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**HARBOUR DEVELOPMENT STUDY FOR  
THE TOWN OF FLATROCK**

**SMALL CRAFT HARBOURS BRANCH  
DEPARTMENT OF FISHERIES AND OCEANS  
NEWFOUNDLAND REGION**

**By: Jane M. Kieley**

**Date: August, 1985**

**Faculty: Engineering**

**University: Memorial University  
of Newfoundland**

**Last Academic Term: Two**

HE  
554  
F6  
K5

August 9, 1985

Division of Coordination  
Faculty of Engineering  
Memorial University of Newfoundland  
St. John's, Newfoundland

Dear Sir:

I am pleased to submit the following report entitled Harbour Development Study for the Town of Flatrock in fulfillment of the requirements of the first Engineering work term in Memorial University's Co-operative Education Program. The purpose of this report is to assess and analyze the present conditions of the marine facilities and fishery in Flatrock and submit proposals for future harbour improvements.

I am presently in my first work term, having successfully completed my second academic semester. Currently I am employed with the Small Craft Harbours Branch of the Federal Department of Fisheries and Oceans, Newfoundland Region, under the supervision of Mr. Dave Arscott, Regional Property Manager.

My responsibilities during this work period have included the drafting of facility plans, site plans and property plans, as well as producing drawings from aerial photographs and updating legal plans. I have also had the opportunity to visit a few locations around the province and complete inspections of marine facilities.

I would like to thank the personnel of Small Craft Harbours for their assistance throughout the work term and especially with regard to the completion of this report.

Yours very truly,

Jane M. Kieley

218247

DEPARTMENT OF FISHERIES AND OCEANS  
SMALL CRAFT HARBOURS BRANCH  
ST. JOHN'S, NEWFOUNDLAND

HARBOUR DEVELOPMENT STUDY FOR THE TOWN OF FLATROCK

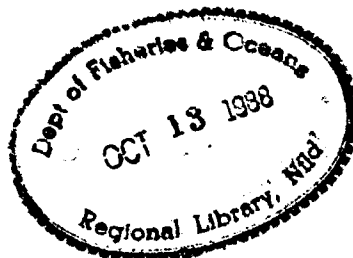
PREPARED FOR:

The Division of Coordination  
Faculty of Engineering and Applied Science  
Memorial University of Newfoundland  
St. John's, Newfoundland

and

Small Craft Harbours Branch  
Department of Fisheries and Oceans  
Building 302, Pleasantville  
St. John's, Newfoundland

By: Jane M. Kieley  
Work Term 1  
August, 1985



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## **1.0 SUMMARY**

## 1.1 Summary

This report was undertaken to recommend a harbour development plan for the community of Flatrock. Through an examination of the present conditions in Flatrock it was found that the existing marine facilities are inadequate to properly serve the needs of the fishermen. A protected landing wharf is needed both to facilitate the landing of fish in rough winds and waves, and to enable more than one vessel to unload its catch at a time.

After an examination of various proposals it was concluded that a new 105m Berm design breakwater be constructed at Wade's Point, as well as a 45m long by 8m wide solid crib wharf inside the new artificial inner harbour, as recommended in Proposal #1. The cost of this proposal, based on a Class D estimate, is approximately 2.2 million dollars. This design was chosen based on an evaluation of all the proposals with respect to a set of design criteria.

It is recommended that this harbour development plan be considered for implementation as soon as possible. However, further investigations of the bathymetry, wave climate and the availability of land and materials must be carried out before the formulation of a final design.

## **2.0 INTRODUCTION**

## **2.1 INTRODUCTION**

This harbour development study was undertaken for Small Craft Harbours Branch - Newfoundland Region, Department of Fisheries and Oceans, as well as in fulfillment of the requirements of the first work term in the Co-operative Engineering Program at Memorial University of Newfoundland.

The methodology used in the completion of this report is as follows :

1. Analysis of the present conditions in Flatrock including current fishing activity, existing facilities, problems definition and advantages of development.

2. Oceanographic analysis of Flatrock and vicinity based on a wave climate study completed in 1984 by W. F. Baird and Associates (WFBA).

3. Investigation of standard wharf and breakwater designs.

4. Development of alternatives

5. Evaluation of solutions with regard to a set of design criteria using a decision matrix.

6. Conclusions and recommendations.

The various proposals put forward in this report are limited in scope and are primarily conceptual designs. Further engineering investigations are required to produce more detailed proposals and cost estimates.

### **3.0 PRESENT CONDITIONS IN FLATROCK**

## INTRODUCTION

Flatrock is located on the Avalon Peninsula, about 4-5 km north of Torbay, and 15km from St. John's (see Figures 3-1 and 3-2). The town is governed by a community council and its population in 1976 was 780. Flatrock is located near some excellent fishing grounds and has always been very dependent on the inshore fishery.

### 3.1 CURRENT FISHING ACTIVITY

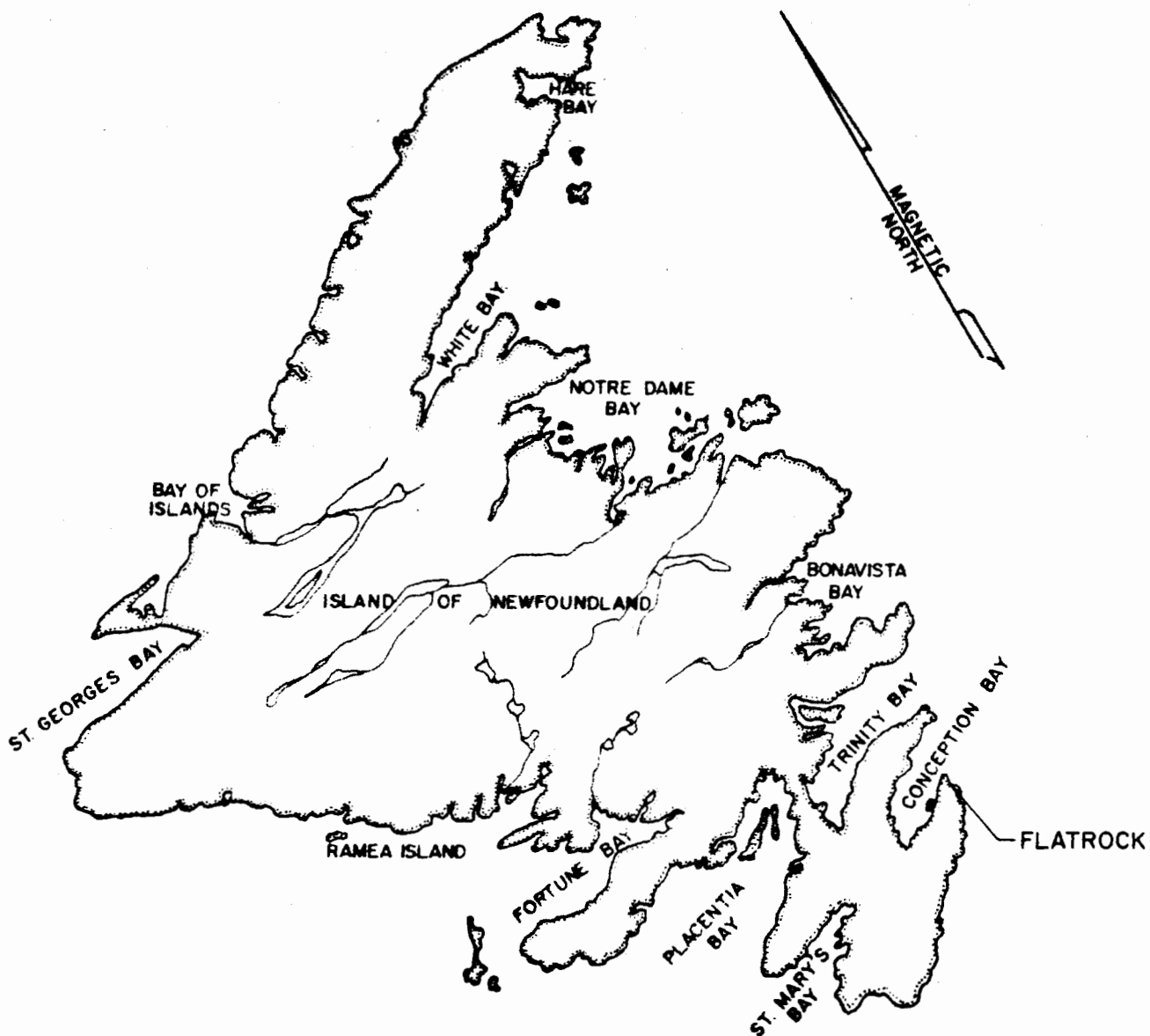
According to 1984 vessel registration statistics, there are currently 18 trap skiffs registered in Flatrock. Of these, six boats lie in the 0.0m - 6.1m class and twelve in the 6.2m -10.7m class. The fishing season extends from about May to October with the greatest activity occurring in June and July. The fishermen in Flatrock are mainly cod trap fishermen but they also use gillnets and hook and line after the regular cod trap fishery has ended. In addition to cod, small amounts of other species have been caught in recent years including herring, salmon, capelin and squid. Table 1 summarizes the total fish landings for Flatrock giving the landings and catch value for each species for the period 1979-1983.

The Flatrock fishermen presently land the vast majority of their fish at a small landing wharf at Martin's Point. The fish is principally sold to Cape Pine Fisheries and Bay

Bulls Fisheries, although some quantity of the landings has been sold over-the-side to foreign vessels in recent years. During the fishing season the trap skiffs are moored on buoys in Flatrock Cove as there is no docking space presently available in the area.

**Table 1**  
**Total Fish Landings for Flatrock**  
**1979-1983 (Round Weight)**

Year	Species	Total Landings(kgs)	Catch value(\$)
1979	Cod	629,042	171,126
	Herring	454	100
	Salmon	736	3,780
	Squid	257,750	56,063
1980	Cod	409,030	128,295
	Salmon	4,490	22,250
	Squid	1,361	150
1981	Cod	290,721	100,276
	Salmon	2,577	11,863
	Capelin	17	10
1982	Cod	875,490	267,927
	Salmon	604	2,995
1983	Cod	883,537	270,458
	Salmon	444	2,834



**FISHERIES & OCEANS**

SMALL CRAFT HARBOURS BRANCH

NEWFOUNDLAND REGION

Drawing Title:

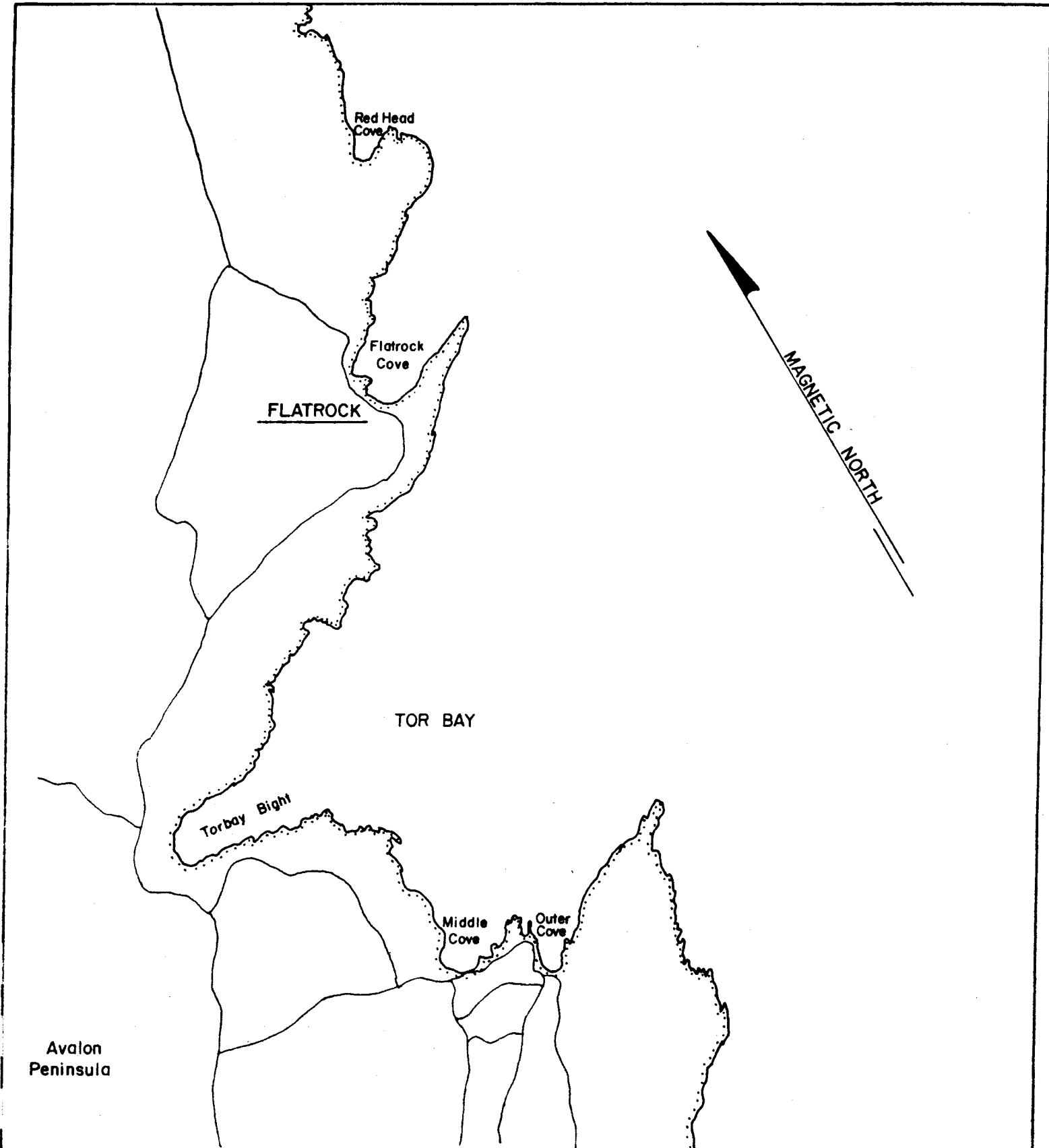
LOCATION MAP  
FLATROCK

Drawn by: J. KIELEY

Date: 07/85

Scale: 1cm = 38.12 km

Plan No.: FIG. 3-1



 **FISHERIES & OCEANS**  
 SMALL CRAFT HARBOURS BRANCH  
 NEWFOUNDLAND REGION

Drawing Title:

LOCATION MAP  
 FLATROCK

Drawn by: J. KIELEY

Date: 07/85

Scale: 1:50,000

Plan No.: FIG. 3-2

### **3.2 EXISTING FACILITIES**

The existing facilities in Flatrock include two slipways, a landing wharf and landing facility, as well as a number of electric and hand winches. The locations of these facilities are shown in Figure 3-3. Plans of the facilities are shown in Figures 3-4, 3-5 and 3-6.

#### **Martin's Point Landing Wharf**

This wharf consists of a concrete headblock and spray-wall with a concrete approach built over the existing rock shoreline. The wharf has one 700 kg electric hoist and one operational berth measuring approximately 15m.

The wharf was built prior to 1949 but since then it has been reconstructed and repaired on numerous occasions. It is now administered by Small Craft Harbours. Both the wharf and hoist are presently in fair to good condition.

#### **Flatrock's Slipway (Martin's Point)**

This slipway is a "T" shape, constructed of untreated square timber supported on concrete posts with creosote timber beams and caps and a solid concrete toe crib. The slipway is provided with one 10 H.P. Acadia engine and winch.

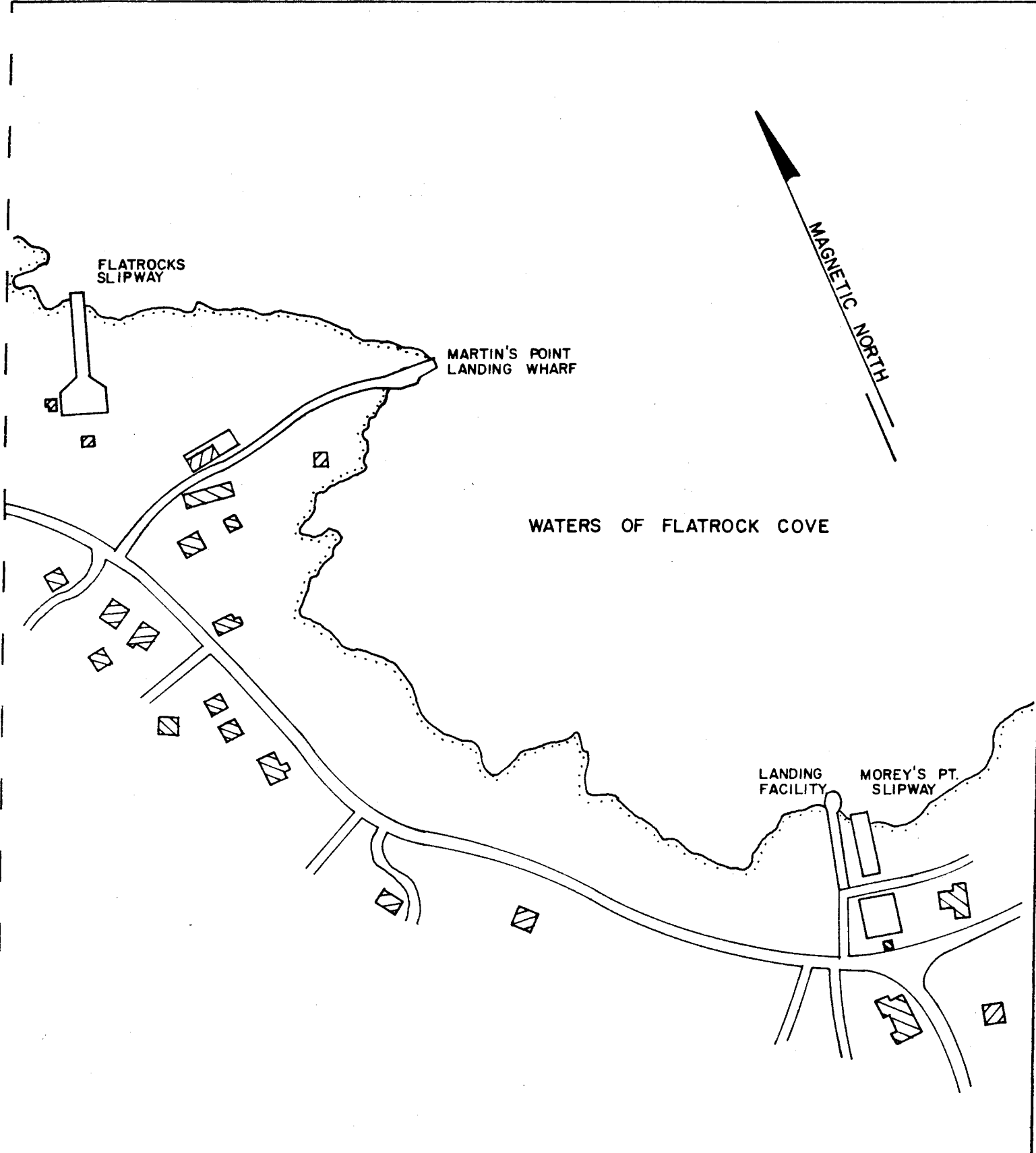
This slipway was constructed in 1978 and extended in 1981-82 by Small Craft Harbours. It is presently in good condition.

### Morey's Point (Beach) Slipway

This slipway is built of wooden runners on concrete beams and is provided with one engine and winch. There is a boat storage area and winch house located near the slipway. This slipway was reconstructed in 1982 but still requires some repairs to the concrete toe section. Otherwise it is in fair condition.

### Morey's Point Landing Facility

In 1983 a landing facility was constructed under the Canadian Community Development Program (CCDP) in Morey's Cove near the slipway. It consists of a concrete slab placed over the existing rock shoreline and is in fair condition. Although there is no fish unloading system provided at this facility, it is presently used as an alternate landing wharf when the fishermen cannot land at Martin's Point.



**FISHERIES & OCEANS**  
 SMALL CRAFT HARBOURS BRANCH  
 NEWFOUNDLAND REGION

Drawing Title:

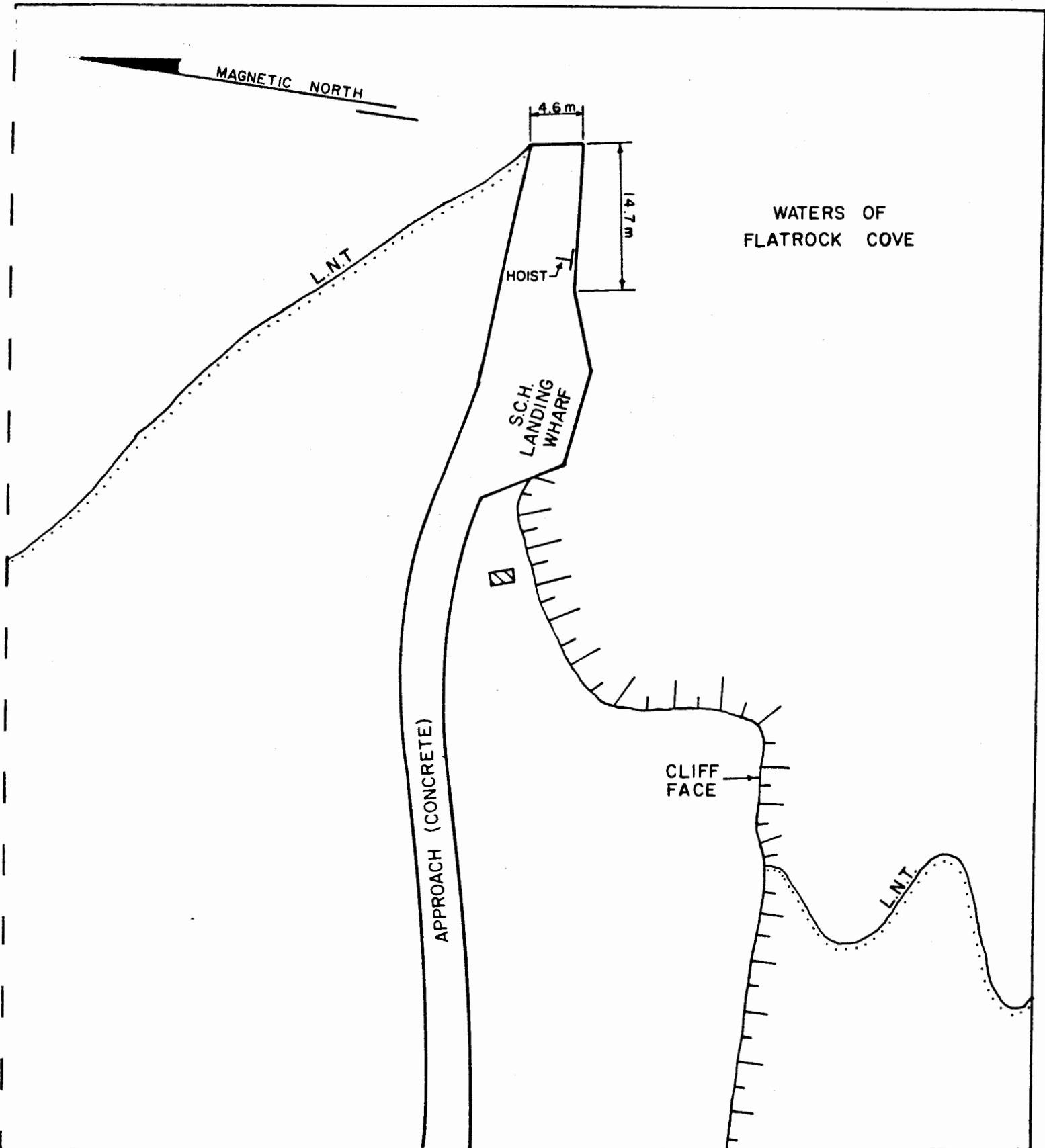
LOCATION PLAN  
 EXISTING FACILITIES  
 FLATROCK

Drawn by: J. KIELEY

Date: 07/85

Scale: 1:2500

Plan No.: FIG. 3-3

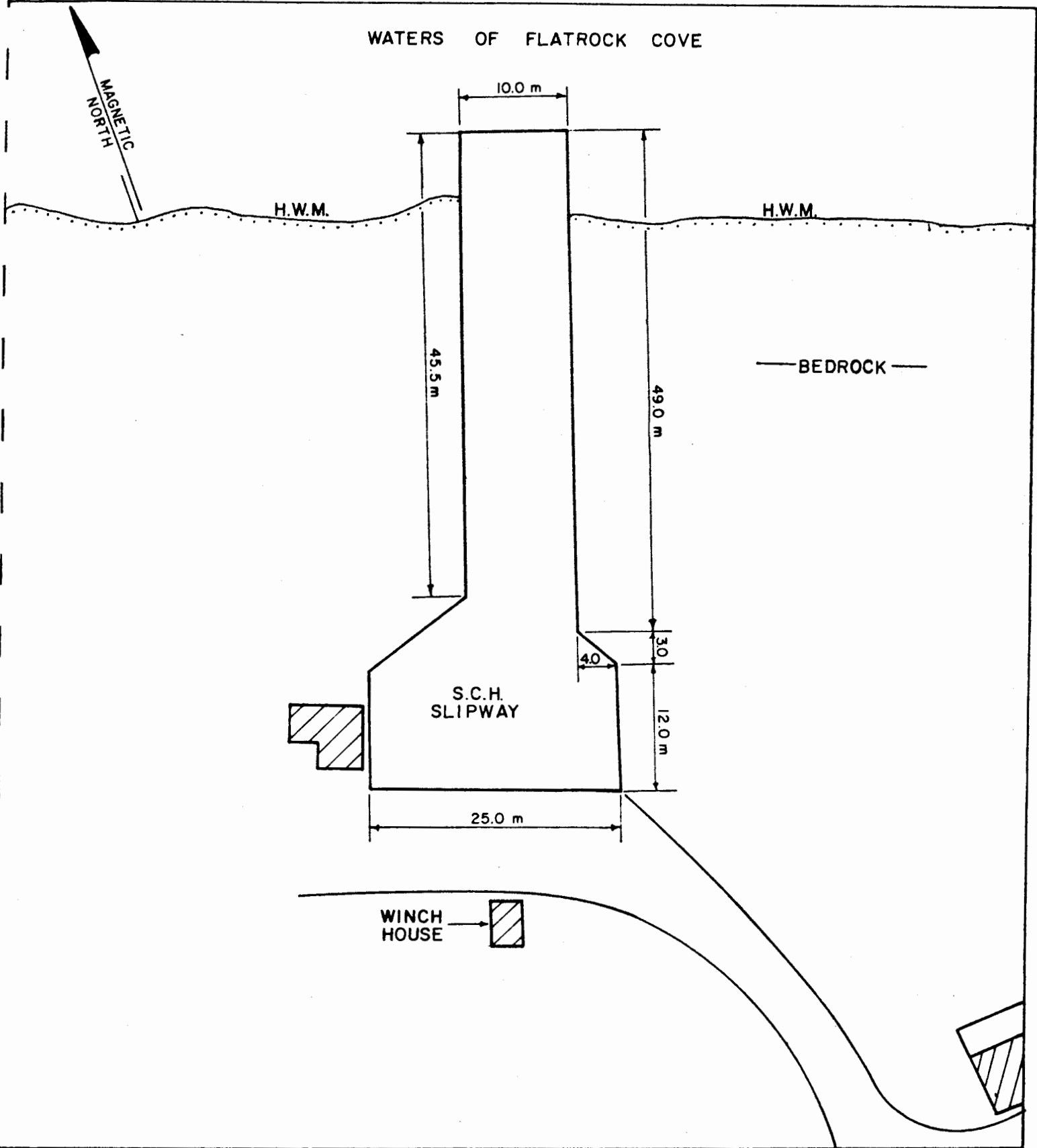


**FISHERIES & OCEANS**  
 SMALL CRAFT HARBOURS BRANCH  
 NEWFOUNDLAND REGION

Drawing Title:  
 MARTIN'S POINT  
 LANDING WHARF  
 FLATROCK,  
 NEWFOUNDLAND

Drawn by: J. KIELEY  
 Date: 07 / 85  
 Scale: 1:500  
 Plan No.: FIG. 3-4

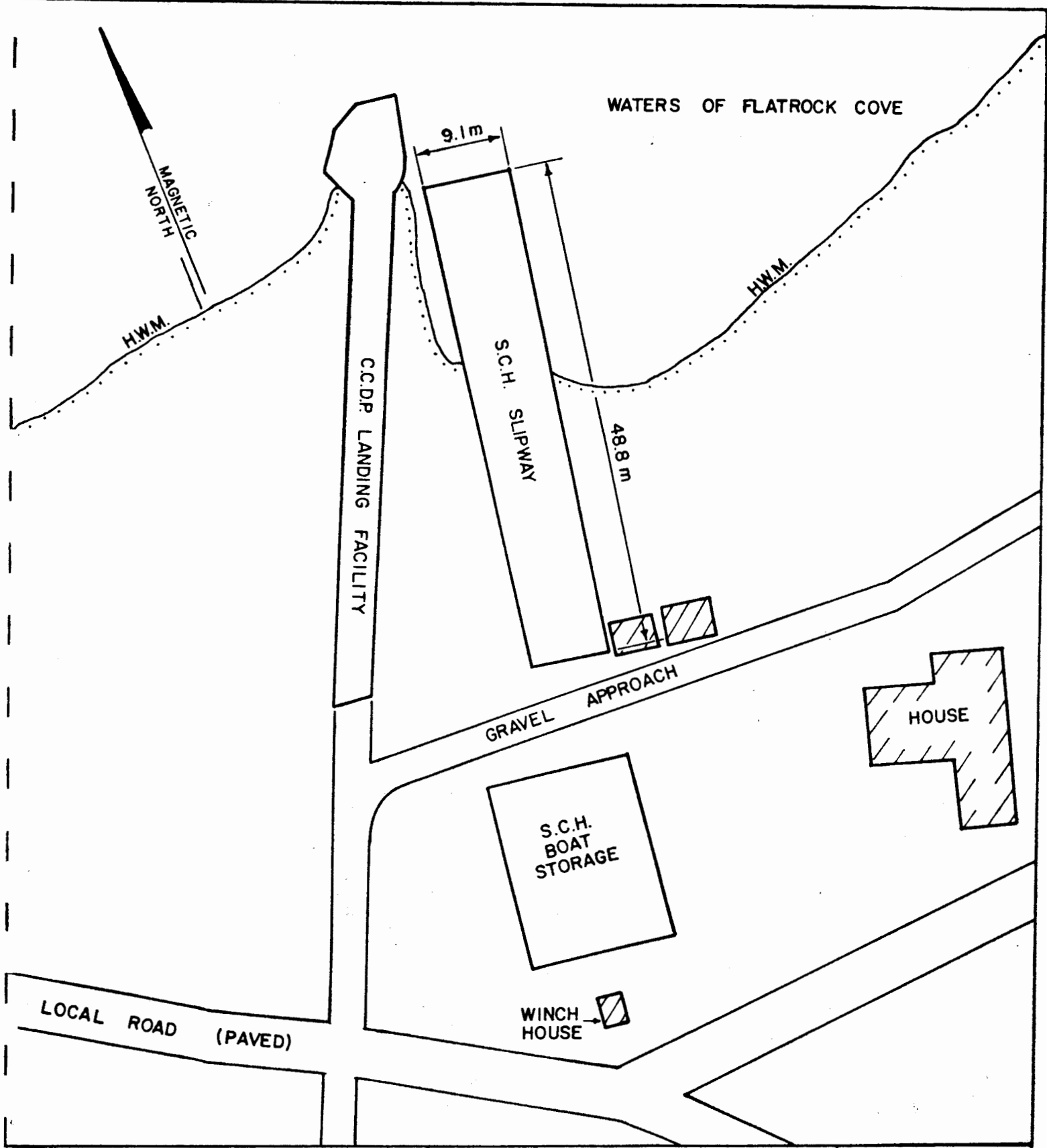
WATERS OF FLATROCK COVE



 **FISHERIES & OCEANS**  
SMALL CRAFT HARBOURS BRANCH  
NEWFOUNDLAND REGION

Drawing Title:  
**FLATROCK'S SLIPWAY  
MARTIN'S POINT**  
**FLATROCK,  
NEWFOUNDLAND**

Drawn by:	J. KIELEY
Date:	07/85
Scale:	1:500
Plan No.:	FIG. 3-5



**FISHERIES & OCEANS**  
 SMALL CRAFT HARBOURS BRANCH  
 NEWFOUNDLAND REGION

Drawing Title:  
**MOREY'S POINT  
 SLIPWAY & LANDING FACILITY  
 FLATROCK,  
 NEWFOUNDLAND**

Drawn by: J. KIELEY  
 Date: 07/85  
 Scale: 1:500  
 Plan No.: FIG. 3-6

### **3.3 PROBLEM DEFINITION**

The fishermen of Flatrock presently land the great majority of their fish at a small landing wharf at Martin's Point. This wharf, however, is very exposed and often no landings can be made in north or northeast winds. In addition, overtopping, run-up and excessive spray often make it dangerous to work on the slipway and landing wharf at Martin's Point in these conditions. Also, due to the single available operational berth only one boat can land at a time, causing delays for the fishermen in unloading their catch. It is reported that during northeast storms the most severe wave conditions in Flatrock occur in the vicinity of Martin's Point while the calmest portion of the harbour is reported to be at Wade's Point. The fishermen often moor their boats in this area during the fishing season.

Although good landing facilities exist in Torbay, they often cannot be reached because the prevailing south and southeast winds make it difficult for small boats to travel down the coast. Also, it appears that at the present time there are only adequate facilities in Torbay to accommodate the local fishermen.

Facilities are therefore required in Flatrock Cove to provide a protected area for landing fish during the fishing season, as well as protected seasonal docking or mooring for the local fishermen.

### **3.4 ADVANTAGES OF HARBOUR DEVELOPMENT**

The development of new harbour facilities in Flatrock would have benefits for both Small Craft Harbours and the fishermen of Flatrock.

The construction of a protected landing facility would enable the fishermen to unload their catch immediately, in safe conditions, and not have it exposed to the sun and elements for prolonged periods of time. This would probably increase both the quality and quantity of fish landed, as well as improve the potential for accommodating a greater number of fishermen in the harbour. This type of development would also result in improved safety, greater user convenience and less maintenance of vessels.

The implementation of a new harbour development plan in Flatrock would also have long term financial benefits for Small Craft Harbours. In the past seven years Small Craft Harbours has spent a great deal of money on the upkeep of facilities in Flatrock and over \$100,000 on the Martin's Point landing wharf alone. This wharf requires almost annual maintenance because of its exposure to sea and storms. It is envisioned that Small Craft Harbours would continue to maintain the slipways after the proposed harbour development is completed, but the wharf at Martin's Point could be considered redundant for fish landing purposes and become obsolete. Less capital will therefore be required in future years to maintain the facilities in Flatrock.

## **4.0 OCEANOGRAPHIC ANALYSIS**

## INTRODUCTION

The choice of an optimum design for new harbour facilities requires some knowledge of the prevailing wind and wave climate, as well as bathymetric data for the area of concern. This information is necessary to determine the best dimensions and orientations for the required structures.

The wind and wave climate data for Flatrock was obtained from a report commissioned by Small Craft Harbours from W. F. Baird and Associates (WFBA) in 1984 entitled Wave Climate Study and Preliminary Breakwater Design for 22 Harbours in Newfoundland and Labrador. This study summarizes the offshore wave climate for each harbour studied and develops preliminary layouts and structures to resolve the problems in the existing harbours. The expected wave conditions within the harbours after the construction of the recommended structures are also determined.

### 4.1 DATA SOURCES AND METHODOLOGY

The WFBA wave climate study uses recorded and hindcast wind and wave data available from a number of sources. Archived wind data was obtained from the Atmospheric Environment Service (AES) for various locations within Newfoundland and Labrador and used to undertake local wave hindcasts where required. As well, the overwater wind field for the

wave hindcasts was estimated using a combination of archived synoptic surface pressure data and ship observations of wind speed and velocity.

Hindcast wave data for the North Atlantic offshore of Newfoundland was available from the Wave Information Study (WIS) undertaken by the U. S. Army Corps of Engineers in 1976. The two data points closest to Newfoundland (G5 and G9) are shown in Figure 4-1. The wave climate at Flatrock was estimated using the results for station G5 of the WIS study which consists of 20 years of six hourly values of significant wave height, peak period and wave direction for the period 1956-1975.

In addition, non-directional wave data from coastal locations around Newfoundland was obtained from the Marine Environment Data Service (MEDS) and used by WFBA in a limited comparison of this recorded wave data with the WIS hindcast results. Further details of this comparison are given in Appendix A.

Once an estimate of the deepwater wave climate was produced, the data was then modified for the effects of shallow water. These effects include shoaling, refraction, wave-breaking and the sheltering effects of islands and headlands. A simplified refraction and shoaling analysis was undertaken for each harbour considered in the study, as well as an estimate of the effects of wave diffraction around the recommended structures. This procedure was used to estimate the wave climate at the entrance to each harbour

as well as inside the harbour at the designated facilities. This information was then utilized in determining projected improvements to the wave climate. The criterion used to evaluate the improvements was the number of hours that the significant wave height equalled or exceeded 0.5m.

All designs and calculations for Flatrock were based on a maximum significant wave height of approximately 0.78 times the depth of water at the locations of interest. The depth considered was high water plus an allowance for storm surge.

#### **4.2 SUMMARY OF WAVE CLIMATE AT FLATROCK**

In attempting to evaluate the wave climate for a certain location one is mainly concerned with the percent occurrence of extreme conditions. In the WFBA wave climate study remedial works proposed at each harbour were based on the criteria that a 0.5 m significant wave height should not be exceeded for more than 100 hours during the fishing season. This value was determined from the Guidelines of Harbour Accommodation provided by Small Craft Harbours. At present this wave height is exceeded in Flatrock for approximately 230 hours each fishing season.

A summary of the wave climate at Flatrock for the years 1956-1975 is provided in Figure 4-2. A summary of the incident wave climate during the fishing season for the same period is shown in Figure 4-3. These scatter diagrams

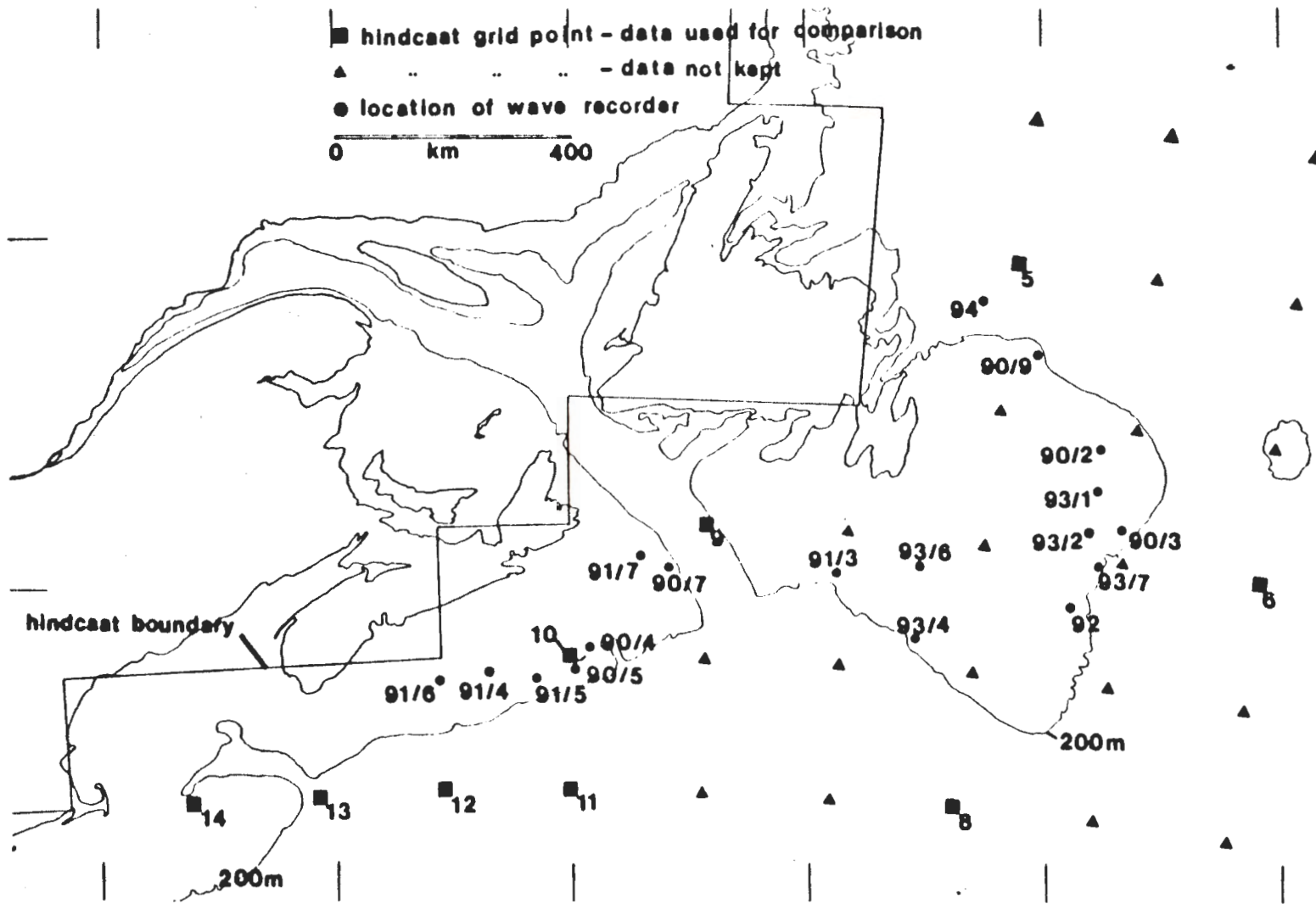
summarize the joint occurrence of significant wave height and peak period for all directions. A summary of the incident wave climate in Flatrock, by direction, for both the full year and the fishing season alone for the period 1956-1975 is provided in Appendix B.

A graphical presentation of the incident wave climate for Flatrock is shown on each proposal plan. This pie chart graph gives an indication of the primary sectors and the percentage of time that waves are from that sector. The shaded sections indicate a concentration of wave direction in the sector. The lines drawn through each shaded section correspond to the median direction based on peak period for all waves within the section.

A summary of the wave climate for the design and layout of structures in Flatrock is given in Table 2.

#### **4.3 BATHYMETRIC DATA**

Bathymetric data for Flatrock was obtained from the WFBA study and Public Works Canada drawing No.F-2-21 (June 11, 1969) . This information is shown on the drawing in Figure 4-4. While this data is somewhat old, the soundings will be fairly accurate because of the rocky harbour floor in Flatrock. A new and more detailed survey of the Wade's Point area of Flatrock is presently being completed by the Department of Public Works.



LOCATION OF WIS HINDCAST AND MEDS RECORDED WAVE DATA

FIGURE 4-1

SCATTERB

-- G5C

Wave data for station FLATROCK

Wave direction ALL

Wind data recorded at WIS STATION G5

Selected from 08JAN56 to 31DEC75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)															see footnote for explanation of row & col percent			
	0 00 to 1 00	1 00 to 2 00	2 00 to 3 00	3 00 to 4 00	4 00 to 5 00	5 00 to 6 00	6 00 to 7 00	7 00 to 8 00	8 00 to 9 00	9 00 to 10 00	10 00 to 11 00	11 00 to 12 00	12 00 to 13 00	13 00 to 14 00	14 00 to 15 00	15 00 & over	total	A(%)	B(%)
0 00 - 0 50		59	756	445	89		7262	3750	1467	1156	15	15				15014	15 01	15 01	100 00
0 50 - 1 00			89	1008	949	815	5973	6403	3439	4995	622	296	44	44		24678	24 68	24 68	84 99
1 00 - 1 50			15	44	1364	652	3824	3602	1808	4995	1260	563	163	30	15	18334	18 33	18 33	60 31
1 50 - 2 00					119	963	1556	1779	1378	2905	1112	593	296	252		1510958	10 97	10 97	41 97
2 00 - 2 50					15	178	2801	889	652	1690	771	534	133	104	148	15 7929	7 93	7 93	31 01
2 50 - 3 00							1867	1497	371	578	815	548	59	44	74	15 5869	5 87	5 87	23 08
3 00 - 3 50							1082	1467	534	474	400	409	133	44	59	4684	4 68	4 68	17 21
3 50 - 4 00							534	1230	637	222	252	341	89	89	30	3424	3 42	3 42	12 52
4 00 - 4 50							311	667	1067	311	222	89	163	89	59	2979	2 98	2 98	9 10
4 50 - 5 00							237	519	593	410	74	44	44	104	44	2090	2 09	2 09	6 12
5 00 - 5 50							133	119	222	415	30	15	104	59		1097	1 10	1 10	4 03
5 50 - 6 00							15	133	119	356	163	15	15	15	15	15 860	0 86	0 86	2 93
6 00 - 6 50								59	207	415	711	371	104	15	104	89 2075	2 07	2 07	2 07
6 50 - 7 00																0	0 00	0 00	0 00
7 00 - 7 50																0	0 00	0 00	0 00
7 50 - 8 00																0	0 00	0 00	0 00
8 00 - 8 50																0	0 00	0 00	0 00
8 50 - 9 00																0	0 00	0 00	0 00
9 00 - 9 50																0	0 00	0 00	0 00
9 50 - 10 00																0	0 00	0 00	0 00
10 00 - 10 50																0	0 00	0 00	0 00
10 50 - 11 00																0	0 00	0 00	0 00
11 00 - 11 50																0	0 00	0 00	0 00
11 50 - 12 00																0	0 00	0 00	0 00
12 00 & over																0	0 00	0 00	0 00
col total	0	59	860	1497	2534	2609	25597	22114	18494	4437	3913	1245	934	608	148	100000			
A(%)	0 0	0 1	0 9	1 5	2 5	2 6	25 6	22 1	12 5	18 9	6 4	3 9	1 2	0 9	0 6	0 1			
B(%)	0 0	0 1	0 9	1 5	2 5	2 6	25 6	22 1	12 5	18 9	6 4	3 9	1 2	0 9	0 6	0 1			
C(%)	100 0	100 0	99 9	99 1	97 6	95 0	92 4	86 8	44 7	32 2	13 3	6 8	2 9	1 7	0 8	0 1			

Number of hourly records this direction 2747  
 Total records used in selected interval 2747  
 Per cent in this direction 100 00

Row and column percentages have the following meanings

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE Total hourly records includes calms

SUMMARY OF FULL YEAR WAVE CLIMATE  
 (1956-1975)

FIG. 4-2

SCATTER DIAGRAM FOR HINDCAST SIGNIFICANT WAVE HEIGHTS AND PEAK PERIODS

SCATTER#

05C

Wave data for station FLATROCK

Wave direction ALL

Wind data recorded at WIS STATION 05

Selected from 08JUL56 to 31AUG75

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD ( SECONDS )																see footnote for explanation of row & col percent						
	0 00 to 1 00	1 00 to 2 00	2 00 to 3 00	3 00 to 4 00	4 00 to 5 00	5 00 to 6 00	6 00 to 7 00	7 00 to 8 00	8 00 to 9 00	9 00 to 10 00	10 00 to 11 00	11 00 to 12 00	12 00 to 13 00	13 00 to 14 00	14 00 to 15 00	15 00 & over	row total	A(%)	B(%)	C(%)			
0 00 - 0 50		76	1970	909	152	25000	10152	4374	1667								44318	44	32	44	32100	00	
0 50 - 1 00			379	2197	1437	606	11061	9470	4773	4091	227						34242	34	24	34	24	55	68
1 00 - 1 50					1667	682	3712	2879	1513	2197	227	152					13030	13	03	13	03	21	44
1 50 - 2 00					152	530	682	530	1136	682	152	76					3939	3	94	3	94	8	41
2 00 - 2 50					76	76	1439	76	379	682	76	76					2879	2	88	2	88	4	47
2 50 - 3 00							76	303	152	227	76						833	0	83	0	83	1	59
3 00 - 3 50							76	227	152		76						530	0	53	0	53	0	76
3 50 - 4 00							76				76						152	0	15	0	15	0	23
4 00 - 4 50										76							76	0	08	0	08	0	08
4 50 - 5 00																	0	0	00	0	00	0	00
5 00 - 5 50																	0	0	00	0	00	0	00
5 50 - 6 00																	0	0	00	0	00	0	00
6 00 - 6 50																	0	0	00	0	00	0	00
6 50 - 7 00																	0	0	00	0	00	0	00
7 00 - 7 50																	0	0	00	0	00	0	00
7 50 - 8 00																	0	0	00	0	00	0	00
8 00 - 8 50																	0	0	00	0	00	0	00
8 50 - 9 00																	0	0	00	0	00	0	00
9 00 - 9 50																	0	0	00	0	00	0	00
9 50 - 10 00																	0	0	00	0	00	0	00
10 00 - 10 50																	0	0	00	0	00	0	00
10 50 - 11 00																	0	0	00	0	00	0	00
11 00 - 11 50																	0	0	00	0	00	0	00
11 50 - 12 00																	0	0	00	0	00	0	00
12 00 & over																	0	0	00	0	00	0	00
col total	0	76	2348	3106	3485	1894	42121	23636	12576	9621	833	307	0	0	0	0	100000						
A(%)	0 0	0 1	2 3	3 1	3 5	1 9	42 1	23 6	12 6	9 6	0 8	0 3	0 0	0 0	0 0	0 0							
B(%)	0 0	0 1	2 3	3 1	3 5	1 9	42 1	23 6	12 6	9 6	0 8	0 3	0 0	0 0	0 0	0 0							
C(%)	100 0	100 0	99 9	97 6	94 5	91 0	89 1	47 0	23 3	10 8	1 1	0 3	0 0	0 0	0 0	0 0							

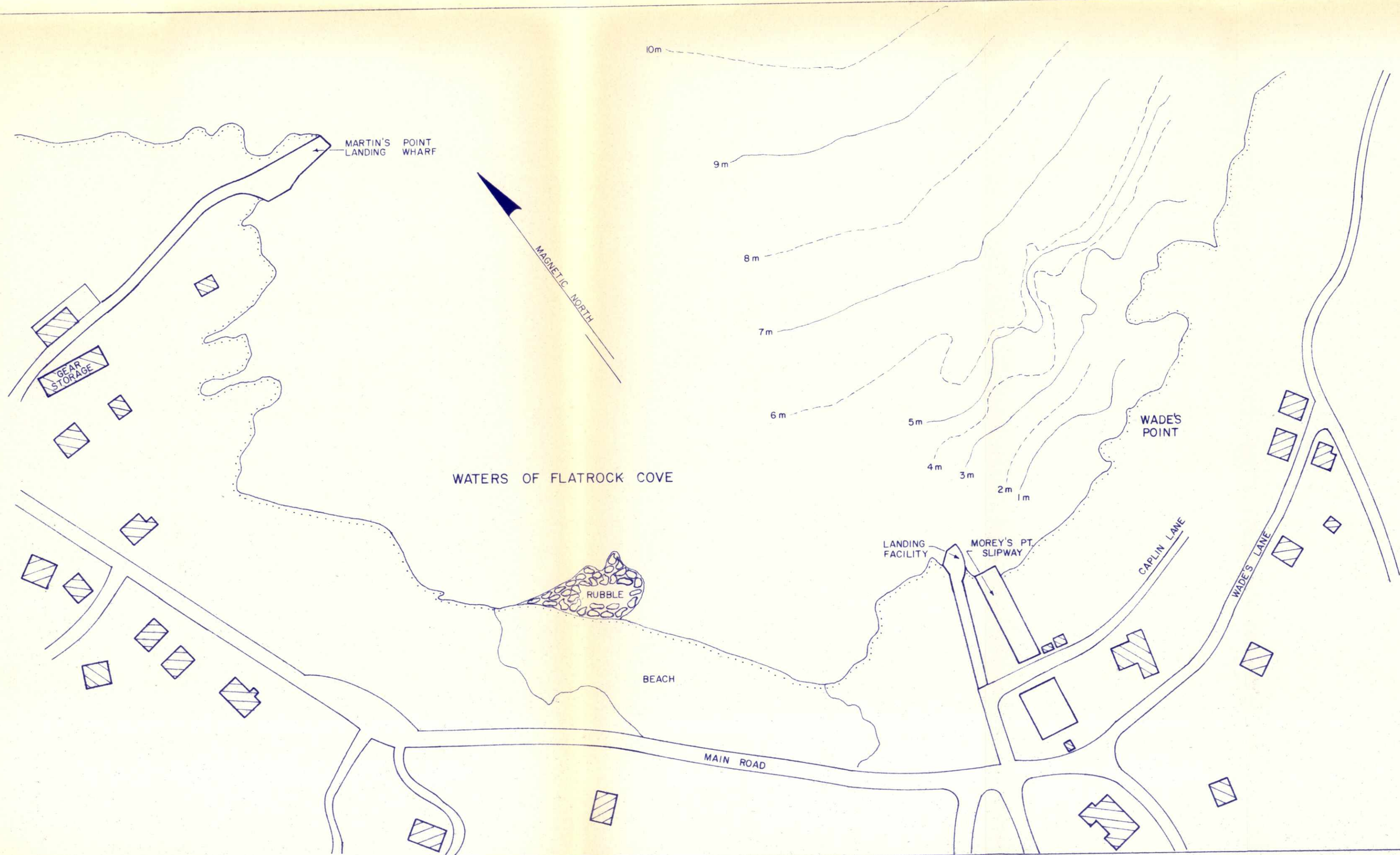
Number of hourly records this direction 1320  
 Total records used in selected interval 1320  
 Per cent in this direction 100 00

Row and column percentages have the following meanings

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE Total hourly records includes calms

SUMMARY OF WAVE CLIMATE DURING FISHING SEASON  
 (1956-1975)



Notes

1. BATHYMETRIC DATA FROM PUBLIC WORKS CANADA DRAWING No. F-2-21 (JUNE, 1969)

Project Title

FLATROCK

Drawing Title

SITE PLAN & BATHYMETRY

Drawn by J. KIELEY

Date JULY, 1985

Scale 1:1250

Drawing No  
FIGURE 4-4

**Table 2**  
**Summary of the Wave Climate in Flatrock for the**  
**Design and Layout of Structures**

Return Period	Depth Limited Wave Height	H <sub>S</sub> (m)	T <sub>p</sub> (sec)	Wave Direction in 8m of Water(deg)	Percent Exceeded (Fishing Season) <sup>5</sup>
50 yr	5-6.5m	*	6-17	334-32	-
20 yr	5-6.5m	*	6-17	334-32	-
Annual/Year <sup>1</sup>	5-6.5m	*	6-17	334-32	-
Annual/Season <sup>2</sup>	-	3.0	6-11	337-35	.03
100 hr/Season <sup>3</sup> (all directions)	-	1.7 0.9	4-12 2-11	N(337-23) NE(23-42)	0.6 3.9
100 hr/Season <sup>4</sup> (per direction)	-	0.8	2-11	NE(23-42)	4.5

Notes : H<sub>S</sub> = Maximum Significant Wave Height  
T<sub>p</sub> = Range of Peak Period Expected  
\* = Depth Limited Wave Height

1. H<sub>S</sub> equalled or exceeded for 6 hr.
2. H<sub>S</sub> equalled or exceeded for 1 hr during fishing season.
3. H<sub>S</sub> which would be exceeded for less than proportion of 100 hrs in this direction.
4. H<sub>S</sub> which would be exceeded for less than 100 hrs from this direction only. (Directions not listed do not exceed 0.5m for more than 100 hrs).
5. Includes all calms.

Source : Wave Climate Study  
W. F. Baird and Associates  
1984

## **5.0 WHARF AND BREAKWATER DESIGN**

This section contains general information about the types of wharves and breakwaters currently being considered for design purposes by Small Craft Harbours.

## 5.1 WHARVES

Public wharves perform the dual functions of providing docking space for offloading fish catches, as well as vessel berthage. There are a number of different types of docking facilities available to the fishing fleet:

1. Native timber crib or crib and span wharves.
2. Creosote dimension timber crib or crib and span wharves.
3. Native timber post wharves.
4. Creosote timber pile wharves.
5. Concrete filled steel pile wharves.
6. Floating wharves.

Pile wharves tend to be the least expensive wharf structure followed by crib and span wharves and then all timber crib wharves. The selection of the most appropriate structure at a given location depends on several factors including subsurface conditions, water depth, ice climate, wave exposure and the degree of vessel protection to be provided. The choice of native or creosote timber or steel piles also depends on local conditions and the funds available.

Two types of wharves are considered in this report for construction in Flatrock. A concrete filled steel pile wharf, although difficult to construct, would be feasible if the right equipment were available. Creosote timber crib or crib and span wharves are also practical. Although the cost of crib and span is about 10-15% less than solid crib, the latter provides far greater structural stability and is considered in this report for all timber crib designs.

## 5.2 BREAKWATERS

The function of a breakwater is to protect marine facilities and fishing vessels from possible wave damage in locations where a severe wave climate is experienced frequently. There are a number of different breakwater designs currently in use:

1. Armour stone rubblemound.
2. Timber crib encased in concrete.
3. Timber crib reinforced with armour stone along the exposed face.
4. Mass concrete.
5. Timber piling with closed faced sheathing.

Generally, armour stone breakwaters are the least expensive to construct, followed by timber crib structures and timber crib structures encased in concrete. Mass concrete structures are considered the most durable but are also the most costly to build. Piled structures are limited to ice-

free sites with moderate wave action. The most appropriate structure for a given location is based on several factors including water depths, subsurface conditions, physical size and the severity of the wave climate in the area.

In this report, two armour stone rubblemound breakwater designs are considered for Flatrock, the conventional rubblemound and the new Berm concept design developed by W. F. Baird and Associates (WFBA).

### 1. Conventional Rubblemound

This type of breakwater, as shown in Figure 5-1 usually consists of a rock filled core of quarry stone covered by a filter layer and protected by one or two layers of armour stone. The armour stone may vary in size depending on the harshness of the wave climate in the area of concern.

### 2. The Berm Concept

This new concept in breakwater design as shown in Figure 5-2 and referred to as the Berm concept, consists of three principle components:

- (a) The outer berm, which extends from the seabed to just above the high water elevation.
- (b) The crest section which extends from the top of the berm to an elevation sufficient to limit overtopping to acceptable quantities.
- (c) The core of the breakwater. Filter layers are not required.

Although this new concept in breakwater design may require a greater volume of material than a conventional structure, it does have certain advantages. Because the design requires smaller stone sizes on average, it maximizes quarry yield. The cost of the extra volume of material for this breakwater is therefore generally offset by the ease and speed of construction, the economy of the quarry operation and the reduction in the required size and capacity of construction equipment. In addition, the porosity of the berm significantly reduces run-up and overtopping, increasing the life and efficiency of the structure.

CROSS SECTION OF A TYPICAL  
RUBBLE MOUND BREAKWATER

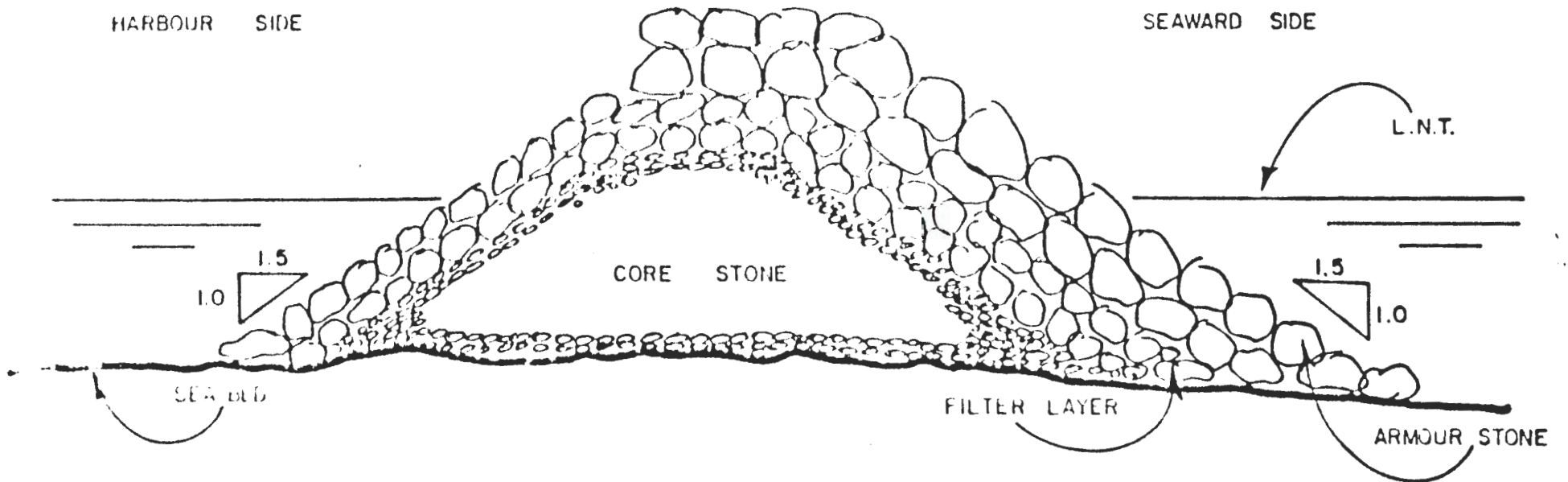
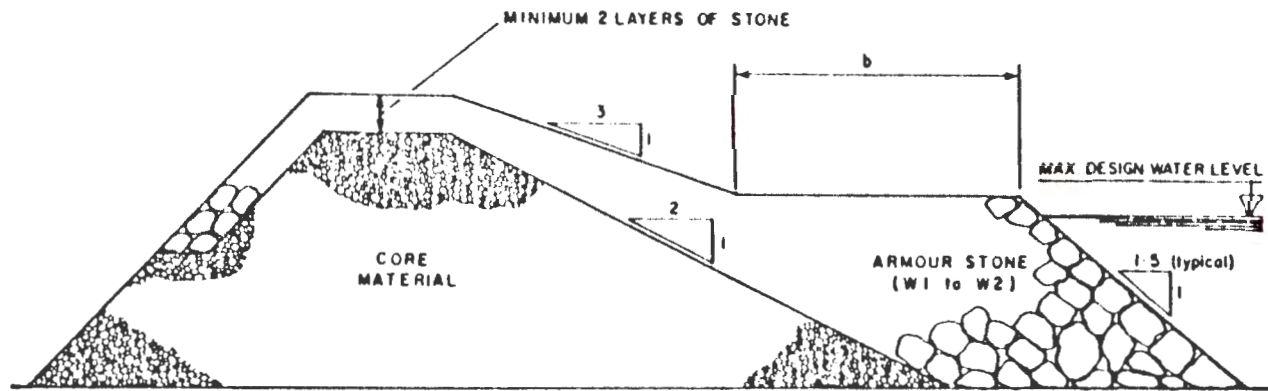


FIGURE 5-1



NOTE: (I) BERM WIDTH " $b$ " AND ARMOUR STONE GRADATION (W1 to W2) DEPEND ON AVAILABLE QUARRY YIELD AND LOCAL ENVIRONMENTAL DESIGN PARAMETERS

(II) SLOPES INDICATED ARE TYPICAL AND MAY VARY

## GENERALIZED BERM CONCEPT

FIGURE 5-2

## **6.0 DESIGN CRITERIA**

## **6.1 DESIGN CRITERIA**

Prior to the development of possible alternatives for harbour improvements in Flatrock, a set of design criteria must be established as a guide for the various proposals and a means by which they can be evaluated. The following criteria were considered in the proposals for new harbour development in Flatrock.

### **1. Meeting the Guidelines**

The development plan must meet the Guidelines of Harbour Accommodation set down by Small Craft Harbours. This includes providing adequate berthage (operational and non-operational) and/or mooring space, as well as sufficient slipway area, gear storage, access roads and parking for the fishermen based in Flatrock. Onshore services including lighting, electrical outlets and water supply should be provided in accordance with the Guidelines.

### **2. Physical Feasibility**

The design must be physically feasible considering the topography and bathymetry of the area. The new facilities should be relatively easy to construct using standard designs and procedures and take into consideration the current availability of materials. The necessity of acquiring the needed land in the area must also be investigated.

### 3. Financial and Economic Feasibility

The initial cost of construction should be reasonable and within the means of Small Craft Harbours, or sponsors should be available. The benefits of the development, both tangible and intangible, should justify the initial cost and any expenditures needed in future.

### 4. Durability

The structures should be durable enough to withstand exposure to the longterm effects of wind, sea and ice action, with as little maintenance as possible. The materials used should be resistant to the effects of marine fouling and rot. All breakwater and wharf designs must be able to withstand the worst expected wave conditions.

### 5. Future Potential

Any development plan should accommodate the existing facilities if possible and provide for the possibility of future expansion.

### 6. Safety

All proposals should take into consideration the safety of those using the facilities, as well as the safety of all vessels and equipment in the area.

### 7. Social Benefits

The social benefits of the development, such as greater convenience and the centralization of facilities, should be greater than any ill effects the proposal would have on the community.

## **7.0 DEVELOPMENT ALTERNATIVES**

## 7.1 General

Several plans for the development of Flatrock harbour are proposed in this report. A description of each proposal is provided, as well as a Class D estimate of the cost involved. The new construction is shaded on the given proposal plans. A decision matrix is then used to evaluate each proposal based on the design criteria.

Wade's Point has been chosen as the site of the design proposals because of its relatively calm seas as compared to those at Martin's Point, as well as the already existing slipway and landing facility in the vicinity. Future development in Flatrock could be concentrated in this area.

The obvious requirement for a protected landing facility would suggest the need for a breakwater and wharf. There has been no provision made for additional slipway area or gear storage as there is presently sufficient slipway area in Flatrock (located mainly at the Martin's Point slipway), as well as a new fishermen's center/gear storage building constructed in 1983 near the Martin's Point landing wharf. However, if in future the harbour facilities are centralized in the Wade's Point vicinity, new gear storage and additional slipway construction may be required in this area. In this case the Flatrocks slipway at Martin's Point would be used primarily for winter storage.

## **7.2 Guidelines of Harbour Accommodation**

Certain requirements for operational and non-operational berthage are set down in the Small Craft Harbours Guidelines of Accommodation for various classes of vessels. Tables 3 and 4 give the berthage requirements for all vessels presently registered in Flatrock.

<b><u>Table 3</u></b> <b><u>Operational Berthage</u></b>		
Class	Number of Vessels	Operational Berth Length
0.0-6.1m	6	8.1m
6.2-10.7m	12	14.7m

Note: The number of unloading systems (i.e. operational berths) per vessel size may vary depending on the number of vessels of that size and the volume of fish landed.

<b><u>Table 4</u></b> <b><u>Non-operational Berthage</u></b>					
Class	Number of Vessels	Non-op. Berth Length	Number Abreast	Total Non-op. Berthage	Average Beam
0.0-6.1m	6	6.7m	4	13.4m	2m
6.2-10.7m	12	11.8m	4	35.4m	4m

### 7.3 Unit Prices

The following list indicates the unit prices used in preparing the Class D estimates for each proposal. These figures were obtained from Small Craft Harbours.

#### Treated Timber Cribwork - \$180/m<sup>3</sup>

This includes concrete deck, fenders, wheelguard, hoists, mooring cleats and lighting.

#### Steel Pile Wharfage - \$1200/m<sup>2</sup>

This includes concrete deck, fenders, wheelguard, hoists, mooring cleats and lighting.

#### Paved Access Road - \$100/m<sup>2</sup>

Provides an approach to the wharf and breakwater.

#### Parking Area - \$100/m<sup>2</sup>

Provides area to park vehicles near the harbour facilities. It can also be used as a working area or for vessel storage in the winter.

#### Rock Core -\$15/tonne

Smaller stone which makes up the interior of a breakwater.

#### Armour Stone - \$20/tonne

Larger stone used for the outside layers of a breakwater.

#### 7.4 PROPOSAL #1

The first proposal requires the construction of a new breakwater, solid crib wharf, access road and parking area.

It is proposed that a 105m rubblemound breakwater, based on the Berm concept design be constructed at Wade's Point. According to WFBA this structure would result in wave conditions inside the artificial inner harbour which would exceed a significant wave height of 0.5m for approximately 40 hours each fishing season. The dimensions of the breakwater are as follows:

<u>Crest Elevation:</u>	6.5m to 8m (LNT)
<u>Slope of Crest Section:</u>	1:1.5
<u>Berm Width</u>	15m to 19m
<u>Armour Stone Criteria:</u>	0.8-5.0 t

The new solid crib wharf would measure 45m long by 8m wide and be constructed of creosote timber cribwork with a reinforced concrete deck. This wharf would provide adequate non-operational berthage for all boats presently registered in Flatrock, as well as two additional operational berths for the 6.2m-10.7m class of boats and one for the 0.0m-6.1m class. Site lighting as well as three conventional fish unloading systems will be provided.

An access road will be constructed from the main road at Morey's Point (Caplin Lane) to the new wharf, a distance of about 50m. A gravel parking area measuring 20m by 54m will be provided to accommodate 18 vehicles.

A Class D estimate for the proposal is provided below and a plan of the proposal is shown in Figure 7-1.

**7.5 COST ESTIMATE - PROPOSAL #1**

Breakwater : Average water depth of 6m.

Rock Core : (39,800t @ \$15/t).....\$ 597,000

Armour Stone : (54,450t @ \$20/t).....\$1,089,000

Solid Crib Wharf : Average water depth of 2.5m and deck  
elevation of 3m above low water mark.

45m x 8m x 5.5m @ \$180/m<sup>3</sup>.....\$ 356,400

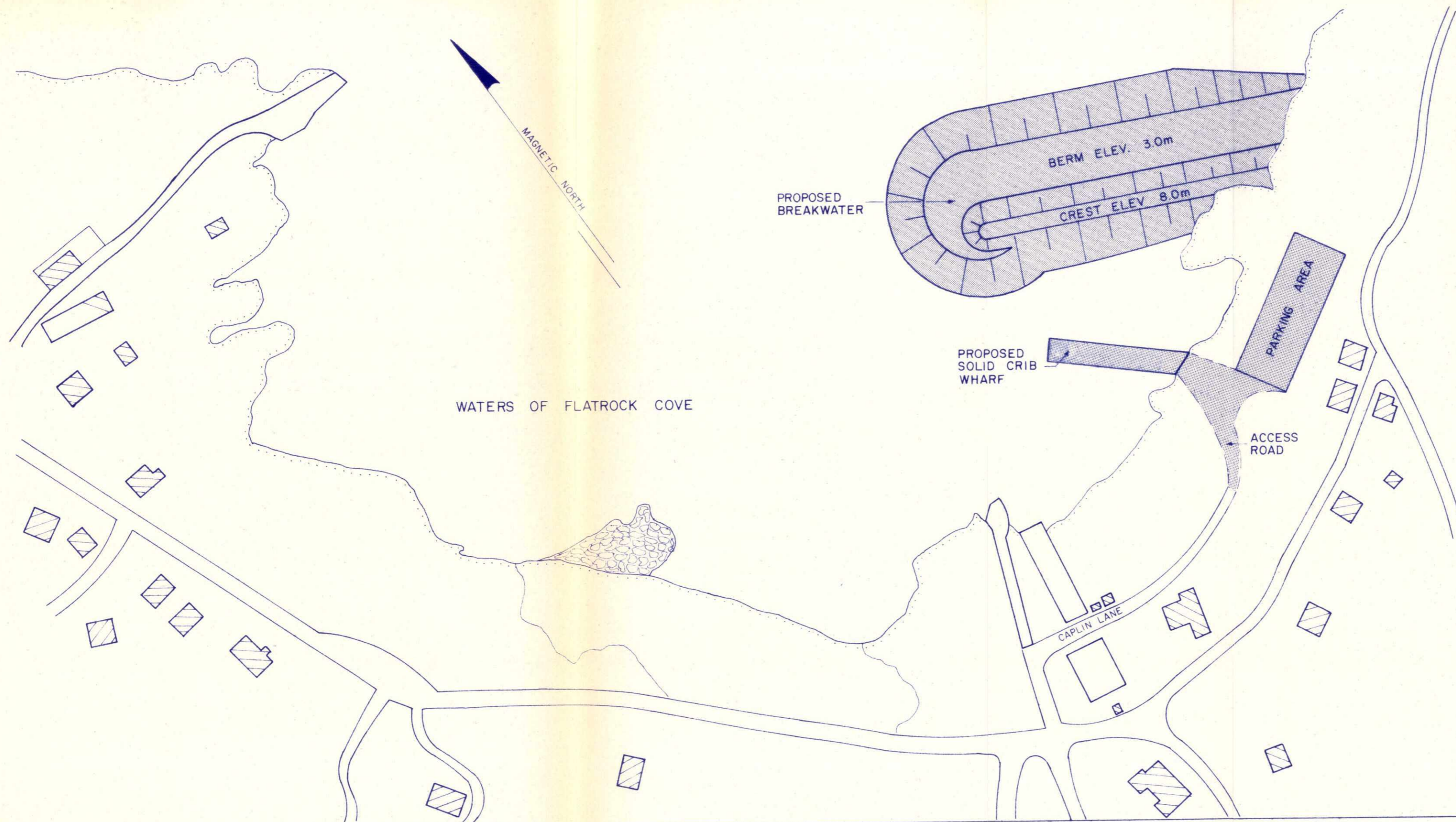
Access Road :

50m x 10m @ \$100/m<sup>2</sup>.....\$ 50,000

Parking :

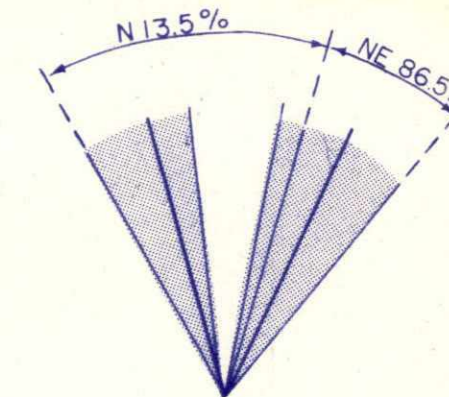
20m x 54m @ \$100/m<sup>2</sup>.....\$ 108,000

-----  
**Total Cost - Proposal #1.....\$2,200,400**



Notes

INCIDENT WAVE CLIMATE



Project Title

FLATROCK

Drawing Title

PROPOSAL NO. 1

Drawn by J. KIELEY

Date JULY, 1985

Scale 1:1250

Drawing No

FIGURE 7-1

## 7.6 PROPOSAL #2

The second proposal also requires the construction of a new breakwater, solid crib wharf, access road and parking area.

It is proposed that a 110m long conventional rubble-mound breakwater, heavily armoured on the exterior slope be constructed at Wade's Point. This structure should result in wave conditions inside the artificial harbour which would exceed a significant wave height of 0.5m for less than 100 hours each fishing season. The dimensions of the breakwater are as follows:

<u>Breakwater Width:</u>	4m
<u>Breakwater Height:</u>	5m above low water
<u>Exterior Slope:</u>	1:1.5
<u>Interior Slope:</u>	1:1.5
<u>Armour Stone Criteria:</u>	6t

The new solid crib wharf, built against the protected side of the breakwater would measure 80m long by 8m wide and be constructed of creosote timber cribwork with a reinforced concrete deck. This wharf would provide adequate non-operational berthage for all boats presently in Flatrock, as well as two additional operational berths for the 6.2m-10.7m class. Site lighting and two conventional unloading systems will be provided.

An access road will be constructed off Wade's Lane to the new wharf, a distance of about 50m. A gravel parking

area measuring 20m by 54m will also be provided to accommodate 18 vehicles.

A Class D estimate for the proposal is provided below and a plan of the proposal is shown in Figure 7-2.

### **7.7 COST ESTIMATE - PROPOSAL #2**

Breakwater : Average water depth of 5m.

Total volume of 20,900m<sup>3</sup>.

Rock Core : (12,320 m<sup>3</sup> x 2t/m<sup>3</sup> @ \$15/t).....\$ 369,600

Armour Stone : (8,580 m<sup>3</sup> x 2t/m<sup>3</sup> @ \$20/t)...\$ 343,200

Wharf : Average water depth of 4m and deck elevation of 3m above low water mark.

80m x 8m x 7m @ \$180/m<sup>3</sup>.....\$ 806,400

Access Road :

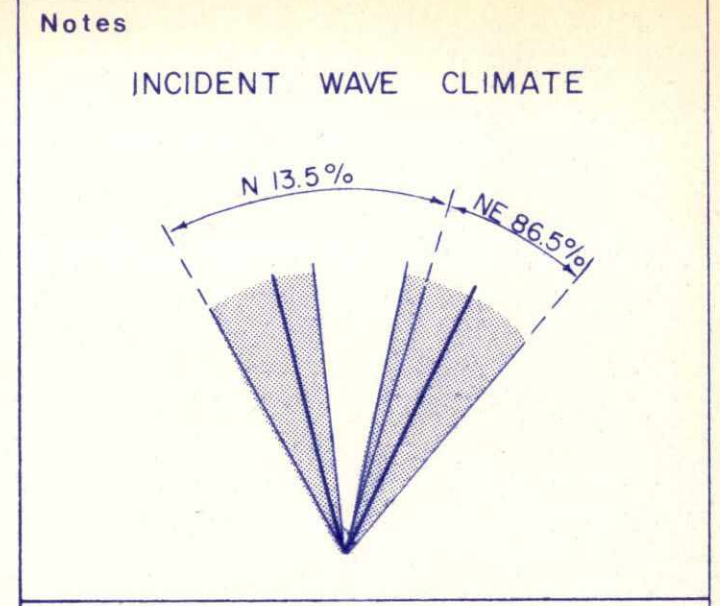
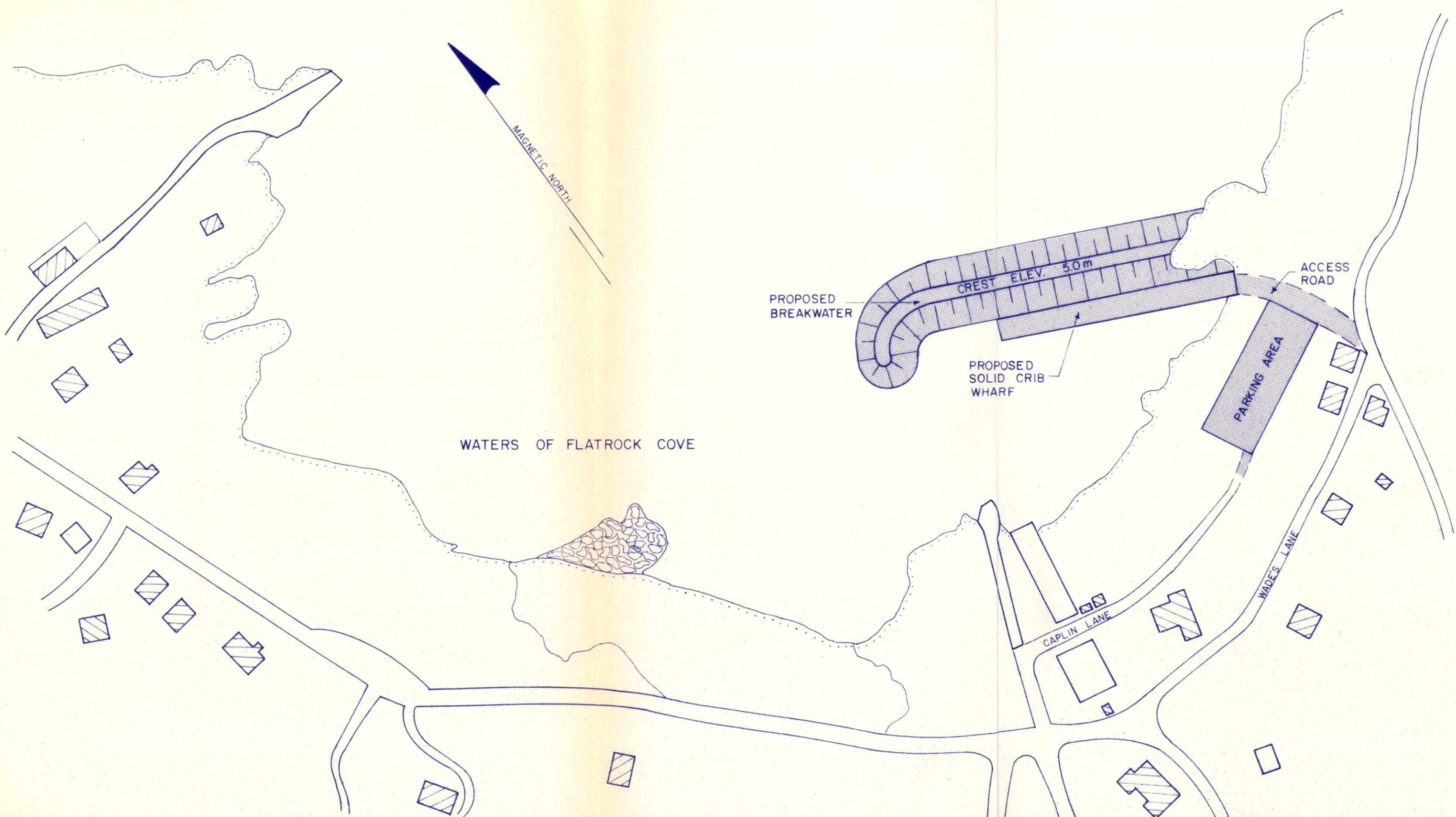
50m x 10m @ \$100/m<sup>2</sup>.....\$ 50,000

Parking :

20m x 54m @\$100/m<sup>2</sup>.....\$ 108,000

-----

**Total Cost - Proposal #2.....\$1,677,200**



Project Title

FLATROCK

Drawing Title

PROPOSAL NO. 2

Drawn by J. KIELEY

Date JULY, 1985

Scale 1:1250

Drawing No

FIGURE 7-2

### 7.8 PROPOSAL #3

The third proposal requires the construction of a new Berm concept breakwater, steel pile wharf, access road and parking area.

In this proposal the breakwater has the same layout and dimensions as in Proposal #1 and would have an identical effect on the wave climate inside the artificial inner harbour.

The proposed wharf is an "L" shaped steel pile marginal wharf with one section 65m long by 8m wide and the other 15m long by 8m wide. This type of wharf is constructed by driving piles into the rock bed and filling them with concrete for stability. A concrete deck is then built on top of the piles. This wharf would provide adequate non-operational berthage for all boats presently in Flatrock, as well as two additional operational berths for the 6.2m-10.7m class of vessels. Site lighting and two conventional unloading systems will be provided.

An access road will be constructed off Wade's Lane to the new wharf, a distance of about 50m. A gravel parking area measuring 20m by 54m will also be provided to accommodate 18 vehicles.

A Class D estimate for the proposal is provided on the following page and a plan of the proposal is shown in Figure 7-3.

**7.9 COST ESTIMATE - PROPOSAL #3**

Breakwater : Average water depth of 6m.

Rock Core : (39,800t @ \$15/t).....\$ 597,000

Armour Stone : (54,450t @ \$20/t).....\$1,089,000

Steel Pile Marginal Wharf :

65m x 8m @ \$1200/m<sup>2</sup>.....\$ 624,000

15m x 8m @ \$1200/m<sup>2</sup>.....\$ 144,000

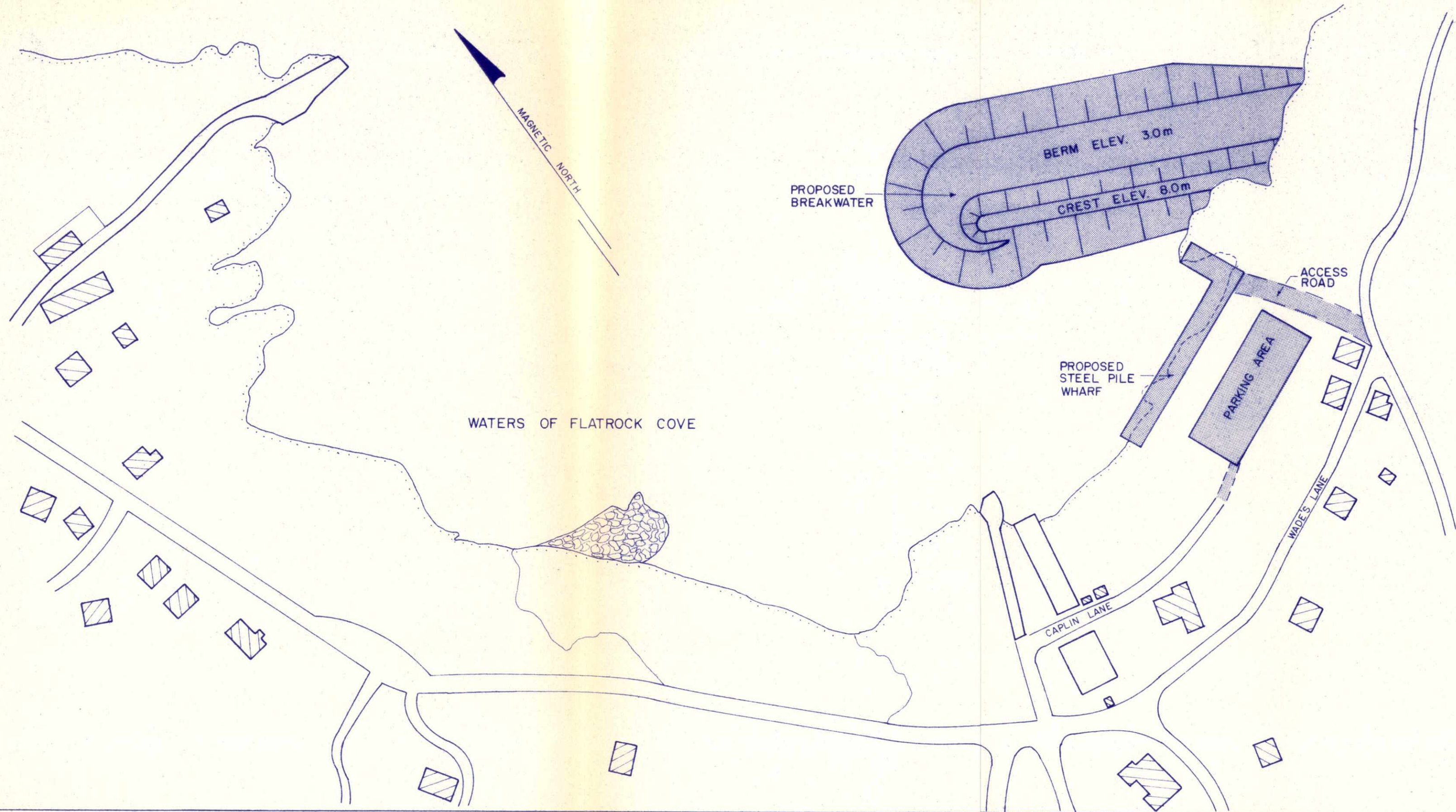
Access Road :

50m x 10m @ \$100/m<sup>2</sup>.....\$ 50,000

Parking :

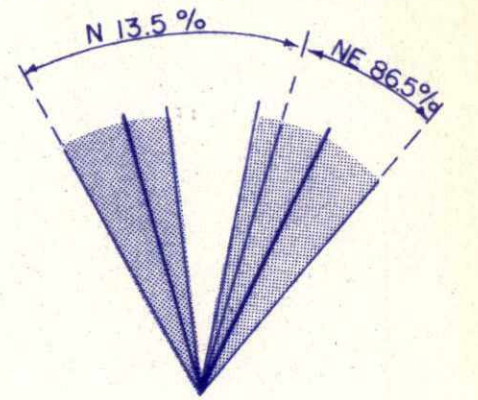
20m x 54m @ \$100/m<sup>2</sup>.....\$ 108,000

-----  
**Total Cost - Proposal #3.....\$2,612,000**



Notes

INCIDENT WAVE CLIMATE



Project Title

FLATROCK

Drawing Title

PROPOSAL NO. 3

Drawn by J.KIELEY

Date JULY, 1985

Scale 1:1250

Drawing No

FIGURE 7-3

## 7.10 DECISION MATRIX

A decision matrix was used to evaluate the preceding proposals based on the design criteria. Each criterion was assigned a weighting factor based on its relative importance to the choice of an optimum design. The proposals were then evaluated by rating the designs on a scale of one to ten according to their fulfillment of each criterion. The weighting factor was then multiplied by the rating for each criterion and a total obtained for each proposal. The proposal with the largest total is considered the optimum design.

<b>Table 5</b>				
<b><u>Decision Matrix</u></b>				
Criterion	Weighting Factor (WF)	Rating [ WF x Rating]		
		No.1	No.2	No.3
Meeting Guidelines	2.0	9 [18]	8 [16]	9 [18]
Physical Feasibility	2.0	8 [16]	7 [14]	6 [12]
Financial/ Economic Feasibility	2.0	5 [10]	6 [12]	4 [8]
Durability	1.5	8 [12]	6 [9]	8 [12]
Future Potential	1.5	7 [10.5]	6 [9]	7 [10.5]
Safety	0.5	8 [4]	8 [4]	8 [4]
Social Benefits	0.5	7 [3.5]	7 [3.5]	7 [3.5]
<b>Total</b>	<b>10.0</b>	<b>52.0</b>	<b>46.5</b>	<b>49.0</b>

## **8.0 CONCLUSIONS AND RECOMMENDATIONS**

## 8.1 CONCLUSIONS

All proposals seem to meet the Guidelines well in providing adequate berthage space, vessel protection, access roads and parking area, although the Berm design breakwaters provide greater protection from wave agitation for the inner harbour. Each proposal also has high ratings for future potential, safety and social benefits. With regard to physical feasibility, all proposals are attainable but considering the smaller stone sizes required, the Berm design breakwaters would be easier to build and more durable than conventional rubblemound structures. Furthermore, a solid timber crib wharf may also be easier to construct than a steel pile wharf considering the large amount of bedrock in the area and the specialized equipment required for the construction of pile structures.

Based on the decision matrix (Table 5), it is concluded that Proposal #1 is the best of the three alternatives presented. The cost of this proposal is approximately 2.2 million dollars, \$400,000 less than Proposal #3 and \$600,000 greater than Proposal #2. However, the additional cost of Proposal #1 over Proposal #2 is offset by the increased structural stability and durability of the Berm concept breakwater over the conventional rubblemound structure.

## 8.2 RECOMMENDATIONS

It is recommended that the harbour development plan proposed in this report be considered for implementation in the near future by Small Craft Harbours in order to maintain and/or improve the productivity of the fishery in Flatrock. However, further investigations must be undertaken and additional information gathered before more detailed plans can be completed.

The following investigations are recommended :

1. Updated bathymetric data is required and will be obtained from the new sounding survey presently being completed at Wade's Point by Public Works Canada. This will provide the information needed for more detailed designs and cost estimates.

2. Further information about the wave climate at Flatrock should be obtained through a wave model study of the area to gather more detailed and reliable data about the shallow water effects around the recommended structures.

3. The necessity of acquiring land in the area of the proposed development should be investigated.

4. The yield and quality of existing and potential local quarries must be determined.

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Kenny, Shawn P.: Harbour Development Study for Lower Island Cove. Work Report, April, 1985.

Mid Ocean Engineering Ltd.: Foxtrap to Flatrock; Harbour Development Study. St. John's: March, 1983.

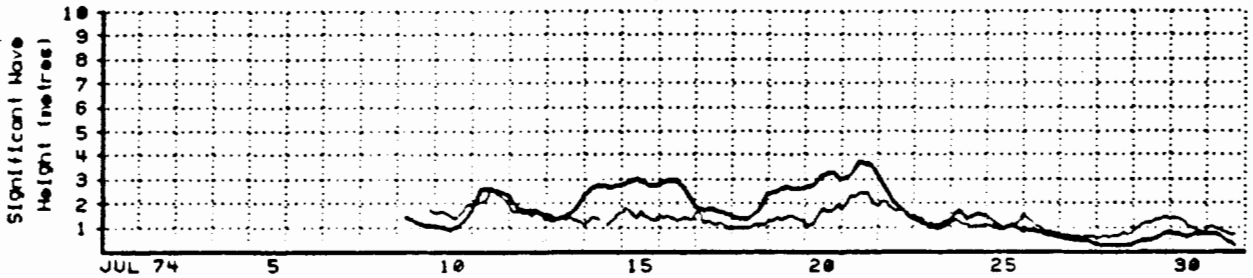
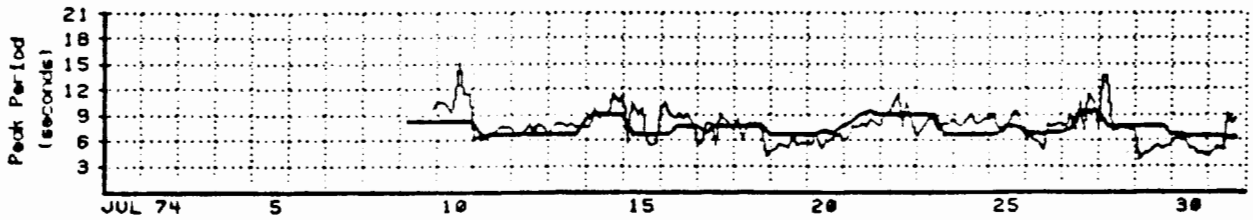
Seashore Engineering and Associates Ltd: Commercial Fishing Harbours Study. St. John's: December, 1979.

U. S. Army Corps of Engineers: Shore Protection Manual. Fort Belvoir, Virginia: 3rd edition, 1977.

## **APPENDIX A**

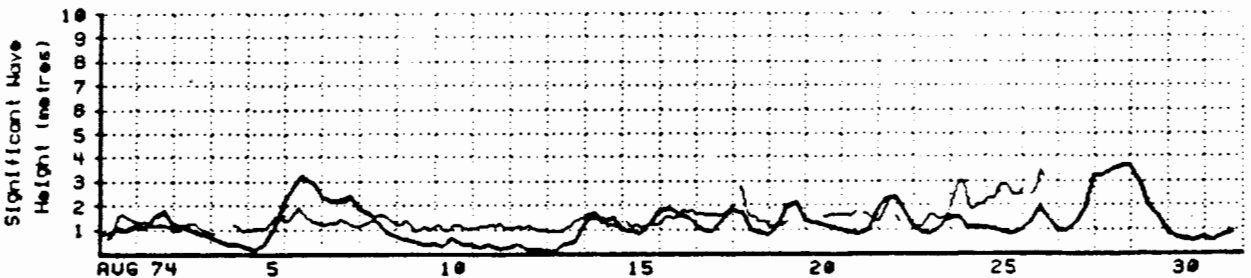
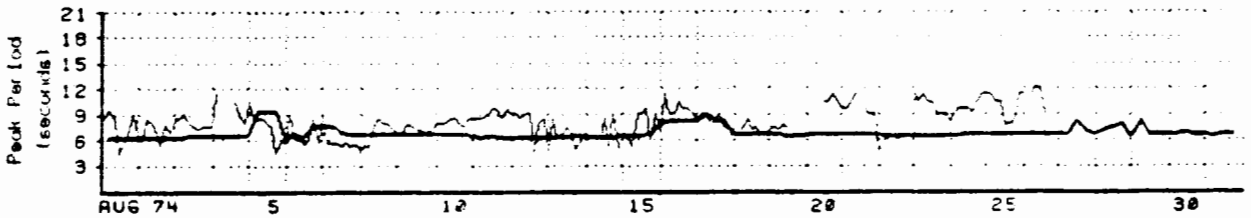
Comparison of Marine Environment Data Service (MEDS) recorded wave data with Wave Information Study (WIS) results.

Source : Wave Climate Study  
W. F. Baird and Associates  
1984



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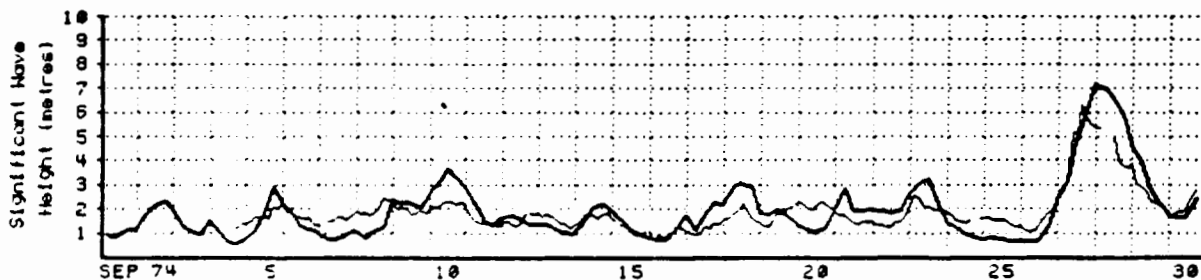
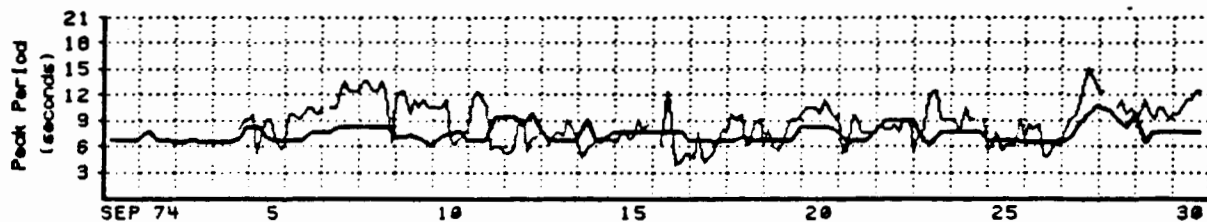
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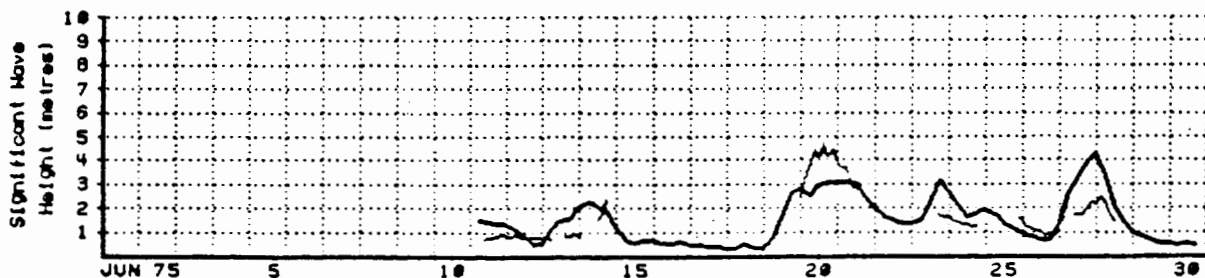
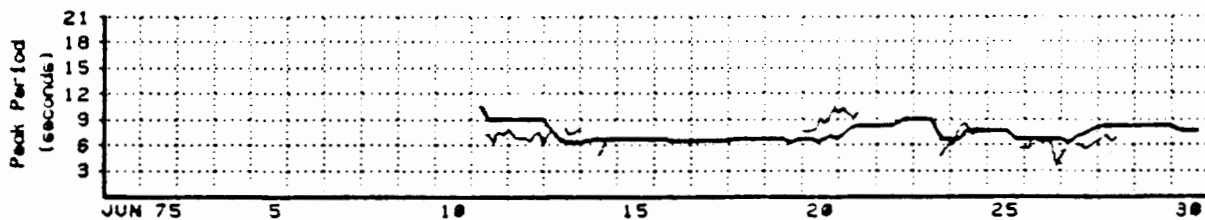
LEGEND: — hindcast      - - - recorded

COMPARISON OF RECORDED WAVE DATA AND  
 DATA FROM WIS STATION G5



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 Recorded Wave File: W\*MEDS.REC.94.GMT  
 Comment : HAYDRILL 94

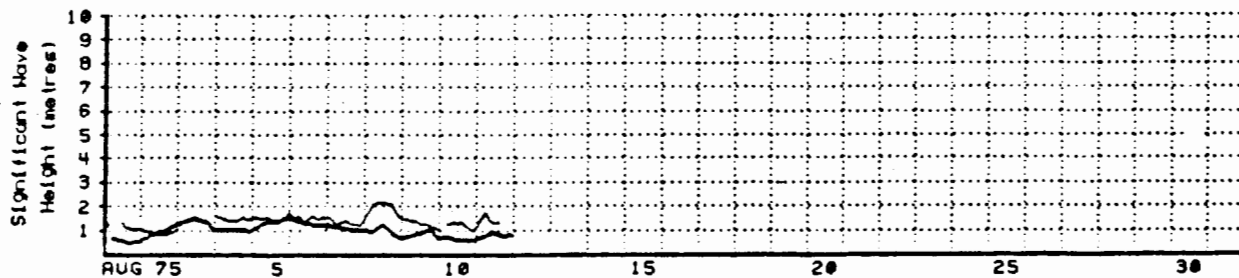
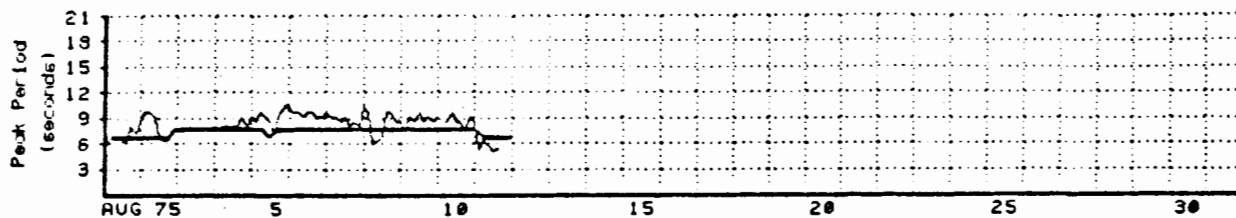
LEGEND: — hindcast — recorded



Hindcast Wave File: W\*SI.BAIRD.5  
 Recorded Wave File: W\*MEDS.REC.94.GMT  
 Comment : HAYDRILL 94

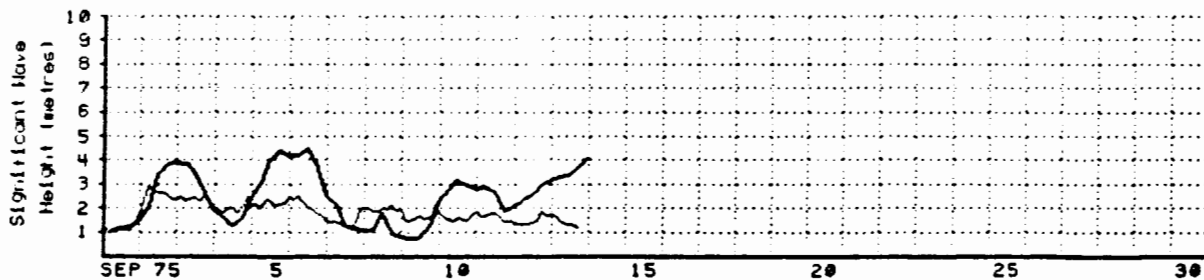
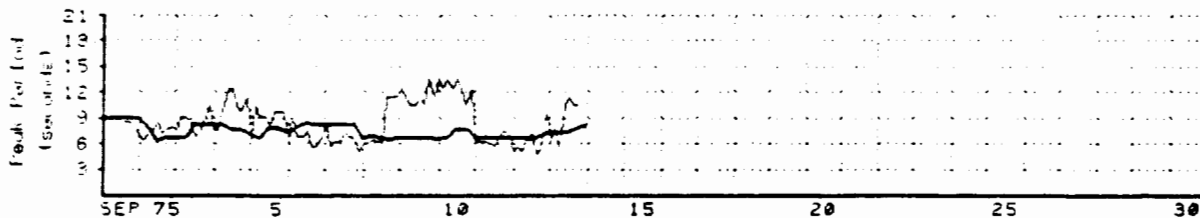
LEGEND: — hindcast — recorded

### COMPARISON OF RECORDED WAVE DATA AND DATA FROM WIS STATION G5



Hindcast Wave File: W+SI.BAIRD.5  
 Recorded Wave File: W+MEDS.REC.94.GMT  
 Comment ..... : HAYDRILL 94

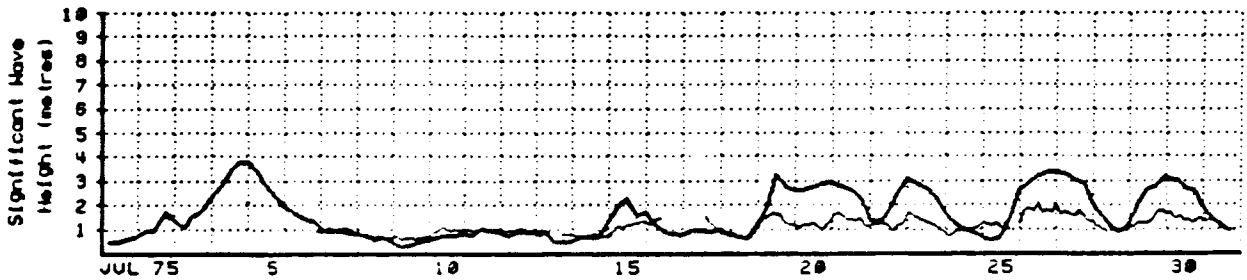
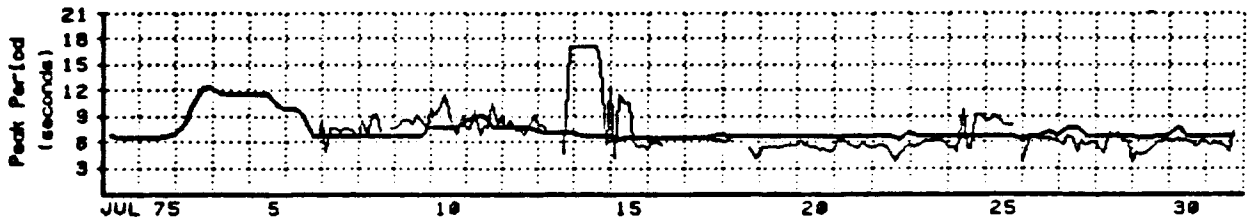
**LEGEND:** — hindcast      - - - recorded



Hindcast Wave File: W+SI.BAIRD.5  
 Recorded Wave File: W+MEDS.REC.90.GMT  
 Comment ..... : SEDCO J 90(9)

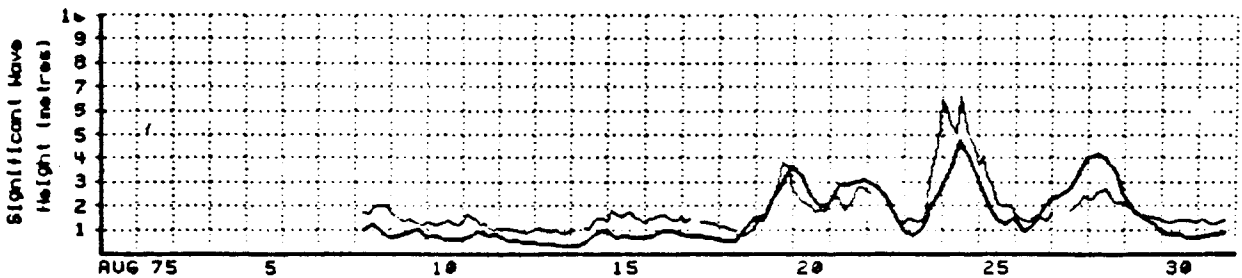
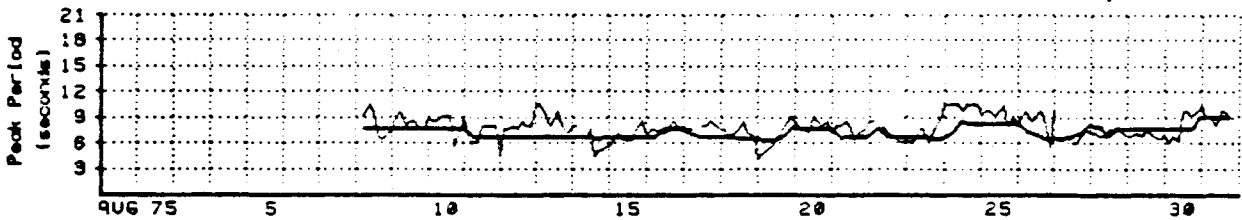
**LEGEND:** — hindcast      - - - recorded

## COMPARISON OF RECORDED WAVE DATA AND DATA FROM WIS STATION G5



Hindcast Wave File: W\*SI.BAIRD.5  
 Recorded Wave File: W\*MEDS.REC.94.GMT  
 Comment ..... : HAYDRILL 94

LEGEND: — hindcast — recorded



Hindcast Wave File: W\*SI.BAIRD.5  
 Recorded Wave File: W\*MEDS.REC.90.GMT  
 Comment ..... : SEDCO J 90(9)

LEGEND: — hindcast — recorded

COMPARISON OF RECORDED WAVE DATA AND  
 DATA FROM WIS STATION G5

## **APPENDIX B**

Summary of incident wave climats for Flatrock

1. Full year
2. Fishing season only

1. FULL YEAR

SCATTER DIAGRAM FOR HINDCAST SIGNIFICANT WAVE HEIGHTS AND PEAK PERIODS

SCATTERB

-- G5C

Wave data for station: FLATROCK

Wave direction: NE

Wind data recorded at: FLATROCK

Selected from 08JAN56 to 31DEC75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)																see footnote for explanation of row & col percent			
	0.00 to 1.00	1.00 to 2.00	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00	5.00 to 6.00	6.00 to 7.00	7.00 to 8.00	8.00 to 9.00	9.00 to 10.00	10.00 to 11.00	11.00 to 12.00	12.00 to 13.00	13.00 to 14.00	14.00 to 15.00	15.00 & over	row total	A(%)	B(%)	C(%)
0.00 - 0.50		91	706	683	137		10749	5534	2232	1754	23						21908	21.91	14.26	65.08
0.50 - 1.00			68	547	1070	1253	7903	8677	4737	7151	797						32202	32.20	20.96	50.82
1.00 - 1.50				23	774	364	4783	4578	2164	6172	1571						20428	20.43	13.29	29.87
1.50 - 2.00					46	433	2027	2141	1412	2733	1002						9793	9.79	6.37	16.57
2.00 - 2.50						91	2027	752	569	1662	660						5762	5.76	3.75	10.20
2.50 - 3.00							1025	752	228	478	660						3143	3.14	2.05	6.45
3.00 - 3.50							455	524	387	387	296						2050	2.05	1.33	4.40
3.50 - 4.00							251	660	342	159	91						1503	1.50	0.98	3.07
4.00 - 4.50							159	296	387	296	68						1207	1.21	0.79	2.09
4.50 - 5.00							205	273	137	182	23						820	0.82	0.53	1.30
5.00 - 5.50							114	46	91	137							387	0.39	0.25	0.77
5.50 - 6.00								68	46	159	68						342	0.34	0.22	0.52
6.00 - 6.50								68	91	182	114						455	0.46	0.30	0.30
6.50 - 7.00																	0	0.00	0.00	0.00
7.00 - 7.50																	0	0.00	0.00	0.00
7.50 - 8.00																	0	0.00	0.00	0.00
8.00 - 8.50																	0	0.00	0.00	0.00
8.50 - 9.00																	0	0.00	0.00	0.00
9.00 - 9.50																	0	0.00	0.00	0.00
9.50 - 10.00																	0	0.00	0.00	0.00
10.00 - 10.50																	0	0.00	0.00	0.00
10.50 - 11.00																	0	0.00	0.00	0.00
11.00 - 11.50																	0	0.00	0.00	0.00
11.50 - 12.00																	0	0.00	0.00	0.00
12.00 & over																	0	0.00	0.00	0.00
col total	0	91	774	1253	2027	2141	24368	21453	5375	0	0	0	0	0	0	100000				
A(%)	0.0	0.1	0.8	1.3	2.0	2.1	29.7	24.4	12.8	21.5	5.4	0.0	0.0	0.0	0.0	0.0				
B(%)	0.0	0.1	0.5	0.8	1.3	1.4	19.3	15.9	8.3	14.0	3.5	0.0	0.0	0.0	0.0	0.0				
C(%)	65.1	65.1	65.0	64.5	63.7	62.4	61.0	41.7	25.8	17.5	3.5	0.0	0.0	0.0	0.0	0.0				

Number of hourly records this direction: 4391  
 Total records used in selected interval: 6747  
 Per cent in this direction: 65.08

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

SCATTERS

-- GSC

Wave data for station: FLATROCK

Wave direction: NW

Wind data recorded at: FLATROCK

Selected from OBJAN56 to 31DEC75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)																see footnote for explanation of row & col percent			
	0.00 to 1.00	1.00 to 2.00	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00	5.00 to 6.00	6.00 to 7.00	7.00 to 8.00	8.00 to 9.00	9.00 to 10.00	10.00 to 11.00	11.00 to 12.00	12.00 to 13.00	13.00 to 14.00	14.00 to 15.00	15.00 & over	row total	A(%)	B(%)	C(%)
0.00 - 0.50												426					426	0.43	0.01	3.48
0.50 - 1.00												851					851	0.85	0.03	3.47
1.00 - 1.50												1702	851				2553	2.55	0.09	3.44
1.50 - 2.00											3404	2553	851				426 7234	7.23	0.25	3.35
2.00 - 2.50											2128	7660		426	426		10638	10.64	0.37	3.10
2.50 - 3.00											3830	9362	851	851	426		15319	15.32	0.53	2.73
3.00 - 3.50											851	7234	2553	1277	1702		13617	13.62	0.47	2.19
3.50 - 4.00											1702	4681	2553	1702	851		11489	11.49	0.40	1.72
4.00 - 4.50											2128	1277	2979	2128	1277		9787	9.79	0.34	1.32
4.50 - 5.00											426	426		2553	1277		4681	4.68	0.16	0.98
5.00 - 5.50											851			1702	851		3404	3.40	0.12	0.82
5.50 - 6.00												426	426	426	426		1702	1.70	0.06	0.70
6.00 - 6.50											5532	5957	2979	426	2553		85118298	18.30	0.64	0.64
6.50 - 7.00																	0	0.00	0.00	0.00
7.00 - 7.50																	0	0.00	0.00	0.00
7.50 - 8.00																	0	0.00	0.00	0.00
8.00 - 8.50																	0	0.00	0.00	0.00
8.50 - 9.00																	0	0.00	0.00	0.00
9.00 - 9.50																	0	0.00	0.00	0.00
9.50 - 10.00																	0	0.00	0.00	0.00
10.00 - 10.50																	0	0.00	0.00	0.00
10.50 - 11.00																	0	0.00	0.00	0.00
11.00 - 11.50																	0	0.00	0.00	0.00
11.50 - 12.00																	0	0.00	0.00	0.00
12.00 & over																	0	0.00	0.00	0.00
col total	0	0	0	0	0	0	0	0	0	0	20851	42553	14043	11489	9787	1277	100000			
A(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.9	42.6	14.0	11.5	9.8	1.3				
B(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.5	0.5	0.4	0.3	0.0				
C(%)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	2.8	1.3	0.8	0.4	0.0				

Number of hourly records this direction: 235  
 Total records used in selected interval: 6747  
 Per cent in this direction: 3.48

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

SCATTER DIAGRAM FOR HINDCAST SIGNIFICANT WAVE HEIGHTS AND PEAK PERIODS

SCATTERB

-- GSC

Wave data for station FLATROCK

Wave direction: N

Wind data recorded at FLATROCK

Selected from OBJAN56 to 31DEC75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)															see footnote for explanation of row & col percent				
	0 00 to 1 00	1 00 to 2 00	2 00 to 3 00	3 00 to 4 00	4 00 to 5 00	5 00 to 6 00	6 00 to 7 00	7 00 to 8 00	8 00 to 9 00	9 00 to 10 00	10 00 to 11 00	11 00 to 12 00	12 00 to 13 00	13 00 to 14 00	14 00 to 15 00	15 00 & over	total	A(%)	B(%)	C(%)
0 00 - 0 50			943				849	471	47	47							2357	2.36	0.74	31.44
0 50 - 1 00			141	2074	802		2640	2405	1132	1084	330	849	141	141			11740	11.74	3.69	30.70
1 00 - 1 50			47	94	2735	1320	2263	1980	1273	3112	754	1603	424	94	47		15747	15.75	4.95	27.00
1 50 - 2 00					283	2169	754	1226	1462	3583	1084	1603	849	802			13814	13.81	4.34	22.05
2 00 - 2 50					47	377	4715	1273	896	1933	849	849	424	283	424		4712117	12.12	3.81	17.71
2 50 - 3 00							3819	3206	707	849	802	707	94	47	189		4710467	10.47	3.29	13.90
3 00 - 3 50							2499	3583	896	707	566	754	141				9147	9.15	2.88	10.61
3 50 - 4 00							1179	2546	1320	377	424	566		94			6506	6.51	2.05	7.74
4 00 - 4 50							660	1509	2593	377	330	141	189	47	47		5893	5.89	1.85	5.69
4 50 - 5 00							330	1084	1603	990	141	94	141	47			4432	4.43	1.39	3.84
5 00 - 5 50							189	283	519	1037		47		141	94		2310	2.31	0.73	2.45
5 50 - 6 00							47	283	283	802	377						47 1839	1.84	0.58	1.72
6 00 - 6 50								47	471	943	1414	519			47		189 3630	3.63	1.14	1.14
6 50 - 7 00																	0	0.00	0.00	0.00
7 00 - 7 50																	0	0.00	0.00	0.00
7 50 - 8 00																	0	0.00	0.00	0.00
8 00 - 8 50																	0	0.00	0.00	0.00
8 50 - 9 00																	0	0.00	0.00	0.00
9 00 - 9 50																	0	0.00	0.00	0.00
9 50 - 10 00																	0	0.00	0.00	0.00
10 00 - 10 50																	0	0.00	0.00	0.00
10 50 - 11 00																	0	0.00	0.00	0.00
11 00 - 11 50																	0	0.00	0.00	0.00
11 50 - 12 00																	0	0.00	0.00	0.00
12 00 & over																	0	0.00	0.00	0.00
col total	0	0	1132	2169	3866	3866	19943	19896	13201	15842	7072	7732	2405	1697	849	330	100000			
A(%)	0.0	0.0	1.1	2.2	3.9	3.9	19.9	19.9	13.2	15.8	7.1	7.7	2.4	1.7	0.8	0.3				
B(%)	0.0	0.0	0.4	0.7	1.2	1.2	6.3	6.3	4.1	5.0	2.2	2.4	0.8	0.5	0.3	0.1				
C(%)	31.4	31.4	31.4	31.1	30.4	29.2	28.0	21.7	15.4	11.3	6.3	4.1	1.7	0.9	0.4	0.1				

Number of hourly records this direction: 2121  
 Total records used in selected interval: 6747  
 Per cent in this direction: 31.44

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

SCATTERB

--- G5C

Wave data for station: FLATROCK

Wave direction: ALL

Wind data recorded at: FLATROCK

Selected from 08JAN56 to 31DEC75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD ( SECONDS )																see footnote for explanation of row & col percent		
	0 00 to 1 00	1 00 to 2 00	2 00 to 3 00	3 00 to 4 00	4 00 to 5 00	5 00 to 6 00	6 00 to 7 00	7 00 to 8 00	8 00 to 9 00	9 00 to 10 00	10 00 to 11 00	11 00 to 12 00	12 00 to 13 00	13 00 to 14 00	14 00 to 15 00	15 00 & over	row total	A(%)	B(%)
0.00 - 0.50		59	756	445	89		7262	3750	1467	1156	15	15				15014	15.01	15.01	100.00
0.50 - 1.00			89	1008	949	815	5973	6403	3439	4995	622	296	44	44		24678	24.68	24.68	84.99
1.00 - 1.50			15	44	1364	652	3824	3602	1808	4995	1260	563	163	30	15	18334	18.33	18.33	60.31
1.50 - 2.00					119	963	1556	1779	1378	2905	1112	593	296	252		1510968	10.97	10.97	41.97
2.00 - 2.50					15	178	2801	889	652	1690	771	534	133	104	146	157929	7.93	7.93	31.01
2.50 - 3.00							1867	1497	371	578	815	548	59	44	74	155869	5.87	5.87	23.08
3.00 - 3.50							1082	1467	534	474	400	489	133	44	59	4684	4.68	4.68	17.21
3.50 - 4.00							534	1230	637	222	252	341	89	89	30	3424	3.42	3.42	12.52
4.00 - 4.50							311	667	1067	311	222	89	163	89	59	2979	2.98	2.98	9.10
4.50 - 5.00							237	519	593	430	74	44	44	104	44	2090	2.09	2.09	6.12
5.00 - 5.50							133	119	222	415	30	15		104	59	1097	1.10	1.10	4.03
5.50 - 6.00							15	133	119	356	163	15	15	15	15	15860	0.86	0.86	2.93
6.00 - 6.50								59	207	415	711	371	104	15	104	892075	2.07	2.07	2.07
6.50 - 7.00																0	0.00	0.00	0.00
7.00 - 7.50																0	0.00	0.00	0.00
7.50 - 8.00																0	0.00	0.00	0.00
8.00 - 8.50																0	0.00	0.00	0.00
8.50 - 9.00																0	0.00	0.00	0.00
9.00 - 9.50																0	0.00	0.00	0.00
9.50 - 10.00																0	0.00	0.00	0.00
10.00 - 10.50																0	0.00	0.00	0.00
10.50 - 11.00																0	0.00	0.00	0.00
11.00 - 11.50																0	0.00	0.00	0.00
11.50 - 12.00																0	0.00	0.00	0.00
12.00 & over																0	0.00	0.00	0.00

col total	0	59	860	1497	2534	2609	25597	22114	12494	18942	6447	3913	1245	934	608	148	100000			
A(%)	0.0	0.1	0.9	1.5	2.5	2.6	25.6	22.1	12.5	18.9	6.4	3.9	1.2	0.9	0.6	0.1				
B(%)	0.0	0.1	0.9	1.5	2.5	2.6	25.6	22.1	12.5	18.9	6.4	3.9	1.2	0.9	0.6	0.1				
C(%)	100.0	100.0	99.9	99.1	97.6	95.0	92.4	66.8	44.7	32.2	13.3	6.8	2.9	1.7	0.8	0.1				

Number of hourly records this direction: 6747  
 Total records used in selected interval: 6747  
 Per cent in this direction: 100.00

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

**2.0 FISHING SEASON ONLY**

SCATTER DIAGRAM FOR HINDCAST SIGNIFICANT WAVE HEIGHTS AND PEAK PERIODS

SCATTERB

65C

Wave data for station: FLATROCK

Wave direction NE

Wind data recorded at: FLATROCK

Selected from 08JUL56 to 31AUG75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)																see footnote for explanation of row & col percent			
	0.00 to 1.00	1.00 to 2.00	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00	5.00 to 6.00	6.00 to 7.00	7.00 to 8.00	8.00 to 9.00	9.00 to 10.00	10.00 to 11.00	11.00 to 12.00	12.00 to 13.00	13.00 to 14.00	14.00 to 15.00	15.00 & over	row total	A(%)	B(%)	C(%)
0.00 - 0.50		88	1051	1051	175		28109	11033	5079	1926							48511	48.51	41.97	86.52
0.50 - 1.00			175	788	876	701	12084	10595	5517	4553	263						35552	35.55	30.76	44.55
1.00 - 1.50					438	88	3940	3065	1576	2364	88						11559	11.56	10.00	13.79
1.50 - 2.00						175	613	525	613	350	88						2364	2.36	2.05	3.79
2.00 - 2.50							788	88	175	613	88						1751	1.75	1.52	1.74
2.50 - 3.00											88						88	0.09	0.06	0.23
3.00 - 3.50							88			88							175	0.18	0.15	0.15
3.50 - 4.00																	0	0.00	0.00	0.00
4.00 - 4.50																	0	0.00	0.00	0.00
4.50 - 5.00																	0	0.00	0.00	0.00
5.00 - 5.50																	0	0.00	0.00	0.00
5.50 - 6.00																	0	0.00	0.00	0.00
6.00 - 6.50																	0	0.00	0.00	0.00
6.50 - 7.00																	0	0.00	0.00	0.00
7.00 - 7.50																	0	0.00	0.00	0.00
7.50 - 8.00																	0	0.00	0.00	0.00
8.00 - 8.50																	0	0.00	0.00	0.00
8.50 - 9.00																	0	0.00	0.00	0.00
9.00 - 9.50																	0	0.00	0.00	0.00
9.50 - 10.00																	0	0.00	0.00	0.00
10.00 - 10.50																	0	0.00	0.00	0.00
10.50 - 11.00																	0	0.00	0.00	0.00
11.00 - 11.50																	0	0.00	0.00	0.00
11.50 - 12.00																	0	0.00	0.00	0.00
12.00 & over																	0	0.00	0.00	0.00
col total	0	88	1226	1839	1489	963	45622	25306	13047	9895	525	0	0	0	0	0	100000			
A(%)	0.0	0.1	1.2	1.8	1.5	1.0	45.6	25.3	13.0	9.9	0.5	0.0	0.0	0.0	0.0	0.0				
B(%)	0.0	0.1	1.1	1.6	1.3	0.8	39.5	21.9	11.3	8.6	0.5	0.0	0.0	0.0	0.0	0.0				
C(%)	86.5	86.5	86.4	85.4	83.8	82.5	81.7	42.2	20.3	9.0	0.5	0.0	0.0	0.0	0.0	0.0				

Number of hourly records this direction: 1142  
 Total records used in selected interval: 1320  
 Per cent in this direction: 86.52

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE Total hourly records includes calms

SCATTERS

-- GUC

Wave data for station: FLATROCK

Wave direction: NW

Wind data recorded at: FLATROCK

Selected from 08JUL56 to 31AUG75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)																see footnote for explanation of row & col percent			
	0.00 to 1.00	1.00 to 2.00	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00	5.00 to 6.00	6.00 to 7.00	7.00 to 8.00	8.00 to 9.00	9.00 to 10.00	10.00 to 11.00	11.00 to 12.00	12.00 to 13.00	13.00 to 14.00	14.00 to 15.00	15.00 & over	total	A(%)	B(%)	C(%)
0.00 - 0.50																	0	0.00	0.00	0.08
0.50 - 1.00																	0	0.00	0.00	0.08
1.00 - 1.50																	0	0.00	0.00	0.08
1.50 - 2.00																	0	0.00	0.00	0.08
2.00 - 2.50																	0	0.00	0.00	0.08
2.50 - 3.00																	0	0.00	0.00	0.08
3.00 - 3.50										100000							\$1000	100.00	0.08	0.08
3.50 - 4.00																	0	0.00	0.00	0.00
4.00 - 4.50																	0	0.00	0.00	0.00
4.50 - 5.00																	0	0.00	0.00	0.00
5.00 - 5.50																	0	0.00	0.00	0.00
5.50 - 6.00																	0	0.00	0.00	0.00
6.00 - 6.50																	0	0.00	0.00	0.00
6.50 - 7.00																	0	0.00	0.00	0.00
7.00 - 7.50																	0	0.00	0.00	0.00
7.50 - 8.00																	0	0.00	0.00	0.00
8.00 - 8.50																	0	0.00	0.00	0.00
8.50 - 9.00																	0	0.00	0.00	0.00
9.00 - 9.50																	0	0.00	0.00	0.00
9.50 - 10.00																	0	0.00	0.00	0.00
10.00 - 10.50																	0	0.00	0.00	0.00
10.50 - 11.00																	0	0.00	0.00	0.00
11.00 - 11.50																	0	0.00	0.00	0.00
11.50 - 12.00																	0	0.00	0.00	0.00
12.00 & over																	0	0.00	0.00	0.00
col total	0	0	0	0	0	0	0	0	0	100000	0	0	0	0	0	100000				
A(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0				
B(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0				
C(%)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0				

Number of hourly records this direction: 1  
 Total records used in selected interval: 1320  
 Per cent in this direction: 0.08

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

SCATTER DIAGRAM FOR HINDCAST SIGNIFICANT WAVE HEIGHTS AND PEAK PERIODS

SCATTERS

G5C

Wave data for station: FLATROCK

Wave direction: N

Wind data recorded at: FLATROCK

Selected from 08JUL56 to 31AUG75

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	*----- WAVE PERIOD (SECONDS) -----*																	see footnote for explanation of row & col percent		
	0.00 to 1.00	1.00 to 2.00	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00	5.00 to 6.00	6.00 to 7.00	7.00 to 8.00	8.00 to 9.00	9.00 to 10.00	10.00 to 11.00	11.00 to 12.00	12.00 to 13.00	13.00 to 14.00	14.00 to 15.00	15.00 & over	row total	A(%)	B(%)	C(%)
0.00 - 0.50			7910			5085	4520										17514	17.51	2.35	13.41
0.50 - 1.00			1695	11299	5085		4520	2260		1130							25989	25.99	3.48	11.06
1.00 - 1.50					9605	4520	2260	1695	1130	1130	1130	1130					22599	22.60	3.03	7.58
1.50 - 2.00					1130	2825	1130	565	4520	2825	565	565					14124	14.12	1.89	4.55
2.00 - 2.50					565	565	5650		1695	1130		565					10169	10.17	1.36	2.65
2.50 - 3.00							565	2260	1130	1130	565						5650	5.65	0.76	1.29
3.00 - 3.50								1695	565								2260	2.26	0.30	0.53
3.50 - 4.00							565			565							1130	1.13	0.15	0.23
4.00 - 4.50									565								565	0.56	0.08	0.08
4.50 - 5.00																	0	0.00	0.00	0.00
5.00 - 5.50																	0	0.00	0.00	0.00
5.50 - 6.00																	0	0.00	0.00	0.00
6.00 - 6.50																	0	0.00	0.00	0.00
6.50 - 7.00																	0	0.00	0.00	0.00
7.00 - 7.50																	0	0.00	0.00	0.00
7.50 - 8.00																	0	0.00	0.00	0.00
8.00 - 8.50																	0	0.00	0.00	0.00
8.50 - 9.00																	0	0.00	0.00	0.00
9.00 - 9.50																	0	0.00	0.00	0.00
9.50 - 10.00																	0	0.00	0.00	0.00
10.00 - 10.50																	0	0.00	0.00	0.00
10.50 - 11.00																	0	0.00	0.00	0.00
11.00 - 11.50																	0	0.00	0.00	0.00
11.50 - 12.00																	0	0.00	0.00	0.00
12.00 & over																	0	0.00	0.00	0.00
col total	0	0	9605	11299	16384	7910	12994	19774	9605	7910	2260	0	0	0	0	0	100000			
A(%)	0.0	0.0	9.6	11.3	16.4	7.9	19.8	13.0	9.6	7.9	2.3	2.3	0.0	0.0	0.0	0.0				
B(%)	0.0	0.0	1.3	1.5	2.2	1.1	2.7	1.7	1.3	1.1	0.3	0.3	0.0	0.0	0.0	0.0				
C(%)	13.4	13.4	13.4	12.1	10.6	8.4	7.3	4.7	3.0	1.7	0.6	0.3	0.0	0.0	0.0	0.0				

Number of hourly records this direction: 177  
 Total records used in selected interval: 1320  
 Per cent in this direction: 13.41

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

SCATTER DIAGRAM FOR HINDCAST SIGNIFICANT WAVE HEIGHTS AND PEAK PERIODS

SCATTERB

-- G5C

Wave data for station: FLATROCK

Wave direction: ALL

Wind data recorded at: FLATROCK

Selected from 08JUL56 to 31AUG75 ( )

Frequencies of occurrence are reported in parts per hundred thousand

WAVE HEIGHT (METRES)	WAVE PERIOD (SECONDS)																see footnote for explanation of row & col percent						
	0 00 to 1 00	1 00 to 2 00	2 00 to 3 00	3 00 to 4 00	4 00 to 5 00	5 00 to 6 00	6 00 to 7 00	7 00 to 8 00	8 00 to 9 00	9 00 to 10 00	10 00 to 11 00	11 00 to 12 00	12 00 to 13 00	13 00 to 14 00	14 00 to 15 00	15 00 & over	row total	A(%)	B(%)	C(%)			
0 00 - 0 50		76	1970	909	152		25000	10152	4394	1667							44318	44	32	44	32	100	00
0 50 - 1 00			379	2197	1439	606	11061	9470	4773	4091	227						34242	34	24	34	24	55	68
1 00 - 1 50					1667	682	3712	2879	1515	2197	227	152					13030	13	03	13	03	21	44
1 50 - 2 00					152	530	682	530	1136	682	152	76					3939	3	94	3	94	8	41
2 00 - 2 50					76	76	1439	76	379	682	76	76					2879	2	88	2	88	4	47
2 50 - 3 00							76	303	152	227	76						833	0	83	0	83	1	59
3 00 - 3 50							76	227	152		76						530	0	53	0	53	0	76
3 50 - 4 00							76				76						152	0	15	0	15	0	23
4 00 - 4 50									76								76	0	08	0	08	0	08
4 50 - 5 00																	0	0	00	0	00	0	00
5 00 - 5 50																	0	0	00	0	00	0	00
5 50 - 6 00																	0	0	00	0	00	0	00
6 00 - 6 50																	0	0	00	0	00	0	00
6 50 - 7 00																	0	0	00	0	00	0	00
7 00 - 7 50																	0	0	00	0	00	0	00
7 50 - 8 00																	0	0	00	0	00	0	00
8 00 - 8 50																	0	0	00	0	00	0	00
8 50 - 9 00																	0	0	00	0	00	0	00
9 00 - 9 50																	0	0	00	0	00	0	00
9 50 - 10 00																	0	0	00	0	00	0	00
10 00 - 10 50																	0	0	00	0	00	0	00
10 50 - 11 00																	0	0	00	0	00	0	00
11 00 - 11 50																	0	0	00	0	00	0	00
11 50 - 12 00																	0	0	00	0	00	0	00
12 00 & over																	0	0	00	0	00	0	00
col total	0	76	2348	3106	3485	1894	42121	23636	12576	9621	833	303	0	0	0	0	100000						
A(%)	0 0	0 1	2 3	3 1	3 5	1 9	42 1	23 6	12 6	9 6	0 8	0 3	0 0	0 0	0 0	0 0							
B(%)	0 0	0 1	2 3	3 1	3 5	1 9	42 1	23 6	12 6	9 6	0 8	0 3	0 0	0 0	0 0	0 0							
C(%)	100 0	100 0	99 9	97 6	94 5	91 0	89 1	47 0	23 3	10 8	1 1	0 3	0 0	0 0	0 0	0 0							

Number of hourly records this direction: 1320  
 Total records used in selected interval: 1320  
 Per cent in this direction: 100.00

Row and column percentages have the following meanings:

- A -- based on hourly records in this direction
- B -- based on total number of records used in selected interval
- C -- percentages exceedance derived from "B"

NOTE: Total hourly records includes calms

**APPENDIX C**

Photographs



1. Martin's Point Landing Wharf



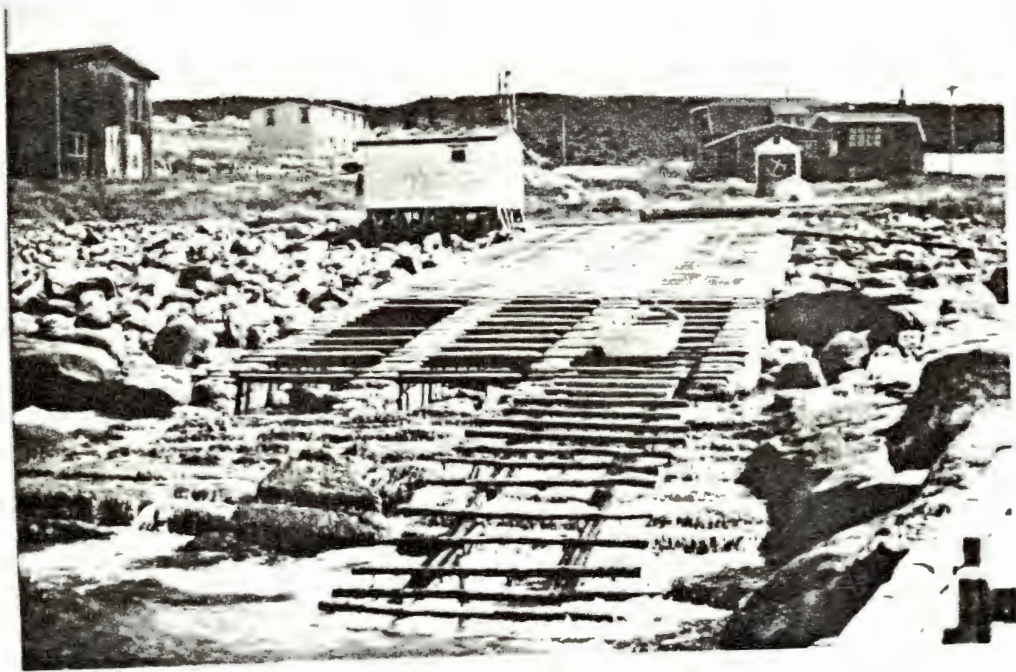
2. Martin's Point Landing Wharf and Approach



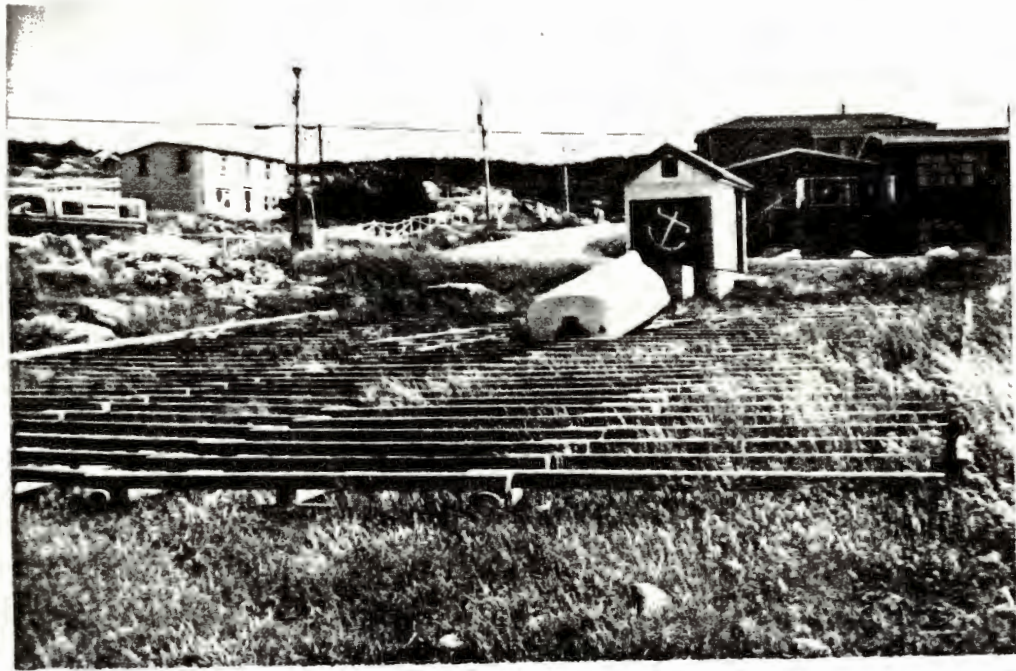
3. Fishermen's Center / Gear Storage Building



4. Martin's Point (Flatrocks) Slipway



5. Morey's Point (Beach) Slipway



6. Boat Storage Area and Winch House (Morey's Point)



7. Morey's Point Slipway and Landing Facility



8. Wade's Point - Site of Proposed Development



9. Overview of Flatrock Harbour