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ONTARIO
DEPARTMENT OF MINES

INDUSTRIAL MINERAL RESOURCES

OF THE

BOLTON AREA

By

D.F. HEWITT AND O.L. WHITE

INDUSTRIAL MINERAL REPORT 30

1969

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INDUSTRIAL MINERAL RESOURCES OF THE BOLTON AREA

By

D.F. Hewitt[1] and O.L. White[2]

Introduction

This report on the Bolton area is one of a series describing the industrial mineral resources of an area comprising a map of the National Topographic Series. The Bolton area comprises the Bolton National Topographic Sheet (30 M/13) extending between latitudes 43°45' and 44°00'N and longitudes 79°30' and 80°00'W. This includes Albion Township and portions of the Townships of King, Vaughan, Toronto Gore, North York, Etobicoke, Tecumseth, Adjala, Mono, Caledon and Chinguacousy. The principal villages are Caledon, Caledon East, Cheltenham, Inglewood, Mono Mills, Palgrave, Bolton, Nobleton, King City, Kleinburg, Maple and Woodbridge.

Overburden is moderate to thick over most of the area as indicated on the Bolton bedrock topography sheet (White and Morrison, 1968). Overburden is generally thick in the north central and north eastern parts of the area from Palgrave to King

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City. Drift thicknesses are in excess of 500 feet in places. Drift is thin in Toronto Gore Township between Tullamore and Ebenezer and there are numerous bedrock outcrops in creeks in this area. Bedrock outcrops extensively along the Niagara Escarpment from Cheltenham to Credit Forks and again to a limited extent north and south of Mono Mills.

The Niagara Escarpment runs up the west side of the area. It forms a prominent topographic feature from Cheltenham to the Credit Forks. Elevations near Credit Forks exceed 1450 feet, while on the till plain below the escarpment near Cheltenham, elevations average about 950 feet above sea level. North of Credit Forks the Escarpment is largely covered and mantled with glacial drift. The caprock of the Escarpment is Amabel Dolomite, a reefy, irregularly to massive-bedded, light grey, fossiliferous, medium to coarsely crystalline dolomite. No rock is seen where the Escarpment is ascended on highway No. 10 south of Caledon. There are limited outcrops of dolomite about three miles east of Caledon, near Sleswick, and southeast of Mono Mills. There is some Amabel Dolomite in concession VI of Mono Township, three miles north of highway No. 9. Elevations from Caledon to Mono Mills range from 1450 to 1500 feet. Amabel Dolomite was quarried for the manufacture of lime three miles east of Caledon in concession IV E, Caledon Township. The remains of the lime kiln are on

the property.

Rocks of the Clinton and Cataract Groups lie beneath the Amabel Dolomite in the face of the Escarpment, and are best exposed in the quarries near Inglewood. These rocks are sparingly exposed in the Caledon-Mono Mills area. The formations of the Clinton and Cataract Groups, with the exception of the Whirlpool Sandstone, have not been quarried commercially to any extent. The Whirlpool Sandstone is quarried near Inglewood in several quarries near the base of the Escarpment, and was formerly quarried at Credit Forks. The Whirlpool Sandstone is the basal formation of the Silurian section in this area.

Below the Whirlpool Sandstone lies the red Queenston Shale of Ordovician age, which outcrops in places along the base of the Escarpment. There are several small outcrops of Queenston Shale in Mono and Adjala Townships within two miles of the Escarpment. Queenston Shale does not again outcrop until it is found along the Escarpment base from Credit Forks to Cheltenham. This formation was formerly quarried near Cheltenham for the manufacture of bricks.

Below the Queenston Shale lies the grey-green Meaford-Dundas Shale. This formation is exposed in creek and river valleys in Albion and Toronto Gore Townships between Tullamore and Ebenezer. There are also some small outcrops in the

Humber valley at Woodbridge and in concession IV of Adjala Township. This formation is not quarried commercially in the area.

The Pleistocene geology of the Bolton area has been mapped by Owen L. White (1968), and the following information is largely from his mapping. The Caledon meltwater channel extends in an arc down the front of the Escarpment from Mono Township through Mono Mills and Sleswick to cross No. 10 highway south of Caledon. Important gravel pits are located in this meltwater channel particularly at Caledon. A spillway with minor gravel deposits extends from Albion to Inglewood.

Ice contact deposits of the Oak Ridges kame moraine occupy the north part of the west half of the Bolton sheet and flank the Escarpment as far south as Inglewood. The Albion Hills and much of the knob and basin topography in the north part of the map area is part of this moraine which contains much outwash. A section of the Oak Ridges moraine occurs in the northeastern part of the Bolton area, southeast of Pottageville. A sandy outwash section of the Oak Ridges moraine extends into Vaughan Township north of Maple. There are many gravel pits in this whole moraine area, particularly at Maple and Palgrave.

White (1968) states that "glacial debris has been deposited as the result of the advance of ice from the northeast and southeast. The deposits have been built up

over a long period and apparently as a result of a number of advances of the ice. Tills representing two advances of ice have been recognized in the north of the area and five tills have been recognized in the south, although only three of the southern tills are found at the surface."

The lower northern till occurs on the Escarpment north of Caledon, at Mount Wolfe and along No. 9 highway north-east of Mt. Wolfe. The upper northern till occurs sparingly in the north part of the eastern half of the Bolton sheet.

The Wentworth (southern) Till occurs on the Escarpment south of Credit Forks, and flanking the southeast side of the Caledon meltwater channel in Caledon Township. The Halton (southern) Till occupies the southeast part of the western half of the Bolton sheet, and a major part of the eastern half of the Bolton sheet. The Wildfield Till - Lacustrine Complex occupies portions of the south part of the east half of the Bolton sheet in Toronto Gore and Vaughan Townships. The stratified clays were laid down in Lake Peel.

Some lacustrine deposits laid down in Lake Schomberg occur along the north edge of the eastern half of the Bolton sheet. Deltaic and lacustrine sands occur along the Humber River from Humber Summit north almost to Bolton. White (1968) points out that "the present major streams in the area, Main

Humber, East Humber and Credit River, occupy valleys that predate the last advance of the ice, and in fact there is even a close relationship between the present valleys and the preglacial drainage valleys. As a result of this, and where the present streams have cut down through the youngest till cover into earlier valley deposits, useful supplies of sand and gravels have been exposed."

Mineral Production

Mineral production in the area consists of sandstone building stone, and sand and gravel. Production in 1966 was estimated as follows:

Product	No. of Producers	Tonnage	Value $
Sandstone	8	5,000	115,000
Sand and gravel	9	8,055,899	4,921,994
Total			$5,036,994

Access

A grid of roads at approximately one mile intervals crosses the map sheet providing excellent access to the entire area. Provincial highways 400, 27, 50, 7, 9, and 10 cross the area, as well as several paved county roads.

Topography

Elevations on the top of the Niagara Escarpment north of Caledon range from 1,400 to over 1,525 feet. Elevations on top of the Escarpment south of Credit Forks range from 1,275 to 1,450 feet. The Credit River valley from Credit Forks to Cheltenham has an elevation of 950 to 850 feet. The Halton Till plain in the southern part of the map area slopes gently eastward from 950 feet in elevation near Victoria to 500 feet, in North York Township in the southeast corner of the map area. The Humber River and its branches dissect the till plain and form valleys over 100 feet deep in places. The knob and kettle topography of the Oak Ridges moraine in northern Albion Township forms the Albion Hills which extend from Sleswick to east of Palgrave. A prominent flat topped hill in northeastern Albion Township, known as Mount Wolfe, rises to 1,175 feet approximately two hundred feet above the surrounding countryside. Elevations in the Albion Hills range from 900 to 1,100 feet. The northern part of King Township has a hummocky knob and kettle type of topography and consists in part of interlobate Oak Ridges kame moraine and in part of till moraine. The Halton Till overrode the kame moraine area from the south. Elevations in northern King Township range from 900 to 1,150 feet.

Drainage

Except for the north edge of the area, drainage is to the south into Lake Ontario via the Credit river and the Humber river and its tributaries. The Credit river flows off the Escarpment at Credit Forks, and follows the base of the Escarpment to Cheltenham. The Humber river rises on the Escarpment west of Mono Mills and some of its tributaries rise in the Oak Ridges interlobate moraine. White (1968) indicates that the Credit and Humber rivers occupy valleys that predate the last advance of the ice and that where present drainage patterns are similar to earlier drainage systems, erosion in some places along the present rivers has uncovered earlier alluvial sands and gravels buried by younger till sheets.

Previous Work

The Pleistocene geology of the Bolton area was mapped by Owen L. White (1968), and his map forms the basis for a large part of the work here reported. The bedrock geology of the area is described by Caley (1940). More recently a study of the Silurian was made by Bolton (1957). The sandstone deposits

of the area were described by Hewitt (1964). Sand and gravel deposits were described by Hewitt and Karrow (1963).

Field Work

Field work was done during part of the summer of 1968.

Paleozoic Geology

The following is the table of bedrock formations for the Bolton area.

Table of Formations

Paleozoic		
Silurian:	Groups	Formations
	Albemarle Group:	Amabel Dolomite
	Clinton Group:	Fossil Hill Dolomite
	Cataract Group:	Cabot Head Shale
		Manitoulin Limestone
		Whirlpool Sandstone
Ordovician:		Queenston Shale
		Meaford-Dundas Shale

Ordovician

Meaford-Dundas Shale

The Meaford-Dundas Shale underlies the area east of a line running roughly from Tullamore through Connor. The formation consists of thin to medium-bedded, grey-green shale interlayered with grey beds of limestone or sandstone up to six inches thick. These hard layers are more common toward the top of the formation. The contact of the Meaford-Dundas with the overlying Queenston Shale is not exposed in the area, but it is gradational over about 10 feet where seen in a quarry at Streetsville. The base of the formation is east of the Bolton area. The thickness of the formation is difficult to ascertain due to the difficulty distinguishing the contact of the underlying Blue Mountain and Collingwood shales, but the thickness probably ranges from 700 to 800 feet.

The Meaford-Dundas Formation outcrops in creek valleys between Tullamore and Ebenezer in Albion and Toronto Gore Townships. Small outcrops are present in creek and river valleys on No. 7 highway on the east and west outskirts of Woodbridge and in lot 1, concession IV, Adjala Township. Perhaps the best exposure of Meaford-Dundas shale is on lot 7, concession VIII, Toronto Gore Township, on the west branch of the Humber river, one half mile north of highway No. 7. The exposure is on the north bank of the river, 100 yards west of the bridge on the 8th line road. The

section has been described by Guillet (personal communication) and the following description was supplied by him, together with tests of a sample from the section.

The section consists of 25 feet of Dundas Shale overlain by 10 to 15 feet of brown-weathering till. Hard layers 1 to 3 inches thick comprise 10 to 15 percent of the shale section. The shale is moderately soft, very thin-bedded, medium grey-green, weathering to pale grey with platy lamination. Some rustiness and minor white efflorescence is present on weathered surfaces. Ripple marks, and various crinoid, pelecypod and bryozoa fossils, are especially associated with the hard layers. The results of chemical, mineral and ceramic testing of a vertical channel sample representing the lower 16 feet of shale are given below.

Partial Chemical Analysis

Fe_2O_3	6.82 percent
CaO	3.88 "
Moisture	0.94 "
Soluble salts	0.55 "
Ignition loss	7.96 "

Mineralogy

(by x-ray diffraction)

Quartz	25 percent
Calcite	5 percent
Dolomite	not detected
Plagioclase	1 percent
K feldspar	less than 1 percent
Illite	abundant
Chlorite	moderate
Expanding mineral	minor

Ceramic Testing

Water of plasticity	18 percent
Lineal drying shrinkage	2.5 percent
Pyrometric cone equivalent (PCE)	5

	Cone 010 (1660°F)	Cone 06 (1840°F)	Cone 03 (1980°F)
Lineal firing shrinkage (%)	0.7	2.2	4.3
Colour	salmon	pale red	dark brown
Hardness	hard	hard	very hard
24-hour absorption (%)	12.2	9.8	1.5
5-hour boiling absorption (%)	14.1	12.0	3.5
Specific gravity	1.96	2.03	2.18

Remarks: Briquettes were blistered and overfired at cone 03.

The Dundas Shale has just sufficient workability for the manufacture of brick by modern extrusion equipment. It burns red and has a short firing range. It is also suitable for the manufacture of lightweight aggregate.

In 1967 some exploratory diamond drilling was carried out in lot 6, concession IX, Toronto Gore Township, to test the Dundas Shale section.

Queenston Shale

Queenston Shale forms the bedrock in a band extending from the base of the Niagara Escarpment to the top of the Meaford-Dundas Shale on a line from Tullamore through Connor. The formation is Upper Ordovician in age and consists of brick red, thinly-bedded, fissile shale with interbeds of greenish arenaceous or calcareous rock. With the red shale sequence are seams and bands of green shale following bedding planes or cross-cutting the sequence along fractures. Round or oval green "eyes" frequently appear in the red shale and these sometimes have centres of calcite or carbonaceous material. Seams and concretions of yellowish gypsum are sometimes present.

In the Bolton area the Queenston Shale is 375 to 475 feet thick, and thins to the north. It is overlain by

Whirlpool Sandstone of Silurian age and underlain by the grey-green Meaford-Dundas Shale. Queenston Shale readily breaks down under weathering processes to form a red clay soil which is characteristic of the area below the Niagara Escarpment from Cheltenham to Inglewood, and north of Mono Mills. There are abundant eroded outcrops of Queenston Shale on the lower slopes of the Escarpment between Cheltenham and Inglewood. The Queenston Shale is covered by overburden north of Credit Forks to Mono Mills. There are outcrops of Queenston Shale north of highway No. 9 in concessions VII and VIII of Mono Township and in concession II of Adjala Township. To the east the Queenston Shale is covered by thick overburden.

The ceramic properties, chemical composition, and chemical and mineral variations of the Queenston Shale are described by Guillet (1967, p.58-59). Domtar Construction Materials Limited formerly operated a quarry in the Queenston Shale and a brick plant a mile southwest of Cheltenham. It was closed on January 1, 1965. A 58 foot section of Queenston Shale was exposed in the quarry. Chemical and mineral analyses and ceramic tests of the shale are given by Guillet (1967, p. 74-76). From this information it is apparent that the Queenston Shale exposed in the Bolton map area would be suitable for the manufacture of brick.

Silurian

Rocks of the Clinton and Cataract Groups are only exposed in the face of the Niagara Escarpment, with the best outcrops being between Inglewood and Credit Forks.

Cataract Group

Whirlpool Sandstone

The basal member of the Silurian resting on the Ordovician Queenston Shale is the Whirlpool Sandstone of the Cataract Group. It outcrops on a broad ledge half way down the Escarpment in concession III W of Caledon Township, southwest and west of Inglewood. Here the sandstone is quarried in a group of small quarries for building stone. The stone goes by the trade name of "Credit Valley Sandstone". The quarries are described by Hewitt (1964, p.32-38).

The Whirlpool Sandstone is a thin to massive-bedded, medium to fine-grained, grey to red or grey and red mottled, crossbedded, compact, unfossiliferous quartzose sandstone. In the map area its thickness is about 12 to 15 feet.

A group of six to eight small sandstone quarries are being operated on a terrace of Whirlpool Sandstone on the side of the Escarpment on lots 1 to 4, concession III W, Caledon Township. About 5 operators are working along a continuous

stretch of sandstone outcrop about three quarters of a mile long in lots 1 and 2, concession III W. These quarries are on properties owned by Credit Valley Quarries, D. Davidson and the University of Toronto. The quarry operators pay a royalty to the owners and the operators change from time to time. In 1968 quarry operations were carried out by Messrs. Smithson, Zilio, Wilson, Shepherd Brothers and Garvin & Logan.

The most southerly quarry face was that of Steve Norrie. The quarry face has been advancing into the side of the Escarpment and the thickness of the overlying rock is now a serious problem which will soon limit quarrying to the west. About 25 feet of Manitoulin Limestone and Cabot Head Shale overlie the sandstone beds. The stone quarried is an 8-foot section of massive, grey, fine-grained Whirlpool Sandstone with good splitting qualities. Production is mainly ashlar, flagstone, steps, coping, dry wall stone and rubble.

Physical properties of grey Whirlpool Sandstone from Norrie's quarry were as follows, Hewitt (1964, p.33):

Compressive strength, p.s.i., maximum: 16700;
minimum: 11000;
average: 13850;

Absorption, 3.01 percent;

Bulk specific gravity, 2.33;

Weight per cubic foot, 145 pounds;

Abrasive hardness, 9.3.

North of the Norrie quarry a flat area of Whirlpool Sandstone has been stripped extending east several hundred feet from the Escarpment. Thin to medium bedded red and grey sandstone are quarried here.

In the quarry openings along the Escarpment cliff operated by Smithson and Wilson, the overlying limestone and shale are exposed in a 30 foot section. This overburden problem is limiting quarrying to the west and the supply of good stone which is readily available is becoming depleted.

Three other small sandstone quarries are located in lots 3 and 4, concessions II and III W, Caledon Township. In 1968 the McAlpine and DeForest quarries were operated (Hewitt, 1964, p.37).

Where the Escarpment turns west toward Credit Forks, the Whirlpool Sandstone was formerly quarried by underground mining into the side of the cliff face. These operations ceased about the turn of the century. Some of these quarries are described by Parks (1912, p.153-156).

Manitoulin Limestone

Overlying the Whirlpool Sandstone in the face of the Escarpment is the Manitoulin Limestone, a formation about 15 feet thick in the Bolton map area. (Bolton 1957, p.15). The Manitoulin Limestone consists of a thick to thin-bedded, grey,

buff-weathering, aphanitic to fine crystalline, argillaceous dolomitic limestone with grey shale partings and occasional white chert. The contact with the overlying Cabot Head Shale is gradational through a few feet of interbedded shale and dolomitic limestone. The Manitoulin Limestone is well exposed in the sandstone quarries southwest of Inglewood. The formation is not utilized commercially in the area.

Cabot Head Shale

Overlying the Manitoulin Limestone in gradational contact is the Cabot Head Shale. The formation consists of thin-bedded, fissile grey shale with thin interbeds of grey to rusty-weathering calcareous sandstone and dolomitic limestone. Bolton (1957, p.17) states that "in almost every section between the type locality on the Bruce Peninsula and Hamilton, the Cabot Head strata include near the top a thin red facies of variable lithology and thickness, predominantly composed of red calcareous sandstone and arenaceous limestone, overlain by green shales of variable thickness." Bolton reports the thickness of the Cabot Head Shale as over 48 feet at Credit Forks (Bolton 1957, p.18).

Cabot Head Shale is exposed in the sandstone quarries southwest of Inglewood, where up to 20 feet is exposed. The shale is not used commercially in the area, however ceramic

tests carried out for G.R. Guillet by the Laboratory Branch of the Ontario Department of Mines indicate that weathered sections of Cabot Head Shale are particularly attractive as a ceramic raw material, having good plasticity and burning to a dense salmon body at low temperatures (Guillet, personal communication). The shrinkage is moderate on firing, and absorption is low. The shale is suitable for the manufacture of brick and tile. Some sections of Cabot Head Shale show promise for production of coated expanded lightweight aggregate (Wilson, 1963, p.25, 40-41), but none of the sections tested were in the Bolton area.

Three shale samples for ceramic testing were taken by G.R. Guillet at Cataract, about three miles northwest of Credit Forks, and proved to be suitable for manufacture of brick. A composite sample of 25 feet of Cabot Head Shale from Cataract gave the following chemical analysis:

	Percent
SiO_2	53.6
Al_2O_3	16.4
Fe_2O_3	5.58
CaO	3.92
MgO	4.76
Na_2O	0.42
K_2O	5.27
TiO_2	0.80
CO_2	5.66
H_2O+	3.10
H_2O-	0.68
SO_3	nil
MnO	0.06
Total	100.3
L.O.I.	8.86

Clinton Group

Fossil Hill Dolomite

The only formation of the Clinton Group present in the area is the Fossil Hill Dolomite which is apparently the lateral equivalent of the Reynales Dolomite, which is seen in the Georgetown-Acton area. The Fossil Hill formation was proposed by Bolton (1957, p.39). The Fossil Hill Dolomite is exposed in a section on lot 13, concession IV E, Caledon Township. Here it is comprised of seven feet of dolomite, brown to brownish grey, fine crystalline, massive, thin-bedded in the upper and lower parts, with abundant fossils (Bolton 1957, p.96). Two feet of Cabot Head Shale outcrop beneath the Fossil Hill Dolomite and 10 feet of Amabel Dolomite outcrop above the Fossil Hill.

Bolton notes that the Fossil Hill contains banks of the brachiopod Pentamerus oblongus and an abundance of corals.

Albemarle Group

Amabel Dolomite

Within the Bolton map area the cap rock of the Niagara Escarpment is the Amabel Dolomite, a reefy, medium-crystalline, highly fossiliferous, light buff to grey, medium to massive bedded dolomite. The Amabel Dolomite outcrops along the edge

of the Escarpment from west of Cheltenham to the Credit Forks. The maximum thickness of Amabel Dolomite exposed is 25 feet at Credit Forks. South of Credit Forks on top of the Escarpment, drift is quite thick ranging up to 90 feet (see figure 1). Farther to the east the drift is thinner and it would be possible to establish a quarry in Amabel Dolomite on top of the Escarpment.

The Amabel Dolomite outcrops in a narrow band on the crest of the Escarpment in lots 12 and 13, concessions III, IV and V East, Caledon Township. A small quarry and lime kiln were formerly operated in lot 13, concession IV East, Caledon Township. Amabel Dolomite also outcrops sparingly along the Escarpment edge from Sleswick to Mono Mills, and north of No. 9 highway in concession VI E, Mono Township. In general the overburden from Sleswick to Mono Mills is too thick for quarrying the underlying dolomite.

The Amabel Dolomite is generally of high chemical purity and qualifies as high-purity dolomite for metallurgical flux. In the Brampton area to the south, the dolomite is principally quarried as crushed stone for concrete aggregate, road stone and asphalt aggregate. Its soundness, absorption and abrasion qualities make it suitable for these uses. Los Angeles abrasion tests range from 21 to 35 percent loss, indicating the rock is generally rather soft. $MgSO_4$ soundness ranges

from 2 to 9 percent loss. The stone is sound. Absorption ranges from 0.4 to 1.6 percent.

In the Bruce Peninsula, Bolton (1957, p.51-57) divides the Amabel formation into four members: Lions Head, Colpoy Bay, Wiarton and Eramosa. However in this area these members are not easily recognized. Within the map area the Amabel Dolomite rests on the Fossil Hill Dolomite, the lateral equivalent of the Reynales formation of the Brampton area.

Bedrock Topography

A bedrock topographic map of the Bolton area (White and Morrison, 1968) indicates considerable relief in the bedrock surface, largely on account of the presence of several deep buried valleys. These valleys were probably formed before glaciation and deepened during subsequent advances of the ice (White, 1968).

Pleistocene Geology.

Information on the Pleistocene geology of the Bolton area is largely taken from White (1968) and the reader is referred to his work for more detailed information.

Glacial History

Glacial ice sheets spread over the Bolton area during

the Illinoian and Wisconsian glacial stages. White (1968) states that "the oldest tills recognized in the south part of the area have only been seen in section where they are exposed in a railroad cut near Woodbridge. These are believed to be correlates of the York Till of Illinoian age and the Sunnybrook Till (Early Wisconsinan)." The ice advances responsible for these tills were probably about 100,000 years and 55,000 years ago. By 28,000 years ago the last major ice advance was under way and by 20,000 years ago the ice had spread to its maximum extent, reaching southern Ohio. As far as is known, all of southern Ontario was covered by glacial ice until about 14,000 years ago, when a retreat of the ice fronts began. As the ice front retreated one ice lobe occupied the Lake Ontario basin and another lobe occupied the Lake Simcoe basin.

As the Lake Ontario and Lake Simcoe lobes parted along a line from Orangeville to Aurora the interlobate kame moraine was formed, or added to, in Albion and King Townships. When the two lobes stood at the edge of the Niagara Escarpment from Mono Mills to Caledon, a glacial meltwater channel along the Escarpment edge was formed and extensive channel gravels were laid down south of Caledon, and north of Mono Mills.

The Wentworth Till was laid down by the southern lobe probably about 13,500 years ago. Later the ice lobe retreated

and then readvanced to lay down the Halton Till. While this ice front lay between Inglewood and Caledon East, frontal ice contact sands and gravels were laid down in a broad zone from Inglewood to Lockton. Shortly afterwards when the ice front lay along the same line, a glacial meltwater channel was formed running from Albion to Inglewood. Very little good quality gravel has been found in this channel. The advance of the ice, during the time of formation of the Halton Till about 12,000 to 13,000 years ago, overrode parts of the Oak Ridges kame moraine in Albion Township and formed a rugged area of till moraine.

As the northern Lake Simcoe lobe retreated, silt and clays were laid down in glacial Lake Schomberg in northern King Township, ponded against the Oak Ridges interlobate moraine.

As the southern ice lobe retreated glacial Lake Peel was formed in Toronto Gore and Vaughan Townships on the south slope and the Wildfield Till-Lacustrine Complex was laid down overlying the Halton Till.

Physiographic Features

The Niagara Escarpment

The Niagara Escarpment occupies a band a few miles wide

along the western edge of the map area from Cheltenham to north of Mono Mills. West of Cheltenham where the Credit River valley has an elevation of about 850 feet, the Escarpment rises in a uniformly moderate slope to a height of 1,325 feet on the western edge of the sheet. West of Cheltenham the lower slopes of the hill are composed of heavily eroded red Queenston shale. West of Inglewood where the Credit River valley has an elevation of about 875 feet, the Escarpment rises on a uniformly moderate slope to a height of about 1,200 feet where there is a broad ledge some half a mile wide. This marks the outcrop shelf of the Whirlpool Sandstone and the sandstone building stone quarries are located from lots 1 to 5 along the shelf. The contours of the National Topographic sheet are misleading in this area as the shelf is not well shown. West of the Whirlpool Sandstone flats, the Escarpment rises in a steep cliff to approximately 1,325 feet.

At Credit Forks, and for a mile to the east, the Escarpment forms a steep cliff standing above the Canadian Pacific Railway line and elevations rise steeply from 1,000 feet in the valley to 1,450 feet on top of the Escarpment at Credit Forks. Old underground sandstone workings occur east of Credit Forks along the side of the Escarpment.

On top of the Escarpment south of Credit Forks the Amabel Dolomite is covered by a hummocky moraine of Wentworth

Till to a depth of up to at least 90 feet. East of The Grange along the eastern edge of the Escarpment, drift thicknesses are reduced to between zero and 16 feet and there is an area of quarriable Amabel Dolomite as indicated on figure 1.

An abandoned sandstone quarry occurs on the north side of Credit Forks on a spur between the north branch and the main river at an indicated elevation of 1,125 feet which does not agree with the indicated elevations for the Inglewood quarries. The Credit River forms a re-entrant in the Niagara Escarpment at Credit Forks.

From Credit Forks to Sleswick the Niagara Escarpment is almost buried in thick, hummocky, bouldery moraine of the Wentworth Till. The covered slope of the Escarpment forms the Caledon Hills. No rock is visible where No. 10 highway climbs the Escarpment southeast of Caledon. Some Amabel Dolomite and underlying Fossil Hill Dolomite and Cabot Head Shale are exposed on the north side of the Mono Mills-Caledon meltwater channel in concessions III to V West, Caledon Township. The hill slope to the south is hummocky Wentworth Till and ice contact sand and gravel.

From Sleswick to Mono Mills the Escarpment again forms no cliff, but is covered by thick moraine deposits and slopes moderately to the rugged knob and kettle topography of the Albion Hills of the Oak Ridges moraine. The elevations on

the top of the Escarpment south of Mono Mills exceed 1,500 feet in places. The area on top of the Escarpment is a till plain with drumlins and moraine ridges, underlain by drift ranging from 20 to over 60 feet thick. This area is not suited for quarry development due to the depth of overburden. Sparse outcrops of Amabel Dolomite may be found between Sleswick and Mono Mills about one quarter mile east of the Airport road.

There is a small re-entrant in the Escarpment where the upper reaches of the Humber River flow off the scarp west of Mono Mills. The valley is in drift. In Mono Township the Escarpment is not well developed but there is a scarp in drift of about 100 feet in concession VII and VIII. The Mono Mills-Caledon meltwater channel deposits blanket the Escarpment in this area and the drift is principally sand and some gravel. The Amabel Dolomite outcrops in concession VI, Mono Township along the edge of the map sheet.

Oak Ridges Moraine

The second prominent topographic feature of the area is a broad hilly moraine extending from the Escarpment in Mono and Caledon Townships eastward across King Township. This is in part an interlobate moraine built up when the Lake Simcoe and Lake Ontario ice lobes split along this line. It is

composed in part of hummocky knob andkettle topography built of ice contact sand, gravel and silt. This is part of the great Oak Ridges moraine which extends from here to the vicinity of Trenton.

In King Township the Halton ice sheet has overridden the kame moraine forming an extensive hilly area of till moraine. Along the north edge of the map in King Township, clays were laid down in Lake Schomberg which was ponded between the Lake Simcoe ice lobe and the Oak Ridges moraine.

Extending southwest from Lockton in Caledon township to the vicinity of Inglewood, is an area of ice contact drift composed of sand, gravel and silt, laid down in front of the Lake Ontario ice lobe, between the lobe and the slopes of the Niagara Escarpment.

Halton Till Plain

The area east of the Escarpment, and the Albion-Inglewood channel, is occupied by the Halton Till plain. This bevelled till plain slopes south and east from an elevation of about 1,000 feet at Mono Road Station to 500 feet in North York Township in the southeast corner of the map area. In Toronto Gore and Vaughan Townships the till plain is deeply dissected by the Humber River and its tributaries.

White (1968) points out that "over much of Toronto Gore and Vaughan townships, thin, discontinuous deposits of the Wildfield Lacustrine-Till Complex overlie the Halton Till. This material was apparently deposited in the temporary ponding of glacial meltwaters referred to as Lake Peel. The deposits are not exclusively lacustrine and in fact are often till like. Frequently the lacustrine and till-like layers are interbedded." The Wildfield deposits are largely below 750 feet in elevation.

Pleistocene Geomorphology

The principal Pleistocene geomorphic forms consist of till moraines, kame moraines, till plains, drumlins, outwash, meltwater channels, deltas and lake plains.

Till Moraines

Till moraine occurs on top of the Escarpment south of Mono Mills and consists of northern till. Wentworth Till moraine occurs on top of the Escarpment south of the Credit Forks and forms the Escarpment slope from Credit Forks to Sleswick. An area of Halton Till moraine occurs in west and central King Township where the ice has overridden the kame moraine.

Kame Moraine

The area of Oak Ridges kame moraine in the northern part of the area extending through Caledon, Albion and King Townships has been previously described.

Till Plains

The principal till plain in the area is the Halton Till plain which extends across the southern part of the area and slopes gently to the southeast. Other till plains are composed of Wentworth Till on the Niagara Escarpment near Inglewood and of northern till on the Escarpment south of Mono Mills.

Drumlins

Drumlins are oval hills usually about ¼ to 1 mile in length and often not more than ¼ mile wide. They stand up 50 to 75 feet above the till plain and are generally composed of sandy loam till. Drumlins are not common in the map area but some occur in Wentworth and northern tills on the Escarpment.

Outwash

A kame and outwash complex occurs in front of the ice sheets in the northern part of the area. This makes up part

of the Oak Ridges kame moraine.

Meltwater Channels

The two prominent glacial meltwater channels extend, one from the north-west corner of the area through Mono Mills to Caledon, and the other from Albion to Inglewood. The former channel has extensive gravel deposits south of Caledon.

Lake Plains

The Lake Schomberg plain extends into the northern part of the area on the north side of the Oak Ridges moraine. The Lake Peel dissected plain occupies a large part of Toronto Gore and western Vaughan Townships. Some sandy deltas were built in the lake.

Economic Geology

The industrial mineral deposits being exploited in the area include Whirlpool Sandstone and sand and gravel. The Meaford-Dundas Shale, the Queenston Shale and the Amabel Dolomite have economic potentialities.

Meaford-Dundas Shale

Ceramic tests indicate that the Meaford-Dundas Shale

would be suitable for manufacture of brick and lightweight aggregate. The principal area available for development lies between Tullamore and Ebenezer where the shale is close to the surface and outcrops in the creek valleys. Further data is given in a previous section of the report.

Queenston Shale

The Queenston Shale is suitable for the manufacture of brick and is used for this purpose in the Brampton area to the south of the Bolton map sheet. The two areas where the Queenston Shale is available in surface outcrops are along the base of the Escarpment from Cheltenham to Inglewood, and in concessions VII and VIII, Mono township, north of highway No. 9.

Other information on the Queenston Shale is given in an earlier part of the report.

Whirlpool Sandstone

The basal member of the Silurian resting on the Queenston Shale is the Whirlpool Sandstone. It is quarried by eight small operators near Inglewood. The stone and the quarry operations are described in an earlier section and by Hewitt (1964, p.32-38). Reserves of Credit Valley sandstone are becoming depleted in the Inglewood area and a further supply

would have to be obtained by underground mining in the side of the Escarpment.

In the area north of the Credit Forks, the Whirlpool Sandstone does not outcrop. It was formerly quarried in the vicinity of Orangeville.

Amabel Dolomite

The outcrop pattern of the Amabel Dolomite is described in a previous section and is shown on the map. The most favourable area for quarrying Amabel Dolomite along the Escarpment extends from Cheltenham to Inglewood as shown by drift thicknesses in figure 1. At the present time competitive economic conditions do not warrant quarrying the dolomite in this area.

Sand and Gravel

Types of sand and gravel deposits in the Bolton area include meltwater channels, kames, outwash, fluvial and deltaic sands. There are numerous small gravel pits in the Bolton area and these are shown on White's map (1968). Most of these are small pits which are abandoned or active on demand. The principal commercial sand and gravel operations are listed and described below. The main operations are at Maple and Caledon.

The following frequency scale is used in pebble counts of gravel:

Flood	over 50%
Abundant	25 - 50%
Common	10 - 25%
Scarce	5 - 10%
Rare	2 - 5%
Very rare	less than 2%

Commercial Sand and Gravel Producers

1. Caledon Sand and Gravel Limited.
2. Peel Construction Company Limited, Caledon pit.
3. Consolidated Sand and Gravel Limited, Caledon pit.
4. Peel Construction Company Limited, Mono Mills pit.
5. Coyles pit.
6. Jas. Dick Construction Limited.
7. Connor Transport Limited, Elder Mills pit.
8. Crawford-Ontario Sand and Gravel Limited, Maple pit.
9. Pinewood Aggregates Limited.
10. J. Chefero Sand and Gravel Limited.
11. Connor Transport Limited, Maple pit.
12. Spragges pit.
13. Schultz pit.

Caledon Sand and Gravel Limited

The gravel pit operated by Caledon Sand and Gravel Limited is on the east side of highway No. 10, a mile south of Caledon, on lot 13, concession I E, Caledon Township, Peel county. The property is described by Hewitt and Karrow (1963, p.65).

A pebble count of gravel from this deposit gave the following assemblage:

	Frequency
Black River and Trenton limestone,	Abundant
Dundas siltstone,	Abundant
Sandstone,	Rare
Dolomite,	Very rare
Precambrian acid igneous rocks,	Scarce
Precambrian basic igneous rocks,	Very rare
Precambrian metamorphic rocks,	Scarce.

Peel Construction Company Limited

Caledon Pit

The Caledon pit of Peel Construction Company Limited is on the west side of highway No. 10, about three-quarters of a mile south of Caledon village, in Caledon Township, Peel County. The deposit is a spillway gravel. One 20-foot face examined

consisted of medium sand (60 percent) and coarse gravel (40 percent). About 30 percent of the stone exceeds 4 inches in size, and 60 percent exceeds one inch in size. Portable plants produce crusher run gravel, sand and stone.

A pebble count of gravel from this pit gave the following assemblage:

	Frequency
Black River and Trenton limestone,	Abundant
Brownish Dundas siltstone,	Abundant
Dolomite,	Rare
Sandstone,	Rare
Black shale,	Very rare
Precambrian granitic rocks,	Rare
Precambrian basic igneous rocks,	Very rare
Precambrian metamorphic gneisses,	Scarce.

Consolidated Sand and Gravel Company

Caledon Pit

A gravel pit is operated by Consolidated Sand and Gravel Company in lot 8 or 9, concession II E, Caledon Township, Peel County. The material was deposited not far from the ice front. A 20-foot face exposed medium gravel (70 percent) and coarse sand (30 percent). The maximum size of boulders is about 8 inches, with 30 percent exceeding 4 inches in size, and 50

percent exceeding one inch in size.

The gravel is hauled to the Malton plant of Consolidated Sand and Gravel for processing.

A gravel pit across the road in concession III E, Caledon township, is operated intermittently by Peel Construction Company Limited. The pit was not in operation when visited by the writer in July 1968.

Peel Construction Company Limited

Mono Mills Pit

A gravel pit is operated by Peel Construction Limited on lot 23, concession VI E, Caledon Township, Peel County, on the south side of highway No. 9, just west of the village of Mono Mills. The pit is described by Hewitt and Karrow (1963 p.67) under the name Mineral Industries Sand and Gravel Limited.

A pebble count of gravel from this deposit gave the following assemblage:

	Frequency
Black River and Trenton limestone,	Flood
Amabel dolomite,	Very rare
Dundas siltstone,	Abundant
Red Queenston shale,	Very rare
White Potsdam sandstone,	Very rare
Precambrian granitic rocks,	Scarce
Precambrian metamorphic rocks,	Scarce.

Coyles Pit

Coyles gravel pit is operated in lot 13, concession III E, Caledon Township, Peel County. In July 1968 it was operated by J. Schwandt Construction Limited. A six foot face exposed poorly stratified silty sand and gravel. There was approximately 50 percent stone, 30 percent sand and 20 percent silt. Maximum size of boulders was about 12 inches; 40 percent of the stone exceeded 4 inches in size and 70 percent exceeded one inch in size. The gravel deposit is covered by a till cap. A portable plant was producing crusher run gravel.

Jas. Dick Construction Limited

A sand pit operated by Jas. Dick Construction Limited is located in lot 20, concession V, Albion Township, Peel County. A 20-foot face exposes stratified fine to medium sand. A few hundred feet to the southwest other 10 and 20 foot faces are opened in stratified fine sand. The products are principally sand fill.

Connor Transport Limited

In 1967 Connor Transport Limited operated a gravel pit

on the west side of highway 27, one half mile north of Elder Mills, in Vaughan Township. Production was by dragline from a pond on the property. There is a portable crushing and screening plant.

Connor Transport Limited

A sand pit was operated in 1967 by Connor Transport Limited on lot 20, concession IX, Vaughan Township, York County, on the west side of highway No. 27, one mile south of Kleinburg. The sand pit is described by Hewitt and Karrow (1963, p.68) under the name of Monarch Sand and Gravel Company.

Crawford - Ontario Sand and Gravel Limited

The pits operated by Crawford-Ontario Sand and Gravel Limited are on lots 22 and 23, concession III, Vaughan Township, York County, ½ mile north of Maple. The deposit consists predominantly of stratified fine and coarse sand with some fine gravel. A fifty-foot face examined consisted of stratified coarse and fine sand. A 35-foot face examined consisted of stratified sand and fine gravel.

A pebble count of gravel from the property gives the following assemblage:

	Frequency
Black River and Trenton limestone,	Flood
Brownish aphanitic dolomite,	Rare
Brownish Dundas siltstone,	Scarce
White Potsdam sandstone,	Rare
Black shale,	Very rare
Precambrian acid igneous rocks,	Common
Precambrian basic igneous rocks,	Very rare
Precambrian metamorphic rocks,	Scarce.

Products include granular A and B gravel, sand fill, asphalt sand, concrete sand, brick sand, and plaster sand.

The property is described by Hewitt and Karrow (1963, p. 71) under the name Ontario Sand and Gravel Company Limited.

Pinewood Aggregates Limited

The sand pit operated by Pinewood Aggregates Limited is ¾ mile north of Maple on lot 25, concession III, Vaughan Township, York County. A 40 to 50 foot face examined consisted of stratified fine sand with sparse fine gravel.

A sieve analysis of sand taken from the face is given in (I):

(I) Pinewood Aggregates Limited

		-4	-8	-14	-28	-48	-100	
Mesh	+4	+8	+14	+28	+48	+100	+200	-200
Weight Percent	Nil	0.25	2.15	16.2	49.15	31.65	0.25	0.35

A mineralogical analysis of the sand by the Laboratory Branch of the Ontario Department of Mines indicates the following mineral constituents: Quartz, 52 percent; feldspar, 10 percent; Paleozoic limestone, 29 percent; grey shale and siltstone, 2.5 percent; black shale and siltstone, 5 percent; garnet, 0.5 percent; acid igneous rock, 1.0 percent.

The principal products are brick sand, asphalt sand, sand fill and pit run material. The property is described by Hewitt and Karrow (1963, p.71).

J. Chefero Sand and Gravel Limited

The sand pit operated by J. Chefero Sand and Gravel Limited is on lot 25, concession III, Vaughan Township, York County, on the first sideroad north of Maple. A 30 foot face examined consisted of stratified fine sand and sparse fine gravel in the proportions of 90 percent sand and 10 percent stone.

A sieve analysis of sand taken from the face is given in (II):

(II) J. Chefero Sand and Gravel Limited

		-4	-8	-14	-28	-48	-100	
Mesh	+4	+8	+14	+28	+48	+100	+200	-200
Weight Percent	0.25	1.45	2.35	7.45	40.85	46.05	1.0	0.6

A mineralogical analysis of the sand by the Laboratory Branch of the Ontario Department of Mines indicates the following mineral constituents: Quartz, 45 percent; feldspar, 11 percent; Paleozoic limestone, 34.5 percent; grey shale and siltstone, 3 percent; black shale and siltstone, 1.5 percent; garnet, 1.5 percent; hornblende, 2 percent; pyroxene, 0.5 percent; cemented aggregates, 1.0 percent.

The principal products are concrete sand, brick sand and sand fill. There are 2 screening plants. The property is described by Hewitt and Karrow (1963, p.71).

A pebble count of gravel from the pit gives the following assemblage:

	Frequency
Black River and Trenton limestone,	Flood
Dolomite,	Very rare
Brownish Dundas siltstone,	Scarce
White Potsdam sandstone,	Rare
Black shale,	Very rare
Precambrian acid igneous rocks,	Scarce
Precambrian basic igneous rocks,	Rare
Precambrian metamorphic rocks,	Common

Connor Transport Limited

The sand pit operated by Connor Transport Limited is on lot 26, concession III, Vaughan Township, York County, on the first sideroad north of Maple. A 30 foot face consists of fine stratified sand. The products are mainly brick sand and sand fill. A sieve analysis of sand from the face is given in (III).

(III) Connor Transport Limited

		-4	-8	-14	-28	-48	-100	
Mesh	+4	+8	+14	+28	+48	+100	+200	-200
Weight Percent	Nil	Nil	Nil	Nil	0.1	11.95	57.75	30.2

This is a very fine sand.

Spragges Pit

Spragges gravel pit is on lot 23, concession III, King Township, York County, 3 miles southeast of Kettleby. The pit is described by Hewitt and Karrow (1963, p.73).

A pebble count of the gravel gave the following assemblage:

	Frequency
Black River and Trenton limestone,	Flood
Dolomite,	Rare
Black shale,	Very rare
Precambrian acid igneous rocks,	Common
Precambrian metamorphic rocks,	Common

In 1967 the pit was re-examined. A 20-foot face being worked consisted of stratified sand with minor gravel. Pit run material made up the major part of the production.

Schultz Pit

The Schultz gravel pit is in lot 16, concession VIII, King Township, York County, two miles north of Nobleton, and one mile east of highway No. 27. A 12 foot face exposes stratified sand and fine gravel. There was no plant in the pit when visited in July 1968 and the principal product was pit run gravel.

Engineering Geology

The shale of the Dundas Formation is prone to rapid disintegration when exposed to the atmosphere. Thus when excavations are made into this material, precaution must be taken to curb deterioration if a good surface is required for

the placement of concrete etc.

The Halton Till is in a medium dense - to dense condition and in general provides a satisfactory bearing surface for most structures, highways etc. It compacts well and has been used for several earth-fill structures including the large embankment for the C.N.R. crossing of the Humber near Woodbridge. For road construction the Halton Till tends to be slightly frost susceptible and to prevent heaving, a blanket of some 24" of gravel is used for a sub-base. Limit values of the Halton Till are as follows:

LL 15-30, PI < 10.

The Wildfield Complex deposits are somewhat more plastic (LL 30-45, PI 10-25) and except for the more silty phases (i.e. silty clay loam) are not so prone to frost heave.

The Wentworth Till is generally non plastic but has enough fines to provide a binder to make good fill. The more gravelly phases of the Wentworth Till can be used as a low quality granular fill.

The northern lower till (LL 14-20, PI 1-12) would also be a suitable source for compacted fill but the northern upper till (LL 27-33, PI 10-15) is somewhat more plastic and generally contains up to 80% of silt and clay sized material.

All materials in the area are quite inactive with activity values rarely in excess of 0.50.

The fine sands and silts of the deltaic deposits are quite prone to frost action and have caused considerable trouble with heave and break-up where traversed by low cost roads.

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MARGINAL NOTES

Mapping of the area was carried out in the 1962 summer field season by P.F. Karrow, B.C. McDonald, L.L. Davies and W.R. McClymont and in the 1963, 1964 and 1965 field seasons by O.L. White assisted by R.A. Fisher, W.D. Morrison, D.B. Steele and J.E. Walker.

Field techniques included the examination of road and railroad cuts, foundation excavations, pipeline trenches, sand and gravel pits and natural exposures in stream banks as well as test pitting and augering by hand. Aerial photographs were used throughout the area. Subsurface information was obtained from several drill holes as well as engineering reports made available by numerous government bodies and private companies. Water well records of the Ontario Water Resources Commission were examined to obtain information on the bedrock surface. The results of the bedrock surface study were published earlier (White & Morrison, 1968).

Bedrock: Bedrock outcrops along the Humber River valley and in several valleys in Toronto Gore Township (Dundas-Meaford Formation) and extensively along, and adjacent to, the Niagara Escarpment at the western edge of the area (Queenston Formation, Clinton and Cataract Groups and the Amabel Formation). Numerous quarries along the Escarpment have been operated over the years to produce building stone and stone for lime production, and several quarries are still operating today in the Whirlpool Sandstone of the Cataract Group. The bedrock surface shows considerable relief on account of several deep pre-glacial valleys some of which were deepened by the subsequent advance of the ice.

Glacial deposits: Glacial debris has been deposited as the result of the advance of ice from the northeast and the southeast. The deposits have been built up over a long period and apparently as a result of a number of advances of the ice. Tills representing two advances of ice have been recognized in the north of the area and five tills have been recognized in the south, although only three of the southern tills are found at the surface. A considerable part of the area mapped is underlain by sands, gravels and silts deposited by the meltwaters of the ice.

Northern tills: The two northern tills have contrasting textures. The older or lowest till is a light brown sandy loam to loam* with considerable (10% - 40%) gravel content where it occurs at and above the Escarpment. East of the Escarpment, it is exposed in several areas but in general is covered by younger deposits. Above the Escarpment, and at the edge, it forms several parallel morainic ridges which are probably the southern part of the Singhampton Moraine.

The lower and upper tills are separated by variable thicknesses of sand and gravel (in the west) or sands, silts and clays (in the east). The upper till is a light grey silty clay to silty clay loam with generally very few pebbles. It occurs in isolated patches on hilltops in the west or as a fairly continuous capping in the northeast corner, but is itself covered by deposits of Lake Schomberg along the north-central edge of the map area. The ice depositing this till did not extend as far as the previous ice nor did it build a moraine at its outer limit.

Southern tills: The oldest tills recognized in the south part of the area have only been seen in section where they are exposed in a railroad cut near Woodbridge. These are believed to be correlates of the York Till of Illinoian age and the Sunnybrook Till (Early Wisconsinan).

These tills are overlain by a gravelly loam to sandy loam till believed to be a correlative of the Wentworth Till. The Wentworth Till has been recognized elsewhere in sub-surface borings but also is exposed at the surface on the western edge of the map-area. Here it forms part of the Paris Moraine and has a much higher gravel content as well as numerous lenses of well sorted sands and gravels. An area of red coloured till occurs near Caledon and is located in front of the Paris Moraine. This red till area contains several drumlins oriented in a NW-SE direction.

The next youngest till is a brown loam to silt loam till which is covered by a younger unit in the Woodbridge cut but is exposed at the surface over most of the map-area. It is believed to correlate with the Halton Till mapped by Karrow in the Hamilton map-area. The outer limit of the ice which deposited the Halton Till is not marked for any great distance by a moraine but by a series of kames and ice block depressions as well as sections of very hummocky topography. The Halton ice rode up over the edge of the Escarpment near Inglewood but failed to reach the Paris moraine either there or further to the north. In the north-central part of the map-area the outer limits of the Halton Till have been overridden (probably for only a small distance) by the ice which deposited the Northern upper till.

In general, the Halton Till is often less than 20 feet thick and in many places can be seen resting on sands, silts etc. deposited prior to the advance of the Halton ice. From a study of valley exposures and subsurface borehole records it is probable that the Halton ice was in a state of constant fluctuation either during its initial advance or during the melting back of the ice front. In the valley sections it is common to find several layers of almost identical till (10-20 feet thick) separated by layers of sands and silts of similar thickness.

Over much of Toronto Gore and Vaughan townships, thin, discontinuous deposits of the Wildfield Lacustrine-Till Complex overlie the Halton Till. This material was apparently deposited in the temporary ponding of glacial meltwaters referred to as Lake Peel. The deposits are not exclusively lacustrine and in fact are often till-like. Frequently the lacustrine and till-like layers are interbedded.

The lacustrine phase of the deposits may contain weekly stratified to well varved clays, silts and occasional sands. The fine-grained materials also contain numerous pebbles, grits and silt balls and may often have a conglomeratic appearance. The till phase may also show evidence of stratification. The till ranges through a clay and silty clay to a silt clay loam texture and textural analyses of the till do not differ markedly from analyses of stratified bands with which the till is often interlayered. The whole appearance and occurrence of the Wildfield Complex suggests the close proximity of a fluctuating ice front as the material was deposited. At the top of the Woodbridge cut the Wildfield Complex is represented by the till phase up to 12 feet in thickness.

Associated with the Wildfield Complex deposits into Lake Peel are the areas of sand which formed deltas at the edge of the lake. Several small areas of sand are located at elevations of 925 and 975 feet but most deltaic sands and the Wildfield Complex deposits themselves are below an elevation of 750 feet. The deltaic sands are thin in general but at the lower elevations thicken to up to 20 feet and cover a much wider area.

Stratified glacial deposits: The present major streams in the area, Main Humber, East Humber and Credit River, occupy valleys that predate the last advance of the ice, and in fact there is even a close relationship between the present valleys and the preglacial drainage valleys. As a result of this, and where the present streams have cut down through the youngest till cover into earlier valley deposits, useful supplies of sands and gravels have been exposed.

Meltwaters from the Wentworth ice as well as those after the Halton advance were confined to two major channels in Albion, Caledon and Dufferin townships. Extensive gravel deposits occur in the channel in front of the Paris Moraine and around the edge of the Escarpment, but the younger meltwater channel running from Albion to Inglewood appears to contain less gravel and is more variable in its composition.

The considerable area of ice-contact stratified drift occuring in the eastern, northern and northwestern part of the map-area consists to a great degree of well stratified sands, silts and gravels. Over much of the area the variability of the deposits and the degree of disturbance of the bedding etc. suggests that conditions of deposition were fluctuating rapidly and that in many areas, the material was deposited on masses of ice which subsequently melted out, collapsing the overlying mantle of sediments. There is also, however, evidence for some reasonably consistent conditions of deposition suggesting that the deposits in part have an outwash origin. This certainly seems to be the case of many of the sands etc. which underlie for most part the Halton Till. It is also suggested that the under-Halton Till sands in the centre of the map area grade into finer grained sediments in the south where silts and clays are predominant under the Halton Till, rather than the sands, silts and gravels of the central area.

Economic Geology

Sand and gravel: The area mapped is favourably located to the large Toronto construction industry and there have been numerous sand and gravel pits operated in the area for a number of years. Major operations are at Maple, along the Main Humber and East Humber valleys, near Tullamore, at Caledon, Mono Mills and Palgrave. Numerous other small pits are spread throughout the area.

Other deposits no doubt exist, and future operations may well follow from an intensive search for buried valleys in both the glacial drift and bedrock.

Groundwater: Groundwater throughout the area is usually obtained from the glacial deposits. Above the Escarpment it is more often obtained from bedrock but water from bedrock in the southern part of the map-area is too high in chloride content to be satisfactory for human consumption. Otherwise, the groundwater quality is satisfactory except for high hardness values.

In areas underlain by the finer-grained tills water wells are usually taken down to sand and gravel lenses within the till or sand beds below the till. In areas of shallow drift which do not contain many sand lenses some difficulties with water supply are experienced. However, with the presence of some buried valleys in the shallow drift area (e.g. in Toronto Gore township) the situation is somewhat alleviated.

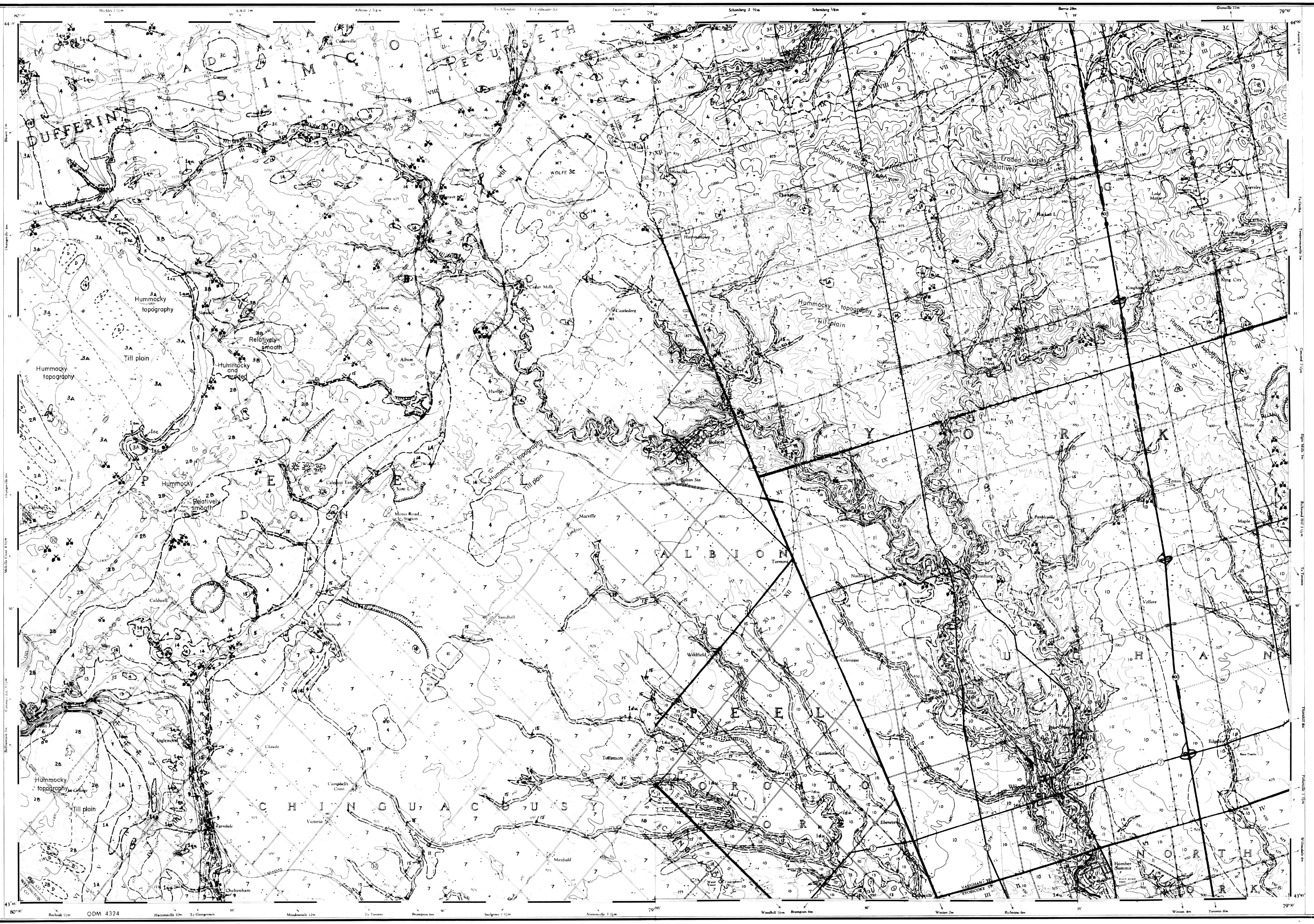
Several domestic water supplies are obtained from springs issuing from the exposed Escarpment rocks as well as at several locations along the steep slopes down from the Escarpment.

Building stone, clay products, limestone, etc: Several small quarries producing "Credit Valley Stone" from the Whirlpool Sandstone are located on the Escarpment slopes to the west of Inglewood. Other quarries have operated in the past, such as a large one at Credit Forks whence came the stone for the Parliament Buildings at Queen's Park.

Limestone and dolomite has been quarried in the past for lime production but none of these operations are current. Nor is there any quarry in the area producing calcareous rocks for crushed stone production.

No shale pits are operated in the map-area although several pits are operating to the south of the map-area. The Queenston Formation is exposed at or very close to the surface in both the southwest and northwest corners of the map area. In Toronto Gore township the Dundas-Meaford Formation is exposed in several valleys, and, in some interfluve areas, the drift cover is less than 25 feet thick.

* Textural descriptions and particle size limits are in accordance with the U.S.D.A. classification.



ONTARIO DEPARTMENT OF MINES

PRELIMINARY GEOLOGICAL MAP No. P.477

PLEISTOCENE GEOLOGY OF THE BOLTON AREA

SOUTHERN ONTARIO

0 — 1 — 2 Miles

Scale 1:50,000

N.T.S. Reference: 30 M/13

LEGEND

CENOZOIC

PLEISTOCENE

Recent

15	15	Modern alluvium: silt, sand, gravel
14	14	Peat, muck, marl

Wisconsinan

13	13	Older alluvium - sands, silts and gravels on elevated terrace remnants.
12	12	Alluvial gravels - usually covered with several feet of sand.
11	11	Deltaic and lacustrine sands, some silt and occasional gravels.
10	10	Wildfield Till - Lacustrine Complex. Stratified or non stratified clay to silty clay loam or silty clay to silty clay loam till. Sometimes till bands are interlayered with stratified material. Silt balls and grits are common in the stratified deposits. Carbonate concretions are common in both lacustrine and till phases.
9	9	Lacustrine - silt and clay, some sand. Usually stratified or varved.
8	8	Northern upper till. Light grey silty clay loam to clay.
7	7	Halton Till - Brown loam to silt loam till.
6	6	Gravel: outwash gravel usually covered by several feet of sand.
5	5	Sand: deposited in meltwater channels - often underlain by gravels.
4	4	Ice contact stratified drift - sand, gravel and (locally) silt. Structure often disturbed. Of kame, outwash and collapse origin. Is frequently exposed along river valleys. May not be shown on map.
3	3A	Northern lower till - Light brown and red sandy loam to loam.
	3B	Northern lower till - Light brown very gravelly sandy loam. Considerable coarse, washed material.
	3C	Northern lower till - Light brown-grey gravelly loam to sandy loam.
2	2A	Wentworth Till - Red sandy loam.
	2B	Wentworth Till - Light brown gravelly sandy loam and loam. Considerable stratified material.
1	1A	Bedrock - drift complex.

PALEOZOIC

SILURIAN

1	1am	Amabel Formation.
	1cc	Clinton and Cataract Groups.

ORDOVICIAN

1	1qu	Queenston Formation.
	1du	Dundas-Meaford Formation.

SYMBOLS

- Geological boundary (actual or inferred).
- Geomorphic boundary (drumlin, hummocky topography, eroded slopes, etc.).
- Drumlin.
- Ice block depression.
- Kame, individual.
- Spillway (water cut channel).
- Abandoned valley of a beheaded stream.
- Sand ridge.
- Sand or gravel pit, operating or abandoned.
- Quarry - for building stone, crushed stone.

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ADDITIONAL SOURCES

Aerial photography: Ontario Department of Lands and Forests; National Air Photo Library, Ottawa.

Pedology: Soil Surveys of Peel, York, Simcoe and Dufferin Counties, Ontario Soil Survey, Ontario Department of Agriculture and Canada Department of Agriculture.

SOURCES OF INFORMATION

Geology by P.F. Karrow and assistants, 1962; by O.L. White and assistants, 1963, 1964, 1965.

Topography directly from map 30 M/13 of the National Topographic Series.

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