DEPARTMENT OF ENVIRONMENTAL PROTECTION
NEW JERSEY GEOLOGICAL SURVEY

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U. S. GEOLOGICAL SURVEY
NATIONAL GEOLOGIC MAPPING PROGRAM

Pamphlet containing tables 1 and 2 accompanies map

INTRODUCTION

Surficial deposits in the Paterson quadrangle include artificial fill, alluvial, alluvial-fan, 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 and are as much as 180 feet thick. Till is as much as 100 feet thick.

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

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 Qfl2f) 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 sand and gravel beds (unit Qsp) beneath till.

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, Qvc, Qdw, Qsh1, Qsh2, Qic, Qn, Qsf, and parts of Qsl and Qspr) 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 10^2 ft/d. Silt and clay lake-bottom deposits (parts of units Qpml, Qpgl, Qsl) are of low permeability, having estimated hydraulic conductivities of 10^{-1} to 10^{-3} ft/d. Fine sand and silt lake-bottom, alluvial, and wetland deposits (Qfl2l and parts of units Qpml, Qpgl, Qpr, Qsl, Qsp, and Qs) and sandy silt till (parts of units Qr and Qry) are somewhat more permeable, having estimated hydraulic conductivities of 10^{-1} 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.

DESCRIPTION OF MAP UNITS

Postglacial Deposits--These include man-made fill (af), stream deposits in fans (Qsf), 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--Artifically 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 the N. J. Geological Survey (ca. 1900).

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.

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

Qst STREAM TERRACE DEPOSITS--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.

Qpt PASSAIC TERRACE DEPOSIT--Sand, pebble-to-cobble gravel, minor silt; reddish-brown to yellowish-brown, brown; moderately to well-sorted, stratified. Deposited by the Passaic River after glacial lakes drained. As much as 30 feet thick.

Qs 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 basalt, 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, Qvc, 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 yellowish-brown 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 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 deposited elsewhere in the quadrangle, where ice had travelled some distance in contact with local bedrock.

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 of Stone and others (2002).

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 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-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 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 ice-dammed 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 Mulland Park was deglaciated.

Qho3 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.

Qho1 Fine-to-medium sand, some pebble-to-cobble gravel. As much as 40 feet thick.

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.

Qpr Fine-to-medium sand, pebbly sand, minor coarse sand and pebble-to-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 Wesnel 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.

Qsh1 Fine-to-medium sand and pebbly sand, minor silt, clay, and pebble-to-cobble 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 (Qfl2l) and lacustrine-fan (Qfl2f) deposits laid down in three stages of a glacial lake occupying the Pond Brook valley. The northwest-draining proglacial valley is west of the present Pond Brook and is entirely filled with lacustrine deposits. The highest spillway (Qfl3) 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.

Qfl3 Fine-to-coarse sand and pebble-to-cobble gravel. As much as 20 feet thick.

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.

Qfl2l 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 records.

Qfl2f 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.

Qfl1 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 Mountain Road.

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.

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

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 315 feet, and the elevation of the lake level at this stage in the Paterson quadrangle ranges from 315 to about 330 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 breached this dam.

Qpm 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.

Qpml 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.

Qpgl Silt, clay, fine sand. As much as 50 feet thick. Deposited on the lake bottom during the Great Notch stage.

Qpl 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. It was controlled by a spillway at an elevation of about 400 feet on the drainage divide at the head of the valley in West Orange, about 5 miles southwest of Little Falls. It lowered slightly to the Moggy Hollow stage of Lake Passaic when the north end of Second Watchung Mountain in Cedar Grove and North Caldwell was deglaciated.

Qvo Fine-to-coarse sand, minor silt and pebble-to-cobble gravel. As much as 50 feet thick.

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 water-well records.

Qsp 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 sediment.

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

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 deposits.

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 Hohokus.

Qmt 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 into Rahway till.

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 sedimentary rock, and from the Hudson Highlands, underlain by Proterozoic gneiss.

Qr 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 than 20 feet thick.

Qry RAHWAY TILL, YELLOW PHASE--Reddish-yellow, yellow, very pale brown silty sand, sandy silt, and silt with some to many subangular and subrounded pebbles 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 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. Found 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 by broken arrow.

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)

Inactive sand and gravel pit (in 2001)

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.

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

Elevation of bedrock surface from seismic survey--From Lacombe and Duran (1988).

Large gneiss boulder--Noteworthy erratic boulder transported from the Hudson Highlands.

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

Qry/Qpm Readvance till observed--Solid triangle indicates exposures where Rahway till, yellow phase (Qry) overlies deformed deltaic sand and gravel (Qpm). Observed in 1987 and 2001. Open triangle indicates former exposure, 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 and 26-2-187).

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

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

50 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.

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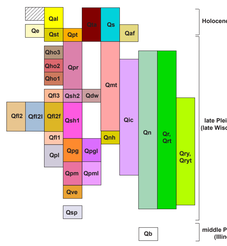
CORRELATION OF MAP UNITS



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40°52'30"
74°15'
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12'30"
ORANGE
10'
40°52'30"
74°07'30"
POMPTON PLAINS
HACKENSACK
Franklin Lake
Pond Brook
Franklin Lake Dam
Franklin Lake Dam
Preakness Valley
Preakness Mountain
Preakness Brook
Preakness Reservoir
Point View Reservoir
Ratzer Road
Hinchliffe Stadium
Totowa
Great Notch
Garrett Mountain
Passaic River
Passaic Falls
Great Falls
Paterson
Diamond Brook
Goffle Brook
Molly Ann Brook
Ryle School of Engineering
Montclair State College
Upper Montclair
Clifton
Nutley
Bloomfield
Glen Ridge
Belleville
Kearny
Harrison
East Newark
Hoboken
Jersey City
Newark Bay
Kearny Marsh
Secaucus
Meadowlands
Rutherford
East Rutherford
Carlstadt
Wallington
Lyndhurst
North Arlington
Garfield
Fairlawn
Saddle River
Ridgewood
Glen Rock
Hawthorne
Paramus
Ridgefield Park
Little Ferry
Moonachie
Teterboro
Wood-Ridge
Elmwood Park
Maywood
Rochelle Park
Lodi
Bogota
Carlstadt
Rutherford
East Rutherford
Wallington
Lyndhurst
Kearny
Harrison
Newark
Belleville
Nutley
Bloomfield
Glen Ridge
Montclair
Upper Montclair
Clifton
Totowa
Paterson
West Paterson
Haledon
Prospect Park
Hawthorne
Fairlawn
Glen Rock
Ridgewood
Saddle River
Ramapo Valley
Pond Brook

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 Qfl2f)
		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	sand and gravel (Qfl2 topset beds)
		8-152	dead sand (Qfl2 over Qfl2l)
		152-160	gravel and sand (Qfl2f)
		cased to 160, yield 20 gpm	
17	23-5169	0-175	sand and gravel (Qfl2 over Qfl2l over Qfl2f)
		175-240	red shale and sandstone
18	23-5263	85	
19	23-5167	85	
20	23-5266	0-109	sand and gravel (Qfl2)
		109-170	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	gravel and sand (Qfl2)
		20-69	hardpan with boulders (Qn)
		69-158	red sandstone
29	23-4956	60	
30	23-4159	0-50	hardpan (Qn)
		50-158	shale
31	23-4710	0-155	gravel and boulder overburden (Qfl2 over Qfl2f)
		155-245	bedrock
32	23-7857	0-22	sand and gravel (Qfl2)
		22-48	sandy soil with boulders (Qfl2)
		48-160	hard packed sand (Qfl2l)
		160-165	sand with some gravel (Qfl2f)
33	23-5328	0-28	gravel with cobbles (Qfl2)
		28-80	dirty sand (Qfl2 or Qic)
		80-113	very fine sand (Qfl2l)
		113-115	sand (Qfl2f)
		cased to 115, yield 20 gpm	
34	23-4931	0-105	sand (Qic over Qfl2l)
		105-107	gravel (Qfl2f)
		cased to 105, yield 12 gpm	
35	23-5830	0-70	sand and gravel (Qic)
		70-140	hardpan (Qfl2l over Qfl2f?)
		140-215	bedrock

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

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

76	23-6761	0-46	clay, sand (Qn)
		46-500	red rock
77	23-7288	0-15	compacted sand and gravel (Qn)
		15-30	boulders in hardpan (Qn)
		30-75	trap rock
		75-285	red rock
78	23-8481	0-23	brown hardpan (Qn)
		23-90	trap rock
		90-185	red sandstone
79	23-3164	0-21	red hardpan (Qr)
		21-100	trap rock
		100-165	red rock
80	23-2002	0-55	sand, gravel, hardpan (Qr)
		55-303	red rock
81	23-5874	0-31	hardpan and boulders (Qr)
		31-150	red rock
82	23-3313	0-27	red hardpan (Qr)
		27-160	red sandstone
83	23-3522	32	
84	23-4029	30	
85	23-4240	31	
86	23-2608	0-40	boulders and fill (Qr)
		40-105	red rock
87	23-1821	0-24	dirt, gravel (Qr)
		24-102	red sandstone
88	23-2997	0-29	hardpan (Qr)
		29-80	red sandstone
89	23-2738	0-21	red hardpan with boulders (Qr)
		21-108	red rock
90	23-2622	0-17	sand, small gravel (Qr)
		17-300	red rock
91	23-859	0-18	hardpan (Qn)
		18-22	soft sandy rock
		22-120	red rock
92	23-283	15	
93	23-4927	0-51	red hardpan (Qr)
		51-190	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	dirt and boulders (Qr)
		24-75	trap rock
		75-180	red rock
98	23-1434	0-31	gravel (Qr)
		31-100	red rock
99	23-1475	14	
100	23-2555	0-17	red hardpan (Qn over Qr)
		17-90	red sandstone
101	23-1244	0-26	hardpan (Qho3 over Qn)
		26-79	bedrock
102	23-4273	0-14	sand and stones, clay (Qho3)
		14-300	sandstone
103	23-4256	0-34	sand, gravel (Qho3)
		34-300	red rock
104	23-596	0-38	coarse sand with plenty of small boulders (Qmt over Qho3)
		38-142	red rock
105	23-3677	0-32	hardpan (Qn)
		32-91	red sandstone
106	23-7158	abbreviated log	
		0-19	brown coarse-to-fine sand, some fine gravel (Qal over Qmt)
		19-22	brown medium-to-fine sand, some silt, occasional boulders (Qn)
107	23-3787	0-18	red hardpan (Qr)
		18-35	red sandstone
108	23-3782	0-23	red hardpan (Qr)
		23-100	red sandstone
109	23-3523	20	
110	23-3210A	0-34	glacial drift with boulders (Qr)
		34-100	red sandstone
111	23-1	28	
112	23-997	22	
113	23-5916	0-22	boulders (Qr)
		22-95	sandstone
114	23-7384	0-10	compact sand and gravel (Qmt over Qr)
		10-205	red sandstone
115	23-1203	0-8	gray hardpan (Qr)
		8-10	soft sandstone
		10-300	red sandstone
116	23-5158	0-14	yellow sand (Qho2)
		14-24	sand and hardpan (Qho2)
		24-28	sand and gravel (Qho2)

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

136	23-1470	0-30	boulders (Qic)
		30-55	hardpan and gravel (Qr)
		55-141	sandstone
137	23-1768	0-15	gravel and hardpan (Qic)
		15-30	boulders and gravel (Qr)
		30-36	gravel (Qr)
		36-118	sandstone
138	23-2033	0-35	sand, gravel (Qpr)
		35-92	red rock
139	23-1467	0-20	hardpan and boulders (Qr)
		20-147	sandstone
140	23-1583	0-47	hardpan and gravel (Qr)
		47-112	sandstone
141	23-1197	0-30	dirt and boulders (Qr)
		30-48	gravel (Qr or Qsp)
		48-180	red rock
142	23-1591	0-41	gravel, boulders (Qpr over Qr)
		41-80	red rock
143	23-968	0-25	coarse sandy soil (Qpr)
		25-103	red rock
144	23-4172	0-41	sand and gravel (Qpr)
		41-300	red sandstone
145	23-42-626	0-20	hardpan (Qr)
		20-32	gravel (Qr or Qsp)
		32-300	red rock
146	23-1073	0-25	hardpan (Qr)
		25-149	red rock
147	23-7721	0-15	red hardpan (Qr)
		15-350	red and brown sandstone
148	23-4691	0-15	hardpan (Qpr)
		15-405	shale and sandstone
149	23-4692	0-17	sand and gravel (Qpr)
		17-22	hardpan (Qr?)
		22-400	brown shale
150	23-5380	15	
151	23-6763	0-10	sandy, rocky soil (Qpr)
		10-15	hardpan (Qr)
		15-17	sand and gravel (Qr or Qsp)
		17-150	sandstone
152	23-318	27	
153	23-3101	0-18	hardpan and sand (Qpr over Qr)
		18-300	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	abbreviated 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)
		screened 35-50, yield 300 gpm (monitoring well)	
159	23-7125	abbreviated log	
		0-10	gravel, cobbles, sand, and silt--fill (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, little silt (Qpr)
		26-51	red sandstone
160	23-8941	0-4	rocks and fill
		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 gravel--till (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	sand (Qpr)
		60-75	hardpan (Qr)
		75-400	red rock
169	23-1907	0-53	sand, gravel and fill (Qpr over Qr)
		53-301	sandstone
170	23-407	0-40	sand (Qpr)
		40-200	red rock
171	23-7885	0-23	medium brown sand (Qpr)
		23-30	gravel in hardpan (Qr)
		30-310	red sandstone
172	23-1954	0-35	sand, hardpan (Qpr over Qr)
		35-100	red rock
173	23-1585	0-19	gravel (Qpr)
		19-80	red rock
174	23-2785	0-33	sand (Qpr)
		33-38	gravel (Qr or Qpr)
		38-302	red rock
175	23-1946	0-14	red hardpan (Qpr, log inverted?)
		14-40	coarse sand and gravel (Qr, log inverted?)
		40-390	red sandstone
176	23-250	0-54	sand, gravel, and boulders (Qpr over Qr)
		54-400	red rock
177	23-251	0-40	hardpan (Qpr over Qr)
		40-400	red rock
178	23-249	0-35	sand, clay, gravel (Qpr over Qr)
		35-300	bedrock
179	23-4635	0-3	sandy clay (Qpr)
		3-20	sand (Qpr)
		20-24	red shale and hardpan (Qr)
		24-230	red sandstone
180	23-1432	0-40	sand, gravel, hardpan, fine sand (Qpr)
		40-275	red rock
181	23-4164	0-30	sand, gravel (Qpr)
		30-400	red rock
182	23-404	0-12	sand and fill (Qpr over Qr)
		12-150	red rock
183	26-1112	0-20	hardpan (Qpr over Qr)
		20-200	red rock
184	26-2925	0-40	sand, boulders, hardpan (Qpr over Qr)
		40-500	red rock
185	26-1032	0-52	sand, gravel (Qpt over Qpr)
		52-350	red shale

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

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

		25-145	trap rock
		145-225	red rock
231	23-554	20	
232	23-490	17	
233	23-802	33	
234	23-1077	0-34	hardpan, sand, and boulders (Qry)
		34-160	trap rock
235	23-1257	0-30	hardpan, sand, gravel, boulders, etc. (Qry)
		30-167	trap rock
236	23-1156	0-14	hardpan (Qry)
		14-121	trap rock
237	23-1209	11	
238	23-4736	18	
239	23-779	14	
240	23-7738	0-30	hardpan (Qry)
		30-245	trap rock
241	23-1528	9	
242	23-8365	abbreviated log	
		0-5	grayish brown silt and fine sand, some gravel and angular cobbles (Qry)
		5-15	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	77	
246	23-3846	0-65	hardpan with boulders (Qry)
		65-150	sandstone
247	23-3833	0-80	rocky yellow hardpan turning red (Qry over Qr)
		80-150	sandstone
248	23-2028	47	
249	23-972	0-77	coarse sandy glacial fill (Qry over Qsp?)
		77-126	red rock
250	N23-42-519	0-4	sand (Qnh or fill)
		4-29	stone and dirt (Qry)
		29-44	sand and gravel (Qsp)
		44-48	hardpan (Qsp)
		48-57	sand and gravel (Qsp)
		57-65	red and yellow mixed clay (Qsp or Qb)
		at 65	soft brown sandstone
251	23-2813	89	

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

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

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

303	26-3028	0-27	sand and gravel (Qmt)
		27-50	clay (Qpml)
		50-58	water-bearing silty sand and gravel (Qr or Qpm)
		58-61	choice water-bearing sand and gravel (Qr or Qpm)
		cased to 61, yield 10 gpm	
304	26-3495	0-60	sand (Qmt over Qpml)
		60-90	clay (Qpml)
		90-98	hardpan (Qr)
		98-400	red shale
305	26-6530	0-14	brown medium-to-fine sand, little silt, little coarse-to-fine gravel (Qry)
		14-31	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)
		35-80	blue clay (Qpml)
		80-89	varicolored clay (Qpml)
		89-130	blue clay (Qpml)
		130-135	till (Qr)
		135-197	brown rock
		197-211	blue slate
308	26-658	0-92	gray clay (Qmt over Qpml)
		92-135	sand and silt (Qpml)
		135-216	red rock
309	26-1871	0-12	fill (af)
		12-90	clay (Qal over Qpml)
		90-120	sand (Qpml and Qpm)
		120-129	red hardpan (Qr)
		129-213	red sandstone
310	26-4918	0-110	sand and gravel (Qpml over Qpm)
		cased to 110, yield 50 gpm	
311	26-3996	31	
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	
316	26-28440	145	

317	26-28785	52	
318	26-28902	50	
319	26-6576	0-39	clay (Qpml)
		39-350	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	abbreviated log	
		0-25	brown silty fine-to-medium sand and coarse-to-fine gravel, some cobbles (Qry)
328	26-16158	0-6	miscellaneous fill
		6-24	brown-gray clay, stiff to very stiff, boulders and cobbles (Qry)
		24-75	basalt
329	26-3543	0-8	clay and cobbles (Qry)
		8-155	trap rock
		155-171	red rock
		171-460	trap rock
330	26-3889	0-12	overburden (Qpg)
		12-14	boulders (Qpg)
		14-60	clay, gravel (Qpg over Qry)
		60-63	boulders (Qry)
		63-92	sand (Qsp?)
		92-100	sand, gravel (Qsp?)
331	26-1394	0-8	hardpan (Qry)
		8-53	trap rock
332	23-4020	0-30	boulders (Qry)
		30-65	trap rock
333	26-5008	4	
334	26-11727	abbreviated log	
		0-22	brown-red clayey sand (Qr)
		22-25	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	yellow hardpan (Qmt over Qpg or Qry)
		32-56	sand and gravel (Qpg or Qsp)
		56-83	red rock
		83-88	trap rock
341	23-9069	abbreviated log	
		0-30	brown fine-to-coarse sand and gravel (Qaf over Qmt)
342	23-7509	0-24	sand and gravel (Qmt)
343	26-3052	0-27	clay (Qmt over Qr)
		27-58	bedrock
344	23-8801	abbreviated log	
		0-15	brown sandy loam, trace cobbles, pebbles (Qmt)
		15-25	sand and gravel (Qmt over Qpg)
345	26-15796	0-23	glacial till with boulders (Qmt over Qr)
		23-43	loose red shale
346	22-9483	0-20	hardpan (Qsh1)
		20-125	sand and gravel (Qpg)
		cased to 124, yield 30 gpm	
347	26-5043	abbreviated log	
		0-25	brown sand and gravel (Qpg)
		25-250	trap rock
		250-500	sandstone
348	26-5081	0-13	sand, boulders (Qpg)
		13-210	trap rock
		210-395	sandstone
349	26-3392	0-40	hardpan (Qry)
		40-45	sand (Qry or Qsp)
		45-405	granite (basalt)
350	26-7883	0-11	brown clayey silt and reddish brown medium-to-fine sand, occasional cobbles (Qry)
		at 11	bedrock
351	26-26449	25	
352	26-1101	0-27	clay (Qpt)
		27-58	bedrock
353	26-25207	11	
354	26-3974	5	
355	25-1500	0-8	hardpan (Qry)
		8-88	trap rock
		88-125	shale
356	26-25795	0-3	sandy clay (Qry)
		3-227	basalt
357	26-3513	22	

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

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

389	23-498	0-41	sand, gravel (Qpt over Qpr)
		41-200	red rock
390	26-28214	abbreviated log	
		0-15	brown silt sand with gravel (Qpt)
		15-44	silty fine sand (Qpr)
		44-46	brown medium silty sand with some gravel (Qpr or Qr)
391	26-7184	abbreviated log	
		0-26	reddish brown clayey sand with gravel (Qr)
		26-28	red shale
392	23-276	0-51	sand (Qpr)
		51-155	red rock
393	23-8176	abbreviated log	
		0-4	dark gray sand fill (af)
		4-16	brown fine-to-coarse sand, trace silt and gravel (Qal)
		16-20	coarse-to-fine gravel (Qal)
		at 20	red sandstone
394	23-6863	0-12	clay (Qpr)
		12-50	hardpan (Qr)
		50-355	red rock
395	23-4825	0-40	hardpan and sand (Qr)
		40-100	red sandstone
396	26-15965	abbreviated log	
		0-25	red-brown silty sand with some gravel and boulders (Qr)
397	26-997	0-22	clay, gravel (Qr)
		22-100	red rock
398	26-3831	0-42	sand and gravel (Qpr)
		42-156	sandstone
399	26-26372	18	
400	26-28677	0-11	fill
		11-13	brown medium-to-fine sand (Qpr)
		13-16	cobbles (Qpr)
		16-30	red-brown silty sand, little gravel (Qr)
401	26-738	0-16	sand (Qpr)
		16-150	red rock
402	26-3202	0-10	hardpan (Qr)
		10-175	red rock
403	26-4313	0-25	fill (af)
		25-43	boulders (Qal over Qr)
		43-200	red rock
404	26-604	0-46	rocky sand and gravel hardpan (Qsh1)
		46-191	red rock
405	26-955	0-25	sand, gravel (Qsh1)
		25-300	red rock
406	26-3346	0-22	sandy soil (Qsh1)

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

		12-20	gravel (Qsh1)
		20-22	hardpan (Qr)
		22-190	red rock
426	23-1290	0-26	fill, ashes, sand and gravel (Qsh1)
		26-NR	red rock
427	26-16475	15	
428	26-1297	24	
429	26-668	0-28	sandy red soil (Qsh2)
		28-199	red rock
430	26-1455	0-37	sand (Qsh2)
		37-140	red sandstone
431	26-6130	abbreviated log	
		0-15	brown to reddish brown silty coarse-to-fine sand, trace fine gravel (Qr)
		at 15	weathered sandstone
432	26-279	0-18	hardpan (Qr)
		18-220	red rock
433	26-29005	0-18	red coarse sand and gravel (Qr)
		18-62	red shale and sandstone
434	26-24819	0-8	brown silty sand with some clay (Qr)
		8-16	red-brown medium-to-coarse sand with some sandstone (Qr)
		16-34	shale and sandstone beds
435	26-25889	0-9	brown gravel and silt (Qr)
		9-12	light brown silt (Qr)
		12-20	red shale
436	26-2116	0-14	hardpan (Qr)
		14-200	red shale and sandstone
437	26-1274	18	
438	26-712	8	
439	26-29286	0-18	sandy silt and small gravel (Qr)
		18-26	large gravel and silt (Qr)
		26-36	soft red rock
		36-200	red rock
440	26-25588	0-5	brown fine sand (Qr)
		5-12	brown-red fine sand (Qr)
		12-53	bedrock
441	26-26403	0-12	red-brown clay, trace coarse-to-fine gravel (Qr)
		12-70	sandstone
442	26-23011	0-34	red-brown clay with trace gravel (Qr)
		34-40	brown clay and sand (Qr)
		40-47	coarse sand and gravel (Qsp?)
		47-67	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	hardpan (Qr)
		3-9	fine sand (Qr)
		9-16	hardpan and boulders (Qr)
		16-58	sand and gravel (Qsp?)
		cased to 58, yield 30 gpm	
445	26-20439	0-3	red gray silty clay, little fine sand (Qr)
		3-5	weathered sandstone
		5-15	red, hard sandstone
446	26-21933	abbreviated log	
		0-7	red-tan silty fine sand (Qr)
		7-16	red silt, weathered siltstone
		16-20	weathered red siltstone
447	26-26586	0-10	sand (Qr)
		10-26	bedrock
448	26-712	8	
449	26-3539	18	
450	26-10548	abbreviated log	
		0-25	reddish brown fine-to-coarse sand with gravel (Qsh2)
451	26-1165	0-15	gravel (Qsh2)
		15-231	red rock
452	26-29099	abbreviated log	
		0-2	gravel (Qpr)
		2-20	sand (Qpr)
453	26-3374	20	
454	26-4991	0-4	fill
		4-12	hardpan (Qpr)
		12-26	silty gray sand (Qpr)
		26-28	red hardpan (Qr)
		28-300	red sandstone
455	26-755	0-11	clay (Qr)
		11-402	red sandstone
456	26-29030	abbreviated log	
		0-24	brown and red sand and boulders (Qr)
		24-30	red sandstone
457	26-4779	0-8	sand (Qr)
		8-200	red shale and sandstone
458	26-29308	0-13	sandy clay, gravel (Qr)
		13-17	red stone
459	26-27866	0-18	reddish brown silty sand and cobbles, some clay (Qr)
		18-19	red shale
460	26-3345	0-23	sand and gravel (Qr)
		23-140	red sandstone

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

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

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

[1]Identifiers 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.

[2]A number without a log is the depth, in feet below land surface, to bedrock reported for wells where the surficial material is either not identified or identified only as “overburden” or “glacial fill”. For wells and borings with logs of the surficial materials, the depth (in feet below land surface) and driller’s or logger’s description 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[3]	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	

[1]Proterozoic gneiss from the Hudson Highlands.

[2]Paleozoic sedimentary rocks from the Wallkill and Hudson valleys.

[3]Local sedimentary rocks from the Newark Basin.

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

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

[6]Quartz 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.

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