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Paleozoic Geology of Ontario

Precambrian Carbonate Resources

Properties, Specifications and Uses

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Volume II — Limestone Industries and Resources of Eastern and Northern Ontario

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Volume III — Limestone Industries and Resources of Central and Southwestern Ontario

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Owen Sound District
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Aylmer District
Wingham District
Chatham District

Limestone Industries of Ontario

Volume II — Limestone Industries and Resources of Eastern and Northern Ontario

Prepared for the Aggregate Resources Section,
Land Management Branch, Ontario Ministry of Natural Resources

by
Derry Michener Booth and Wahl
and
Staff of the Engineering and Terrain Geology Section, Ontario Geological Survey,
Ministry of Northern Development and Mines

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1989

Ontario

Ministry of Natural Resources
Vincent G. Kerrio
Minister

Ministry of Northern Development and Mines
Sean Conway
Minister

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Printed in Ontario, Canada

ISBN 0-7729-3533-5 (3v. set)
ISBN 0-7729-3535-1 (v. 2)

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Derry Michener Booth and Wahl and Ontario Geological Survey
1989: Limestone Industries of Ontario, Volume II — Limestone Industries and Resources of Eastern and Northern Ontario; Ontario Ministry of Natural Resources, Land Management Branch, 196p.

Cover photo of St. Marys Cement plant is courtesy of St. Marys Cement.

Acknowledgments

The authors are indebted to industry personnel and landowners who allowed close examination of their properties, and who generously provided product lists and plant flowcharts.

The members of the study's steering committee made a valuable contribution to the study by guiding the authors, providing materials and reviewing the report.

A large study such as this is completed only through the efforts of many people. The geological/mining engineering firm, Derry Michener Booth and Wahl, was the lead consultant and was responsible for the plant inventory and descriptions. Staff who prepared the material included David Wahl, Martin Taylor, Wes Roberts and Charles Pitcher, with the assistance of W.G. Wahl, Wahlex Ltd., G. Robert Guillet, Consultant, and Jack Kriens, IMD Laboratories. Don Hains of Hains Technology Associates was responsible for the material on commodities and economics of the limestone industries. Mr. Hains and Mr. W.G. Wahl prepared the plant descriptions for cement, lime and fillers operations.

Staff of the Engineering and Terrain Geology Section, Ontario Geological Survey of the Ministry of Northern Development and Mines prepared the geological description of each site as well as the regional descriptions of the geology of limestone and related carbonate rocks in Volume I. This work was supervised by Dr. Owen White, Chief, Engineering and Terrain Geology Section, and Mike Johnson, Acting Supervisor, Paleozoic/Mesozoic Geology Sub–Section. Staff involved in preparing the site descriptions included Dr. Max Vos, Rainer Wolf, Ruth Bezys, Derek Armstrong, Julie Stevenson–Demeester, Val Mazur, and Chris Fouts. Dr. Peter Telford of the Mineral Development and Lands Branch, Ministry of Northern Development and Mines assisted in the interpretation of geological data and the review of the report.

The project was initiated by the Aggregate Resources Section, Ministry of Natural Resources, under the direction of Dale Scott. Geoff Bell was the project coordinator and report editor.

Preface

Products from the limestone industries find their way into many of the items that are essential to our modern way of life. In one way or another, the output of the various members of the limestone industries is used in constructing or manufacturing items as diverse as office towers, homes, transportation networks, steel, glass, paper, or rubber products.

This report examines Ontario's limestone industries from two perspectives: the geological resource, including limestone, dolostone, marble and carbonatites; and secondly, the various industries which rely on these resources to manufacture products which are vital to Ontario's economy. These products include construction aggregate, cement, lime, fillers and extenders, building stone and pulverized stone.

In order to undertake a study on such a large and important economic sector, a steering committee was struck to formulate the terms of reference for the study and guide the research and field work through to the report stage. Members of the steering committee were:

- Dale Scott, Chairman, Ministry of Natural Resources
- Norris Walker, Aggregate Producers' Association of Ontario
- Vic Perry, Canadian Portland Cement Association
- Don Stonehouse, Energy Mines and Resources Canada
- Dr. Owen White, Ministry of Northern Development and Mines
- Dr. Peter Telford, Ministry of Northern Development and Mines
- Dr. Max Vos, Ministry of Northern Development and Mines
- Mike Johnson, Ministry of Northern Development and Mines
- Zoltan Katona, Ministry of Transportation
- Chris Rogers, Ministry of Transportation
- Geoff Bell, Executive Secretary, Ministry of Natural Resources

The study brings together the most up to date geological information pertaining to carbonate rocks and describes the current operations of the members of the limestone industry. In addition, information on the economics of the various commodities is presented in order to give a more complete picture of this resource activity. Field work and data compilation were performed in 1986 and 1987. The authors have attempted to incorporate changes in plant design and ownership up until summer 1988.

The geological and plant site descriptions are organized based on the Ministry of Natural Resources administrative districts. This approach was taken to accommodate the multi–commodity nature of the industry, as well as to facilitate review of the material. This format also allows district updates of activity to be produced easily at a future date.

Metric units are used in the geological descriptions throughout the report, and in parts of the plant and operations descriptions. Since plant equipment is normally sized in Imperial units, these measurements have not been converted to metric units for ease of presentation.

Contents

Introduction

Ontario is fortunate in possessing ample resources of limestone and related carbonate rocks, including dolostone, marble and carbonatite. The rocks, which consist primarily of calcium carbonate, have many uses in today's economy. This report examines Ontario's limestone resources as well as the industries which rely on them: crushed stone aggregates; cement; lime, chemical and metallurgical stone; fillers and extenders; building stone; and pulverized stone. These industries supply the materials upon which Ontario's construction and transportation infrastructure rely. In addition, many limestone products are used in industrial processes which manufacture a host of products such as steel, chemicals, paper and composite materials.

This report attempts to capture the many aspects of the resource sector. The geology of Ontario's carbonate rocks has received considerable attention over the last fifteen years. Part 1 of Volume I deals with the geology of Paleozoic limestone formations on a regional scale. Part 1 integrates all the recent interpretation of stratigraphy, lithology and nomenclature. This is particularly important in southeastern Ontario which relies heavily on bedrock aggregates because of a shortage of sand and gravel aggregate. The geology of southeastern Ontario has been analyzed in depth by geologists of the Ontario Geological Survey over the past eight years. The latest interpretation of the bedrock formations is presented. Part 2 describes the geology of marble deposits in southeastern Ontario, and carbonatites in northern Ontario, as well as calcite veins and marl deposits.

Part 3 of Volume I describes the main limestone industries in Ontario. The commodities of the various sectors are examined in light of physical characteristics, processing techniques, end–uses and specifications of products.

Part 4 describes the economics of each of the limestone industries, and deals with factors such as energy and transportation costs, prices, and competing products which determine the viability and competitiveness of the various products. An outlook for the commodities is given.

Volumes II and III of the report describe the geology, plant, processing and products of the active members of the industry. Volume II includes the operations which are located in northern and southeastern Ontario. Volume III examines the sites in south central and southwestern Ontario. The two volumes consist of detailed site–by–site inventories of each operation. The site inventories include a geological interpretation of the exposed rock in the quarry, a description of the operator's quarry operations and stone processing plant, plus a products list and in many instances a plant flowchart. In addition to commercial sites, many sites with important geological features are included in the inventory.

In the almost thirty years since the late Don Hewitt authored the first study of this type (Hewitt, 1960), many changes have taken place in Ontario's economy. The limestone industries have kept pace with this change, achieving higher production rates with lower energy, labour and raw material input. The primary value for the various products manufactured by the limestone industries is currently approaching one billion dollars annually. The limestone industries are positioned to remain a vital segment of Ontario's economy well into the 21st century.

Part 1
Eastern Ontario

Cornwall District

INTRODUCTION

Cornwall District is situated in the Eastern Region of southern Ontario and is bounded by the Ottawa River, the Province of Quebec, the St. Lawrence River and MNR Districts of Brockville and Carleton Place. The district includes the United Counties of Prescott and Russell, and the United Counties of Stormont, Dundas and Glengarry, as shown in Figure CW-0-1.

Sixty-eight quarries are documented in the Cornwall District quarry inventory (Appendix IV, Volume I); fourteen are currently active, twelve operate intermittently and the balance represent past producing quarries or those properties identified for future production.

Twenty-seven quarries and one marble plant were visited during the study and include the following:

CW-1 *Barry Forbes - Forbes Quarry (active)*

CW-2 *M. Fetterley - Cornwall Gravel Co. Ltd. - Iroquois Quarry (active)*

CW-3 *Cruickshank Construction Ltd. - Williamsburgh Quarry (active)*

CW-4 *A.L. Blair Construction Co. Ltd. - St. Albert Station Quarry (active)*

CW-5 *A.L. Blair Construction Co. Ltd. - Embrun Quarry (active)*

CW-6 *Dibblee Construction Co. Ltd. - Limoges Quarry (intermittent)*

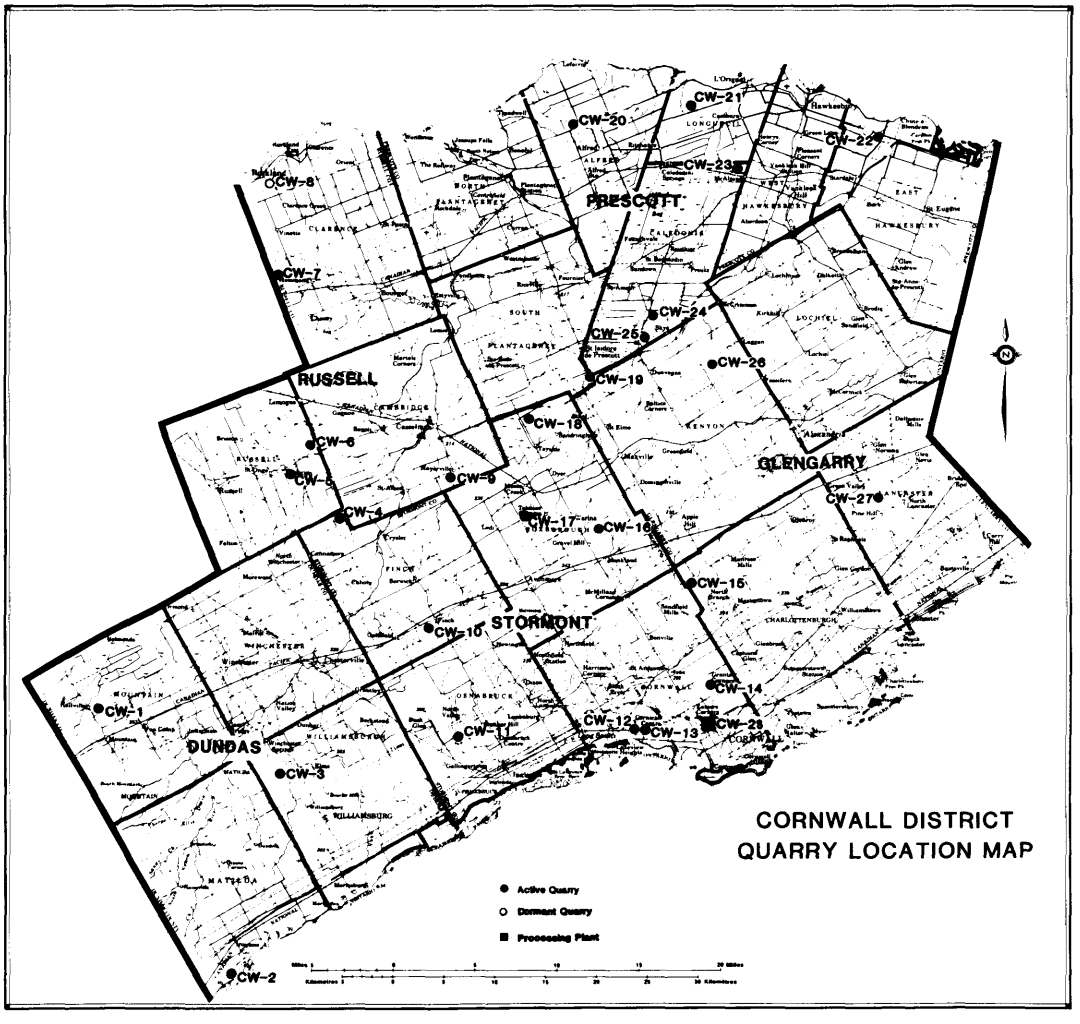


Figure CW-0-1. CORNWALL DISTRICT QUARRY LOCATION MAP.

CW-7 *Township of Clarence - Canaan Quarry (active)*

CW-8 *Rockland (Stewart) Quarry (abandoned)*

CW-9 *Cornwall Gravel Company Ltd. - Richier Quarry (active)*

CW-10 *A.L. Blair Construction Co. Ltd. - McLean (Finch) Quarry (intermittent)*

CW-11 *A.L. Blair Construction Co. Ltd. - Plumadore Quarry (intermittent)*

CW-12 *Permanent Concrete - Cornwall Quarry (active)*

CW-13 *Dibblee Construction Co. Ltd. - Cornwall Quarry (intermittent)*

CW-14 *Cornwall Gravel Company Ltd. - MacLeod Quarry (active)*

CW-15 *A.L. Blair Construction Co. Ltd. - Christie Quarry (intermittent)*

CW-16 *A.L. Blair Construction Co. Ltd. - Gravel Hill Quarry (intermittent)*

CW-17 *A.L. Blair Construction Co. Ltd. - Moose Creek Quarry (intermittent)*

CW-18 *A.L. Blair Construction Co. Ltd. - Martin (Tayside) Quarry (intermittent)*

CW-19 *Bertrand & Freres Construction Company Ltd. - St. Isidore Quarry (active)*

CW-20 *R. Tierney - Tierney Quarry (active)*

CW-21 *Bertrand & Freres Construction Company Ltd. - L'Orignal Quarry (active)*

CW-22 *Sintra Inc. - Ross Quarry (intermittent)*

CW-23 *Cliftondale Aggregates - Cliftondale (McAlpine) Quarry (intermittent)*

CW-24 *Sintra Inc. - Leroux (Skye) Quarry (intermittent)*

CW-25 *Cruickshank Construction Ltd. - Gauthier Quarry (intermittent)*

CW-26 *A.L. Blair Construction Co. Ltd. - Duval Quarry (active)*

CW-27 *Cruickshank Construction Ltd. - Green Valley Quarry (active)*

CW-28 *Karnuk Marble Industries Inc. - Cornwall Plant*

REGIONAL GEOLOGY

Cornwall District extends westward from the Ontario/Quebec border to a line running north from the town of Cardinal, on the St. Lawrence River, to the Ottawa River (Figure CW-0-1). Along the Ottawa River, north-facing, fault-controlled bedrock escarpments line portions of the river. The rest of the district is underlain by flat-lying Paleozoic strata.

Thick glacial deposits cover most of the district, though in several areas bordering the St. Lawrence and Ottawa Rivers glacial overburden is much thinner or completely absent, revealing the underlying bedrock.

The Cornwall District is underlain by rocks of Upper Cambrian, and Lower, Middle, and Upper Ordovician age. Unlike most of Central Ontario, the Paleozoic rocks have been disrupted by large-scale faults. In the Cornwall District major faults trend west-east along the Ottawa River and northwest- southeast across the interior of the district. Although bedrock exposures are generally limited, drill hole data confirm the presence of many of these faults (Williams, in prep.). Smaller-scale faults are commonly exposed in quarries.

The Paleozoic strata consist of carbonate and clastic sedimentary rocks which are subdivided (Figure CW-0-2) into the following formations (in ascending stratigraphic order).

The Upper Cambrian to Lower Ordovician Potsdam Group consists of the conglomerates and arkoses of the Covey Hill Formation, and the overlying quartz arenites of the Nepean Formation. Only small operations currently utilize these rocks for aggregate and dimensional stone, although historically the sandstones of the Nepean Formation have been used extensively as building material, for example, in the Parliament Buildings in Ottawa.

The overlying Lower Ordovician Beekmantown Group consists of the March and Oxford Formations. The March Formation is transitional between the clastic rocks of the Potsdam Group and the overlying dolostones of the Oxford Formation, and consists of alternating beds of quartz arenite and dolostone, with gradations between the two rock types. Most common are fine-crystalline dolostones which consist of up to 50% medium- to coarse-grained, well-rounded quartz grains, which "float" in the dolostones. The lower contact of the March Formation is placed at the base of the lowest dolostone bed (Williams, in prep.); the formation thickens from 20 m in the west to 60 m in the east.

In Eastern Ontario, the March Formation has been quarried extensively over the years although there is currently no production from the formation in the Cornwall District. Large blocks of sandy dolostone were utilized in the construction of the Rideau Canal system in the 1830s and those strata as well as dolostone beds were also quarried for building and ornamental stone. In addition to being a source for crushed stone in recent years, the sandy dolostone beds have proven to be an excellent source of skid-resistant aggregate (Rogers, 1980).

The Oxford Formation consists of grey-brown, microcrystalline to medium-crystalline, medium-bedded dolostones. Scattered, coarse-grained quartz sand and sandy interbeds (up to 30 cm thick) are present in the lower part of the formation. Calcite-filled vugs of varying sizes are common in most intervals - small, white chert nodules are less common. The lower contact of the Oxford Formation is placed at the top of the uppermost sandstone bed in the underlying March Formation (Wil-

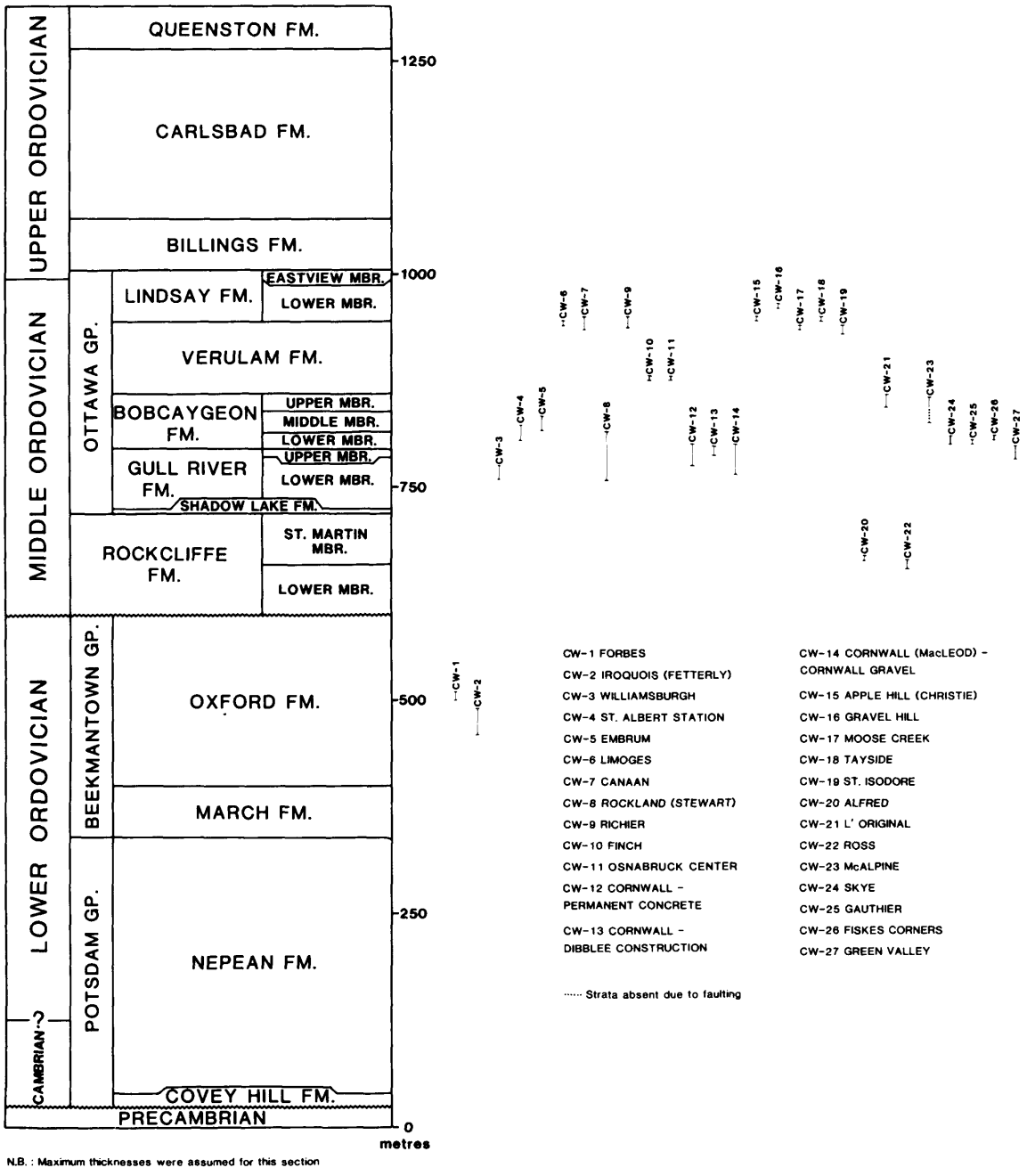


Figure CW-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF CORNWALL DISTRICT.

liams, in prep.). The formation maintains a uniform thickness of 200 m across the district and is quarried for crushed stone along the St. Lawrence River at the Iroquois Quarry (CW-2) and to the north at the Forbes Quarry (CW-1).

Unconformably overlying the Oxford Formation, the Middle Ordovician Rockcliffe Formation is subdivided into two members (Williams, in prep.), a lower clastic and an upper carbonate member. The light grey to green-grey, fine- grained, thin- to thick-bedded, commonly crossbedded, quartz sandstones of the lower member are interbedded with olive green to grey (rarely maroon), laminated shales which contain numerous burrows. The upper St. Martin Member consists of light grey to grey-brown, microcrystalline to fine crystalline lime-

stone to more commonly coarse–grained, thick–bedded, crossbedded calcarenites. The very high calcium content of these limestones along the Ottawa River (Williams, in prep.) increases their potential usefulness. The St. Martin Member also contains thin intervals of grey–brown, shaly to silty dolostone. The formation reaches a maximum thickness of 120 m at the extreme eastern end of the district along the Ottawa River although it rapidly thins westward to an average thickness of 50 m near Ottawa. Each member maintains a sub–equal thickness across the district.

The Rockcliffe Formation is quarried along the Ottawa River at the Alfred Quarry of R. Tierney (CW–20) for ornamental stone and at the Ross Quarry (CW–22) for crushed stone. In the past, the limestones of the St. Martin Member were much more extensively quarried (Goudge, 1938).

The Ottawa Group consists of five formations which, except for the Shadow Lake Formation, are extensively utilized by the limestone industry in Cornwall District. The Shadow Lake Formation, which overlies the Rockcliffe Formation with a minor disconformity, is a thin (3 m thick) interval of sandstone and shale which represent the initial deposits of the Ottawa Group.

The Gull River Formation is subdivided into two members, a lower member consisting of interbedded dolostone and limestone and an upper member consisting of shaly limestone. The dolostones of the lower member are grey–brown to grey–green, fine crystalline, thin to medium bedded, and commonly contain some clastic material, ranging from mud to sand sized. Large calcite–filled vugs are common in some beds. The interbedded limestones range from light grey and microcrystalline, commonly with "birdseye" texture, to medium grey, fine to medium crystalline. The lower member thins from 60 m in the west to 40 m in the east. The 10 m thick upper member commonly consists of light grey, microcrystalline to fine–crystalline, thin–bedded limestone, with thin shale interbeds. The colonial coral *Tetradium* is very abundant in this member.

The Gull River Formation is extensively quarried across Cornwall District for crushed stone. The larger quarries include the Williamsburgh Quarry (CW–3), the Cornwall Quarries of Permanent Concrete (CW–12), Dibblee Construction (CW–13) and Cornwall Gravel (CW–14), and the Green Valley Quarry (CW–27). Not all the strata of the lower member can be used for concrete aggregate because of the alkali–reactivity of some of the grey–green dolostone beds (Rogers, 1985).

The Bobcaygeon Formation overlies the Gull River Formation and consists of limestone with shale partings and interbeds of varying thickness and frequency. Three members have been identified in the Bobcaygeon Formation (Williams, in prep.), with the middle member characterized by substantially more shale interbeds than the lower and upper members. The lower member consists of light grey, microcrystalline to fine–crystalline, thick– to massive–bedded limestone, with interbedded intervals of fine– to medium–grained calcarenites. Black chert nodules are common in some beds. Shale partings are very thin, and are not always present between beds. The middle member consists of grey, thin– to medium–bedded, fine– to medium–crystalline limestone and fine– to coarse–grained calcarenite, which are interbedded with shale beds up to 2 cm thick. The upper member, which is rarely exposed, consists of grey, fine– to medium–crystalline, thin– to medium–bedded limestone with rare, thin shale partings. The formation is about 60 to 75 m thick, with each member maintaining a thickness of 20 to 25 m across the district.

Quarries in the Bobcaygeon Formation are concentrated in the lower member, and include the St. Albert Station Quarry (CW–4), the abandoned Rockland Quarry (CW–8), the Leroux Quarry (CW–24), the Gauthier Quarry (CW–25) and the Duval Quarry (CW–26). In addition, the thick limestone beds at the base of the member cap several quarries (see Figure CW–0–2). The middle member is best exposed in the Embrun Quarry (CW–5), while the upper member occurs in the L'Orignal Quarry (CW–21) and the Cliftondale Quarry (CW–23). Many smaller, now abandoned quarries also occur within the strata of the formation across the district.

The Verulam Formation overlies the Bobcaygeon Formation and consists of interbedded limestones and shales. The former range from microcrystalline to medium–crystalline limestone and fine– to coarse–grained calcarenites which occur in thin– to medium–bedded intervals. Coarse–grained horizons of fossil debris commonly occur within the limestone beds. The shales are commonly calcareous with abundant fossils and burrows and occur in beds up to 15 cm thick. The formation thickens from 40 to 60 m eastward across the district.

The high shale content and lack of exposures have inhibited extensive quarrying of the Verulam Formation. Several small quarries do utilize this rock for crushed stone, including the McLean (CW–10) and the Plumadore (CW–11) Quarries.

The Lindsay Formation is a limestone with thin calcareous shale interbeds which conformably overlies the Verulam Formation. The Lindsay Formation is divisible into two members: the lower (un–named) member – a nodular limestone with thin calcareous shale partings – and the upper Eastview Member – a black, petroliferous, calcareous shale. The limestones are commonly microcrystalline to medium crystalline with interbedded medium– to coarse–grained calcarenites which occur in thin to thick beds. The upper Eastview Member can be very shaly and exudes a petroliferous odour from a fresh surface. Across the district both the lower and upper

members maintain a uniform thickness, 50 m for the lower and 10 m for the upper member.

The limestones of the lower member are a significant source of crushed stone in the Cornwall District. The major quarries include the Limoges Quarry (CW–6), the Canaan Quarry (CW–7), the Richier Quarry (CW–9), the Christie Quarry (CW–15), the Gravel Hill Quarry (CW–16), the Moose Creek Quarry (CW–17), the Martin Quarry (CW–18) and the St. Isidore Quarry (CW–19). The Eastview Member is not utilized by the limestone industry.

The overlying Upper Ordovician strata, the Billings, Carlsbad, and Queenston Formations primarily consist of shale, with some limestone in the Carlsbad Formation, totalling approximately 300 m of strata. These formations are not currently utilized by the limestone industry, although the red shales of the Queenston Formation are used by the ceramic and brick industry.

LIMESTONE INDUSTRIES

The limestone industries in the Cornwall District are construction aggregate and building stone. Stone production in 1985, as reported by the 1986 Ontario Mineral Score, amounted to some 1,615,000 tonnes and was principally used in the construction industry as road and concrete aggregate.

Approximately 832,000 tonnes were produced in the United Counties of Prescott and Russell and includes production from A.L. Blair Construction Co. Ltd. – Embrun Quarry (CW–5), Township of Clarence – Canaan Quarry (CW–7), Cornwall Gravel Company Ltd. – Richier Quarry (CW–9), Bertrand & Freres Construction Company Ltd. – St. Isidore Quarry (CW–19) and L'Orignal Quarry (CW–21), R. Tierney – Tierney Quarry (CW–20), Sintra Inc. – Ross Quarry (CW–22) and Leroux (Skye) Quarry (CW–24), Cliftondale Aggregates – Cliftondale (McAlpine) Quarry (CW–23) and Cruickshank Construction Co. Ltd. – Gauthier Quarry (CW–25). With the exception of Cornwall Gravel Company Ltd. – Richier Quarry (CW–9) and Bertrand & Freres Construction Company Ltd. – L'Orignal Quarry (CW–21), each reporting production in excess of 100,000 tonnes per year, the aforementioned quarries each reported annual production of less than 50,000 tonnes per year.

Stone production in the United Counties of Stormont, Dundas and Glengarry was reported to be in the order of 783,000 tonnes and includes production from Barry Forbes – Forbes Quarry (CW–1), M. Fetterley/ Cornwall Gravel Co. Ltd. – Iroquois Quarry (CW–2), Cruickshank Construction Ltd. – Williamsburgh Quarry (CW–3) and Green Valley Quarry (CW–27), A.L. Blair Construction Co. Ltd. – St. Albert Station Quarry (CW–4), McLean (Finch) Quarry (CW–10), Plumadore Quarry (CW–11), Christie Quarry (CW–15), Gravel Hill Quarry (CW–16), Moose Creek Quarry (CW–17), Martin (Tayside) Quarry (CW–18), Duval Quarry (CW–26), Permanent Concrete – Cornwall Quarry (CW–12), Dibblee Construction Co. Ltd. – Cornwall Quarry (CW–13) and Cornwall Gravel Company Ltd. – MacLeod Quarry (CW–14). The majority of the production, however, is derived from A.L. Blair Construction Ltd. – St. Albert Station Quarry (CW–4), Permanent Concrete –Cornwall Quarry (CW–12) and Cornwall Gravel Company Ltd. – MacLeod Quarry (CW–14) each reporting production in excess of 100,000 tonnes per year. The remaining quarries each reported annual production of less than 50,000 tonnes per year. On a total annual production basis, A.L. Blair Construction Co. Ltd., reporting production from nine quarry–properties, is the largest single producer in the United Counties of Stormont, Dundas and Glengarry.

Building stone production is intermittent and is currently being produced by Cornwall Gravel Company Ltd. at their MacLeod Quarry (CW–14), on request from Karnuk Marble Industries Inc. (CW–28) of Cornwall. The massive black limestone is extensively used in the making of polished tiles.

CW–1 BARRY FORBES — FORBES QUARRY

LOCATION AND OWNERSHIP

The Forbes Quarry is located 1 km east of Hallville, in the west half of Lot 8, Concession 8, Mountain Township, Dundas County (Figure CW–1–1). The quarry was opened in 1981 by Barry Forbes, the owner and operator, and is licensed for an area of 40 ha.

GEOLOGY

The 8 m deep quarry exposes fine–crystalline dolostones of the Oxford Formation which commonly contain cal-

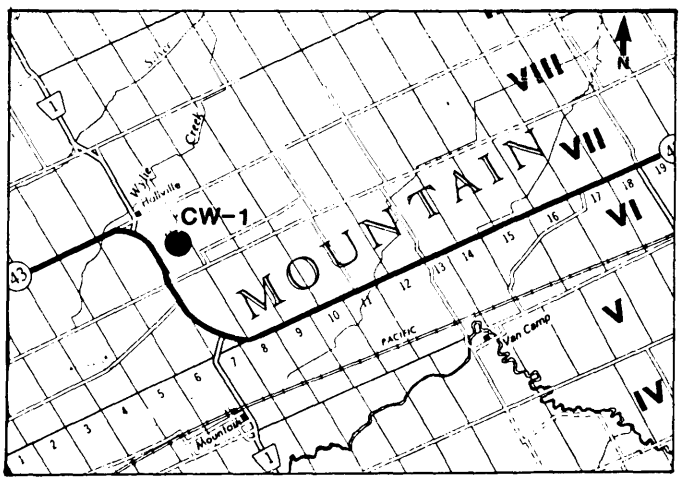


Figure CW–1–1. LOCATION MAP FOR FORBES QUARRY.

cite-filled vugs of varying sizes. Glacial overburden around the quarry is less than 2 m thick.

Geological Section

	Thickness
UNIT 2 Oxford Formation	*5.0m*
Dolostone: light grey-green to medium grey-brown, weathers buff; fine crystalline; thin to medium bedded, with sharp and planar contacts, thin shale partings present between some beds; calcite-filled vugs present in some beds; lower contact of unit sharp and planar.	
UNIT 1 Oxford Formation	*3.0m*
Dolostone: light grey-green to medium grey-brown, weathers buff; fine crystalline; medium to thick bedded; calcite-filled vugs present.	
Total thickness	*8.0m*

QUARRY OPERATION

The disturbed area of the quarry is approximately 5 ha, presently worked on two lifts of 9 m each. The first lift is drilled on a 2.7 m x 2.7 m pattern with 7.6 cm diameter holes and produces only Granular "A". stone. The second (lower) lift is drilled on a 2.1 m x 2.1 m pattern with 7.6 cm diameter holes and is used to produce concrete stone and HL4 and 5. Drilling and blasting is contracted; crushing is performed by the owner.

PROCESSING

A Cat 966 loader (3 1/2 yd.) is used to haul stone from the blast face to the portable crushing plant. Primary crushing is carried out with a 30 in. x 42 in. Cedarapids jaw crusher, and a Cedarapids Commander crusher is used to further process the stone. An 80-ton Canadian scale with digital print-out is stationed at the Forbes Quarry.

PRODUCTS

Pit Run Gravel
Granular "A" and "B"
1 1/4 in. Clear
3/4 in. Clear
1/2 in. Clear
Concrete Sand
Screened Sand
5/8 in. Traffic Bond Stone
1/2 in. Traffic Bond Stone
3/8 in. Chips
Stone Dust
Top Soil Screened
Unscreened Fill
HL4 and 5

REFERENCES

Williams, in prep., Appendix 1 – Section LQ KE-2

MAPS

Carson, 1982d, OGS Map P.2493

CW-2 M. FETTERLEY - CORNWALL GRAVEL CO. LTD. — IROQUOIS QUARRY

LOCATION AND OWNERSHIP

This large quarry is located in Lots 30 and 31, Range 1, Matilda Township, Dundas County, 2.5 km southwest of the Village of Iroquois (Figure CW-2-1).

The quarry was first opened in 1955 by Iroquois Rock Company, coinciding with the St. Lawrence Seaway Project (1955-59). Much of the stone produced at the quarry during that period was used either in the construction of the seaway or in the relocation of public/private property and facilities, i.e. relocation of the CN railway line from Cardinal to Cornwall. The quarry also supplied concrete stone for the construction of the Ogdensberg to Johnstown bridge in 1960, and was purchased late that year by the present owner and co-operator, Mac Fetterley.

GEOLOGY

The 27.6 m deep quarry is operated with two lifts, the lower of which is currently being used. The quarry exposes fine- to medium-crystalline, medium- to thick-bedded dolostones of the Oxford Formation. Thin calcite veins up to 5 cm thick trend across the quarry at 080° and dip 85° to the south. Glacial overburden around the quarry is up to 3 m thick. An excellent section of the quarry is illustrated in Hewitt (1960, p.21), and the quarry has not changed substantially since then.

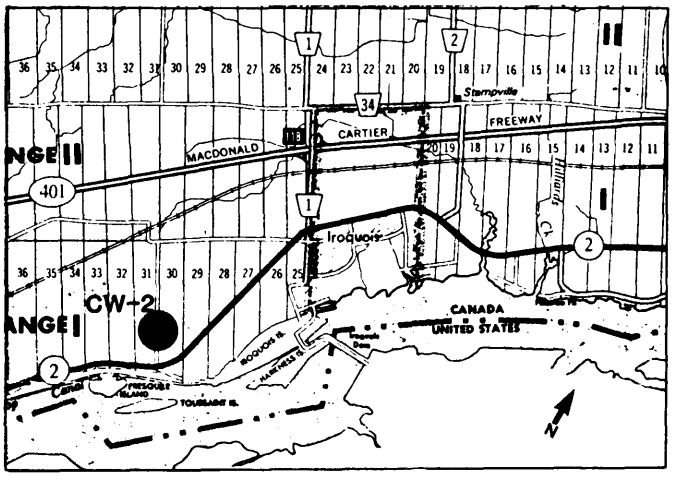


Figure CW-2-1. LOCATION MAP FOR IROQUOIS QUARRY.

Photo CW-2-1. PORTABLE CRUSHING/SCREENING PLANT AT IROQUOIS QUARRY (LOOKING NORTH-WEST).

Geological Section

		Thickness
UNIT 2	*Oxford Formation*	*20.4m*
	Dolostone: medium to dark grey, weathers buff to light grey; fine to medium crystalline; medium to thick bedded (20-50 cm) with rare thin shale partings; large calcite-filled vugs occur in lowermost 5.5 m.	
UNIT 1	*Oxford Formation*	*7.2m*
	Dolostone: light grey, weathers buff to light grey; very fine to fine crystalline; medium to thick bedded (20-50 cm); large calcite- filled vugs present throughout unit.	
Total thickness		*27.6m*

QUARRY OPERATION

The Iroquois Quarry has been excavated to a depth of approximately 27.6 m on two lifts, the lower of which is currently active. Drilling, blasting and processing is carried out under contract.

PROCESSING

A Cat 980 loader is used to haul blasted stone to a Cedarapids 663 Commander crushing and screening plant and to stockpile finished products.

PRODUCTS

Granular "A"
Granular "B"
Granular "C"
Screenings
7/8 in. Concrete Stone
5/8 in. Concrete Stone

REFERENCES

Goudge, 1938, p. 57–59
Hewitt, 1960, p. 20–24
Hewitt, 1964a, p. 26
Hewitt and Vos, 1972, p. 10–11
Rogers, 1980, p. 71
Williams, in prep., Appendix 1 – Section LQ MO–3

MAPS

Williams, Wolf and Carson, 1985b, OGS Map P.2722

CW-3 CRUICKSHANK CONSTRUCTION LTD. — WILLIAMSBURGH QUARRY

LOCATION AND OWNERSHIP

The Williamsburgh Quarry is located 13 km north of Morrisburg in Lot 31, Concession 7, Williamsburgh Township, Dundas County (Figure CW-3-1). The quarry was opened in 1969 and is owned and operated by Cruickshank Construction Ltd. The quarry licence covers an area of 6 ha.

GEOLOGY

The 14.15 m deep quarry exposes interbedded limestones and dolostones of the lower member, Gull River Formation. Most of the dolostone contains some mud

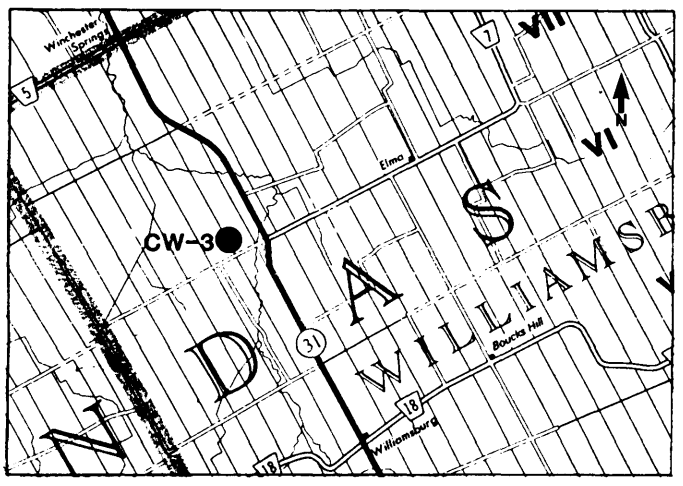


Figure CW-3-1. LOCATION MAP FOR WILLIAMSBURGH QUARRY.

and silt and is calcitic to some degree. The presence of a quartz sandstone bed suggests that the strata exposed in this quarry are near the base of the Gull River Formation. Glacial overburden around the quarry is generally 1–2 m thick.

Geological Section

		Thickness
UNIT 5	*Gull River Formation, lower member*	*4.85m*

Silty dolostone interbedded with limestones: grey-brown to grey-green, weathers buff to grey-brown; dolostone: fine crystalline, limestones: microcrystalline to fine crystalline; thin to thick bedded with thin shale partings common between beds; calcite-filled vugs present; beds fracture conchoidally; intraclasts of light grey, microcrystalline limestone in some of the dolostone beds.

UNIT 4	*Gull River Formation, lower member*	*0.2m*

Sandstone: light grey, weathers medium grey-green; fine- to coarse-grained, well-sorted, well-rounded quartz grains in a calcareous cement; scattered burrows.

UNIT 3	*Gull River Formation, lower member*	*8.75m*

Silty dolostone, with interbeds of limestone: grey-brown to grey-green, weathers buff to red-brown; dolostone: fine crystalline, limestone: microcrystalline to very fine crystalline; thin to thick bedded; calcite- filled vugs present; conchoidal fractures common; intraclasts of light grey, microcrystalline limestone in some limestone beds; pyritized cephalopods present.

UNIT 2	*Gull River Formation, lower member*	*0.25m*

Limestone: medium grey, weathers blue-grey to grey; oolitic; one bed; intraclasts of light grey, microcrystalline limestone present.

UNIT 1	*Gull River Formation, lower member*	*0.1m*

Silty dolostone: grey-brown, weathers buff to red-brown; very fine to fine crystalline; one bed, with shale partings at top of unit; calcitic; scattered burrows.

Total thickness	*14.15m*

CHEMICAL ANALYSIS – Unit 5*

Components in Percent

SiO_2	19.6	CaO	33.0
Al_2O_3	3.75	P_2O_5	0.04
Fe_2O_3	1.27	SO_3	0.90
MgO	6.51	L.O.I.	33.3
		Total	98.4

**after Hewitt and Vos, 1972, p. 21.*

QUARRY OPERATION

Overburden material has been placed in the quarry to provide two access ramps to the quarry floor and north blastface.

The excavated area of the quarry is about 2.8 ha, with two lifts. The quarry is currently advancing to the north on a single lift of 12.2 m. A Gardner-Denver 3100 air track and 750 cfm compressor are used to drill 7.6 cm diameter blast holes on a 2.1 m x 2.1 m pattern. AN/FO is used as a bulk explosive, initiated by electric caps – all blasts are monitored for vibration levels.

PROCESSING

A portable crushing system is set up on-site when required and consists of a Cedarapids primary jaw crusher, a Cedarapids 855 Commander secondary crusher, and a Suntract 5 ft. x 14 ft. double-deck portable screen.

A Cat 988 loader is used to haul rock to the crusher and a Cat 966 is used to load trucks and handle stockpiles.

PRODUCTS

Granular "A" and "B"
3/4 in. Clear Stone
–5/8 in. Screenings

REFERENCES

Goudge, 1938, p. 58–59
Hewitt and Vos, 1972, p. 20–21
Williams, in prep., Appendix 1 – Section LQ WI-1

MAPS

Williams, Wolf and Carson, 1985c, OGS Map P.2721

CW-4 A.L. BLAIR CONSTRUCTION CO. LTD. — ST. ALBERT STATION QUARRY

LOCATION AND OWNERSHIP

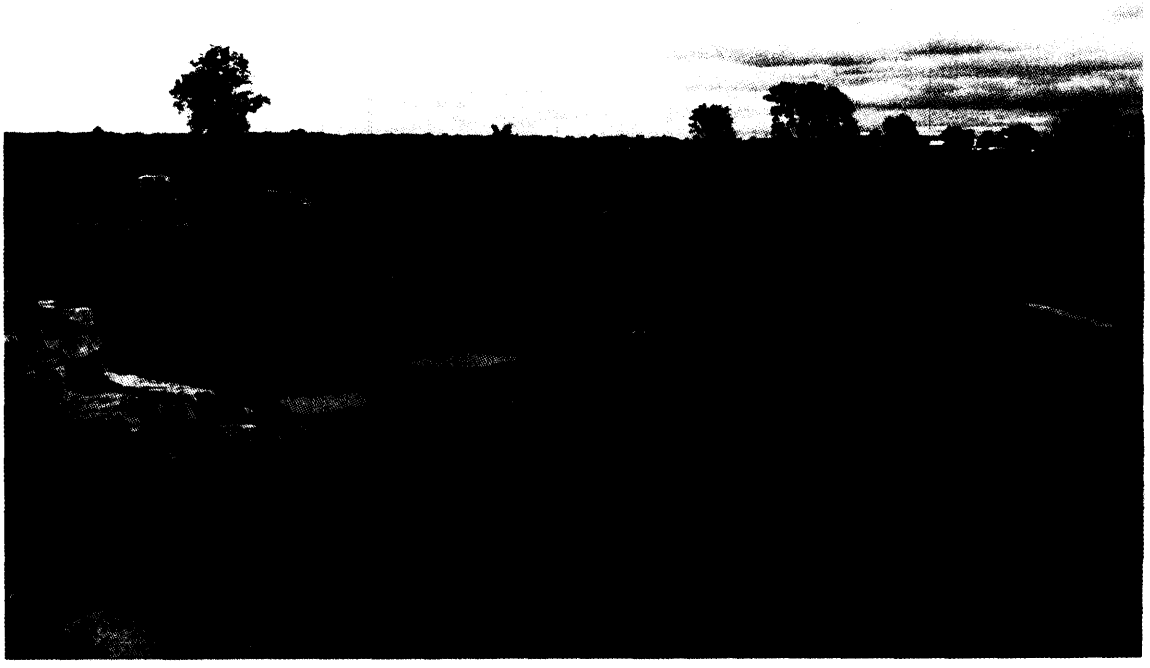
The St. Albert Station Quarry is located 1.5 km west of St. Albert Station in Lots 7 and 8, Concession 12, Finch Township, Stormont County (Figure CW-4-1). This quarry is the largest and oldest of the many quarries owned and operated by A. L. Blair Construction Co. Ltd. The quarry licence covers an area of about 80 ha.

The old Silvertone Black Marble Quarry described by Goudge (1938, p. 191–195), is located on the property. This historically significant quarry was a major source of building stone. Details of its geology and production follow the description of the St. Albert Station Quarry.

GEOLOGY

The 14.9 m deep quarry exposes limestones of the lower and middle members of the Bobcaygeon Formation (Figure CW-4-2). The contact between the two members is placed where the thicker bedded, less shaly limestones of the lower member are overlain by thinner bedded, much more shaly limestones of the middle member. Glacial overburden around the quarry is up to 2 m thick.

Photo CW-3-1. VIEW OF WILLIAMSBURGH QUARRY (LOOKING NORTHWEST).



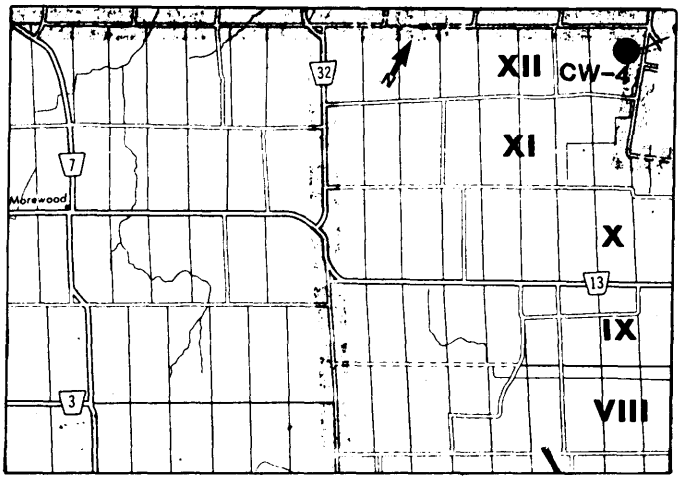


Figure CW-4-1. LOCATION MAP FOR ST. ALBERT STATION QUARRY.

Geological Section

		Thickness
UNIT 2	*Bobcaygeon Formation, middle member*	*5.9m*

Limestone: medium grey, weathers grey-brown; very fine to fine crystalline; thin to medium bedded, sharp contacts, commonly with dark grey shale partings; fossiliferous with abundant brachiopods and crinoids; top of lower lift at base of unit.

UNIT 1	*Bobcaygeon Formation, lower member*	*9.0m*

Limestone: medium grey, weathers same; very fine crystalline; medium to thick bedded, contacts rarely have very thin dark grey shale partings; fossiliferous with abundant brachiopods.

Total thickness *14.9m*

CHEMICAL ANALYSIS - Unit 2*

Components in Percent			
SiO_2	2.46	CaO	52.5
Al_2O_3	0.66	P_2O_5	0.02
Fe_2O_3	0.44	SO_3	0.53
MgO	1.37	L.O.I.	42.3
		Total	100.3

* *after Hewitt and Vos, 1972, p.15.*

QUARRY OPERATION

Two lifts of 5.9 m and 9.0 m have been excavated; the lower of which is currently being worked. There is also the potential for a third lift.

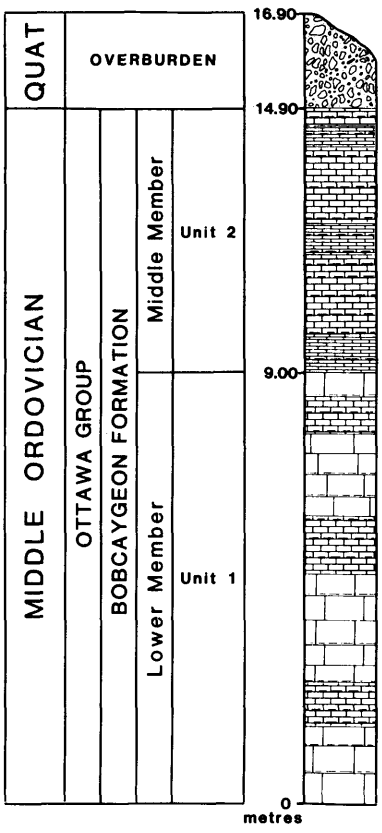


Figure CW-4-2. STRATIGRAPHIC COLUMN FOR ST. ALBERT STATION QUARRY.

A drilling pattern of 2.4 m x 2.4 m with 7.6 cm diameter holes is used. Approximately 20,000 tonnes is blasted ahead of crushing, which is carried out by a contractor.

PROCESSING

A. L. Blair Construction owns three portable crushing plants, consisting of the following equipment.

Primary Crushers

1 – Parker 24 in. x 36 in. Jaw
2 – Cedarapids 30 in. x 42 in. Double Impeller
1 – Cedarapids 22 in. x 48 in. Jaw
1 – Cedarapids 43 in. x 40 in. Impact

Secondary Crushers

1 – 443 Cedarapids Commander
1 – 855 Cedarapids Commander
1 – Cedarapids 40 in. x 33 in. Hammer Mill

Screening

1 – 5 ft. x 16 ft. Cedarapids Screening Plant
1 – 4 ft. x 12 ft. Cedarapids Screening Plant

Heavy Equipment

3 – Terex 7261 61/2 yd. Loaders
2 – Hough International 90E 4 1/2 yd. Loaders
1 – Hough International 90C 4 1/2 yd. Loader
1 – Cat 966 4 1/2 yd. Loader
1 – 690B John Deere Backhoe
1 – Cat D7 Bulldozer
1 – Cat D5 Bulldozer
7 – Tandem Dump Trucks

PRODUCTS

Granular "A" & "B" & "C"
3/4 in. Clear
1/2 in. Clear
3/8 in. Clear
Screenings
5/8 in. Concrete Stone
Agricultural Lime
Approved for HL products, though not currently being made.

SILVERTONE BLACK MARBLE QUARRY

This abandoned dimension stone quarry lies adjacent to the active aggregate quarry. Although the quarry is not active, the steel derrick for removing blocks remains in place on the south side.

GEOLOGY

Eighteen quarriable beds of black, microcrystalline to fine–crystalline limestone of the lower member, Bobcaygeon Formation, are exposed. A few beds are brownish–black, which would necessitate careful control to assure colour consistency. Scattered crystals of coarse, grey calcite impart an attractive silvery sheen to the polished surface. Beds range from 30 cm to 80 cm in thickness, but occasional thin shaly partings may cause planes of weakness in a few beds. The limestone is of high calcium composition and belongs to the lower member of the Bobcaygeon Formation.

QUARRY OPERATION

The building stone quarry was operated from 1931 to 1957 and was worked on three lifts to a depth of 10 m. The quarry opening is 40 m by 25 m. Water now fills the lowest level. Overburden thickness is thin, but 1 m of thin–bedded limestone is removed from the top of the quarry section.

A regular pattern of vertical jointing in two directions at right angles facilitates the quarrying of large blocks. East–west jointing is spaced at 1.5 m to 3 m; north–

Photo CW-4-1. BOBCAYGEON FORMATION FORMERLY EXTRACTED FOR INTERIOR CLADDING; SILVERTONE BLACK MARBLE QUARRY.

south jointing at 4 m to 5 m. The stone was quarried by close drilling and broaching.

PRODUCTS

The stone took an excellent polish and was highly prized for interior decorative purposes. According to M. F. Goudge (1938, p. 193) it was used in the following buildings: British Empire building, Rockefeller Centre, New York; Postal Terminal building and Notre Dame de Grace post office, Montreal; Ottawa Hydro Electric building, Postal Terminal building and the Justice building, Ottawa; Toronto Hydro Electric building and the T. Eaton Company store, Toronto; and in federal buildings in Hamilton, Guelph, Fort William, Winnipeg and Vancouver.

REFERENCES

Goudge, 1938, p.191–195

Hewitt, 1964a, p.41

Hewitt and Vos, 1972, p.15

Williams, in prep., Appendix 1 – Section LQ WI–3

MAPS

Williams, Wolf and Carson, 1985c, OGS Map P.2721

CW-5 A.L. BLAIR CONSTRUCTION CO. LTD. — EMBRUN QUARRY

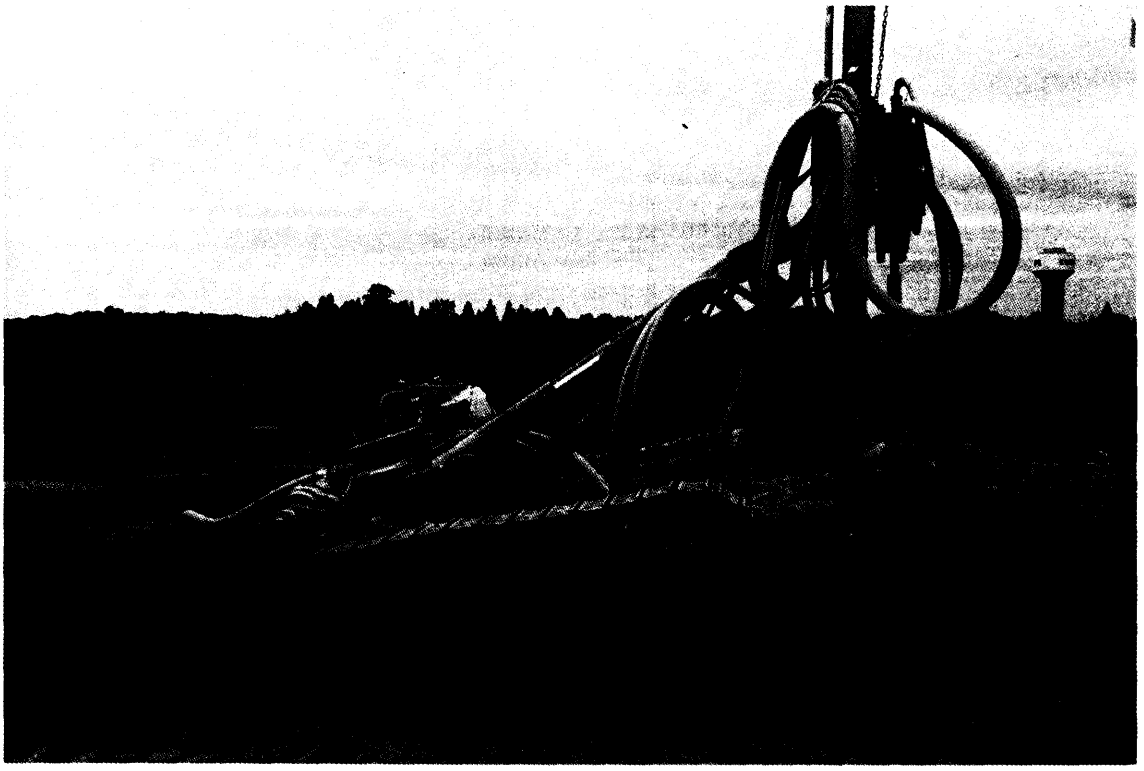
LOCATION AND OWNERSHIP

The Embrun Quarry is located 1.0 km southeast of the village of Embrun in the north half of Lot 6 and the south half of Lot 7, Concession 8, Russell Township, Russell County (Figure CW–5–1). The quarry is owned and operated by A. L. Blair Construction Co. Ltd.

GEOLOGY

The 12.0 m deep quarry exposes fine– to medium–crystalline, thin–bedded, shaly limestone of the middle member, Bobcaygeon Formation. Several minor faults can be seen in the quarry, trending between 070° and 110° with a southwest–side down displacement. Glacial overburden around the quarry is 1 to 2 m thick.

Photo CW-5-1. GARDNER-DENVER AIR TRACK DRILLING BLAST HOLES AT EMBRUN QUARRY (LOOKING NORTHWEST).



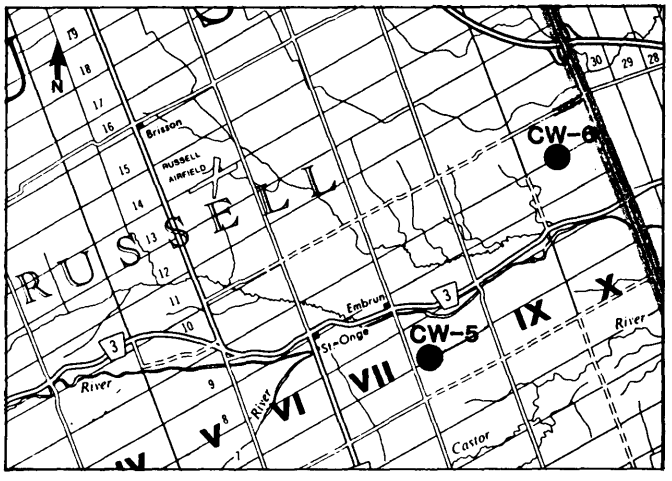


Figure CW-5-1. LOCATION MAP FOR EMBRUN QUARRY.

Geological Section

		Thickness
UNIT 1	*Bobcaygeon Formation, middle member*	*12.0m*

Limestone: medium grey, weathers light grey; fine to medium crystalline, rarely coarse crystalline; thin bedded, rarely medium bedded, sharp, planar, and slightly undulating contacts, with shale partings common; calcite crystals are present in the coarse-crystalline beds; fossiliferous with abundant brachiopods, crinoidal debris, corals, gastropods, and bryozoans.

Total thickness *12.0m*

QUARRY OPERATION

Granular "A", "B" & "C" and 3/4 in. Clear were produced in 1986, from a single lift within the quarry.

REFERENCES

Williams, in prep., Appendix 1 – Section LQ RU-5

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CW-6 DIBBLEE CONSTRUCTION CO. LTD. — LIMOGES QUARRY

LOCATION AND OWNERSHIP

This quarry, located 5 km south of Limoges in Lot 9, Concession 10, Russell Township, Russell County, is in-

termittently operated by Dibblee Construction Co. Ltd (Figure CW-6-1).

GEOLOGY

The 6.0 m deep quarry exposes limestone of the Lindsay Formation, lower member. The thin-bedded, nodular limestone is folded and contorted adjacent to a minor fault which trends at 120° and dips 70° to the southwest. The southwest side was downthrown only a few metres. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

		Thickness
UNIT 1	*Lindsay Formation, lower member*	*6.0m*
	Limestone: medium to dark grey-brown, weathers blue-grey to brown; fine to medium crystalline; very thin to thin bedded, with shale interbeds up to 5 cm thick; weathering produces a nodular texture in upper part of quarry; fossiliferous with abundant brachiopods, crinoidal debris, gastropods, corals, and burrows.	
Total thickness		*6.0m*

REFERENCES

Williams, in prep., Appendix 1 – Section LQ RU-6

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CW-7 TOWNSHIP OF CLARENCE — CANAAN QUARRY

LOCATION AND OWNERSHIP

The Canaan Quarry is located 4.5 km east of Sarsfield in Lot 11, Concession 11, Clarence Township, Russell County (Figure CW-7-1). The quarry was developed in 1950 by Clarence Township for road construction material and local commercial sales. The firm of McNeely Eng. Ltd. of Nepean has been retained since 1967 to manage production, contracting, product specifications and product inventory.

GEOLOGY

The 17.0 m deep quarry exposes medium- to coarse-crystalline, thin-bedded, nodular limestone of the lower member of the Lindsay Formation in a single lift. The quarry has been developed southward into an east-west trending hillside. Glacial overburden around the quarry is 1-2 m thick.

Geological Section

		Thickness
UNIT 2	*Lindsay Formation, lower member*	*2.0m*
	Limestone: light to medium grey, weathers light brown; medium to coarse crystalline; thin bedded; nodular appearance.	
UNIT 1	*Lindsay Formation, lower member*	*15.0m*
	Limestone: medium grey-brown, weathers light grey-brown; fine to coarse crystalline; thin to medium bedded with 1-2 cm thick shale partings between beds; fossiliferous with abundant gastropods, brachiopods, trilobites, crinoidal debris, and bryozoa.	
Total thickness		*17.0m*

QUARRY OPERATION

A single lift of about 17.0 m has been excavated over an area of approximately 350 m x 300 m (10.5 ha). The quarry will soon reach the property limits. Quarry drainage is assisted by a smooth and gently graded floor. A 4 in. submersible pump is used for dewatering of the quarry.

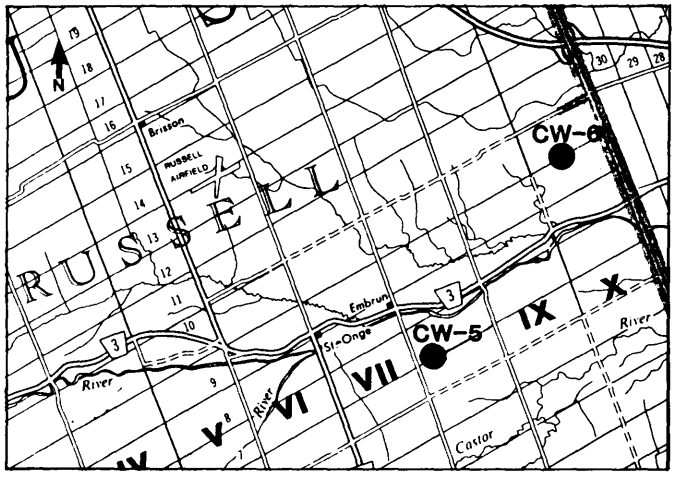


Figure CW-6-1. LOCATION MAP FOR LIMOGES QUARRY.

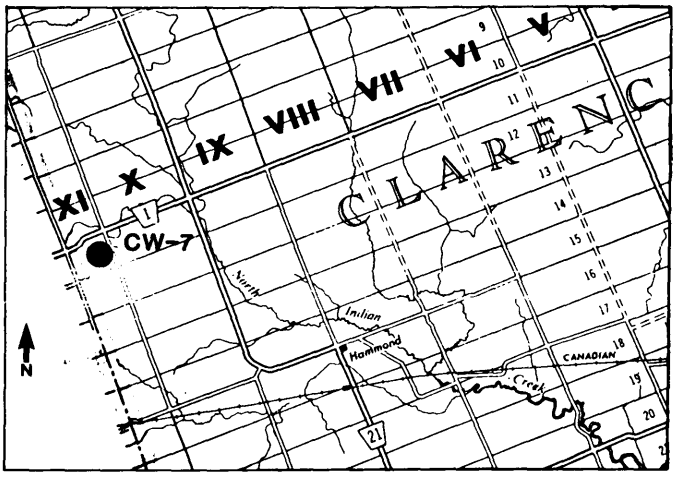


Figure CW-7-1. LOCATION MAP FOR CANAAN QUARRY.

Photo CW-7-1. SOUTHWEST QUARRY FACE, WITH DRILLING IN PROGRESS; CANAAN QUARRY.

PROCESSING

Drilling and blasting is contracted and a 1.8 m x 1.8 m drill pattern is used with 3.8 cm diameter holes. Crushing is performed by portable systems. The quarry operates over a 9-month operating year, producing road base aggregates.

REFERENCES

Hewitt, 1964a, p.40
Hewitt and Vos, 1972, p.17
Williams, in prep., Appendix 1 - Section LQ RU-2

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CW-8 ROCKLAND (STEWART) QUARRY

LOCATION AND OWNERSHIP

This abandoned quarry, located 2.5 km south of the Town of Rockland, covers portions of Lots B and C, Concession 9, Clarence Township, Russell County (Figure CW-8-1). The quarry is not licensed under the Pits and Quarries Control Act.

GEOLOGY

This long abandoned quarry has been included in this study as it displays a significant geological section of the Gull River and Bobcaygeon Formations. The two lifts expose 29.75 m of strata; silty dolostones and limestones of the lower member and thin-bedded shaly limestones of the upper member, Gull River Formation, overlain by thick bedded limestones of the lower member, Bobcaygeon Formation (Figure CW-8-2). The quarry was excavated into the face of an east-west escarpment which parallels the nearby Ottawa River. Glacial overburden at the escarpment's crest ranges from 1 to 4 m thick.

Geological Section

		Thickness
UNIT 4	*Bobcaygeon Formation, lower member*	*11.1m*

Limestone: medium to dark grey-brown, weathers blue-grey to grey-brown; microcrystalline to fine crystalline; thick to massive bedded, with rare thin to medium beds, some with thin, dark grey shale partings between them; rare nodular beds up to 30 cm thick.

UNIT 3	*Bobcaygeon Formation, lower member*	*8.4m*

Limestone: medium to dark grey-brown; weathers blue-grey to grey-brown; microcrystalline to fine crystalline; thick to massive bedded, with some very thin to thin beds, some of which have very thin shale partings; fossiliferous with abundant brachiopods, bryozoa, cephalopods, and gastropods; top of lower lift is at lower contact.

UNIT 2	*Gull River Formation, upper member*	*7.85m*

Limestone: medium grey-brown, weathers blue-grey; microcrystalline; very thin to thin bedded with thicker beds at base of unit, sharp and planar contacts, commonly with shale partings present; oolitic and intraclasts of limestone in the interval 1.5-2.35 m above base of unit; small calcite crystals, "birdseye" texture, very abundant in uppermost 5.5 m; fossiliferous, colonial coral, *Tetradium*, very abundant in upper 5.0 m of unit.

UNIT 1	*Gull River Formation, lower member*	*2.4m*

Limestone: with interbeds of silty dolostone (up to 80 cm thick); medium grey-brown; weathers blue-grey to grey-brown; limestones microcrystalline to fine crystalline, dolostones fine crystalline; very thin to medium bedded; most beds contain intraclasts of light grey limestone.

Total thickness	*29.75m*

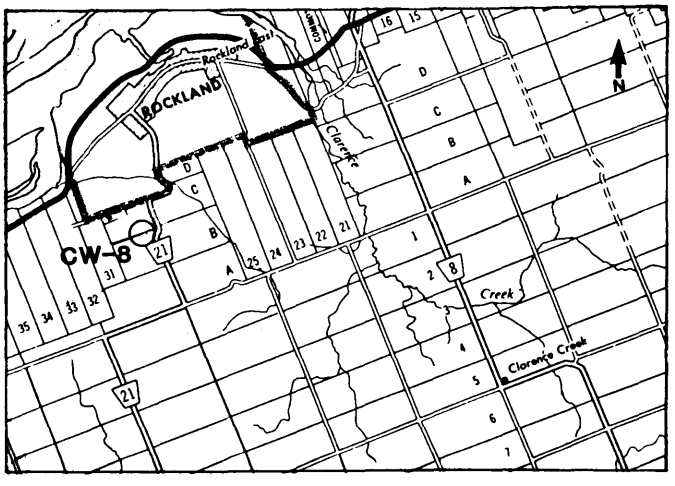


Figure CW-8-1. LOCATION MAP FOR ROCKLAND (STEWART) QUARRY.

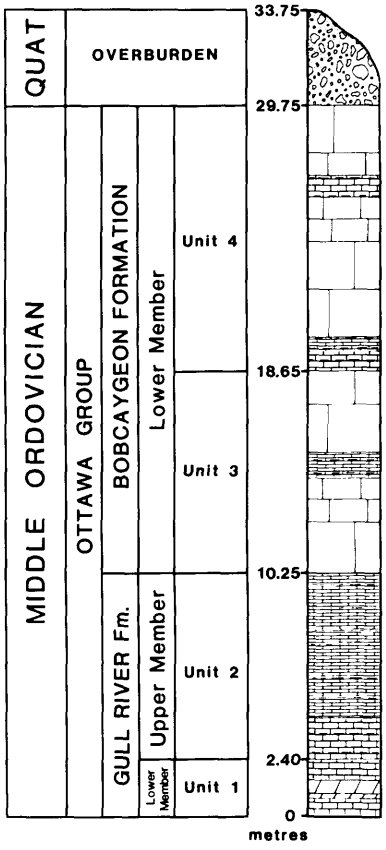


Figure CW-8-2. STRATIGRAPHIC COLUMN FOR ROCKLAND (STEWART) QUARRY.

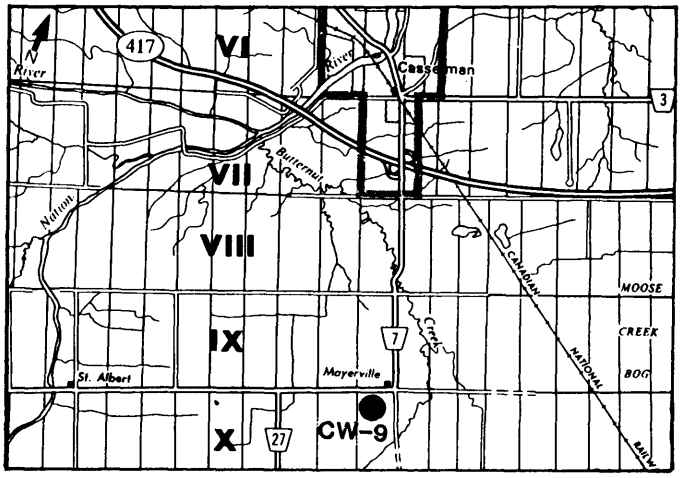


Figure CW-9-1. LOCATION MAP FOR RICHIER QUARRY.

Photo CW-9-1. WEST FACE OF RICHIER QUARRY WITH LOAD OUT FROM STOCKPILES.

REFERENCES

Goudge, 1938, p.180–182
Schoft, 1966
Barnes, 1967
Barnes, 1968, p.170
Williams, in prep., Appendix 1 – Section AQ TH–1

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CW-9 CORNWALL GRAVEL COMPANY LTD. — RICHIER QUARRY

LOCATION AND OWNERSHIP

The Richier Quarry is located at Mayerville, 5 km south of Casselman, in Lot 10, Concession 10, Cambridge Township, Russell County (Figure CW–9–1). The quarry was first opened on a commercial basis in 1983 by the owner and operator Cornwall Gravel Company Ltd.

GEOLOGY

The 12.7 m deep quarry exposes fine– to medium–crystalline, thin–bedded, nodular limestone of the lower member, Lindsay Formation. Water once filling the quarry has only recently been pumped out; the limestone that is now exposed is almost white in colour. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

		Thickness
UNIT 1	*Lindsay Formation, lower member*	*12.7m*

Limestone: medium grey, weathers dark grey (light grey where once under water); fine to medium crystalline with some coarse-grained bioclastic beds; medium bedded (10–20 cm), regular, sharp contacts, with thin (1 cm) shale partings producing a faint nodular texture in places; fossiliferous, with abundant crinoidal debris and brachiopods, and burrows are also common.

Total thickness *12.7m*

QUARRY OPERATION

The Richier Quarry is mined to a depth of 12.7 m on two lifts over an area of approximately 1.5 ha. The stone is quarried by drilling and blasting.

PROCESSING

A portable crusher system is used at the site. Rock is hauled by Michigan 275 6.5 yd. loader to a 43 in. x 40 in. Cedarapids impeller primary crusher and then screened by an 8 ft. x 20 ft. Pioneer screening plant producing Granular "A" and oversize that is sent to a Cedarapids 855 Commander jaw and roller secondary crusher. Stone leaving the secondary crusher is screened by a Suntract 6 ft. x 16 ft. portable screen, producing weeping tile stone, HL3, HL4 and dust.

The quarry stone possesses relatively low silica content (2%), and is principally used for road base and asphalt. No tests have been made to date to determine potential concrete stone applications.

Products

Granular "A" and "B"
1 in. Clear
Weeping Tile Stone
HL3, HL4
Dust

REFERENCES

None

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CW-10 A.L. BLAIR CONSTRUCTION CO. LTD. — McLEAN (FINCH) QUARRY

LOCATION AND OWNERSHIP

The McLean Quarry is located 2 km southwest of Finch in Lot 11, Concession 2, Finch Township, Stormont County (Figure CW-10-1). The property is licensed for an area of approximately 2 ha. The quarry has been opened on a single lift of 4.0 m and is operated intermittently by A. L. Blair Construction Co. Ltd.

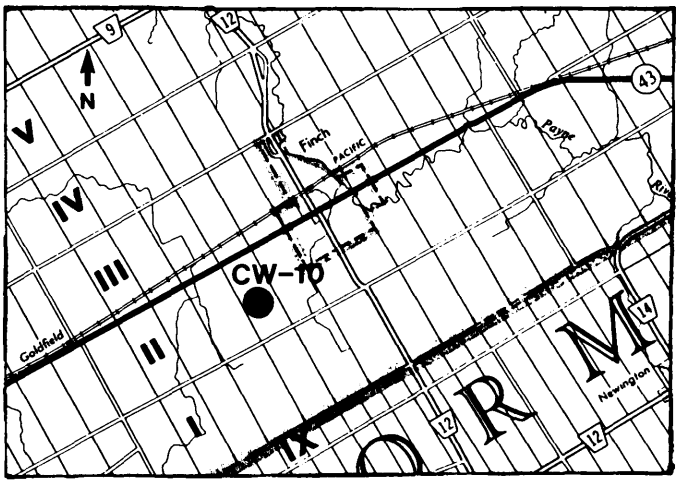


Figure CW-10-1. LOCATION MAP FOR McLEAN (FINCH) QUARRY.

GEOLOGY

The 4.0 m deep quarry exposes interbedded limestones and shales of the Verulam Formation. The fine- to coarse-crystalline, thin-bedded limestones alternate with very thin-bedded shale. Glacial overburden around the quarry is 1–2 m thick.

Geological Section

		Thickness
UNIT 1	*Verulam Formation*	*4.0m*

Limestone, interbedded with shale: medium grey, weathers light to medium grey; fine to coarse crystalline; limestones are thin bedded (7–10 cm), shales are very thin bedded (2–4 cm), sharp and planar contacts; some coarse crystalline beds are bioclastic and calcarenitic; fossiliferous with abundant brachiopods, crinoidal debris, and trilobites (mainly fragments), burrows are abundant on bedding planes.

Total thickness *4.0m*

REFERENCES

None

MAPS

None

CW-11 A.L. BLAIR CONSTRUCTION CO. LTD. — PLUMADORE QUARRY

LOCATION AND OWNERSHIP

The Plumadore Quarry is located in Lot 27, Concession 5, Osnabruck Township, Cornwall County (Figure CW-11-1). The quarry was opened in 1979 by the present owner and operator, A. L. Blair Construction Co. Ltd. Immediately to the west is a second quarry operated by Osnabruck Township.

GEOLOGY

The two quarries were both partially flooded at the time of the site visit. Above the water level 3.0 m of thin-bedded shaly limestone of the Verulam Formation was visible in both quarries. Glacial overburden around the quarries is less than 0.5 m thick.

Geological Section

	Thickness
UNIT 1 Verulam Formation	*3.0m*
Limestone, with shale partings: light to dark grey-brown, weathers blue- grey to brown; very fine to medium crystalline; thin to medium bedded, with shale partings up to 2 cm thick; fossiliferous, with abundant brachiopods, bryozoa, and crinoidal debris.	
Total thickness	*3.0m*

QUARRY OPERATION

The Plumadore Quarry had been excavated by drilling and blasting on two lifts of 6.1 m each. The quarry was filled with water in 1986.

PROCESSING

The quarried stone is delivered to a portable crushing and screening plant for processing.

PRODUCTS

The primary product is granular road base and is produced on demand for local road construction projects.

REFERENCES

Williams, in prep., Appendix 1 – Section LQ WI-4

MAPS

Williams, Wolf and Carson, 1985c, OGS Map P.2721

CW-12 PERMANENT CONCRETE — CORNWALL QUARRY

LOCATION AND OWNERSHIP

The Cornwall Quarry of Permanent Concrete is located approximately 6 km northwest of Cornwall, in Lots 25–29, Concession 4, Cornwall Township, Stormont County (Figure CW-12-1).

Stone blocks were removed from the property during the 1880s for the initial construction of the Cornwall Canal. The present quarry was opened in 1968 by Permanent Concrete, now a division of Canfarge Ltd., and supplies crushed stone for construction projects.

GEOLOGY

The 24.8 m deep quarry exposes a section from the lower member of the Gull River Formation to the lower member of the Bobcaygeon Formation (Figure CW-12-2). The lower part of the quarry exposes interbedded microcrystalline limestones and fine-crystalline dolostones of the lower member, Gull River Formation. The overlying very fine-crystalline, thin-bedded shaly limestones of the upper member are, in turn, overlain by the microcrystalline to fine-crystalline, thick-bedded limestones of the lower member, Bobcaygeon Formation. The three lift levels of the quarry correspond to each member. Glacial overburden around the quarry is 1 to 3 m thick.

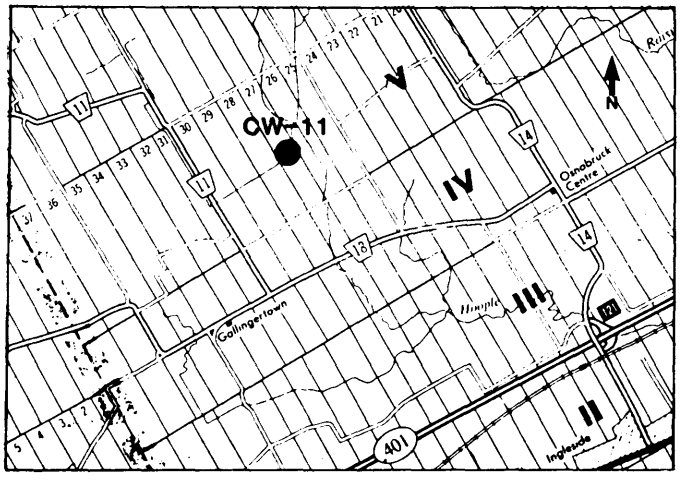


Figure CW-11-1. LOCATION MAP FOR PLUMADORE QUARRY.

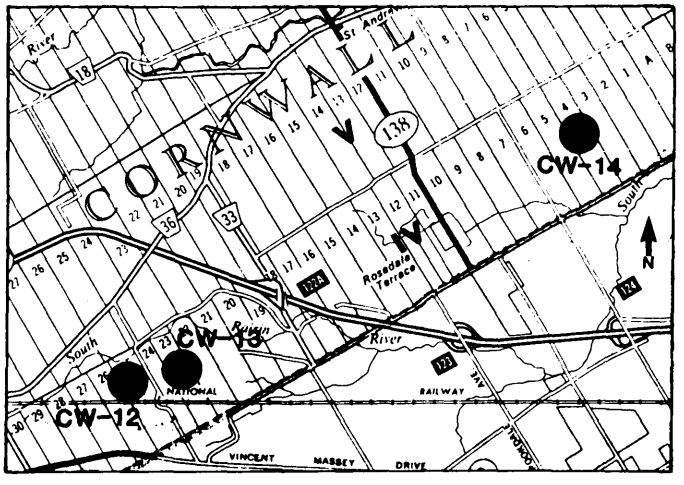


Figure CW-12-1. LOCATION MAP FOR CORNWALL QUARRY.

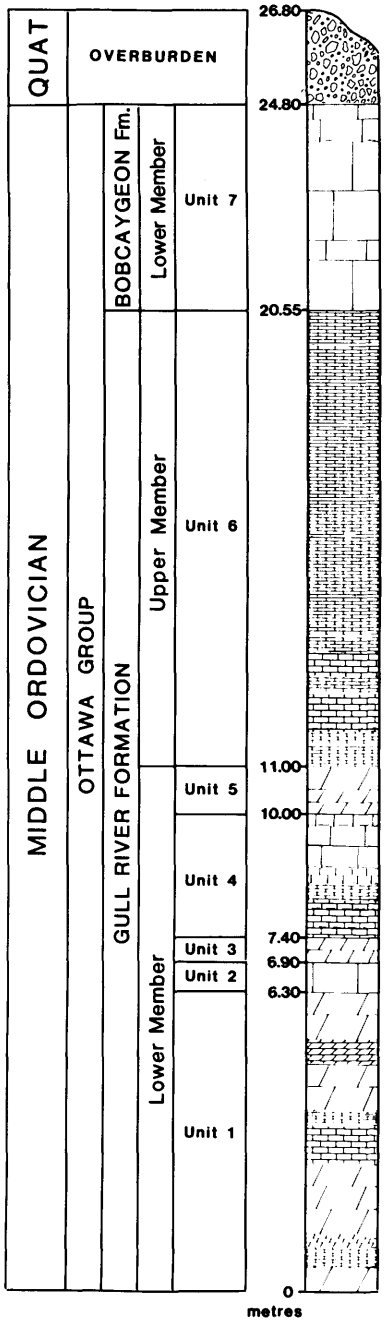


Figure CW-12-2. STRATIGRAPHIC COLUMN FOR CORNWALL QUARRY.

Geological Section

Thickness

UNIT 7 Bobcaygeon Formation, lower member *4.3m*

Limestone: medium to dark brown, weathers blue-grey; microcrystalline to fine crystalline; thick to massive bedded, with rare, very thin shale partings; top of 2nd lift at base of unit.

UNIT 6 Gull River Formation, upper member *9.5m*

Limestone, with shale partings: medium to dark grey-brown, weathers blue-grey to brown; microcrystalline to fine crystalline; very thin to thin bedded, with thicker beds occurring in the lower part of the unit; beds containing intraclasts of limestone common; top of 1st (lower) lift at base of unit.

UNIT 5 Gull River Formation, lower member *1.0m*

Dolostone: light grey-green, weathers buff to red-brown; microcrystalline to fine crystalline, portions of unit may contain mud and silt; medium to thick bedded; some beds contain intraclasts of limestone; calcite and pyrite mineralization common; vugs commonly filled with calcite crystals.

UNIT 4 Gull River Formation, lower member *2.6m*

Limestone, with shale partings: medium to dark grey-brown; weathers blue-grey to brown; microcrystalline to fine crystalline; thin to thick bedded, with thin shale partings; intraclasts of limestone common.

UNIT 3 Gull River Formation, lower member *0.5m*

Dolostone: light grey-green, weathers buff to red-brown; microcrystalline to fine crystalline; single bed; contains intraclasts of limestone.

UNIT 2 Gull River Formation, lower member *0.6m*

Limestone: dark grey, weathers blue-grey to dark grey; single bed of oolitic limestone which contains intraclasts of light grey limestone.

UNIT 1 Gull River Formation, lower member *6.3m*

Dolostone, interbedded with limestone, shaly limestone and shaly dolostone:

limestone - medium grey, weathers light grey; microcrystalline to very fine crystalline; medium bedded; small calcite patches rare; oolitic and intraclastic limestone in lowermost 30 cm of unit;

dolostone - light grey to grey-green, weathers light grey-green; very fine to fine crystalline; thick bedded; small calcite patches common;

shaly limestones and dolostones - typically dark grey and light green, respectively; very thin to thin bedded; contacts are generally sharp and planar.

Total thickness *24.8m*

CHEMICAL ANALYSES*

	Components in Percent	
	Unit 7	Unit 6
SiO_2	1.01	6.34
Al_2O_3	0.95	3.33
Fe_2O_3	0.60	1.08
MgO	0.91	1.47
CaO	53.5	48.3
L.O.I.	43.0	38.6
Total	99.97	99.12
CO_2	42.0	38.9

* *after Hewitt and Vos, 1972, p.37.*

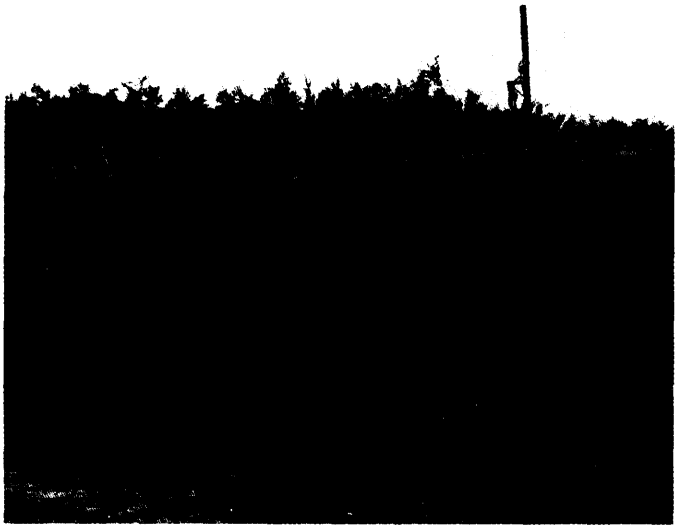


Photo CW-12-1. LOWER LIFT OF THE WEST FACE OF CORNWALL QUARRY.

QUARRY OPERATION

Most of the overburden is removed by a Cat 980C 5-yd. loader; a backhoe with Gradall bucket is used to clean down to the rock surface. The quarry is mined on three lifts of 4.3 m, 9.5 m, and 11.0 m. The first lift primarily supplies concrete stone, the second lift HL and granular stone products, and the third lift produces solely granular stone.

Drilling and blasting is by contract. A drill pattern of 2.1 m x 2.1 m with 7.6 cm diameter holes is used on the first lift while a 2.4 m x 2.4 m pattern is used on the second and third lifts.

PROCESSING

Blasted stone is loaded by a Cat 980C loader to Euclid trucks and hauled approximately 150 m to the primary surge hopper. Minus 5/8 in. material is scalped by a vibrating screen and stockpiled. Oversize stone passes to a Cedarapids 36 in. x 45 in. impactor for primary crushing and is then sent to the "centre screen" (single deck), which can be set to size at -4 in. or -2 in., depending on the desired products. Oversize from the screen is returned to the primary crusher, while undersize stone is sent to the screening tower for separation by two 5 ft. x 12 ft. triple-deck Tyler screens producing 1/4 in. fines, 3/8 in. chips, 3/4 in. clear and -2 in. +3/4 in. sizings. These products are stored in four hoppers. The oversize product can be returned by 30 in. conveyor to the primary crusher, which is equipped with a surge bin.

PRODUCTS

Granular "A", "B" and "C"
3/4 in. Clear
3/8 in. Clear
Screenings
HL3, HL4 and HL8

REFERENCES

Goudge, 1938, p.194
Hewitt and Vos, 1972, p.37
Williams, in prep., Appendix 1 - Section LQ CO-2

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

CW-13 DIBBLEE CONSTRUCTION CO. LTD. — CORNWALL QUARRY

LOCATION AND OWNERSHIP

This quarry, located 6 km northwest of Cornwall in Lot 23, Concession 4, Cornwall Township, Stormont County (Figure CW-13-1), is intermittently operated by the Dibblee Construction Co. Ltd., part of the Warren Paving and Materials Group Ltd. This quarry is located east of the Cornwall Quarry of Permanent Concrete Ltd. (CW-12).

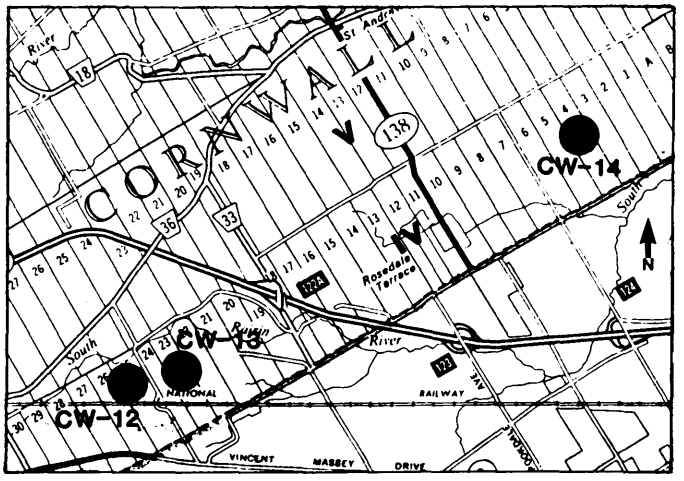


Figure CW-13-1. LOCATION MAP FOR CORNWALL QUARRY.

GEOLOGY

The old, original quarry on the Dibblee property is partially flooded, with approximately 2 m of limestone exposed above the water level. A recently excavated extension southward of the old quarry provided a section of 9.7 m. Thin-bedded, microcrystalline, shaly limestones of the upper member, Gull River Formation are overlain by the microcrystalline to fine-crystalline, thick-bedded limestones of the lower member of the Bobcaygeon Formation. Glacial overburden around the quarry ranges from 1 to 4 m in thickness.

Geological Section

		Thickness
UNIT 4	*Bobcaygeon Formation, lower member*	*3.0m*

Limestone: medium to dark grey, weathers very light grey; very fine to fine crystalline, becomes medium crystalline (calcarenitic) at the top; massive bedded (1.0-1.5 m), with stylolitic contacts; calcite replaces fossils; abundant brachiopods; lower contact of unit sharp and slightly irregular.

UNIT 3	*Gull River Formation, upper member*	*1.6m*

Limestone: light to medium grey, weathers light grey- brown; microcrystalline to very fine crystalline; medium bedded with sharp, planar contacts, either shaly or stylolitic with the number of stylolites increasing upwards; abundant, small calcite crystals, "birdseye" texture, with rare larger crystals; sparsely fossiliferous, with rare brachiopods; on joint planes bedding appears thicker (30 to 50 cm).

UNIT 2	*Gull River Formation, upper member*	*2.0m*

Limestone: light to medium grey, weathers light grey- brown; microcrystalline to very fine crystalline; thin to medium bedded, with sharp stylolitic contacts; "birdseye" texture is common; lower contact of unit sharp and planar.

UNIT 1	*Gull River Formation, upper member*	*3.1m*

Limestone: light medium grey, weathers medium grey; microcrystalline to very fine crystalline; medium bedded with sharp, planar contacts, either shaly or stylolitic with the number of stylolites increasing upwards; abundant, small calcite crystals, "birdseye" texture, with rare larger crystals; sparsely fossiliferous, with rare brachiopods; on joint planes bedding appears thicker bedded (30 to 50 cm).

Total thickness	*9.7m*

REFERENCES

Goudge, 1938, p.194-196

Hewitt, 1964a, p.42

Hewitt and Vos, 1972, p.22

Williams, in prep., Appendix 1 - Section LQ CO-3

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

CW-14 CORNWALL GRAVEL COMPANY LTD. — MacLEOD QUARRY

LOCATION AND OWNERSHIP

The MacLeod Quarry is located about 5 km north of Cornwall in Lots 3-5, Concession 4, Cornwall Township, Stormont County (Figure CW-14-1). Stone blocks were first removed from the MacLeod Quarry during the 1880s for use in the initial construction of the Cornwall Canal. In 1959 the quarry was opened by the present owner and operator, Cornwall Gravel Company Ltd.

GEOLOGY

The 33.4 m deep quarry exposes strata of the lower and upper members of the Gull River Formation, and of the lower member of the Bobcaygeon Formation (Figure CW-14-2). The lower member, Gull River Formation consists of fine-crystalline, medium-bedded dolostones which are interbedded with microcrystalline to fine-crystalline, medium-bedded limestones. The upper member consists of microcrystalline to very fine-crystalline, thin-bedded limestone which is interbedded with thin, dark grey shale beds. The lower member of the Bobcaygeon Formation consists of microcrystalline to fine-crystalline, thick- to massive-bedded limestone. Overburden ranges from 2.4 m to 7.6 m in thickness.

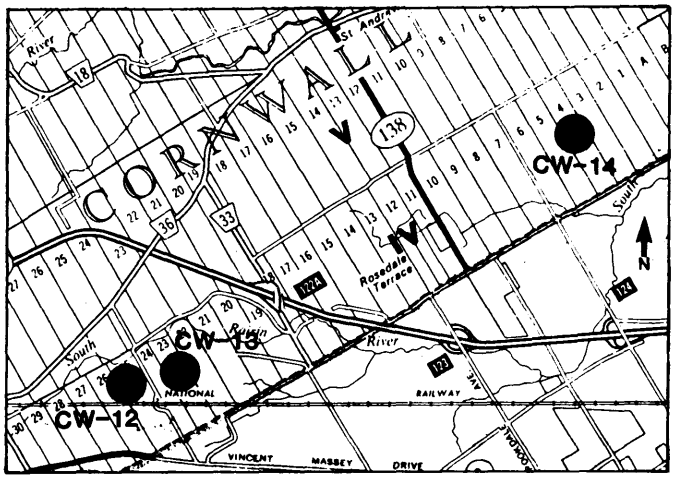


Figure CW-14-1. LOCATION MAP FOR MacLEOD QUARRY.

Geological Section

Thickness

UNIT 19 Bobcaygeon Formation, lower member *4.4m*

Limestone: medium to dark grey-brown, weathers blue-grey to medium grey; microcrystalline to fine crystalline; thick to massive bedded; lower contact of unit sharp and planar; top of 2nd lift at base of unit.

UNIT 18 Gull River Formation, upper member *1.8m*

Limestone: medium to dark grey-brown, weathers light blue-grey to medium grey; microcrystalline; very thin to thin bedded, with thin shale partings common between beds; lower contact of unit sharp.

UNIT 17 Gull River Formation, upper member *7.1m*

Limestone: medium to dark grey-brown, weathers light blue-grey to medium grey; microcrystalline; very thin to rarely thick bedded, with shale partings (1 cm thick) common between beds; intraclasts of light grey limestone abundant; small calcite crystals, "birdseye" texture in some beds; fossiliferous, with abundant crinoidal debris, brachiopods, bryozoans, and abundant colonial corals (*Tetradium*); lower contact of unit sharp and slightly irregular; top of 3rd lift is at base of unit.

UNIT 16 Gull River Formation, lower member *1.1m*

Dolostone: light grey-green to medium grey-brown, weathers buff to red-brown; microcrystalline to fine crystalline, with significant amounts of mud and silt in some beds; medium to thick bedded; intraclasts of limestone present; calcite-filled vugs present; lower contact of unit sharp.

UNIT 15 Gull River Formation, lower member *1.0m*

Limestone: medium to dark grey-brown, weathers light blue-grey to medium grey; microcrystalline to fine crystalline; thin to thick bedded, with thin shale partings between some beds; intraclasts of limestone common; lower contact of unit sharp and planar.

UNIT 14 Gull River Formation, lower member *0.8m*

Dolostone: light grey-green to medium grey-brown, weathers buff to red-brown; microcrystalline to fine crystalline, may contain some mud and silt; medium to thick bedded; lower contact of unit sharp.

UNIT 13 Gull River Formation, lower member *0.8m*

Limestone: dark grey, weathers blue-grey to dark grey; oolitic in a fine crystalline matrix; thick bedded; intraclasts of light grey limestone present; lower contact is sharp and undulatory.

UNIT 12 Gull River Formation, lower member *5.2m*

Limestone: dark grey, weathers medium grey; microcrystalline to very fine crystalline; thin to medium bedded, sharp and planar contacts, with few thin shale limestone partings; pyrite crystals are common, as are very small calcite patches; fossiliferous with abundant ostracods present in some beds; lower contact of unit sharp and planar; top of 4th lift at base of unit.

UNIT 11 Gull River Formation, lower member *2.6m*

Limestone: dark grey, weathers medium grey; microcrystalline to very fine crystalline; medium bedded, with sharp and planar contacts; beds are poorly defined; pyrite patches are common, large calcite-filled vugs in upper 20 cm; lower contact of unit is sharp and planar.

UNIT 10 Gull River Formation, lower member *1.4m*

Limestone, with some dolomitic mottles: light to medium grey, weathers medium grey; microcrystalline to very fine crystalline; medium bedded, sharp, planar to slightly irregular contacts; abundant, large (10-15 cm) calcite-filled vugs and patches, pyrite patches also common; lower contact of unit is sharp and irregular.

UNIT 9 Gull River Formation, lower member *0.3m*

Dolostone: light green, weathers same; fine crystalline; medium to thick bedded; this unit is only visible where there is no talus; lower contact of unit sharp and planar; top of 5th lift at base of unit.

UNIT 8 Gull River Formation, lower member *1.1m*

Dolostone: light green, weathers light grey-green; very fine to fine crystalline; thick bedded, with sharp and planar contacts; calcite- filled vugs very abundant in lower 50 cm; 15 cm thick, medium grey, microcrystalline limestone bed 0.5 m above base of unit; lower contact of unit sharp, slightly irregular, and stylolitic.

UNIT 7 Gull River Formation, lower member *0.3m*

Limestone: dark grey, weathers medium grey; microcrystalline to very fine crystalline; medium bedded; lower contact of unit sharp and slightly irregular.

UNIT 6 Gull River Formation, lower member *0.7m*

Dolostone: light green to light grey-green, weathers light grey-green; very fine crystalline; thick bedded; small calcite-filled vugs present; lower contact of unit sharp and planar.

UNIT 5 Gull River Formation, lower member *0.6m*

Limestone: dark grey, weathers medium grey; microcrystalline; thick bedded; lower contact of unit sharp and slightly irregular.

UNIT 4 Gull River Formation, lower member *0.4m*

Dolostone: light green, weathers light grey-green; fine crystalline; medium bedded; contains some silt and mud; lower contact of unit sharp and planar.

UNIT 3 Gull River Formation, lower member *0.8m*

Limestone: dark grey, weathers medium grey; microcrystalline to very fine crystalline; very thin to thin bedded, with sharp, undulatory contacts, with very thin dark grey shale partings; lower contact of unit sharp and planar.

UNIT 2 Gull River Formation, lower member *0.6m*

Sandy dolostone: light green, weathers light grey-green; coarse- to very coarse-grained quartz sand grains in a fine-crystalline dolostone; single, thick bed; lower contact of unit sharp, planar and in places welded.

UNIT 1 Gull River Formation, lower member *2.4m*

Limestone: medium to dark grey, weathers medium grey; microcrystalline to very fine crystalline; medium to thick bedded, contacts are sharp and planar; small calcite patches present.

Total thickness *33.4m*

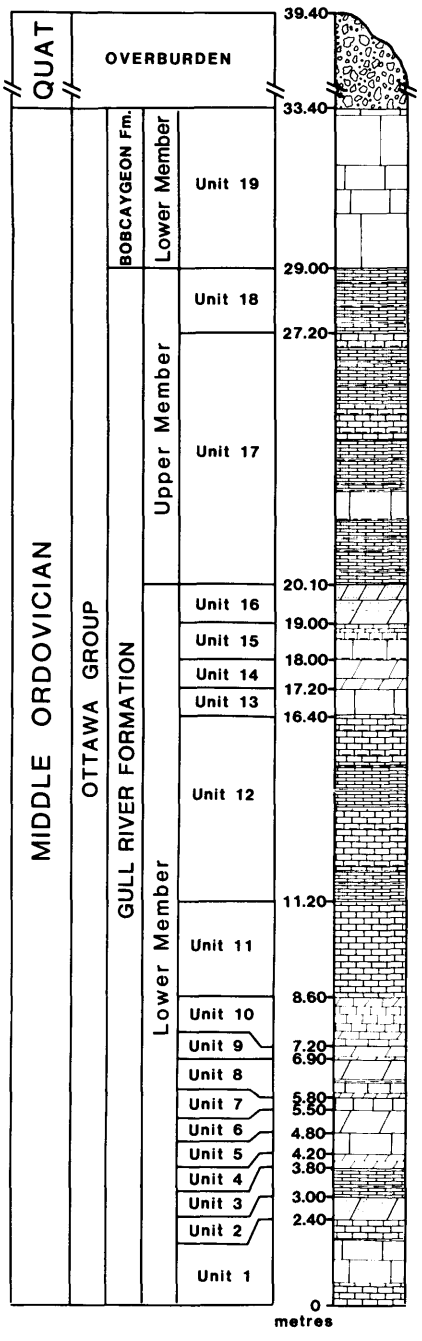


Figure CW-14-2. STRATIGRAPHIC COLUMN FOR MacLEOD QUARRY.

CHEMICAL ANALYSES*

	Components in Percent		
	Units 18-19	Unit 17	Units 13-16
SiO_2	5.63	9.33	15.0
Al_2O_3	1.75	2.12	3.25
Fe_2O_3	0.72	1.02	1.13
MgO	1.10	1.52	3.70
CaO	49.3	46.6	40.0
P_2O_5	0.01	0.02	0.02
SO_3	0.98	0.98	0.43
L.O.I.	39.9	38.0	35.4
Total	99.4	99.6	98.9

* *after Hewitt and Vos, 1972, p.20.*

QUARRY OPERATION

The quarry is presently excavated on five lifts of approximately 4.4 m, 8.9 m, 8.9 m, 4.3 m, 6.9 m in height. The first and second lifts supply clear and concrete stone products. The following design changes are presently being considered at the MacLeod Quarry:

(1) Grouping first and second lifts as a single lift.

(2) Grouping third, fourth and fifth lifts as a single lift.

(3) Increase blast fragmentation by tightening the drilling pattern to 2.1 m x 2.1 m, with 6.4 cm diameter blast holes.

Overburden is removed during the winter when the crushing operation is discontinued for maintenance and repair work.

PROCESSING

The crushing and screening plant can be adapted to produce a variety of finished materials according to the screen sizings used and flow path set. One example is used below.

The blasted stone is loaded by two, 6 1/2 yd. Michigan 275 loaders into four, 35-ton Wabco trucks and hauled approximately 500 m to a permanent 43 in. x 50 in. Cedarapids double-impeller primary crusher. Fine material is scalped and bypasses the crusher. Crushed stone and the scalped fines are screened by a double-deck 6 ft. x 16 ft. scalping screen producing -7/8 in. material (Granular "A") for bin storage and oversize to a 30 in. x 30 in. Cedarapids double-impeller secondary crusher. The stone then passes to a 5 ft. x 16 ft. triple-deck Nordberg vibratory screen, from which an undersize product (HL3) goes to bin storage, and oversize to a 5 ft. x 14 ft. Cedarapids screen. The Cedarapids screen produces a 5/8 in. clear stone and an oversize to a 42 in. Pulvamatic cage crusher. Stone leaving the Pulvamatic crusher returns in closed circuit to the 5 ft. x 14 ft. Cedarapids screen. Three Euclid 22-ton trucks are used for stockpiling finished products at the plant.

Photo CW-14-1.
VIEW OF
MacLEOD QUARRY
(LOOKING
SOUTHEAST).

Photo CW-14-2. PROCESSING PLANT (LOOKING SOUTH); MacLEOD QUARRY.

PRODUCTS

2 in. to 4 in. Quarry Stone
Granular "A", "B" and "C"
1 1/2 in. Field Bed Stone
1 in. Clear
3/4 in. Clear
5/8 in. Clear
1/2 in. Clear
3/8 in. Clear
Masonry Sand
Sand
Stone Dust

REFERENCES

Goudge, 1938, p.195–196
Hewitt, 1964a, p.42
Hewitt and Vos, 1972, p.20
Williams, in prep., Appendix 1 – Section LQ CO–1

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

CW-15 A.L. BLAIR CONSTRUCTION CO. LTD. — CHRISTIE QUARRY

LOCATION AND OWNERSHIP

The Christie Quarry is located 5 km south of the hamlet of Apple Hill in Lot 12, Concession 9, Charlottenburgh Township, Glengarry County (Figure CW-15-1) and is licensed for 60.7 ha. The quarry was opened in 1983 by the owner and operator A. L. Blair Construction Co. Ltd. and the excavated area is now approximately 1 ha. The property was first used to provide building stone for local uses but is now intermittently operated on a single lift of 7.3 m for aggregates.

GEOLOGY

The quarry exposes 4.5 m of very fine- to fine-crystalline, thin-bedded, nodular limestones of the lower member of the Lindsay Formation. During field work in 1986 the quarry was partially filled with water. Glacial overburden around the quarry is less than 0.5 m thick.

Geological Section

	Thickness
UNIT 1 Lindsay Formation, lower member	*4.5m*
Limestone: medium to dark grey, weathers medium grey to grey-brown; very fine to fine crystalline; thin to medium bedded (5-20 cm), sharp contacts with some thin shale partings, weathers into nodular texture in uppermost 2 m; fossiliferous with abundant brachiopods and crinoidal debris.	
Total thickness (exposed in 1986)	*4.5m*

PRODUCTS

Granular "A" and "B"

3/4 in. Tile Stone
Screenings
MTO approved for HL products

REFERENCES

None

MAPS

None

CW-16 A.L. BLAIR CONSTRUCTION CO. LTD. — GRAVEL HILL QUARRY

LOCATION AND OWNERSHIP

This quarry is located 1.5 km northeast of the hamlet of Gravel Hill in Lot 9, Concession 4, Roxborough Township, Stormont County (Figure CW-16-1). The property is licensed for an approximate area of 4 ha. The quarry presently covers an area of about 1 ha.

GEOLOGY

The 4.2 m deep quarry exposes fine- to medium-crystalline, thin-bedded, nodular limestone of the lower member of the Lindsay Formation. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Lindsay Formation, lower member	*4.2m*
Limestone: light to dark grey-brown, weathers blue- grey to brown; most beds very fine crystalline with some medium crystalline beds; very thin to rare thick bedded, with thin, irregular shale partings common between most beds; nodular texture in places.	
Total thickness	*4.2m*

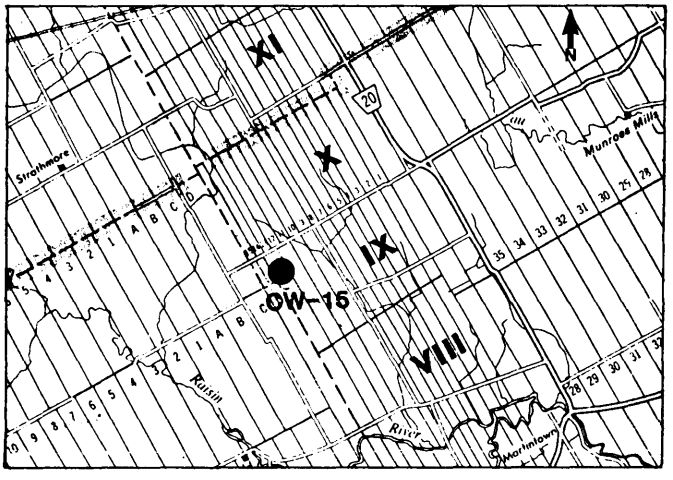


Figure CW-15-1. LOCATION MAP FOR CHRISTIE QUARRY.

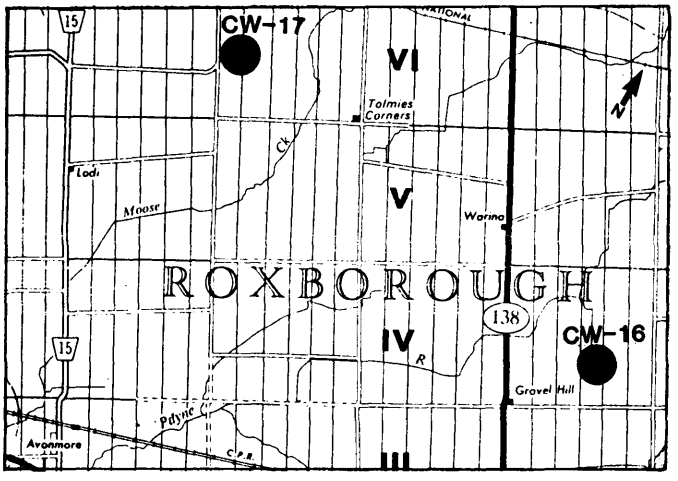


Figure CW-16-1. LOCATION MAP FOR GRAVEL HILL QUARRY.

QUARRY OPERATION

The quarry was opened in 1980 and currently operates on an intermittent basis.

PROCESSING

The quarried stone is processed by a portable crushing and screening plant.

PRODUCTS

Granular "A", "B" and "C"

REFERENCES

Williams, in prep., Appendix 1 – Section LQ CO–4

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

CW–17 A.L. BLAIR CONSTRUCTION CO. LTD. — MOOSE CREEK QUARRY

LOCATION AND OWNERSHIP

The Moose Creek Quarry is located 3 km southwest of Moose Creek, in Lot 24, Concession 6, Roxborough Township, Stormont County (Figure CW–17–1) and is owned by A. L. Blair Construction Co. Ltd.

GEOLOGY

The 5.6 m deep quarry exposes fine– to medium–crystalline, thin–bedded, nodular limestone of the lower member, Lindsay Formation. Glacial overburden around the quarry is less than 1 m thick.

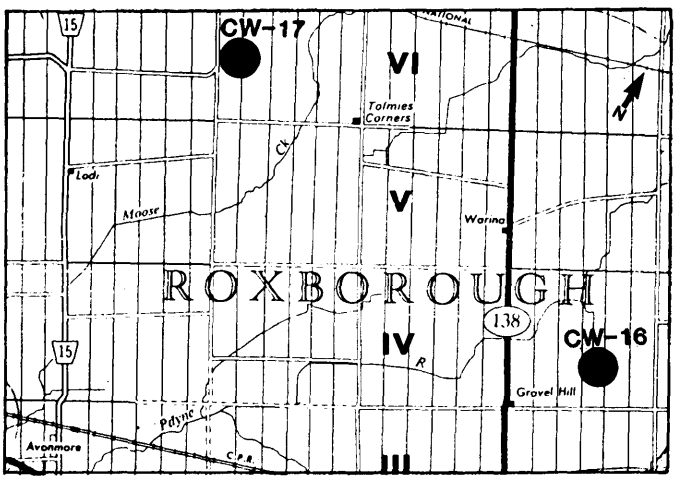


Figure CW–17–1. LOCATION MAP FOR MOOSE CREEK QUARRY.

Geological Section

		Thickness
UNIT 1	*Lindsay Formation, lower member*	*5.6m*
	Limestone: light to dark grey–brown, weathers blue– grey to brown; most beds very fine crystalline with some medium crystalline; very thin to rare thick bedded, commonly with shale partings between beds which produce a nodular texture.	
Total thickness		*5.6m*

QUARRY OPERATION

The stone is quarried by drilling and blasting and produces on an intermittent basis.

PROCESSING

The stone is processed by a portable crushing and screening plant.

PRODUCTS

Granular "A", "B" and "C"
3/4 in. Clear Stone

REFERENCES

Williams, in prep., Appendix 1 – Section LQ CO–5

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

CW–18 A.L. BLAIR CONSTRUCTION CO. LTD. — MARTIN (TAYSIDE) QUARRY

LOCATION AND OWNERSHIP

This small quarry is located 1.5 km southeast of the Highway 417/Highway 138 interchange, in Lot 10, Concession 10, Roxborough Township, Stormont County (Figure CW–18–1) and is operated intermittently by A. L. Blair Construction Co. Ltd.

The quarry was opened in 1983 and is licensed for an area of 8.1 ha, of which approximately 1 ha has been excavated on a single lift of 6.6 m. Stone from the Martin Quarry was used for the construction of Highway 417 in 1984. Production in 1986 consisted of primarily Granular "A", "B" and "C", 3/4 in. clear stone and screenings.

GEOLOGY

The 6.6 m deep quarry exposes fine– to medium–crystalline, thin–bedded, nodular limestone of the lower member, Lindsay Formation. Glacial overburden around the quarry is less than 1 m thick.

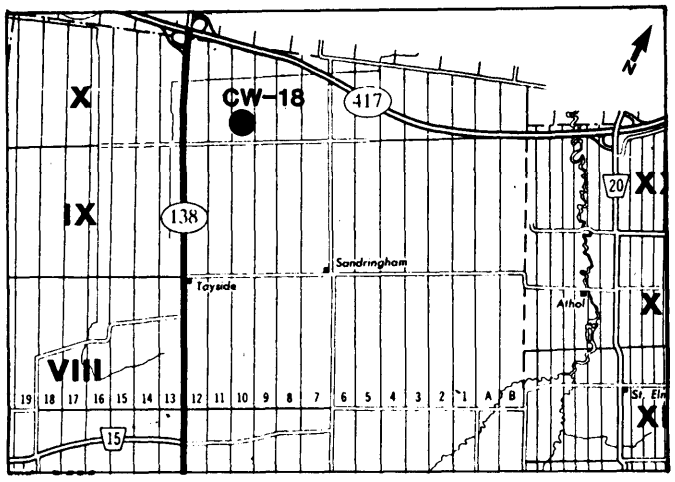


Figure CW-18-1. LOCATION MAP FOR MARTIN (TAYSIDE) QUARRY.

Geological Section

		Thickness
UNIT 4	*Lindsay Formation, lower member*	*1.8m*

Limestone: light to medium grey, weathers light brown; fine to medium crystalline; thin bedded; nodular texture; intraclasts of light grey limestone present; fossiliferous with abundant bryozoa, corals, and brachiopods.

UNIT 3	*Lindsay Formation, lower member*	*1.4m*

Limestone: medium grey, weathers light brown; fine crystalline with some beds of coarse crystalline calcarenites; medium bedded, with thin irregular shale partings; intraclasts of light grey limestone in some beds; sparsely fossiliferous.

UNIT 2	*Lindsay Formation, lower member*	*0.9m*

Limestone: medium grey, weathers light brown; very fine crystalline, with beds of coarse-crystalline calcarenite; medium bedded, with shale interbeds up to 2 cm thick; intraclasts of limestone in some beds; fossiliferous, with abundant crinoidal debris, brachiopods, and corals.

UNIT 1	*Lindsay Formation, lower member*	*2.5m*

Limestone: medium grey, weathers light brown; fine to medium crystalline; thin to medium bedded, with thin irregular shale partings.

Total thickness	*6.6m*

REFERENCES

Williams, in prep., Appendix 1 – Section LQ AL-1

MAPS

Williams, Rae and Wolf, 1985a, OGS Map P.2719

CW-19 BERTRAND & FRERES CONSTRUCTION COMPANY LTD. — ST. ISIDORE QUARRY

LOCATION AND OWNERSHIP

The St. Isidore Quarry is located 3 km south of St. Isidore de Prescott in Lot 7, Concession 20, South Plantaganet Township, Prescott County, (Figure CW-19-1) and was opened in 1971 to supply asphalt and road base stone for the construction of Highway 417. The St. Isidore Quarry is owned and operated by Bertrand & Freres Construction Company Ltd.

GEOLOGY

The 10.85 m deep quarry exposes fine- to medium-crystalline, thin- bedded, nodular limestone of the lower member, Lindsay Formation. Glacial overburden around the quarry is less than 1 m thick.

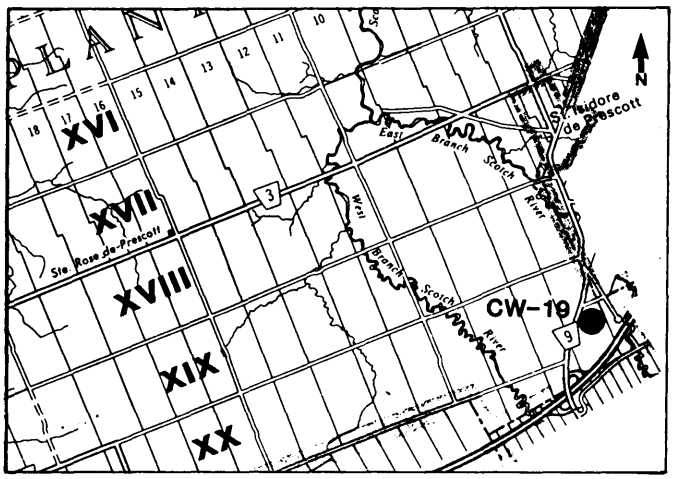


Figure CW-19-1. LOCATION MAP FOR ST. ISIDORE QUARRY.

Geological Section

		Thickness
UNIT 3	*Lindsay Formation, lower member*	*4.15m*

Limestone: medium grey, weathers light brown; fine to medium crystalline; thin to medium bedded, with thin, irregular shale partings which produce a nodular appearance; top of lower lift at base of unit.

UNIT 2	*Lindsay Formation, lower member*	*2.85m*

Limestone, with shale partings: medium grey, weathers light brown; fine crystalline with rare beds coarse crystalline; medium bedded, with shale partings common between beds; nodular in places; fossiliferous with abundant brachiopods, crinoidal debris, and trilobites.

UNIT 1	*Lindsay Formation, lower member*	*3.85m*

Limestone, with irregular shale partings: medium to dark grey, weathers light brown; fine to medium crystalline; thin to medium bedded, with thin, irregular shale partings; nodular in places; fossiliferous with abundant brachiopods, corals, trilobites, and burrows.

Total thickness *10.85m*

QUARRY OPERATION

Drilling, blasting and crushing is performed intermittently during a 9–month operating year, though the ready–mix plant on site is operated more continuously. The quarry is mined on two lifts and presently covers an area of approximately 4 ha. Drilling and blasting is performed by a subcontractor on a 2.6 m x 2.6 m pattern with 7.6 cm diameter holes. A portable crushing system is used at the site.

PROCESSING

The quarried stone is processed by a portable crushing and screening plant.

PRODUCTS

Granular "A", "B" and "D"
Concrete Stone
HL4, HL6

REFERENCES

Williams, in prep., Appendix 1 – Section LQ AL–2

MAPS

Williams, Rae and Wolf, 1985a, OGS Map P.2719

CW–20 R. TIERNEY — TIERNEY QUARRY

LOCATION AND OWNERSHIP

This small quarry, recently opened by R. Tierney in Lot 28, Concession 3, Alfred Township, Prescott County, (Figure CW–20–1), is located about 3 km northwest of the Village of Alfred.

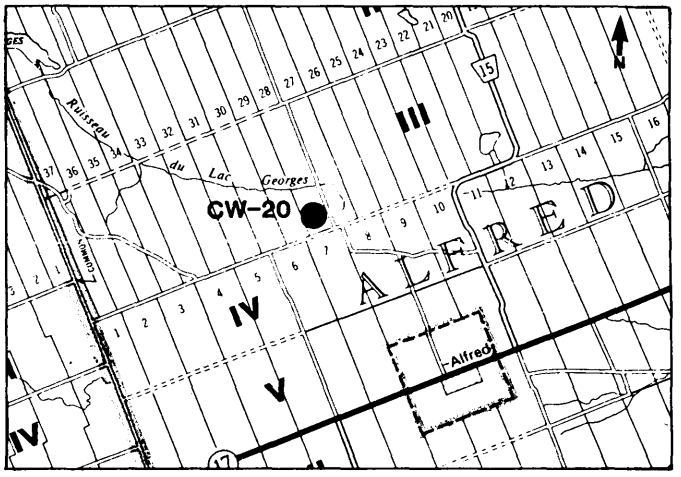


Figure CW–20–1. LOCATION MAP FOR TIERNEY QUARRY.

GEOLOGY

The 3.0 m deep quarry exposes interbedded limestone, shale and sandstone of the St. Martin Member of the Rockcliffe Formation. The thin–bedded limestones are fine crystalline, and often contain abundant fossil debris. During field work in July, 1986, several large (10 to 22 cm) fossil nautiloids were observed. The grey–green shales and sandstones are often burrowed with well developed trace fossils occurring on bedding surfaces. The upper 0.5 m is deeply weathered producing a thin–bedded interval of shale and sandstone. Glacial overburden around the quarry may be up to 2 m thick in places.

PRODUCTS

The Tierney Quarry presently produces sized stone, riprap, fill and agricultural lime. A 3/4 yd. diesel shovel is used to strip overburden and to excavate stone.

REFERENCES

None

MAPS

None

CW–21 BERTRAND & FRERES CONSTRUCTION COMPANY LTD. — L'ORIGNAL QUARRY

LOCATION AND OWNERSHIP

This large quarry is located 5 km west of the Village of L'Orignal in Lots 213–215, Longueuil Township, Prescott County (Figure CW–21–1). The quarry is owned and operated by Bertrand & Freres Construction Company Ltd.

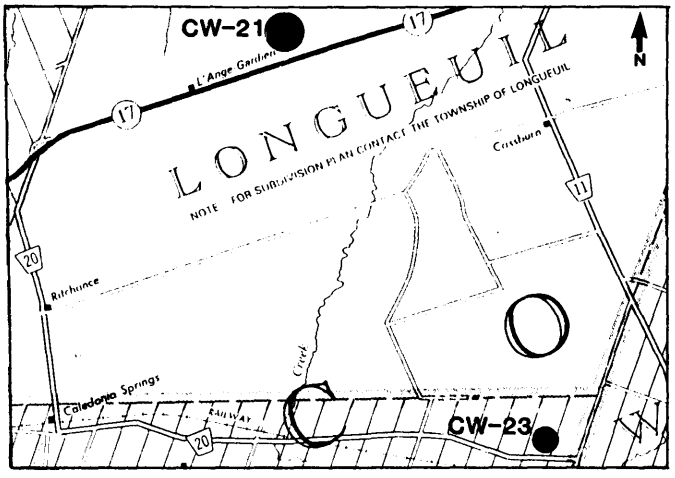


Figure CW-21-1. LOCATION MAP FOR L'ORIGNAL QUARRY.

GEOLOGY

The 15.2 m deep quarry exposes fine- to coarse-crystalline, thin- to medium-bedded limestones of the upper member, Bobcaygeon Formation. In addition, a second quarry, which is now filled with water, had been opened (Hewitt and Vos, 1972, p.15) 3 km north of the operating quarry. Glacial overburden around the active quarry is less than 0.5 m thick.

Geological Section

		Thickness
UNIT 4	*Bobcaygeon Formation, upper member*	*1.6m*

Limestone: medium grey, weathers grey-brown; fine to medium crystalline; thin bedded, with shale partings; fossiliferous, with abundant brachiopods, bryozoa, trilobites, and crinoidal debris.

UNIT 3	*Bobcaygeon Formation, upper member*	*3.0m*

Limestone: light to medium grey, weathers dark grey; fine crystalline with some coarse-crystalline intervals; medium bedded, with shale interbeds up to 1 cm thick; fossiliferous with abundant bryozoa, brachiopods, and crinoidal debris.

UNIT 2	*Bobcaygeon Formation, upper member*	*0.4m*

Limestone: light grey, weathers dark grey; medium crystalline; one single bed; shale interbeds 5 cm thick occur at base and top of unit.

UNIT 1	*Bobcaygeon Formation, upper member*	*10.2m*

Limestone: dark grey, weathers same; fine to coarse crystalline; thin to medium bedded, with thin shale interbeds; fossiliferous, with abundant crinoidal debris, graptolites, bryozoa, brachiopods and burrows.

Total thickness	*15.2m*

CHEMICAL ANALYSES*

	Components in Percent	
	Main quarry Units 2-4 3/4 in. crushed stone	North quarry 2 in. crusher run
SiO_2	4.33	22.1
Al_2O_3	0.47	4.50
Fe_2O_3	0.20	1.64
MgO	1.10	3.11
CaO	51.4	35.3
P_2O_5	0.11	0.12
SO_3	0.21	1.81
L.O.I.	42.0	30.6
Total	99.8	99.2

* *after Hewitt and Vos, 1972, p.15.*

QUARRY OPERATION

The quarry covers approximately 12 ha and is currently excavated in two lifts of 6.1 m each. A third lift is scheduled to be developed as the haulage distance from the blast face becomes too great. Blasted stone is presently hauled a distance of approximately 500 m by four 30-ton Euclid trucks.

A 3-yd. Northwestern diesel shovel and Cat 980-B loader are used for the loading of haulage trucks. Stone from the first (upper) lift is used primarily for granular products and the second lift, which has a silica content of approximately 4%, is used for concrete and asphalt products.

Drilling and blasting is subcontracted, and a 2.7 m x 2.7 m pattern is used with 7.6 cm diameter holes. A 4 in. Flygt submersible pump is used to dewater the quarry during the operating season.

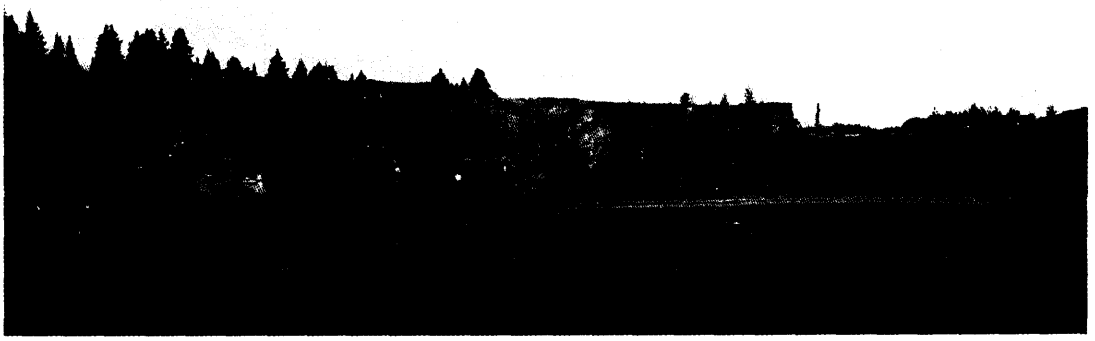
PROCESSING

The blasted stone is hauled to a primary hopper that feeds a Seco vibratory grizzly, from which +6 in. oversize is sent to a Cedarapids 30 in. x 30 in. impactor crusher. Minus 6 in. material is fed to a 5 ft. x 16 ft. double-deck screen that produces 2 in. clear and Granular "A" that are sent to two 40-ton bins, and a +2 in. oversize that is sent to a Pulvamatic 45 in. cage crusher in closed circuit with a 5 ft. x 16 ft. screen. Stone leaving the Cedarapids impactor is passed over a 4 ft. x 16 ft. single-deck screen, from which -3/4 in. material is fed to a 4 ft. x 10 ft. triple-deck screen. Plus 3/4 in. oversize is sent to a 30 in. Ferano Roller crusher in closed circuit with the 4 ft. x 10 ft. screen, which produces 3/4 in. clear, 1/2 in. clear, and 1/4 in. dust to 25-ton storage bins. Two 25-ton Volvo trucks and two 30-ton Euclid trucks load stone products from the bins for stockpiling.

PRODUCTS

Armour Stone
Riprap
Granular "A", "B" and "D"

Photo CW-21-1.
WORKING FACE AT L'ORIGNAL QUARRY (LOOKING NORTHWEST).



1/4 in. Dust
3/4 in. Clear
1/2 in. Clear
HL4, HL6

REFERENCES

Goudge, 1938, p.154

Hewitt, 1960, p.80

Hewitt and Vos, 1972, p.15

Williams, in prep., Appendix 1 – Sections LQ HA-1 and AQ HA-1

MAPS

Williams, Rae and Wolf, 1985b, OGS Map P.2718

CW-22 SINTRA INC. — ROSS QUARRY

LOCATION AND OWNERSHIP

The Ross Quarry, located 8 km southeast of Hawkesbury in Lot 29, Concession 2, East Hawkesbury Township, Prescott County (Figure CW-22-1), is owned by Sintra Inc. and operates on an intermittent basis for local road construction projects.

GEOLOGY

The quarry exposes a total of 9.5 m of sandstone and limestone of the lower and upper (St. Martin) members of the Rockcliffe Formation (Figure CW-22-2). The lower member consists of quartz-rich sandstones interbedded with green shale beds. The upper (St. Martin) member consists of coarse-grained calcarenites. The beds in the quarry dip to the east at about 10° exposing a stratigraphic section which is greater than the depth of the quarry (which is about 6.5 m deep). When visited in 1986 the quarry was partially filled with water. Glacial overburden around the quarry is 1 to 2 m thick.

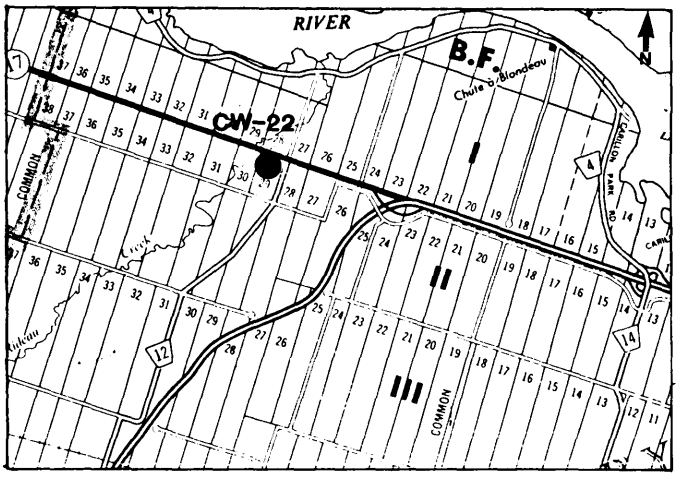


Figure CW-22-1. LOCATION MAP FOR ROSS QUARRY.

Geological Section

		Thickness
UNIT 2	*Rockcliffe Formation, St. Martin Member*	*4.5m*
	Limestone: medium grey, weathers grey-brown; coarse crystalline, commonly a coarse-grained calcarenite, with abundant fragmented crinoidal debris; massive bedded, 1-2 m thick with well developed cross-beds in some intervals; bedding plane contacts are stylolitic; fossiliferous, with abundant brachiopods; lower contact of unit sharp.	
UNIT 1	*Rockcliffe Formation, lower member*	*5.0*
	Sandstone with shale interbeds: light grey-green, weathers grey-green, with shales usually a slightly darker colour; fine-grained, well-sorted sandstone; burrows common, especially at shale- sandstone contacts.	
Total thickness		*9.5m*

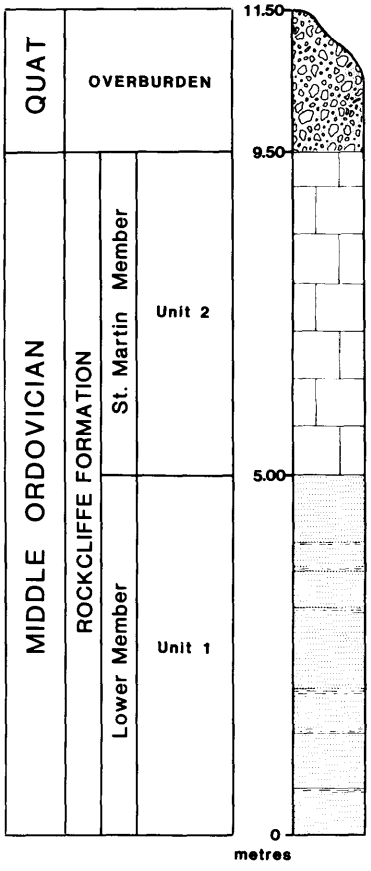


Figure CW-22-2. STRATIGRAPHIC COLUMN FOR ROSS QUARRY.

REFERENCES

Parks, 1912
Goudge, 1938, p. 155–156
Williams, in prep., Appendix 1 – Section LQ HA-2

MAPS

Williams, Rae and Wolf 1985b, OGS Map P.2718

CW-23 CLIFTONDALE AGGREGATES — CLIFTONDALE (McALPINE) QUARRY

LOCATION AND OWNERSHIP

The Cliftondale Quarry is located 7 km west of the Town of Vankleek Hill, Lot 2, Concession 1, Caledonia Township, Prescott County (Figure CW–23–1) and is a family operation owned by Dale and Lorrie Clare. The property has been intermittently quarried for seventy years and was previously known as the McAlpine Quarry. The old quarry is located immediately to the east of the current workings.

GEOLOGY

The current quarry extends southeastward into a northwest–southeast trending hillside just west of the old workings. The recent blasting has revealed that a fault zone parallels the hillside. The main fault exposed shows a downthrow to the southwest of more than 10 m, with several parallel minor faults showing displacements of less than 1 m each. The faults all trend at 130° and dip 70° to the southwest and are normal faults, commonly paralleled by thin calcite veins. The presence of a 1 m wide breccia zone at the extreme north end of the quarry suggests that other faults may be present north of the current exposure.

The thickest part of the quarry, southwest of the main fault, exposes 10.2 m of thick–bedded limestone of the upper member of the Bobcaygeon Formation. To the northeast, 4.8 m of thin–bedded, shaly limestone of the middle member, Bobcaygeon Formation are exposed. The beds within each fault block are essentially horizontal, with minor drag folds present along the main fault. The breccia zone is characterized by angular limestone clasts set in a matrix of very large calcite crystals.

Glacial overburden at the crest of the hill is up to 3 m thick.

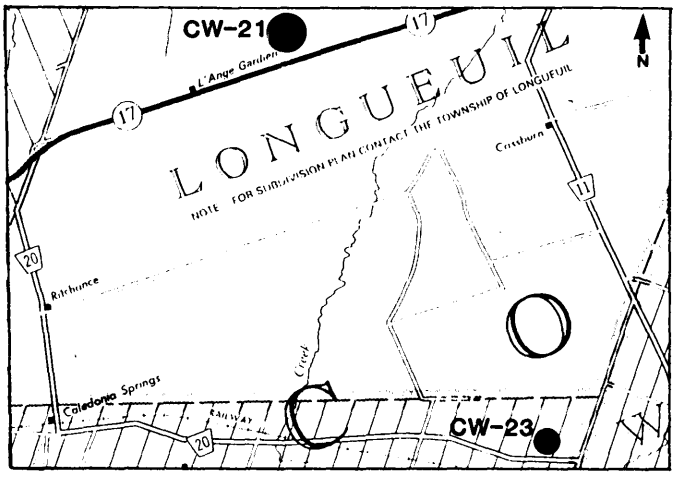


Figure CW-23-1. LOCATION MAP FOR CLIFTONDALE (McALPINE) QUARRY.

Geological Section

Southwest of Main Fault — *Thickness*

UNIT 1 Bobcaygeon Formation, upper member — *10.2m*

Limestone: medium grey, weathers light grey to grey- brown at top; medium crystalline, with both fine- and coarse-crystalline beds present; medium to thick bedded (20-80 cm), with rare, very thin, shale partings; small calcite crystals common in coarse- crystalline beds, thin calcite veins present adjacent to fault zone; very fossiliferous, with abundant crinoidal debris and brachiopods; at east end of quarry main fault zone delineates edge of outcrop, while outcrop continues across fault on west side of quarry.

Total thickness — *10.2m*

Northeast of Main Fault

UNIT 3 Bobcaygeon Formation, middle member — *1.7m*

Limestone, with shale interbeds: medium grey, weathers grey-brown; fine to medium crystalline; thin bedded (10 cm) with shale partings 2-3 cm thick between beds, sharp and planar contacts; sparsely fossiliferous; lower contact of unit sharp and planar.

UNIT 2 Bobcaygeon Formation, middle member — *1.2m*

Limestone: medium grey, weathers dark grey-brown; medium to coarse crystalline; thick bedded (30-70 cm), with sharp, planar contacts, shale partings less than 1 cm thick; fossil fragments common; lower contact of unit sharp and planar.

UNIT 1 Bobcaygeon Formation, middle member — *1.9m*

Limestone, with shale interbeds: medium grey, weathers same; fine to medium crystalline; thin bedded (5 cm, rarely 10 cm) with shale partings up to 2 cm thick, sharp and planar contacts; abundant fossil fragments.

Total thickness — *4.8m*

QUARRY OPERATIONS

The quarry is excavated on a single lift of 12.1 m, approximately to the water table level. Potential for excavation of an additional 10.7 m exists. Drilling, blasting and crushing is contracted; screening and trucking is performed by Cliftondale Aggregates.

An 80-ton scale with computerized printout is available on-site. The only other scale available in the area is that owned by Bertrand & Freres Construction Co. at the L'Orignal Quarry.

PRODUCTS

Quarry Rock
Blasted Rock
Pit Run
Granular "A" and "B"
2 in. Clear
1 in. Clear
5/8 in. Clear
3/8 in. Clear
Filter Sand (government approved)
Stone Dust and Liming Dust

References

Goudge, 1938, p. 155

Maps

None

CW-24 SINTRA INC. — LEROUX (SKYE) QUARRY

LOCATION AND OWNERSHIP

The Leroux Quarry, owned and intermittently operated by Sintra Inc. is located 6 km south of the village of St. Bernardin, in Lot 12, Concession 8, Caledonia Township, Prescott County (Figure CW-24-1).

GEOLOGY

The 9.3 m deep quarry exposes fine-crystalline, thick-bedded limestones of the lower member, Bobcaygeon Formation. Glacial overburden around the quarry is about 1 m thick.

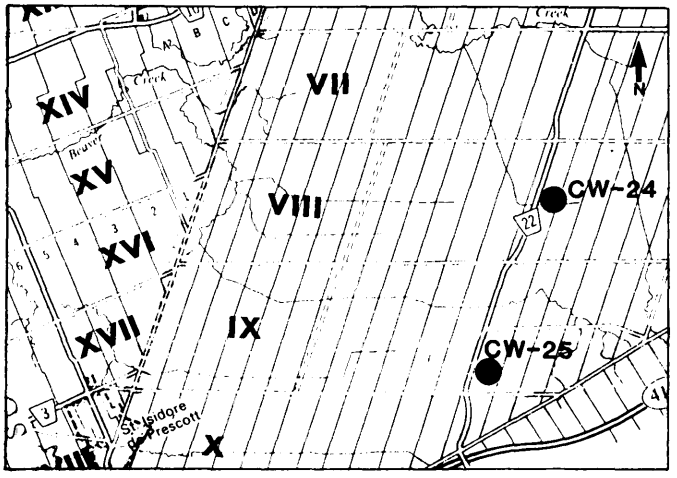


Figure CW-24-1. LOCATION MAP FOR LEROUX (SKYE) QUARRY.

Photo CW-24-1.
QUARRY SECTION
AT LEROUX
(SKYE) QUARRY
(LOOKING
SOUTH).

Geological Section

		Thickness
UNIT 4	*Bobcaygeon Formation, lower member*	*3.0m*

Limestone: light to medium grey, weathers light buff and brown; fine crystalline; thin to medium bedded, with undulating shale partings; small calcite-filled vugs present; fossiliferous with abundant brachiopods, gastropods, crinoidal debris and corals; lower contact of unit sharp and planar.

UNIT 3	*Bobcaygeon Formation, lower member*	*2.5m*

Limestone: grey, weathers tan; fine crystalline; massive bedded with black shale partings; sparsely fossiliferous with fragments of trilobites and brachiopods.

UNIT 2	*Bobcaygeon Formation, lower member*	*0.8m*

Limestone: grey, weathers tan; fine crystalline; medium bedded with interbeds of 1 cm thick black shale beds, undulating contacts; rusty brown stained beds; scattered fossil fragments.

UNIT 1	*Bobcaygeon Formation, lower member*	*3.0m*

Limestone: light to medium grey, weathers light buff and tan; very fine to fine crystalline; medium to massive bedded, with black shale partings and undulating contacts; calcite-filled vugs present; small stylolites occur within limestone beds; some fossil fragments present.

Total thickness	*9.3m*

QUARRY OPERATIONS

The Leroux Quarry is currently operating from a single lift of 4.5 m that has exposed an area of about 1 ha.

PROCESSING

The quarried stone is processed by a portable crushing and screening plant comprising a Hewitt-Robins 36 in. x 42 in. primary jaw crusher which feeds a Hewitt-Robins 5 ft. x 16 ft. triple-deck screening plant. A 4 1/4 ft. Symons cone is operated as a secondary crusher in closed circuit with the screening plant.

PRODUCTS

Granular "A" and "B"

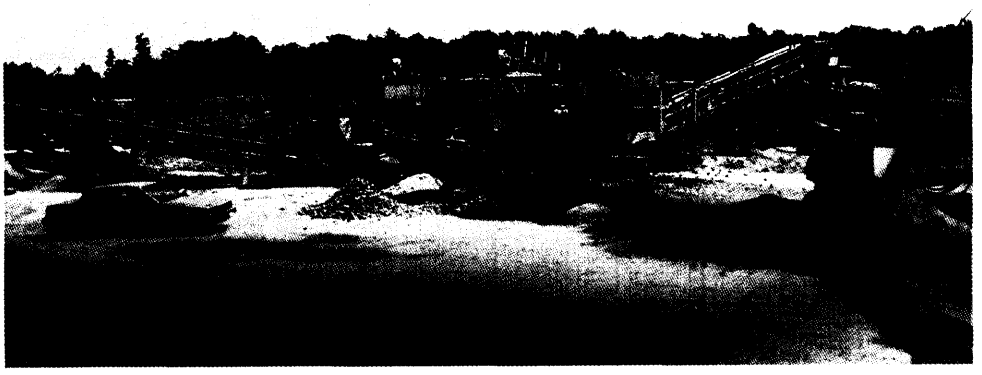
REFERENCES

None

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

Photo CW-24-2. PORTABLE PROCESSING PLANT AT LEROUX (SKYE) QUARRY (LOOKING EAST).



CW-25 CRUICKSHANK CONSTRUCTION LTD. — GAUTHIER QUARRY

LOCATION AND OWNERSHIP

The Gauthier Quarry is located 8 km east of St. Isidore de Prescott in Lot 12, Concession 9, Caledonia Township, Prescott County (Figure CW-25-1). The quarry is operated by Cruickshank Construction Ltd., on a local demand basis, and has been opened on a single lift of 5.5 m over an area of about 2 ha. The primary products are Granular "A" and "B".

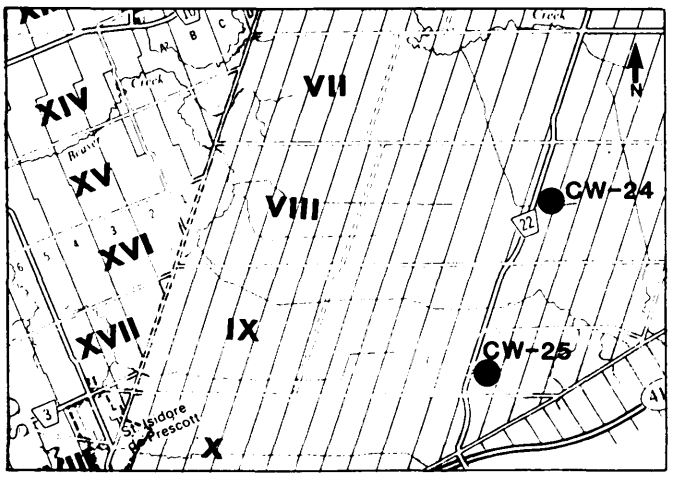


Figure CW-25-1. LOCATION MAP FOR GAUTHIER QUARRY.

GEOLOGY

The 5.5 m deep quarry exposes interbedded, medium-crystalline and coarse-grained, medium- to thick-bedded limestones of the lower member of the Bobcaygeon Formation. Glacial overburden around the quarry is 1 to 2 m thick.

Geological Section

		Thickness
UNIT 1	*Bobcaygeon Formation, lower member*	*5.5m*
	Limestone: medium grey, weathers light grey-brown to medium grey; medium to coarse crystalline, with very coarse-grained calcarenite beds; medium to thick bedded (10-50 cm), contacts are sharp, irregular, with some very thin, black shale partings (less than 0.25 cm); calcite crystals are present in coarse-crystalline beds; calcarenites more abundant in upper part of quarry; fossiliferous, with abundant brachiopods, crinoidal debris, and trilobites.	
Total thickness		*5.5m*

REFERENCES

None

MAPS

None

CW-26 A.L. BLAIR CONSTRUCTION CO. LTD. — DUVAL QUARRY

LOCATION AND OWNERSHIP

This recently opened quarry, located 6 km east of the village of Dunvegan in Lot 11, Concession 7, Kenyon Township, Glengarry County (Figure CW-26-1), is operated by the A. L. Blair Construction Co. Ltd.

Photo CW-26-1. OPENING OF FIRST LIFT AND PORTABLE PROCESSING PLANT AT DUVAL QUARRY (LOOKING SOUTH).

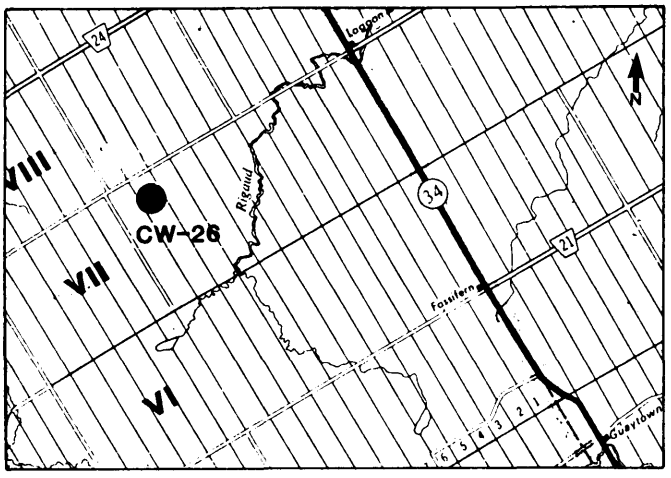


Figure CW-26-1. LOCATION MAP FOR DUVAL QUARRY.

GEOLOGY

The 7.0 m deep quarry exposes medium- to coarse-crystalline, medium-bedded limestones of the lower member, Bobcaygeon Formation. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

		Thickness
UNIT 1	*Bobcaygeon Formation, lower member*	*7.0m*
	Limestone: medium grey, weathers same; medium to coarse crystalline, with beds of very coarse-grained calcarenites; medium bedded, sharp and planar contacts, some with thin, dark grey, shale partings; small calcite crystals present in coarse- crystalline beds; fossiliferous with abundant brachiopods, trilobites, and crinoidal debris.	
Total thickness		*7.0m*

QUARRY OPERATION

The quarry is currently producing from a single lift of approximately 7.0 m which has been opened over an area of about 1.6 ha.

PROCESSING

A portable crushing and screening plant is used to process the quarry run material.

PRODUCTS

Granular "A" and "B"
3/4 in. Clear Stone

REFERENCES

None

MAPS

None

CW-27 CRUICKSHANK CONSTRUCTION LTD. — GREEN VALLEY QUARRY

LOCATION AND OWNERSHIP

This large quarry is located in Lots 29 and 30, Concession 6, Lancaster Township, Glengarry County (Figure CW-27-1). The quarry is owned and operated by Cruickshank Construction Ltd., and was purchased in 1981 from Menard Construction Limited. Cruickshank Construction Ltd. is engaged in road construction projects and also provides custom drilling and blasting services. The quarry is licensed for approximately 31 ha.

GEOLOGY

The three lifts in the quarry expose 13.75 m of limestones from the Gull River and Bobcaygeon Formations (Figure CW-27-2). The lower member of the Gull River Formation consists of interbedded fine-crystalline dolostone and microcrystalline limestone. The upper member consists of thin-bedded shaly limestone, which is overlain by the thick-bedded limestones of the lower member of the Bobcaygeon Formation.

On the south face of the quarry, a nearly vertical fault is present which trends 115° with a 40 cm downthrow to the southwest. The fault zone is up to 60 cm wide with thick (5-7 cm) calcite veins in the shear zone. A second fault zone, several metres wide with only minor displacement, is present in the northeast corner of the quarry. Glacial overburden around the quarry is up to 2 m thick.

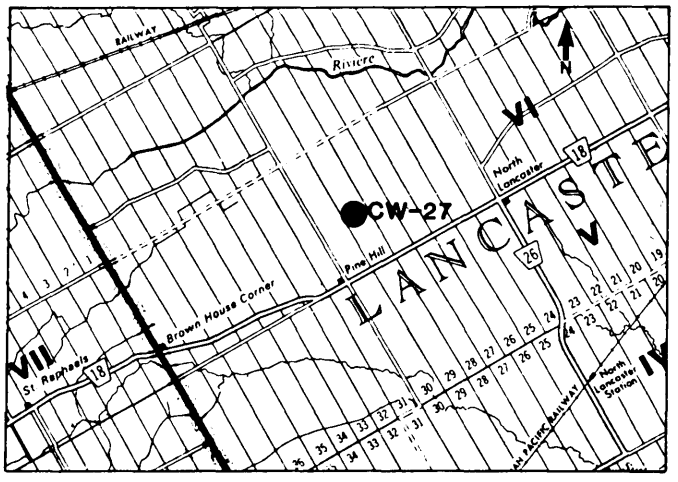


Figure CW-27-1. LOCATION MAP FOR GREEN VALLEY QUARRY.

Geological Section

		Thickness
UNIT 4	*Bobcaygeon Formation, lower member*	*3.5m*

Limestone: grey-brown to dark grey, weathers light grey-brown to red-brown; very fine to fine crystalline; massive bedded, rarely thin bedded, with very thin, dark shale partings between some beds; fossiliferous with abundant crinoidal debris, brachiopods, bryozoa, cephalopods, corals, and burrows; lower contact of unit sharp and planar.

UNIT 3	*Gull River Formation, upper member*	*4.2m*

Limestone: light to medium brown and grey-brown, weathers blue-grey to light brown and red- brown; microcrystalline to fine crystalline; very thin bedded, with thin to medium beds at base of unit, shale interbeds up to 2 cm thick common between beds; fossiliferous with abundant crinoidal debris, brachiopods, bryozoa, cephalopods, and burrows; lower contact of unit sharp and planar at 2 cm thick shale parting; top of 2nd lift at top of unit.

UNIT 2	*Gull River Formation, upper member*	*3.9m*

Limestone: dark grey, weathers medium grey; microcrystalline to very fine crystalline (rare fine- and coarse-crystalline beds); thin to medium bedded (5-15 cm), sharp contacts, some are stylolitic, and some have very thin dark grey shale partings; some beds contain intraclasts of light grey microcrystalline limestone; abundant calcite crystals present, either disseminated or replacing fossil fragments; fossiliferous with abundant brachiopods; lower contact of unit sharp at base of 4 cm thick shaly limestone bed; top of lower lift at top of unit.

UNIT 1	*Gull River Formation, lower member*	*2.2m*

Limestone capped with dolomitic limestone: medium grey to light grey; weathers light grey to light green-grey; very fine to fine crystalline; limestones thin bedded (10 cm), dolomitic limestone a single bed (80 cm thick) which caps unit; sharp and planar contacts; burrows common on bedding planes.

Total thickness	*13.8m*

QUARRY OPERATION

The quarry has an excavated area of about 4 ha, and is operated on three lifts of 3.5 m, 4.2 m and 6.1 m with a maximum depth of 18.3 m projected. The overburden is a mixture of soil and caprock; the latter is removed by blasting or bulldozer-ripper. Drilling is performed with Gardner-Denver air track on a drill pattern of 2.4 m x 2.4 m with 7.6 cm diameter holes.

PROCESSING

A portable crushing system is set up on-site, consisting of a Cedarapids 3645-H primary impeller crusher, a Cedarapids 855 Commander secondary crusher and a Suntract 5 ft. x 14 ft. double-deck screening plant. Stone leaving the primary crusher (-3 in.) can be stockpiled as Granular "B" or sent to a 4 ft. x 6 ft. Powerscreen that produces -5/8 in. material for a stockpile and -3 in. + 5/8 in. material that is sent to the secondary crusher. After secondary crushing the stone is transferred to the Suntract screening plant, which produces stone dust, 3/4 in. clear and 3/4 in. concrete stone.

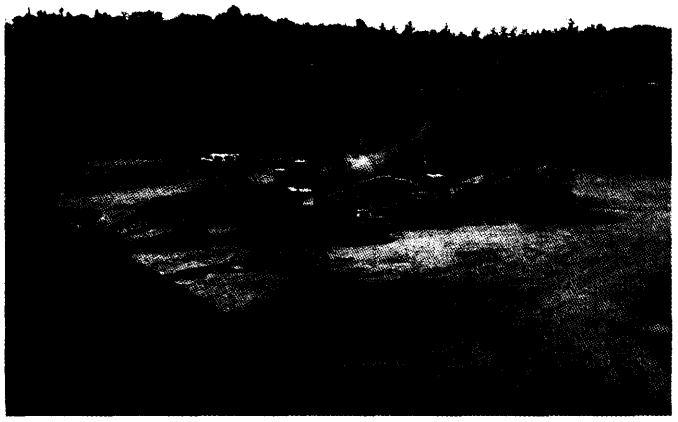


Photo CW-27-1. PORTABLE PROCESSING PLANT AT GREEN VALLEY QUARRY (LOOKING NORTH-WEST).

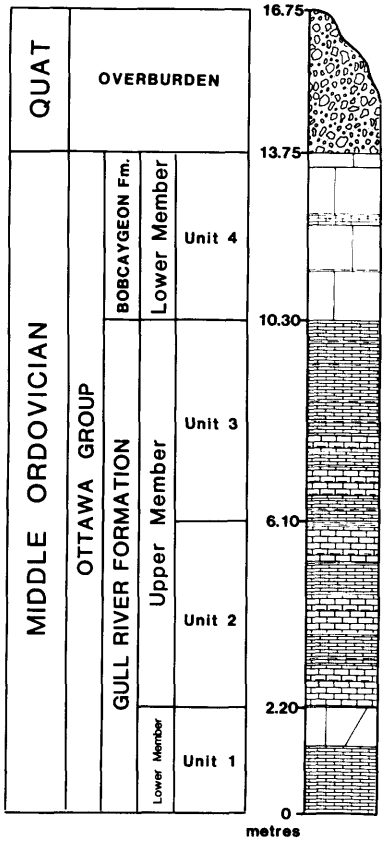


Figure CW-27-2. STRATIGRAPHIC COLUMN FOR GREEN VALLEY QUARRY.

The stone quality is sufficient for the production of HL grades, though the plant would need modifications to the screening process.

PRODUCTS

Granular "A" and "B"
3/4 in. Clear (Septic Bed Stone)
3/4 in. Concrete Stone
Stone Dust

REFERENCES

Williams, in prep., Appendix 1 – Section LQ CO–6

MAPS

Williams, Wolf and Carson, 1985a, OGS Map P.2720

CW-28 KARNUK MARBLE INDUSTRIES INC. — CORNWALL PLANT

LOCATION AND OWNERSHIP

Karnuk Marble is a stone dressing plant which was established on Marleau Avenue on the east side of Cornwall in 1984. It is owned and operated by Karnuk Marble Industries Inc. and in 1986 employed 14 to 20 people in cutting and polishing marble and granite blocks obtained from a variety of sources. A planned addition of a further 4,000 m^2 of working space will double the plant's present capacity. The modern automated equipment was almost entirely supplied by the Breton Company of Castello di Godego, Italy.

PLANT OPERATION

In 1986 the market for polished granite slabs and tiles was particularly strong. Blocks of Vermilion Bay Pink from northwestern Ontario were being used along with a variety of granites from Quebec.

In addition to the marbles imported from Europe, blocks of coarse–grained white calcitic marble, faintly veined in green or peach, were being obtained from the Tatlock area north of Perth, Ontario. Also, blocks of dark beige limestone from the Wiarton area were in occasional use, although the best thickness of 50 cm to 60 cm was less than desirable for optimum sawing capacity.

A massive black limestone from the nearby MacLeod Quarry of Cornwall Gravel Company Limited, is extensively used in the making of polished tiles (see Quarry CW–14). The stone is a black micrite containing fossil fragments and calcite pore fillings. It belongs to the lower member, Bobcaygeon Formation and occurs in two horizontal beds 90 cm to 125 cm thick at the top of the quarry section.

PROCESSING

Quarry blocks from various sources are received by truck and are handled in the yard by a 25–ton gantry crane.

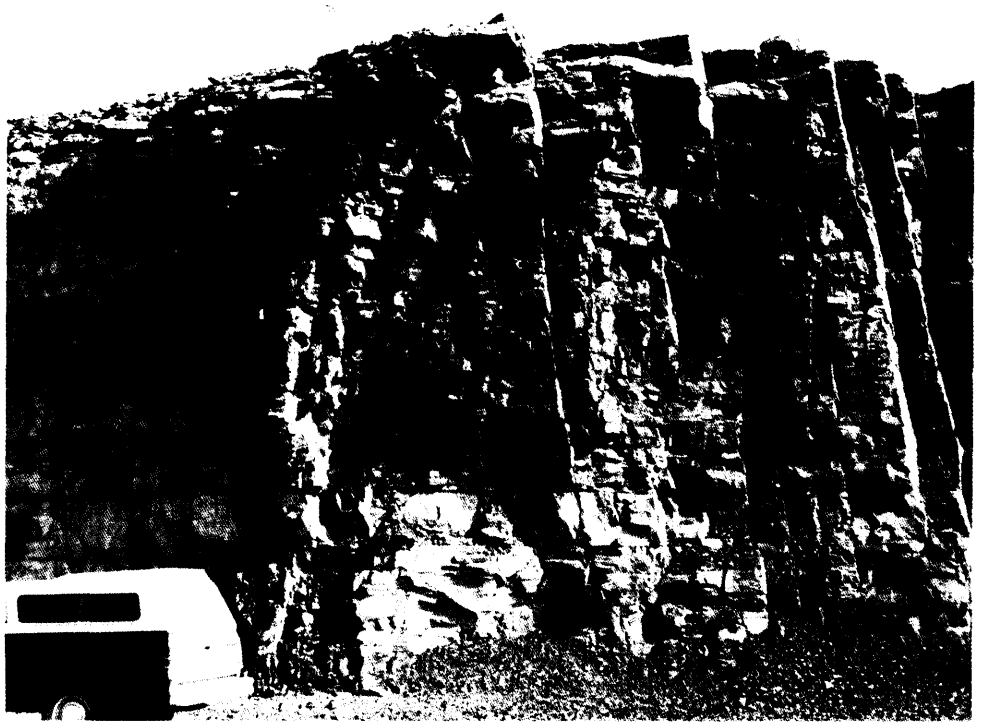


Photo CW-27-2. EAST FACE AT GREEN VALLEY QUARRY SHOWING VERTICAL JOINTING.

Granite blocks are positioned two to a car for sawing. Preferred sizes are 3 m by 1.5 m by widths of about 1 m. Blocks are bonded and levelled on the car with cement, sand and straw. Marble blocks are similiarly handled, except that only one block is sawn at a time. Preferred size is 2.2 m by 1.2 m by 1.2 m. Loaded cars are moved on rail to the saws.

Blocks are slabbed by gang saws using a slurry of steel shot, lime and water as the cutting medium. Cutting rate in granite is typically 4.5 cm per hour, requiring about 70 hours to reduce the two blocks to slabs of about 3 cm in thickness. Cutting rates in marble are typically 16 to 20 cm per hour, requiring about 10 hours to completely slab the block. Gang saw blades used for cutting granite must be replaced every 4 or 5 cuts due to excessive wear. Blades are imported from Italy.

The finishing plant consists essentially of two lines: one for tiles and one for slabs. Polished tiles of granite and black limestone were in particular demand in 1986.

Unslabbed blocks are fed directly to the tile cutting machine which consists of three vertical and one horizontal diamond-studded circular saw blades cutting simultaneously. Three strips are cut at a time in thicknesses of 1.25 inches, .75 inches or .375 inches, in

Photo CW-28-1. BLOCKS OF BLACK BOBCAYGEON FORMATION LIMESTONE AT CORNWALL PLANT.

Photo CW-28-2. CUTTING TILES FROM A BLOCK OF BOBCAYGEON FORMATION LIMESTONE AT CORNWALL PLANT.

widths of 12 inches and lengths of 7 or 8 ft. These strips proceed in single file beneath two diamond calibrating heads which grind the strips to within 1 mm of their final thickness. Final finish is provided by a 12–head polishing machine. The first six heads prepare the surface using abrasives and the last six provide the final polish. Tiles are cut and trimmed to their final 12–inch square size and packaged for shipment. The tile line requires five labourers and one supervisor.

Slabs of either granite or marble are removed from the gangsaws and fed to a slab polisher via two side–by–side drive belts, each 1 m wide. Hence, slabs up to 2 m in width and any length can be polished. The 15 polishing heads are equipped with composite pads consisting of sand and wood for polishing marble; lead and felt pads for granite. Tin oxide, oxalic acid and colour dyes are minor additives to the pad polishing medium.

Two edges of each slab are squared by diamond saws; a third edge by wire saw. Final cutting to desired size is accomplished in a diamond bridge saw.

Carleton Place District

INTRODUCTION

Carleton Place District is situated in the Eastern Region of southern Ontario nestled between the Ottawa River to the north, Cornwall District to the east, Brockville District to the south, and Tweed and Pembroke districts to the west and northwest, respectively. The district includes the Regional Municipality of Ottawa–Carleton and Lanark County (Figure CP–0–1).

Sixty–eight quarry properties are documented in the Carleton Place District quarry inventory (Appendix IV, Volume I) including 15 active quarries, 9 intermittently active quarries and 44 past producing quarries of geological significance. In addition, the Steep Rock Calcite Tatlock Quarry (CP–25) is documented.

All of the currently active and intermittently active quarries were visited during the project and include the following:

- *CP–1* *Thomas Cavanagh Construction Ltd. – Arnprior Quarry (intermittent)*
- *CP–2* *Thomas Cavanagh Construction Ltd. – Kinburn Quarry (intermittent)*
- *CP–3* *R. C. Lyle (Burntlands Aggregates Ltd.) – Almonte Quarry (intermittent)*
- *CP–4* *Thomas Cavanagh Construction Ltd. – West Carleton Quarry (active)*

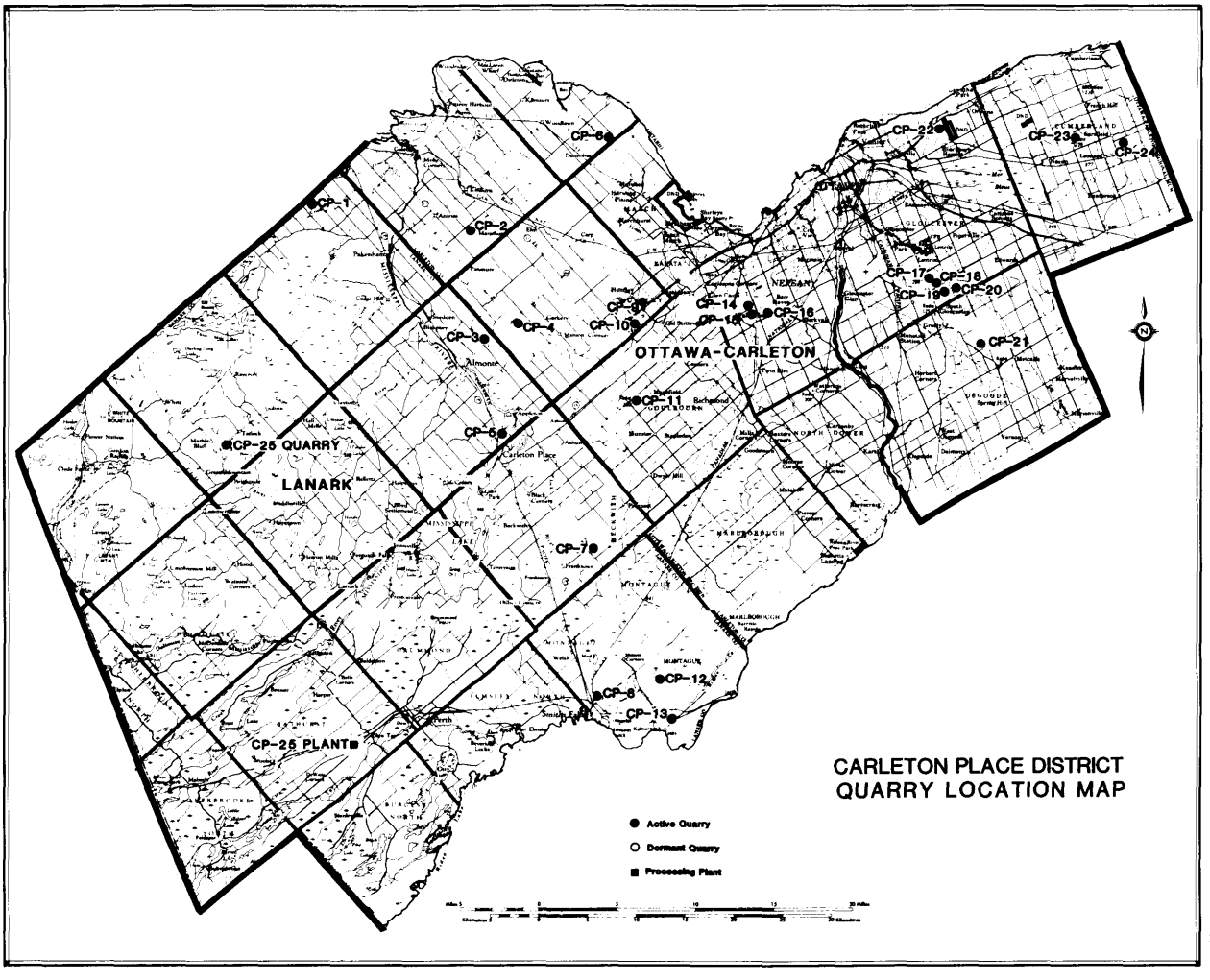


Figure CP-0-1. CARLETON PLACE DISTRICT QUARRY LOCATION MAP.

CP–5 *Duffy Road Oiling Ltd. – Carleton Place Quarry (intermittent)*

CP–6 *George Kennedy – Dunrobin Quarry (intermittent)*

CP–7 *Thomas Cavanagh Construction Ltd. – Franktown Quarry (intermittent)*

CP–8 *Warren Paving & Materials Group Ltd. – Smiths Falls (Dibblee) Quarry (intermittent)*

CP–9 *Spratt Sand and Gravel Ltd. – Spratt Quarry (active)*

CP–10 *West Carleton Sand and Gravel Inc. – Clarke Quarry (active)*

CP–11 *Thomas Cavanagh Construction Ltd. – Goulbourn Quarry (active)*

CP–12 *G. Tackaberry and Sons Construction Co. Ltd. – Rosedale Quarry (intermittent)*

CP–13 *G. Tackaberry and Sons Construction Co. Ltd. – Kilmarnock Quarry (intermittent)*

CP–14 *R. W. Tomlinson Ltd. – Fallowfield Quarry (active)*

CP–15 *George Wimpey Canada Ltd. – Moodie Drive (Fallowfield) Quarry (active)*

CP–16 *Warren Paving & Materials Group Ltd. – Houlahan (Fallowfield) Quarry (active)*

CP–17 *United Aggregates Ltd. – South Gloucester Quarry (active)*

CP–18 *Warren Paving & Materials Group Ltd. – Boyce (South Gloucester) Quarry (active)*

CP–19 *Beaver Asphalt Paving Co. Ltd. – Ottawa (South Gloucester) Quarry (active)*

CP–20 *Permanent Concrete – Hawthorne Road Quarry (active)*

CP–21 *Cornwall Sand & Gravel Company – Greely Quarry (active)*

CP–22 *Francon Division of Canfarge Ltd.– North and South (Francon) Quarries (active)*

CP–23 *Permanent Concrete – Navan (LeBlanc) Quarry (active)*

CP–24 *Bertrand & Freres Construction Company Limited – Sarsfield Quarry (active)*

CP–25 *Steep Rock Calcite – Tatlock Quarry (active)*

REGIONAL GEOLOGY

The main geomorphic features of Carleton Place District include the Ottawa Valley to the north and east and the Precambrian highlands of the Canadian Shield to the west. Flat lying plains occur in the eastern part of Carleton Place District.

Glacial overburden varies considerably from nearly absent over the Precambrian highlands, to thin sand deposits in the south and to thick clay deposits along parts of the Ottawa Valley.

Large–scale normal faults trend northwest–southeast across the district (Williams, in prep.). In the main Paleozoic outcrop area, down–dropped fault blocks juxtapose strata that are several hundred metres apart stratigraphically. Although bedrock exposures are generally limited, drillhole data confirm the presence of many of these faults (Williams, in prep.). Smaller–scale faults are common throughout the region, many of which are exposed in quarries.

The Paleozoic strata underlying Carleton Place District consist of Upper Cambrian to Upper Ordovician carbonate and clastic rocks (Figure CP–0–2). The following formations occur within the district (in ascending stratigraphic order): the Covey Hill and Nepean Formations of the Potsdam Group, the March and Oxford Formations of the Beekmantown Group; the Rockcliffe Formation; the Shadow Lake, Gull River, Bobcaygeon, Verulam, and Lindsay Formations of the Ottawa Group; the Billings Formation; the Carlsbad Formation; and the Queenston Formation.

The Upper Cambrian to Lower Ordovician Potsdam Group consists of conglomerates and arkoses of the Covey Hill Formation and the overlying quartz arenites of the Nepean Formation. Only small operations currently utilize this rock for aggregate and dimension stone, although historically the sandstones of the Nepean Formation have been used extensively as building stone in, for example, the Parliament Buildings in Ottawa.

The overlying Lower Ordovician Beekmantown Group consists of two formations: the March and Oxford Formations. The March Formation is transitional between the clastic rocks of the Potsdam Group and the overlying dolostones of the Oxford Formation and consists of alternating beds of quartz arenite and dolostone, with gradations between the two rock types. The most common lithology is a fine–crystalline dolostone which consists of up to 50% medium– to coarse–grained well–rounded quartz grains that "float" in the dolostones. The lower contact of the March Formation is placed at the base of the lowest dolostone bed (Williams, in prep.). The formation thickens from its erosional edge to an average thickness of 20 m in the Ottawa area and even more to the southeast.

The March Formation has been quarried extensively over the years. Large blocks of sandy dolostone were utilized in the construction of the Rideau Canal system in the 1830s and dolostone and sandy dolostone beds were also quarried for building and ornamental stone. In addition to being a source for crushed stone in recent years, the sandy dolostone beds have proven to be an excellent source of skid–resistant aggregate (Rogers, 1980). The principal quarries which extract rock from the formation

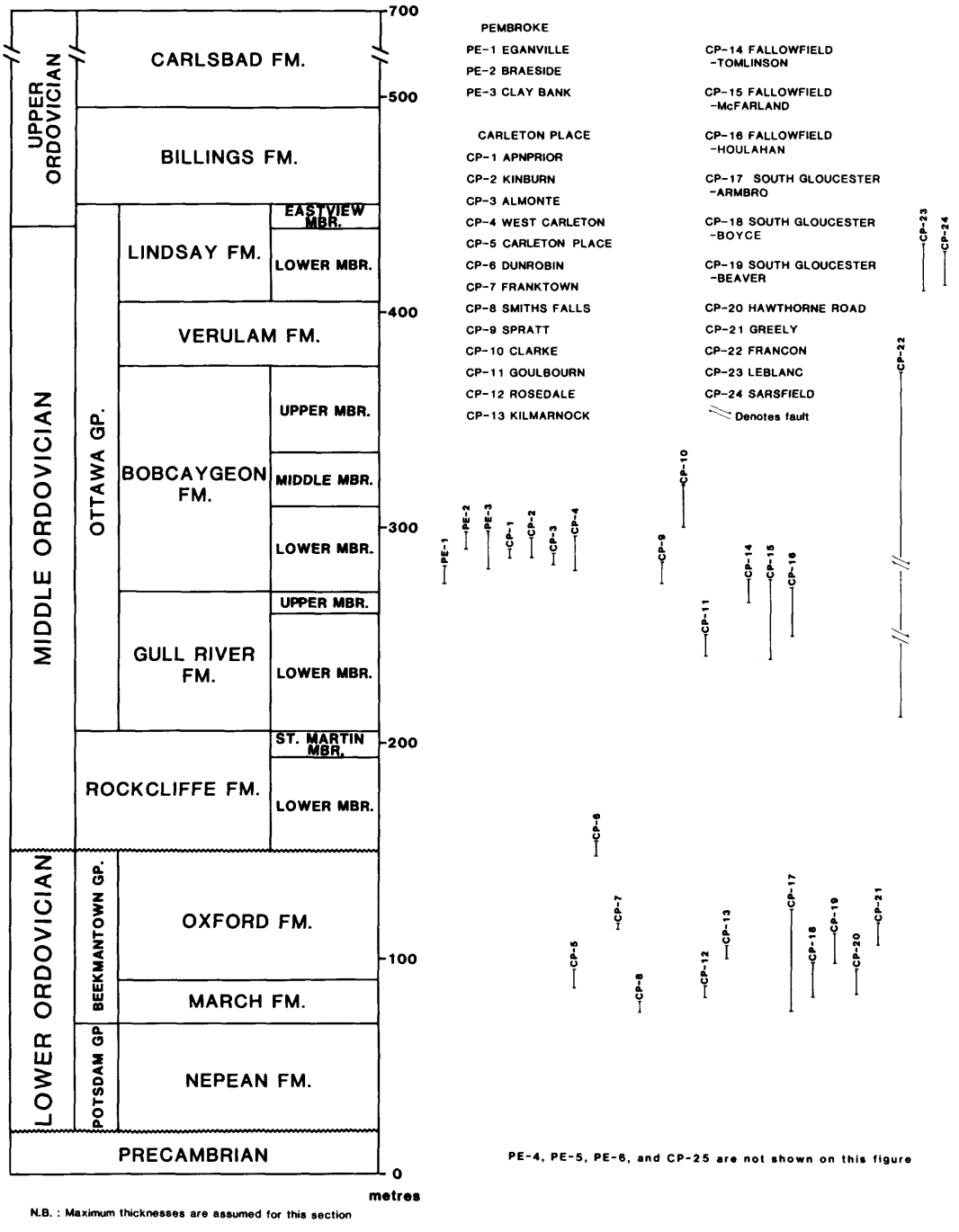


Figure CP-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF PEMBROKE AND CARLETON PLACE DISTRICTS.

include the lower part of the Carleton Place Quarry (CP–5), the Smiths Falls Quarry (CP–8), the Rosedale Quarry (CP–12), the lower parts of the South Gloucester quarries of United Aggregates (CP–17) and Warren Paving (CP–18), and the lower part of the Hawthorne Road Quarry (CP–20). Numerous small quarries, now abandoned, occur throughout the western part of the Carleton Place District.

The Oxford Formation consists of grey–brown, fine–crystalline, medium–bedded dolostones which may vary from microcrystalline to medium–crystalline and occur in

thin– to thick–bedded intervals. Scattered, coarse–grained quartz sand and sandy interbeds (up to 30 cm thick), are present in the lower part of the formation. Calcite–filled vugs of varying sizes are common in most intervals; small, white chert nodules are less common. The lower contact of the Oxford Formation is placed at the top of the uppermost sandstone bed in the underlying March Formation (Williams, in prep.). The formation maintains an average thickness of 60 m in Carleton Place District, although it does thin northwestward into the Pembroke District.

The Oxford Formation is quarried for crushed stone across the Carleton Place District. The major producers of aggregate include the Greely Quarry (CP–21), the Kilmarnock Quarry (CP–13), the Carleton Place Quarry (CP–5), the Hawthorne Road Quarry (CP–20), and the South Gloucester quarries of United Aggregates (CP–17), Warren Paving (CP–18) and Beaver Asphalt (CP–19).

Unconformably overlying the Oxford Formation is the Middle Ordovician Rockcliffe Formation. The Rockcliffe Formation is subdivided into two members (Williams, in prep.), a lower clastic and upper carbonate member (Figure CP–0–2). The light grey to green–grey, fine–grained, thin– to thick–bedded, commonly crossbedded, quartz sandstone of the lower member is interbedded with olive green to grey (rarely maroon), laminated shale which commonly contains numerous burrows. The upper St. Martin Member consists of light grey to grey–brown, microcrystalline to fine–crystalline limestone to more commonly coarse– grained, thick–bedded, cross–bedded calcarenites. The very high calcium content of these limestones along the Ottawa River (Williams, in prep.) increases the potential usefulness of these rocks. The uppermost part of the St. Martin Member also contains thin intervals of grey–brown, shaly to silty dolostones. The formation reaches a thickness of 50 m at the extreme eastern end of the district along the Ottawa River although it thins westward to a thickness of 25 m near Arnprior. (The lower member ranges in thickness from 40 to 25 m east to west, while the upper member thins from 10 m in the east to zero where it pinches out west of Ottawa.)

The Rockcliffe Formation is intermittently quarried for crushed stone at the Dunrobin Quarry (CP–6), although several test pits near Carleton Place have been excavated to evaluate the sandier portions of the lower member.

The Middle Ordovician Ottawa Group consists of five formations which, except for the Shadow Lake Formation, are extensively utilized by the limestone industry in Carleton Place District. The Shadow Lake Formation, which overlies the Rockcliffe Formation with a minor disconformity, is a thin (3 m) interval of sandstone and shale which marks the initial deposits of the Ottawa Group.

The Gull River Formation is subdivided into two members (Williams, in prep.): the lower member consists of interbedded dolostone and limestone and the upper member consists of shaly limestone. The dolostones of the lower member are grey–brown to grey–green, fine crystalline, thin to medium bedded, and commonly contain some clastic material ranging in size from mud to sand. Large calcite–filled vugs are common in some beds. The interbedded limestones range from light grey, microcrystalline limestone, commonly with "birdseye" texture, to medium grey, fine– to medium–crystalline limestone. The lower member maintains a uniform thickness of 50 m across the district. The 10 m thick upper member commonly consists of light grey, microcrystalline to fine–crystalline, thin–bedded limestone with shale interbeds. The colonial coral *Tetradium* is very abundant in this member.

The Gull River Formation is quarried for crushed stone in several places around Ottawa. The major producers include the Goulbourn Quarry (CP–11), the Fallowfield Quarries of Tomlinson (CP–14) and of Warren Paving (CP–16), the Moodie Drive Quarry (CP–15) and the lower part of the northern quarry of the Francon Quarry (CP–22). Not all the rock of the lower member can be used for concrete aggregate because of the alkali–reactivity of some of the grey–green dolostone beds (Rogers, 1985).

The Bobcaygeon Formation overlies the Gull River Formation and consists of limestone with varying amounts of shale partings and interbeds. Three members have been identified in the Bobcaygeon Formation (Williams, in prep.); the middle member is characterized by substantially more shale interbeds than the lower and upper members. The lower member consists of light grey, microcrystalline to fine–crystalline, thick– to massive–bedded limestone interbedded with fine– to medium–grained calcarenites. Black chert nodules are common in some beds. Shale partings are very thin and are not present between every bed. The middle member consists of grey, thin– to medium–bedded, fine– to medium–crystalline limestone and fine– to coarse–grained calcarenites interbedded with shale beds up to 2 cm thick. The upper member, which is rarely exposed, consists of grey, fine– to medium–crystalline, thin– to medium–bedded limestone, with rare, thin shale partings. The formation is about 95 m thick with the lower, middle, and upper members maintaining thicknesses of 30, 25 and 40 m, respectively, across the district.

The lower member of the Bobcaygeon Formation is exposed as a caprock at the top of several quarries, including the Fallowfield Quarries (CP–14, 15, 16). It also occurs within the Francon Quarry (CP–22), at the top of the north quarry and within several fault blocks of the south quarry. Several quarries are entirely within the lower member: the Arnprior Quarry (CP–1), the Kinburn Quarry (CP–2), the Almonte Quarry (CP–3), the

West Carleton Quarry (CP–4), the Spratt Quarry (CP–9), and the lower part of the Clarke Quarry (CP–10). The middle member occurs at the top of the Clarke Quarry (CP–10), and within most of the fault blocks in the south quarry of the Francon Quarry (CP–22). The upper member is only exposed in a few of the fault blocks of the south quarry of the Francon Quarry (CP–22). Many smaller, now abandoned quarries also occur within the strata of the formation across the district.

Conformably overlying the Bobcaygeon Formation is the Verulam Formation which consists of interbedded limestones and shales. The limestones range from microcrystalline to medium–crystalline limestone and fine– to coarse–grained calcarenites which occur in thin– to medium–bedded intervals. Beds of coarse fossil debris commonly occur within the limestone beds. The shales are commonly calcareous with abundant fossils and burrows and occur in beds up to 15 cm thick. The formation thickens eastward from 40 to 60 m across the area.

The high shale content and lack of exposures have prohibited any quarrying of the Verulam Formation in Carleton Place District.

The Lindsay Formation is a limestone with thin calcareous shale interbeds, conformably overlying the Verulam Formation. The Lindsay Formation is divisible into two members (Figure CP–0–2): the lower a nodular limestone, and the upper, Eastview Member, a black petroliferous, calcareous shale (Williams, in prep.). The main characteristic of the limestones of the lower member is the nodular texture which is enhanced by thin calcareous shale partings. The thin– to thick–bedded limestones are commonly microcrystalline to medium–crystalline with interbeds of medium– to coarse–grained calcarenites. The upper Eastview Member is a black, calcareous shale that exudes a petroliferous odour from a fresh surface. Across the district the lower and upper members maintain a uniform thickness of 20 m and 10 m respectively.

The limestones of the lower member are quarried for crushed stone in the eastern end of Carleton Place District at the Navan (CP–23), and Sarsfield (CP–24) Quarries. The Eastview Member is not utilized by the limestone industry.

The overlying Upper Ordovician rocks, the Billings, Carlsbad, and Queenston Formations primarily consist of shale, with some limestone in the Carlsbad Formation, and total approximately 300 m of strata. These formations are not currently utilized by the limestone industry, although the red shales of the Queenston Formation are used by the brick industry.

LIMESTONE INDUSTRIES

The principal limestone industries in Carleton Place District are construction aggregate and the production of calcite chips and fillers from Grenville marble.

The 1986 Ontario Mineral Score reported stone production for the district in 1986 was approximately 6,890,000 tonnes; the majority was used in the construction industry as road, asphalt and concrete aggregate.

Approximately 6,403,000 tonnes of stone were produced in the Regional Municipality of Ottawa–Carleton, some 50% of which was derived from Geo. Wimpey Canada Ltd. – Moodie Drive (Fallowfield) Quarry (CP–15), United Aggregates Ltd. – South Gloucester Quarry (CP–17), Francon Division of Canfarge Ltd. – North and South (Francon) Quarries (CP–22), and R. W. Tomlinson Ltd. – Fallowfield Quarry (CP–14), each producing in excess of 500,000 tonnes per year. The remaining production can be broken down into two groups; those quarries producing between 250,000 and 500,000 tonnes per year which include Spratt Sand and Gravel Ltd. – Spratt Quarry (CP–9), West Carleton Sand and Gravel Inc. – Clarke Quarry (CP–10), Warren Paving & Materials Group Ltd. – Boyce (South Gloucester) Quarry (CP–18), Beaver Asphalt Paving Co. Ltd. – Ottawa (South Gloucester) Quarry (CP–19), and Permanent Concrete – Navan (LeBlanc) Quarry (CP–23) and those quarries producing less than 250,000 tonnes per year which include Thomas Cavanagh Construction Ltd. – Kinburn Quarry (CP–2), West Carleton Quarry (CP–4), and Goulbourn Quarry (CP–11), George Kennedy – Dunrobin Quarry (CP–6), Warren Paving & Materials Group Ltd. – Houlahan (Fallowfield) Quarry (CP–16), Permanent Concrete – Hawthorne Road Quarry (CP–20) and Bertrand & Freres Construction Company Limited – Sarsfield Quarry (CP–24).

Stone production in Lanark County is relatively small in comparison to that reported in the Regional Municipality of Ottawa–Carleton. The total stone production in 1986 in Lanark County amounted to approximately 446,000 tonnes which is derived largely from the Grenville marbles of the Tatlock Quarry of Steep Rock Calcite (CP–25) with minor contribution on an intermittent basis from the following Paleozoic carbonate quarry properties: Thomas Cavanagh Construction Ltd. – Arnprior Quarry (CP–1) and Franktown Quarry (CP–7), R. C. Lyle (Burntlands Aggregates Ltd.) – Almonte Quarry (CP–3), Duffy Road Oiling Ltd. – Carleton Place Quarry (CP–5), Warren Paving & Materials Group Ltd. – Smiths Falls (Dibblee) Quarry (CP–8) and G. Tackaberry & Sons Construction Co. Ltd. – Rosedale Quarry (CP–12) and Kilmarnock Quarry (CP–13).

CP-1 THOMAS CAVANAGH CONSTRUCTION LTD. — ARNPRIOR QUARRY

LOCATION AND OWNERSHIP

This quarry, located 8 km south of Arnprior at the Renfrew–Lanark county lines, in Lots 26–27, Concession 9, Pakenham Township, Lanark County (Figure CP–1–1), has been intermittently operated by Thomas Cavanagh Construction Ltd. When visited in 1986, the quarry was inactive and partially flooded. The quarry licence covers an area of 38.2 ha.

GEOLOGY

Above the water level, 4.0 m of fine– to medium–crystalline, medium–bedded limestones of the lower member, Bobcaygeon Formation are exposed. The quarry has been excavated westward into a low hillside. Glacial overburden varies from 1 to 2 m around the quarry site.

Geological Section

	Thickness
UNIT 1 Bobcaygeon Formation, lower member	*4.0m*
Limestone: medium to dark grey, weathers light grey; microcrystalline to fine crystalline, with rare beds medium to coarse crystalline or calcarenitic; medium bedded (20–30 cm), with a thick bed (80 cm) capping quarry face; contacts sharp with rare, very thin shale partings between some beds; very fossiliferous, brachiopods especially abundant in coarser–crystalline beds.	
Total thickness	*4.0m*

REFERENCES

None

MAPS

Williams, Wolf and Rae, 1984, OGS Map P.2726

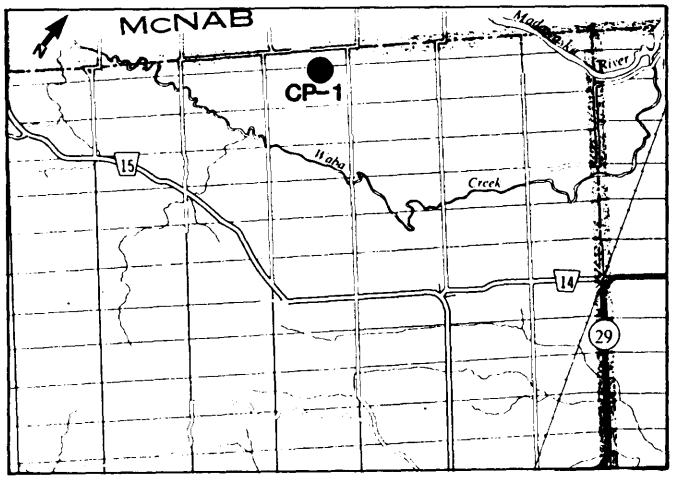


Figure CP-1-1. LOCATION MAP FOR ARNPRIOR QUARRY.

CP-2 THOMAS CAVANAGH CONSTRUCTION LTD. — KINBURN QUARRY

LOCATION AND OWNERSHIP

The Kinburn Quarry is located 4 km south of the village of Kinburn in Lot 4, Concession 5, West Carleton Township (Fitzroy Ward), Regional Municipality of Ottawa–Carleton (Figure CP–2–1).

The quarry was opened in 1980 by the present owner and operator Thomas Cavanagh Construction Ltd. Stone from the Kinburn Quarry is extracted and processed on an intermittent basis, and a portable crushing plant is set up on site when product stockpiles become exhausted. The quarry licence covers an area of 40.46 ha.

GEOLOGY

The 9.3 m deep quarry exposes thin–bedded, shaly limestone of the middle member of the Bobcaygeon Formation. In addition to abundant fossils, some of the bedding planes within this quarry display exceptionally large burrows. Glacial overburden around the quarry, which has been excavated southward into a hillside, varies from 1 to 2 m in thickness.

Geological Section

	Thickness
UNIT 1 Bobcaygeon Formation, middle member	*9.3m*
Limestone: medium grey to grey–brown, weathers light grey–brown to light brown; fine to medium crystalline with some beds coarse calcarenitic and bioclastic; medium bedded (10–20 cm), with sharp and planar contacts marked by 1–2 cm thick, dark grey, shale partings; very fossiliferous with abundant brachiopods, trilobites and large burrows on bedding planes.	
Total thickness	*9.3m*

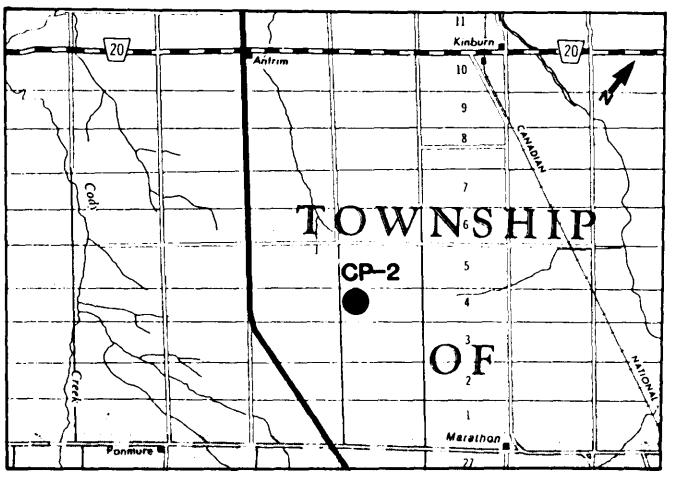


Figure CP-2-1. LOCATION MAP FOR KINBURN QUARRY.

REFERENCES

None

MAPS

None

CP-3 R.C. LYLE (BURNTLANDS AGGREGATE LTD.) — ALMONTE QUARRY

LOCATION AND OWNERSHIP

This quarry, located 3 km northeast of Almonte in Lots 16–17, Concession 12, Ramsay Township, Lanark County (Figure CP-3-1), has been operated by R. C. Lyle (Burntlands Aggregate Ltd.). When visited in 1986, the quarry was inactive and partially filled with water. The quarry licence covers an area of 74.87 ha.

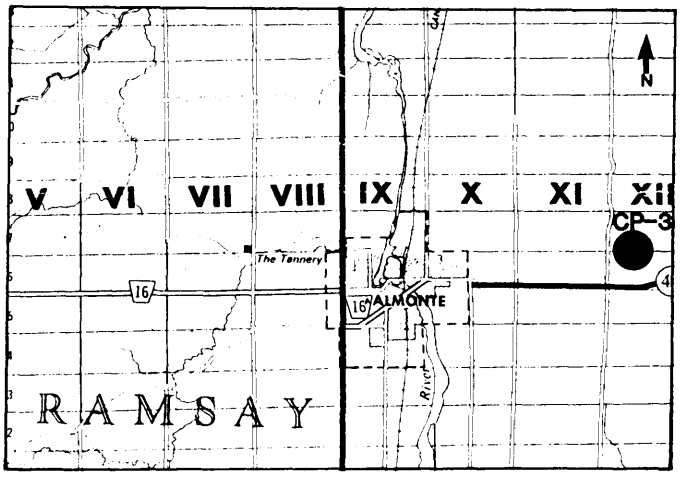


Figure CP-3-1. LOCATION MAP FOR ALMONTE QUARRY.

GEOLOGY

The 5.0 m deep quarry exposes fine-crystalline, thin- to medium-bedded limestones of the lower member of the Bobcaygeon Formation. The description below was recorded in 1982 before the quarry filled with water. Glacial overburden around the quarry is shallow, generally less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Bobcaygeon Formation, lower member	*5.0m*
Limestone: medium to dark grey, light grey in lowest metre, weathers medium grey, to grey-brown at top; fine to coarse crystalline with microcrystalline beds present at base of quarry face; thin to medium bedded (5- 25 cm), with some thin shale partings between beds; small patches of calcite crystals ("birdseye" texture) common in microcrystalline beds; fossiliferous, especially with large colonial corals in upper part of quarry.	
Total thickness	*5.0m*

REFERENCES

Williams, in prep., Appendix 1 – Section LQ AR-1

MAPS

Williams, Wolf and Rae, 1984, OGS Map P.2726

CP-4 THOMAS CAVANAGH CONSTRUCTION LTD. — WEST CARLETON QUARRY

LOCATION AND OWNERSHIP

The West Carleton Quarry is located 6 km northeast of Almonte on Highway 44 in Lots 14 and 15, Concession 11, West Carleton Township (Huntley Ward), Regional Municipality of Ottawa-Carleton (Figure CP-4-1). The quarry, originally opened by Metcalf Construction, was subsequently purchased by Thomas Cavanagh Construction Limited in 1971. Stone from the West Carleton Quarry was used in the construction of Highway 17. The quarry is licensed for an area of 121.18 ha.

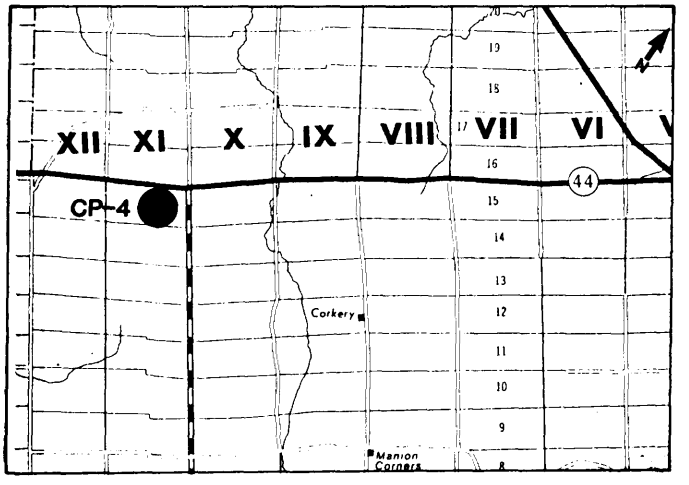


Figure CP-4-1. LOCATION MAP FOR WEST CARLETON QUARRY.

GEOLOGY

The 16.5 m deep quarry exposes limestones of the lower member of the Bobcaygeon Formation in two lifts which have been excavated southwestward into a hillside. Glacial overburden around the quarry site varies from 1 m to 2 m in thickness.

Geological Section

Thickness

UNIT 13 Bobcaygeon Formation, lower member *1.6m*

Limestone: medium to dark grey, weathers same; very fine to fine crystalline; thin bedded (5–10 cm), with sharp and irregular contacts; very fossiliferous with numerous large fossils (corals and stromatoporoids) producing a rubbly weathered surface; lower contact of unit sharp at base of thin shale bed.

UNIT 12 Bobcaygeon Formation, lower member *1.1m*

Limestone; medium to dark grey, weathers medium grey; interbedded microcrystalline to fine-crystalline and medium- to coarse-grained calcarenites; medium bedded (15–20 cm) with sharp planar contacts; moderately fossiliferous; lower contact of unit sharp and planar.

UNIT 11 Bobcaygeon Formation, lower member *1.5m*

Limestone: medium to dark grey, weathers same; very fine crystalline; thin bedded (5–10 cm) with thin shale partings, with sharp and slightly undulating contacts; lower contact of unit sharp and planar at base of 2 cm shale bed.

UNIT 10 Bobcaygeon Formation, lower member *2.2m*

Limestone: dark grey, weathers light to medium grey; microcrystalline; thick bedded (40–50 cm), with sharp and planar contacts; sparsely fossiliferous; lower contact of unit sharp.

UNIT 9 Bobcaygeon Formation, lower member *0.5m*

Limestone: light grey, weathers lighter grey; coarse-grained calcarenite; single bed; lower contact of unit sharp and planar.

UNIT 8 Bobcaygeon Formation, lower member *1.6m*

Limestone: dark grey, weathers same; very fine crystalline; medium bedded (10–15 cm) with sharp and planar contacts; sparsely fossiliferous; lower contact of unit sharp and planar.

UNIT 7 Bobcaygeon Formation, lower member *1.3m*

Limestone: medium to dark grey, weathers same; fine to medium crystalline; medium bedded (20- 25 cm), although weathers into thinner beds; moderately fossiliferous; lower contact of unit sharp and irregular; top of lower lift at top of unit.

UNIT 6 Bobcaygeon Formation, lower member *1.3m*

Limestone: light grey, weathers same; very coarse-grained calcarenite which fines upwards to coarse grained in places; single bed composed of large scale crossbeds, with sets of crossbeds separated by thin shale partings; lower contact of unit sharp and planar.

UNIT 5 Bobcaygeon Formation, lower member *1.5m*

Limestone: medium to dark grey, weathers same; very fine to fine crystalline; thin to medium bedded (8–15 cm), with sharp and planar contacts; lower contact of unit sharp at top of 2 cm thick shaly limestone bed.

UNIT 4 Bobcaygeon Formation, lower member *1.4m*

Limestone: dark grey, weathers light grey; microcrystalline to very fine crystalline; thin bedded (8–10 cm) with sharp and planar contacts; lower contact of unit sharp and irregular.

UNIT 3 Bobcaygeon Formation, lower member *0.7m*

Limestone: dark grey, weathers light brown; fine crystalline; single bed with irregular contacts; slump structures present in places; lower contact of unit sharp and irregular.

UNIT 2 Bobcaygeon Formation, lower member *0.8m*

Limestone: dark grey, weathers light to medium brown; very fine crystalline; thin bedded (8–10 cm), in regular beds with sharp and planar contacts; lower contact of unit sharp and planar.

UNIT 1 Bobcaygeon Formation, lower member *1.0m*

Limestone: dark grey, weathers light brown to grey-brown; very fine to fine crystalline; medium bedded (15 cm), with rare thin shale partings and sharp, planar contacts; moderately fossiliferous.

Total thickness *16.5m*

QUARRY OPERATION

The property is excavated on two lifts of about 8.2 m each. The first lift has an area of approximately 10 ha and is not currently mined. The second lift is actively mined toward the southwest.

PROCESSING

The stone is hard and is crushed by either a 36 in. x 45 in. Cedarapids impeller or a Cedarapids Commander crusher. A Cat 988B loader is used to haul blasted stone to the crushing plant. The quarry produced granular stone, tile bed and HL products in 1986.

REFERENCES

Williams, in prep., Appendix 1 – Section LQ AR–2

MAPS

Williams, Wolf and Rae, 1984, OGS Map P.2726

CP–5 DUFFY ROAD OILING LTD. — CARLETON PLACE QUARRY

LOCATION AND OWNERSHIP

This quarry, located 1 km northeast of Carleton Place in Lot 2, Concession 8, Ramsay Township, Lanark County (Figure CP–5–1), is operated intermittently by Duffy Road Oiling Ltd. The quarry licence covers an area of 62.63 ha.

GEOLOGY

The 8.8 m deep quarry exposes the contact between the sandstones and sandy dolostones of the March Forma-

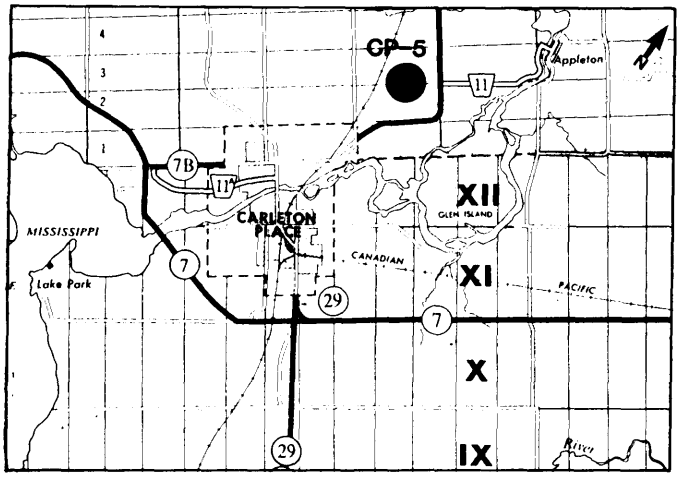


Figure CP-5-1. LOCATION MAP FOR CARLETON PLACE QUARRY.

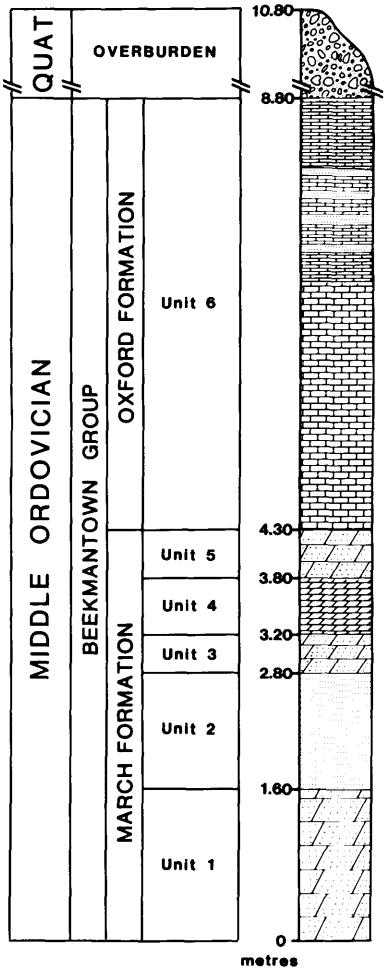


Figure CP-5-2. STRATIGRAPHIC COLUMN FOR CARLETON PLACE QUARRY.

tion and the dolostones of the overlying Oxford Formation (Figure CP-5-2). Glacial overburden around the quarry varies from 1 m to 2 m in thickness.

Geological Section

		Thickness
UNIT 6	*Oxford Formation*	*4.5m*

Dolostone: light grey-brown to light brown, weathers light brown to buff; fine crystalline with rare, thin intervals of medium to coarse grained sandy dolostones; thin to medium bedded (5-20 cm), with sharp and planar contacts; some calcite-filled vugs present in lowest 2 m of unit; lower contact of unit sharp and planar.

UNIT 5	*March Formation*	*0.5m*

Sandy dolostone: light grey-brown, weathers buff; fine- crystalline dolostone with abundant medium- to coarse-grained quartz grains; medium bedded (25 cm), with sharp and planar contacts; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 4	*March Formation*	*0.6m*

Dolostone: medium to dark grey, weathers light brown; fine crystalline; thin bedded (5-10 cm) with sharp and planar contacts; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 3	*March Formation*	*0.4m*

Sandy dolostone: light to medium grey-brown, weathers medium grey; fine-crystalline dolostone with abundant coarse-grained quartz grains; medium bedded (20 cm); calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 2	*March Formation*	*1.2m*

Sandstone: white, weathers white with light reddish-brown stains; medium-grained, well-sorted, well-rounded quartz grains; calcareous cement; medium bedded (15-25 cm) with small to medium scale crossbeds common in most beds; small burrows present in some beds; lower contact of unit sharp and planar.

UNIT 1	*March Formation*	*1.6m*

Sandy dolostone: medium grey, weathers light to medium grey; fine crystalline with medium- to coarse-grained, well-rounded quartz grains.

Total thickness	*8.8m*

REFERENCES

Goudge, 1938, p.114
Hewitt, 1964a, p.18
Rogers, 1980, p.36-38
Williams, in prep., Appendix 1 - Section LQ CA-4

MAPS

Williams and Wolf, 1984a, OGS Map P.2725

CP-6 GEORGE KENNEDY — DUNROBIN QUARRY

LOCATION AND OWNERSHIP

This small quarry, located 3 km northeast of the hamlet of Dunrobin, in Lot 1, Concession 5, West Carleton Township (Torbolton Ward), Regional Municipality of

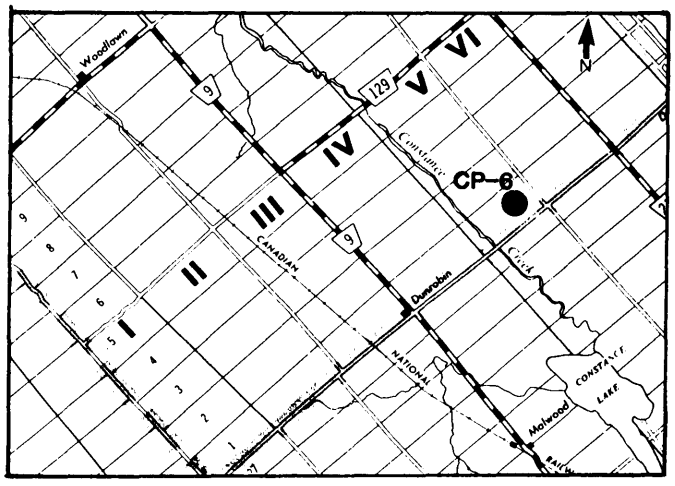


Figure CP-6-1. LOCATION MAP FOR DUNROBIN QUARRY.

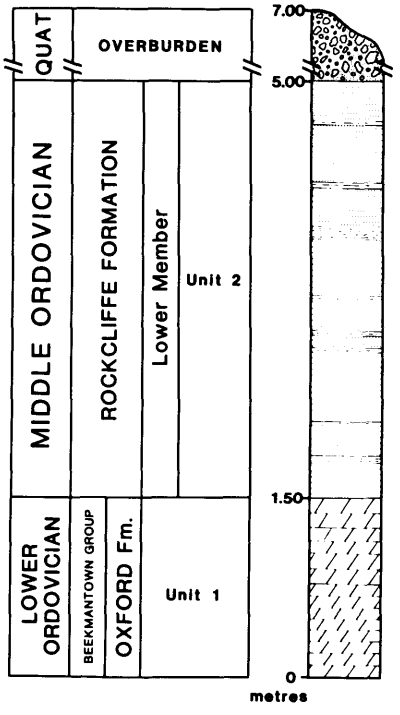


Figure CP-6-2. STRATIGRAPHIC COLUMN FOR DUNROBIN QUARRY.

Ottawa-Carleton (Figure CP-6-1), has been operated intermittently over the last several years. The quarry is licensed for an area of 6.47 ha.

GEOLOGY

The 5.0 m deep quarry exposes the contact between the very fine-crystalline, medium-bedded dolostones of the Lower Ordovician Oxford Formation and the fine-grained, thin- to medium-bedded sandstones of the Middle Ordovician Rockcliffe Formation (Figure CP-6-2). A northwest-southeast trending fault is exposed along the southwest face of the quarry. Glacial overburden around the quarry varies from 1 m to 2 m in thickness.

Geological Section

Northeast of Fault	*Thickness*
UNIT 2 Rockcliffe Formation, lower member	*3.5m*
Sandstone and shale: light grey-green to light brown sandstone with dark green shale, weathers light grey- green; fine-grained sandstone with coarse-grained intervals at base of unit; slightly calcareous cement; thin to medium bedded (5-20 cm) with thin (5 cm) shale interbeds; rare burrows in sandstone and along bedding planes; lower contact of unit sharp with irregular erosional surface.	
UNIT 1 Oxford Formation	*1.5m*
Dolostone: medium grey, weathers buff to light reddish brown; very fine crystalline; medium bedded (15-20 cm).	
Total thickness	*5.0m*

REFERENCES

Williams, in prep., Appendix 1 - Section LQ OT-6

MAPS

Williams, Rae and Wolf 1984, OGS Map P.2716

CP-7 THOMAS CAVANAGH CONSTRUCTION LTD. — FRANKTOWN QUARRY

LOCATION AND OWNERSHIP

This small quarry, located 4 km northeast of Franktown, in Lot 16, Concession 2, Beckwith Township, Lanark County (Figure CP-7-1), has been operated intermittently by Thomas Cavanagh Construction Ltd.. The quarry licence covers an area of 20.6 ha.

GEOLOGY

The quarry was partially flooded when visited in 1986 and only 1.7 m of dolostones of the Oxford Formation were exposed. Glacial overburden around the quarry is generally less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Oxford Formation	*1.7m*
Dolostone: medium grey to light brown, weathers light grey to buff; fine crystalline; thin bedded (5-10 cm).	
Total thickness	*1.7m*

REFERENCES

Williams, in prep., Appendix 1 - Section LQ CA-3

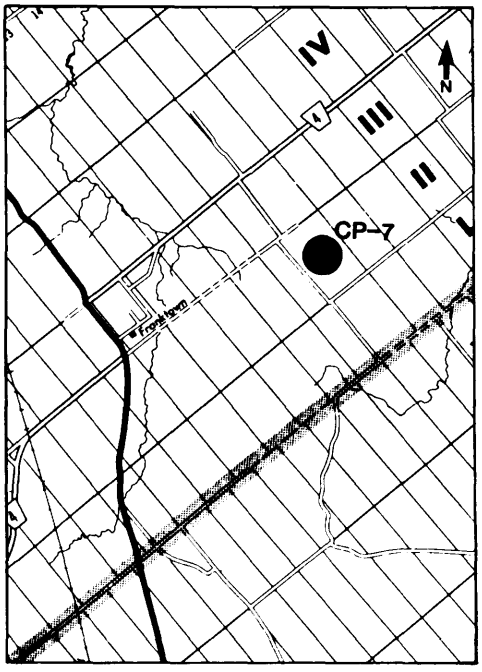


Figure CP-7-1. LOCATION MAP FOR FRANKTOWN QUARRY.

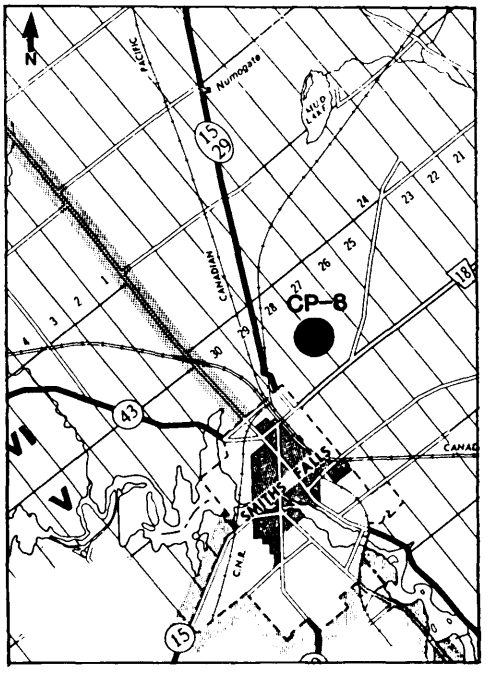


Figure CP-8-1. LOCATION MAP FOR SMITHS FALLS (DIBBLEE) QUARRY.

MAPS

Williams and Wolf, 1984a, OGS Map P.2725

CP-8 WARREN PAVING & MATERIALS GROUP LTD. — SMITHS FALLS (DIBBLEE) QUARRY

LOCATION AND OWNERSHIP

This large quarry, located 1 km north of Smiths Falls in Lots 27–28, Concession 5, Montague Township, Lanark County (Figure CP–8–1), has been operated intermittently by Dibblee Construction Co. Ltd. (a subsidiary of Warren Paving & Materials Group Ltd.), for many years. The quarry licence covers an area of 84.2 ha.

GEOLOGY

The quarry contains two lifts, of which the lower is almost completely filled with water. Recent excavations have been carried out along the east face of the upper lift. A total of 5.2 m of sandy dolostone, dolostone, and sandstone of the March Formation is exposed in the quarry. Glacial overburden around the quarry is about 1–2 m thick.

Geological Section

Thickness

UNIT 6 March Formation *2.3m*

Sandy dolostone: light grey to light grey-brown, weathers light grey-brown; fine crystalline with abundant medium- to coarse-grained, well- rounded, well-sorted quartz grains; thin to medium bedded (5–25 cm) with sharp and planar contacts; abundant calcite-filled vugs in some beds; fossiliferous with accumulations of gastropods on some bedding planes; lower contact of unit is sharp and planar.

UNIT 5 March Formation *0.5m*

Sandstone: light grey to light green, weathers same; medium grained, with well-sorted, well-rounded quartz grains; calcareous cement; medium bedded (25 cm); lower contact of unit is sharp.

UNIT 4 March Formation *0.5m*

Sandy dolostone: light grey, weathers light grey-brown; fine crystalline with coarse-grained, well-rounded, well-sorted quartz grains; thin bedded (5–8 cm); lower contact of unit is covered.

UNIT 3 March Formation *0.4m*

Covered interval.

UNIT 2 March Formation *0.8m*

Sandy dolostone: light brown to light grey-brown, weathers light grey-brown; fine crystalline with medium- to coarse- grained, well-rounded, well-sorted quartz grains; thin to medium bedded (5–20 cm), with sharp and planar contacts; calcite-filled vugs present in some beds; lower contact of unit sharp and planar; top of lower lift at top of the unit.

UNIT 1 March Formation *0.7m*

Dolostone: medium grey, weathers light to medium grey; fine crystalline; thin bedded (5–8 cm); calcite-filled vugs present, base of unit at water level.

Total thickness *5.2m*

REFERENCES

Goudge, 1938, p.118

Hewitt, 1964a, p.19

Rogers, 1980, p.63

Williams, in prep., Appendix 1 – Section LQ PE–4

MAPS

Williams and Wolf, 1984b, OGS Map P.2724

CP-9 SPRATT SAND AND GRAVEL LTD. — SPRATT QUARRY

LOCATION AND OWNERSHIP

The Spratt Sand and Gravel Ltd. head office, processing plant and quarry operations are located 5 km northwest of Stittsville in Lots 2–5, Concession 2, West Carleton Township (Huntley Ward), Regional Municipality of Ottawa–Carleton (Figure CP–9–1).

In 1915 J. Howard Spratt began selling gravel from a deposit on his farm; at that time the gravel was hand loaded and delivered in horse–drawn wagons. The first truck (a Beaver), and shovel (3/4 yd. Austin Western "Badger"), were purchased in 1920 and 1943, respectively, and in the 1920s the first stationary screening facility was used to process gravel. In 1934 the business was taken over by George Spratt, son of J. Howard Spratt, and in 1956 the company was incorporated as Spratt Sand and Gravel Ltd. In 1965 Charles and John Spratt, grandsons of the founder, joined the company. The land containing the limestone quarry was purchased by Spratt Sand and Gravel in 1961; the quarry itself was opened in 1975. The quarry is licensed for 40.46 ha.

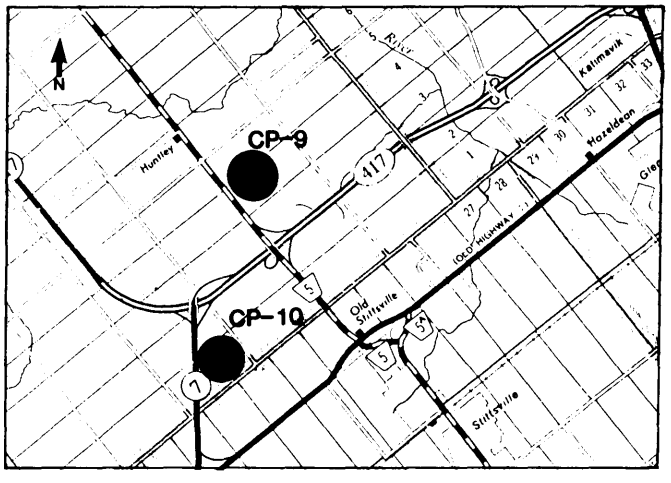


Figure CP-9-1. LOCATION MAP FOR SPRATT QUARRY.

Spratt Sand and Gravel markets a wide variety of products. Quality control is maintained by a full–time technician at a laboratory attached to the head office; the laboratory is equipped to carry out gradation, magnesium sulphate soundness loss, colour plate, mortar strength and Proctor tests.

GEOLOGY

The 11.3 m deep quarry exposes medium to thick–bedded medium– to coarse–crystalline limestones of the lower member of the Bobcaygeon Formation. Glacial overburden around the quarry varies from 1 m to 2 m.

Geological Section

Thickness

UNIT 6 Bobcaygeon Formation, lower member *4.8m*

Limestone: light to medium grey, weathers light grey; medium to coarse crystalline and calcarenitic; medium to thick bedded (20–50 cm), with contacts commonly stylolitic; fossiliferous with corals and brachiopods most abundant; lower contact of unit is sharp and planar.

UNIT 5 Bobcaygeon Formation, lower member *1.3m*

Limestone: dark grey, weathers light blue–grey; very fine crystalline; thin to medium bedded (5–15 cm) with thin shaly partings common between beds; fossiliferous with brachiopods abundant; lower contact of unit sharp and stylolitic.

UNIT 4 Bobcaygeon Formation, lower member *0.5m*

Limestone: light to medium grey, weathers light grey; medium to coarse crystalline and calcarenitic; single bed; black chert in 5 cm thick interval at top of unit; fossiliferous with corals and brachiopods most abundant; lower contact of unit sharp and stylolitic.

UNIT 3 Bobcaygeon Formation, lower member *0.3m*

Limestone: light grey, weathers same; fine crystalline, with medium– to coarse–crystalline interbeds up to 5 cm thick; single bed; fossiliferous with abundant brachiopods; lower contact of unit sharp and stylolitic.

UNIT 2 Bobcaygeon Formation, lower member *0.3m*

Limestone: light to medium grey, weathers light grey, medium to coarse crystalline; single bed; fossiliferous with some corals and brachiopods; lower contact of unit sharp and planar.

UNIT 1 Bobcaygeon Formation, lower member *4.1m*

Limestone: dark grey, weathers medium grey with blue–grey tones; microcrystalline to very fine crystalline; thin to medium bedded (5–25 cm) with thin shale partings commonly present between beds; fossiliferous with brachiopods most common.

Total thickness *11.3m*

QUARRY OPERATION

The quarry is excavated on two lifts of 5.2 m and 6.1 m, and has an annual production capacity of approximately 450,000 tonnes. Drilling is performed by the company

and blasting is contracted. The blasting conditions are generally wet; AN/FO is used as much as possible. The top lift has a 1 m thick capstone layer which requires a 2.1 m x 2.4 m drill pattern and 102 mm diameter holes to achieve good blast fragmentation. The finely broken stone lightens the load on the primary crusher (at quarry floor), and is more suitable for belt conveyor transfer. Armour and gabion stone are rarely produced during blasting and there is little demand for these products in the area.

PROCESSING

The process flow sheet for the plant is shown on Figure CP-9-2. The blasted stone is loaded by a Cat 980C loader (6 yd.) and hauled by two Euclid R-22 Rock Trucks to the primary crusher, a portable 36 in. x 52 in. Cedarapids double impeller crusher stationed on the quarry floor. The crushed stone is transferred 800 m by a 36 in. field conveyor at 400 tonnes/hr. to a 150 ft. x 30 in. radial stacker producing a -6 in. surge pile. Below the surge pile a 36 m reclaim tunnel equipped with two 36 in. feeders transfers the stone to a 30 in. belt which feeds two 4 ft. x 16 ft. double-deck Dillon screens, producing Granular "A" or stone dust to storage bins, and +7/8 in. oversize. Secondary crushing of the oversize stone is by a single impeller impact crusher feeding the two double-deck Dillon screens. The Granular "A & B" and stone dust products are conveyed and stockpiled. Clear stone and raw sand are conveyed to the washing plant and fed to two 5 ft. x 14 ft. triple-deck Dillon wash screens producing 3/4 in. clear, 1/2 in. clear and 3/8 in. clear to truck bins. The -1/4 in. sand is sent to a Wemco Classifier producing concrete fine aggregate and masonry mortar sand. These products are sent to dewatering screws and stockpiled by two 120 ft. x 24 in. radial stackers. Waste products and extracted water are sent to a cyclone classifier and then to a settling pond. Adjustments to the screening processes and complex blending allow a wide range of products to be marketed.

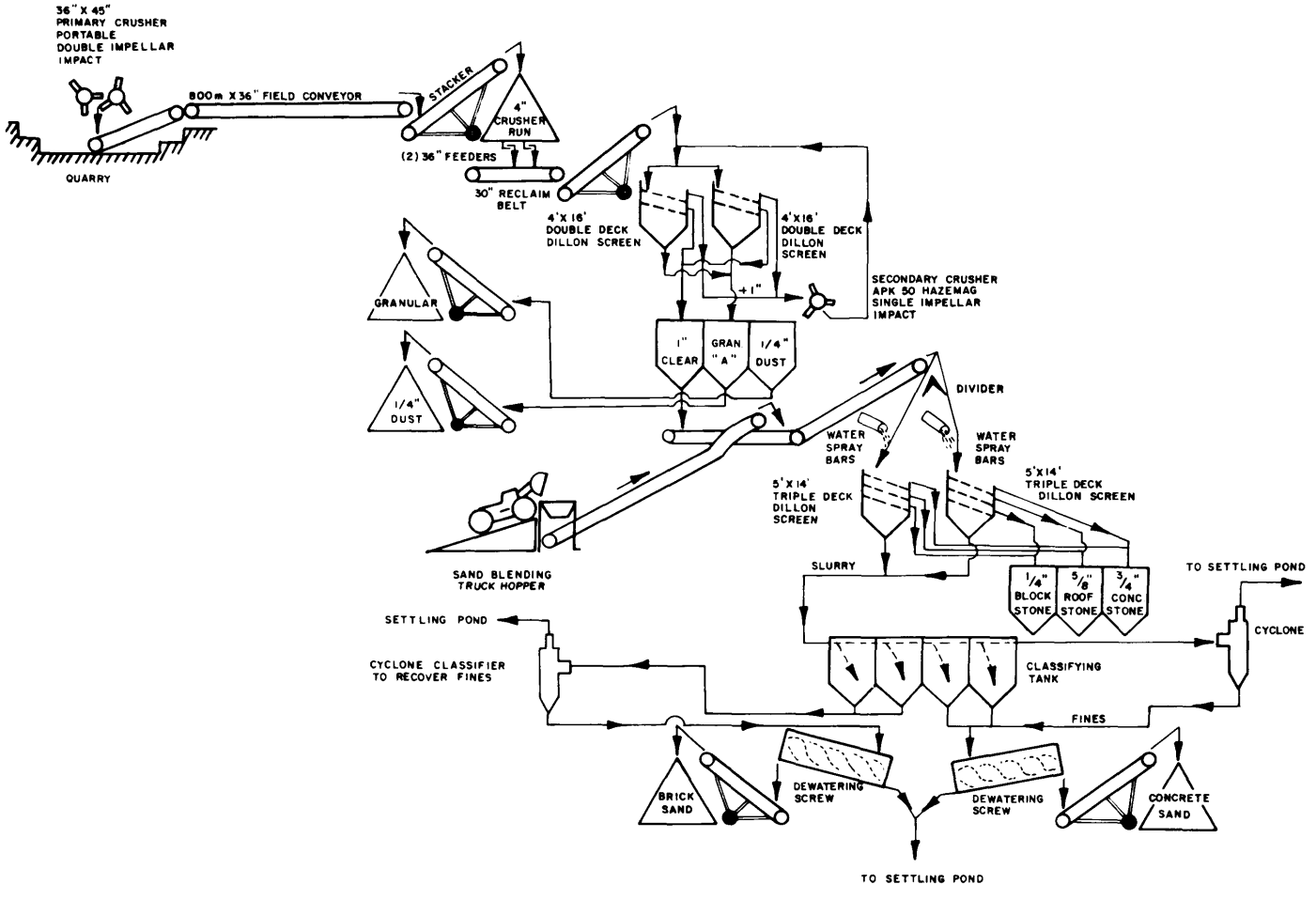


Figure CP-9-2. PROCESS FLOW SHEET FOR SPRATT QUARRY.

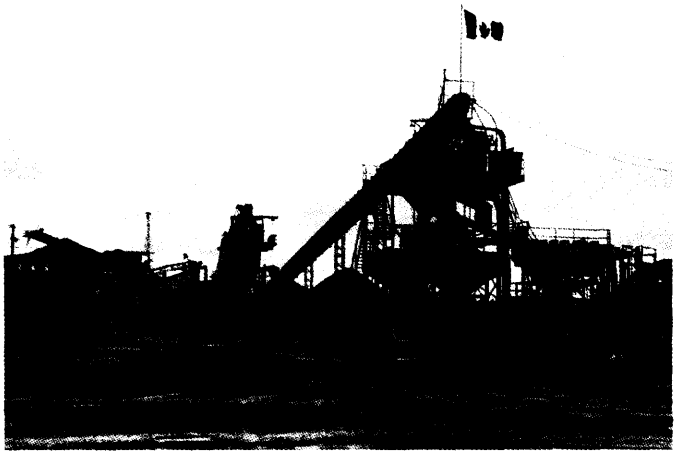


Photo CP-9-1. WASH PLANT TOWER (FOREGROUND) AND SECONDARY CRUSHING SCREENING (BACKGROUND) AT THE SPRATT QUARRY.

PRODUCTS

Group 1

Blasted Rock
Crusher Run Screenings
Crusher Run 6 in. Granular "C"
Crusher Run 4 in. Granular "B"
Crusher Run 2 in. Granular "B"
Crusher Run 5/8 in. Granular "A"
Crusher Run 3/4 in. Granular "A"

Group 2

Graded Washed 3/4 in. Concrete Stone
Graded Washed 1/2 in. Concrete Stone
Graded Washed 3/8 in. Concrete Stone
Graded Washed 3/8 in. Roofing
Graded Washed 5/8 in. Roofing
HL3 Asphalt Stone
HL5 Asphalt Stone
HL6 Asphalt Stone
Surface Treatment Stone

Group 3

Washed Classified Concrete Sand
Washed Classified Plaster Sand
Washed Classified Masonry Sand
Screened Bedding Sand
Washed Winter Road Grit
Blended Asphalt Sand
Sand fill
Quarry Strippings
Sand fill Class "C"
Pickled Sand

Group 4

Clear Washed 5/16 in.
Clear Washed 3/8 in.
Clear Washed 5/8 in.
Clear Washed 3/4 in.
Clear Screened 1/4 in.

REFERENCES

Williams, in prep., Appendix 1 – Section LQ OT-1

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP-10 WEST CARLETON SAND AND GRAVEL INC. — CLARKE QUARRY

LOCATION AND OWNERSHIP

The Clarke Quarry is located 3 km west of Stittsville in Lots 1 and 2, Concession 2, West Carleton Township (Huntley Ward), Regional Municipality of Ottawa–Carleton (Figure CP–10–1).

The quarry was first opened by H. J. McFarland Construction to supply aggregates for construction of Hwy. 417. In 1979 the quarry was purchased by West Carleton Sand and Gravel Inc. and is currently licensed for an area of 62.72 ha.

GEOLOGY

The presence of a northwest trending fault system in the 10.0 m deep quarry results in a total exposure of 20.0 m of limestones of the lower and middle members of the Bobcaygeon Formation. Several individual faults combine to produce a total down–throw of approximately 9 m to the northeast. In addition, the fault block northeast of the fault system dips northwards at 10°

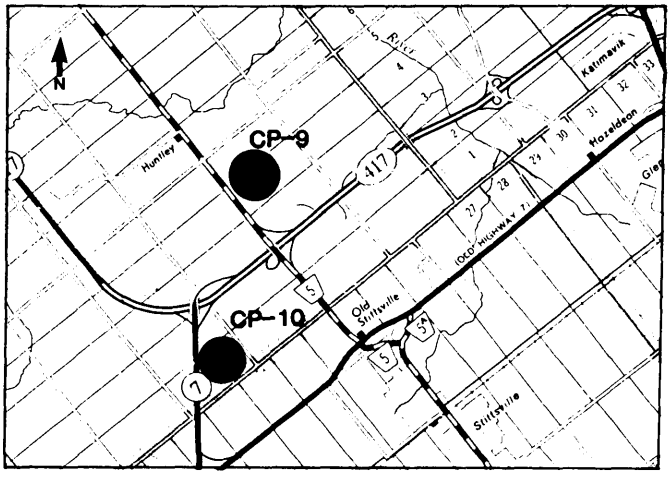


Figure CP-10-1. LOCATION MAP FOR CLARKE QUARRY.

Within the fault system, and well displayed on the west face of the quarry, extensive rotation and fracturing of fault blocks has produced a complex exposure. In addition to high angle normal faults which dip northeast at about 80°, a lower angle irregular fault plane appears in one of the fault blocks. Veins of calcite appear sporadically along some of the fault planes.

The contact between the lower and middle members of the Bobcaygeon Formation is exposed at the south end of the fault block northeast of the main fault system in the quarry. The contact disappears into the quarry floor to the north as these beds are dipping northwards at about 10°. The remainder of the quarry faces, northeast of the fault system, consist of thin-bedded, shaly limestone of the middle member.

Thicker bedded fine- to medium-crystalline limestone of the lower member of the Bobcaygeon Formation is exposed to the southwest and within the fault zone.

Glacial overburden around the quarry varies from 1-4 m in thickness.

Geological Section

	Thickness
UNIT 2 Bobcaygeon Formation, middle member	*10.0m*

Limestone, with shale partings: light to medium grey, weathers light grey; fine to medium crystalline; thin to medium bedded (5-20 cm) with shale partings up to 2 cm thick present between most beds; fossiliferous with brachiopods and corals most abundant; lower contact of unit is sharp and planar at base of shaly limestone.

UNIT 1 Bobcaygeon Formation, lower member	*10.0m*

Limestone: medium grey, weathers light to medium grey, with a blue-grey tinge in places; microcrystalline to very fine crystalline to rarely medium crystalline; medium bedded (20-30 cm) with some thicker (40-60 cm) beds scattered throughout unit; sparsely fossiliferous.

Total section thickness	*20.0m*
Total quarry depth	*10.0m*

QUARRY OPERATION

The quarry is presently advancing to the west on a single lift of about 10 m and the disturbed area is approximately 5 ha. Overburden is used to construct berms, or is stockpiled.

Drilling and blasting is contracted; a 2.4 m x 2.4 m pattern is used with 7.6 cm diameter holes. In some sections of the quarry drilling and blasting is hindered by structurally complex ground. Amex II (AN/FO) and 40% Forcite are used as explosives, initiated by electric delay caps. All blasts are monitored for vibration levels.

PROCESSING

A Komatsu 500 loader (5.5 yd.) is used to load two 35-ton Euclid trucks with blasted stone. A 43 in. x 40 in. Cedarapids single impeller crusher is used for primary breaking, the stone leaving the crusher at about -4 in. and feeding an Assinck 6 ft. x 20 ft. triple-deck screening plant. To make 3/4 in. clear stone, the screens are set to feed -4 in. plus 1 in. oversize material to a 30 in. x 30 in. New Holland (1939) impactor crusher and 3/4 in. clear and Granular "A" to stockpiles. The stone leaving the New Holland secondary crusher is returned to the Assinck screening plant. If desired, a crusher-run product can also be scalped from the screening plant surge

Photo CP-10-1.
CRUSHING/SCREEN FACILITIES AT THE CLARKE QUARRY (LOOKING SOUTH).

bin. A Volvo 4600 (4 yd.) loader is used for stockpiling and truck loading.

PRODUCTS

Gabion Stone 4 in. and 8 in.
Granular "A", "B" and "C"
3/4 in. Clear Concrete Stone
1 in. Septic or Weeping Bed Stone
HL3

REFERENCES

Williams, in prep., Appendix 1 – Section LQ OT–2.

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP–11 THOMAS CAVANAGH CONSTRUCTION LTD. — GOULBOURN QUARRY

LOCATION AND OWNERSHIP

The Goulbourn Quarry is located 4 km northwest of the village of Munster, in Lot 11, Concession 8, Goulbourn Township, Regional Municipality of Ottawa–Carleton (Figure CP–11–1). The quarry was opened in 1975 by the present owner and operator Thomas Cavanagh Construction Ltd. The property is licensed for an area of 20.23 ha.

The quarry produces crushed aggregate on a single lift of 9.7 m. The disturbed area is about 10 ha.

GEOLOGY

The 10.4 m deep quarry exposes limestones and dolostones of the lower member of the Gull River Formation.

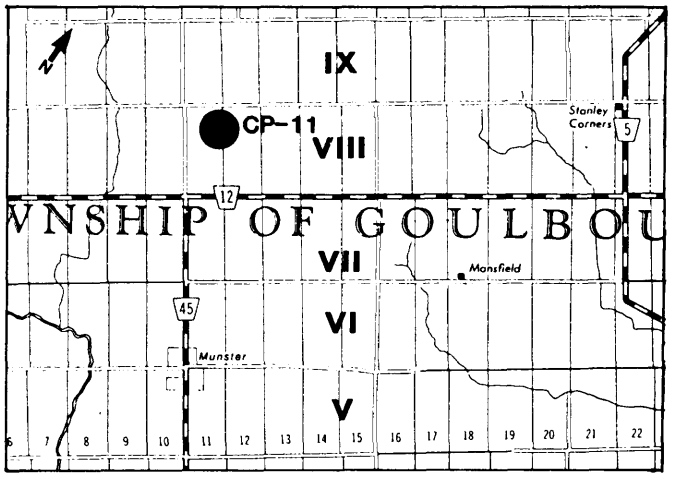


Figure CP-11-1. LOCATION MAP FOR GOULBOURN QUARRY.

The two rock types alternate in intervals of 2 m to 4 m. A small fault trends across the quarry at 105° with a down–throw to the north of 20 cm. Also present, although apparently not associated with the fault, is a small monoclinal fold which displaces the strata about 2 m down to the south. Glacial overburden around the quarry ranges from 1 to 3 m in thickness.

Geological Section

		Thickness
UNIT 6	*Gull River Formation, lower member*	*4.2m*

Limestone: medium grey, weathers light grey, microcrystalline to fine crystalline; thin to medium bedded (5–25 cm) with thin interbeds of light grey-green dolostone and dark grey shale.

UNIT 5	*Gull River Formation, lower member*	*0.8m*

Dolostone: grey-green to grey-brown, weathers light grey-green to light grey-brown; fine crystalline with varying amounts of very fine-grained terrigenous material; medium bedded (15–25 cm); some beds range from dolomitic limestone to calcitic dolostone.

UNIT 4	*Gull River Formation, lower member*	*1.0m*

Dolostone: grey-brown to grey-green, weathers light grey-brown to light grey-green; fine crystalline with varying amounts of very fine-grained terrigenous material; medium bedded (20–25 cm) with thin (1–2 cm), dark grey shale interbeds; some beds of calcitic dolostone are also present; burrows common, especially in and near shale beds.

UNIT 3	*Gull River Formation, lower member*	*0.4m*

Dolostone: grey-brown to grey-green, weathers light grey-brown to light grey-green; fine crystalline with varying amounts of very fine-grained terrigenous material; medium bedded (15–25 cm).

UNIT 2	*Gull River Formation, lower member*	*3.5m*

Limestone: medium grey, weathers light grey; microcrystalline to fine crystalline; medium bedded (10–20 cm) with thin shale partings between most beds.

UNIT 1	*Gull River Formation, lower member*	*0.5m*

Dolostone: grey-green to grey-brown, weathers light grey-green to dark grey-brown; fine crystalline; medium bedded (15–25 cm); some beds of calcitic dolostone are also present.

Total thickness	*10.4m*

QUARRY OPERATION

All drilling and blasting is performed by Thomas Cavanagh Construction Ltd. A drill pattern of 2.74 m x 2.74 m is used with 7.6 cm diameter holes. AN/FO is used as a bulk explosive and plastic liners are placed in blast holes in wet conditions.

PROCESSING

A portable crushing plant is installed at the quarry on a demand basis. Primary crushing is by Cedarapids 36 in. x 45 in. impeller or Cedarapids Commander Crusher. Stone is loaded and hauled to the crusher by a Cat 988B loader.

PRODUCTS

The Goulbourn Quarry produces various sizes of clear, crusher run and HL stone products.

REFERENCES

Carson, 1982f, Section C-1
Williams, in prep., Appendix 1 – Section LQ KE-3

MAPS

Carson, 1982d, OGS Map P.2493

CP-12 G. TACKABERRY AND SONS CONSTRUCTION CO. LTD. — ROSEDALE QUARRY

LOCATION AND OWNERSHIP

This quarry located 3.5 km north of the hamlet of Rosedale in Lot 17, Concession 4, Montague Township, Lanark County (Figure CP-12-1), is currently operated by G. Tackaberry and Sons Construction Co. Ltd. The quarry is licensed for an area of 18.37 ha.

GEOLOGY

The 4.5 m deep quarry exposes fine- to medium-crystalline dolostones and sandy dolostones of the March Formation. Green tinges in the rock are the result of minor amounts of glauconite along the bedding planes. Glacial overburden around the quarry is thin.

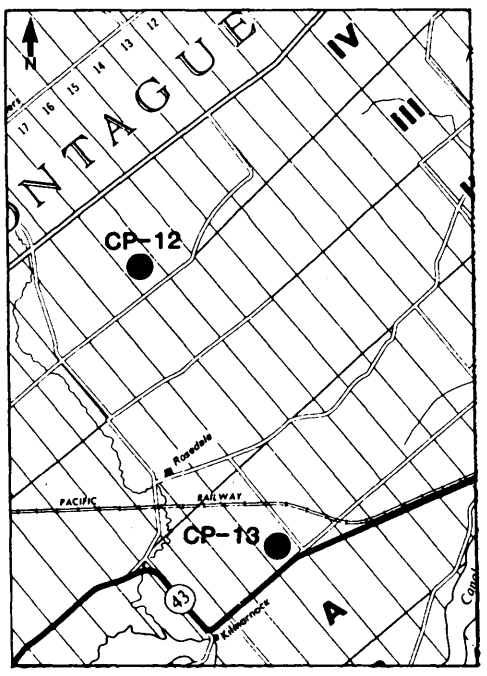


Figure CP-12-1. LOCATION MAP FOR ROSEDALE QUARRY.

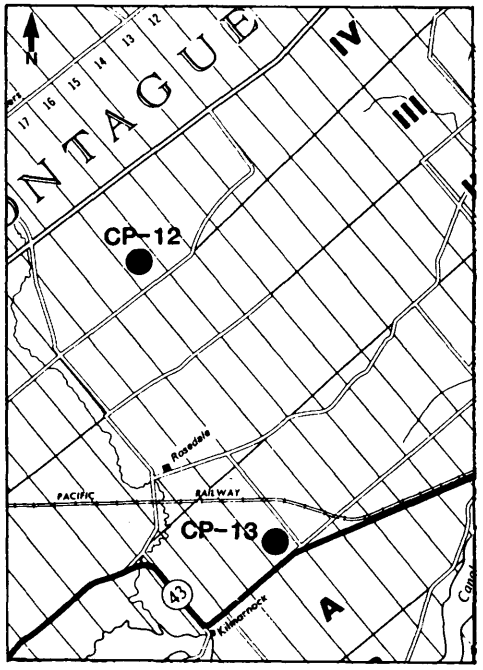


Figure CP-13-1. LOCATION MAP FOR KILMARNOCK QUARRY.

Geological Section

	Thickness
UNIT 1 March Formation	*4.5m*

Dolostone: medium grey-brown to medium grey, weathers light grey-brown with light green tinge along bedding planes; fine to medium crystalline; thin bedded (5-10 cm), with sharp, slightly irregular bedding contacts; most beds contain some amount of well- rounded coarse grains of quartz, some beds contain significant amounts; vugs very abundant throughout unit, most small and completely filled with calcite, larger vugs partially filled with large calcite crystals with rare small pyrite crystals present; green tinge due to glauconite; very large burrows on some bedding planes.

Total thickness *4.5m*

REFERENCES

Williams, in prep., Appendix 1 – Section LQ ME-3

MAPS

Carson, 1982e, OGS Map P.2494

CP-13 G. TACKABERRY AND SONS CONSTRUCTION CO. LTD. — KILMARNOCK QUARRY

LOCATION AND OWNERSHIP

This quarry, located on Highway 43, 2 km northeast of Kilmarnock in Lot 19, Concession 1, Montague Township, Lanark County (Figure CP-13-1), has been oper-

ated intermittently by G. Tackaberry and Sons Construction Co. Ltd.

GEOLOGY

The 6.0 m deep quarry exposes fine-crystalline, medium-bedded dolostones of the Oxford Formation. Overburden around the quarry is about 1 m thick.

Geological Section

		Thickness
UNIT 1	*Oxford Formation*	*6.0m*
	Dolostone: light grey-brown weathers light brown; fine crystalline; medium bedded (10-20 cm) with sharp and planar contacts; vugs filled with calcite crystals common in some beds.	
Total thickness		*6.0m*

REFERENCES

Williams, in prep., Appendix 1 - Section LQ ME-4

MAPS

Carson, 1982e, OGS Map P.2494

CP-14 R.W. TOMLINSON LTD. — FALLOWFIELD QUARRY

LOCATION AND OWNERSHIP

The Fallowfield Quarry is located in Lots 24 and 25, Concession 5, City of Nepean, Regional Municipality of Ottawa-Carleton (Figure CP-14-1), 1.5 km northeast of Fallowfield. Since opening in 1979 the quarry has been owned and operated by R. W. Tomlinson Ltd. The quarry is licensed for 29.6 ha. The extracted area is about 14.2 ha with quarrying of a single lift of 6.1 m to 10.7 m.

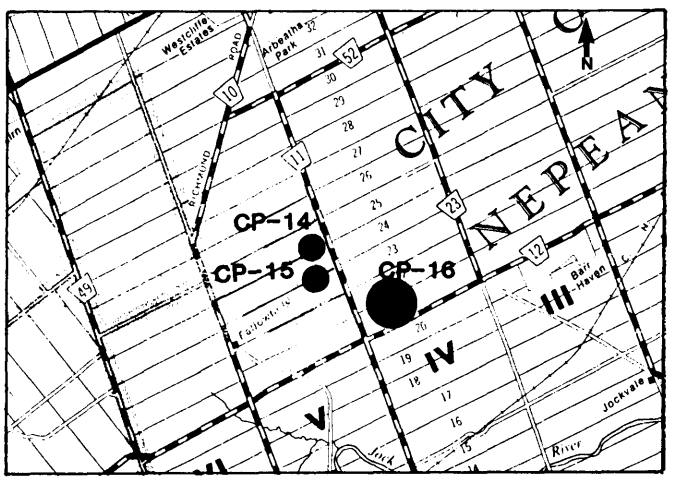


Figure CP-14-1. LOCATION MAP FOR FALLOWFIELD QUARRY.

An extensive study of the quarry property has been completed by the operator and establishes a reserve of concrete-quality stone. Core samples recovered to a depth of approximately 30 m have been analyzed for alkali reactivity.

GEOLOGY

The 10.9 m deep quarry exposes thin-bedded shaly limestones of the upper member of the Gull River Formation and the overlying thick-bedded limestones of the lower member of the Bobcaygeon Formation. A few minor faults were observed in the faces of the quarry, but often could not be traced across the quarry because of large stockpiles of crushed stone against the quarry walls. Overburden around the quarry is generally less than 2 m thick.

Geological Section

		Thickness
UNIT 3	*Bobcaygeon Formation, lower member*	*3.3m*
	Limestone: medium to dark grey, weathers blue-grey to brown; very fine to fine crystalline; medium to thick bedded (25-50 cm) with rare thinner beds, with sharp and planar contacts, and rare, thin, dark grey shale partings; moderately fossiliferous with brachiopods most abundant; lower contact of unit is gradational where shale partings become more abundant.	
UNIT 2	*Bobcaygeon Formation, lower member*	*2.7m*
	Limestone: medium to dark grey-brown, weathers blue-grey to light brown; fine crystalline, with some very fine-crystalline to microcrystalline beds; medium to thickly bedded (25-50 cm) with rare thinner beds, sharp and irregular contacts, with very rare and very thin shale partings; lower contact of unit is sharp at base of thicker bedded, generally shale-free limestone.	
UNIT 1	*Bobcaygeon Formation, lower member*	*4.9m*
	Limestone: light to dark grey, weathers light blue-grey to dark grey; microcrystalline with some fine-crystalline beds; thin to medium bedded (5-15 cm) with rare thicker beds, sharp and planar contacts with shale partings, rarely up to 1 cm thick, common between most beds.	
Total thickness		*10.9m*

QUARRY OPERATION

A 2.74 m x 2.74 m drill pattern with 8.9 cm diameter holes is used; blast holes are loaded with AN/FO which is initiated with electric caps. A Huff 560 loader (7 yd.) with a Cat 245 shovel are used to load blasted stone into 30-ton Terex haulage trucks.

PROCESSING

A 48 in. x 66 in. Hewitt-Robins impact crusher feeds a 5 ft. x 14 ft. scalping screen, from which oversize is sent for secondary crushing by two 30 in. x 42 in. Hewitt-Robins hammer mills. Undersize from the scalping screen and secondary crushed material are fed to two 6 ft. x 16 ft. Hewitt-Robins triple-deck screens. A 6,000 lb. batch asphalt plant located on the site is jointly owned by R.W. Tomlinson Ltd. and Tarcon Ltd. Approximately

35% of all asphalt stone produced at the quarry is supplied to the plant.

PRODUCTS

Granular Stone
Asphalt Stone
5/16 in. stone (for cement block manufacture)
Clear Stone and Concrete Stone

REFERENCES

Williams, in prep., Appendix 1 – Section LQ OT–4

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP–15 GEORGE WIMPEY CANADA LTD. — MOODIE DRIVE (FALLOWFIELD) QUARRY

LOCATION AND OWNERSHIP

The Moodie Drive (Fallowfield) Quarry, is located 1.5 km northeast of Fallowfield in Lot 23 and Lot 24, Concession 5, City of Nepean, Regional Municipality of Ottawa–Carleton (Figure CP–15–1). The quarry was owned and operated by H. J. McFarland Construction Ltd. since 1960 and is now licensed by George Wimpey Canada Ltd. Approximately 36 ha of a licensed area of 82.4 ha have been opened and over 18,000,000 tonnes of aggregate removed from the quarry. Two asphalt batch plants of 12,000 lbs. and 5,000 lbs. operate at the site; the former replaced a 4,000 lb. plant in late 1986.

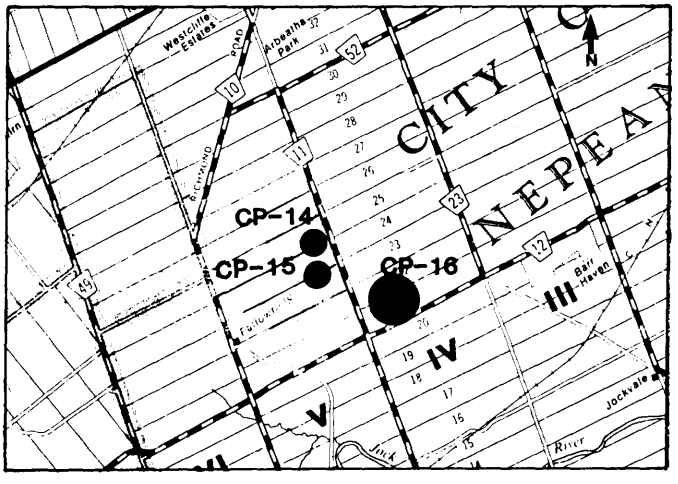


Figure CP-15-1. LOCATION MAP FOR MOODIE DRIVE (FALLOWFIELD) QUARRY.

GEOLOGY

The three lifts in the quarry expose a total of 36.2 m of section, with the deepest part of the quarry at the northeast end. Limestones and dolostones of the lower member of the Gull River Formation are overlain by thin-bedded shaly limestones of the upper member. Thick-bedded limestones of the lower member of the Bobcaygeon Formation at the top of the quarry overlie the Gull River Formation (Figure CP–15–2).

The section is disrupted by several normal faults, in which displacements are generally less than 3 m. In addition, the quarry floor exhibits large buckles (Adams, 1982), although some were subsequently removed when the lower lift was enlarged. Glacial overburden around the quarry ranges from 2 to 3 m in thickness.

Geological Section

Thickness

UNIT 13 Bobcaygeon Formation, lower member — *5.9m*

Limestone: medium to dark grey-brown, weathers blue-grey to light brown; very fine to fine crystalline; medium to thick bedded (25–50 cm) with some thinner beds present, sharp contacts with very thin shale partings present between a few beds; lower contact of unit is sharp at base of shale-free, thicker-bedded limestone.

UNIT 12 Gull River Formation, upper member — *9.2m*

Limestone, with shale partings: dark grey, weathers dark grey, except for a white, 25 cm thick bed 7.0 m above base of unit; microcrystalline to fine crystalline; thin to medium bedded (5–20 cm), with rare thicker beds, sharp and planar to undulating contacts with shale partings up to 1 cm thick common between most beds; intraclasts of light grey, microcrystalline limestone occur in some beds of fine-crystalline limestone; small patches of calcite crystals, "birdseye" texture, commonly occur throughout unit; moderately fossiliferous, colonial coral *Tetradium* most common; lower contact of unit is sharp.

UNIT 11 Gull River Formation, lower member — *0.7m*

Dolostone: medium grey, weathers light brown to buff; very fine to fine crystalline with a minor amount of terrigenous mud and silt; thin to medium bedded (5–15 cm), with thin shale partings between some beds; lower contact of unit is sharp.

UNIT 10 Gull River Formation, lower member — *3.2m*

Limestone: dark grey, weathers light to medium grey, commonly with a blue-grey tinge; microcrystalline to fine crystalline; thin to thick bedded (5–50 cm) with thin shale partings between some beds; lower contact of unit is sharp.

UNIT 9 Gull River Formation, lower member — *0.6m*

Limestone: dark grey, weathers medium grey with blue-grey tinge; medium bedded (30 cm) with thin shale partings; oolites and light to medium grey, microcrystalline intraclasts abundant throughout unit; lower contact of unit is sharp.

UNIT 8 Gull River Formation, lower member — *1.1m*

Dolostone: green-grey, weathers buff to red-brown; very fine crystalline; thin to medium bedded (5–20 cm) with thin shale partings common; intraclasts of light brown, fine-crystalline dolostone present; some parts of unit are slightly calcitic; lower contact of unit is sharp.

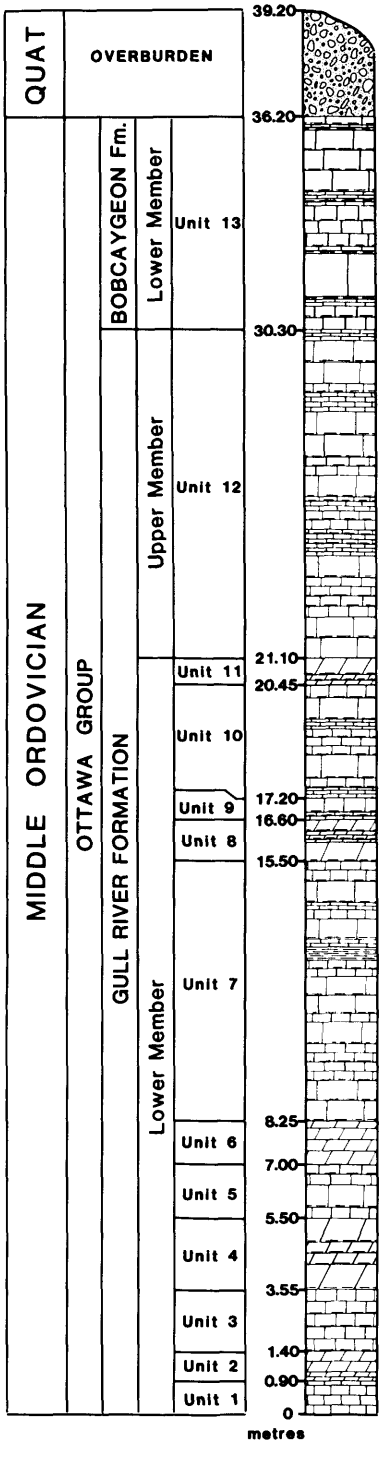


Figure CP-15-2. STRATIGRAPHIC COLUMN FOR MOODIE DRIVE (FALLOWFIELD) QUARRY.

UNIT 7 Gull River Formation, lower member *7.3m*

Limestone: dark grey, weathers blue-grey; microcrystalline to fine crystalline; thin to thick bedded (5-50 cm) with thin shale partings common between most beds; intraclasts of light grey microcrystalline limestone common in some beds; moderately fossiliferous with brachiopods most abundant; black shale bed, 20 cm thick, 4.7-4.9 m above base of unit; lower contact of unit is sharp.

UNIT 6 Gull River Formation, lower member *1.2m*

Dolostone: medium grey, weathers light green-grey to light brown; very fine to fine crystalline with minor amount of terrigenous mud and silt; medium bedded (20 cm); vugs filled with calcite crystals present in most beds; lower contact of unit is sharp.

UNIT 5 Gull River Formation, lower member *1.5m*

Limestone: dark grey, weathers same; microcrystalline, with some fine crystalline beds; medium to thick bedded (20-50 cm); lower contact of unit is sharp.

UNIT 4 Gull River Formation, lower member *2.0m*

Dolostone: light grey-green, weathers buff to light brown; very fine to fine crystalline; medium to thick bedded (20-60 cm) with thin shale partings present between some beds; vugs filled with calcite crystals common in some beds; lower contact of unit is sharp.

UNIT 3 Gull River Formation, lower member *2.1m*

Limestone: dark grey, weathers same with blue-grey tinge; microcrystalline to very fine crystalline; medium bedded (20-30 cm) with thin shale partings between some beds; lower contact of unit is sharp.

UNIT 2 Gull River Formation, lower member *0.5m*

Dolostone: medium grey, weathers grey-green; very fine crystalline with minor amounts of terrigenous mud and silt; thin to medium bedded (5-15 cm); lower contact of unit is sharp.

UNIT 1 Gull River Formation, lower member *0.9m*

Limestone: dark grey, weathers same with blue-grey tinge; fine crystalline; medium bedded (20-30 cm).

Total thickness *36.2m*

QUARRY OPERATION

The surface elevation of bedrock rises progressively to the west. Three lifts have been excavated to date at heights of 7.6 m to 15.2 m, 10.7 m to 15.2 m, and 10.7 m to 15.2 m. The third (lower) lift is normally operated during the dry summer months, but was flooded throughout 1986.

A drill pattern of 3 m x 3 m is used with 7.6 cm diameter holes. Holes are loaded with Powerfrac and AN/FO which is initiated with electric delay caps.

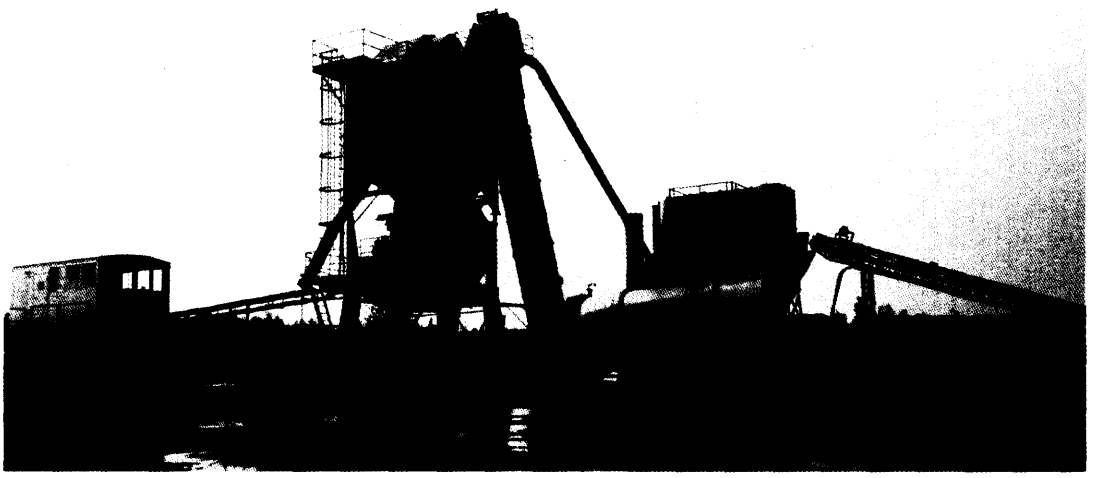
A Cat 988B loader (7 yd.) is used to load three 35-ton Terex trucks. A fourth truck (Wabco) is added for long haulage distances of 600 m to 900 m to keep pace with the crushing capacities.

PROCESSING

The process flow sheet is shown on Figure CP-15-3. A 30 in. x 42 in. Lipman (Grizzly King) jaw crusher feeds a 40 in. x 72 in. scalping screen producing 2 in. crusher

Photo CP-15-1.
VIEW OF MOODIE DRIVE (FALLOWFIELD) QUARRY (LOOKING WEST).

Photo CP-15-2.
NEW 12,000 LB. ASPHALT BATCH PLANT AT THE MOODIE DRIVE (FALLOWFIELD) QUARRY (LOOKING NORTHWEST).



run (stockpile) and −12 in. + 2 in. oversize that passes to a 36 in. x 45 in. Cedarapids double impeller crusher. Stone leaving the secondary crusher is conveyed to two Cedarapids 4 ft. x 14 ft. triple–deck screens (two decks are used), providing −6 in. +2 in. material to a Symons 4 1/4 ft. standard cone crusher, −2 in. + 1 1/4 in. material to a Symons 4 1/4 ft. short head crusher and a −1 1/4 in. fines product to a second pair of Cedarapids 4 ft. x 14 ft. triple–deck screens. Stone leaving the two Symons crushers is sent back in closed circuit to the first pair of 4 ft. x 14 ft. screens. The second set of Cedarapids 4 ft. x 14 ft. screens produce screenings, HL4 and 3/4 in. clear to three 50–ton bins, and a −1 1/4 in. + 7/8 in. oversize to a Hazemag APS–1013K hammer mill. Stone leaving the hammer mill passes over a 5 ft. x 16 ft. Cedarapids triple–deck screen, producing 3/4 in. clear (bedding stone), HL4 and screenings.

Adjustments to the screen processes, and blending of sizes, allow the production of a wide variety of grades of stone.

PRODUCTS

Armour Stone
Riprap
Gabion Stone
Blasted Rock
6 in. Crusher Run
4 in. Crusher Run
2 in. Crusher Run
Granular "A"
2 in. Clear
1 in. Clear
3/4 in. Clear
5/8 in. Clear

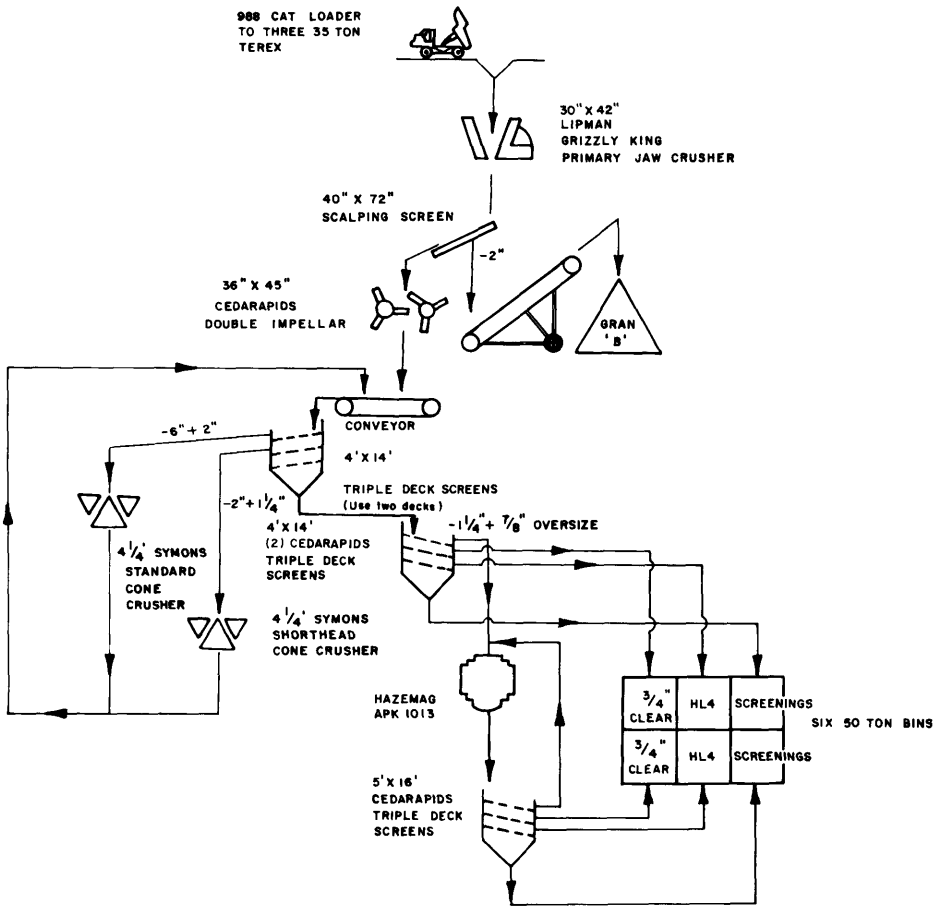


Figure CP-15-3. PROCESS FLOW SHEET FOR MOODIE DRIVE (FALLOWFIELD) QUARRY.

3/4 in. Concrete Stone
5/8 in. Concrete Stone
3/8 in. chips/concrete stone
5/16 in. chips/concrete stone
1/4 in. chips
HL4/5 Stone
HL6/8 Stone
Screenings
HL1 Mix
HL2 Mix
HL3 Mix
HL4 Mix
HL5 Mix
HL6 Mix
HL3 Fine Mix
HL8 Mix
Open Friction Course Stone
Dense Friction Course Stone
Rubber Granule
Rubber Latex
HL3 Modified Mix
HL4/5 Modified Mix
HL6/8 Modified Mix
Cold Patch
Driveway Mix

REFERENCES

Hewitt, 1964a, p.38
Hewitt and Vos, 1972, p.30–31
Adams, 1982
Williams, in prep., Appendix 1 – Section LQ OT–3

MAPS

Williams, Rae and Wolf 1984, OGS Map P.2716

CP–16 WARREN PAVING & MATERIALS GROUP LTD. — HOULAHAN (FALLOWFIELD) QUARRY

LOCATION AND OWNERSHIP

This large quarry, located 2.5 km east of Fallowfield in Lot 21, Concession 4, City of Nepean, Regional Municipality of Ottawa–Carleton (Figure CP–16–1), is operated

on a demand basis by Dibblee Construction Company Limited, a subsidiary of Warren Paving & Materials Group Ltd.. The quarry licence covers an area of 26.3 ha. After about four years of inactivity, the quarry was projected to reopen in early 1987 with portable equipment.

GEOLOGY

This quarry exposes at least 18.7 m of the lower and upper members of the Gull River Formation, and part of the lower member, Bobcaygeon Formation in two lifts. The lower lift is partially filled with water so that the total quarry depth is not known and the detailed description (below) begins at the 1986 water level. The interbedded dolostones and limestones of the lower member, Gull River Formation are overlain by the thin-bedded, shaly limestone of the upper member. The quarry is capped by the thick-bedded, microcrystalline limestones of the lower member, Bobcaygeon Formation. Recent excavation of the northeast corner has revealed a zone of spectacular folding. Glacial overburden around the quarry is 1 to 2 m thick.

Geological Section

Thickness

UNIT 7 Bobcaygeon Formation, lower member *1.5m*

Limestone: medium to dark grey-brown, weathers brown to grey-brown with blue-grey tinge; microcrystalline to fine crystalline; generally a single bed which weathers out into 25-50 cm thick partings; lower contact of unit sharp and slightly irregular.

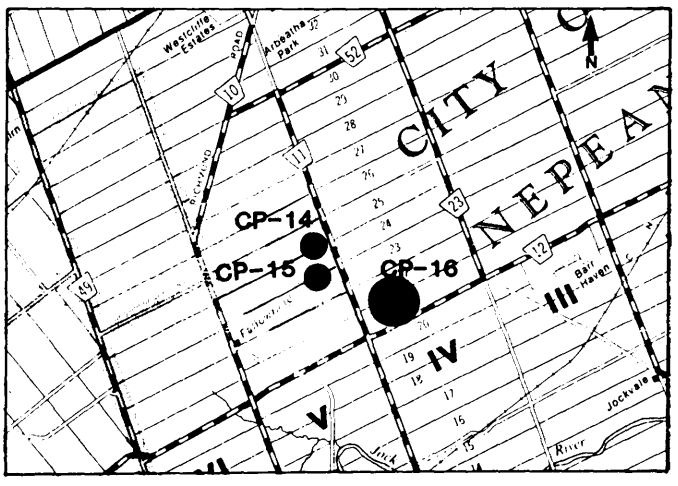


Figure CP-16-1. LOCATION MAP FOR HOULAHAN (FALLOWFIELD) QUARRY.

UNIT 6 Gull River Formation, upper member *7.1m*

Limestone with shale partings: dark grey, weathers light blue-grey to dark grey, with a white bed between 4.8-5.1 m above base of unit; microcrystalline to fine crystalline; thin to medium bedded (5-15 cm) with rare thicker beds, bedding contacts sharp with shale partings up to 1 cm thick common between beds; small patches of calcite crystals, "birdseye" texture, common in some beds; intraclasts of light grey, microcrystalline limestone common in some fine-crystalline beds; moderately fossiliferous, with brachiopods and the colonial coral *Tetradium* most common; lower contact of unit sharp and planar.

UNIT 5 Gull River Formation, lower member *0.6m*

Dolostone: medium grey, weathers buff; fine crystalline; thin to medium bedded (5-20 cm), with sharp and planar contacts; lower contact of unit sharp and planar.

UNIT 4 Gull River Formation, lower member *5.3m*

Limestone: dark grey, weathers blue-grey; microcrystalline to very fine crystalline; medium to thick bedded (10-50 cm), with thin shale partings present between some beds; lower contact of unit sharp and planar.

UNIT 3 Gull River Formation, lower member *0.6m*

Limestone: dark grey, weathers medium grey; oolitic with numerous microcrystalline limestone intraclasts in a very fine-crystalline matrix; medium bedded (20-30 cm), with thin, shale partings present between some beds; lower contact of unit sharp and irregular; top of lower lift at top of unit.

UNIT 2 Gull River Formation, upper member *1.1m*

Dolostone: grey-green, weathers grey-brown to reddish brown; very fine to fine crystalline, with significant amounts of very fine- grained quartz sand and silt; thin to medium bedded (5-15 cm), with shale partings common between beds; some intervals slightly calcitic; scattered intraclasts of light brown, silty dolostone in some intervals; lower contact of unit sharp and planar.

UNIT 1 Gull River Formation, lower member *2.5m*

Limestone: dark grey, weathers blue-grey; microcrystalline to very fine crystalline; medium to thick bedded (10-50 cm), with thin, dark grey shale partings common; scattered intraclasts of light grey, microcrystalline limestone in some intervals; moderately fossiliferous, with brachiopods most abundant; (lower contact of unit is at water level).

Total thickness *18.7m*

REFERENCES

Hewitt, 1964a, p.39
Williams and Telford, 1986, p.14-16
Williams, in prep., Appendix 1 - Section LQ OT-5.

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP-17 UNITED AGGREGATES LTD. — SOUTH GLOUCESTER QUARRY

LOCATION AND OWNERSHIP

This large quarry, located 3 km north of the hamlet of South Gloucester, in Lots 23-25, Concession 5, City of Gloucester, Regional Municipality of Ottawa-Carleton

(Figure CP–17–1), is operated by Armbro Aggregates, a division of United Aggregates Limited since 1984. The quarry is licensed for 122.21 ha, and the excavated area of the quarry is approximately 37 ha.

GEOLOGY

The 27.3 m deep quarry exposes strata of the March and Oxford Formations (Figure CP–17–2). Interbedded sandstones, sandy dolostones, and dolostones of the March Formation occur in the lower 15 m at the eastern end of the quarry. Dolostones of the overlying Oxford Formation occur at the top of the quarry; at the eastern end a total of 12 m is exposed. As the strata have a shallow westerly dip an additional 6 m of section is present at the western end of the quarry. The following description is of a section located at the eastern end of the quarry. Glacial overburden around the quarry varies from 1 to 3 m in thickness.

Geological Section

Thickness

UNIT 11 Oxford Formation — *12.1m*

Dolostone: grey-brown, weathers grey-brown to buff; fine to medium crystalline; medium to thick (10–50 cm) bedded, with thin, grey-brown shale partings present between a few beds; some intervals slightly calcitic; calcite-filled vugs common in some beds, scattered throughout most beds; lower contact of unit sharp and slightly irregular.

UNIT 10 March Formation — *0.4m*

Sandy dolostone: grey-brown, weathers medium grey; fine-crystalline dolostone with medium- to coarse-grained quartz sand; slightly calcitic; single bed; calcite-filled vugs common; lower contact of unit sharp and planar.

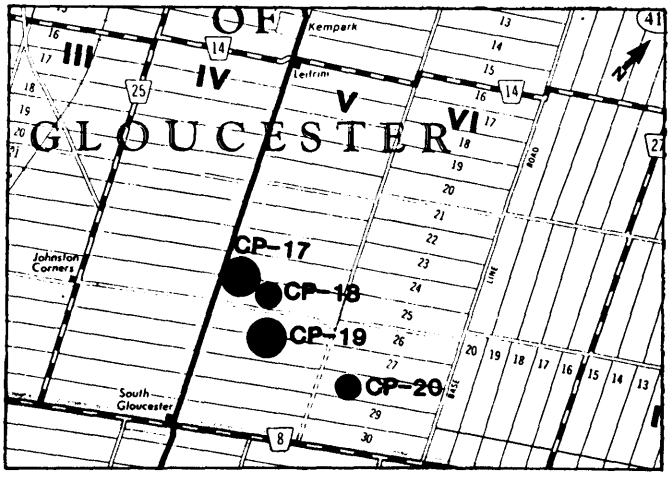


Figure CP-17-1. LOCATION MAP FOR SOUTH GLOUCESTER QUARRY.

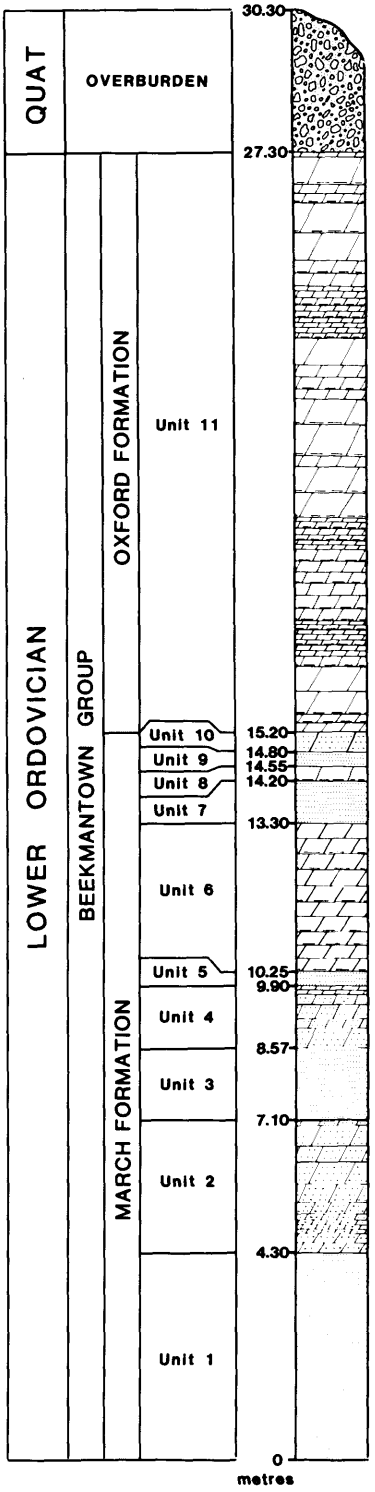


Figure CP-17-2. STRATIGRAPHIC COLUMN FOR SOUTH GLOUCESTER QUARRY.

UNIT 9 March Formation *0.3m*

Sandstone: white to light grey, weathers same; fine to medium grained with a calcitic cement; single bed; lower contact of unit sharp and planar.

UNIT 8 March Formation *0.3m*

Dolostone: grey-brown, weathers grey-green to buff; fine to medium crystalline; slightly calcitic; single bed with shale partings at top and bottom; calcite-filled vugs present; lower contact of unit sharp.

UNIT 7 March Formation *0.9m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained, with slightly calcitic cement; single bed; lower contact of unit sharp and slightly irregular.

UNIT 6 March Formation *3.1m*

Dolostone: grey-brown, weathers grey-green to buff; fine to medium crystalline; slightly calcitic in some intervals; medium (10-30 cm) bedded, with thin, dark grey shale partings present between some beds; calcite-filled vugs scattered throughout most beds; lower contact of unit sharp and planar.

UNIT 5 March Formation *0.3m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained, with slightly calcitic cement; single bed; lower contact of unit sharp and slightly irregular.

UNIT 4 March Formation *1.3m*

Sandy dolostone: light grey to grey-brown, weathers medium grey to grey-green; very fine- to fine-crystalline dolostone with medium- to coarse-grained quartz sand; medium bedded; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 3 March Formation *1.5m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained, with a dolomitic and quartz cement; thin to medium bedded; lower contact of unit sharp and planar.

UNIT 2 March Formation *2.8m*

Sandy dolostone: grey-brown, weathers medium grey; fine crystalline with medium to coarse-grained quartz sand; medium to thick (10-50 cm) bedded; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 1 March Formation *4.3m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained; thin to massive bedded, with thin calcareous shale partings between some beds; small-scale crossbeds present in most beds.

Total thickness *27.3m*

QUARRY OPERATIONS

The quarry is worked on three lifts of 12 m, 8 m and 7 m. A drill pattern of 2.74 m x 2.74 m with 10.2 cm diameter blast holes is used on the top and middle lifts. The bottom lift is a very hard dolomitic sandstone and requires a drilling pattern of 2.43 m x 2.43 m with 10.2 cm blast holes to achieve good blast fragmentation. The bottom lift was opened in 1981 and is excavated solely to produce HL3 modified stone, a top quality skid-resistant aggregate used for asphalt surfaces on high traffic volume highways. The South Gloucester Quarry is one of a limited number of quarries currently producing HL3 modified. A Cat 988B loader is used to load Cat 769B 35-ton haulage trucks. Two trucks are used for haulage from the top and middle lifts, averaging a distance of about 330 m and a third truck is required for haulage from the bottom lift, a distance of approximately 500 m to the crusher.

PROCESSING

The blasted stone is crushed by a 42 in. x 48 in. Pioneer jaw crusher, feeding a Simplicity screen. Oversize from the screen (+4 in.) is re-crushed by a Symons 5 1/2 ft. cone and undersize is stockpiled in a -4 in. surge pile. The re-crushed material from the Symons cone is added to the surge pile. Stone recovered from the surge pile is re-crushed by two Symons 5 1/2 ft. cones, feeding three 8 ft. x 20 ft. Tyler triple-deck screens. The South Gloucester Quarry supplies concrete stone for local ready-mix plants, asphalt stone and 1 in. weeping bed stone.

PRODUCTS

Granulars
1 in. Clear (weeping bed stone)
3/4 in. Clear
3/4 in. Concrete Stone
HL3 modified
HL3

REFERENCES

Hewitt, 1960, p.24
Hewitt, 1964a, p.26

Photo CP-17-1. WEST QUARRY FACE AT THE SOUTH GLOUCESTER QUARRY.

Hewitt and Vos, 1972, p.7
Rogers, 1980, p.40–44
Williams and Telford, 1986, p.16
Williams, in prep., Appendix 1 – Section LQ OT–7

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP–18 WARREN PAVING & MATERIALS GROUP LTD. — BOYCE (SOUTH GLOUCESTER) QUARRY

LOCATION AND OWNERSHIP

The Boyce Quarry is located in the south half of Lot 25, Concession 5, City of Gloucester, Regional Municipality of Ottawa–Carleton (Figure CP–18–1), immediately southeast of the South Gloucester Quarry (CP–17). The quarry produces aggregates solely for company use in construction projects. The Boyce Quarry was opened in 1964 by Dibblee Construction Company, now part of Warren Paving & Materials Group Ltd. The quarry licence covers an area of 50.58 ha.

GEOLOGY

The 15.2 m deep quarry exposes sandstones, sandy dolostones, and dolostones of the March Formation, which are overlain by the dolostones of the Oxford Formation. The section exposed is similar to that in the adjacent quarry of United Aggregates (CP–17). Glacial overburden around the quarry is 1 to 3 m thick.

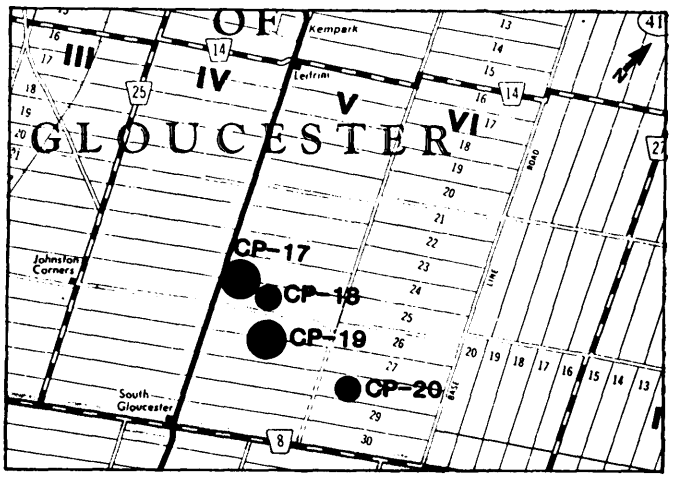


Figure CP-18-1. LOCATION MAP FOR BOYCE (SOUTH GLOUCESTER) QUARRY.

Geological Section

	Thickness
UNIT 11 Oxford Formation	*1.1m*

Dolostone: medium grey, weathers buff; fine crystalline; thin bedded; lower contact of unit sharp and planar.

UNIT 10 Oxford Formation	*0.8m*

Dolostone: light grey, weathers same; fine crystalline; thin bedded; intraclasts of grey-brown silty dolostone in some beds; lower contact of unit sharp and planar.

UNIT 9 Oxford Formation	*0.4m*

Dolostone: medium grey, weathers same, fine crystalline; single bed; lower contact of unit sharp and planar.

UNIT 8 Oxford Formation	*0.6m*

Dolostone: light grey, weathers same; very fine crystalline; thin to medium bedded, with thin shale partings; lower contact of unit sharp and planar.

UNIT 7 Oxford Formation	*1.7m*

Dolostone: medium grey, weathers light to medium grey; fine crystalline; medium bedded; calcite-filled vugs present in some beds; lower contact of unit sharp and planar.

UNIT 6 Oxford Formation	*3.0m*

Dolostone: light to medium grey, weathers medium grey; fine crystalline; thin bedded with thin shale partings between some beds; calcite-filled vugs present in some beds; lower contact of unit sharp and slightly irregular.

UNIT 5 March Formation	*0.4m*

Sandy dolostone: grey-brown, weathers medium grey; fine crystalline with medium- to coarse-grained quartz sand, slightly calcitic in places; single bed; calcite-filled vugs present; lower contact of unit sharp and planar.

UNIT 4 March Formation	*0.3m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained; single bed, with small-scale crossbeds; lower contact of unit sharp and slightly irregular.

UNIT 3 March Formation	*0.3m*

Dolostone: grey-brown, weathers buff to grey-green; fine to medium crystalline; single bed, with shale partings at base and top of bed; calcite-filled vugs present; lower contact of unit sharp and planar.

UNIT 2 March Formation	*0.9m*

Sandstone: white to light grey, weathers white to reddish brown, fine to medium grained; medium bedded, with small-scale crossbeds; lower contact of unit sharp and irregular.

UNIT 1 March Formation	*5.7m*

Dolostone: grey-brown, weathers buff to grey-green; fine to medium crystalline, with thin intervals containing medium- to coarse-grained quartz sand; medium bedded, with thin, dark grey shale partings between some beds; calcite-filled vugs common in some beds.

Total thickness	*15.2m*

QUARRY OPERATION

The property has an excavated area of about 25 ha and is worked on two lifts of 7.6 m. A third lift consisting of hard dolomitic sandstone is available to produce HL3 modified if desired.

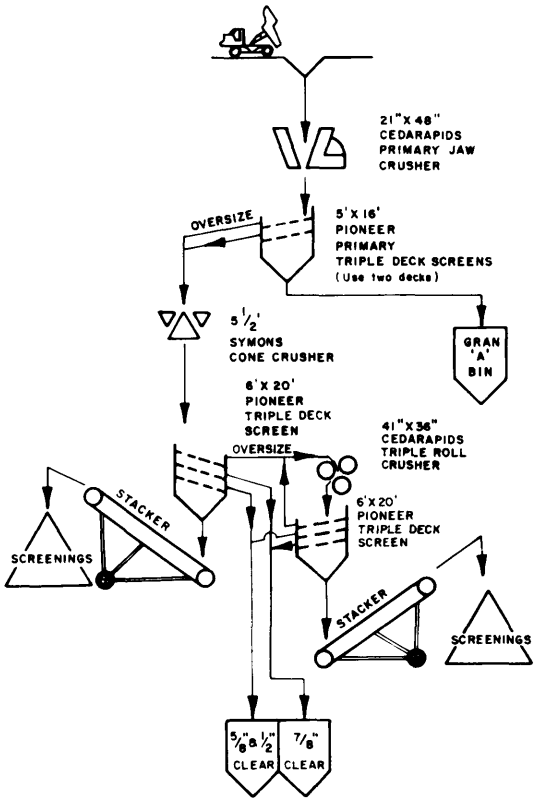


Figure CP-18-2. PROCESS FLOW SHEET FOR BOYCE (SOUTH GLOUCESTER) QUARRY.

All drilling and blasting is subcontracted; a 2.1 m x 2.1 m drill pattern and 7.6 cm diameter holes are used. Holes are often wet, and stick powder (Powerfrac 75% and Cilgel 70%) is used at the toe of the hole. AN/FO is used in blast holes above the water level. Holes are delayed from 0 to 18 milliseconds with electric caps, and blasts are monitored for vibration.

PROCESSING

The process flow sheet is shown on Figure CP-18-2. Blasted stone is hauled by two Cat 988B and one Yale 7500 (7.25 yd.) loaders to the primary crusher, a Cedarapids 21 in. x 48 in. jaw feeding a Pioneer 5 ft. x 16 ft. triple-deck screen (only two decks are used). The screen produces -7/8 in. Granular "A" that is sent to a storage bin and +7/8 in. oversize that is fed to a Symons 5.5 ft. cone crusher. After this secondary crushing, the stone is sent to a Pioneer 6 ft. x 20 ft. triple-deck screen which produces 7/8 in. clear, 5/8 in. and 1/2 in. clear to bin storage, screenings to a stockpile and oversize to a Cedarapids 41 in. x 36 in. triple roll crusher. Stone leaving the roll crusher feeds a second Pioneer 6 ft. x 20 ft. triple-deck screen which produces 7/8 in. clear, 5/8 in. and 1/2 in. clear, crusher run for bin storage and dust/screenings which are stockpiled.

The crushed stone products are hauled by four 18-ton Hustler trucks to the on-site asphalt plant.

PRODUCTS

Granular "A" and "B"
HL8 (7/8 in. Clear)
HL4 (5/8 in. Clear)
HL3 (1/2 in. Clear)
Dust

REFERENCES

Hewitt, 1964a, p.27
Hewitt and Vos, 1972, p.10-11
Rogers, 1980, p.45-48
Williams, in prep., Appendix 1 - Section LQ OT-8

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP-19 BEAVER ASPHALT PAVING CO. LTD. — OTTAWA (SOUTH GLOUCESTER) QUARRY

LOCATION AND OWNERSHIP

The Beaver Asphalt Quarry operation is located approximately 9 km southeast of Ottawa and consists of three properties in the City of Gloucester, Regional Municipality of Ottawa-Carleton (Figure CP-19-1).

The properties are:

(1) The Grant Quarry (formerly operated by Bertrand & Freres Construction), north half of Lot 28, Concession 5, licensed for 35.49 ha.

(2) The Miller Quarry (owned by Michael Miller and Sons), operated by Beaver Asphalt, south half of Lot 27, Concession 5, licensed for 24.28 ha.

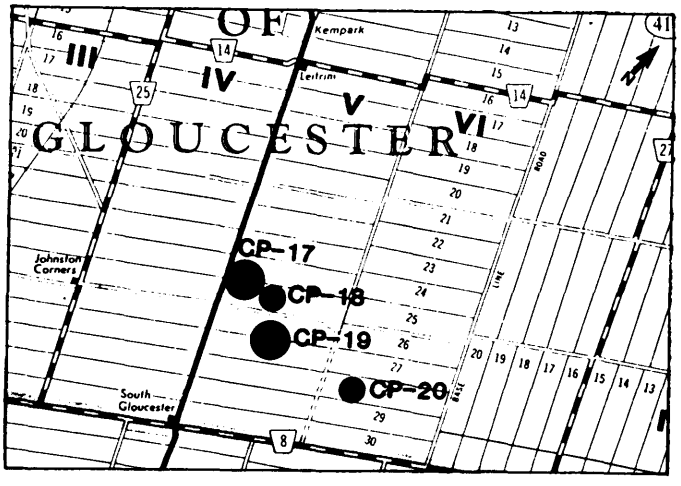


Figure CP-19-1. LOCATION MAP FOR OTTAWA (SOUTH GLOUCESTER) QUARRY.

(3) Beaver property, parts of Lot 26 and 27, Concession 5, licensed for 6.07 ha.

The Grant and Miller Quarries are now worked as a single operation and known as the Ottawa Quarry. The third property has not yet been opened for extraction.

Beaver Asphalt Paving Company Ltd. was founded in 1954 and operates mainly in eastern Ontario from headquarters in Ottawa.

GEOLOGY

The 13.5 m deep quarry exposes fine-crystalline, thin- to medium-bedded dolostones of the Oxford Formation. Calcite-filled vugs are common in many of the beds. Glacial overburden around the quarry varies from 1 to 3 m in thickness.

Geological Section

		Thickness
UNIT 7	*Oxford Formation*	*1.5m*

Dolostone: light grey, weathers buff; very fine crystalline; thin to medium bedded, with thin, dark grey shale partings common; lower contact of unit sharp and planar.

UNIT 6	*Oxford Formation*	*0.9m*

Dolostone: light grey, weathers light grey-green; very fine crystalline; thin bedded; lower contact of unit sharp and planar.

UNIT 5	*Oxford Formation*	*1.1m*

Dolostone: medium grey, weathers medium to dark grey; fine crystalline; medium bedded, with thin, dark grey shale partings; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 4	*Oxford Formation*	*0.9m*

Dolostone: light grey, weathers same; fine crystalline; thin bedded; calcite-filled vugs common; lower contact of unit sharp and planar.

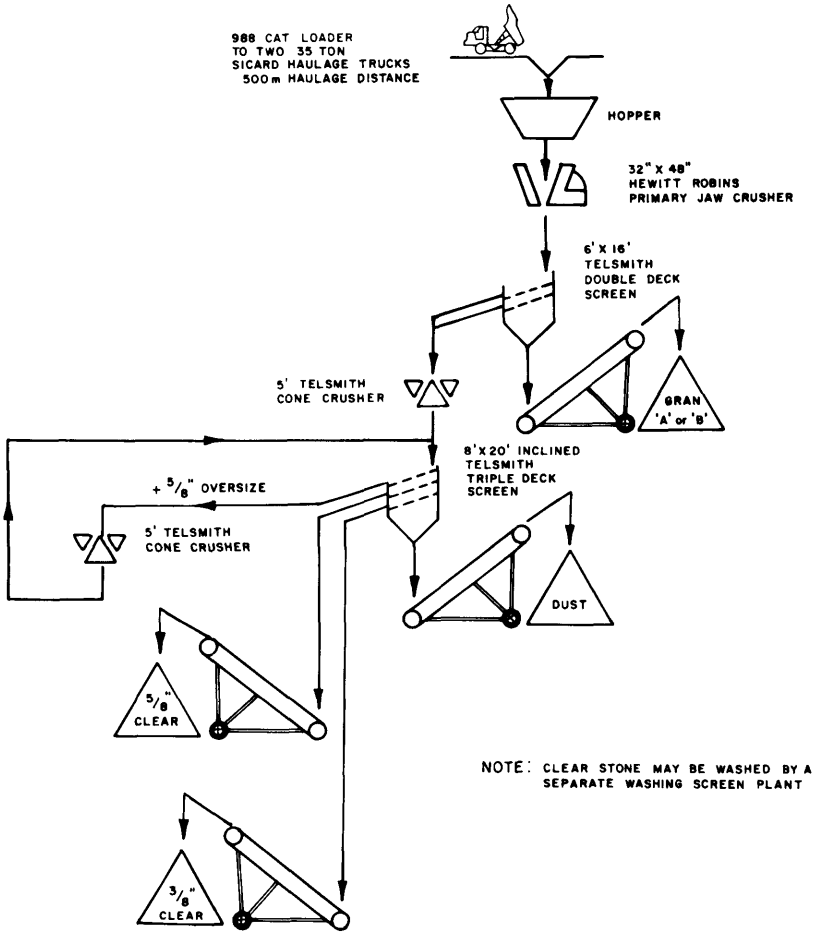


Figure CP-19-2. PROCESS FLOW SHEET FOR OTTAWA (SOUTH GLOUCESTER) QUARRY.

UNIT 3 Oxford Formation *1.4m*

Dolostone: dark grey, weathers dark grey to dark brown; fine crystalline, medium bedded; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 2 Oxford Formation *0.8m*

Dolostone: light grey, weathers medium grey; fine crystalline; medium bedded, with thin, dark grey shale partings between some beds, other contacts stylolitic; calcite-filled vugs common; lower contact of unit sharp and planar; top of lower lift at top of unit.

UNIT 1 Oxford Formation *6.9m*

Dolostone: medium grey, weathers dark grey; fine crystalline; medium to thick bedded, with thin shale partings rare between some beds; calcite-filled vugs common in most beds.

Total thickness *13.5m*

QUARRY OPERATION

Approximately 80% of the crushed aggregate produced at the Beaver Asphalt Quarry is consumed in company-related construction projects, the balance going to retail sales.

Drilling and blasting is subcontracted and a 2.4 m x 2.7 m drill pattern is used with 7.6 cm diameter holes. The quarry is excavated on a single lift of about 13.5 m, originally two lifts of 4.6 m and 6.1 m in the old Miller Quarry. A Cat 988 loader is used in the quarry to load two 35-ton Sicard trucks that haul approximately 450 m to the primary feed hopper.

PROCESSING

The flow chart for the processing plant is shown on Figure CP-19-2. The blasted stone is fed to a 32 in. x 48 in. Hewitt-Robins jaw crusher and then to a double-deck 6 ft. x 16 ft. Telsmith screen that produces Granular "A" or "B", and an oversize that is sent to a 5 ft. Telsmith cone crusher. After secondary crushing, the stone is fed to an 8 ft. x 20 ft. triple-deck Telsmith screen that produces dust, 3/8 in. and 5/8 in. chips, and a +5/8 in. oversize that is sent for tertiary crushing by a second 5 ft. Telsmith cone crusher. A separate washing screen is available to make washed aggregate products used for precast concrete.

PRODUCTS

Beaver Asphalt Paving Co. Ltd. produces a variety of products at this quarry including, but not restricted to, the following:

Granular "A" and "B"
5/8 in. Clear
3/8 in. Clear
Variety of Asphalt Mixes
Dust

REFERENCES

Hewitt and Vos, 1972, p.8-9
Rogers, 1980, p. 51-52
Williams, in prep., Appendix 1 - Section LQ OT-9

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

Photo CP-19-1.
HEWITT-ROBINS PRIMARY JAW CRUSHER AT THE OTTAWA (SOUTH GLOUCESTER) QUARRY.

CP-20 PERMANENT CONCRETE — HAWTHORNE ROAD QUARRY

LOCATION AND OWNERSHIP

The Hawthorne Road Quarry is located approximately 9 km south of Ottawa in Lot 28, Concession 6, City of Gloucester, Regional Municipality of Ottawa–Carleton (Figure CP-20-1). The quarry is owned by John Leonard and was opened in 1977 by G. W. Drummond Ltd. The quarry is currently licensed to Permanent Concrete, a division of Lafarge Canada Inc. The quarry licence covers an area of 40.46 ha.

GEOLOGY

The 11.9 m deep quarry exposes sandstones, sandy dolostones and dolostones of the March Formation, which in turn are overlain by dolostones of the Oxford Formation. The quarry, which has been excavated into the hillside, has two lifts. Glacial overburden around the quarry is up to 2 m thick.

Geological Section

		Thickness
UNIT 6	*Oxford Formation*	*5.1m*

Dolostone: light to medium grey, weathers buff to dark grey; fine crystalline; medium bedded, with some thin, dark grey shale partings present between some beds; calcite-filled vugs occur in most beds; lower contact of unit sharp and planar.

UNIT 5	*March Formation*	*0.4m*

Sandy dolostone: grey-brown, weathers medium grey; fine crystalline with medium- to coarse-grained quartz sand; slightly calcitic; single bed; calcite-filled vugs present; lower contact of unit sharp and planar.

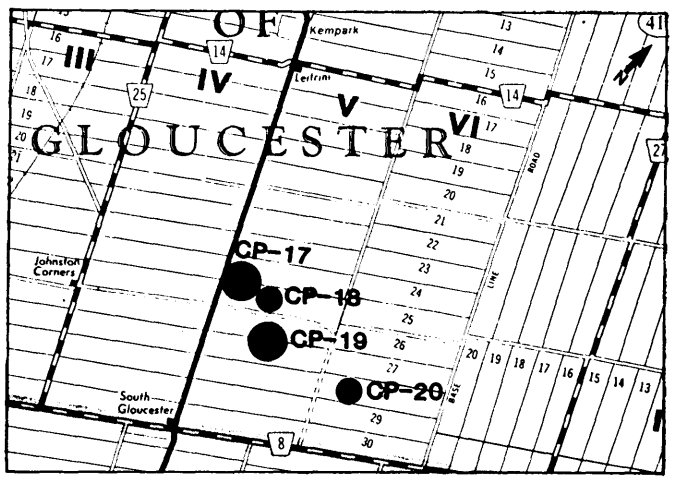


Figure CP-20-1. LOCATION MAP FOR HAWTHORNE ROAD QUARRY.

UNIT 4	*March Formation*	*0.3m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained in a dolomitic cement; single bed; lower contact of unit sharp and planar.

UNIT 3	*March Formation*	*0.3m*

Dolostone: grey-brown, weathers grey-green to buff; fine to medium crystalline; single bed; calcite-filled vugs common; lower contact of unit sharp and planar.

UNIT 2	*March Formation*	*0.3m*

Sandstone: white to light grey, weathers white to reddish brown; fine to medium grained; single bed, small-scale crossbeds common; lower contact of unit sharp and slightly irregular.

UNIT 1	*March Formation*	*5.5m*

Interbedded sandstone, sandy dolostone, and dolostone: grey-brown, some of sandstone is white, weathers same; fine- to medium-crystalline dolostone, with some beds containing medium- to coarse-grained quartz sand, interbedded with fine- to medium-grained sandstone: medium (10-20 cm) bedded, with sharp and planar contacts; calcite-filled vugs in some sandy dolostone and dolostone beds.

Total thickness	*11.9m*

QUARRY OPERATION

The quarry has two lifts of about 6.1 m, the lower of which is presently being worked, and covers an area of about 10 ha. All drilling and blasting is contracted and a drill pattern of 2.1 m x 2.4 m with 7.6 cm diameter holes is used.

PROCESSING

The flow sheet for the processing plant is shown on Figure CP-20-2. Stone is fed to the primary crusher, a portable 30 in. x 42 in. Hewitt-Robins jaw stationed in the quarry floor, by two Cat 988 loaders. The crusher has a capacity of 325 tonnes per hour and feeds two surge bins that lead to a Hewitt-Robins 5 ft. x 18 ft. triple-deck screen (two decks are used), or a 5 ft. x 14 ft. Cedarapids double-deck screen. The two screens produce -7/8 in. crusher run (Granular "A") to stockpile and +7/8 in. oversize that is fed to one of two Symons Standard 4 1/4 ft. cone crushers and returned to the surge bins. If required, the Granular "A" is fed to a Suntract 5 ft. x 14 ft. portable screening plant for separation into 3/4 in. clear, 3/8 in. clear, and dust.

Finished products are loaded into trucks by Cat 950 (3 yd.) and Komatsu (5.2 yd.) loaders and are used for both internal construction projects and commercial sales.

PRODUCTS

2 in. Granular "B"
7/8 in. Granular "A"
3/4 in. Clear
3/8 in. Clear
Dust

Photo CP-20-1.
CAT 988 FEEDING 30 IN. X 42 IN. HEWITT-ROBINS PRIMARY JAW CRUSHER AT THE HAWTHORNE ROAD QUARRY.

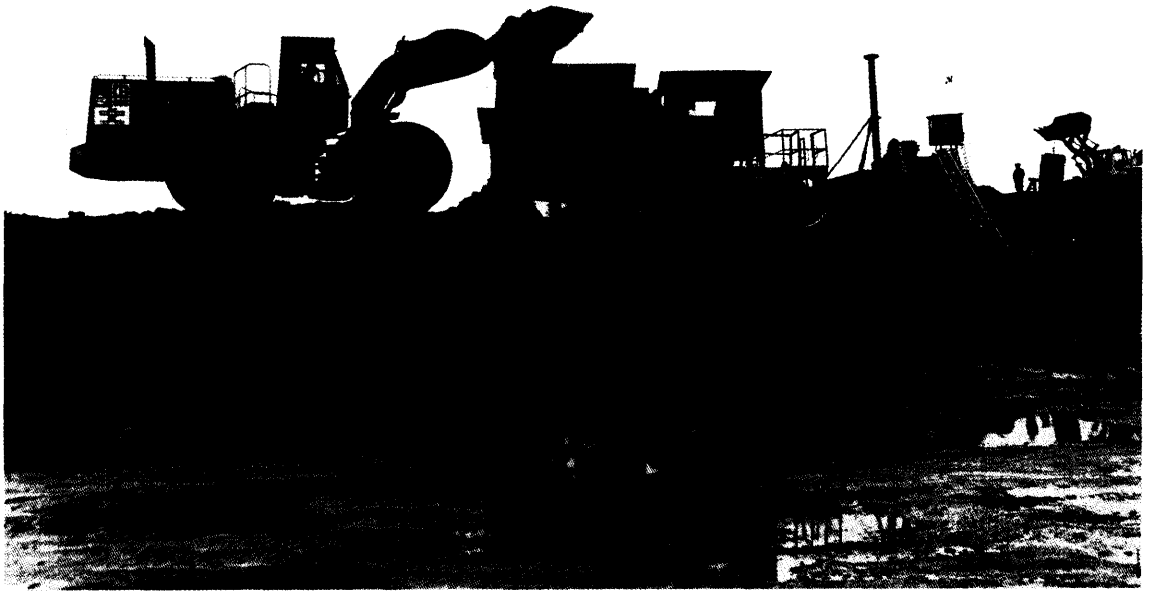
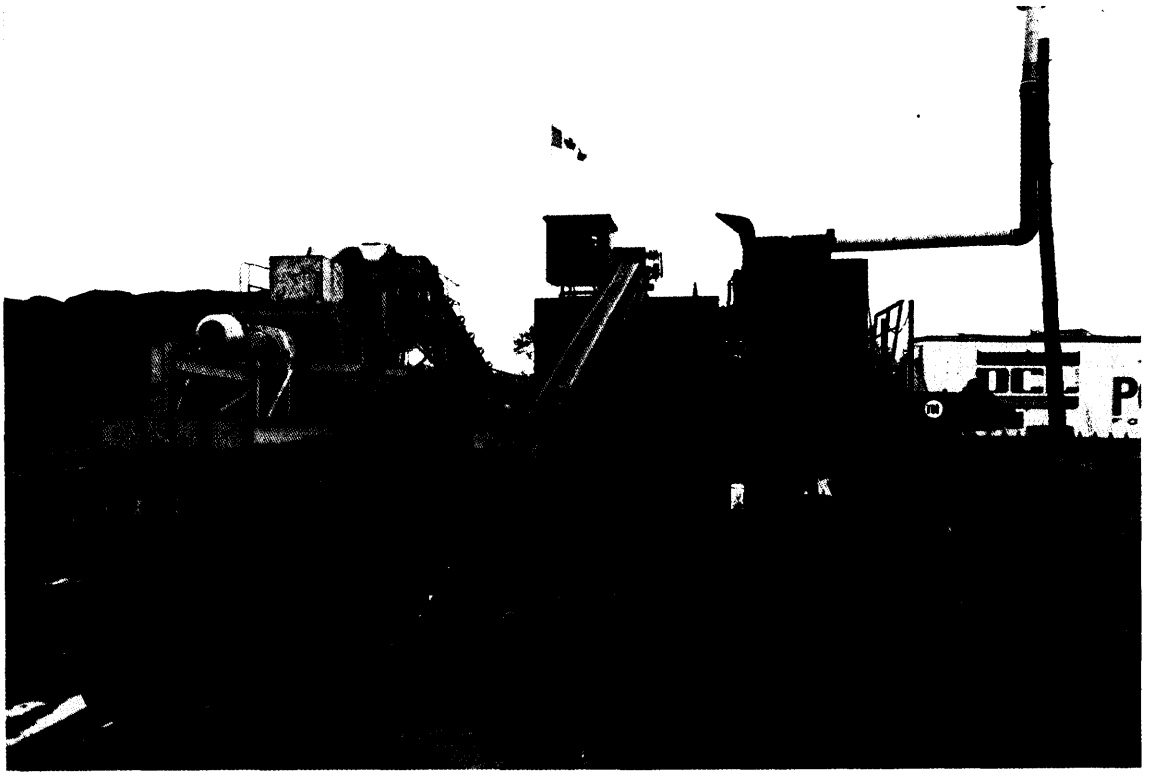


Photo CP-20-2.
TWO SYMONS STANDARD 4 1/4 FT. CONE CRUSHERS IN PARALLEL CIRCUIT. CRUSHED STONE IS CONVEYED TO SURGE BIN; HAWTHORNE ROAD QUARRY.



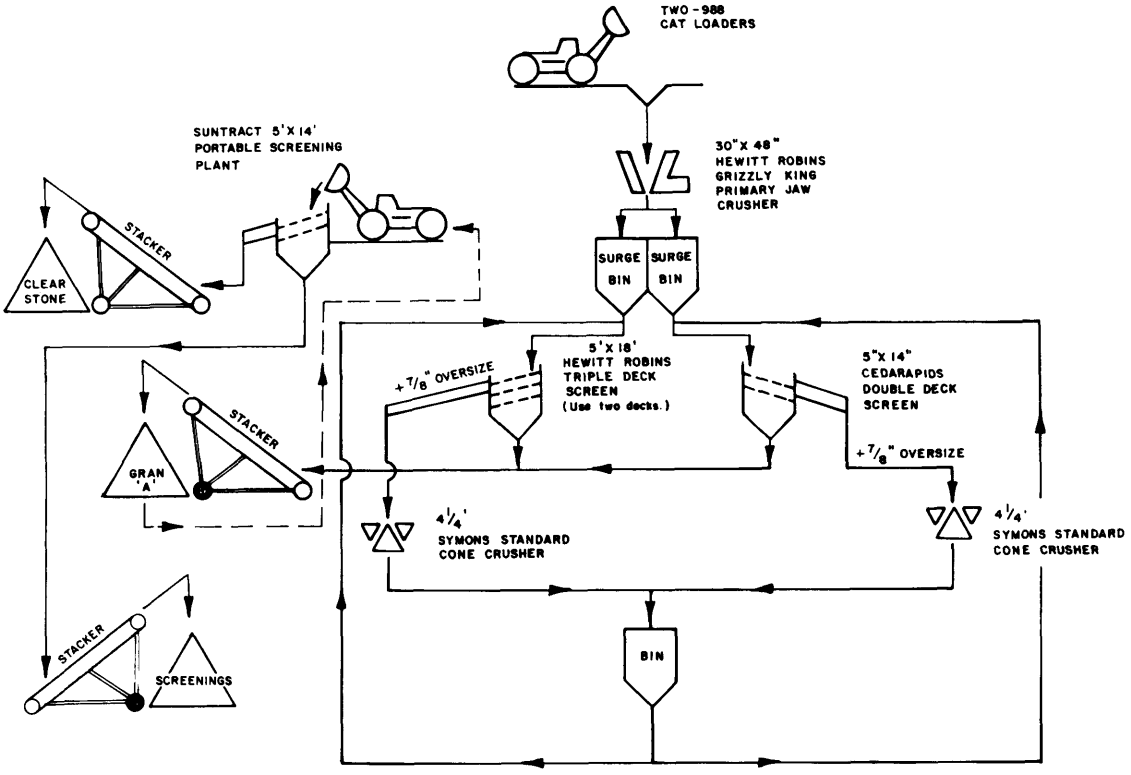


Figure CP-20-2. PROCESS FLOW SHEET FOR HAWTHORNE ROAD QUARRY.

REFERENCES

Rogers, 1980, p.49–50
Williams, in prep., Appendix 1 – Section LQ OT–10

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP-21 CORNWALL SAND & GRAVEL COMPANY — GREELY QUARRY

LOCATION AND OWNERSHIP

This recently opened quarry, located 3 km south of Greely, in Lot 14, Concession 6, Osgoode Township, Regional Municipality of Ottawa–Carleton (Figure CP–21–1), is operated by Cornwall Sand & Gravel Company. The licensed property covers 20.24 ha.

GEOLOGY

The 8.0 m deep quarry exposes medium–bedded, fine–crystalline dolostones of the Oxford Formation. Most beds contain at least a few large calcite–filled vugs; however, in some beds the vugs are numerous. Glacial overburden around the quarry is up to 3 m thick in places.

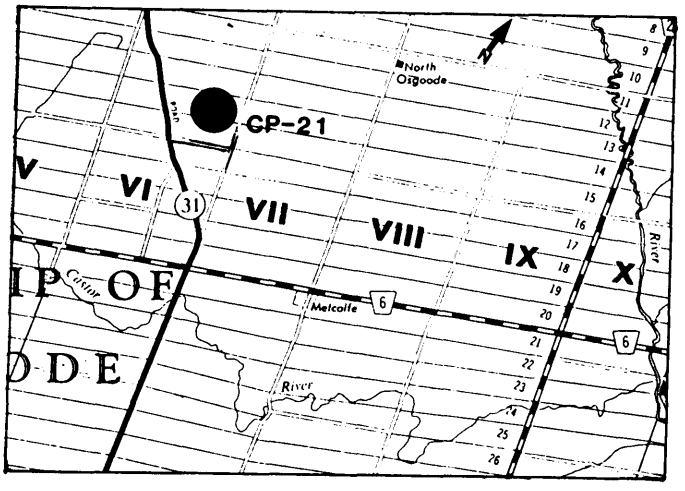


Figure CP-21-1. LOCATION MAP FOR GREELY QUARRY.

Geological Section

	Thickness
UNIT 2 Oxford Formation	*2.2m*
Dolostone: medium grey, weathers dark grey-brown; fine crystalline; medium bedded (20 cm), with sharp, planar contacts; scattered small calcite-filled vugs present; lower contact of unit sharp and planar; this unit occurs as a bench, at the west side of the quarry, set back from the main quarry face.	
UNIT 1 Oxford Formation	*5.8m*
Dolostone: medium grey, weathers grey-brown; fine crystalline; medium (10–15 cm) bedded, with sharp, undulating contacts, some up to 5 cm of relief; scattered large (10 cm diameter) calcite-filled vugs present.	
Total thickness	*8.0m*

QUARRY OPERATION

The quarried stone is processed by a portable crushing system (see Richier Quarry CW-9 in the Cornwall District section).

REFERENCES

None

MAPS

None

CP-22 FRANCON DIVISION OF CANFARGE LTD. — NORTH AND SOUTH (FRANCON) QUARRIES

LOCATION AND OWNERSHIP

Two quarries, North and South, operated on this property, are located in Lots 12, 13 and 14, Concession 2, Gloucester Township, Regional Municipality of Ottawa–Carleton (Figure CP-22-1), just south of Highway 17 between Eastview and Orleans. The North and South Quarries were opened in 1948 by Ottawa Valley Crushed Stone and in 1967 by Francon, respectively. The quarry operations were initially located on the outskirts of Ottawa but over the years have been completely engulfed by city expansion. The operation produces all grades of asphalt, concrete and granular stone. The quarry licence covers an area of 100.73 ha.

GEOLOGY

A 135 m thick stratigraphic succession from the lower member, Gull River Formation to the upper member,

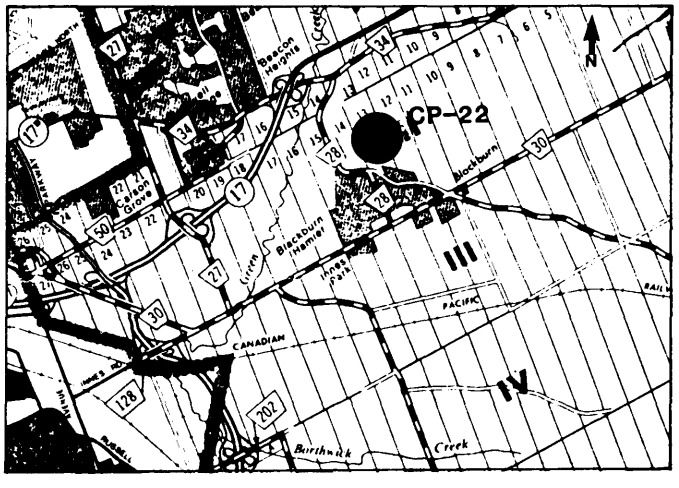


Figure CP-22-1. LOCATION MAP FOR NORTH AND SOUTH (FRANCON) QUARRIES.

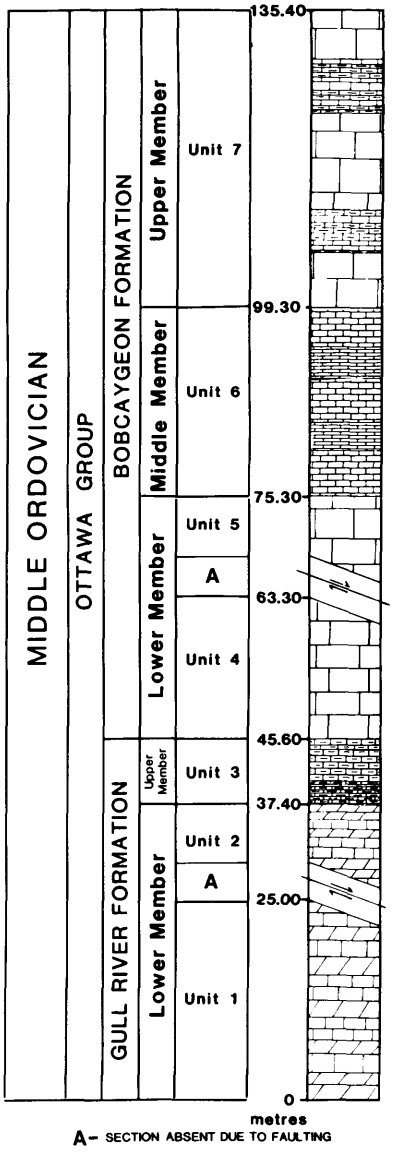


Figure CP-22-2. STRATIGRAPHIC COLUMN FOR NORTH AND SOUTH (FRANCON) QUARRIES.

Bobcaygeon Formation, is exposed in these quarries as a result of several, near-vertical normal faults (Figure CP-22-2, 22-3 and Table CP-22-1). Only two intervals (in the lower member, Gull River Formation and the lower member, Bobcaygeon Formation), have been cut out by the faulting. The stratigraphic succession exposed in these quarries can be correlated with the same interval in the G.S.C. Russell drill hole (Williams, in prep.).

The main fault exposed at this site lies along the southern boundary of Fault Block II (Figure CP-22-3) where the southern block has been downthrown by over 85 m. In the northeast corner of the South Quarry this fault is characterized by a 6 m wide breccia zone which contains large fragments of limestone and dolostone. Where a second fault branches off to the southeast at this spot, the intervening strata of Fault Block III dip to the south at about 30°. A second breccia zone, 3 m wide, occurs along the southern boundary of Fault Block III. The remaining faults are relatively minor and have no associated breccias, although some faults have adjacent drag folds. The anomalous movement (20 m north-side down of the southern fault) of Fault Block VII is the result of a significant rotation of this fault block.

Each fault block exposes about 20 to 30 m of section (Table CP-22-1) in two lifts in both of the North and South Quarries. The following summarizes the descriptions of each member exposed in these fault blocks.

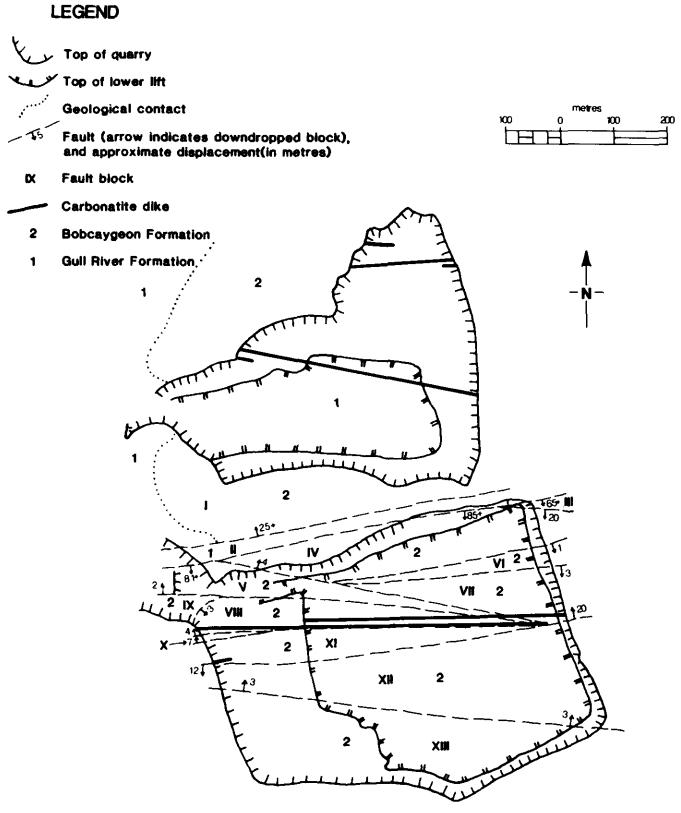


Figure CP-22-3. GEOLOGICAL MAP FOR NORTH AND SOUTH FRANCON QUARRIES.

Geological Section

		Thickness
UNIT 7	*Bobcaygeon Formation, upper member*	*36.1m*

Alternating intervals of thin-bedded, shaly limestone and thick-bedded, shale-free limestone: medium to dark grey, weathers light grey, microcrystalline to fine crystalline, medium- to coarse-crystalline intervals in thicker bedded limestones; thin-bedded (5-10 cm) with thin (less than 1 cm), dark grey shale partings common, alternating with thick bedded (30-100 cm), shale free intervals; very fossiliferous, especially in shaly limestones, with abundant brachiopods, trilobites, bryozoans, and crinoidal debris.

UNIT 6	*Bobcaygeon Formation, middle member*	*24.0m*

Limestone with shale interbeds: medium to dark grey, weathers light to medium grey; fine to coarse crystalline, with medium to coarse calcarenites in some beds; thin bedded (5-7 cm) with thin (1-2 cm), dark grey shale interbeds; small black chert nodules scattered in lower beds; very fossiliferous with abundant brachiopods, bryozoans and crinoidal debris.

UNIT 5 and UNIT 4

	Bobcaygeon Formation, lower member	*29.7m*

Limestone: medium to dark grey, grey-brown, weathers light grey, grey-brown; microcrystalline to fine crystalline; medium to massive bedded (50-120 cm) with rare thinner-bedded intervals, thickest beds most common in lower part of member; generally shale-free, but where present, shale commonly very thin and black; black chert nodules present in some beds; very fossiliferous, with abundant brachiopods, corals, bryozoans, trilobites and crinoidal debris.

UNIT 3	*Gull River Formation, upper member*	*8.2m*

Limestone with shale partings: dark grey, weathers light to medium grey, or blue-grey; microcrystalline to very fine crystalline; thin to medium (5-30 cm) bedded with thin (less than 1-2 cm), dark grey shale partings between most beds; abundant small calcite crystals, "birdseye" texture; very fossiliferous, with abundant corals *(Tetradium)*, brachiopods and bryozoans.

UNIT 1 and UNIT 2

	Gull River Formation, lower member	*37.4m*

Alternating units of limestone and dolostone: Limestone: medium grey to light grey-brown, weathers light grey; microcrystalline, with some fine-crystalline beds; thin to thick bedded (5-50 cm) with rare, very thin shale partings; small calcite crystals, "birdseye" texture, common in some beds; moderately fossiliferous with brachiopods and bryozoans present;

Dolostone: dark grey-brown to light grey-green, weathers light grey-brown, brown and light grey-green; fine crystalline, with some beds in Fault Block II containing silt and sand; thin to medium bedded (5-25 cm); calcite filled vugs present in some beds; unfossiliferous; units range from 0.05 m to 2.5 m thickness.

Total thickness	*135.4m*

QUARRY OPERATION

The North Quarry has been excavated on two lifts of 20 m to 21.4 m and 10.7 m. Both lifts are currently advanc-

TABLE CP-22-1. FAULT BLOCK THICKNESSES, NORTH AND SOUTH (FRANCON) QUARRIES.

FAULT BLOCK		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII West	XII East	XIII
FORMATION	MEMBER							(metres)							
BOBCAYGEON	*UPPER*				26.0		20.0	24.0							
				5.0	—— 4.0	15.6	—— 7.0	—— 12.0	6.0		5.0		5.0	4.0	20.0
	MIDDLE			21.0	14.0	7.5	8.0	3.0	7.0	12.0	12.0	18.0	6.0	2.0	——
				—— 3.0		——			—— 15.0	——	——	——	—— 15.0	—— 12.0	15.0
	LOWER											15.0			
				12.0											
		17.7													
GULL RIVER	*UPPER*														
		6.1													
		—— 2.1													
	LOWER														
		12.4	25.0 ——												

——*Position of the top of the lower lift*

ing to the southwest; the first lift supplies concrete stone and the second lift supplies asphalt and granular base aggregates. All drilling and blasting is subcontracted and a 2.75 m x 2.75 m drill pattern is used with 7.6 cm diameter blast holes. A Cat 988B loader is used in the quarry with three Mack 35–ton trucks that haul approximately 500 m to the primary crusher.

The South Quarry is presently excavated on two lifts of 20 m to 21.4 m and 12.2 m with potential to develop an additional two lifts of 13.7 m each. Excessive overburden restricts the advance of the first lift. The South Quarry primarily supplies granular products.

PROCESSING

Stone is crushed to –6 in. by a 48 in. x 36 in. Lipman jaw crusher (installed in 1967), and sent to a surge stockpile from where the crushed stone is drawn by three feeders to a tunnel conveyor belt and sent to a 4 1/4 ft. Symons cone crusher. The secondary crushed stone is then conveyed to the screenhouse where two 4 ft. x 12 ft. double–deck screens produce a +1 1/2 in. oversize that is fed to two 3 ft. Symons cone crushers and then returned to the 4 ft. x 12 ft. screens, and a –1 1/2 in. material that is fed to twin double–deck Dillon 5 ft. x 12 ft. screens. The screened products are stored in five bins and stockpiled by truck.

PRODUCTS

The operation produces all grades of asphalt, concrete and granular stone.

REFERENCES

Hewitt, 1960, p. 74–77
Hewitt, 1964a, p. 40
Hon, 1970, p. 24–27
Baird, 1972, p. 20–22
Hewitt and Vos, 1972, p.23–25
Rushforth, 1985
Hogarth and Rushforth, 1986, p. 9
Williams and Telford, 1986, p. 22
Williams, in prep., Appendix 1, Section LQ OT–11a, OT–116

MAPS

Williams, Rae and Wolf, 1984, OGS Map P.2716

CP-23 PERMANENT CONCRETE — NAVAN (LEBLANC) QUARRY

LOCATION AND OWNERSHIP

The Navan Quarry is located approximately 2 km east of the village of Navan, in Lots 7, 8 and 9, Concession 6, Cumberland Township, Regional Municipality of Ottawa–Carleton (Figure CP–23–1). The quarry, formerly known as the Leblanc Quarry, was opened in the early 1970s by Laurent Leblanc and was purchased during the summer of 1986 by the present owner and operator, Permanent Concrete. The property is licensed for extraction on 176.03 ha and has an excavated area of 40 ha.

GEOLOGY

The 21.0 m deep quarry exposes fine– to medium–crystalline, thin–bedded, nodular limestone of the lower member of the Lindsay Formation. The south face of the quarry exposes a small, near–vertical, normal fault which has a trend of 040°. The southeast side has a downthrow of approximately 1.0 m. Glacial overburden around the quarry is less than 2 m in thickness.

Geological Section

	Thickness
UNIT 1 Lindsay Formation, lower member	*21.0m*
Limestone: medium grey, weathers light to medium grey; fine to medium crystalline; thin (5–10 cm) bedded, with dark grey, shale partings present, some 2–5 cm thick; most beds display a faint nodular texture, beds at top of quarry weather into nodular, rubbly horizons; some limestone beds contain light grey, fine–crystalline limestone intraclasts; very fossiliferous, with abundant brachiopods, trilobites, corals, and crinoidal debris, burrows also common.	
Total thickness	*21.0m*

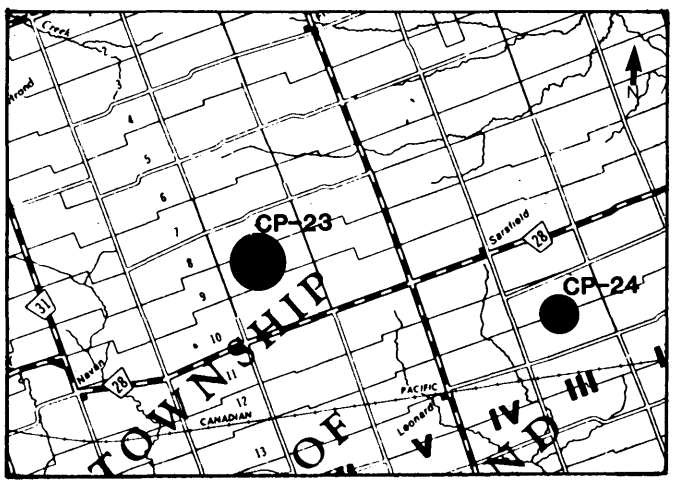


Figure CP-23-1. LOCATION MAP FOR NAVAN (LEBLANC) QUARRY.

QUARRY OPERATION

The quarry is opened on two lifts of 12 m and 9 m. The top lift (12 m) is used to supply concrete stone products and the bottom lift mainly supplies crusher run material. Lower lifts are available for future extraction. Drilling and blasting is contracted and a 2.44 m x 2.44 m drill pattern with 7.6 cm diameter blast holes is used. Blasted stone is loaded by two Cat 992 loaders for haulage to the primary crusher, a Pioneer 4654 impact crusher that feeds a Canica 105 vertical shaft secondary crusher. A Pioneer 8 ft. x 20 ft. triple–deck/Eljay 5 ft. x 16 ft. double–deck screening plant is currently used.

PROCESSING

A sequence of drilling/blasting and crushing alternates from lower to upper lifts which are presently worked at opposite ends of the quarry. After blasting approximately 150,000 tons, the portable crushing units are moved close to the stone pile and drilling is resumed at the alternate quarry lift.

PRODUCTS

Armour Stone
Gabion Stone 3 in. to 6 in.
Granular "A", "B" and "C"
1 1/4 in. Clear – Septic Bed Stone
3/4 in. Concrete Stone
3/8 in. Chips
1/4 in. Dust

REFERENCES

Williams, in prep., Appendix 1 – Section LQ RU–1

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CP-24 BERTRAND & FRERES CONSTRUCTION COMPANY LTD. — SARSFIELD QUARRY

LOCATION AND OWNERSHIP

The Sarsfield Quarry is located 1 km southeast of Sarsfield, in Lot 12, Concession 3, Cumberland Township, Regional Municipality of Ottawa–Carleton (Figure CP–24–1), and was opened in 1979 by the owner and operator, Bertrand & Freres Construction Company Ltd. The quarry is licensed for an area of 22.25 ha.

GEOLOGY

The 13.0 m deep quarry exposes fine– to medium–crystalline, thin–to medium–bedded, nodular limestones of the lower member of the Lindsay Formation. Glacial overburden around the quarry is less than 1 m thick.

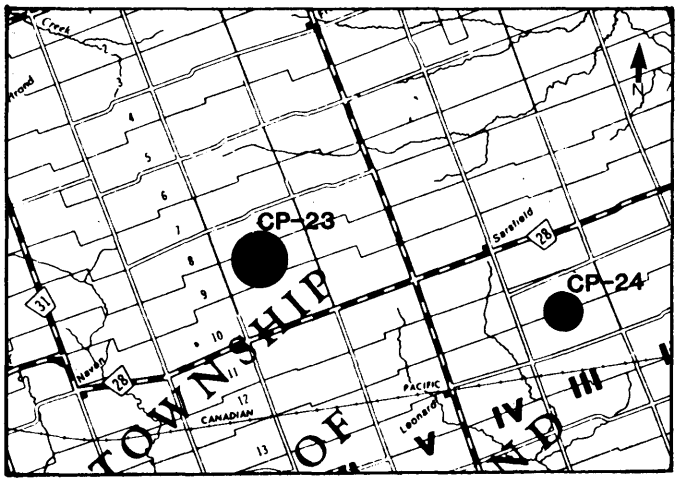


Figure CP-24-1. LOCATION MAP FOR SARSFIELD QUARRY.

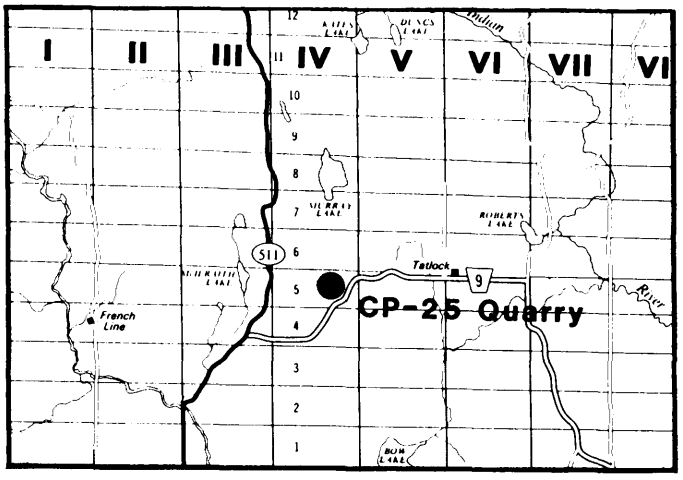


Figure CP-25-1. LOCATION MAP FOR TATLOCK QUARRY.

Geological Section

	Thickness
UNIT 1 Lindsay Formation, lower member	*13.0m*

Limestone: light to medium grey, weathers light grey-brown to brown; fine to medium crystalline; thin to medium bedded, with shale partings up to 5 cm common between beds; fine-crystalline limestone intraclasts present in some beds; fossiliferous, with abundant brachiopods, corals, and crinoidal debris.

Total thickness *13.0m*

QUARRY OPERATION

In 1986, the quarry produced weeping bed stone and granular stone that was used for local road, bridge and subdivision construction.

REFERENCES

Williams, in prep., Appendix 1 – Section LQ RU-3

MAPS

Williams, Rae and Wolf, 1985c, OGS Map P.2717

CP-25 STEEP ROCK CALCITE — TATLOCK QUARRY

LOCATION AND OWNERSHIP

Steep Rock Calcite, a division of Steep Rock Resources Inc., operates a high purity calcite quarry in Lots 4, 5 and 6, Concession 3, 4 and 5, Darling Township, Lanark County, near the village of Tatlock some 40 km north of Perth (Figure CP-25-1). The quarry property covers about 280 ha; part is located on private land, the remainder on Crown land.

The deposit contains in excess of 6 million tonnes of high purity white crystalline calcite and includes two former building stone quarries previously held by Angelstone Ltd. and Omega Marble Tile and Terrazzo Ltd. (Hewitt 1964c, p. 61, 64).

GEOLOGY

A white, medium crystalline calcite at this quarry was described by Hewitt (1964c, p. 62). Details of the geology in the quarry mapped by C. Fox, consulting geologist, were kindly made available by the company. In plan, a series of parallel zones of calcite with different silica* content are shown trending to the north. A wide belt of low silica* content (less than 3%) is bounded by dolomite to the west and by zones with higher silica* content (3% – 11%) to the east. The latter zones underlie the initial quarry which produced crushed calcite of high brightness but limited use as calcite filler. In cross section the parallel zones or beds of calcite are shown to dip eastward at approximately 55°. This dip is variable on the property within limits of 40° to 70°.

The low silica zone reaches true thicknesses of 85 m. Here the calcite is white, medium to coarse crystalline, with negligible phlogopite and essentially free of graphite.

The footwall boundary is determined by impure dolomitic material with increased silica content and inclusions of boudinaged amphibolite. Rare boudinaged quartz veins cross cut the marble belt.

Along strike the calcite is also limited by higher silica content. Quartz and tremolite are the major silicate min-

** The use of the term silica includes silica in the form of both quartz and various silicate minerals.*

erals. The presence of phlogopite and diopside (Hewitt 1964c, p. 66) has also been recorded.

Reserves of high purity calcite remaining in the present orebody are calculated to be 6.8 million tonnes to a depth of 61 m. Available reserves would be substantially increased if shown to continue below the present quarry design and if amenable to underground mining, and by beneficiation of the material with higher silica content. Additional deposits of high quality calcite have been indicated by exploratory drilling to the west and northwest of the present orebody within the limits of the existing claim group.

QUARRY OPERATION

The quarry is operated only during the summer months. The drilling, blasting, pit haulage, primary and secondary crushing is performed by a mining contractor and the crushed rock, essentially $-1^1/_2$ in., is transported to the processing plants located on the south side of Highway 7 just west of Perth (Figure CP–25–2).

PROCESSING

The delivered stone is stockpiled at the plant in amounts sufficient to provide feed for the full operating year. The Perth plant has an annual capacity of 250,000 tonnes. The primary crushed rock stockpile is covered with a special reinforced vinyl cover, which protects the ore from excessive rain and snow.

Steep Rock operates three separate but interconnected production facilities with each plant making its own range of products. The first plant consists of a drying operation, using an oil fired rotary drier, that processes all the crushed rock required for "dry processed" filler products. Dried stone is screened in the first plant or screen house into a range of closely sized granular products or diverted to provide feed material for the dry process filler plant.

Screen oversize products are recirculated to a Hazemag impact crusher operating in closed circuit with the screening operation. The plant also has the facility to air classify granular products to remove undesirable fines

Photo CP-25-1.
VIEW OF TATLOCK QUARRY.

from the screened products. These fines have a controlled size and are used in several filler applications.

Granular products are held in individual storage bins adjacent to the screening plant, from where they can be loaded directly into trucks or carried by pneumatic conveyor to the "dry process" filler plant or to the bagging plant for packing in 50 lb. paper bags.

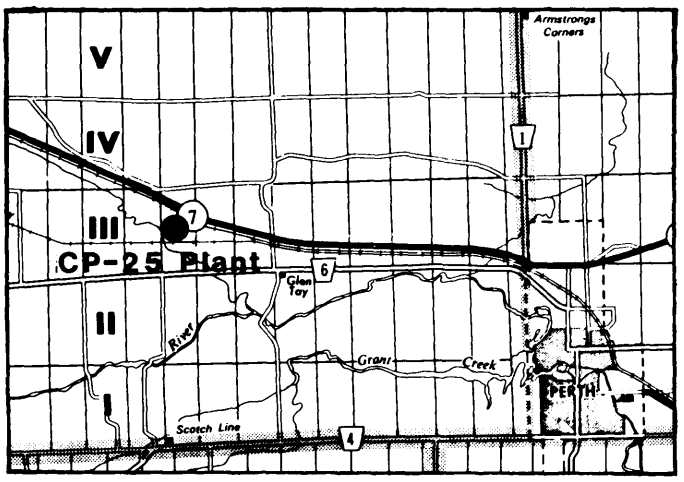


Figure CP-25-2. LOCATION MAP FOR STEEP ROCK RESOURCES PLANT.

Medium Fine and Fine Grind Products

Part of the dried −3/4 in. stone is conveyed to a bulk storage silo, feeding a 5 1/2 ft. Raymond roller mill. This mill, with its own internal classifier, produces coarse and medium fine filler products and granular feed for a 10 ft. x 7 ft. Koppers–Hardinge pebble mill. This mill uses ceramic liners and fused alumina grinding media, and operates in closed circuit with a Hardinge gyrotor classifier, to produce medium fine products ranging from 84% to 99.5% passing 325 mesh (44 micron).

Medium fine products are further classified with two highly efficient air classifiers to produce fine filler products ranging from 30 micron topsize down to a product with a 10 micron topsize.

Products are stored in six large "mass flow" 120–ton storage bins, located adjacent to the grinding plant, from which bulk trucks can be loaded directly. It is also possible to transfer products from these silos by separate pneumatic conveyors to several bagging stations. Conveying of intermediate or finished product in the plant is by dust tight airslides or pneumatic conveyors. Dust collectors are installed in the plant to remove process dust at points where products are exposed to atmosphere on storage silos, loading facilities and bagging operations.

Photo CP-25-2. STEEP ROCK RESOURCES, FINE GRINDING PLANT, PERTH.

Bagged products are stored by grade in a large warehouse with truck loading docks.

The dry process plant is operated from a large central control room. Many of the process functions are automated but are under full control of the operator. The plant is operated year round, three shifts per day, excluding scheduled maintenance shifts.

In 1985, Steep Rock Resources Inc. and a Canadian affiliate of Georgia Kaolin Company, Inc. concluded a joint venture agreement for the construction and operation of an ultra fine calcium carbonate plant at Perth. The objective is to produce high purity, high brightness ultra-fine particle calcium carbonate. The processes involved are proprietary, using a beneficiation process as well as highly specialized super fine grind technology developed by Georgia Kaolin Company, Inc.

The latter plant came into production in early 1987, producing high solids slurried calcium carbonate paper filler and coating products through wet processing methods. The joint venture sales agency operates under the name Ontario Carbonate Ltd.

PRODUCTS

Coarse Product

A range of coarse materials are produced by passing the $-1^1/_2$ in. stone through a portable screening plant, e.g. landscape chips, exposed aggregates, precast concrete stone, terrazzo chips, fertilizer diluents, poultry grits and agricultural limestone.

Granular Products

Products from the #1 plant screen house range from 6 x 16 mesh, 12 x 40 mesh to 40 mesh products. Excess fines are removed by the air classifiers located in plant #1 screen house. Granular products are used in such applications as stucco mix, cultured marble products, floor tile and animal feed supplements.

Medium Fine Products

Products from the Raymond mill and medium fine products from the pebble mill circuit are used in floor tile, wall jointing compounds, architectural textured coatings, adhesives and traffic paints.

Fine Products

Fine calcium carbonate filler products ranging from nominal top sizes of 30, 20 and 10 microns are used in interior paints, rubber, polyvinyl chloride, polyesters and adhesives. Calcium carbonate is a very functional filler and is non-reinforcing except when coated with organic additives such as coupling agents. As such it is a "prime" resin stretcher in plastics, reducing the cost of the manufactured product because of its own relatively low cost. Its natural high brightness also contributes to maintain clean colours in pigmented products. In paints it is used primarily as a pigment extender in conjunction with TiO_2.

REFERENCES

Hewitt, 1964c, p. 61-66

MAPS

none

Note: At the time of printing, the operations and shares of Steep Rock Calcite were being purchased by MAS Minerals Corp., a wholly owned subsidiary of Pluess-Stauffer AG of Switzerland.

Brockville District

INTRODUCTION

The Brockville District is situated in the Eastern Region of southern Ontario lying immediately west and south of Cornwall and Carleton Place Districts, respectively. The St. Lawrence River defines the southern extent of the district which is bounded on the west by the Napanee District.

Forty–three quarry properties have been documented in the Brockville District quarry inventory (Appendix IV, Volume I); five are currently active, ten operate intermittently and the balance represent past producing quarries of geological significance.

All of the principal quarries currently in either full or intermittent production were visited during the study and include the following:

BR–1 *Griffin Bros. (Gananoque) Ltd. – Westport Quarry (active)*

BR–2 *G. Tackaberry and Sons Construction Company Limited – Harlem Quarry (intermittent)*

BR–3 *G. Tackaberry and Sons Construction Company Limited – O'Grady Quarry (intermittent)*

BR–4 *O. Shirley and Sons Quarry (intermittent)*

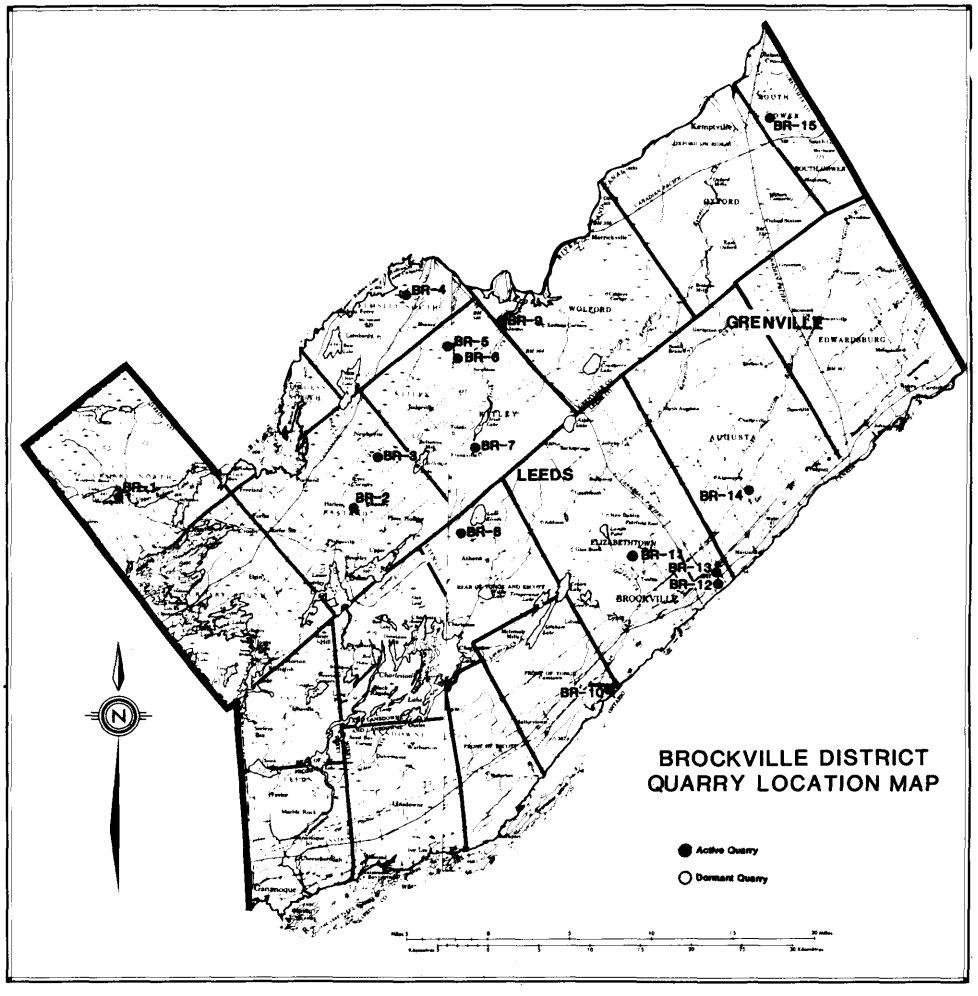


Figure BR-0-1. BROCKVILLE DISTRICT QUARRY LOCATION MAP.

BR–5 *G. Tackaberry and Sons Construction Company Limited – Willows (Newbliss) Quarry (intermittent)*

BR–6 *G. Tackaberry and Sons Construction Company Limited – Ronan (Leeds) Quarry (intermittent)*

BR–7 *G. Tackaberry and Sons Construction Company Limited – Mercier (Frankville) Quarry (intermittent)*

BR–8 *G. Tackaberry and Sons Construction Company Limited – Lawson (Athens No. 2) Quarry (active)*

BR–9 *G. Tackaberry and Sons Construction Company Limited – Jasper Quarry (active)*

BR–10 *William Clow – Sherwood Springs Quarry (intermittent)*

BR–11 *G. Tackaberry and Sons Construction Company Limited – Woods (Tincap) Quarry (active)*

BR–12 *Permanent Concrete – Brockville Quarry (active)*

BR–13 *Warren Paving and Materials Group Ltd. – Brockville Quarry (intermittent)*

BR–14 *G. Tackaberry and Sons Construction Company Limited – Wings (Maitland) Quarry (intermittent)*

BR–15 *Maple Grove (Kemptville) Ltd. – Kemptville Quarry (intermittent)*

REGIONAL GEOLOGY

The Brockville District extends northward from the St. Lawrence River, between Gananoque and Cardinal to the Rideau River–Rideau Lakes system (Figure BR–0–1), and encompasses all of Leeds and Grenville Counties. The main geomorphic features in the district include the Frontenac Axis, the Precambrian highlands to the west and the flat plains to the east underlain by Paleozoic strata.

Glacial overburden is essentially absent in the western and central parts of the district. Thick Quaternary deposits, however, occur in the eastern part of the district, especially around the Kemptville area in the northeast.

The Brockville District is underlain by Precambrian and Lower to Middle Ordovician rocks. The Precambrian rocks outcrop to the west where the southeastward extension of the Canadian Shield, the Frontenac Axis, crosses the St. Lawrence River at the Thousand Islands and joins with the Adirondack Mountains of New York State. Several small operations near Gananoque extract granitic rocks for ornamental and armour stone.

Unlike most of Central Ontario, the Paleozoic rocks of Eastern Ontario have been disrupted by large–scale faults (Williams, in prep.). In the Brockville District one of the major faults is the Rideau Lake Fault which trends northeast from Westport to Smiths Falls. Smaller–scale faults also occur although most, especially those which occur within the Oxford Formation, have such small displacements that only actual exposures reveal their presence.

The Paleozoic strata underlying the district consist of Lower to Middle Ordovician clastic and carbonate rocks (Figure BR–0–2). The following formations are present (in ascending order): the Covey Hill and Nepean Formations of the Potsdam Group (the lower part of which may be Cambrian in age), the March and Oxford Formations of the Beekmantown Group, the Rockcliffe Formation, and the Shadow Lake and Gull River Formations of the Ottawa Group (Williams, in prep.).

The Potsdam Group consists of the conglomerates and arkoses of the Covey Hill Formation and the overlying quartz arenites of the Nepean Formation. Small operations currently utilize this stone for aggregate and dimensional stone. Historically, the sandstones of the Nepean Formation have been used extensively as building material as, for example in the Parliament Buildings in Ottawa.

The overlying Lower Ordovician Beekmantown Group consists of the March and Oxford Formations. The March Formation is transitional from the clastic rocks of the Potsdam Group to the overlying dolostones of the Oxford Formation and thus consists of alternating beds of quartz arenite and dolostone, with gradations between the two rock types. Most common are fine–crystalline dolostones which consist of up to 50% medium–to coarse–grained, well rounded quartz grains, which "float" in the dolostone. The lower contact of the March Formation is placed at the base of the lowest dolostone bed (Williams, in prep.). The formation thickens from its erosional edge in the west to an average thickness of 15 to 20 m in the east.

The March Formation has been quarried extensively over the years. Large blocks of sandy dolostone were utilized in the construction of the Rideau Canal system in the 1830s. Dolostone and sandy dolostone beds were also quarried for building and ornamental stone. In addition to being a source for crushed stone, the sandy dolostone beds have proven to be an excellent source of skid–resistant aggregate (Rogers, 1980). The currently active quarries, which are entirely within the March Formation, are the O'Grady (BR–3), O. Shirley (BR–4), Mercier (BR–7), Lawson (BR–8), and Sherwood Springs (BR–10) Quarries. The March Formation is also exposed at the base of the Harlem (BR–2) and Brockville (BR–12) Quarries.

The Oxford Formation consists of grey–brown, fine–crystalline, medium–bedded dolostones which may vary from microcrystalline to medium crystalline and thin to thick bedded. Scattered, coarse–grained quartz sand and

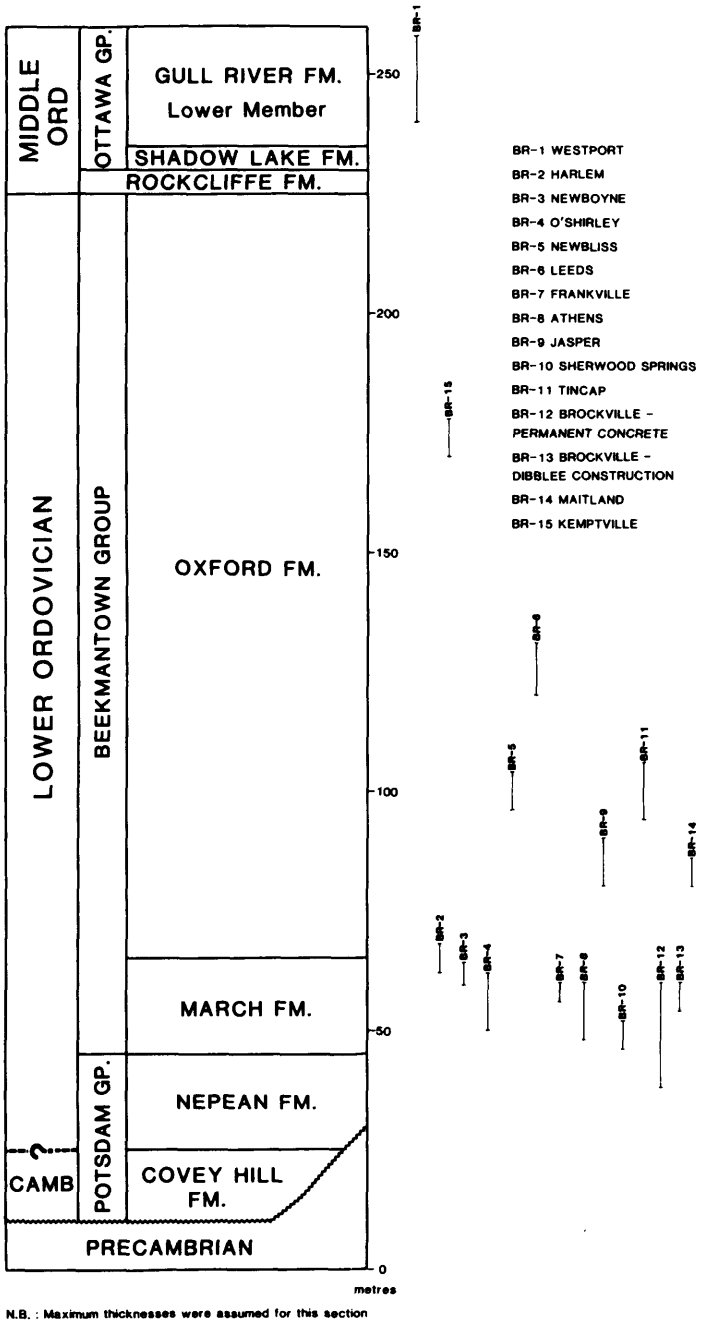


Figure BR-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF BROCKVILLE DISTRICT.

sandy interbeds (up to 30 cm thick) are present in the lower part of the formation. Calcite-filled vugs, of varying sizes, are common in some intervals as are small, white chert nodules. The lower contact of the Oxford Formation is placed at the top of the uppermost sandstone bed in the underlying March Formation (Williams, in prep.). The formation thickens from its erosional edge to a thickness of over 180 m at the eastern edge of the district.

Most of the Brockville District is underlain by the flat-lying dolostones of the Oxford Formation, usually with less than 1 m of overburden. Many quarries have been developed in these dolostones, primarily as aggregate sources. The principal active quarries in the Oxford Formation in the district (Figure BR-0-2) include the Jasper (BR-9) and Brockville - Permanent Concrete (BR-12) Quarries, two of the larger crushed stone operations. In addition there are numerous abandoned quarries in the Oxford Formation across the district (Appendix IV, Volume I).

In the Westport area, an outlier of Middle Ordovician strata (Figure BR-0-1) is currently being quarried for crushed stone by Griffin Brothers (Gananoque) Ltd. at the Westport Quarry (BR-1) (Figure BR-0-1). Dolostones and limestones of the lower part of the lower member of the Gull River Formation are exposed in this quarry. The dolostones, which contain silty intervals, commonly are buff to light brown, fine crystalline, and thin to thick bedded with thin shale partings between the beds. The limestones are generally light grey, microcrystalline to fine crystalline, thin to thick bedded, and are often mottled with light brown dolomitized burrows. Small calcite- and gypsum-filled nodules occur in some limestone beds. A shallow drillhole (collared 0.46 m above the quarry floor) intersected (in descending order): 4.6 m of limestone and dolostone of the lower member, Gull River Formation; 2.8 m of shale and shaly dolostone assigned to the Shadow Lake Formation; 1.5 m of green shale assigned to the Rockcliffe Formation; 3.8 m of dolostones of the Oxford Formation; 8.9 m of sandy dolostone of the March Formation; and terminated 10.5 m into the quartz arenites of the Nepean Formation (D.A. Williams, written communication, 1987). The thin interval of the Oxford Formation reflects the influence of the major unconformity between the Lower and Middle Ordovician.

The Westport Quarry (BR-1) is the only active quarry in the Middle Ordovician outlier near Westport, although a few small abandoned quarries were found in the area (Appendix IV, Volume I).

LIMESTONE INDUSTRIES

Aggregate production is the principal limestone industry in the Brockville District. In 1985 and 1986 stone production from the United Counties of Leeds and Grenville, was approximately 660,000 tonnes and 671,000 tonnes, respectively, and was used by the construction industry as road, asphalt and concrete aggregate.

The largest single producer in the District is G. Tackaberry and Sons Construction Company Limited report-

ing production not only from their currently active Lawson (BR–8) and Jasper (BR–9) quarries but also from eight intermittently operated quarries including Harlem (BR–2), O'Grady (BR–3), Willows (BR–5), Ronan (BR–6), Mercier (BR–7), Woods (BR–11) and Wings (BR–14) quarries. The second largest active producer in the district is Permanent Concrete–Brockville Quarry (BR–12) followed by Warren Paving and Materials Group Limited–Brockville Quarry (BR–13). The remaining quarries including Westport (BR–1), O. Shirley and Sons (BR–4), Sherwood Springs (BR–10), and Kemptville (BR–15) operate on an intermittent basis usually providing stone for a specific project.

BR–1 GRIFFIN BROS. (GANANOQUE) LTD. — LYNN (WESTPORT) QUARRY

LOCATION AND OWNERSHIP

The Westport Quarry is located in Lot 12, Concession 7, North Crosby Township, United Counties of Leeds and Grenville, 1.5 km southwest of Westport on Highway 42 (Figure BR–1–1). The quarry was opened during the mid–1960s and licensed in 1981 for extraction over an area of 12.7 ha. The Lynn Quarry is operated by Griffin Bros. (Gananoque) Ltd. The quarry products are primarily used for local township road maintenance and construction.

GEOLOGY

The 16.7 m deep quarry exposes limestones and dolostones of the lower member of the Gull River Formation (Figure BR–1–2). The limestone beds are often mottled with dolomitized burrows or indistinct patches. Most of the limestone is light to dark grey, thin to medium bedded and microcrystalline. The medium–bedded, fine–crystalline dolostones usually weather a light brown or green and often contain vugs. In addition to the numerous calcite–filled vugs, some vugs are filled with gypsum. Shale interbeds are present in the upper 10 m of the quarry. Glacial overburden varies considerably both adjacent to and on top of the quarry, but is commonly 3 to 4 m in thickness.

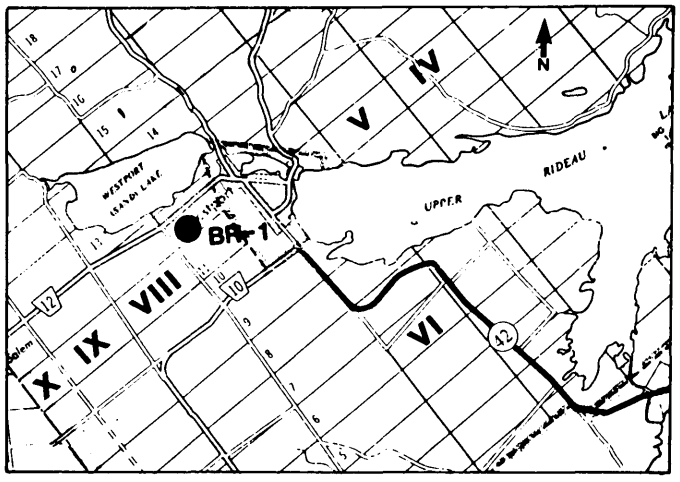


Figure BR-1-1. LOCATION MAP FOR WESTPORT QUARRY.

Geological Section

Thickness

UNIT 3 Gull River Formation, lower member *9.9m*

Dolostone, with limestone interbeds: light grey–green to dark grey, weathers buff to red–brown; fine to medium crystalline, with some silty intervals, and microcrystalline limestone beds; thin to thick bedded (limestone interbeds up to 35 cm thick) with thin shale partings and shale interbeds up to 10 cm thick; calcite and gypsum filled vugs common, gypsum molds are present in limestone; sparsely fossiliferous; lower contact of unit sharp and planar.

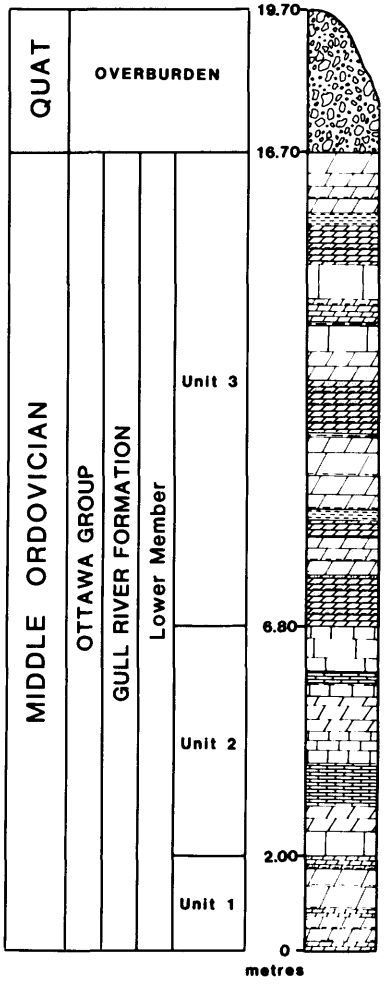


Figure BR-1-2. STRATIGRAPHIC COLUMN FOR WESTPORT QUARRY.

UNIT 2 Gull River Formation, lower member *4.8m*

Limestone, with dolomitic mottling and dolostone interbeds: medium to dark grey, weathers light to medium grey; microcrystalline to fine crystalline; thin to thick bedded with dolostone interbeds up to 25 cm thick; dolostone intraclasts are present in limestone beds at the base; oolitic limestone present in several intervals; gypsum nodules present in limestones; lower contact of unit sharp and planar.

UNIT 1 Gull River Formation, lower member *2.0m*

Dolostone, with shale partings: light grey-green, weathers buff; fine crystalline with some silt present; thin to thick bedded; slightly calcitic; conchoidal fractures common; sparsely fossiliferous with scattered brachiopods.

Total thickness *16.7m*

QUARRY OPERATION

The Westport Quarry presently covers an area of approximately 300 m x 500 m. The stone is quarried by drilling and blasting with production being derived from a single 8 m to 11 m lift. To achieve optimum fragmentation 6.4 cm blast holes are drilled in a 2.1 m x 2.1 m pattern.

PROCESSING

The broken rock is delivered to a portable Cedarapids 30 in. x 42 in. double impeller primary crusher which is in series with a Cedarapids 896 Commander secondary crusher. The main products are 4 in. and 5/8 in. crusher run stone. During the summer of 1986 stone from the Westport Quarry was used to construct a local airstrip for service aircraft involved in the MNR gypsy moth spraying program.

REFERENCES

Williams, in prep., Appendix 1 - Section LQ WE-6

MAPS

Williams and Wolf, 1984c, OGS Map P.2723

BR-2 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — HARLEM QUARRY

LOCATION AND OWNERSHIP

The Harlem Quarry, which was not in operation at the time of the field work in June 1986, is located in Lot 15, Concession 6, Bastard Township, United Counties of Leeds and Grenville, 1 km south of Harlem (Figure BR-2-1). The quarry is licensed for 5.1 ha and is intermittently operated by G. Tackaberry and Sons Construction Company Limited.

GEOLOGY

The 3.7 m deep quarry exposes sandy dolostones and sandstones of the March Formation and the overlying dolostones of the Oxford Formation. The strata of the March Formation consist of fine-crystalline dolostone with medium-to coarse-grained quartz grains scattered throughout. Some beds are fine- to medium-grained sandstones with a dolomitic cement. The dolostones of the Oxford Formation are medium bedded and fine crystalline. The contact between the two formations is well exposed in this quarry. Glacial overburden around the quarry is very thin.

Geological Section

Thickness

UNIT 3 Oxford Formation *2.4m*

Dolostone: light grey-brown, weathers same; fine crystalline, minor fine-grained quartz; medium bedded (15-25 cm); small calcite filled vugs common in some beds; the lower 25 cm is a distinctive, very thin-bedded dolostone; lower contact of unit sharp and planar.

UNIT 2 March Formation *0.2m*

Sandstone: green to light grey; weathers light brown to medium grey; coarse grained; slightly calcareous cement; single bed; lower contact of unit sharp and planar.

UNIT 1 March Formation *1.1m*

Dolostone, sandy: light brown, weathers medium grey; fine crystalline with scattered coarse grains of quartz sand; very thin to thin bedded (2-8 cm); lower 5 cm is a sandy dolostone with coarse grained, well rounded quartz grains.

Total thickness *3.7m*

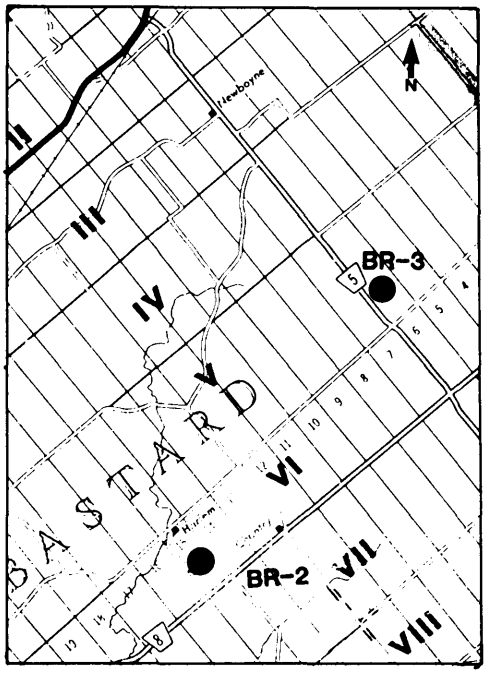


Figure BR-2-1. LOCATION MAP FOR HARLEM QUARRY.

REFERENCES

Hewitt, 1964a, p. 20–21
Hewitt and Vos, 1972, p. 10
Rogers, 1980, p. 58
Williams, in prep., Appendix 1 – Section LQ WE–2

MAPS

Williams and Wolf, 1984c, OGS Map P.2723

BR–3 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — O'GRADY QUARRY

LOCATION AND OWNERSHIP

The O'Grady Quarry is intermittently operated by G. Tackaberry and Sons Construction Company Limited and is located 3.5 km southeast of Newboyne in Pt. Lot 6, Concession 5, Bastard Township, United Counties of Leeds and Grenville (Figure BR–3–1). The property is licensed for 25.5 ha.

GEOLOGY

The 3.8 m deep quarry exposes medium–bedded dolostones, sandy dolostones and sandstones of the March Formation. Glacial overburden around the quarry is very thin.

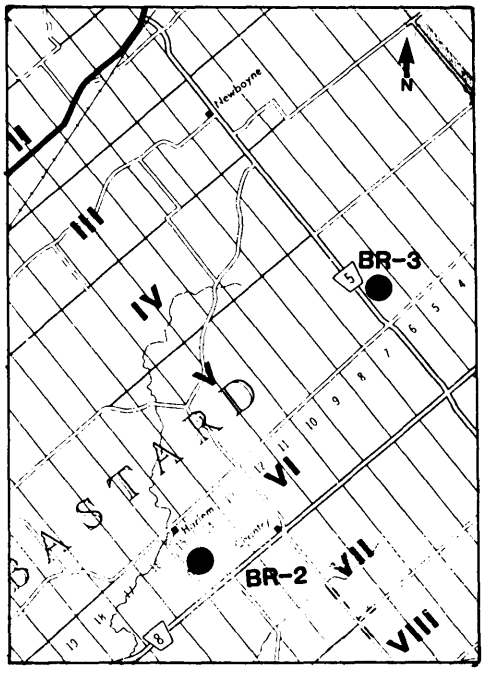


Figure BR-3-1. LOCATION MAP FOR O'GRADY QUARRY.

Geological Section

		Thickness
UNIT 3	*March Formation*	*3.0m*
	Dolostone, sandy: light brown-grey, weathers same; fine crystalline with medium-grained quartz; medium bedded (10–30 cm); calcite filled vugs are present; lower contact of unit is sharp and planar.	
UNIT 2	*March Formation*	*0.3m*
	Sandstone: light green, weathers same; very coarse grained, well sorted, well-rounded quartz grains; single bed; calcareous cement; lower contact of unit covered.	
	Covered Interval	*0.4m*
UNIT 1	*March Formation*	*0.1m*
	Dolostone: light grey-brown, weathers light brown; fine crystalline, this unit exposes only the uppermost part of a thicker bed.	
Total thickness		*3.8m*

REFERENCES

Williams, in prep., Appendix 1 – Section LQ WE–3

MAPS

Williams and Wolf, 1984c, OGS Map P.2723

BR–4 O. SHIRLEY AND SONS — SHIRLEY QUARRY

LOCATION AND OWNERSHIP

This quarry, located 5 km southwest of Smiths Falls in Pt. Lot 10, Concession 3, South Elmsley Township, United Counties of Leeds and Grenville, has been inter-

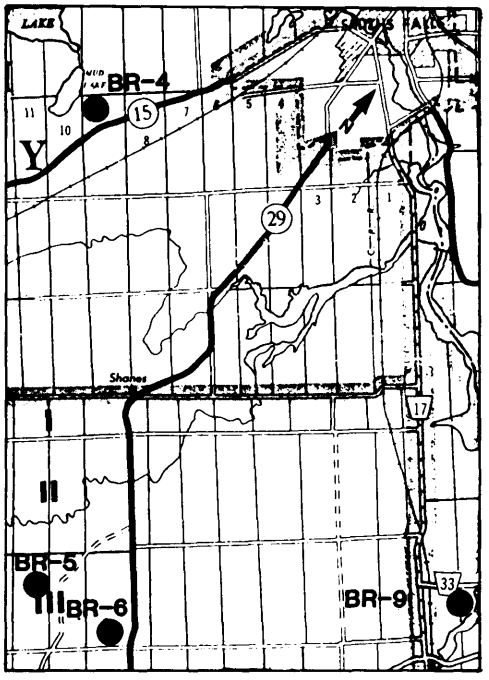


Figure BR-4-1. LOCATION MAP FOR SHIRLEY QUARRY.

mittently operated by O. Shirley and Sons (Figure BR-4-1). The quarry licence covers an area of 13.6 ha.

GEOLOGY

The 11.0 m deep quarry exposes dolostone, commonly very sandy, of the March Formation. The grey-brown, medium-bedded, fine-crystalline dolostones commonly contain medium- to coarse-grained, well-rounded quartz grains. A minor fault zone trends northwest-southeast through the quarry with a 2 m wide breccia zone and associated calcite veins. Displacement of the strata across the fault is less than 1 m. Glacial overburden is about 1 m thick around the quarry.

Geological Section

		Thickness
UNIT 1	*March Formation*	*11.0m*
	Dolostone, with interbeds of sandy dolostone and calcareous sandstone: grey-brown to light grey, weathers light brown to grey-brown; medium- to coarse-grained quartz in fine-crystalline dolostqne; medium bedded (10-30 cm), with sharp and planar contacts; calcite-filled vugs common in some beds.	
Total thickness		*11.0m*

REFERENCES

Goudge, 1938, p. 120

Rogers, 1980, p. 68-69

Williams, in prep., Appendix 1 - Section LQ PE-1

MAPS

Williams and Wolf, 1984b, OGS Map P.2724

BR-5 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — WILLOWS (NEWBLISS) QUARRY

LOCATION AND OWNERSHIP

The Willows Quarry is located along Highway 29 south of Smiths Falls, in Pt. Lots 14, 15 and 16, Concession 3, Kitley Township, United Counties of Leeds and Grenville (Figure BR-5-1). The quarry is licensed for 40.5 ha and has been excavated over an area of about 2 ha on a single 6.1 m lift. It is operated intermittently by G. Tackaberry and Sons Construction Company Limited. Production is dependent on the demand of local road construction projects.

GEOLOGY

The 8.0 m deep quarry exposes dolostones of the Oxford Formation. The grey-brown, medium-bedded, fine-crystalline dolostones commonly contain calcite-filled vugs. Glacial overburden around the quarry is usually 1 to 2 m thick.

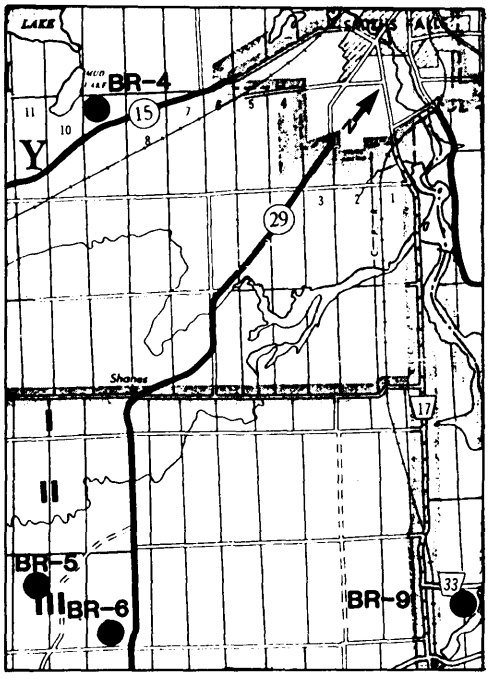


Figure BR-5-1. LOCATION MAP FOR WILLOWS (NEWBLISS) QUARRY.

Geological Section

		Thickness
UNIT 1	*Oxford Formation*	*8.0m*
	Dolostone: medium grey-brown, weathers light brown to grey-brown; fine crystalline; medium bedded (15-25 cm), with sharp and planar contacts; abundant calcite-filled vugs in some beds.	
Total thickness		*8.0m*

REFERENCES

Williams, in prep., Appendix 1 - Section LQ PE-2

MAPS

Williams and Wolf, 1984b, OGS Map P.2724

BR-6 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — RONAN (LEEDS) QUARRY

LOCATION AND OWNERSHIP

This quarry, located 1.5 km northwest of the hamlet of Newbliss in Lot 13, Concession 3, Kitley Township, United Counties of Leeds and Grenville, was previously operated by Leeds Asphalt Products (Figure BR-6-1). When visited in 1986 this quarry was licensed to G. Ronan and was inactive. It is now operated intermittently by G. Tackaberry and Sons Construction Company Limited.

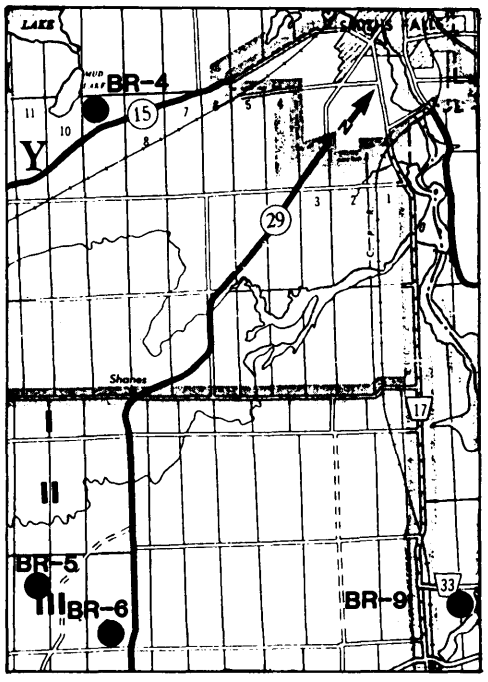


Figure BR-6-1. LOCATION MAP FOR RONAN (LEEDS) QUARRY.

GEOLOGY

The 10.4 m deep quarry exposes dolostones of the Oxford Formation which are grey–brown, medium bedded, fine to medium crystalline and commonly contain calcite–filled vugs. Glacial overburden around the quarry is generally thin.

Geological Section

		Thickness
UNIT 2	*Oxford Formation*	*6.0m*
	Dolostone: light grey, weathers light grey-brown; medium crystalline; medium bedded (15-30 cm); calcite-filled vugs common in some beds; lowermost 20 cm is a thin-bedded dolostone with shale partings; lower contact of unit sharp and planar.	
UNIT 1	*Oxford Formation*	*4.4m*
	Dolostone: medium grey, weathers same; fine crystalline; very thin to thick bedded (2–50 cm); 3.2 m above the base of unit is a 20 cm thick interval of thin-bedded dolostone with shale partings.	
Total thickness		*10.4m*

REFERENCES

Carson, 1982f, OGS OFR 5385 Section B–1
Williams, in prep., Appendix 1 – Section LQ ME–2

MAPS

Carson, 1982e, OGS Map P.2494

BR-7 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — MERCIER (FRANKVILLE) QUARRY

LOCATION AND OWNERSHIP

The Mercier Quarry is located 0.5 km northwest of Frankville on Highway 29, in Pt. Lots 19 and 20, Concession 8, Kitley Township, United Counties of Leeds and Grenville (Figure BR–7–1). The property, operated intermittently by G. Tackaberry and Sons Construction Company Limited, is licensed for 32.6 ha.

GEOLOGY

The 4.5 m deep quarry exposes fine– to medium–crystalline dolostones, interbedded with quartz–rich sandstones of the March Formation. Glacial overburden around the quarry is generally thin.

Geological Section

		Thickness
UNIT 1	*March Formation*	*4.5m*
	Dolostone, with interbeds of sandstone: light to medium grey-brown, weathers buff; fine to medium crystalline; thin to thick bedded; calcite-filled vugs present in some dolostone beds; stromatolites present in dolostone beds.	
Total thickness		*4.5m*

REFERENCES

Williams, in prep., Appendix 1 – Section LQ BR–6

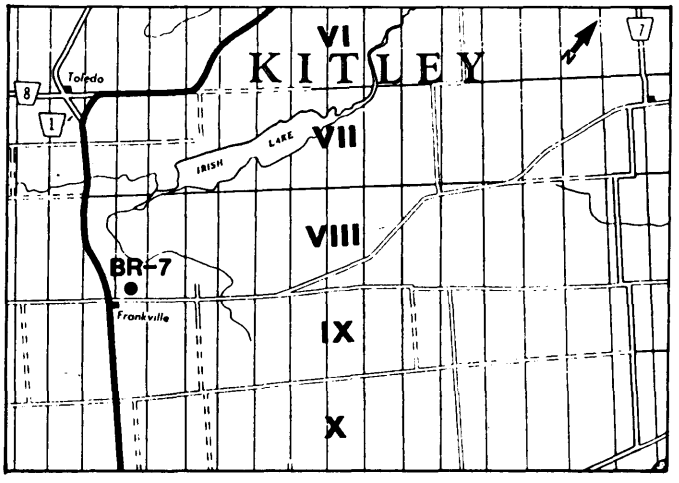


Figure BR-7-1. LOCATION MAP FOR MERCIER (FRANKVILLE) QUARRY.

BR-8 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — LAWSON (ATHENS NO. 2) QUARRY

LOCATION AND OWNERSHIP

The Lawson Quarry is located 3.5 km northwest of Athens, in Lots 15 and 16, Concession 10, Rear of Yonge & Escott Township, United Counties of Leeds and Grenville (Figure BR-8-1). The quarry is owned and operated by G. Tackaberry and Sons Construction Company Limited and was purchased from the Brundige Construction Company in 1979. The Lawson Quarry has a licensed area of 39 ha.

GEOLOGY

The 12.45 m deep quarry exposes dolostones, sandy dolostones, and sandstones of the March Formation (Figure BR-8-2). The dolostones range from fine to medium crystalline and are thin to medium bedded. The sandy dolostones are similar except for the presence of medium- to coarse-grained quartz. The sandstones consist of fine- to coarse-grained, well-rounded, well-sorted, quartz arenite. Glacial overburden is generally about 1 m thick around the quarry.

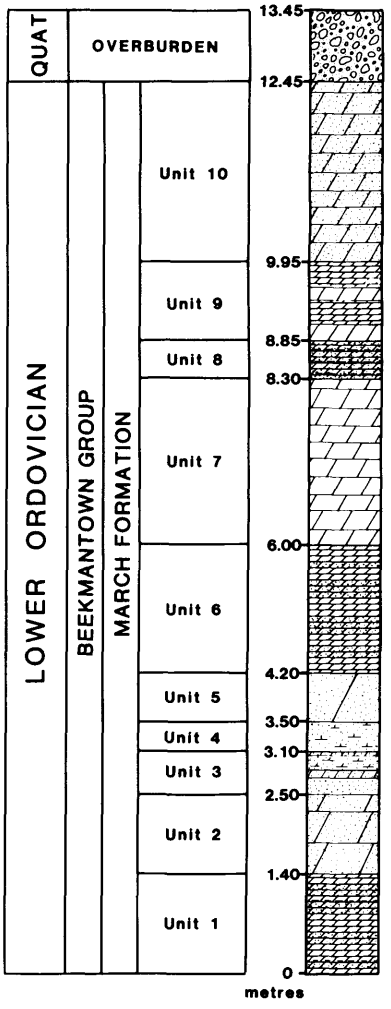


Figure BR-8-2. STRATIGRAPHIC COLUMN FOR LAWSON (ATHENS NO. 2) QUARRY.

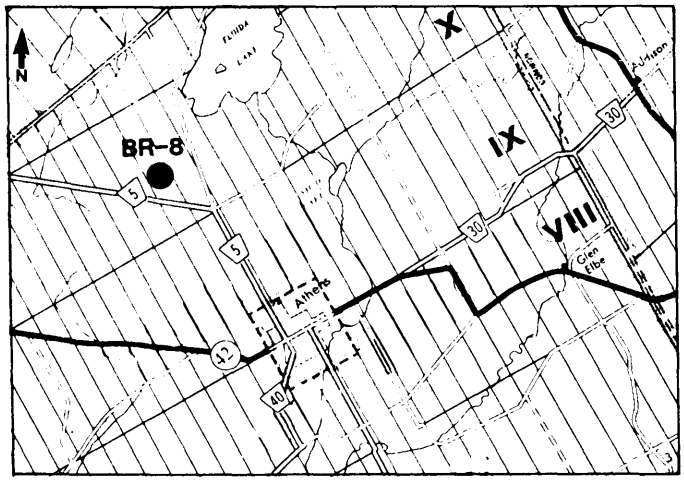


Figure BR-8-1. LOCATION MAP FOR LAWSON (ATHENS NO. 2) QUARRY.

Geological Section

Thickness

UNIT 10 March Formation *2.5m*

Dolostone: grey-brown with light green stains, weathers light grey; fine crystalline with minor amounts of fine- to coarse-grained quartz; medium bedded (10-20 cm); light green due to thin shale partings which contain glauconite; lower contact of unit sharp and planar.

UNIT 9 March Formation *1.1m*

Dolostone: light grey-brown, weathers light brown; fine to medium crystalline; thin to medium bedded (8-12 cm); small calcite-filled vugs common, some with small pyrite crystals; lower contact of unit sharp and planar.

UNIT 8 March Formation *0.55m*

Dolostone, with shale partings: light grey-brown, weathers light grey; medium crystalline with medium- to coarse-grained quartz; very thin to thin bedded (2-10 cm) with thin (2 cm) interbeds of shale; small calcite-filled vugs present; lower contact of unit sharp and planar.

UNIT 7 March Formation *2.3m*

Dolostone: light grey-brown, weathers light grey; medium crystalline; medium bedded (10-15 cm); top of lower lift at base of unit; lower contact of unit sharp, planar to irregular, probably erosional.

UNIT 6 March Formation *1.8m*

Interbedded sandy dolostone and dolostone, with beds interlaminated: Medium grey, weathers grey-brown to brown; very fine- to fine-crystalline dolostone, medium- to very coarse- crystalline sandy dolostone; very thin to thin bedded (3-10 cm), sharp and planar contacts; calcite-filled vugs (3-8 cm in diameter) and isolated patches of calcite crystals; scattered pyrite crystals (1-3 mm); scattered glauconite in sandy dolostone and on bedding planes; rare stromatolites in dolostones; lower contact of unit sharp and irregular, probably erosional.

UNIT 5 March Formation *0.7m*

Sandy dolostone: grey-brown, weathers medium grey; dolostones are fine crystalline, sand is coarse grained; one bed; calcite patches are common (2-5 cm), usually white, green, and pink in colour; pyrite crystals are common (1-3 mm); lower contact of unit gradational and burrowed.

UNIT 4 March Formation *0.4m*

Calcareous sandstone: white, weathers cream to white; coarse to very coarse grained; one bed; small calcite patches common; some glauconite at top of unit; this bed acts as a good marker within the lower lift; lower contact of unit sharp and irregular, probably erosional.

UNIT 3 March Formation *0.6m*

Interlaminated dolostones, dolomitic sandstones, and sandstones: dark grey, weathers medium grey-brown; very fine-crystalline dolostones, medium- grained sandstones; thin bedded (3-5 cm), sharp and planar contacts; calcite patches present, (1-3 cm in size) especially in sandy dolostones; lower contact of unit sharp and planar.

UNIT 2 March Formation *1.1m*

Sandy dolostone: light grey-brown, weathers grey-brown; very fine crystalline, with medium-grained quartz grains; thick bedded (50-60 cm), sharp and slightly irregular contacts; abundant calcite patches and calcite-filled vugs are present (2-8 cm in size); some pyrite crystals are present (up to 0.5 cm in size); lower contact of unit sharp and slightly irregular.

UNIT 1 March Formation *1.4m*

Sandy dolostone, interbedded with dolostone: medium dark grey, weathers medium grey; fine-crystalline dolostones, with medium- to coarse-grained quartz grains; very thin to thin bedded (2-8 cm), contacts are sharp and planar, with rare very thin shale or shaly dolostone partings; some white calcite patches (2-5 cm in size); most of unit is covered by talus.

Total thickness *12.45m*

QUARRY OPERATION

The quarry is currently excavated on two 6.1 m lifts. Drilling and blasting is contracted. The stone is very hard and requires a tight drill pattern of 2.1 m x 2.1 m with 7.6 cm diameter blast holes.

PROCESSING

Primary treatment of the blasted rock is performed by a Cedarapids 25 in. x 40 in. jaw crusher, followed by a Cedarapids 855 Commander crusher for secondary treatment. Product sizing is performed with a 5 ft. x 16 ft. Pioneer screening plant.

PRODUCTS

Shot Rock
Gabion Stone
5/8 in. Crushed Rock
Granular "A", "B" and "C"
1 1/2 in. Clear
7/8 in. Clear
Screenings
HL Products

Photo BR-8-1.
PRIMARY AND SECONDARY CRUSHING AND SCREENING FACILITIES AT THE LAWSON (ATHENS NO. 2) QUARRY (LOOKING NORTH).

COMPANY EQUIPMENT LISTINGS

Loaders

(2) Cat 977–L (3 yd.)
(2) Cat 988 (7 yd.)
(3) Cat 980 (5 yd.)
(2) Terex 7261–B (6.5 yd.)
(5) Terex 7251–B (4.5 yd.)
(2) Terex 7251–A (3 yd.)
(1) Terex 7271 (7 yd.)
(2) Cat 966D (4 yd.)

Bulldozers

(2) Cat D6
(1) Cat D7
(1) Cat D3
(1) Terex 7240

Backhoe

(2) Cat 225 (1.5 yd.)
(1) Cat 215 (1 yd.)
(1) Cat 235 (1 7/8 yd.)

Crushing Equipment

22 in. x 48 in. and 22 in. x 36 in. and 24 in. x 38 in. Cedarapids Jaw crushers
855 and 555 Cedarapids Commander crushers
Pioneer 5 ft. x 16 ft. Screening Plant
Parker Screening Plant
Power Screen
51 in. Hewitt–Robins cone crusher

The company also owns a fleet of trailer dump (14), belly dump (11), tandem and rock trucks.

REFERENCES

Hewitt, 1964a, p. 22
Hewitt and Vos, 1972, p. 8–9
Rogers, 1980, p. 56–57
Carson, 1982f, OFR 5385 – Section A–7
Williams, in prep., Appendix 1 – Section LQ BR–1

MAPS

Carson, 1982b, OGS Map P.2495

BR-9 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — JASPER QUARRY

LOCATION AND OWNERSHIP

The Jasper Quarry is licensed for 16.4 ha and is located 1 km north of Jasper, in Lots 29 and 30, Concession 1, Wolford Township, United Counties of Leeds and Grenville (Figure BR–9–1). The quarry was first opened in 1940 and is now owned and operated by G. Tackaberry and Sons Construction Company Limited. The property was purchased in 1982 from Brundige Construction Co.

GEOLOGY

The 11.0 m deep quarry exposes fine–crystalline, medium–bedded dolostones of the Oxford Formation in two lifts. Glacial overburden around the quarry is generally thin.

Geological Section

	Thickness
UNIT 2 Oxford Formation	*5.0m*
Dolostone: dark grey, weathers same; fine crystalline; medium bedded (10–15 cm), with sharp and planar contacts; calcite–filled vugs abundant; top of lower lift at base of unit; lower contact of unit sharp and planar.	
UNIT 1 Oxford Formation	*6.0m*
Dolostone: medium to dark grey, weathers light grey; fine crystalline; medium bedded (25–30 cm, rarely 15 cm), with sharp, planar contacts and rare, very thin shale partings; scattered small calcite patches present; some beds have fine laminae.	
Total thickness	*11.0m*

QUARRY OPERATION

The first lift of approximately 6.1 m has been completed and stone is now extracted from a second lift of approximately 6.7 m. Drilling and blasting is by contract, on a 2.1 m x 2.1 m drill pattern with 7.6 cm diameter holes.

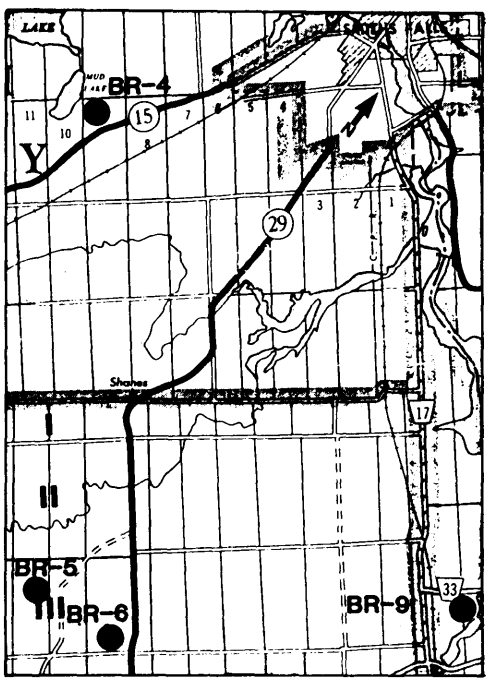


Figure BR–9–1. LOCATION MAP FOR JASPER QUARRY.

Photo BR-9-1. LOADING BLAST HOLES AT THE JASPER QUARRY (LOOKING WEST).

PROCESSING

Crushing and screening is performed by a portable system assembled onsite as required.

PRODUCTS

Gabion Stone
Shot Rock
Granular "A", "B", and "C"
1 1/2 in. Clear
7/8 in. Clear
Screenings
HL Stone
Concrete Stone

REFERENCES

Hewitt, 1964a, p. 19–20
Hewitt and Vos, 1972, p. 10
Rogers, 1980, p. 57
Williams, in prep., Appendix 1 – Section LQ ME–1

MAPS

Carson, 1982e, OGS Map P.2494

BR–10 WILLIAM CLOW — SHERWOOD SPRINGS QUARRY

LOCATION AND OWNERSHIP

This quarry is located at the eastern junction of Highway 401 and the Thousand Islands Parkway, 1 km south of the hamlet of Sherwood Springs in Pt. Lots 2–3, Concession 1, Front of Yonge Township, United Counties of Leeds and Grenville (Figure BR–10–1). It was once used as a source for aggregate for asphalt laid down on the nearby Highway 401. The quarry also has been intermittently operated by W. Clow for crushed stone. The property is licensed for 70.9 ha.

GEOLOGY

The 4.5 m of strata exposed above the water level in the partially flooded quarry consist of sandy dolostones and sandstones of the March Formation. A recent excavation east of the main quarry above the water level is described below. Glacial overburden around the quarry is generally less than 2 m thick.

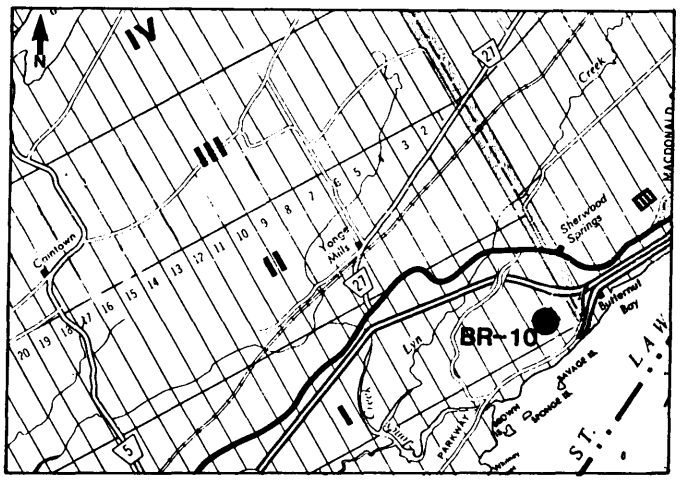


Figure BR-10-1. LOCATION MAP FOR SHERWOOD SPRINGS QUARRY.

Geological Section

		Thickness
UNIT 3	*March Formation*	*1.5m*

Dolostone: blue-grey to medium grey, weathers same; fine crystalline with medium- to coarse-grained quartz common; thin to medium bedded; calcitic patches common; lower contact of unit sharp.

UNIT 2	*March Formation*	*1.5m*

Sandstone: white to light brown, weathers light brown; medium grained; thin bedded; well sorted, subrounded, non-calcareous; lower contact sharp and slightly irregular.

UNIT 1	*March Formation*	*1.5m*

Dolostone: blue-grey to medium grey, weathers same; fine crystalline with medium- to coarse- grained quartz common; thin to medium bedded; calcitic patches common.

Total thickness	*4.5m*

REFERENCES

Rogers, 1980, p. 54–55
Williams, in prep., Appendix 1 – Section LQ BR–5

MAPS

None

BR-11 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — WOODS (TINCAP) QUARRY

LOCATION AND OWNERSHIP

The Woods Quarry was licensed and opened in 1985 by the owner and operator, G. Tackaberry and Sons Construction Company Limited (Figure BR–11– 1).

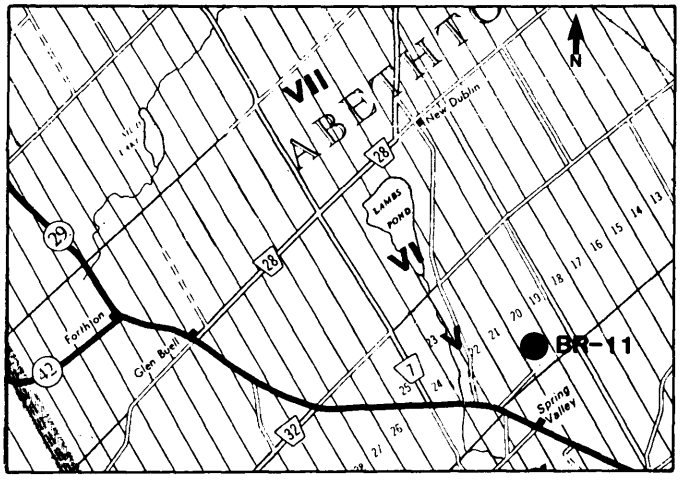


Figure BR-11-1. LOCATION MAP FOR WOODS (TINCAP) QUARRY.

Photo BR-11-1. BLOWING OUT RAIN WATER IN BLAST HOLES BEFORE LOADING WITH EXPLOSIVES AT WOODS (TINCAP) QUARRY (LOOKING NORTH).

The property is licensed for 21 ha and is located 2.5 km west of Tincap in part Lot 20, Concession 5, Elizabethtown Township, United Counties of Leeds and Grenville.

GEOLOGY

The 10.1 m thick quarry face exposes fine- to medium–crystalline dolostones of the Oxford Formation. Glacial overburden around the quarry is thin, varying from a trace to 30 cm in thickness.

Geological Section

		Thickness
UNIT 1	*Oxford Formation*	*6.0m*

Dolostone: grey-brown to medium grey, weathers light grey-brown; fine to medium crystalline; medium bedded; calcite-filled vugs present in some beds.

Total thickness	*6.0m*

QUARRY OPERATION

The quarry is opened over approximately 2 ha on a single lift of 6 m. Drilling and blasting is contracted. Crushing and screening is performed by a portable system.

PRODUCTS

Granular "A" and "B"

REFERENCES

None

MAPS

None

BR-12 PERMANENT CONCRETE — BROCKVILLE QUARRY

LOCATION AND OWNERSHIP

The large Brockville Quarry is located on the north side of Highway 2, on the eastern outskirts of the City of Brockville, in Part Lots 3, 4, 5, Concession 1, Elizabethtown Township, United Counties of Leeds and Grenville (Figure BR-12- 1). The property is licensed for 77 ha and is owned and operated by Permanent Concrete, a division of Lafarge Canada Inc.

GEOLOGY

The 21.0 m deep quarry exposes sandy dolostones and dolostones of the March Formation which are overlain by dolostones of the Oxford Formation (Figure BR-12-2). The contact between the two formations is exposed just below the top of the lowest lift. Glacial overburden around the quarry is about 3 to 5 m thick over the irregular bedrock surface.

Geological Section

Thickness

UNIT 2 Oxford Formation *14.5m*

Dolostone: light grey to light grey-brown, weathers grey-brown to medium brown; fine crystalline; dominantly medium bedded (10-30 cm) with some thinner (5-10 cm) beds, with sharp, planar contacts, some with dark grey shale partings; rare, very thin, sandy dolostone intervals at base of unit; calcite-filled vugs are common, especially in beds with abundant stromatolites; top of lower lift 0.3 m above base of unit; lower contact of unit sharp and slightly irregular.

UNIT 1 March Formation *6.5m*

Sandy dolostone, with interbeds of dolostones, calcareous and non-calcareous sandstones: light grey-brown to medium grey-white and light brown, weathers light grey to light grey-brown to light brown; fine-crystalline dolostones, medium- to coarse-grained sandy dolostones; medium bedded (20-30 cm), sharp contacts with very rare, very thin shale partings; some sandy dolostone beds have rare, large calcite-filled vugs; uppermost bed of formation is a thick, white sandstone just below the top of the bottom lift.

Total thickness *21.0m*

QUARRY OPERATION

The quarry is operated on three lifts of 6 m, 8.5 m and 6.5 m. The third lift is in a very hard dolomitic sandstone and is excavated solely to produce HL3 modified stone, a top quality skid-resistant aggregate used on highways with high volume traffic, and currently produced in a limited number of quarries in southern Ontario. Drilling and blasting is contracted; a drill pattern of 2.4 m x 2.1 m is used on the first and second lifts and a pattern of 2.1 m x 2.1 m is used on the third (bottom) lift, with 6.4 cm diameter blast holes.

PROCESSING

Two loaders, a Terex 9 yd. and a Cat 980 6 yd., are used to haul the blasted stone approximately 120 m to a Hewitt-Robins 30 in. x 48 in. primary jaw crusher. The crushed stone is conveyed approximately 60 m to a Hewitt-Robins screening plant. Oversize material is sent

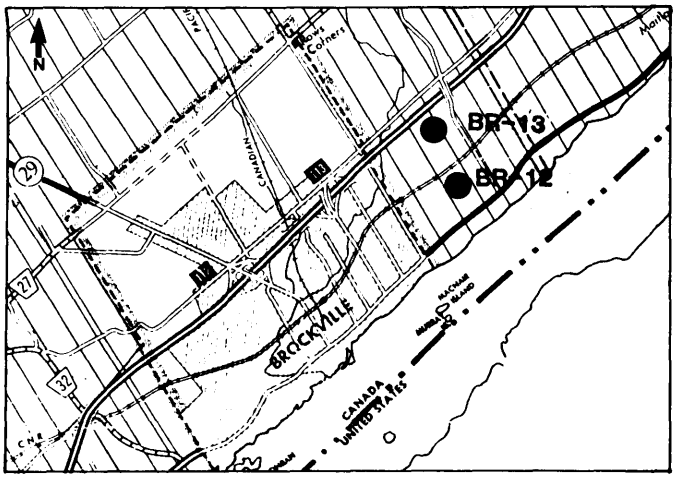


Figure BR-12-1. LOCATION MAP FOR BROCKVILLE QUARRY.

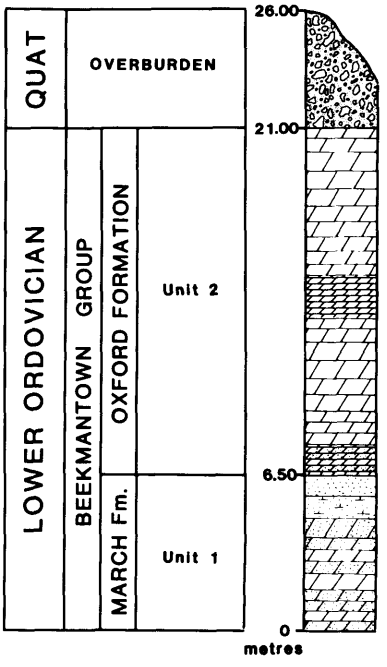


Figure BR-12-2. STRATIGRAPHIC COLUMN FOR BROCKVILLE QUARRY.

to two Symons 4 1/4 ft. cone crushers for secondary treatment, the product then being rescreened.

Permanent Concrete has a quality control laboratory and technician at the Brockville Quarry to ensure that product specifications are met at both the Brockville and Cornwall quarry operations.

PRODUCTS

Armour Stone
Gabion Stone 3 in. to 6 in.
Granular "A", "B" and "C"
Septic 1 1/4 in. Clear
3/4 in. Concrete Stone
3/8 in. Chips
1/4 in. Dust
HL3 Modified

REFERENCES

Goudge, 1938, p. 122–123
Hewitt, 1960, p. 19–20
Hewitt, 1964a, p. 24–25
Hewitt and Vos, 1972, p. 11–12
Rogers, 1980, p. 61–62
Williams, in prep., Appendix 1 – Section LQ BR–3

MAPS

Carson, 1982b, OGS Map P.2495

BR–13 WARREN PAVING AND MATERIALS GROUP LIMITED — BROCKVILLE QUARRY

LOCATION AND OWNERSHIP

This quarry, located 3 km northeast of Brockville, just south of Highway 401, in Lots 3–4, Concession 1, Elizabethtown Township, United Counties of Leeds and Grenville, has been operated by Dibblee Construction Company Limited, a division of the Warren Paving and Materials Group Ltd. (Figure BR–13–1). The property is licensed for 37.7 ha.

GEOLOGY

The quarry was partially filled with water at the time of the field work. Above the water level 5.6 m of Oxford Formation dolostone was exposed. The dolostones are light grey, fine crystalline and are medium bedded (20–30 cm); some of the beds contain minor amounts of medium– to coarse–grained quartz grains. These beds are very similar to those exposed in the upper part of the Brockville Quarry of Permanent Concrete (BR–12) which is located 1 km to the south of this quarry. Glacial overburden around the quarry is generally less than 2 m thick.

REFERENCES

Rogers, 1980, p. 63–64

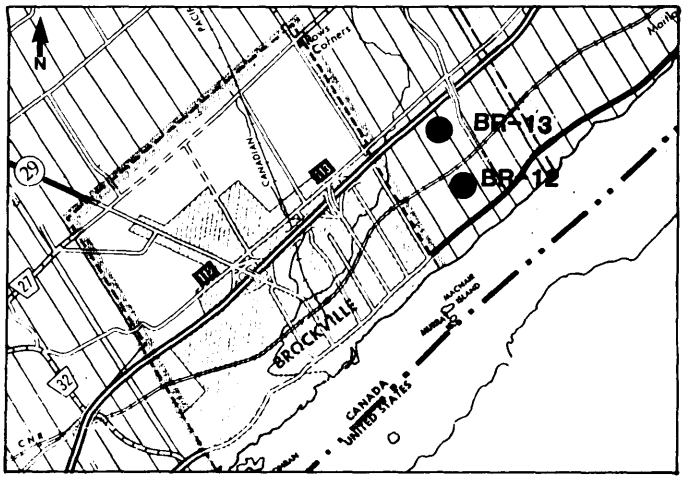


Figure BR-13-1. LOCATION MAP FOR BROCKVILLE (WARREN) QUARRY.

Williams, in prep., Appendix 1 – Section LQ BR–4

MAPS

Carson, 1982b, OGS Map P.2495

BR–14 G. TACKABERRY AND SONS CONSTRUCTION COMPANY LIMITED — WINGS (MAITLAND) QUARRY

LOCATION AND OWNERSHIP

The Wings Quarry is located 6 km north of Maitland in part Lots 24, 25 and 26, Concession 3, Augusta Township, United Counties of Leeds and Grenville (Figure

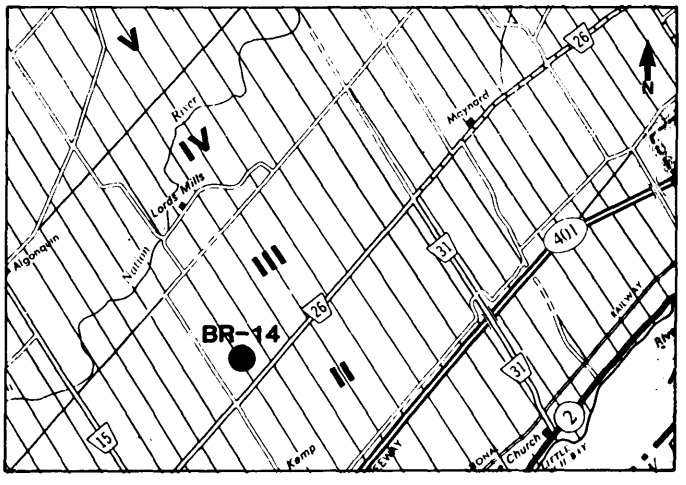


Figure BR-14-1. LOCATION MAP FOR WINGS (MAITLAND) QUARRY.

BR–14–1). The quarry is owned and operated intermittently by G. Tackaberry and Sons Construction Company Limited. The quarry was acquired in 1982 and is licensed for 15.1 ha. In 1980 aggregate was supplied from this quarry for the repaving of Highway 401 from Maitland to Prescott.

GEOLOGY

The 6.0 m deep quarry exposes fine– to medium–crystalline, medium–bedded dolostones of the Oxford Formation. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Oxford Formation	*6.0m*
Dolostone: medium brown to grey, weathers brown; fine to medium crystalline; medium bedded; minor amount of fine–grained quartz sand is also present in some beds.	
Total thickness	*6.0m*

QUARRY OPERATION

The quarry has been excavated to a depth of 6.0 m over an area of about 4 ha. Drilling and blasting is contracted. Crushing and screening is performed by a portable system.

PRODUCTS

Granular "A" and "B"

REFERENCES

Hewitt, 1964a, p. 25–26
Hewitt and Vos, 1972, p. 8–9
Rogers, 1980, p. 57
Williams, in prep., Appendix 1 – Section LQ BR–2

MAPS

Carson, 1982b, OGS Map P.2495

BR–15 MAPLE GROVE (KEMPTVILLE) LTD. — KEMPTVILLE QUARRY

LOCATION AND OWNERSHIP

This recently opened quarry, located 3 km east of Kemptville in Lot 10, Concession 6, South Gower Township, United Counties of Leeds and Grenville, is operated intermittently by Maple Grove (Kemptville) Limited (Figure BR–15–1). The property is licensed for 12.0 ha.

GEOLOGY

The 7.0 m deep quarry exposes fine–crystalline, thin– to medium–bedded dolostones of the Oxford Formation. Small calcite–filled vugs are common throughout the quarry. Glacial overburden is between 1 and 2 m thick.

Geological Section

	Thickness
UNIT 1 Oxford Formation	*7.0m*
Dolostone: dark grey, weathers grey–brown; very fine to fine crystalline; thin to medium bedded (5–15 cm), sharp contacts, with some very thin, dark grey shale partings; calcite– filled vugs and patches are very common in some beds, both white and pink calcite present; stromatolites rarely present; some beds faintly laminated.	
Total thickness	*7.0m*

REFERENCES

None

MAPS

None

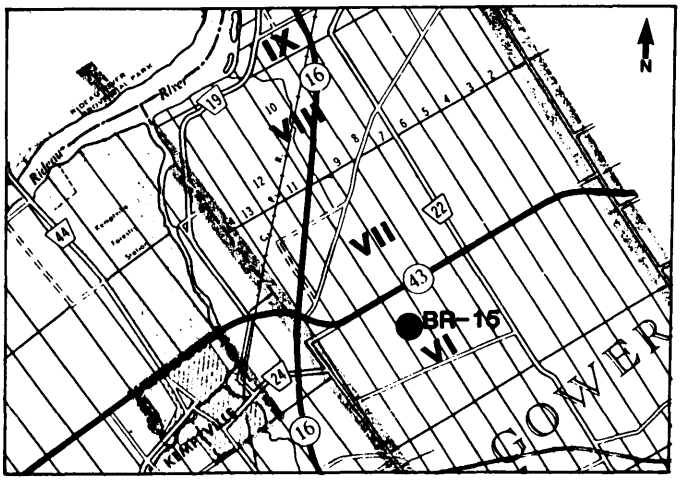


Figure BR–15–1. LOCATION MAP FOR KEMPTVILLE QUARRY.

Napanee District

INTRODUCTION

Napanee District is the westernmost district in the Eastern Region of southern Ontario, adjoining Brockville District on the east, Tweed District on the north, Lindsay District on the west and Lake Ontario to the south.

Three hundred and sixteen quarries in the Napanee District are documented in the quarry inventory (Appendix IV, Volume I); twenty–two are currently active, fifteen report intermittent production with the balance representing past producing quarries of geological significance.

All of the active and intermittently active quarries were visited during the study and include the following:

NP–1 *St. Lawrence Cement Company Inc. – Ogden Point Quarry, Colborne (active)*
NP–2 *Trenton Gravel Products Ltd. – Consecon Quarry (intermittent)*
NP–3 *H.J. McFarland Construction Co. – Mountain View Quarry (intermittent)*
NP–4 *Harvey Putnam – Cannifton Quarry (active)*
NP–5 *H.J. McFarland Construction Co. – Point Anne (Belleville) Quarry (active)*
NP–6 *H.J. McFarland Construction Co. – Long Quarry (intermittent)*
NP–7 *Lake Ontario Cement Ltd. – Picton Quarry (active)*
NP–8 *Miller Paving Limited – Prince Edward (Picton) Quarry (active)*
NP–9 *Trenton Gravel Products Ltd. – Napanee Quarry (active)*
NP–10 *H.J. McFarland Construction Co. – Roblindale Quarry (intermittent)*
NP–11 *Custom Mobile Concrete – Selby Quarry (active)*
NP–12 *J.R. Storey Construction Ltd. – Napanee Quarry (active)*
NP–13 *J.C. Dennison – Napanee Quarry (intermittent)*
NP–14 *Griffin Brothers (Gananoque) Ltd. – Dillon Quarry (active)*
NP–15 *Township of Camden East – Camden East Quarry (intermittent)*
NP–16 *J.R. Storey Construction Ltd. – Morven Quarry (intermittent)*
NP–17 *J.C. Denison – Storms Corners Quarry (active)*
NP–18 *Lafarge Canada Inc. – Bath Quarry and Plant (active)*
NP–19 *F.G. Bezanson and Son Ltd. – Wilton Quarry (active)*
NP–20 *Township of Amherst Island – Amherst Island (Caughey) Quarry (intermittent)*
NP–21 *Portland Township (Hartington) Quarry (intermittent)*
NP–22 *W.J. McKendry and Sons Limited – Westbrook Quarry (active)*
NP–23 *Wood's Sand and Gravel Ltd. – Collins Bay Quarry (active)*
NP–24 *H.J. McFarland Construction Company – Kingston Quarry (intermittent)*
NP–25 *Township of Kingston – Kingston Quarry (intermittent)*
NP–26 *W.J. McKendry and Sons Ltd. – Cranston (Kepler) Quarry (active)*
NP–27 *Frontenac Aggregates and Construction – Elginburg Quarry (active)*
NP–28 *Spaffordton Quarry (intermittent)*
NP–29 *W.J. McKendry and Sons Limited – Glenburnie (Kingston) Quarry (active)*
NP–30 *Wood's Sand and Gravel Limited – Macadoos Lane (Glen Lawrence) Quarry (active)*
NP–31 *H.J. McFarland Construction Company – Macadoos Lane (Bilow) Quarry (intermittent)*
NP–32 *Frontenac Aggregates and Construction – Pittsburgh Quarry (active)*
NP–33 *Mill Point Quarry (intermittent)*
NP–34 *Griffin Brothers (Gananoque) Ltd. – Battersea Quarry (active)*
NP–35 *Griffin Brothers (Gananoque) Ltd. – Joyceville Quarry (active)*
NP–36 *Howe Island Quarry (intermittent)*
NP–37 *Warren Paving and Materials Group Limited – Westbrook Quarry (active)*

REGIONAL GEOLOGY

Napanee District extends southward from a line 60 km north of and parallel to Lake Ontario's northern shoreline (Figure NP–0–1). The study area encompasses all, or parts of, Northumberland, Hastings, Lennox and Addington, Frontenac, and Prince Edward Counties.

Most of Napanee District is underlain by rocks of Paleozoic age with some Precambrian rocks present in the northern part of the district. The Paleozoic– Precambrian contact approximately follows the northern boundary of the Napanee District. This contact is delineated in scattered areas by a northward–facing escarpment, such as in the Tweed area and north of Kingston. Elsewhere

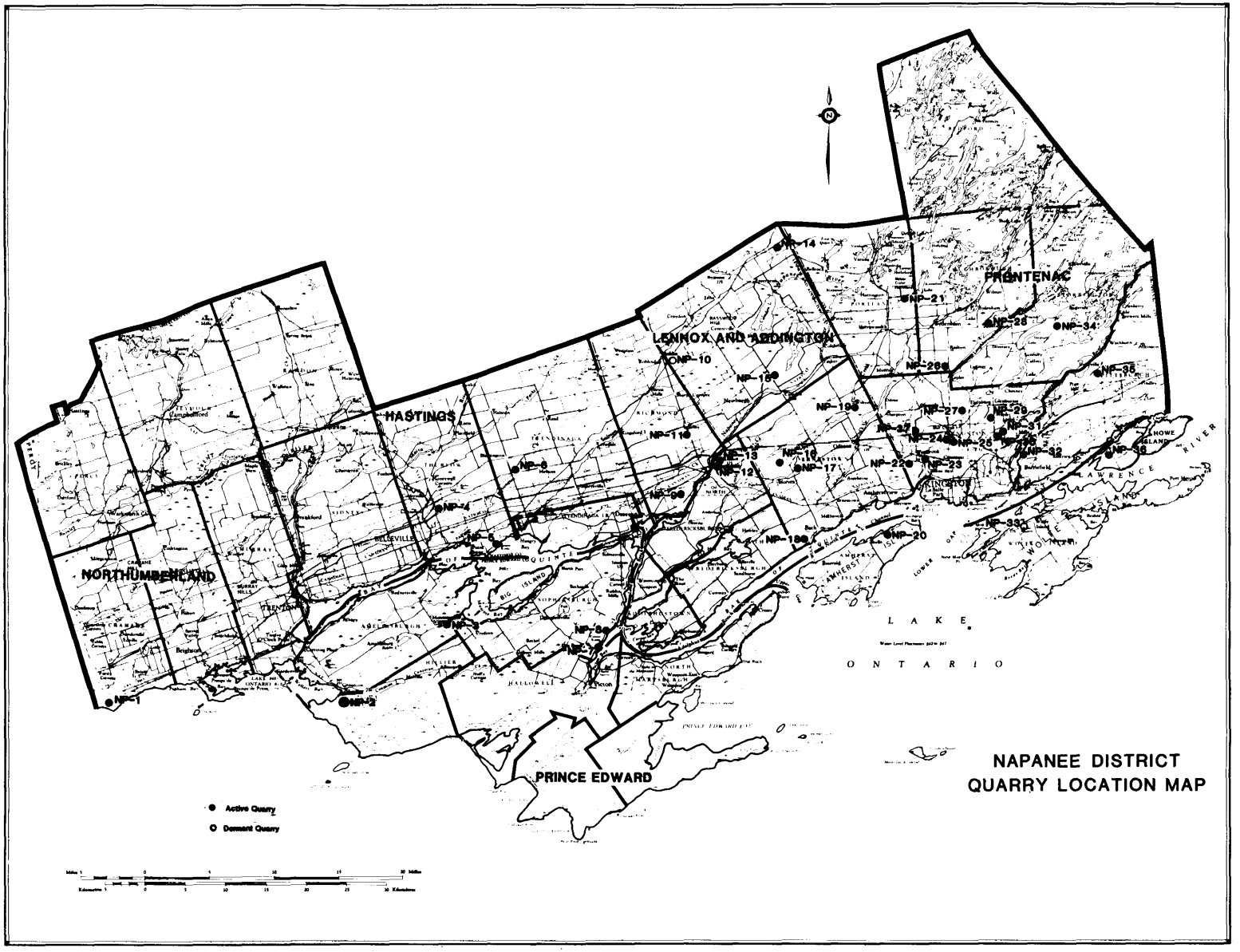


Figure NP-0-1. NAPANEE DISTRIST QUARRY LOCATION MAP.

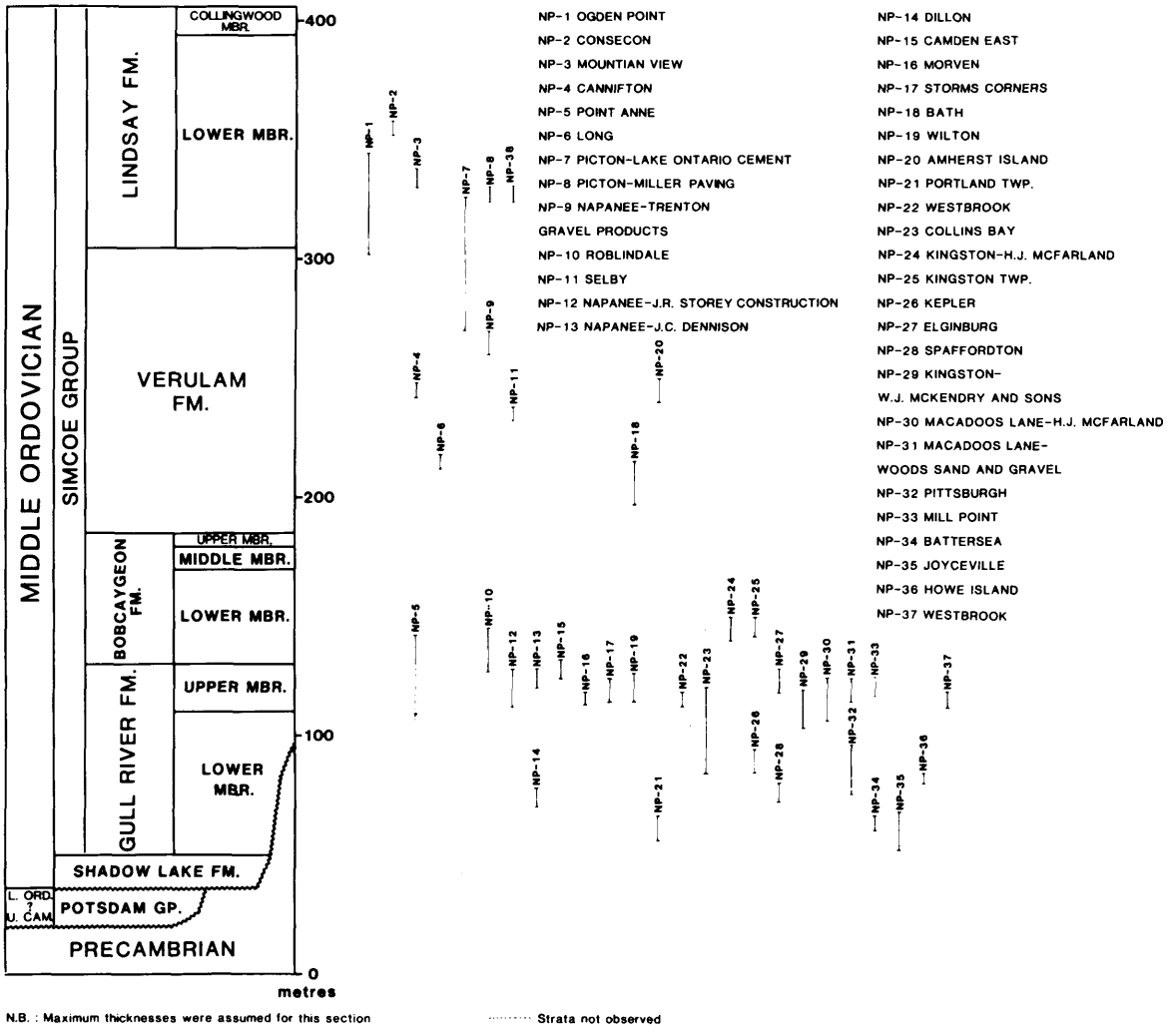


Figure NP-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF NAPANEE DISTRICT.

the contact is covered by glacial debris. Most of the Paleozoic strata are covered with thin glacial deposits, and bedrock exposures are numerous in many areas, especially south of Belleville and eastward to Kingston.

The oldest Paleozoic rocks in the Napanee District include the Cambro-Ordovician sandstones of the Potsdam Group northeast of Kingston, and the sandstones and shales of the Middle Ordovician Shadow Lake Formation (Figure NP-0-2).

The Potsdam Group consists of up to 20 m of arkoses and quartz arenites and is located in a small area north and east of Kingston. Although these rocks were, and still are, a source for building and ornamental stone, these sandstones are not used by the limestone industry.

The Shadow Lake Formation usually consists of a basal conglomerate overlain by arkosic sandstones and shales. It varies in thickness from zero, where it is absent over Precambrian topographic highs, to up to 15 m thick where it fills depressions in the Precambrian surface. None of the quarries in the Napanee District extend down into the Shadow Lake Formation, and there are only small scattered exposures evident.

Overlying the Shadow Lake Formation is the Gull River Formation of the Simcoe Group, which outcrops in a band from Campbellford to Kingston, and has been utilized in numerous quarries, including many abandoned ones.

The Gull River Formation is subdivided into two members, based on work by Williams (in prep.) and the exposure in the Marmora Pit (TW-1) in Tweed District. This differs from the four-fold subdivision proposed by Liberty (1971c) for these strata in the Kingston area. The Gull River Formation (as defined by Williams, in

prep.) varies in thickness from 30 to 80 m, increasing in thickness from west to east.

The lower member of the Gull River Formation consists of alternating limestone and dolostone units, 0.5 to 1.5 m thick. The limestones are light to medium grey, thin to medium bedded, and microcrystalline, and the dolostones are light brown to light green, thin to medium bedded, fine crystalline. The lower part of the member includes thin intervals of shale and quartz-rich sandstone. Several of the light green dolostone beds weather distinctively and provide excellent marker horizons. The lower member ranges in thickness from 20 m in the Marmora Pit (TW-1) to about 60 m in the Kingston area. Numerous quarries, including the Collins Bay Quarry of Wood's Sand and Gravel (NP-23) and the Pittsburgh Quarry of Frontenac Aggregates and Construction (NP-32), expose thick intervals of the member. Most operations extract the rock for aggregates.

The upper member of the Gull River Formation consists of thin-bedded, microcrystalline to fine-crystalline limestones which are interbedded with thin, dark grey, usually calcareous, shale partings. The member thickens from 7 m in the Marmora Pit (TW-1) to over 16 m near Napanee (NP-12). Unlike regions to the west, the upper member is utilized as a source of aggregate in the Napanee-Kingston area. Significant exposures of this member are displayed in the Napanee Quarry of J.R. Storey Construction (NP-12), the Wilton Quarry (NP-19), and the Macadoos Lane Quarry of Wood's Sand and Gravel (NP-31).

Overlying the Gull River Formation is the Bobcaygeon Formation which outcrops sporadically in the Napanee District. Most exposures occur between Belleville and Napanee. Of the few quarries that have been excavated into this formation, most expose strata of the lower member.

The Bobcaygeon Formation is subdivided into three members, based primarily on their shale content (Williams, in prep.). The lower and upper members generally have minor amounts of interbedded shale whereas the middle member has more significant amounts. The limestones of the lower member consist of thick to massive beds of microcrystalline limestone and medium- to coarse- grained calcarenites. The limestones of the middle and upper members are thin- to medium-grained calcarenitic limestone. The formation maintains a uniform thickness of 50 to 60 m across the district.

The 40 m thick lower member of the Bobcaygeon Formation is characterized by thick- to massive-bedded (0.5-1.5 m) limestone, often with black chert nodules in many beds. Around Kingston these thick beds easily fracture and weather into thinner layers which can be mistaken for bedding. Quarries which expose a significant amount of this member include the Point Anne Quarry (NP-5), the Roblindale Quarry (NP-10), the Kingston Quarry of H.J. McFarland Construction Company (NP-23), and the Township of Kingston Quarry (NP-25). The rock from these quarries is currently used as a source for crushed stone, although previously the cement manufacturing (Point Anne Quarry; NP-5) industry utilized these limestones.

The middle and upper members of the Bobcaygeon Formation are both about 10 m thick throughout the Napanee District. Only a thin interval of the lowermost section of the middle member is exposed in the Point Anne Quarry (NP-5). The upper member is not exposed in any quarries in this district.

Overlying the Bobcaygeon Formation are the interbedded limestones and shales of the Verulam Formation, which in the Napanee District underlie the area west of Kingston and the Trenton-Belleville area. The rocks of this formation are an important source for the cement manufacturing industry, in addition to being a source of crushed stone.

The Verulam Formation consists of interbedded thin-bedded limestone, shaly limestone, and shale. The very fossiliferous limestones vary from an evenly textured, fine-crystalline limestone to medium- to coarse-grained calcarenites. The upper part of the formation weathers to a distinctive blue-grey colour, different from the usual light to medium grey colour. The formation is up to 120 m thick in the Napanee District.

Outcrops of the Verulam Formation are common along the Lake Ontario shoreline between Kingston and Belleville and across the northern part of Prince Edward County. The quarries in this formation that are utilized by the cement manufacturing industry include the Picton Quarry of Lake Ontario Cement (NP-7) and the Bath Quarry of Lafarge Canada (NP-18). Several quarries west of Napanee and around Belleville use rock from the Verulam Formation as a source of crushed stone.

Overlying the Verulam Formation are the nodular limestones of the Lindsay Formation which underlies the extreme western and southern parts of the Napanee District. These rocks are used both for cement manufacturing and as a source of crushed stone.

The Lindsay Formation is subdivided into two members (Russell and Telford, 1983); the nodular limestone of the lower member, as used in this report, corresponds to the Lindsay Formation as defined by Liberty (1969), and the black shales of the upper, Collingwood Member that have been assigned previously to the lower member of the Whitby Formation as defined by Liberty (1969). Recent subsurface studies of this part of the section (Johnson et al., 1983) suggest the inclusion of these black shales as an upper member of Lindsay Formation because of the highly calcareous nature of the shales and the apparently conformable contact between the two members (Russell and Telford, 1983).

The lower member of the Lindsay Formation has a total thickness greater than 100 m in the southern part of

Prince Edward County. It consists mainly of grey to brown, fine-crystalline, medium- to thick-bedded, nodular limestone. The upper member, referred to as the Collingwood Member, is a calcareous, petroliferous black shale with a rich invertebrate fossil content. The contact between the lower and Collingwood members of the Lindsay Formation also marks the contact between the Middle and Upper Ordovician in Central Ontario. The upper member is not exposed in the Napanee District, but it does occur in the Bowmanville Quarry (L-1), in the Lindsay District to the west.

Extensive outcrops of the lower member of the Lindsay Formation occur in the southern three-quarters of Prince Edward County. Numerous quarries, most now abandoned, were excavated in this area for crushed stone, including the Consecon Quarry (NP-2), the Mountain View Quarry (NP-3), and the Picton Quarry of Miller Paving (NP-8). In addition, rock for the cement manufacturing industry is quarried at the Ogden Point Quarry of St. Lawrence Cement Inc. (NP-1) and the Picton Quarry of Lake Ontario Cement Ltd. (NP-7), both of which expose significant sections of the lower member of the Lindsay Formation.

LIMESTONE INDUSTRIES

The principal limestone industries in Napanee District are cement and construction aggregates with agricultural lime being produced from several high purity limestone quarries.

Cement production in 1986 for the district including production from the Lake Ontario Cement Picton plant and the Lafarge Canada plant at Bath was reported to be 1,689,000 tonnes (1987 Ontario Mineral Score).

Both plants produce a wide variety of products including, but not restricted to, Normal Portland, High Early Strength Portland, Sulfate Resisting Portland, Low Heat of Hydration Portland and Masonry Cement.

Stone production in 1986 for the district comprising production from Northumberland and Prince Edward Counties and the southern portions of Frontenac, Lennox and Addington and Hastings Counties, was approximately 5,986,000 tonnes (1987 Ontario Mineral Score) and was used by the cement industry for the production of cement and by the construction industry as road, asphalt and construction aggregate.

The largest stone producers include St. Lawrence Cement - Ogden Point Quarry (NP-1), Lake Ontario Cement - Picton Quarry (NP-7) and Lafarge Canada - Bath Quarry (NP-18) which between them quarry approximately 4,860,000 tonnes or about 80% of the stone produced, all of which is internally consumed.

The balance of the production, or about 1,126,000 tonnes, is quarried primarily for use as road building and construction aggregate.

Agricultural lime is produced in the district on a demand basis and includes production from the J. R. Storey Construction Ltd. high purity limestone quarry at Napanee (NP-12) which is trucked to their Morven (NP-16) quarry for crushing and screening.

NP-1 ST. LAWRENCE CEMENT COMPANY INC. — OGDEN POINT QUARRY

LOCATION AND OWNERSHIP

St. Lawrence Cement Company Inc. operates a large quarry at Ogden Point in Lots 29-35, Broken Front and Concession 1, Cramahe Township, Northumberland County. The quarry, which began operations in 1959, is located approximately 2 km south of the Village of Colborne on the shore of Lake Ontario (Figure NP-1-1) and has an annual capacity in excess of 2.5 million tonnes. All shipments are by water from a large dock facility to the St. Lawrence Cement plant at Clarkson (Mississauga).

GEOLOGY

The quarry exposes about 41 m of Middle Ordovician limestone of the Verulam and Lindsay Formations (Figure NP-1-2) and is operated in two lifts of subequal height. The lowest 3.2 m of the lower lift consists of interbedded limestone and shale of the Verulam Formation. The remaining strata in the quarry are thin to medium bedded, usually alternating fine-crystalline and medium-grained calcarenitic limestones of the lower member of the Lindsay Formation. These limestone beds commonly display a nodular texture, in which the nodules are enveloped in thin shale partings. The lower 12.8 m of this formation are thicker bedded than the overlying strata. The Lindsay Formation strikes 030° and dips to the south at less than 1°.

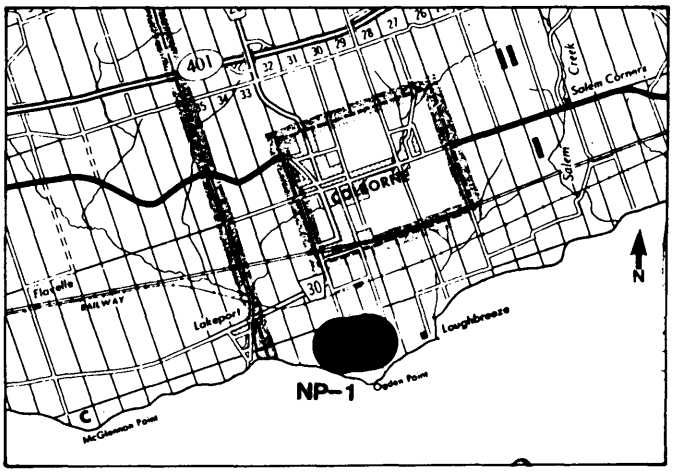


Figure NP-1-1. LOCATION MAP FOR OGDEN POINT QUARRY.

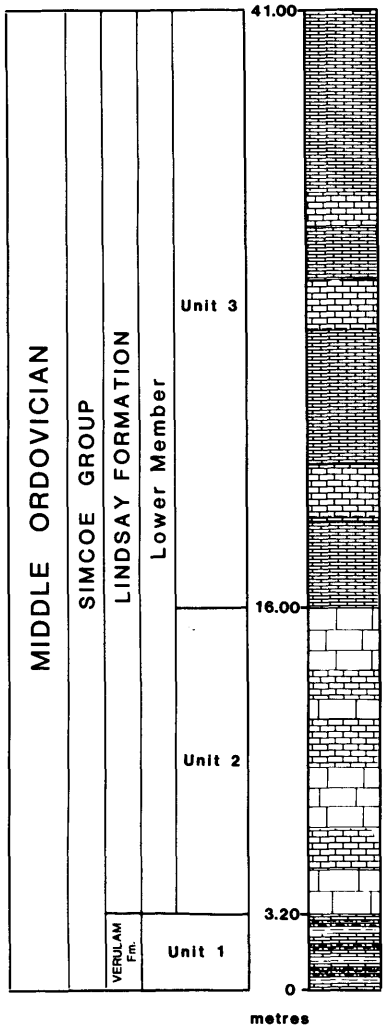


Figure NP-1-2. STRATIGRAPHIC COLUMN FOR OGDEN POINT QUARRY.

Overburden at the quarry site ranges from 0.3 to 1.5 m in thickness.

Geological Section

Thickness

UNIT 3 Lindsay Formation, lower member *25.0m*

Limestone: dark grey to grey-brown at top, weathers light grey to light grey-brown at top; alternating beds of very fine- to fine-crystalline limestone with coarse- to very coarse-grained calcarenites and bioclastic limestone; mostly thin bedded (5-10 cm), with some medium bedded (10-30 cm), contacts generally marked by dark grey, thin shale partings; very fossiliferous with brachiopods, crinoidal debris and trilobites commonly present; upper 8 m of unit displays distinct nodular texture, weathering to a rubble in uppermost 2 m; top of lower lift 7.0 m above base of unit; lower contact of unit sharp.

UNIT 2 Lindsay Formation, lower member *12.8m*

Limestone: medium to dark grey, weathers light to medium grey to grey-brown; generally fine to medium grained and calcarenitic, interbedded with fine crystalline; medium to thick bedded (20-60 cm), with very thin shale partings present between some beds; fossiliferous with brachiopods common; lower contact of unit sharp and planar.

UNIT 1 Verulam Formation *3.2m*

Limestone and shale: dark grey, weathers light to medium grey; limestone beds are commonly fine crystalline, with some fine- to coarse-grained calcarenites also present; limestone thin bedded (5-10 cm), with 2-5 cm interbeds of dark grey shale and shaly limestone; fossiliferous with brachiopods most abundant.

Total thickness *41.0m*

Exploration diamond drilling by St. Lawrence Cement Inc. was designed to test the stratigraphy underlying the licence area. The analytical results from the drill core as presented in Table NP-1-1 are reported by St. Lawrence to be typical for the licence area.

The alkalis of K_2O and Na_2O combined rarely exceed 1.0%. SO_3 is relatively constant at 0.60%. Chlorine at about 0.1% is most erratic, differing not only along strike and down dip but also across the bedding.

By combining the different members of the Lindsay Formation, a natural cement raw material can be obtained.

QUARRY OPERATION

The current quarry occupies an area of approximately 100 ha. The quarry operates on two benches, each approximately 20 m high, the upper bench varying in places to 16.7 m. The north and east faces of the upper bench are thin bedded with some shale in the east face. The west face of the upper bench is characterized by more massive bedding with a higher carbonate content stone.

The lower bench was opened in 1985. It is 20 m in height and is composed of two distinct layers. The lower 7.6 m of the bench has a higher carbonate content and is being used as a sweetener stone.

Blasting in the quarry is conducted using a 20 cm R40 Pesageri rotary percussion drill on a 6.7 m x 7.3 m pattern. The explosive agent is AN/FO with a 6% fuel mix at a rate of 170 g/t. The quarry reaches a maximum depth of 41.0 m.

Water infiltration is from surface runoff and is controlled by a large sump in the top bench equipped with single 10 in. and 8 in. horizontal turbine pumps. The lower bench is drained by two 6 in. horizontal turbine pumps.

Shot rock is loaded by three 15-yd. LeTourneau loaders into two 105-ton, one 85-ton and three 75-ton Euclid rear-dump trucks. The average haul distance to the primary crushers is 300 m.

TABLE NP-1-1. OGDEN POINT QUARRY, ST. LAWRENCE CEMENT, DRILL HOLE CHEMICAL ANALYSIS.

Hole #	Depth (ft)	LOI	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	K_2O	Na_2O	Cl	Total	C_3S
U-22	0-50	35.06	12.58	3.69	1.51	43.18	1.92	0.78	0.81	0.17	0.098	99.80	82.90
U-22	50-100	36.23	12.08	3.45	1.24	44.02	1.85	0.60	0.72	0.16	0.142	100.49	97.69
U-22	100-150	35.47	13.18	3.79	1.38	42.75	2.08	0.58	0.77	0.16	0.148	100.29	71.69
U-22	150-200	36.83	10.05	3.36	1.25	44.83	2.16	0.61	0.66	0.14	0.123	100.01	129.85
U-22	200-250	39.22	6.97	2.13	0.77	48.17	2.11	0.47	0.50	0.06	0.042	100.45	207.95
U-22	250-300	39.00	7.01	2.17	0.81	48.11	2.23	0.60	0.49	0.08	0.042	100.53	206.02
U-22	300-350	40.57	4.58	1.14	0.50	50.75	2.17	0.52	0.31	0.08	0.042	100.66	270.76
R-16	0-50	37.56	9.29	2.44	1.09	56.14	1.64	0.62	0.55	0.06	0.068	99.45	160.48
R-16	50-100	34.33	13.81	4.23	1.58	41.92	1.76	0.77	0.95	0.10	0.066	99.52	54.16
R-16	100-150	35.78	12.21	3.56	1.27	43.73	1.60	0.61	0.76	0.05	0.077	99.63	93.40
R-16	150-200	35.75	12.68	3.78	1.30	43.32	1.71	0.58	0.75	0.18	0.096	100.14	82.27
R-16	200-250	36.99	10.27	3.43	1.22	44.94	1.69	0.60	0.66	0.10	0.091	99.99	127.41
R-16	250-300	38.97	7.24	2.38	0.79	47.80	2.30	0.48	0.52	0.10	0.081	100.57	198.33
R-16	300-350	38.59	7.63	2.60	0.90	47.16	2.32	0.62	0.55	0.11	0.070	99.82	186.25
R-16	350-400	40.35	4.86	1.25	0.55	50.13	1.86	0.56	0.27	0.03	0.076	99.89	263.67
O-22	0-50	37.43	9.85	2.51	1.09	45.72	1.63	0.62	0.56	0.09	0.023	99.51	149.76
O-22	50-100	34.58	13.50	3.91	1.54	42.18	1.62	0.76	0.87	0.11	0.025	99.09	63.46
O-22	100-150	35.57	13.14	3.58	1.29	43.12	1.57	0.61	0.74	0.10	0.028	99.73	77.84
O-22	150-200	35.38	13.27	3.87	1.34	42.89	1.69	0.57	0.78	0.16	0.026	99.77	70.06
O-22	200-250	37.48	9.90	3.13	1.14	45.46	1.59	0.59	0.61	0.07	0.040	100.01	139.42
O-22	250-300	37.45	9.43	2.39	0.79	47.61	1.50	0.50	0.54	0.09	0.033	100.01	197.22
O-22	300-350	38.59	7.68	2.41	0.86	47.32	1.50	0.63	0.52	0.10	0.042	99.64	191.54
O-22	350-400	39.49	5.11	1.12	0.46	50.22	1.43	0.52	0.23	0.06	0.034	99.68	264.27

Photo NP-1-1.
15-YD. LETOURNEAU FRONT END LOADER LOADING SHOT ROCK AT THE WEST FACE OF THE OGDEN POINT QUARRY.

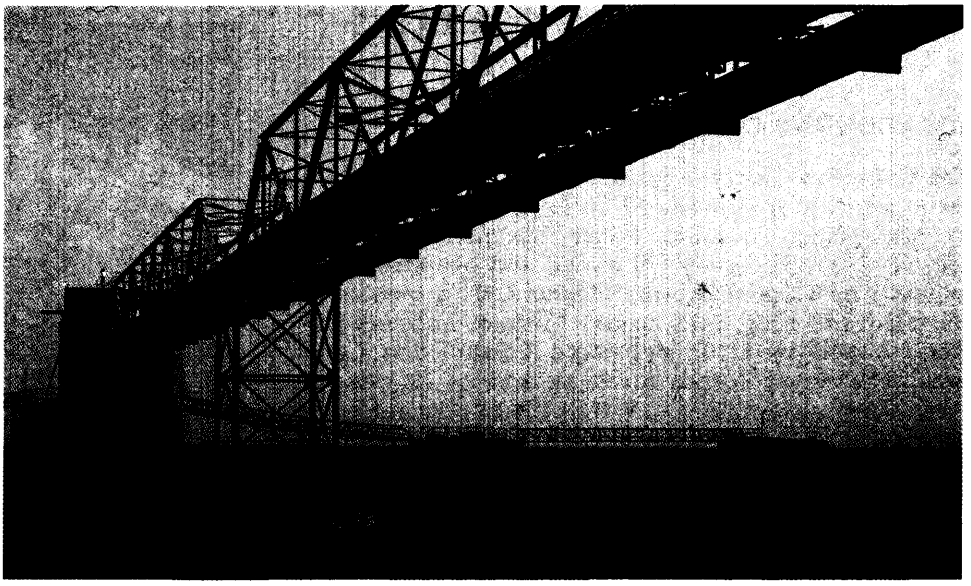
PROCESSING

A process flow sheet is shown in Figure NP-1-3.

The primary crusher, a 54 in., 400 hp belt driven gyratory with a capacity of 2,000 tons per hour, is set in the quarry floor. Primary crushed material (-8 in.) is transported 550 m by a 48 in. covered belt conveyor to a 10,000 ton surge pile.

The material is reclaimed from the surge pile by a 48 in. conveyor and delivered 490 m to a 100,000 ton stockpile. A transfer station at the stockpile transfers the material to a 42 in. conveyor which delivers the stone 350 m to a second transfer station. At this point, the

Photo NP-1-2.
SHIP LOADOUT AT OGDEN POINT QUARRY.



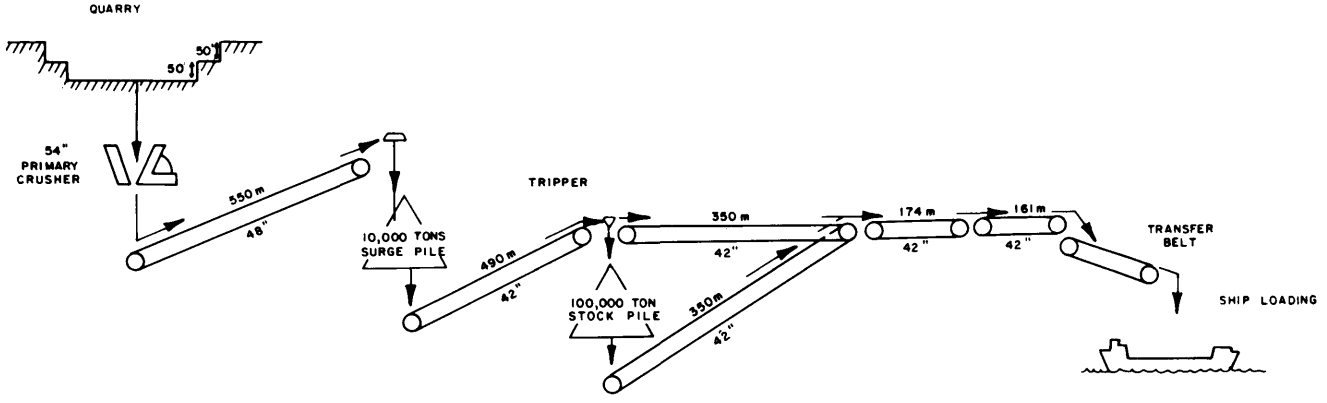


Figure NP-1-3. PROCESS FLOW SHEET FOR OGDEN POINT QUARRY.

material is transferred to two 42 in. conveyors and onto belts leading to the ship loader. Material which is not loaded directly is reclaimed from the stockpile by a 350 m, 42 in. belt which then transfers to the belts leading to the ship loader. All belts are covered. Water sprays are fitted at the primary crusher and at the ship loader to control dust.

The stone is shipped to the St. Lawrence Cement plant (site MA–1, Maple District) at Clarkson (Mississauga).

REFERENCES

Hewitt, 1960, p.49–51
Liberty, 1960c, p.3
Hewitt, 1964a, p.29–30
Mirynech and Liberty, 1964, p.35
Winder, 1964
Blair, 1965, p.52–54
Winder, 1966
Lee and Winder, 1967
Hewitt and Vos, 1972, p.41–42
Dolar–Mantuani, 1975, p.29–40
Carson, 1981d, Sect. D4 and D5

MAPS

Liberty, 1960d, GSC Map 17–1960
Carson, 1980b, OGS Map P.2375

NP-2 TRENTON GRAVEL PRODUCTS LTD. — CONSECON QUARRY

LOCATION AND OWNERSHIP

The Consecon Quarry is located 2 km southeast of Consecon just east of Highway 33, in Lot 107, Concession 5 Bayside, Hillier Township, Prince Edward County (Figure NP-2-1). The quarry is owned and operated intermittently by Trenton Gravel Products Ltd., a division of Harnden and King Construction Limited, and was formerly owned by H. J. McFarland Construction Company. The quarry licence covers an area of 20.3 ha.

GEOLOGY

The 11.2 m deep quarry has been excavated into the top of an east–west trending ridge of thin-bedded, nodular limestone of the lower member, Lindsay Formation. A second, currently inactive quarry, which exposes a similar section, is located immediately across Highway 33 on the west side. The bedrock surface on the ridge is covered with less than 0.25 m of overburden.

Geological Section

		Thickness
UNIT 1	*Lindsay Formation, lower member*	*11.2 m*

Limestone: light grey-brown to light grey, weathers light grey; microcrystalline alternating with fine- to coarse-grained bioclastic and calcarenitic limestone; ranges from thin to thick bedded (5-50 cm), with most thin bedded (5-10 cm), sharp contacts, ranging from planar to undulating, with thin shale partings common between beds; very fossiliferous, with brachiopods most abundant; upper 4 m displays distinct nodular texture, becoming very rubbly in uppermost 0.5 m.

Total thickness *11.2 m*

CHEMICAL ANALYSES *

Above Floor (m)	Components in Percent 5.24 - 7.07	3.41 - 5.24	0 - 11.2
SiO_2	11.80	9.79	14.60
Al_2O_3	2.90	2.50	3.68
Fe_2O_3	1.03	0.93	1.34
MgO	1.28	1.48	1.60
CaO	44.8	45.9	42.1
P_2O_5	0.06	0.07	0.05
SO_3	0.23	0.47	0.58
L.O.I.	37.1	38.0	35.3
Total	99.2	99.1	99.3

* *after Hewitt and Vos, 1972, p.30.*

QUARRY OPERATION

The quarry at present totals some 4 ha and is operated intermittently on a single 4.3 m lift. A drill pattern of 3 m x 3 m is used with 7.6 cm diameter holes, blasting conditions are dry and AN/FO is used as a bulk explosive. Crushing is contracted from within house.

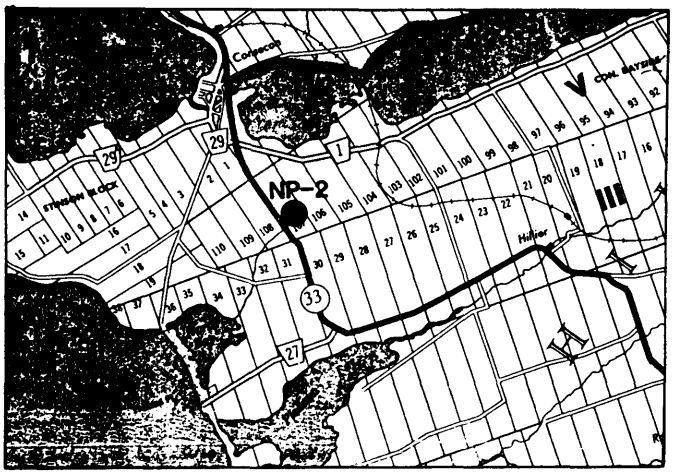


Figure NP-2-1. LOCATION MAP FOR CONSECON QUARRY.

PRODUCTS

Granular "A"
Granular "B"

REFERENCES

Goudge, 1938, p. 160
Hewitt, 1964a, p. 31
Hewitt and Vos, 1972, p. 30
Williams and Trotter, 1984

MAPS

Carson, 1980b, OGS Map P.2375

NP-3 H.J. McFARLAND CONSTRUCTION CO. — MOUNTAIN VIEW QUARRY

LOCATION AND OWNERSHIP

H. J. McFarland Construction Company intermittently operates this quarry east of Mountain View, in Lots 64–65, Concession 4, Ameliasburgh Township, Prince Edward County (Figure NP-3-1). The quarry licence covers an area of 15.75 ha.

GEOLOGY

Nodular limestone of the lower member, Lindsay Formation occurs in the 8.4 m deep quarry, which consists of two equal depth lifts. The most common lithology is a light grey, thin-bedded, very fine-crystalline limestone, interbedded with rare, thin shale partings. Also present are 10 cm thick beds of coarse-crystalline, bioclastic limestone, usually very fossiliferous. The uppermost metre in the quarry weathers into thin rubbly beds.

Figure NP-3-1. LOCATION MAP FOR MOUNTAIN VIEW QUARRY.

Geological Section

		Thickness
UNIT 1	*Lindsay Formation, lower member*	*8.4m*
	Limestone: blue-grey to medium grey, weathers light grey to light brown; very fine crystalline, with some coarse-crystalline beds, usually bioclastic; thin bedded (5-7 cm), with rare thin shale partings, commonly producing a nodular texture, coarser crystalline beds up to 10 cm thick; very fossiliferous with abundant shelly and trace fossils; uppermost metre of quarry very rubbly.	
Total thickness		*8.4m*

REFERENCES

Liberty, 1960a, p. 7

MAPS

Liberty, 1960b, GSC Map 45-1960

NP-4 HARVEY PUTNAM — CANNIFTON QUARRY

LOCATION AND OWNERSHIP

This quarry, owned and operated by Mr. Harvey Putnam, was opened in 1983 in Lot 10, Concession 3, Thurlow Township, Hastings County, at the intersection of Highways 37 and 401, 2 km north of Belleville (Figure NP-4-1). The property has a licensed area of approximately 20 ha.

GEOLOGY

The 6.2 m deep quarry exposes thin-bedded limestones and interbedded thinner shales of the Verulam Formation. Glacial overburden around the quarry site is thin, ranging from 0.5 m to 1 m in thickness.

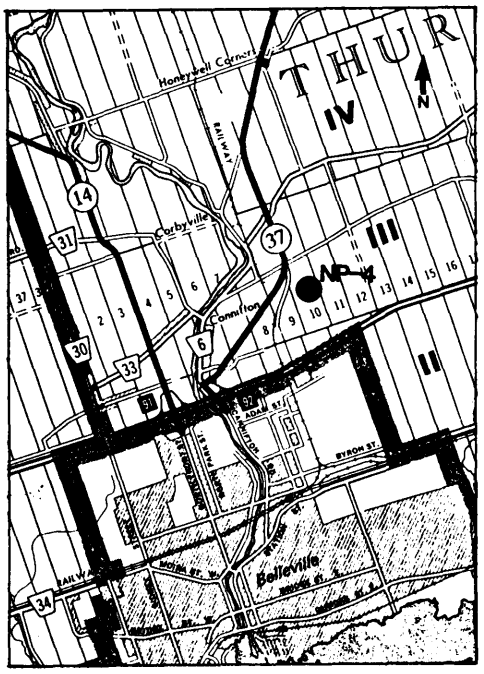


Figure NP-4-1. LOCATION MAP FOR CANNIFTON QUARRY.

Geological Section

		Thickness
UNIT 1	*Verulam Formation*	*6.2m*
	Interbedded limestone and shale: dark grey, weathers medium grey to grey brown; limestone either fine crystalline or coarse crystalline and bioclastic; thin- bedded (3-10 cm) limestone with thin interbeds (2-4 cm) of shale; sharp, planar to slightly undulating contacts; very fossiliferous.	
Total thickness		*6.2m*

QUARRY OPERATION

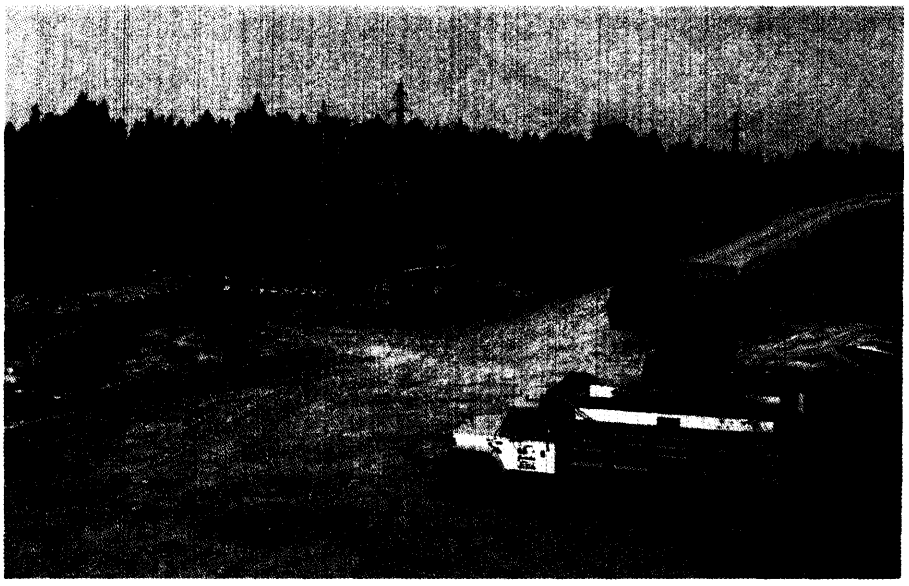
Overburden is stripped by a Lorain 6 yd. loader and piled along the quarry limits. The quarry is situated in the southern part of the property and is advancing in two lifts towards the southeast boundary. On reaching this limit, development will continue to the east. Drilling and blasting is contracted; a 2.1 m x 2.1 m pattern is used with 7.6 cm diameter holes. Nilite (AN/FO) is used as a bulk explosive, primed with Tovex (slurry cartridges) and initiated with electric caps. Approximately 10,000 tonnes of rock are blasted on a single shot.

PROCESSING

Crushing was performed on contract from the start of operations in 1983 until 1986, when Harvey Putnam took over the work.

The blasted rock is loaded by a Hough H100-C 5 yd. loader and transported to the primary crusher

Photo NP-4-1.
VIEW OF CANNIFTON QUARRY (LOOKING NORTH).



(Cedarapids 30 in. x 30 in. impeller). The product is separated by a 5 ft. x 10 ft. double-deck Dillon screen. The +3 in. oversize material is returned to the crusher; finished products are stockpiled by a 100 ft. stacker.

PRODUCTS

3 in. Crusher Run
7/8 in. Crusher Run
5/8 in. Crusher Run
3 in. Clear Stone
1 1/4 in. Clear Stone
3/4 in. Clear Stone
Tile Bed Stone

REFERENCES

None

MAPS

None

NP-5 H.J. McFARLAND CONSTRUCTION CO. — POINT ANNE (BELLEVILLE) QUARRY

LOCATION AND OWNERSHIP

The very large quarry located at Point Anne, 7 km east of Belleville, in Lots 16–27, Concessions 1 and Broken Front, Thurlow Township, Hastings County, is owned by Lafarge Canada Inc. and was operated as a source of stone for the manufacture of cement (Figure NP-5-1). Operations ceased in 1981 and the quarry is now partially filled with water. Subsequently, H.J. McFarland Construction Co. has excavated into the east face of the upper lift to obtain stone for aggregate, under an operating agreement with Standard Industries Ltd. (a division of Lafarge). The property has been in operation since the late 1800s. The quarry licence covers an area of 619.6 ha.

Figure NP-5-1. LOCATION MAP FOR POINT ANNE (BELLEVILLE) QUARRY.

GEOLOGY

The quarry is over 30 m deep and when dry exposes limestones of the Gull River and Bobcaygeon Formations

(Hewitt, 1960). Above the present water level, up to 10 m of the Bobcaygeon Formation are still exposed, although inaccessible. At the newly exposed section in McFarland's quarry, 8 m of generally thin- to medium-bedded, microcrystalline to medium-crystalline limestone of the Bobcaygeon Formation is exposed. Glacial overburden around the original quarry varied from 1 to 5 m in thickness.

REFERENCES

Goudge, 1938, p.90-92
Hewitt, 1960, p. 57-61
Hewitt, 1964a, p. 31
Blair, 1965, p.52-54
Hewitt and Vos, 1972, p. 16

MAPS

Liberty, 1960b, GSC Map 45-1960
Carson, 1981a, OGS Map P.2412

NP-6 H.J. McFARLAND CONSTRUCTION CO. — LONG QUARRY

LOCATION AND OWNERSHIP

The Long Quarry is located in Lot 6, Concession 3, Tyendinaga Twp., Hastings County and is 6 km north of Shannonville (Figure NP-6-1).

Figure NP-6-1. LOCATION MAP FOR LONG QUARRY.

The quarry is owned by Mr. Arthur Long, licensed to Charles H. Demill Construction Ltd., and is leased and operated by H. J. McFarland Construction Co. The property has a licensed area of approximately 24 ha. The excavated area of the quarry is approximately 12 ha. The quarry operates from April to November.

GEOLOGY

The 6.7 m deep quarry exposes interbedded limestones and shales of the Verulam Formation. The limestones vary from very fine-crystalline to medium-crystalline and bioclastic. The gently northward-rising bedrock surface results in higher quarry faces at the north end of the quarry. Glacial overburden around the quarry is up to 2 m thick.

Geological Section

		Thickness
UNIT 1	*Verulam Formation*	*6.7m*
	Interbedded limestone and shale: dark grey, weathers medium grey to grey-brown; either very fine crystalline or medium crystalline and bioclastic; thin to medium bedded (5-15 cm) with shale beds up to 5 cm thick; sharp, slightly undulating to planar contacts; very fossiliferous.	
Total thickness		*6.7m*

QUARRY OPERATION

Overburden is stripped by Caterpillar 988 (7 yd.) loader and D8 bulldozer. The quarry limits have been reached to the south, west and east and it is advancing northward on a single 6.7 m lift. Drilling and blasting is subcontracted; a 2.6 m x 2.6 m drill pattern is used with 7.6 cm diameter holes. AN/FO (Amex) is used for the column charge, primed with Forcite 75% stick powder and initiated by electric caps. A Flygt 2 in. electric submersible pump handles dewatering of the quarry.

PROCESSING

The blasted stone is transported approximately 50 m by Cat 988 loader to the primary feed hopper. Primary crushing is by Cedarapids 36 in. x 45 in. double impeller crusher. The crushed stone (- 4 in.) is sent to a 40-ton surge bin and fed to an 8 ft. x 20 ft. triple-deck Tyler screen. The top deck produces a - 4 in. + 1 1/4 in. oversize that is sent to a secondary crusher (4 ft. Symons short head), the middle deck produces - 1 1/4 in., + 1 in. or - 1 1/4 in., + 3/4 in. tile bed stone, and the bottom deck produces - 3/4 in. + 1/4 in. or 100% - 1 in. + 1/4 in. and - 1/4 in. screenings. The bottom deck oversize product is weighed by belt scale and sent by field conveyor to an 80 ft. radial stacker. The - 1/4 in. screenings are sent to an 80 ft. radial stacker and repiled by Michigan 125-III-A (4 yd.) loader. The operation has a washing facility that produces 5/8 in. and 3/8 in. chips from the bottom deck oversize.

PRODUCTS

+9 in. Riprap

Photo NP-6-1.
PROCESSING PLANT AT LONG QUARRY (LOOKING WEST).

-9 in. +4 in. Gabion Stone
6 in. Crusher Run
4 in. Crusher Run
7/8 in. Crusher Run
5/8 in. Crusher Run
-1 1/2 in. +3/4 in. Tile Bed Stone
Screenings
HL3
HL4
HL8

REFERENCES

None

MAPS

Liberty, 1960b, GSC Map 45-1960
Carson, 1981a, OGS Map P.2412

NP-7 LAKE ONTARIO CEMENT LTD. — PICTON QUARRY AND PLANT

LOCATION AND OWNERSHIP

Lake Ontario Cement Ltd. operates a large quarry and cement plant on a 405 ha property on the west shore of Picton Bay, 4 km northeast of Picton in Lots 13 to 18, Concession 1, Sophiasburg Township, Prince Edward County (Figure NP-7-1). Highway 49 passes through the property. The cement plant is equipped with four dry process kilns, two of which are maintained on standby. The original plant was built in 1958 and has been subject to several modernizations and expansions, the last being in 1978.

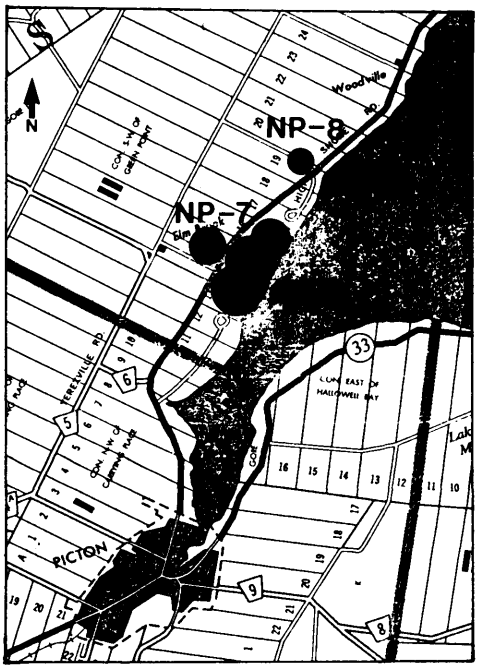


Figure NP-7-1. LOCATION MAP FOR PICTON QUARRY.

GEOLOGY

The main quarry to the south exposes 34.5 m of limestones and shales of the Verulam Formation and 19.5 m of limestones of the overlying lower member, Lindsay Formation (Figure NP-7-2). A total of 54 m of strata is exposed in three large lifts in this quarry. The new quarry

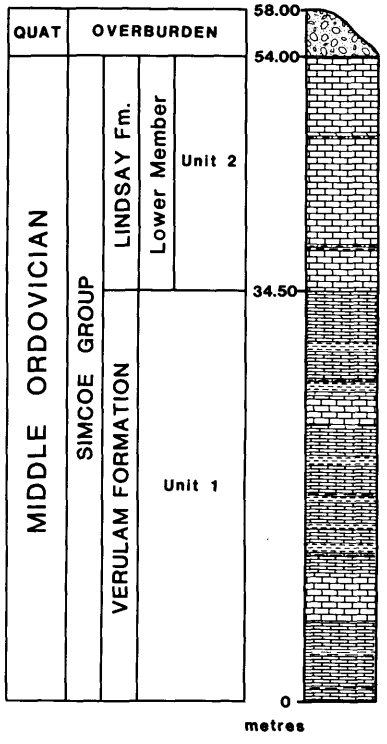


Figure NP-7-2. STRATIGRAPHIC COLUMN FOR PICTON QUARRY.

to the north exposes about 10 m of the Lindsay Formation.

Up to 4 m of glacial overburden, which was previously used as a source of silica and clay, overlies a massive, grey, medium-bedded limestone of the Lindsay Formation. These rocks have a very shallow dip to the south and trend slightly north of west.

The Verulam Formation consists of interbedded limestones and shale. The limestone ranges from fine-crystalline, non-fossiliferous limestone to coarse-grained bioclastic calcarenite. The interbedded shales are commonly burrowed. The overlying lower member of the Lindsay Formation consists of medium-bedded limestones which range from fine to medium-crystalline. These limestone beds commonly are separated by very thin, undulating shale partings which impart a distinctive nodular texture to this member.

On the western side of the main quarry an ultramafic dyke is visible. Recent paleomagnetic and K-Ar age-dating studies conducted on this rock revealed that the intrusive was emplaced during the Jurassic (Barnett et al., 1984).

Drillhole No. 85-1 was drilled by Lake Ontario Cement in 1985 in the immediate vicinity of the Main Quarry and analysed over its entire length of 60.96 m. The analytical results as reported by Lake Ontario Cement are presented in Tables NP-7-1 and NP-7-2. Precise correlation of the Lindsay and Verulam Formations with the analytical results is not available but the Lindsay Formation is characterized by lower SiO_2 (7.74% versus 13.58%), Al_2O_3 (1.85% versus 3.91%), K_2O, Fe_2O_3, TiO_2, P_2O_5 and F, and higher CaO (48.4% versus 42.85%) and L.O.I. The content of MgO is fairly constant within the range of 0.97% to 1.71%.

The high lime section of the Lindsay Formation encountered at Lake Ontario's quarry correlates with the high lime horizon in the Ogden Point Quarry (NP-1). These two sections of the Lindsay are comparable even to the higher Cl and K_2O zone underlying the high lime section.

Geological Section

		Thickness
UNIT 2	*Lindsay Formation, lower member*	*19.5m*

Limestone: dark grey, weathers light to medium grey; fine to medium crystalline; medium bedded (10 - 25 cm), with rare, very thin shale and shaly limestone partings present between some beds, otherwise contacts sharp and planar; sparsely fossiliferous; uppermost 5-10 m around the quarry exhibits a nodular to rubbly texture of varying amounts, best developed in areas of jointing; bedrock surface usually weathers into rubble; lower contact of unit sharp and planar, enhanced by a zone of water seepage; top of second lift 5.5 m above base of unit.

UNIT 1	*Verulam Formation*	*34.5m*

Interbedded limestone and shale: dark grey, weathers medium grey; limestones either fine crystalline or medium to coarse grained, bioclastic and calcarenitic; limestone thin (5-10 cm) to rarely medium bedded (10-15 cm) with thin (2-8 cm) interbeds of shale; thin calcite veins coat joint surfaces; very fossiliferous with abundant brachiopods, trilobites, bryozoans and crinoidal debris, shales commonly burrowed; top of first (lowest) lift 13.5 m above base of unit.

Total thickness	*54.0m*

QUARRY OPERATION

Lake Ontario Cement operates two quarries. The original, or South quarry, has been developed on three benches. The upper bench is 12 m in height and consists of massive-bedded high carbonate rock. The middle bench is 20 m high and is composed of thin-bedded, low carbonate rock. The lower bench is 12 m and is composed of a natural cement rock.

The new North quarry has been opened up on the north side of Highway 49. Access to the quarry is provided by a tunnel completed in 1985 that was developed by top drilling and blasting and has its roof epoxy bolted and screened. The tunnel is sufficiently wide to accommodate 35-ton trucks plus a 42 in. belt conveyor, which is planned for later installation. The North quarry has been designed on 10.6 m benches for possible aggregate production.

TABLE NP-7-1. TYPICAL CHEMICAL ANALYSES, PICTON QUARRY OF LAKE ONTARIO CEMENT CO.

Depth	0-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
SiO_2	9.98	7.89	5.96	5.71	6.76	7.73	7.97	7.02	7.72
Al_2O_3	1.99	1.94	1.46	1.39	1.55	1.89	1.94	1.58	1.86
CaO	48.3	48.3	49.6	50.0	48.8	49.1	48.0	48.9	47.8
MgO	0.97	1.41	1.26	1.18	1.32	1.39	1.37	1.37	1.45
Na_2O	0.09	0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	0.01
K_2O	0.37	0.30	0.13	0.12	0.22	0.32	0.2	0.23	0.27
Fe_2O_3	0.85	0.90	0.77	0.74	0.92	0.98	0.87	0.83	0.94
MnO	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
TiO_2	0.06	0.09	0.05	0.06	0.05	0.03	0.07	0.06	0.06
P_2O_5	0.14	0.09	0.09	0.08	0.08	0.08	0.08	0.03	0.03
Cr_2O_3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
L.O.I.	37.8	38.8	39.9	39.3	39.5	38.8	38.5	39.2	38.5
Sum	100.7	99.8	99.3	98.6	99.2	100.5	99.1	99.3	98.8

Depth	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95
SiO_2	8.18	10.2	13.0	12.4	12.1	20.7	15.3	16.3	12.4
Al_2O_3	2.07	2.68	3.84	3.60	3.37	5.97	4.55	4.95	3.59
CaO	47.8	46.1	43.4	44.3	44.8	36.1	41.6	39.8	43.7
MgO	1.38	1.36	1.55	1.47	1.50	1.71	1.45	1.45	1.34
Na_2O	0.02	0.03	0.02	0.04	0.05	0.03	0.04	0.06	0.03
K_2O	0.33	0.41	1.04	0.66	0.53	1.40	0.88	1.24	0.83
Fe_2O_3	0.94	1.16	1.57	1.42	1.41	2.34	1.75	1.71	1.42
MnO	<0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.01
TiO_2	0.08	0.08	0.13	0.12	0.13	0.21	0.16	0.17	0.13
P_2O_5	0.08	0.09	0.09	0.11	0.16	0.22	0.14	0.11	0.12
Cr_2O_3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
L.O.I.	33.4	36.5	34.8	35.3	35.8	29.5	33.4	32.5	35.4
Sum	99.3	98.7	99.5	99.5	99.9	98.3	99.3	98.5	99.0

Depth	95-100	100-105	105-110	110-115	115-120	120-125	125-130	130-135	135-140
SiO_2	15.1	12.6	13.7	15.1	19.9	13.2	13.4	12.7	11.9
Al_2O_3	4.37	3.48	3.56	4.26	5.70	3.69	3.79	3.53	3.32
CaO	41.4	44.8	43.1	41.8	37.7	43.5	42.8	44.0	44.5
MgO	1.45	1.37	1.46	1.46	1.71	1.41	1.34	1.30	1.28
Na_2O	0.05	0.03	0.02	0.06	0.09	<0.01	0.06	0.01	0.02
K_2O	0.98	0.71	0.75	0.90	1.27	0.73	0.82	0.71	0.65
Fe_2O_3	1.44	1.32	1.26	1.51	1.92	1.37	1.32	1.18	1.20
MnO	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.01
TiO_2	0.15	0.12	0.12	0.15	0.20	0.13	0.13	0.13	0.11
P_2O_5	0.11	0.11	0.10	0.12	0.13	0.11	0.13	0.11	0.11
Cr_2O_3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
L.O.I.	34.2	36.0	35.5	34.3	30.9	35.4	35.2	35.9	36.4
Sum	99.3	100.6	99.6	99.8	99.6	99.6	99.1	99.7	99.6

Depth	140-145	145-150	150-155	155-160	160-165	165-170	170-175	175-180	180-185	185-190
SiO_2	12.2	10.1	15.6	15.1	14.0	15.7	13.9	11.6	10.5	11.2
Al_2O_3	3.13	2.68	4.39	3.96	3.74	4.44	4.30	3.53	3.28	3.89
CaO	44.4	45.9	40.7	41.8	42.8	40.7	41.9	44.2	45.0	43.6
MgO	1.36	1.22	1.61	1.66	1.43	1.49	1.38	1.40	1.38	1.45
Na_2O	<0.01	<0.01	<0.01	0.04	0.04	0.05	0.06	0.07	0.04	0.04
K_2O	0.66	0.52	1.08	0.82	0.76	1.01	0.89	0.62	0.57	0.81
Fe_2O_3	1.17	1.05	1.44	1.35	1.33	1.60	1.49	1.24	1.14	1.29
MnO	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01
TiO_2	0.12	0.09	0.16	0.13	0.14	0.15	0.15	0.12	0.12	0.13
P_2O_5	0.12	0.10	0.11	0.11	0.11	0.18	0.15	0.10	0.10	0.10
Cr_2O_3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
L.O.I.	36.2	37.6	33.9	34.4	35.0	33.6	34.7	36.4	37.2	36.5
Sum	99.5	99.4	99.1	99.5	99.4	99.0	99.0	99.3	99.4	99.0

Note: The boundary between the Verulam and Lindsay Formations is found at approximately 50-foot depth.

TABLE NP-7-2. TYPICAL CHEMICAL ANALYSES, PICTON QUARRY OF LAKE ONTARIO CEMENT CO.

Depth	0-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55
F (ppm)	240	260	280	200	220	240	260	250	240	290
S (%)	0.21	0.38	0.35	0.41	0.52	0.49	0.44	0.47	0.54	0.54
Cl (ppm)	200	200	250	300	200	150	200	200	200	200

Depth	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105
F (ppm)	340	520	500	550	810	550	620	560	620	630
S (%)	0.63	0.77	0.69	0.63	1.04	0.76	0.73	0.60	0.55	0.41
Cl (ppm)	250	200	150	100	150	100	50	200	150	100

Depth	105-110	110-115	115-120	120-125	125-130	130-135	135-140	140-145	145-150	150-155
F (ppm)	620	680	850	600	620	630	590	550	540	750
S (%)	0.44	0.48	0.67	0.50	0.45	0.35	0.38	0.35	0.31	0.43
Cl (ppm)	100	100	150	100	200	200	200	200	150	150

Depth	155-160	160-165	165-170	170-175	175-180	180-185	185-190	190-195	195-200
F (ppm)	660	720	740	620	640	630	660	560	660
S (%)	0.37	0.41	0.53	0.45	0.38	0.32	0.33	0.30	0.35
Cl (ppm)	250	200	200	250	300	250	400	300	550

Note: the boundary between the Verulam and Lindsay Formations is found at approximately 55-foot depth.

Access to the South pit is provided by 7.6 m wide roads to the pit floor and the intermediate benches. Haulage distances for transport of shot rock from the quarry face to the primary crusher vary from 460 m to 1,000 m.

Drilling is carried out with an Ingersoll–Rand DMD4 rig using 16.5 cm bits, on a 5.2 m x 5.8 m pattern to bench depth. The blasting agent is AN/FO, using prills and a 13% fuel mix for dry holes or a premix watergel for wet holes. Explosives requirements range from 4.5 to 7.0 kg per tonne of rock. Secondary breakage is required for shot rock from the first and third benches, and is done by drop ball, rock breaker or limited secondary blasting.

PROCESSING

Loading of shot rock is by one 12 yd. and four 7 yd. front–end loaders into two 50–ton Wabco and three 35–ton Wabco rear dump units. Material is delivered to a KVS 48 in. gyratory primary crusher set at –5 in. and having a capacity of 450 tons per hour. Material from the primary crusher is carried by a 42 in. belt conveyor equipped with a continuous weigh scale to a 60,000 tonne surge pile, that is is divided into two sections to separate the high carbonate and low carbonate material. The conveyor is on a swing mechanism to allow placement of the rock.

Primary crushed material is recovered from the surge pile by two parallel 36 in. conveyor systems. One system delivers material to a 48 in. Pennsylvania impact crusher which reduces the stone to –1/2 in. This crusher operates in closed circuit with Tyler screens. The second conveyor delivers material to a swing beam mill to reduce the rock to –3 in. size. Secondary crushed material is then conveyed directly to the roller mills, ball mills or to raw material storage.

Mill scale, Hay Bay sand and/or Potsdam Formation sandstone are added at the secondary crushing stage to yield the raw mix.

In general, material from the impact crusher (–1/2 in.) is delivered to the ball mills. Material from the swing beam mill (–3 in.) is delivered to the roller mill (also capable of accepting –1/2 in. material from the impact crusher).

There are two primary raw mills. The main raw mills are Loesche roller mills, installed in 1974, which combine the grinding, drying and classifying steps in one operation. Material from the roller mills is passed to the blending silos for final blending and storage.

Two 11 ft. x 20 ft., 1,250 hp KVS ball mills provide additional grinding capacity of 150 tons per hour. Material from the ball mills is also transferred to the blending and storage silos. Total raw feed storage capacity is 10,000 tons in 8 silos.

KILNS

The primary kiln is an F.L. Smidth 17 ft. x 270 ft., 3,000 ton per day unit equipped with a four-stage preheater. The kiln is coal fired but can also be fired by gas. This kiln mostly uses material from the roller mills. There is a second Allis-Chalmers kiln measuring 13 ft. 6 in. x 500 ft. with a capacity of 1,100 tons per day. This kiln is used to supplement the capacity of the larger kiln and to produce low alkali clinker. The kiln is coal fired with gas firing as auxiliary, and processes raw mill mix from the ball mills.

Two 11 ft. x 375 ft., 650 tons per day, KVS kilns are maintained on standby. They are also coal fired.

Coal for the kilns is stored on the shore and trucked daily to a 1,000 ton storage bin where it is withdrawn and processed to -200 mesh in KVS and Raymond mills.

Raw kiln feed from the blending silos is transferred by airslide and screw pump to the 4-stage preheater tower. The preheater is equipped with two gas conditioners. The raw kiln feed enters the first stage of the preheater at 650°F and exits the fourth stage of the preheater at a temperature of 1,800°F. The preheater and kiln are controlled by an HP process controller and F.L. Smidth digital system. Both kilns are fitted with electrostatic precipitators.

Hot clinker is discharged to a grate cooling system, sized, and then passed to clinker storage. The second kiln also has a grate cooling system.

Chloride control has been troublesome as the chloride content in the stone is very erratic. Best operation of the preheater and kiln is achieved when Cl_2 content in the stone is below 0.02%. Chloride content is controlled through selective quarrying.

Clinker for export is moved by conveyor from storage to loading at dockside. Clinker and gypsum for grinding are recovered and passed to five finish grinding mills. These consist of two KVS 11 ft. x 20 ft., 1,250 hp ball mills and one F.L. Smidth 9.5 ft. x 26 ft., 1,250 hp mill and two 11 ft. 6 in. x 32 ft. 2,250 hp Allis-Chalmers ball mills. The mills are in closed circuit with air classifiers.

Finished cement is transferred by airslide and screw pump to storage in the packhouse (19,000 tons) or to storage in the dockside silos (16,800 tons). Shipment is by boat, bulk rail, truck, and in bags.

PRODUCTS

Normal Portland
High Early Strength Portland
Sulfate Resisting Portland
Low Heat of Hydration Portland
Masonry Cement

REFERENCES

Hewitt, 1960, p. 54-60
Hewitt, 1964a, p. 31-32
Blair, 1965, p.52-54
Hewitt and Vos, 1972, p. 27-28
Dolar-Mantuani, 1975
Barnett et al., 1984

MAPS

Liberty, 1960b, GSC Map 45-1960

NP-8 MILLER PAVING LIMITED — PRINCE EDWARD (PICTON) QUARRY

LOCATION AND OWNERSHIP

The Prince Edward Quarry is located 8 km northeast of Picton in Lots 19 and 20, Concession 1, Sophiasburg Twp., Prince Edward County (Figure NP-8-1). The quarry was opened in 1976 by John Doranburg of Picton and in February of 1986, the property was purchased by Miller Paving Limited, the present operators. The quarry licence covers an area of 47.6 ha. The quarry is within a few hundred metres of the the waters of the Bay of Quinte. The northwest part of the quarry is under a separate licence of 8.1 ha held by H.J. McFarland Construction Co.

GEOLOGY

The 6.4 m deep quarry exposes thin-bedded, nodular limestone of the lower member of the Lindsay Forma-

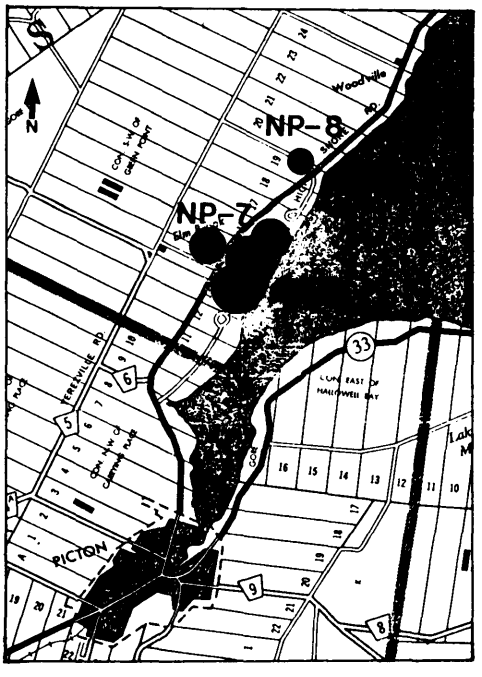


Figure NP-8-1. LOCATION MAP FOR PRINCE EDWARD (PICTON) QUARRY.

tion. The beds consist of fine- to medium-crystalline limestone with some interbeds of very coarse-grained calcarenites which are quite fossiliferous. Glacial overburden around the quarry is generally less than 0.5 m in thickness.

Geological Section

	Thickness
UNIT 1 Lindsay Formation, lower member	*6.4m*
Limestone: medium to dark grey, weathers light to medium grey; dominantly fine to medium crystalline with some beds very coarse grained and calcarenitic; thin-bedded (2-10 cm) with thin shale partings common between beds, undulating contacts producing a nodular texture, especially in uppermost 2 m of quarry; very fossiliferous, especially on bedding planes.	
Total thickness	*6.4m*

QUARRY OPERATION

The Prince Edward Quarry covers an area of about 8 ha on a lift of 6.4 m. Currently the primary products are crusher run materials, though a chemical analysis and marketing study of the stone is underway to determine other potential uses. Drilling and blasting is subcontracted, and a drill pattern of 2.4 m x 2.4 m is used with 7.6 cm diameter holes.

PROCESSING

Crushing is performed by Miller Paving Limited with a portable system consisting of a primary impeller impactor and double-deck screen that is assembled as required.

PRODUCTS

Armour Stone
3 in. Crusher Run
7/8 in. Granular "A"
5/8 in. Granular "A"
3/4 in. Clear
2 in. Oversize (Road Base)

REFERENCES

Hewitt and Vos,1972, p. 34
Williams and Trotter, 1984

MAPS

Carson, 1981a, OGS Map P.2412

NP-9 TRENTON GRAVEL PRODUCTS LTD. — NAPANEE QUARRY

LOCATION AND OWNERSHIP

The Napanee Quarry is located in Lot 12, Concession 1, Richmond Township, Lennox and Addington County, 3 km southwest of Napanee (Figure NP-9-1). The quarry was opened in 1972 by Covert Construction and purchased in 1984 by Trenton Gravel Products. The property is not within an area designated under the Pits and Quarries Control Act. The area of the quarry is approximately 2.5 ha.

GEOLOGY

The 7 m deep quarry exposes interbedded limestones and shales of the Verulam Formation; the former varies from fine-crystalline limestone to coarse-grained calcarenite. The quarry is deeper at the north end because of the southerly sloping bedrock surface. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Verulam Formation	*7.0m*
Interbedded limestone and shale: dark grey, weathers light grey-brown; limestone is either fine to medium crystalline or is coarse to very coarse grained, usually bioclastic or calcarenitic; gently undulating contacts; coarser crystalline limestone usually has small patches of calcite crystals, commonly the result of recrystallization of fossil debris; very fossiliferous with abundant brachiopods, trilobites, bryozoans, and crinoidal debris; shale may also contain varying amounts of very thin laminae of very fine-crystalline limestone.	
Total thickness	*7.0m*

QUARRY OPERATION

A single lift of 7 m is currently excavated, with potential for a second lift of approximately 6.0 m. Drilling and blasting is subcontracted: a 2.7 m x 2.7 m drill pattern is

Figure NP-9-1. LOCATION MAP FOR NAPANEE QUARRY.

Photo NP-9-1. STOCKPILE AREA AT NAPANEE QUARRY (LOOKING NORTHEAST).

practised with 7.6 cm diameter drill holes. Crushing is performed on demand by an associated company (Harnden & King Construction Ltd.), using portable equipment.

PRODUCTS

Gabion Stone 8 in. x 8 in.
7/8 in. Crusher Run
5/8 in. Crusher Run
1 1/2 in. Clear
3/4 in. Clear
Prime Rock –4 in.
Shot Rock
Brick Sand
Sand Fill

REFERENCES

None

MAPS

Carson, 1982a, OGS Map P.2497

NP-10 H.J. McFARLAND CONSTRUCTION CO. — ROBLINDALE QUARRY

LOCATION AND OWNERSHIP

The Roblindale Quarry is owned by H.J. McFarland Construction of Belleville and is located east of Roblindale village, about 10 km north of Highway 401, in Lot 1, Concession 6, Camden East Township, Lennox and Addington County (Figure NP–10–1). During field work in June 1986, the quarry was not in operation.

The quarry was very active in the 1940s and 1950s and was mined to a depth of 18.3 m on three lifts. The quarry is not in an area designated under the Pits and Quarries Control Act.

GEOLOGY

The 18.3 m face exposes 3 m of the upper member of the Gull River Formation, overlain by 15.3 m of the lower member of the Bobcaygeon Formation (Figure NP–10–2). The contact between the formations is diffi-

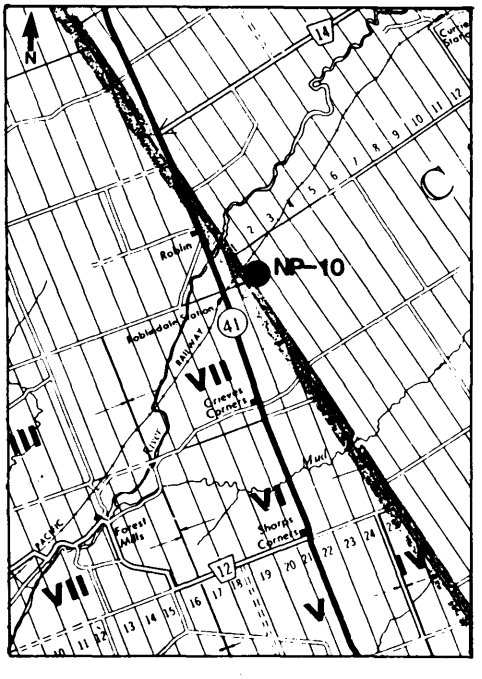


Figure NP-10-1. LOCATION MAP FOR ROBLINDALE QUARRY.

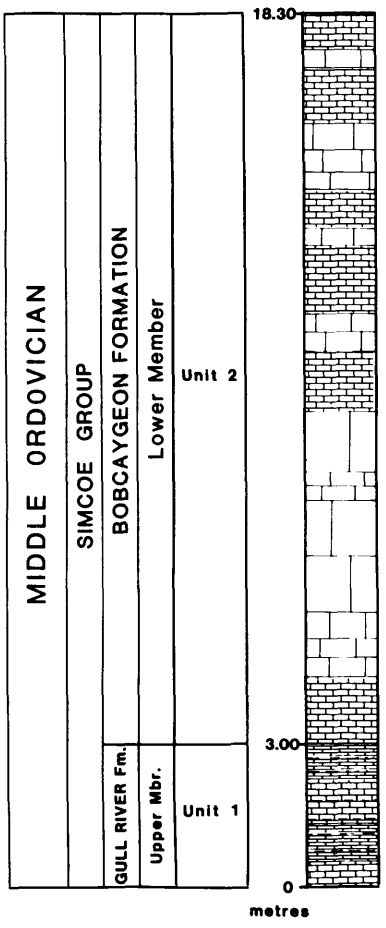


Figure NP-10-2. STRATIGRAPHIC COLUMN FOR ROBLINDALE QUARRY.

cult to see because extensive blasting in the quarry has created thinner beds than are usual through this interval.

The upper member of the Gull River Formation in this quarry consists of grey–brown, light grey weathering, microcrystalline, thin– to medium–bedded (7–12 cm) limestone, with thin dark grey shale partings commonly separating the limestone beds. The overlying lower member of the Bobcaygeon Formation is characterized by medium grey, light grey weathering, fine– to medium–crystalline and medium– to coarse–grained calcarenitic, medium– to thick–bedded (10–50 cm) limestone. Shale partings are generally absent through this interval.

The uppermost part of the section includes several massive beds, greater than 1 m thick. The formational contact is marked by a distinct limestone conglomerate in the Bobcaygeon Formation –– microcrystalline limestone clasts occur in a matrix of fine– to medium–crystalline limestone. Glacial overburden around the top of the quarry is 1 to 3 m thick.

Geological Section

		Thickness
UNIT 2	*Bobcaygeon Formation, lower member*	*15.3m*

Limestone: medium grey, weathering light grey, light brown in upper beds; fine to medium crystalline and medium to coarse grained calcarenitic, rarely microcrystalline; medium bedded to massive (10–50 cm in lower part, over 1 m in upper part); small patches of calcite crystals common in coarser calcarenites; generally fossiliferous, some beds contain many fragments of coral *Tetradium*; lowermost 0.3 m includes limestone conglomerate with microcrystalline clasts in a fine– to medium–crystalline matrix; lower contact of unit sharp and irregular, at base of conglomerate.

UNIT 1	*Gull River Formation, upper member*	*3.0m*

Limestone: medium grey to grey–brown, weathers light grey; microcrystalline to fine crystalline; thin to medium bedded (7–12 cm) commonly separated by thin, dark grey shale partings; small patches of calcite crystals, "birdseye" texture, common in microcrystalline beds.

Total thickness	*18.3m*

REFERENCES

Goudge, 1938, p.125
Hewitt, 1960, p.61–63
Hewitt, 1964a, p.32
Sabina, 1970, p.94–95
Hewitt and Vos, 1972, p.41
Verschuren et al., 1985, p.50

MAPS

Liberty, 1963b, GSC Map 24–1963
Hewitt, 1964e, ODM Map 2053
Carson, 1981b, OGS Map P.2411

NP–11 CUSTOM MOBILE CONCRETE — SELBY QUARRY

LOCATION AND OWNERSHIP

This small quarry located in Lot 21, Concession 3, Richmond Township, Lennox and Addington County is used by Custom Mobile Concrete as a source of aggregate for concrete (Figure NP–11–1).

GEOLOGY

The 6.0 m deep quarry exposes thin–bedded shaly limestone of the Verulam Formation beneath glacial overburden that is generally 1 m thick. A very old abandoned quarry (Liberty, 1971d), almost totally filled in, is located just to the east between Highway 41 and the concrete plant.

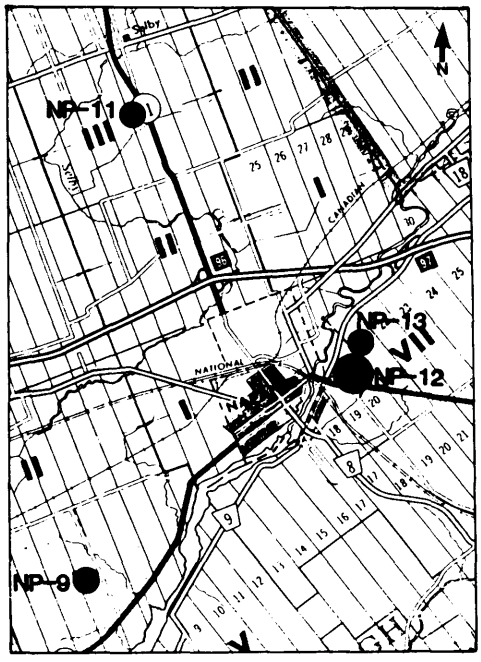


Figure NP-11-1. LOCATION MAP FOR SELBY QUARRY.

NP-12 J.R. STOREY CONSTRUCTION LTD. — NAPANEE QUARRY

LOCATION AND OWNERSHIP

J.R. Storey Construction Ltd. owns and operates this quarry in Lot 19, Concession 7, North Fredericksburgh Township, Lennox and Addington County, located on the eastern outskirts of Napanee, north of Highway 2 (Figure NP-12-1). The quarry has been expanded to include what was once known as H.J. McFarland's Napanee Quarry (Hewitt, 1964c, p. 33). The Storey family has operated the Napanee Quarry and adjacent North Fredericksburg Quarry since the turn of the century. This quarry is not in an area designated under the Pits and Quarries Control Act and has an area of 6.6 ha.

GEOLOGY

The 16 m of strata in the quarry consist of predominantly thin-bedded limestone of the upper member, Gull River Formation. Most of the limestone is microcrystalline to very fine crystalline and only rarely do coarser-crystalline beds occur. Thin shale partings commonly occur between the limestone beds, especially in a 0.75 m thick interval in the uppermost unit in the quarry. Bedrock is overlain by up to 2 m of glacial overburden.

Geological Section

		Thickness
UNIT 1	*Verulam Formation*	*6.0m*
	Interbedded limestone and shale: medium to dark grey, weathers light grey; medium to coarse (rarely very coarse) crystalline limestone, laminae of very fine-crystalline limestone also present in shale; thin to medium bedded (5-15 cm), with shale beds 1-3 cm thick, sharp contacts, planar to slightly undulating; very fossiliferous with abundant brachiopods, trilobites, bryozoans, and crinoidal debris.	
Total thickness		*6.0m*

REFERENCES

Goudge, 1938, p.126

MAPS

Hewitt, 1964e, ODM Map 2053
Liberty, 1971d, GSC Map 17-1970

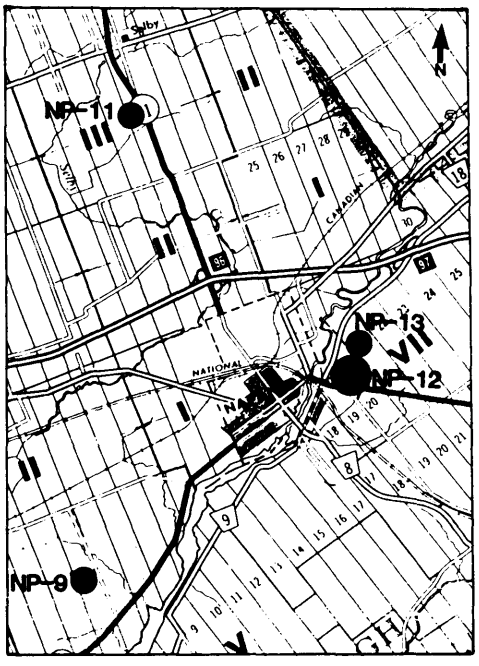


Figure NP-12-1. LOCATION MAP FOR NAPANEE QUARRY.

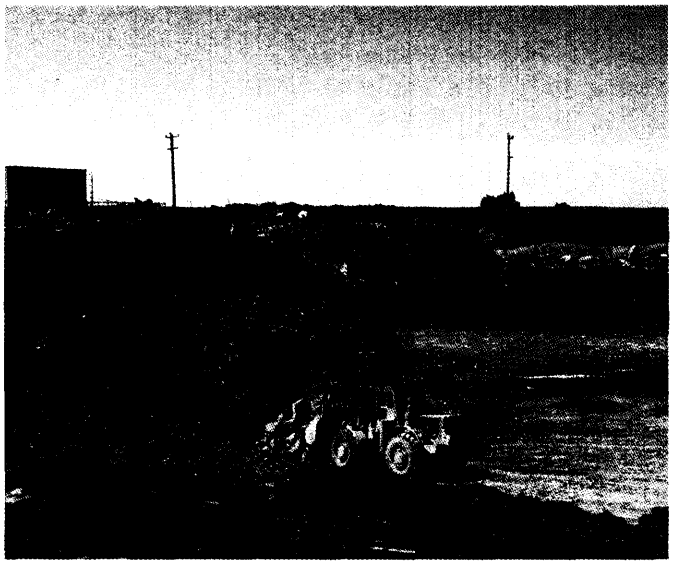


Photo NP-12-1. TEREX 7251 LOADER HAULING BLASTED ROCK TO CRUSHER; NAPANEE QUARRY (LOOKING SOUTH).

The quarry limestone possesses a very high lime content (38.8% CaO) and conversely, low magnesia (0.73% MgO) and silica contents (less than 0.1% SiO_2).

Geological Section

		Thickness
UNIT 3	*Gull River Formation, upper member*	*5.7m*

Limestone: dark to medium grey, weathers light to medium grey; microcrystalline to very fine crystalline; medium bedded (10–20 cm) with very thin shale partings common between most beds, uppermost bed 30 cm thick; 4.25 m above base of unit is a 0.75 m interval of thinner bedded, fine-crystalline limestone interbedded with thin-laminated, fissile, shaly limestone and shale; small calcite crystals common in most beds; fossiliferous with brachiopods and trilobites most abundant; lower contact of unit sharp and planar at base of lowest shale parting.

UNIT 2	*Gull River Formation, upper member*	*4.7m*

Limestone: dark grey, weathering medium grey to light brown; microcrystalline to very fine crystalline; thin bedded (5–10 cm), with sharp, planar contacts; small calcite crystals common; moderately fossiliferous; west side of quarry at bedrock surface, with the surface rising to the southeast; lower contact of unit sharp and planar; top of the middle lift at top of unit.

UNIT 1	*Gull River Formation, upper member*	*5.6m*

Limestone: dark grey, weathering medium grey; microcrystalline to very fine crystalline; thin to medium bedded (5–15 cm) in very regular beds with sharp and planar contacts, generally shale-free; small calcite crystals very abundant; sparsely fossiliferous; top of the lower lift at top of this unit.

Total thickness	*16.0m*

QUARRY OPERATION

The quarry has been excavated into the crest of a northeast trending escarpment and the present working face is in the southwest corner. The complex lift pattern exposed in the quarry is the result of a long operating history and an uneven bedrock surface. Three primary lifts can be identified, totalling 16.0 m in thickness.

The first lift of 4.5 m has been completely extracted; a second lift of about 6.0 m is presently in production. Drilling and blasting is subcontracted; a drill pattern of 2.4 m x 2.4 m used with 7.6 cm diameter holes. Amex II (AN/FO) is used as a bulk explosive, primed with Forcite 75%, initiated with electric delay caps.

PROCESSING

The blasted stone is loaded and transported by a Cat 988 loader to the portable crushing system. Primary crushing is by Cedarapids 30 in. x 42 in. double impeller crusher. A Terex 7251 4 yd. loader is used to handle stockpiling and loading of trucks.

PRODUCTS

1 1/2 in. Clear Stone
3/4 in. Clear Stone
5/8 in. Crushed Rock
Agricultural Lime (produced at the Morven Quarry, NP–16)

REFERENCES

Hewitt, 1960, p. 64
Hewitt, 1964a, p. 33

MAPS

Hewitt, 1964e, OPM Map 2053
Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

NP–13 J.C. DENNISON — NAPANEE QUARRY

LOCATION AND OWNERSHIP

J.C. Dennison operates this quarry on Lot 21, Concession 7, North Fredericksburgh Township, Lennox and Addington County (Figure NP–13–1). It is located on the north side of Highway 2, on the eastern outskirts of Napanee.

GEOLOGY

The quarry consists of two lifts of thin–bedded, generally microrystalline limestone of the upper member of the Gull River Formation. At the time of the field work in 1986, the lower lift was partially filled with water and a total of 7.5 m of strata was exposed above the water level. Glacial overburden on the bedrock surface ranges from 1–2 m in thickness.

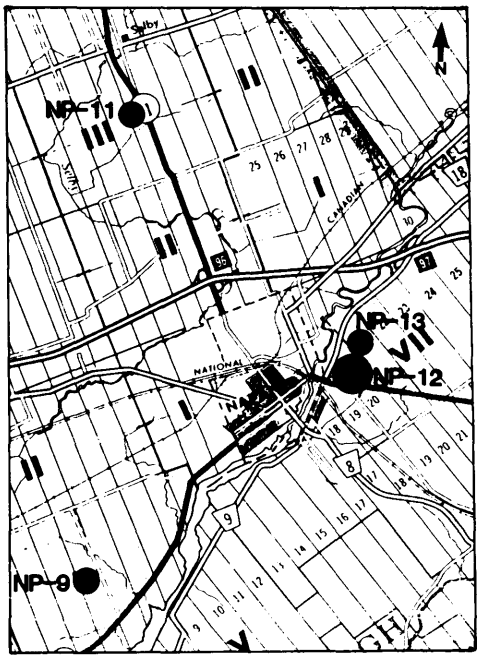


Figure NP-13-1. LOCATION MAP FOR NAPANEE QUARRY.

Geological Section

	Thickness
UNIT 1 Gull River Formation, upper member	*7.5m*

Limestone: dark grey, weathering medium grey; microcrystalline to very fine crystalline, with rare beds of fine crystalline; thin to medium bedded (5–15 cm), with sharp, planar contacts; thin shale partings usually present; 2.5 m above base of upper lift is a 0.7 m thick interval of thinner bedded limestone with more abundant and thicker shaly limestone and shale interbeds; small calcite crystals common; fossiliferous; top of the lower lift was 4.0 m below top of the quarry (3.5 m above the water level at the time of the field visit).

Total thickness *7.5m*

CHEMICAL ANALYSES*

Components in Percent			
SiO_2	3.44	CaO	52.4
Al_2O_3	0.76	P_2O_5	0.04
Fe_2O_3	0.40	SO_3	0.48
MgO	0.60	L.O.I.	42.0
		Total	100.1

* *after Hewitt and Vos, 1972, p. 21–22.*

REFERENCES

Hewitt and Vos, 1972, p. 21–22

MAPS

Hewitt, 1964e, OPM Map 2053
Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

NP-14 GRIFFIN BROTHERS (GANANOQUE) LTD. — DILLON QUARRY

LOCATION AND OWNERSHIP

In 1980 this quarry was opened in the northern half of Lot 49, Concession 8, Camden East Township, Lennox and Addington County by Griffin Brothers (Gananoque) Ltd. (Figure NP–14–1). Stone crushed in this quarry is stockpiled in an old abandoned quarry across the road to the north, located in the southern half of Lot 49, Concession 9, Camden East Township.

GEOLOGY

The 6.6 m face of the new quarry consists of limestones and dolostones of the lower member of the Gull River Formation. The lowest unit of green–grey dolostone grades upwards into a shaly dolostone. The remaining strata in the quarry consist of light grey, microcrystalline to very fine–crystalline limestone with uniform bedding of 10–15 cm which thickens to 50 cm at the top of the quarry. Glacial overburden around the quarry is generally less than 1 m thick.

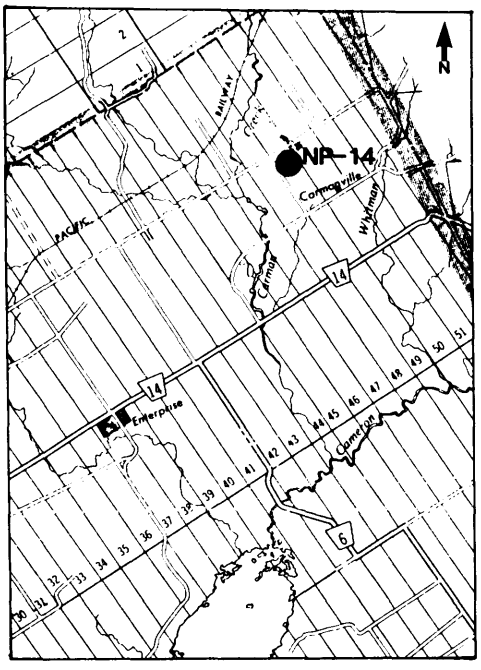


Figure NP-14-1. LOCATION MAP FOR DILLON QUARRY.

Geological Section

	Thickness
UNIT 3 Gull River Formation, lower member	*4.5m*

Limestone: light to medium grey, weathers light grey; microcrystalline, with some very fine crystalline intervals; thin bedded (5–10 cm) which thickens (to 50 cm) upwards, sharp and planar contacts; unfossiliferous; lower contact of unit sharp and planar.

UNIT 2 Gull River Formation, lower member	*1.0m*

Limestone: light grey, weathers same; very fine crystalline; medium bedded (10–15 cm), very uniform beds, with sharp, planar contacts; unfossiliferous; lower contact of unit sharp and planar.

UNIT 1 Gull River Formation, lower member	*1.1m*

Dolostone, grading upwards into shaly dolostone: light green-grey, weathers light green; fine crystalline; medium bedded (20–30 cm) with sharp, planar contacts, beds break down with weathering into 2–5 cm thick intervals with very irregular partings; upper part of unit weathers recessively.

Total thickness	*6.6m*

REFERENCES

None

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

NP-15 TOWNSHIP OF CAMDEN EAST — CAMDEN EAST QUARRY

LOCATION AND OWNERSHIP

The Township of Camden East intermittently operates this quarry in Lot 26, Concession 2, Camden East Township, Lennox and Addington County (Figure NP–15–1). It is located on the eastern side of County Road 4, 2.5 km northwest of the village of Camden East. The area is not designated under the Pits and Quarries Control Act.

GEOLOGY

The 7.0 m quarry face exposes limestone of the upper member of the Gull River Formation and the lower member of the overlying Bobcaygeon Formation. The lowest 4.2 m in the quarry consist of dark grey, microcrystalline to fine–crystalline, thin–bedded limestone. Some beds contain clusters of very small pyrite crystals, although no iron oxide staining was visible. The overlying 1.8 m consist of light brown, very fine–to fine–crystalline, thin–bedded limestone which weathers more recessively than the under– and overlying units.

The uppermost unit consists of two 0.5 m thick beds of light grey, microcrystalline limestone of the lower member, Bobcaygeon Formation. The upper bedrock surface exhibits a pitted appearance, and fractures and joints have been greatly enlarged by dissolution.

Geological Section

	Thickness
UNIT 3 Bobcaygeon Formation, lower member	*1.0m*

Limestone: light to medium grey, weathers light grey; microcrystalline; thick bedded (50 cm) with sharp stylolitic contacts; small patches of calcite crystals, "birdseye" texture, present; upper bedrock surface pitted, with fractures and joints enlarged by dissolution; lower contact of unit sharp and planar.

UNIT 2 Gull River Formation, upper member	*1.8m*

Limestone: light grey–brown to light brown, weathers medium brown; very fine to fine crystalline; thin bedded (5–10 cm), with sharp, planar contacts; unit weathers more recessively than other units; lower contact of unit sharp and planar.

UNIT 1 Gull River Formation, upper member	*4.2m*

Limestone: dark grey, weathers medium grey; microcrystalline to fine crystalline; thin bedded (5–10 cm) with sharp, planar, rarely stylolitic contacts; small clusters of very small pyrite crystals occur rarely, numerous small patches of calcite crystals, "birdseye" texture; fossiliferous.

Total thickness	*7.0m*

REFERENCES

Parks, 1912, p.214–215
Hewitt, 1964a, p.29–30
Verschuren et al., 1985, p.50

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

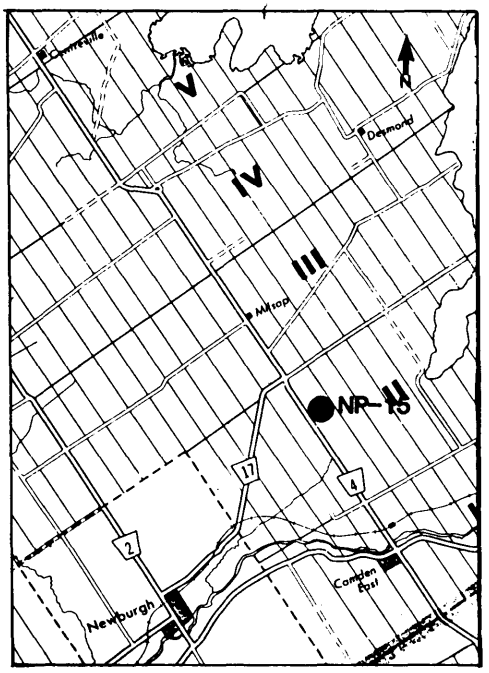


Figure NP-15-1. LOCATION MAP FOR CAMDEN EAST QUARRY.

NP-16 J.R. STOREY CONSTRUCTION LTD. — MORVEN QUARRY

LOCATION AND OWNERSHIP

J.R. Storey Construction Company owns and intermittently operates this recently opened quarry 10 km east of Napanee in Lot 9, Concession 5, Ernestown Township, Lennox and Addington County (Figure NP-16-1). The Morven Quarry is not designated under the Pits and Quarries Act and has an excavated area of 3 ha.

GEOLOGY

The 4.2 m deep quarry exposes thin-bedded, shaly limestone of the upper member, Gull River Formation. The limestone is generally microcrystalline to very fine crystalline with a few beds of fine- to medium-grained calcarenite. Glacial overburden around the quarry is generally less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Gull River Formation, upper member	*4.2m*
Limestone: dark grey to rarely grey-brown, weathers medium grey; microcrystalline to very fine crystalline, rarely fine- to medium-grained calcarenite; thin bedded (5-10 cm), with beds commonly separated by thin (less than 1.0 cm), dark grey, shale and shaly limestone partings; calcite-filled vugs occur sporadically in a few beds, small calcite crystals replacing fossils are common; moderately fossiliferous with brachiopods most common.	
Total thickness	*4.2m*

QUARRY OPERATION

The limestone of the Morven Quarry is well-bedded and blasting produces a finely broken stone (-6 in). An "open" drilling pattern of 2.75 m x 3.7 m is used with 7.6 cm diameter holes.

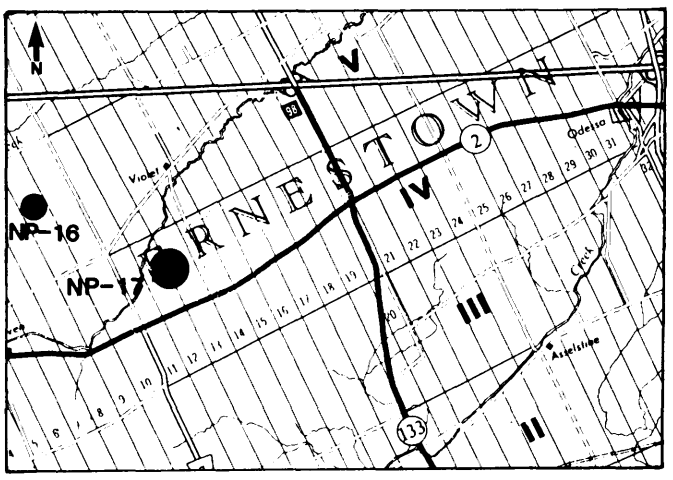


Figure NP-16-1. LOCATION MAP FOR MORVEN QUARRY.

PROCESSING

The Morven stone is a good quality road base material. High quality limestone from the J.R. Storey Construction Ltd. Napanee Quarry (NP-12) is trucked to the Morven site for crushing and screening to produce agricultural lime.

REFERENCES

None

MAPS

None

NP-17 J.C. DENISON — STORMS CORNERS QUARRY

LOCATION AND OWNERSHIP

J.C. Denison owns and operates this recently opened quarry, 12 km east of Napanee in Lots 12-13, Concession 4, Ernestown Township, Lennox and Addington County (Figure NP-17-1). The quarry is not in an area designated under the Pits and Quarries Control Act.

GEOLOGY

The quarry face exposes 10.0 m of the upper member of the Gull River Formation. The strata are characterized by thin-bedded microcrystalline to fine- crystalline limestone. Fossils occurring in these beds include large colonies of the coral *Tetradium*, other colonial corals, brachiopods, and crinoidal debris. Glacial overburden around the quarry is between 1 and 2 m thick.

Geological Section

	Thickness
UNIT 1 Gull River Formation, upper member	*10.0m*
Limestone: dark grey, weathers light to medium grey; microcrystalline to very fine crystalline, with some fine- to medium-grained calcarenite beds; thin bedded (5-10 cm), with thin (1 cm), dark grey shale and shaly limestone partings common between most limestone beds; small patches of calcite crystals common, "birdseye" texture; very fossiliferous, with large colonies of the coral *Tetradium* on the quarry floor and in lowermost 2 m, large colonial coral fragments, brachiopods, trilobites, and abundant crinoidal debris.	
Total thickness	*10.0m*

REFERENCES

None

MAPS

None

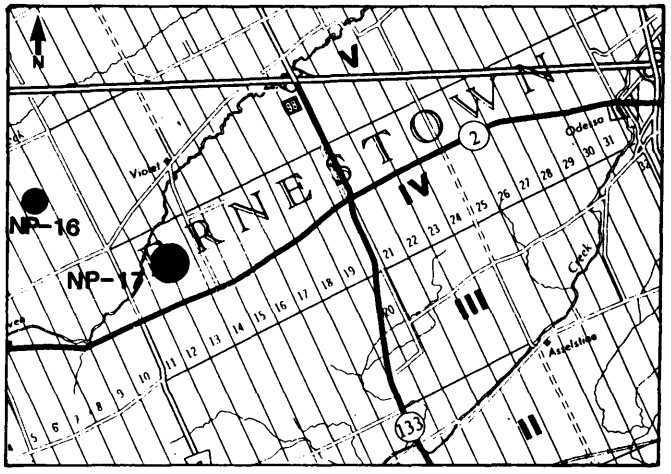


Figure NP-17-1. LOCATION MAP FOR STORMS CORNERS QUARRY.

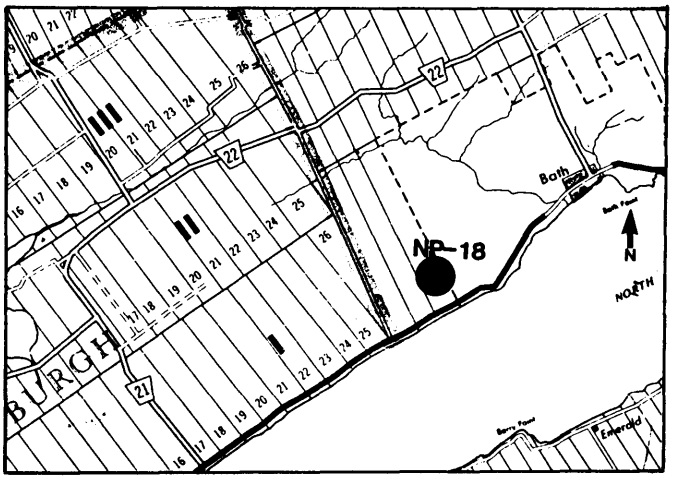


Figure NP-18-1. LOCATION MAP FOR BATH QUARRY AND PLANT.

NP-18 LAFARGE CANADA INC. — BATH QUARRY AND PLANT

LOCATION AND OWNERSHIP

Lafarge Canada Inc. began development of the Bath quarry and plant in 1970 with exploratory drilling of the site. The plant began operations in 1974. The quarry and plant are situated on the north side of Highway 33 approximately 2 km west of the Village of Bath in Lots 3 and 4, Concession I, Ernestown Township, Lennox and Addington County, as shown in Figure NP–18–1. The plant is serviced by road and rail (CN) transport and by a modern dock facility located on the shore of Lake Ontario immediately south of the plant.

GEOLOGY

The quarry exposes an 18 m section of Middle Ordovician Verulam Formation limestone.

Exploration percussion and diamond drilling in 1970 by Lafarge tested the stratigraphy of the licence area. The analytical results from the chip and core samples, as shown in Table NP–18–1, are reported by Lafarge to be representative of the chemical composition of the underlying stratigraphy within the property.

The site is overlain by a veneer of glacial debris ranging in depth from approximately 1 m to 4.5 m and averaging 2 m. The Verulam Formation trends N50°E and dips to the south at about .3 m in 53 m. The Verulam Formation is characterized by dark grey, thin–bedded limestone with two horizons of dark grey, thin–bedded, argillaceous and siliceous limestone. The upper horizon

TABLE NP-18-1. DRILL HOLE ANALYSIS, 1970 DRILLING PROGRAM. CANADA CEMENT LAFARGE LIMITED, BATH QUARRY.

		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	K_2O	Loss	Total	SrO	TiO_2	P_2O_5
Holes 1–35 incl.	Avg.	8.75	2.76	1.09	46.61	1.73	0.96	0.59	38.03	100.52	0.10	0.09	0.07
61 m grid	Max.	9.51	3.01	1.16	47.38	2.05	1.04	0.65	38.46	100.83	0.10	0.12	0.07
	Min.	8.22	2.60	0.98	46.04	1.39	0.82	0.54	37.46	100.28	0.09	0.07	0.06
Holes 5,15,25,	Avg.	8.69	2.71	1.07	46.71	1.73	0.95	0.55	38.04	100.45	0.10	0.08	0.07
35–57 incl.,	Max.	9.11	2.97	1.14	47.27	2.05	1.03	0.60	38.58	100.83	0.11	0.11	0.07
59–61 incl.,	Min.	8.27	2.52	1.03	46.28	1.12	0.84	0.51	37.30	99.85	0.09	0.06	0.06
63–69 incl.													
122 m grid													

Notes: Samples for each hole were obtained by percussion drilling to 18 m depth.

is up to 6 m thick and occurs in the middle of the quarry face at depths ranging from 6 m to 12 m. The lower horizon is approximately 3 m thick and occurs in the lower 3 m of the formation. The chlorine content is low on the quarry face, averaging about 0.026%, though it tends to increase into the face.

Geological Section

	Thickness
UNIT 1 Verulam Formation	*17.7m*

Limestone with alternating shaly limestone and shale: medium to dark grey, weathers medium grey; limestone generally fine to medium crystalline, with some very fine-crystalline beds; limestone thin bedded (2-7 cm), shaly limestone and shale thin bedded (2-5 cm); small calcite crystals replacing fossils common; very fossiliferous with brachiopods, trilobites and crinoid debris most common.

Total thickness	*17.7m*

QUARRY OPERATION

The quarry occupies an area of approximately 50 ha with a single bench of about 18 m in height. Drilling is done with a Gardner-Denver rotary drill using 150 mm diameter holes. Holes are drilled to the quarry floor. Drilling is conducted on a single line basis with 9 to 18 holes spaced 1.8 m apart. The blasting agent is AN/FO, which is mixed in the hole. The use of a premix blasting system is being examined. The typical blasting charge is 150 g/t. Rock shatter is excellent and no secondary blasting or breaking is required.

PROCESSING

Loading of shattered rock is by two 12-yd. front-end loaders (Cat 992, Clark 975B) directly to the primary crusher, which is located on the quarry floor. Primary crushing is conducted by a Hazemag 887C, two rotor impact crusher producing -3 in. and -1 in. stone at a rate of 500 tonnes per hour. Crushed material is conveyed from the pit by a 500 m long, 42 in. belt and then transferred to a 1,000 tonne per hour Stephens-Adamson travelling stacker system located inside a large raw material and clinker storage building adjacent to the plant. Crushed limestone storage is approximately 25,000 tonnes.

At the time of the site visit, a small scale test program was being undertaken to determine the feasibility of removing the fines from the larger blasted material. A portable screening system was installed on the pit floor and selected portions of each blast were processed to remove small-sized material. Analysis indicated that the fines have a higher than average alkali content, which can cause problems with the refractories and alkali buildup in the electrostatic precipitators.

Silica is provided in the form of Hay Bay sand or Potsdam sandstone, the latter being ground in an autogenous ball mill. Sand is dried to 1% moisture content and then stored in a 1,000 ton concrete silo.

Fly ash, gypsum and anhydrite are stored in the open on the quarry floor and transported to raw mill feed storage by front-end loader. Previously, mill scale had been used as a source of iron but it was found that trace ele-

Photo NP-18-1. EAST FACE OF BATH QUARRY.

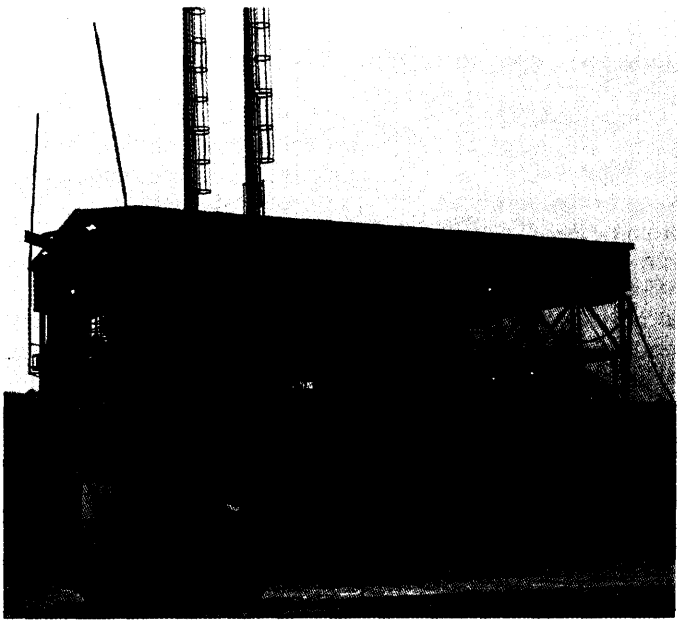


Photo NP-18-2. HAZEMAG IMPACT CRUSHER AT BATH QUARRY.

Photo NP-18-3.
PORTABLE SCREEN SYSTEM FOR SEPARATION OF HIGH ALKALI FINES; BATH QUARRY.

ments in the material were causing problems with the operation of the precipitator.

The raw mill is an F.L. Smidth 29.5 ft. x 16.5 ft. single compartment ball mill having a rated capacity of 320 short tons per hour. Silica is prepared in a 34 ft. 4 in. x 9 ft. 6 in., 2–compartment F.L. Smidth ball mill having a rated capacity of 22 short tons per hour. Limestone and sand are pneumatically conveyed to the ball mills from raw material storage by Stephens–Adamson stacker/reclaimers. The limestone reclaimer has a capacity of 500 tons per hour while the silica reclaimer has a capacity of 90 tons per hour.

Raw feed is pneumatically conveyed to two 51 ft. I.D. x 200 ft. high homogenizing towers each with a capacity of 5,000 tonnes. Sturtevant air classifiers are used to ensure homogenization of the raw mix.

KILN

Raw feed is passed from the homogenizing towers to an F.L. Smidth single stage, four–compartment preheater tower by bucket elevator. The preheater is fitted with two gas conditioners and an electrostatic precipitator to remove particulates. The preheater heats the raw feed to 400°C when it enters the kiln.

The kiln is a coal–fired F.L. Smidth dry process type with dimensions of 19 ft. x 22 ft. x 650 ft. and a rated capacity of 1.1 million tonnes per year. Coal for the kiln is prepared in an ultramodern plant supplied by Kennedy Van Saun. Coal and delayed coke are stored in two 500 tonne storage tanks and fed to a 21 ft.6 in. x 11 ft. ball mill by means of a variable speed screw–type feeder. The capacity of the ball mill is 20 tonnes per hour. The coal is processed to 85% passing 200 mesh, with oversize being returned to the mill by means of a Sturtevant air classifier. Crushed coal is pneumatically conveyed through cyclones to a 6 tonne storage bin. From the storage bin the coal is fed to the kiln via an air lock and screw conveyor. The coal preparation plant is equipped with a nitrogen flooding system to prevent explosions.

Hot clinker is discharged to Lurgi gravel bed coolers and then carried by Aumund pan conveyor to hot clinker storage. Once cooled, the clinker is conveyed to the raw materials storage building where it is stacked by a 350 tonnes–per–hour Stephens–Adamson travelling stacker. There is stored capacity for approximately 100,000 tonnes of clinker.

Clinker is retrieved from storage by a 300 tonnes per hour Ameco reclaimer. Final grinding is carried out in two 2–compartment ball mills with dimensions of 13 ft. x 49 ft., and a capacity of 93 tonnes per hour each. The finish mills are in closed circuit with Sturtevant air classifiers. Gypsum and anhydrite in a 70:30 ratio are added to the clinker and represent approximately 3.5% of the finished cement, which is then pneumatically conveyed to six 4,500–tonne silos.

Finished cement is recovered from the storage silos and pneumatically conveyed for loading by airslides for road, rail and water shipment (70% of shipment volume is by water).

Process control for all sections of the cement plant is handled by a Foxboro Fox 1 digital system and a General Electric analog system.

PRODUCTS

Normal Portland
High Early Strength Portland
Sulfate Resisting Portland
Low Heat of Hydration Portland
Masonry Cement

REFERENCES

None

MAPS

Carson, 1982a, OGS Map P. 2497

NP-19 F.G. BEZANSON AND SON LTD. — WILTON QUARRY

LOCATION AND OWNERSHIP

The Wilton Quarry, owned and operated by F.G. Bezanson and Son Ltd., is located in Lot 36, Concession 6, Ernestown Township, Lennox and Addington County, 1 km south of the village of Wilton (Figure NP-19-1). The quarry is not designated under the Pits and Quarries Control Act and was opened as a pit in 1975 to extract sand and gravel. The operation was subsequently deepened into the bedrock and produces aggregate for local road construction, primarily operating from May to November.

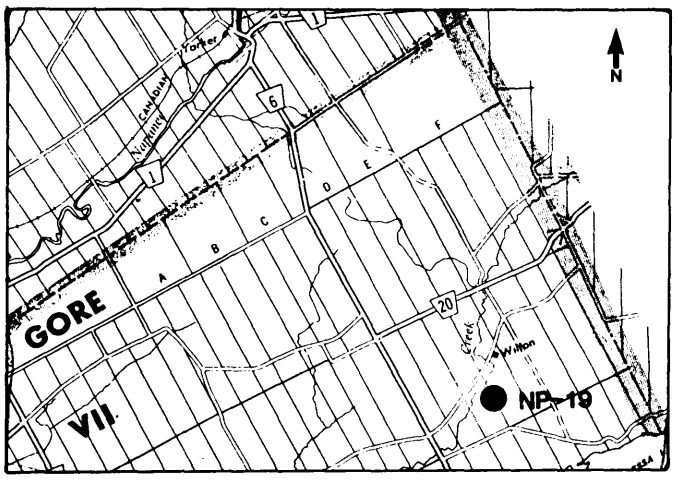


Figure NP-19-1. LOCATION MAP FOR WILTON QUARRY.

GEOLOGY

The single lift of 11 m exposes thin-bedded limestone of the upper member of the Gull River Formation. The generally microcrystalline to very fine-crystalline limestone is rarely interbedded with thin beds of fine- to medium-crystalline limestone. A few thin, slightly dolomitic limestone beds in the lower 2 m of the quarry suggest that the top of the lower member of the Gull River Formation is just below the quarry floor. Glacial overburden at the top of the quarry is thin, although a considerable thickness of sand is present along the flank of the hill into which the quarry is excavated.

Geological Section

		Thickness
UNIT 1	*Gull River Formation, upper member*	*11.0m*

Limestone: medium to dark grey, weathers medium grey, light brown near the top of quarry; microcrystalline to very fine crystalline, with rare, thin beds of fine to medium crystalline; thin bedded (5-10 cm), generally with sharp, planar contacts, only rarely with thin shale partings; numerous small patches of calcite crystals, "birdseye" texture; moderately fossiliferous with brachiopods, corals, and trilobites present; basal 2 m has very thin interbeds of light green-grey, silty, slightly dolomitic, limestone beds.

Total thickness *11.0m*

Photo NP-19-1. TYPICAL SECTION AT WILTON QUARRY (LOOKING WEST).

QUARRY OPERATION

The quarry area is currently about 300 m x 300 m on a single lift of 11 m. A drill pattern of 2.4 m x 2.4 m is used with 7.6 cm diameter blast holes. Holes are loaded with AN/FO and initiated with electric caps.

PROCESSING

Two Michigan 175 loaders transfer shot rock to Louisville and International (25-ton) diesel trucks for haulage (approximately 200 m) to the primary crusher. Primary crushing is performed by a Cedarapids 25 in. x 40 in. jaw, feeding a 42 in. Pulvamatic Roller secondary crusher. Michigan 175 and Terex 51 (4 yd.) loaders are used for stockpiling and loading of trucks.

PRODUCTS

4 in. Crusher Run
2 in. Crusher Run
Granular "A"
3/4 in. Clear Stone

3/8 in. Screenings
1/2 in. Chips

REFERENCES

None

MAPS

Carson, 1981c, OGS Map P.2413

NP-20 TOWNSHIP OF AMHERST ISLAND — AMHERST ISLAND (CAUGHEY) QUARRY

LOCATION AND OWNERSHIP

The quarry on Amherst Island is used intermittently as a source of crushed stone for local roads. It is located in the northeast quarter of Lot 9, North Shore Concession, Amherst Island Township, Lennox and Addington County, 2 km east of Stella (Figure NP-20-1). The quarry is not within an area designated under the Pits and Quarries Control Act.

GEOLOGY

The quarry face exposes 9.3 m of interbedded limestone and shale of the Verulam Formation. The thin-bedded, fine- to medium-crystalline limestones are interbedded with coarse-crystalline bioclastic limestone beds. Two lifts are present; the top of the lowest lift is 4.3 m above the floor of the quarry. Glacial overburden around the quarry is thin.

Geological Section

	Thickness
UNIT 1 Verulam Formation	*9.3m*
Limestone, interbedded with shaly limestone and shale: limestone - medium to dark grey to blue-grey on very fresh surfaces, weathers grey-brown to medium grey; fine to medium crystalline with rare beds coarse crystalline, bioclastic; thin-bedded (5-10 cm) with sharp, slightly undulating contacts; most beds very fossiliferous; shaly limestone and shale - medium to dark grey, weathers dark grey; in beds 2-5 cm thick which can weather into very fissile partings; beds commonly burrowed.	
Total thickness	*9.3m*

REFERENCES

Verschuren et al., 1985, p47

MAPS

Liberty, 1971a, GSC Map 19-1970
Carson, 1982a, OGS Map P.2497

NP-21 PORTLAND TOWNSHIP (HARTINGTON) QUARRY

LOCATION AND OWNERSHIP

The Township of Portland operates this quarry in Lot 3, Concession 7, Portland Township, Frontenac County, approximately 6 km northwest of Sydenham (Figure NP-21-1). The quarry is not designated under the Pits and Quarries Control Act.

GEOLOGY

The 10.0 m deep quarry exposes limestones and dolostones of the lower member of the Gull River Formation. The limestone and dolostone alternate in units which vary from 0.5 to 1.0 m thick. The limestones are dominantly microcrystalline and medium bedded whereas the

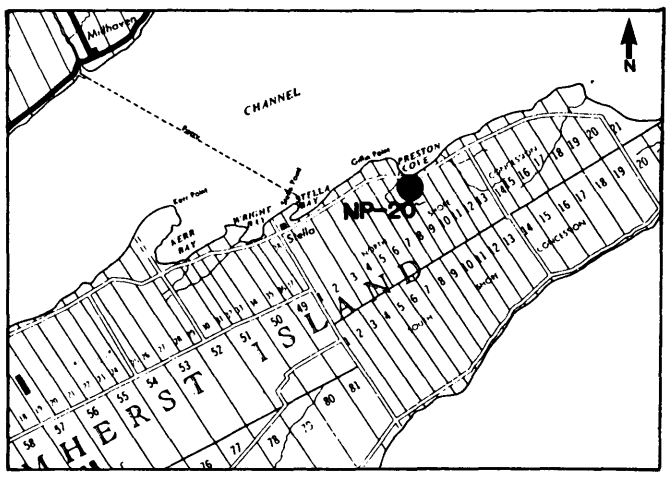


Figure NP-20-1. LOCATION MAP FOR AMHERST ISLAND (CAUGHEY) QUARRY.

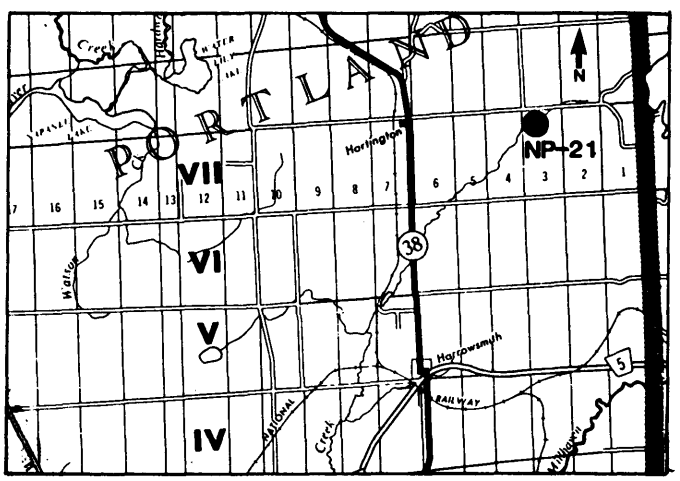


Figure NP-21-1. LOCATION MAP FOR PORTLAND TOWNSHIP (HARTINGTON) QUARRY.

dolostones are very fine crystalline and thin to medium bedded. The site had originally been excavated for sand, and up to 4 m of this material is present in the overburden.

Geological Section

	Thickness
UNIT 1 Gull River Formation, lower member	*10.0m*

Alternating limestone and dolostone: limestone: light to dark grey, weathers light grey; microcrystalline to rarely very fine crystalline; medium bedded (20–30 cm), with sharp and planar contacts, in intervals 0.5–1.5 cm thick; uppermost bed in quarry 1.0 m thick;

dolostone: light green-grey; weathers light green-grey to light brown; very fine crystalline; thin to medium bedded (10–30 cm), with sharp and planar contacts, in intervals 0.5–1.0 m thick; small patches of calcite crystals present in some beds.

Total thickness *10.0m*

CHEMICAL ANALYSES*

Components in Percent			
SiO_2	4.01	CaO	47.3
Al_2O_3	2.30	L.O.I.	41.0
Fe_2O_3	0.86	Total	99.55
MgO	4.08	CO_2	40.5

* *after Hewitt and Vos, 1972, p. 38–39.*

REFERENCES

Hewitt and Vos, 1972, p. 38–39.

MAPS

None

NP-22 W.J. McKENDRY AND SONS LIMITED — WESTBROOK QUARRY

LOCATION AND OWNERSHIP

The Westbrook Quarry is located in Lots 6 and 7, Concession 2, Kingston Township, Frontenac County (Figure NP–22–1). The quarry is owned by Justice William Henderson and operated by W.J. McKendry and Sons Limited. The property is licensed for 12.2 ha. The Westbrook Quarry is one of three quarries operated by W.J. McKendry and Sons Limited in the Frontenac County area (see Glenburnie (NP–29) and Cranston (NP–26) quarries).

GEOLOGY

The single quarry lift exposes 6.0 m of medium to dark grey, thin–bedded, microcrystalline to very fine–crystalline shaly limestone of the upper member of the Gull River Formation. A few thin beds of fine– to medium–grained calcarenitic limestone occur in the upper 2.5 m of the quarry. Glacial overburden around the quarry is less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Gull River Formation, upper member	*6.0m*

Limestone: medium to dark grey, weathers light grey, buff at top; microcrystalline to very fine crystalline, in upper 2.5 m rare beds of fine– to medium–grained calcarenites; thin to medium bedded (5–15 cm) with sharp, stylolitic contacts, or with thin, dark grey shale partings; small patches of calcite crystals, "birdseye" texture, very abundant; small pyrite crystals up to 2 mm occur rarely; moderately fossiliferous; 4.6 m above base of unit is 6 cm of dark grey, shaly limestone which weathers recessively.

Total thickness *6.0m*

QUARRY OPERATION

A single 6.0 m lift is presently mined, and is planned to reach a depth of 9.8 m. A drill pattern of 2.1 m x 2.4 m is used with 7.6 cm holes. Amex II (AN/FO) is used as a bulk explosive and primed with 75% Forcite (40 mm x 200 mm) stick powder.

PROCESSING

The rock is crushed with a portable system consisting of a Cedarapids 30 in. x 42 in. impeller primary crusher, with a 544 Commander crusher as a secondary unit. The crushing and screening are operated on a custom basis; a wide variety of stone sizes can be produced.

PRODUCTS

Gabion Stone (+8 in., –12 in. coarse)
Gabion Stone (6 in. fine)
Rubble Rock
3 in. Crusher Run
5/8 in. Crusher Run
1/2 in. Crusher Run
3 in. Clear
1 in. Clear

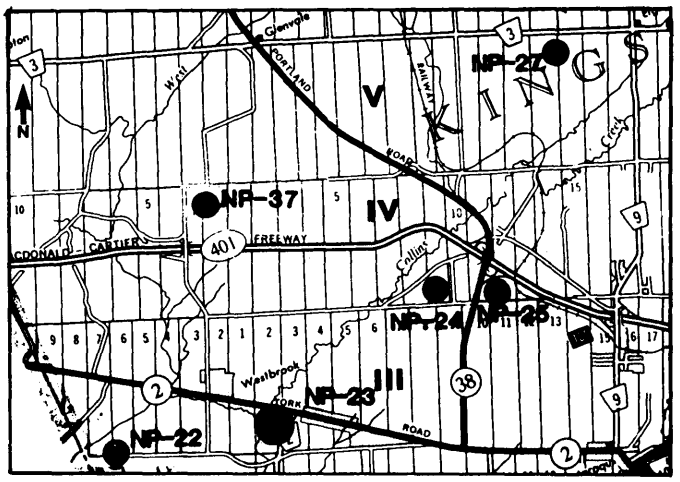


Figure NP-22-1. LOCATION MAP FOR WESTBROOK QUARRY.

Photo NP-22-1.
175C CLARK LOADER AT FACE AND PORTABLE CRUSHER (BACKGROUND) AT WESTBROOK QUARRY (LOOKING NORTH).

3/4 in. Clear
3/4 in. Concrete Stone
3/8 in. chips (concrete and asphalt grades)
Stone Dust

REFERENCES

Hewitt, 1964a, p. 33

MAPS

Liberty, 1971d, GSC Map 17-1970
Carson, 1981c, OGS Map P.2413

NP-23 WOOD'S SAND AND GRAVEL LTD. — COLLINS BAY QUARRY

LOCATION AND OWNERSHIP

This large quarry covers parts of Lots 2 and 3, Concession 3, Kingston Township, Frontenac County (Figure NP-23-1). It is located just south of Highway 2 on the west side of Collins Bay Road, approximately 2.5 km west of the Highway 38-Highway 2 interchange in Kingston. The quarry is owned and operated by Wood's Sand and Gravel and has been in operation since 1967. The quarry licence covers an area of 7.1 ha.

GEOLOGY

The quarry has been worked for several years into the side of a north- south trending hillside; because the bedrock surface rises to the east a complex lift pattern has developed. The four lifts in the quarry expose a total of 36 m of strata from the Gull River Formation (Figure NP-23-2).

The lower 26.1 m in the quarry consist of interbedded limestone and dolostone of the lower member. The thin- to medium-bedded limestones are dominantly microcrystalline to very fine crystalline whereas the medium- to thick-bedded dolostones are fine crystalline. The thin- to medium-bedded, shaly limestone of the upper 9.9 m in the quarry is assigned to the upper member of the Gull River Formation. Glacial overburden around the quarry is up to 2 m thick.

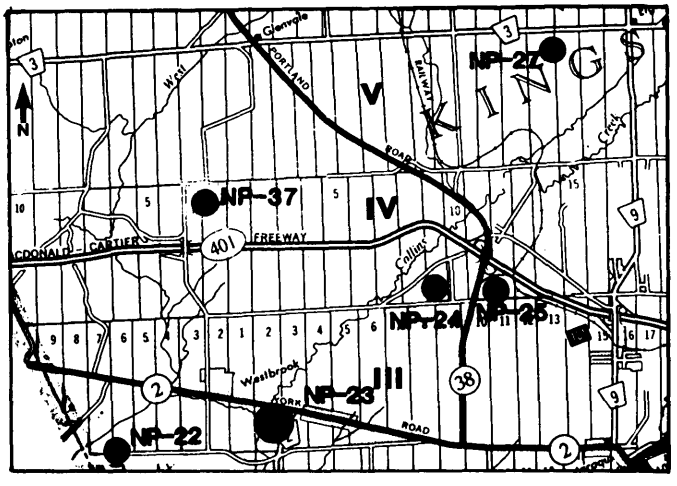


Figure NP-23-1. LOCATION MAP FOR COLLINS BAY QUARRY.

Geological Section

Thickness

UNIT 13 Gull River Formation, upper member *5.25m*

Limestone: medium to dark grey, weathers light to dark grey, lowest 30 cm weathers nearly white; microcrystalline to very fine crystalline; medium bedded (10–30 cm) with sharp, stylolitic contacts or with very thin shale partings; large calcite-filled vugs very abundant in some beds, especially in beds 1.2 and 3.0 m above base of unit, pyrite crystals rarely present in a few beds; uppermost 0.5 m of quarry a single bed of light grey intraclastic limestone; lower contact of unit sharp and planar.

UNIT 12 Gull River Formation, upper member *0.15m*

Shaly limestone: very dark grey, weathers dark grey; very fine crystalline; thin laminated with even, parallel laminae; weathers recessively, makes a good marker; lower contact of unit sharp and planar.

UNIT 11 Gull River Formation, upper member *2.0m*

Limestone: medium grey, weathers same; microcrystalline; medium bedded (20–30 cm) with sharp, stylolitic contacts; most beds contain intraclasts of light grey, microcrystalline limestone; lower contact of unit sharp and planar.

UNIT 10 Gull River Formation, upper member *2.5m*

Limestone, with shaly limestone partings: medium grey, weathers light grey; most beds microcrystalline with some beds very fine crystalline; medium-bedded (25–30 cm) limestone, very thin-bedded (2–4 cm) shaly limestone interbeds; small patches of calcite crystals, "birdseye" texture, common in most beds; most beds are disrupted to some degree by deep mudcracks; lowest 25 cm of unit is a bed of dark grey limestone with light grey, microcrystalline intraclasts; lower contact of unit sharp and planar, at base of intraclastic conglomerate; top of third lift at top of unit.

UNIT 9 Gull River Formation, lower member *4.25m*

Interbedded limestone, dolostone and sandy dolostone with shaly limestone and shaly dolostone partings:

limestone – medium to dark grey, weathers medium grey; microcrystalline; medium bedded (15–25 cm); frequency of limestone beds increases in upper half of section;

dolostone – includes some partially dolomitized limestone; light grey to light green-grey, weathers light green-grey to light brown; very fine to fine crystalline;

thick bedded (30–70 cm) with thin shaly limestone or dolostone partings;

sandy dolostone – (only the interval from 2.25–3.25 m above base of unit) light green-grey, weathers green-grey to light brown; fine crystalline with about 2% coarse-grained, well-rounded quartz sand; massive on fresh surface, weathers into thin, rubbly partings at west end because it is at bedrock surface; unit exposed in entirety only in northeast corner of quarry; lower contact of unit sharp and planar, at base of 3–4 cm thick, dark grey, shaly limestone bed.

UNIT 8 Gull River Formation, lower member *7.1m*

Limestone: dark grey, weathers medium grey to grey- brown; microcrystalline to very fine crystalline; medium to thick bedded (10–40 cm) with sharp contacts, either stylolitic or very thin shale partings; very small patches of calcite crystals abundant, uppermost bed displays rusty brown surface stain although no obvious pyrite was observed; on west and southwest side of quarry this unit is at the top of the quarry due to the irregular bedrock surface, elsewhere in the quarry the top of this unit marks the top of the second lift; lower contact of unit sharp and planar.

UNIT 7 Gull River Formation, lower member *0.35m*

Dolomitic limestone: dark grey, weathers same; very fine to fine crystalline; one bed of 35 cm, with very faint thin laminae; contains very large (up to 20 cm diameter) calcite-filled vugs; both pink and white calcite occur, some vugs have open centres; lower contact of unit sharp and planar.

UNIT 6 Gull River Formation, lower member *5.4m*

Limestone: dark grey, weathers medium to dark grey; microcrystalline; apparently massive although irregular thin beds (5–10 cm) appear on some faces; small patches of calcite crystals rare; unit contains many fractures obscuring most bedding relationships; top of lowest lift is 1.6 m above the base of the unit, although this horizon varies because of irregularities in the height of the lower lift; lower contact of unit gradational over 2 cm, placed at base of lowest limestone bed.

UNIT 5 Gull River Formation, lower member *1.1m*

Sandy to muddy dolostone: light green to light grey-green, weathers light green to light grey; very fine crystalline with coarse-to very coarse-grained quartz sand grains; single bed; small patches of calcite crystals near base of unit; 20 cm above base of unit is a mottled, intraclastic conglomerate, containing gravel-sized clasts of dark grey, very fine-crystalline limestone; overlying 25 cm is light green, sandy dolostone with 10–15% coarse- to very coarse-grained, well-rounded quartz sand; balance of unit is a muddy dolostone, laminated in some intervals; lower contact of unit very sharp and abrupt.

UNIT 4 Gull River Formation, lower member *0.5m*

Limestone: dark grey, weathers same; microcrystalline to very fine crystalline; unit includes top of a bed and base of overlying bed, with the bedding plane subdividing this unit in half; lower 30 cm laminated with interlaminae of light grey, fine-crystalline dolostone; lower contact of unit sharp and planar at base of lowest limestone lamina.

UNIT 3 Gull River Formation, lower member *2.55m*

Dolostone: light green-grey to light grey, weathers light grey; very fine crystalline; massive bedded, with bedding planes 1.2–1.5 m apart, although beds weather into thinner layers; bedding plane contacts sharp and planar, except for one shaly dolostone interval 3 cm thick 0.9 m above base of unit: large calcite-filled vugs (up to 5 cm in diameter) commonly filled with pink calcite; lower contact of unit sharp and planar.

UNIT 2 Gull River Formation, lower member *3.45m*

Limestone: dark grey, weathers medium to dark grey; microcrystalline to very fine crystalline; thick bedded (30–60 cm), with sharp, planar, rarely stylolitic contacts; lower contact of unit sharp and planar, at 1 cm thick, recessive, dark grey shale interval.

UNIT 1 Gull River Formation, lower member *1.4m*

Dolostone: light green-grey to light grey, weathers green-grey to light grey; very fine crystalline; medium bedded (20 cm), with very even beds, most thin laminated, and with sharp and planar contacts; 0.7 m above base of unit is a 30 cm thick bed of medium grey, microcrystalline limestone.

Total thickness *36.0m*

QUARRY OPERATION

The Collins Bay quarry has reached its mineable area limit of approximately 3 ha. The excavation is to a depth of 36 m on four lifts of 9 m, 6 m, 11 m and 10 m and a fifth lift of 10.5 m is projected for future production.

Drilling and blasting is performed by a subcontractor; a drill pattern of 2.7 m x 2.7 m is used with 7.6 cm diameter holes. Blast holes are column loaded with AN/FO (Nilite), primed with Tovex and initiated with electric delay caps. Due to a jointed seam structure of the rock the best blast fragmentation has been found to occur when using a choke blasting technique, where a "retaining wall" of previously blasted stone is left along the face during blasting

PROCESSING

The blasted stone is transported by a Cat 966D (4.5 yd.), a distance of 50 m to 125 m to a portable crushing system. Primary crushing is by a Cedarapids 30 in. x 42 in. double impeller. The crushed stone (–3 in.) is fed into a surge hopper and can be sent for sorting by a Barber–Greene 4 ft. x 10 ft. double–deck screen, or drawn by chute as a Granular "B" product.

The screened products are –1 in (Granular "A"), – 1 1/4 in. + 1 in. (3/4 in. clear) and –3 in. + 1 1/4 in. oversize that is sent to a Telsmith 3 ft. cone crusher for secondary treatment. The secondary crushed material is returned for screening. A Yale 2500 (4 yd.) loader is used for stockpiling and loading trucks.

PRODUCTS

Rubble Rock
Granular "A" & "B"
3 in. Clear Stone
3/4 in. Clear Stone
Screenings
Top soil, sandfill and masonry sand.

REFERENCES

Hewitt and Vos, 1972, p. 43–44

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

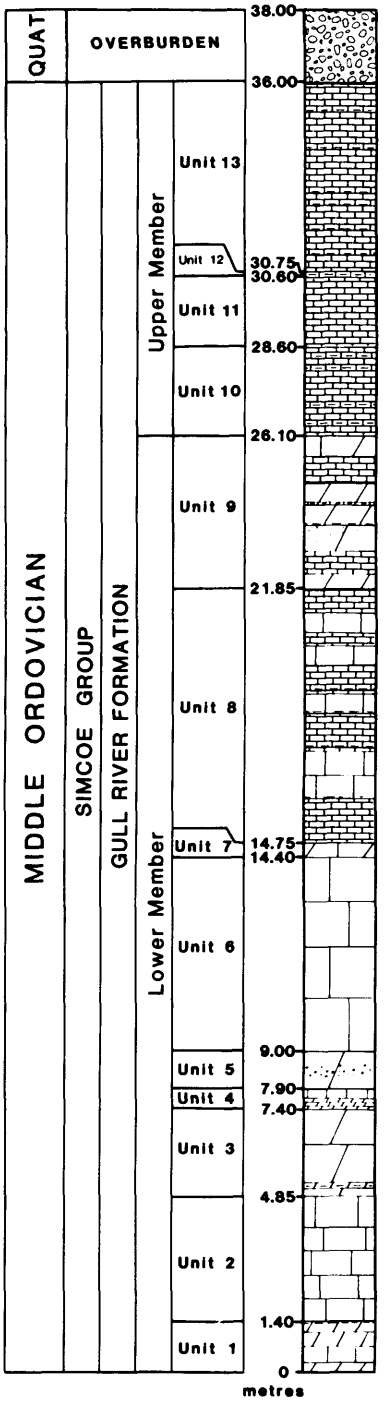
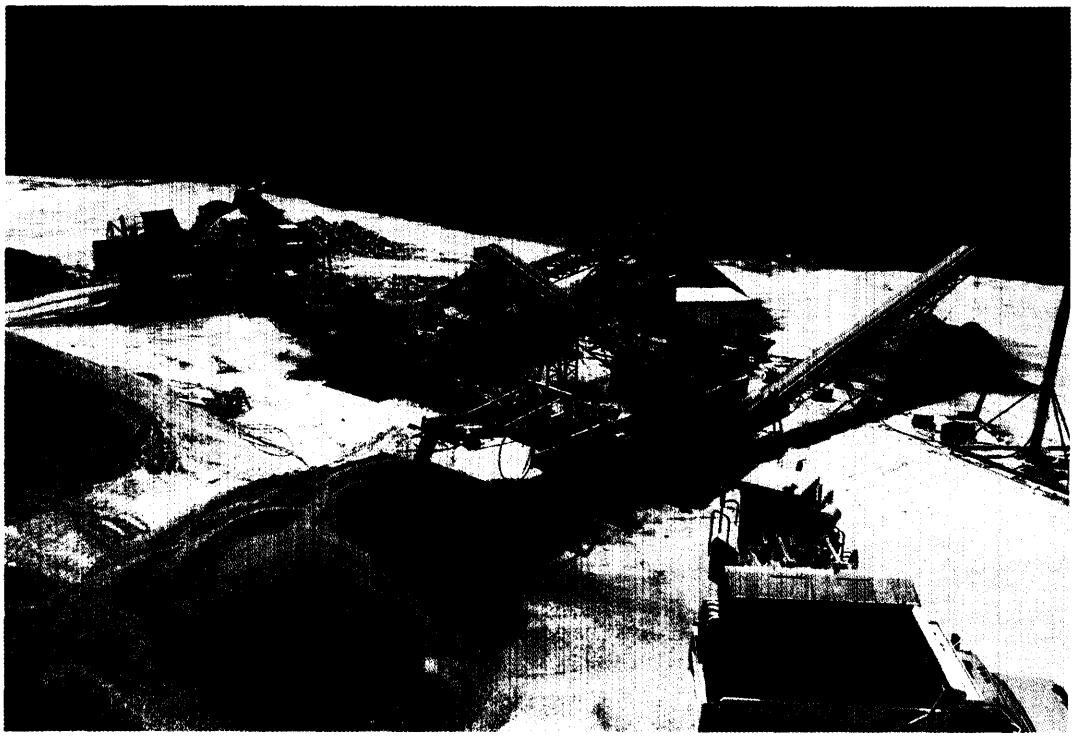


Figure NP-23-2. STRATIGRAPHIC COLUMN FOR COLLINS BAY QUARRY.

Photo NP-23-1. CAT 966D LOADER FEEDING THE CEDARAPIDS PRIMARY CRUSHER; COLLINS BAY QUARRY.



NP-24 H.J. McFARLAND CONSTRUCTION COMPANY — KINGSTON QUARRY

LOCATION AND OWNERSHIP

The Kingston Quarry of H.J. McFarland Construction Co. is located west of the Highway 38 – Highway 401 interchange in Lot 9, Concession 4, Kingston Township, Frontenac County (Figure NP-24-1). This quarry was inactive at the time of the field work in 1986. The quarry licence covers an area of 8.5 ha.

GEOLOGY

The quarry is 10.4 m deep and exposes limestones of the lower member of the Bobcaygeon Formation. Although the quarry face has weathered into thin-bedded limestone the original thick to massive bedding can still be identified, both in the quarry and in the roadcuts on the adjacent highways. The limestones are generally microcrystalline with some fine- to medium-crystalline and calcarenitic intervals present. Liberty (1971d) had assigned the rocks exposed in this quarry to Member D, Gull River Formation. Based upon the revisions by Williams (in prep.), these limestones are now assigned to the lower member of the Bobcaygeon Formation. The section exposed in this quarry is similar to that in the Kingston Quarry of the Township of Kingston (NP-25). Glacial overburden is generally thin around the quarry.

CHEMICAL ANALYSIS*

	Components in Percent		
SiO_2	4.29	CaO	51.2
Al_2O_3	1.26	P_2O_5	0.03
Fe_2O_3	0.59	SO_3	0.73
MgO	1.13	L.O.I.	41.0
		Total	100.2

* *after Hewitt and Vos, 1972, p. 30-33.*

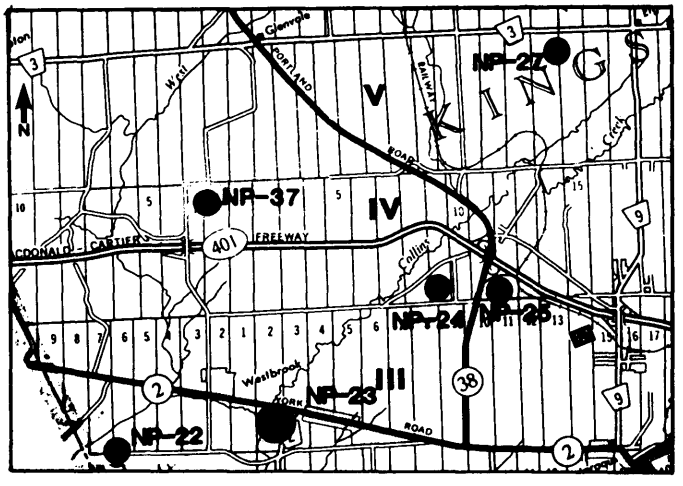


Figure NP-24-1. LOCATION MAP FOR KINGSTON QUARRY.

REFERENCES

Hewitt and Vos, 1972, p. 30–33
Sabina, 1983, p. 6

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2143

NP-25 TOWNSHIP OF KINGSTON — KINGSTON QUARRY

LOCATION AND OWNERSHIP

This quarry, located in Lots 11 and 12, Concession 4, Kingston Township, Frontenac County just southeast of the Highway 38 – Highway 401 interchange, has been operated by the Township of Kingston as a source of aggregate (Figure NP–25–1). This quarry was inactive at the time of the field work in 1986. The quarry licence covers an area of 12.1 ha.

GEOLOGY

The single lift exposes a 9.0 m face of limestones of the lower member of the Bobcaygeon Formation. These limestones are medium to dark grey, weather light to medium grey, and range from microcrystalline to fine crystalline. Original bedding in the quarry ranged from 0.5 to 1.5 m in thickness, but extensive weathering, and fracturing due to blasting have resulted in a thinner–bedded (5–10 cm) appearance. The thicker bedding can be seen in the adjacent roadcuts on Highway 401. Bedding plane contacts are sharp and slightly irregular due to stylolites, and no shale or shaly limestone is present. The assignment of these strata to the Bobcaygeon Formation is based upon revisions by Williams (in prep.) and differs from the previous work of Liberty (1971d) and Carson (1981c) who had assigned the strata in this quarry to the upper member of the Gull River Formation. Glacial overburden around the quarry is generally thin.

CHEMICAL ANALYSIS*

	Components in Percent		
SiO_2	3.46	CaO	51.5
Al_2O_3	0.94	P_2O_5	0.02
Fe_2O_3	0.36	SO_3	0.34
MgO	0.96	L.O.I.	41.8
		Total	99.4

** after Hewitt and Vos, 1972, p. 36–37.*

REFERENCES

Hewitt and Vos, 1972, p. 36–37

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

NP-26 W.J. McKENDRY AND SONS LTD. — CRANSTON (KEPLER) QUARRY

LOCATION AND OWNERSHIP

This quarry is located approximately 1 km north of Kepler on Sydenham Road, in Lot 6, Concession 1, Loughborough Township, Frontenac County (Figure NP–26–1). The quarry is outside the area designated under the Pits and Quarries Control Act. The Cranston property covers 18 ha and was purchased in 1978 by W.J. McKendry and Sons Ltd.

GEOLOGY

The 9.0 m deep quarry exposes alternating intervals of limestone and dolostone of the lower member of the Gull

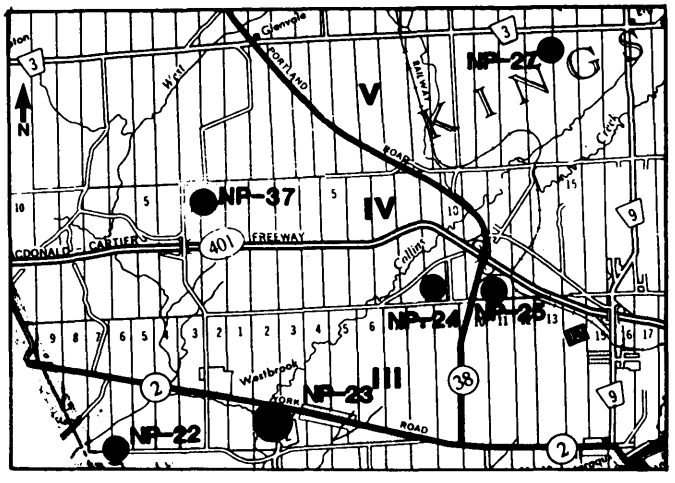


Figure NP-25-1. LOCATION MAP FOR KINGSTON QUARRY.

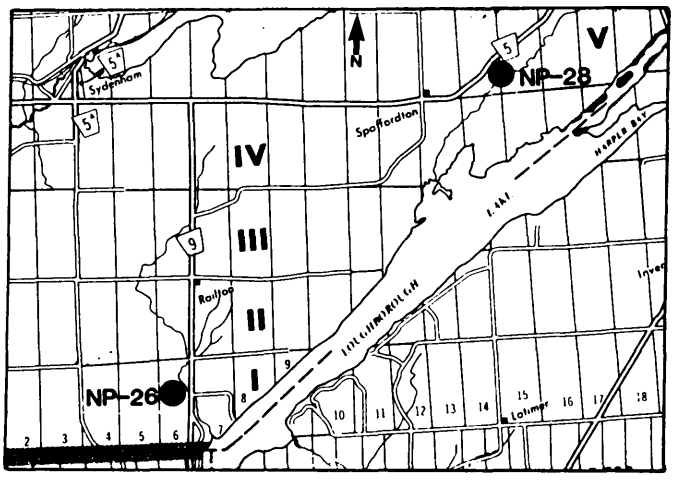


Figure NP-26-1. LOCATION MAP FOR CRANSTON (KEPLER) QUARRY.

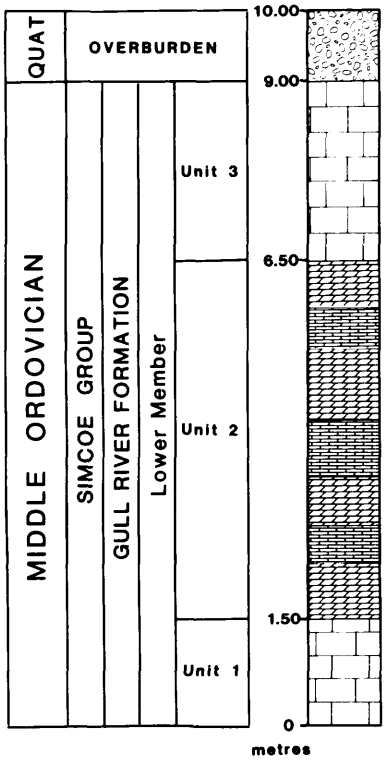


Figure NP-26-2. STRATIGRAPHIC COLUMN FOR CRANSTON (KEPLER) QUARRY.

River Formation (Figure NP-26-2). The limestones are generally microcrystalline and range from thin to thick bedded. The dolostones are generally fine crystalline and thin bedded. Glacial overburden overlying the bedrock surface reaches 1 m in thickness.

Geological Section

Thickness

UNIT 3 Gull River Formation, lower member *2.5m*

Limestone: dark grey, weathers light to medium grey; microcrystalline to rarely very fine crystalline; thick bedded (30-60 cm), though weathered surfaces exhibit a thin bedded appearance, sharp and planar contacts; sparsely fossiliferous; small patches of calcite crystals common; rarely intraformational conglomerates occur, with small clasts of light brown silty, dolomitic limestone in a matrix of microcrystalline limestone; lower contact of unit sharp and planar at base of lowest limestone bed.

UNIT 2 Gull River Formation, lower member *5.0m*

Interbedded limestone and dolostone: limestone - light grey brown to medium grey, weathers buff to light grey; microcrystalline; thin bedded (5-10 cm), with sharp and planar contacts, small patches of calcite crystals present; dolostone - light brown to light green-grey, weathers medium brown to green-brown; very fine to fine crystalline; thin bedded (5-10 cm), with sharp and planar contacts; some silty and shaly dolostone beds also present; lower contact of unit sharp and planar base of lowest dolostone bed.

UNIT 1 Gull River Formation, lower member *1.5m*

Limestone: dark grey, weathers medium grey; microcrystalline, with rare fine-crystalline beds; thick bedded (30-40 cm), which commonly breaks down into thin beds (5-10 cm), sharp contacts that range from planar to irregular.

Total thickness *9.0m*

QUARRY OPERATION

The Cranston Quarry is in the early stages of development and primarily supplied Granular products in 1986. A single 9.1 m lift is currently mined. The property represents a reserve of several million tonnes of aggregate.

REFERENCES

None

MAPS

Carson, 1981c, OGS Map P.2413.

NP-27 FRONTENAC AGGREGATES AND CONSTRUCTION — ELGINBURG QUARRY

LOCATION AND OWNERSHIP

The property is located in Lots 14 and 15, Concession 5, Kingston Township, Frontenac County, 1 km west of Elginburg (Figure NP-27-1). The Elginburg quarry was purchased in 1965 by McGinnis & O'Connor Limited and was opened by the same in 1970. The property is now owned and operated by Frontenac Aggregates and Construction, a division of Cruickshank Construction Ltd. The quarry is licensed for an area of 56.9 ha.

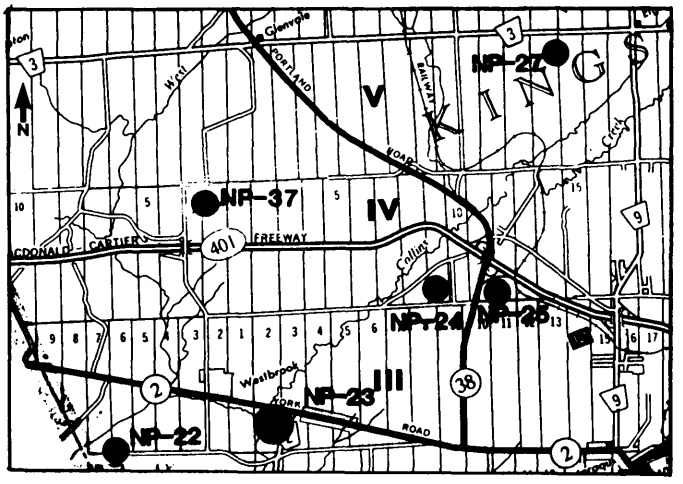


Figure NP-27-1. LOCATION MAP FOR ELGINBURG QUARRY.

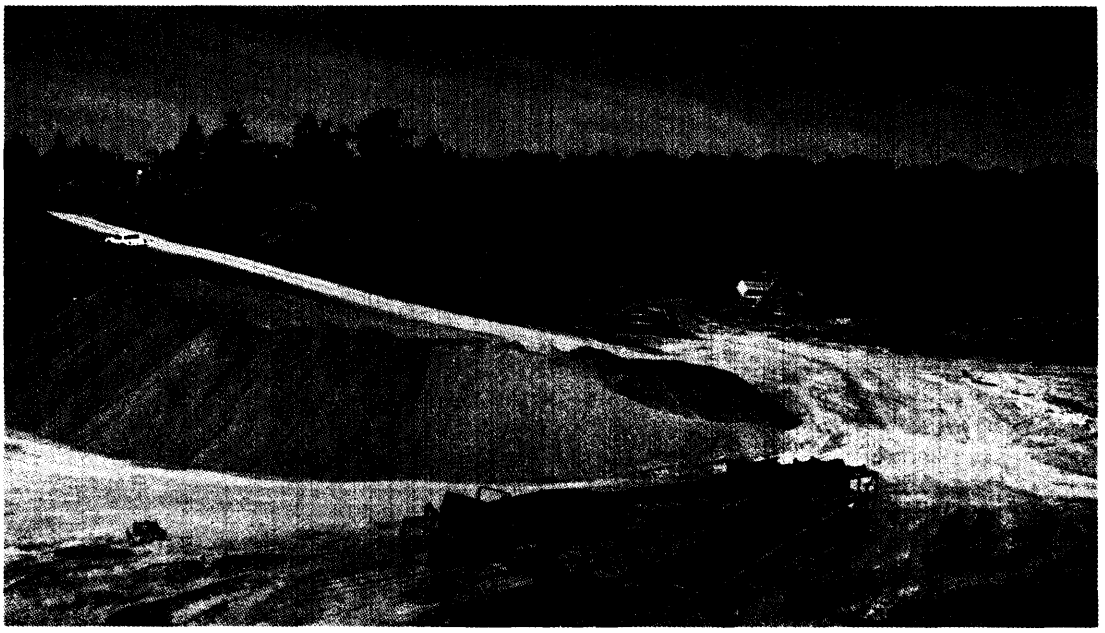


Photo NP-27-1. VIEW OF ELGINBURG QUARRY (LOOKING WEST).

GEOLOGY

The quarry is 10 m deep and exposes thin–bedded limestones of the upper member of the Gull River Formation. The limestones vary from microcrystalline to medium–grained calcarenites, although the calcarenites occur only sporadically. Shale partings are common between most limestone beds. Overburden thickness can vary from a few centimetres to about 3 m.

Geological Section

		Thickness
UNIT 1	*Gull River Formation, upper member*	*10.0m*
	Limestone: dark grey, weathers medium grey; microcrystalline to very fine crystalline, with sporadic beds of fine- to medium- grained calcarenites; thin bedded (5–10 cm) with thinner and thicker beds occurring, contacts sharp, ranging from planar to slightly irregular, commonly with thin shale partings; moderately fossiliferous.	
Total thickness		*10.0m*

CHEMICAL ANALYSIS*

Components in Percent			
SiO_2	4.43	CaO	50.4
Al_2O_3	1.70	L.O.I.	40.8
Fe_2O_3	0.74	Total	99.26
MgO	1.19	CO_2	40.9

* *after Hewitt and Vos, 1972, p. 34-35.*

QUARRY OPERATION

The excavated area of the quarry is about 4 ha and a single lift of 6.0 m to 9.1 m is worked. Overburden is stockpiled for rehabilitation of worked out areas. Drilling equipment includes a Gardner–Denver 3100 airtrack and Sullair compressor. A 2.7 m x 2.7 m drilling pattern is used with 7.6 cm diameter holes.

PROCESSING

Crushing is performed on site by an associated company, Glengary Aggregates & Concrete of Green Valley, Ontario.

A Terex 7290 (7 yd.) loader is used to transport blasted stone from the face to the portable crusher. Primary crushing is by a 36 in. x 45 in. Cedarapids double impeller crusher feeding a Cedarapids 855 Commander (jaw & roller) secondary crusher.

The crushed stone is screened to produce Granular "A" or "B", 3/4 in. and 1/2 in. clear stone. A Stedman 44 in. pulverizer is available for recrushing and processing of screenings to manufacture a sand product.

PRODUCTS

Granular "A" & "B"
3/4 in. Clear Stone (concrete aggregate)
1/2 in. Clear Stone
Screenings
Manufactured Sand

REFERENCES

Liberty, 1971c, p. 9
Hewitt and Vos, 1972, p. 34–35

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

NP-28 SPAFFORDTON QUARRY

LOCATION AND OWNERSHIP

This quarry, just east of Spaffordton, is operated by the Township of Loughborough as a source for aggregate (Figure NP-28-1). It is located in Lot 14, Concession 5, Loughborough Township, Frontenac County, approximately 6 km east of Sydenham and is outside the area designated under the Pits and Quarries Control Act.

GEOLOGY

The 8.3 m deep quarry exposes alternating units of limestones and dolostones of the lower member of the Gull River Formation. The limestones are dominantly microcrystalline and occur in medium-bedded intervals, which range from 0.5 to 1.5 m in thickness. Most of the limestone is extensively burrowed, which produces a mottled appearance on some exposures. The fine-crystalline dolostones commonly contain significant amounts of mud and silt, and intraclasts of light grey, microcrystalline limestone are also present in some beds. The dolostones are thin to medium bedded and occur in intervals which range from 0.5 to 1.0 m in thickness. Glacial overburden around the quarry is thin.

Geological Section

	Thickness
UNIT 1 Gull River Formation, lower member	*8.3m*

Alternating limestone and dolostone:

limestone - light to medium grey, rarely grey-brown, weathers light grey; microcrystalline to rarely very fine crystalline; medium bedded (10-15 cm) with sharp, planar to stylolitic contacts, in intervals of 0.5 to 1.5 m thick; beds extensively burrowed.

dolostone - dark brown to light green- brown, weathers buff to light grey-green; fine crystalline with beds containing terrigenous mud and silt commonly present; thin to medium bedded (5-20 cm), with sharp and planar contacts, in intervals 0.5 to 1.0 m thick; some beds contain intraclasts of light grey, microcrystalline limestone.

Total thickness *8.3m*

REFERENCES

None

MAPS

Hewitt, 1964d, ODM Map 2054
Liberty, 1971d, GSC Map 17-1970
Carson, 1981c, OGS Map P.2413

NP-29 W.J. McKENDRY AND SONS LIMITED — GLENBURNIE (KINGSTON) QUARRY

LOCATION AND OWNERSHIP

The Glenburnie Quarry is located in Lot 25, Concession 5, Kingston Township, Frontenac County, 4 km north of Highway 401 on Division Street (Figure NP-29-1). The quarry has been in operation since the mid-1960s and is currently owned and operated by W. J. McKendry and Sons Limited. The original property licence, issued in 1972, was for 8 ha, to which a further 16 ha were added under a second licence in 1980.

GEOLOGY

The quarry is 15.9 m deep and exposes strata of both the lower and upper members of the Gull River Formation (Figure NP-29-2). Dolostones and limestones of the lower member extend 8.9 m above the floor and are overlain by 7.0 m of shaly limestones of the upper member. The irregular bedrock surface is covered by up to 1 m of glacial overburden.

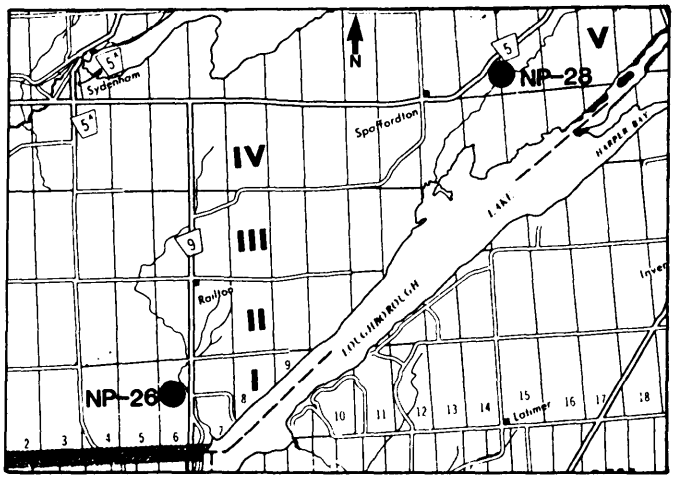


Figure NP-28-1. LOCATION MAP FOR SPAFFORDTON QUARRY.

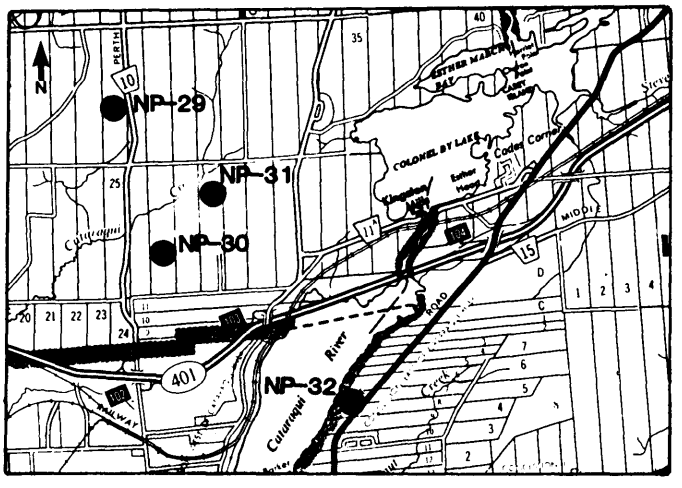


Figure 29-1-1. LOCATION MAP FOR GLENBURNIE (KINGSTON) QUARRY.

Photo NP-29-1.
PORTABLE CRUSHING AND SCREENING PLANT (LOOKING NORTHWEST); GLENBURNIE (KINGSTON) QUARRY.

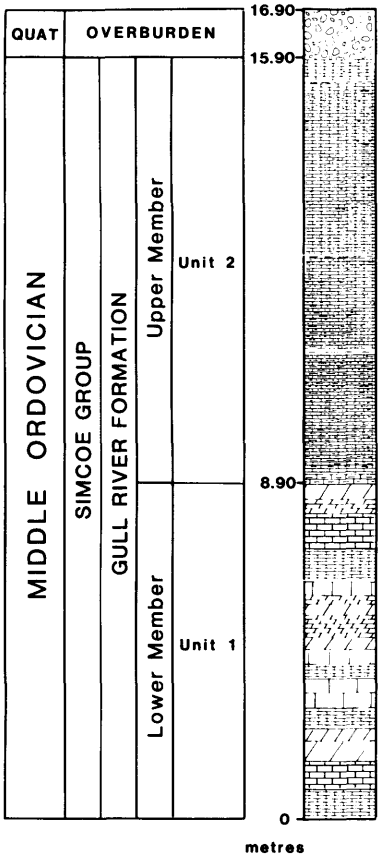


Figure NP-29-2. STRATIGRAPHIC COLUMN FOR GLENBURNIE (KINGSTON) QUARRY.

Geological Section

		Thickness
UNIT 2	*Gull River Formation, upper member*	*8.9m*

Limestone, shaly: grey-brown to medium grey, weathers light to medium grey; microcrystalline to very fine crystalline; thin bedded (5-8 cm), with beds commonly separated by thin shale partings, some up to 2 cm thick; small calcite crystals common; moderately fossiliferous; lower contact of unit sharp and planar at base of lowest shale parting, coincident with the top of uppermost dolostone bed.

UNIT 1	*Gull River Formation, lower member*	*7.0m*

Interbedded limestone and dolostone;

limestone - light grey to light brown, weathers light grey; microcrystalline with rare beds of fine crystalline; thin to medium bedded (5-15 cm), in intervals 1 to 2 m thick; sparsely fossiliferous;

dolostone - light brown to light green, weathers light green-grey to grey-brown to brown; fine crystalline with muddy, silty and sandy intervals; thin partings to medium bedded (less than 1-20 cm), in intervals less than 1 cm to 1.5 m thick; clusters of calcite crystals common.

Total thickness	*15.9m*

QUARRY OPERATION

Currently all stone is extracted from the western property (16 ha) on a single 10.6 m to 12.1 m lift. A second 6 m lift was taken on an experimental basis during the winter of 1985; results proved promising for future development.

Drilling equipment includes a Gardner-Denver 3100 air track (PR 123 Hammer) and 750 cfm compressor. A 2.1 m x 2.4 m drill pattern is used with 7.6 cm diameter holes. Amex II (AN/FO) is used as a bulk explosive and primed with 75% Forcite stick powder (40 mm x 200 mm). The blast holes are bottom capped with short period delays using electric delay caps.

PROCESSING

W.J. McKendry and Sons Limited supply aggregate products to the Kingston area with a fleet of 3 tractor-

trailers, 6 tandem and 6 tri-axle trucks. A portable crushing system is set up on the site with a Cedarapids 30 in. x 42 in. jaw and a 543 Commander plant. The Commander plant contains a 4 ft. x 12 ft. internal screen and jaw and roller crushers that produce Granular "A". A second portable system consisting of a Cedarapids 30 in. x 42 in. impeller primary and a 544 Commander crusher is used at the Westbrook Quarry (NP–22) for custom crushing.

PRODUCTS

Gabion stone (8 in. x 12 in., coarse)
Gabion stone (6 in. fine)
Rubble Rock
3 in. Crusher Run
5/8 in. Crusher Run
1/2 in. Crusher Run
3 in. Clear stone
1 in. Clear stone
3/4 in. Clear stone
3/4 in. Concrete stone
3/8 in. chips, concrete and asphalt grades
Stone dust

REFERENCES

Hewitt, 1964a, p. 26
Hewitt and Vos, 1972, p. 36–37

MAPS

Liberty, 1971d, GSC Map 17–1970
Carson, 1981c, OGS Map P.2413

NP–30 WOOD'S SAND AND GRAVEL LIMITED — MACADOOS LANE (GLEN LAWRENCE) QUARRY

LOCATION AND OWNERSHIP

The Macadoos Lane Quarry, owned and operated by Wood's Sand and Gravel Limited, is located on Macadoos Lane, east of Division Street in Lots 26 and 27, Concession 4, Kingston Township, Frontenac County (Figure NP–30–1). The quarry was formerly owned by Glen Lawrence Construction Company. The quarry licence covers an area of 24 ha.

GEOLOGY

Excavation of the quarry eastward into a hillside has exposed 17.0 m of limestone from the lower and upper members of the Gull River Formation (Figure NP–30–2). The lower lift consists primarily of interbedded limestone and dolostone of the lower member, whereas the overlying strata in the upper lift is assigned to the upper member of the Gull River Formation. The bedrock surface around the quarry rises to the east which results in the quarry face increasing in height from 5 to 17 m. The

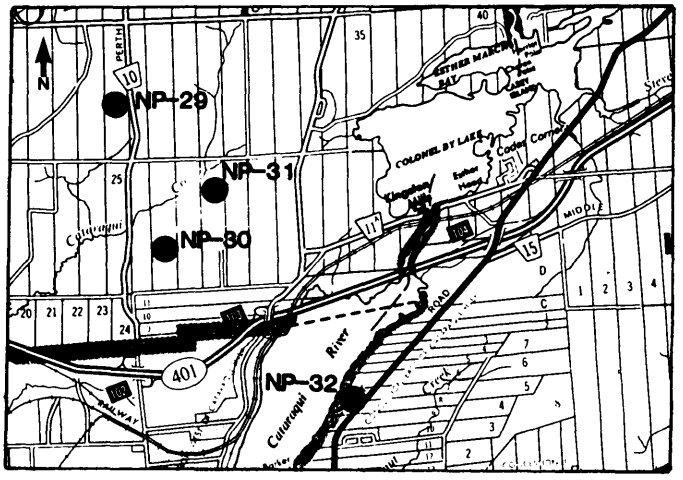


Figure NP–30–1. LOCATION MAP FOR MACADOOS LANE (GLEN LAWRENCE) QUARRY.

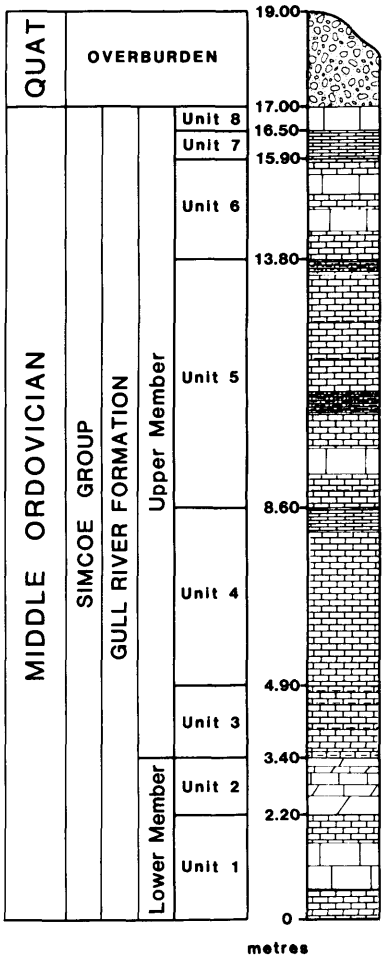


Figure NP–30–2. STRATIGRAPHIC COLUMN FOR MACADOOS LANE (GLEN LAWRENCE) QUARRY.

glacial overburden around the quarry ranges from 1–2 m in thickness.

Geological Section

Thickness

UNIT 8 Gull River Formation, upper member *0.5m*

Limestone: dark grey, weathers light grey; microcrystalline; one bed 50 cm thick; small patches of calcite crystals, "birdseye" texture, present; upper surface not deeply weathered; lower contact of unit sharp and planar.

UNIT 7 Gull River Formation, upper member *0.6m*

Limestone: dark grey, weathers light grey-brown to light brown; microcrystalline; thin bedded (2–5 cm) with beds thinly laminated, often producing a shaly limestone upon weathering, sharp and planar contacts; lower contact of unit sharp and planar.

UNIT 6 Gull River Formation, upper member *2.1m*

Limestone: medium to dark grey, weathers light grey; microcrystalline to very fine crystalline; medium to thick bedded (20–40 cm), with sharp and planar contacts (no shale partings); large calcite-filled vugs common, as are small patches of calcite crystals, "birdseye" texture; lower 50 cm consists of an intraformational limestone conglomerate with very light grey, microcrystalline limestone intraclasts in a matrix of darker grey very fine-crystalline limestone; overall the crystallinity in the unit decreases in size upwards; lower contact of unit sharp and planar.

UNIT 5 Gull River Formation, upper member *5.2m*

Limestone: medium to dark grey, weathers light grey; microcrystalline to very fine crystalline; medium bedded (20–30 cm) with sharp, planar to rarely stylolitic contacts, very thin shale partings also occur; small patches of calcite crystals, "birdseye" texture, very abundant; some beds display deep, penetrative mud cracks; at 1.35 m above base of unit is a single 1.0 m thick bed of microcrystalline limestone, at both 2.5 m and 5.15 m above base of unit are 10 cm beds of dark grey, thinly laminated, shaly limestone; lower contact of unit sharp and planar.

UNIT 4 Gull River Formation, upper member *3.7m*

Limestone: dark grey, weathering light to medium grey; microcrystalline; medium bedded (20–30 cm), upper 0.5 m more thinly bedded (2–5 cm), sharp contacts with only rare, thin shale partings; small patches of calcite crystals, "birdseye" texture, common; upper part of unit weathers more recessively due to thinner bedding; lower contact of unit sharp and planar.

UNIT 3 Gull River Formation, upper member *1.5m*

Limestone: dark grey, weathers medium grey (to light brown at northwest corner of quarry because it is at surface); microcrystalline to very fine crystalline; medium bedded (20–30 cm), with shale partings 2–4 cm thick between limestone beds; small patches of calcite crystals, "birdseye" texture, numerous in limestone beds, especially in upper part of unit; lower contact of unit sharp; top of lower lift occurs at top of this unit.

UNIT 2 Gull River Formation, lower member *1.2m*

Dolostone, with dolomitic limestone and limestone interbeds: light to medium grey to green-grey, weathers light green-grey to light green; limestone is microcrystalline to very fine crystalline, dolostone is very fine to fine crystalline; massive, one bed; about 40% of unit consists of dolostone, with the remainder varying between limestone and dolomitic limestone; lower contact of unit sharp and planar.

UNIT 1 Gull River Formation, lower member *2.2m*

Limestone: dark grey, weathers same; microcrystalline, with rare beds of fine crystalline; medium to thick bedded (20–40 cm) bedded, with sharp planar contacts and rare, thin shale partings; small patches of calcite crystals, some of which are recrystallized brachiopod shells.

Total thickness *17.0m*

Photo NP-30-1.
PORTABLE CRUSHING PLANT AT MACADOOS LANE (GLEN LAWRENCE) QUARRY (LOOKING NORTHEAST).

QUARRY OPERATION

The excavated area of the quarry is about 12 ha worked in two lifts of 14 m and 6 m.

Drilling and blasting is subcontracted; a drill pattern of 3 m x 3 m is used with 7.6 cm diameter holes. Fragmentation is good due to the well bedded nature of the rock.

PROCESSING

The blasted stone is transported approximately 100 m to 150 m by a Yale 3000 (4.5 yd.) loader to a portable crushing system. This consists of a Cedarapids 30 in. x 30 in. double impeller crusher in closed circuit with a 4 ft. x 10 ft. Parker double-deck screen. The screen products are -3/16 in. (screenings), -5/8 in. + 3/16 in., and +5/8 in. oversize to recrush.

PRODUCTS

Rubble Rock
Granular "A" & "B"
-5/8 in. + 3/16 in.
Concrete Stone
Screenings

REFERENCES

Liberty, 1971c, p. 9
Hewitt and Vos, 1972, p. 25-26

MAPS

Carson, 1982c, OGS Map P.2496

NP-31 H.J. McFARLAND CONSTRUCTION COMPANY— MACADOOS LANE (BILOW) QUARRY

LOCATION AND OWNERSHIP

The Macadoos Lane Quarry of H.J. McFarland Construction Co. is located in Lot 29, Concession 4, Kingston Township, Frontenac County on the northern outskirts of the City of Kingston (Figure NP-31-1). The quarry was inactive at the time of the field work in 1986. The quarry licence covers an area of 13.0 ha.

GEOLOGY

The quarry is split into two levels; the upper lift is stepped back from the lower because the bedrock surface rises gently to the south. The entire 9.35 m thick section consists of dark grey, microcrystalline to fine-crystalline, thin-bedded, shaly limestone of the upper member of the Gull River Formation. Shale partings are dark grey, commonly calcareous, and rarely exceed 1 cm in thickness. Some of the beds contain intraclasts of light grey, microcrystalline limestone. The crystal size in the limestone beds increases upward to the top of the quarry,

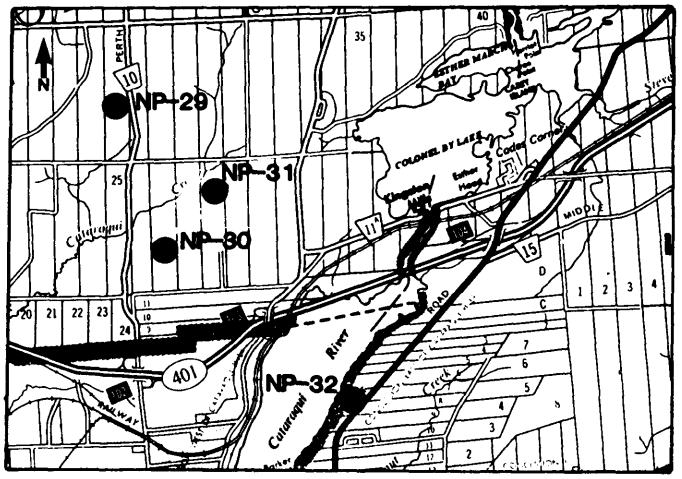


Figure NP-31-1. LOCATION MAP FOR MACADOOS LANE (BILOW) QUARRY.

becoming a fine-grained bioclastic calcarenite in the topmost metre, where the coral *Tetradium* is abundant. Glacial overburden around the quarry is generally less than 2 m thick.

CHEMICAL ANALYSIS*

	Components in Percent	
Above Floor (m)	4.69 - 9.35	0 - 4.69
SiO_2	3.44	8.20
Al_2O_3	0.88	2.16
Fe_2O_3	0.34	0.88
MgO	1.35	2.24
CaO	51.8	46.1
P_2O_5	0.03	0.04
SO_3	0.17	0.64
L.O.I.	42.5	38.7
Total	100.5	99.0

* *after Hewitt and Vos, 1972, p.17-18.*

REFERENCES

Hewitt, 1964a, p. 36
Hewitt and Vos, 1972, p. 17-18

MAPS

None

NP-32 FRONTENAC AGGREGATES AND CONSTRUCTION — PITTSBURGH QUARRY

LOCATION AND OWNERSHIP

The Pittsburgh Quarry is located on the east bank of the Cataraqui River, approximately 3.5 km north of the village of Barriefield (Figure NP-32-1). It extends across Lots 7 and 8, in the Concession East of the Cataraqui River, Pittsburgh Township, Frontenac County. This quarry was previously operated by McGinnis and O'Con-

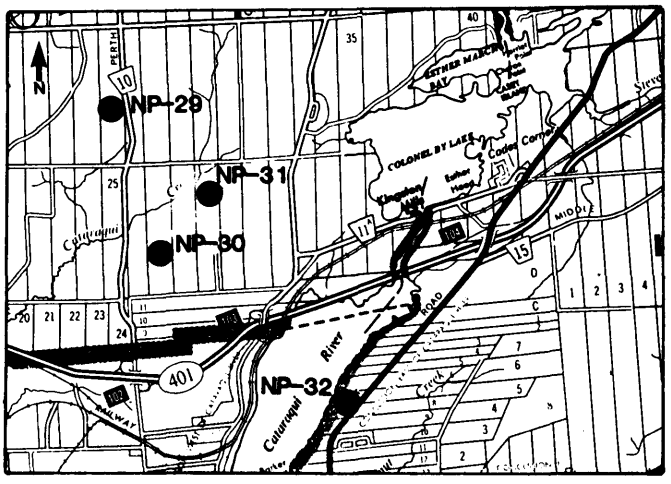


Figure NP-32-1. LOCATION MAP FOR PITTSBURGH QUARRY.

nor Limited, from 1949–1986, and was purchased in January 1986 by Frontenac Aggregates and Construction, the present operators. The quarry licence covers an area of 17.4 ha.

GEOLOGY

The quarry exposes limestones and dolostones of the lower member of the Gull River Formation (Figure NP–32–2). The limestones and dolostones alternate in units generally 0.5 to 2.0 m thick. The dolostones in the lower part of the quarry are commonly silty or sandy, while some of those near the top of the quarry contain large calcite–filled vugs. Glacial overburden around the quarry is up to 2 m thick.

Geological Section

Thickness

UNIT 11 Gull River Formation, lower member *2.2m*

Dolomitic limestone: light to medium grey, weathers light grey–brown to light brown at top of quarry; very fine crystalline; medium bedded (20–30 cm) with sharp and planar contacts; at the base and 1.0 m above base of unit are 1 cm thick shale partings which weather recessively; large (up to 20 cm diameter) calcite–filled vugs are prominent in some beds; lower contact of unit sharp and planar.

UNIT 10 Gull River Formation, lower member *1.1m*

Limestone: light to medium grey, weathers very light grey, almost white; microcrystalline; thick bedded (40 cm), although extensive fracturing obscures bedding in places, sharp and commonly stylolitic contacts; small patches of calcite crystals occur rarely; lower contact of unit sharp and planar.

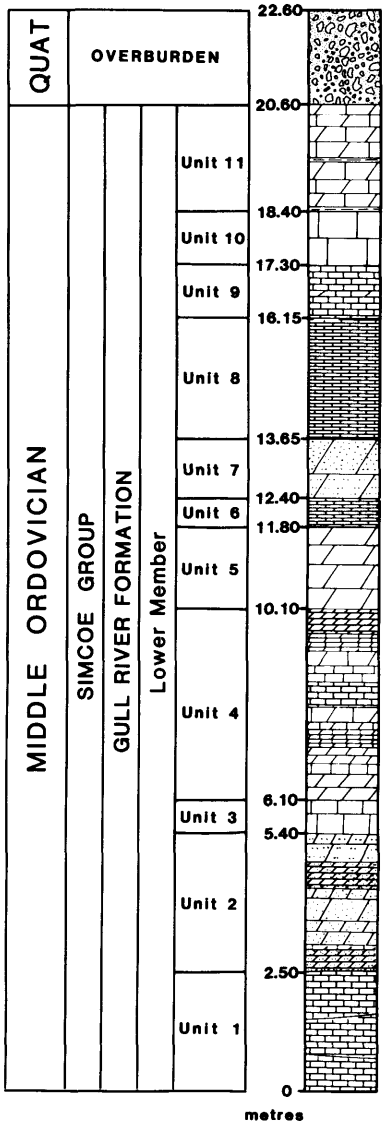


Figure NP-32-2. STRATIGRAPHIC COLUMN FOR PITTSBURGH QUARRY.

UNIT 9 Gull River Formation, lower member *1.15m*

Limestone: in places dolomitic; medium grey, weathers medium to light grey–brown; very fine crystalline; medium bedded (20–30 cm), with sharp and planar contacts, some beds are thinly laminated; large (up to 15 cm diameter) calcite–filled vugs occur in uppermost bed of 25 cm; lower contact of unit sharp and planar.

UNIT 8 Gull River Formation, lower member *2.5m*

Limestone: medium to dark grey, weathers medium grey near base and lightens to nearly white at top of unit; microcrystalline, with a few beds very fine crystalline near base of unit; thin bedded (5–10 cm), in very even beds, sharp and planar contacts in lower part changing to

stylolitic in upper part; small patches of calcite crystals occur rarely; lower contact of unit sharp and planar.

UNIT 7 Gull River Formation, lower member 1.25m

Dolostone, muddy to sandy: light green to light green-grey, (30 cm above base of unit very distinct medium green horizon), weathers light to dark green-grey; very fine crystalline, with mud to very coarse-grained sand intermixed; two beds - lower 35 cm and upper 90 cm; lower contact of unit gradational over 5 cm with laminae of dark grey limestone and light green dolostone.

UNIT 6 Gull River Formation, lower member 0.6m

Limestone: medium grey, weathers dark grey-brown; very fine crystalline; thin bedded (5-7 cm) with beds commonly laminated, sharp and planar contacts; unit prominently resistant to weathering; lower contact of unit sharp and abrupt.

UNIT 5 Gull River Formation, lower member 1.7m

Dolostone: light grey-brown, weathers light green-grey; very fine crystalline; thick bedded (80-90 cm), with sharp and slightly irregular contacts; faint laminae in some beds; numerous conchoidal fractures throughout unit; lower contact of unit very sharp and abrupt.

UNIT 4 Gull River Formation, lower member 4.0m

Dolomitic limestone, with interbeds of limestone and dolostone:

dolomitic limestone and dolostone - medium grey, weathers light green-grey to light grey; very fine crystalline; medium bedded, (15-35 cm), thin bedded (5-10 cm) in upper metre; patches of calcite crystals, up to 5 cm in diameter, present in some beds;

limestone - medium to dark grey, weathers light grey to grey-brown; microcrystalline; medium bedded (20-30 cm); lower contact of unit sharp and planar; top of unit is at top of second lift.

UNIT 3 Gull River Formation, lower member 0.7m

Limestone: medium to dark grey, weathers medium grey to light brown in uppermost 10 cm; very fine crystalline; medium bedded (30 cm); lower contact of unit sharp and planar; top of unit is at top of first (lowest) lift.

UNIT 2 Gull River Formation, lower member 2.9m

Dolostone, silty sandy: light grey to light green-grey, weathers same; very fine to fine crystalline; bedding variable, ranging from thin to thick bedded (10-80 cm), with sharp and planar contacts; lowest 40 cm is light green dolostone which displays extensive fractures and easily disintegrates into gravel; interval from 1.8 to 2.3 m above base of unit is a single bed of sandy dolostone in which very coarse to small pebble-sized quartz clasts make up 25% of the rock; the interval 2.3 to 2.5 m above the base of the unit is a distinctly laminated, dark grey, fine-crystalline, dolomitic limestone; lower contact of unit is sharp and irregular, with up to 20 cm of relief.

UNIT 1 Gull River Formation, lower member 2.5m

Limestone: dark grey, weathers medium to dark grey; microcrystalline to very fine crystalline; medium bedded (15-30 cm) with sharp, undulating to stylolitic contacts.

Total thickness 20.6m

QUARRY OPERATION

The quarry has been developed over an area of about 10 ha. A total of 4 lifts have been established at heights of 6.7 m, 3.6 m, 6.7 m and 4.9 m; each lift is active with asphalt quality stone obtained from the 1st (top) and 3rd lifts and crusher run material from the 2nd and 4th (bottom) lifts. A drill pattern of 2.1 m x 2.1 m or 2.1 m x 2.4 m is used, 7.6 cm diameter holes being drilled with a Joy MS-4E air track and 750 cfm Jaeger compressor. The bottom lift of the quarry is approximately 2.0 m above the Cataraqui River, providing good natural drainage. From 18 to 30 holes are blasted each day using AN/FO (Nilite) as a bulk charge primed with Tovex 500 and initiated with electric delay caps.

PROCESSING

The blasted stone is loaded by a 745-HB (5 yd.) Fiat-Allis loader into one of two 20-ton Terex haulage trucks. Primary crushing is by a Missouri Rogers 25 in. x 40 in. jaw crusher. The crushed stone (-6 in.) is then passed over a Kennedy Van Saun vibrating screen to remove -1 in. fines, and the -6 in. + 1 in. material is sent for secondary crushing by a Cedarapids 30 in. x 20 in. impeller crusher. The secondary crushed material is combined with the -1 in. fines and screened by a Cedarapids 42 in. x 10 ft. horizontal two-deck screen. The resulting -4 in. + 1/2 in. material is sent for tertiary crushing by a Cedarapids 40 in. x 30 in. hammer mill. The -1/2 in. fines are added to the hammer mill crushed product and passed through a 6 ft. x 14 ft. Simplicity double-deck screen to generate the desired HL product, screenings and an oversize that is returned to the hammer mill.

Fine material is screened out before entering the crushers to lighten their load.

Fiat-Allis 545, 645, and 745 loaders (2 yd., 3 yd., 5 yd., respectively) are used to stockpile material and load trucks.

PRODUCTS

3/4 in. Crusher Run
5/8 in. Crusher Run
Granular "B"
HL 3 (-1/2 in. + 1/4 in.)
HL 4 and 5 (-5/8 in. + 1/4 in.)
HL 6 and 8 (-1 in. + 1/4 in.)

REFERENCES

Swenson, 1957
Hewitt, 1960, p. 69-71
Swenson and Gillot, 1960
Hewitt, 1964a, p. 37
Liberty, 1971c, p. 9
Gorman and Code, 1972
Hewitt and Vos, 1972, p. 35-36
Smith, 1974
Dolar-Mantuani, 1975
Pagano and Cady, 1982
Dolar-Mantuani, 1983

Photo NP-32-1.
VIEW OF ASPHALT BATCH PLANT (BACKGROUND) AT THE PITTSBURGH QUARRY (LOOKING NORTHEAST).

Sabina, 1983, p. 34
Rogers, 1985

MAPS

Wynne-Edwards, 1962, GSC Map 27-1962
Hewitt, 1964d, ODM Map 2054
Liberty, 1971b, GSC Map 18-1970
Carson, 1982c, OGS Map P.2496

NP-33 MILL POINT QUARRY

LOCATION AND OWNERSHIP

This quarry, located 2 km west of Marysville, Wolfe Island, in Lot 11, Registered Plan No. 73, Wolfe Island Township, Frontenac County, is operated intermittently on demand (Figure NP-33-1). The quarry is not within an area designated under the Pits and Quarries Control Act.

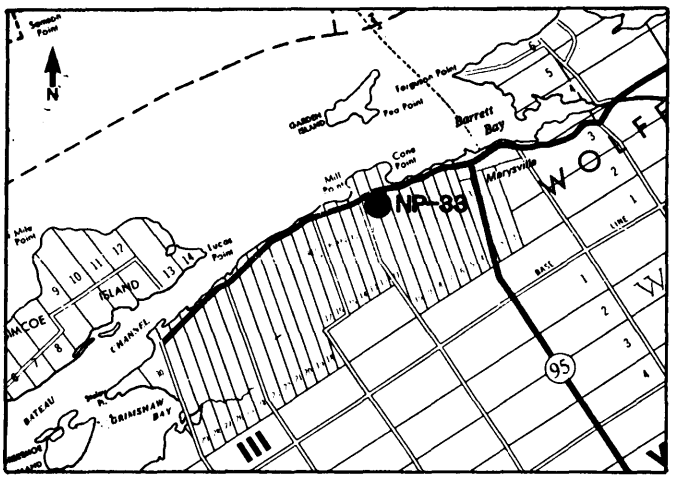


Figure NP-33-1. LOCATION MAP FOR MILL POINT QUARRY.

GEOLOGY

The 8 m deep quarry exposes thin-bedded limestones of the upper member of the Gull River Formation. There are two uneven lifts reflecting a long history of extraction. Glacial overburden around the quarry is generally less than 0.5 m in thickness.

Geological Section

		Thickness
UNIT 1	*Gull River Formation, upper member*	*8.0m*
	Limestone: medium grey-brown to medium grey, weathers light to medium brown; microcrystalline to very fine crystalline; thin bedded (5-10 cm) with thin shale partings; very fossiliferous, especially the coral Terradium; some beds contain small intraclasts of light grey, microcrystalline limestone.	
Total thickness		*8.0m*

REFERENCES

None

MAPS

Liberty, 1971e, GSC Map 20-1970
Carson, 1982c, OGS Map P.2496

NP-34 GRIFFIN BROTHERS (GANANOQUE) LTD. — BATTERSEA QUARRY

LOCATION AND OWNERSHIP

This quarry, located 3 km southwest of Battersea on Frontenac County Road 10, in Lot 5, Concession 8, Storrington Township, Frontenac County is owned and operated by Griffin Brothers (Gananoque) Ltd. (Figure

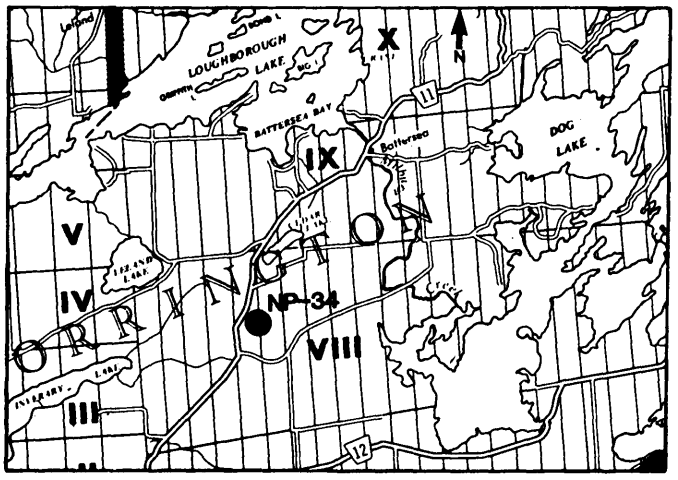


Figure NP-34-1. LOCATION MAP FOR BATTERSEA QUARRY.

NP–34–1). The quarry property covers an area of 3.2 ha.

GEOLOGY

The 5.5 m deep quarry exposes dolostones and limestones of the lower member of the Gull River Formation. East–west trending joints in this quarry are commonly lined with calcite veins up to 0.5 cm wide. Glacial overburden around the quarry varies from 1 to 2 m in thickness.

Geological Section

		Thickness
UNIT 2	*Gull River Formation, lower member*	*3.5m*

Limestone: medium to dark grey, weathers light brown on joint planes otherwise weathers medium grey; microcrystalline to very fine crystalline; thin bedded (5–10 cm) with sharp and planar contacts, rarely stylolitic; rare patches of small calcite crystals, "birdseye" texture, present; lower contact of unit sharp and planar.

UNIT 1	*Gull River Formation, lower member*	*2.0m*

Dolostone, sandy in some beds: light green to light green-grey, weathers light green; very fine to fine crystalline; thin bedded (5–10 cm), with sharp and planar contacts; beds commonly exhibit fractures which trend 30–40 degrees from horizontal; coarse-grained, well-rounded quartz sand grains are present.

Total thickness	*5.5m*

QUARRY OPERATIONS

A drill pattern of 2.7 m x 2.7 m is used with 7.6 cm diameter holes. AN/FO is used as the explosive charge and initiated with electric caps.

PROCESSING

A portable crushing system, consisting of a primary 22 in. x 48 in. Cedarapids jaw crusher, a secondary Cedarapids 896 Commander crusher and a screening plant is set up as required.

PRODUCTS

Rubble Rock
Granular "B" and "C"
1/2 in. chips
Screenings

REFERENCES

Hewitt and Vos, 1972, p. 26

MAPS

Liberty, 1971b, GSC Map 18–1970
Carson, 1982c, OGS Map P.2496

NP–35 GRIFFIN BROTHERS (GANANOQUE) LTD. — JOYCEVILLE QUARRY

LOCATION AND ACCESS

Griffin Brothers (Gananoque) Ltd. owns and operates this quarry in Lots 17 and 18, Concession 5, Pittsburgh Township, Frontenac County, on the southwestern outskirts of the village of Joyceville (Figure NP–35–1). The quarry licence covers an area of 63.4 ha.

GEOLOGY

The 13.1 m deep quarry has been in operation since 1950 and exposes interbedded limestones, dolostones, shales, and sandstones of the lower member, Gull River Formation (Figure NP–35–2). Most of the quarry consists of a single lift, of approximately 5 m depth, which

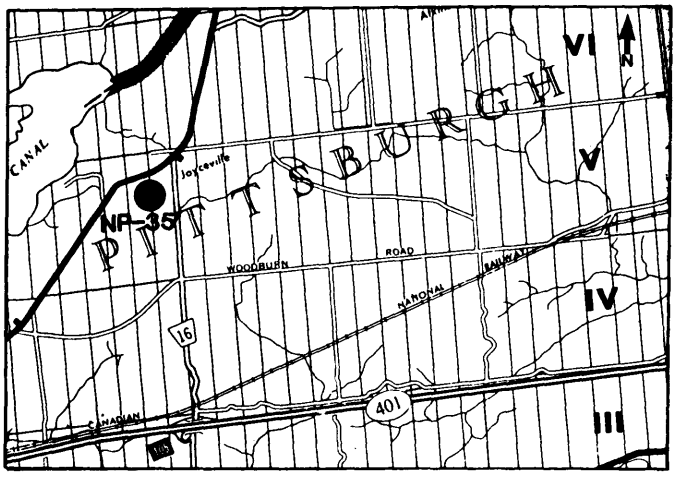


Figure NP-35-1. LOCATION MAP FOR JOYCEVILLE QUARRY.

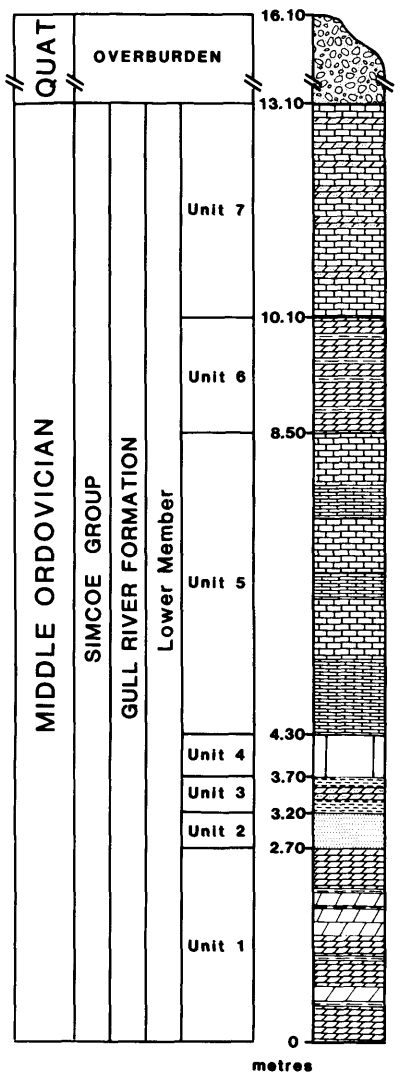


Figure NP-35-2. STRATIGRAPHIC COLUMN FOR JOYCEVILLE QUARRY.

reveals an irregular bedrock surface. A second, lower lift has been excavated in two places, the deeper of which exposes an additional 8.5 m of strata. The thickness of the glacial overburden varies from 1 to 3 m around this quarry site.

Geological Section

Thickness

UNIT 7 Gull River Formation, lower member *3.0m*

Limestone, interbedded with silty dolostone: dark grey, with light brown dolostones, weathers medium grey, with medium brown dolostones; microcrystalline to very fine crystalline, with fine-crystalline dolostones; medium bedded (20–30 cm); lower contact of unit sharp and planar.

UNIT 6 Gull River Formation, lower member *1.6m*

Dolostone, interbedded with shale: medium brown, weathers light brown; very fine grained; very thin bedded (1–3 cm); lower contact of unit sharp and planar.

UNIT 5 Gull River Formation, lower member *4.2m*

Limestone: light to medium grey, weathers medium grey; microcrystalline to very fine crystalline; thin to medium bedded (5–15 cm); most beds bioturbated; lower contact of unit sharp and planar.

UNIT 4 Gull River Formation, lower member *0.6m*

Limestone: light grey, weathers light brown to light green; fine to medium crystalline; single bed; rare calcite-filled vugs; lower contact of unit sharp and planar.

UNIT 3 Gull River Formation, lower member *0.5m*

Shale, interbedded with silty dolostone: light green, weathers same; very fine grained texture in most beds; very thin bedded (1–3 cm); lower contact of unit sharp and planar.

UNIT 2 Gull River Formation, lower member *0.5m*

Sandstone: medium green, weathers light green to light brown; fine-grained quartz; single bed; lower contact of unit sharp and planar.

UNIT 1 Gull River Formation, lower member *2.7m*

Dolostone, interbedded with shale: medium to dark green, weathers light green; very fine crystalline; thin to medium bedded (5–20 cm) with shale beds 2–5 cm thick; small scattered crystals of pyrite present.

Total thickness *13.1m*

CHEMICAL ANALYSIS*

	Components in Percent	
Above Floor (m)	Units 4,5	Units 1 to 3
SiO_2	2.07	21.50
Al_2O_3	0.66	4.88
Fe_2O_3	0.59	1.64
MgO	2.24	8.67
CaO	51.5	28.8
P_2O_5	0.02	0.06
SO_3	0.26	1.25
L.O.I.	42.9	31.7
Total	100.2	98.5

* *after Hewitt and Vos, 1972, p.26-27.*

QUARRY OPERATION

A drill pattern of 2.75 m x 2.75 m is used with 7.6 cm diameter holes. Blasting is with AN/FO and electric caps.

PROCESSING

A portable crushing system is set up on site, consisting of a primary 22 in. x 48 in. Cedarapids jaw, and a secondary Cedarapids 896 Commander crusher feeding a screening plant. Production for 1986 was approximately 60,000 tonnes, primarily of crusher run granular products.

PRODUCTS

Rubble Rock
Granular "B" & "C"

1/2 in. chips
Screenings

REFERENCES

Hewitt and Vos, 1972, p. 26–27
Sabina, 1983, p. 34

MAPS

Wynne-Edwards, 1962, GSC Map 27–1962
Hewitt, 1964d, ODM Map 2054
Liberty, 1971b, GSC Map 18–1970
Carson, 1982c, OGS Map P.2496

NP-36 HOWE ISLAND QUARRY

LOCATION AND OWNERSHIP

This small quarry was opened in the spring of 1986 in Lot 5, North Range, Howe Island Township, Frontenac County to supply the township with aggregate for its gravel roads (Figure NP-36-1). The quarry is not designated under the Pits and Quarries Control Act.

GEOLOGY

When visited, the quarry was partially flooded with only 3.0 m of medium-bedded, microcrystalline limestone exposed above the water level. Light green dolomitic limestone fragments were observed in the adjacent rubble pile indicating that this quarry contains strata of the lower member of the Gull River Formation. Overburden thickness varies considerably from less than 0.5 to 3.0 m.

Geological Section

		Thickness
UNIT 1	*Gull River Formation, lower member*	*3.0m*
	Limestone: light to dark grey, grey-brown at top, too fresh to show any different weathered colours; microcrystalline to very fine crystalline; medium bedded (20-25 cm) with sharp, planar to stylolitic contacts; sparsely fossiliferous; some light green, very fine-grained, dolomitic limestone fragments found in rubble pile, lower part of quarry not visible due to water in quarry.	
Total thickness		*3.0m*

REFERENCES

None

MAPS

None

NP-37 WARREN PAVING AND MATERIALS GROUP LIMITED — WESTBROOK QUARRY

LOCATION AND OWNERSHIP

The Westbrook Quarry, operated by Dibblee Construction Ltd. of the Warren Paving and Materials Group, extends across Lots 1, 2, and 3, Concession 4 West Division, Kingston Township, Frontenac County, just north of Highway 401 on the Westbrook Road (Figure NP-37-1). Most of the quarry production is used to supply an on-site asphalt plant. The quarry licence covers an area of 151.8 ha.

GEOLOGY

The 5.0 m deep quarry exposes thin-bedded, shaly limestones of the upper member, Gull River Formation. The limestones range from microcrystalline to fine crystalline.

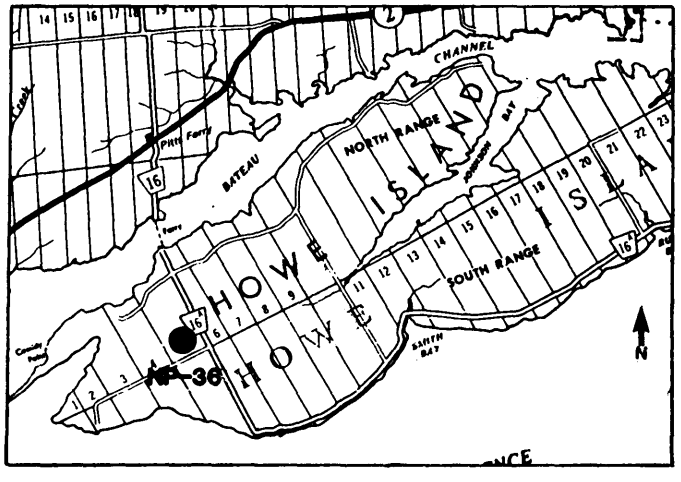


Figure NP-36-1. LOCATION MAP FOR HOWE ISLAND QUARRY.

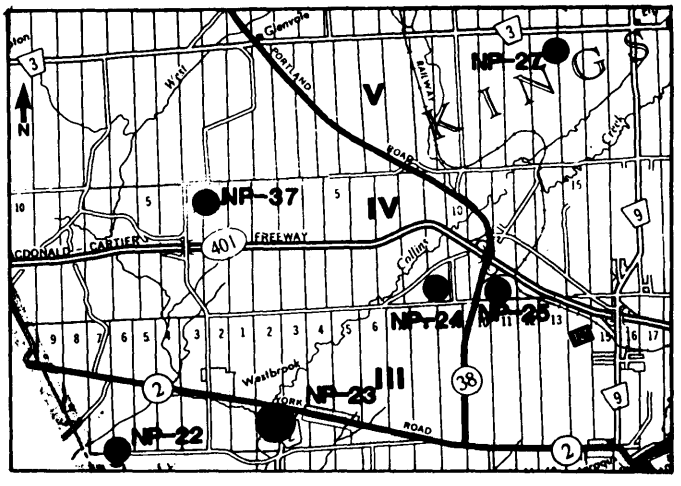


Figure NP-37-1. LOCATION MAP FOR WESTBROOK QUARRY.

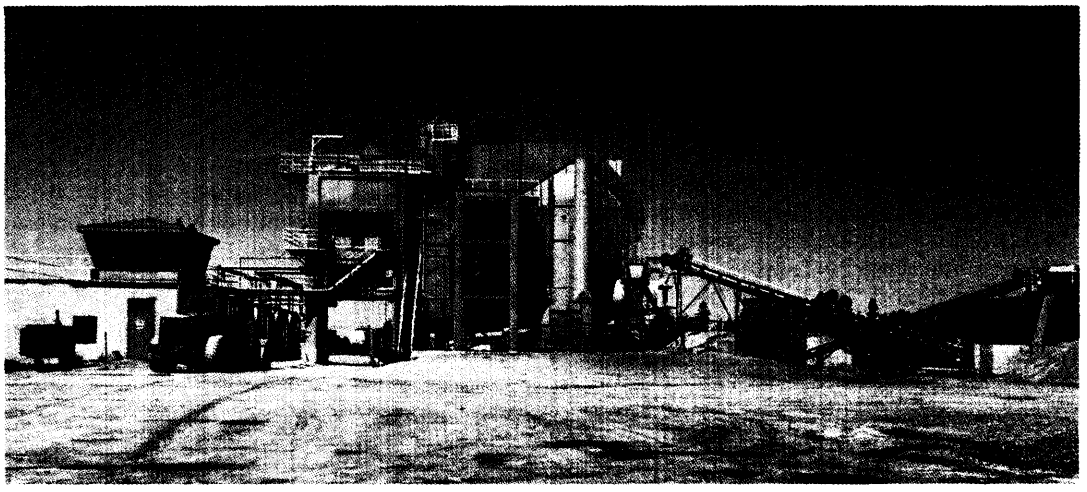


Photo NP-37-1.
6,500 LB. ASPHALT BATCH PLANT AT THE WESTBROOK QUARRY (LOOKING WEST).

Glacial overburden around the quarry is generally less than 1 m thick.

Geological Section

	Thickness
UNIT 1 Gull River Formation, upper member	*5.0m*
Limestone: medium to dark grey, weathers medium grey; microcrystalline to rarely fine crystalline; thin (5–10 cm) to rarely medium bedded (14–30 cm), with thin shale partings present between some beds; moderately fossiliferous; small patches of calcite crystals, "birdseye" texture, abundant.	
Total thickness	*5.0m*

QUARRY OPERATION

The quarry has an excavated area of about 4 ha on a single lift of 6.1 m.

Drilling and blasting is contracted; a 2.1 m x 2.7 m drill pattern is used with 6.4 cm diameter blast holes.

PROCESSING

A portable crushing plant is transported from the Warren Paving and Materials Group Boyce Quarry (CP–18) on a demand basis.

PRODUCTS

Granular "A"
Granular "B"

HL3

HL4

HL6

Concrete stone as required

REFERENCES

None

MAPS

Carson, 1981c, OGS Map P.2413

Tweed District

INTRODUCTION

Tweed District is situated in the Eastern Ontario Region of southern Ontario. The district is bounded on the east by Carleton Place District, on the south by Napanee District, on the west by Lindsay District, and on the north by Bancroft and Pembroke Districts. Tweed District includes the northern half of Hastings, Lennox and Addington, and Frontenac Counties (Figure TW-0-1).

Twenty-one limestone quarries are documented in the quarry inventory (Appendix IV, Volume I). Three of the limestone quarries are licensed and operate on an intermittent basis; the balance represent post-producing quarries. Ten marble quarries are also operated intermittently.

During the study, all of the intermittently active limestone and marble quarries, one historic limestone quarry,

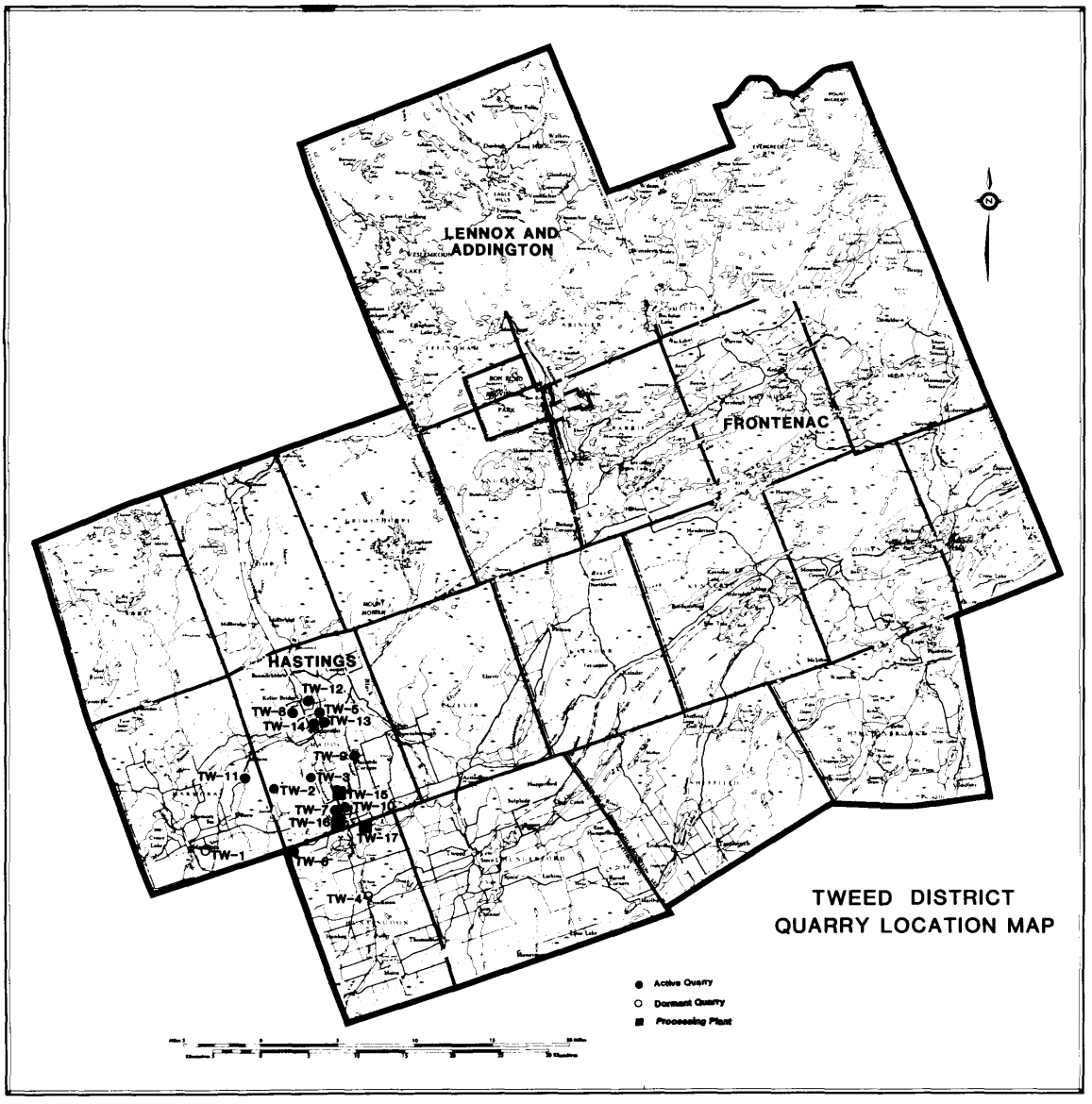


Figure TW-0-1. TWEED DISTRICT QUARRY LOCATION MAP.

two past producing marble quarries and two processing plants were visited and include the following:

- *TW-1* *Marmoraton Mining Company – Marmora Pit (abandoned)*
- *TW-2* *Stoklosar Marble Quarries Limited – Jarvis Lake Quarry (dormant)*
- *TW-3* *Stoklosar Marble Quarries Limited – Madoc Marble Quarry (intermittent)*
- *TW-4* *H. J. McFarland Construction Co. – Crookston Quarry (dormant)*
- *TW-5* *Stoklosar Marble Quarries Limited – Fox Corners Pink Marble Quarry (intermittent)*
- *TW-6* *Stoklosar Marble Quarries Limited – Madoc Green Marble Quarry (intermittent)*
- *TW-7* *Stoklosar Marble Quarries Limited – Madoc Grey–Black Marble Quarry (intermittent)*
- *TW-8* *Stoklosar Marble Quarries Limited – Madoc Buff Marble Quarry No. 1 (intermittent)*
- *TW-9* *Stoklosar Marble Quarries Limited – Madoc Buff Marble Quarry No. 2 (abandoned)*
- *TW-10* *Stoklosar Marble Quarries Limited – Madoc Black Marble Quarry (abandoned)*
- *TW-11* *Stoklosar Marble Quarries Limited – Marmora Brucitic Marble Quarry (intermittent)*
- *TW-12* *Stoklosar Marble Quarries Limited – Keller Bridge Blue Marble Quarry (intermittent)*
- *TW-13* *Stoklosar Marble Quarries Limited – Eldorado Light Buff Marble Quarry (intermittent)*
- *TW-14* *Stoklosar Marble Quarries Limited – Eldorado Dark Buff Marble Quarry (intermittent)*
- *TW-15* *Stoklosar Marble Quarries Limited – Madoc Plant No. 1*
- *TW-16* *Stoklosar Marble Quarries Limited – Madoc Plant No. 2*
- *TW-17* *Canada Talc Industries Limited – Madoc Talc Mine*

PRECAMBRIAN GEOLOGY

Grenville marbles in the Tweed District are part of the Elzevir, Sharbot Lake and Frontenac sedimentary terranes (Bartlett et al., 1984). They are characterized by the presence of both dolomite– and calcite–dominated varieties, intercalated with occasional metavolcanic or metasedimentary beds. The marbles are fine to coarse

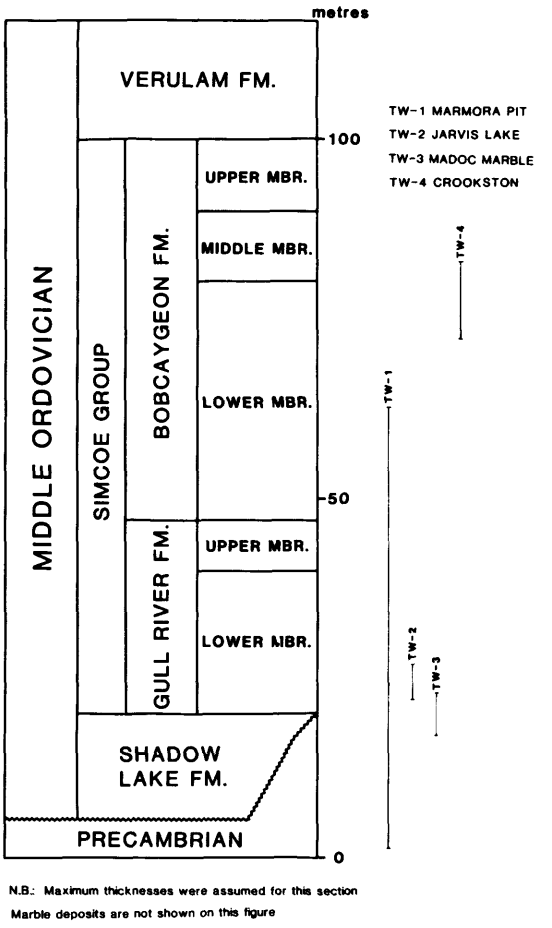


Figure TW-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF TWEED DISTRICT.

crystalline, layered white, grey or buff, and locally they are pink and microcrystalline. A wide band of dolomitic marble between Ompah and Plevna was tested for building stone purposes (Hewitt, 1964c).

PALEOZOIC GEOLOGY

Most of the Tweed District is underlain by Precambrian rocks of the Grenville Province. The Paleozoic rocks of the Middle Ordovician Shadow Lake, Gull River and Bobcaygeon Formations only occur in the extreme southern part of the district.

The Paleozoic–Precambrian contact approximately follows the southern boundary of the Tweed District. This contact is delineated in scattered areas by a northward–facing escarpment such as in the Tweed area. Elsewhere the contact is covered by a ramp of glacial debris.

The Paleozoic rocks in the Tweed District include the sandstones and shales of the Middle Ordovician Shadow Lake Formation (Figure TW–0–2) and the carbonate rocks of the Gull River and Bobcaygeon Forma-

tions of the overlying Simcoe Group. The Verulam and Lindsay Formations of the upper part of the Simcoe Group do not occur in Tweed District.

The Shadow Lake Formation usually consists of a basal conglomerate overlain by arkosic sandstones and shales. It varies in thickness from zero, where it is absent over Precambrian topographic highs, to up to 15 m thick where it fills lows in the Precambrian surface.

There are only small scattered exposures of the Shadow Lake Formation in the Tweed District. A complete section through the formation is exposed at the base of the Paleozoic section in the Marmora Pit (TW–1) where between 6 to 12 m of arkosic sandstones and shale overlie the irregular Precambrian surface. This formation is also exposed at the base of the Madoc Marble Quarry (TW–3).

Overlying the Shadow Lake Formation is the Gull River Formation which is exposed in southwestern Tweed District. There are several abandoned quarries which utilized the Gull River Formation in this district.

The Gull River Formation is subdivided into two members, based on the work of Williams (in prep.) and the exposure in the Marmora Pit (TW–1). This differs from the four–fold subdivision proposed by Liberty (1971c) for these strata in the Kingston area. The Gull River Formation (as defined by Williams, in prep.) varies in thickness from 30 m in the Marmora Pit to 80 m in the Kingston area.

The lower member of the Gull River Formation consists of alternating units, 0.5 to 1.5 m thick, of limestone and dolostone. The limestone is light to medium grey, thin to medium bedded and microcrystalline, and the dolostones are light brown to light green, thin to medium bedded and fine crystalline. The lower part of the member includes thin intervals of shale and quartz–rich sandstone. Several of the light green dolostone beds weather distinctively and provide excellent marker horizons. The lower member ranges in thickness from 20 m in the Marmora Pit (TW–1) to about 60 m in the Kingston area. Stone from these strata in the Jarvis Lake (TW–2) and Madoc Marble (TW–3) quarries is used for terrazzo chips.

The upper member of the Gull River Formation consists of thin–bedded, microcrystalline to fine–crystalline limestones which are interbedded with thin, dark grey, usually calcareous, shale partings. The member thickens from 7 m in the Marmora Pit (TW–1), the only significant exposure in Tweed District, to over 16 m near Napanee.

Overlying the Gull River Formation is the Bobcaygeon Formation which outcrops sporadically in the Tweed District.

The Bobcaygeon Formation is subdivided into three members, based primarily on their shale content (Williams, in prep.). The lower and upper members generally have minor amounts of interbedded shale whereas the middle member has more signficant amounts. The limestones of the lower member consist of thick to massive beds of microcrystalline limestone and medium to coarse–grained calcarenites. The middle and upper members are thin– to medium–bedded, fine– to medium–crystalline limestone and medium–grained calcarenitic limestone. The formation maintains a uniform thickness of 50 to 60 m across the region.

The 40 m thick lower member of the Bobcaygeon Formation is characterized by thick to massive–bedded (0.5 to 1.5 m thick) limestone, often with black chert nodules in many beds. Both the Crookston Quarry (TW–4) and the upper part of the Marmora Pit (TW–1) expose this member.

The middle and upper members of the Bobcaygeon Formation are both about 10 m thick throughout Tweed District. Only a thin interval of the lowermost section of the middle member is exposed in the Crookston Quarry (TW–4). The upper member is not exposed in any quarries in this region.

LIMESTONE INDUSTRIES

The limestone and marble industries in the Tweed District produce principally marble chips for terazzo flooring, and aggregate. Marble chips are produced by Stoklosar Marble Quarries Limited at two plants and by Canada Talc Limited as a by–product of talc mining and processing. Although exact production figures are not available it is estimated that several thousand tonnes of marble chips are produced annually.

Construction aggregates are produced intermittently by Armbro Materials and Construction Ltd. from the waste limestone produced during the operation of the Marmoraton iron mine (TW–1) which ceased production in the late 1970s. Production figures are not available for this operation.

TW–1 MARMORATON MINING COMPANY — MARMORA PIT

LOCATION AND OWNERSHIP

This open pit mine, southeast of the Village of Marmora, on Lots 4–5, Concessions 5–6, Marmora Township, Hastings County (Figure TW–1–1), was once a major producer of iron ore from a magnetite–rich skarn in the Precambrian. A brief history of the mine is presented by Bartlett and Moore (1985, p. 188–189). The overlying Paleozoic rock was stripped off, revealing a continuous 55 m section of Middle Ordovician strata. The removal of over 20 million tonnes of limestone resulted in an open pit 800 m long and 400 m wide. It was eventually deepened to 220 m using a circular ramp system. The waste piles of limestone have recently been worked as a source for aggregate by Armbro Materials and Construc-

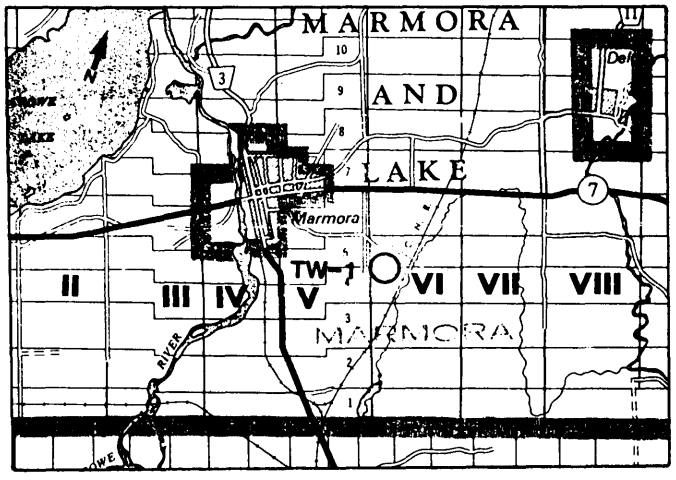


Figure TW-1-1. LOCATION MAP FOR MARMORA PIT.

tion Ltd. A large quantity of limestone waste remains on the property. At the time of the field work in 1986, the lowermost part of the pit was beginning to fill with water.

GEOLOGY

The Paleozoic strata in this pit unconformably overlie a magnetite–rich skarn of Precambrian age. The entire Shadow Lake and Gull River Formations, and part of the lower member of the Bobcaygeon Formation are exposed in the walls of the open pit (Figure TW–1–2). These excellent exposures provide a reference section for the Middle Ordovician strata in central Ontario (Williams and Thompson, 1986). A brief summary of the Paleozoic geology is presented here.

The Shadow Lake Formation can vary in thickness from 6 to 12 m due to the irregular Precambrian surface. The trace of the unconformity itself is sharp and is usually overlain by a basal conglomerate. The formation, as exposed in the pit, consists of a basal conglomerate overlain by interbedded red and green, fine– to medium–grained, dolomitic, feldspathic sandstones and siltstones. Generally, grain size decreases upwards in the formation. The contact with the overlying Gull River Formation, which is considered to be conformable, is placed at the base of the lowest carbonate bed, usually a fine–crystalline silty dolostone.

The Gull River Formation is subdivided into two members (Figure TW–1–2). The lower member consists of 19.8 m of interbedded dolostone and limestone, usually alternating in units about 1 m thick. The limestones range from microcrystalline to fine crystalline, and may include some mud and silt in the lower part of the formation. The dolostones are generally fine crystalline and may contain varying amounts of mud, silt, or sand, and

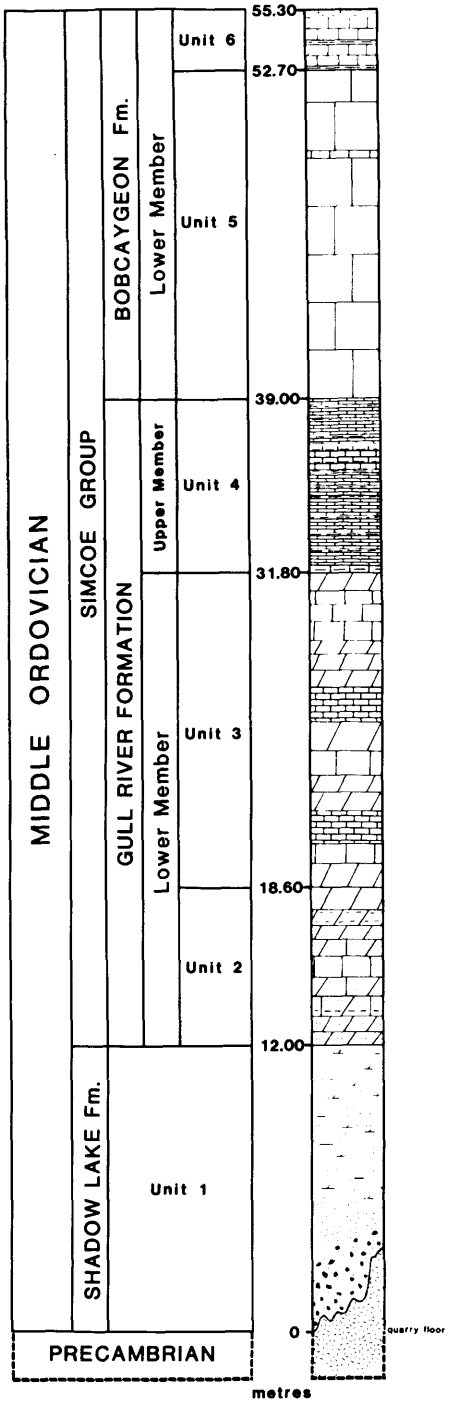


Figure TW-1-2. STRATIGRAPHIC COLUMN FOR MARMORA PIT.

may be considerably calcitic in composition. Bedding is generally thin to medium, with the dolostone beds usually thicker than the limestone beds. The contact with

the overlying upper member is placed at the top of the uppermost dolostone bed, coincident with the base of a considerably more thin-bedded shaly limestone.

The upper member of the Gull River Formation consists of 7.2 m of thin- to rarely medium-bedded limestone, with abundant shale partings. The limestones are generally microcrystalline, although fine- and medium-crystalline beds occur rarely. The contact with the overlying Bobcaygeon Formation is placed at the base of the lowest massive bed of microcrystalline to very fine-crystalline limestone. The contrast between the thin-bedded, shaly limestone of the upper member, Gull River Formation and the massive beds of the lower member, Bobcaygeon Formation clearly identifies this contact.

In the Marmora Pit, 16.3 m of the lower member of the Bobcaygeon Formation are exposed. The lower member consists of massive beds of microcrystalline limestone, with some thinner interbeds of microcrystalline to fine-crystalline limestone which coarsen upwards to include fine- to coarse-grained calcarenites. Thin shale partings occur in the uppermost portion of the section. Black chert nodules occur in a 2 m thick interval, 10 m above the base of the formation. The limestones are generally fossiliferous with brachiopods, corals, and stromatoporoids occurring in large numbers. The stratigraphic nomenclature used here follows the revisions in Middle Ordovician stratigraphy proposed by Williams (in prep.).

REFERENCES

Winder, 1955a, p.10
Hewitt, 1960, p.45–47
Mirynech and Liberty, 1964, p. 32–33
Gross, 1967, p.80–82
Sabina, 1970, p. 136–137
Winder and Sanford, 1972, p.52–53
Winder et al., 1975, p. 140–141
Carson, 1981d, p.52–56, and Sect. C–1
Bartlett and Moore, 1985, p.188–189
Verschuren et al., 1986, p. 296–298
Williams and Thompson, 1986

MAPS

Winder, 1955b, GSC Map 54–17
Carson, 1980a, OGS Map P.2374

TW-2 STOKLOSAR MARBLE QUARRIES LIMITED — JARVIS LAKE QUARRY

LOCATION AND OWNERSHIP

Stoklosar Marble Quarries Limited owns this quarry in Lot 11, Concession 1, Madoc Township, Hastings County (Figure TW–2–1). This quarry was operated intermittently for the production of terrazzo chips and ornamental stone, but has been inactive in recent years.

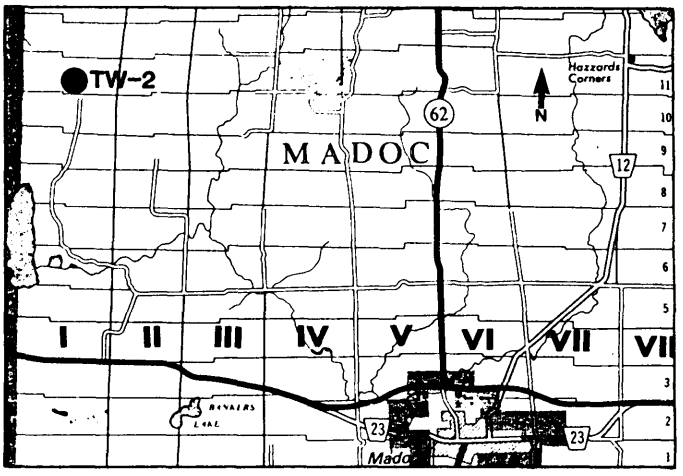


Figure TW-2-1. LOCATION MAP FOR JARVIS LAKE QUARRY.

GEOLOGY

The quarry face exposes 4.5 m of the lower member of the Gull River Formation. A reddish-brown, sandy limestone occurs in this quarry, in addition to the more typical light grey, microcrystalline limestone. Small quartz pebbles occur in some of the sandy limestone beds. Overburden thickness is generally less than 0.5 m around the quarry.

Geological Section

	Thickness
UNIT 1 Gull River Formation, lower member	*4.5m*
Limestone, with some sandy limestone: light reddish-brown to light grey, weathers light to medium reddish-brown; microcrystalline, with fine- to coarse-grained quartz grains; thin to medium bedded (5–15 cm), with sharp and planar, or stylolitic contacts, thin-laminated beds common; burrows rare to common; some iron oxide stains on quarry face.	
Total thickness	*4.5m*

REFERENCES

Hewitt, 1964b, p.33
Hewitt, 1964c, p. 14
Carson, 1981d, Sect. C–3
Verschuren et al., 1986, p.290–292

MAPS

Hewitt, 1968, ODM Map 2154
Carson, 1980a, OGS Map P.2374

TW-3 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC MARBLE QUARRY

LOCATION AND OWNERSHIP

Stoklosar Marble Quarries Limited intermittently produces terrazzo chips from the old Madoc Marble Quarry in Lot 10, Concession 4, Madoc Township, Hastings County (Figure TW–3–1). A second smaller quarry is located immediately to the northwest, also in Lot 10, Concession 4.

GEOLOGY

The northern quarry, opening into a hillside, exposes arkoses (feldspar–rich sandstones) of the Shadow Lake Formation which are overlain by limestones of the lower member, Gull River Formation (Figure TW–3– 2). The lower 2.5 m of the quarry consists of reddish brown, thick–bedded arkosic sandstones of the Shadow Lake Formation. The overlying 3.0 m consists of light grey to light red, thin–bedded limestones of the lower member of the Gull River Formation, which are the primary source for terrazzo chips. Glacial overburden thickness (approximately 2 m) apparently increases over the hill-

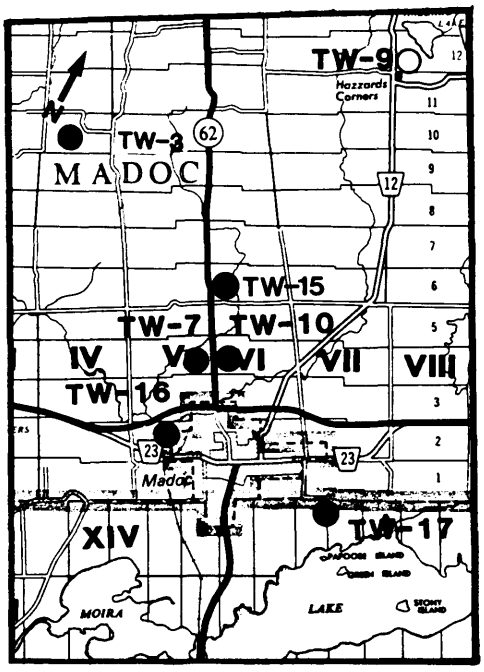


Figure TW-3-1. LOCATION MAP FOR MADOC MARBLE QUARRY.

Photo TW-3-1. FACE AT MADOC MARBLE QUARRY (NORTH QUARRY).

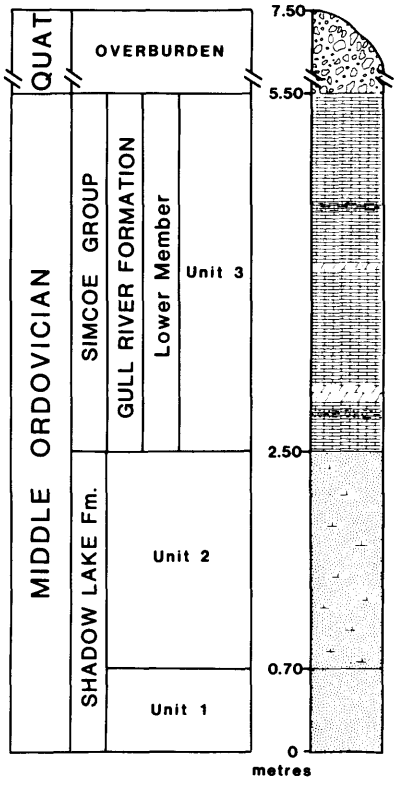


Figure TW-3-2. STRATIGRAPHIC COLUMN FOR MADOC MARBLE QUARRY.

top. The southern quarry exposes a similar section. The thin bedding and irregular joint patterns limited these rocks to products such as terrazzo chips and architectural products.

Geological Section

	Thickness
UNIT 3 Gull River Formation, lower member	*3.0m*

Limestone, interbedded with silty limestone and silty dolostone: light grey, light green to light red, weathers light red with light grey mottles; microcrystalline, interbedded with very fine-crystalline dolostones; thin bedded (4-5 cm) with sharp planar contacts producing a very evenly bedded appearance; some burrows present in silty limestone beds; silty beds are often laminated; lower contact of unit sharp and planar.

UNIT 2 Shadow Lake Formation	*1.8m*

Calcareous arkose: mottled light red and light green, weathers mottled very light red and green; generally fine grained with pebbles and cobbles commonly present; thick (40-50 cm) bedded with sharp and planar contacts; lower contact of unit sharp and planar.

UNIT 1 Shadow Lake Formation	*0.7m*

Arkose: dark reddish-brown, weathers dark red; fine to medium grained with pebbles and cobbles common, some up to 50 cm in diameter; single bed; contact with underlying Precambrian probably not far below floor of quarry as an outcrop of Precambrian rock occurs between the quarry and the gravel road, this also suggests that this contact is very irregular.

Total thickness	*5.5m*

QUARRY OPERATION

The two quarries are operated on an intermittent basis by Stoklosar Marble Quarries Limited. Both of the quarries are about the same size being approximately 10 m by 10 m and having a working face of about 5 m. The stone is quarried from a single lift by drilling and blasting. The shot rock is loaded at the face into two tandem highway trucks and delivered to one of the two processing plants currently operated by Stoklosar Marble Quarries.

PROCESSING

The Stoklosar processing plant is described in site descriptions TW-15 and TW-16.

PRODUCTS

Terrazzo Chips

REFERENCES

Hewitt, 1964a, p.15
Carson, 1981d, Sect. C-2

MAPS

Carson, 1980a, OGS Map P.2374

TW-4 H.J. McFARLAND CONSTRUCTION CO. — CROOKSTON QUARRY

LOCATION AND OWNERSHIP

This quarry is located on the northern outskirts of the village of Crookston, in Lot 10, Concession 9, Huntingdon Township, Hastings County (Figure TW-4-1). Once a source for building stone (Parks, 1912; Goudge, 1938), this quarry is now licensed to H. J. McFarland Construction Company who, to date, have not yet extracted any significant amount of rock.

GEOLOGY

The quarry face, which extends eastward into a hillside, exposes 8.0 m of very thick-bedded limestone of the lower member, Bobcaygeon Formation (Figure TW-4-2). Immediately overlying the top of the quarry in the hillside is 2.5 m of the middle member of the Bobcaygeon Formation. The lower member is characterized by massive-bedded (greater than 1.0 m thick), microcrystalline to very fine-crystalline limestone. The uppermost 2 m in the quarry contains numerous nodules of hard, black chert. The overlying middle member exposed in the hillside consists of thin-bedded, medium-crystalline to medium-grained calcarenitic limestone. Glacial overburden thickens from 0.2 m eastward over the hill top.

Geological Section

	Thickness
UNIT 2 Bobcaygeon Formation, middle member	*2.5m*

Limestone: grey-brown, weathers light brown; fine- to medium-grained calcarenite; thin (5-10 cm) bedded, sharp contacts, commonly with thin shale partings; fossiliferous; some black chert nodules in lower 0.5 m; lower contact of unit sharp.

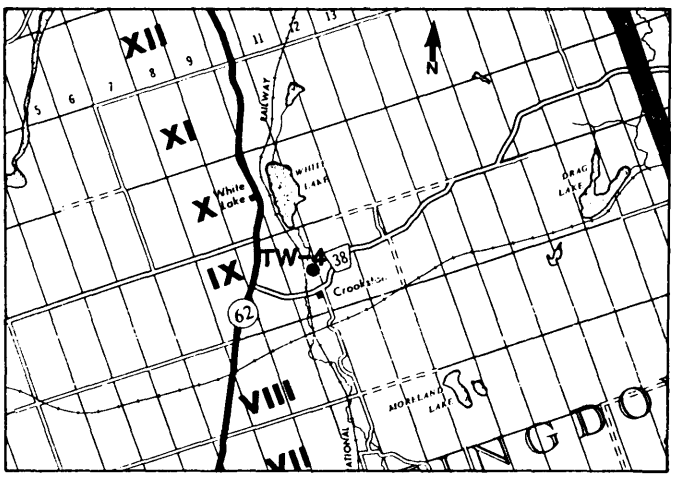


Figure TW-4-1. LOCATION MAP FOR CROOKSTON QUARRY.

UNIT 1 Bobcaygeon Formation, lower member *8.0m*

Limestone: medium to dark grey, weathers light grey; microcrystalline to very fine crystalline; thick to massive bedded (0.7-1.2 m), with rare, very thin, dark grey shale partings; abundant black chert nodules common in upper 2.0 m, thin calcite veins trending east-west occur rarely; some beds very fossiliferous with very large corals, stromatoporoids, stromatolites, bryozoans, and brachiopods.

Total thickness *10.5m*

REFERENCES

Parks, 1912, p.218–220
Goudge, 1933, p. 90–91
Goudge, 1938, p.94
Liberty, 1963a, p.12
Hewitt, 1964b, p.30–31
Sabina, 1970, p. 129–130
Verschuren et al., 1985, p.63
Verschuren et al., 1986, p.270–277

MAPS

Wilson, 1940, GSC Map 559A
Liberty, 1963b, GSC Map 24–1963
Hewitt, 1968, ODM Map 2154
Carson, 1981b, OGS Map P.2411

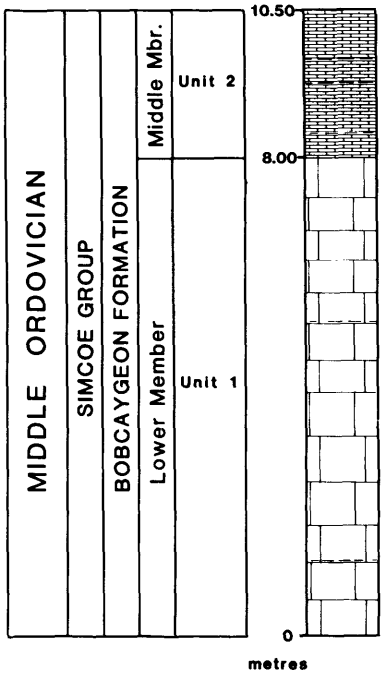


Figure TW-4-2. STRATIGRAPHIC COLUMN FOR CROOKSTON QUARRY.

TW-5 STOKLOSAR MARBLE QUARRIES LIMITED — FOX CORNERS PINK MARBLE QUARRY

LOCATION AND OWNERSHIP

Pink Grenville marble is quarried for terrazzo chips by Stoklosar Marble Quarries Limited at a site 1 km east of Fox Corners. The quarry is in the east half of Lot 20, Concession 6, Madoc Township, Hastings County (Figure TW-5-1). It is located in rolling farmland less than 100 m south of the Fox Road.

GEOLOGY

The rock is variable in texture, but is most commonly a medium-crystalline pink calcitic marble, strongly foliated with a north-south strike, vertical dip and a lineation plunging 60° north. The texture of the rock is generally banded, comprising layers and lenses in pink, white, red and black. Fine flakes of muscovite are common on joint and foliated surfaces, and minor disseminated pyrite is occasionally present. Jointing is rather intensely developed but randomly oriented, making the quarrying of blocks unlikely. Horizontal jointing is spaced at about 1 m intervals, and vertical jointing at the same spacing is evident in two directions at right angles, trending northeast and northwest.

Outcrops are sparse in the vicinity of the quarry and the overburden averages 1 to 2 m in thickness.

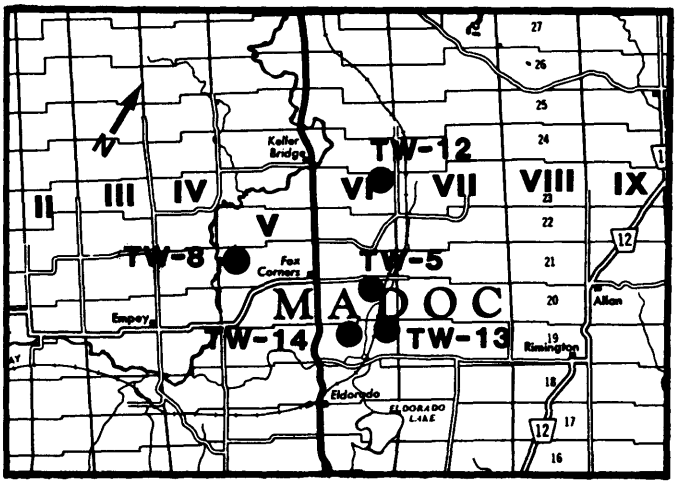


Figure TW-5-1. LOCATION MAP FOR FOX CORNERS PINK MARBLE QUARRY.

PHYSICAL PROPERTIES*

Compressive strength,	MPa	
	Maximum	102
	Minimum	79
	Average	88
Absorption, percent		0.05
Bulk Specific Gravity		2.71
Kg per cubic metre		2709
Abrasive hardness		23.1

CHEMICAL COMPOSITION*

Acid insoluble	1.26%
Lime, CaO	54.40%
Magnesia, MgO	0.70%
Loss on ignition	43.10%
Total	99.46%

* *After Hewitt, 1964c, p.43*

QUARRY OPERATION

The quarry measures 40 m by 15 m, elongated in a northeasterly direction. It is operated on an intermittent basis with production being derived from a single bench exposing a 6 m face above a partially flooded quarry floor. The stone is quarried by drilling and blasting utilizing a jackhammer and controlled blasting methods. The broken rock is loaded at the face into two 12–tonne tandem highway trucks, using a rubber tired front end loader equipped with a 1.5 to 3.5 yd. bucket, as required, and delivered to the Stoklosar processing plants.

PROCESSING

The stone is processed at either of the two plants currently operated by Stoklosar Marble Quarries Limited (sites TW–15 and TW–16).

PRODUCTS

Terrazzo Chips

REFERENCES

Hewitt, 1964c, p.43

TW–6 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC GREEN MARBLE QUARRY

LOCATION AND OWNERSHIP

This terrazzo chip quarry, operated in a green and purple mottled calcitic marble by Stoklosar Marble Quarries Limited, is located 100 m north of the old Marmora–Madoc road in Lot 1, Concession 14, Huntingdon Township, Hastings County (Figure TW–6–1). Opened about 1960, the quarry is licensed and is operated intermittently.

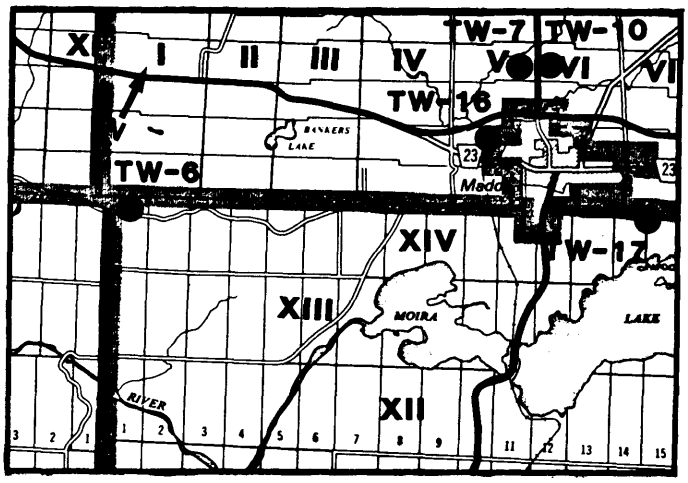


Figure TW–6–1. LOCATION MAP FOR MADOC GREEN MARBLE QUARRY.

GEOLOGY

The marble is calcitic to weakly dolomitic, predominantly pale green in colour, but with attractive patches of mottled green and purple. According to Hewitt (1964c, p.50) "it is composed of fine–grained calcite grains with very irregular serrate intergrown boundaries which give the rock great strength. The calcite grains are intergrown with laths of chlorite and serpentine which make up at least 10% of the rock. Grain size averages 0.1 to 0.2 mm." Occasional patches of disseminated pyrite cubes are present, as are a few narrow siliceous streaks and veins. The rock is massive with a weak foliation which may reflect bedding striking east–west and dipping vertically. The deposit is of the skarn type, occurring near the contact of the Deloro granite (Verschuren et al., 1986, p. 238).

Jointing in the marble is rather irregular but not too closely spaced for the recovery of large mill blocks if desired. Vertical east–west jointing is spaced 2 m to 5 m apart and a nearly horizontal jointing is spaced at 1 m to 5 m. Fracturing due to blasting might limit the suitability of the site for dimension stone, but other deposits may exist nearby (Verschuren et al., 1986, p. 238).

PHYSICAL PROPERTIES*

Compressive strength,	MPa	
	Maximum	318
	Minimum	237
	Average	270
Absorption, %		0.04
Bulk specific gravity		2.64
Kg per cubic metre		2,639
Abrasive hardness		125

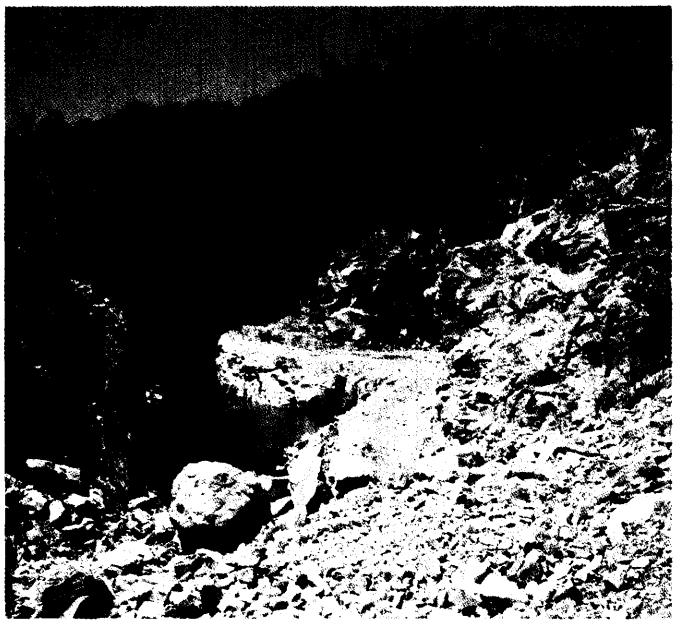


Photo TW-6-1. GREEN GRENVILLE MARBLE AT MADOC GREEN MARBLE QUARRY.

Photo TW-6-2. MOTTLED GREEN AND PURPLE GRENVILLE MARBLE AT MADOC GREEN MARBLE QUARRY.

CHEMICAL COMPOSITION*

Acid insoluble	26.42%
Lime, CaO	30.10%
Magnesia, MgO	13.80%
Loss on ignition	29.35%
Total	99.67%

* *Hewitt, 1964c, p. 50*

QUARRY OPERATION

The quarry is opened into the south side of a steep ridge and is worked on two levels; an upper bench with maximum face of 16 m and a lower one of 4 m in which the floor is covered by water to a shallow depth. The workings are irregular, occupying an area of 40 m by 20 m. Drilling is done by a jackhammer and compressor. Small rounds are taken using controlled blasting methods. One of three 1.5 to 3.5 yd. front end loaders transfer the broken rock at the working face into two tandem highway trucks, each having a capacity of 12 tonnes, for delivery to the Stoklosar processing plants.

PROCESSING

The stone is processed at either one of two plants currently operated by Stoklosar Marble Quarries Limited (sites TW–15 and TW–16).

PRODUCTS

Terrazzo Chips

REFERENCES

Hewitt, 1964c, p.50
Verschuren et al., 1986, p.238

TW–7 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC GREY-BLACK MARBLE QUARRY

LOCATION AND OWNERSHIP

This quarry is located in Lot 4, Concession 5, Madoc Township, Hastings County (Figure TW–7–1) and is worked as needed by Stoklosar Marble Quarries Limited. It is opened into the north flank of a hill at a point 300 m west of Highway 62.

GEOLOGY

The marble is grey–black on the fresh surface, weathering to medium–grey with noticeable rustiness on old fractures. Clastic quartz grains comprise about 10% (Hewitt, 1964c, p.38). Bedding is thin and strikes 030° and dips 50°E.

Jointing is moderately to intensively developed in an irregular pattern. Northwest trending vertical jointing is most common. The site is unsuitable for blocks of any

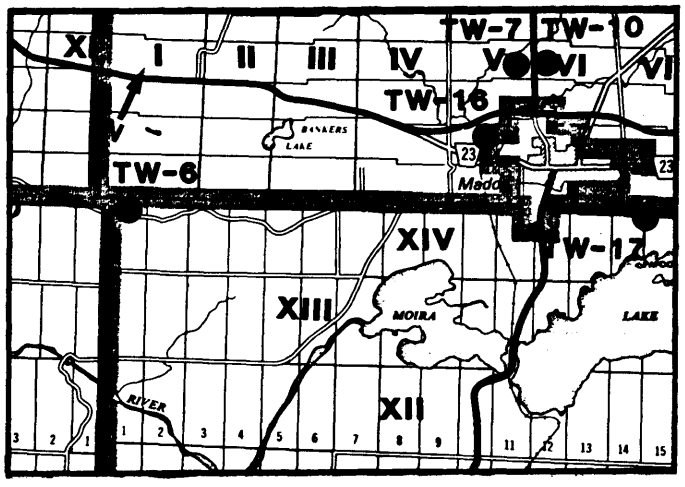


Figure TW-7-1. LOCATION MAP FOR MADOC GREY-BLACK MARBLE QUARRY.

size because of jointing but is satisfactory for terrazzo chips.

Outcrops in the vicinity of the quarry are scarce and overburden probably averages about 30 cm.

PHYSICAL PROPERTIES*

Compressive strength,	MPa	
	Maximum	157
	Minimum	118
	Average	135
Absorption, %		0.05
Bulk specific gravity		2.73
Kg per cubic metre		27.28
Abrasive hardness		35.3

CHEMICAL COMPOSITION*

Acid insoluble	15.40%
Lime, CaO	45.40%
Magnesia, MgO	1.28%
Loss on ignition	36.11%
Total	98.19%

* *Hewitt, 1964c, p.37-40.*

QUARRY OPERATION

The quarry measures approximately 25 m x 10 m with limited production being derived from a single lift with a 5 m working face. At the time of the visit there was some water on the quarry floor. The stone is quarried by drilling and blasting. The blasted rock is loaded into two 12-tonne tandem highway trucks at the working face by either a 1.5 yd. or 3.5 yd. front-end loader and transported to either of the two processing plants currently operated by Stoklosar Marble Quarries Limited.

PROCESSING

The stone is processed at either one of Stoklosar's plants (sites TW-15 or TW-16).

PRODUCTS

Terrazzo Chips

REFERENCES

Hewitt, 1964c, p.38
Verschuren et al., 1986, p.241

TW-8 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC BUFF MARBLE QUARRY NO. 1

LOCATION AND OWNERSHIP

Fine-crystalline, buff coloured marble has been quarried at three sites in Lots 21 and 22, Concession 5, Madoc Township, Hastings County (Figure TW-8-1). The original workings are near the old Eldorado Talc Mine on the east side of the Moira River, while quarrying by Stoklosar Marble Quarries Limited is now periodically active in Lot 21. A third quarry, now inactive, is located 1 km to the east near Fox Corners.

GEOLOGY

The marble is a surprisingly uniform, fine-crystalline dolomite with an attractive pale pink-brown, beige or buff colour, weathering to cream-grey brown. The stone is medium bedded with individual beds varying from 20 cm to 40 cm. Texture of the stone within individual beds is massive to weakly foliated. Bedding strikes 150° and dips 45°NE.

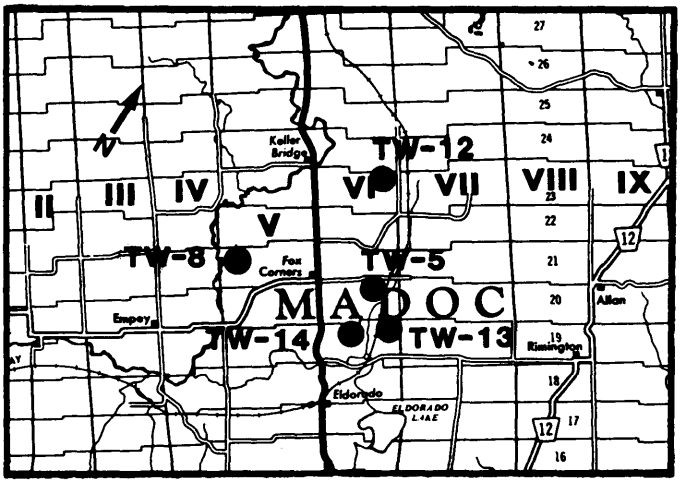


Figure TW-8-1. LOCATION MAP FOR MADOC BUFF MARBLE QUARRY NO. 1.

Hexagonal mica crystals, both white and yellow in colour, are locally common in books up to several millimetres in diameter, but form less than 1% of the rock overall. Similarly, streaks of mauve–purple coloration, perhaps caused by hematite dust, are rarely present. Thin stringers of white quartz up to 1 cm in thickness are also rarely present.

The marble is moderately to intensively jointed on a scale that would prevent the quarrying of blocks. Vertical joints in a direction of 070° are spaced at 30 cm to 1 m intervals. More closely spaced (5 cm to 30 cm) jointing strikes 110° and dips 70°S. The stone is suitable for terrazzo chips and decorative landscaping.

QUARRY OPERATION

The principal quarry area in Lot 22 is at the north end of a bush road that provides access from the Fox Corners–Empey Road via the old talc mine. The Stoklosar quarry is located along strike of a low ridge and adjoins an older water–filled quarry which occupies an area of about 60 m by 20 m with a face oriented toward the south. The current production is derived from a single lift which has opened an area of approximately 60 m x 30 m with a 5 m working face. Drilling is by jackhammer and compressor and only small volumes of stone are blasted at a time. Two tandem highway trucks, each having a 12–tonne capacity, are loaded at the face by one of three rubber–tired loaders equipped with 1.5 to 3.5 yd. buckets as required and the stone is delivered to either one of the two Stoklosar processing plants.

PROCESSING

The delivered stone is processed by Stoklosar at either their main plant located immediately north of Madoc or their smaller plant west of Madoc (sites TW–15 and TW–16).

PRODUCTS

Terrazzo Chips

REFERENCES

Hewitt, 1964c, p.39

TW–9 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC BUFF MARBLE QUARRY NO. 2

LOCATION AND OWNERSHIP

Buff dolomitic marble was formerly quarried by Stoklosar Marble Quarries Limited in Lot 12, Concession 8, Madoc Township, Hastings County (Figure TW–9–1). There are several irregular quarry openings on the east side of County Road 12 just north of Hazzards Corners. The main quarry is 60 m by 15 m with a depth of 10 m and was worked on two levels. A smaller quarry to the south is 10 m by 6 m with a 5 m face.

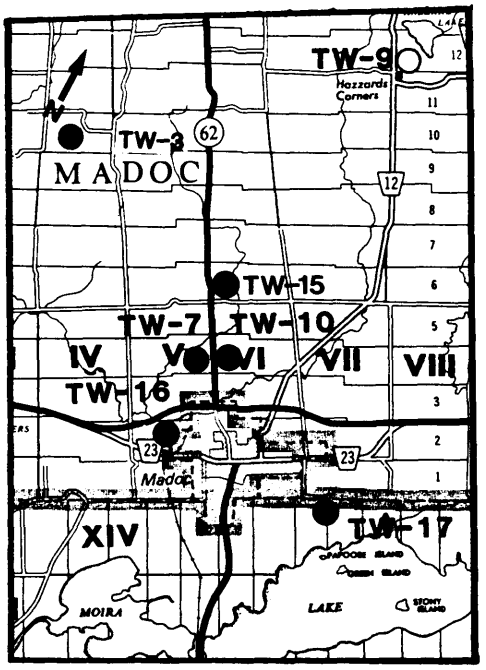


Figure TW–9–1. LOCATION MAP FOR MADOC BUFF MARBLE QUARRY NO. 2.

GEOLOGY

The stone is uniformly microcrystalline and grey–buff in colour, weathering to mottled brown and black. The fabric is weakly laminated due to a thin wavy bedding which strikes north–south and dips 70°W. Numerous thin (1 to 2 mm) streaks of white quartz cut across the bedding and there are occasional concentrations of pyrite cubes to 5 mm in size. While bedding is obvious on the weathered surface, it is all but obscure on freshly broken rock.

Intensive jointing makes the stone suitable for chips only. Vertical jointing strikes N15°E with a spacing of 10 cm to 1 m. A northwesterly–trending joint system dips 70°SW at a spacing of 30 cm to 60 cm. Horizontal jointing is spaced at 10 cm to 30 cm.

Bedrock exposures are poor and overburden depth averages about 30 cm.

These quarries could be worked again if there was a demand for chips of this colour. Physical properties of the stone are reported to be as follows:

PHYSICAL PROPERTIES*

Compressive strength	MPa	
	Maximum	297
	Minimum	157
	Average	206
Absorption		0.13%
Bulk specific gravity		2.84
Kg per cubic metre		2,825
Abrasive hardness		46.6

* *After Hewitt, 1964c, p.46.*

REFERENCES

Hewitt, 1964c, p.46

TW-10 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC BLACK MARBLE QUARRY

LOCATION AND OWNERSHIP

This dormant quarry located in Lot 4, Concession 6, Madoc Township, Hasting County (Figure TW-10-1) is situated on the north side of a hill on the east side of Highway 62. The quarry was previously operated by Stoklosar Marble Quarries Limited and currently occupies an area about 30 m by 10 m and has a 5 m working face.

GEOLOGY

Initially opened in fairly uniform blue-grey to black fine-grained marble, quarrying advancing to the south has intersected thinly laminated marble in which the dark marble is interlayered with coarser recrystallized white calcite and quartz, the latter comprising 20 to 30% overall (Hewitt, 1964c, p. 39). Bedding strikes 040° and dips 55°SE. Rustiness is common on some of the weathered beds.

Jointing is moderately developed but irregular. Most common jointing is vertical, trending northwesterly with a spacing of about 50 cm. Block sizes of 100 cm by 50 cm by 50 cm may be possible.

Overburden is thin and outcrops in the vicinity of the quarry are abundant.

PHYSICAL PROPERTIES*

Compressive strength,	MPa	
	Maximum	197
	Minimum	89
	Average	143
Absorption, %		0.09
Bulk specific gravity		2.67
Kg per cubic meter		2,669
Abrasive hardness		45.6

* *Hewitt, 1964c, p.37-40.*

REFERENCES

Hewitt, 1964c, p. 37-40

TW-11 STOKLOSAR MARBLE QUARRIES LIMITED — MARMORA BRUCITIC MARBLE QUARRY

LOCATION AND OWNERSHIP

Cream-coloured, brucitic marble is periodically quarried on the west bank of the Moira River south of Malone in Lot 14, Concession 10, Marmora Township, Hastings County (Figure TW-11-1). Access is provided by a cottage road leading from County Road No. 11 at a point 2 km south of Malone.

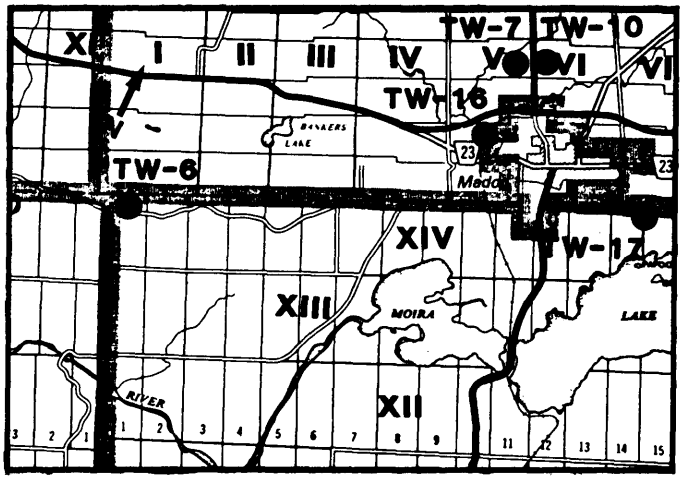


Figure TW-10-1. LOCATION MAP FOR MADOC BLACK MARBLE QUARRY.

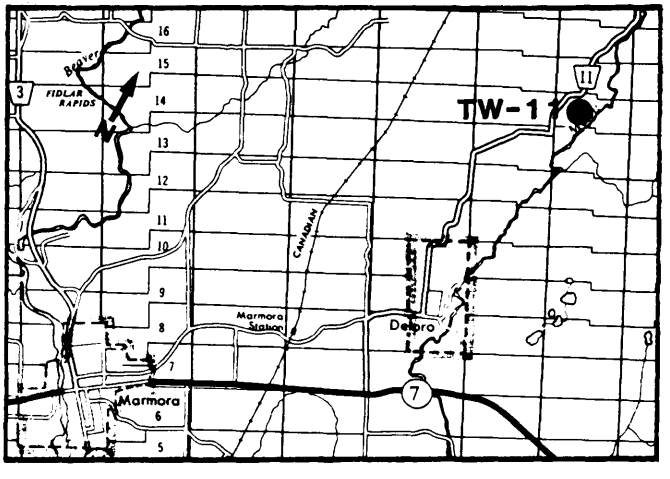


Figure TW-11-1. LOCATION MAP FOR MARMORA BRUCITIC MARBLE QUARRY.

Photo TW-11-1. WEATHERED MARBLE AND TALCOSE DYKE AT MARMORA BRUCITIC MARBLE QUARRY.

GEOLOGY

The marble is calcitic and cream–grey in colour, but it varies to buff–yellow and pale green. The weathered surface is grey, mottled with brown, and it has an abrasive texture due to the more rapid weathering of the chalky white brucite. Serpentine and tremolite are accessory minerals. Crystal size is fine to medium, and the texture of the rock is generally massive except where serpentine is more abundant, when a weak foliation is evident striking 030° and dipping 70°E. A green and black dyke of talcose rock 1 m thick cuts the marble with a strike of 130° and a dip of 45°NE.

The stone is intensely fractured and jointed, restricting its use to terrazzo and decorative landscaping. There is no regular jointing pattern although one common orientation is 115° with a vertical dip and a spacing of 15 cm to 1 m. Various other joint orientations include some nearly horizontal and some with shallow easterly dips. Brown staining on weathered surfaces and fractures appear to be responsible for a substantial amount of rock being discarded as waste.

QUARRY OPERATION

Sporadic quarrying is reported to have taken place at this site since 1938, but the most consistent activity has been since 1981 (Bartlett and Moore, 1985, p.194).

There are at least six openings exposing rock faces of 5 m to 10 m over an area of about 200 m by 100 m. All are worked in a single bench with a common floor elevation of about 1 m above the adjacent river. The stone is quarried by drilling and blasting. The product from the quarry is loaded into two 12–tonne tandem highway trucks and delivered to the designated Stoklosar processing plant.

PROCESSING

The delivered stone is processed at either one of the two plants currently owned by Stoklosar Marble Quarries Limited (sites TW–15 and TW–16).

PRODUCTS

Terrazzo Chips

REFERENCES

Bartlett and Moore, 1985, p.194

TW–12 STOKLOSAR MARBLE QUARRIES LIMITED — KELLER BRIDGE BLUE MARBLE QUARRY

LOCATION AND OWNERSHIP

This small quarry in blue Grenville marble is periodically worked by Stoklosar Marble Quarries Limited. Located about 1.5 km due east of the hamlet of Keller Bridge, the quarry is in the east half of Lot 23, Concession 6, Madoc Township, Hastings County (Figure TW–12–1).

GEOLOGY

The rock is a uniformly medium blue–grey, aphanitic, dolomitic marble that is nearly white on weathered surfaces. Its texture is massive and dense, but it contains minor streaks of white quartz which in places form a ribbon pattern of closely–spaced parallel veins individually ranging to 2 cm in thickness. Joint planes are moderately

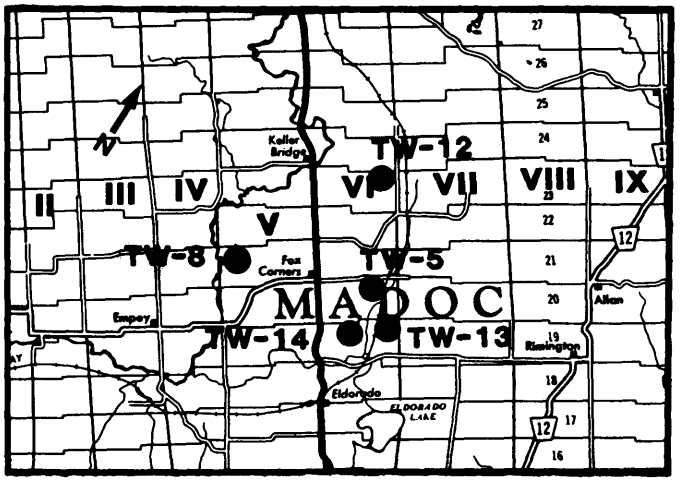


Figure TW-12-1. LOCATION MAP FOR KELLER BRIDGE BLUE MARBLE QUARRY.

frequent but irregularly oriented, so that maximum quarry blocks of about 1 cubic meter might be recovered. The most economic utilization, however, is as chips for terrazzo applications.

Bedrock exposure is poor, and overburden is moderately thick.

QUARRY OPERATION

The quarry is being developed on the east flank of a low ridge of marble and occupies an area of approximately 12 m by 12 m exposing a 10 m working face. Limited production is derived from a single lift by drilling and blasting. The broken rock is loaded at the face and delivered to one of the Stoklosar processing plants.

PROCESSING

The details of the Stoklosar processing plant are summarized in TW–15 and TW–16.

PRODUCTS

Terrazzo Chips

REFERENCES

None

TW–13 STOKLOSAR MARBLE QUARRIES LIMITED — ELDORADO LIGHT BUFF MARBLE QUARRY

LOCATION AND OWNERSHIP

Light buff–coloured marble chips are obtained by Stoklosar Marble Quarries Limited from a quarry in the east half of Lot 19, Concession 6, Madoc Township, Hastings County (Figure TW–13–1). The quarry is being developed on the southeast flank of a high wooded knoll located 1.5 km northeast of Eldorado.

GEOLOGY

The marble is dolomitic, and is fine crystalline to microcrystalline. While it is dominantly pale buff, there is some variation due to a grey shadow coloration and there are occasional patches of mauve–pink hematitic coloration and red fracture alterations. Streaks of white quartz to 2 mm in thickness may locally form as much as 5 percent of the rock.

Moderate jointing is irregularly developed, the most consistent being a vertical pattern striking east–west and spaced at 25 cm to 2 m. However, other random jointing, fracturing, and foliation due to flowage would inhibit the recovery of large blocks.

QUARRY OPERATION

The quarry is operated intermittently by Stoklosar Marble Quarries Limited. The stone is quarried by drilling and blasting and production derived from a single lift consisting of an area about 50 m by 15 m with a working face of approximately 10 m. The blasted rock is loaded at the face and transported to the Stoklosar plant for processing.

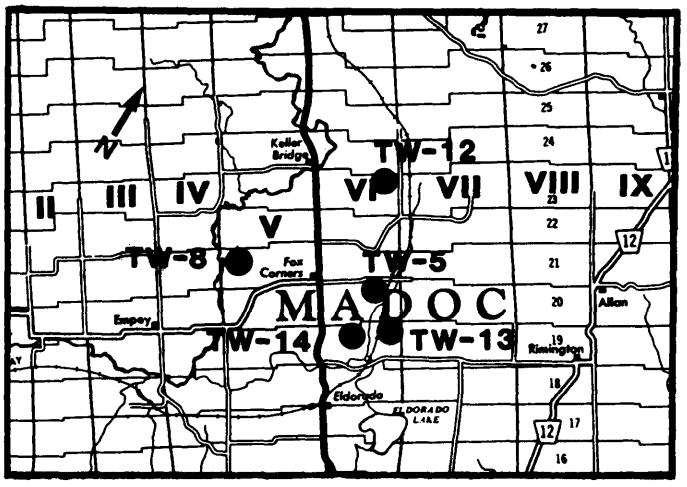


Figure TW–13–1. LOCATION MAP FOR ELDORADO LIGHT BUFF MARBLE QUARRY.

PROCESSING

The Stoklosar processing plant is described in site descriptions TW–15 and TW–16.

PRODUCTS

Terrazzo Chips

REFERENCES

None

TW–14 STOKLOSAR MARBLE QUARRIES LIMITED — ELDORADO DARK BUFF MARBLE QUARRY

LOCATION AND OWNERSHIP

Stoklosar Marble Quarries Limited works a quarry about 1 km northeast of Eldorado in dark buff Grenville marble. The quarry is located on the west half of Lot 19, Concession 6, Madoc Township, Hastings County (Figure TW–14–1). It is opened on the crest of a high wooded ridge.

GEOLOGY

The marble is fine crystalline to microcrystalline dolomitic, and massive to somewhat foliated. It is rather variable in colour with shades of buff–brown, and in places has streaks and patches of white, mauve and blue–grey. Lenticles of white quartz may compose up to

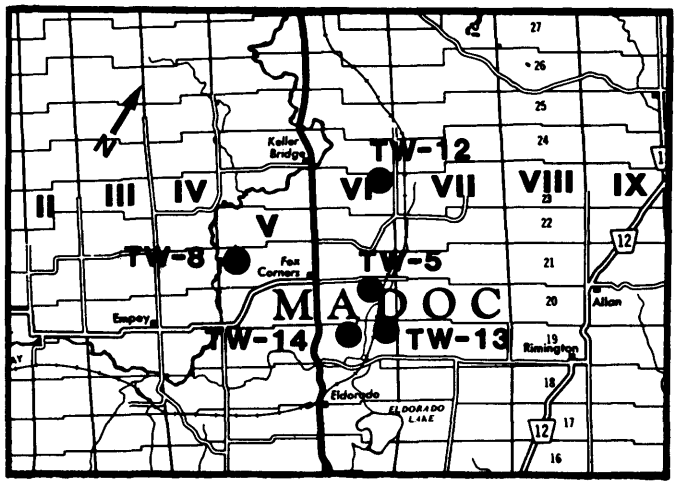


Figure TW-14-1. LOCATION MAP FOR ELDORADO DARK BUFF MARBLE.

5 percent of the rock in places. The rock strikes north–south and dips east at 70°. It is intensely jointed in an irregular pattern, the only consistent direction being east–west, vertical, and spaced from 2 cm to 50 cm. Fracturing, jointing and foliation would prevent the recovery of blocks; the quarry is worked exclusively for terrazzo chips.

PHYSICAL PROPERTIES*

Compressive strength	MPa	
	Maximum	244
	Minimum	196
	Average	220
Absorption, %		0.10
Bulk, specific gravity		2.85
Kg per cubic metre		2,834
Abrasive hardness		25.9

* *After Hewitt, 1964c, p.42.*

QUARRY OPERATION

The quarry is operated on an intermittent basis by Stoklosar Marble Quarries Limited and is being developed on the crest of a marble ridge. It is irregular and occupies an area of about 50 m by 35 m exposing an 8 m working face. Blast holes are drilled with a jackhammer and small volumes of rock are blasted at a time. The broken rock is loaded at the face by a rubber–tired front end loader, equipped with 1.5 to 3.5 yd. buckets as required, into two 12–tonne tandem trucks for delivery to one of the Stoklosar processing plants.

PROCESSING

The Stoklosar processing plant is described in site descriptions TW–15 and TW–16.

PRODUCTS

Terrazzo chips

REFERENCES

Hewitt, 1964c, p.42

TW–15 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC PLANT NO. 1

LOCATION AND OWNERSHIP

Stoklosar Marble Quarries Limited currently operate two stone processing plants in the Madoc, Ontario area (Figure TW–15–1). Both plants receive quarry run material by truck from any of the previously described quarries currently owned or leased by Stoklosar in Hastings County.

The main plant is located in the southwest corner of Lot 6, Concession 6, Madoc Township approximately 1 km north of the Village of Madoc on the east side of Highway 62.

PROCESSING

The delivered stone is off–loaded into a storage bin which feeds a 14 in. by 30 in. primary jaw crusher. The crusher discharge is conveyed to a surge bin which feeds a "picking belt" where obvious waste material and off–colour rock is removed before the stone is fed into a 10 in. x 14 in. secondary jaw crusher which discharges the

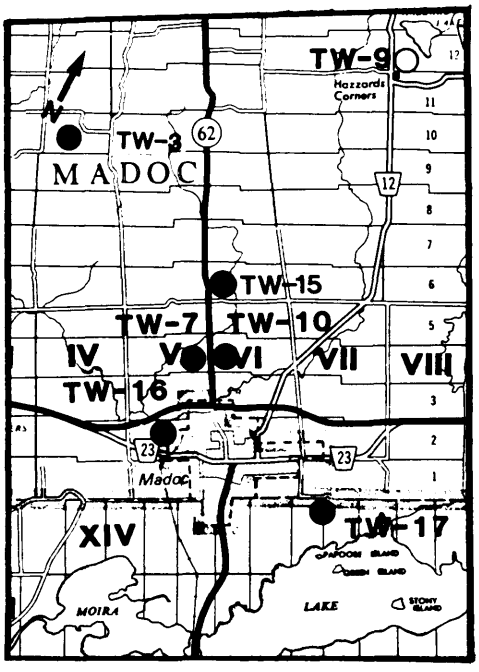


Figure TW-15-1. LOCATION MAP FOR MADOC PLANT NO. 1.

stone into a secondary surge bin. The stone is fed from the secondary surge bin to a hammer mill which is in closed circuit with a 3 ft. x 8 ft. triple–deck vibrating screen. Screened products are collected in six bins, all equipped with bagging facilities. Most of the production is sold in heat–sealed plastic bags of 100 lb. capacity. Minor amounts are sold in 50 lb. bags for stucco use. Bulk shipments can also be made.

PRODUCTS

Six principal chip sizes are marketed, plus undersized dust products, as follows:

Product Designation	Chip size (inches)
0	−1/8+1/16
1	−1/4 +1/8
2	−3/8+1/4
3	−5/8 +3/8
5	−7/8+5/8
7	−1 1/4 +7/8
Dust Products	−1/16

TW–16 STOKLOSAR MARBLE QUARRIES LIMITED — MADOC PLANT NO. 2

LOCATION AND OWNERSHIP

The Stoklosar Madoc No. 2 plant (Figure TW–16–1) is smaller than the main plant and is located in Lot 2, Concession 5, Madoc Township on the west side of the Village of Madoc.

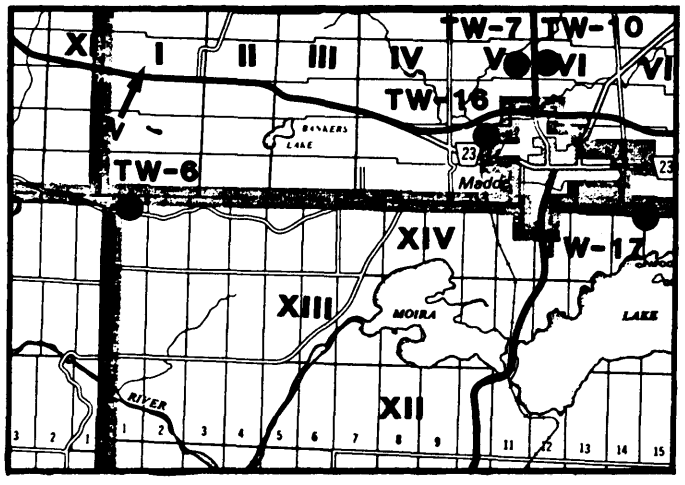


Figure TW–16–1. LOCATION MAP FOR STOKLOSAR MADOC PLANT NO. 2.

Photo TW–16–1. STOKLOSAR PROCESSING PLANT NO. 2.

PROCESSING

The delivered stone is off–loaded into a storage bin which feeds a 12 in. x 20 in. primary jaw crusher. As at the main plant, the crusher discharge is stored in a surge bin and provides feed for the "picking belt" where the obvious waste material and off–colour rock is removed. The stone is then delivered to a hammer mill which is in closed circuit with a 3 ft. by 13 ft. triple–deck screen. The screened products are stored in 8–tonne storage bins equipped with bagging facilities. The products are bagged in 100 lb. capacity plastic bags.

PRODUCTS

Six principal chip sizes are marketed, plus undersized dust products, as follows:

Product Designation	Chip size (inches)
0	−1/8+1/16
1	−1/4 +1/8
2	−3/8 +1/4
3	−5/8 +3/8
5	−7/8 +5/8
7	−11/4+7/8
Dust Products	−1/16

TW-17 CANADA TALC LIMITED — MADOC TALC MINE

LOCATION AND OWNERSHIP

Canada Talc Limited operates a talc mine near Madoc, Ontario. The mine is located in Lots 14 and 15, Concession 14, Huntingdon Township, Hastings County (Figure TW–17–1) and has seen limited but continuous production since 1896.

GEOLOGY

A fine–grained white dolomitic marble, with or without minor amounts of talc, tremolite, calcite, and pyrite is the host rock for foliated lenses of talc.

QUARRY/MINE OPERATION

The mine comprises a past producing open pit and underground operation with development on eight working levels to a depth of 180 m. Canada Talc, in addition to producing a good quality talc, produces terrazzo chips from the host white, fine–grained dolomitic marble.

PROCESSING

The marble chips are produced as a by–product of talc mining and processing at the Canada Talc plant.

PRODUCTS

Terrazzo Chips

REFERENCES

None

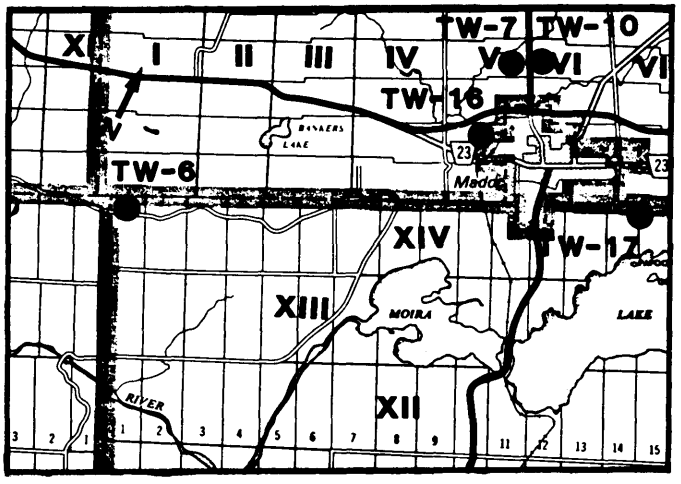


Figure TW-17-1. LOCATION MAP FOR MADOC TALC MINE.

Pembroke District

INTRODUCTION

The Pembroke District is situated in the Algonquin Region of southern Ontario, bounded in the north and east by the Ottawa River, on the south by the Districts of Carleton Place and Tweed and on the west by Bancroft, Algonquin Park and North Bay Districts. The district includes all of the County of Renfrew (Figure PE-0-1).

Six quarries are documented in the Pembroke District Quarry Inventory; one is active and two report intermittent production. In addition, Timminco Metals Division of Timminco Ltd. operates two marble quarries to provide stone for their magnesium plant.

The sites visited during the study include:

PE-1 *Fourth Chute Quarry*

PE-2 *Smiths Construction Co. Ltd. - Braeside Quarry*

PE-3 *H&H Aggregates Co. Ltd. - Clay Bank Quarry*

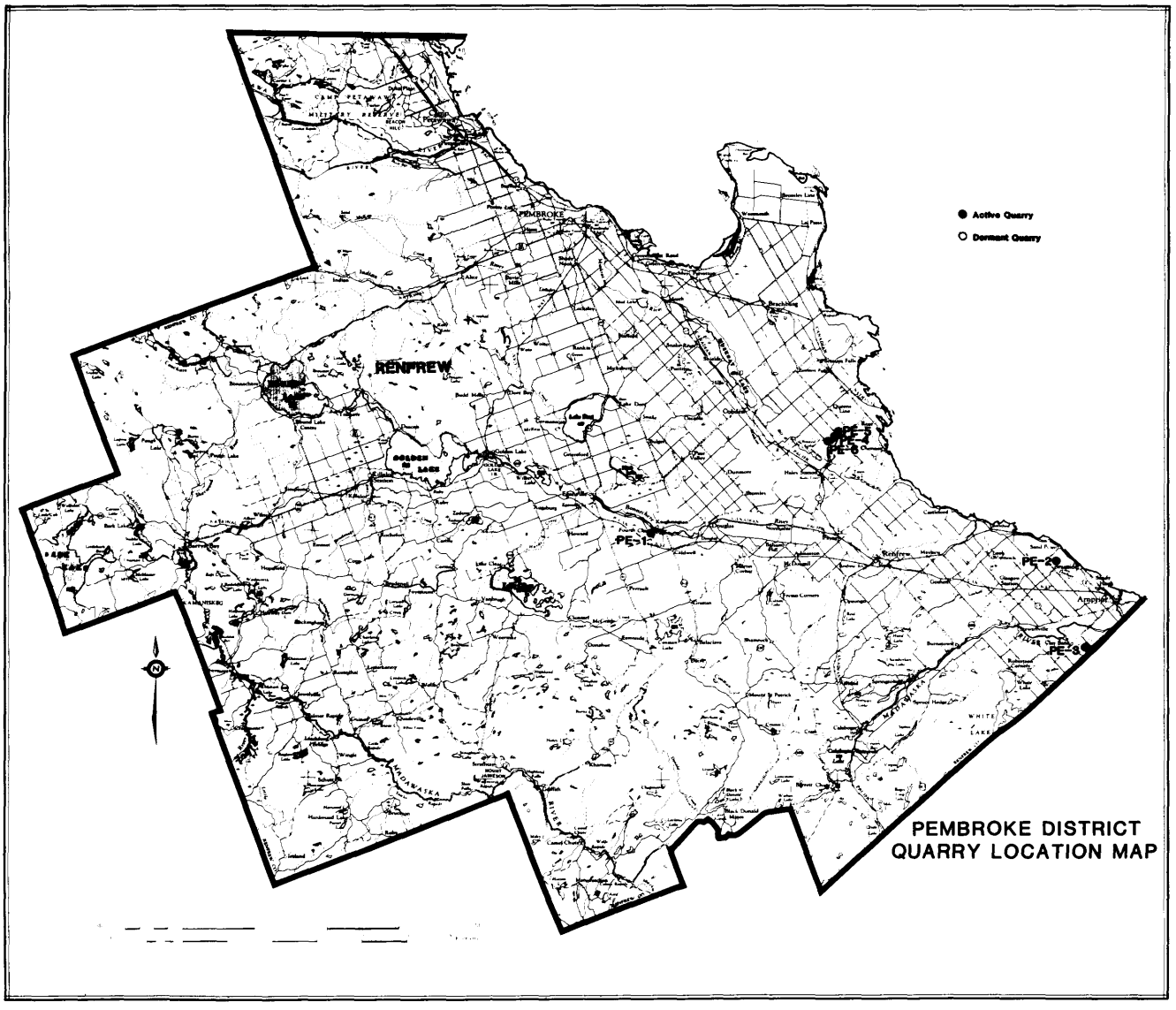


Figure PE-0-1. PEMBROKE DISTRICT QUARRY LOCATION MAP.

PE-4 *Timminco Limited - Haley Station Quarry No. 1*
PE-5 *Timminco Limited - Haley Station Quarry No. 2*
PE-6 *Timminco Limited - Haley Station Plant*

REGIONAL GEOLOGY

Pembroke District extends westward from the Ottawa River between Arnprior and Deux Rivieres. The main geomorphic features in this district include the Ottawa Valley to the north and east, and the Precambrian highlands of the Canadian Shield within which the limited Paleozoic outcrops occur.

Glacial overburden varies considerably from nearly absent over the Precambrian highlands, to thick clay deposits along parts of the Ottawa Valley.

Large-scale normal faults trend northwest-southeast across the Pembroke District (Russell and Williams, 1985a-c, Williams, in prep), and the Paleozoic strata occur in well defined down-dropped fault blocks which had protected the enclosed strata from erosion. Although bedrock exposures are generally limited, drillhole data confirm the presence of many of these faults (Williams, in prep). Smaller-scale faults are common throughout the region, many of which are exposed in the quarries.

PROTEROZOIC

Rocks of the Proterozoic-age/Grenville supracrustal sequence underlie the southeastern part of Pembroke District and unconformably overlie Middle Precambrian metasediments and intrusive rocks exposed to the northwest (Lumbers, 1982). The Grenville/Middle Precambrian unconformity extends southwest from Pembroke Township, southeast of the City of Pembroke.

The supracrustal metasedimentary sequence begins at the unconformity with a basal arkose, followed by a mafic metavolcanic and clastic metasedimentary sequence with subordinate marble, that extends from Renfrew to Bancroft. Southeast of this belt, carbonates become more common and purer. The grade of metamorphism varies from medium to high, mostly in the middle to upper almandine-amphibolite facies. Sedimentary structures in the carbonates have been eliminated, while those in the clastic metasediments are frequently preserved.

The marble units in the southeastern part of Pembroke District vary from a few metres to 1-3 km wide and up to 10 km in length. The smallest belts commonly consist of a single marble unit, often containing large amounts of mica, quartz and other siliceous minerals indicating a very impure limestone or lime-mud as primary sediment. The dominant trend of the marble belt is northeastward. The marbles, together with the quartzofeldspathic gneisses and metavolcanics, were subject to the Grenville Orogeny (950 m.y.) and as a result are recrystallized and complexly refolded.

PALEOZOIC

The Paleozoic strata underlying Pembroke District consist of Lower to Middle Ordovician carbonate and clastic strata (*see* Figure CP-0-2, Carleton Place District). The following formations occur within this district (in ascending order): the March and Oxford Formations of the Beekmantown Group; the Rockcliffe Formation and the Shadow Lake, Gull River and Bobcaygeon Formations of the Ottawa Group.

The Lower Ordovician Beekmantown Group consists of two formations: the March and overlying Oxford Formations. The March Formation consists of alternating beds of quartz-rich sandstone and dolostone with gradations between the two rock types. Most common are fine-crystalline dolostones consisting of up to 50% medium- to coarse-grained, well-rounded quartz grains, which "float" in the dolostones. The formation thickens from its erosional edge to an average thickness of 20 m in the Ottawa area.

The March Formation has been quarried extensively to the southeast in Carleton Place District over the years. Large blocks of sandy dolostone were utilized in the construction of the Rideau Canal system in the 1830s. Dolostone and sandy dolostone beds were also quarried for building and ornamental stone. In addition to being a source for crushed stone, in recent years the sandy dolostone beds have proven to be an excellent source of skid-resistant aggregate (Rogers, 1980).

The Oxford Formation consists of grey-brown, fine-crystalline, medium- bedded dolostones which may vary from microcrystalline to medium-crystalline and occur in thin- to thick-bedded intervals. Scattered, coarse-grained quartz sand and sandy interbeds (up to 30 cm thick) are present in the lower part of the formation. Calcite-filled vugs, of varying sizes, are common in most intervals; small, white chert nodules are less common. The lower contact of the Oxford Formation is placed at the top of the uppermost sandstone bed in the underlying March Formation (Williams, in prep). The formation maintains an average thickness of 60 m in Carleton Place District, although it does thin northwestward into the Pembroke District.

Unconformably overlying the Beekmantown Group is the Middle Ordovician Rockcliffe Formation. The Rockcliffe Formation is subdivided into two members (Williams, in prep), a lower clastic and an upper carbonate member (Figure CP-0-2). The light grey to green-grey, fine-grained, thin- to thick-bedded, commonly crossbedded, quartz sandstone of the lower member is interbedded with olive green to grey (rarely maroon), laminated shale which contains numerous burrows. The

upper St. Martins Member does not occur in Pembroke District.

The Ottawa Group consists of five formations, of which only the Bobcaygeon Formation is utilized by the limestone industry in Pembroke District. The Bobcaygeon Formation overlies the Gull River Formation and consists of limestone with shale partings and interbeds of varying amount. Three members have been identified in the Bobcaygeon Formation (Williams, in prep); the middle member is characterized by substantially more shale interbeds than the lower and upper members. The lower member consists of light grey, microcrystalline to fine-crystalline, thick- to massive-bedded limestone, with interbedded intervals of fine- to medium-grained calcarenites. Black chert nodules are common in some beds. Shale partings are very thin, and are not present between every bed. The middle member consists of grey, thin- to medium-bedded, fine- to medium-crystalline limestone and fine- to coarse-grained calcarenite, interbedded with shale beds up to 2 cm thick. The upper member, which is rarely exposed, consists of grey, fine- to medium-crystalline, thin- to medium-bedded limestone, with rare, thin shale partings. The formation is about 95 m thick, with the lower, middle, and upper members maintaining thicknesses of 30, 25 and 40 m, respectively.

Several quarries are entirely within the lower member of the Bobcaygeon Formation, including three in the Pembroke District: the Fourth Chute Quarry (PE-1), the Braeside Quarry (PE-2), and the Clay Bank Quarry (PE-3).

LIMESTONE INDUSTRIES

The limestone industries in the Pembroke District are aggregate, metallurgical stone and lime. The 1986 Ontario Mineral Score reports aggregate and metallurgical stone production in 1985 to be in the order of 283,000 tonnes, used in the construction industry as road, asphalt and concrete aggregate and as feed for Timminco's magnesium production plant. Production came primarily from Smiths Construction Co. Ltd. (PE-2) and the two quarries operated by Timminco Ltd. (PE-4, PE-5). The Fourth Chute Quarry (PE-1) and the Clay Bank Quarry (PE-3) also produce on an intermittent basis, reporting production of less than 50,000 tonnes per year. Almost all of the stone produced by the Haley Station No. 1 and No. 2 quarries is consumed internally by Timminco for the production of magnesium. The small amount of stone not consumed internally is a by-product of the processing plant and is marketed for refractory purposes, agricultural stone or terrazzo chips.

Lime production in the District as reported in the 1986 Ontario Mineral Score was about 44,000 tonnes and is assumed to be a by-product of Timminco magnesium processing plant. In 1985 Timminco produced about 8,400 tonnes of magnesium metal at their Haley Plant ("Ontario Mineral Score", Ontario Ministry of Northern Development and Mines, 1986).

PE-1 FOURTH CHUTE QUARRY

LOCATION AND OWNERSHIP

This old quarry, located just south of the Fourth Chute on the Bonnechere River, in Lot 8, Concession 15, Grattan Township, Renfrew County (Figure PE-1-1), has recently been re-opened with the excavation of a lower lift into the original floor. The quarry is operated by Bromley Township on a demand basis and the aggregate produced is used by the surrounding townships.

GEOLOGY

The 8.5 m deep quarry exposes limestones of the Middle Ordovician Bobcaygeon Formation. The presence of black chert nodules in the interbedded coarse-grained calcarenites and microcrystalline limestones suggests that these strata may be in the lower member of the formation. Minor east-west trending faults were observed on the northeast face; displacements were minor and never greater than 0.5 m on a single fault plane. Glacial overburden around the old quarry is approximately 1 m thick.

REFERENCES

Goudge, 1938, p.165-166
Satterly, 1945

MAPS

Russell and Williams, 1985b, O.G.S. Map P.2729

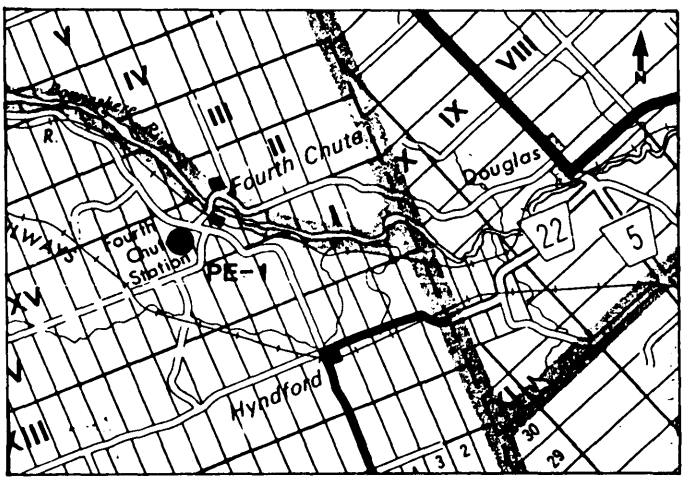


Figure PE-1-1. LOCATION MAP FOR FOURTH CHUTE QUARRY.

PE-2 SMITHS CONSTRUCTION CO. LTD. — BRAESIDE QUARRY

LOCATION AND OWNERSHIP

The Braeside quarry is located about 7 km northwest of Arnprior, in Lots 16 and 17, Concession A, McNab Township, Renfrew County (Figure PE-2-1) and is owned and operated by Smiths Construction Co. Ltd.

The quarry property covers an area of 80.0 ha and is not designated under the Pits and Quarries Control Act. The property was first opened in the 1930s to supply sand and gravel and in the 1950s was purchased by Smiths Construction Co. Ltd. The property was opened as an aggregate quarry in 1973 to supply concrete stone for the construction of the Arnprior hydro-electric dam. The quarry currently supplies a company-owned 5,000 lb. asphalt batch plant located in Renfrew, and much of the balance of the annual production of the Braeside quarry is used to supply company construction projects. The company also does custom crushing for various concrete plants in the area, supplying all materials. The National Research Council Canada test results on stockpiled material indicates that the stone has an extremely low expansion rate.

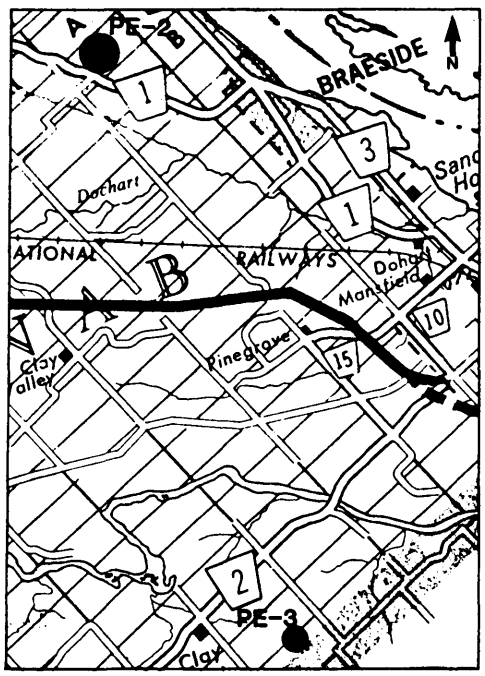


Figure PE-2-1. LOCATION MAP FOR BRAESIDE QUARRY.

GEOLOGY

The 8.1 m deep quarry exposes very fine-crystalline, medium- to thick-bedded limestones of the lower member of the Bobcaygeon Formation. Glacial overburden around the quarry varies from 0.5 to 2 m in thickness.

Geological Section

	Thickness
UNIT 1 Bobcaygeon Formation, lower member	*8.1m*
Limestone: medium-grey, rarely dark grey, weathers light grey to grey-brown at top; very fine crystalline, with rare medium-crystalline beds; medium to thick bedded with intervals of thin-bedded, shaly limestone; some beds contain intraclasts of microcrystalline limestone; moderately fossiliferous, especially with large colonial corals.	
Total thickness	*8.1m*

QUARRY OPERATION

The disturbed area of the quarry is currently about 3.5 ha with a single lift of 8.5 m. Overburden has been stripped over an area of about 6 ha.

All drilling and blasting is contracted; a 1.2 m x 1.5 m drill pattern with 38.5 mm diameter blast holes is used on front holes, while a 1.8 m x 2.4 m pattern is used for deep cut blasts on the back holes.

Recent alkali-aggregate reactivity tests of the National Research Council Canada on stockpile material revealed virtually no evidence of any expansion due to alkali-aggregate reactivity.

PROCESSING

Smiths Construction Co. Ltd. owns three complete portable crushing systems which are available for custom crushing projects and include the following:

Primary Crushers

1 – Pioneer 30 in. x 42 in. jaw
1 – Cedarapids 30 in. x 42 in. jaw
1 – Cedarapids 24 in. x 36 in. jaw
1 – Cedarapids 855 Super Commander
1 – Cedarapids 877 Commander
1 – Pioneer 369 Triple Roll
1 – Cedarapids Impeller

Screening Plants

2 – 5 ft. x 16 ft. Assinck Bros.
Various stackers from 50 ft. to 120 ft.

PRODUCTS

6 in. Crusher Run
3 in. Crusher Run
7/8 in. Class "A"
5/8 in. Class "A"
Concrete Stone
Septic Stone

REFERENCES

Hewitt, 1964a, p. 36-37

Steele and Sinclair, 1971
Williams, in prep, Appendix 1 – Section LQ AR–5

MAPS

Lumbers, 1982, OGS Map 2462
Williams, Wolf and Rae, 1984, OGS Map P.2726

PE–3 H&H AGGREGATES CO. LTD. — CLAY BANK QUARRY

LOCATION AND OWNERSHIP

This quarry, located 6 km southwest of Arnprior in Lot 1, Concession 9, McNab Township, Renfrew County (Figure PE–3–1), is operated intermittently by H&H Aggregates Co. Ltd.

GEOLOGY

The 17.4 m deep quarry, which extends southward into an east–west trending bluff, exposes limestones of the lower member, Bobcaygeon Formation. The limestones are generally medium to thick bedded, microcrystalline to fine crystalline, and are interbedded with thinner–bedded, shaly limestones. Glacial overburden at the top of the quarry is between 1 and 3 m thick.

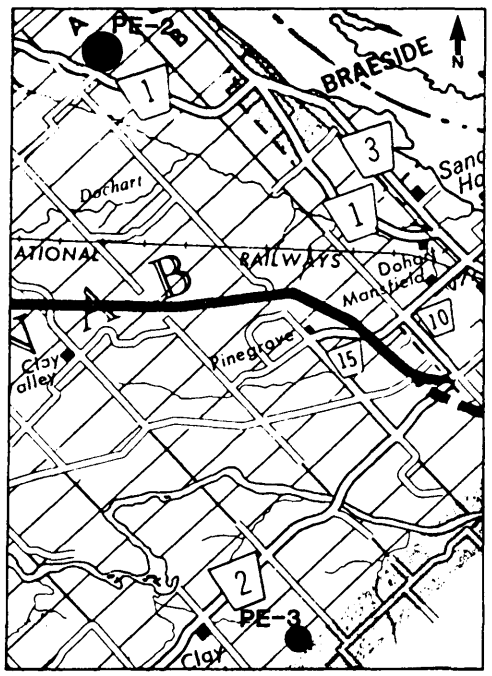


Figure PE-3-1. LOCATION MAP FOR CLAY BANK QUARRY.

Geological Section

		Thickness
UNIT 8	*Bobcaygeon Formation, lower member*	*0.5m*

Limestone: light to medium grey, weathers light brown; fine to medium crystalline; thin bedded, with thin shale partings between beds; fossiliferous with abundant brachiopods.

UNIT 7	*Bobcaygeon Formation, lower member*	*2.2m*

Limestone: light grey, weathers light brown; fine to medium crystalline; medium bedded, with thin shale partings between beds.

UNIT 6	*Bobcaygeon Formation, lower member*	*1.3m*

Limestone: light grey, weathers light brown; fine to coarse crystalline to calcarenitic; thin– to medium–bedded intraclasts of light grey, microcrystalline limestone in lower beds.

UNIT 5	*Bobcaygeon Formation, lower member*	*3.1m*

Limestone: medium grey, weathers same; microcrystalline to very fine crystalline; thin bedded with irregular shale partings between beds; small calcite crystals common, "birdseye" texture; fossiliferous, with colonial corals common.

UNIT 4	*Bobcaygeon Formation, lower member*	*2.4m*

Limestone: light to medium grey, weathers light grey; microcrystalline to very fine crystalline; thin to medium bedded with thin shale partings; small calcite crystals common, "birdseye" texture; fossiliferous, with ostracods and colonial corals most common.

UNIT 3	*Bobcaygeon Formation, lower member*	*4.4m*

Limestone: medium grey, weathers same; microcrystalline to fine crystalline; thin to medium bedded, with shale partings common between beds; light grey, microcrystalline limestone intraclasts common in some beds; fossiliferous, with colonial corals most abundant.

UNIT 2	*Bobcaygeon Formation, lower member*	*1.0m*

Limestone: medium grey, weathers same; microcrystalline to very fine crystalline; medium bedded with sharp planar contacts.

UNIT 1	*Bobcaygeon Formation, lower member*	*2.5m*

Limestone: medium grey, weathers same, microcrystalline to fine crystalline; medium bedded with shale partings common between beds; fossiliferous with colonial corals most abundant.

Total thickness	*17.4m*

REFERENCES

Williams, in prep, Appendix 1 – Section LQ AR–4

MAPS

Williams, Wolf and Rae, 1984, OGS Map P.2726

PE–4 TIMMINCO LIMITED — HALEY STATION QUARRY NO. 1

LOCATION AND OWNERSHIP

Timminco Metals, a division of Timminco Limited, operates two dolomitic marble quarries and a magnesium reduction and extrusion plant at Haley, Ontario. The quarries and plant are located on Lot 20, Concessions 5 and 6, Ross Township, Renfrew County immediately north of

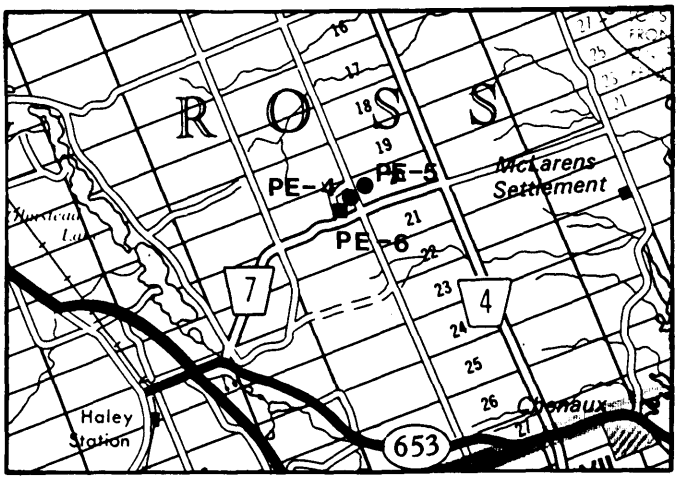


Figure PE-4-1. LOCATION MAP FOR HALEY STATION QUARRY NO. 1.

Highway 653, at the intersection of old Highway 17, 4.56 km east of Haley Station (Figure PE-4-1).

This historic quarry property first reported production around the turn of the century providing a high quality building stone that can be seen today in homes and other buildings in the district. During the period from 1910 to about 1939, the quarry saw sporadic production of building stone and/or construction aggregate but it was not until the onset of World War II that the quarry property realized its full potential as a source of raw material for production of magnesium.

GEOLOGY

This quarry exposes a metallurgical grade, very coarse crystalline, white, Grenville dolomitic marble which strikes northerly across the property and dips 55°E. The high purity stone occupies a zone about 75 m wide and is banded on either side by chemically impure dolomitic marble containing quartz and masses of amphibolite.

QUARRY OPERATION

The quarry occupies an area of approximately 4 ha and is only operated during the summer months. The quarry has been developed on four 6 m benches with production being derived on a selected basis from the current working face. A track mounted Sullair percussion drill is used to drill 7.6 cm diameter blast holes on a 1.2 m x 1.2 m pattern to a depth equal to the bench height. The holes are charged with Tovex at a rate of 25 kg per hole. Blasting is done on two-week cycles and each blast produces about 3,000 tonnes of broken rock, which is loaded at the face into 20-tonne Terex trucks by a 2.5 yd. Dominion shovel and transported to the processing plant.

PROCESSING

The quarry run material is trucked to the Timminco Plant (PE-6) for processing.

REFERENCES

Parks, 1912
Goudge, 1938, p.168
Satterley, 1945, p.66
Hewitt, 1964a, p.17
Hewitt, 1964b, p.75
Storey and Vos, 1981, p. 69-70

PE-5 TIMMINCO LIMITED — HALEY STATION QUARRY NO. 2

LOCATION AND OWNERSHIP

In 1968 Timminco opened a second quarry, about 300 m northeast of the original quarry on Lot 20, Concession 6, Ross Township, Renfrew County (Figure PE-5-1). This second quarry currently provides most of the stone for the magnesium operation.

GEOLOGY

The quarry currently comprises an area of approximately 4 ha and has exposed a metallurgical grade dolomitic marble which strikes N10°E and dips 50°E. The high purity stone, which is similar to that exposed in the original quarry, occupies a zone up to 60 m wide and is bounded on one side by a very siliceous impure dolomitic marble. Thick overburden impedes expansion eastward.

QUARRY OPERATION

The quarry operates year-round and is currently being developed on two benches with production being derived from a 7.6 m working face. Drilling is conducted using a

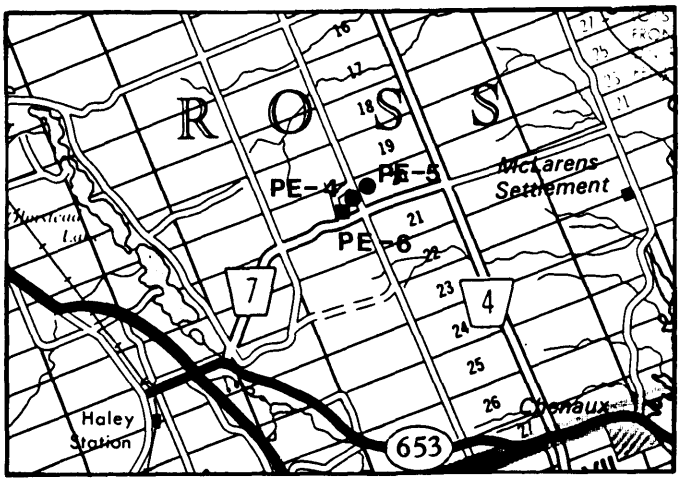


Figure PE-5-1. LOCATION MAP FOR HALEY STATION QUARRY NO. 2.

Sullair track mounted drill. Blast holes are approximately 9 cm in diameter and are drilled to a depth of about 9.6 m or 1 m below the quarry floor. The holes are drilled on a 2.1 m x 2.1 m pattern which extends 6.5 m from the working face. The holes are loaded with Tovex at a rate of 25 kg per hole. Blasting is done twice a month, with about 6,000 tonnes broken with each blast. Secondary breaking, if required, is by drop ball. The broken rock is loaded at the face into 20-tonne Terex trucks by either a 1 yd. Clark front-end loader or a 2.5 yd. Dominion shovel and transported to the processing plant.

PROCESSING

The quarry run material is trucked to the magnesium plant (PE-6) for processing.

REFERENCES

Storey and Vos, 1981, p.69-70

PE-6 TIMMINCO LIMITED — HALEY STATION PLANT

LOCATION AND OWNERSHIP

Timminco Limited operates a magnesium reduction and extrusion plant at Haley, Ontario (Figure PE-6-1).

PROCESSING

The Haley plant uses the silicothermic reduction process (Figure PE-6-2). Under this process magnesium is produced from calcined dolomite, under vacuum at high temperature, using silicon as a reducing agent. The process and the high quality of raw materials used by Timminco allow it to produce magnesium of the highest purity, which has important applications in the nuclear energy and the pharmaceutical industries. Timminco is also a major supplier of high purity magnesium to the chemical reduction markets where it is used as a reducing agent in the production of a number of metals including uranium, beryllium, titanium and zirconium.

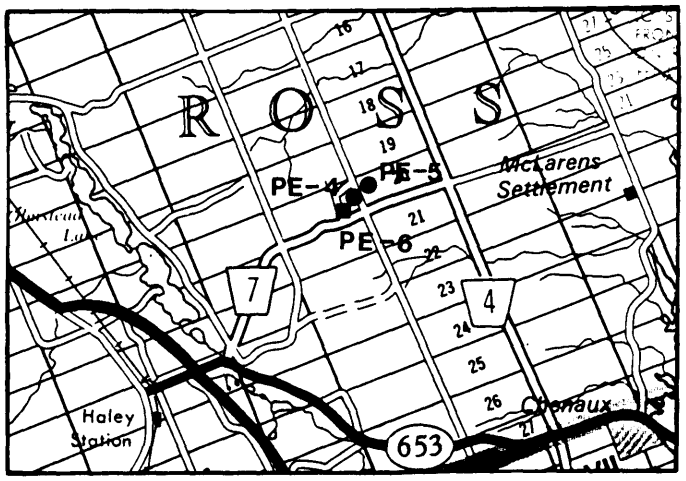


Figure PE-6-1. LOCATION MAP FOR HALEY STATION PLANT.

The first stage in the production process at Haley is the quarrying of dolomite. Approximately 125,000 tonnes are extracted each year from the on-site quarries. The dolomite is crushed, then calcined by burning off carbon dioxide in rotary kilns. This calcined dolomite is then pulverized before being mixed with ferrosilicon and a catalyst. The resultant mixture is then briquetted.

The next stage in the process is reduction, which begins with the mechanical loading of briquettes into nickel-chrome alloy retorts in reduction furnaces which have an operating temperature of about 1,200°C. The reduction operation is a batch process, with charging and discharging of furnaces occurring in regular 8-hour cycles. Magnesium condenses into "crowns", which are removed from the furnace at the end of the process and melted in crucibles. The liquid metal is then cast into ingots and billets of magnesium metal or magnesium alloys, as required, ready for sale or for use in the extrusion plant.

Approximately 10% of the magnesium production is used at Haley in a secondary manufacturing operation which extrudes magnesium into higher value-added finished products, comprising many structural shapes such as angles, channels and tubes, as well as exclusive shapes for special products such as water heater anodes and luggage frames.

In response to the demands of the aluminum industry, Timminco designed and implemented during 1985 its own system of producing static castings of massive magnesium ingots. These 125 kg and 250 kg castings result in more efficient handling operations as well as improved magnesium recovery for customers producing aluminum-magnesium alloys.

RAW MATERIALS

The principal raw materials used in the production of magnesium are ferrosilicon and dolomite. The company estimates that its Haley plant is the largest North American consumer of ferrosilicon, which it obtains from its ferrous metals facility at Beauharnois, Quebec. High quality dolomite is obtained from two open-pit quarries on the Haley site. It is the company's view that dolomite deposits at Haley will suffice for at least 25 years at present consumption levels.

The Haley plant's other major requirement is energy. The principal energy source is natural gas which is used in kiln firing, the silicothermic reduction process and melting operations. Electricity is also used in the production process.

Timminco currently purchases strontium carbonate, the primary raw material used to produce strontrium

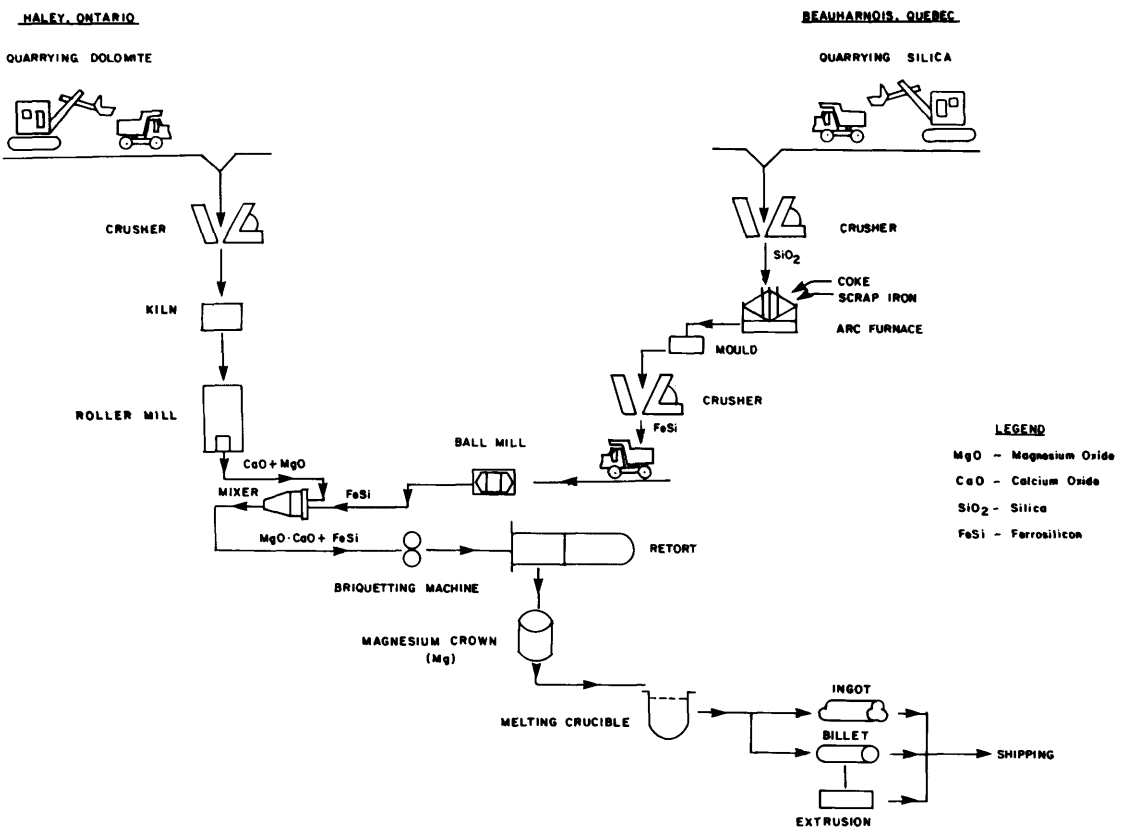


Figure PE-6-2. PROCESS FLOW SHEET FOR HALEY STATION PLANT, ILLUSTRATING THE INTERRELATIONSHIP BETWEEN THE PLANTS AT HALEY, ONTARIO AND BEAUHARNOIS, QUEBEC.

metal, from a limited number of offshore suppliers. Strontium carbonate is derived from the concentration and conversion of high-quality celestite. In November 1985, Timminco was granted a licence by the Province of Nova Scotia to carry out a work program to develop celestite ore deposits in Cape Breton County. The Division is continuing its work program to determine the economic viability of the orebodies.

KILN OPERATION

The −1 in. +1/4 in. product is discharged from the storage bins as required and calcined in either of two gas-fired rotary kilns; both have provisions for standby oil firing. The kilns are 7 ft. and 8 ft. in diameter and 120 ft. and 153 ft. long, respectively. Both have rotary coolers which cool the lime to approximately 200°C before it is conveyed to storage bins. The calcined material is crushed in a Raymond roller mill to −10 mesh, with the dominant fraction being −100 mesh.

Part 2
Northern Ontario

Included in the Northern Ontario Region are the lime/cement plants at Spragge in Blind River District, and the limestone quarries of Cobalt, Espanola and Moosonee Districts.

Eighteen quarries in the Northern Ontario Region are documented in the quarry inventory (Appendix IV, Volume I); three are currently active, four report intermittent production and the balance represent past–producing quarries.

The principal limestone industries in Northern Ontario Region are limestone aggregates and metallurgical stone, with minor production of agricultural lime and building stone. The Reiss Lime Company of Canada Ltd. plant at Spragge produces high calcium lime from limestone quarried in the United States, and slag cement from slag produced by Algoma Steel Corp. Ltd. at Sault Ste. Marie.

Stone production for 1986 in District of Manitoulin totalled approximately 1.2 million tonnes, (Ontario Mineral Score, 1987) comprised mainly of aggregate and metallurgical stone and small tonnages of building stone.

Production in 1986 of metallurgical flux and aglime from Dymond Clay Products Ltd. Quarry (CO–4), in Cobalt District, was reported at 130,000 tonnes (Owsiacki, 1987).

Espanola District

INTRODUCTION

The active and intermittently active quarries in Espanola District were visited during the study, and include the following:

ES-1	*Standard Aggregates Inc. – Manitoulin (Meldrum Bay) Quarry (active)*
ES-2	*Hercules Ornamental Stone – Foxey Quarry (intermittent)*
ES-3	*Cup and Saucer quarry (intermittent)*

PALEOZOIC GEOLOGY

The Paleozoic strata of Espanola District are confined to Manitoulin Island and the smaller adjacent islands in northern Lake Huron (Figure ES-0-1). Located along the northern rim of the Michigan Basin, the exposed Ordovician and Silurian stratigraphic succession (Figure ES-0-2) closely resembles the sequence of the Niagara Escarpment to the south. Glacial cover on Manitoulin Island is generally thin, creating large areas of bedrock exposure. Quarry development on Manitoulin Island (Figure ES-0-1) is currently restricted to a major operation near Meldrum Bay (ES-1), a small ornamental stone operation near Foxey (ES-2), and a wayside quarry at the Cup and Saucer (ES-3). The potential for additional development on Manitoulin Island and nearby St. Joseph Island is high, especially as these islands are adjacent to Great Lakes shipping routes.

The Paleozoic succession in the Espanola District consists of Ordovician and Silurian sedimentary rocks which include thick limestone and dolostone intervals. Recent revisions to the nomenclature that have been proposed by Johnson and Telford (1985a,b,c,d) are used in this report.

The oldest unit exposed on the islands north of Manitoulin Island is a clastic sequence of conglomerates, sandstones, and shales, similar to the Shadow Lake Formation of Central Ontario. A unit of older sandstone and dolostone occurs at the base of the Paleozoic sequence in deep drillholes on Cockburn Island (Wolf, 1986) and St. Joseph Island (Johnson et al., 1985). No bedrock exposures of these dolostones have yet been reported.

The overlying Middle Ordovician limestones superficially resemble the Simcoe Group of Central Ontario, but the limited exposures of these strata in the district reveal a different succession which has yet to be studied in detail. North of Manitoulin Island are smaller islands which are underlain by these limestones and may have some potential for quarry development. The predominantly shale-rich Upper Ordovician strata of the Blue Mountain and Georgian Bay Formations (Figure ES-0-2) outcrop in the northern Lake Huron region.

The Lower Silurian on Manitoulin Island consists of the Manitoulin Formation and the overlying Cabot Head Formation, characterized by thin-bedded dolostones and red shales, respectively. A small ornamental stone operation, the Foxey Quarry of Hercules Ornamental Stone (ES-2) extracts glacially polished dolostones from the Manitoulin Formation.

The Middle Silurian sequence (Figure ES-0-2) includes the following (in ascending stratigraphic order): the Dyer Bay Formation – a thin, fossiliferous dolostone; the Wingfield Formation – a green shale and shaly dolostone; the St. Edmund Formation – predominantly a thin-bedded, microcrystalline dolostone; the Fossil Hill Formation – a thin-bedded, fossiliferous, chert-rich dolostone; and the Amabel Formation – a massive-bedded, evenly textured dolostone. The wayside quarry at the Cup and Saucer (ES-3) is excavated into the upper part of the St. Edmund Formation, with a thin interval of the overlying Fossil Hill Formation present as a caprock in the quarry. The large quarry near Meldrum Bay (ES-1), operated by Standard Aggregates Inc., exposes the massive-bedded dolostones of the Amabel Formation. Crushed on-site to a variety of sizes, the stone is shipped by lake freighter to markets from the dock adjacent to the quarry. Northeast of the village of South Baymouth is the inactive Leason Quarry. This quarry was a source of Amabel Formation armour stone blocks used for the construction of the South Baymouth docks.

ES-1 STANDARD AGGREGATES INC. — MANITOULIN (MELDRUM BAY) QUARRY

LOCATION AND OWNERSHIP

The Manitoulin Quarry is located on the western tip of Manitoulin Island, 9 km west of the village of Meldrum Bay, in Lot 45, Concession 9, Dawson Township, District of Manitoulin (Figure ES-1-1).

The quarry is owned and operated by Standard Aggregates Incorporated, purchased in May of 1986 from Seeley and Arnill Construction Ltd., and Upper Lakes Shipping. The quarry has been in operation since 1980, supplying chemical grade stone and construction aggregate to U.S. and Canadian markets. The quarry operates on a 7 months per year basis, and all stone products are shipped by boat over an 8-month shipping season at about 25,000 tonnes per load.

GEOLOGY

The dolostones of the Amabel Formation are excavated in a single lift of 17.8 m. Adjacent to the primary

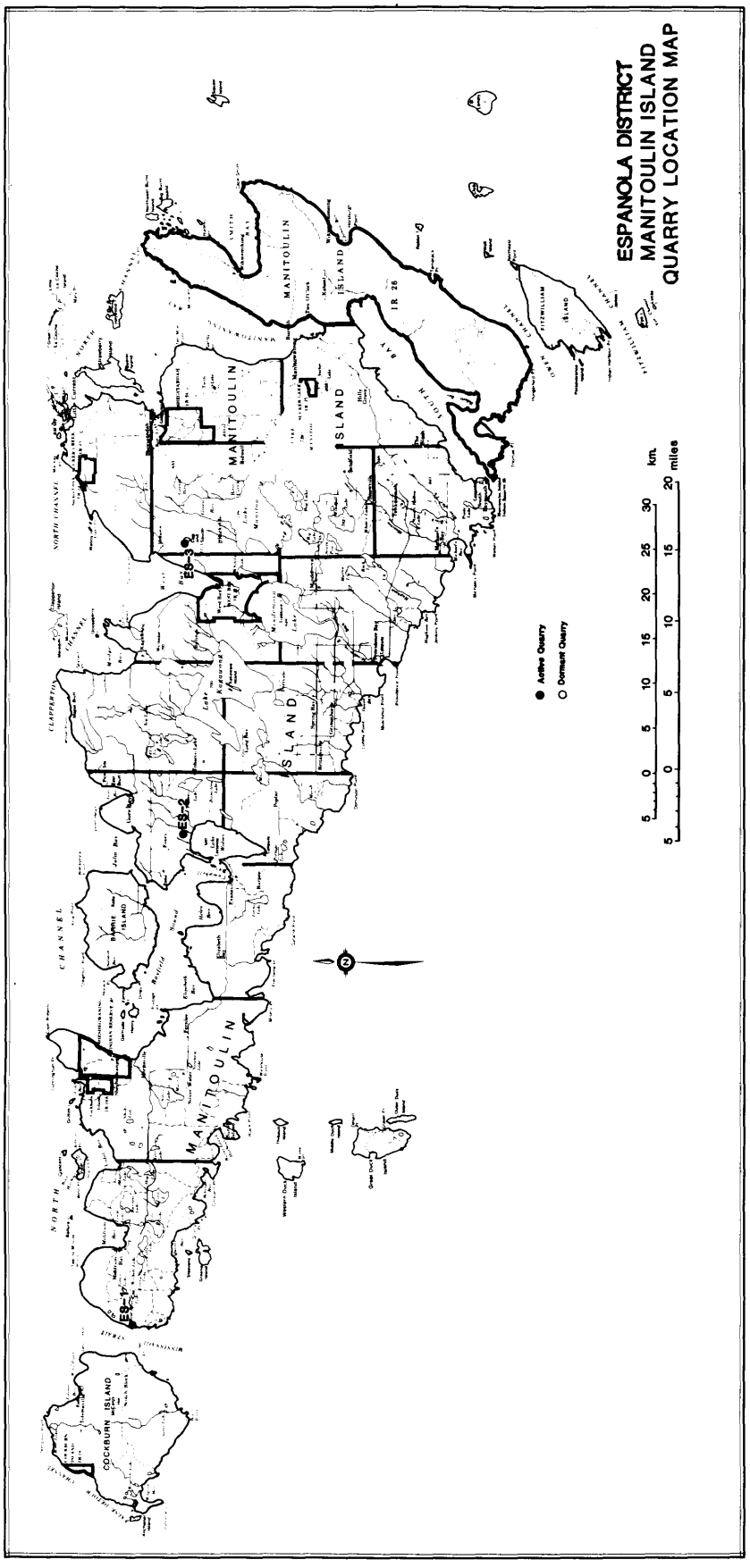


Figure ES-0-1. ESPANOLA DISTRICT (MANITOULIN ISLAND) QUARRY LOCATION MAP.

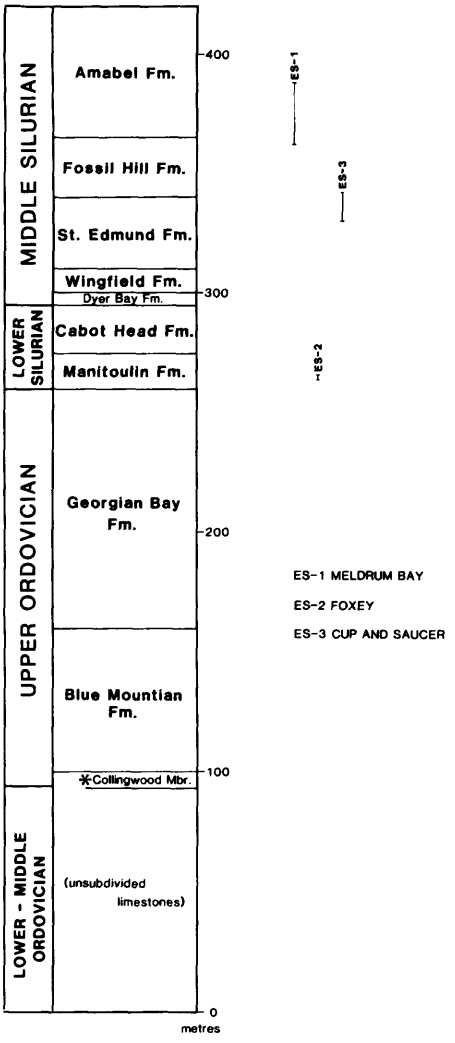


Figure ES-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF ESPANOLA DISTRICT (MANITOULIN ISLAND).

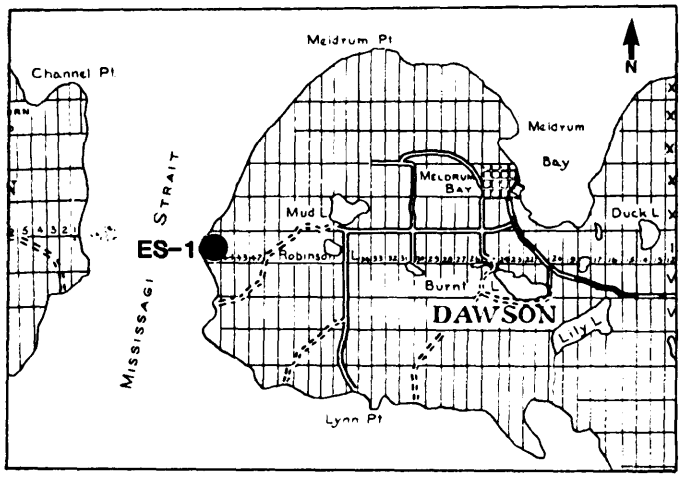


Figure ES-1-1. LOCATION MAP FOR MANITOULIN (MELDRUM BAY) QUARRY.

Geological Section

		Thickness
UNIT 2	*Amabel Formation*	*22.5m*

Dolostone: blue-grey, to light grey, cream and white; weathers light grey, to light brown and tan; dominantly fine crystalline with some medium-crystalline intervals, in a very uniform texture; thick bedded (0.5-1.0 m) with sharp contacts; very rare, very thin, dark grey, shale partings present, especially in lowermost 10.0 m; small white chert nodules present in lowermost 30 cm; small vugs, commonly open, present in most beds; sparsely fossiliferous; uppermost 2 m on south and east faces extensively fractured and jointed, elsewhere a massive 1.5-2.0 m thick bed is present; lower contact of unit sharp, slightly irregular, coincident with floor of primary crusher.

UNIT 1	*Fossil Hill Formation*	*2.5m*

Dolostone: light grey-brown to light grey, tan in upper 10 cm, weathers medium grey-brown; fine to medium crystalline, with patches of coarse crystalline; thin bedded (5-10 cm) with slightly undulating contacts and rare, very thin, black shale partings; very chert-rich horizons 1.5 m and 2.1 m above base of unit, with chert nodules sporadic throughout unit; very fossiliferous with silicified corals and stromatoporoids most common.

Total thickness	*25.0m*

crusher, an additional 7.2 m is exposed below the quarry floor, of which the lower 2.5 m are assigned to the Fossil Hill Formation (Figure ES-1-2).

The dolostones of the Fossil Hill Formation are primarily thin-bedded and contain significant amounts of chert and silicified fossil material. In contrast the dolostones of the Amabel Formation are thick bedded, contain virtually no chert, and are sparsely fossiliferous. Glacial overburden around the quarry varies in thickness from a few centimetres to 2.5 m.

QUARRY OPERATION

Overburden is removed by Cat 988B loader and Euclid 40-ton trucks for the construction of a berm along the northeast quarry boundary. The chemical grade stone is currently mined on a single lift of 17.8 m on the south and east faces, 250 m and 400 m in length respectively. A second lift of aggregate quality stone is held in reserve.

Drilling and blasting is contracted and a drill pattern of 3 m x 3.7 m is used with 11 cm diameter holes. Groundwater seepage is excessive and holes must be

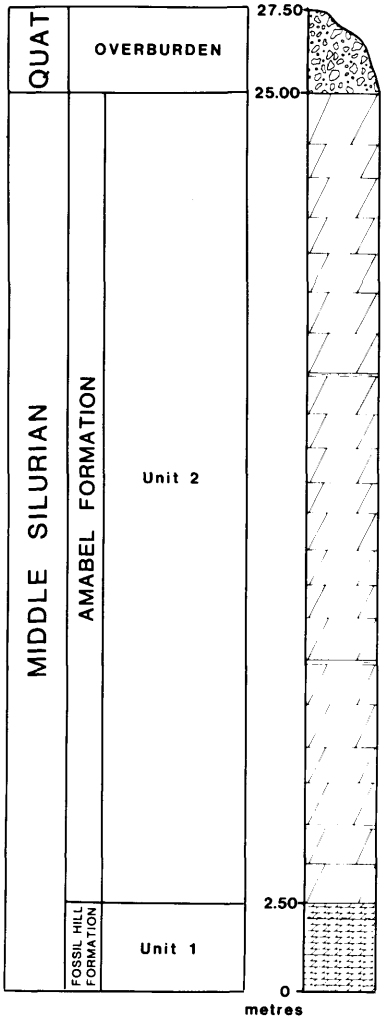


Figure ES-1-2. STRATIGRAPHIC COLUMN FOR MANITOULIN (MELDRUM BAY) QUARRY.

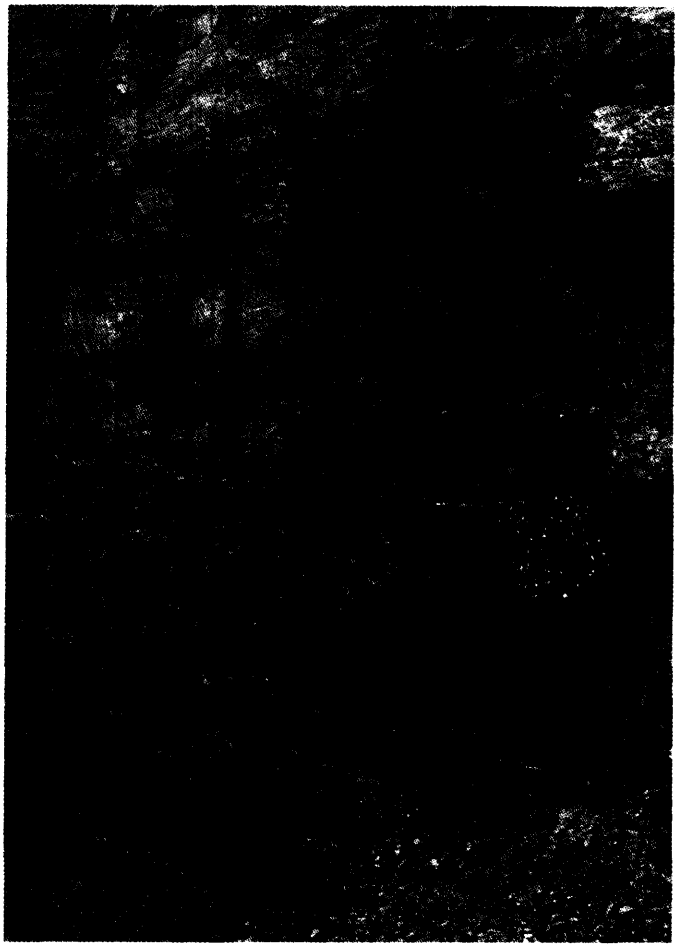


Photo ES-1-1. PRIMARY CRUSHER SUMP AT MANITOULIN (MELDRUM BAY) QUARRY. HAMMER HEAD INDICATES CONTACT OF FOSSIL HILL FORMATION AND AMABEL FORMATION.

pumped before explosives are loaded. A bulk mixing truck is used to load the blast holes, with hydromex slurry used as a toe charge and Amex II (AN/FO) as a column charge. Holes are primed with Pro-Core primers and initiated with primacord. Approximately 22,000 tonnes are blasted per shot.

A Cat 988B 7 yd. loader is used at the face to load trucks (two Euclid 40-ton) for a haulage distance of about 300 m. Future quarry design calls for the use of a Cat 992 loader and two 55-ton Cat trucks when the haulage distance becomes too long to supply the primary crusher at a continuous rate of 1,000 tonnes per hour with the smaller units.

PROCESSING

The flow sheet for the plant is shown on Figure ES-1-3. Primary crushing is done with a 48 in. x 60 in. jaw, presently stationed in the centre of the quarry. The -10 in. product is carried approximately 150 m by a 36 in. conveyor belt to a stacker feeding a primary surge pile. This pile is recovered by a tunnel conveyor and sent to a Cedarapids 5 ft. x 16 ft. triple deck screen. Minus 1 in. fines from this screen are sent directly to a Granular "A" stockpile while oversize from the middle and bottom decks is sent to a secondary surge pile. Oversize from the top screen is sent to a 5 ft. Eljay Rollercone for secon-

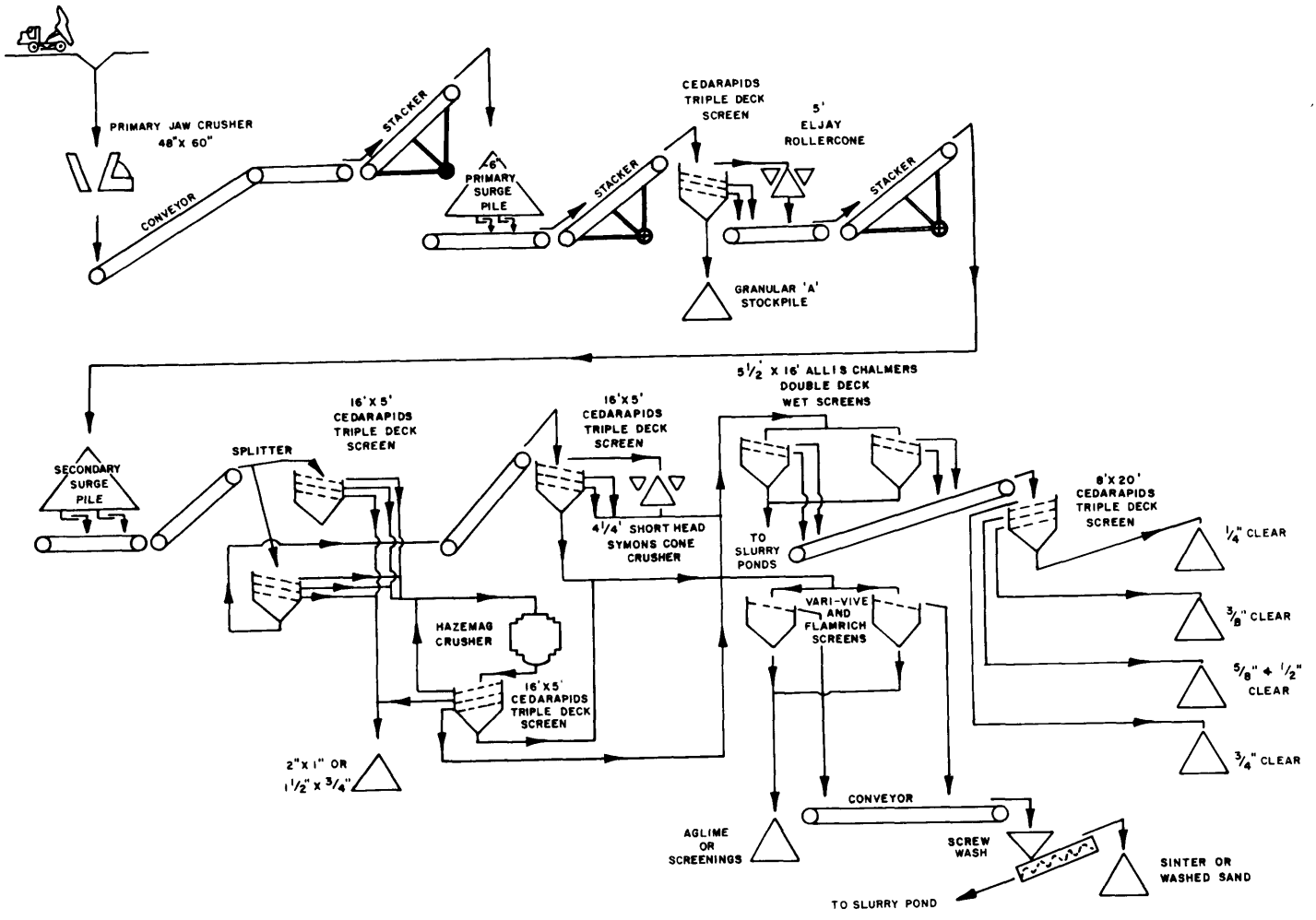


Figure ES-1-3. PROCESS FLOW SHEET FOR MANITOULIN (MELDRUM BAY) QUARRY.

dary crushing to −4 in. and added to the secondary surge pile.

The secondary surge pile material is split between two Cedarapids 5 ft. x 16 ft. triple–deck screens. Oversize (+1 1/2 in.) from the top two decks of each screen is sent for tertiary crushing by a Hazemag hammer mill, while −1 1/2 in. +3/4 in. oversize from the third decks is stockpiled as a chemical stone product. Fines (−3/4 in.) from both screens are sent to a third triple–deck screen.

Oversize material from the top deck of the third screen is sent for tertiary crushing by a Symons 4 1/4 ft. short head cone crusher, the product being returned to the screen. Fines are sent to a single deck Vari–vive or Flamrich screen. Intermediate–sized material is sent to two in–series Allis–Chalmers 5 1/2 ft. x 16 ft. double deck wash screens.

Stone leaving the Hazemag hammer mill is sent to a Cedarapids 5 ft. x 16 ft. triple–deck screen. Fines are sent to the Vari–vive/Flamrich screens; oversize from the bottom deck is sent to the wash screens; −1 1/2 in. +3/4 in. stone from the middle deck goes to the chemical stone stockpile; and oversize from the top deck is recrushed by the hammer mill.

Fines from the Allis–Chalmers wash screens are sent to a settling pond. Oversize from both screens is sent to a Cedarapids 8 ft. x 20 ft. triple–deck screen, producing four clear stone products, 1/4 in., 3/8 in., 1/2 in. and 3/4 in.

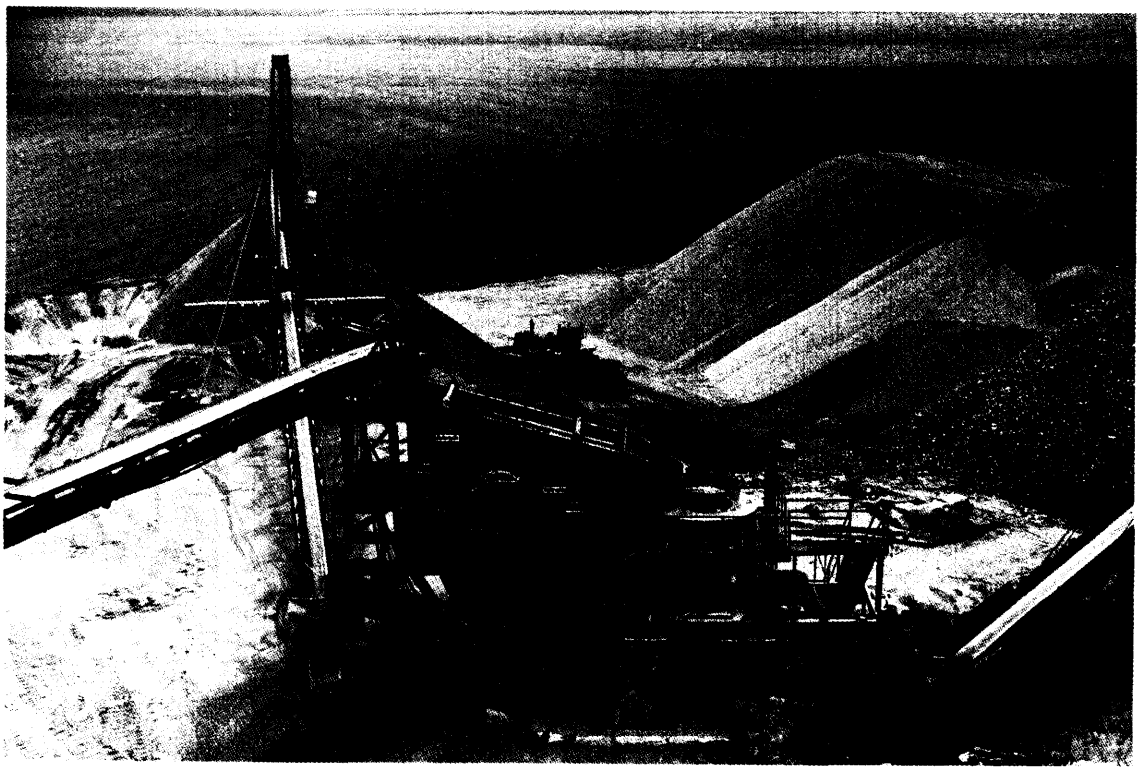


Photo ES-1-2. CEDARAPIDS TRIPLE DECK SCREEN WITH ELJAY ROLLERCONE SECONDARY CRUSHER; MANITOULIN (MELDRUM BAY) QUARRY.

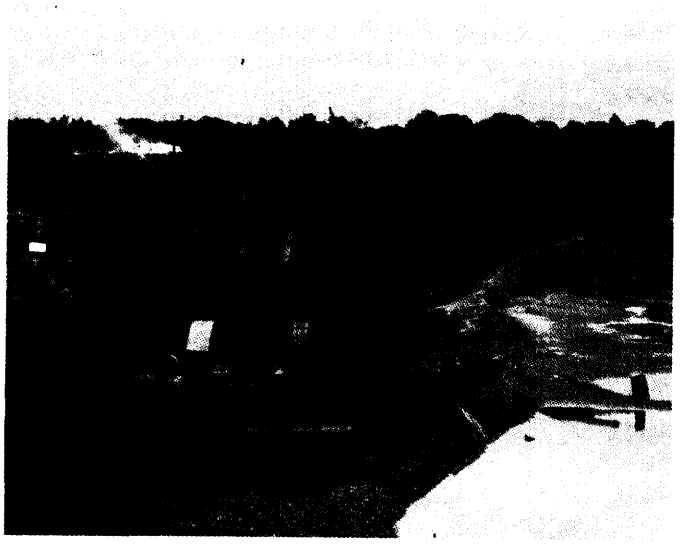


Photo ES-1-3. PRIMARY CRUSHER WITH DRILLING IN BACKGROUND; MANITOULIN (MELDRUM BAY) QUARRY.

Fines from the Vari-vive and Flamrich screens are stockpiled as a screening or aglime product. Oversize from both screens is sent to a screw crusher producing a sinter or washed sand product. Stone is blended from various stockpiles by feeders to tunnel conveyors to achieve construction specifications.

PRODUCTS

Granular "A"
3/4 in. Clear
5/8 in. Clear
3/8 in. Clear
1/4 in. Clear
Washed Concrete Sand
Sinter Sand
Screenings
2 in. to 1 in. Chemical Grade Stone
Agricultural Lime – 10 mesh

REFERENCES

None

MAPS

Johnson and Telford, 1985c, OGS Map P.2667

Photo ES-2-1. TYPICAL QUARRY RUN MATERIAL AT FOXEY QUARRY.

ES-2 HERCULES ORNAMENTAL STONE — FOXEY QUARRY

LOCATION AND OWNERSHIP

Hercules Ornamental Stone operates this small quarry in Lot 17, Concession 5, Gordon Township, District of Manitoulin, about 1.5 km south of the hamlet of Foxey (Figure ES-2-1).

GEOLOGY

The bedrock surface of the dolostones of the Manitoulin Formation at this site has been highly polished by glacial processes. The surface bed, which is usually 10–20 cm thick, is cut by saws into ornamental stone which is used primarily in home construction.

The dolostones of the Manitoulin Formation exposed at this site are blue–grey, buff weathering, fine crystalline, and thin to medium bedded. Small nodules of soft white chert are scattered throughout the beds. Up to 2 m of overburden is removed to expose the glaciated surface.

REFERENCES

None

MAPS

Johnson and Telford, 1985d, OGS Map P.2668

ES-3 CUP AND SAUCER QUARRY

LOCATION AND OWNERSHIP

Located in Lot 29, Concession 8, Bidwell Township, District of Manitoulin (Figure ES-3-1), the quarry at the Cup and Saucer is operated intermittently by the Ministry of Transportation for aggregate, most of which is used in asphalt.

GEOLOGY

The quarry extends northward into an east–west trending escarpment and exposes 11.0 m of dolostone (Figure ES-3-2). The lower 9.5 m is assigned to the St. Edmund Formation and the overlying 1.5 m to the Fossil Hill Formation. The upper part of the quarry is generally inaccessible due to the adjacent escarpment. Overburden

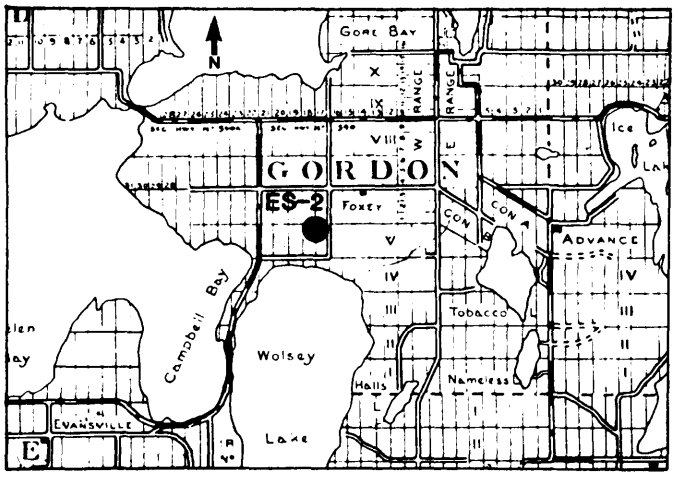


Figure ES-2-1. LOCATION MAP FOR FOXEY QUARRY.

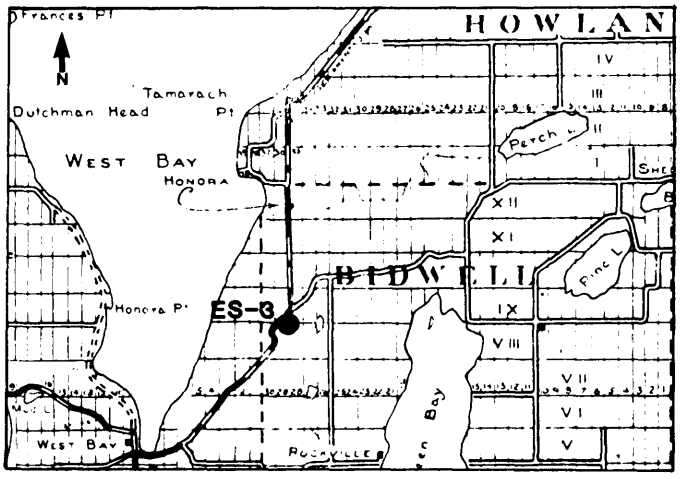


Figure ES-3-1. LOCATION MAP FOR CUP AND SAUCER QUARRY.

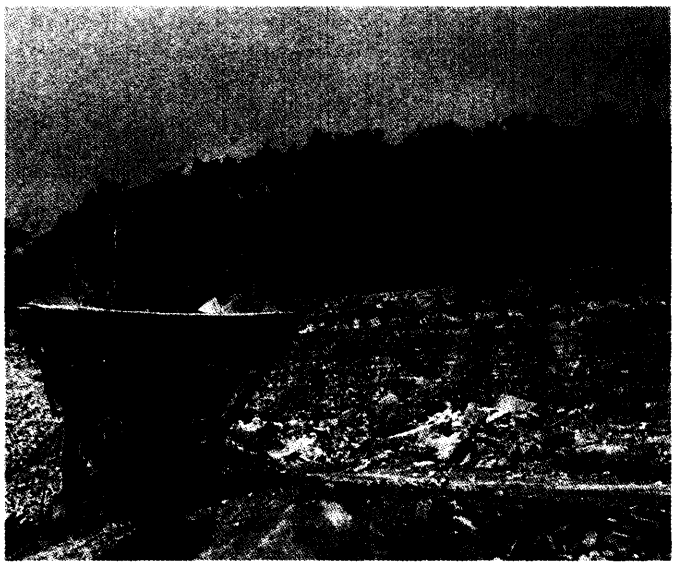


Photo ES-3-1. EAST FACE AT CUP AND SAUCER QUARRY.

along the escarpment varies from a few centimetres to 2.0 m.

Geological Section

		Thickness
UNIT 2	*Fossil Hill Formation*	*1.5m*

Dolostone: medium grey-brown, weathering dark grey-brown; fine to medium, rarely coarse crystalline with intermixing of crystal sizes; thin bedded (5-10 cm) with thin shale partings and irregular contacts; white chert common, with both soft, chalk-like and hard, flint-like varieties; very fossiliferous, with fossils commonly silicified, corals and pentamerid brachiopods most abundant; lower contact of unit sharp and slightly irregular.

UNIT 1	*St. Edmund Formation*	*9.5m*

Dolostone: light grey, rarely medium brown, weathers light grey to tan, rarely medium brown; very fine crystalline, rare beds of medium crystalline (sugary texture); medium bedded (10-15 cm), fine-crystalline beds commonly laminated, with sharp, planar contacts; mud cracked surfaces, muddy dolostone intraclasts, and burrows common on bedding plane surfaces.

Total thickness	*11.0m*

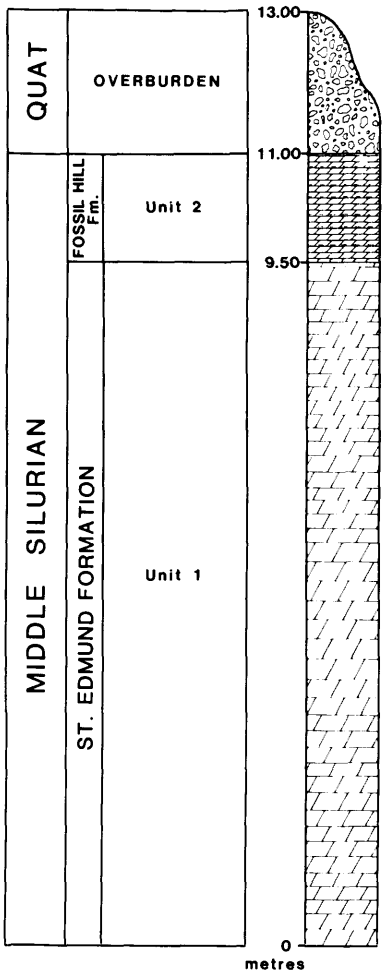


Figure ES-3-2. STRATIGRAPHIC COLUMN FOR CUP AND SAUCER QUARRY.

REFERENCES

None

MAPS

Johnson and Telford, 1985a, OGS Map P.2669

Blind River District

INTRODUCTION

The lime and slag cement plants of Reiss Lime Company of Canada Ltd. are located in Blind River District. There are no limestone quarries located in the district. Reiss Lime imports high-calcium limestone from quarries in Michigan.

BL-1 REISS LIME COMPANY OF CANADA LTD. — SPRAGGE PLANT

LOCATION AND OWNERSHIP

Reiss Lime Company of Canada Ltd. operates a 550 tonne/day high calcium lime plant and a 200,000 tonne/year slag cement plant at Spragge, Ontario on the north shore of Lake Huron. The company is jointly owned by Reiss Lime Inc. of the United States and Denison Mines Ltd. of Canada.

PROCESSING

No details on the equipment and production process are available from the company.

PRODUCTS

Most of the output of the lime plant is destined for the nearby uranium, nickel and copper mines and smelters at Elliot Lake and Sudbury where it is used for acid neutralization and for use in steel manufacturing at Algoma Steep Corp. Ltd. in Sault Ste. Marie.

The slag cement operation was started up in 1986, using material provided by Algoma Steel Corp. Ltd. The cement is sold under long-term contract to INCO Ltd. for use in mine backfilling operations in their Sudbury area mines.

Cobalt District

INTRODUCTION

The active and intermittently active quarries in Cobalt District that were visited during the study include the following:

CO–1	*Nortario Limestone Ltd. – McNammaras Quarry (intermittent)*
CO–2	*Township of Harley Quarry (intermittent)*
CO–3	*Hanbury Quarry (abandoned)*
CO–4	*Dymond Clay Products Ltd. – Bucke Quarry (active)*
CO–5	*Farr Quarry (abandoned)*

PALEOZOIC GEOLOGY

The Paleozoic rocks of the Lake Timiskaming outlier (*see* Figure CO–0–1 on chart in back pocket of Volume I), located around the northwestern end of Lake Timiskaming, are geologically important as they represent the only significant Paleozoic strata between northern Lake Huron and the Hudson Bay Platform. The outlier is nearly equidistant between two major depositional centres in Ontario, the Michigan Basin to the south and the Moose River Basin to the north, and occupies a fault–controlled depression (a graben) that includes Lake Timiskaming and an area extending northwest from the lake. This region has been called the Lake Timiskaming Rift Valley (Lovell and Caine, 1970) and is the northerly extension of the Ottawa Valley structural province. The major geomorphic feature within the graben is an easterly–facing escarpment of Silurian strata (Russell, 1984). A noteworthy topographic high is Casey Mountain (a Precambrian inlier) located on the eastern edge of the outlier. Glacial overburden over the outlier is thick and permits only limited exposure of the bedrock, except near the crest of the escarpment as it trends northwest from Dawson Point.

The western edge of the outlier is bounded by two northwesterly trending normal faults with a cumulative downthrow to the northeast of at least 240 m. The outlier's eastern edge is poorly defined, although it is also fault controlled. South of New Liskeard, the northwest trending faults are intersected by northeast trending faults (Russell, 1984).

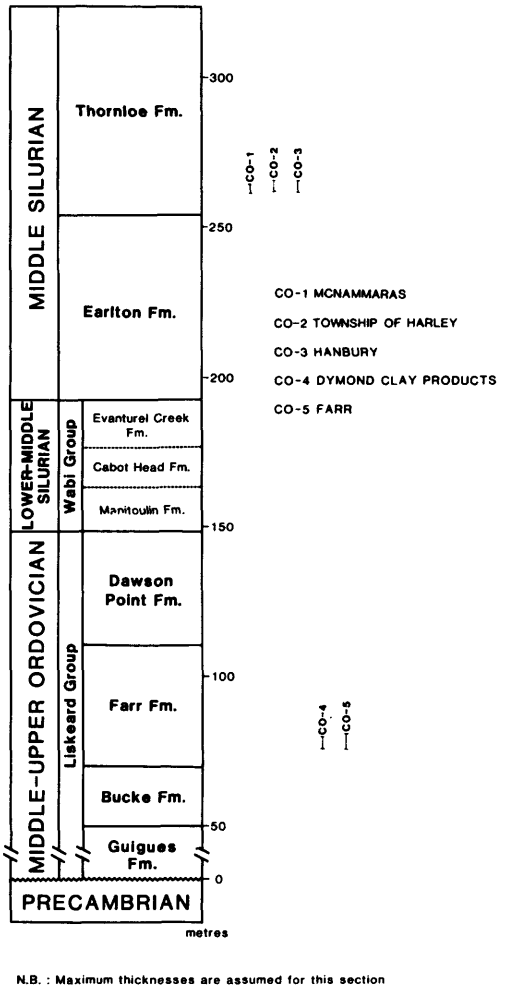


Figure CO-0-2. STRATIGRAPHIC COLUMN SHOWING PRINCIPAL QUARRIES OF COBALT DISTRICT.

Paleozoic rocks of the Lake Timiskaming outlier range in age from Middle Ordovician to Middle Silurian. The discussion which follows is summarized from Russell (1984). The oldest unit in the area is the Middle to Upper Ordovician Liskeard Group (Figure CO–0–2) which includes (in ascending order): the Guigues, Bucke, Farr, and Dawson Formations. These units consist of coarse–grained sandstones and conglomerates, interbedded blue–grey shales and nodular limestones, interbedded calcarenites and dolomitic limestones, and interbedded shales and calcarenites, respectively. Outcrops of the Liskeard Group occur within two smaller fault blocks south of the main outlier and west of Casey Mountain.

Quarries have been developed in the Farr Formation, which is also the most extensively exposed unit of

the group. The currently active Dymond Clay Products Ltd. Quarry (CO–4) (Grant and Owsiacki, 1987) exposes 4.6 m of this formation, as does the nearby abandoned Farr Quarry (CO–5).

The Lower to Middle Silurian Wabi Group disconformably overlies the Liskeard Group and consists of (in ascending order): the Manitoulin, Cabot Head, and Evanturel Creek Formations. They consist of mottled dolostones, red shales (both correlative to the Manitoulin Island and Bruce Peninsula sequences, respectively), and interbedded shales and dolostones. Only the Evanturel Creek Formation is exposed in the outlier along the creek of the same name.

The Wabi group is overlain by the Middle Silurian Earlton and Thornloe Formations, the former being a thin–bedded, very fine–crystalline limestone and dolostone with interbeds of bioclastic and oolitic limestones. The unit is well exposed at the southern tip of Dawson Point. Except for the abandoned quarry near the Earlton Airport (from which material was used for runway construction) there are no quarries in this formation.

The Thornloe Formation is a very thick–bedded dolostone which forms the crest of the spectacular cliff exposures along Dawson Point. This formation is also exposed in the intermittently–operated McNammaras (CO–1) and Township of Harley (CO–2) Quarries, and in the abandoned Hanbury Quarry (CO–3).

CO–1 NORTARIO LIMESTONE LTD. — McNAMMARAS QUARRY

LOCATION AND OWNERSHIP

This quarry, located 5 km north of Earlton in Lot 6, Concession 6, Armstrong Township, District of Timiskaming (Figure CO–1–1), has been operated intermittently by Nortario Limestone Ltd.

GEOLOGY

The 3.3 m deep quarry exposes thin–bedded dolostones of the Thornloe Formation which contain some white chert nodules in addition to numerous, commonly silicified fossils. Material from this quarry has been used as a source of aggregate. Glacial overburden around the quarry is generally less than 1 m thick.

Photo CO–1–1. SOUTH FACE AT MCNAMMARAS QUARRY.

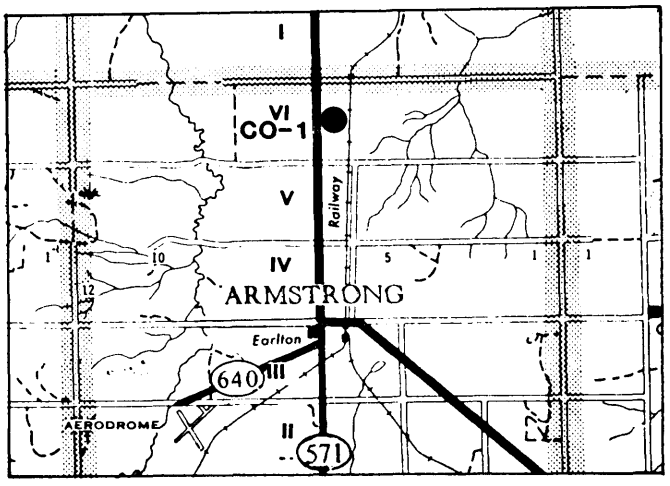


Figure CO-1-1. LOCATION MAP FOR MCNAMMARAS QUARRY.

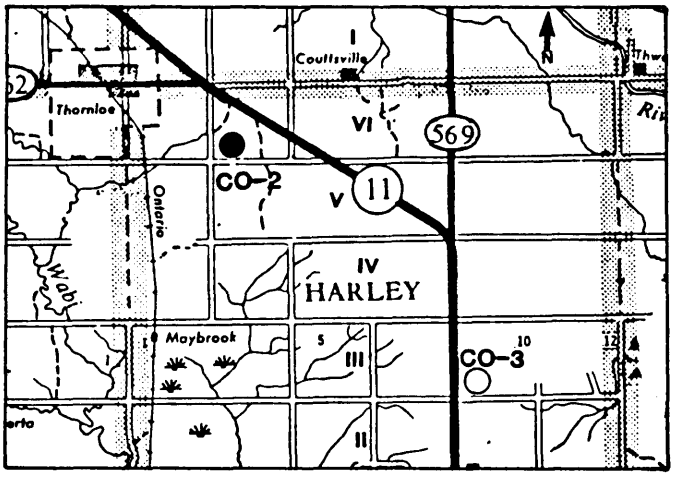


Figure CO-2-1. LOCATION MAP FOR TOWNSHIP OF HARLEY QUARRY.

Geological Section

	Thickness
UNIT 1 Thornloe Formation	*3.3m*

Limestone: grey, weathers grey-brown, very fine crystalline; thin bedded; white chert nodules present (7 cm diameter), some reddish-brown stains on uppermost beds; shale and sandy limestone drapes are present; fossiliferous with crinoidal debris most abundant, and with rare colonial corals, stromatoporoids, bryozoa, trilobites and brachiopods; some beds are highly bioturbated.

Total thickness	*3.3m*

REFERENCES

Bolton and Copeland, 1972, p.19
Grant and Owsiacki, 1987

MAPS

Russell, 1984, OGS Map P.2700

CO-2 TOWNSHIP OF HARLEY QUARRY

LOCATION AND OWNERSHIP

This quarry, operated intermittently by the Township of Harley, is located 2 km southeast of the village of Thornloe, in Lot 7, Concession 6, Harley Township, District of Timiskaming (Figure CO-2-1).

GEOLOGY

The quarry exposes 4.5 m of sandy dolostones from the Thornloe Formation. The material from this quarry is mainly used as fill because of the highly friable nature of the rock.

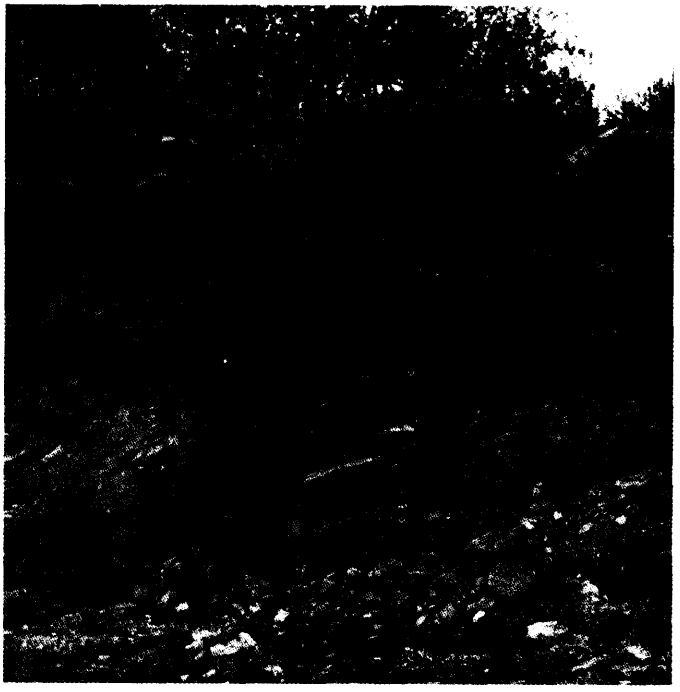


Photo CO-2-1. EAST FACE AT TOWNSHIP OF HARLEY QUARRY.

Geological Section

	Thickness
UNIT 1 Thornloe Formation	*4.5m*

Sandy dolostone: light grey-brown, weathers medium brown, fine- to medium-grained quartz within fine- to medium-crystalline dolostone; medium to thick bedded; unit is very friable; lower 1.7 m forms a talus slope in most parts of the quarry; patches of white chert present in lower 1.7 m;fossiliferous with corals, stromatoporoids and pentamerid brachiopods abundant.

Total thickness *4.5m*

REFERENCES

Bolton and Copeland, 1972, p.19
Grant and Owsiacki, 1987
Lovell and Frey, 1976

MAPS

Russell, 1984, OGS Map P.2700
Lovell and Frey, 1974, OGS Map 2301

CO-3 HANBURY QUARRY

LOCATION AND OWNERSHIP

This abandoned quarry is located 2 km north of Hanbury, in Lot 9, Concession 3, Harley Township, District of Timiskaming (Figure CO-3-1).

GEOLOGY

This quarry exposes 5.5 m of dolostones and interbedded sandy limestones of the Thornloe Formation. The quarry is partially overgrown and flooded.

Geological Section

	Thickness
UNIT 1 Thornloe Formation	*5.5m*

Dolostone, with sandy limestones: grey, weathers grey-brown; fine crystalline; dolostone is very fine crystalline; limestone is microcrystalline and bioclastic; thin to thick bedded, with some beds laminated; abundant crinoids; low amplitude anticline is present on quarry floor.

Total thickness *5.5m*

REFERENCES

Bolton and Copeland, 1972, p.19
Grant and Owsiacki, 1987

MAPS

Lovell and Frey, 1974, OGS Map 2301
Russell, 1984, OGS Map P. 2700

CO-4 DYMOND CLAY PRODUCTS LTD. — BUCKE QUARRY

LOCATION AND OWNERSHIP

Dymond Clay Products Ltd. own and operate a limestone quarry approximately 2.5 km northwest of Haileybury, in Lot 9, Concession 4, Bucke Township, District of Timiskaming (Figure CO-4-1). The property was first developed in 1980, primarily for its agricultural lime potential, by the parent company Jacksic Brothers Sand & Gravel of New Liskeard. Since 1980 Dymond Clay Products Ltd. has expanded from producing small amounts of agricultural lime to supplying metallurgical stone for flux. The quarry produced about 130,000 tonnes in 1986 with over 90% of production used in the pelletizing operations of local iron mines (Owsiacki, 1987).

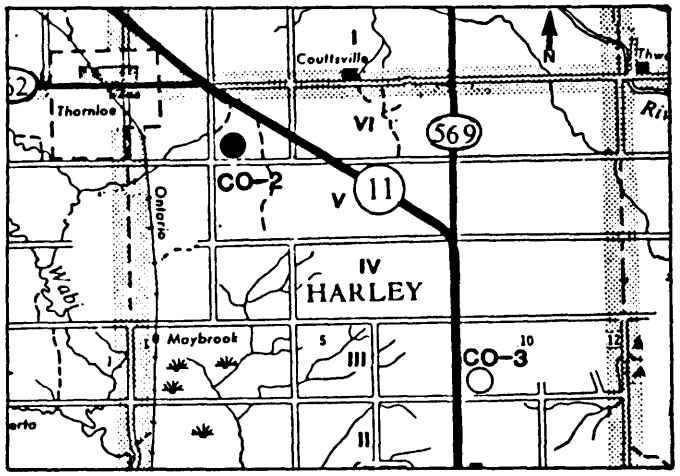


Figure CO-3-1. LOCATION MAP FOR HANBURY QUARRY.

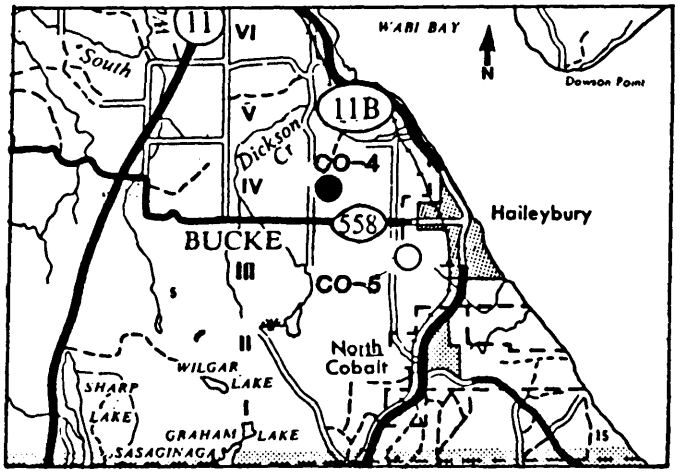
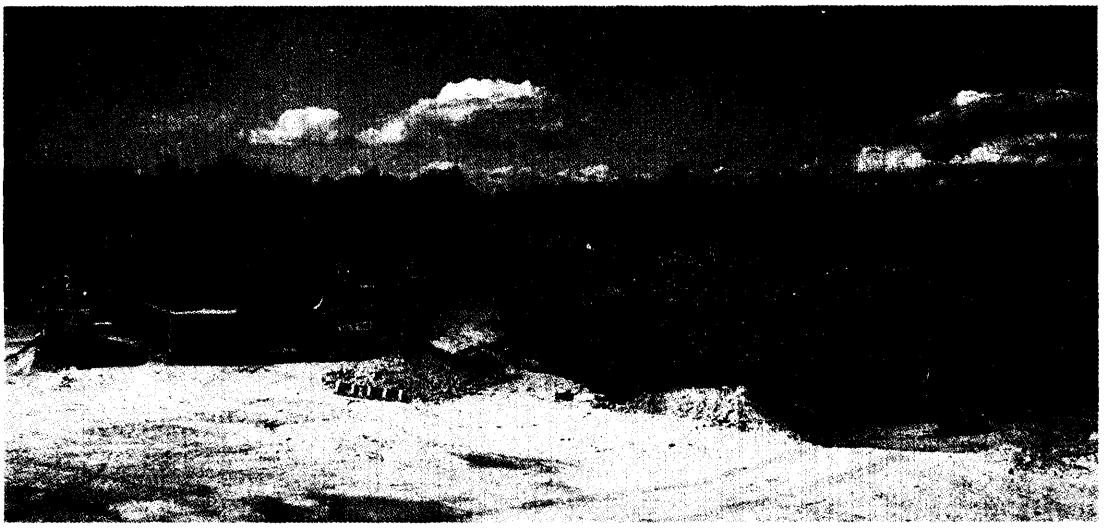


Figure CO-4-1. LOCATION MAP FOR BUCKE QUARRY.

Photo CO-4-1. PORTABLE CRUSHING FACILITIES AT BUCKE QUARRY (LOOKING NORTH).



GEOLOGY

The 4.6 m deep quarry exposes limestones and interbedded dolostones of the Farr Formation. The high purity of the carbonates makes this stone suitable for use as a metallurgical flux and as agricultural lime.

Geological Section

		Thickness
UNIT 1	*Farr Formation*	*4.6m*
	Limestone, with some interbedded dolostones: medium to dark grey, weathers light brown; medium- to coarse-crystalline limestones and very fine- to fine-crystalline dolostone; medium to thick bedded, upper beds thinner, sharp but irregular contacts; in upper half of unit thin shale partings occur; weathered surfaces show distinct mottling and pitting; sparsely fossiliferous although large corals are present.	
Total thickness		*4.6m*

QUARRY OPERATION

As of July 1986 the quarry had dimensions of about 50 m x 50 m, opened on a single lift of 6 m, with potential for deepening to 12 m. Overburden is about 2 m in thickness, consisting of loose limestone boulders and clay, and is stockpiled and later screened to produce riprap and armour stone. Drilling and blasting is contracted and a 2.4 m x 2.4 m drill pattern is used with 7.6 cm diameter holes.

PROCESSING

A Cat 988 loader is used to transport shot rock from the blast face to the primary crusher. At the time of the visit the primary crusher (Cedarapids jaw) was set up on the quarry floor. Crushed stone was conveyed to a Pioneer secondary crusher on the rim of the quarry, producing −1 in. material that was stockpiled.

Stone from the stockpile was either trucked to customers as a metallurgical stone product or transported approximately 100 m by front-end loader to a Stedman Cage Crusher for tertiary crushing. Material leaving the cage crusher was carried by a 9 in. paddle conveyor to a stacker for storage in a 6,000 tonne shed.

PRODUCTS

Armour Stone
Riprap
−1 in. Metallurgical Stone
Agricultural Lime

REFERENCES

Grant and Owsiacki, 1987

MAPS

Russell, 1984, OGS Map P.2700

CO-5 FARR QUARRY

LOCATION AND OWNERSHIP

This abandoned quarry is located 1.5 km west of Haileybury, in Lot 5, Concession 3, Bucke Township, District of Timiskaming (Figure CO-5-1).

GEOLOGY

The 6 m deep quarry exposes limestone from the Farr Formation. The quarry was originally used as a source of building stone which resulted in five shallow lifts, each essentially one bed thick. Glacial overburden around the quarry is generally less than 0.5 m thick.

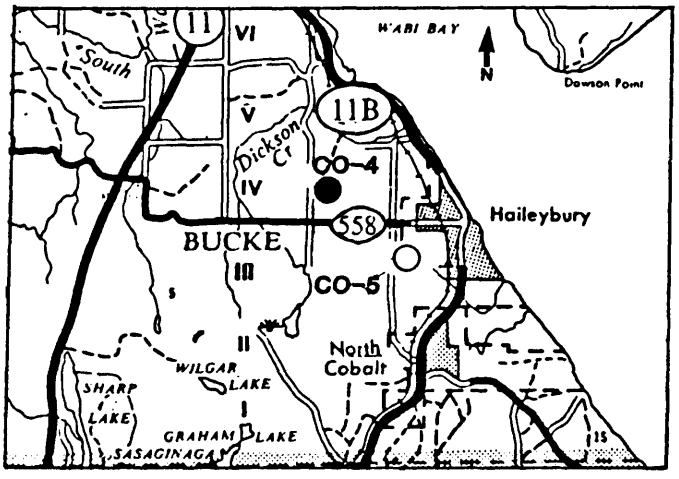


Figure CO-5-1. LOCATION MAP FOR FARR QUARRY.

Geological Section

	Thickness
UNIT 1 Farr Formation	*6.0m*

Limestone: medium grey, weathers blue-grey; fine to medium crystalline; becomes coarser crystalline upwards; thick bedded; some beds with minor amounts of coarse-grained sand; sharp contacts with rare thin shale partings; calcite crystals line vugs; abundant fossils include stromatoporoids and brachiopods, with rare corals, gastropods, and the algae *Receptaculites*.

Total thickness	*6.0m*

REFERENCES

Goudge, 1938, p.344–346
Thomson, 1965, p.58
Bolton and Copeland, 1972, p.18
Lovell and Frey, 1976, p.19–20
Grant and Owsiacki, 1987

MAPS

Russell, 1984, OGS Map P.2700

Moosonee District

INTRODUCTION

There is only one quarry located in Moosonee District. The quarry is operated by M.J. Labelle Co. Ltd. which has several aggregate operations in northeastern Ontario.

PALEOZOIC GEOLOGY

The Moose River Basin occupies the James Bay Lowland physiographic area including Moosonee District and contains Paleozoic and Mesozoic age strata totalling approximately 760 m in thickness (Figure MO-0-1). This sequence includes Ordovician, Silurian, Devonian, Middle Jurassic and Lower Cretaceous age rocks.

The James Bay Lowland area is covered with poorly-drained muskeg resulting in sparse bedrock exposures along river banks and severely limiting accessibility and transportation for limestone quarrying. The main modes of surface transportation through the James Bay Lowland in summer are by canoe or small boat on the rivers, or by the Ontario Northland Railway.

The main carbonate units of the Moose River are those of Middle Devonian age. The Kwataboahegan Formation (MO-1) is the only one of these which has thus far been exploited.

MO-1 M. J. LABELLE CO. LTD. — MOOSONEE QUARRY

LOCATION AND OWNERSHIP

The Moosonee Quarry is located 8 kms south of Moosonee, in Lot 7, Concession 8, Horden Township, Cochrane District and is adjacent to Maidmans Creek, next to the Moose River (Figure MO-1-1). The quarry was opened in 1970 by the operator M. J. Labelle Co. Ltd.

Deposits of sand and gravel in the Moosonee area are limited, therefore aggregate material must be supplied from limestone sources. Crushed stone products from the quarry are used in road and airport maintenance in Moosonee and Moose Factory. The quarry is usually put into operation every winter as the product stockpiles become exhausted. Approximately 50,000 tonnes are extracted and crushed to replenish the stockpiles. All excavation/crushing equipment is shipped by rail from Cochrane to Moosonee.

GEOLOGY

The Moosonee Quarry exposes approximately 6 m of Middle Devonian Kwataboahegan Formation limestone in three lifts. The Kwataboahegan Formation, at its type location at Coral Rapids (on the Abitibi River), is typi-

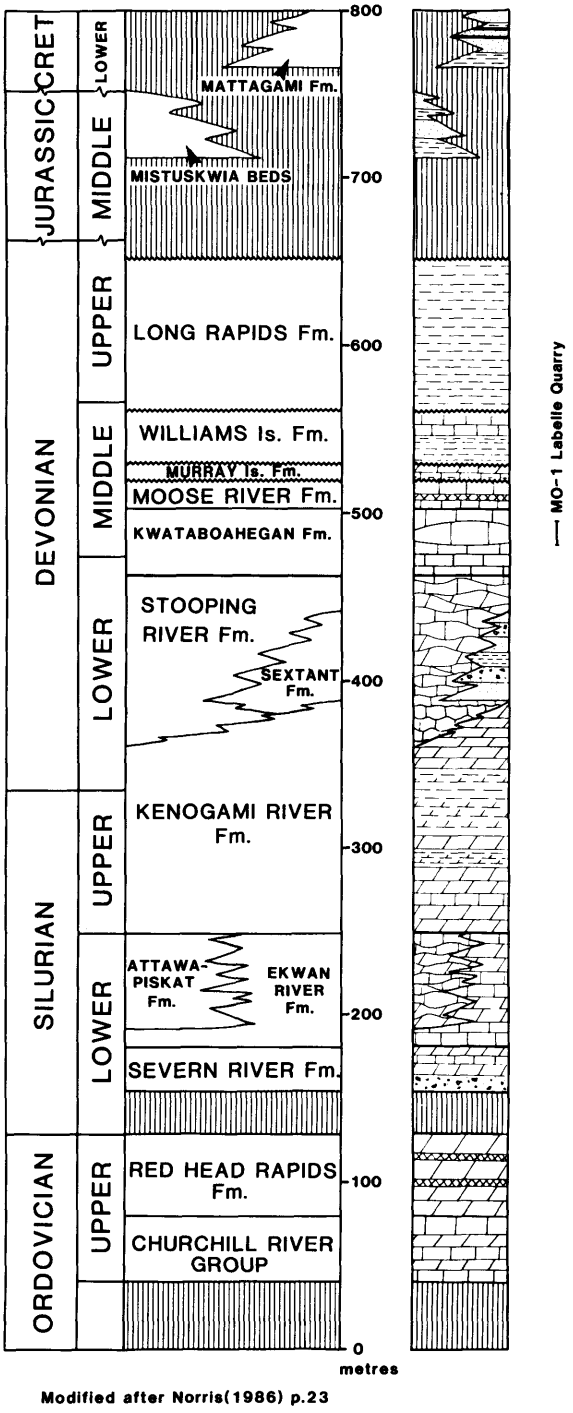


Figure MO-0-1. STRATIGRAPHIC COLUMN FOR THE MOOSE RIVER BASIN AND MOOSONEE QUARRY.

cally a light to dark brown, calcarenaceous, bituminous, thick– to massive–bedded, extremely fossiliferous limestone. It weathers light grey to grey, and occasional recessive dolomitic beds also occur. Some beds have a microgranular to microsucrosic texture and are highly porous. At other localities it is thin–bedded, darker, less fossiliferous, and very bituminous. It is the most fossiliferous unit in the Moose River Basin and includes corals, stromatoporoids, bryozoans, tentaculitids, crinoids, pelecypods, gastropods, trilobites, ostracods, and conodonts. This unit has tentatively been correlated with the Onondaga Formation in southern Ontario. The silty overburden is up to 2.7 m thick around the quarry.

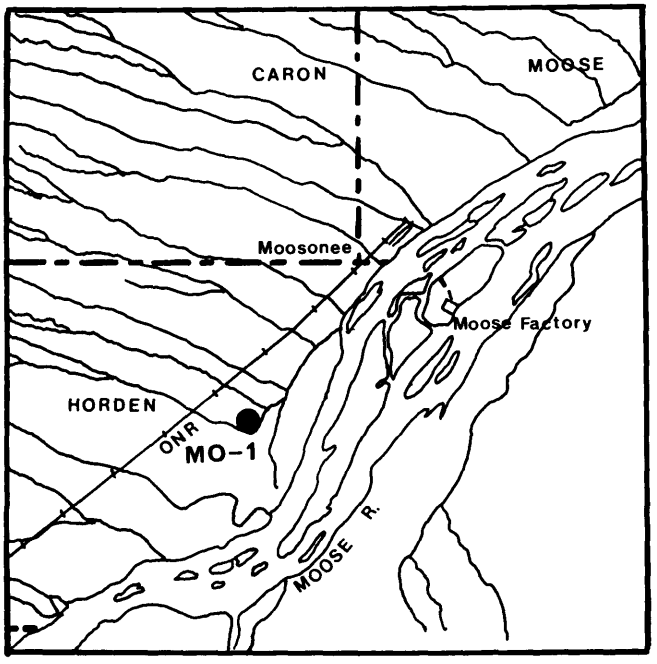


Figure MO-1-1. LOCATION MAP FOR MOOSONEE QUARRY.

QUARRY OPERATION

The quarry is excavated on three lifts of approximately 4 m over an area of 2 ha. The Moosonee region possesses a high water table hence all overburden stripping, drilling/blasting and primary crushing are performed during the winter season. A 10 in. diesel pump is used to dewater the quarry. All blast holes are loaded with watergel explosives (column charge) and stick powder (toe charge), initated by electric caps.

PROCESSING

A Pioneer 30 in. x 42 in. jaw is used for primary crushing, and a Cedarapids 877 Master Commander (32 in. x 41 in. roll and 12 in. x 42 in. jaw) as a secondary crusher. The Commander crusher is equipped with a 5 ft. x 16 ft. double–deck screen and ball tray (to remove soil).

PRODUCTS

4 in. Crusher Run (for fill base)
Granular "A"
3/4 in. Concrete Stone (washed)
Approved Asphalt Stone
5/8 in. (washed)

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