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Surficial Geology of the West Newfield 7.5-minute Quadrangle, York County, Maine

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INTRODUCTION

The West Newfield 7.5' quadrangle lies on the Maine-New Hampshire border approximately 50 miles west of Portland. The area is predominantly rural in character with only a few very small villages such as West Newfield and Parsonsfield.

Surficial mapping was conducted during the summers of 1991 through 1994 as part of the COGEOMAP program of the Maine Geological Survey and the U.S. Geological Survey. Both surficial geologic and materials maps (Newton, 1997, 1998) have been prepared at a scale of 1:24,000 using the 1983 USGS Provisional Edition of the West Newfield quadrangle as a base map. Unfortunately, the contour lines on this map fail to adequately show a lot of the fine details of the topography. For example, a major esker system which shows clearly on the Newfield 15' topographic map is not shown at all on the newer 7.5' quadrangle covering the same area.

This report describes mapping units and details the glacial and postglacial history of the area. Previous work in the quadrangle was done by Stone (1899) and Smith (1977).

PHYSIOGRAPHY

The landscape in the quadrangle can be characterized as rolling hills with as much as 800 ft of relief. The area lies along the NE-SW trending divide between the Ossipee and Little Ossipee Rivers. The South River in the northwest corner of the map flows from Province Lake northward toward the Ossipee River, while southeast of the divide a series of parallel streams (Pendexter Brook, Chellis Brook, Moulton Brook, and Branch Brook) flow towards the Little Ossipee River. Most of the stream valleys have a strong NW- SE orientation and tend to have relatively broad flat bottoms which are commonly occupied by numerous wetlands. Many of the valleys appear to continue across the drainage divide thus forming poorly-defined through valleys mainly oriented along the NW-SE trend.

The lowest elevation is in the northwest corner of the map where the South River exits the quadrangle at an elevation of 420 ft. The highest elevation is the summit of Wiggin Mountain, located in the center of the quadrangle at an elevation of 1,298 ft.

There are a number of lakes and ponds throughout the area. The largest of these is Province Lake which lies mainly in New Hampshire. Many of the lakes and ponds are influenced by small dams. Belleau Lake, also located in New Hampshire, was formed in large part by the flooding of a number of small kettle-hole ponds when a small dam was constructed in the 1960's. In some cases lakes created by dams have returned to their original wetland condition due to the failure of the dams. This appears to be the case for a lake shown on some of the older maps in the northwest corner of the quadrangle where there is a wetland today.

BEDROCK GEOLOGY

Gilman (1991) mapped the bedrock geology of the Newfield 15' quadrangle. Most of the quadrangle is underlain by igneous and metamorphic rocks of Silurian and Devonian age. Granitic rocks of the New Hampshire plutonic series (Devonian to Carboniferous) outcrop in the north, west, and central parts of the quadrangle, while Silurian-age Rindgemere Formation outcrops over much of the remaining area. Bands of rusty-weathering sulfidic schist of the lower member of the Rindgemere Formation outcrop in the northeast corner of the quadrangle. This unit also includes lime-silicate granulite. In general, outcrops of the Rindgemere Formation are moderate to highly weathered.

The granitic rocks are part of the Effingham pluton that extends across the border into New Hampshire as far west as the Ossipee Mountains. This is predominantly a light gray binary

granite which averages 30% quartz, 45% K-feldspar, 15% plagioclase, 10% mica, and 3% accessory minerals (Gilman, 1991).

SURFICIAL GEOLOGY

Till

Till (map unit Pt) is unsorted and generally unstratified sediment deposited directly by the glacial ice. It mantles much of the bedrock surface except at higher elevations and on steeper slopes where bedrock is exposed at the land surface. In the West Newfield quadrangle, till is exposed at the surface over more than 50% of the area. In addition, a thin layer of till is found frequently between glacial-fluvial sand and gravel deposits and bedrock.

Till can be deposited in a number of different ways and may have a wide range of characteristics. Lodgement till is deposited directly beneath actively moving ice and therefore tends to be compact, with a relatively high concentration of silt and clay (up to 50%). Ablation till accumulates on the surface of melting ice and is eventually deposited as the ice melts. Washing out of silt and clay by the action of meltwater causes ablation till to have a much higher sand content than lodgement till. It is also less compact than lodgement till.

Thick deposits of till can occur on the lower hillside slopes, or as streamlined hills (drumlins). The long axis of a drumlin is oriented parallel to the direction of glacial ice flow. A small drumlin in the southwest corner of the map has a NW-SE orientation which is parallel to striations (S 30°E) just west of Wiggin Mountain.

Thick till can also accumulate at a stable, active ice margin to produce moraines. In general, moraines are uncommon in areas inland from the late-glacial marine limit in Maine, where the glacier tended to undergo stagnation zone retreat (Koteff and Pessl, 1981). However, a series of short thick till ridges covered with large boulders occur just west of Dearborn Mountain in the northeast corner of the quadrangle. These features are mapped as morainal ridges (Pem) as they appear to have formed at the end of a tongue of ice extending up the small, northwest trending valley.

Glacial-Fluvial Deposits

These deposits are sorted sands and gravels deposited by glacial meltwater streams. They are stratified and commonly have cross-bedding suggestive of braided stream deposition. They can be deposited in a variety of topographic forms depending on the position of the meltwater stream relative to the ice.

Ice-Contact Deposits (Pgi). These are sediments deposited by meltwater streams in intimate association with ice. The material generally has a wide range in grain-size and sorting characteristics. It is usually stratified, but the stratification is commonly disrupted by high-angle normal faults which formed during the melting of ice either adjacent to or under the deposit.

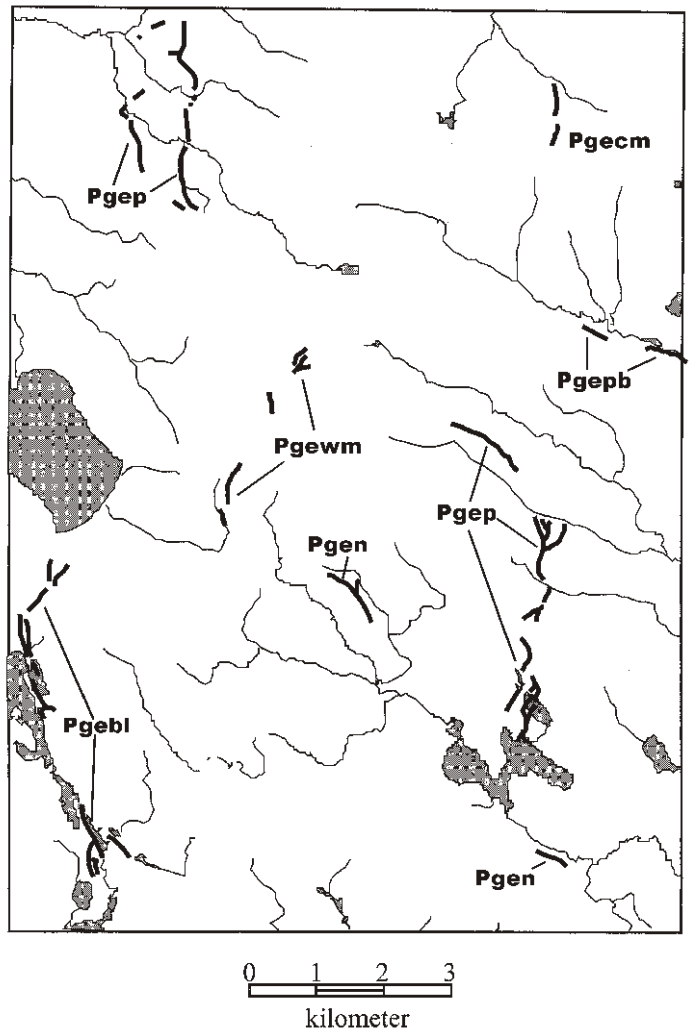

Figure 1. Map of esker systems in the West Newfield quadrangle. Pgecm - Cedar Mountain system; Pgepb - Pendexter Brook system; Pgep - Parsonsfield system; Pgewm - Wiggin Mountain system; Pgen - Newfield system; Pgebl - Belleau Lake system.

These features occur as isolated deposits generally on the sides of hills or valleys.

Eskers (Pge series). Eskers are sinuous ridges of sand and gravel formed by meltwater streams flowing within or under glacial ice. Eskers in the West Newfield quadrangle are up to 60 ft high and 4000 ft in length and most are less than 200 ft wide. They exhibit both meandering and braided channel patterns. In many areas there is clear evidence that the eskers were deposited by meltwater streams flowing up and over bedrock ridges. This suggests that in these systems the flow was hydrostatically controlled.

The eskers in the West Newfield quadrangle have been divided into a series of discontinuous systems which are thought to have been deposited within part of a single glacial drainage network. The largest is the Parsonsfield system (Pgep, Figure 1)

which includes segments which run from the northwest to the southeast corners of the map. Meltwater in this system traveled up and over at least two divides, both at elevations of approximately 650 ft. Meltwater in the system generally moved parallel to the NW - SE trend of the valleys, but occasionally sidestepped over the divide to the next valley to the south. This behavior suggests that the meltwater was flowing within a confined hydrologic tunnel system.

Glacial-Fluvial Sand and Gravel Deposits (Pg series). These are sediments deposited by glacial meltwater streams as they flowed across relatively ice-free areas or areas covered by moderate amounts of stagnant ice. The material typically ranges from moderately well-sorted to poorly-sorted coarse sand and gravel. The deposits commonly lie within the confines of modern underfit stream valleys and morphologically appear either as flat to gently undulating surfaces of low relief or kettle and kame areas having up to 50 ft of relief. The Pendexter Brook deposits (Pgp) in Parsonsfield are typical of the low-relief surface. They extend from the head of outwash just west of the village of Parsonsfield eastward into the Limerick quadrangle. These sediments were deposited in the lower part of a glacial-fluvial meltwater system which extended west of the current headwater divide of Pendexter Brook. Thus the meltwater stream which formed them had a much higher discharge and sediment load than the modern Pendexter Brook. Sediments exposed in these deposits include poorly sorted coarse cobble gravels. The lack of kettles and kames in this map unit suggests the area was essentially ice free when these sediments were deposited.

The Balch Pond system (Pgbp) is typical of a kame-and-kettle meltwater deposit. This system originates in part from a head of outwash just south of Province Lake. The Pgbp deposits form an irregular surface surrounding deeper kettle-hole lakes (Belleau Lake) and eskers of the Belleau Lake system (Pgebl). Surface elevations range from 680 ft at the head of outwash to 560 ft where the deposits enter the Great East Lake quadrangle. Unlike the Pendexter Brook system, these sediments were deposited in and around stagnant ice filling the valley. This landscape shows the effect of large amounts of glacial meltwater and sediment which flowed through this area, fed in part by the Pine River esker system to the west.

Glacial Lacustrine Deposits

Glacial lacustrine deposits include both deltas (Pld) and lake bottom sediments (Plb). The deltas formed where streams entered a lake and deposition occurred in response to a decrease in stream velocity. These deposits include relatively coarse sand and gravel in horizontally stratified topset beds, which overlie sandy foreset beds that were deposited on the delta front. The foreset bed deposits are generally much thicker than the topset deposits. The contact between the topset and foreset beds lies approximately at the former lake level. Geomorphically, the deltas are flat-topped features except where they have undergone collapse near the ice front or have been extensively dissected by postglacial drainage. Lake bottom deposits in this area are generally fine, laminated, sand and silt. No varved clay was observed within the study area.

Deposits associated with five glacial lakes have been identified in the West Newfield quadrangle. A delta (unit $Plmd_3$) deposited mainly in the Little Ossipee River basin occurs in the extreme southeast corner of the map at an elevation of 520 ft. This unit was defined by Boothroyd (1997a,b) as having been deposited in the third (and lowest) stage of glacial Lake Mousam in the Great East Lake quadrangle, and the same unit was mapped over a large area in the adjacent Mousam Lake quadrangle by Meglioli (1997a,b). These $Plmd_3$ deposits are inferred to correlate with the Lake Mousam deltas identified by Wilch (1999a,b) in the adjacent Limerick quadrangle at approximately 500 ft.

Immediately north of the $Plmd_3$ deposits are a series of deltas at elevations ranging from 460 to 480 ft. A pit in one of these deltas on the north shore of Rock Haven Lake exposes approximately 3 ft of topset gravels overlying 15 ft of medium sand. This indicates a lake at a lower elevation (460 ft) than the $Plmd_3$ deposits, which is here defined as Glacial Lake Newfield (Plnd and Plnb). Fine sands deposited northeast of Rock Haven Lake are lake-bottom deposits. Lake Newfield was probably dammed by $Plmd_3$ deltas that formed at an ice-margin position. Lake Newfield formed as the ice retreated from this position.

Two glacial lakes occupied the northwest corner of the map. The largest is here defined as Glacial Lake Effingham (Pled and Pleb). This lake occupied much of the lowland area north and east of what is now Province Lake and extended across the state line into New Hampshire. A pit just north of Route 153, just across the New Hampshire state line, exposes delta sands at an elevation of approximately 520 ft. The lake appears to have extended southeast to the drainage divide between Province Lake and Rock Haven Lake where it was dammed by glacial-fluvial deposits (Pgrh) and till (Pt). A higher lake, here defined as Glacial Lake Champion (Plchd) lies within the Emerson Brook drainage north of Province Lake. This lake developed as the ice retreated from an ice-marginal position just west of Parsonfield. Two lake levels have been identified with separate spillways, one at 620 ft and the other at 560 ft. Lake Champion eventually lowered and merged with Lake Effingham.

The last glacial lake was located in a north-flowing stream valley just north of Cedar Mountain. This lake extended from the meltwater channel just east of Cedar Mountain northward off the north end of the quadrangle and is here defined as Glacial Lake Cedar Mountain (Plcmd).

Holocene Deposits

Alluvium (Ha). Alluvium is sediment deposited by modern streams. It is composed mostly of sand and silt although coarser gravels can occur on steeper slopes.

Fresh Water Wetlands (Hw). Fresh water wetlands are areas where thick organic deposits accumulate due to high water table conditions. These areas can occur in areas underlain by either till or stratified drift. Some of the wetlands occur in kettle holes in stratified drift which have become mostly filled with bog type vegetation. In some instances these bogs are underlain by significant thickness of peat. Wetlands underlain by till generally have much thinner accumulations of organic sediments.

Province Mountain Landslide (Hsd). A large fan of landslide debris lies just north of Province Mountain. This material was generated from a landslide which occurred on the north side of the mountain in postglacial time. The debris has been partially reworked by stream processes, but is essentially a poorly sorted mass of boulders, cobbles, gravel, sand, and silt. A horseshoe shaped scarp marks the upper limit of the source area for the slide, which apparently originated from an area of thick till deposits. The relatively steep slope probably coupled with a high moisture content of the soil during an unusually rainy period led to the slope failure.

GLACIAL AND POSTGLACIAL GEOLOGIC HISTORY

Although this area of Maine has undoubtedly been subjected to multiple advances and retreats of glaciers throughout the Pleistocene Epoch (1.7 million to 10,000 yr B.P. - years before present), most of the landforms we see today were created during the last glacial event (late Wisconsinan glaciation). During this period the Laurentide Ice Sheet advanced over the entire area reaching offshore all the way to the break in slope at the continental shelf (Thompson and Borns, 1985a, 1985b).

Regional ice flow was to the southeast (Thompson and Borns, 1985a). This agrees with the orientation of drumlins and striae measured in the West Newfield quadrangle. Many of the larger stream valleys (Pendexter Brook, Chellis Brook) are also oriented parallel to the ice flow direction and have been modified by glacial erosion. This is evidenced by the cutting of these valleys across drainage divides. For example, the valley of Chellis Brook draining southeast extends across the divide into the valley of Emerson Brook draining northwest. Similarly the valley extending across the divide between Province Lake and Rock Haven Lake is oriented parallel to the regional ice flow direction.

Retreat of the ice margin began approximately 17,000 yr B.P. (Thompson and Borns, 1985b) and the ice front had retreated to the present coast by approximately 14,000 yr B.P. (Smith, 1985). Initially the ice front terminated in the late-glacial sea which transgressed the coastal lowland as the ice retreated due to isostatic depression of the land surface (Koteff and others, 1993). By the time the ice front retreated into the adjoining Limerick quadrangle, it was no longer in contact with the sea (Wilch, 1999a,b). There is no evidence of marine sediments in the West Newfield quadrangle.

The oldest materials in the area are till deposits associated with the last Wisconsinan glaciation. These deposits were formed by both lodgement and ablation processes with the lodgement till probably being older than the ablation till, although all till units are probably time-transgressive.

Glacial fluvial deposits were formed in association with the retreat of an ice margin characterized by the presence of a narrow stagnant ice zone. Glacial fluvial deposition in this zone resulted in the formation of fluvial and lacustrine morphosequences as defined by Koteff and Pessl (1981). In this style of glacial retreat, ice-marginal positions are marked by heads of outwash characterized by ice-contact deposits. Eskers were deposited upstream from the head of outwash by meltwater streams flowing in tunnels under the ice.

Esker Systems. The eskers in the West Newfield quadrangle have been classified on the surficial geologic map according to their location within a drainage system. However, as Figure 1 shows, the eskers together form a coherent rectangular drainage pattern. It is interesting to note that they do not continuously follow the valley bottoms but frequently make abrupt southerly shifts up and over a ridge to an adjacent valley. The Parsonsfield esker system (Pgep), for example, runs from the northwest to the southeast corners of the map. Meltwater in this system appears to have flowed southeast under hydrostatic pressure in the valley of Emerson Brook, then up and over the divide just south of Champion Pond. From this point, the subglacial stream flowed downhill to the southeast, parallel to Chellis Brook, until it reached the area just east of Maplewood. Here it climbed up out of the Moulton Brook valley, over a ridge, and into the area of Rock Haven Lake where it merged with the Newfield esker system (Pgen). It is unclear why the meltwater system would apparently climb out of a valley trending parallel to the general direction of ice flow, but it appears to happen elsewhere in the quadrangle. Just north of Wiggin Mountain in the central part of the quadrangle the Wiggin Mountain esker system (Pgewm) appears to have been formed by meltwater streams flowing westward up and over a small saddle in the ridge. This system occurs at an elevation considerably higher (800-950 ft) than the Parsonsfield system (600-650 ft) and therefore probably formed earlier. The Cedar Mountain esker system (Pgecm) also appears to be hydrostatically controlled, flowing up and through an erosional meltwater channel just west of Dearborn Mountain in the northeast corner of the map. Although no esker segments were mapped south of the gap, Stone (1899) reported reticulated gravel ridges in what appears to be this area.

One possible explanation is that the meltwater streams which formed these eskers were initially flowing in englacial tunnels oriented along fractures in the ice. The meltwater streams eroded downward through the ice and became draped over the underlying terrain. The meltwaters could continue to flow through the systems even in an uphill direction as they were hydrostatically controlled and acted like siphons pulling meltwater up and over the intervening ridges. However they formed,

the eskers in the West Newfield quadrangle appear to be part of a larger system that extends through the adjacent quadrangles

Deposits in Branch Brook Area (Plmd$_3$). As the ice retreated from the Great East Lake quadrangle to the south, sediments associated with a glacial lake in the North Shapleigh area were deposited at the southern edge of the West Newfield quadrangle. A head of outwash marks an ice margin position near where Branch Brook exits the quadrangle. These deposits are part of a delta complex that filled a glacial lake that extended into adjacent quadrangles. They correlate with the Plmd$_3$ unit of Boothroyd (1997a,b) and Meglioli (1997a,b), and with the Plmd/Plmdi units of Wilch (1999a,b). The Plmd$_3$ deposits completely blocked the Branch Brook drainage, damming a glacial lake here referred to as Glacial Lake Newfield, in the Rock Haven Lake area.

Lake Newfield Stage (Plnd, Plnb). The level of Lake Newfield (460 ft) is defined by a foreset/topset contact exposed in a gravel pit just north of Rock Haven Lake. This lake progressively developed as the ice front retreated from the head of outwash associated with unit Plmd$_3$, producing a series of deltas extending northwestward up the valley towards Province Lake. This lake was probably short-lived as the glacial-fluvial deposits making up the dam were fairly easily eroded.

Lake Effingham Stage (Pled, Pleb). An erosional meltwater channel cut through glacial-fluvial deposits at the modern divide between Province Lake and Rock Haven Lake marks the spillway for Glacial Lake Effingham which occupied the Province Lake area. Province Lake currently drains northward via the South River to the Ossipee River. During deglaciation this drainage was blocked by ice creating Lake Effingham at an elevation of approximately 520 ft. Progressive retreat of the ice northward allowed deposition of a series of deltas and lake bottom sediments (map units Pled and Pleb).

Lake Champion Stage (Plchd$_{1-2}$). Lake Champion was formed as the ice retreated from the head of outwash located just west of the village of Parsonsfield. Initially meltwaters flowed eastward forming the Pendexter Brook glacial-fluvial sequence (Pgp) and Lake Champion deltas at 620 ft (Plchd$_1$). As the lake expanded northwestward, a lower outlet was uncovered and a spillway formed at 570 ft. This spillway lies within a prominent 40 - 60 ft deep meltwater channel which cut through a till ridge and drained southwestward into Lake Effingham. This indicates that the ice front had retreated northward at this time, not northwestward parallel to the orientation of the stream valleys. This may simply be a local phenomenon due to stagnation of ice in the lee of Green Mountain which lies just northwest of the quadrangle in New Hampshire. With subsequent retreat of the ice front, Lake Champion merged with Lake Effingham and Lake Effingham was maintained until, or soon after, the ice front retreated north of the quadrangle boundary. It is possible that deposits in the Kezar Falls quadrangle may have maintained the lake for a while before erosion of the spillway drained the lake.

Cedar Mountain Stage (Plcmd). Numerous meltwater channels near Cedar Mountain in the northern part of the quadrangle suggest that ice still occupied this area while the area to the south was ice free. There are also two ridges of boulder-covered till which morphologically appear to be moraines and suggest an active ice margin in this area. This is not totally unexpected as the lowlands of the Ossipee River to the north could have sustained active ice as opposed to a stagnation zone. Stagnation zones are most likely created by the emergence of ridges as the ice thins. Since regional topography generally descends in elevation to the north, there is nothing to block the ice flow to create a stagnant zone. Small lakes appear to have formed in northward-flowing valleys as the ice retreated (Plcmd).

Postglacial History. During postglacial times, modern streams cut valleys and formed floodplains modifying the glacial topography. At some time during this postglacial period a large landslide occurred on the north slope of Province Mountain just south of Province Lake. Materials from this landslide (Hsd) form a large fan-shaped feature at the base of the hill. This deposit has been developed as a recreational community. Although no evidence was found indicating instability of these slopes, future development in this area is unwise.

ENVIRONMENTAL AND ECONOMIC GEOLOGY

Surface Water Alkalinity

The chemistry of surface waters is in large part a function of watershed geology. Generally, bedrock units containing highly weatherable minerals such as calcite produce alkaline surface waters, while granitic rocks composed of less weatherable quartz and feldspar result in waters with low alkalinity. However, it has also been found that surface waters may have relatively high alkalinity in granitic terrains when the bedrock is overlain by thick surficial deposits such as till or stratified drift. The thicker deposits provide a large ground-water reservoir which fills during precipitation and snowmelt events. The slow draining of this reservoir into rivers and streams during dry periods allows them to maintain relatively high baseflows. The long residence time of water in the ground-water system allows time for chemical reactions to occur with minerals such as feldspar to raise the alkalinity of the water before it reaches the surface water.

Samples were collected from streams and lakes throughout the West Newfield area. All samples were analyzed for alkalinity (acid neutralizing capacity) within 1 week of sample collection using the Gran (1952) titration. Results are shown in Table 1 and show alkalinities ranging from 88 - 224 eq/L.

Alkalinity is a measure of a water's ability to resist acidification from acidic deposition. Kahl and others (1991) report that fewer than 2 % of Maine lakes are acidic due to high base-cation release rates which cause relatively high alkalinity. Alkalinity values in Table 1 indicate that most of the surface waters in this area are only moderately susceptible to acidification. This is due to two factors. First, much of the area is underlain by the Rindgemere Formation which, although it contains some pyrite which is

TABLE 1: SURFACE WATER ALKALINITY

Sample #	Sample	Date	Acid Neutralizing Capacity
100	Moulton Brook	10/24/91	184 eq/L
101	Emerson Brook	9/21/91	146
102	Champion Pond	9/25/91	151
104	swamp pond	10/23/91	176
105	Dearborn Mtn Strm	10/23/91	224
107	Benson Brook	10/24/91	201
109	Pendexter Brook	10/24/91	216
110	Symmes Pond	10/24/91	153
111	Rock Haven Lake	10/23/91	161
112	Randall Lake	10/24/91	145
113	beaver pond	10/25/91	133
114	pond NW of Cedar Mtn	10/23/91	88

Acid Neutralizing Capacity (ANC) determined by Gran titration

a potential source of acid, has more carbonate minerals which weather rapidly to produce high alkalinity. Second, in areas underlain by granite, the surficial sediments are quite thick. This allows precipitated water to infiltrate into the surficial sediments and move relatively slowly through a ground-water system where reactions with feldspar minerals results in acid neutralization.

Ground-water Resources

Usable quantities of ground water can occur within both surficial sediments and bedrock. In the West Newfield quadrangle, the glacial-fluvial and glacial lacustrine delta units are likely to be the most significant aquifers as these materials are well-sorted, relatively coarse-grained and tend to occur as relatively thick deposits. Till deposits can potentially provide enough water for a single family dwelling if the till deposit is relatively thick and sandy. However, water levels in till wells tend to fluctuate greatly, and they can run dry during the summer as the till has a lower specific yield than the sand and gravel deposits.

The yield of bedrock wells varies greatly as this water comes principally from fractures within the rock. In the West Newfield quadrangle, the Rindgemere Formation is likely to yield more water than the granites, but ground water from the Rindgemere Formation is likely to have more dissolved solids and may potentially have dissolved Fe and Mn which can cause staining problems.

Potentially high-yielding aquifers exist wherever glacial-fluvial or glacial lacustrine deltas occur. These features may be hydraulically connected to gravel deposits which might be located under the lake-bottom sediments. This situation is fairly common in other parts of New England and can be explained by the following depositional model. A thick ice-contact delta is formed during a pause in the retreat of the glacier ($Plchd_1$ for example). A lake forms as the ice front begins a more rapid phase of retreat. A layer of gravel is deposited at the bottom of the lake by meltwater streams emerging from the ice front. This time-transgressive gravel is overlain by fine-grained bottom sediments as the locus of glacial-fluvial deposition shifts back with the receding ice front. This results in a relatively thin glacial-fluvial gravel layer hydraulically connected to the delta and overlain by lacustrine sediments. The area of the delta deposits represents the recharge area for the gravel aquifer beneath the lacustrine sediments. The lacustrine sediments may act as an aquitard, causing the glacial-fluvial aquifer to become confined.

The suite of glacial lacustrine deposits in the northwest corner of the quadrangle represent one area where this model may apply. The delta deposits of the Lake Champion stage ($Plchd_n$) may represent the recharge area for a confined aquifer extending northwest under the Lake Effingham bottom sediments (Pleb). A seismic refraction line was run in the area to determine the thickness of the lake sediments and possibly determine the presence of gravel under the lake sediments. A Geometrics Nimbus 12-channel signal enhancement seismograph was used in conjunction with a 10-gauge Buffalo gun to acquire seismic signals at 3 m offsets over a 100 m distance. The line was backshot to determine the dip of any interfaces present. Results (Figure 2) were calculated using the Refract program of Burger (1992) and show approximately 16m of low velocity material on top of a high velocity layer. The 263 m/sec and 1,563 m/sec materials are most likely unsaturated and saturated sand, while the 4,115 m/sec layer has a velocity consistent with bedrock. The presence of 16 m of surficial sediment in this area suggests the possible presence of a significant aquifer.

A number of ground-water springs were found just east of the Maine State Line in South Effingham. These springs occur where the contact between the lacustrine sand (Pleb) and till (Pt) rises to within 3-4 m of the surface. Sapping by the springs has created small valleys approximately 3m deep.

Sand and Gravel Resources

Sand and gravel is the principal type of natural aggregate found in Maine. It is used in the construction of roads, bridges, railroads, and almost all commercial and residential buildings. According to Langer and Glanzman (1993), the value of aggregate production in the United States in 1990 amounted to approximately $9.1 billion. This is more than double the value of all precious metal production (gold, silver, platinum). Clearly, sand and gravel is one of the most valuable and important natural resources found in Maine.

The sand and gravel deposits are also important as they often form important aquifers from which we derive our ground-water supplies. The well-sorted and coarse-grained texture of these deposits create large pore spaces which can hold substantial quantities of water. Deposits of sand and gravel on the valley walls often serve as the recharge area for valley bottom aquifers. Thus a clear understanding of the distribution of sand and gravel resources is necessary before informed decisions can be made concerning where mining these deposits is appropriate.

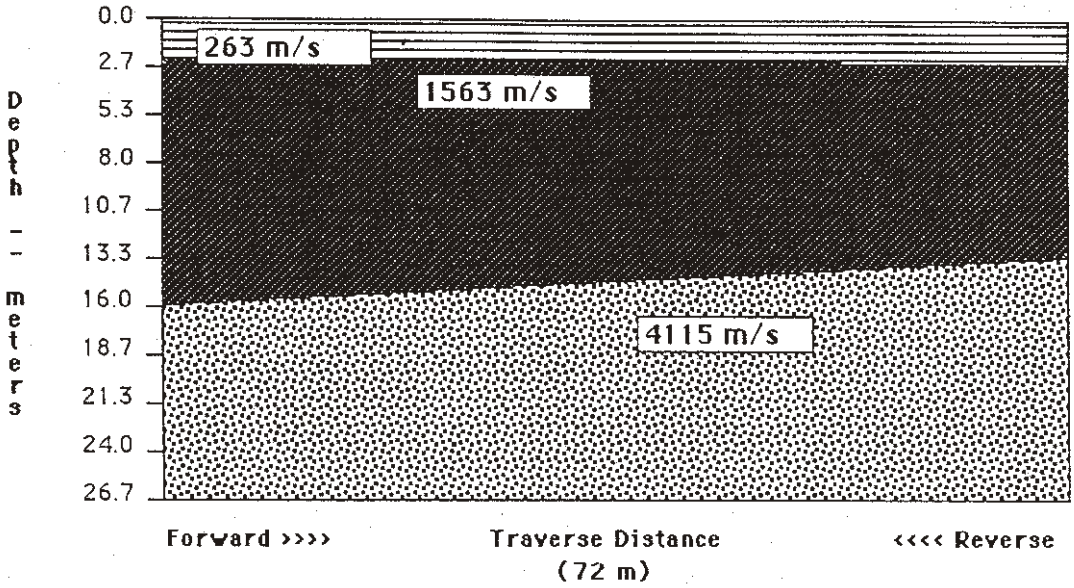

Figure 2. Results of seismic refraction line in glacial lacustrine sands associated with Glacial Lake Effingham. Seismic velocities suggest 16 m of sand overlying bedrock.

The West Newfield quadrangle does not have the extensive sand and gravel deposits which are found in adjoining quadrangles. Much of the deposits are found within the esker systems which cross the area. Some coarse outwash/delta deposits are found in the southeastern corner of the map (south of Rock Haven Lake), but most of the other areas of stratified drift are composed of finer-grained lacustrine sands.

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