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**MARGINAL NOTES**

**INTRODUCTION**

Cockburn Island, situated in northern Lake Huron between Manitoulin Island and Drummond Island, Michigan, is accessible only by boat, helicopter, or float plane. Gravel roads, well maintained by the Township of Cockburn Island, provide access to most of the interior of the island.

The first geological description of the island was by Bigsby (1821, 1824) who noted the presence of fossiliferous limestones along the shoreline. Subsequent geological mapping (Murray 1849; Bell 1870; Williams 1919; Kelley 1949) culminated with the study by Liberty between 1954 to 1957 (Liberty 1972). Recent revisions to the geological maps of Manitoulin Island (Johnson and Telford 1985) indicated the need for the re-examination of the Paleozoic rocks on Cockburn Island.

The topography of Cockburn Island is controlled by thick Quaternary deposits. A central hill of morainic till, with surface reworking by glaciolacustrine beach processes, is surrounded by approximately concentric glacial beaches and wave-cut terraces. Bedrock outcrops are confined to the northern part of the island, generally as flat bedding plane exposures. Regional dip of the bedrock is about 6 m per kilometre to the north.

To supplement the outcrop data, a deep stratigraphic test hole (OGS 85-7, Cockburn Island) was drilled. The drillhole was located on lot 16, concession II, Township of Cockburn Island. A continuous section from the Middle Silurian down into the Precambrian, for a total depth of 521 m, was obtained (Table 1). The thickness of the Middle Silurian formations discussed below was measured from this drillhole.

**STRATIGRAPHY**

Only those Middle Silurian rock units which form part of the bedrock surface on Cockburn Island are described in detail. The thickness and names of older units present only in the subsurface, and intersected in OGS 85-7, are provided in Table 1. Detailed descriptions of these units will be released in a subsequent Ontario Geological Survey Open File Report.

The Cabot Head, Dyer Bay, Wingfield, and St. Edmund rock units (in ascending order) were previously designated as members of the Cabot Head Formation (Liberty and Bolton 1971; Liberty 1972). Due to recent revisions of Middle Silurian stratigraphy on Manitoulin Island (Johnson and Telford 1985), these four units are now accorded formal status, as previously used by Bolton (1957) and earlier workers.

**DYER BAY FORMATION**

The oldest exposed unit on Cockburn Island is the Dyer Bay Formation. Outcrops are restricted to a small area at the northern extremity of the island. Neither the lower nor the upper contacts are exposed on Cockburn Island, though outcrops on nearby Manitoulin Island and drillhole OGS 85-7 indicate that the Dyer Bay Formation conformably overlies the Cabot Head Formation. The contact is placed at the top of the uppermost green or red shale of the Cabot Head Formation. The exposed thickness of the Dyer Bay Formation is <0.5 m; in drillhole OGS 85-7, 4.4 m of Dyer Bay Formation was measured (Table 1).

The Dyer Bay Formation consists of blue-grey to grey-brown, thinly-bedded, medium crystalline, fossiliferous dolostone which weathers a light brown. Where fossils are absent, a silty to very fine grained sandy dolostone may occur. The fossils consist exclusively of the pentamerid brachiopod *Virgana*.

**WINGFIELD FORMATION**

No outcrops of the Wingfield Formation were observed on Cockburn Island, though 13.1 m of this formation occurs in drillhole OGS 85-7. The unit is considered to subcrop beneath surficial deposits in a narrow band across the northernmost part of the island. On Manitoulin Island, Johnson and Telford (1985) described this formation as a thin and evenly bedded green shale, interbedded with brown, very finely crystalline dolostone. The lower contact with the underlying Dyer Bay Formation, as seen in the drillhole core, is sharp and conformable.

**ST. EDMUND FORMATION**

The St. Edmund Formation was redefined by Johnson and Telford (1985) when detailed mapping and subsurface studies on Manitoulin Island (Johnson and Telford 1981a, 1981b) revealed that the St. Edmund Member (Cabot Head Formation) and Mindemoya Formation of Liberty (1968, 1972) actually constitute a single, mappable rock unit.

The base of the St. Edmund Formation is placed at the top of the uppermost green shale of the Wingfield Formation. The lower contact is not exposed on Cockburn Island but in drillhole OGS 85-7 it appears to be fairly sharp and conformable. The formation is 39.6 m thick in drillhole OGS 85-7 (Table 1). Outcrops occurring in a narrow band across the northern part of the island display only about 12.0 m of stratigraphic thickness.

The St. Edmund Formation consists of pale grey, thinly bedded, lithographic to sub-lithographic, laminated dolostone weathering white to cream alternating with beds of medium brown, medium bedded, medium to coarsely crystalline dolostone. The pale grey, lithographic dolostone occurs predominantly in the upper part of the formation whereas the brown, medium to coarsely crystalline dolostone is more common in the lower part. Some outcrops of the brown dolostone beds also contain horizons which exhibit a distinctive vuggy texture due to extensive silicification.

A 2 m thick interval of medium grey, medium bedded, lithographic limestone occurs along the northwestern shoreline, south of Burns Bay. This interval may correlate with the Fiborn Limestone Member of the Hendricks Dolomite, Drummond Island, Michigan (Johnson and Sorensen 1978). The Hendricks Dolomite is the equivalent formation in Michigan to the St. Edmund Formation of Ontario. Lithographic limestone was also observed in the St. Edmund Formation during a preliminary examination of the core from drillhole OGS 85-7.

Most of the St. Edmund Formation, especially the lithographic dolostone, is extensively jointed. The dominant trend is 140° and there is a minor trend at 050°; joints are spaced up to 1 m apart.

**FOSSIL HILL FORMATION**

The Fossil Hill Formation disconformably overlies the St. Edmund Formation, though the contact is not well exposed on Cockburn Island. In exposures and drillholes on Manitoulin Island (Johnson and Telford 1985), and in drillhole OGS 85-7, the contact is sharp and exhibits features suggestive of only a short period of erosion. From surface exposures, the Fossil Hill Formation is estimated to be 30 m thick. In the core of drillhole OGS 85-7, 33.2 m of the Fossil Hill Formation was measured (Table 1). Individual surface exposures do not exceed 2 m in thickness.

The Fossil Hill Formation consists of light brown to grey-brown, irregularly thin to medium bedded, fine to coarsely crystalline, fossiliferous dolostone which weathers buff to cream. Soft, white chert is abundant near the top of the formation and also occurs sporadically throughout. Several horizons within the Fossil Hill Formation are profusely fossiliferous, usually with disarticulated and disoriented, silicified fragments. The most common fossils include pentamerid brachiopods, stromatoporoids, and a large variety of tabulate and rugose corals. Other less common types include gastropods, cephalopods, and orthid brachiopods. The informally named "False Mindemoya beds", a 3 to 4 m thick horizon of lithographic dolostone (St. Edmund Formation lithology), occurs 5 m above the base of the Fossil Hill Formation. It is also present across much of Manitoulin Island (Johnson and Telford 1985).

**AMABEL FORMATION**

The Amabel Formation, the youngest Paleozoic formation exposed on Cockburn Island, and most areally extensive, disconformably overlies the Fossil Hill Formation. The lower contact is very sharp and easily identified in drillhole OGS 85-7; it was not found in any surface exposures. Most outcrops of the Amabel Formation are flat bedding plane exposures which usually display deeply weathered and enlarged joints and fractures. The Amabel Formation was the uppermost unit in drillhole OGS 85-7; 45.5 m of the formation was cored (Table 1).

The Amabel Formation on Manitoulin Island was subdivided into four major lithofacies by Johnson and Telford (1985). Only one of these facies, Facies III, has been identified on Cockburn Island. The strata consists of white to blue grey, thick to massive bedded, medium crystalline dolostone, which weathers a light to medium grey. Thin horizons of pentamerid brachiopods were observed in a few outcrops.

**ECONOMIC GEOLOGY**

A small abandoned quarry southeast of the village of Cockburn Island was worked for a short period during the early part of this century to obtain rock for use in a sulphite-pulp mill (Miller 1904; Gouge 1938). Three petroleum exploration wells were drilled on Cockburn Island during 1936 and 1937. All three penetrated the Precambrian, but were unsuccessful in locating commercial oil or gas deposits (Sanford 1964). Several small gravel pits are used as sources for aggregate on local roads.

Manitoulin Dolomite Limited is currently operating a quarry on nearby Manitoulin Island, approximately 3 km west of Cinder Point. Dolostone from the Amabel Formation is crushed on site, loaded onto lake boats and is shipped to both Canadian and American ports to supply a variety of industries. Outcrops of the Amabel Formation on Cockburn Island, north of Ricketts Harbour, may also be a potential source of similar dolostone.

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TABLE 1

AGE	FORMATION	DEPTH TO TOP (m)	THICKNESS (m)
PLEISTOCENE	Sand and gravel	0	29.0
MIDDLE SILURIAN	Amabel	29.0	45.5
	Fossil Hill	74.5	33.2
	St. Edmund	107.7	39.6
	Wingfield	147.3	13.1
	Dyer Bay	160.4	4.4
LOWER SILURIAN	Cabot Head	164.8	20.2
	Manitoulin	185.0	15.9
UPPER ORDOVICIAN	Georgian Bay	200.9	58.8
	Blue Mountain	259.7	66.95
	Lindsay (Collingwood Member)	326.65	5.05
MIDDLE ORDOVICIAN	Undifferentiated limestone and shale	331.7	100.3
	?Glenora*	432.0	8.5
	?St. Peter*	440.5	12.1
LOWER ORDOVICIAN	?Prairie du Chien*	452.6	30.95
PRECAMBRIAN		483.55	37.45
TOTAL DEPTH		521.0	

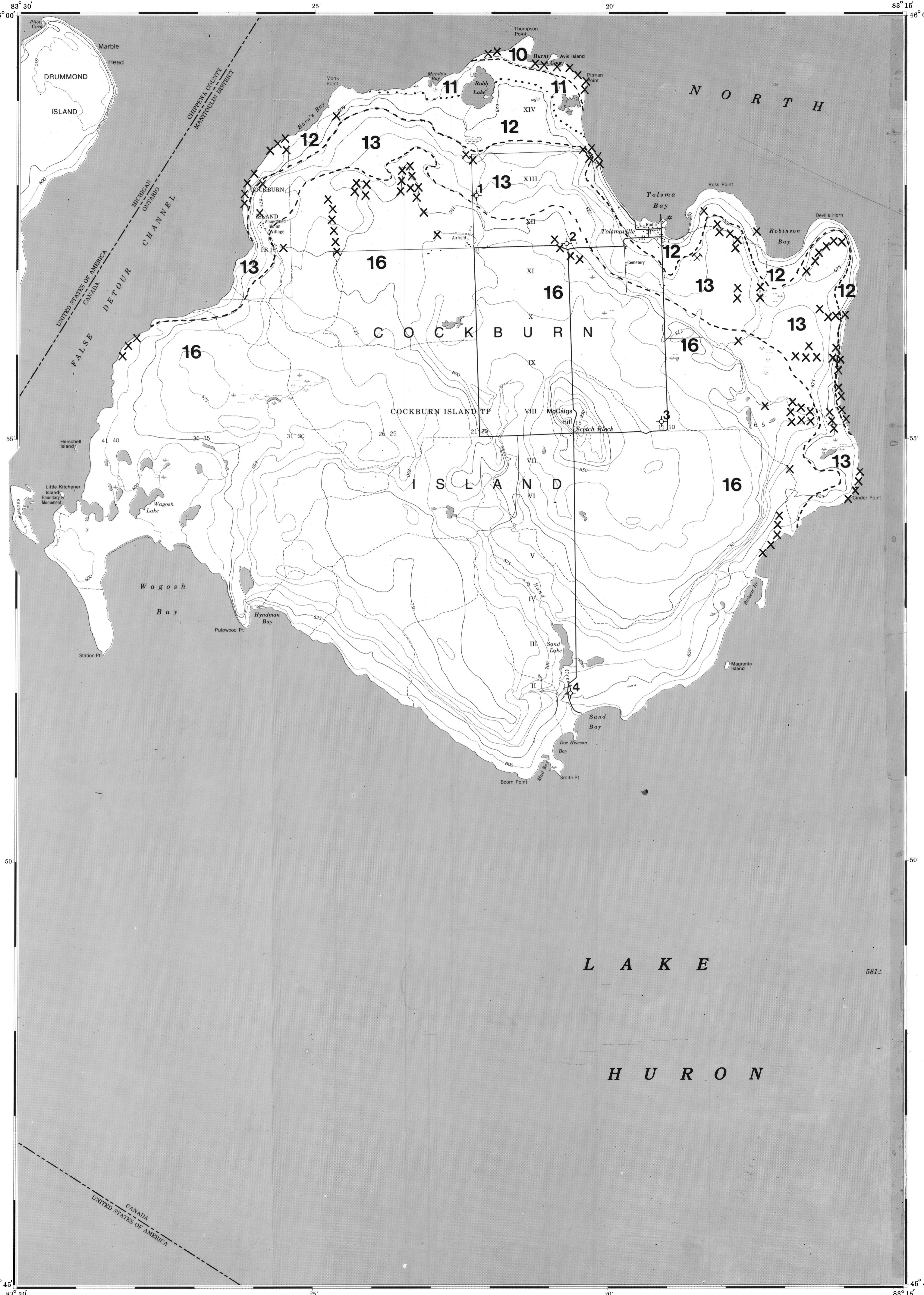
\*These units are tentatively assigned to the listed formations. A more precise determination awaits more detailed lithological, sedimentological, and paleontological study.

**DRILLHOLES**

1. Flood No. 1
2. McMillan No. 1
3. Bay City Bank No. 1
4. OGS 85-7 Cockburn Island

**SYMBOLS**

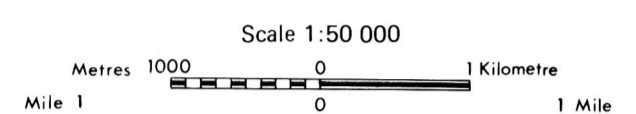
- Bedrock outcrop
- Quarry
- Drillhole site
- Geological boundary, approximate
- Geological boundary, interpreted



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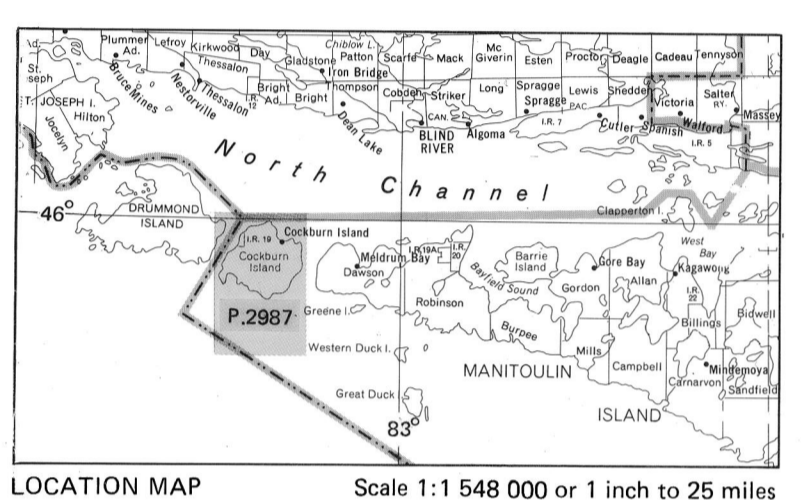
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**PALEOZOIC GEOLOGY  
COCKBURN ISLAND  
DISTRICT OF MANITOULIN**



NTS Reference: 41 G/14W  
ODM-GSC Aeromagnetic Map, 2225G  
OGS Geological Compilation Map, 2441

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**LEGEND**

- PALEOZOIC  
MIDDLE SILURIAN
- 17\* Amabel Formation (Facies IV): Dolostone, granular, soft, white, massive
  - 16 Amabel Formation (Facies III): Dolostone, medium to coarsely crystalline, blue-grey, massive to thickly bedded
  - 16c\* Facies III, abundant crinoidal debris
  - 16p\* Facies III, abundant pentamerid brachiopods
  - 15\* Amabel Formation (Facies II): Dolostone, fine to medium crystalline, blue-grey to buff, massive; minor, thinly bedded, lenticular bodies forming hummocky topography
  - 15c\* Facies II, abundant crinoidal debris
  - 14\* Amabel Formation (Facies I): Dolostone, finely crystalline, brown, thinly bedded
  - 14b\* Facies I, richly fossiliferous
  - 14c-h\* Facies I, abundant nodular chert
  - 13 Fossil Hill Formation: Dolostone, fine to coarsely crystalline, buff-brown, thinly bedded, chert-rich, fossiliferous
  - 12 St. Edmund Formation: Dolostone, lithographic, pale grey and medium crystalline, buff-brown; thin to medium bedding; lithographic, grey limestone near base
  - 11 Wingfield Formation: Interbedded dolostone and green shale
  - 10 Dyer Bay Formation: Dolostone, fine to medium crystalline, buff to grey-brown, thinly bedded, fossiliferous

\*Not present in this map area.  
Note: Older units underlying the Dyer Bay Formation are listed in the accompanying log of drillhole OGS 85-7 (Table 1). These units have only been recognized in the subsurface and do not outcrop or subcrop beneath surficial deposits on Cockburn Island.

**SOURCES OF INFORMATION**

Topography from Map 41 G/14 of the National Topographic System.  
Metric conversion factor: 1 foot = 0.3048 m

**CREDITS**

Geology by R.R. Wolf, 1985. Additional geological information from drillhole OGS 85-7 Cockburn Island.

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