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Surficial materials of the Steep Falls quadrangle, Open-File 98-190

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# *Surficial Geology of the Steep Falls 7.5-minute Quadrangle, York and Cumberland Counties, Maine*

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## INTRODUCTION

This study is based on detailed 1:24,000-scale mapping of surficial deposits and interpretation of the regional glacial history of the Steep Falls quadrangle. The Steep Falls 7.5-minute quadrangle is situated directly west and southwest of Sebago Lake in southern Maine, occupying portions of Cumberland and York Counties (Figure 1). The area covered by this quadrangle is about 14 km (8.7 mi) from north to south, and 10 km (6.2 mi) from east to west. The region is characterized by a wide range of relief and landforms. The Saddleback Hills in the northwest are a rugged, heavily dissected bedrock terrain with a generally thin and patchy cover of surficial sediments, and have a maximum local relief exceeding 220 m (722 ft). The lowland plains in the central and southeastern portions of the Steep Falls quadrangle contain all of the largest ponds and more than 80% of the wetlands in the map area. The southwest corner of the quadrangle is dominated by gently rolling hills where bedrock highs protrude through the surficial deposits.

The Steep Falls quadrangle contains diverse surficial sediments. The topographically lowest areas, which were inundated by the sea in late-glacial time, have voluminous sand resources in the deltas and other glacial meltwater deposits, as well as in the postglacial stream terraces developed on these deposits. In areas above the limit of marine submergence (higher than about 100 m [~330 ft] in elevation), variably thick deposits of glacial sand and gravel and sandy till are widespread. Segmented esker ridges string across hills and valleys, and larger eskers occur in the area of marine transgression (e.g. near Horne Pond). Glaciolacustrine deposits are found in valleys that once held glacially dammed lakes. The Saco River and its tributaries are responsible for considerable modification of the glacial landscape through fluvial deposition and erosion. Over fifty sand and gravel pits have been identified within the Steep Falls quadrangle, but only twelve were active at the time of mapping.

Two maps depicting the surficial geology and materials of the quadrangle are associated with this report. The surficial materials map (Gosse and Thompson, 1998) provides the user with the locations and abbreviated descriptions of the earth materials found at about 300 observation sites ranging from shovel holes to large gravel pits. Data from these numbered sites are summarized in Appendix A. The surficial geology map (Gosse and Thompson, 1999) not only shows the areal extent of the surficial materials, but also our interpretation of the late Quaternary geologic history of the area. The units shown on the geologic map are summarized in Table 1. Some of these deposits contain only one type of surficial material (for example, stream alluvium is almost always a sand or pebbly sand), but others contain multiple materials (for instance, a delta can have silt, sand, and pebble to boulder gravel).

The field work for the maps was completed in 1994. Aerial photograph interpretation before, during, and after field work assisted in producing the geologic map. Much of the information in this report originated from previous studies related to the surficial geology of the Steep Falls region. Smith and Thompson (1977) prepared a reconnaissance surficial map (1:62,500) of the region for the Maine Geological Survey. Holland (1986) described the glacial geology of the area, and Prescott (1979, 1980) investigated the surficial aquifers. Thompson and others (1995) provided an overview of the glacial history of the Sebago Lake region, including sites of interest in the Steep Falls quadrangle. Sand and gravel aquifer data were compiled by Williams and

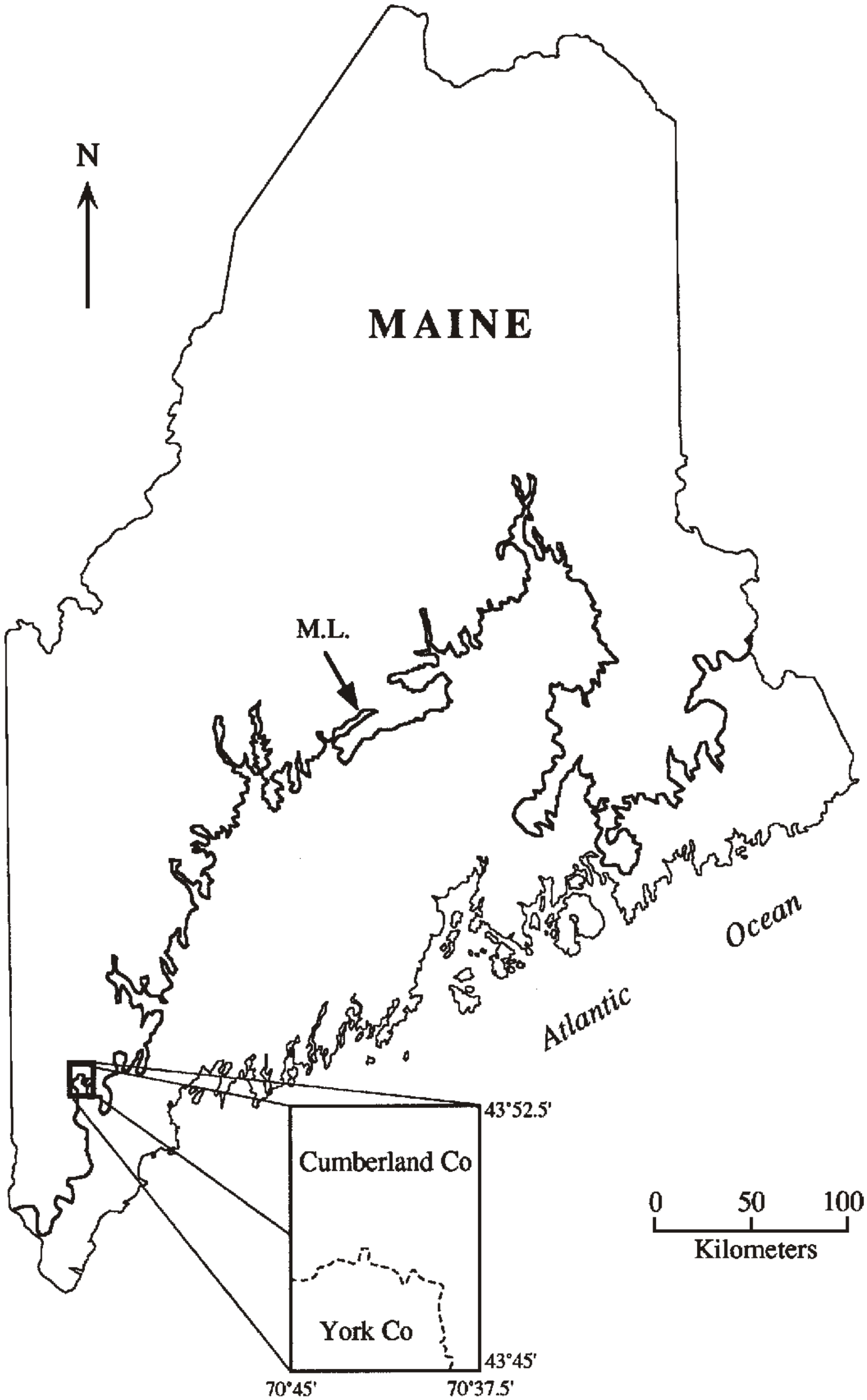


Figure 1. Map showing location of the Steep Falls quadrangle. The "M.L." line marks the inland limit of marine submergence in late-glacial time.

Lanctot (1987), and a National Wetlands Map for Steep Falls was published in 1992 (U.S. Department of the Interior). Soil survey reports for Cumberland County (Hedstrom, 1974) and York County (Flewelling and Lisante, 1982) assisted in the initial aerial photograph interpretation.

## BEDROCK GEOLOGY

In general, the bedrock in the Steep Falls quadrangle can be grouped into two main rock types—Sebago batholith granodiorite and pegmatites, and Lower Paleozoic metasedimentary rocks (Hussey, 1985). The Mississippian Sebago batholith is exposed in the northeastern sector of the quadrangle and is the only local source of granodiorite. The batholith covers an extensive area north of the quadrangle, providing a source for much of the glacial drift in the eastern half of the map sheet and for much of the glaciofluvial and deltaic deposits over the entire region. Most till derived from this lithology is sandy, and spherical and well–rounded clasts are common in the associated fluvial sediments. Large (> 1 m) boulders are abundant in till derived from the granodiorite.

The Lower Member of the Silurian Rindgemere Formation comprises most of the highlands in the western parts of (and west of) the quadrangle, such as the Saddleback Mountains, Moody Mountain, and Town Farm Hill. Within the quadrangle, the Rindgemere Formation includes fine-grained metapelites, metamorphosed argillaceous sandstone, and abundant coarse-grained biotite schists with varying proportions of garnet, muscovite, sillimanite, staurolite, muscovite, and quartz (Hussey, 1985). The sulfide-rich metapelites weather to produce a rusty color, which is particularly evident in the Robinson Hill region (locally known as "Sulfur Hill" due to the sulfides). The metasediments of the Rindgemere Formation are very easily comminuted, and clasts of this rock type are unlikely to be transported in glacial drift for any great distance without being pulverized. One belt of calcareous metasediments consisting of marble with grossular, diopside, and light-green amphibole outcrops north and east of North Baldwin (Hussey, 1985). Detailed provenance and boulder-train mapping on this 300 m (~1000 ft) wide south-southeast trending belt may help tightly constrain the local ice flow directions, especially if the outcrop area experienced southwestward ice flow from the Sebago Lake basin.

In central and southern parts of the quadrangle, a large belt of Ordovician Vassalboro Formation granofels and schistose granofels separates the Rindgemere metasediments and the Sebago batholith. Like the Rindgemere Formation, the Vassalboro metasediments are easily comminuted and generally can be recognized only in locally-derived glacial sediments. Although the Vassalboro and Rindgemere Formation are mica-rich, the typical till covering these terrains is very sandy -— not silty as one might expect.

No definite source has been located for the abundant basalts and other light-to-dark colored aphanitic igneous rocks found in many of the glacial deposits throughout the quadrangle (mainly in the southern and eastern sections of the study area). The nearest known source for volcanic rocks is the swarm of Mesozoic volcanics 16 km (10 mi) northwest of the quadrangle. Fragments of these volcanic bodies could have been transported to the Steep Falls region by an early southeastward (~120$^{o}$) flow of glacial ice, but could not have arrived via either of the last two dominant ice flow directions (160$^{o}$ or 180$^{o}$) identified throughout the quadrangle (Table 3). It is possible that volcanic rocks exposed northwest of the Sebago batholith are the primary source of the volcanic clasts found in the quadrangle. However, it seems likely that some of the basalts and other lithologies were derived from narrow, very local dikes such as those which are commonly observed cutting the bedrock in this region.

## SURFICIAL DEPOSITS AND LANDFORMS

### *Till*

Till (map unit **Pt**; Table 1) is a homogeneous and massive (mostly poorly sorted and matrix-supported) diamicton, that was deposited directly by glacial ice. The majority of till in the Steep Falls quadrangle was deposited during the most recent (late Wisconsinan) glaciation and subsequent deglaciation of the area. No evidence to differentiate tills from either of these two phases has been recognized in the Steep Falls quadrangle (i.e. the tills have not been classified into various facies or types). Similarly, till older than late Wisconsinan age has not been recognized in the quadrangle.

A variably thick and locally discontinuous till cover overlies most highland regions in the Steep Falls quadrangle. The bedrock data on the geologic map (line pattern indicating thin-drift areas and abundant bedrock outcrops) suggests the thin nature of the till cover. Bedrock protrudes through the till on most hill tops. The texture of the till is a function of parent bedrock lithologies and depositional process. Till derived from the Sebago batholith granodiorite is generally a gray, silty-sandy, matrix-supported, and variably compact diamicton. Locally it contains many large boulders. In contrast, till originating from Vassalboro and Rindgemere metasediments is generally a gray-brown sandy to silty-sandy loose diamicton. Metasediment-derived till is pebbly and cobbly, and there are noticeably fewer large boulders relative to the till derived from granite. The sandy and gravelly nature of most tills in the Steep Falls quadrangle can cause confusion when distinguishing them from waterlaid glacial deposits.

Where till thickness is greatest (e.g. in valleys or on lee slopes) the till commonly exists as hummocky moraine (map unit **Phm**; Table 1) with local relief on the order of several meters. Hummocky moraine throughout the quadrangle is consistently a very sandy, poorly-consolidated, partially-stratified gravelly diamicton, with stones up to several meters in diameter (Figure 2). These hummocky deposits are commonly incised by short meltwater channels and are therefore closely associated

TABLE 1. SURFICIAL MAP UNITS IN THE STEEP FALLS QUADRANGLE

| Symbol | Unit | Description |
|---|---|---|
| **Hls** | Lake shoreline | Postglacial sandy sediments deposited on past or present shorelines of Sebago Lake. Unit locally includes exposures of underlying bedrock, till, or clay. |
| **Ha** | Alluvium | Generally well-sorted and stratified sand, silt, and gravel deposited by modern rivers and streams. Occurs most extensively along the Saco River. |
| **Hw, Hws** | Wetland deposits | Poorly drained areas with variable tree cover. Materials include clay, muck, peat, and silt. Mapped units are swamps (Hws) and undifferentiated wetlands (Hw). Units may include areas of marshes and heaths. |
| **Qst** | Stream terrace deposits | Sand and gravel deposits and erosion surfaces formed by streams when they flowed at higher levels than at present. Unit includes broad terraces along the Saco River. |
| **Qe** | Eolian deposits | Typically well sorted very fine sand to granular sand. Derived from wind erosion of glacial deposits in the Saco Valley. |
| **Qc** | Colluvium | Poorly sorted debris moved down slopes by gravity. |
| **Pld** | Glaciolacustrine deposits | Sand and gravel deposited in a glacial lake in the Saco River valley. This lake probably was dammed by a plug of glacial sediments blocking the narrow part of the valley west of Goulds Island. |
| **$Pltf_3$** | Lake Town Farm deposits - low stage | Sand and gravel deposited in the lowest stage of glacial Lake Town Farm, when ice retreat in the Back Brook valley allowed the lake to drain through the gap at about 400 ft, just south of Moody Mountain. |
| **$Pltf_2$** | Lake Town Farm deposits - middle stage | Sand and gravel deposited in the second stage of glacial Lake Town Farm, which existed when the ice-dammed lake drained eastward through channels at about 415 and 425 ft on the north end of Town Farm Hill. |
| **$Pltf_1$** | Lake Town Farm deposits - high stage | Sand and gravel deposited in the highest and earliest stage of glacial Lake Town Farm. Ice dammed the Back Brook valley west of Town Farm Hill, impounding the lake, which drained through a gap at about 485 ft just south of the quadrangle. |
| **Pdu** | Delta of uncertain origin | Sand and gravel deposited in a ponded water body on the north side of the Saco Valley. Includes the Baldwin Delta (north of Halfmoon Pond). It is not known whether these deposits formed in a lake or the ocean. |
| **Pmd** | Marine delta | Generally thick deposits of sand and gravel deposited in the ocean during recession of the last glacial ice sheet. |
| **Pgi** | Ice-contact gravels | Gravel and sand deposits that show evidence of being deposited near the glacier margin. Typically kettled and often coarse-grained and poorly sorted. May include outwash. |
| **Pge** | Esker | Locally discontinuous ridges of massive to stratified, commonly interbedded, glaciofluvial sand and gravel. Deposited by meltwater streams in subglacial and englacial conduits during glacial retreat. |
| **Phm** | Hummocky moraine | Massive to stratified, poorly sorted diamict (till) with variable percentage of gravel and sand. Characterized by hummocky topography, many boulders, and sandy texture. |
| **Pem** | End moraine | Till ridges and/or fan deposits comprised of sand and gravel. Inferred to have been deposited into the sea. The deposits mark former ice margin positions. |
| **Pt** | Till | Homogeneous to weakly stratified, compact mixture of a wide range of particle sizes, typically containing numerous stones in a sandy-silty matrix. Unit may vary greatly in thickness but probably is 1-5 m thick in most places. |

with well-sorted glaciofluvial sediments. Patches of glaciofluvial deposits within the hummocky moraine are often too small to show on the map at the scale of the quadrangle.

An end moraine has been identified south of Long Beach, near Rainbow Pond (map unit **Pem**; Table 1). The Rainbow Pond Moraine includes till ridges formed at the glacier margin. In addition, ice-contact gravel and sand, which in places form large fans, are associated with and flank the till ridges. The end moraine marks the position of the glacier margin at the time of deposition. A second moraine, in the southeast corner of the quadrangle, appears to consist chiefly of sand and gravel deposited as a linear series of submarine fans.

The significance of concentrations of large boulders in some of the till deposits is uncertain. Most boulder fields occur on the till-covered lee (down-ice) slopes of Sebago batholith granodiorite knobs. The widely-spaced joint patterns (low fracture density) and resistant nature of the granodiorite may have induced plucking of large bedrock blocks that were not easily transported great distances from their source. Other boulder aggregations are associated with large glacial drainage systems,

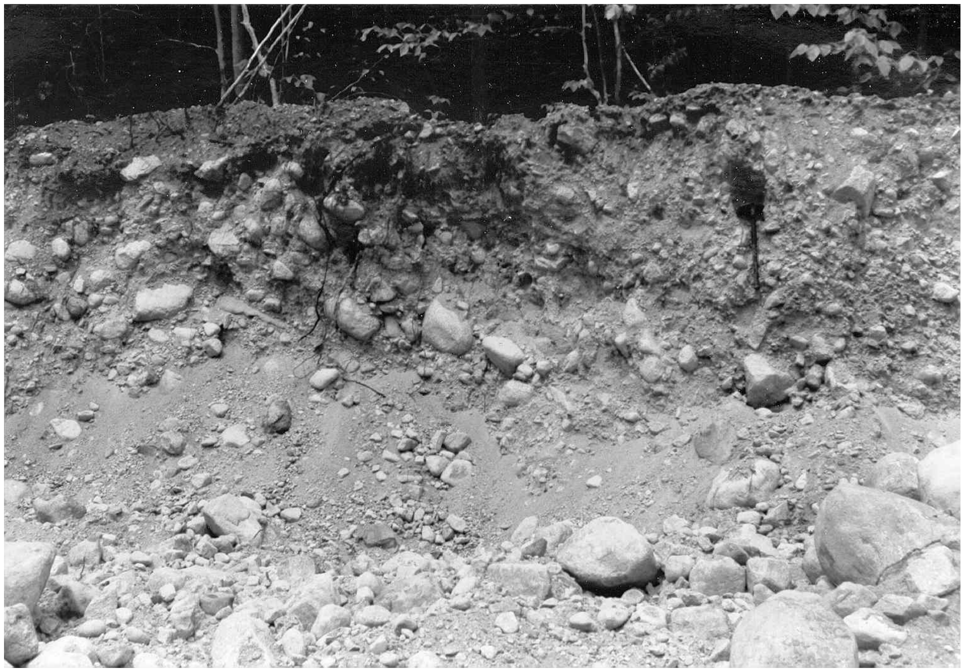

Figure 2. Bouldery diamicton and gravel in hummocky moraine deposit on south side of Long Hill Road, near north edge of quadrangle (locality 257 on surficial materials map).

which may indicate the boulder abundance is due to the erosion and winnowing of finer materials by meltwater.

***Glaciofluvial Deposits***

Glaciofluvial sediments are deposited by meltwater streams. Two types of glaciofluvial deposits are found in the Steep Falls quadrangle: eskers (map unit **Pge**; Table 1) and ice-contact stratified sediments (map unit **Pgi**; Table 1). Eskers are sinuous, sharp-crested ridges comprised of moderately to very well-sorted sand and gravel. The gravel typically contains well-rounded and spherical clasts which are generally less than 1 m in diameter. Eskers are formed in conduits within or below a glacier. In the Steep Falls quadrangle, most eskers are short (< 3 km long) single-crested ridges that reach heights greater than 12 m (40 ft) in places (e.g. Horne Pond Esker). They typically occupy valleys or lowlands and are generally absent where the glacial drainage passed through cols in the hills (the Davis Road Esker below Robinson Hill, and the esker southwest of Winn Mountain). The eskers also occur in groups of one or more sub-parallel ridges, such as the systems southwest of Sebago Lake. The latter have been mapped individually, since we are not sure if all ridges formed concurrently.

In several places the eskers are associated with ice-contact glacial fan deposits (e.g the esker ending 0.5 km west of Adams Pond; locality 127 on materials map). Previous studies (such as Klassen and Thompson, 1993) document that eskers tend to align with the direction of last ice flow. Thus, the esker systems in the Stony Brook and Adams Pond area may indicate an anomalous south-southwestward ice flow direction, possibly from an ice mass in the Sebago Lake basin.

Materials mapped as ice-contact stratified sediments (unit Pgi) consist of sand and gravel that was deposited by meltwater in contact with the glacier. Evidence for the proximity of glacial ice includes the presence of till lenses, striated stones, and the occurrence of folds and faults indicating collapse next to decaying ice. Like the hummocky moraine, unit Pgi often has bumpy, irregular topography, and there are scattered kettles resulting from melting of ice blocks. The ice–contact deposits are closely associated with eskers throughout the quadrangle and are widespread along the lee slopes of the Saddleback Hills.

***Glaciomarine Deposits***

Glaciomarine deltas (map unit **Pmd**; Table 1) are one of the most abundant types of glacial meltwater deposits in the quadrangle. The stratigraphy of most of these deltaic deposits is not well exposed, so they have often been identified on the basis of their flat upper surfaces, which coincide with the extrapolated marine-limit plane indicated by glaciomarine deltas in adjacent areas to the south and east (Thompson and others, 1989, 1995). Where they have not been modified by later erosion, the deltas have two principal components. The upper part is a horizontal layer usually consisting of 1-3 m (3-10 ft) of massive or cross-bedded gravelly sediments (topset beds) deposited by streams flowing across the delta top. These beds are underlain by in-

clined sandy foreset beds, which were deposited on the front of the delta as it grew in a seaward direction. One such delta is well-exposed in a pit west of the intersection of Routes 25 and 11, located just south of the Steep Falls quadrangle in North Limington. The contact between topset and foreset beds in the North Limington Delta has an elevation of 94.5 m (310 ft), which provides a measure of local relative sea level in late-glacial time.

The most extensive series of deltaic deposits extends from below the southeastern part of the Steep Falls quadrangle up along the Saco River valley. The upper parts (topset and upper foreset beds) of these marine deltas have been eroded over large areas by the late-glacial (and possibly early Holocene) Saco River. This erosion has formed flat terrace surfaces (map unit Qst) with occasional evidence of meander scars, such as at Pickpole Swamp and 0.5 km (0.3 mi) west of the intersection between Tucker Road and Skip Road, in the south-central part of the quadrangle. No unambiguous ice-contact zones or abrupt large-scale changes in sediment grain size were identified within the Saco Valley delta complex, making it difficult to delineate former ice margin positions or differentiate the individual deltas that probably exist within this complex.

Due to extensive postglacial erosion, we cannot rule out the possibility that some of the deposits in the Saco Valley delta complex are actually submarine fans. Evidence to suggest late-glacial wave reworking and formation of nearshore deposits has likewise been obliterated by subsequent river activity. The majority of the delta complex is comprised of thick units of fine to coarse sand and minor pebble to cobble gravel, interpreted as foreset beds and remnants of topset beds, respectively. Cobble gravel is common along the surface of the delta complex in the center of the quadrangle, and is interpreted to represent reworked topset material. The absence of any extensive cobble gravel unit east and south of Horne Pond may indicate the distal nature of the deltaic sediments in this area.

At least some of the marine deltas are thought to have been fed by sediment from glacial ice tunnels, whose paths are indicated by eskers (map unit Pge). For example, the eskers in the Stony Brook valley may have deposited sediments into the delta complex in the Sand Pond area when the sea abutted the glacier margin. Although the relative position of ice margins around the delta complex is uncertain, the abundance of numerous kettle lakes in the delta complex (Sand Pond, Dollar Pond, Horne Pond, Wards Pond, and numerous smaller ones) suggests that the marine deltaic sedimentation closely accompanied deglaciation.

The Baldwin Delta, located north of Halfmoon Pond and 2 km (1.2 mi) northwest of East Baldwin, has well-developed gravelly topset beds and thick sand to pebbly sand foresets. Paleoflow indicators, the kettled topography, and the proximity of the Saddleback Road and Sand Pond eskers to the north, suggest that this deposit is an ice-contact delta that was fed by glacial meltwater drainage from the northeast. For example, the foreset beds in the Guptill Pit (locality 001; Table 2) dip toward the southwest, indicating that the Baldwin Delta was built in that direction. The delta has a topset/foreset contact at an elevation of 101.2 m (332 ft). If this delta is marine, the topset-foreset contact provides a minimum estimate for the marine limit in this area. At present, we cannot rule out the possibility that the delta may have been deposited in a glacial lake formed by ice damming the Saco River Valley to the south, although we consider this ice configuration less likely.

TABLE 2. PALEOFLOW DIRECTION DATA IN THE STEEP FALLS QUADRANGLE

| Locality | Description | Trend ( º ) |
|---|---|---|
| 001 | delta foresets | 214–270 |
| 002 | delta foresets | 090-135 |
| | trough cross-bedded topsets | 066 |
| | planar cross-beds just below topset/foreset contact | 051 |
| 003 | delta or fan foresets | 040, 100 |
| 033 | foresets? | 325 |
| | foresets? | 130 |
| | foresets? | 120 |
| 038 | foresets? | 352 |
| | fluvial cross-beds | 360 |
| | lowest foresets | 036 |
| 062 | fluvial cross-beds | 142 |
| | fluvial cross-beds | 155 |
| | foresets? | 125 |
| 122 | foresets | 143 |

The East Sebago Delta (localities 002 and 003, near East Sebago village; see also Figure 3) likewise may be marine, although the genesis of this deposit is not completely understood. The modern Northwest River dissects the delta. Although it is possible that drainage from the Stony Brook valley fed the delta, we believe the main sediment source was the late-glacial Northwest River valley because the foreset beds generally indicate southeastward progradation (Table 2) and the sediment grades (grain size decreases) toward the southeast. The morphology of the delta supports this interpretation. The northern half of the delta reaches elevations above 100 m (330 ft), but the southern half of the complex reaches only 94.5 m (310 ft), although differential erosion of the delta top in postglacial time cannot be ruled out. A residual glacial ice mass probably occupied the Sebago Lake basin when the delta was deposited, so if the delta is marine, the incursion of the sea could have occurred from the southwest through the head of the Stony Brook valley, whose threshold elevation is approximately 94.5 m (310 ft). The elevation of a topset-foreset contact measured in the East Sebago Delta at locality 002 is 99.4 m (326 ft), which is above the threshold elevation and below the maximum elevation of the marine limit inferred from the Baldwin Delta (locality 001). Alternatively, it is possible that no marine water entered the basin and the East Sebago Delta is lacustrine.

Sediment which may be marine clay (Presumpscot Formation; Bloom, 1960) was reported in well logs (localities 205, 227) and by residents near the Saco River (localities 055, 100). Also, clay of probable marine origin was found in a cut-bank ex-

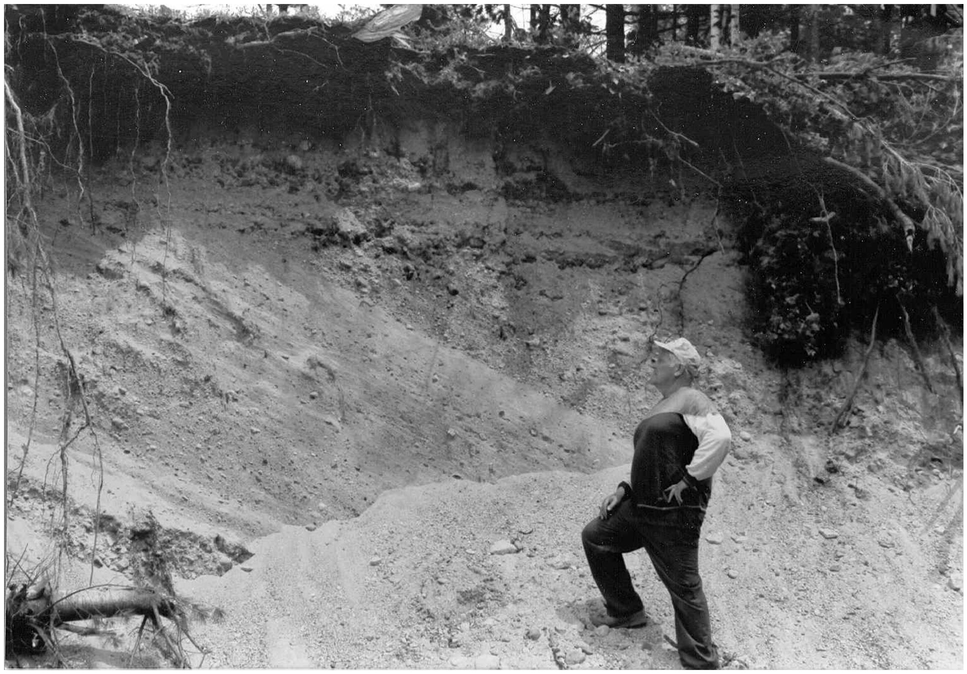

Figure 3. Horizontal gravelly topset beds overlying inclined foreset beds at the Crowe Pit in the East Sebago Delta (locality 002 on surficial materials map).

posure along Strout Brook, on the east side of the Saco Valley (see surficial materials map). The Presumpscot Formation may occur abundantly along the Saco Valley in the southeast part of the quadrangle, but is concealed beneath the deltaic deposits.

***Glaciolacustrine Deposits***

During the recession of the last ice sheet, a glacial lake formed west of Town Farm Hill in the southwestern part of the quadrangle, where meltwater was ponded against the ice margin as it receded northward from the Back Brook valley. As ice retreat opened lower outlets, "glacial Lake Town Farm" dropped to successively lower levels (stages). Each group of deltas and other deposits formed in a particular stage of the lake is a "morphosequence" (Koteff, 1974; Koteff and Pessl, 1981). These morphosequences are indicated on the geologic map as units $Pltf_{1-3}$. The highest, near-ice parts of each morphosequence indicate the approximate position of the glacier margin when those deposits formed (note labeled ice-margin lines on the geologic map). Many of the Pltf sediments have collapsed adjacent to melting ice, thus lowering their elevations; and the scarcity of good exposures makes it difficult to determine whether they are deltas, subaqueous fans, or lake-bottom deposits. Therefore, the assignment of some of the deposits to particular Pltf units is inferred mainly from their location, topography, and elevation.

Former spillways (outlets) for the three stages of glacial Lake Town Farm are clearly indicated by erosional meltwater channels. The spillway elevations match those of the uppermost delta surfaces for each particular lake level. The Town Farm deltas included in units $Pltf_1$ and $Pltf_2$ locally show well-developed foreset units which rapidly grade into the lake basin from coarse cobble gravel to fine sand and silt. The foreset beds are unconformably overlain by topsets dominantly comprised of pebbly sand to cobble gravel. In contrast, associated lacustrine fans do not have topset beds. Lake bottom sediments finer than fine sand have not been recognized in the Back Brook valley.

The elevations of the glacial Lake Town Farm deltas are above the marine limit. The topset-foreset contact of a delta in unit $Pltf_1$ has an elevation of approximately 136 m (480 ft, from the topographic map), which should mark the water level of the earliest and highest lake stage. The probable outlet for this glacial lake would have been southward, through a spillway at about 146-148 m (480-485 ft) in the northermost part of the adjacent Limington quadrangle (Meglioli and Thompson, 1999a,b).

The $Pltf_2$ delta top (locality 038) lies to the north of unit $Pltf_1$. It is relatively lower at < 131 m (< 430 ft, from topographic map). The elevation of a topset-foreset contact in unit $Pltf_2$ is estimated at about 128 m (420 ft). Spillways for this stage of glacial Lake Town Farm are located on the northern extension of Town Farm Hill, where the escaping lake waters cut two deep channels into the glacial till. The elevations of the floors of these channels are about 130 m (425 ft) and 127 m (415 ft), with the lower -- and presumably younger -- channel lying just north of the higher one. The retreating ice margin continued to prevent drainage north toward the Saco River valley, so the lake spilled southeastward along Stone Brook.

Continued retreat of the ice margin from the Back Brook valley allowed the lake to drain into Stone Brook via the gap just south of Moody Mountain. The elevation of the spillway is about 122 m (400 ft). During this third stage of glacial Lake Town Farm, unit $Pltf_3$ was deposited. When the ice ultimately receded into the Saco River valley, meltwater was able to escape down the Saco River to the east. However, a ponded water body is believed to have persisted in the Saco Valley, and the sand and gravel deposits of unit Pld are inferred to be a delta that formed in this lake. Unit Pld is not well exposed, but lake-bottom sediments observed just upriver in the Cornish quadrangle show that a lake existed in this part of the Saco Valley (Holland, 1986; R. Newton, pers. comm.; Thompson and others, 1995). The dam for the lake is not obvious, since postglacial erosion by the Saco River has dissected the earlier glacial sediments. A likely site for the former dam is just west of Goulds Island, where the Saco Valley is very narrow and could have been blocked by the ice-contact and marine deltaic deposits (units Pgi and Pmd).

### *Nonglacial Deposits and Landforms*

Various deposits of nonglacial origin are found throughout the Steep Falls quadrangle. Most of the nonglacial sediments are of Holocene (postglacial) age, but are labeled as Quaternary in cases where the deposits may have formed immediately after ice retreat and therefore may overlap the Pleistocene-Holocene boundary (about 10,000 years ago). Large mounds, up to 5 m (16 ft) high and generally with radii greater than 6 m (20 ft), and which are comprised of very well sorted sand, are interpreted to be postglacial eolian (windblown) deposits (map unit **Qe**; Table 1). The sand dunes are presently inactive. They have been mapped only in the southern portion of the quadrangle, on the sandy plains east of the Saco River. Many of the dunes in this area were too small to depict at 1:24,000. No accurate indication of dune type or trend could be inferred that would indicate paleowind directions.

Forested and nonforested swamp and marshland (map units **Hws** and **Hw**; Table 1) occur throughout the region, although the vast majority of wetlands are found in lowland plains in the eastern and central portions of the quadrangle. Many wetlands are located on the periphery of extant rivers, streams, and ponded water bodies. Others are associated with poorly drained areas in till and shallow bedrock basins, the floors of glacial meltwater channels, and surfaces of marine affinity where underlying clay-rich zones or very compact, moderately-sorted gravels impede drainage of ground water.

Holocene alluvium (map unit **Ha**; Table 1) is mapped adjacent to the Saco River and a few other streams where sediments have accumulated on modern flood plains. Unit Ha is characterized by flat or terraced benches comprised of sediments ranging from very well-sorted fine sand and silt to poorly-sorted, often imbricated, pebble and cobble gravel. Meander scrolls along the Saco River flood plain are easily recognized from air photos.

Extensive flat areas in the Saco Valley have been mapped as stream terrace deposits (unit **Qst**). These areas are former flood-plain surfaces that developed when the river flowed at higher levels than today. The stream terraces formed as postglacial uplift occurred, and the river incised the glaciomarine deltas and other glacial deposits. For example, the crescent-shaped western edge of Pickpole Swamp marks a former river bank where the Saco River cut into the adjacent delta. In large parts of the Qst unit along the Saco River, the terrace surfaces are proably underlain by considerable thicknesses of deltaic sand (remnants of unit Pmd), and perhaps also by glaciomarine clay.

In one section of the Sebago Lake shoreline, the width of the modern beach (map unit **Hls**; Table 1) permits mapping at the scale of the 7.5-minute quadrangle. The lacustrine beach is predominantly a thin layer of pebbly sand to fine sand. Large boulders (often > 1 m) litter the Sebago Lake shoreline and commonly are seen along the sandy beaches. The majority of these shore boulders are probably erratics from a wave-winnowed till which originally formed the shoreline. Recently, a large number of boulders have been brought in by residents to protect lake-front property against further wave undercutting. In places, sand and cobble beach deposits overlie till or gray clay. The clay is generally finely laminated and no shells have been observed *in situ*. The clay has a different color and texture, and is generally more evenly laminated than the marine clays (Presumpscot Formation; Bloom, 1960) found south and east of Sebago Lake (Gosse, 1999a,b), suggesting that the clay is lacustrine rather than marine.

Although broad wedges or isolated patches of colluvium (map unit **Qc**; Table 1) have been deposited along many steep slopes in the highland regions of the quadrangle, the unit is seldom mapped because (1) the areal extent is too small for the scale of the map sheet; or (2) the colluvium originates from till and it is difficult to distinguish the two. Colluvium is mapped in a valley in the southwest corner of the map sheet where the loose, massive diamicton overlies a fluvial cobble gravel. The colluvium is slightly less consolidated than the till which flanks the hill slope but similar in all other respects, implying a genetic relation between the till and the colluvium.

## ICE FLOW DIRECTIONS IN THE STEEP FALLS QUADRANGLE

Three significant glacial ice flow directions have been delineated in the Steep Falls quadrangle (Table 3). These directions were inferred from erosional features on bedrock (grooves, striae, crescentic gouges, and stoss-and-lee features). Evidence for glaciations older than the most recent one has not been found, so all indicators are interpreted to record late Wisconsinan ice flow. No definite age relationship between the three different flow directions could be resolved. Southeast flows (averaging 142° and 162°; Table 3) may represent the dominant flow direction during glacial advance, as suggested by others for most of southern Maine (Thompson and Borns, 1985). The 160-164°

TABLE 3. GLACIAL FLOW DIRECTION INDICATORS IN THE STEEP FALLS QUADRANGLE
(**S**, striation; **G**, groove; **PF**, P-form; **SL**, stoss-and-lee feature)

| Locality | Indicator | Azimuth ( °) |
|---|---|---|
| 012 | S,G | 150 |
| 015 | G | 162 |
| 019 | S,G | 161 |
| 020 | S,G | 162 |
| 028 | S,G | 160-164 |
| 029 | G | 167 |
| | S,G | 162 |
| 040 | poor G | 182 |
| 044 | G | 180 |
| 045 | S | 165 |
| 049 | poor S | 188 |
| 051 | poor S | 142 |
| 066 | S | 161 |
| | S | 141 |
| 067 | S,G | 161 |
| | G | 142 |
| | PF | 110 |
| 068 | poor G | 144 |
| | S | 161 |
| 076 | S | 144 |
| 104 | poor S | 142 |
| 115 | S | 142 |
| | S | 162 |
| | S | 185 |
| | S | 175-200 / 151(older set) |
| 125 | S,G,SL | 110-115 |
| | poor S | 240 |

flow direction is ubiquitous throughout the quadrangle, while 140-148° is most common in the southern half of the quadrangle. A southward ice flow (averaging 180°; Table 3) may represent a later flow during deglaciation, when the ice sheet was thinner and more subject to topographic control.

The southwestward trends found along Burnell Road (averaging 220°) are interesting because they may record flow from an extensive ice mass which occupied the Sebago Lake basin during the final stages of deglaciation. This is supported by the southwestward trend of two nearby esker complexes. Even though the Stony Brook eskers may have been confined to the shallow valley they occupy, the Adams Pond eskers had no such restraints, suggesting that the trend of esker systems paralleled the direction of flow of the last ice to cover that area (e.g. Klassen and Thompson, 1993). A late-glacial ice mass in the Sebago Lake basin was likewise proposed in this report to help explain the formation of the East Sebago Delta. This remnant ice also may have blocked the drainage of the Crooked River north of Sebago Lake, which would explain the presence of lake sediments in the valley of the latter stream.

## GLACIAL AND POSTGLACIAL HISTORY

Many interpretations of Maine's surficial geology by G. H. Stone (1899) have been verified and expanded upon over the last three decades (Bloom, 1960; Stuiver and Borns, 1975; Thompson, 1982; Borns 1973, 1985; Smith 1985; Belknap and others, 1989), although important details of the regional glacial history remain unresolved. In the Steep Falls quadrangle, there is no precise chronology of glacial retreat, although radiocarbon dates from shells collected at a similar latitude in Freeport, Maine, suggest deglaciation of the study area around 14,000 ($^{14}C$) years ago (Weddle and others, 1993). Consequently we have relied on relationships that indicate the relative order of events when interpreting the glacial and postglacial history.

During the last glaciation, the late Wisconsinan Laurentide Ice Sheet advanced south and southeastward to the present Maine coast and onto the continental shelf, where it reached its maximum extent before about 18 ka (18,000 years ago). Evidence of these flow directions is found throughout the Steep Falls quadrangle. The weight of the ice caused the underlying continental crust to subside at least 240 m (787 ft) (Stuiver and Borns, 1975). A veneer of till was deposited beneath this advancing ice sheet.

Most of the surficial deposits in the Steep Falls quadrangle formed during and after the deglaciation of this ice sheet. Rapid retreat of the Laurentide Ice Sheet northwestward from the Gulf of Maine occurred between 15 ka and 14 ka (Tucholke and Hollister, 1973; Thompson and Borns, 1985; Dorion, 1994) although initial retreat probably began shortly after 18 ka. As the ice margin pulled back and the ice mass thinned, the contemporaneous Atlantic Ocean inundated the subsided land (Bloom, 1960; Stuiver and Borns, 1975; Smith, 1985). Marine deposits such as deltas, fans, and marine clays were deposited as the sea transgressed over the deglaciated lowlands south and east of the Steep Falls quadrangle. By the time the quadrangle was being deglaciated, topography began to control the ice flow. High mountains became deglaciated before deep basins, and flow was directed along the axes of valleys. This is supported by the different ice flow directions measured in the Steep Falls quadrangle (Table 3).

As the ice margin retreated, various deposits were laid down. Till continued to be deposited and end moraines (e.g. Rainbow Pond Moraine) were formed at ice margins. Subglacial and englacial sediment-laden streams deposited eskers. The eskers often fed sand and gravel deposits at the ice margin (e.g. west of Adams Pond); and where there were proglacial water bodies, the eskers fed subaquatic fans and deltas (Baldwin Delta).

From the presence of marine deltas and patches of clay which are probably marine, it seems clear that the Saco River valley was drowned by the transgressing sea across much of the Steep Falls quadrangle. Considering the flux of meltwater down this valley, the marine water was probably very brackish, similar to modern estuarine environments. Relative sea level may have reached as high as 102 m (335 ft.) in this region, if the Baldwin Delta is of marine origin. However, most of the Steep Falls map area would have been above the marine limit. Glacial lakes formed where the ice margin blocked drainage in north-sloping

valleys, and in places where plugs of glacial sediment or remnant ice temporarily prevented meltwater from draining freely to the sea. Deltas, fans, and lake-bottom deposits were laid down in these glaciolacustrine environments. It is noticeable that many of the free-draining south slopes have extensive ice-contact gravels and other glaciofluvial deposits on their flanks.

Late-glacial and postglacial features were formed following glacial retreat, including swamps and other wetlands in poorly drained areas, stream alluvium and terraces, and colluvium in unstable areas—especially along steep slopes. Many of the processes responsible for these deposits are continuing today.

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## APPENDIX A

**The following are edited field notes describing numbered sites on the surficial materials map.**

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 001 | active pit | West of East Baldwin; pit owned and operated by William O. Guptill. Top of deposit reaches elevation of at least 340 ft. Pit walls up to about 25 ft high; section described here is in NE part of pit area; maximum clast diameter is 40 cm; deposit is predominantly fine to medium sand; this sand unit is interpreted as delta foresets. The foreset beds occur as finely laminated sequences up to about 2 ft thick. Paleoflow direction indicated by the foresets is between 210° and 250°, with an average of about 220°. Up to 6 ft of gravelly delta topsets (?) overlie foresets in the eastern part of the pit. These gravels fine toward the southeast, from coarse moderately-sorted cobble gravel to pebbly sand; paleoflow in this unit appears to be toward the southwest in some places, based on cross-bedding, but in other places cross-bedding and clast imbrication suggest flow generally toward the east; in most places the topset/foreset contact is sharp and horizontal (but some channel cuts are present, suggesting fluvial action); there appears to be some evidence of collapse; approximate clast lithology: 80% granitic, 20% volcanic, no metasediments. Surveyed elevation of the topset/foreset contact is 332 ft. |
| 002 | active pit | Pit near East Sebago. Deposit varies from fine sand to coarse cobble gravel; the highest section is about 15 ft. The pit is in a delta, which appears to have been built southeastward. Deposit may have been partly eroded, as suggested by the present topography. The delta top slopes gently eastward, and shows a meltwater channel in woods east of pit. Overall, the lower (foreset) unit appears to fine southward. Foreset beds dip E to SE. Individual foreset beds are up to 4 cm thick, consisting of fine to coarse sand and pebbly sand. The foreset unit is capped by 3 ft of poorly sorted gravel and pebbly sand interpreted as delta topsets. Fluvial cross-bedding in topsets indicates flow toward 051-066°. Surveyed elevation of topset/foreset contact is 326 ft. |
| 003 | active pit | Pit is being filled; this is site of Town Pit and Garage for East Sebago; fresh sections are presently exposed; deepest part is approximately 35 ft, in northern pit where horizontally bedded to trough cross-bedded units comprise the upper 15 ft of the deposit. The majority of the site is fine to coarse, very well-sorted sand, interbedded with pebble-cobble gravel. Outsized cobbles up to 50 cm occur rarely. The top 2 ft is pebbly sand to pebble-cobble gravel, imbricated and often weakly cross-bedded or horizontally bedded, and interpreted as topsets. The underlying, poorly exposed, foresets appear to dip toward 040°, although this measurement was made in only one dug-out trench, approximately 10 ft below the topset/foreset contact. Original soil profile remains on top. |
| 004 | inactive pit | East of N. Baldwin; well-rounded to sub-rounded cobbly poorly-sorted gravel; with wide range of clast lithologies: mafic volcanics; crystalline rocks; aphanitic porphyry; < 1% metasedimentary rocks (none seen); deposit capped in places by well-sorted fine sand containing large angular to sub-rounded boulders; no section > 15 ft; poorly bedded and massive in general; east entrance into the pit may be located in esker but this is uncertain; pit is in large plain of gravel which appears to be mostly outwash. Striated small bedrock outcrop at east pit entrance. |
| 005 | inactive pit | New pit ; thin-bedded fine to medium sand; up to 10 ft exposed section; retains original soil profile. |
| 006 | road cuts | Very shallow road cuts on a dirt road north of E. Sebago; maximum 5 ft high; fine to coarse sand; this whole plain is covered by gravel from pit 002 eastward, and from this site southward. |
| 007 | active pit | Just south of pit 002; operated by the State; ridge on east side of the small lake (Mill Pond) to the west of the pit is not an esker, but just a ridge bounded on both sides by depressions (kettles or stream eroded); section in this ridge exposes well-sorted fine to coarse sand with cobbles and pebbles; most stones are subrounded to subangular crystalline and volcanic rocks; no metasediments; relief here is on the order of 30-50 ft, indicating a thick deposit. |
| 008 | excavation | North of E. Sebago; cut exposing sandy till with angular to subangular clasts; massive matrix-supported diamicton with well-sorted, fine-sand matrix; boulders abundant – up to 2 m in diameter. |
| 009 | new house | Till exposure. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 010 | bedrock | Murch Rd.; garnetiferous and staurolite-biotite-quartz schist; covered by a thin veneer of till; very bouldery; no striae. |
| 011 | inactive pit | On Douglas Hill Rd.; a lot of small pits; deposit may be an esker complex; moderately to well-sorted gravel; largest clasts up to 40 cm; very sandy in places; could be a sandy diamicton and there are some faceted stones, but based on morphology and proximity to a nearby esker ridge, it appears to be an esker. |
| 012 | bedrock | Winn Mtn.; glacially streamlined features, with grooves and striae trending 150°. |
| 013 | shovel hole | West of Douglas Hill; thick till deposit; massive matrix-supported diamicton with sandy-silt matrix and boulders up to 80 cm; forms ridges that trend about 290-300°, which may be end moraines. |
| 014 | excavation | New house on Robinson Hill Rd.; brown, massive, matrix-supported diamicton with sandy-silt matrix; boulder in yard is up to 1.75 m across. |
| 015 | bedrock | On west side of Robinson Hill; this outcrop is a stoss-side surface (sloping toward 250°); covered by > 2 ft of till with protruding bedrock in most places; poor to fair glacial striae trending142°; good grooves trending 162°; there may be a till ridge (not bedrock cored) trending 214°. |
| 016 | road cut | Three exposures (max. 4 ft high) of till; massive matrix-supported diamicton with silty sand; siltier than most other local tills; majority of clasts are rounded granitic cobbles. |
| 017 | shovel holes | On top of esker ridge; two holes; 11 in of silty sand and black to gray humus, overlying very fine to medium (apparently massive) brown and light-brown sand; some very well-rounded and spherical granitic cobbles up to 6 cm diameter at 30-in depth; esker ridge is broad-topped (40-50 ft maximum), with up to 20 ft relief above small stream; ridge appears to bifurcate here. |
| 018 | shovel holes | Esker ridge; didn't dig below about 14 in because of compact cobble gravel; cobbles very well-rounded and spherical with average diameter of 10 cm; even boulders up to 50 cm are rounded and spherical; esker ridge is sharp-crested (15ft wide on top, 50 ft on bottom); averages 20 ft high but over 40 ft in places. |
| 019 | bedrock | Lots of stoss-side bedrock outcrops along the Tower Trail; bedrock surface shows glacial polish, striae, and grooves trending 160-162° in many places; no other directions were noted. |
| 020 | bedrock | Douglas Mtn, north side and top of hill; all glacial grooves and striae trend 162°; some crescentic gouges noted with same direction. |
| 021 | inactive pit | Very small pit in esker ridge; esker up to 30 ft across with a flat broad top; maximum 20 ft high, but in most places 8-10 ft high; cobble and sandy pebble gravel, but not good exposure. |
| 022 | inactive pit | Inactive small pit on Rte. 11, N of East Baldwin, in what appears to be an esker but is more likely a stream-cut ridge. Difficult to interpret (ice-contact deposit?); poorly-sorted to well-sorted cobble-boulder gravel with medium -coarse sand matrix; mostly clast-supported, but locally matrix-supported; ridge stands about 15ft above road level; area is hummocky. |
| 023 | road cut / shovel pit | East side of road, south of jct. of Hanson Robinson Rd. with Douglas Hill Rd.; large rounded cobbles in very poorly-sorted massive cobble gravel; may be an esker segment but origin is uncertain; doesn't look like a till, though there are large boulders in the vicinity (but not on the ridge). |
| 024 | auger hole | Down hill from cemetery on opposite side of road, off Rte. 117 in the southwest corner of map; material ranges from moderately well-sorted, massive, matrix-supported diamicton to gravel; contains a very fine sandy matrix with < 5% silt; no clay; sandy diamicton has angular clasts up to 10 cm but no large boulders; however, area is surrounded by large angular to subrounded boulders up to 70 cm. Must be a till. |
| 025 | shovel hole and road cut | Well-sorted sand and pebbly sand to pebble gravel; also, well-sorted, massive, matrix-supported to clast-supported gravel/diamicton with many rounded clasts; latter is interpreted to be a till; a lot of large boulders in surrounding areas. |
| 026 | inactive pit | Pit in what appears to be an esker ridge; 15ft high, with very narrow top; well-rounded and spherical cobbles in massive, matrix-supported to clast-supported gravel. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 027 | inactive pit | It appears that an esker turns across the valley; the old pit is in a gravel ridge; massive, matrix-supported (in most places) cobble-boulder gravel; clasts up to 30 cm are common; most clasts very well-rounded and some very spherical; ridge widens and narrows; widest part 50 ft across top; about 15 ft high. |
| 028 | bedrock | Good deep and wide glacial grooves and striae exposed in a dirt road; all trending 160-164°. |
| 029 | bedrock | Entire hill has outcrops; surficial sediment cover is sparse; a trench shows dark-brown, silty-sandy, massive, poorly-sorted, matrix-supported diamicton (definite till); many stone walls with angular to subrounded clasts up to 60 cm diameter; cleared areas on top of hill show outcrops well; good glacial grooves trend 167°; few good polished surfaces; striae trend 162° . |
| 030 | road cut | 3-4 ft section on Rte. 117; very angular clasts in a sorted sandy, massive, mostly matrix-supported diamicton; clast-supported in places; till. |
| 031 | shovel hole | Corner of Christian Hill Rd. and Rte. 25; very compact, very poorly-sorted, clast-supported massive gravel or diamicton; gravelly, but interpreted as till; lots of large boulders and stone walls nearby as well. |
| 032 | inactive pit | Ridge of coarse cobble gravel (massive, clast-supported, poorly sorted) extends across the road here. It may be an esker, but difficult to be sure; low relief, but definitely a ridge. |
| 033 | inactive pit | Christian Hill Rd.; interesting pit but sections are slumped; overview: fluvial pebble gravel to pebbly sand (some cobbles) overlies a thick, dominantly fine to pebbly sand unit, interpreted to be delta foresets; sections up to 30 ft high; top shows what appears to be original soil profile; topography drops rapidly toward the west; possible cut by a river channel now occupied by a small stream; the deposit appears to be a delta; paleoflow direction in the limited exposure of foresets trends toward 325°, although various directions were measured; in areas along the south-facing pit wall, laterally extensive (> 10 m) beds of fine to coarse sand about 10-15 cm thick are interbedded with coarser sand and gravel; 1-1.5 m thick lenses of coarse, poorly-sorted, massive, clast-supported gravel occur in the middle of this face; many lensoid beds present, and what appear to be undulatory beds (wavelength ~ 3 m). There is possible ice-contact collapse here. Upper fluvial unit is at most 2 m thick, with lots of pebble gravel that is internally massive, but in one area has some cross-bedding; contact between delta topsets and foresets is at about 460 ft elevation Clast lithology is a mixture of crystalline and volcanic rocks, with up to 15% metasediments. Climbing ripples, convoluted bedding, wavy beds, and lensoid bedding are seen throughout the foresets; large boulder in upper gravel unit may be a dropstone. The deposit is interpreted to be a lacustrine delta; closest spillway at 460 ft elevation is to the south, but this is not the direction expected with the northward paleoflow. There is little confidence in the paleoflow direction because of exposure, and with the entire deposit appearing to taper toward the west, a southward drainage is plausible. The esker to the north probably is not associated with this deposit. The esker is lower (site 039). |
| 034 | bedrock | Town Farm Hill; lots of exposed bedrock, but no good examples of glacially polished rock surfaces; sandy till cover. |
| 035 | shovel hole | On Town Farm Hill; massive, matrix-supported, poorly-sorted brown sandy diamicton, compact in places, with angular to subrounded clasts; at depth of more than 20 in below a thick humus and root layer. |
| 036 | shovel hole | Just above the stream, on the east bank. 40-in hole showing light-brown very fine to fine sand with a few pebbles. Only one cobble (5 cm, angular) found, at very top of hole; deposit is probably colluvium from Town Farm Hill. Only 4 in of humus cover here. Surrounding area appears to be same material. |
| 037 | backhoe trench | 45-in deep hole exposes 7 in of humus/AE horizon; about a foot of pebbly well-sorted massive sand with imbricated stones; and the remainder is moderately sorted coarse cobble gravel; clasts up to 20 cm are well rounded and some are spherical; surrounding area is basically flat and appears to be the same material. |
| 038 | active pit | Located off Rte. 25; complex and very interesting glacial lake deposits. Overview: there are two main pits here; an upper level and lower level; the upper level has the original surface material removed, and exposes |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 038 | (continued) | mainly fine to coarse sand and moderately well-sorted pebble-cobble gravel; the lower level lies to the west. A ridge that forms the westernmost boundary of the pit area may be an esker, but it looks more like the remnant of a dissected gravel deposit. The upper pit level shows the following: 3 ft of highly convoluted fine to pebbly sand, in places interbedded with pebble gravel; this unit overlies a more laterally extensive sand unit which may be delta foresets. Cross-bedding abundant. Striated clasts are present in the pit. Evidence for ice-contact influence includes folding and faulting in the sand unit. There are apparently multi-directional paleoflow directions. Uppermost (latest) flow was toward 360°. To the north of the sand exposure, a faintly bedded, poorly-sorted cobble gravel appears to be in angular unconformable fault contact with the sand; these materials appear to be in place, and suggest ice melting and collapse. If the upper sand and gravel is a delta topset unit and the lower sands are foresets, this may be a lacustrine delta, with topset/foreset contact at about 410 ft elevation In the lower level to the west (NW portion of pit) crude foresets dipping 14° toward 352° consist of pebbly to fine sand (up to 6 ft exposed); these sand foresets are overlain by openwork cobble gravel and a fine sand cap. The gravel over the crude foresets is moderately well sorted and up to 2.5 ft thick. Nearby, a 20-30 in thick package of apparently folded cobble gravel overlies more foresets, but here the foresets dip both north and southward. The interpretation here is that the upper-level unit was deposited first, with a higher delta topset/foreset contact indicating a higher lake level; this was followed by deposition of a second lacustrine delta in a shallower ( lower) lake. |
| 039 | inactive pit | Small gravel pit up to 14 ft deep. Rusty fluvial gravel; poorly-sorted, clast-supported, massive to faintly bedded pebble-cobble gravel with mostly rounded clasts; the pit is in a ridge, north of a swamp. This may be an esker connecting to one that crosses the road toward site 033. |
| 040 | bedrock | Exposure on old dirt road; no glacial polish or striae; poor grooves trend 182°; area surrounded by till. |
| 041 | shovel hole | West of North Road; 36 in of fine silty-sandy till with angular to subrounded cobbles; massive, matrix- supported, poorly-sorted, light-brown diamicton. |
| 042 | shovel hole | Till occurs along the transmission line; large boulders here, > 3 m across. |
| 043 | bedrock | Top of Moody Mountain; few good bedrock exposures except on the very top; none retain glacial polish or striae; all glacially transported stones are schists and metasedimentary rocks of some sort. |
| 044 | bedrock | Outcrop on South Road; glacial grooves trend 180°. |
| 045 | bedrock / shovel hole | South Road; shovel holes down to only 20-in depth hit bedrock; fine sand with pebbles and cobbles; largest boulders here up to 1.5 m; material is sandy till; clasts are mostly (95%) biotite schist and other metasediments; a few crystalline boulders, which are very rounded. Glacial striae on bedrock outcrop on E side of road indicate ice-flow direction of 165°. |
| 046 | road cut | Jct. of Whaleback Rd. and Rte. 25; sandy till exposed; lots of boulders (< 1m). |
| 047 | road cut | Whaleback Rd.; faintly bedded sand exposed in shallow (3 ft high) roadcut; beds are ~10 cm thick, in sequences fining upwards from medium to very fine sand; the sand appears to be capped by till, but it may just be colluvium, up to 2 ft thick. |
| 048 | road cut | At least 2.5 ft of sorted fine to coarse sand with angular and rounded clasts; looks like colluvium; very loose. |
| 049 | bedrock | Transmission line; entire hill is bedrock covered by thin till veneer; all schist, with some aplite zones that were too fractured to preserve good glacial striae; poor striae trend 188°; the till stones are mostly schist. |
| 050 | bedrock | On lawn across from cemetery; local materials look sandy but till surrounds the area. |
| 051 | bedrock | Along transmission line; glacial striae on quartz vein trend 142°, covered by a silty-sandy diamicton (till). |
| 052 | river section | Saco River; fine sand 10-15 ft above river; 30-40 ft above river, upper 20 in is very compact fine and pebbly sand underlain by less compact sand; no clay encountered. |
| 053 | auger hole | Tucker Rd.; auger holes, shallow road cuts, and shovel holes to depth of 30 in; poorly sorted and massive, loose, sandy gravel with sandy matrix; clasts up to cobble size. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 054 | test pit | Inactive test pit north of Tucker Rd.; 15-in humus and AE horizon overlies 20 in of pebbly sand to poorly sorted sandy gravel with clasts up to 3 cm; latter unit in turn overlies well-sorted coarse sand. |
| 055 | river cut | Along Saco River; this section not visited, but observations were made at similar site upstream; 30-ft section exposes sand; some silt is interbedded with the sand at 15 ft above the river; resident reports that clay outcrops across the river. |
| 056 | inactive pit | Pebble gravel; mostly clast-supported, moderately well-sorted, unconsolidated; majority of pebbles are crystalline rock types; pit wall 4 ft high. |
| 057 | road cut | Shallow cut (3 ft) along Rte. 117; compact, pebbly, massive, matrix-supported, poorly-sorted diamicton; appears that till occurs in highlands around here, but sandy gravel occupies the lowlands. |
| 058 | shovel holes | Compact, massive, poorly-sorted, matrix-supported diamicton; 35-in hole; lots of boulders; hummocky on the order of 2 m (not gravel). |
| 059 | shovel hole | Along stream bank; no gravel; some boulders > 2 m; all till. |
| 060 | shovel hole | Valley west of Rte. 117; contact between till and bedrock; gravel and colluvium also present; shallow hole (1 ft) but deeper pits by resident indicate that the gravel occurs as a belt parallel to valley, ending abruptly against hillside; map unit Pg here is mostly unconsolidated, massive, clast-supported cobble gravel with sandy matrix; colluvium overlies the gravel as a wedge extending from the hill; till outcrops on hill slope. |
| 061 | bedrock | Near corner of Whaleback Rd. and Rte. 25; no ice-flow indicators; till overlies bedrock. |
| 062 | active pit | Sand pit on Rte. 25; 20-ft sections show very fine to coarse sand; some rhythmites; normal faulting; some wavy beds; intense folding in places; dropstones >50 cm only slightly deform the underlying bedding; pit is in sand hill that has a fan-like morphology, which may be the original geometry. Paleoflow in a southeast direction (155°, 142°, 125°), but fans out; some pebble gravel lenses; climbing ripples; good foresets and internally laminated fining-upward sequences in beds 2-10 cm thick. |
| 063 | excavation | All fine sand; up to 10 ft exposed thickness. |
| 064 | excavation | Large rounded spherical cobbles and boulders averaging 25-35 cm indicate presence of coarse gravel; nearby, hill is comprised of till. |
| 065 | stream cut | Very loose pebble gravel and sand; sections up to 12 ft high; looks like this may be river gravel from the Saco River. |
| 066 | bedrock | Two ice-flow directions indicated: 161° and 141° from striae and grooves. |
| 067 | bedrock | Rte. 113; bedrock overlain by poorly sorted silty-sandy diamicton; glacial flow directions indicated from striae and grooves: 161° and 142°; one p-form trending parallel to road at 110°; no relative ages of flow directions could be deciphered. |
| 068 | bedrock | Rte. 113; bedrock exposed on south side of road; fresh till cut on north side under transmission line; very sandy unconsolidated and cobbly diamicton; glacial striae on bedrock trend 161° and grooves trend 144°. |
| 069 | road cuts | Series of small road cuts and tiny excavations exposing fine to medium sand interbedded with pebbly sand and pebble gravel; the pits north of the railroad off Chase Siding road also show pebbly sand and pebble gravel. |
| 070 | inactive pit | Sand pit at jct. of Chase Siding Rd. and Rte. 113; sections up to 10 ft high; coarse to fine sand interbedded with pebble gravel; pebbles up to 4 cm. |
| 071 | shovel hole | Till along transmission line; huge boulders but no bedrock exposed. |
| 072 | shovel hole | South of railroad; hole down to 2.5 ft; all pebbly sand and coarse sand. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 073 | shovel hole | Along transmission line; pits occur in the ridges around here; longest ridge (about 400 m) has cobble gravel and sandy pebble gravel on crest – possibly an esker ridge; the remaining ridges are comprised of cobble gravel over sand; cobbles up to 15 cm; no bedrock showing; all cobbles rounded; mostly crystalline rock types. |
| 074 | road cut | East of East Baldwin; 10-ft high section; well sorted fine to pebbly sand. |
| 075 | stream cut | Well-sorted cobble gravel with clasts averaging 10-15 cm; either an esker ridge or result of dissection by streams . |
| 076 | bedrock | NE side of Bald Mountain; good glacial striae trending 144°; fair-quality grooves and striae trending 153°. |
| 077 | shovel holes | Thin veneer of till over bedrock; in most places just moss and humus; very little exposed bedrock. |
| 078 | shovel hole | Top of esker ridge 10-12 ft across; 20-25ft high; esker bifurcates near road. |
| 079 | shovel hole | Brown Mtn. Rd.; very bouldery, generally thin veneer of poorly-sorted massive diamicton which is very silty in places; 24-in hole and shallow excavations. |
| 080 | excavation | Esker ridge 15 ft high and 10 ft across; pebble and cobble gravel; behind house. |
| 081 | auger hole | 4-ft hole; top 26 in consists of coarse, poorly-sorted, matrix and clast-supported, sandy cobble gravel; overlies iron-stained, very compact, pebble to granular gravel which is almost openwork. |
| 082 | excavation | Silty sand to sandy-matrix diamicton; till. |
| 083 | shovel holes | Very hummocky terrain; ridges up to 15 ft high; all diamicton with lots of boulders (some > 40 cm); most very well rounded; looks mostly like till. |
| 084 | shovel holes | Very sandy diamiction with angular clasts; could be colluvium or till; some sandy gravel. |
| 085 | road cut | 4-ft section; poorly-sorted, massive, matrix-supported pebble-cobble gravel; sandy matrix; topography doesn't suggest an esker; well-rounded cobbles. |
| 086 | inactive pits | Terrain similar to sites 083 and 085, but looks like an esker ridge; there are several small pits here; sandy on top but very poorly-sorted gravel at depth; ridge is 10 ft high, 15 ft wide, and appears to bifurcate in places. |
| 087 | road cuts | Rte. 107; cuts up to 10 ft high; unconsolidated, well-sorted pebbly sand; some large angular to subrounded boulders are scattered on the ground surface. |
| 088 | road cut | 6-ft section with fine to pebbly sand. |
| 089 | auger hole | Very fine to pebbly sand; more compact cobble gravel at 40-in depth. |
| 090 | stream cut | Poorly exposed 7-ft section with fine to granular sand; < 5% pebbles. |
| 091 | shovel pit | Along Saco River; 3 ft deep; all very fine to coarse sand; no pebbles. |
| 092 | stream cut | Poorly exposed 3-ft section in loose medium-pebbly sand. |
| 093 | excavation | Pebbly sand down to 2.5-ft depth. |
| 094 | road cut | 7-ft section with 50% pebbly sandy gravel; 40% cobble gravel; 10% sand beds. |
| 095 | inactive pits | Small pits expose sand and pebble gravel. |
| 096 | shovel hole | Small hill; may be an esker ridge; broad top of ridge is 20-25 ft across; 15 ft high; upper 15 in is angular cobbly sand; underlain by very fine sand with less than 10% cobbles and pebbles; this in turn overlies cobble gravel at 36 in. |
| 097 | inactive pit | Off map sheet; south of jct. of Rtes. 25 and 11; pebble gravel and pebbly sand; upper 2-3 ft looks imbricated; deposit appears to be fluvial. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 098 | auger hole | 5 ft deep; no pebbles; all fine sand; sand dune; some ridges around here stand up to 7 ft above surrounding level; dunes appear equant in shape, so difficult to determine paleowind direction. |
| 099 | river cut | Saco River; 8-ft high section; fine to very fine sand; no pebbles or clay seen; beds 10 cm thick, appear to be graded. |
| 100 | shovel hole | Fine sand and granular sand; no large stones; some clay-rich patches around this area according to local residents; no sand dunes evident. |
| 101 | road cut | Up to 3.5 ft of fine sand and pebbly sand; less than 10% pebbles. |
| 102 | active pit | Gravel and sand pit in the side of a hill with sections to 12-14 ft high; uppermost 20 in is a poorly-sorted, fluvial, gravelly sand which in places appears to be cryoturbated and massive; part of deposit is bedded and massive clast-supported cobble gravel. Below this fluvial unit is at least 8 ft of interbedded fine to very coarse sand with lenses of pebble gravel. The beds are mostly laterally extensive over 4 m, 10 cm thick, and in places have a faint suggestion of internal cross-laminations; the beds dip 26° toward 148° in one place. Appears to be a fan deposit, judging by the presence of the foresets. |
| 103 | inactive pit | Just north of the Limington Airport runway; section only 10 ft high; poor exposure but deposit is evidently comprised mostly of cobble gravel and sand; locally all of the high points appear to be capped with gravel; no bedrock, till, or boulders seen; these gravels are at 310 ft elevation, which could be the local marine limit; it is therefore possible that the gravels may be topsets of a large glacial-marine delta. |
| 104 | section along Saco River | fine to very fine sand; well bedded; no clay but there are some silt laminae and beds. Rhythmites resemble those at site 099. Bedrock is exposed on west bank but shows no ice-flow indicators besides a single, poor to fair striation trending 142°. Many large (> 1m) boulders are scattered about. Resident indicates there may be 4 ft of clay at road level, underlain by sand. |
| 105 | excavation | fine to medium sand forming low mound approximately 2.5 ft above surrounding surface; may be a sand dune. |
| 106 | inactive pit | Abandoned sand and gravel pit near what may be a sand dune (50 m2 of fine sand up to 3 ft deep). Pit does not appear to be in an esker. |
| 107 | road cut | Gravel hill comprised of a massive, poorly-sorted, matrix-supported, pebble-cobble gravel. Stones in nearby walls were brought in by residents. |
| 108 | active pit | Large sand and gravel pit with sections > 20 ft high. Largest clast observed is 40 cm diameter; most are less than 30 cm. Excellent exposure of a cross-section through an esker. Long axis of esker trends 140°. Most of deposit is well to chaotically bedded, imbricated to massive, matrix-supported, poorly-sorted, gravelly sand. To the east and west of the ridge axis, the sediments grade to fine to medium sand and sorted pebble gravel. Lots of channel cut-and-fill structures. Local bedding disruptions and normal faults provide evidence of collapse. Highly oxidized, massive, poorly-sorted pebble gravel caps and flanks the ridge. |
| 109 | inactive pit | Abandoned pit; no fresh sections; appears to be a matrix-supported, sandy pebble-cobble gravel. |
| 110 | shovel hole | 4 ft deep; located along transmission line; showed coarse-pebbly sand. |
| 111 | shovel hole | 3 ft deep, showing contact between sand and massive, matrix-supported diamicton interpreted as till; boulders are present. |
| 112 | inactive pit | Abandoned sand and gravel pit with two ridges separated by a depression. Largest clast is 15 cm diameter. Material is sand to sandy gravel, down to at least 6 ft. The depression is probably a kettle hole. The ridges are not eskers. |
| 113 | inactive pit | Abandoned gravel pit. Flat-topped surface on east side of a till hill. The surface is on sandy cobble gravel with a few boulders. 10 ft of cobble gravel here. |
| 114 | inactive pit | Abandoned gravel pit and old fill. Situated on a terraced surface that surrounds a till hill. Material is cobble gravel; no boulders. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 115 | inactive pit | Abandoned pit; glacially striated bedrock has been exposed by removing overlying till. Glacial flow directions based on striae measurements average 185° on subhorizontal rock surface near pit entrance, and this trend is probably representative of latest ice-flow direction. Elsewhere in pit, a set of striae trending 151° are preserved on a sheltered lee surface, and are older than those trending 175°–200°. |
| 116 | active pit | North of North Baldwin; this sand and gravel pit may be an esker-fed deposit, because an esker provides the foundation for a house north of here. Sand and cobble gravel are present, however a detailed description was not made due to a dog. |
| 117 | inactive pit | Small abandoned pit in an esker ridge. Cobble gravel. |
| 118 | inactive pit | Small abandoned pit west of site 001. Cobble gravel. |
| 119 | inactive pit | Abandoned pit; now being filled. Pit is > 20 ft deep, but no fresh sections are exposed. Apparently cobble gravel. No boulders except where probable till is exposed. |
| 120 | surface exposure | Till with large angular boulders. |
| 121 | active pit | Along the road to the pit, sections expose sand and gravelly sand. In the pit, the highest face is 7 ft high and exposes loose cobble gravel. North and west of the pit is a till hill. |
| 122 | active pit | Only one part of the pit is active. Almost entirely sand and pebbly sand, although some beds of cobble gravel appear throughout the pit. Faces are up to 15 ft high. Paleoflow indicated by foreset beds about 5 ft below surface is 19° toward 143°, and this is the trend in the rest of the pit. South and east of the pit there is pebble gravel but no till. At the north end of the ridge is a depression which probably is a kettle. |
| 123 | esker ridge | Up to 20 ft high; sandy gravel with cobbles up to 30 cm diameter, all well rounded and spherical. On the west side of Long Beach Hill, there are not many large till boulders. The esker is very sinuous and near- 90° curves are common. |
| 124 | esker ridge | Esker here is up to 20 ft high above marshy area. |
| 125 | bedrock | Coarse-grained granite. Peculiar ice flow direction recorded here. Some striae and the geometry of the outcrop (stoss/lee) indicate an ice-flow direction of about 115°. There are also grooves trending 107° to 113°. |
| 126 | esker ridge | Ridge (up to 20 ft wide, but with some narrower parts), covered with large boulders. |
| 127 | shovel hole | 6 ft deep; sand with no cobbles or pebbles. Deposit appears to be an apron at the end of an esker. |
| 128 | surface exposure | Till and very large boulders on a bedrock knob. Sandy to the southeast. No indication of an esker. |
| 129 | road cut | No boulders around here. All very sandy. Nearby, a road cut exposes 3 ft of fine to very coarse sand. |
| 130 | shovel hole | Poorly sorted pebble-cobble gravel. |
| 131 | test trench | fine to coarse sand in a 3-ft deep trench. |
| 132 | shovel hole | Where Wildlife Conservation boundary intersects railroad track; dug to depth of 40 in. Upper 12 in is poorly-sorted gravel, which overlies loose, well-sorted pebble gravel. |
| 133 | railroad cut | Nearly 4 ft high; pebbly sand. |
| 134 | shovel hole | Poorly-sorted gravel, with abundant large cobbles and boulders up to 40 cm diameter, overlain by fine to pebbly sand. |
| 135 | shovel hole | Sandy diamicton, apparently till. |
| 136 | test pit | 3-4 ft deep; medium-coarse sand. |
| 137 | road cut | Massive diamicton with boulders up to 70 cm diameter; interpreted as till. |
| 138 | esker ridge | End of esker ridge. Ridge averages 10 ft wide on top, but is wider near 021 pit. Maximum height is 20 ft above adjacent ground surface. Sandy cobble-boulder gravel. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 139 | excavation | Massive sandy diamicton (till). |
| 140 | road cut | 3-ft section exposing fine to medium sand. |
| 141 | river cut | 15-ft section. Upper 11 ft is fine to very fine sand, overlying 4 ft of interbedded silt-coarse sand; very little clay, if any. |
| 142 | surface exposure | The entire hill is covered with very stony till. |
| 143 | shovel hole | Sandy pebbly-cobbly diamicton, interpreted as till. |
| 144 | shovel holes | Till throughout the area; particularly stony in the valley |
| 145 | surface exposure | Till. Shovel holes were shallow due to abundance of stones or near-surface bedrock. |
| 146 | bedrock | Biotite schist with a mafic dike; poor-quality glacial striae trend 142°. |
| 147 | esker ridge | Low esker ridge, with two grave sites in what appears to be sandy pebble gravel. |
| 148 | old excavation | Sandy pebbly diamicton interpreted as till, exposed around an old foundation. |
| 149 | shovel holes | North of Woods Mill Pond, south of trail; topographic relief is 10-20 ft (less than the contour interval of the map). High areas are bouldery till. No unequivocal indication of sorting or washing on the hills. Till is a sandy diamicton with a silty-sand matrix. Lower, flat areas are poorly-sorted granular sands with no cobbles (maximum pebble size is 2 cm diameter). The sands are faintly bedded. |
| 150 | esker ridge | Shovel hole to depth of 2.5 ft; coarse, poorly-sorted pebble gravel on an esker ridge. Ridge is up to 15 ft high, and 10 ft wide across top. |
| 151 | inactive pit | Abandoned gravel pit in an esker ridge. Sandy cobble gravel; poor exposure. |
| 152 | road cuts | 10-ft high sections through an esker ridge; sandy gravel with cobbles up to 10 cm diameter. |
| 153 | esker ridge | Large esker, 25 ft high ,and 15 ft wide along the top. |
| 154 | shovel holes | Large boulders (> 1 m diameter) on very hummocky till. No sorted sand found in shovel holes. Poorly drained. |
| 155 | esker ridge | Top of esker is flat near the junction with the previously described esker (153). Pebbly sand for 2.5 ft below a thick humus layer. |
| 156 | shovel hole | Compact sand and sandy pebble gravel, oxidized. |
| 157 | surface exposure | This entire hill is comprised of till and colluvium with abundant large (> 1 m) diameter boulders. |
| 158 | esker ridge? | Cobble gravel; poorly exposed along road cut. |
| 159 | surface exposure | Bouldery till. |
| 160 | inactive pits | Small abandoned sand pits expose 4-ft section, with granular and pebbly sand overlying fine to medium sand. |
| 161 | inactive pit | Small sand pit exposing granular sand. |
| 162 | surface exposure | Till with large boulders. |
| 163 | road cut | Very compact, pebbly-sandy, matrix-supported, very poorly-sorted diamicton interpreted as till. The ridge has very few stones on the surface, but it is probably a moraine. |
| 164 | shovel hole | 3-ft deep hole in massive diamicton below 10 in of humus. Boulders up to 70 cm diameter are common. |
| 165 | shovel hole | 30-in deep hole exposes medium sand. |
| 166 | shovel hole | Loose, oxidized, poorly-sorted, pebble-cobble gravel; clast-supported at 2.5 ft depth. The steep bank to the west of this site is a very sharp cut through till, and is probably a glacial meltwater channel. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 167 | shovel hole | 20-in shovel hole in coarse poorly-sorted pebble gravel. This is not an esker ridge. |
| 168 | section | 8 ft-high exposure of poorly-sorted sandy gravel with boulders; interpreted as ice-contact deposit. |
| 169 | shovel hole | 3-ft hole exposes poorly-sorted pebble-boulder gravel. |
| 170 | shovel holes | Unsuccessfully attempted to dig deeper than 2 ft, but there appear to be large boulders beneath the hummocky surface; deposit interpreted as till. |
| 171 | esker ridge | Clast-supported cobble gravel in 2-ft deep hole. Clasts average 10 cm. |
| 172 | inactive pit | Abandoned pit in a very narrow-crested esker. Sandy cobble gravel. Ridge height up to 15 ft; width only 5 ft along crest in many places. Ridge trends ~ 160°. |
| 173 | shovel holes | Near cemetery; very poorly-sorted gravel or diamicton on top of sand. 2 ft to bedrock. Upper "gravel" may be till because it contains subangular to subrounded clasts. |
| 174 | esker ridge | Large boulders on top and sides of this ridge. Pulled up angular and rounded clasts in a shovel hole. Sandy cobble gravel. |
| 175 | shovel hole | Sandy diamicton with large cobbles and some boulders. Till. |
| 176 | inactive pits | Five abandoned pits expose cobble gravel in an esker ridge. |
| 177 | shovel hole | fine to medium sand with a few boulders. |
| 178 | surface exposure | Till with abundant large boulders. Bedrock is shallow but not exposed on the surface. |
| 179 | inactive pit | Small abandoned pit and shovel holes (2 ft deep) in what appears to be an esker ridge, exposing very loose, sandy pebble gravel. |
| 180 | road cut | 4 ft section exposes cobble gravel. |
| 181 | traverse | Traverse from (001) to (021). Pebble gravel to 3 ft depth. In surrounding areas there is till with large (> 1 m diameter) boulders, and low poorly-drained areas (small marshes). Nearby, an esker ridge trends 250° but is very low (< 10 ft high). There are no boulders but lots of cobbles (10-15 cm diameter) on the esker ridge. |
| 182 | shovel hole | 3-ft hole showing fine to medium sand; pebble gravel nearby. |
| 183 | road cut | Cobble to boulder gravel. |
| 184 | auger hole | Boulder gravel. |
| 185 | auger hole | Cobble gravel. |
| 186 | auger hole | Near Sand Pond. Cobble gravel |
| 187 | auger hole | Near Sand Pond. Boulder gravel. |
| 188 | auger hole | Boulder gravel. |
| 189 | auger hole | Cobble gravel. |
| 190 | auger hole | Cobble gravel. |
| 191 | auger hole | Cobble gravel. |
| 192 | auger hole | Boulder gravel. |
| 193 | auger hole | Till. |
| 194 | auger hole | Till. |
| 195 | auger hole | Till. |
| 196 | auger hole | Sand. |

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 197 | auger hole | Pebbly sand. |
| 198 | auger hole | Near Adams Pond; till. |
| 199 | auger hole | Near Adams Pond; sand. |
| 200 | dug well† | Depth to bedrock > 14 ft. |
| 201 | dug well† | Depth to bedrock > 12 ft. |
| 202 | drilled well† | Gravel; depth to bedrock > 163 feet. |
| 203 | drilled well† | Series of four drilled wells; 80-125 ft to bedrock, but till encountered at 28-30 ft below ground surface. Presumably in sand and gravel for the uppermost 28 ft. |
| 204 | drilled well† | Depth to bedrock > 93 ft; upper 45 ft all sand; sand and gravel below 48 ft. |
| 205 | dug well† | Clay at 14 ft below ground surface. |
| 206 | seismic data† | West end of 12-channel seismic line; 73 ft to bedrock. |
| 207 | seismic data† | East end of 12-channel seismic line; 63 ft to bedrock. |
| 208 | drilled well† | 35 ft to bedrock. |
| 209 | dug well† | Depth to bedrock > 5 ft. |
| 210 | drilled well† | 90 ft to bedrock. |
| 211 | dug well† | Depth to bedrock > 20 ft. |
| 212 | dug well† | Depth to bedrock > 8 ft. |
| 213 | seismic data† | West end of 12-channel seismic line; 60 ft to bedrock. |
| 214 | seismic data† | East end of 12-channel seismic line; 75 ft to bedrock. |
| 215 | seismic data† | West end of 12-channel seismic line; 87 ft to bedrock. |
| 216 | seismic data† | East end of 12-channel seismic line; 109 ft to bedrock. |
| 217 | dug well† | Depth to bedrock > 11 ft. |
| 218 | drilled well† | Depth to bedrock > 39 ft; all gravel. |
| 219 | drilled well† | 100 ft to bedrock. |
| 220 | drilled well† | 60 ft to bedrock. |
| 221 | drilled well† | 52 ft to bedrock. |
| 222 | dug well† | Depth to bedrock > 22 ft. |
| 223 | seismic data† | West end of 1-channel seismic line; 33 ft to bedrock. |
| 224 | seismic data† | East end of 1-channel seismic line; 31 ft to bedrock. |
| 225 | drilled well† | 22 ft to bedrock. |
| 226 | drilled well† | 12 ft to bedrock. |
| 227 | driven point† | Depth to bedrock > 18 ft; gravel overlies clay. |
| 228 | driven point† | Depth to bedrock > 25 ft; through sand and/or gravel. |
| 229 | dug well† | 12 ft to bedrock. |
| 230 | driven point† | Depth to bedrock > 25 ft. |

† Williams and Lanctot, 1987

| ID# | TYPE | DESCRIPTION |
|---|---|---|
| 231 | resident | Resident reports that an artesian well went down 210 ft without hitting bedrock. |
| 232 | auger hole | Till. |
| 233 | auger hole | Pebbly sand. |
| 234 | auger hole | Sand. |
| 235 | auger hole | Cobble gravel. |
| 236 | auger hole | Pebble gravel. |
| 237 | auger hole | Cobble gravel. |
| 238 | auger hole | 4 ft of cobbly sand over pebble gravel. |
| 239 | surface exposure | Saco River stream terrace sediment. |
| 240 | auger hole | Sand. |
| 241 | auger hole | Till. |
| 242 | auger hole | Fine sand. |
| 243 | auger hole | Silt. |
| 244 | auger hole | Sand. |
| 245 | auger hole | Fine sand. |
| 246 | section | 10 ft of cobble gravel over till. |
| 247 | auger hole | Sand. |
| 248 | auger hole | Till. |
| 249 | surface exposure | Stream terrace. |
| 250 | auger hole | 4 ft of very fine sand. |
| 251 | auger hole | Pebbly sand. |
| 252 | auger hole | Cobble gravel. |
| 253 | auger hole | Cobble gravel. |
| 254 | auger hole | Boulder gravel. |
| 256 | shovel hole | 30 in of sandy cobble gravel with no big boulders. Not an esker. |
| 257 | inactive pits | Two abandoned pits along roadside; section up to 15 ft high, exposing coarse gravel (some bouldery) with sand. Definite coarsening northward. |
| 258 | active pit | Till occurs between Dyke Mountain and Decker Mountain. Also, large active pit exposes 15 ft sections showing boulders (> 1 m diameter, but average 50 cm) in predominantly cobble gravel to fine sand. Very poorly sorted overall, but some areas have clast-supported zones that appear more sorted and give a stratified appearance. About 60% of the clasts are rounded but many are very angular. Sediment is loose and generally poorly bedded. Interpreted to be ice-contact stratified drift, however bedding is rarely > 3 m laterally extensive. 95% of clasts are granites and pegmatites. |
| 259 | shovel hole | 30 in of sandy till on Robinson Hill. |

## APPENDIX B

### Glossary of terms used but not defined within the text.

**Clast:** pebble-, cobble-, or boulder-size fragment of rock or other material in a finer-grained matrix.

**Clast-supported:** refers to sediment that consists mostly or entirely of a clast component, generally with more than 40% clasts. Usually the clasts are in contact with each other. For example, a well-sorted cobble gravel.

**Delta:** a body of sand and gravel deposited where a stream enters a lake or ocean and drops its sediment load. Usually consists of two parts: (1) coarse, horizontal, often gravelly **topset beds** deposited in stream channels on the flat delta top, and (2) underlying, finer-grained, inclined **foreset beds** deposited on the advancing delta front.

**Diamicton:** any poorly-sorted sediment, containing a wide range of particle sizes.

**Englacial:** Occurring or formed within glacial ice.

**Esker:** A ridge of sand and gravel deposited by meltwater streams in a tunnel within or beneath glacial ice.

**Fluvial:** Formed by running water, for example by meltwater streams discharging from a glacier.

**Glaciolacustrine:** refers to sediments or processes involving a lake which received meltwater from glacial ice.

**Glaciomarine:** refers to sediments and processes related to the environment where marine water and glacial ice are in contact.

**Holocene:** term for the time period from 10,000 years ago to the present. It is often used synonymously with "postglacial" because most of New England has been free of glacial ice since that time.

**Late glacial:** refers to the time when the most recent glacial ice sheet was receding from Maine, approximately 15,000-10,000 years ago.

**Late Wisconsinan:** the most recent part of Pleistocene time, during which the latest continental sheet covered all or portions of New England (approx. 25,000-10,000 years ago).

**Lodgement till:** very dense variety of till, deposited beneath flowing glacial ice. May be known locally as "hardpan."

**Matrix:** the fine-grained material, generally silt and sand, which comprise the bulk of many sediments and may contain clasts (q.v.).

**Matrix-supported:** refers to any sediment that consists mostly or entirely of a fine component such as silt or sand. Generally contains less than 20-30% **clasts**, which are not in contact with one another. For example, a fine sand with scattered pebbles.

**Pleistocene:** term for the time period between 2-3 million years ago and 10,000 years ago during which there were glaciations. Also called the "Ice Age."

**Proglacial:** Occurring or formed in front of a glacier.

**Quaternary:** term for the era between 2-3 million years ago and the present. Includes both the Pleistocene and Holocene.

**Stria(e):** narrow scratch(es) on bedrock or stones, produced by the abrasive action of debris-laden glacial ice.

**Subaqueous fan:** a somewhat fan-shaped deposit of sand and gravel that was formed by meltwater streams entering a lake or ocean at the margin of a glacier. Similar to a delta, but was not built up to the water surface.

**Subglacial:** Occurring or formed beneath a glacier.

**Till:** a heterogeneous, usually non-stratified sediment deposited directly from glacial ice. Particle size may range from clay through silt, sand, and gravel to large boulders.

**Topset/foreset contact:** the more-or-less horizontal boundary between topset and foreset beds in a **delta**. This boundary closely approximates the water level of the lake or ocean into which the delta was built.