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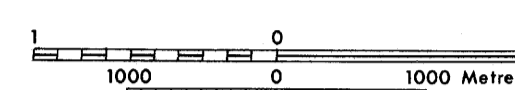


Ontario
Division of Mines

HONOURABLE LEO BERNIER, Minister of Natural Resources
Dr. J. K. REYNOLDS, Deputy Minister of Natural Resources
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PRELIMINARY MAP P. 981
GEOLOGICAL SERIES
**QUATERNARY GEOLOGY
DUNNVILLE AREA**

SOUTHERN ONTARIO
Scale: 1:50,000
1.25 inches to 1 mile approximately



NTS Reference: 30 L/13

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LEGEND

CENOZOIC
QUATERNARY
RECENT

- 14 Cultural Features: settling basins, gravel, sand, concrete, etc.
- 13 Lake Erie shore dune sand
- 12 Lake Erie beach gravel and sand
- 11 Stream deposits: predominantly silt and clay, some gravel and sand

PLEISTOCENE
LATE WISCONSINAN

- 10 Inland dune sand
- 9 Stream terrace and deltaic sand
- 8 Shallow water lacustrine sand and silt
- 7 Glaciolacustrine beach gravel and sand
- 6 Glaciolacustrine sand and silt
- 5 Glaciolacustrine clay and silt
- 4 Halton Till: clay till, clayey silt till
- 3,3a Wentworth Till: gravelly silt till (3d in drumlins)

UNCONFORMITY

PALEOZOIC
DEVONIAN

- 2 Dundee (Onondaga) Formations: cherty limestone Bois Blanc

DISCONFORMITY
Oriskany Formation: sandstone

DISCONFORMITY
PALEOZOIC
SILURIAN

- 1 Bertie Formation: dolostone

Note: Only that part of a mappable unit with thickness equal to or greater than 3 feet is outlined.

SYMBOLS

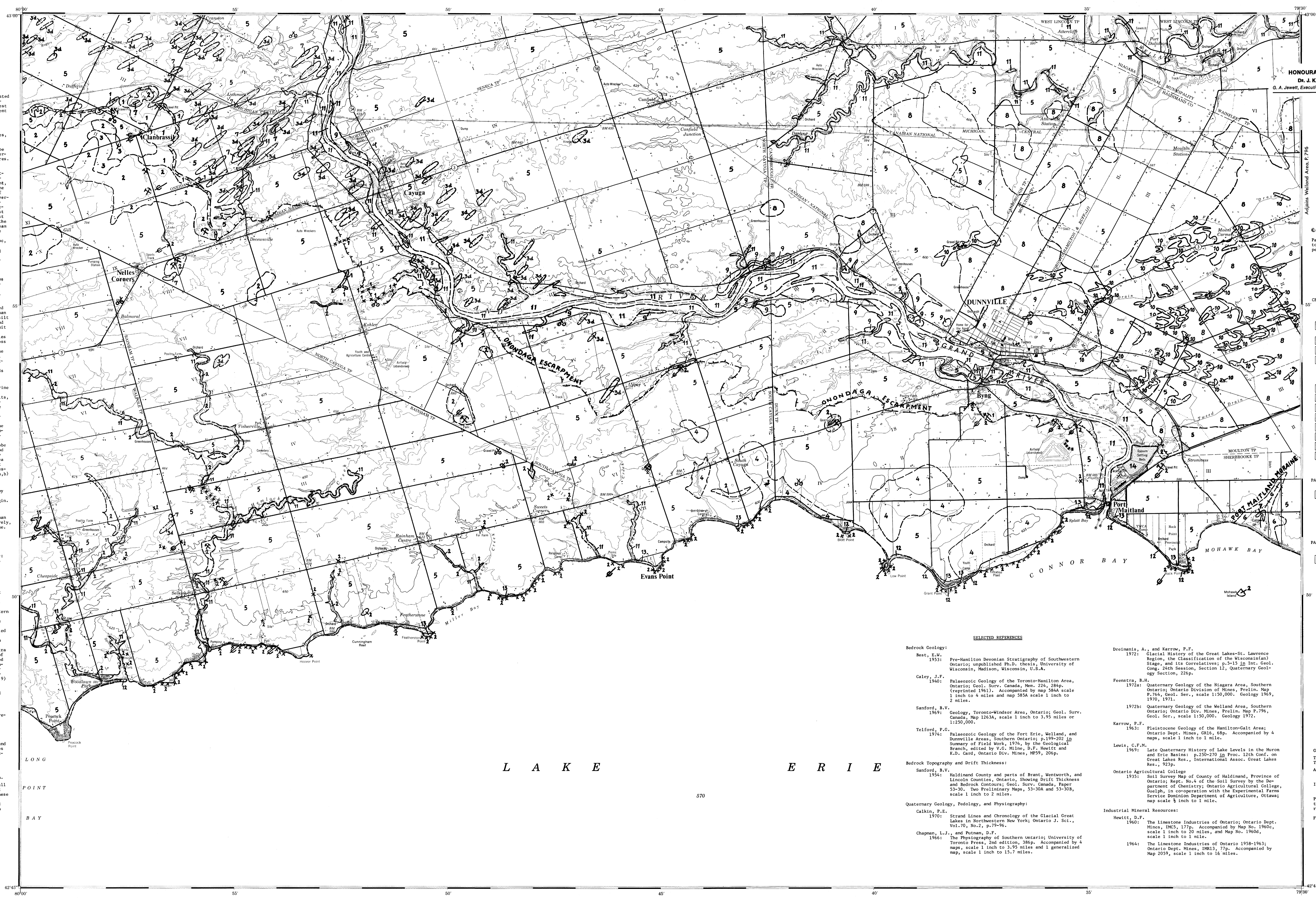
- x Bedrock outcrop
- Geological boundary (actual or approximate)
- Glacial striae on bedrock (direction of ice movement known)
- Moraine crest
- x Rock quarry
- x Sand and gravel pit
- Bedrock escarpment (relatively large)
- Bluff marking abandoned shoreline

SOURCES OF INFORMATION

Geology by B.H. Feenstra and assistants, 1973. Topography from Map 30 L/13b, and 30 L/13W of the National Topographic Series.
Aerial Photography: Ontario Division of Lands.

Issued 1974

Parts of this publication may be quoted if credit is given to the Ontario Division of Mines. It is recommended that reference to this map be made in the following form:
Feenstra, B.H.
1974: Quaternary Geology of the Dunnville Area, Southern Ontario; Ontario Div. Mines, Prelim. Map P. 981, Geol. Ser., scale 1:50,000. Geology 1973.



MARGINAL NOTES

Geological mapping of the Dunnville area was initiated and completed during the summer of 1973 under the supervision of B. Feenstra. P. Barrett, who mapped the largest part of the area, G. Baker, and P. Finamore gave competent assistance in the field. The map-area lies within the Haldimand-Norfolk Planning Area except for its extreme northeastern corner which forms part of the Regional Municipality of Niagara. Dunnville and Cayuga, located along the Grand River, are the largest population centres, while Highways 3 and 56 form the major access routes.

Field techniques included the use of a sampling tube driven into the deposits with a sledge hammer, hand augering, and the examination of natural and man-made exposures.

Bedrock Geology: The north-facing Onondaga Escarpment crosses the map-area from the Grand River near Port Maitland, in a west to northeast direction. Numerous Paleozoic bedrock outcrops occur along parts of the escarpment, along the shore of Lake Erie, and in the area between the escarpment and Lake Erie. They consist predominantly of Silurian dolostone (Bertie Formation, map-unit 1) and overlying Devonian cherty limestone (map-unit 2). The dolostone is only exposed along the escarpment and in particular from the southern bank of the Grand River, southeast of Cayuga, northwest to the boundary of the map-area west of Clabgrassill. The cherty limestone is exposed along the escarpment, along the shore of Lake Erie, and along stream courses in the area between the escarpment and Lake Erie where it also forms subsidiary scarps and mounds. It comprises in ascending order of succession the Bois Blanc, Amherstburg, and Dundee Formations according to Sanford (1964) while Telford (1974) calls Sanford's Amherstburg the Onondaga Formation in the Niagara Peninsula. Basal Devonian sandstone (Oriskany Formation, map-unit 2) outcrops near the escarpment in the area between Nelles Corners and Clabgrassill.

Bedrock Topography and Drift Thickness: Preliminary maps at a scale of 1 inch to 2 miles (1:126,720) showing bedrock and drift thickness contours based on oil and gas wells in the area, have been published by the Geological Survey of Canada (Sanford 1954).

Quaternary Geology: The oldest, mappable, unconsolidated deposit of the map-area is the Late Wisconsinan Wentworth Till (map-units 3 and 3d). It is a gravelly silt till found only in the western part of the map-area and there almost exclusively in the form of drumlins (map-unit 3d). They protrude through a cover of glaciolacustrine clay and silt (map-unit 5) and extend to a point 6 miles (9 km) southeast of Cayuga in a northeast direction across the area, while their southern limit coincides with the Onondaga Escarpment as only a few occur south of it. The Wentworth Till was deposited by the Ontario-Erie glacial lobe, locally advancing mainly over bedrock. The orientation of striae on bedrock and of long axes of drumlins indicates that glacial movement was predominantly towards the southeast across the map-area.

The younger Halton Till (map-unit 4) is a clay to clayey silt till and contains incorporated glaciolacustrine clay and silt. It is generally only covered by glaciolacustrine clay and silt (map-unit 5) and younger deposits, and is exposed only in the southern part of the map-area. The best exposures of this till are formed by the bluffs along the shore of Lake Erie. The bluff along Mohawk Bay, 3 miles (4.8 km) east of Port Maitland, provides a section through the Port Maitland Moraine. The hummocky surface of the thick Halton Till in this area is blanketed by glaciolacustrine fine sand and silt (map-unit 6). The Halton Till was also deposited by the Ontario-Erie glacial lobe, moving generally in a southerly direction across the Niagara Peninsula. This glacial lobe advanced to a position which paralleled the present Grand River east of Cayuga, and ended in the vicinity of Evans Point, and probably farther westward in the area now occupied by Lake Erie (shore margin). The Port Maitland Moraine probably forms part of a series of recessional moraines in the Niagara Peninsula (Feenstra 1972a,b) constructed during general glacial retreat.

Various pits located south and west of the Grand River expose sand and gravel deposits which are capped by glaciolacustrine clay and silt (map-unit 5). These deposits, in some pits, are definitely of ice-contact origin.

Glaciolacustrine clay and silt (map-unit 5), fine sand and silt (map-unit 6), and coarse beach sand and gravel (map-unit 7) form the next younger Late Wisconsinan deposits. Clay (and silt) covers the area most extensively, while sand and silt covers only the Port Maitland Moraine. The surficial beach deposits are small and rest predominantly on till and in a few places on bedrock or clay. Till in the higher drumlins and in the Port Maitland Moraine formed the main local source of this material. The beach deposits were found at the following approximate elevations (in feet (metres) above mean sea level): 750 (228) (Clabgrassill), 710 to 715 (216 to 217) (Nelles Corners), and 620 (189 to 204) (drumlins, Port Maitland Moraine). According to Calkin (1970, Fig. 4) they represent respectively the levels of proglacial lakes Wayne, Grassmere or Lundy, and Lundy or Early Algonquin.

Later, when water level had dropped to 600-610 feet aml (182 to 186 m) an ancestral Grand River entered a lake from the west and northwest near present Dunnville. Part of the shoreline of this lake was found as a small bluff in Halton Till. This lake was shallow in the eastern half of the map-area, in the Welland map-area (Feenstra 1972b), and in the southern part of the Niagara map-area (Feenstra 1972a). A thin apron of predominantly very fine- and fine-grained sand and silt (map-unit 8), carried by the river, was deposited on top of glaciolacustrine clay (map-unit 5) in part of the shallow lake area north and east of Dunnville, and farther eastward as far as Ferry Station and Winger in the Welland map-area (Feenstra 1972b, map-unit 3d/3b). A thin but much smaller apron of generally coarser grained sand (map-unit 9) was deposited in the form of a delta at the mouth of the river at Dunnville, and in an upstream section in the form of older alluvial terraces. When the lake level dropped probably more than 40 feet (12 m) these deposits (map-units 8 and 9) dried, and mainly the very fine- and fine-grained sand from the sand-silt unit (map-unit 8) was blown by prevailing westerly winds into the form of longitudinal and parabolic dunes covering the area between Dunnville and Winger (map-unit 10) Feenstra 1972b, map-unit 3d.

Mappable recent Quaternary deposits consist of stream deposits (map-unit 11), predominantly those along the present Grand River, beach deposits (map-unit 12) and dune sand (map-unit 13) along the shore of Lake Erie, and of settling beds of gypsum and other fill (map-unit 14) at Port Maitland.

Industrial Mineral Resources: The Bertie, Bois Blanc, and Oriskany Formations are presently being quarried 3 1/2 miles (5.6 km) west of Cayuga by Cayuga Materials and Construction Company Limited, and 3/4 mile (0.8 km) south of Byng by Dunnville Rock Products Limited. Products are Granular "M" and "P" for road construction, aggregate for concrete and asphalt plants, railroad ballast, agricultural lime, and silica sand for use in cement production.

Sand and gravel are intermittently extracted in small quantities from such deposits capped by clay and silt at various locations south and west of the Grand River. These resources are rather limited in the map-area and mainly used locally in road construction and as backfill. Sand from inland dunes east of Dunnville is also extracted in small quantities.

SELECTED REFERENCES

Bedrock Geology:
Nast, E.W.
1953: Pre-Hamilton Devonian Stratigraphy of Southwestern Ontario; unpublished Ph.D. thesis, University of Wisconsin, Madison, Wisconsin, U.S.A.
Caley, J.F.
1940: Paleozoic Geology of the Toronto-Hamilton Area, Ontario; Geol. Surv. Canada, Mem. 224, 284p. (reprinted 1961). Accompanied by map 585A scale 1 inch to 4 miles and map 585A scale 1 inch to 2 miles.
Sanford, B.V.
1969: Geology, Toronto-Windsor Area, Ontario; Geol. Surv. Canada, Map 1263A, scale 1 inch to 3.95 miles or 1:250,000.
1974: Paleozoic Geology of the Fort Erie, Welland, and Dunnville Areas, Southern Ontario; p.199-202 in Summary of Field Work, 1974, by the Geological Branch, edited by V.C. Milne, D.F. Hewitt and K.D. Card, Ontario Div. Mines, MP59, 206p.
Bedrock Topography and Drift Thickness:
Sanford, B.V.
1954: Haldimand County and parts of Brant, Wentworth, and Lincoln Counties, Ontario, Showing Drift Thickness and Bedrock Contours; Geol. Surv. Canada, Paper 33-50. Two Preliminary Maps, 53-30A and 53-30B, scale 1 inch to 2 miles.
Quaternary Geology, Pedology, and Physiography:
Calkin, P.E.
1970: Strand Lines and Chronology of the Glacial Great Lakes in Northwestern New York; Ontario J. Sci., Vol.70, No.2, p.79-96.
Chapman, L.J., and Putnam, D.F.
1966: The Physiography of Southern Ontario; University of Toronto Press, 2nd edition, 386p. Accompanied by 4 maps, scale 1 inch to 3.95 miles and 1 generalized map, scale 1 inch to 15.7 miles.

Dreimanns, A., and Karrow, P.F.
1972: Glacial History of the Great Lakes-St. Lawrence Region, the Classification of the Wisconsinan Stage, and its Correlatives; p.15 in Int. Geol. Cong., 24th Session, Section 12, Quaternary Geology Section, 226p.
Feenstra, B.H.
1972a: Quaternary Geology of the Niagara Area, Southern Ontario; Ontario Division of Mines, Prelim. Map P.784, Geol. Ser., scale 1:50,000. Geology 1969, 1970, 1971.
1972b: Quaternary Geology of the Welland Area, Southern Ontario; Ontario Div. Mines, Prelim. Map P.796, Geol. Ser., scale 1:50,000. Geology 1972.
Karrow, P.F.
1963: Pleistocene Geology of the Hamilton-Galt Area; Ontario Dept. Mines, ORL, 68p. Accompanied by 4 maps, scale 1 inch to 1 mile.
Lewis, C.F.M.
1969: Late Quaternary History of Lake Levels in the Huron and Erie Basins; p.250-270 in Proc. 12th Conf. on Great Lakes Res., International Assoc. Great Lakes Res., 92p.
Ontario Agricultural College
1935: Soil Survey Map of County of Haldimand, Province of Ontario; Rept. No.4 of the Soil Survey by the Department of Chemistry; Ontario Agricultural College, Guelph, in co-operation with the Experimental Farm Service Dominion Department of Agriculture, Ottawa; map scale 1/2 inch to 1 mile.
Industrial Mineral Resources:
Hewitt, D.F.
1960: The Limestone Industries of Ontario; Ontario Dept. Mines, IMCS, 177p. Accompanied by Map No. 1960c, scale 1 inch to 20 miles, and Map No. 1960d, scale 1 inch to 1 mile.
1964: The Limestone Industries of Ontario 1958-1963; Ontario Dept. Mines, IMR13, 77p. Accompanied by Map 2039, scale 1 inch to 16 miles.

L A K E E R I E