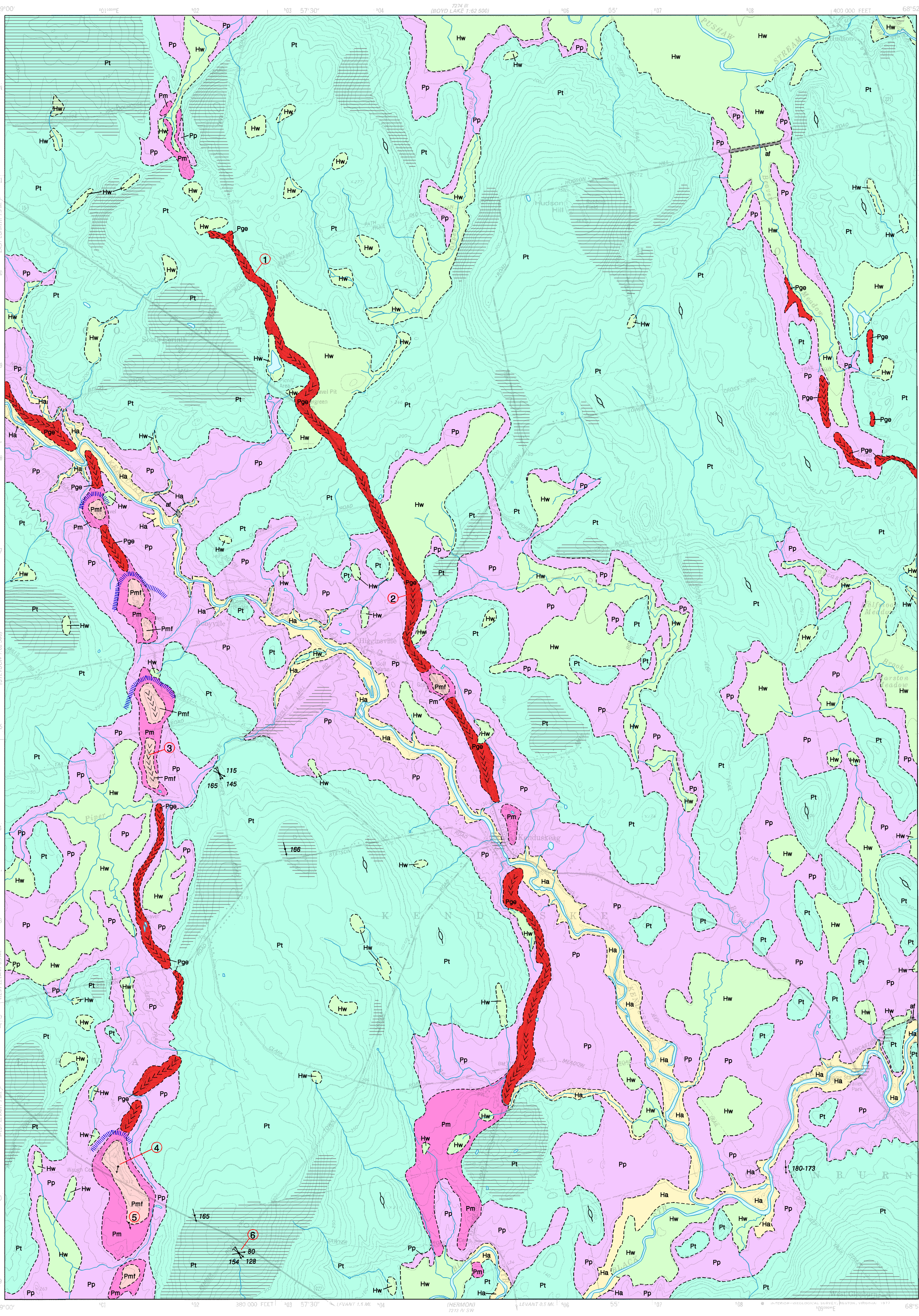
Surficial Geology



SOURCES OF INFORMATION

Surficial geologic mapping by Thomas K. Weddle completed during the 2008 field season; funding for this work provided by the U.S. Geological Survey STATEMAP program.

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 Kenduskeag 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.

Kenduskeag Quadrangle, Maine

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Funding for the preparation of this map was provided in part by the U.S. Geological Survey STATEMAP Program, Cooperative Agreement No. 08HQAG0050.

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Open-File No. 09-16
2009

The recession of the late Wisconsinan Laurentide ice sheet in south-central Maine is represented by deposits of a marine-based ice sheet. These include glaciomarine sediments and nearshore deposits associated with highstands of sea-level that accumulated in a transgressive ice-marginal sea, and younger deposits formed as relative sea level fell during postglacial emergence of the land. For a more complete review of the depositional processes for the sediments shown below refer to the citations and other sources of information section on this map. Permission for access to gravel pits must be obtained from the landowner.

Figure 1. Oblique exposure in core of esker showing coarse debris and crest shape of the landform (Locality 1). Esker ridges are believed to be formed in ice tunnels in the glacier, where meltwater and sediment is transported toward the margin of the glacier to be deposited at the ice margin. The near continuous nature of this esker ridge for almost four miles from South Corinth to Kenduskeag is somewhat unusual. More often, as seen in the esker system near the western border of the quadrangle, the esker systems have shorter segments that are interrupted by areas where glacial marine fans were deposited at the ice margin and into the sea that covered the area during deglaciation.

Figure 2. Closer view of coarse debris at Locality 1. Note poor sorting and subangular nature of large stones, in particular those closer to the top of the esker. The crude bedding of the finer-grained gravel at the base and central section of the esker and weak imbrication of stones in the upper part of the section indicate flow of water in the ice tunnel was to the south (from left to right in the photo). Folding shovel at base of section for scale.

Figure 3. An area along the same esker system noted above where the landform has not been altered (low ridge with house on esker). The site is along a broader portion of the esker found just north of the intersection between Route 15 and the Hudson Hill Road (Locality 2).

Figure 4. Gravel pit south of Tay Road in which the succession from an ice marginal esker – glacial marine fan deposit is overlain by a thick glacial marine sequence. Boulders and cobbles in foreground have been sorted and will eventually be crushed for aggregate (Locality 3).

Figure 5. Exposure in pit shown in Figure 4 where the lower coarse material can be seen in abrupt contact with an overlying fine-grained sand deposit. The lower coarse unit is part of an esker-fed glacial marine fan that was deposited into the ocean when the ice-margin stood at this site. After the ice margin retreated some distance to the north, the ice-tunnel continued to discharge sediment into the ocean and the fine-grained overlying sand was draped over the older coarse sediment.

Figure 6. Close-up of section in Figure 4. The succession shown in this photo represents the time when an actively retreating ice margin in glacial marine conditions was depositing sediment in this area, through the later period when the land was rebounding after the ice mass had retreated. From the base up, a coarse gravelly sand is found, which is mantled by fine-grained material washed down from above (note rill erosion on the surface; the coarse material seen in Figure 5 is obscured by the slope-wash). The dark massive-appearing unit above the slope-wash covered gravelly sand is silty fine sand that was draped over the gravel as a distal deposit as the ice-margin receded even farther to the north. As relative sea-level began to fall due to glacial rebound of the land, currents in the ocean reworked the esker-fan deposit. Above the silty sand are low-angle sand beds that formed as a spit. As the deposit rose into shallowing water and eventually through wave base, coarser debris was reworked and laid down as a near-shore regressive deposit seen just above the low-angle fine sand unit. The dark circular features along the contact between those two units are bank swallow nests.

Figure 7. Waugh Cemetery, southwest corner of quadrangle (Locality 4). The cemetery is on the toe of a glacial marine fan and most likely sitting on bottomset beds represented by the low angle of the land surface slope. The slope begins to steepen at the right side of the photo near the tree line, beyond which there is a series of gravel pits.

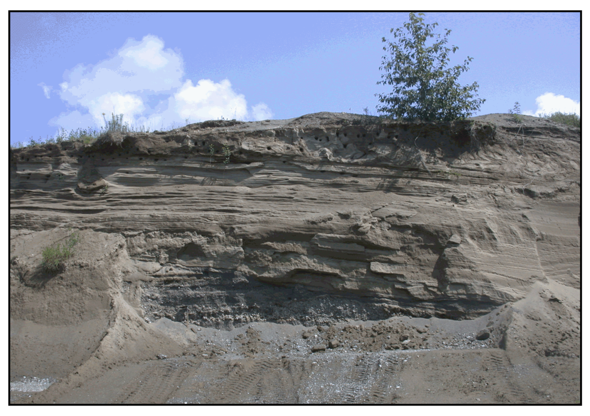

Figure 8. Exposure in gravel pit south of Waugh Cemetery glacial marine fan (Figures 7 and 9) showing fine-grained sand beds truncating and overlying coarse-gained pebbly sand beds. Both units have low-angle bedding and represent the distal bottomset beds of the fan, trending to the southeast at 165-degrees (Locality 5).

Figure 9. Exposure in active pit just north of Waugh Cemetery where moderately dipping foreset beds of the glacial marine fan can be seen, trending 193-degrees to the southwest.

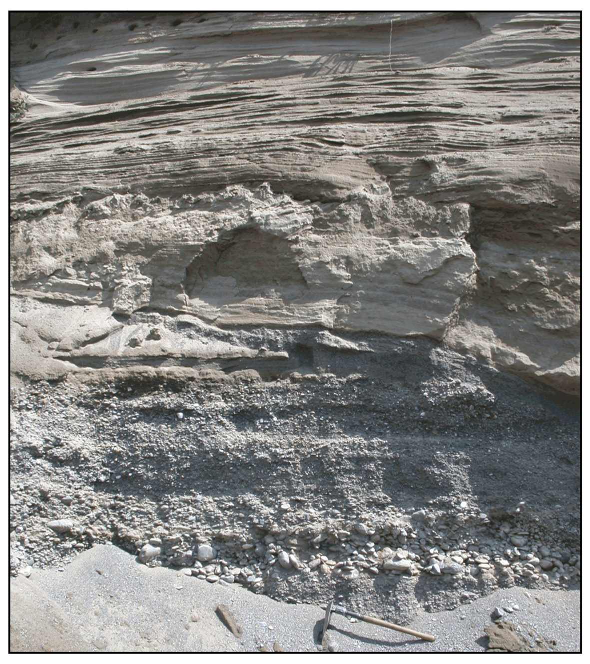

Figure 10. Close-up of contact between fine-grained beds and coarse-grained beds in Figure 8.

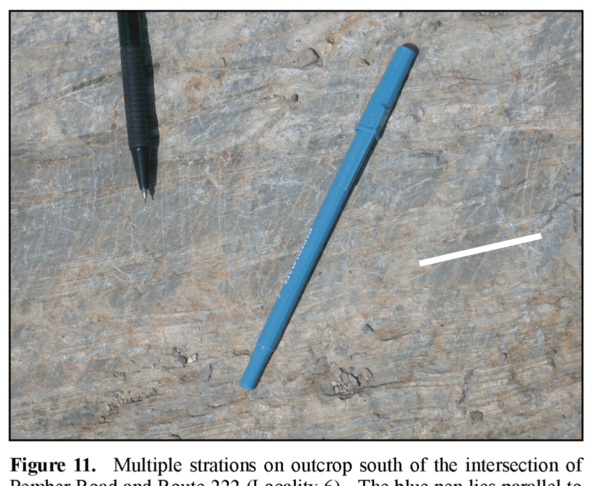

Figure 11. Multiple strations on outcrop south of the intersection of Pember Road and Route 222 (Locality 6). The blue pen lies parallel to striations trending 154-degrees and are the oldest striation set. The black pentel is parallel to a younger striation set trending 128-degrees. A third set of faint striations trending 80-degrees represent the youngest set of striations (parallel to white bar). The shift from a southeasterly ice flow to an easterly flow corresponds with striation data in adjacent quadrangles on both sides of the Penobscot River valley, and supports evidence for a calving embayment at the ice margin in the valley during deglaciation (Syverson and others, 2009).

Ha **Stream alluvium** - Sand, gravel, and silt deposited on flood plains of Souadabscook Stream and other streams. May include some wetland deposits.

Hw **Wetland deposits** - Peat, muck, silt, and clay in poorly drained areas.

Pp **Presumpscot Formation** - Glaciomarine silt, clay, and sand deposited on the late-glacial sea floor.

Pmf **Glaciomarine fans** - Sand and gravel deposited as submarine fans at the glacier margin during recession of the late Wisconsinan ice sheet.

Pm **Pleistocene glaciomarine deposit** - undifferentiated; may consist of gravel, sand, silt, or clay or any combination, deposited during marine transgression and regression.

Pge **Eskers** - Sand and gravel deposited in tunnels in ice. Chevrons show inferred direction of water flow. Esker deposits draped with fine-grained glaciomarine deposits. Regressive phase, reworked sand deposits commonly associated with esker crests and upper slopes of esker flanks.

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 water-laid sand and gravel. 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.

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, dashed where approximate.

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.

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 inferred from striations on bedrock. Dot marks point of observation. Number is azimuth (in degrees) of flow direction. Where two directions are observed in the same outcrop, flags indicate older trends where discerned. Symbol with no arrow indicates unknown flow direction.

Paleocurrent direction - Average dip direction of cross bedding (including foreset beds in deltas) in sand or gravel. Indicates direction of flow of glacial meltwater. Dot marks point of observation.

>>>>> **Crest of esker** - Alignment of symbols shows trend of esker ridge. Chevrons point in direction of meltwater flow.

4 **Photo locality**

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

1. Weddle, T. K., 2009, Surficial materials of the Kenduskeag quadrangle, Maine: Maine Geological Survey, Open-File Map 09-17.
2. Lewis, E. B., Locke, D. B., Neil, C. D. (compilers), 2009, Significant sand and gravel aquifers in the Kenduskeag quadrangle, Maine: Maine Geological Survey, Open-File Map 09-56.
3. Syverson, K. M., Thompson, A. H., and Weddle, T. K., 2009, Convergent ice-flow indicators in the Penobscot River valley, Bangor Maine - evidence for a calving embayment: Geological Society of America, Abstracts with Program, v. 41, no. 3, p. 36.
4. Syverson, K. M., and Thompson, A. H., 2008, Surficial geology of the Bangor 7.5-minute quadrangle, Penobscot County, Maine: Maine Geological Survey, Open-File Report 08-52, 16 p.
5. Thompson, W. B., and Borns, H. W., Jr., 1985, Surficial geologic map of Maine: Maine Geological Survey, scale 1:500,000.