sand (Qpmd) sand and gravel (Qpmf)	
321		0-30 30-75 75-115 115-120 0-25 25-80 80-125	log brown sandy silt, boulders (Qr) sand (Qpmd) sand and gravel (Qpmf) brown silt (Qpml) gravel and sand (Qpmd) sand (Qpmd) sand and gravel (Qpmf) brown sand and silt (Qpml)	
	25-14488	0-30 30-75 75-115 115-120 0-25 25-80 80-125 125-166 abbreviated 0-11 11-23 23-44	log brown sandy silt, boulders (Qr) sand (Qpmd) sand and gravel (Qpmf) brown silt (Qpml) gravel and sand (Qpmd) sand (Qpmd) sand and gravel (Qpmf) brown sand and silt (Qpml)	

		15-113 113-425	clay (Qpml) shale
325	25-8717	0-30 30-110 110-115 115-148 148-162 at 162	sand (Qpmd) clay (Qr over Qpml) gravel (Qis?) clay (Qisl) gravel (Qis or Qb) rock
326	25-960	0-20 20-30 30-40 40-60 60-130 130-142 142-330	sand, gravel, clay—hardpan (Qpmd) sand, gravel (Qpmd) hardpan (Qr) sand, clay, fine sand (Qpml) clay, some sand and gravel (Qpml over Qb) dry hard gray clay (Qisl or Qb) red and gray clay
327	25-15756	0-10 10-60 60-175 175-350	fill hardpan and boulders (Qpmd) fine silty sand (Qpml, Qisl, Qb) red sandstone
328	N 25-14-178	172	
329	25-3701	0-50 50-90	sand and gravel (Qpmd) hardpan (Qr over Qpml)
330	25-15105	abbreviated 0-15 15-102 102-113 113-142 screened 13	log fill and sand (Qst) gray clay (Qpml) yellow clay (Qisl) sand and gravel (Qis) 81-141, yield 15 gpm
331	25-41264	abbreviated 0-6 6-12 12-39	log fill medium-to-coarse sand (Qal) silty clay (Qpml)
332	25-32177	0-14 14-165 165-188 188-298	clay and gravel (Qpmd) gray-brown clay and silt (Qpml) soft rotten shale red shale
333	N 25-13-634	0-95 95-?	gray muck (Qpmd over Qpml) pinkish gray conglomerate
334	25-31230	>100	
335	25-41391	0-14 14-20	weathered gneiss (Qwg) gneiss
336	25-42845	0-9 9-25	brown medium-to-fine sand, trace clay and silt (Qwg) yellow tan schist, trace mica
337	25-30436	0-25 25-798	sandy hardpan (Qwg) granite
338	25-7631	0-65 65-75 75-82 82-506	clay and stones (Qcg over Qwg) granite rock rotten rock and gray clay (Qwg) granite
339	25-13043	0-74 74-90 90-135 135-150	sand (Qpmd) silt and brown clay (Qpml) gravel (Qis) hardpan and gravel (Qb)

340	25-15508	109		
341	25-2685	0-30 30-65 65-120 120-299	coarse brown sand (Qpmd) fine brown sand (Qpmd) clay (Qpml) red and gray shale	
342	25-13048	0-60 60-125 125-150	sand and gravel (Qpmd) gray clay (Qpml) red rock	
343	25-13593	abbreviated 0-37 37-57 57-442	log brown clay and hardpan with broken stones and rocks gray clay hardpan with coarse sand and gravel (Qwc) red and gray rock	(Qpml over Qwc)
344	25-14035	0-2 2-48 48-60 60-80 85-86 86-145 145-167 167-177 177-197 197-221 at 221	cinder and ash fill (af) brown, gray sandy clay (Qpml) yellowish brown hardpan (Qws) yellow clay and sand (Qws) coarse brown sand (Qws) brown rock, sharp gray rock and clay brown rock reddish brown rock gray rock and clay reddish brown rock	
345	25-14520	0-1 1-3 3-41 41-265	fill dead sand (Qpml or slopewash) swamp clay (Qpml) gray and brown shale	
346	25-5647	0-40 40-140 140-504	brown sand (Qpmd) brown clay (Qpml) gray and red sandstone	
347	25-8577	0-18 18-110 110-130 130-146 146-507	sand (Qpmd) fine sand, clay (Qpmd over Qpml) gravel, clay (Qr or Qpmf) hardpan (Qr) red and gray rock	
348	25-43775	abbreviated 0-48 48-52	log brown sand (Qpmd) silt, little fine sand (Qpml)	
349	25-13439	0-35 35-95 95-118 118-120 120-496	gray clay (Qpml) brown clay (Qpml) yellow clay and stones (Qpml over Qr) red hardpan (Qr) red rock	
350	25-22128	abbreviated 0-60 60-63	log fine sand (Qpmd) silty sand (Qpml)	
351	25-13003	0-50 50-175	sand, gravel (Qpmd) gray clay (Qpml)	
352	25-21873	0-215 215-220 220-298	sand and gravel (Qpmd over Qpmf) red clay, gravel, water (Qb or Qr) red shale	
353	25-11968	abbreviated 0-104 104-125 125-135 135-183	log dirty sand and gravel (Qpmd) dirty sand (Qpmd) clay (Qpml) sand and gravel (Qpmf)	

		183-193 193-600	clay (Qr?) red and gray shale	
354	25-25348	abbreviated 0-32 32-52 52-74	log fill sand, silty sand (Qpmd) sand, gravel, boulders (Qpmf)	
355	25-26568	0-158 158-330 adjacent we	gravel, sand shale ell (45-44955) is screened 141-159, yield 133 gpm	
356	25-14658	0-15 15-78 78-88 88-90 screened 78	clay and small boulders (Qr) brown silt with fine sand and gravel (Qpc, Qpcl) clean gravel (Qis) red clay (Qb or Qisl) -88, yield 100 gpm	
357	25-34001	abbreviated 0-26 26-78	log brown clay, silt, and gravel (Qr) coarse sand and gravel (Qpc)	
358	25-4660	0-98 98-101 101-111 111-160 screened 12	brown shelly rock (Qpml over Qr over Qpc, Qpcl) gravel (Qis) brown shale (Qis or Qisl) good water-bearing sand (Qis) 20-160, yield 1353 gpm	
359	25-42064	0-15 15-25 25-65	brown clayey to sandy till (Qtmr) brown medium-to-fine sand (Qpc) brown gravel and sand (Qpc)	
360	25-6982	0-44 44-72 cased to 72	clay (Qr) sand and gravel (Qpc) , yield 20 gpm	
361	25-4918	0-98 98-101 108-111 111-168 screened 12	brown shaley formation (Qr over Qpc over Qpcl) gravel (Qis) brown shale (Qis or Qisl) good water-bearing sand 20-160, yield 1353 gpm	
362	25-14168 Vecchioli and others, 1967, OEP test hole 11	abbreviated 0-30 30-40 40-79 79-88 88-102 102-108 108-114 114-138 138-141 141-144	log silty sandy brown till (Qr) fine sand with interbedded silt (Qpc or Qpmf) medium-to-coarse sand (Qpc or Qpmf) silty sandy yellowish-brown till (Qr) medium-to-coarse sand, water-bearing (Qpc) fine-to-coarse silty sand (Qpc) laminated brown silty clay (Qpcl) silty sandy clayey yellowish brown to reddish brown till (Qb) silty fine-to-coarse reddish brown sand (Qb) reddish brown shale	
363	25-14149 Vecchioli and others, 1967, OEP test hole 9	abbreviated 0-20 20-30 30-50 50-57 57-71 71-103 103-110 110-120 120-125 screened 10	log yellow-brown clayey till (Qpml over Qr) silty medium sand (Qpc) clayey yellow-brown, brown, and rust colored till, crystalline and s pebbles are highly weathered (Qb) clayey sand (Qisl) sandy, pebbly till, some pebbles highly weathered (Qis or Qb) medium-to-coarse sand with gravel, water-bearing (Qis) medium-to-coarse sand, water-bearing (Qis) coarse sand and gravel, water-bearing (Qis) red shale 00-110, yield 205 gpm	shale
364	25-14147 Vecchioli	abbreviated	log brown silty clay (Qpml)	

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and others,
                       19-30
                                  silty sandy brown till (Qr)
       1967, OEP
                       30-40
                                   sand (Qpc)
       test hole 10
                       40-88
                                  silty sandy brown till, pebbles moderately weathered (Qb)
                       88-120
                                   sand, some fine gravel (Qis)
                       120-124
                                  clayey reddish brown till (Qb or Qws)
                       a 124
                                  red shale
                       screened 105-115, yield 100 gpm
365
       EO 8
                       87
       Thompson,
       1932
366
       EO 36
                       83
       Thompson,
       1932
367
       25-32364
                       0-64
                                   sand, gravel, red clay (Qr over Qpc, Qpcl)
                       64-76
                                  soft red shale and red clay (Qb, Qws)
                       76-123
                                  red and gray rock
       25-14146
368
                       abbreviated log
                                  clayey, pebbly brown till (Qr)
       Vecchioli
                       0-18
       and others,
                       18-30
                                   silty very fine sand (Qpc)
       1967, OEP
                       30-33
                                  sandy brown till (Qpc or Qr)
       test hole 13
                       33-41
                                  sand (Qpc)
                                  pebbly, clayey, silty brown till (Qb)
                       41-49
                       49-54
                                   very-fine-to-fine sand (Qis)
                       54-58
                                  brown till (Qb)
                       58-75
                                  sand (Qis)
                       75-78
                                   reddish brown clay with some sand and gravel (Qis over Qws)
                       78-90
                                   red, gray, tan shale
                       screened 63-73, yield 95 gpm
369
       25-14165
                       abbreviated log
       Vecchioli
                       0-10
                                   sandy brown clay (Qr)
       and others,
                       10-25
                                  silty brownish red very compact till (Qr)
       1967, OEP
                       25-30
                                   coarse-to-medium sand (Qpc)
       test hole 12
                       30-50
                                  silty, sandy, brown to rust till (Qb)
                       50-70
                                  coarse water-bearing sand (Qis)
                       70-75
                                  medium brown silty clayey sand (Qis)
                       75-80
                                   brown plastic clay, some silt and sand (Qisl)
                       80-85
                                  clayey silty reddish brown till (Qb)
                       85-120
                                  silty fine sand, rust-brown, water-bearing (Qis)
                       120-125
                                  red clayey till (Qb or Qws)
                       125-135
                                  red shale
370
       25-4207
                       abbreviated log
       Madison
                       0-15
                                  gray clay and sand (Qr)
                       15-30
                                  brown clay and sand (Qr)
       well B
                                  brownish gray clay (Qpcl)
                       30-45
                       45-60
                                  brownish gray clay mixed with sand (Qpcl)
                       60-70
                                  buff-gray clay (Qpcl)
                       70-118
                                  brown clayey sand (Qis)
                       118-138
                                  yellow clayey sand (Qis)
371
       Hoffman
                       abbreviated log
                       0-22
       and others,
                                   loam and sand (Qr)
       in review,
                       22-42
                                   sand and gravel (Qpc)
       W0367
                       42-73
                                  sand and clay (Qpc, Qpcl)
       (Madison
                       73-164
                                   sand, some gravel and pebbles (Qis)
                       164-169
                                  limestone [shale or till] fragments (Qb?)
                       at 169
                                   rock
       25-1962
                       0-21
                                  hardpan (Qr)
                                   sand and gravel (Qpc)
                       21-27
                       27-28
                                  big gravel (Qpc)
                                   sand and gravel (Qpc)
                       28-30
                       30-65
                                   sand with some clay (Qpc, Qpcl)
                       65-82
                                   coarse sand (Qis)
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		82-90 90-148 148-153 screened 90	sand with clay (Qis) coarse sand and gravel (Qis) fine sand (Qis) 0-130, yield 824 gpm
373	Hoffman and others, in review, W0365 (Madison 6)	abbreviated 0-20 20-27 27-34 34-44 44-60 60-92 92-140 140-163 at 163	log loam and sand (Qr) sand with clay (Qr or Qpc) clean fine sand, some pebbles (Qpc) clay with sand (Qpcl) sand with pebbles (Qpc) clay and hardpan (Qpcl) sand (Qis) sand and shale fragments (Qis, Qb) rock
374	Hoffman and others, in review, W0361 (Madison 1)	abbreviated 0-25 25-40 40-100 100-176 176-200	log dirt and boulders (Qr) coarse gravel (Qpc) clay, dirty sand (Qpcl) sand and gravel (Qis) soft red rock
375	25-14041	same log as screened 25	374 -176, yield 310 gpm
376	25-9821	0-79 79-119 119-127 127-149 149-156	hardpan (thin Qpmf over Qtmr) silty sand (Qpc) red clay (Qpcl or Qisl) water-bearing fine sand (Qis) water-bearing coarse sand (Qis)
377	25-8858	0-5 5-88 88-102 102-112 112-122 122-136 136-140 140-151 151-204 screened 19	earth, clay (Qtmr) clay and fine sand (Qtmr over Qpc, Qpcl) fine sand (Qpcl or Qis) sand and gravel (Qis) granite rock formation (Qis gravel?) clay (Qisl) clay and fine sand (Qisl) clay (Qisl) sand and gravel (Qis) sand and gravel (Qis) 3-203, yield 335 gpm
378	25-34869	abbreviated 0-25 25-38 38-42 42-90 90-205 205-207 at 207 screened 13	log red-brown sand (Qpmf or Qtmr) very coarse sand (Qpc) cobbles and coarse sand (Qpc) silty sand with some gravel (Qpc, Qpcl) red-brown sand and gravel (Qis) rough drilling (Qb?) fresh angular red shale with coarse sand 1-161, yield 23 gpm
379	25-16225	0-20 20-68 68-101 101-116 116-134 134-177 screened 13	fill dirt, overburden, clay and gravel (Qtmr) clay, cobble stones (Qr over Qpc) fine silt and sand (Qpcl) dirty fine brown sand (Qpcl or Qis) solid brown clay (Qpcl or Qisl) clean brown sand and rock (Qis) 7-177, yield 80-100 gpm
380	25-39989	abbreviated 0-39 39-52	log red-brown clayey silt to silty clay with some gravel (Qtmr) sandy silt (Qpc)
381	25-43395	abbreviated 0-25 25-40 40-65	log brown silty sand to clayey silt with gravel (Qtmr) sand (Qpmd) sand, some gravel (Qpmd or Qpc)

		65-70 at 70	very fine sand and silt (Qpcl) refusal (Qis?)	
382	25-37610	0-67	sand and gravel (Qpmd)	
383	25-4209 Hoffman and others, in review W1500	abbreviated 0-15 15-30 30-60 60-151 151-188 188-205 205-217	gray clayey silt (Qpmd?) yellow-brown clayey silt and pebbles (Qr) gray-brown silt and clay (Qpml) brown, reddish brown, yellow-brown clayey sand to s over Qisl) brown sand (Qis) brown clay (Qisl) yellowish brown clay and sand (Qis, Qisl)	andy clay (Qpml-Qpcl
		217-238 238-249 249-266 266-289	red and gray clay mixed with fine-to-coarse sand (Qb) brown clay and fine-to-coarse sand, mixed (Qb or Qis) gray shale red shale	
384	25-11997	0-139 139-148 148-167 screened 15	sand and gravel (Qpmd) clay (Qpml) water-bearing heaving sand and gravel (Qis) 7-167, yield 10 gpm	
385	N 25-14-814	0-75 75-98 98-160	no samples reddish sand and gravel (Qpmd) reddish clay and sand (Qpml)	
386	25-40537	abbreviated 0-79 79-82	log brown sand and gravel (Qpmd) brown silty clay, some sand (Qpml)	
387	25-22329	abbreviated	log brown sand and gravel, little silt (Qpmd)	
388	25-29470	0-60 60-100 100-180 180-250 250-300	dry fine sand and gravel (Qpmd) dry fine sand (Qpmd) clay and sand (Qpml) fine sand (Qis) red rock	
389	25-22182	abbreviated 0-60 60-63	log dry brown fine sand (Qpmd) brown moist silty sand (Qpmd, Qpml)	
390	25-22341	0-20 20-130 130-154 154-156 cased to 15	overburden (Qpml) clay and gravel (Qpml, Qpcl over Qis) fine sand (Qis) sand and gravel (Qis) 4, yield 20 gpm	
391	25-34323	0-50 50-100 100-125 125-160 160-300 screened 13	sand, clay (Qpmd) fine sand (Qpmd, Qpml) coarse sand (Qpmf) coarse sand mixed with gravel (Qpmf) silt, clay (Qpml over Qpcl) 80-150, yield 100 gpm	
392	25-23876	0-15 15-45 45-60 60-80 80-98 98-124 124-132 132-147 147-149 149-165 screened 15	clay, sand, boulders, and gravel (Qtmr) sand, gravel and clay (Qtmr over Qpmd) sand, gravel, and some clay (Qpmd) clay, silt, and a little gravel (Qpml) clay (Qpml) gravel and sand (Qpmf) coarse sand and gravel (Qpmf) fine sand (Qpmf) clay and sand (Qpmf) sand, gravel, and a little clay (Qpmf over Qpml-Qpcl) 10-165, yield 125 gpm	

393	25-33503	0-77	brown sands and cobbles (Qpmd)
		77-115	fine sand and light color clays (Qpml)
		115-155	brown, beige clays and some fine sands (Qpml)
		155-182	red-brown hard clay (Qr)
		182-205 205-208	gray fine-to-coarse sands (Qpmf)
		203-208	multi-colored hard quartz and large stone (Qpmf) brown-yellow sandy clays (Qpcl, Qisl)
		215-222	red clays (Qisl, Qb)
			84-217, yield 660 gpm
394	25-31331	0-32	sand and silt (Qpmd)
		32-87	red-brown medium sand (Qpmd)
		87-132	red-brown silt (Qpml)
		132-147	olive-green clay (Qpml)
		147-152	red-brown clay (Qpml)
		152-172	red-brown silt traced with clay (Qpml)
		172-185 185-202	hard red clay (Qr) medium sand (Qpmf)
		202-218	rock
395	25-25876	190	
396	25-13104	0-6	soil, sand, stones (Qe over Qwb)
		6-84	trap rock
		84-118	red rock
		118-149	trap rock
397	25-40737	0-7	brown clay, silt, trace sand, gravel (Qwb)
371	23 10737	7-16	basalt
398	25-26419	0-7	sandy soil and stones (Qwb)
		7-130	basalt
399	25-27766	10	
400	25-27323	0-6	wet sand (Qwb)
		6-20	clay and stones (Qwb)
		20-170	trap rock
401	25-19966	0-8	overburden (Qwb)
	20 10000	8-100	trap rock
		100-198	red rock
402	25-44231	0-22	yellow brown clay (Qwb)
		22-90	trap rock
403	25-31148	0-12	sandy rocky overburden (Qwb)
103	23 311 10	12-200	shale with layers of rocks and sandstone
404	25-20520	0-30	clay and stones (Qws)
		30-120	shale
405	25.20562		
405	25-20563	23	
406	25-10294	0-406	red shale
		406-426	trap
405	05.41050	0.12	1 (0)
407	25-41960	0-12	clay (Qws)
		12-305	shale
408	25-20168	0-50	red shale
		50-270	gray shale
409	25-19137	0-5	overburden (Qws)
		5-450	sandstone
410	25 24700	0.14	alay (On mil a r Orya)
410	25-34700	0-14 14-71	clay (Qpml or Qws) gray shale
		17-/1	Sing sinuic

		71-198	red shale	
411	25-17858	0-30 30-175	gravel (Qpml over Qws or Qal?) gray and red rock	
412	24-7102	0-59 59-95 95-120	clay (Qpml) clay and gravel (Qpml over Qws or Qwc) gray shale and sandstone	
413	25-12156	0-2 2-198 198-212	dirt (Qwb) trap rock red shale	
414	25-34109	0-5 5-21 21-46 46-400	sand and gravel (fill) sand and silt, cobbles (fill) gray and red clay (Qws) red shale	
415	25-32124	30		
416	25-13785	21		
417	25-13008	0-22 22-95 95-300	red clay (Qwc) gray rock trap rock	
418	25-13084	0-40 40-225	clay and gravel (Qcg over Qws) red rock	
419	25-26099	0-20 20-400	overburden (Qr) sand, gravel, red rock (Qpc over bedrock, cased to 110 rock)), possible depth to
420	25-13414 Vecchioli and Nichols, 1966, area 2, OEP test well 2	abbreviated 0-5 5-18 18-27 27-39 39-43 43-60 60-62 62-95 95-99 99-104 screened 7	black clay brown clayey silt, laminated, little fine sand and grave yellowish brown till (Qr) sand and gravel (Qpc) yellowish brown till (Qr) medium-to-coarse sand and gravel (Qpc) yellowish brown till (Qr) sand and gravel (Qpc or Qis) brown till (Qb) reddish brown shale 1-81, yield 505 gpm	l (Qr, Qpml)
421	25-42738	0-15 15-40 40-52 52-75 75-85 85-105 105-115	clayey silt (Qpml, Qr) glacial till (Qr) medium-to-coarse silty sand with little clay (Qpc) coarse gravel (Qpc) fine-to-medium sand (Qpc) clay, weathered shale (Qpcl over Qb) shale	
422	45-231	0-58 58-60 60-90 90-120 120-135 135-150 screened 12	clay and small stones (Qpmf over Qr) fine sand (Qpc) water-bearing sand mixed with clay (Qpc, Qpcl) clay mixed with stones (Qisl) sand, gravel, water-bearing (Qis) coarse sand, water-bearing (Qis) 20-150, yield 790 gpm	

¹Identifiers of the form 25-xxxx, 45-xxxx, or 24-xxxx are well permit numbers issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation. Identifiers of the form "N xx-xx-xxx", are entries in the N. J. Geological Survey permanent note collection. Identifiers accompanied by a reference, for example, "P47,

Canace and others, 1993" are from the cited publication.

²A 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 other non-informative nomenclature. 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 indicated in parentheses. Map units are omitted in a few cases where logs have insufficient detail. 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, or have minor details omitted. Many bedrock descriptions have been condensed; these are not identified as abbreviated. For wells completed in surficial materials, the screened interval, or depth to which the well is cased, and yield (in gallons per minute, gpm) are reported beneath the log. Map units are inferred from the known extent of materials at the surface and from known depositional settings, in addition to the drillers' descriptions.