GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRELIMINARY SERIES

SHEET 21 O/4

LEGEND

CENOZOIC

PLEISTOCENE AND RECENT

7 — Alluvium: silt, stratified sand and gravel, reworked till on steeper slopes; includes some clay of unit 6 that locally outcrops at the surface

GRAND FALLS DRIFT AND YOUNGER SEDIMENTS UNDIVIDED

6 — 6A. Lake Madawaska sediments: gravel beach terrace
6B. Lake Madawaska and oxbow lake sediments: bluish grey to buff clay, black organic silt and clay, varved clay, (exposed in sections only)

GRAND FALLS DRIFT

5 — 5A. Valley train outwash: well sorted gravel underlying terraces; numerous cut-and-fill channel structures; includes in places a capping of alluvium (7)
5B. Glacial outwash in valley bottoms (in part older than 2B): moderate to poorly sorted gravel, sand and silt; includes much alluvium (7)

4 — 4A. Rill wash: mixed sand and stones, reworked till; streaks of gravel and silt, minor bedrock
4B. Pond deposits: clay, mixed clay and stones

3 — Pitted outwash and kame deposits: gravel and sand

2 — End moraine and associated alluvial fans:
2A. Stratified gravel and sand, and compact, stony till in ridges and hummocks
2B. Compact stony till, with undulating surface

GRAND FALLS DRIFT AND OLDER SEDIMENTS UNDIVIDED

1 — Basal till: grey, compact, silty to sandy till with subrounded stones. Area includes some colluvium and alluvium, and bedrock outcrops

PALAEOZOIC

BEDROCK OUTCROPS

× — Slate, limestone, sandstone, diabase

Geological boundary (defined, approximate, assumed)
Limit of geological mapping
Glacial striae (direction of ice movement unknown)
Closed depression or kettle hole
Scarp, usually bounded by a terrace on river side
Rill patterns and ice marginal channels (flow direction indicated); ice marginal channels (flow direction not indicated)
Highest strandline of extinct Lake Madawaska (largely inferred)

Geology by Hulbert A. Lee, 1953 and 1956

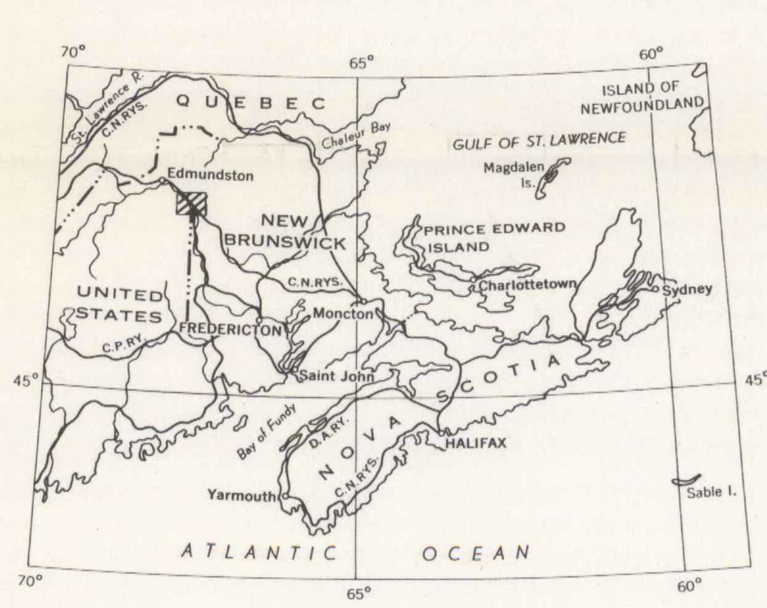
Main highway
Other roads
Cart track
Trail or portage
Power transmission line
Post Office
International boundary
County boundary
Parish boundary
Intermittent stream
Marsh

Cartography by the Geological Survey of Canada, 1959

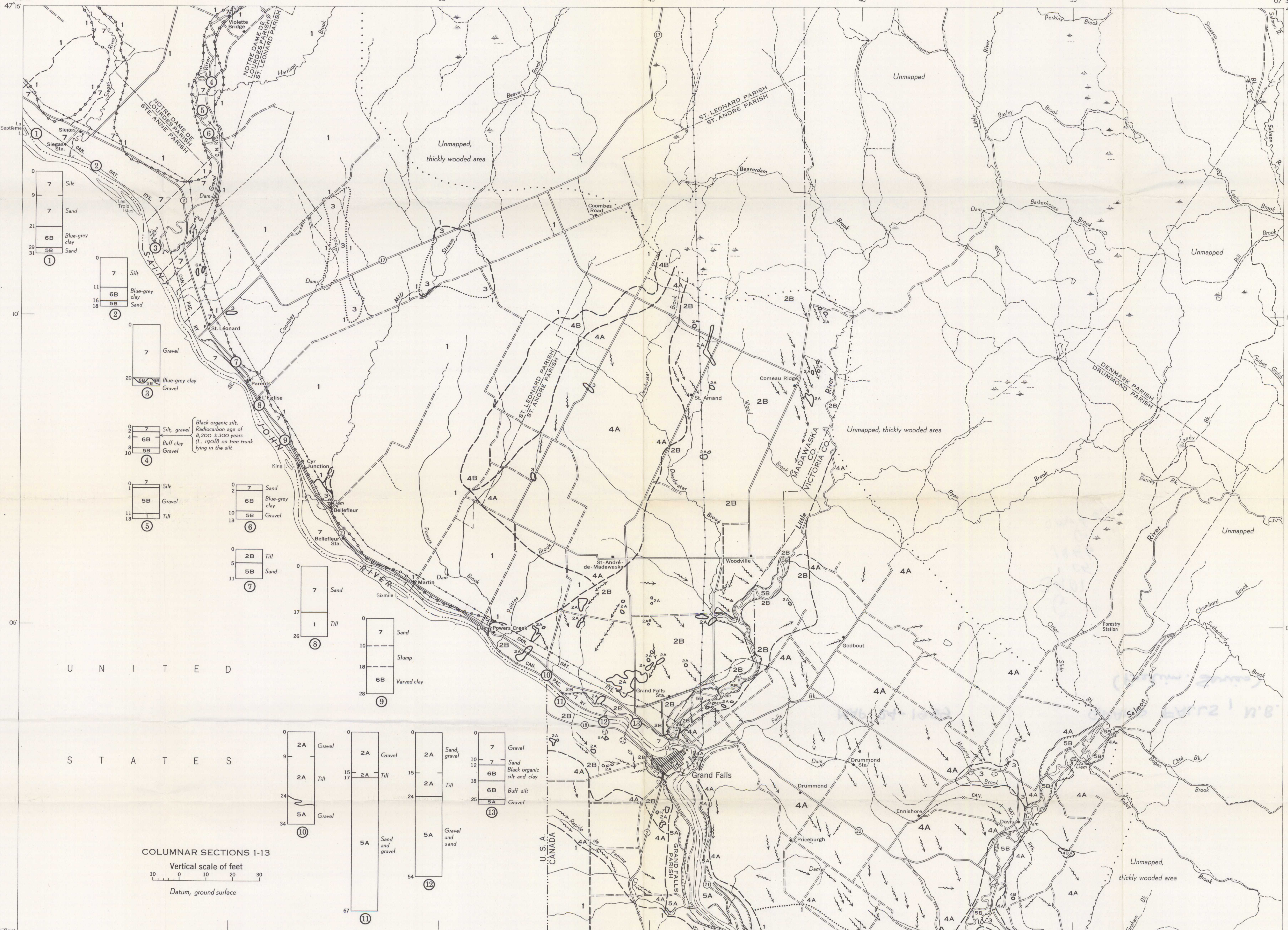
Approximate magnetic declination, 22° 20' West

Air photographs covering this area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario

In response to public demand for earlier publication, Preliminary Series maps are now being issued in this simplified form, thereby effecting a substantial saving in time. There is no loss of information, but the maps will be clearer to read if all or some of the map-units are hand-coloured.



INDEX MAP



PUBLISHED, 1959
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MAP 24-1959
SURFICIAL GEOLOGY
GRAND FALLS
MADAWASKA AND VICTORIA COUNTIES
NEW BRUNSWICK

Scale: One Inch to One Mile = $\frac{1}{63,360}$

PRINTED BY THE SURVEYS AND MAPPING BRANCH

24-1959

DESCRIPTIVE NOTES

The most important glacial feature in the area is the Grand Falls end moraine with associated alluvial fans. The Grand Falls moraine marks an ice-frontal position of a major lobe of the Wisconsin ice-sheet in the St. John River valley. This is indicated by the abundance of erratics such as granite gneiss, derived from north of the St. Lawrence River, and of fossiliferous limestone, similar to outcrops in the Temiscouata Lake region of Quebec. A readvance of the ice-margin is indicated by till overlying proglacial outwash at Parents (47° 09' N; 67° 55' W).

Glacial rivers from the melting ice-sheet eroded and washed the till south of the moraine, and deposited outwash chiefly in river valleys. When the ice-margin finally withdrew northward the gravel and till of the moraine blocked the channel of the former St. John River, and gave rise to a lake northwest of the town of Grand Falls. This former lake has been named Glacial Lake Madawaska[1]. The great thickness of outwash gravels, deposited by the glacial rivers south of Grand Falls, became terraced as the ancestral St. John River eroded its way laterally and downward to its present position. The numerous and prominent terraces along this part of the river mark the old slip-off slopes. A buried river channel passes under the western part of the town of Grand Falls and is nearly filled by about 170 feet of glacial drift. The postglacial course of the river is through a bedrock gorge that is still actively migrating headwards. Large potholes have been formed in the bedrock floor of the gorge. Well-rounded and nearly spherical cobbles can still be seen in some of the potholes. These cobbles and some sand were the abrading agents used by swirling waters to carve the "wells in the rocks".

Peat collected from a section on the east bank of Green River a few miles northwest of the Grand Falls map-area (47° 19' N; 68° 07' W) gave a radiocarbon age of 10,200± 350 years (sample LC 56-886, Isotopes Inc.). The peat was collected from the bottom 1/2 inch of a bog layer 1.4 feet thick, underlying 10 feet of gravel and 2 feet of silt, and overlying 13 feet of clay, 4 feet of gravel, and 2 feet of till. As the till antedates the peat, glacial ice must have disappeared from this site considerably more than 10,200± 350 years ago.

The orderly retreat of the ice-sheet was interrupted by minor advances or 'stand-stills' of the ice-front. The retreat may thus be considered cyclic, a cycle consisting of the events that took place while the ice-front was retreating from one position of temporary halt, or minor advance, to another such position. The glacial and related deposits of the St. John Basin, of which the map-area is a part, is divisible into a succession of 'drifts', each laid down during one of these cycles. The Grand Falls Drift[2] is marked near its southern limit by a unit of end moraine and associated alluvial fans, and by rillwash and valley train.

The surficial geology map shows only some of the bedrock outcrops, as only cursory attention was given to the bedrock geology.

Basal till (1) of the Grand Falls Drift cannot everywhere be separated from earlier drift, hence much of it is classed as undivided. The till occurs in patches 2 to 3 feet thick.

Ridges and hummocks (2A) of the Grand Falls end moraine are best developed about 2 miles northwest of Grand Falls on the road to St. André de Madawaska. West of the road the end moraine ridge is about 50 feet high and about 300 feet wide. It is composed mainly of gravel, but also includes till. The surface of a large alluvial fan lying east of the road is grooved by long, deep kettle-depressions. Beds of gravel in the alluvial fan generally dip easterly except under the depressions where there are slump dips. These are believed to record the position of former ice-tongues buried by gravels built against the ice-sheet. The area of till (2B) without a distinctive moraine topography is included with the unit of end moraine and alluvial fans. Ice-marginal channels are on many north-facing slopes of the till area. On some hillsides these channels form a succession of small terraces underlain in a few places by streaks of gravel. The ice-marginal channels are distributed over a wide region that suggests a slow-shrinking glacier.

Kame and outwash (3) occur as disconnected plateaux and ridges on the higher land and on the sides and upper reaches of valleys. Areas of pitted outwash in the southeastern part of the map-area are associated with glacial outwash in valley bottoms (5B) and may represent gravels deposited over glacial ice that has since melted. The dip of gravel beds in two small kames (3) northwest of the village of St. André de Madawaska is consistently southeastward. Their origin may be similar to the alluvial fans described above. The two large areas of outwash in the centre part of the map-area are about 3 feet thick and are composed of dirty gravel.

Rill patterns in the southeastern area of rillwash (4A) lead southeastwards from the end moraine and trend roughly at right angles to it. Individual rill channels may be up to 1/2 mile long. They were probably formed by water coming from the melting ice-sheet as the margin occupied different positions during a slow retreat northwestward. The rill patterns are distinct on aerial photographs, but not easily seen on the ground. Rill channels average about 6 feet in depth in the deeper parts and vary considerably in width to form braided patterns from 25 feet to 1/2 mile wide; the channels are commonly underlain by a streak of stony gravel with an infilling of sand. Depth to bedrock in this area averages 2 feet.

Stony clays of the pond deposits (4B) located in the centre of the map-area, have no discernible topographic expression and the presence of these deposits cannot be readily explained. Two patches of clay (4B) in the southeastern part of the map-area are possible remnants of a former lake that occupied the Salmon River valley. No strandlines were found, however, to indicate limits of such a lake.

The valley-train outwash (5A) consists of gravels deposited from meltwater carried in the St. John River valley. In many places on terrace levels the gravels are capped by about 5 to 10 feet of gravel alluvium. The terraces were formed and the alluvium was laid down by the ancestral St. John River as it cut down through the valley-train outwash. A thickness of about 200 feet of valley-train gravel is exposed near the southern limits of the town of Grand Falls. Valley-bottom gravels (5B) are neither continuously thick nor extensive.

Beaches (6A) are most numerous near the 525-foot contour level in the basin of Glacial Lake Madawaska, but are absent at higher elevations. The position of the 525-foot contour thus represents the inferred position of the highest Lake Madawaska strandline[2]. Several well-developed beach terraces about 1 mile north of the village of St. Léonard are about 500 feet long, 5 feet high and 100 feet wide, and are composed of slate pebbles shaped like melon seeds. Varved clay (6B), near the settlement of l'Eglise, probably indicates seasonal deposition of sediments carried by meltwater. A bluish grey to buff clay lies within the basin of Glacial Lake Madawaska, but outcrops only in river valleys along present stream-cuts. The clay is characterized by vertical fractures and contains wood particles which are in part replaced by vivianite. A black, highly organic silt overlies the bluish grey clay in many places. The silt probably represents backwater deposition formed under flood conditions. A tree-trunk lying in the silt at a section along Grand River has a radiocarbon age of 8,200± 300 years (L. 190B).

Two possible environments of deposition can be postulated for the bluish grey clay; namely as Lake Madawaska clays or as stream deposits in isolated depressions such as oxbow lakes. The numerous outcrops of clay within the old lake basin suggest a lacustrine origin. On lithologic and topographic grounds they are considered to be Glacial Lake Madawaska sediments. However recent radiocarbon dates favour the alternative interpretation of isolated, non-contemporaneous deposits. A radiocarbon age of 8,250± 200 years (W-353) has been determined for wood taken from the clay near the mouth of the Quisibis River northwest of the area[2]. Lithologically similar clay in the same lake basin, however, is overlain by peat, 10,200± 350 years old, at the Green River section described above.

Alluvium (7) is stream-transported material and includes sediments that vary, over short distances, in both texture and sorting. Much of the shallower alluvial deposits are derived from till- and colluvium-covered slopes. Thicker deposits of gravel and sand are located where tributary streams enter the St. John River.

[1] Kiewiet de Jonge, E.J.C.: Glacial Water Levels in the St. John River Valley; PhD Thesis, Clark University, Worcester, Mass., 116 pages, 1951.
[2] Lee, H.A.: Surficial Geology of Edmundston, Madawaska and Temiscouata Counties, New Brunswick and Quebec; Geol. Surv., Canada, Paper 55-15, 1955.

MAP 24-1959
GRAND FALLS
NEW BRUNSWICK
SHEET 21 O/4