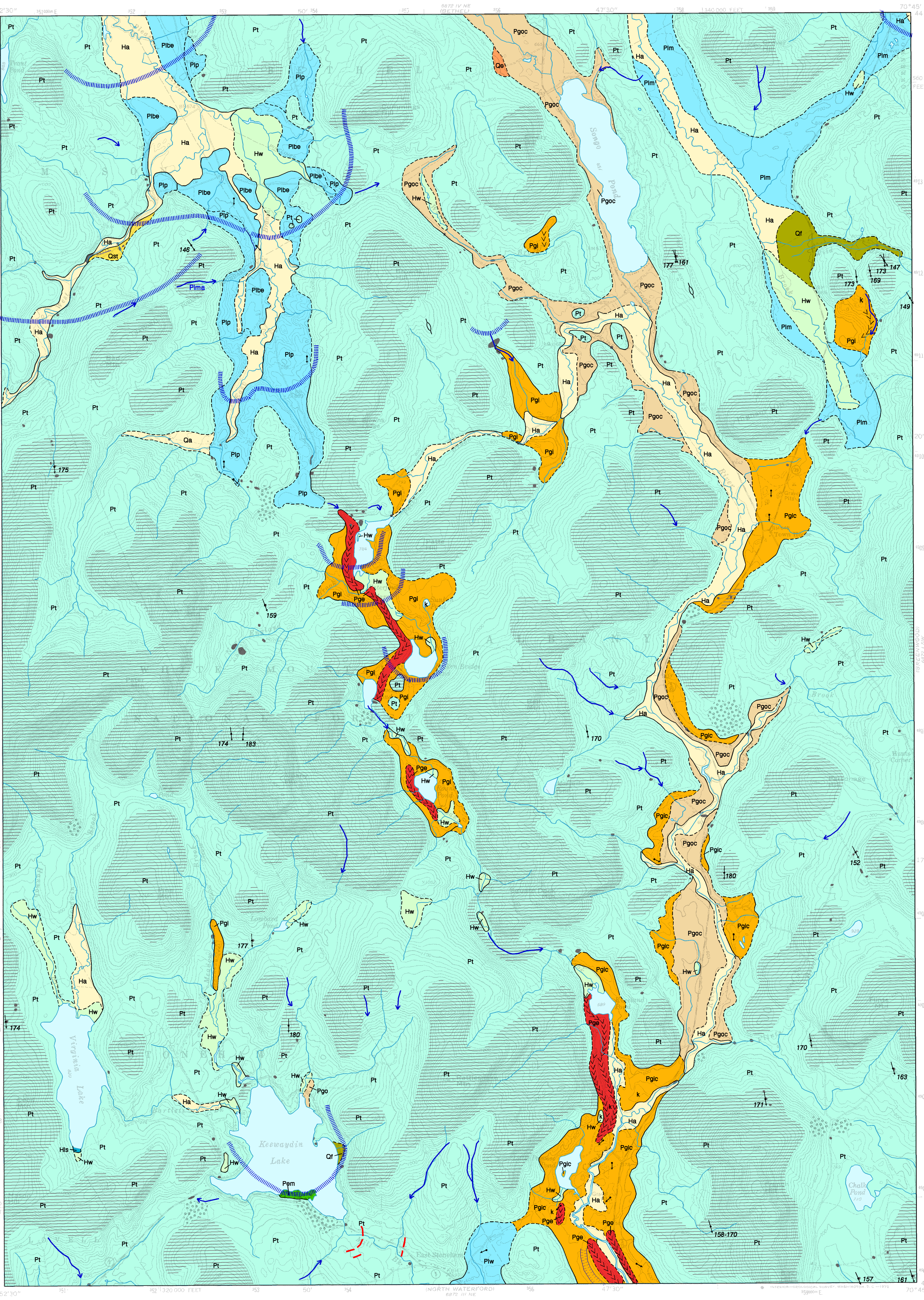
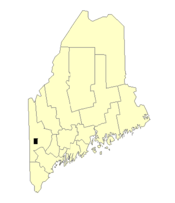
Surficial Geology



SOURCES OF INFORMATION

Surficial geologic mapping of the East Stoneham quadrangle was conducted by Woodrow B. Thompson in 1983 for the Maine Geological Survey's sand and gravel aquifer mapping program and in 2001 and 2002 for the STATEMAP program. This map was funded from the MGS / USGS STATEMAP cooperative (award no. 01HQAG0090).



Quadrangle Location

SCALE 1 : 24,000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

CONTOUR INTERVAL 20 FEET

TRUE NORTH

Topographic base from U.S. Geological Survey East Stoneham 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.

East Stoneham 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 East Stoneham quadrangle.

The most recent "Ice Age" in Maine began about 25,000 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 years ago, soon after it reached its southernmost position on Long Island (Sirkin, 1986). The edge of the glacier withdrew from the continental shelf east of Long Island and reached the present position of the Maine coast by 13,800 years ago (Dorion, 1993). 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. Age dates on these fossils tell us that ocean waters covered parts of Maine until about 11,000 years ago, when the land surface rebounded as the weight of the ice sheet was removed.

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 10,000 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: Pipeline trench cutting through area of near-surface granite ledges, southwest of Songo Pond in Albany (1998).

Figure 2: Glacially striated granite outcrop on White Mountain National Forest woods road, east of Farwell Mountain in Albany. Striations at this locality trend 159°.

Figure 3: Till section formerly exposed on hillside south of Route 5, near southwest corner of Keewaydin Lake in Stoneham. Shovel blade marks contact between silty lodgement till (probably from an earlier glaciation) and overlying sandy ablation till of late Wisconsinan age. Note inclusions of lower till in the upper unit. See quadrangle report for details; photo taken in 1986.

Figure 4: Till exposure in pit south of Bad Mountain in Albany.

Figure 5: Sand and gravel (unit Pgic) in Crooked River valley. Glacially plucked bedrock cliffs on southeast face of Rattlesnake Mountain are seen in background.

Figure 6: Part of pit face at same locality as Figure 5. Photo shows deformed vertical gravel beds (center) truncating gravelly sand unit at left. Disturbance probably resulted from slumping adjacent to melting glacial ice.

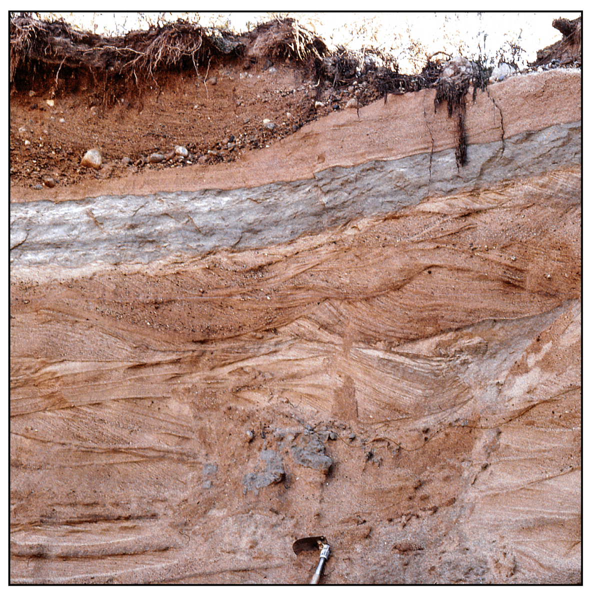

Figure 7: Sedimentary structures formerly exposed in unit Pgic on east side of Crooked River valley near south edge of quadrangle. Fluvial cross bedding indicates glacial meltwater flow from left to right (southward). Photo taken in 1990.

Figure 8 : Large granite boulder in unit Pgic on east side of Crooked River valley (northwest of Flints Brook). The boulder rolled off from glacial ice and was buried. It has been exposed by excavation of the surrounding gravel pit.

Explanation

Unit	Description
Ha	**Stream alluvium** - Sand, gravel, silt, and organic sediment. Deposited on flood plains of modern streams. Unit includes some wetland areas.
Hw	**Wetland deposits** - Peat, muck, silt, and clay. Deposited in poorly drained areas. Unit may include and be underlain by stream alluvium.
Hls	**Lake shoreline deposit** - Modern sand beach at south end of Virginia Lake.
Qa	**Stream alluvium** - Sand and gravel deposited by a small unnamed tributary stream in the East Branch Pleasant River basin. Probably of Holocene age in large part, but may include an early postglacial component.
Qst	**Stream terrace deposit** - Gravel terrace on southeast side of West Branch Pleasant River. Deposited by the river in early postglacial time.
Qf	**Fan deposits** - Alluvial fans on east side of Keewaydin Lake and in the Wild Brook valley.
Qe	**Eolian deposit** - Small sand deposit of inferred windblown origin on west side of Crooked River valley.
Plbe	**Glacial Lake Bethel deposits** - Sand and gravel deposited in a glacial lake in the Pleasant River valley. This lake extended into the Androscoggin River valley to the north and was controlled by one or more spillways at ~690 ft elevation.
Plm	**Glacial Lake Mill Brook deposits** - Sand and gravel deposited in or graded to a glacial lake in the Mill Brook valley. Lake level was controlled by a spillway southeast of Ingham Hill, at ~710 ft elevation.
Plp	**Glacial Lake Pleasant deposits** - Sand and gravel deposited in a glacial lake in the Pleasant River basin. Lake level was controlled by a spillway southwest of Browns Ledge, at ~830 ft elevation.
Pgi	**Ice-contact deposits** - Miscellaneous sand and gravel deposits formed in contact with remnants of stagnant glacial ice in the Meadow Brook, Albany Brook, New England Brook, Patte Brook, Walker Brook, and Mill Brook valleys. May include glacial-stream and glacial-lake sediments. Kettles, hummocks, and collapse structures occur locally.
Pgoc	**Crooked River outwash deposits** - Sand and gravel. Outwash deposited by glacial meltwater streams in the Crooked River valley.
Pgic	**Crooked River ice-contact deposits** - Sand and gravel. Deposited adjacent to remnants of stagnant glacial ice in the Crooked River valley. Locally collapsed and kettled from melting of supporting ice.
Pgo	**Outwash deposit** - Small sand deposit on north side of Keewaydin Lake. Inferred to have been deposited by a glacial meltwater stream.
Plw	**Glacial Lake Waterford deposits** - Sand, gravel, and silt deposited in a glacial lake controlled by a spillway at Kezar Falls gorge in the North Waterford quadrangle.
Pge	**Esker deposits** - Sand and gravel deposited by meltwater streams in subglacial tunnels.
Pem	**End moraine deposit** - Ridge of bouldery till deposited at the glacier margin when it stood along the south side of Keewaydin Lake.
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. Locally includes lenses of waterlaid sand and gravel.
	Bedrock outcrops/thin-drift areas - Ruled pattern indicates areas where outcrops are common and/or surficial sediments are generally less than 10 ft thick (mapped partly from air photos). Gray areas and dots show individual outcrops.

Contact - Boundary between map units. Dashed where very approximate.

Scarp - Scarp separating adjacent terrace levels in sand and gravel deposits. Symbol also shows walls of large meltwater channel at south edge of quadrangle.

Glacially streamlined hill - Symbol shows trend of long axis, which is parallel to former glacial ice-flow direction.

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

Dip of cross-bedding - Arrow shows average dip direction of cross-bedding in fluvial or deltaic deposits, which indicates direction of stream flow or delta progradation. Point of observation at dot.

Meltwater channel - Channel eroded by glacial meltwater stream or drainage from glacial lake. Arrow shows inferred direction of former stream flow. "Plma" is spillway for glacial Lake Mason in Speckled Mountain quadrangle.

k **Kettle** - Topographic depression formerly occupied by a block of melting glacial ice.

>>>>> **Crest of esker** - Shows trend of esker ridge. Chevrons point in direction of meltwater flow.

Area of many large boulders, where observed. May be more extensive than shown.

Crest of end moraine - Symbol indicates till ridges in the East Stoneham area which are inferred to be end moraines.

Ice-margin position - Shows an approximate position of the glacier margin during ice retreat, based on meltwater deposits, moraines, and/or positions of meltwater channels.

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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