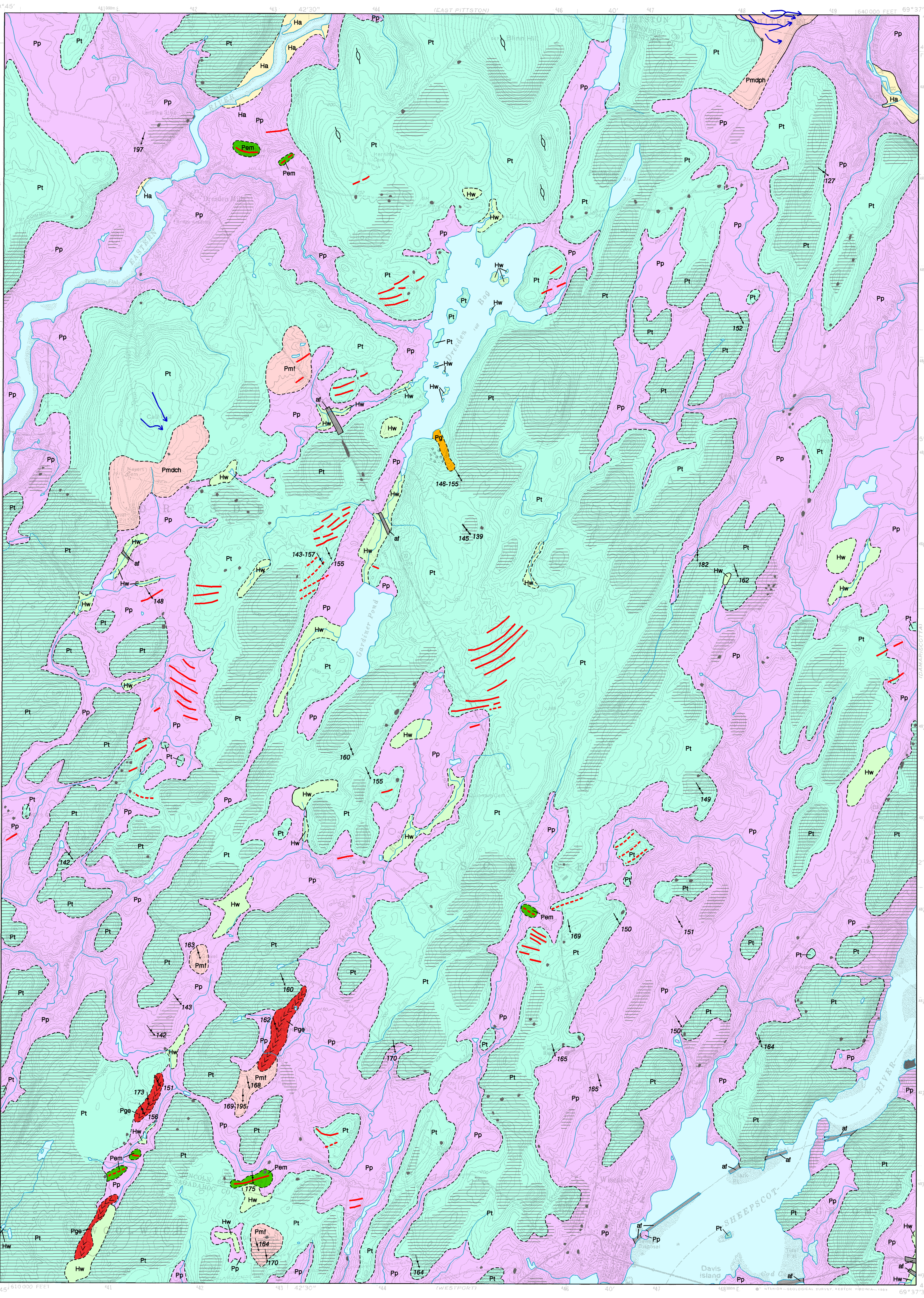
Surficial Geology



Wiscasset Quadrangle, Maine

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SURFICIAL GEOLOGY OF MAINE

Continental glaciers like the ice sheet now covering Antarctica probably extended across Maine several times during the Pleistocene Epoch, between about 1.5 million and 10,000 years ago. The slow-moving ice superficially changed the landscape as it scraped over mountains and valleys, eroding and transporting boulders and other rock debris for miles. The sediments that cover much of Maine are largely the product of glaciation. Glacial ice deposited some of these materials, while others washed into the sea or accumulated in meltwater streams and lakes as the ice receded. Earlier stream patterns were disrupted, creating hundreds of ponds and lakes across the state. The map at left shows the pattern of glacial sediments in the Wiscasset quadrangle.

The most recent "Ice Age" in Maine began about 30,000 years ago, when an ice sheet spread southward over New England (Stone and Borns, 1986). During its peak, the ice was several thousand feet thick and covered the highest mountains in the state. The weight of this huge glacier actually caused the land surface to sink hundreds of feet. Rock debris frozen into the base of the glacier abraded the bedrock surface over which the ice flowed. The grooves and fine scratches (striations) resulting from this scraping process are often seen on freshly exposed bedrock, and they are important indicators of the direction of ice movement. Erosion and sediment deposition by the ice sheet combined to give a streamlined shape to many hills, with their long dimension parallel to the direction of ice flow. Some of these hills (drumlins) are composed of dense glacial sediment (till) plastered under great pressure beneath the ice.

A warming climate forced the ice sheet to start receding as early as 21,000 calendar years ago, soon after it reached its southernmost position on Long Island (Ridge, 2004). The edge of the glacier withdrew from the continental shelf east of Long Island and reached the present position of the Maine coast by about 16,000 years ago (Borns and others, 2004). Even though the weight of the ice was removed from the land surface, the Earth's crust did not immediately spring back to its normal level. As a result, the sea flooded much of southern Maine as the glacier retreated to the northwest. Ocean waters extended far up the Kennebec and Penobscot valleys, reaching present elevations of up to 420 feet in the central part of the state.

Great quantities of sediment washed out of the melting ice and into the sea, which was in contact with the receding glacier margin. Sand and gravel accumulated as deltas and submarine fans where streams discharged along the ice front, while the finer silt and clay dispersed across the ocean floor. The shells of clams, mussels, and other invertebrates are found in the glacial-marine clay that blankets lowland areas of southern Maine. Ages of these fossils tell us that ocean waters covered parts of Maine until about 13,000 years ago. The land rebounded as the weight of the ice sheet was removed, forcing the sea to retreat.

Meltwater streams deposited sand and gravel in tunnels within the ice. These deposits remained as ridges (eskers) when the surrounding ice disappeared. Maine's esker systems can be traced for up to 100 miles, and are among the longest in the country.

Other sand and gravel deposits formed as mounds (kames) and terraces adjacent to melting ice, or as outwash in valleys in front of the glacier. Many of these water-laid deposits are well layered, in contrast to the chaotic mixture of boulders and sediment of all sizes (till) that was released from dirty ice without subsequent reworking. Ridges consisting of till or washed sediments (moraines) were constructed along the ice margin in places where the glacier was still actively flowing and conveying rock debris to its terminus. Moraine ridges are abundant in the zone of former marine submergence, where they are useful indicators of the pattern of ice retreat.

The last remnants of glacial ice probably were gone from Maine by 12,000 years ago. Large sand dunes accumulated in late-glacial time as winds picked up outwash sand and blew it onto the east sides of river valleys, such as the Androscoggin and Saco valleys. The modern stream network became established soon after deglaciation, and organic deposits began to form in peat bogs, marshes, and swamps. Tundra vegetation bordering the ice sheet was replaced by changing forest communities as the climate warmed (Davis and Jacobson, 1985). Geologic processes are by no means dormant today, however, since rivers and wave action modify the land, and worldwide sea level is gradually rising against Maine's coast.

References Cited

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Figure 1. Glacially sculpted bedrock knob in floor of old gravel pit on hillside south of Gardiner Pond in Wiscasset. In this view, the ice flowed from left to right (south-southeast), eroding the rock surface into an asymmetric form with a smooth, strongly abraded "upstream" side and a steeper SSE face.

Figure 2. Glacial grooves on polished surface of granite ledge in same locality as Figure 1. The pencil points in the direction of former ice flow (160°).

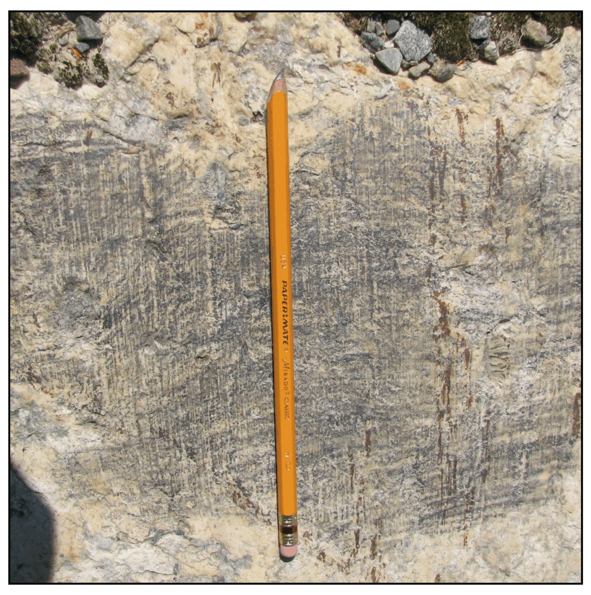


Figure 3. Glacial striations on horizontal surface of granite ledge next to parking lot at Wiscasset Community Center (east side of Route 27). Pencil rubbing made the striations easier to see. The pencil points in the inferred direction of ice flow, which was 165°.

Figure 4. Large granitic boulders on densely forested moraine ridge west of Dresden Bog. This is the southernmost ridge in a cluster of moraines on a hill just west of the bog. They were deposited along the glacier margin in a shallow-water marine environment. The close spacing of the moraines suggests they may be annual features. The boulders probably were eroded from a local igneous rock body called the Blinn Hill granodiorite.

Figure 5. View looking north at moraine ridge (map unit Pem) at Pine Grove Cemetery in Dresden. Boulders have been cleared from the ridge surface. The flat area in the foreground is underlain by clay or other water-laid marine sediments of late-glacial age.

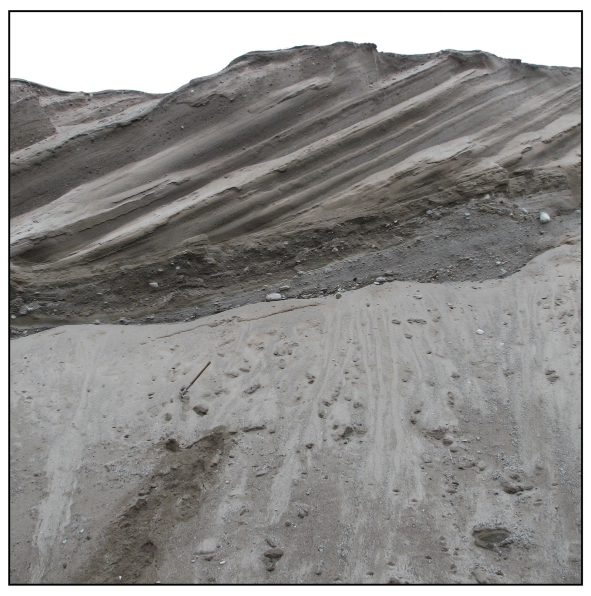


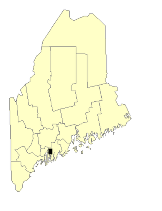
Figure 6. Pit exposure of sand and gravel in the Palmer Hill delta (map unit Pmdph), near the northeast corner of the quadrangle. The delta was built into the ocean during glacial retreat from the area. The sloping layers seen here are part of the delta foreset beds, which were deposited on the front of the delta as it expanded seaward. The dark-colored stony layer in lower part of the vertical pit face was formed by a debris flow.

Figure 7. View looking east across blueberry field on the horizontal upper surface of the Palmer Hill delta. A low beach ridge at the seaward edge of the delta (under utility pole in photo) was formed by wave action. Shallow swales crossing delta top are channels cut by meltwater flowing from the glacier margin at head of delta (in adjacent East Pittston quadrangle).

Figure 8. Same locality as Figure 1. The upper edge of this pit (at treeline) exposes marine nearshore gravel that underlies a narrow beach(?) terrace at elevation of 240-250 ft. Exposures on pit floor (foreground) show thin deposits of till and water-laid clay-silt-sand overlying bedrock.

SOURCES OF INFORMATION

Surficial geologic mapping of the Wiscasset quadrangle was conducted by Woodrow B. Thompson during the 2008 field season. Funding for this work was provided by the U. S. Geological Survey STATEMAP program and the Maine Geological Survey, Department of Conservation.



Quadrangle Location

SCALE 1 : 24,000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

TRUE NORTH

Topographic base from U.S. Geological Survey Wiscasset quadrangle, scale 1:24,000 using standard U.S. Geological Survey topographic map symbols.

The use of industry, firm, or local government names on this map is for location purposes only and does not impute responsibility for any present or potential effects on the natural resources.

Ha — **Stream alluvium** - Sand, gravel, and silt deposited on flood plains of the Eastern and Sheepscot Rivers. May include some wetland deposits.

Hw — **Wetland deposits** - Peat, muck, silt, and clay in poorly drained areas. May include areas of stream alluvium.

Pp — **Presumpscot Formation** - Glaciomarine silt, clay, and sand deposited on the late-glacial sea floor. This map unit overlies the irregular surface of the underlying glacial till in a complex manner, so it is likely to include areas of till exposed at the ground surface.

Pmd — **Glaciomarine delta** - Sand and gravel deposited into the sea and built up to the ocean surface. Formed at the glacier margin during recession of the most recent (late Wisconsinan) ice sheet. Elevation of boundary between topset and foreset beds (T/F contact) in each delta indicates the position of sea level when the delta was deposited.

Pmdph - Palmer Hill delta. T/F contact surveyed at 287.5 ft (87.6 m) in the adjacent East Pittston quadrangle.
Pmdch - Call Hill delta. T/F contact not exposed.

Pmf — **Glaciomarine fan** - Sand and gravel deposited in a submarine environment at the glacier margin during recession of the late Wisconsinan ice sheet.

Pg — **Glacial sand and gravel** - Formed by meltwater from glacial ice, but the depositional environment is unknown. Located on southeast side of Dresden Bog.

Pge — **Esker** - Sand and gravel deposited in part by glacial meltwater flowing in a tunnel beneath the ice. Chevron symbols show inferred direction of former stream flow. This unit forms ridges in some places. The sediment deposited in the ice tunnel is typically composed of gravel, which is locally overlain by sand and gravel deposited at the mouth of the tunnel as it migrated northward during glacial retreat. Younger glacial-marine mud of the Presumpscot Formation likewise drapes over the eskers in places. Unit Pge may also include thin deposits of sand and gravel formed by wave action in nearshore environments as the ocean withdrew.

Pem — **End moraine** - Ridge formed along the margin of the late Wisconsinan glacial ice sheet during a brief pause in its retreat. Composed of till and/or sand and gravel.

Pt — **Till** - Loose to very compact, poorly sorted, massive to weakly stratified mixture of sand, silt, and gravel-size rock debris deposited by glacial ice. This map unit locally includes lenses of water-laid sand and gravel, as well as patches of overlying Presumpscot Formation (Pp). Boulders commonly present on ground surface.

Bedrock outcrops/thin-drift areas - Ruled pattern indicates areas where bedrock outcrops are common and/or surficial sediments are generally less than 10 ft thick. Mapped from air photos and ground observations. Actual thin-drift areas probably are more extensive than shown. Dots mark locations of individual outcrops.

af — **Artificial fill** - Variable mixtures of earth, rock, and/or man-made materials used as fill for roads and railroads. Usually shown only where large enough to affect the contour pattern on the topographic map.

Contact - Boundary between map units. Many contacts are approximately located and therefore indicated by dashed lines.

Meltwater channel - Channel eroded by a glacial meltwater stream. Arrow shows inferred direction of water flow.

>>>>> **Axis of esker** - Alignment of symbols shows trend of esker. Chevrons point in direction of former glacial meltwater flow.

Area of many large boulders southeast of Dresden Bog.

Moraine ridge - Line shows inferred crest of moraine ridge deposited along the retreating margin of the most recent glacial ice sheet. These moraines are composed mostly of till but may also include sand and gravel. Dashed where identity is uncertain, including possible moraines mapped from air photos.

Glacially streamlined hill - Symbol shows long axis of hill or ridge shaped by flow of glacial ice, and which is parallel to former ice-flow direction.

135 — **Glacial striation locality** - Arrow shows ice-flow direction(s) inferred from striations on bedrock. Dot marks point of observation. Number is azimuth (in degrees) of flow direction.

USES OF SURFICIAL GEOLOGY MAPS

A surficial geology map shows all the loose materials such as till (commonly called hardpan), sand and gravel, or clay, which overlie solid ledge (bedrock). Bedrock outcrops and areas of abundant bedrock outcrops are shown on the map, but varieties of the bedrock are not distinguished (refer to bedrock geology map). Most of the surficial materials are deposits formed by glacial and deglacial processes during the last stage of continental glaciation, which began about 25,000 years ago. The remainder of the surficial deposits are the products of postglacial geologic processes, such as river floodplains, or are attributed to human activity, such as fill or other land-modifying features.

The map shows the areal distribution of the different types of glacial features, deposits, and landforms as described in the map explanation. Features such as striations and moraines can be used to reconstruct the movement and position of the glacier and its margin, especially as the ice sheet melted. Other ancient features include shorelines and deposits of glacial lakes or the glacial sea, now long gone from the state. This glacial geologic history of the quadrangle is useful to the larger understanding of past earth climate, and how our region of the world underwent recent geologically significant climatic and environmental changes. We may then be able to use this knowledge in anticipation of future similar changes for long-term planning efforts, such as coastal development or waste disposal.

Surficial geology maps are often best used in conjunction with related maps such as surficial materials maps or significant sand and gravel aquifer maps for anyone wanting to know what lies beneath the land surface. For example, these maps may aid in the search for water supplies, or economically important deposits such as sand and gravel for aggregate or clay for bricks or pottery. Environmental issues such as the location of a suitable landfill site or the possible spread of contaminants are directly related to surficial geology. Construction projects such as locating new roads, excavating foundations, or siting new homes may be better planned with a good knowledge of the surficial geology of the site. Refer to the list of related publications below.

OTHER SOURCES OF INFORMATION

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