Nova Scotia Department of Natural Resourses
Minerals and Energy Branch

OFM 1998-003

SURFICIAL GEOLOGY

SHUBENACADIE AREA

N.S. digital topographic database

(NTS SHEET 11E/03)

Colchester, Halifax, Hants County,
NOVA SCOTIA

R. R. Stea and C.M. Kennedy

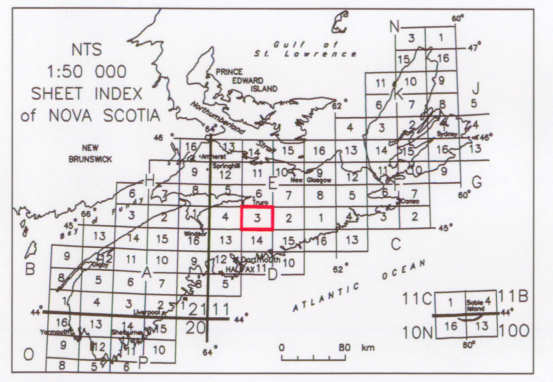
Scale 1 : 50 000

0 2.5 5
kilometres

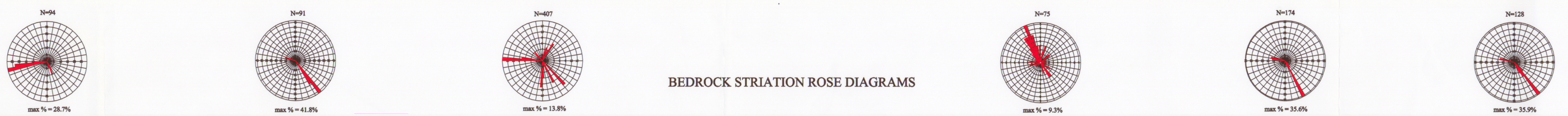
Nova Scotia Department of Natural Resources
Halifax, Nova Scotia
1998

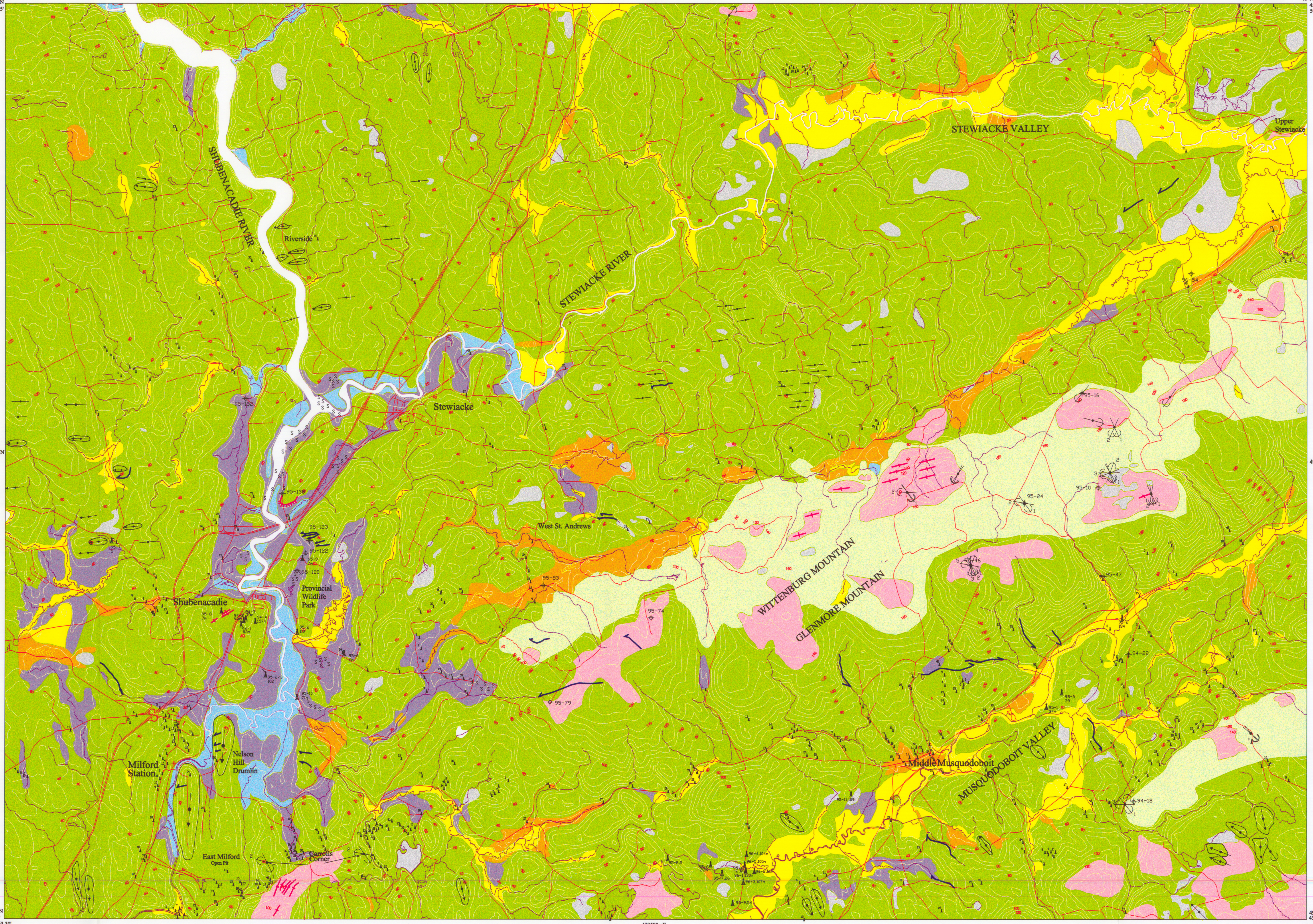
Field work for the Shubenacadie map area was completed during the summers of 1992, 1993 and 1994 by Rudolph Stea, Phillip Finck, Jennifer Shynal and Derek Dwyer.

The 1: 50 000 digital map base (Universal Tranverse Mercator) was obtained from the Nova Scotia Geomatics Centre.



BEDROCK STRIATION ROSE DIAGRAMS





EXPLANATORY NOTES

SURFICIAL LANDFORMS AND DEPOSITS

This open file map depicts the nature, distribution and thickness of surficial (surface-unconsolidated) deposits in the Shubenacadie and Musquodoboit region of central mainland Nova Scotia (NTS 11E/03). Additional sources of surficial geological information for this map come from Hughes (1957), MacNeill (1956), Cann et al. (1954), MacDougall et al. (1963) and Webb et al. (1991). Surficial deposits are linked in a hierarchial classification with their host landforms. The broadest classification of landscapes within this area are the uplands and lowlands, (cf. Goldthwait, 1924) over which the style of surficial landforms and deposits vary markedly. Wittenburg Mountain, a typical upland block is characterized by thin glacial cover, and outcrop of Cambro-Ordovician metasedimentary bedrock. Lowlands such as the Musquodoboit and Stewiacke river valleys are filled with thick glacial deposits (70 m maximum) overlying Carboniferous bedrock and Mesozoic fault-bounded valleys filled with up to 200m of unconsolidated sand-silt and clays (Stea et al., 1992).

Surficial landforms and deposits are classified according to age, origin and lithology. Broad genetic-landforms groupings (eg. glaciofluvial landforms, silty-till plain) are further subdivided into lithostratigraphic units (eg. Hants Till) which describe in detail the nature of the deposits that comprise the glacial landform.

GLACIALLY-SCULPTED ROCK

Rock outcrops are common in upland regions north of the Stewiacke River and on Wittenburg Mountain. These outcrops are often marked by small-scale glacier erosional forms such as striae, grooves and crescentric chatter marks (see Prest, 1983) and display asymmetric profiles, with abraded, gently dipping, stoss sides and steep, unabraded lee slopes. Metawacke outcrops without till cover often display irregular erosional grooves, 0.5 - 3 cm deep, with sharp edges that crosscut glacial striae. These irregular marks disappear quickly under till cover. They often display branching or anastomosing patterns with internal pitting and mamillated surfaces. These are interpreted as tree root casts.

A distinctive feature of glaciated outcrops on Wittenburg Mountain and regions south of the Carboniferous basins are several distinct "sets" of glacial striae. Stop 95-46 reveals five crosscutting sets of striae. Relative ages of each set shown on the map were established based on scouring and stoss/lee relationships.

GROUND MORAINE AND STREAMLINED DRIFT

Sixty-five percent of the Shubenacadie map area is covered by ground moraine, a non-linear, smooth to hummocky glacial drift cover, mostly composed of subglacial lodgement or melt out till (unsorted boulders, sand and mud deposited under a glacier). The ground moraine can be subdivided into two landform types, silty and stony till plains. Streamlined drift is an assemblage of elongate hills, molded by ice erosion, including drumlins.

SILTY TILL PLAIN AND DRUMLINS

The silty till plain is a rolling to flat plain, with mostly thick glacial cover, composed of multiple tills with intervening layers of gravel, sand or mud (glacio-fluvial) or nonglacial organic horizons (Goldthwait, 1989). The plain completely masks underlying Carboniferous bedrock undulations and reaches a maximum thickness of 70 m. The predominant till formations of the silty till plain are the Hants and Milford tills, characterized by a silty-clay matrix. Drumlins are streamlined, elongate hills, molded by ice action, with a steeper, upglacier facing or stoss slope, consisting of layers of glacial till up to 30 m thick. Drumlins over Meguma Group bedrock in the southeastern corner of the map sheet are overlain by the Lawrencetown Till (Stea and Fowler, 1979). Meltwater channels are found on the western side of drumlins in the Shubenacadie area (figure 1).

STONY TILL PLAIN

The stony till plain in the southeastern portion of the map sheet is developed over Cambro-Ordovician Meguma Group metawacke and slate. It is characterized by flat to hummocky terrain, with occasional development of arcuate ridges (ribbed moraine) with a maximum thickness of 20 m. The surface is strewn with boulders 0.5 to 5 m in diameter. The Beaver River Till is the predominant till-formation. Stop 94-22 is a road cut where the Beaver River Till overlies the Hants Till, indicating northward ice flow from the Meguma bedrock source to the south.

GLACIOFLUVIAL AND GLACIOLACUSTRINE LANDFORMS AND DEPOSITS

About 20 percent of the map area is covered by sediments and landforms formed by glacial meltwater (glaciofluvial), and later shaped by glacial lake currents or waves (glaciolacustrine), composed mostly of well-sorted sediments.

KAME FIELDS AND ESKERS

Kames are patches of irregular hummocks and short ridges in any direction, located on valley floors or on the sides of hills (kame terraces). One kame within the large kame and esker complex at St. Andrew's (Stop 95-83) is composed of 3 m of crossbedded bouldery, gravelly-sand overlain by 15 m of ripple-laminated and crossbedded medium to fine sand.

GLACIOLACUSTRINE LANDFORMS AND DEPOSITS

Areas below 30 m (100') in the Shubenacadie Valley are filled with finegrained sediments (mud and sand). These deposits thin over hills below 30 m, and become thicker and coarser (sand and gravels marked by S on map) near the shorelines and meltwater sources (channels, see Stop 95-123). In the southern part of the map area the glaciolacustrine deposits are composed of brown, massive to cryptically-bedded silty-clay. Further north, near presumed ice margins, Stop 95-132 reveals a classic rythmically-laminated (varved) muds with 1 cm thick brown (winter) clays layers and thinner silty (summer) layers. Shorelines of glacial lakes within the Shubenacadie Valley are marked by wave-cut terraces (Stop 95-138), and gravel paleoberms. Two glacial lake phases (Glacial Lake Shubenacadie 1 and 2) are indicated by stratigraphic sections with lacustrine diamictons, clays and sands separated by a soil and peat layer (10.8 -11.4 ka) indicating lake drainage and a period of climatic warming (Stop 95-120; Stea and Mott, 1998).

HOLOCENE LANDFORMS AND DEPOSITS

Fifteen percent of the map area is underlain by Holocene sediments, deposited after the retreat of glaciers and sea-level rise starting 10 000 years ago. These consist of marine estuary, river (alluvial) and organic (bog, fen) deposits. The tidal bore extends well past the village of Shubenacadie and marine estuarine sediments are intercalated with alluvial deposits along the Shubenacadie floodplain and its tributaries.

Alluvial landforms consist of rivers, abandoned channels, oxbow lakes, (developed when river segments are bypassed through bank erosion) and flat floodplains where fine sediment from periodic floods settle out. The floodplain of the Stewiacke River is the largest in the province, developed on a former glacial outwash plain. Stop 96-54 (a borrow pit in the floodplain) reveals coarse glacial outwash (boulder-cobble gravelly sand) overlain by brown silty sand (alluvium). Surficial sediment thickness in parts of the Stewiacke Valley exceed 100 m. Peat bogs, formed primarily of decaying plant material, are best developed over the large floodplain areas at, or near, the water table.

GLACIAL HISTORY

The Shubenacadie map area records a complex history of glacier advances and retreats relating to the formation and reorganization of several maritime ice centres during the last ice age (Wisconsinan 70 ka to 10 ka). The earliest ice flow (Ice Flow Phase 1) was southeastward across the map area (130° and 150°; Stop 95-46). At the East Milford gypsum quarry, organic lake and bog deposits containing spruce, pine and fir logs, shells, amphibian and bird bones, as well as the nearly complete skelton of a mastodon dating to the end of the last interglacial period (Sangamon-125-70 ka) have been found. These interglacial deposits are buried under 20 m+ of till (East Milford Till) formed by Phase 1 ice flow. This was followed by southward (Ice Flow Phase 2 ; 180°-190) flow from an ice centre near Prince Edward Island which molded the large drumlins at Milford Station and formed much of the surface Hants Till. Ice flow (Ice Flow Phase 3) later reversed when a divide formed south of the map area (Scotian Ice Divide), first flowing 20 (Stop 94-18; Stop 95-46) then later rotating to the northwest (Stop 95-46). The final ice flow phase was a southwestward ice flow (Ice Flow Phase 4; Stop 95-16) that moulded drumlins in the Riverside area.

Phase 4 ice retreated eastward across the map area, stagnating largely by downwasting, with an active margin possibly located east of Upper Stewiacke, where gravel-laden meltwater spread outwash into the south branch and main Stewiacke Valleys. Truro, at the head of the Minas Basin, became ice free as early as 12.0 ka (Mott and Stea, 1994), but an ice lobe must still have blocked the lower Shubenacadie River valley sometime before 11.7 ka as basal peat radio-carbon dates at Lantz and Shubenacadie suggest (Stop 95-122). Glaciolacustrine sediments were deposited in a large glacial lake henceforth termed "Glacial Lake Shubenacadie 1" that would have encompassed much of the Shubenacadie Valley below 30 m elevation and formed sometime between 12.5 and 11.7 ka. This lake lasted for a few hundred years (varve counts at Brookfield; V.K. Prest personal communication, 1984) with a southern outlet to the Atlantic through the Lake William, Lake Charles, MicMac Lake system, present site of the Shubenacadie Canal. Once the ice corridor blocking the Shubenacadie outlet was breached, flow through the outlet would have rapidly drained the lake after 11.7 ka. Peat deposits formed on the abandoned lake plain. A lake formed again in the Shubenacadie Valley (Glacial Lake Shubenacadie 2) as the mouth of the Shubenacadie River was blocked by glacier advance ca. 10.8 ka (The Younger Dryas). The extent of this lake is less certain than Glacial Lake Shubenacadie 1. It is interesting to note that meltwater drainage channels (Stop 95-123) are graded to lacustrine sand deposits that overlie peat at the Shubenacadie Wildlife Park (Stea and Mott, 1998).

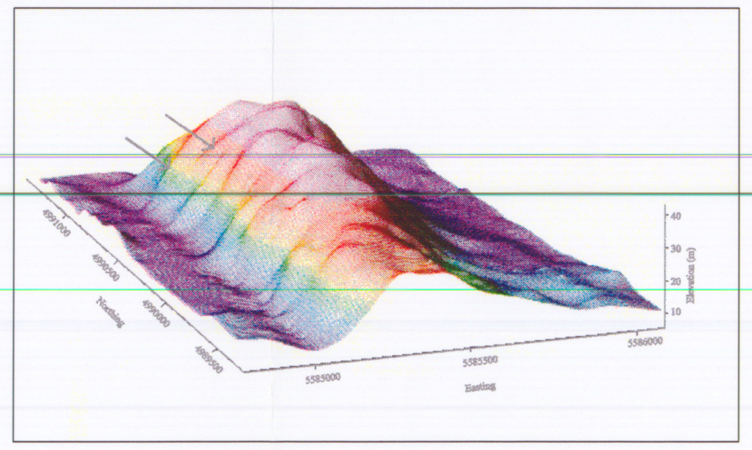


Fig.1: 3-D view of Nelson Hill drumlin, showing west side meltwater channels

LEGEND

SURFICIAL LANDFORMS AND DEPOSITS

QUATERNARY

HOLOCENE LANDFORMS AND DEPOSITS

ORGANIC LANDFORMS AND DEPOSITS: Moss and peat, gyttja (organic clay), inorganic clay, minor silt and sand forming bogs, fens and swamps, generally 1-15 m thick.

ALLUVIAL LANDFORMS AND DEPOSITS

ALLUVIAL CHANNEL AND FLOODPLAIN: Gravel, gravelly-sand, sand forming bar and channel deposits within stream floodplains (1-5 m), fine sand, silt and clay in levee and floodplain deposits (2-15 m) (undifferentiated).

MARINE (ESTUARY): Fine sand, silt and clay, locally overlain by saltmarsh peat, interidal mud flat and distributary channels.

WISCONSINAN GLACIAL LANDFORMS AND DEPOSITS

GLACIOLACUSTRINE: Sand, silt, clay, clay-rich diamicton (mixture of gravel, sand, mud), bedded and massive, forming flat clay plains and terraces above the Shubenacadie River intertidal mud flat, 2-20 m thick. Lacustrine sand and delta deposits marked by S.

GLACIOFLUVIAL LANDFORMS AND DEPOSITS

KAME FIELDS AND ESKERS: Gravelly-sand, sand, mud, diamicton, crudely to well bedded, abrupt changes in grain size between beds, faulting common, forming kames (conical hills) and eskers (sinuous, steep sided ridges) and hummocky terraces flanking the sides of hills (kame terraces), 5-30 m thick.

GROUND MORAINE AND STREAMLINED DRIFT

STONY TILL PLAIN
BEAVER RIVER TILL: Grey-white diamicton (10YR8/1), sandy matrix, stony, predominately local lithologies (>80%). Forms hummocky till plain and ribbed moraine.

SILTY TILL PLAIN AND DRUMLINS
HANTS TILL: Reddish brown to brown diamicton (2.5-7.5 YR4/4) silty-sand matrix, noncalcareous, MnO_2 staining along fissility planes, mixture of local Carboniferous and erratic Cobequid Highland-Meguma Zone lithologies. Forms rolling till plain and drumlins in study area.

ROCK

GLACIALLY-SCULPTED BEDROCK: Bedrock exposure and thin (1-2 m), discontinuous till veneer, bedrock scoured by glacial action, with grooves, straie, and other small-scale forms of glacial erosion.

SYMBOLS

Glacial striae (large and small linear grooves on rock; ice flow direction known, unknown, 1 indicates older striae, arrow points in the direction of ice flow) 3 2 1

Drumlins, fluted terrain (ridges and elliptical hills parallel to ice flow ....

Esker (direction of meltwater flow assumed or known, unknown) ....

Meltwater spillway, channel (flat-bottomed valleys with misfit streams) ....

Terrace scarp ....

Strike ridge ....

Drillhole locations, number, depth (m) 95-10 71m

Stop location, number 95-100

Depth to bedrock (m) 9

Contours (m) 50

REFERENCES

Cann, D.B., Hilchey, J. D. and Smith, G. R., 1954: Soil survey of Hants County, Nova Scotia; Nova Scotia Soil Survey, Report no. 5, 65 p.

Goldthwait, J. W. 1924: Physiography of Nova Scotia; Geological Survey of Canada, Memoir 140 103 p.

Goldthwait, R. P., 1989: Classification of glacial morphologic features; In Genetic Classification of Glacigenic Deposits; eds. R.P. Goldthwait, and C.L. Matsch; Balkema Rotterdam, p. 267-278.

Hughes, O. L. 1957: Surficial geology of the Shubenacadie map area, Nova Scotia; Geological Survey of Canada, Paper 56-3, 10 p.

MacDougall, J. I., Cann, D. B. and Hilchey, J. D. 1963: Soil survey of Halifax County, Nova Scotia; Nova Scotia Soil Survey, Report no. 13, 53 p.

MacNeill, R. H. 1956: Surficial geology maps of Nova Scotia; Nova Scotia Research Foundation Corporation, Dartmouth, Nova Scotia, scale 1:50 000

Mott, R. J. and Stea, R. R., 1994: Late-Glacial (Allerod/Younger Dryas) buried organic deposits, Nova Scotia, Canada; Quarternery Science Reviews, v. 12, p. 645-657.

Prest, V. K., 1983: Canada's heritage of glacial features; Geological Survey of Canada, Miscellaneous Report 28, 119 p.

Stea, R. R., Conley, H. and Brown, Y. (compilers) 1992: Surficial geology of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Map 92-1, scale 1:500 000.

Stea, R. R. and Mott, R. J. 1998: Deglaciation of Nova Scotia: Stratigraphy and chronology of lake sediment cores and buried organic sections. Geographie physique et Quaternaire, v. 52, n.1, p. 3-21.

Stea, R. R. and Fowler, J. H. 1979: Minor and trace-element variations in Wisconsinan tills; Eastern Shore region, Nova Scotia; Nova Scotia Department of Mines and Energy, Paper 79-4, 30 p.

Webb, K. T., Thompson, R. L., Beke, G. J. and Nowland, J. L. 1991: Soils of Colchester County, Nova Scotia; Nova Scotia Soil Survey, Research Branch, Agriculture Canada, Report no.19, 201 p.