DEPARTMENT OF ENVIRONMENTAL PROTECTION
NEW JERSEY GEOLOGICAL SURVEY

EXPLANATION

This map depicts the thickness and extent of glacial sediment in New Jersey. Most of this sediment was deposited during the late Wisconsinan glaciation, which reached its maximum extent approximately 20,000 years ago. Some of the sediment was deposited during the Illinoian glaciation, which reached its maximum extent approximately 150,000 years ago, and during a pre-Illinoian (formerly known as "Jerseyan") glaciation, which may have occurred as long as 2.1 million years ago. On the map, deposits of Illinoian age are prefixed by the letter "i" and deposits of pre-Illinoian age are prefixed by the letter "j". Deposits of late Wisconsinan age are unprefixed. A complete description of the geologic history of the glacial sediment and the glaciations is provided in Stone and others (2002) and Salisbury (1902).

Productive glacial aquifers occur within map units d, l, and fl, within units m and im where they overlie sand and gravel in the Pequest, Musconetcong, Lamington, and Rockaway valleys, and in the Passaic lowland between Morristown and Summit, within unit f where it is in hydraulic connection with surface water, and within unit ct in restricted locations in the Passaic lowland where it overlies sand and gravel. The inset map to the right shows the extent of the principal glacial aquifers. The three accompanying block diagrams illustrate the structure, mode of deposition, and hydrogeologic properties of map units d, l, fl, and f.

The extent and thickness of discrete water-producing beds within the map units varies from valley to valley, and from place to place within valleys. The location of these beds cannot be inferred directly from this map. Mapping these beds requires detailed study of individual valleys.

Recharge to the glacial aquifers occurs by a combination of infiltration of surface water from streams, lakes, and wetlands; infiltration of rainfall and snowfall on outcrop areas of the aquifers; and flow of groundwater from adjacent glacial sediment and bedrock. As with the aquifers themselves, the location and relative importance of these recharge processes vary from valley to valley, and from place to place within valleys. The location of recharge areas cannot be inferred directly from this map. Mapping recharge areas requires detailed study of individual valleys.

MAP UNITS

Symbol	Unit	Description	Hydrogeologic Character
ct	continuous till	Continuous till generally greater than 20 feet thick. May be as much as 200 feet thick. Grain size of matrix generally reflects underlying bedrock. Silty sand to sandy till forms on gneiss, sandstone, quartzite, and conglomerate; silty till forms of shale, carbonate, basalt and diabase; silty clay till forms locally on shale and on Cretaceous clay.	May be a local unconfined aquifer where thick and sandy. In the Passaic basin between Summit and Morristown till overlies productive, confined lacustrine-fan and fluvial sand and gravel aquifers in places. These areas are shown by a ruled pattern.
dt	discontinuous till	Discontinuous till generally less than 20 feet thick, numerous bedrock outcrops.	No significant surficial aquifer overlying bedrock.
m, im	moraine deposits	Till, sandy diamict, and minor sand and gravel deposited as ridges and knolls along former ice margins. May interbed with and overlie fluvial, deltaic, lacustrine-fan, and lake-bottom sediment where moraines traverse valleys and glacial lake basins. May be as much as 200 feet thick. Symbol "im" indicates moraines of Illinoian age.	May be a local unconfined aquifer where thick; productive confined and semi-confined lacustrine-fan, deltaic, and fluvial sand and gravel aquifers may occur beneath morainic deposits in places. These areas are shown by a ruled pattern.
l	lake-bottom sediment	Silt, clay, and fine sand deposited on the bottoms of glacial lakes. As much as 250 feet thick.	Generally a confining or semi-confining layer. Underlain by productive confined and semi-confined lacustrine-fan and fluvial aquifers in places.
d, id	deltaic and lacustrine-fan sediment	Sand and gravel deposited as deltas and fans in glacial lakes. May locally overlie lake-bottom sediment. As much as 200 feet thick. Symbol "id" indicates delta and fan sediment of Illinoian age.	Unconfined aquifer where sufficiently thick. Lacustrine-fan sand and gravel is a productive confined or semi-confined aquifer in places in the subsurface, where it is overlain by lake-bottom sediment. Surface outcrops of deltas and fans may be recharge areas for these confined lacustrine-fan aquifers.
fl	fluvial over lacustrine sediment	Generally a three-part vertical sequence of fluvial sand and gravel overlying deltaic and lake-bottom fine sand, silt, and minor clay, in turn overlying lacustrine-fan sand and gravel. Entire section may be as much as 250 feet thick.	Upper sand and gravel may be an unconfined aquifer where thick or where hydrologically connected to surface water. Middle silt and fine sand unit is a confining or semi-confining layer. Lower sand and gravel may be a productive confined or semi-confined aquifer.
if, f	fluvial sediment	Sand and gravel deposited in plains in valleys not occupied by glacial lakes. Generally less than 50 feet thick. Symbol "if" indicates fluvial sediment of Illinoian age.	Unconfined aquifer where sufficiently thick or where hydrologically connected to surface water.
ic	ice-contact sediment	Sand and gravel and sandy, bouldery diamict forming hummocky topography. May be as much as 200 feet thick.	Unconfined aquifer where sufficiently thick; in large lake basins may be recharge areas for confined lacustrine-fan aquifers.
it	till of Illinoian age	Sandy silt to clayey sandy silt till. Occurs as erosional remnants on gentle to moderate slopes. Maximum thickness 50 feet.	Too thin to be an aquifer. May retard movement of surface water into the underlying bedrock.
jt	till of pre-Illinoian age	Sandy silt till to clayey silt till. Occurs as erosional remnants on flat upland areas. Maximum thickness 30 feet.	Too thin to be an aquifer. May retard movement of surface water into the underlying bedrock.
js	sand and gravel of pre-Illinoian age	Sand and gravel of both fluvial and deltaic origin. Occur as erosional remnants on flat upland areas. Maximum thickness 80 feet but generally less than 30 feet thick.	Too thin to be an aquifer. Readily transmits surface water into the underlying bedrock.
x	non-glacial material	Non-glacial surficial material including weathered bedrock, colluvium, and alluvium. Weathered bedrock may be as thick as 300 feet on carbonate bedrock and 100 feet on gneiss and conglomerate bedrock but is generally less than 20 feet thick elsewhere. Colluvium occurs in wedge-shaped deposits at the base of hillslopes,and may be as much as 50 feet thick. Alluvium occurs in floodplains and terraces along streams and is generally less than 30 feet thick.	Weathered gneiss and conglomerate may be a local unconfined aquifer where thick and sandy. Otherwise, non-glacial materials are too thin to be aquifers.
(ruled pattern)		Area where till (unit ct) and morainic deposits (units m, im) overlie sand and gravel (units f and d) and silt, fine sand, and clay (unit l).	

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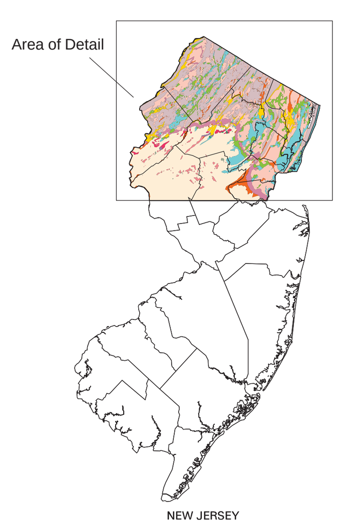


HYDROGEOLOGIC CHARACTER AND THICKNESS OF THE GLACIAL SEDIMENT OF NEW JERSEY

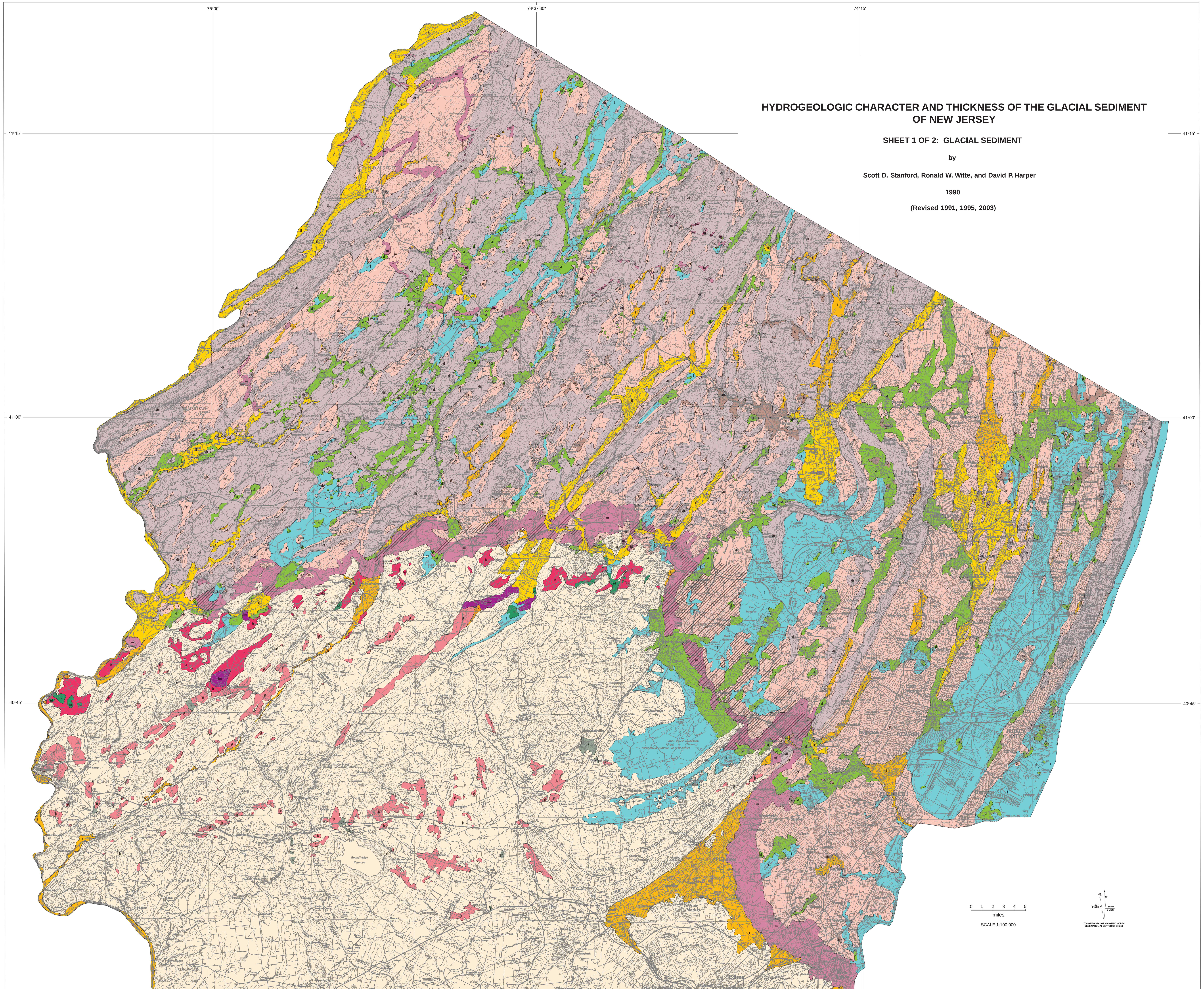
SHEET 1 OF 2: GLACIAL SEDIMENT

by

Scott D. Stanford, Ronald W. Witte, and David P. Harper

1990

(Revised 1991, 1995, 2003)



Base map from U.S. Geological Survey, 1984 and 1986.
Contour interval 20 meters; supplemental contour interval 10 meters.

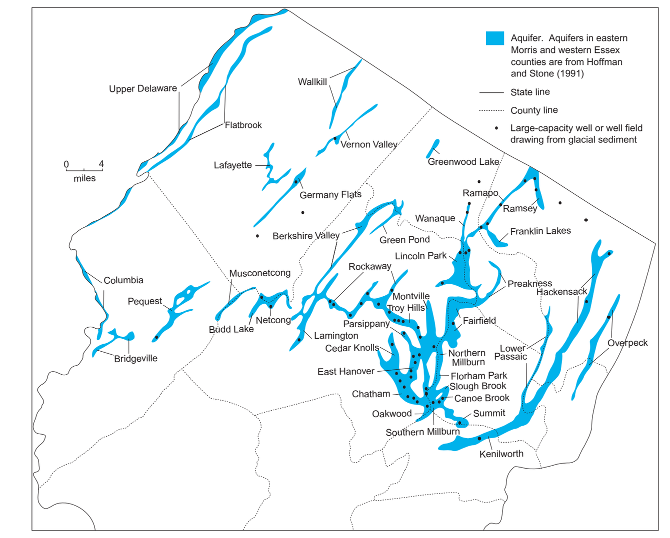
Digital data is available upon request from the New Jersey Geological Survey.

Geologic contacts modified from Stone and others (2002), Ridge (1983), and Salisbury (1895)

The interpretations presented here are provisional pending peer review. There may be revisions prior to publication.

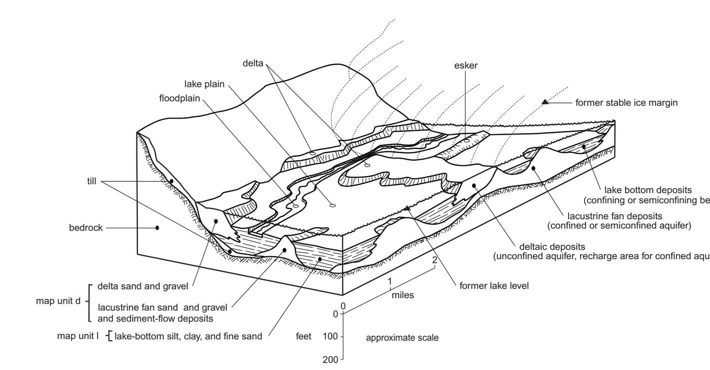
Cartography by M.W. Girard

PRINCIPAL GLACIAL AQUIFERS



BLOCK DIAGRAMS OF TYPICAL VALLEY-FILL AQUIFER SYSTEMS

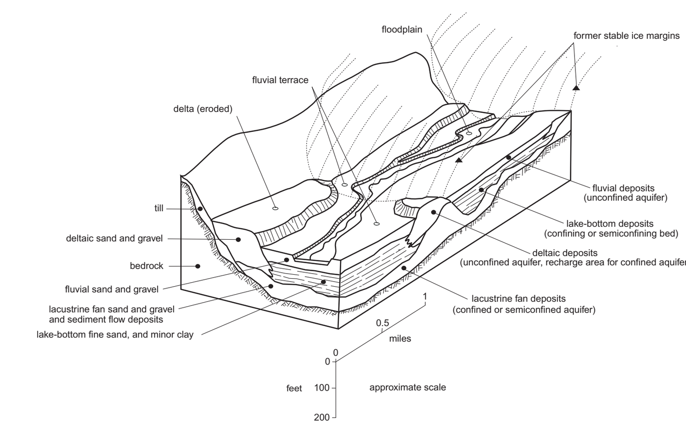
Landforms are indicated by open circles and are identified at the top of the diagrams. Sediment is indicated by filled circles and is identified on the left side of the diagrams. The hydrologic character of the sediment is indicated on the right side of the diagrams. Triangles indicate former ice margins and lake levels during deglaciation.



Map Units “l” and “d”: delta, fan, and lake-bottom sediment in unfilled glacial lakes

This diagram illustrates glacial lake basins that were either too large, too deep, or received too little glacial deposition to become completely filled with sediment. Deltas, fed by meltwater discharging from the glacier in subglacial tunnels and in channels along the ice margin on uplands, built outward into the lake from stable ice margins during glacial retreat. Sand and gravel were deposited in the deltas as inclined foreset beds below lake level and as horizontal fluvial topset beds above lake level. Deltas generally coarsen upward from sand and pebbly sand foreset beds to pebble- and cobble-gravel topset beds, and their distal parts may overlie silt and clay lake-bottom sediment. Between stable ice margin positions, fans of sand and gravel were deposited where subglacial tunnels discharged meltwater into the lake. Bedding and grain size are more variable in the fans than in deltas, and fans may contain beds of unsorted sediment deposited by mass flow of material from the glacier or from the unstable slopes of deltas or the fans themselves. In quiet water away from the ice margin, silt and clay and, in places closer to the ice front, fine sand, settled onto the lake bottom. This fine sediment gradually filled the lowest areas of the lake and covered much of the fan sediment.

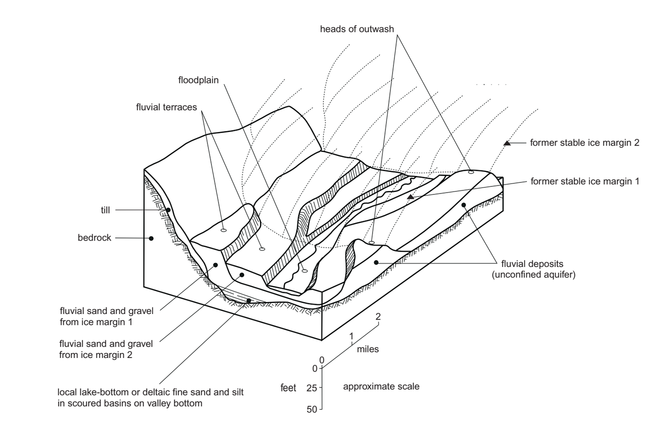
The fans are productive confined aquifers in many places, but in broad lake basins they occur on only a small portion of the lake bottom, generally as linear strings trending northward in the basin. The lake-bottom sediment is a confining or semiconfining unit. The deltas are, locally, unconfined aquifers and in places may recharge the confined lacustrine-fan aquifers.



Map Unit “fl”: fluvial over lacustrine sediment in filled glacial lakes

This diagram illustrates glacial lake basins that were sufficiently small or received enough glacial deposition to fill completely with sediment. As in the unfilled glacial lakes described above, deltas build outward into the lakes from stable ice margins, lacustrine-fan sediment blankets the floor of the lake, and lake-bottom sediment, generally more sandy than in the unfilled lake basins, fills the low areas. As the ice margin retreats, the lake bottom is gradually exposed as the accumulating lake-bottom sediment fills the basin and as the lake level drops when the sediment and ice-block dams holding in the lake erode or melt. Rivers of meltwater flowing across the exposed lake bottom deposit fluvial sand and gravel on top of the lake sediment. This completes the three-part layering typical of filled glacial lakes: an uppermost fluvial sand and gravel; over lake-bottom and deltaic fine sand, silt, and minor clay; over a basal lacustrine-fan sand and gravel.

The fans are, as in the unfilled lakes, productive confined aquifers in places. The lake-bottom sediment is a semi-confining unit, and the fluvial sand and gravel may be an unconfined aquifer, particularly where it is in hydrologic connection with rivers, lakes, and wetlands. The deltas may also be unconfined aquifers and in places may recharge the confined lacustrine-fan aquifers.



Map Unit “f”: fluvial sediment in non-ponded valleys

This diagram illustrates valleys that did not contain glacial lakes. Rivers of meltwater deposited plains of sand and gravel from successive stable ice margins during glacial retreat. These plains rise in elevation to heads of outwash which mark the former position of the ice margin. Plains deposited from later ice margins erode into earlier plains, forming terraces. The deposits in each plain generally coarsen from sand and pebbly sand far from the ice margin to cobble gravel near the ice margin. In places on the valley bottom where the glacier scoured basins in the bedrock, there may be small deposits of deltaic and lake-bottom sand and silt beneath the fluvial sand and gravel.

Where it is sufficiently thick and in hydrologic connection with rivers, lakes, and wetlands, the fluvial sediment is an unconfined aquifer. In general, sediment in these non-ponded valleys is thinner than in valleys that contained glacial lakes and generally does not support productive aquifers.

HYDROGEOLOGIC CHARACTER AND THICKNESS OF THE GLACIAL SEDIMENT OF NEW JERSEY

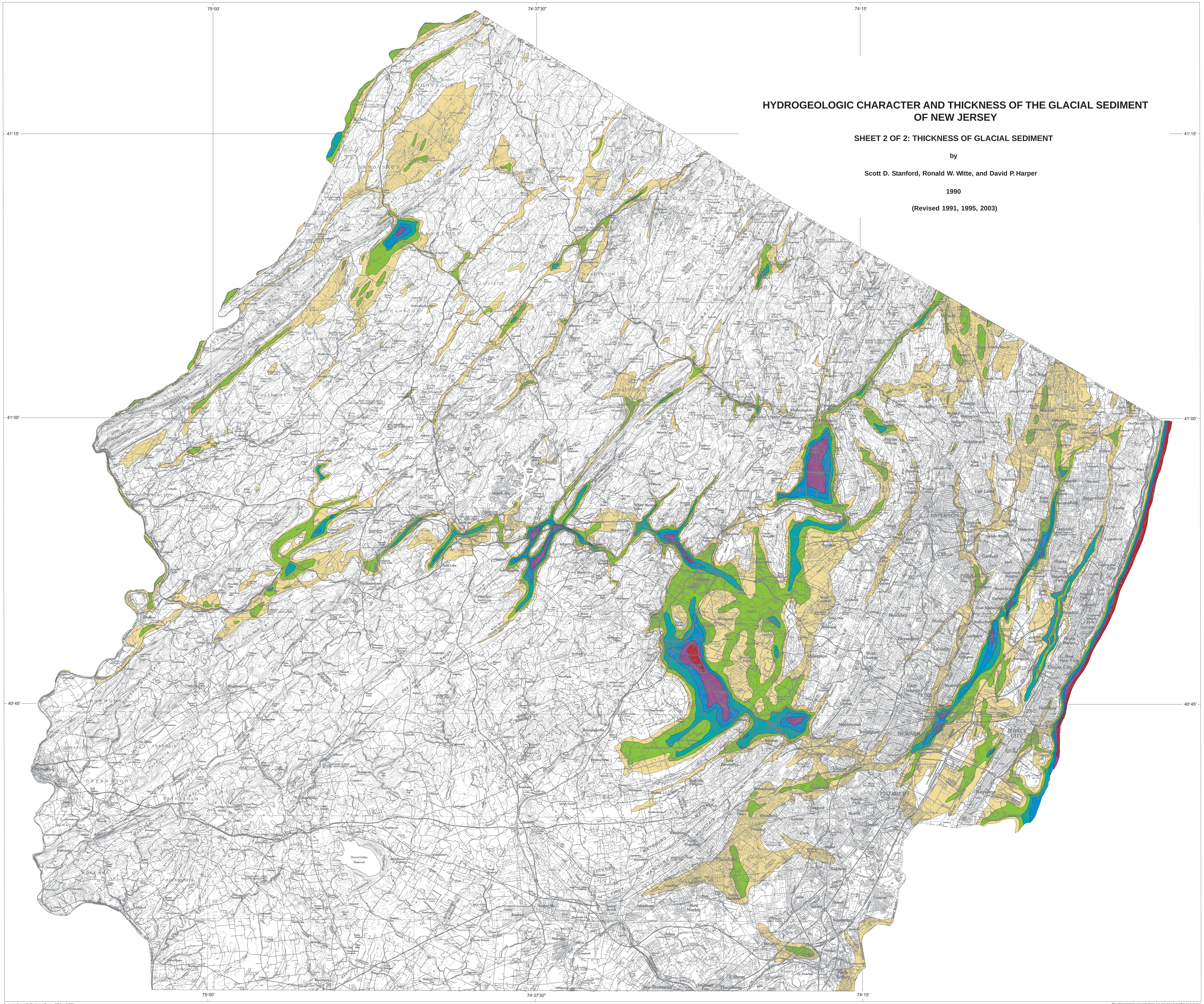
SHEET 2 OF 2: THICKNESS OF GLACIAL SEDIMENT

by

Scott D. Stanford, Ronald W. Witte, and David P. Harper

1990

(Revised 1991, 1995, 2003)



Base map from U.S. Geological Survey, 1984 and 1986.
Contour interval 20 meters; supplemental contour interval 10 meters.

Digital data is available upon request from the New Jersey Geological Survey.

RANGE OF THICKNESS

- 0 to 49 feet
- 50 to 99 feet
- 100 to 149 feet
- 150 to 199 feet
- 200 to 249 feet
- 250 to 299 feet
- 300 to 350 feet

SOURCES OF INFORMATION

The thickness contours are based on several thousand records of water wells and test borings selected from files at the New Jersey Department of Environmental Protection, Bureau of Water Allocation, at the New Jersey Geological Survey, and at the New Jersey Department of Transportation. Additional thickness data were obtained from:

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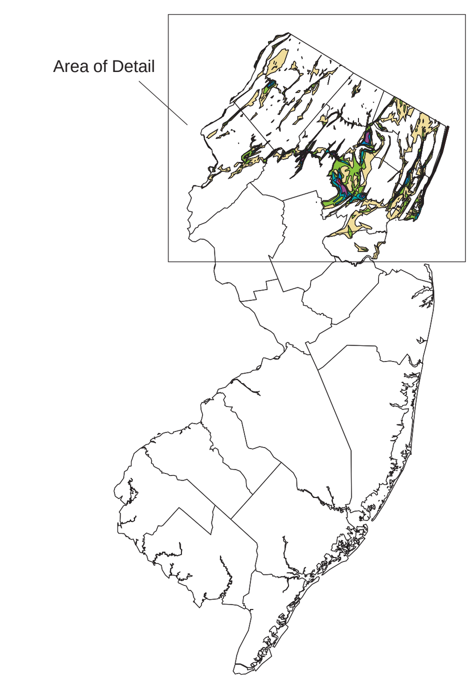

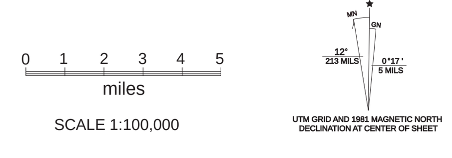

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