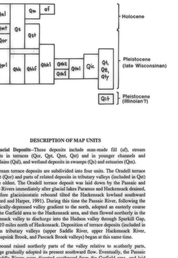
INTRODUCTION

Surficial deposits in the Hackensack quadrangle include alluvial, swamp, estuarine, and stream terrace deposits, all of postglacial age; glaciofluvialine and glaciolacustrine deposits of late Wisconsinan age; and till of late Wisconsinan and pre-late Wisconsinan age. These deposits are delineated on the accompanying map and described in this text. The glacial and postglacial events that the deposits record are also discussed. The surficial geologic map depicts generalized bedrock surface contours and to infer the subsurface distribution of deposits are provided in table 1. The temporal relationships of the deposits are shown on the correlation chart.

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Postglacial Deposits–These deposits include man-made fill (af), stream deposits in terraces (Qst, Qm, Qbt, Qbl) and in younger channels and floodplains (Qsf), and wetland deposits in swamps (Qs) and estuaries (Qm).

The stream terrace deposits are subdivided into four units. The Closkill terrace deposit (Qst) and parts of related deposits in tributary valleys (included in Qs) are the oldest. The Closkill terrace deposit was laid down by the Paramus and Saddle Rivers immediately after glacial lakes Paramus and Hackensack drained, but before glaciofluvialine rebound lifted the Hackensack lowland southward (Stanford and Harper, 1991). During this time the Passaic River, following the isostatically depressed valley gradient to the north, adopted an easterly course from the Garfield area to the Hackensack area, and then flowed northerly in the Hackensack valley to Oradell Reservoir (figure 1). The Closkill terrace is 20 to 25 feet above north of Hackensack. Deposition of terrace deposits (included in Qs) in tributary valleys (upper Saddle River, upper Hackensack River, Musquapsink Brook, and Pascack Brook valleys) began at this same time.

As rebound raised southerly parts of the valley relative to southerly parts, drainage gradually adapted to present southward flow. Eventually, the Paramus and Saddle Rivers were diverted southward from the Garfield area, and laid down the lower Paramus terrace deposit (Qm). The Hackensack River established a southerly course in its valley, and laid down the Moonachie terrace deposit (Qbt).

After deposition of the terraces, the Hackensack, Passaic, and Saddle Rivers became entrenched in their valleys. Until Qsf was, and continues to be, deposited in the entrenched floodplains and channels.

af — **ARTIFICIAL FILL**–Artificially emplaced sand, gravel, silt, clay, and rock; and man-made materials including cinders, ash, slag, construction rubble, and refuse. Fill ranges up to 30 feet thick. Many small areas of fill are not mapped. Extent of fill is based on air photos taken in 1979. Deposits of fill on the north side of Oradell Reservoir are chiefly sand from units Qsl and Qoe, and some clay from unit Qbl, excavated during construction of the reservoir. This material is present around most of the perimeter of the reservoir, but only the larger deposits are mapped.

Qsf — **ALLUVIUM**–Silt and sand; minor clay and gravel. Contains variable amounts of organic matter. Color of fine sediment is brown, dark brown, and gray. As much as 20 feet thick.

Qm — **ESTUARINE DEPOSITS**–Organic silt and clay, silt-mesh peat, sand, and minor gravel. Color of fine sediment is black, dark brown, and gray. As much as 20 feet thick.

Qs — **SWAMP DEPOSITS**–Freshwater peat and organic silt and clay; black to dark brown. As much as 10 feet thick.

Qst — **MOONACHIE TERRACE DEPOSIT**–Sand, minor pebble gravel and silt, very pale brown to yellowish brown. As much as 25 feet thick.

Qbt — **LOWER PASSAIC TERRACE DEPOSIT**–Sand, minor pebble gravel and silt, very pale brown to yellowish brown. As much as 20 feet thick.

Qbl — **STREAM TERRACE DEPOSITS**–Sand, minor pebble gravel and silt, very pale brown to yellowish brown. As much as 30 feet thick.

Qbr — **ORADELL TERRACE DEPOSIT**–Sand, minor pebble gravel and silt, very pale brown to yellowish brown. As much as 30 feet thick.

Glacial Deposits–These deposits include till and stratified sediment. Till is a poorly-sorted, unstratified mixture of clay, silt, sand, gravel, and boulders deposited directly from glacial ice (Qt, Qm, Qbl). The stratified sediments are generally well-sorted. They include sand and gravel laid down by glacial meltwater in a river plain (Qsv), and in glacial-lake deltas (Qbk, Qw, Qbt, Qbl, Qbd) and fans (Qbd). The stratified sediments also include silt, clay, and fine sand deposited on glacial-lake bottoms (Qbl, Qwl, Qbd), and poorly-sorted sand and gravel deposited in ice-walled ponds and/or kettles (Qkt). All of these deposits are of late Wisconsinan age, except for Qbd Qb, which may be of Illinoian age.

The orientations of striations and drumlins indicate that late Wisconsinan ice advanced in a slightly west of south direction across the Hackensack quadrangle. This ice was in the center of an advancing lobe channelled between the Palisades ridge to the east and the Watchung Mountains to the west (Salisbury, 1902; Stanford and Harper, 1991). During advance, the underlying bedrock surface was shaped by glacial erosion. The topography of the bedrock surface (plotted at 50-foot contour interval on the map) shows that there are bedrock valleys that are cut deeper and extend to more than 50 feet below sea level beneath the Passaic valley, to more than 50 feet below sea level in the Saddle River valley, and more than 200 feet below sea level in the Hackensack valley. To the south and to the north, the bedrock surface is more irregular, and the trough-forms die out (Parrillo, 1959; Stanford and others, 1990). This indicates that they are glacial-scour features rather than buried fluvial valleys. On the uplands between the troughs, the sandstone and conglomerate bedrock was glacially eroded into streamlined forms that parallel both the strike of the bedrock and ice flow. Till on these uplands is generally less than 20 feet thick.

In places that ice was wet-sensitive, and instead till was deposited in drumlins. Logs of wells (for example, wells 23, 28, 29, 33, 38, 42, 43, 46, 100, 108), and seismic refraction data indicate that late Wisconsinan till (Qt) is as much as 100 feet thick, and in places overlies stratified sediment and a lower till of possible Illinoian age (Qb).

Late Wisconsinan ice advanced to a southernmost position at Perth Amboy, about 30 miles southwest of Hackensack, and the ice front began to recede from this position about 20,000 B.P. (Stanford, 1993). As the ice receded, it formed glacial lakes, with the open of the lobe centered on the Hackensack valley (fig. 1). In the Hackensack quadrangle, several proglacial lakes covered lowlands as the ice front retreated (fig. 1). The Passaic River, Saddle River, and Musquapsink Brook valleys, were occupied by glacial lake Paramus. This lake was dammed by a delta previously deposited in a small lake in the Passaic valley. The delta blocked the valley at Rutherford (indicated by the abbreviation "Rtf" on figure 1). Lake Paramus drained when the ice front receded about 20 feet. The spillway distinct south along the Passaic valley into glacial Hackensack. Lake Paramus was drained eastward into Lake Hackensack when the ice margin retreated north of the Musquapsink Brook valley at Westwood (margin MS on fig. 1), although shallow postglacial ponds likely remained in low areas in the Spring Brook and Musquapsink Brook valleys. Deposits in Lake Paramus include deltaic (Qpv) and lake-bottom (Qpl) sediment. Some of the sediment in and Qpl is in the Saddle River valley, but most of the deposits may have been deposited in the Passaic valley proper. Some of the deposits in the Hackensack valley may have been laid down in a temporary, slightly higher area of the lake that formed when the Paramus delta (fig. 1) blocked the valley south of Both El Cemetery.

After Lake Paramus drained, meltwater draining down the Saddle River and Hohokus Brook valleys from ice margins and glacial lakes north of the Hackensack quadrangle deposited sand and gravel (Qsv) in a river plain into the earlier Lake Paramus deposits in Ridgewood and Hohokus.

To the east, the Hackensack and Passaic valleys were occupied by glacial Lake Hackensack (fig. 1). This lake filled the glacially-scoured Hackensack valley, and was controlled by sluiced spillways on bedrock in the Edit van Kalt at 20 feet below sea level (about 17 miles south of Hackensack) and in the Arthur Kill at 30 feet below sea level (about 24 miles southwest of Hackensack) (Stanford and Harper, 1991). The Edit van Kalt spillway drained eastward into the Hudson River, and the Arthur Kill spillway drained southwest into the Raritan and Raritan Bay. Lake Hackensack drained eastward into the Hudson valley when the ice front retreated north of Spuyten Duyvil, about 12 miles southwest of Hackensack. As in the Lake Paramus basin, proglacial ponds likely remained in low areas in the Hackensack valley. Deposits in Lake Hackensack include delta (Qbk), and lake-bottom (Qbl) sediment. Some of the sediment in units Qbl and Qw may have been deposited in the proglacial ponds.

Farther east, a small lake, glacial Lake Tenneck, occupied the north-draining valley of Tenneck Brook. This valley was cut across by the retreating ice front, and ponded water the drainage divide in Teaneck at an elevation of about 100 feet (fig. 1) heading southward into Lake Hackensack. Deltaic sediments deposited in this plane of the lake comprise unit Qbt. The lake, lower plane was controlled by a spillway across the drainage divide in Bergenfield at an elevation of about 80 feet (fig. 1) leading southwestward into Lake Hackensack. Deltaic sediments deposited in this phase of the lake comprise unit Qbl2. Lake-bottom sediment (Qbl) was also deposited in these lakes. When the ice margin retreated north of the upland between Bergenfield and New Milford (margin MS on fig. 1), Lake Tenneck was drained eastward into Lake Hackensack.

Qsf — **SADDLE RIVER DEPOSIT**–Sand, reddish brown to brown, silty sand, and minor gravel. Deposited in floodplains of Saddle, Hohokus and Ridgewood, As much as 20 feet thick.

GLACIAL LAKE HACKENSACK DEPOSITS

Qbk — **Delta deposits**–Sand, gravel, and cobbles. As much as 80 feet thick.

Qbl — **Lake-bottom deposits**–Silt, clay, fine sand, reddish brown to gray, thinly layered to varved. As much as 200 feet thick.

Qbl2 — **Lacustrine fan deposits**–Sand and gravel, as much as 100 feet thick (estimated) but generally less than 50 feet thick. In subsurface only (sections AA', BB', DD').

GLACIAL LAKE PARAMUS DEPOSITS

Qpv — **Delta deposits**–Sand, gravel, and cobbles. As much as 80 feet thick.

Qpl — **Lake-bottom deposits**–Silt, clay, fine sand, reddish brown to gray, thinly layered to varved. As much as 80 feet thick.

GLACIAL LAKE TENNECK DEPOSITS

Qbt — **Delta deposits in higher stage of Lake Tenneck**–Sand, reddish yellow to yellow, some gravel. As much as 40 feet thick (estimated).

Qbl2 — **Delta deposits in lower stage of Lake Tenneck**–Sand, reddish yellow to yellow, some gravel. As much as 40 feet thick (estimated).

Qbl1 — **Lake-bottom deposits**–Fine sand and silt, reddish brown to gray. As much as 20 feet thick (estimated).

Qt — **TILL**–Reddish brown to reddish yellow silty sand, sandy silt, and sand, with some to many subrounded and subangular pebbles and cobbles and few subrounded boulders. Gravel include, in approximate order of abundance, red and gray mudstone and sandstone, gneiss, conglomerate, quartzite, and rounded quartz pebbles. Boulders are shaly gneiss and conglomerate. The clasts are derived from the bedrock units in the drift area to northeast, along the line of ice flow. The gneiss pebbles are derived from the Ringwood Formation, a proglacial fluvial gravel that formerly covered much of the region. The till is as much as 100 feet thick in drumlins. Elsewhere, as much as 60 feet thick, but generally less than 30 feet thick. Qt delineates areas where till is continuous and generally more than 10 feet thick. Qt delineates areas where till is discontinuous and generally thinner. The extent of unit Qt is based on field mapping by Stanford (1993), and on earlier others (1993), and unpublished manuscript maps of C. E. Parsons, B. D. Salisbury, and H. B. Kummel (in *file at the N. J. Geological Survey*).

Qty — **RAHWAY TILL (YELLOW PHASE)**–Till as above, except fine sediment is a reddish yellow to yellow silty sand, not much as 40 feet thick (estimated). Yellow color reflects increased content of light-colored quartz derived from gneiss bedrock of the Hudson Highlands. The southern edge of the Hudson Highlands is about 12 miles north to Ridgewood. Contact with Qt is gradational.

Qb — **ILLINOIAN? TILL**–Reddish brown to reddish yellow silty sand till, similar to unit Qt. Gneiss and sandstone clasts may have weathering rinds. As much as 70 feet thick. In subsurface only (section CC'), inferred from records of wells.

MAP SYMBOLS

Contact–Solid where well-defined by landforms; dashed where approximate, gradational, or feathered; dotted where concealed by fill or by water. Contacts between surficial deposits (Qsf and above) and Qbk, Qbrk, and others (Ttrk) are indicated by the same symbol as contact between surficial deposits of C. E. Parsons and B. D. Salisbury (in file at the N. J. Geological Survey).

Fluvial scarp–Line at top of scarp, ticks on slope.

Striation–Observation at site. Flag indicates data from Salisbury (1902).

Drumlin–Line along crest, symbol at summit.

Meltwater channel–Line in channel bottom, arrow shows drainage direction.

Spillway for glacial lake–Symbol in spillway, arrow shows drainage direction. Lettering indicates associated deposit.

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

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

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

Elevation of bedrock surface–Contour interval 50 feet. Not shown on bedrock aquifers above 100 feet in elevation.

Bedrock outcrop–Some small outcrops are not shown.

Unit to left of dashed contact and to right–Shows extent of underlying map unit beneath large areas of artificial fill. Extent of units Qm, Qbr, and Qsf beneath fill based, in part, on Merrill and others (1982), Darton and others (1968), and unpublished manuscript maps of C. E. Parsons and B. D. Salisbury (on file at the N. J. Geological Survey).

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

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

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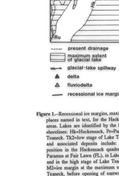

Table 1.–Selected Well Logs

Well Permit Number	Depth (feet)	Description
1	25-1133	0-32 sand and gravel (Qpv)
	32-58	red sandstone
2	25-5867	0-18 overburden (QsQsQpv)
	18-23	red rock
3	25-4763	0-30 sand and gravel (Qpv)
	30-35	red sandy hardpan (Qp)
	35-48	red sandstone
4	25-1148	0-34 sand (Qpv)
	34-47	red sandstone
5	25-1147	0-18 sand and gravel (Qpv)
	18-28	yellow sand, some stones (Qpv)
	28-33	reddish sand, some gravel (Qpv)
	33-50	hardpan, layers of red shale (Qp)
	50-58	brown sandstone and red shale
6	25-8511	0-20 sand and gravel (Qpv)
	20-25	red sandstone
7	25-393	0-25 sand (QsQpv)
	25-40	red sandstone
8	25-5577	0-60 coarse sand (Qpv)
	60-70	red sandstone
9	25-682	0-18 sand and gravel (Qpv)
	18-30	sand and gravel (Qpv)
	30-40	red sandstone
10	25-1422	0-30 sand with large gravel (Qpv)
	30-47	red sandstone
11	25-1457	0-32 sand and gravel (Qpv)
	32-43	red sandstone
12	25-6351	0-52 sand and gravel (Qpv)
	52-53	red sandstone
13	25-14	0-8 sand and gravel (Qpv)
	8-50	sand (Qpv)
	50-52	red sandstone
14	25-1690	0-53 sand and gravel (Qpv)
	53-61	red rock
15	25-1576	0-18 sand and gravel (Qpv)
	18-35	red rock
16	25-1055	0-24 sand and gravel (Qpv)
	24-35	red rock
17	25-1576	0-18 sand (Qpv)
	18-35	hardpan (Qp)
	35-100	red sandstone
18	25-678	0-35 sand (Qpv)
	35-38	gravel (Qp or pre-advance stratified sediment)
	38-50	red sandstone
19	25-674	0-5 sand and gravel (Qpv)
	5-11	sand and gravel (Qp)
	11-50	red sandstone
20	25-5313	0-13 sand and gravel (Qpv)
	13-23	red hardpan (Qp)
	23-50	red sandstone
21	25-5599	0-31 hardpan (thin Qpv)
	31-50	red sandstone
22	25-3962	0-38 boulders, sand (thin QsQpv)
	38-50	red rock
23	25-1459	0-52 hardpan (Qp)
	52-58	red sandstone
24	25-38	0-18 sand and boulders (Qp)
	18-28	red hardpan (Qp)
	28-86-112	hard sand and gravel (Qp or pre-advance stratified sediment)
	86-112	red sandstone
25	25-409	0-18 sand and boulders (Qp)
	18-108	red hardpan (Qp or Qb)
	108-118	red fine sand with some water (pre-advance stratified sediment)
	118-120	red sandstone
26	25-5974	0-12 sand (Qp)
	12-50	red sandstone
27	25-3397	0-22 hardpan (Qp)
	22-33	red rock
28	25-4363	0-20 sand (Qp)
	20-120	red rock
29	25-1147	0-18 sand and boulders (Qp)
	18-108	red hardpan with some gravel on top of rock (Qb? Qpv?)
30	25-1564	0-31 stony hardpan (Qp)
	31-35	red sandstone
31	25-1359	0-5 sand (Qp)
	5-17	red sandy hardpan (Qp)
	17-50	red sandstone
32	25-1375	0-18 sand (Qp)
	18-37	red sandstone
33	25-187	0-20 sand (Qp)
	20-28	red sandstone
34	25-1423	0-20 hardpan with gneiss boulders (Qp)
	20-183	red rock
35	25-1191	0-18 sand and boulders (Qp)
	18-25	red sandstone
40	25-1362	0-54 hardpan with some sand (Qp)
	54-60	red sandstone
41	25-1363	0-40 hardpan (Qp)
	40-50	red sandstone
42	25-897	0-15 hardpan with boulders (Qp)
	15-20	red sandstone, soft
43	25-879	0-20 sand (Qp)
	20-29	red hardpan (Qp)
	29-45	coarse red sandstone
	45-53	red shale
44	25-1226	0-20 sand (Qp)
	20-50	red sandstone
45	25-895	0-20 hardpan (Qp)
	25-34	sandy hardpan, some water (Qp)
	34-50	red sandstone
	50-70	red shale
	70-75	red shale
46	25-982	0-15 stony hardpan (Qp)
	15-47	red sandy hardpan (Qp), pre-advance stratified sediment
	47-60	red shale
	60-75	red sandstone
47	25-1358	0-38 sand (Qp)
	38-75	red sandstone
48	25-5369	0-4 clay fill
	4-20	sand (Qp)
	20-30	red hardpan (Qp)
	30-50	red sandstone
49	25-2869	0-18 sand (Qp)
	18-50	red rock
50	25-6465	0-20 sand (QsQpv)
	20-50	red sandstone
51	25-6461	0-18 sand (QsQpv)
	18-47	hardpan (Qp)
	47-50	red sandstone
52	25-551	0-18 sand (Qp)
	18-75	red sandstone
53	25-377	0-20 sand and gravel (Qp)
	20-50	clay (Qp or Qt)
	50-75	red sandstone (Qp or Qt)
54	25-365	0-20 sand (Qp)
	20-25	hardpan (Qp)
	25-50	red sandstone
	50-58	red shale
55	25-510	0-18 sand and gravel (Qp)
	18-50	red sandstone, hard
56	25-3242	0-44 sand and gravel (Qp)
	44-50	red rock
57	25-839	0-20 sandy hardpan with boulders (Qp)
	20-47	red sandy hardpan (Qp)
	47-50	red hardpan (Qp)
	50-141	red sandstone
58	25-3390	0-20 sand and gravel (ssQpQpv)
	20-50	red sandstone
59	25-4241	0-20 sand (Qp)
	20-50	shale and red rock
60	25-1197	0-15 sand and gravel (Qpv)
	15-65	sand and gravel (QsQpv)
61	25-8468	0-34 red sand (Qpv)
	34-50	red sandstone
62	25-4469	0-35 sand and gravel (QsQpv)
	35-50	red sandstone
63	25-8868	0-34 red sand (Qpv)
	34-50	red sandstone
64	25-4470	0-31 sand and gravel (Qpv)
	31-50	red sandstone
65	25-4470	0-30 sand (Qpv)
	30-120	red rock
66	25-6469	0-18 sand and gravel (Qpv)
	18-50	red sandstone
67	25-8467	0-30 sand (Qpv)
	30-50	red sandstone
68	25-4468	0-30 sand (Qpv)
	30-50	red sandstone
69	25-5950	0-18 sand, clay (QsQpv)
	18-50	red sandstone
70	25-3841	0-4 sand (Qpv)
	4-50	red sandstone
71	25-3082	0-30 sand (Qpv)
	30-50	red sandstone
72	25-751	0-35 sand (Qpv)
	35-100	sandstone, red
73	26-4363	0-20 sand with some water around 25 ft. (Qpv)
	20-50	red shale and sandstone
74	25-631	0-20 sand and gravel (Qpv)
	20-50	red sandstone, some water around 25-30 ft. (Qpv)
75	25-831	0-20 sand (Qpv)
	20-50	red rock, mostly sandstone
76	25-4361	0-20 sand and gravel (Qpv)
	20-50	red sandstone
77	25-4362	0-20 sand (Qpv)
	20-50	red sandstone
78	25-1360	0-20 sand (Qpv)
	20-50	red sandstone
79	25-1361	0-20 sand (Qpv)
	20-50	red sandstone
80	25-4359	0-20 sand (Qpv)
	20-50	red sandstone
81	25-4360	0-20 sand (Qpv)
	20-50	red sandstone
82	25-4358	0-20 sand (Qpv)
	20-50	red sandstone
83	25-4357	0-20 sand (Qpv)
	20-50	red sandstone
84	25-4356	0-20 sand (Qpv)
	20-50	red sandstone
85	25-4355	0-20 sand (Qpv)
	20-50	red sandstone
86	25-4354	0-20 sand (Qpv)
	20-50	red sandstone
87	25-4353	0-20 sand (Qpv)
	20-50	red sandstone
88	25-4352	0-20 sand (Qpv)
	20-50	red sandstone
89	25-4351	0-20 sand (Qpv)
	20-50	red sandstone
90	25-7584	0-20 sand (Qpv)
	20-50	red sandstone
91	25-4350	0-20 sand (Qpv)
	20-50	red sandstone
92	25-4349	0-20 sand (Qpv)
	20-50	red sandstone
93	25-7659	0-20 sand (Qpv)
	20-50	red sandstone
94	25-1466	0-15 sand (Qpv)
	15-60	red sandstone
95	25-7584	0-37 sand (Qpv)
	37-50	red sandstone
96	25-5270	0-20 sand (Qpv)
	20-50	red sandstone
97	25-4527	0-35 sand, gravel, clay (Qpv)
	35-50	red sandstone
98	25-5482	0-18 clay
	18-50	clay, peat, some stones (Qst)
99	25-1359	0-18 sand and boulders (QsQpv?)
	18-93	sandstone
99	26-5579	0-12 sand (Qpv)
	12-50	red sandstone
100	25-7649	0-18 sand and gravel (Qpv)
	18-31	clay, gravel (Qm)
	31-50	red sandstone
101	25-9359	0-18 sand (Qpv)
	18-50	red sandstone
102	25-7649	0-18 sand (Qpv)
	18-50	red sandstone
103	25-1979	0-20 sand (Qpv)
	20-50	red sandstone
104	25-3984	0-20 sand (Qpv)
	20-50	red sandstone
105	25-4471	0-20 sand (Qpv)
	20-50	red sandstone
106	25-3370	0-18 sand, boulders (sdQsQpv?)
	18-50	sandstone and shale
107	25-3370	0-18 sand, boulders (sdQsQpv?)
	18-50	sandstone and shale
108	25-6262	0-18 sand (Qpv)
	18-50	red sandstone
109	25-7614	0-18 sand (Qpv)
	18-50	red sandstone
110	25-6263	0-18 sand (Qpv)
	18-50	red sandstone
111	25-6264	0-18 sand (Qpv)
	18-50	red sandstone
112	25-6193	0-41 hardpan (Qpv)
	41-50	red sandstone
113	25-1414	0-18 hard sand with coarse gravel (Qp)
	18-50	red sandstone
114	25-7579	0-14 clay, gravel (Qm)
	14-19	hardpan (Qp)
	19-50	red sandstone
115	25-224	0-5 sand (Qp)
	5-15	sandy clay and gravel (QsQp)
	15-50	red sandstone
116	26-6472	0-34 hardpan, clay and stones (Qp)
	34-50	red sandstone
117	25-3913	0-18 sand and gravel (Qp)
	18-50	red sandstone
118	26-11137	abbreviated log
	0-38	light brown, brown, red brown fine-to-medium sand, some fine gravel and stones (Qp)
119	25-4340	0-74 sand and gravel, overburden (Qpv over Qp)
	74-100	sandstone
120	26-3217	0-15 sand (Qp)
	15-50	red sandstone, yield 25 gpm.
121	25-4361	0-34 sand (Qp)
	34-50	red sandstone
122	25-4349	0-19 overburden (Qp)
	19-50	red sandstone
123	25-4350	0-20 sand (Qp)
	20-147	red sandstone
124	25-4353	0-26 sand (Qp)
	26-155	red rock
125	23-4207	0-15 sand (Qp)
	15-25	clay (Qp)
	25-42	sand (Qpv), yield 23 gpm.
126	26-8	abbreviated log
		log by H. Kasper, NGS
	0-20	fill, sand, some fine-to-medium sand (Qpv)
	20-51	reddish sandy-clay-to-coarse-sand with red sandstone fragments (Qpv or Qp)
	51-500	red sandstone
127	26-7693	0-24 sand (Qpv)
	29-31	clay (Qm)
		assumed 11-31, yield 30 gpm.
128	26-13	abbreviated log
	0-29	fill, brown, clay (DSBQm)
	29-29	gray clay (Qm or Qpl)
	29-46	sand and gravel (Qpv)
	46-56	hardpan, cemented gravel (Qp)
129	26-2463	0-30 sandy fill (Qpv)
	30-50	red sandstone
130	26-1384	0-40 sand and gravel (Qpv)
	40-112	red shale
131	26-324	0-71 overburden (Qpv)
	71-101	red sandstone
132	26-4803	0-25 sand (Qpv)
	25-42	gravel (Qpv)
	42-54	boulders (Qp)
133	26-412	0-18 sand (Qp)
	18-70	red sandstone
134	26-1224	0-18 sand (Qp)
	18-120	red rock
135	26-3912	0-4 fill (fill Qm)
	4-8	grey clay (QsQpv)
	8-40	sand and hardpan (Qp)
	40-50	red sandstone
136	26-3910	0-4 fill (fill Qm)
	4-40	grey-red clay (QsQpv)
	40-50	sand and hardpan (Qp)
137	26-4363	0-51 overburden (Qp)
	51-100	red sandstone
138	26-4803	0-25 sand (Qpv)
	25-42	gravel (Qpv)
	42-54	boulders (Qp)
139	26-4363	0-18 sand (Qp)
	18-70	red sandstone
140	26-5963	0-3 topsoil-overburden (Qp)
	3-50	red sandstone
141	26-1097	0-4 fill (fill Qm)
	4-70	red hardpan (Qp)
	70-84	red rock
142	26-794	0-16 glacial fill (Qp)
	16-50	red sandstone
143	26-5001	0-16 fill (Qm)
	16-97	fine sandy sand with clay (QsQpv)
	97-63	sand and gravel (Qpv)
	63-84	gravel (Qpv)
	84-74	fine sand, clay, coarse sand with some gravel (Qpv?)
	74-475	sandstone and shale
144	26-792	0-2 topsoil (Qp)
	2-34	boulders (Qp)
	34-56	red hardpan (Qp)
	56-57	sand, little gravel (Qp)
	57-58	hardpan (Qp)
	58-175	reddish brown sandstone
145	26-432	0-5 fill (Qm)
	5-40	sand (Qpv)
	40-52	sand and gravel (Qp or Qt)
146	26-501	0-20 sand (Qpv)
	20-30	gravel (Qpv)
	30-42	sand (Qpv)
	42-130	red rock
147	26-4327	0-10 sand (Qp)
	10-33	sand and gravel (Qpv)
	33-40	red sandy hardpan (Qp)
	40-49	red hardpan (Qp)
	49-50	red sandstone
148	26-9357	0-34 sand (Qpv)
	34-50	light brown, brown, red brown sand, trace fine gravel and clay (Qp)
149	26-4802	0-14 sand (Qpv)
	14-20	overburden
	20-30	sand (Qpv)
	30-40	fine sand (Qpv)
	40-50	sand and gravel (Qp or Qt)
	50-140	red rock
150	26-191	0-15 sand (Qpv)
	15-25	red shale
	25-148	red sandstone
151	26-792	0-2 fill (Qm)
	2-22	brown to gray silt and clay (Qm?)
	22-31	red to yellow sand (Qp)
	31-33	till and weathered rock
	33-175	reddish brown sandstone and shale, red
152	26-7552	0-5 fill
	5-12	fine grey, some stones (Qm)
	12-23	brown sand and boulders (QsQpv?)
	23-27	till and weathered rock
	27-175	reddish brown sandstone and shale, red
153	26-484	0-16 fill (Qm)
	16-79	brown clay (Qm)
	79-150	red rock
154	26-5037	0-12 stony soil (Qm)
	12-50	red sandstone
155	26-1791	0-13 sand (QsQpv)
	13-45	sand (QsQpv)
	45-77	hardpan (Qp)
	77-150	red sandstone
156	26-5551	0-11 fine sand (Qm)
157	26-4483	0-83 hard sand (QsQpv)
	83-90	red sand (Qpv)
	90-150	red rock
158	26-4484	0-83 hard sand (QsQpv)
	83-90	red sand (Qpv)
	90-163	red rock
159	26-4544	0-10 fill (Qm)
	10-40	clay (Qm)
	40-52	sand (Qpv)
	52-163	red rock
160	26-3310	0-22 sand (Qp)
	22-72	clay (Qm)
	72-150	red sandstone
161	26-5256	sandstone log on 162
162	26-3703	0-18 sand, sand and gravel mixed (QsQpv?QpQm)
	18-183	red sandstone
163	26-4321	0-18 sand (QsQpv)
164	26-4322	0-18 sand (Qp)
165	26-4323	0-18 sand (Qp)
166	26-4324	0-18 sand (Qp)
167	26-4325	0-18 sand (Qp)
168	26-4326	0-18 sand (Qp)
169	26-4327