NEW JERSEY GEOLOGICAL SURVEY

Surficial deposits in the Paterson quadrangle include artificial fill, alluvial, alluvialfan, swamp, talus, and stream-terrace deposits, all of postglacial age; glaciolacustrine and glaciofluvial deposits of late Wisconsinan age; and till of late Wisconsinan and possible Illinoian age. Postglacial deposits are generally less than 30 feet thick. Glaciofluvial sand and gravel deposits are also generally less than 30 feet thick. The glaciolacustrine deposits include stratified sand, gravel, silt, and clay

The accompanying map and sections show the surface extent and subsurface relations of these deposits. The composition and thickness of the deposits, and the glacial and postglacial events they record, are described in the Description of Map *Units*. Well and boring data used to construct bedrock-surface elevation contours and to infer the subsurface distribution of the deposits are provided in table 1 (in pamphlet). The composition of pebbles in the surficial deposits is shown in table 2 (in pamphlet). The chronologic relationships of the deposits are shown in the Correlation of Map Units. Aquifer properties of the deposits are briefly described

and are as much as 180 feet thick. Till is as much as 100 feet thick.

AQUIFER PROPERTIES

Surficial deposits in the quadrangle yield ground water to domestic, industrial, and public-supply wells in several areas and affect the movement of water and pollutants from the land surface into lakes, streams, and underlying bedrock and glacial aquifers. Yields and screened intervals for wells tapping glacial deposits are provided in table 1. In the Franklin Lake area, wells draw water from glaciolacustrine sand and gravel (units Qfl1, Qfl2, and Qfl2f), with yields of as much as 400 gallons per minute (gpm). Fine sand and silt in this area (unit Qfl21) are much less productive, and may locally act as a semi-confining layer. A few wells also draw water from glaciolacustrine sand and gravel (units Qpm and Qpg) in the Preakness Valley. Much of this valley, however, is underlain by fine-grained lake-bottom sediment that is not an aquifer. Glaciolacustrine sand and gravel (unit Qpg) is also tapped by a few wells in the Passaic and Peckman River valleys in Totowa and West Paterson, where the producing beds may be locally confined by overlying silt and clay (unit Qpgl). Elsewhere, sand and gravel deposits are generally too thin to be productive aquifers. Till is not sufficiently thick or permeable to be an aquifer, although a few wells withdraw small quantities of water from either sandy till or

Hydraulic conductivities of the surficial deposits may be estimated from statewide glacial aquifer-test data on file at the N. J. Geological Survey (Mennel and Canace, 2001) and published aquifer-test and laboratory data summarized by Stanford and Witte (in press). Sand and gravel deposits (units Qho1, Qho2, Qho3, Qfl1, Qfl2, Qfl3, Qfl2f, Qpm, Qpg, Qnh, Qpr, Qpt, Qmt, Qve, Qdw, Qsh1, Qsh2, Qic, Qst, Qaf, and parts of Qal and Qsp) 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 (Qn, parts of Qr and Qry) are also permeable, having estimated hydraulic conductivities from 10⁻¹ to 10² ft/d. Silt and clay lake-bottom deposits (parts of units Qpml, Qpgl, Qpl) are of low permeability, having estimated hydraulic conductivities of 10⁻⁵ to 10⁻³ ft/d. Fine sand and silt lake-bottom, alluvial, and wetland deposits (Qfl2l and parts of units Qpml, Qpgl, Qpr, Qal, Qsp, and Qs) and sandy silt till (parts of units Qr and Qry) are somewhat more permeable, having estimated hydraulic conductivities of 10^{-3} to 10^{-1} ft/d. Swamp deposits (Qs) and fill (af) have variable hydraulic conductivities that depend on the clay and silt content of the material. Peats with little mineral soil, and fill composed of sand, cinders, gravel, demolition debris, slag, and trash, may be highly permeable.

sand and gravel beds (unit Qsp) beneath till.

DESCRIPTION OF MAP UNITS

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

- ARTIFICIAL FILL--Artificially emplaced sand, gravel, silt, clay, and rock fragments, and man-made materials including cinders, ash, brick, concrete, wood, slag, asphalt, metal, glass, and trash. Color variable but generally dark brown, gray, or black. As much as 60 feet thick but generally less than 20 feet thick. Many small areas of fill are not mapped. Some areas of fill are inferred from the extent of swamps and alluvial deposits shown on manuscript geologic and topographic maps on file at
- Qal ALLUVIUM--Sand, silt, pebble-to-cobble gravel, minor clay; dark brown, brown, reddish-brown, gray; moderately to well sorted, stratified to massive. Contains variable amounts of organic matter, demolition debris, and trash. As much as 20 feet thick.

the N. J. Geological Survey (ca. 1900).

- ALLUVIAL FAN DEPOSITS--Pebble-to-cobble gravel, sand, minor silt; brown to yellowish-brown; moderately sorted, stratified. As much as 20
- STREAM TERRACE DEPOSITS--Sand, pebble-to-cobble gravel, minor silt; brown, yellowish-brown, reddish-brown; moderately to well sorted, stratified. As much as 20 feet thick (estimated). Forms terraces with surfaces slightly above the modern floodplain along Peckman River and Preakness Brook.
- PASSAIC TERRACE DEPOSIT--Sand, pebble-to-cobble gravel, minor silt; reddish-brown to yellowish-brown, brown; moderately to wellsorted, stratified. Deposited by the Passaic River after glacial lakes

drained. As much as 30 feet thick.

- SWAMP DEPOSITS--Peat and organic silt, clay, and fine sand; black, dark brown, and gray. As much as 40 feet thick (Waksman and others, 1943, p. 200), but generally less than 20 feet thick.
- TALUS--Angular chips, flagstones, cobbles, and, locally, boulders, of salt, with little or no matrix material. Forms aprons at base of cliffs. As much as 10 feet thick (estimated). Many small talus deposits not mapped.
- Qe EOLIAN SAND--Fine sand, yellowish-brown to very pale brown. Forms small dunes on surface of the Passaic terrace in Totowa and Paterson. As much as 15 feet thick.

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 Qn, Qr, Qry, 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 (Qho1, Qho2, Qho3, Qfl1, Qfl2, Qfl3, Qfl2f, Qpm, Qpg, Qhn, Qpr, Qve, Qdw, Qsp). The stratified sediments also include silt, clay, and fine sand deposited on the bottoms of glacial lakes (Qfl2l, Qpml, Qpgl, Qpl) and moderately to poorly sorted sand and gravel deposited in ice-walled basins and ponds (Qic). All of these deposits are of late Wisconsinan age except Qb, which may be of Illinoian age.

The orientation of striations and distribution of till indicates that late Wisconsinan ice advanced toward the southwest across the Paterson quadrangle. This ice was on the west side of an advancing lobe channeled between the Palisades Ridge to the east and the Watchung Mountains to the west (Salisbury, 1902; Stanford and Harper, 1991). During advance the land surface was shaped by glacial erosion. Throughout most of the quadrangle, older glacial deposits and soils were stripped off and the underlying sandstone and basalt bedrock was eroded into streamlined forms. Elevation contours of the bedrock surface, plotted at 50-foot interval on the map, show this streamlined topography. Sandstone and shale were locally eroded into closed-basin troughs beneath the Passaic Valley east of First Watchung Mountain, in West Paterson and Totowa, and at the south end of Preakness Valley. Where the ice did not erode deeply, for example, beneath the drumlin in Ridgewood,

along the east slope of Preakness Mountain and Second Watchung Mountain, and

in scattered locations east of First Watchung Mountain, earlier glacial deposits (Qb,

Qsp) are locally preserved beneath till.

Till was deposited discontinuously on the bedrock surface. It is thickest on the east- and northeast-facing slopes of the Watchung ridges, which faced the advancing ice, and on sandstone uplands east of First Watchung Mountain, where it forms drumlins or contributes to the streamlined shape of bedrock ridges. It is thin and patchy on the top and west slopes of the Watchung ridges, where bedrock outcrop is abundant. The late Wisconsinan till includes three varieties: a yellowishbrown to gray silty sand till (Netcong till, Qn) derived mostly from the gneiss bedrock of the Hudson Highlands, just north of the quadrangle, a reddish-brown silty sand to sandy silt till (Rahway till, Qr) derived from the local red sandstone bedrock, and a yellow to reddish-yellow sandy silt till (Rahway till, yellow phase, Qry) derived from local basalt. Netcong till was deposited chiefly on uplands in the

NORTH HALEDON DEPOSIT--Deltaic deposit laid down in a small lake between the ice margin and east slope of Second Watchung Mountain, with a spillway to the south along the ice-walled valley side at an elevation of about 380 feet. northern part of the quadrangle where the base of the glacier had not travelled far in contact with the local bedrock, whereas Rahway till (both Qr and Qry) was

Late Wisconsinan ice advanced to its southernmost position at Perth Amboy, about 40 miles south of Paterson. The ice front began to retreat from this position before 20,000 yrs B. P., and had likely retreated north of the Paterson quadrangle by 18,000 yrs B. P. (Stanford and Harper, 1991). The retreating ice margin maintained a lobate form with an apex centered in the broad lowland east of the quadrangle. Recessional ice margins, which are marked by ice-contact glaciolacustrine deposits, trend north-south or slightly northwest-southeast in the Paterson quadrangle (fig. 1). The retreating ice margin dammed east- or north-draining valleys, including the main Passaic Valley, to form the glacial lakes in which most of the recessional deposits were laid down. Glacial-stream deposits were laid down in three valleys after lakes drained. Details of the history of glacial lakes and glacial streams are provided in the following description of map units. Names of the lakes follow those

deposited elsewhere in the quadrangle, where ice had travelled some distance in

Till overlying deformed lacustrine deposits was observed in two exposures in the Preakness Valley and was formerly exposed in two clay pits in Totowa. These exposures, and westerly striations on Second Watchung Mountain in Totowa that cut across the earlier southwesterly regional striations, suggest a local readvance of the ice margin (from M1 to M2 on figure 1) during retreat. This readvance was just before Lake Passaic lowered from its highest stage, and may have occurred in part because the deep water in the lake at this time (over 200 feet) buoyed the ice margin, permitting easier movement.

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. Bedding in the deltas includes inclined foreset beds of sand, pebbly sand, and minor pebble-tocobble 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 and gray mudstone and sandstone, with some reddish-brown sandstone and conglomerate, white quartz, purple quartzite, and basalt.

HOHOKUS DEPOSITS--Deltaic deposits laid down in three lake stages in the icedammed headwaters of the Goffle Brook valley. Spillways are across a sandstone escarpment at elevations of about 420 feet (Qho1), 355 feet (Qho2), and 330 feet (Qho3). Drainage from the Qho3 spillway carved the ravine in sandstone along Deep Brook. The portion of the lake in the Paterson quadrangle drained when the Goffle Brook valley in Midland Park was deglaciated.

- Very fine-to-coarse sand, pebbly sand, minor silt and cobbles. As much as 30 feet thick.
- Qho2 Fine-to-medium sand. As much as 30 feet thick.
- Fine-to-medium sand, some pebble-to-cobble gravel. As much as 40 feet

GLACIAL LAKE PARAMUS DEPOSITS--Deltaic and lake-bottom deposits, undifferentiated, laid down in glacial Lake Paramus. Lake Paramus occupied the Passaic Valley downstream from Hawthorne and was controlled by a spillway at an elevation of about 35 feet across a dam of previously deposited deltaic sediment that blocked the Passaic Valley at Rutherford, about 5 miles south of Paterson. Lake level in the Paterson quadrangle rises northward from about 45 feet in Clifton to 60 feet in the Hawthorne area due to postglacial rebound. Lake Paramus drained when the Musquapsink Brook valley near Westwood, 8 miles northeast of Paterson, was deglaciated, opening eastward drainage into the Hackensack Valley. Unit Qpr includes glaciofluvial deposits in the Diamond Brook and Goffle Brook valleys that grade downstream to deltaic deposits.

Fine-to-medium sand, pebbly sand, minor coarse sand and pebble-to-cobble gravel. Well and horing logs indicate that silt wars for any logs. cobble gravel. Well and boring logs indicate that silt, very fine sand, and clay occur locally in the subsurface. As much as 70 feet thick.

SANDY HILL DEPOSITS--Deltaic and lake-bottom deposits, undifferentiated, laid down in two lake stages in the main Passaic Valley. The high stage (Qsh1) was controlled by one or two spillways at between 140-150 feet in elevation across a sandstone upland, draining south into the Weasel Brook valley. The lower stage (Qsh2) was controlled by a spillway at 85-90 feet that drained south into Lake Delawanna. The lower stage lowered to the Lake Paramus level when ice melted off the west slope of the Passaic Valley at Cedar Lawn Cemetery.

Qsh2 Fine-to-medium sand and pebbly sand. As much as 40 feet thick.

Fine-to-medium sand and pebbly sand, minor silt, clay, and pebble-tocobble gravel. As much as 60 feet thick. Includes an erosional remnant of a nonglacial delta at Mount Nebo and Laurel Grove cemeteries in Totowa deposited by the Passaic River.

GLACIAL LAKE DELAWANNA DEPOSIT--Deltaic deposits laid down in Lake Delawanna. This lake occupied the Passaic Valley and western tributary valleys between Clifton and Belleville, which is about 6 miles south of Clifton. The lake was held in by a sediment dam across the Passaic Valley near Belleville. The lake level in the Paterson quadrangle was about 70 feet. Lake Delawanna lowered to the Lake Paramus level when the Belleville dam was eroded.

Qdw Fine-to-medium sand and pebbly sand. As much as 40 feet thick. FRANKLIN LAKES DEPOSITS--Deltaic (Qfl1, Qfl2, Qfl3), lake-bottom and deltaic

(Qfl2I) and lacustrine-fan (Qfl2f) deposits laid down in three stages of a glacial lake occupying the Pond Brook valley. The northwest-draining preglacial valley is west of the present Pond Brook and is entirely filled with lacustrine deposits. The highest spillway (Qfl1) is at about 460 feet, along the base of High Mountain, into the Molly Ann Brook valley. The intermediate spillway (Qfl2) is at about 435 feet, through Franklin Clove, a deep gap in Preakness Mountain, into the Preakness Valley. The lowest spillway (Qfl3) is at about 420 feet, across Qfl2 deposits, into the Molly Ann Brook valley. The lake drained into the Ramapo Valley when the Ramapo and Pond Brook valleys at Oakland, about 2 miles northwest of Franklin Lake, were deglaciated.

Qfi3 Fine-to-coarse sand and pebble-to-cobble gravel. As much as 20 feet Qfl2 Fine-to-coarse sand and pebble-to-cobble gravel. As much as 120 feet thick. Includes deltaic foreset and topset beds laid down in the

intermediate lake stage.

Very fine-to-fine sand, minor silt and clay. As much as 120 feet thick. Includes deltaic bottomset beds and lake-bottom deposits laid down in the intermediate lake stage. In subsurface only. Inferred from water-well Sand and pebble-to-cobble gravel. As much as 70 feet thick. Includes lacustrine-fan deposits laid down in the intermediate lake stage. In subsurface only. Inferred from water-well records.

Fine-to-coarse sand, pebble-to-cobble gravel. As much as 130 feet thick. Includes possible crevasse-fill deposits forming the ridge east of High

Qnh Fine-to-coarse sand, minor pebble-to-cobble gravel. As much as 30 feet

GLACIAL LAKE PASSAIC DEPOSITS--Deltaic, lake-bottom, and lacustrine-fan deposits laid down in two stages of glacial Lake Passaic. Lake Passaic filled the central Passaic River basin between Second Watchung Mountain and the Highlands. The high, or Moggy Hollow, stage (Qpm) was controlled by a spillway at Moggy Hollow near Far Hills, 30 miles southwest of Paterson. Elevation of the lake level at this stage in the Paterson quadrangle was 390 to 410 feet. The lower, or Great Notch, stage (Qpg) was established when the retreating ice front

uncovered Great Notch, a gap in First Watchung Mountain just south of the quadrangle boundary. The Great Notch spillway is at an elevation of about 305 feet, and the elevation of the lake level at this stage in the Paterson quadrangle ranges from 305 to about 320 feet. The Great Notch stage lowered to the level of stage 1 of the Sandy Hill lake (see above) when the north end of Garrett Mountain was deglaciated. Discharge from this lowering cut a large channel that forms the valley east of Broad Street in Clifton. For a short time after this lowering, the lacustrine-fan deposit at Laurel Grove Cemetery in Totowa may have dammed the Passaic Valley upstream of that point, holding in a postglacial lake (here named the "Totowa stage") with a spillway at an elevation of about 190-195 feet. The channel cut into the deposit along Dewey Avenue may be this spillway. Erosion, however, soon

- Fine-to-coarse sand and pebble-to-cobble gravel, minor silt and very fine sand. As much as 120 feet thick. Deposited in the Moggy Hollow stage of Lake Passaic. Includes lacustrine-fan, delta, and ice-contact deposits. A readvance till was observed within these deposits at two places in the northern end of the Preakness Valley (indicated by symbols on the map), and is also reported by several water-well logs in the same area. This readvance deformed the underlying sediments and may account for the hummocky, ridged topography of the deposits between Point View
- Reservoir and Ratzer Road. Silt, clay, fine sand. As much as 100 feet thick. Deposited on the lake bottom during the Moggy Hollow stage. Readvance till was formerly observed overlying and deforming these deposits at two pits in Totowa (indicated by symbols on the map).
- **Qpg** Fine-to-coarse sand and pebble-to-cobble gravel, minor very fine sand, clay, and silt. As much as 100 feet thick. Deposited in the Great Notch stage of Lake Passaic. Includes lacustrine-fan deposits between West Paterson and Haledon, and a delta in the Preakness Valley deposited by meltwater flowing through the gap in Preakness Mountain and eroding the earlier Moggy Hollow-stage deposits.
- Silt, clay, fine sand. As much as 50 feet thick. Deposited on the lake bottom during the Great Notch stage.
- Silt, clay, fine sand. As much as 70 feet thick. Lake-bottom deposits undifferentiated as to stage. In northern Preakness Valley only.

GLACIAL LAKE VERONA DEPOSITS--Deltaic deposits laid down in Lake Verona. This lake occupied the north-draining Peckman River valley and was controlled by a spillway at an elevation of about 400 feet on the drainage divide at the head of the

Watchung Mountain in Cedar Grove and North Caldwell was deglaciated. Qve Fine-to-coarse sand, minor silt and pebble-to-cobble gravel. As much as

to the Moggy Hollow stage of Lake Passaic when the north end of Second

PRE-ADVANCE STRATIFIED DEPOSITS--Deltaic and lake-bottom deposits, undifferentiated. In subsurface only, beneath late Wisconsinan till. Laid down in proglacial ponds that were dammed, and then overrun, by the advancing ice. Exposed in a ravine in the valley south of High Mountain; elsewhere inferred from

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

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

Pebble-to-cobble gravel and sand, locally cobble-to-boulder gravel and sandy, cobbly diamicton; moderately sorted; variably stratified. As much

Glacial Stream Deposits--These are stratified and generally well-sorted. They include sand and gravel forming plains and terraces in the Preakness, Molly Ann Brook, and upper Goffle Brook valleys, which were exposed after glacial lakes drained. Color and sand and gravel composition similar to that of glacial-lake

MELTWATER TERRACE DEPOSITS--Glacial-stream deposits forming terraces in the Preakness, Molly Ann Brook, and upper Goffle Brook valleys. Deposits in the Preakness Valley were laid down after draining of the Great Notch stage of Lake Passaic by meltwater discharging through the gap in Preakness Mountain from spillway Qfl2. This meltwater channeled into the Lake Passaic deltas at the head of the valley and deposited the eroded sand and gravel in a plain on the former lake bottom. The downstream part of this plain may be a shallow-water delta deposited in the Totowa stage of Lake Passaic (see above) before the Passaic River completed downcutting through the lacustrine fan in Totowa. The terrace deposit in the Molly Ann Brook valley was laid down after draining of the Great Notch stage of Lake Passaic. The downstream end of this deposit may be a shallow-water delta laid down in the upper stage of the Sandy Hill glacial lake (Qsh1). The terrace deposit

in the upper Goffle Brook valley was laid down after draining of stage 3 of Lake

Fine-to-coarse sand, pebbly sand, minor pebble-to-cobble gravel. As much as 30 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 late Wisconsinan tills are in gradational contact with each other. Netcong till in places grades downward

Qn NETCONG TILL--Yellow, yellowish-brown, reddish-yellow, very pale brown (oxidized) to grayish- brown and brown (unoxidized) silty sand to sandy silt with many (10-40 percent by volume) subrounded to subangular pebbles and cobbles, and few (less than 5 percent) to some (5-10 percent) boulders. Depth of oxidation ranges from 10 to about 50 feet. Till 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 a little red sandstone and conglomerate, basalt, and purple-to-gray quartzite. Boulders are chiefly gneiss; very few are quartzite, basalt, or gray and red sandstone. Clast composition reflects southerly glacial transport from the Wallkill and Hudson Valleys underlain by Paleozoic RAHWAY TILL--Reddish-brown, light reddish-brown, reddish-yellow silty sand to sandy silt containing some to many subrounded and subangular pebbles and cobbles and few subrounded boulders. Matrix is compact, nonsticky, nonplastic to slightly plastic, nonjointed, and may have subhorizontal fissility. Gravel clasts include chiefly red and gray sandstone and siltstone, gray gneiss, and a little white quartz, purple quartzite, and basalt. Boulders are chiefly gneiss; a very few are quartzite, gray and red sandstone, and basalt. As much as 80 feet thick.

Unit Qrt delineates areas where Qr is discontinuous and generally less

RAHWAY TILL, YELLOW PHASE--Reddish-yellow, yellow, very pale brown silty sand, sandy silt, and silt with some to many subangular and subrounded pebbbles and cobbles and few subrounded boulders. Matrix is compact, nonsticky to slightly sticky, slightly plastic, nonjointed, and may have subhorizontal fissility. Gravel clasts include chiefly gray (weathering reddish-yellow) basalt and gray gneiss, with some gray and red sandstone and siltstone and purple quartzite. Boulders are chiefly

than 20 feet thick.

gneiss and basalt, with few quartzite and sandstone. As much as 60 feet thick. Unit Qryt delineates areas where Qry is discontinuous and generally less than 20 feet thick. On steep slopes on Preakness Mountain, particularly in the gap just south of Franklin Lake, Qryt includes thin rubbles of angular basalt cobbles and flagstones with little or no till cover. These rubbles were formed by both postglacial mechanical weathering and glacial deformation of finely jointed basalt

Qb BERGEN TILL--Reddish-brown to reddish-yellow sandy clayey silt to sandy clay. Gravel content and composition similar to Rahway till. Matrix is compact, moderately sticky and plastic, and weakly jointed. Gneiss, sandstone, and mudstone clasts have weathering rinds or are fully decomposed. As much as 30 feet thick. In subsurface only. Exposed in ravine in the valley on the south side of High Mountain, and likely occurs elsewhere under thick late Wisconsinan till. Of pre-Wisconsinan (possible Illinoian) age.

MAP SYMBOLS Contact--Long-dashed where approximately located, short-dashed where gradational or feather-edged, dotted where concealed by fill or water.

— **Drumlin--**Line along crest, symbol on summit. **Striation--**Observation at dot. Solid dot indicates striation measured on

bedrock surface. Open dot indicates striation measured on surface of large boulder. On outcrops with multiple striations, older striations are indicated

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

Scarp cut by glacial meltwater--Line at top, ticks on slope. Excavation scarp--Line at top of slope, ticks toward excavation. Outlines quarries and former sand and gravel pits. Topography within these areas may differ from that on the base map.

Active quarry (in 2001) **★** Inactive quarry (in 2001) X Inactive sand and gravel pit (in 2001)

Qsh1 Spillway for glacial lake--Symbol in spillway area, arrow indicates direction of drainage.

•247 Well with log in table 1--Location accurate within 100 feet.

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

75▲ Elevation of bedrock surface from seismic survey--From Lacombe and **▽ e Large gneiss boulder-**-Noteworthy erratic boulder transported from the

Hudson Highlands. **Boulder lag--**On till surface washed by meltwater, with thin alluvium.

Readvance till observed--Solid triangle indicates exposures where Rahway till, yellow phase (Qry) overlies deformed deltaic sand and gravel (Qpm). Qry/Qpml Observed in 1987 and 2001. Open triangle indicates former exposures where Rahway till (Qr and Qry) overlies deformed lake-bottom silt and clay (Qpml) (Salisbury, 1902; N. J. Geological Survey permanent notes 26-1-639

—Qb Subsurface unit exposed--In ravine banks, observed in 2001.

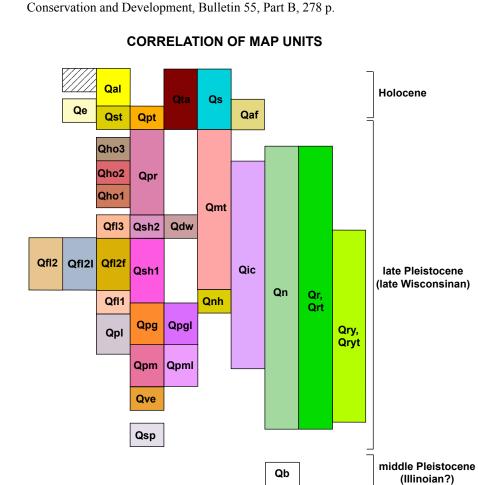
 \triangle 6 Site of pebble lithology count--Data in table 2. Elevation of bedrock surface—Contour interval 50 feet.

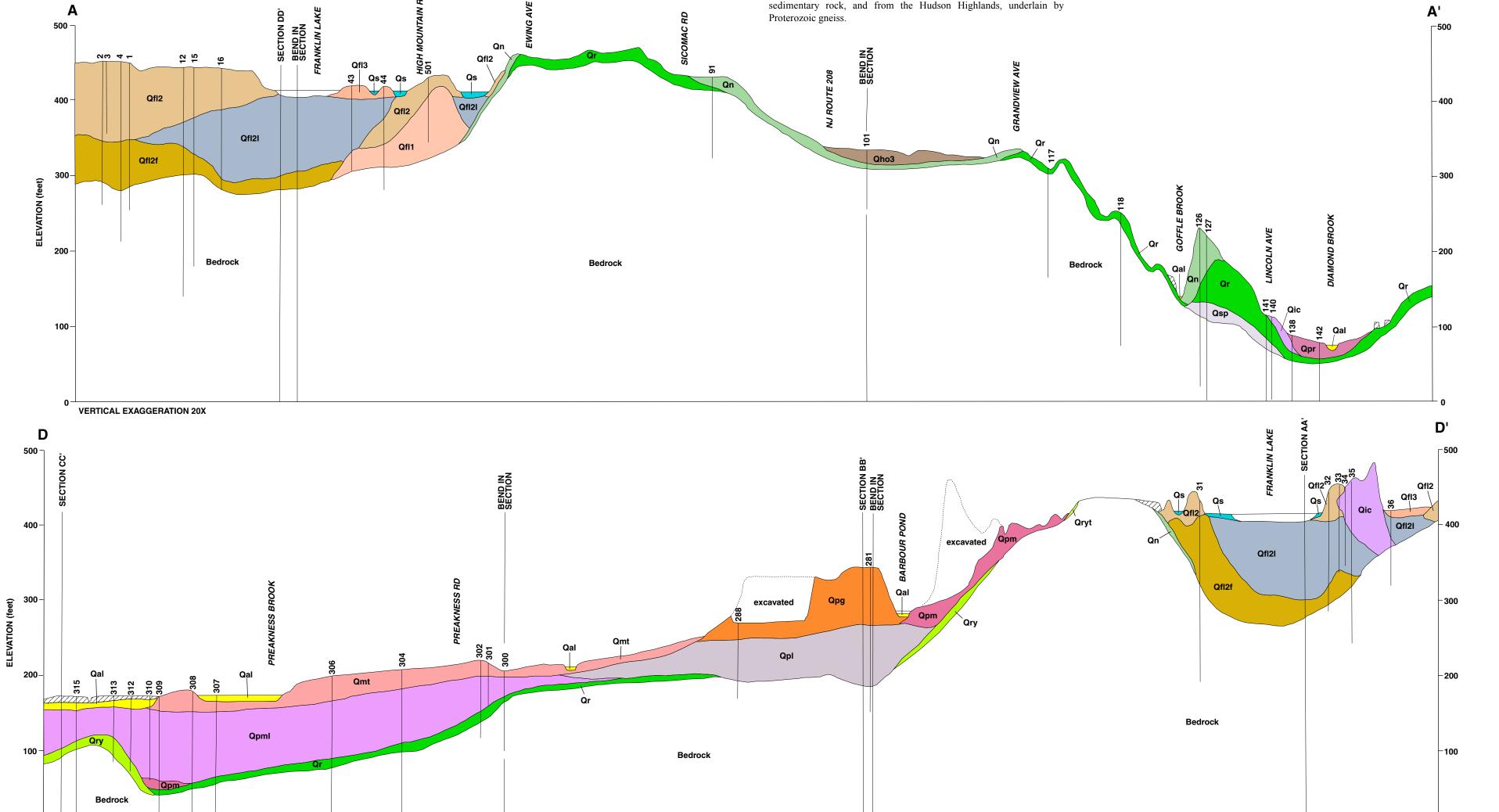
Bedrock outcrop--Many small outcrops on the Watchung Mountains, within units Qrt and Qryt, are not shown.

Well on sections--Projected to line of section. REFERENCES

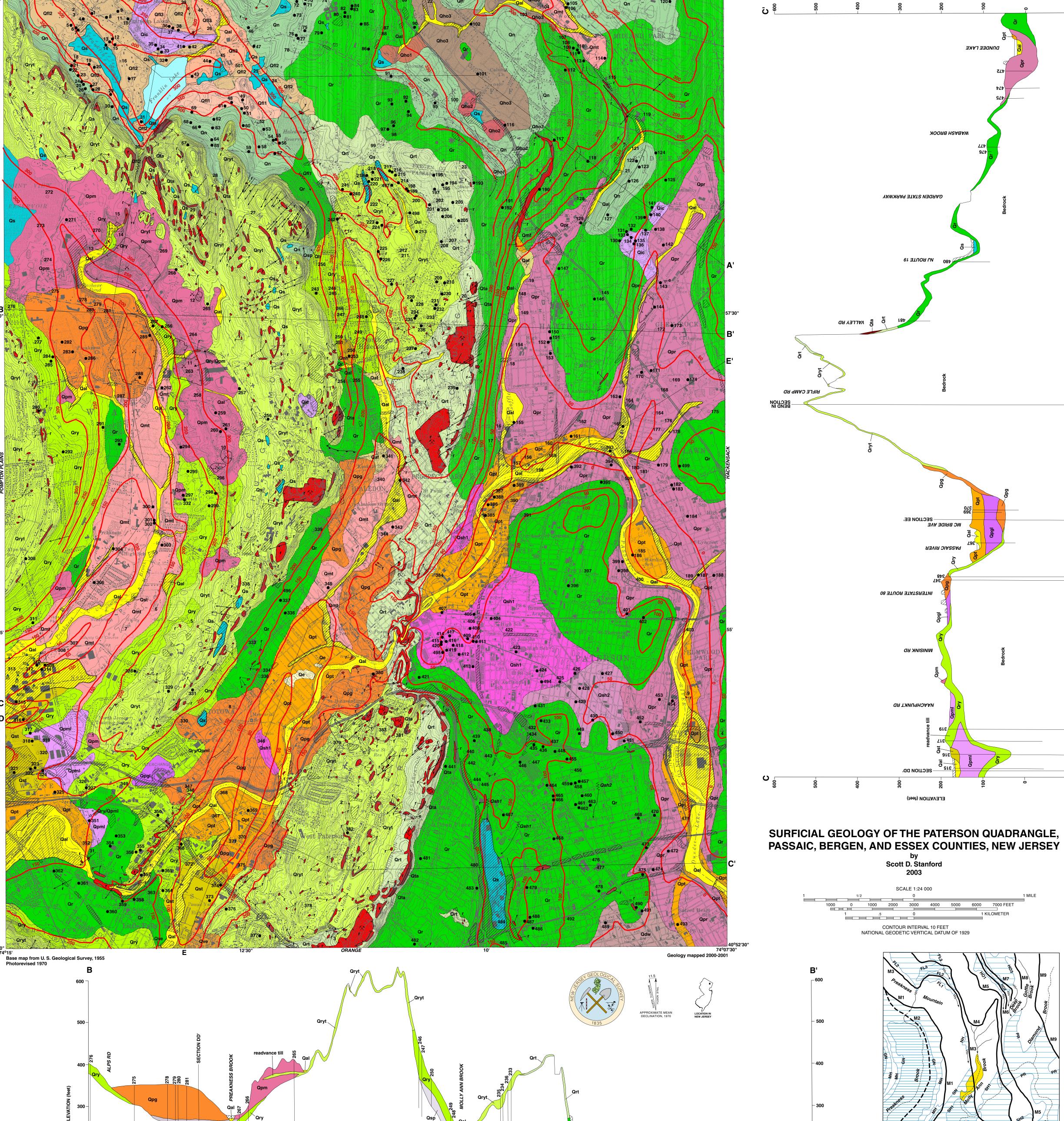
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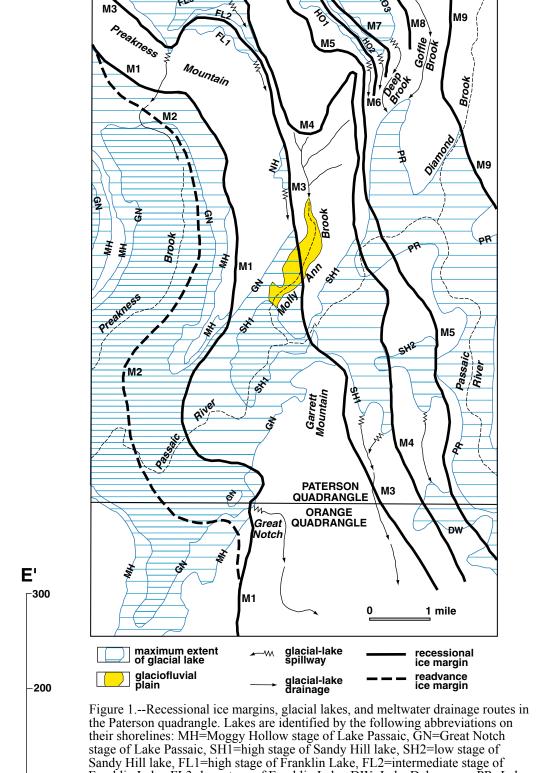
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Prepared in cooperation with the SURFICIAL GEOLOGY OF THE PATERSON QUADRANGLE U. S. GEOLOGICAL SURVEY PASSAIC. BERGEN. AND ESSEX COUNTIES. NEW JERSEY **NATIONAL GEOLOGIC MAPPING PROGRAM OPEN FILE MAP OFM 54**





Pamphlet containing tables 1 and 2 accompanies map

Franklin Lake, FL3=low stage of Franklin Lake, DW=Lake Delawanna, PR=Lake Paramus, HO1= high stage of Lake Hohokus, HO2=intermediate stage of Lake Hohokus, HO3=low stage of Lake Hohokus. Ice-margin abbreviations are: M1=last margin before Great Notch is uncovered and Lake Passaic drops from the Moggy Hollow stage to the Great Notch stage. Delta and ice-contact deposits laid down at the head of Preakness Valley. M2=approximate limit of readvance from M1, as inferred from readvance till localities. M3=last margin before draining of Great Notch stage. North Haledon deposits and deposits in high stage of Franklin Lakes laid down. Meltwater drainage through the gap in Preakness Mountain deposits a non-ice-contact delta in Lake Passaic at the head of Preakness Valley. M4=last margin before high stage of Sandy Hill lake lowers to the low stage, and before intermediate stage of Franklin Lake lowers to the low stage. M5=last margin before Lake Delawanna and low stage of Sandy Hill lake lower to Lake Paramus level. M6=ice margin during high stage of Lake Hohokus. M7=ice margin during intermediate stage of Lake Hohokus. M8=last ice margin before low stage of Lake

Hohokus drains. M9=Fair Lawn ice margin. Deltas built into Lake Paramus in the Goffle and Diamond Brook valleys. Ice-contact deposits laid down in Ridgewood.

Surficial Geology of the Paterson Quadrangle Passaic, Bergen, and Essex Counties, New Jersey

New Jersey Geological Survey Open-File Map 54 2003

pamphlet to accompany map

Table 1.--Selected well and boring records.

Well No.	Identifier ¹	Depth to bedrock or driller's log with depth and description ²
1	23-5378	0-110 sand and gravel (Qfl2) 110-297 trap rock
2	23-5693	155
3	23-2393	0-97 layers of sand and gravel (Qfl2) cased to 97, yield 6 gpm
4	23-5802	170
5	23-4383	0-105 sand and hardpan(Qfl2) 105-112 gravel bed (Qfl2f) cased to 112, yield 15 gpm
6	23-5857	129
7	23-5473	0-127 bouldery overburden turning to hardpan, then layers of hardpan and gravel (Qfl2 over
		Qf12f) 127-172 bedrock
8	23-3815	0-103 layers of hardpan, sand, and gravel (Qfl2) cased to 103, yield 9 gpm
9	23-3731	0-100 sand and gravel cased to 100, yield 15 gpm
10	23-2650	0-70 sand and gravel (Qfl2) yield 7.5 gpm
11	23-2799	0-80 sand and gravel (Qfl2) cased to 80, yield 8 gpm
12	23-5430	164
13	23-5830	0-70 sand and gravel (Qfl2) 70-140 hardpan (Qfl2f?) 140-215 bedrock
14	23-5756	126
15	23-5869	0-135 sand and gravel (Qfl2 over Qfl2f) 135-170 red shale 170-265 trap rock

16	23-2576	0-8 8-152 152-160 cased to 1	sand and gravel (Qfl2 topset beds) dead sand (Qfl2 over Qfl2l) gravel and sand (Qfl2f) 60, yield 20 gpm
17	23-5169	0-175 175-240	sand and gravel (Qfl2 over Qfl2l over Qfl2f) red shale and sandstone
18	23-5263	85	
19	23-5167	85	
20	23-5266	0-109 109-170	sand and gravel (Qfl2) red shale
21	23-5267	25	
22	23-5221	48	
23	23-5203	40	
24	23-5202	56	
25	23-5205	63	
26	23-5264	56	
27	23-4502	49	
28	23-4091	0-20 20-69 69-158	gravel and sand (Qfl2) hardpan with boulders (Qn) red sandstone
29	23-4956	60	
30			
	23-4159	0-50 50-158	hardpan (Qn) shale
31	23-4159		
31		50-158 0-155	shale gravel and boulder overburden (Qfl2 over Qfl2f)
	23-4710	0-158 0-155 155-245 0-22 22-48 48-160 160-165 0-28 28-80 80-113 113-115	gravel and boulder overburden (Qfl2 over Qfl2f) bedrock sand and gravel (Qfl2) sandy soil with boulders (Qfl2) hard packed sand (Qfl2l)
32	23-4710	0-158 0-155 155-245 0-22 22-48 48-160 160-165 0-28 28-80 80-113 113-115 cased to 1	gravel and boulder overburden (Qfl2 over Qfl2f) bedrock sand and gravel (Qfl2) sandy soil with boulders (Qfl2) hard packed sand (Qfl2l) sand with some gravel (Qfl2f) gravel with cobbles (Qfl2) dirty sand (Qfl2 or Qic) very fine sand (Qfl2l) sand (Qfl2f)

36	23-3959	50	
37	23-5175	0-47 47-215	clay and sand (Qfl3 over Qfl2l) trap rock
38	23-5176	0-61 61-223	clay and sand (Qfl3 over Qfl2l) trap rock
39	23-3301	0-62 62-85 85-140	sand, gravel, and boulders (Qfl2) brown hardpan (Qn) red rock
40	23-2666	17	
41	23-5314	122	
42	23-5315	117	
43	23-2433	0-104 104-105 screened	sand over fine sand (Qfl3 over Qfl2l) coarse gravel (Qfl2f) 95-105, yield 50 gpm
44	23-6439	abbreviat 0-15 15-30 30-50 50-95 95-115 115-133 133-137 screened	brown sand and gravel (Qfl3) brown sand, medium to fine (Qfl3) gray to brown fine sand (Qfl2l) brown sand and gravel (Qfl2) coarse gravel (Qfl1) brown to reddish brown fine sand (Qfl1) red rock 114-134, yield 353 gpm
45	23-6764	0-20 20-52 52-72 screened	sand, gravel (Qfl3) clay (Qfl2l) gravel (Qfl2) 57-72, yield 400 gpm
46	23-4412	12	
47	23-4980	12	
48	23-3240	0-91 91-145	sand and gravel with boulders (Qfl1 over Qn) red rock
49	23-6686	0-40 40-82 82-140	brown hardpan with boulders (Qfl1) sandy soil with some streaks of gravel (Qfl1) red sandstone with some layers of shale
50	23-5270A	0-72 72-179	hardpan with boulders (Qn) red rock
51	23-5269A	70	
52	23-295	0-87 87-240 240-307	sand and gravel (Qfl1 over Qn) red sandstone and slate blue soapstone
53	23-5714	65	

54	23-5362	74	
55	23-5375	66	
56	23-5581	0-75 75-232	hardpan, boulders (Qn) trap rock
57	23-5347	43	
58	23-4105	0-80 80-145	red hardpan with boulders (Qn over Qr) red sandstone
59	23-5398	0-105 105-115 115-199	sand, gravel, and boulders (Qn) red hardpan with boulders (Qr) red sandstone
60	23-3319	0-68 68-91 91-145	hardpan and boulders (Qn) coarse sand and gravel (Qsp) mixture of red trap and blue trap
61	23-3239	0-35 35-50 50-125	hardpan (Qfl1) hardpan and gravel (Qn) red rock
62	23-4124	0-56 56-140	hardpan with boulders (Qn) red sandstone
63	23-4320	0-67 67-165	hardpan (Qn) red sandstone
64	23-5404	76	
65	23-5271	0-73 73-225	hardpan and boulders (Qn) red shale and gray slate
66	23-5265	0-79 79-198	boulders, sand, gravel, hardpan (Qn) red shale
67	23-8398	3	
68	23-5003	45	
69	23-4005	64	
70	23-5470	28	
71	23-5708	15	
72	23-5527	0-22 22-153	bouldery overburden (Qn) bedrock
73	23-5048	45	
74	23-2604	0-4 4-98 98-248	brown hardpan (Qn) trap rock red rock
75	23-3040	0-47 47-82	hardpan (Qn) trap rock

76	23-6761	0-46 46-500	clay, sand (Qn) red rock
77	23-7288	0-15 15-30 30-75 75-285	compacted sand and gravel (Qn) boulders in hardpan (Qn) trap rock red rock
78	23-8481	0-23 23-90 90-185	brown hardpan (Qn) trap rock red sandstone
79	23-3164	0-21 21-100 100-165	red hardpan (Qr) trap rock red rock
80	23-2002	0-55 55-303	sand, gravel, hardpan (Qr) red rock
81	23-5874	0-31 31-150	hardpan and boulders (Qr) red rock
82	23-3313	0-27 27-160	red hardpan (Qr) red sandstone
83	23-3522	32	
84	23-4029	30	
85	23-4240	31	
86	23-2608	0-40 40-105	boulders and fill (Qr) red rock
87	23-1821	0-24 24-102	dirt, gravel (Qr) red sandstone
88	23-2997	0-29 29-80	hardpan (Qr) red sandstone
89	23-2738	0-21 21-108	red hardpan with boulders (Qr) red rock
90	23-2622	0-17 17-300	sand, small gravel (Qr) red rock
91	23-859	0-18 18-22 22-120	hardpan (Qn) soft sandy rock red rock
92	23-283	15	
93	23-4927	0-51 51-190	red hardpan (Qr) red shale
94	23-274	15	
95	23-377	18	
96	23-648	0-36	hardpan (Qr)

		36-143	red rock
97	23-800	0-24 24-75 75-180	dirt and boulders (Qr) trap rock red rock
98	23-1434	0-31 31-100	gravel (Qr) red rock
99	23-1475	14	
100	23-2555	0-17 17-90	red hardpan (Qn over Qr) red sandstone
101	23-1244	0-26 26-79	hardpan (Qho3 over Qn) bedrock
102	23-4273	0-14 14-300	sand and stones, clay (Qho3) sandstone
103	23-4256	0-34 34-300	sand, gravel (Qho3) red rock
104	23-596	0-38 38-142	coarse sand with plenty of small boulders (Qmt over Qho3) red rock
105	23-3677	0-32 32-91	hardpan (Qn) red sandstone
106	23-7158	abbreviat 0-19 19-22	brown coarse-to-fine sand, some fine gravel (Qal over Qmt) brown medium-to-fine sand, some silt, occasional boulders (Qn)
107	23-3787	0-18 18-35	red hardpan (Qr) red sandstone
108	23-3782	0-23 23-100	red hardpan (Qr) red sandstone
109	23-3523	20	
110	23-3210A	0-34 34-100	glacial drift with boulders (Qr) red sandstone
111	23-1	28	
112	23-997	22	
113	23-5916	0-22 22-95	boulders (Qr) sandstone
114	23-7384	0-10 10-205	compact sand and gravel (Qmt over Qr) red sandstone
115	23-1203	0-8 8-10 10-300	gray hardpan (Qr) soft sandstone red sandstone
116	23-5158	0-14 14-24 24-28	yellow sand (Qho2) sand and hardpan (Qho2) sand and gravel (Qho2)

		28-300	red sandstone
117	23-1337	8	
118	23-1646	0-22 22-175	hardpan (Qr) red rock
119	23-974	22	
120	23-4573	0-27 27-445	sandy hardpan, rocky (Qn) sandstone, shale
121	23-4470	0-10 10-14 14-299	sand and stones (Qr) gravel (Qr) sandstone
122	23-3729	0-84 84-220	hardpan, boulders (Qn) red rock
123	23-1211	0-84 84-149	hardpan (Qn) red rock
124	23-1193	0-30 30-36 36-220	dirt (Qr) gravel (Qr) red rock
125	23-1212	0-31 31-114	hardpan (Qr) red rock
126	23-1996	0-98 98-111 111-213	brown hardpan (Qn) sand and gravel (Qsp) red rock
127	23-1176	0-85 85-110 110-234	sand and gravel (Qn, log inverted?) hardpan (Qsp, log inverted?) red sandstone
128	25-13251	0-16 16-287	sand, clay (Qr) red sandstone
129	23-3723	25	
130	23-1601	0-23 23-38 38-151	boulders (Qr) gravel and hardpan (Qr) brown sandstone
131	23-1081	0-32 32-160	sand and gravel (Qic over Qr) red rock
132	23-1071	0-27 27-151	sand (Qr) red rock
133	23-1221	0-32 32-180	sand, gravel (Qic) red rock
134	23-1083	0-48 48-161	sand and gravel (Qic) red rock
135	23-1213	0-52 52-143	sand and gravel (Qic) red rock

136	23-1470	0-30	boulders (Qic)
		30-55 55-141	hardpan and gravel (Qr) sandstone
137	23-1768	0-15 15-30	gravel and hardpan (Qic) boulders and gravel (Qr)
		30-36 36-118	gravel (Qr) sandstone
138	23-2033	0-35 35-92	sand, gravel (Qpr) red rock
139	23-1467	0-20 20-147	hardpan and boulders (Qr) sandstone
140	23-1583	0-47 47-112	hardpan and gravel (Qr) sandstone
141	23-1197	0-30 30-48	dirt and boulders (Qr) gravel (Qr or Qsp)
		48-180	red rock
142	23-1591	0-41 41-80	gravel, boulders (Qpr over Qr) red rock
143	23-968	0-25 25-103	coarse sandy soil (Qpr) red rock
144	23-4172	0-41 41-300	sand and gravel (Qpr) red sandstone
145	23-42-626	0-20 20-32 32-300	hardpan (Qr) gravel (Qr or Qsp) red rock
146	23-1073	0-25 25-149	hardpan (Qr) red rock
147	23-7721	0-15 15-350	red hardpan (Qr) red and brown sandstone
148	23-4691	0-15 15-405	hardpan (Qpr) shale and sandstone
149	23-4692	0-17 17-22 22-400	sand and gravel (Qpr) hardpan (Qr?) brown shale
150	23-5380	15	
151	23-6763	0-10	sandy, rocky soil (Qpr)
		10-15	hardpan (Qr)
		15-17 17-150	sand and gravel (Qr or Qsp) sandstone
152	23-318	27	
153	23-3101	0-18 18-300	hardpan and sand (Qpr over Qr) red rock

154	23-3099	0-10	fill
		10-20	hardpan (Qpr)
		20-39	sand (Qpr)
		39-300	red rock
155	23-5139	0-40	hardpan (Qpr)
		40-400	red shales
156	23-7619	0-70	sand and gravel (Qpt over Qpr)
		70-280	sandstone
157	23-7208	abbreviat	ted log
		0-7	fill
		7-22	sand and clay (Qpt)
		22-35	sand and gravel (Qpr)
		35-37	red shale
158	23-7620	0-50	sand and gravel (Qal over Qpr)
150	23 7020		35-50, yield 300 gpm (monitoring well)
159	23-7125	abbreviat	
10)	23 / 123	0-10	gravel, cobbles, sand, and siltfill (af)
		10-17	brownish black coarse-to-fine sand, little to some silt (Qal)
		17-26	reddish brown medium-to-fine sand, little coarse sand, some fine-to-coarse gravel,
		17-20	little silt (Qpr)
		26-51	red sandstone
160	23-8941	0-4	rocks and fill
100	23-0941	4-8	sand and clay (Qpt)
		8-12	yellow clay (Qpr)
		12-20	brown sand (Qpr)
		20-30	brown sand and stone (Qpr)
		30-33	brown sand and clay (Qpr)
		33-37	brown sand and red clay (Qpr)
		37-40	fine red sand (Qpr)
		40-45	red sand and gravel (Qpr)
		45-49	sand and boulder and gravel (Qpr)
		49-90	rock
161	23-3952	0-32	sandy clay (Qpt over Qpr)
		32-300	red sandstone
162	23-9085	0-25	red-brown medium-to-fine sand and silt (Qpr)
		25-30	brown clay, trace coarse-to-fine sand and graveltill (Qr)
		at 30	refusal on sandstone
163	23-4715	25	
164	23-7100	0-22	sand, red hardpan (Qpr over Qr)
		22-160	red rock
165	23-6893	0-14	sand (af/Qal)
		14-400	red shale
166	23-467	0-32	sand, gravel (af over Qal over Qpr)
		32-503	red rock
167	23-5707	0-60	sand (Qpr)
		60-65	gravel (Qr or Qpr)
		65-300	red rock

168	26-4533	0-60 60-75 75-400	sand (Qpr) hardpan (Qr) red rock
169	23-1907	0-53 53-301	sand, gravel and fill (Qpr over Qr) sandstone
170	23-407	0-40 40-200	sand (Qpr) red rock
171	23-7885	0-23 23-30 30-310	medium brown sand (Qpr) gravel in hardpan (Qr) red sandstone
172	23-1954	0-35 35-100	sand, hardpan (Qpr over Qr) red rock
173	23-1585	0-19 19-80	gravel (Qpr) red rock
174	23-2785	0-33 33-38 38-302	sand (Qpr) gravel (Qr or Qpr) red rock
175	23-1946	0-14 14-40 40-390	red hardpan (Qpr, log inverted?) coarse sand and gravel (Qr, log inverted?) red sandstone
176	23-250	0-54 54-400	sand, gravel, and boulders (Qpr over Qr) red rock
177	23-251	0-40 40-400	hardpan (Qpr over Qr) red rock
178	23-249	0-35 35-300	sand, clay, gravel (Qpr over Qr) bedrock
179	23-4635	0-3 3-20 20-24 24-230	sandy clay (Qpr) sand (Qpr) red shale and hardpan (Qr) red sandstone
180	23-1432	0-40 40-275	sand, gravel, hardpan, fine sand (Qpr) red rock
181	23-4164	0-30 30-400	sand, gravel (Qpr) red rock
182	23-404	0-12 12-150	sand and fill (Qpr over Qr) red rock
183	26-1112	0-20 20-200	hardpan (Qpr over Qr) red rock
184	26-2925	0-40 40-500	sand, boulders, hardpan (Qpr over Qr) red rock
185	26-1032	0-52 52-350	sand, gravel (Qpt over Qpr) red shale

186	26-3585	0-14 14-22 22-40 40-230	hardpan (Qpt) sand, gravel with large gravel stones and cobbles (Qpt) hard-packed sand (Qpr) sandstone
187	26-3531	46	
188	23-4479	42	
189	26-2688	0-57 57-360	sand, gravel (Qpr) red rock
190	23-6811	0-8 8-205	hardpan (Qr) brown sandstone
191	23-5814	0-30 30-290	hardpan (Qr) red rock
192	23-3241	0-31 31-185	red hardpan (Qr) red rock
193	23-1328	0-40 40-260	red hardpan (Qr) brown sandstone and red shale
194	23-4695	0-20 20-80 80-250	hardpan (Qr) trap red rock
195	23-5407	0-20 20-240	hardpan (Qr) trap rock
196	23-4999	16	
197	23-5000	24	
198	23-8116	0-20 20-200	clay (Qry) trap rock
199	23-1710	0-14 14-18	clay and hardpan (Qry) trap rock
200	23-1992	0-42 42-95	hardpan with boulders (Qry) trap rock
201	23-2994	0-40 40-65	dirt (Qr) rotten trap
		65-120	shale
202	23-1050	0-38 38-50	hardpan and boulders (Qr) trap
203	23-5332	0-69 69-120 120-305	sand and gravel (Qr over weathered basalt) trap rock brown and red sandstone
204	23-5710	65 (includ	des weathered basalt)
205	23-2707	19	
206	23-5283	0-33	hardpan (Qr)

		33-128 128-265	trap red rock
207	23-791	3	
208	23-4180	10	
209	23-4030	0-42 42-123	fine sand and boulders (Qry) trap rock
210	23-1523	60	
211	23-1384	14	
212	23-569	12	
213	23-3424	0-20 20-115 115-245	hardpan (Qry) trap rock red rock
214	23-1763	12	
215	23-5261	14	
216	23-5147	12	
217	23-5329	8	
218	23-6057	17	
219	23-741	0-19 19-43	sand and gravel (Qry and weathered basalt) trap rock
220	23-42-534	0-17 17-32	sand, gravel (Qry and weathered basalt) trap rock
221	23-740	0-7 7-41	sand, gravel (Qry and weathered basalt) trap rock
222	23-42-284	8	
223	23-7292	0-7 7-205	gray hardpan (Qry) trap rock
224	23-795	0-20 20-150	clay and hardpan (Qry) trap rock
225	23-815	10	
226	23-6095	8	
227	23-775	0-8 8-137	hardpan (Qry) trap rock
228	23-3659	0-12 12-213	hardpan (Qry) trap rock
229	23-425	14	
230	23-5489	0-25	hardpan (Qry)

		25-145 145-225	trap rock red rock
231	23-554	20	
232	23-490	17	
233	23-802	33	
234	23-1077	0-34 34-160	hardpan, sand, and boulders (Qry) trap rock
235	23-1257	0-30 30-167	hardpan, sand, gravel, boulders, etc. (Qry) trap rock
236	23-1156	0-14 14-121	hardpan (Qry) trap rock
237	23-1209	11	
238	23-4736	18	
239	23-779	14	
240	23-7738	0-30 30-245	hardpan (Qry) trap rock
241	23-1528	9	
242	23-8365	abbreviat 0-5 5-15	ed log grayish brown silt and fine sand, some gravel and angular cobbles (Qry) reddish brown to brown silt and fine sand, some gravel, angular cobbles, little clay (Qr)
		at 15	refusal on basalt
243	23-5002	53	
244	23-1765	74	
245	23-1764		
246		77	
	23-3846	77 0-65 65-150	hardpan with boulders (Qry) sandstone
247		0-65	
	23-3846	0-65 65-150 0-80	sandstone rocky yellow hardpan turning red (Qry over Qr)
247	23-3846	0-65 65-150 0-80 80-150	rocky yellow hardpan turning red (Qry over Qr)
247 248	23-3846 23-3833 23-2028	0-65 65-150 0-80 80-150 47 0-77 77-126	rocky yellow hardpan turning red (Qry over Qr) sandstone coarse sandy glacial fill (Qry over Qsp?)

252	23-1667	58	
253	23-367	0-15 15-49 49-120	dirt (Qnh) gravel (Qnh over Qry) shale rock
254	23-145	80	
255	23-592	0-64 cased to 6	hardpan and boulders (Qr, over Qsp?) 62, yield 7 gpm
256	23-2384	0-23 23-140	boulders and sand (Qry) trap rock
257	23-6116	0-31 31-170	hardpan, boulders (Qry) trap rock
258	23-470	0-10 10-30 30-33 33-45 45-70 70-108	boulders (Qpm) hardpan (Qry, readvance till?) gravel, sand (Qpm) sand and clay (Qpm) sand (Qpm) trap rock
259	23-7162	abbreviat 0-17 at 17	ed log brown coarse-to-fine sand (Qpm) basalt
260	23-5232	114 cased to 1	114, no penetration into rock, yield 25 gpm
261	23-5258	0-97 97-250	sand and gravel (Qpm) trap rock
262	23-8623	34	
263	23-8152	0-18 18-500	sand, gravel (Qpm) granite (basalt)
264	23-2540	0-38 38-45 screened	sand, gravel (Qpm) trap rock 28-38, yield 150 gpm
265	23-2319	0-23 23-45 45-476	boulders and hardpan (Qry, readvance till?) gravel (Qpm) granite (basalt)
266	23-5607	0-26 26-453	sand, clay (Qry) trap rock
267	23-5461	0-30 30-43 43-213	hardpan and gravel (af over Qal) sand, then hardpan (Qpm overQry) trap rock
268	23-5301	0-20 20-453	hardpan (Qry) trap rock
269	23-5685	34	

270	23-5409	0-38 38-54 54-85 85-315	boulders (Qpm) gravel (Qpm) boulders (Qpm) trap
271	23-5561	0-80 80-103 103-204	gravel (Qpm) hardpan (Qry) trap
272	23-537	0-80 80-235	very fine sand (Qpm) trap rock
273	23-290	0-30 30-68 68-72 72-150	boulders (Qpm) sand and gravel (Qpm) very fine sand (Qpm) red rock
274	23-908	0-60 60-171	sand (Qpm) red shale
275	23-3458	0-35 35-50 50-325	sand (Qpm) clay (Qpml) red and gray shale
276	23-213	23	
277	23-4353	0-20 20-120	sand and gravel (Qry) red shale
278	23-5706	0-115 115-125 125-270	sand, gravel(Qpg) broken rock red rock
279	N23-41-639	0-51 51-136 136-141 141-317 317-340	sand, gravel, small boulders (Qpg) blue clay (Qpl) coarse gravel, no water (Qpm or Qry) shale trap
280	23-164	95	
281	23-160	0-20 20-80 80-160 160-190 190-193	boulders, coarse gravel (Qpg, topset beds) fine sand (Qpg, foreset beds) blue clay, some fine sand (Qpl) red and blue hardpan (Qr or weathered rock) red shale
282	26-3057	0-49 49-75 75-175	sand (Qpg) brown clay (Qpl) red rock
283	23-5162	0-30 30-75 75-145	bankrun (Qpg sand and gravel) sand (Qpg over Qpl) shale
284	23-4270	0-5 5-12 12-200	overburden (Qry) sand (Qry) red shale
285	23-4269	0-3	overburden (Qry)

		3-9 9-18 18-150	sand (Qry) soft red rock red shale
286	23-5001	55	
287	23-4756	0-36 36-342	boulders and mud (Qry) red shale with a little sandstone
288	23-3951+ 23-4331	0-20 20-45 45-110 110-250	sand (Qpg) clay (Qpl) sand (Qpl or Qpm) trap rock
289	23-6858	0-22 22-298	sand, clay (Qpg over Qpl) trap rock
290	23-3316	11	
291	23-4046	0-20 20-58 58-100	hardpan (Qry) gray rock red shale
292	23-3989	0-22 22-54 54-173	hardpan (Qry) trap red rock
293	23-5984	0-18	hardpan, sand and gravel (Qr)
		18-75	red shale and sandstone
294	23-5320	0-20 20-35 35-253	hardpan (Qpm) gravel (Qpm) trap rock
295	23-4381	15	
296	26-727	0-10 10-22 22-25 25-32	clay (Qry) hardpan (Qry) sand (Qry) trap
297	26-4209	10	
298	23-8259	0-37 37-375	sand, clay, gravel overburden (Qry) granite (basalt)
299	23-5146	20	
300	26-2990	0-8 8-18 18-35 35-106	dirt (Qmt) clay (Qpml) sand (Qr) shale
301	26-4279	0-14 14-46 46-48 48-57	hardpan and stones (Qmt) clay (Qpml) water-bearing sand and gravel (Qr or Qpm) red shale
302	26-3968	50	

304 26-3495 0-60 sand (Qmt over Qpml) 60-90 shardpan (Qr) red shale 305 26-6530 0-14 brown medium-to-fine sand, little silt, little coarse-to-fine gravel (Qry) basalt 306 23-2670 0-120 sand, clay, gravel, boulders (Qmt over Qpm over Qr) 120-185 red rock 307 N26-1-368 0-35 sandy loam (Qmt) blue clay (Qpml) varicolored clay (Qpml) varicolored clay (Qpml) blue clay (Qpml) sand and silt (Qpml) sand and silt (Qpml) sand and silt (Qpml) sand (Qpml)	303	26-3028	0-27 27-50 50-58 58-61 cased to 6	sand and gravel (Qmt) clay (Qpml) water-bearing silty sand and gravel (Qr or Qpm) choice water-bearing sand and gravel (Qr or Qpm) 61, yield 10 gpm
14-31 basalt	304	26-3495	60-90 90-98	clay (Qpml) hardpan (Qr)
120-185 red rock	305	26-6530		= 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
35-80 blue clay (Qpml) varicolored clay (Qpml) varicolored clay (Qpml) sep-130 blue slate sep-130 sep-135 sand and silt (Qpml) sep-135 sand and silt (Qpml) sep-135 sand and silt (Qpml) sep-135 sand (Qpml) sep-135 sand (Qpml) sep-135 sand (Qpml) sep-135 sand (Qpml) sep-135 sep-135 sand (Qpml) sep-135 sep-135	306	23-2670		
92-135 sand and silt (Qpml)	307	N26-1-368	35-80 80-89 89-130 130-135 135-197	blue clay (Qpml) varicolored clay (Qpml) blue clay (Qpml) till (Qr) brown rock
12-90 clay (Qal over Qpml) 90-120 sand (Qpml and Qpm) 120-129 red hardpan (Qr) 129-213 red sandstone	308	26-658	92-135	sand and silt (Qpml)
cased to 110, yield 50 gpm 311 26-3996 31 312 26-5186 abbreviated log	309	26-1871	12-90 90-120 120-129	clay (Qal over Qpml) sand (Qpml and Qpm) red hardpan (Qr)
312 26-5186 abbreviated log 0-15 brown and gray sand and stones (af) 15-20 brown and gray sand (Qal) 20-90 gray clay (Qpml) 90-97 gravel, some clay (Qr) 97-100 red rock 313 U. S. Army 0-3 clay, roots (af over Qal) Corps of 3-12 sand (Qal) Engineers 12-52 silty clay (Qpml) boring 52-87 till (Qry) DC-102 at 87 gray sandstone 314 26-4760 0-70 clay (af over Qal over Qpml) 70-82 hardpan, boulders (Qr) 82-215 red rock 315 26-29824 68	310	26-4918		
0-15 brown and gray sand and stones (af) 15-20 brown and gray sand (Qal) 20-90 gray clay (Qpml) 90-97 gravel, some clay (Qr) 97-100 red rock 313 U. S. Army 0-3 clay, roots (af over Qal) Corps of 3-12 sand (Qal) Engineers 12-52 silty clay (Qpml) boring 52-87 till (Qry) DC-102 at 87 gray sandstone 314 26-4760 0-70 clay (af over Qal over Qpml) 70-82 hardpan, boulders (Qr) 82-215 red rock 315 26-29824 68	311	26-3996	31	
Corps of 3-12 sand (Qal) Engineers 12-52 silty clay (Qpml) boring 52-87 till (Qry) DC-102 at 87 gray sandstone 314 26-4760 0-70 clay (af over Qal over Qpml) 70-82 hardpan, boulders (Qr) 82-215 red rock	312	26-5186	0-15 15-20 20-90 90-97	brown and gray sand and stones (af) brown and gray sand (Qal) gray clay (Qpml) gravel, some clay (Qr)
70-82 hardpan, boulders (Qr) 82-215 red rock 315 26-29824 68	313	Corps of Engineers boring	3-12 12-52 52-87	sand (Qal) silty clay (Qpml) till (Qry)
	314	26-4760	70-82	hardpan, boulders (Qr)
316 26-28440 145	315	26-29824	68	
	316	26-28440	145	

317	26-28785	52	
318	26-28902	50	
319	26-6576	0-39 39-350	clay (Qpml) sandstone, granite (basalt)
320	26-28901	28	
321	26-29306	42	
322	26-29305	46	
323	26-29304	40	
324	26-25208	16	
325	26-26194	33	
326	26-1480	25	
327	26-24228	abbreviate 0-25	ed log brown silty fine-to-medium sand and coarse-to-fine gravel, some cobbles (Qry)
328	26-16158	0-6 6-24 24-75	miscellaneous fill brown-gray clay, stiff to very stiff, boulders and cobbles (Qry) basalt
329	26-3543	0-8 8-155 155-171 171-460	clay and cobbles (Qry) trap rock red rock trap rock
330	26-3889	0-12 12-14 14-60 60-63 63-92 92-100	overburden (Qpg) boulders (Qpg) clay, gravel (Qpg over Qry) boulders (Qry) sand (Qsp?) sand, gravel (Qsp?)
331	26-1394	0-8 8-53	hardpan (Qry) trap rock
332	23-4020	0-30 30-65	boulders (Qry) trap rock
333	26-5008	4	
334	26-11727	abbreviate 0-22 22-25	ed log brown-red clayey sand (Qr) red sandstone
335	26-5663	20	
336	26-3622	20	
337	23-1552	34	
338	26-90	3	

339	26-27964	0-72	light brown medium-to-fine silty sand, some gravel (Qr)
340	23-4449	0-32 32-56 56-83 83-88	yellow hardpan (Qmt over Qpg or Qry) sand and gravel (Qpg or Qsp) red rock trap rock
341	23-9069	abbreviat 0-30	ed log brown fine-to-coarse sand and gravel (Qaf over Qmt)
342	23-7509	0-24	sand and gravel (Qmt)
343	26-3052	0-27 27-58	clay (Qmt over Qr) bedrock
344	23-8801	abbreviat 0-15 15-25	ed log brown sandy loam, trace cobbles, pebbles (Qmt) sand and gravel (Qmt over Qpg)
345	26-15796	0-23 23-43	glacial till with boulders (Qmt over Qr) loose red shale
346	22-9483	0-20 20-125 cased to 1	hardpan (Qsh1) sand and gravel (Qpg) 124, yield 30 gpm
347	26-5043	abbreviat 0-25 25-250 250-500	ed log brown sand and gravel (Qpg) trap rock sandstone
348	26-5081	0-13 13-210 210-395	sand, boulders (Qpg) trap rock sandstone
349	26-3392	0-40 40-45 45-405	hardpan (Qry) sand (Qry or Qsp) granite (basalt)
350	26-7883	0-11 at 11	brown clayey silt and reddish brown medium-to-fine sand, occasional cobbles (Qry) bedrock
351	26-26449	25	
352	26-1101	0-27 27-58	clay (Qpt) bedrock
353	26-25207	11	
354	26-3974	5	
355	25-1500	0-8 8-88 88-125	hardpan (Qry) trap rock shale
356	26-25795	0-3 3-227	sandy clay (Qry) basalt
357	26-3513	22	

358	26-10332	0-10 10-12 12-15	fill brown clayey silt, some medium-to-fine angular gravel, little medium-to-fine sand (Qr) sandstone
359	26-934	0-40 40-202	boulders and hardpan (Qr) sandstone
360	26-1802	15	
361	26-21789	0-6 6-11 11-18	fill sand and gravel (Qr) basalt
362	26-25587	0-9 9-77	brown fine sand, silt with gravel (Qr) bedrock
363	23-353	0-18 18-90	hardpan (Qr) red sandstone
364	26-601	0-12 12-20 20-43 43-115	hardpan (Qry) sand (Qry or Qpm) hardpan (Qry) red sandstone
365	26-28439	13	
366	26-3451	0-39 39-95	hardpan (Qry) bedrock
367	26-20829	abbreviat 0-20 20-37 37-56 56-61 61-71	ed log fine-to-medium sand, some gravel (Qpt) fine sand and silt (Qpgl) silty clay, trace fine sand (Qpgl) fine sand, silt, some gravel (Qry) red sandstone
368	26-1395	0-33 33-150	boulders, hardpan (Qpt) red rock, trap rock
369	26-6060	0-10 10-20 20-30 30-40 40-50 50-60 60-70 screened	fine-to-coarse sand (Qpt) sand and gravel (Qpt) coarse sand and gravel, some small cobbles (Qpt) gray silty clay (Qpgl) fine silty sand (Qpgl) fine sand (Qpgl) sand and gravel (Qpg) 60-70, yield 80 gpm
370	26-4833	0-10 10-20 20-40 40-60 60-78 78-80 80-500	sand (Qpt) sand, clay, gravel (Qpt) sand, small gravel (Qpgl?) sand, gravel (Qpg) packed sand and clay (Qpgl or Qry) trap rock type hardpan (Qry) trap rock
371	26-25367	0-15 15-17 17-35	sand and silt (Qpt) sand, fine gravel (Qpt) sandy silt (Qpgl)

372	26-3044	0-5 5-26 26-67 67-71 71-81 81-201	fill sand and gravel (Qal over Qst) clay (Qpgl) silty sand, water-bearing and heaving (Qpgl) water-bearing sand, clay, and gravel (Qry) trap rock
373	26-26066	49	
374	26-28244	0-7 7-17 17-26 26-31 at 31	silty sand and clay (af) medium-to-fine sand, some silt and gravel (Qst) red-brown silt and fine sand (Qpgl) red-brown silty clay, little coarse-to-fine sand and gravel (Qpgl or Qr) possible rock
375	26-29993	0-5 5-14 14-20 20-23	light brown clayey silt (Qpt or Qpgl) dark gray clay (Qpgl) light gray sand (Qpg) shale
376	26-25490	19	
377	26-28438	6	
378	26-18660	0-4 4-275 275-290	clay, sand, boulder (Qry) trap rock red sandstone
379	26-29724	0-6 6-18	brown clay silt, trace medium-to-fine sand (Qry) basalt
380	26-17143	abbreviated log 0-8 brown fine-to-coarse sand, pea gravel, some silt (Qpg) 8-16 basalt	
381	26-1183	5	
382	26-5540	18	
383	26-4780	4	
384	26-18997	abbreviat 0-15 15-28 28-43	ed log silty fine sand (Qpt) coarse sand and gravel (Qpt) sandy clay with some gravel from 35-43 (Qsh1)
385	26-24562	abbreviat 0-45	ed log sand and gravel (Qpt over Qsh1)
386	23-6672	0-50 50-198	sand and big gravel (Qpt over Qpr) red rock
387	23-7106	0-20 20-45 45-300	sand, gravel, boulders (Qpt) sand, gravel, and silt (Qpr) red shale
388	23-7137	0-16 16-31 31-300	wood fill clay, sand, rocks (Qpt) red shale

389	23-498	0-41 41-200	sand, gravel (Qpt over Qpr) red rock
390	26-28214	abbreviat 0-15 15-44 44-46	brown silt sand with gravel (Qpt) silty fine sand (Qpr) brown medium silty sand with some gravel (Qpr or Qr)
391	26-7184	abbreviat 0-26 26-28	red log reddish brown clayey sand with gravel (Qr) red shale
392	23-276	0-51 51-155	sand (Qpr) red rock
393	23-8176	abbreviat 0-4 4-16 16-20 at 20	dark gray sand fill (af) brown fine-to-coarse sand, trace silt and gravel (Qal) coarse-to-fine gravel (Qal) red sandstone
394	23-6863	0-12 12-50 50-355	clay (Qpr) hardpan (Qr) red rock
395	23-4825	0-40 40-100	hardpan and sand (Qr) red sandstone
396	26-15965	abbreviat 0-25	red log red-brown silty sand with some gravel and boulders (Qr)
397	26-997	0-22 22-100	clay, gravel (Qr) red rock
398	26-3831	0-42 42-156	sand and gravel (Qpr) sandstone
399	26-26372	18	
400	26-28677	0-11 11-13 13-16 16-30	fill brown medium-to-fine sand (Qpr) cobbles (Qpr) red-brown silty sand, little gravel (Qr)
401	26-738	0-16 16-150	sand (Qpr) red rock
402	26-3202	0-10 10-175	hardpan (Qr) red rock
403	26-4313	0-25 25-43 43-200	fill (af) boulders (Qal over Qr) red rock
404	26-604	0-46 46-191	rocky sand and gravel hardpan (Qsh1) red rock
405	26-955	0-25	sand, gravel (Qsh1)
		25-300	red rock

		22-200	red sandstone	
407	26-1279	0-39 39-NR	sand, gravel (Qsh1) red rock	
408	26-282	0-25 25-NR	sand (Qsh1) red rock	
409	26-1182	0-35 35-229	sand (Qsh1) red sandstone	
410	26-182	25		
411	26-14714	abbrevia 0-16 16-18	, 8 , (1)	
412	26-24041	0-12 12-20 20-30	red-brown silts and sands with some medium-to-coarse sands and gravels (Qsh1) medium-to-coarse sands with some gravels throughout (Qsh1) medium-to-coarse sands with little rounded gravels (Qsh1)	
413	26-28866	abbreviat 0-12 12-16 16-20	silt, sand, gravel (Qsh1) soft red shale (Qr?) red rock	
414	26-235	23		
415	26-638	0-33 33-300	hardpan with sand streaks (Qsh1) red rock	
416	26-506	0-32 32-201	sand (Qsh1) red sandstone	
417	26-6005	0-16 16-190	hardpan with some gravel (Qsh1) red sandstone	
418	26-23679	0-8 8-27 27-40	sand and concrete fill brown coarse-to-fine sand, some fine gravel (Qsh1) red-brown silty clay, some fine sand, little coarse-to-fine gravel, trace cobbles (Qsh1) or Qr)	
419	26-1892	49		
420	26-534	0-29 29-250	sand and silt (Qsh1) red sandstone	
421	26-21	27		
422	26-20788	0-27	fine-to-medium silty sand (Qsh1)	
423	26-3494	0-5 5-32 32-60 60-63 63-313	fill coarse sand (Qsh1) fine sand and silt (Qsh1) hard clay with gravel (Qr) sandstone	
424	26-8395	0-30 30-270	sand, boulders (Qsh1) sandstone	
425	26-196	0-12	dump	

		12-20 20-22 22-190	gravel (Qsh1) hardpan (Qr) red rock
426	23-1290	0-26 26-NR	fill, ashes, sand and gravel (Qsh1) red rock
427	26-16475	15	
428	26-1297	24	
429	26-668	0-28 28-199	sandy red soil (Qsh2) red rock
430	26-1455	0-37 37-140	sand (Qsh2) red sandstone
431	26-6130	abbrevia 0-15 at 15	ted log brown to reddish brown silty coarse-to-fine sand, trace fine gravel (Qr) weathered sandstone
432	26-279	0-18 18-220	hardpan (Qr) red rock
433	26-29005	0-18 18-62	red coarse sand and gravel (Qr) red shale and sandstone
434	26-24819	0-8 8-16 16-34	brown silty sand with some clay (Qr) red-brown medium-to-coarse sand with some sandstone (Qr) shale and sandstone beds
435	26-25889	0-9 9-12 12-20	brown gravel and silt (Qr) light brown silt (Qr) red shale
436	26-2116	0-14 14-200	hardpan (Qr) red shale and sandstone
437	26-1274	18	
438	26-712	8	
439	26-29286	0-18 18-26 26-36 36-200	sandy silt and small gravel (Qr) large gravel and silt (Qr) soft red rock red rock
440	26-25588	0-5 5-12 12-53	brown fine sand (Qr) brown-red fine sand (Qr) bedrock
441	26-26403	0-12 12-70	red-brown clay, trace coarse-to-fine gravel (Qr) sandstone
442	26-23011	0-34 34-40 40-47 47-67	red-brown clay with trace gravel (Qr) brown clay and sand (Qr) coarse sand and gravel (Qsp?) fine sand with trace gravel (Qsp?)
443	26-24570	0-5	clay, silt, tan-orange (Qr)

		5-30	sandstone with red shale lenses
444	26-3656	0-3 3-9 9-16 16-58 cased to 5	hardpan (Qr) fine sand (Qr) hardpan and boulders (Qr) sand and gravel (Qsp?) 8, yield 30 gpm
445	26-20439	0-3 3-5 5-15	red gray silty clay, little fine sand (Qr) weathered sandstone red, hard sandstone
446	26-21933	abbreviate 0-7 7-16 16-20	red-tan silty fine sand (Qr) red silt, weathered siltstone weathered red siltstone
447	26-26586	0-10 10-26	sand (Qr) bedrock
448	26-712	8	
449	26-3539	18	
450	26-10548	abbreviate 0-25	ed log reddish brown fine-to-coarse sand with gravel (Qsh2)
451	26-1165	0-15 15-231	gravel (Qsh2) red rock
452	26-29099	abbreviate 0-2 2-20	ed log gravel (Qpr) sand (Qpr)
453	26-3374	20	
454	26-4991	0-4 4-12 12-26 26-28 28-300	fill hardpan (Qpr) silty gray sand (Qpr) red hardpan (Qr) red sandstone
455	26-755	0-11 11-402	clay (Qr) red sandstone
456	26-29030	abbreviate 0-24 24-30	ed log brown and red sand and boulders (Qr) red sandstone
457	26-4779	0-8 8-200	sand (Qr) red shale and sandstone
458	26-29308	0-13 13-17	sandy clay, gravel (Qr) red stone
459	26-27866	0-18 18-19	reddish brown silty sand and cobbles, some clay (Qr) red shale
460	26-3345	0-23 23-140	sand and gravel (Qr) red sandstone

461	26-4220	8	
462	26-29307	0-7 7-20	sandy clay (Qr) red stone
463	26-4960	0-5 5-10 10-20 20-23 23-180	fill hardpan (Qr) silty sand some clay (Qr) sticky red clay with sand (Qr) sandstone
464	26-5239	0-2 2-7 7-200	fill yellow grayish sandy clay (Qr) sandstone
465	26-29661	0-4 4-17	red-brown clay, trace medium-to-fine sand (Qr) red sandstone
466	26-15125	0-16 at 16	till and red clay with red sand (Qr) rock
467	26-2916	4	
468	26-29192	0-12 12-35	brown red silt (Qr) red sandstone
469	26-27232	0-20 20-42	reddish brown silty sand (Qr) light brown medium sand (Qsp?)
470	26-4223	0-8 8-120	clay overburden (Qr) red sandstone
471	26-29145	0-23 23-50	red-brown medium-to-fine sand, trace silt (Qpt over Qpr) siltstone
472	26-3883	0-30 30-50 50-65 cased to 0	hardpan and boulders (Qpr) fine sand (Qpr) gravel 65, yield 15 gpm
473	26-18518	0-20 20-30 30-40	boulders, cobbles, gravel (Qr) fine-to-medium silty sand with sandstone and shale fragments (Qr) red shale rock
474	26-5300	6	
475	26-21093	3	
476	26-10983	0-6 6-25 25-29	fillsand, gravel, bricks, cinders red-brown medium-to-fine sand, trace fine gravel and silt (Qr) red-brown sandstone
477	26-12640	0-21 21-30	red-brown medium-to-fine sand and silt, trace coarse-to-fine gravel (Qr) sandstone
478	26-28009	0-9 9-27	sand fill (Qr) shale and sandstone
479	26-902	32	
480	26-1293	0-8	clay and hardpan (Qr)

		8-125	red shale
481	26-8319	abbreviat 0-20 20-23	ed log reddish brown silty fine sand with pebbles and boulders (Qr) red rock
482	26-3320	5	
483	26-29	21	
484	26-24573	0-11 11-13 13-30	fillbrick, concrete, wood soft rock red shale
485	26-2821	0-20 20-400	hardpan (Qr) red shale
486	26-3782	0-5 5-27 27-125	dirt (Qr) sand and gravel (Qr or Qsp) shale
487	26-3545	0-8 8-144	clay (Qr) sandstone
488	26-4105	11	
489	26-4285	31	
490	26-15628	0-6 6-33	red-brown weathered sandstone (Qr?) sandstone
491	26-1343	0-8 8-300	hardpan (Qr) red rock
492	26-7499	0-7 7-16 16-27	brown medium-to-fine clayey sand and silt (Qr) red-brown coarse-to-fine sand, trace medium-to-fine gravel, silt, and cobbles (Qr or Qsp) red-brown sandstone
493	26-4669	0-21 21-34 34-68	hardpan and stones (Qpt) sandy (Qpr) red shale and sandstone
494	26-2934	0-20 20-250	boulders, red clay (Qsh1 over Qr) red sandstone
495	26-28609	0-6 6-28	fill brown medium-to-fine sand (Qsh1)
496	26-12299	0-16 16-33	red-brown silty clayey fine-to-medium sand and gravel (Qr) red shale
497	23-3994	23	
498	23-3158	0-18 18-145	hardpan (Qry) trap rock
499	23-8386	0-5 5-15 15-45 45-175	brown sand (Qr) red sand (Qr) sand and gravel (Qr or Qsp) red rock

500	26-18932	0-18 18-80	glacial till with brown fine sand (Qpr over Qr) bedrock
501	23-3216	0-84 screened	fill, sand and gravel (Qfl3 over Qfl2) 62-82, yield 250 gpm

¹Identifiers of the form 26-xxxx and 23-xxxx are well permit numbers issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation. Identifiers of the form Nxx-xx-xxx are N. J. Atlas Sheet grid coordinates of entries in the N. J. Geological Survey permanent note collection.

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 "glacial fill". For wells and borings with logs of the surficial materials, the depth (in feet below land surface) and driller's or logger's description is provided. Inferred map units and comments by author are in parentheses. All descriptions are reproduced as they appear in the original source, except for minor format, punctuation, and spelling changes. Logs identified as "abbreviated" have been condensed for brevity. Many bedrock descriptions have been condensed; these are not identified as abbreviated. The notation "NR" indicates "not reported". For wells completed in surficial materials, the screened interval or length of well casing 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.

Table 2.--Composition of pebbles in surficial deposits

Site	Unit	Number of pebbles	Percentages of pebbles					
			gneiss ¹	gray mudstone ²	red sandstone, mudstone, conglomerate	purple quartzite ⁴	basalt ⁵	white quartz pebbles ⁶
1	Qpm	126	28	27	6	11	28	
2	Qry	88	7	8		2	83	
3	Qr	128	3	16	78	2		
4	Qr	189	15	12	69	2	3	
5	Qry	115	19	12	23	4	42	
6	Qmt	58	64	26			10	
7	Qmt	59	51	47 ⁷	2			
8	Qpg	87	21	29	44	1	6	
9	Qpt	193	18	30	52	0.5		
10	Qpm	192	32	27	11	3	20	8
11	Qpm	169	44	31	3	4	18	
12	Qpm	95	58	24	7	2	5	3
13	Qpm	137	72	17	2	4	5	
14	Qpm	89	73		18	3	6	
15	Qpm	140	71	16	3		9	
16	Qpr	155	32	34	30			4
17	Qr	117	21	9	60		3	7
18	Qpr	111	45	37	10	2		6
19	Qpr	210	48	26	22			4
20	Qr	177	54	33	9	2		2
21	Qn	124	61	23	14	2		
22	Qho3	126	63	33	3			
23	Qr	205	49	32	12			7
24	Qfl2	172	58	20	9			13
25	Qfl2	158	60	17	9			14
26	Qfl3	191	52	21	16			10
27	Qry-Qn	133	64	21		3	12	

28	Qn-Qry	150	37	14			49	
29	Qry	149	19	13		1	67	
30	Qfl2	152	57	33	4			6
31	Qr	157	13	20	32		35	

¹Proterozoic gneiss from the Hudson Highlands.

²Paleozoic sedimentary rocks from the Wallkill and Hudson valleys.

³Local sedimentary rocks from the Newark Basin.

⁴Quartzite-conglomerate from the Green Pond and Skunnemunk formations in the Hudson Highlands.

⁵Local basalt and gabbro from the Watchung basalt flows of the Newark Basin.

⁶Quartz pebbles are chiefly from local weathered conglomerates of the Newark Basin. Some may be from the Pensauken Formation, a preglacial fluvial deposit that formerly occupied lowland areas of the Newark Basin.

⁷Includes 1% chert from Paleozoic carbonate rocks in the Wallkill Valley or Hudson Highlands.