Nova Scotia Department of Natural Resources
Minerals and Energy Branch

OFM 1998-002

SURFICIAL GEOLOGY

BRIDGETOWN

N.S. digital topographic database
(NTS SHEET 21A/14)
Annapolis County

NOVA SCOTIA

R. R. Stea and C. M. Kennedy

Scale 1 : 50,000

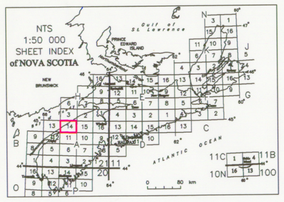
0 2.5 5
kilometres

Nova Scotia Department of Natural Resources
Halifax, Nova Scotia
1998

Field work for the Annapolis Valley part of the Bridgetown map sheet was completed in the summer of 1988 by Rudolph Stea, Robert Turner and Andrew Dudka. Phillip Finck compiled the surficial geology of the South Mountain area.

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

This map is part of a new series of 1:50:000 open-file colour surficial geological maps that are planned for the entire province. It is available in digital form (AUTOCAD 14). Polygon and point data from this map will be converted into ARCINFO format to be assimilated into a database that will also include surficial data from stop and sampling locations; descriptions of type sections; stratigraphic logs (well logs; diamond drill holes etc.), and summary schematics of the basin architecture and geologic history. Please contact the Nova Scotia Department of Natural Resources about errors and omissions in this database.



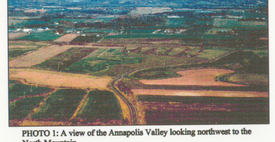


PHOTO 1: A view of the Annapolis Valley looking northwest to the North Mountain

PHOTO 3: A kame complex and large boulders near the former ice margin on the slopes of the South Mountain (Stop 32/88).

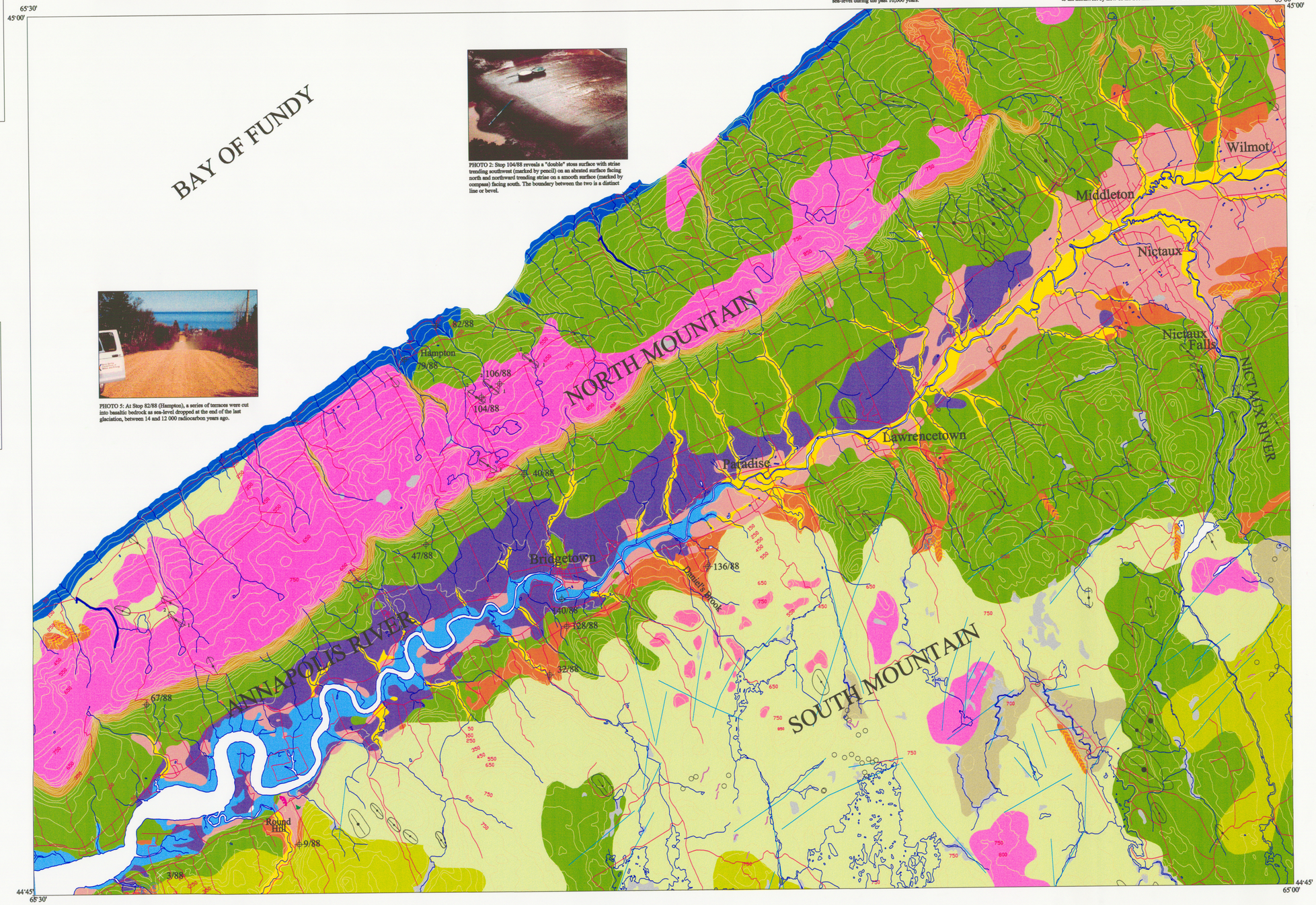
PHOTO 4: Kame at Stop 136/88, showing channelized gravelly sand and coarse sand.

PHOTO 6: At Stop 140/88, 1-2 m of estuarine sediment is found on top of trees in growth position, reflecting the rapid rise in sea-level during the past 10,000 years.

PHOTO 7: At Stop 106/88 on the North Mountain a large boulder of granodiorite is found resting on the surface, transported to the northwest by flow of the Scotian Ice Divide over Nova Scotia.

PHOTO 2: Stop 104/88 reveals a "double" stoss surface with striae trending southwest (marked by pencil) on an abrated surface facing north and northward trending striae on a smooth surface (marked by compass) facing south. The boundary between the two is a distinct line or bevel.

PHOTO 5: At Stop 82/88 (Hampton), a series of terraces were cut into basaltic bedrock as sea-level dropped at the end of the last glaciation, between 14 and 12 000 radiocarbon years ago.



CLASSIFICATION OF SURFICIAL LANDFORMS AND DEPOSITS

This open file map depicts the nature, distribution and thickness of surficial (surface-unconsolidated) deposits in the Bridgetown map sheet of southwest Nova Scotia (NTS 21A/14). Surficial deposits are classified with their host landforms. The broadest classifications of landscapes in this area are the uplands and lowlands (cf. Goldthwait, 1924), over which the style of surficial landforms and deposits vary markedly. The North Mountain, for example, is characterized by a veneer of glacial drift over basalt. The Annapolis Valley (photo 1), the major lowland region in the map area, is filled with >50 m of drift over Triassic sedimentary bedrock.

In the legend, surficial landforms and deposits are classified according to age, origin and lithology. Broad, genetic landform groupings (e.g. glaciofluvial landforms, silty till plain) are further subdivided into lithostratigraphic units (formations- eg. Lawrencetown Till), which are regionally mappable layers of drift, distinguished on the basis of lithic characteristics and stratigraphic position. The following is a brief description of the surficial units and a summary of glacial history.

RESIDUUM

Residuum, or disaggregated and weathered bedrock, is found sporadically throughout the map area. Along the south slopes of the North Mountain (Stop 67/88) patches of saprolitic basalt are found, characterized by extensive kaolinization and Fe-oxidation of constituent feldspars and ferromagnesian minerals. Granites of the South Mountain are similarity disaggregated by kaolinization of plagioclase feldspars, but with preservation of K-feldspar and quartz, retain some of their original textures.

GLACIALLY SCULPTED ROCK

Rock outcrops are common in both the North and South Mountains. Outcrops are often marked by small-scale glacier erosional forms such as striae, grooves, and crescentic chatter marks. These outcrops display asymmetric profiles, with abraded, gently dipping, stoss sides and steep, rough lee slopes. Distinctive features of glaciated outcrops are several distinct "sets" of glacial striae formed by consecutive ice flows from different directions. Landforms that exhibit erosional scours from several events are termed "palimpsest". Stop 104/88 (photo 2) reveals two sets of striae on differing faces or "facets" of a basalt outcrop. On the north-facing side, striae trend southeast, whereas on the south-facing side the striae trend northwest. The relative ages of each set were established based on weathering of the north-facing stoss facet. Fault displacement of these striated outcrops was noted at several locations (Stop 104/88).

GROUND MORAINE AND STREAMLINED DRIFT

Sixty five percent of the Bridgetown map area is covered by ground moraine, a non-linear, smooth to hummocky glacial drift cover, consisting mostly 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.

SILTY TILL PLAIN AND DRUMLINS

The silty till plain is a strongly to slightly rolling plain, with thick drift cover, composed of multiple tills with intervening layers of gravel, sand or mud (glaciofluvial) or non-glacial organic horizons. The plain completely masks underlying Mesozoic and Paleozoic bedrock undulations and reaches a maximum thickness of 70 m. The Lawrencetown Till is the predominant till formation of the silty till plain. Drumlins are streamlined, elongate hills, consisting of layers of glacial till up to 30 m thick. Several southeast-trending drumlin-like hills are found on the south side of the North Mountain east of Middleton.

STONY TILL PLAIN

The stony till plain in the southern portion of the map sheet is developed over Paleozoic metawacke, slate and granite. It is characterized by hummocky terrain, with occasional development of arcuate ridges (ribbed moraine). The Beaver River Till is the predominant till formation. The surface of the Beaver River Till is commonly strewn with large boulders 0.5-5 m in diameter (Photo 3). Extensive boulder fields are found south of ice contact-kame complexes on the north slope of the South Mountain, probably formed at an ice margin.

GLACIOFLUVIAL AND GLACIOLACUSTRINE LANDFORMS AND DEPOSITS

About 15 percent of the map area is covered by sediments deposited by glacial meltwater streams (glaciofluvial) on (kames) or in front of (outwash) retreating glaciers, or in impounded glacial lakes (glaciolacustrine). These are composed mostly of well-sorted, stratified sediments.

KAME FIELDS AND ESKERS

Kames form patches of irregular hummocks and short ridges located in valley floors or on the sides of hills (kame terraces). The kame terrace complex at Daniels Brook (Stop 136/88, Photo 4) revealed two units: Unit 1. Cross-bedded and planar-bedded cobble-gravelly sand fining upwards into planar silt-fine sand beds (5 m). Unit 2. Massive, channelized, pebble gravelly-sand, faintly laminated, with faults evident.

OUTWASH FANS AND DELTAS

An ice marginal kame-outwash complex is located at Round Hill (Stop 9/88) on the south slope of the Annapolis Valley. On the northern, ice proximal side of the complex, a 15 m section reveals channelized, normally graded gravelly sand to coarse sand, overlain by bouldery, gravelly sand. To the south, 10 m of sand -dominated, foreset beds are exposed, overlying bottomset sand-silt rhythmites. These rhythmites become finer grained to the north and eventually grade into massive, brown mud. Much of the Annapolis Valley east of Lawrencetown is covered by outwash consisting of planar and cross-bedded coarse to fine sand.

GLACIOMARINE LANDFORMS AND DEPOSITS

Areas below 30 m (100') elevation in the western Annapolis Valley are covered with fine-grained sediments (brown, massive and laminated mud and muddy diamicton). At Stop 128/88 a new highway cut reveals a 10 m section with complex interfingering of diamicton and laminated clay-sand, indicating a former tide water ice margin. Bailey (1898) described layers of marine shells in the clay at Middleton, indicating a marine origin. On the Bay of Fundy side of the North Mountain, an emerged wave-cut platform, scarps, and gravel deposits indicate higher post-glacial sea-levels. At Hampton (Stop 79/88) marine limit reaches 40 m, and the beach deposits are characterized by planar-bedded, coarse sand overlying open work, well-rounded pebble-gravel. At Stop 82/88 (photo 5) three distinct terrace levels occur at 18 m (60'), 24 m (80') and 43 m (140') (marine limit). Shells from the base of a kettle lake on raised glaciomarine deposits on Brier Island gave a radiocarbon age of 13.2 ka (Stea and Mott, in press).

HOLOCENE LANDFORMS AND DEPOSITS

Holocene sediments were deposited after the final retreat of glaciers, starting about 10-11,000 radiocarbon years ago. These consist of marine estuary, alluvial (river), organic (bog, fen), and colluvial (slope) environments. Marine estuarine sediments are found along the Annapolis River, where tidal influence extends as far as Paradise. Sections along the Annapolis River (Stop 140/88) revealed 2-3 m of massive and laminated red silty clay overlying peat and wood layers with trees in growth position (photo 6), reflecting the rapid post-glacial rise in sea-level.

Alluvial landforms consist of river channels and bars with gravel and sand, levee, splay and floodplain deposits of coarse to fine sand and silty clay.

GLACIAL HISTORY

The Bridgetown map area records a complex history of glacier advances and retreats relating to the formation and organization of several maritime ice caps during the Wisconsinan age (75-10 ka). The earliest flow recorded in the map area is a southeastward flow event (Caledonia Phase ca 75-25 ka). A subsequent southward ice flow (Escuminac Phase ca 25-20 ka) is recorded on a few striated outcrops. The development of an ice divide over southern mainland Nova Scotia (Scotian Ice Divide) resulted in northwestward ice flow over much of the map area between 20 and 15 ka (Scotian Phase), when large boulders of South Mountain granite were moved over the Annapolis Valley and deposited on the North Mountain. The last major ice flow event was a re-advance from an ice lobe in the eastern Annapolis Valley (Chignecto Phase) that left kames over a glaciofluvial delta at Margaretville, (Hickox, 1969) and formed the large outwash fan at Middleton.

The Chignecto Phase ice lobe receded eastward up the valley, while ice remained on the South Mountain flank of the valley. Glacial Lake Allerdyce (Purdy, 1951) was impounded in the western Annapolis Valley, by ice to the east. This lake was probably connected to the glacio-isostatic DeGeer Sea (Grant, 1989) through Digby Gut or over a sunken corridor through to St. Mary's Bay. As the land rebounded and sea-level fell, the lake drained. Sea-level fell to it's lowest point between 30 and 60m (Fader, et al. 1977) before it rose to its present height, burying forests and bogs along the Annapolis River with estuarine sediment.

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LEGEND

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.

COLLUVIAL DEPOSITS: A complex mixture of glacial deposits, weathered and frost-shattered rock, and soils on steep slopes, subjected to mass wasting.

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

MARINE LANDFORMS AND DEPOSITS: Sand, silt and clay, peat and wood, forming tidal estuary mudflats, with Spartina saltmarsh above mean high tide, 1-12 m thick.

WISCONSINAN GLACIAL LANDFORMS AND DEPOSITS

GLACIOMARINE LANDFORMS AND DEPOSITS

RAISED BEACHES AND TERRACES: Gravel and sand forming beach ridges and raised shoreface sandbodies, thin veneer of gravel over bedrock on terraces, scarps and sea stacks developed at marine limit.

DEPOSITS OF GLACIAL LAKE ALDERSHOT: Sand, silt, clay, brown (7.5YR5/6) clay-rich diamicton (mixture of gravel, sand, mud), bedded and massive, forming flat clay plain in the Annapolis Valley, 1-20 m thick.

GLACIOFLUVIAL LANDFORMS AND DEPOSITS

OUTWASH FANS AND DELTAS: Gravelly sand and sand, massive to horizontally bedded, channels common; forms flat plains and fan-shaped deposits at the mouths of valleys, 2-30 m thick.

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

HUMMOCKY GROUND MORAINE

BEAVER RIVER TILL (FACIES C): Grey-white (10YR8/1) diamicton, loose, medium- to fine-sand matrix, zones of bedded, sorted sand. Forms distinctive low hummocks in barren areas, 3-6 m high and 10-25 m in diameter, surrounded and overlain by large boulders (5-20 m thick).

STONY TILL PLAIN

BEAVER RIVER TILL (FACIES B): Grey-white (10YR8/1) to pale brown to yellowish-brown (10YR7/4-5/4) diamicton, sandy matrix, stony, predominantely local (underlying granitic) lithologies (> 90%). Forms irregular undulating till plain and ribbed moraine. 1-10 m thick. Parent material for Gibraltar series soils.

BEAVER RIVER TILL (FACIES B-hybrid): Similar colour and texture to Facies B, but with higher percentages of foreign lithologies, indicating inheritance from underlying sources of Lawrencetown Till or overprinting by later ice flows Overall surficial thicknesses are greater in these areas, with multiple till stratigraphy implied (2-15 m thick).

SILTY TILL PLAIN AND DRUMLINS

LAWRENCETOWN TILL: Reddish- brown to brown (2.5-7.5YR 3/4, 4/4, 4/6) diamicton; silty-sand matrix, noncalcareous, Mn O_2 staining along fissility planes, mixture of local and foreign lithologies. Forms rolling till plain and drumlins in study area, 5-30 m thick, parent material for Wolfville soils.

TRIASSIC OR OLDER LANDFORMS AND DEPOSITS

BEDROCK

RESIDUUM: Fragmented rock consisting of weathered interstitial debris and angular competent blocks; in granitic bedrock, feldspars are weathered to clay; veneer to >3 m thick.

GLACIALLY SCULPTED BEDROCK: Bedrock exposure and thin (1-2 m), discontinuous till, scoured by glacial action, with grooves, striae, 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).....

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

Moraine ridge (ridges perpendicular to ice flow) .....

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

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

Terrace scarp.....

Lineation (from air photo).....

Hummocks (mounds of till, sand and gravel).....

Delta (kame, outwash).....

Kettle (circular depressions or pits, large,small).....

Topographic Contours (ft).....

Stop locations, numbers.....