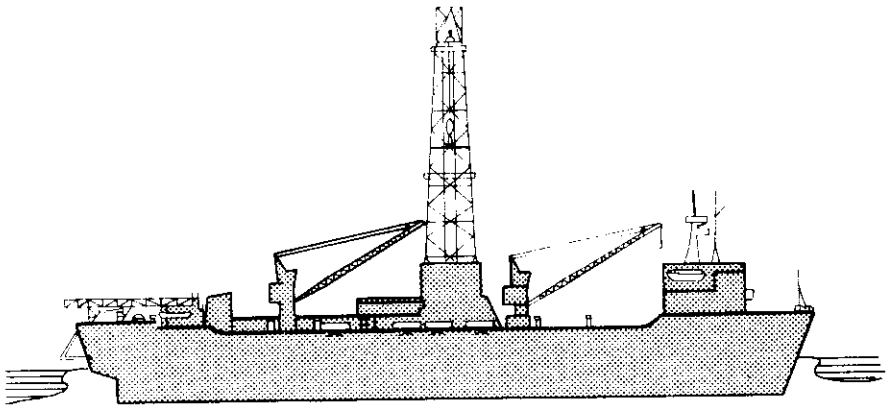
1176

Exploration Plan

OCS Lease Sale Area 109

Chukchi Sea, Alaska

Remote Offshore Prospects



Prepared for

Shell Western E&P Inc.

Anchorage, Alaska

Prepared by

ENSR Consulting & Engineering

Anchorage, Alaska

January 1989

Shell Western E&P Inc.

601 West Fifth Avenue • Suite 810
Anchorage, Alaska 99501

July 24, 1989

Mr. Rodney A. Smith
Minerals Management Service
Alaska OCS Region
U. S. Department of the Interior
949 East 36th Avenue
Anchorage, Alaska 99508

Dear Mr. Smith:

SUBJECT: TYPOGRAPHICAL ERRORS IN SWEPI CHUKCHI EXPLORATION PLAN AND MMS FINDING OF NO SIGNIFICANT IMPACT

During a review of the subject documents, we discovered the following typographical errors:

Exploration Plan - Remote Offshore Prospects

Page 5, Table 1, OCS-Y-1368-1 should be OCS-Y-1365-1 NR 3-1
71-09-16.34N should be 71-08-16.34N

Page 7, Table 1, OCS-Y-1355-1 should be OCS-Y-1335-1 NR 3-1

Finding of No Significant Impact

Page 2, Lease 1355 Block 801 should be Lease 1335 Block 676 NR 3-1
Lease 1368 Block 888 should be Lease 1365 Block 854 NR 3-1

If you have any questions or required further information, please call me at 907/276-2545.

Sincerely,

W. F. Simpson

W. F. Simpson
Manager Regulatory Affairs
Alaska Division

WFS/kd

Enclosure

WFSE/072189

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Cerveza	OCS-Y-1176-1	72-35-37.22N 168-04-30.49W	15,000	180
	OCS-Y-1178-1	72-30-14.34N 168-11-48.75W	15,000	180
Crackerjack	OCS-Y-1305-1	71-28-49.00N 165-45-12.10W	11,500	140
	OCS-Y-1304-1	71-30-06.63N 165-49-41.48W	9,500	140
	OCS-Y-1320-1	71-25-07.71N 165-32-29.51W	15,000	140
	OCS-Y-1321-1	71-23-23.57N 165-26-33.33W	15,000	140
	OCS-Y-1350-1	71-13-37.71N 166-13-44.23W	9,000	140
	OCS-Y-1355-1	71-20-08.97N 165-57-39.88W	10,600	140
	OCS-Y-1336-1	71-18-22.00N 165-48-57.45W	15,000	140

TABLE 1

Preliminary List of Exploratory Well Locations
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Baby Ruth	OCS-Y-1365-1	71-08-16.34N 165-43-08.75W	15,000	140
	OCS-Y-1366-1	71-07-48.38N 165-32-38.87W	15,000	140
Blizzard	OCS-Y-1386-1	71-46-18.59N 163-34-50.92W	15,000	130
	OCS-Y-1391-1	71-40-59.63N 163-43-08.56W	15,000	130
	OCS-Y-1389-1	71-43-45.54N 163-41-49.46W	15,000	130
Burger	OCS-Y-1413-1	71-15-04.91N 163-11-40.78W	12,300	145
	OCS-Y-1421-1	71-12-13.52N 163-18-35.25W	12,600	145
	OCS-Y-1400-1	71-20-03.86N 163-10-42.06W	10,000	145

CORRECTIONS Page 2

United States
Department of the Interior
Minerals Management Service
Alaskan OCS Region
949 East 36th Avenue
Anchorage, Alaska 99508

NOTICE

February 17, 1989

FINDING OF NO SIGNIFICANT IMPACT

The Minerals Management Service (MMS), in accordance with the regulations implementing the National Environmental Policy Act (NEPA) (40 CFR 1501.4 [e] [1] and 1506.6 [b], announces the availability of a Finding of No Significant Impact (FONSI) for the activity listed below:

Proposal

Shell Western Exploration and Production Inc., as operator for itself and others; Conoco Inc.; and Elf Aquitaine Inc. propose to drill one or two wells per year for 3 to 5 years to explore 13 "Remote Offshore" prospects and 5 "Near Offshore" prospects on leases acquired from Lease Sale 109 of May 1988. The Near Offshore leases are located in the eastern Chukchi Sea west of Icy Cape and Point Lay, 10 to 50 miles offshore in approximately 65 to 120 feet of water. The Remote Offshore leases are located in the central and northern Chukchi Sea Planning Area, 60 to 210 miles offshore in approximately 130 to 180 feet of water. The Remote Offshore prospects will most likely be explored first. The wells will be drilled during the open-water season, generally late June through October, from the CANMAR Explorer III--an ice-strengthened drillship--beginning as early as 1989. Drilling operations will occur after the spring bowhead whale migration.

Location

Lease		Block(s)
Near Offshore Leases		
OCS-Y	1505	NR 6-4 366
	1506	367
	1509	368
	1510	411
	1511	412
	1512	413
	1516	414
	1517	456
	1518	457
	1520	458
	1525	501

Remote Offshore Leases

Lease	Block(s)
1176	NS-208 373
1183	NS-307 227
1185	271
1196	400
1200	488
1204	574
1264	NR-301 106
1275	150
1305	502
1321	592
1336	677
1355	AMOCO 801 676
1366	855
1386	NR-302 187
1391	274
1400	630
1405	673
1415	720
1421	761
1456	NR-303 109
1465	155
1476	241
1483	288

Lease	Block(s)
1178	NS-208 460
1184	NS-307 229
1189	317
1198	444
1203	531
1207	618
1265	NR-301 107
1304	501
1320	591
1326	632
1350	762
1359	807
1368	TEXACO 888 854
1389	NR-302 230
1399	629
1404	672
1413	718
1420	760
1430	807
1462	NR-303 152
1466	156
1482	287
1494	418

Environmental Assessment (EA)

EA No. 89-01

FONSI Date

February 17, 1989

SUPPLEMENTARY INFORMATION: The MMS prepares EA's and FONSI's for proposals which relate to exploration of oil and gas resources on the Alaska Outer Continental Shelf (OCS).

The EA's examine the potential environmental effects of activities described in the proposals and present MMS conclusions regarding the significance of those effects. The EA's are used as a basis for determining whether approval of the proposals constitutes major Federal actions that significantly affect the quality of the human environment in the sense of NEPA Section 102 (2) (C).

A FONSI is prepared in those instances where the MMS finds that approval will not result in significant effects on the quality of the human environment. The FONSI briefly presents the basis of that finding and includes a summary or copy of the EA.

The FONSI and associated EA for the activity listed above are available for public inspection between the hours of 7:30 a.m. and 4:30 p.m., Monday through Friday at:

Minerals Management Service
Alaska OCS Region
Library
949 East 36th Avenue, Room 502
Anchorage, Alaska 99508
Phone: (907) 261-4435

Persons interested in reviewing specific environmental documents, or obtaining information about EA's and FONSI's prepared for activities on the Alaska OCS, are encouraged to contact the above-listed MMS office.

Alan D. Powers

Shell Western E&P Inc.

601 West Fifth Avenue • Suite 810
Anchorage, Alaska 99501

January 13, 1989

Mr. Rodney O. Smith
Regional Supervisor
Field Operations (RS/FO)
U. S. Department of the Interior
Minerals Management Service
Alaska OCS Region
949 East 36th Avenue, Suite 110
Anchorage, Alaska 99508-4302

Dear Mr. Smith:

SUBJECT: SUBMISSION OF CHUKCHI SEA EXPLORATION PLANS

We are pleased to submit Shell Western E&P Inc. (SWEPI's) Exploration Plans for leases in the Chukchi Sea obtained through OCS Sale 109.

SWEPI is submitting two separate Exploration Plans to cover these leases. We have determined that our Chukchi Sea drilling prospects located 50 miles or more from the mainland have a higher priority for exploration activities than those closer to shore. Due to the significant differences between the two areas in terms of water depths, geology, environmental sensitivities, and subsistence use of land adjacent to the near offshore tracts, SWEPI has prepared a separate Exploration Plan for each area (Remote Offshore Prospects and Near Offshore Prospects).

During the initial years of operation (1989 and 1990), SWEPI will attempt to concentrate all drilling activities within the more remote offshore leases. Exploration drilling in the leases located within 50 miles of the mainland (some of which are within the spring whale migration area) will not be considered during these early years unless ice conditions farther offshore preclude the possibility of drilling in the deeper waters. As such, we request priority approval be given the Remote Offshore plan.

Minimal impact to seasonal whale migration and feeding zones is anticipated as a result of Chukchi Sea exploratory drilling activities. Consequently, the cultural impacts, particularly those related to subsistence whaling, are considered to be minimal. Although the Beaufort offshore exploration activities have served as a model for expected Chukchi Sea activities, any potential cultural influences are further reduced due to the remoteness of the prospects and timing of the drilling season relative to the subsistence whale hunting season.

However, SWEPI has taken further steps to mitigate even minimal adverse impacts. These steps include:

- Drilling and seismic activities are planned to be conducted from June through November. This will postpone rig startup until after the spring bowhead migration.

- An oil spill response barge will be outfitted and will generally remain within close proximity of the exploration prospects during drilling activities.

  Depending on the weather and sea conditions, the Oil Spill Response Barge could be positioned in Kotzebue Sound. Also, the barge may sometimes be stationed mid-way between Barrow and the rig location as an emergency helicopter landing site.

- Barrow's existing facilities will be used for all primary air logistics support.

- Kotzebue will provide marine support when required.

- Kuparuk, Deadhorse, and Umiat will be utilized as secondary air logistics support bases.

- Except for emergencies, no direct support facilities are planned at Wainwright, Point Hope, and Point Lay. This will minimize onshore activities near all identified environmentally sensitive areas.

- Air and marine transportation routes will be selected to minimize adverse effects on subsistence resources and activities.

- The drilling support vessels will employ state-of-the-art ice management procedures.

- A life-saving capability will exist through the availability of the medic on the drillship and helicopter support.

- A minimum of four Native residents from each of four villages along the Chukchi coast (Pt. Hope, Pt. Lay, Wainwright, and Barrow) will be offered employment opportunities for various drillship, support vessel, and oil spill response duties.

SWEPI recognizes the critical importance of local cultural resources, has taken early steps to identify key local cultural resource concerns, and has prepared exploration plans with strong considerations for North Slope resident concerns.

The Exploration Plan submission is complete with the following exceptions:

1) Exhibit 1-1. General Geological Information. This proprietary information was submitted under separate cover on January 4, 1989.

2) Exhibit 1-2. Geohazards Report. A geohazards report, based upon 1988 surveys, will be submitted in early 1989. Additional reports from future surveys will be submitted when they become available.

3) Exhibit 3-1. Environmental and Cultural Orientation Program. The production of the video portion of the program is currently scheduled to be completed by January, 1989. The handout materials should be completed by February, 1989.

4) Exhibit 3-2. Local Consultation Document, Stipulation No. 8--Subsistence Whaling and other Subsistence Activities. SWEPI met with residents and officials of Barrow, Wainwright, Point Lay, and Point Hope in July, 1988, and again in mid-December. The comments and questions received at each village and our responses are included in Exhibit 3-2. When this process is complete, Exhibit 3-2 will be sent to you. We anticipate that this will be in early January, 1989.

5) Exhibit 5-1. Hydrogen Sulfide Contingency Plan. This Plan is being finalized and should be available to the MMS in February, 1989.

6) Exhibit 6-1 and 6-2. Explorer III Operations Manual and Explorer III Critical Operations Plan. These proprietary exhibits will be forwarded under separate cover.

Please direct further information requests on the Exploration Plans to me or Ms. Susan Brown-Maunder at (907)276-2545.

Sincerely,

W. F. Simpson

W. F. Simpson
Manager Regulatory Affairs
Alaska Division

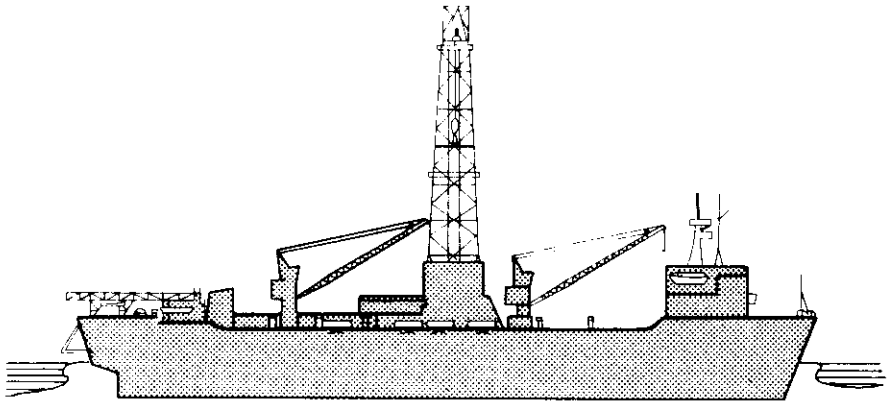
WFS/kt

Exploration Plan

OCS Lease Sale Area 109

Chukchi Sea, Alaska

Remote Offshore Prospects



Prepared for

Shell Western E&P Inc.

Anchorage, Alaska

Prepared by

ENSR Consulting & Engineering

Anchorage, Alaska

January 1989

EXPLORATION PLAN

TABLE OF CONTENTS

EXPLORATION PLAN

LIST OF TABLES

LIST OF FIGURES

EXPLORATION PLAN

LIST OF ATTACHMENTS

EXPLORATION PLAN ATTACHMENTS

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF TABLES (Cont'd)

EXPLORATION PLAN ATTACHMENTS

LIST OF FIGURES

LIST OF EXHIBITS*

Exhibit	Title
1	Canmar Explorer III, General Arrangement Tank Top and Tweendecks
2	Canmar Explorer III, General Arrangement Main Deck and Deckhouses
3	Canmar Explorer III, General Arrangement Outboard Profile
4	Canmar Explorer III, Flammable and Toxic Gas Detection and Alarm System Arrangement
1-1	General Geological Information
1-2	Geohazards Report
2-1	Oil Spill Contingency Plan
3-1	Environmental Orientation Program
3-2	Local Consultation Documentation
5-1	Hydrogen Sulfide Contingency Plan
6-1	Canmar Explorer III Operations Manual
6-2	Canmar Explorer III Critical Operations and Curtailment Plan

* All exhibits are prepared as separate documents.

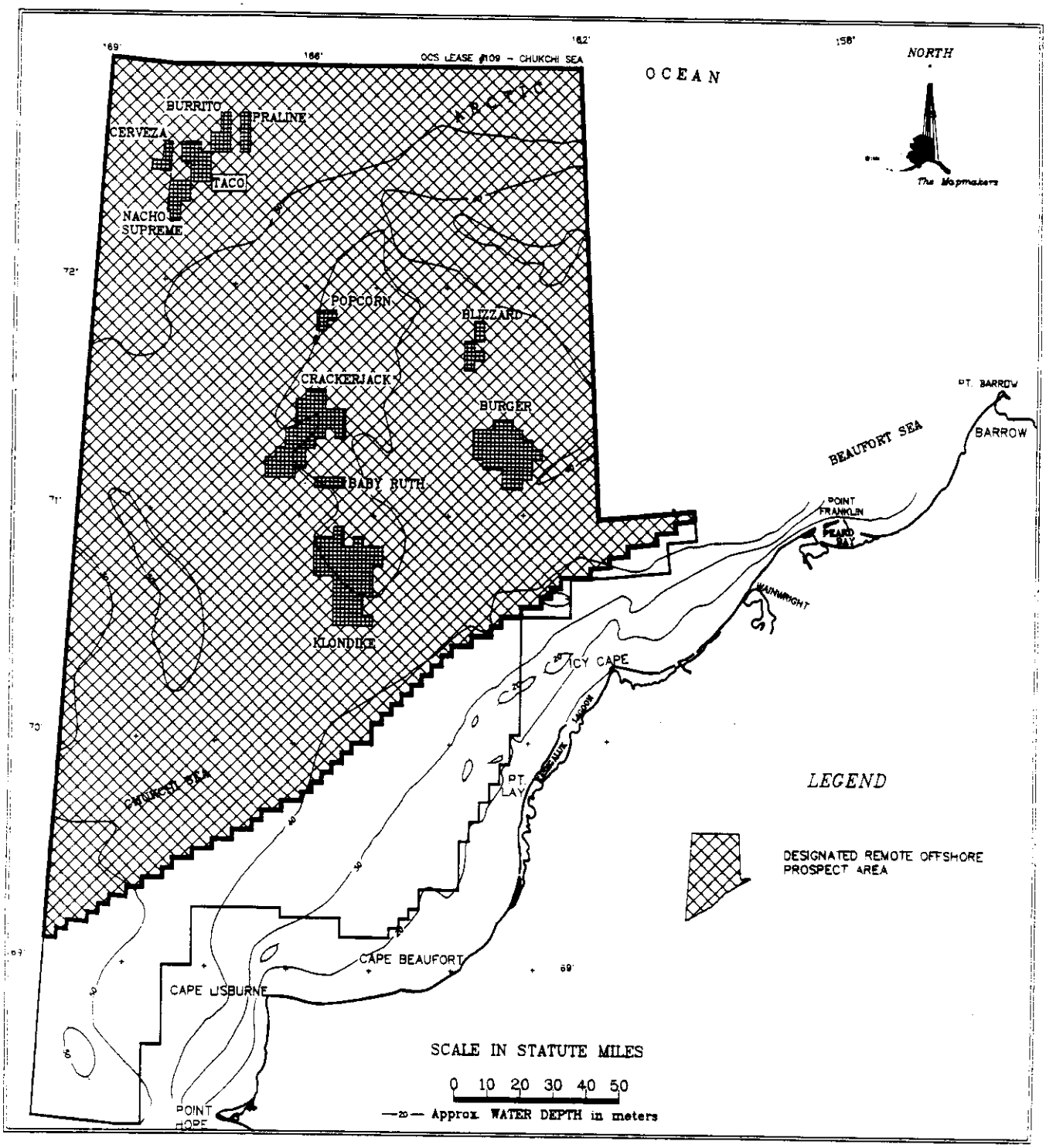


FIGURE 1. REMOTE OFFSHORE PROSPECT AREA REFERENCE MAP

1. INTRODUCTION

1.1 General

This Exploration Plan is submitted by Shell Western E&P Inc. (SWEPI) and covers proposed exploratory oil and gas drilling activities for REMOTE OFFSHORE PROSPECTS in OCS Lease Sale Area 109, Chukchi Sea, Alaska.

The Exploration Plan has been prepared under the revised 30 CFR, Parts 250 and 256, "Oil and Gas and Sulphur Operations in The Outer Continental Shelf, Final Rule" as presented in the April 1, 1988 Federal Register. The format presented in the Final Rule has been used throughout this document to retain consistency. In accordance with these new guidelines, information which would have been previously provided within a separate Environmental Report, is presented in the 21 Attachments to this Exploration Plan. Documentation referenced in the Attachments, which is extensive or proprietary, is provided as separate exhibits.

In general, SWEPI considers the leases which are more than 50 miles offshore to have a higher priority for exploration activities than leases located nearshore, within 50 miles of the coastline. For presentation purposes within this Exploration Plan, the 50-mile demarcation line will coincide with the Minerals Management Service (MMS) lease block boundary line presented in Lease Stipulation Numbers 6 and 7, OCS Lease Sale Area 109, Chukchi Sea, Alaska. Leases seaward of this line will be designated herein as REMOTE OFFSHORE PROSPECTS Figure 1, Reference Plan, opposite; while leases landward of this line will be designated herein as NEAR OFFSHORE PROSPECTS. Some NEAR OFFSHORE PROSPECTS lie within the spring whale migration area, while all REMOTE OFFSHORE PROSPECTS lie outside the spring whale migration area, Figure 2, Lease Stipulation Boundary Line. SWEPI has prepared a separate exploration plan for the REMOTE OFFSHORE and NEAR OFFSHORE PROSPECTS due, primarily, to the

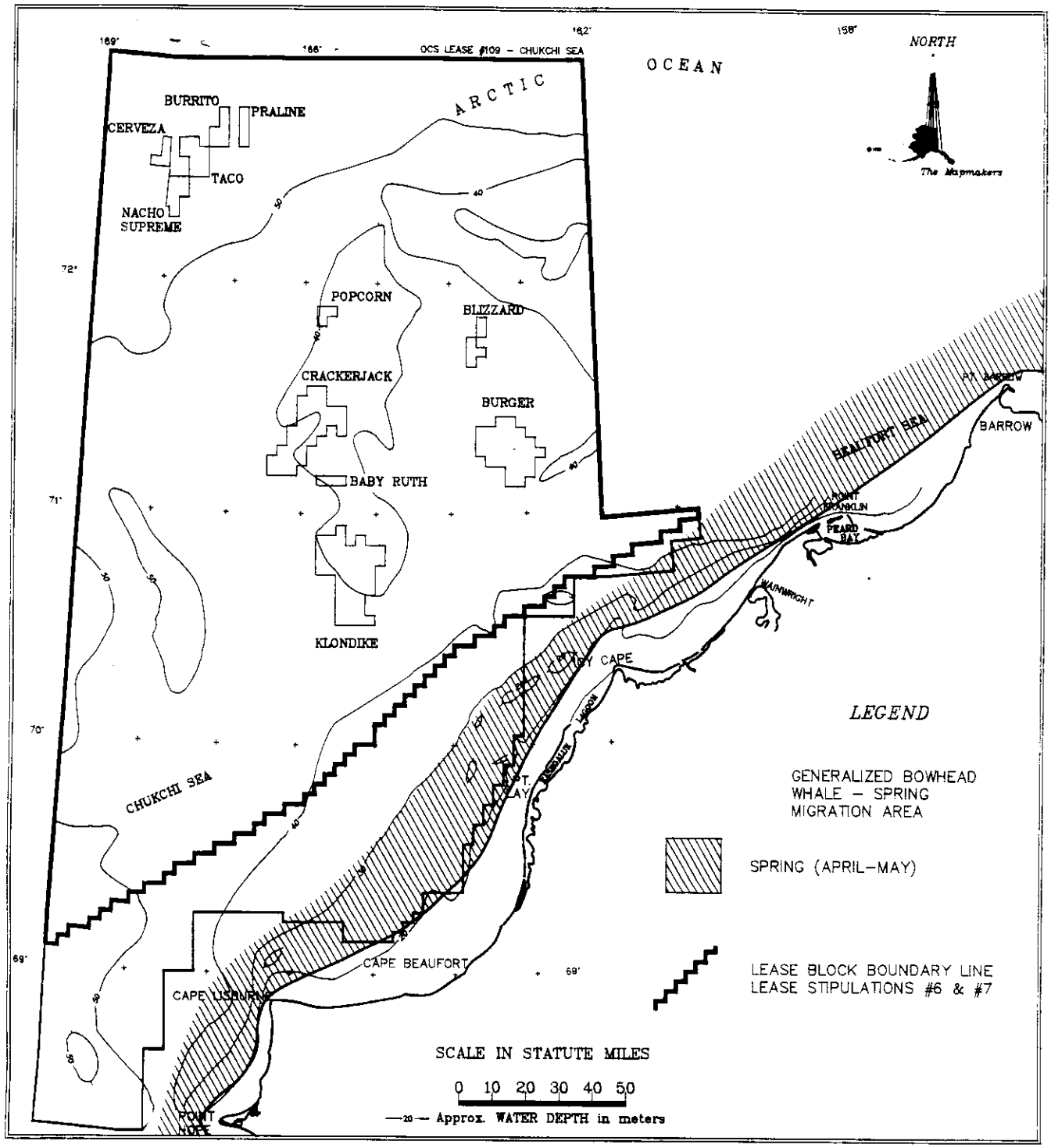


FIGURE 2. LEASE STIPULATION NUMBERS 6 and 7 BOUNDARY LINE

distinct geological and environmental characteristics associated with the respective areas.

During the initial years (1989/1990), SWEPI will concentrate drilling activities on the REMOTE OFFSHORE PROSPECTS. During this period, drilling activities on the NEAR OFFSHORE PROSPECTS will be conducted only if the ice conditions do not permit drilling on the REMOTE OFFSHORE PROSPECTS. SWEPI anticipates conducting geohazard surveys, as required, within both the REMOTE OFFSHORE and NEAR OFFSHORE PROSPECT areas during most summer seasons and years.

1.2 Type and Sequence of Exploration Activities

This Exploration Plan covers the drilling of exploratory wells on SWEPI's REMOTE OFFSHORE PROSPECTS during the ten-year term of the affected leases. The specific drilling program for each exploratory well will be defined in the Applications for Permit to Drill (APD) which will be submitted in advance of each drilling season. In these applications, the drilling fluid program, coring design, formation evaluation program, cementing program, hydraulics program, and other engineering material will be presented in detail. Much of this information will be proprietary in nature.

Table 1 is a preliminary list of exploratory well locations which are being considered for evaluation of the hydrocarbon potential of SWEPI's leases in the OCS Lease Sale Area 109, Chukchi Sea, Alaska during the exploration drilling phase of this project. Figure 3 shows the presently defined sequence of exploration activities through 1992. The schedule of activities, as well as the decision on when and where to drill specific wells, must remain flexible so that adjustments can be made as new data are

obtained from drilling. These decisions also will be dependent upon weather, sea state, ice conditions, availability of appropriate drilling equipment, results of drilling and seismic surveys conducted in the area, and/or government-imposed restrictions. Variations in the proposed schedule are likely due to early or late breakup, major interference from masses of multi-year ice, or early or late freezeup.

SWEPI has contracted the Canmar Explorer III drillship for the proposed program. So long as this is the only drilling vessel contracted for the project, exploration will most likely be limited to one or two wells per season. In the event that SWEPI contracts for an additional drilling vessel, the drilling schedule could be accelerated.

At present, the drillship Explorer III and its support vessels are in Victoria, B.C., Canada. The Explorer III is being modified to meet current U.S. Coast Guard Fire and Safety regulations; a top drive is being installed on the derrick; and SWEPI's communication equipment is being placed onboard. It is anticipated that this work on the drillship will be completed by May 1989 and that the Explorer III and support vessels will be moved to the Chukchi Sea in June 1989. Actual drilling will occur during the months of June through November depending on weather and ice conditions. At the completion of the 1989 drilling season, the Explorer III and support vessels will move to an undetermined West Coast port for overwintering and restocking for the following year's drilling activity.

Some lease block clearing activities (i.e., geohazards surveys) were conducted over SWEPI's blocks during 1988. It is planned that those activities will be continued during successive open water seasons, as required, in support of drilling activities.

TABLE 1

Preliminary List of Exploratory Well Locations
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Baby Ruth	OCS-Y-~~1368~~ 1365-1	71-08-16.34N 165-43-08.75W	15,000	140
	OCS-Y-1366-1	71-07-48.38N 165-32-38.87W	15,000	140
Blizzard	OCS-Y-1386-1	71-46-18.59N 163-34-50.92W	15,000	130
	OCS-Y-1391-1	71-40-59.63N 163-43-08.56W	15,000	130
	OCS-Y-1389-1	71-43-45.54N 163-41-49.46W	15,000	130
Burger	OCS-Y-1413-1	71-15-04.91N 163-11-40.78W	12,300	145
	OCS-Y-1421-1	71-12-13.52N 163-18-35.25W	12,600	145
	OCS-Y-1400-1	71-20-03.86N 163-10-42.06W	10,000	145

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Burger (Cont'd)	OCS-Y-1415-1	71-16-28.54N 162-57-23.40W	9,000	145
	OCS-Y-1405-1	71-17-33.03N 163-20-55.56W	10,500	145
	OCS-Y-1430-1	71-10-03.81N 163-03-30.47W	9,500	145
	OCS-Y-1399-1	71-22-23.79N 163-21-46.01W	10,000	145
	OCS-Y-1420-1	71-12-24.37N 163-27-06.57W	9,500	145
	OCS-Y-1404-1	71-19-07.26N 163-29-36.86W	9,000	145
Burrito	OCS-Y-1185-1	72-41-11.93N 167-15-47.82W	16,000	175
	OCS-Y-1183-1	72-36-00.37N 167-14-41.91W	16,000	175

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Cerveza	OCS-Y-1176-1	72-35-37.22N 168-04-30.49W	15,000	180
	OCS-Y-1178-1	72-30-14.34N 168-11-48.75W	15,000	180
Crackerjack	OCS-Y-1305-1	71-28-49.00N 165-45-12.10W	11,500	140
	OCS-Y-1304-1	71-30-06.63N 165-49-41.48W	9,500	140
	OCS-Y-1320-1	71-25-07.71N 165-32-29.51W	15,000	140
	OCS-Y-1321-1	71-23-23.57N 165-26-33.33W	15,000	140
	OCS-Y-1350-1	71-13-37.71N 166-13-44.23W	9,000	140
[redacted] Corrected by Shell 7/29/89	OCS-Y-~~1355~~ 1335-1	71-20-08.97N 165-57-39.88W	10,600	140
	OCS-Y-1336-1	71-18-22.00N 165-48-57.45W	15,000	140

7

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Crackerjack (Cont'd)				
	OCS-Y-1359-1	71-11-57.22N 166-05-45.32W	12,000	140
	OCS-Y-1326-1	71-21-22.05N 166-03-41.36W	8,500	140
Klondike	OCS-Y-1482-1	70-42-39.20N 165-14-58.71W	15,000	140
	OCS-Y-1476-1	70-45-18.23N 165-27-17.51W	11,500	140
	OCS-Y-1466-1	70-51-24.93N 165-03-11.32W	15,500	140
	OCS-Y-1494-1	70-36-17.99N 165-20-36.64W	12,500	140
	OCS-Y-1465-1	70-50-20.97N 165-12-25.38W	12,500	140
	OCS-Y-1456-1	70-52-33.10N 165-23-33.93W	12,500	140

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Klondike (Cont'd)				
	OCS-Y-1462-1	70-49-58.33N 165-34-28.00W	14,000	140
	OCS-Y-1483-1	70-42-33.01N 165-00-13.27W	12,500	140
Nacho Supreme	OCS-Y-1204-1	72-22-33.43N 167-58-39.16W	15,700	170
	OCS-Y-1207-1	72-20-15.59N 167-51-37.48W	15,700	170
	OCS-Y-1203-1	72-25-25.57N 167-49-36.71W	15,400	170
Popcorn	OCS-Y-1275-1	71-51-16.28N 165-48-23.57W	14,500	140
Alternate	OCS-Y-1275-1	71-51-18.35N 165-49-42.81W	14,500	140

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Popcorn (Cont'd)				
	OCS-Y-1275-2	71-50-24.97N 165-44-11.14W	15,000	140
	OCS-Y-1265-1	71-51-20.60N 165-36-19.48W	15,000	140
	OCS-Y-1264-2	71-52-45.03N 165-49-46.74W	14,000	140
	OCS-Y-1264-3	71-52-03.96N 165-43-08.49W	15,000	140
Praline	OCS-Y-1189-1	72-38-18.20N 166-57-34.79W	17,000	175
	OCS-Y-1184-1	72-43-37.51N 166-53-49.61W	17,000	175

TABLE 1

Preliminary List of Exploratory Well Locations (Cont'd)
REMOTE OFFSHORE PROSPECTS*

Prospect Area	Well Name	Geodetic Coordinates Surface Location	Proposed TD (in ft)	Approximate Water Depth (in ft)
Taco	OCS-Y-1196-1	72-33-19.34N 167-43-11.05W	15,000	180
	OCS-Y-1200-1	72-27-04.39N 167-36-37.91W	16,000	180
	OCS-Y-1198-1	72-30-40.44N 167-35-07.93W	15,500	180

* In spite of the large number of identified well locations, the total number drilled in any single year is not expected to be more than 1 or 2 wells. Partially, this number is limited by the availability of rigs capable of drilling in the rigorous Arctic conditions of the Chukchi Sea. The actual number of wells drilling in any single year will depend strongly on the results of early wells.

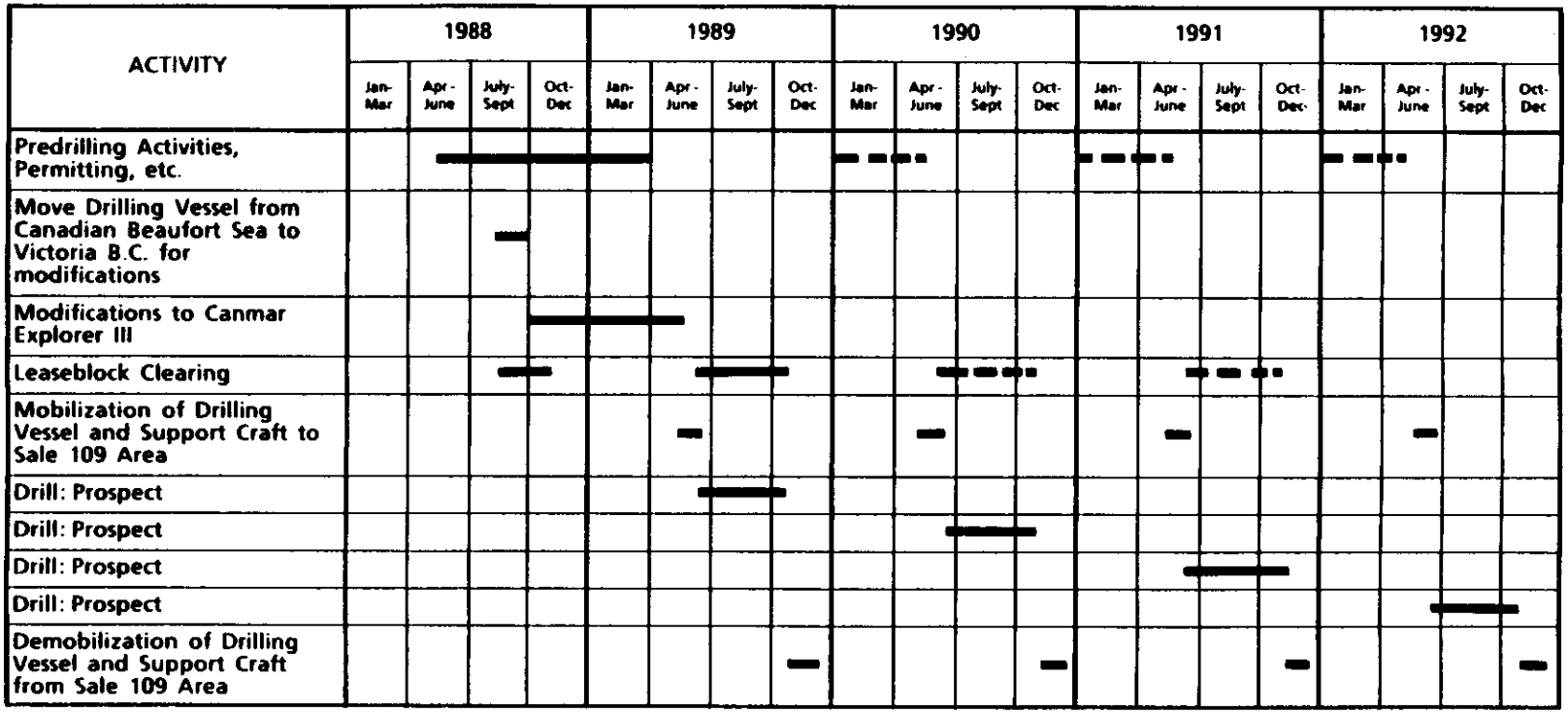


Figure 3. Proposed Schedule of Exploration Activities

2. DESCRIPTION OF THE DRILLING UNIT AND SUPPORT VESSELS

2.1 General

The drillship Canmar Explorer III or another suitable vessel will be used to drill the exploratory wells covered by this Exploration Plan. Prior to the use of an alternate vessel, details and specifications will be provided.

The Explorer III was built in 1973 specifically for offshore oil and gas operations in the Arctic regions of the world. The physical layout of the vessel is illustrated in Exhibits 1 through 4 presented as separate documents. Support vessels will include the M/V Robert LeMeur, the M/V Supplier III, the M/V Supplier IV, and the U.S. flag oil spill response barge and tug.

The following sections provide brief descriptions of the Canmar vessels. Additional information is provided on the data sheets of the following pages and in the appendices.

2.2 Explorer III Specifications

The Explorer III is the largest drillship in the Canmar fleet, and was developed for offshore oil and gas exploration in the Arctic regions of the world. The hull is built to DNV 1A1* Ice A* specifications, is fully equipped for open water arctic environmental conditions, and is classified by Det Norske Veritas (DNV).

The Explorer III has a rated drilling capacity of 24,000 feet in water depths up to 1,000 feet. The large storage capacity and up-to-date drilling equipment enable the drillship to sustain long periods of uninterrupted service.

CANMAR

EXPLORER III

CANMAR Explorer III is the largest drillship in the CANMAR fleet, developed for offshore oil and gas exploration in the Arctic regions of the world. The hull has been built to DNV 1A1*Ice A* specifications, is fully equipped for open water Arctic environmental conditions, and is classified by DNV.

CANMAR Explorer III has a rated drilling capacity of 6 000 metres in water depths up to 300 metres. The large storage capacity and most up-to-date drilling equipment enable the drillship to sustain long periods of uninterrupted service.

The derrick has a 600 tonne gross nominal capacity and is supported by advanced handling equipment for drill pipe, casing, tubing and B.O.P.s to ensure efficient drilling operations. Power is provided by a diesel electric system, consisting of five S.A.C.M. AGO-V16-ESHR-240 turbocharged engines driving five AEG generators delivering a total of 12 000 KW at 6000V and 60HZ. The ship is propelled by four electric motors with a total output of 4 472 KW (6,000 HP), and five 1 350 KW (1,750 HP) thrusters.

All eight mooring lines are equipped with remote anchor release units. This special feature, in conjunction with the collapsible pawls installed on the drums, allows quick disconnection from the anchors, enabling the ship to withdraw from the drilling location quickly in the event of ice encroachment.

CANMAR Explorer III has accommodation for 103 persons, and includes offices, a galley and mess room, a recreation area, and a 4-bed hospital.

CANMAR

EXPLORER III

PRINCIPAL DIMENSIONS

Length overall	149.25 m (489'-8")
Beam, main deck	23.79m (78'-1")
Depth	12.50 m (41'-0")
Draft (max)	7.50 m (24'-7")
Displacement (max)	16 519 tonnes (16,260 tons)
Displacement (lightship)	9 299 tonnes (9,152 tons)
Variable load	7 220 tonnes (7,106 tons)
Water depth capacity	30 m - 305 m (100'-1,000')
Helideck	Sikorsky S-61 or similar, plus refuelling system
Accommodation	Quarters for 103 persons, also recreation area and a 4-bed hospital

STORAGE CAPACITY

Bulk cement and mud (12 silos)	532 m^3 (18,000 ft^3)
Sack material	400 tonnes (440 tons)
Liquid mud	334 m^3 (2,100 bbls.)
Fuel	3 397 m^3, (897,300 U.S. gal.)
Potable water	269 m^3 (71,000 U.S. gal.)
Drill Water	424 m^3 (112,100 U.S. gal.)
Casing	697 tonnes (686 tons)
Drill Pipe	440 tonnes (433 tons)
Riser	110 tonnes (108 tons)

POWER PLANT

Main Engines AC Generators	Five S.A.C.M. AGO V16, 2 500 kW (3,400 BHP) Five A.E.G. 3 000 kVA-6 000 VAC
DC Conversion	Eight A.E.G. SCR's, 1,200 Amp @ 530 VDC
Habor Generator	One S.A.C.M. MGO V12, 600 kW (800 HP), 440 VAC
Emergency Generator	One SCANIA 120 kW (160 HP), 440 VAC

PROPULSION

Main Propulsion	Four 1 120 kW (1,500 HP) motors, total continuous power 4 472 kW (6,000 HP). Two 3.96 m (13') variable pitch propellers
Thrusters	Five LIPS NV Model BP-176 tunnel-type thrusters driven by five AEG model AJ63055 motors at six KV, 1 350 kW (1,750 HP) each
Speed	Fourteen knots

POSITIONING

Mooring System	Eight point system with acoustic quick release modules on all eight lines. Four Skagit model DMW-250 diesel driven double drum winches with collapsible pawls and 70 mm (2-¾") wires. Eight 6 500 kg (14,300 lbs) Bruce anchors
Dynamic Postioning	Honeywell dual-automatic system

MAJOR DRILLING EQUIPMENT

Derrick	48.66 m 13.51 x 10.97 m base (160', 44' x 36') 600 tonnes (665 tons) capacity. Designed for 160 km/h (100 mph) wind
Drawworks	National Model 1625-DE with Baylor Elmagco Model 7838 auxiliary brake
Rotary Table	National Model C375 953 mm (37½")
Motion Compensator	IHC crown block heave compensator with 200 tonnes (220 tons) capacity and a 4.6 m (15') stroke
Mud Pumps	Two National Model 12P-160 pumps each driven by two AEG 800 HP DC motors
Solids Control	Three Swaco tandem shale shakers, desander, two Swaco desilters, Wagner Sigma 100 Centrifuge
Cement Pumps	One Dowell electric drive model TLO rated at 34.5 MPa (5,000 psi) One Dowell electric driven model TLO rated at 69.0 MPa (10,000 psi)
Drill String	6 000 m (20,000') 127 mm (5") drill pipes, Grade E & G

B.O.P./RISER

Blowout Preventers	476 mm 69.0 MPa WP (18-¾" 10,000 psi) system One NL Shaffer type LWS triple ram One NL Shaffer type LWS single ram One NL Shaffer double spherical, 34.5 MPa (5,000 psi) WP
Marine Riser	559 mm (22") Vetco riser with MR6C connectors c/w ball joint 69.0 MPa (10,000 psi) choke and kill lines
Telescopic Joint	Vecto 17 m (55') stroke
Diverter	Regan KFDS system
B.O.P. Control	Koomey Hydraulics control system
Choke Manifold	69.0 MPa (10,000 psi) system with Cameron auto choke

AUXILIARY EQUIPMENT

B.O.P. Handling System	Two 90 tonne (100 ton) capacity hydraulic trolley carts
Cranes	One IHC 28 m (90') 36 tonnes (40 tons) One IHC 28 m (90') 23 tonnes (25 tons) Both equipped with remote control
Pipe Racker	Byron Jackson
TV and Diving	T.V. system rated at 366 m (1,200') C.G. Dorsi with bell and guiding device and decom-pression chamber rated at 300 m (1,000')
Re-Entry	Acoustic long baseline navigation system

SPECIAL FEATURES

Ice Reinforcement	Hull reinforced to DNV 1A1* Ice A* specification. Propulsion equipment meets DNV 1A1 Ice B specification. Hull corresponds to Type C of Canadian Regulations
Radar	Derrick Top for Ice Managment

Printed in Canada

ROBERT LEMEUR

Icebreaker/Supply Vessel

REGISTRATION

Builder	Burrard Yarrows Corp. Vancouver, B.C.
Commissioned	1982
Managing Company	Canadian Marine Drilling Ltd. P.O. Box 200 Calgary, Alberta Canada, T2P 2H8
Official Number	801810
Radio Call Sign	VY7841
Port of Registry	Edmonton, Alberta
Classification	Lloyds +100 A1
ASPPR Arctic Class	Arctic Class 3
Flag	Canadian

PRINCIPAL DIMENSIONS

Length O.A.	271.6 ft. (82.80 m)
Breadth: Moulded	59.1 ft. (18.0 m)
Depth: Moulded	24.6 ft. (7.5 m)
Draft: Summer Load	18.6 ft. (5.67 m)
Gross Tonnage	3,186.3 T
Net Tonnage	1,501.5 T
Accommodation	16 crew 10 supernumeraries

PROPULSION

Main Propulsion	Twin screw installation, 2 *MAK* 12M453AK turbo charged diesel engines clutched to reduction gears driving *LIPS* C.P. propellers in fixed nozzles - 2 rudders
B.H.P.	9,600
Thrusters	2 - 4 blade fixed pitch tunnel type bow thrusters
Auxiliary Machinery	4 *CAT* 16V D399 800 kW diesel generators 600V 3 phase 60 Hz 1 *CAT* 3304 75kW diesel generator
Speed	10.5 knots (max. 13 kts)
Fuel Consumption	176 bbls. (28 m³/day) at cruising speed

DECK EQUIPMENT

Design Bollard Thrust	101 T
Deck Machinery	4 - 12 ton tugger winches 4 - 15 ton capstans 1 - 2 ton SWL crane Capacity (Min. Rad.) 3.5 ton at 23.8 ft. (7.25 m) Capacity (Max. Rad.) 2.5 ton at 33.8 ft. (10.3 m) 1 hose handling crane 1 stores davit

NAVIGATION & COMMUNICATION EQUIPMENT

To I.M.O. and M.O.T. Standards

3 manoeuvering control stations
1 *Wagner* Mk4 autopilot
2 *Lilley & Gilley* Type SR2 magnetic compasses
2 *Marconi* CH150 SSB transceivers
2 *Marconi* SM100 distress tone generators
2 *Raytheon* Ray 55 multi-channel VHF radios
2 *Raytheon* Ray 55 slave radios
1 *Magnavox* MX3102 Satellite Navigator
1 Facsimile Receiver
1 *Genave*/Alpha 270 Air to Ground Radio
1 *ELAC* LAZ SI BT 1202 echo sounder
1 CB radio
1 *Airchime* EP90 Ice Breaking Siren
4 Xenon remote control searchlights

CAPACITIES

Deadweight at Max. Draft	2,648 T
Clear Deck Space	
Length	118 ft. (36 m)
Breadth	47.6 ft. (14.5 m)
Total Area	5,618.5 ft.² (522 m²)
Max. Deck Cargo	594.1 T
Bulk (Barite/Cement)	
Pressure Tanks	9
Capacity/each	2,062.36 ft³ (58.4 m³)
Potable Water	763 bbls. (121.4 m³)
Ballast/Drill Water	13,480 bbls. (2 143 m³)
Fuel/Fuel Cargo	13,247 bbls. (2 106 m³)
Refrigerated Storage	
Deep Freeze	883 ft.³ (25 m³)
Cooler	883 ft.³ (25 m³)

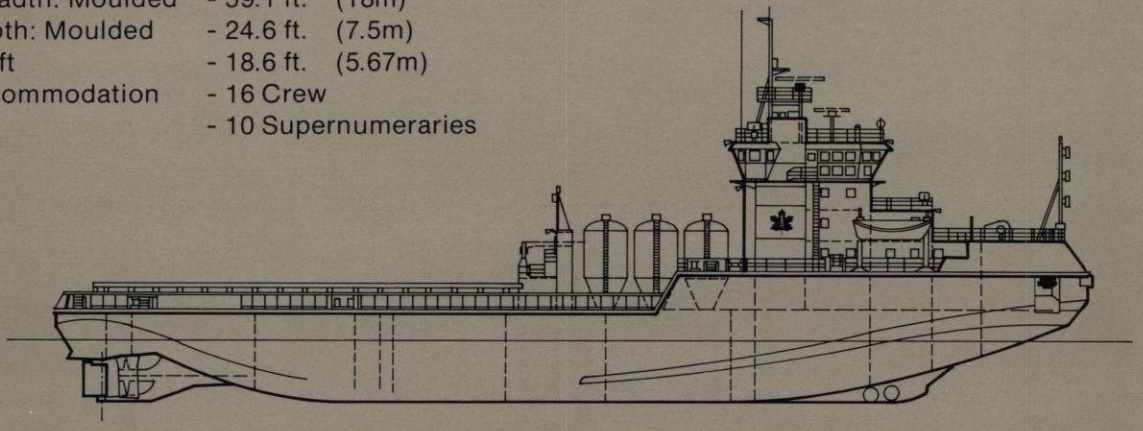
SPECIAL FEATURES

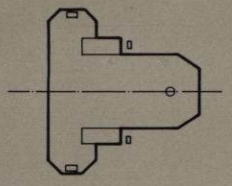
- Meets MARPOL requirements
- Equipped with high speed rescue craft
- 360° visibility wheelhouse
- Double skin hull
- Quick heeling system for increased manoeuverability in ice
- Bow reamers
- Air bubble system
- Icebreaking hull wash system
- Special ice-breaking low friction hull coating

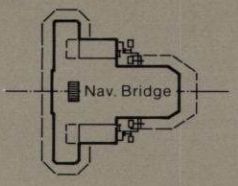
CANMAR ROBERT LEMEUR

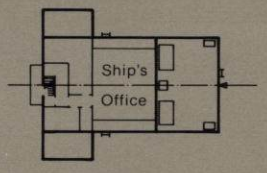
Principal Dimensions

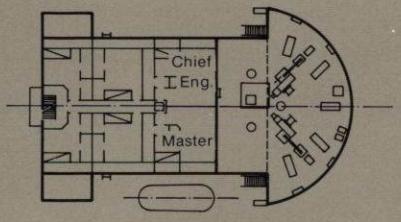
Length Overall	- 271.6 ft. (82.8m)
Breadth: Moulded	- 59.1 ft. (18m)
Depth: Moulded	- 24.6 ft. (7.5m)
Draft	- 18.6 ft. (5.67m)
Accommodation	- 16 Crew
	- 10 Supernumeraries

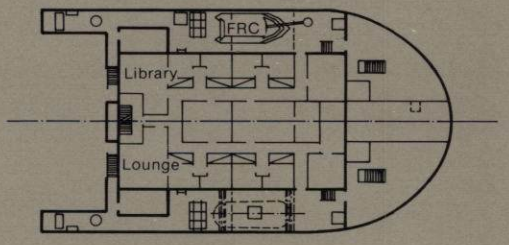


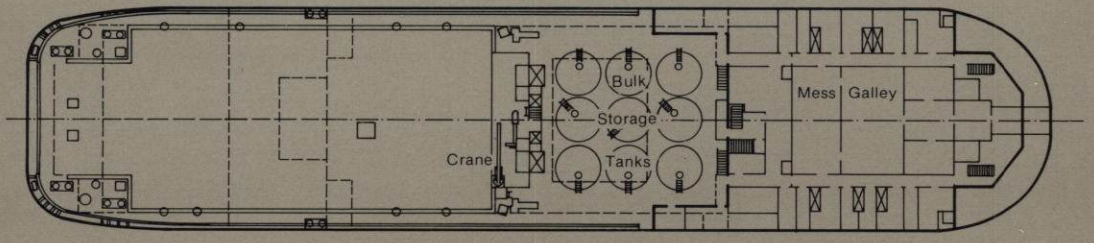


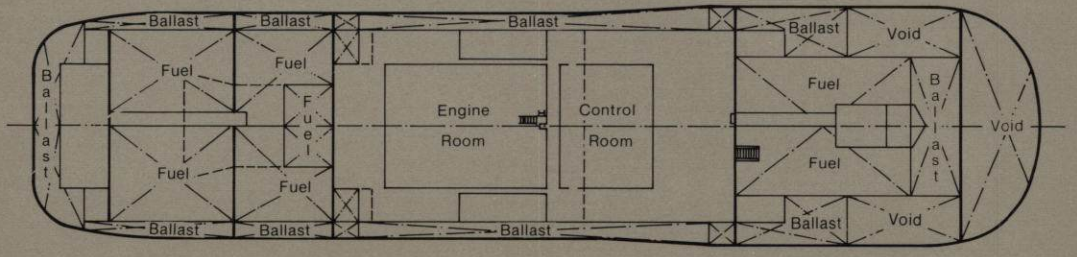












Printed in Canada

CANMAR SUPPLIER III

Icebreaking Anchor Handling, Tug Supply Vessel

REGISTRATION

Builder	Burrard Drydock Co. Ltd. Vancouver, B.C.
Commissioned	1975
Managing Company	Canadian Marine Drilling Ltd. P.O. Box 200 Calgary, Alberta Canada, T2P 2H8
Official Number	370260
Radio Call Sign	CZ6462
Port of Registry	Vancouver, B.C.
Classification	Lloyds +100 A1
ASPPR Arctic Class	Arctic Class 2
Flag	Canadian

PRINCIPAL DIMENSIONS

Length O.A.	205 ft. (62.48 m)
Breadth: Moulded	45 ft. (13.72 m)
Depth: Moulded	18.2 ft. (5.56 m)
Draft: Summer Load	14.2 ft. (4.33 m)
Gross Tonnage	1,190 T
Net Tonnage	387 T
Accommodation	13 crew 3 supernumeraries

PROPULSION

Main Propulsion	Twin screw installation, 2 *G.M.* EMD 20 - 645-E7 turbo charged diesel engines, clutched to reduction gears driving open *Ka Me Wa* propellers — 2 rudders
B.H.P.	7,200
Thrusters	1 - 350 B.H.P. tunnel type bow thruster
Auxiliary Machinery	2 *CAT* D343TA 200 kW diesel generators 1 *CAT* D343 (bow thruster)
Speed (cruising)	12.5 knots (max. 15.5 kts.)
Fuel Consumption	100 bbls. (16 m³/day) at cruising speed

DECK EQUIPMENT

Bollard Pull	71 T
Tow Winch	1 Hydraulic double drum waterfall type anchor handling tow winch 1 - 136 ton capacity towing drum with 3,000 ft. (914 m) of 2¼ inches (57 mm) dia. wire
Deck Machinery	4 - 5 ton tugger winches 2 - 7 ton capstans 1 - 3 ton SWL service boom 1 storage reel
Stern Roller	12 ft. long by 6 ft. dia. (3.66 m long by 1.83 m dia.)

NAVIGATION & COMMUNICATION EQUIPMENT

To I.M.O. and M.O.T. Standards

4 manoeuvering control stations
1 *Sperry* auto pilot
1 *Sperry* Mk.227 gyro compass
1 *Sestral* magnetic compass
1 *Decca* AC1226C radar
1 *Decca* AC1230C radar
1 *Marconi* CH150 multi-channel SSB transceiver
1 *Motorola* Triton 40S synthesized SSB transceiver
2 *Raytheon* Ray 55 multi-channel VHF radios
1 *Simrad* Model EN echo sounder
1 *Simrad* IC echo sounder
1 *Honeywell* distress generator
1 *Simrad* Taiyo TDL-1100 radio direction finder
1 *Johnson* A.M. air to ground radio
1 Facsimile receiver
1 *Johnson* messenger C.B. radio
1 *Magnavox* Mk.4102 satellite navigator
3 Searchlights

CAPACITIES

Deadweight at Max. Draft	981 T
Clear Deck Space	
Length	98.4 ft. (30 m)
Breadth	36 ft. (11 m)
Total Area	3,616 ft.² (336 m²)
Max. Deck Cargo	700 T
Bulk (Barite/Cement)	
Pressure Tanks	3
Capacity/each	1,200 ft³ (34.3 m³)
Potable Water	1,358 bbls. (216 m³)
Drill Water	4,208 bbls. (669 m³)
Fuel/Fuel Cargo	2,765 bbls. (440 m³)
Refrigerated Storage	
Deep Freeze	317 ft.³ (9 m³)
Cooler	317 ft.³ (9 m³)

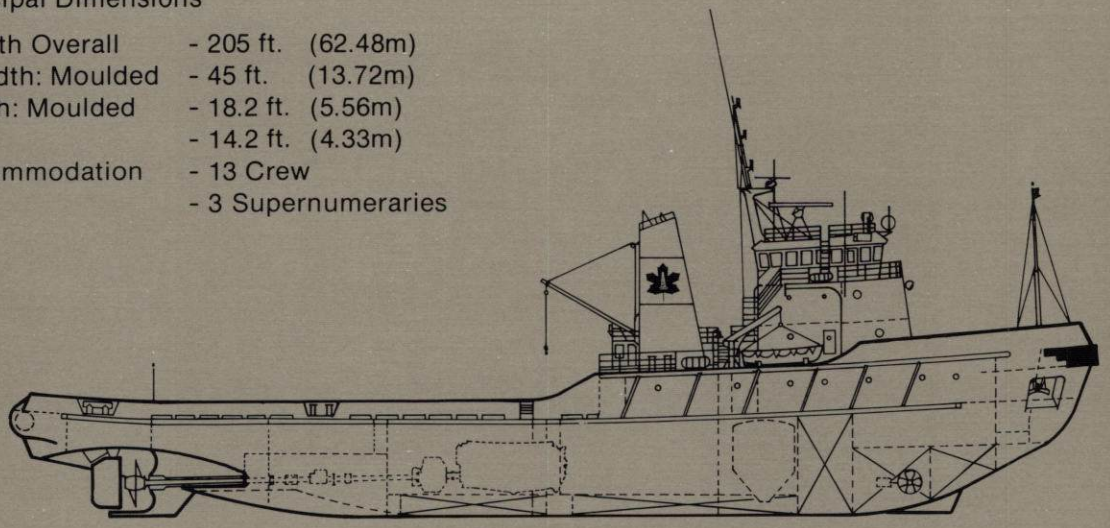
SPECIAL FEATURES

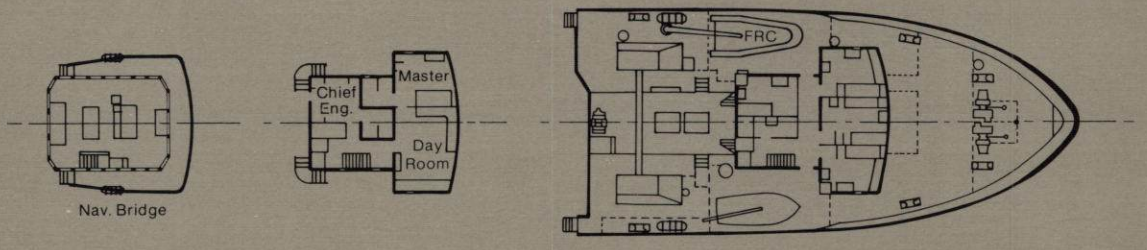
- Meets MARPOL requirements
- Equipped with high speed rescue craft
- 360° visibility from bridge
- Totally enclosed winch house
- Double skin hull
- Independent rudder control system

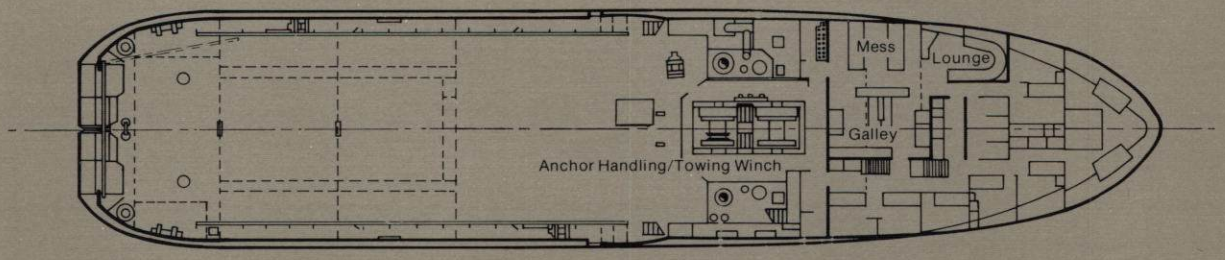
CANMAR SUPPLIER III

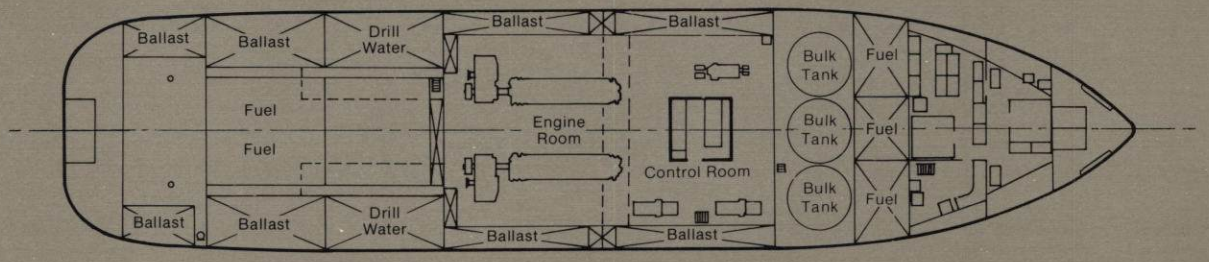
Principal Dimensions

Length Overall	- 205 ft.	(62.48m)
Breadth: Moulded	- 45 ft.	(13.72m)
Depth: Moulded	- 18.2 ft.	(5.56m)
Draft	- 14.2 ft.	(4.33m)
Accommodation	- 13 Crew	
	- 3 Supernumeraries	









Printed in Canada

CANMAR SUPPLIER IV

Anchor Handling Supply Vessel

REGISTRATION

Builder	Yarrows Ltd. Victoria, B.C.
Commissioned	1975
Managing Company	Canadian Marine Drilling Ltd. P.O. Box 200 Calgary, Alberta Canada, T2P 2H8
Official Number	370261
Radio Call Sign	CZ6463
Port of Registry	Vancouver, B.C.
Classification	Lloyds +100 A1
ASPPR Arctic Class	Arctic Class 2
Flag	Canadian

PRINCIPAL DIMENSIONS

Length O.A.	205 ft. (62.48 m)
Breadth: Moulded	45 ft. (13.72 m)
Depth: Moulded	18.2 ft. (5.56 m)
Draft: Summer Load	14.2 ft. (4.33 m)
Gross Tonnage	1,190 T
Net Tonnage	387 T
Accommodation	13 crew 3 supernumeraries

PROPULSION

Main Propulsion	Twin screw installation, 2 *G.M.* EMD 20 - 645-E7 turbo charged diesel engines, clutched to reduction gears driving open *Ka Me Wa* propellers – 2 rudders
B.H.P.	7,200
Thrusters	1 - 350 BHP tunnel type bow thruster
Auxiliary Machinery	2 *CAT* D343TA 200 kW diesel generators 1 *CAT* D343 (bow thruster)
Speed (cruising)	12.5 knots (max. 15.5 kts.)
Fuel Consumption	100 bbls. (16 m^3/day) at cruising speed

DECK EQUIPMENT

Bollard Pull	71 T
Towing Winch	1 - Hydraulic double drum waterfall type anchor handling tow winch 1 - 136 ton capacity towing drum with 3,000 ft. (914 m) of 2¼ inches (57 mm) dia. wire
Deck Machinery	4 - 5 ton tugger winches 2 - 7 ton capstans 1 - 3 ton SWL service boom 1 storage reel
Stern Roller	12 ft. long by 6 ft. dia. (3.66 m long by 1.83 m dia.)

NAVIGATION & COMMUNICATION EQUIPMENT

To I.M.O. and M.O.T. Standards

4 manoeuvering control stations
1 *Sperry* auto pilot
1 *Sperry* Mk.227 gyro compass
1 *Sestral* magnetic compass
1 *Sperry* Selescan 1024 radar
1 *Sperry* 1270 radar
1 *Marconi* CH150 multi-channel SSB transceiver
1 *Motorola* Triton 40S synthesized SSB transceiver
2 *Raytheon* Ray 55 multi-channel VHF radios
1 *Simrad* Taiyo TDL-1100 radio direction finder
1 *Honeywell* Elac Echograph Laz 51 echo sounder c/w remote digital readout
1 *SAIT* GR2672A radio direction finder
1 *Honeywell* distress generator
1 *Johnson* A.M. air to ground radio
1 Facsimile receiver
1 *Johnson* Messenger C.B. radio
1 *Magnavox* Mk.4102 satellite navigator
1 *Omega* receiver, model 832
1 *Realistic* S.I.B. receiver
2 Searchlights

CAPACITIES

Deadweight at Max. Draft	981 T
Clear Deck Space	
Length	98.4 ft. (30 m)
Breadth	36 ft. (11 m)
Total Area	3,616 $ft.^2$ (336 m^2)
Max. Deck Cargo	700 T
Bulk (Barite/Cement)	
Pressure Tanks	3
Capacity/each	1,200 ft^3 (34.3 m^3)
Potable Water	1,358 bbls. (216 m^3)
Drill Water	4,208 bbls. (669 m^3)
Fuel/Fuel Cargo	2,765 bbls. (440 m^3)
Refrigerated Storage	
Deep Freeze	317 $ft.^3$ (9 m^3)
Cooler	317 $ft.^3$ (9 m^3)

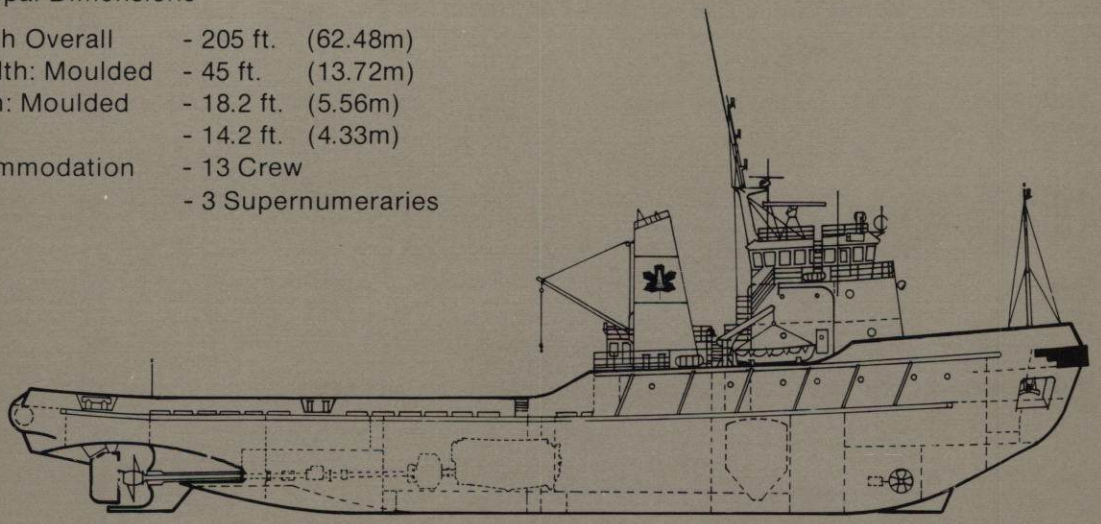
SPECIAL FEATURES

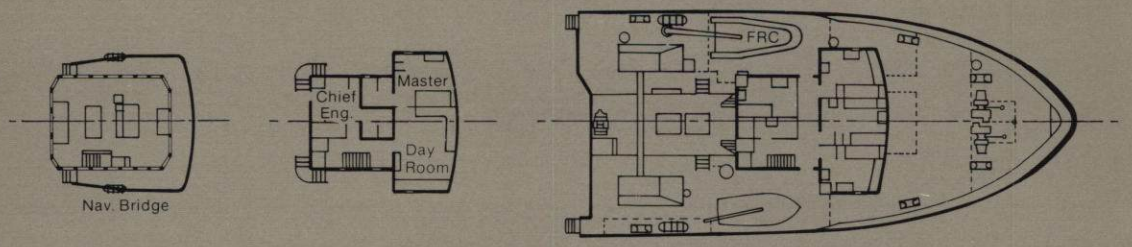
- Meets MARPOL requirements
- Equipped with high speed rescue craft
- 360° visibility from bridge
- Totally enclosed winch house
- Double skin hull
- Independent rudder control system

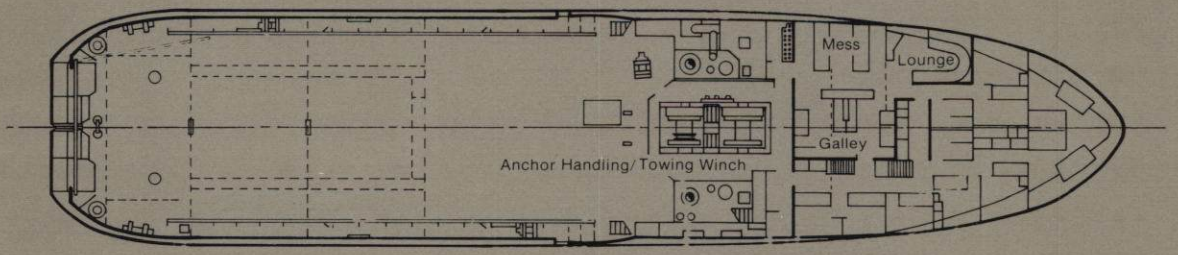
CANMAR SUPPLIER IV

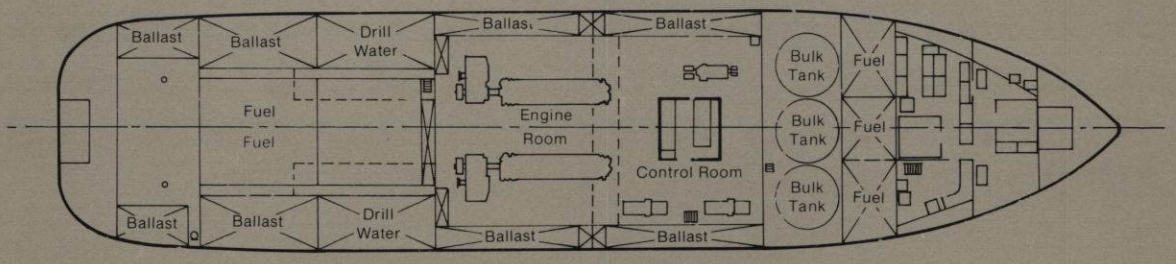
Principal Dimensions

Length Overall	- 205 ft.	(62.48m)
Breadth: Moulded	- 45 ft.	(13.72m)
Depth: Moulded	- 18.2 ft.	(5.56m)
Draft	- 14.2 ft.	(4.33m)
Accommodation	- 13 Crew	
	- 3 Supernumeraries	









Printed in Canada

Power is provided by a diesel electric system, consisting of five turbocharged engines driving five AEG generators. The ship is propelled by four electric motors and five thrusters.

All eight mooring lines are equipped with remote anchor release units. This special feature, in conjunction with the collapsible pawls installed on the drums, allows quick disconnection from the anchors, enabling the ship to quickly withdraw from the drilling location in the event of ice encroachment.

The Explorer III has accommodations for 103 persons and includes offices, a galley and mess room, a recreation area, and a four-bed hospital.

Detailed specifications on the Explorer III and its communication equipment are presented in Appendix A.

2.3 Explorer III Drilling Equipment

Drilling equipment on the Explorer III consists primarily of a derrick with a 665 ton gross nominal capacity. The Explorer III uses state-of-the-art handling equipment for drill pipe, casing, tubing and Blowout Preventer Systems (BOPs) to ensure efficient drilling operations. A complete discussion of the Canmar Explorer III drilling equipment is presented in Appendix B of this plan.

The Explorer III will be equipped with a 20-foot diameter bit for drilling a 30 to 40 foot deep glory hole for protection of the BOP. The BOP will be positioned so that the top of the unit is approximately 8 feet below the seafloor elevation.

2.4 Support Vessels' Description

Three Canadian flag support vessels will accompany the Explorer III drillship. The M/V Robert LeMeur will be the primary ice handling vessel, specifically designed as an Arctic Class 3 icebreaker. The Canmar M/V Supplier III and M/V Supplier IV are similar ships, specifically designed as Arctic Class 2. Principal duties of these vessels will include ice management and anchor handling. Detailed information covering each of these three vessels is presented in Appendix C.

A U.S. flag barge and tug will accompany the above fleet to provide oil spill response capabilities and vessel refueling operations. A more complete description of the oil spill barge is provided in the Oil Spill Contingency Plan, Exhibit 2-1. Other U.S. flag vessels will be used if additional supplies are required.

2.5 Specialized Safety Systems and Pollution Prevention

In addition to the pollution prevention and safety equipment described in Appendices A, B and C, the vessel is equipped with a Toxic Gas Detection and Alarm System. The physical arrangement of this system is shown in Exhibit 4 as a separate document. Specific key components are described in Sections 2.5.1 through 2.5.8.

2.5.1 Mud Logging

Primary well control will be maintained by over-balancing formation pressure with drilling fluid. Automatic and manual monitoring equipment will be installed to detect any abnormal variations in the mud system and drilling parameters. A mud

logging unit, manned by experienced personnel, will be in continuous use throughout the drilling operations and will monitor formation pressure, hydrocarbon shows, and loss or gain in mud tanks.

2.5.2 Hydrogen Sulfide

The area covered by this Exploration Plan is not known to contain hydrogen sulfide in the stratigraphic section to be drilled. However, a Hydrogen Sulfide Contingency Plan is included as a separate document, Exhibit 5-1. Personnel safety is the prime concern of this plan. If hydrogen sulfide gas is encountered, procedures will be in place to handle the situation.

The Hydrogen Sulfide Contingency Plan will thoroughly familiarize all personnel with the following:

1) Training for H_2S emergencies including identification of safe briefing areas.
2) Visible H_2S Warning System.
3) H_2S Detection and Monitoring System.
4) Personnel Protective Equipment.
5) Ventilation Equipment.
6) Metallurgical Equipment Considerations and Adjustments to the Mud Program.
7) Flare Systems.
8) Rig Evacuation Procedures.

The basic premise for the protection of both personnel and the environment is planning. In the remote event of any accidental release of H_2S gas, all safeguards and control procedures will be adhered to by all personnel.

2.5.3 Oil Spill Contingency Plan

The prevention of pollution is given a high priority, exceeded only by the protection and safety of personnel. Proper equipment is provided on the rig, on support craft, and at onshore facilities, so as to avoid the possibilities of pollution. Personnel are trained in the use of this equipment and made aware of the potential consequences of spills. Good housekeeping practices will be emphasized and cleanup equipment will be provided at several locations on the rig to handle spills before they can escape from the drilling vessel. The equipment and procedures for responding to oil spills in the Chukchi Sea are detailed in the Oil Spill Contingency Plan, which is submitted as a separate document.

2.5.4 Fuel Transfers

Fuel quantities will be monitored daily. Occasional fuel transfers from the oil spill response barge to the drillship and support vessels may occur. A fuel transfer plan has been developed which addresses fuel flow diagrams, valving sequences, safety precautions, and transfer procedures. One man on duty will have the responsibility for all fuel transfers and he will be thoroughly trained in the above procedures. No fuel transfers will be made without this responsible party in attendance.

2.5.5 Fire Drills

Procedures for emergencies such as fires will be posted on the rig and in the quarters. Specific emergency responsibilities for crew members will also be posted at appropriate conspicuous places on the drilling rig. Fire, abandon rig, and H_2S drills will be conducted periodically for all crew members.

2.5.6 Safety Meetings

Safety meetings will be conducted periodically to make crews aware of safety procedures as well as to review potential sources of accidents and the means of preventing them. Accident causes and corrective measures to be taken in the event of accidents will be discussed. An Emergency Medical Technician (EMT)/Radio Operator/Environmental Monitor person will be on the rig at all times and will coordinate the safety program with supervisory personnel.

2.5.7 Testing Program, Disposal of Produced Test Fluids

If a decision is made to test any well, a testing program will be written at that time based on the known downhole conditions. Produced gas will be flared. Potentially, a test recommendation could include flaring oil, although this is considered unlikely in the near future. Produced fluids will probably be reinjected (bullheaded) back into the formation from which they originated or by injected down the 13-3/8 inch x 9-5/8 inch casing annulus.

As stated previously, the specific program for each exploratory well will be defined in the Application for Permit to Drill (APD) which will be submitted in advance of each drilling season. All permit restrictions and stipulations will be observed during any of these operations.

2.5.8 Qualifications of Key Personnel

All wellsite operations will be under the direct supervision of an on-site drilling foreman. Geologists will also be on-site to supervise, as necessary, mud logging, sample collection, and core recovery. Additional operations personnel will be at the wellsite as specific specialized activities dictate, i.e., wireline logging operations, testing, etc.

The Anchorage and Houston offices of Shell Western E&P Inc. will receive daily reports and frequent telephone and data fax communications to monitor activities at the wellsite.

Company and contractor personnel involved directly in drilling operations (including rotary helpers and derrickmen) will be trained in subsea well control methods and in detection of abnormal pressures. Such training will be completed in approved company or industry schools before drilling commences. Blowout prevention drills will also be conducted as required by the

Minerals Management Service (MMS). A list of personnel and their completed training will be maintained on the drilling rig and will be available on request.

All supervisory drilling personnel will be MMS certified as operator's representatives both in surface and subsea applications.

Appropriate personnel engaged on the project will receive Oil Spill Containment and Cleanup training as specified in the Oil Spill Contingency Plan.

3. EMERGENCY SITUATIONS RELATING TO ALASKA OCS REGION

The following paragraphs discuss preparedness for emergency situations which are common to all wells drilled under this Exploration Plan. These include relief well considerations, loss or disablement of the drilling unit, loss or damage to support craft, and severe weather operations.

3.1 Relief Well Considerations

All operating procedures on the rig, whether automated or controlled by Company or Contractor personnel, are specifically designed and operated to prevent a loss of well control. The primary method of well control utilizes the hydrostatic pressure exerted by a column of drilling mud of sufficient density to prevent an undesired flow of formation fluid into the well bore.

In the unlikely event it becomes necessary to elevate from primary to secondary control, the blowout prevention system will be utilized to maintain secondary control while primary control is re-established. For example, in the event that the well kicks, the blowout preventers will be used to shut in the well immediately and confine the well fluids within a closed system. The casing programs are designed so that any anticipated formation pressure can be shut in at the seafloor. The operator's representative assigned to the drill site will have extensive training, including MMS approved blowout prevention training school, as well as actual experience in controlling and killing kicks from floating drilling vessels. Such training is an ongoing program of Shell Western E&P Inc. These personnel will be further supported by well-trained rig crews approved by the operator. Pressure resulting from a kick will be circulated out using industry approved methods and the well will be restored to its normal operating condition.

Leakoff tests or formation competency tests will be made after running each string of casing, both for well control information, and as an indicator of the depth at which the next string of casing will be required.

In the highly unlikely event that primary and secondary well control are lost, and a blowout occurs which cannot be contained, the rig may have to be abandoned to prevent loss of life. This is an extremely remote possibility, due to the extensive precautions taken to prevent such an occurrence. Fundamental to these precautions is the training required for all personnel involved in exploratory drilling operations and the safety equipment on the rig itself. All crew and supervisory personnel will be trained in accordance with MMS/OCS regulations. A list of personnel and training received will be available on the rig.

If subsequent efforts to control the well fail, a relief well may be required. This relief well will be drilled from either the Canmar Explorer III, assuming it had been able to disconnect from the original well, or another comparable rig transported to the Chukchi Sea (such as the Canmar Explorer I, II, IV or the Beaudril Kulluk). The relief well will be directionally drilled to communicate with the original well.

Sufficient wellhead assemblies, tubulars, and materials (i.e., mud, cement, bits, fuel, etc.) are available in Alaska or on the West Coast to rapidly mobilize for a relief well program. The Relief Well Plan is discussed further in the Oil Spill Contingency Plan.

3.2 Loss or Disablement of Drilling Unit

If the drilling unit becomes partially or totally disabled while under contract to Shell Western E&P Inc., the priorities for action in all cases will be:

1) Personnel safety and evacuation, if required.
2) Prevention of pollution.
3) Minimize property and rig damage.
4) Regulatory agency and SWEPI management notification.

All contingency plans are developed with these objectives in mind. If the drilling vessel is damaged to the point where it cannot be repaired on location, then after both evacuation of non-essential personnel (if necessary) and any securing or plugging of the well in progress, the rig will mobilize to the nearest suitable harbor (or dry dock) facility for repairs. If the rig is damaged beyond repair, a new rig will be brought in, if necessary, to continue drilling or plug and abandon the well. Re-entering an offshore well in this fashion is a routine procedure as long as the subsea wellhead and permanent guide base assemblies are not severely damaged. Debris removal from the seafloor would be done in accordance with U.S. Coast Guard (USCG) regulations and other agency requirements.

3.3 Loss or Damage to Support Craft

The same priorities for emergency response in the event of a boat or helicopter accident will be followed as for a rig mishap. Since several supply boats and helicopters will be dedicated to support of SWEPI operations in the Chukchi Sea, there will be a strong back-up capability to provide assistance in the event any one of these support craft requires help. Assistance for search and rescue operations could also be provided by other active operators, the North Slope Borough Search and Rescue Unit, and by the USCG along with other military organizations.

3.4 Severe Weather Operations

Drilling or marine operations become critical when the weather and/or sea state conditions approach the design limits of the drilling rig or drilling vessel. Potential critical operations are anchoring, ballasting/deballasting, drilling, coring, running casing, logging or other wireline operations, and testing.

The most probable factors that could result in the curtailment of drilling operations in the Chukchi Sea area will be winds, waves, and ice. Specific limits for critical operations onboard the Canmar Explorer III are defined in the Vessel Operations Manual (Exhibit 6-1) which is being submitted separately as supporting documentation. This Operations Manual is proprietary and therefore not included in this public document.

As a general rule, no drilling operations will commence or be conducted when any of the following conditions exist:

1) The SWEPI Drilling Supervisor is not satisfied that the rig is properly anchored, ballasted, and rigged up to begin operations. The Drilling Supervisor will make an entry in the IADC Report regarding the above.

2) There is an insufficient supply of drilling fluid materials on board to control the well.

3) Sufficient emergency containment and cleanup equipment is not on location or is not maintained in good working order.

4) The manpower required to safely conduct the drilling operation is not available.

5) Any critical machinery needed to assure a normally safe operation is not operative.

IMPORTANT: The above list is only a guideline. The decision as to what action to take during a given emergency, no matter what the cause, must be based on the judgement of the SWEPI Drilling Supervisor, the Drilling Contractor Tool Pusher, and the Vessel Engineer.

APPENDIX A

APPENDIX A. CANMAR EXPLORER III SPECIFICATIONS

A.1 Classification

The construction of the hull is in accordance with Arctic Shipping Pollution Regulations and Ice Class Canadian Arctic "C" DNV Construction Class 1A1* Ice 1A* Hull.

A.2 Principal Dimensions

The principal dimensions are as follows:

Length	501.50 ft
Beam	78.05 ft
Depth	41.01 ft
Net registered tons	5,758.26 Long Tons
Draft (loaded)	24.6 ft
Displacement	16,033.98 Long Tons
Center well (Moon pool)	23 ft x 27 ft
Drilling depth	24,000 ft
Water depth range, drilling	100-1000 ft

A.3 Thruster System and Propulsion

The propulsion system includes five LIPS NV Model BP-176 tunnel type thrusters rated at 1750 hp. Two are situated aft and three are situated forward. The eight ft diameter four-blade propellers are rated at 225 rpm and are driven by five AEG model AJ63055 x six KV electric motors. They are rated at 6000 VAC at 730 rpm through a gear box. Each unit will develop 39,690 lb thrust.

A.4 Mooring System

The mooring system includes the following:

1) Four Skagit Model DMW 250 double drum winches with double drum side by side, underwinding drum and each are powered by 8V71 GM Diesels. Each is equipped for a maximum of 3300 ft x 2-3/4 inch wire but will always have a minimum of 2700 ft available. The anchor wire has a rated maximum pull of 350,000 lb.

2) Eight main deck mounted swivel-type wire fairleaders for 2-3/4 inch wire manufactured by Skagit.

3) Sixteen Bruce anchors 14,300 lb complete with all required chain, pendant wires, shackles, buoys and related equipment to adequately moor the vessel.

4) Eight Interocean mooring line disconnects. Proof load 605,000 lb, release load 292,000 lb hydraulic release with acoustic control and diagnostic system. Complete with command unit and transducer with 164 ft of cable and permanent release cable.

5) Anchor tension indicator system consisting of eight Martin Decker Model ATD winch station indicating systems, footage counter, line speed monitoring, tension readout and recorder, and one remote monitoring station.

A.5 Storage Capacities

Storage capacities are indicated as follows:

Fuel Storage	594,000 gallons U.S. (14,143 bbls) 2 Day Tanks at 485 gallons
Helicopter Fuel	6,000 gallons, U.S.
Glycol	476 Tons, short
Drill Water	107,000 gallons U.S. (2,548 bbls)
Potable Water	71,000 gallons U.S. (1,690 bbls)
Sack Material	440 Tons, short
Casing	900 Tons, short

A.6 Bulk Materials Handling System

The bulk material handling system includes Dowell bulk dry mud and cement handling equipment consisting of:

1) One 21 ft^3 pneumatic cement surge tank utilizing positive pressure.

2) Three 70 ft^3 pneumatic mud surge tanks.

3) Twelve 1600 ft^3 silos are available for the storage of bulk cement, barite, and bentonite. Transfer system operates at 35 psi.

A.7 Accommodations

There are 103 berths in 43 cabins as indicated below:

5 single	5
26 double	52
2 triples	6
10 quadruple	40
	103

The mess hall has seven tables seating 52 people and is completely equipped. There is a modern galley, with storage space, freezer space, and cooler space. The recreation room seats 60 persons complete with separate reading and card areas. The Medical Room is a four-bed unit with all necessary equipment.

A.8 Helideck

The helideck has capacity for a Super Puma or similar helicopter. The helideck is currently being modified to meet the Det Norske Veritas (DNV) rules governing foam-dry chemical fire suppression systems.

A.9 Power Plant System

The power plant system includes:

1) Five S.A.C.M. Model AGO-V16-ESHR 240 driving one AEG generator each at 1200 rpm. Each generator delivers 2400 kw, 3000 KVA, 6000 volts AC at 60 Hz.

2) The 6000 V network provides power for the four 1500 hp motors main propulsion system and the five 1750 hp motors driving the thrusters.

3) The basic AC supply is transformed to 440 and 220 V for general distribution. The 6000 V network provides power for the DC drilling machinery through automatically controlled thruster-rectifiers.

4) One 750 KVA standby Harbour generator and one 150 KVA emergency generator are available for the onboard network.

5) 1982 installation of one Telemechanique MCC 440 Volt.

A.10 Air Compressors

The following are included onboard the drilling unit:

1) One Atlas Copco BT 314 ARR air compressor to supply the kelly spinner with 125 psi air.

2) Control system for automatic start, stop, and shutdown in the event of malfunction.

3) RW liquids separator and pressure reducing valve for bulk systems.

4) Atlas Copco Model HD-8 after cooler and filter.

5) One XEBEC Indust. Air Dryer No. 1885.

6) Pure Air Dryer WP 150 psi, 640° F.

7) Three Atlas Copco - BT6 - 240 CFM at 100 psi.

8) One Atlas Copco - BE63 - 500 CFM at 50 psi.

9) One Poppe - WP 32L-100 - Cold start air compressor.

10) Two Sullair Rotary screw compressors rated max. 145 psi at 300 CFM each equipped with water cooling.

A.11 Vessel Pumps

The following pumps are onboard the drilling unit.

Amt.	Pump	Manufacturer	Model
2	Ballast Pumps	Thune-Eureka	CGB V48BA
2	Bilge, Fire & G.S. Pumps	Thune-Eureka	C5AB 5-6M2
1	Domestic Fresh Water Pump	Sihi	NA03602K
1	Emergency Fire Pump	Svanhoy	NM 50B
1	Evaporator Feed Pump	Girdlestone	3Y59M
2	Fresh Water Glycol Cooling Pumps	Thune-Eureka	CGB 100
2	Fuel Oil Transfer Pumps	Netzsch Mohnopumpen	
1	Fuel Oil Trimming Pump	AB IMO-Industrial	
1	Gearbox Standby Lube Oil Pump	AB IMO-Industrial	ACG 60-2N2F
4	Hydraulic CP Propeller Pumps	AB IMO-Industrial	3818 LN 2D/56
1	Lube Oil Transfer Pump	AB IMO-Industrial	ACG 52-2N2F
2	Main Engine Pre-Heating Pumps	Thune-Eureka	CGA 50
1	Main Reduction Gear Oil Pump	Tuthill Pump Co.	CE
1	Oily Water Separator Pump	Iron A/S Pumps	BDV-50
2	S.W. Cooling Aft Thruster Pumps	Thune-Eureka	CGA65
2	S.W. Cooling Forward Thruster Pumps	Thune-Eureka	CGA65
2	S.W. Cooling CP Propeller Pumps	Thune-Eureka	CGB100
2	S.W. Booster F.W. Generator Pumps	Thune-Eureka	CGA50
2	S.W. Cooling Air Conditioning Pumps	Thune-Eureka	CGB100
5	Scavenging Air Cooling Water Pumps	Thune-Eureka	CGB100
2	Fuel Oil Purifiers	Alfa Laval	MAB 204S

A.12 Potable Water System

The potable water system includes the following:

1) One Aqua Chem Model S600, 14,400 gal capacity at 600 gal/hr.

2) Two Pressure tanks with a 250 gal. capacity.

3) Two Atlas Denmark fresh water generator Model AFGU No. 6.

4) One Wier waste heat flashtype 30 T/day.

A.13 Boiler

There are two Clayton of Belgium Model EO-185-B-18/5-44 oil fired boilers rated at 200 hp.

A.14 Garbage Disposal Unit

The garbage disposal unit is a CAN-PAC - Model D-1.

A.15 Sanitation Unit

The sanitation unit is incorporated in the ship design and is approved by the appropriate regulatory authorities.

A.16 Cranes and Cargo Handling Equipment

There are two I.H.C. offshore cranes, 40 ton and 25 ton, complete with automatic overload protection. The maximum permissible list is 5° and the maximum permissible trim angle is 2°. The 40 ton crane is located forward of drill well on starboard side, and the 25 ton unit is located aft of drill well on portside.

Cargo Cranes include:

1) Three Gantry Cranes of traveling type, one in each of three holds to handle tubular goods, 5500 lb ea.

2) One Gantry Crane in container room to handle mud material. 8300 lb.

3) Auxiliary Lifting Gear - Max. 5.5 ton.

Cargo Handling Equipment includes:

1) One nylon cargo net
2) One pair flying forks
3) One set can hooks
4) Two personnel baskets
5) Assortment of wire rope slings

The supply vessel mooring system includes four YOKAHAMA Fenders.

Bulk material transfer hoses for delivery of drill water, fuel oil, portable water, dry bulk cement, and dry bulk mud products are dedicated to a single product and will not be used for other products. Bulk transfer plumbing on the drilling unit is segregated to ensure that no contamination or mixing of bulk materials will occur.

A.17 Safety Equipment

Life boats have a total capacity for 206 persons and include:

1) Two Bjorke Batbyggeri 26 ft x 9 ft, 50-person (forward)
2) Two Maseco 30 ft x 9 ft, 53-person (aft)

The life boats are totally enclosed fiberglass construction, built to U.S. Coast Guard Regulations and pursuant to Sulas 1960 Convention, equipped with a 37 hp Westerbeke diesel engine, a 12-minute air breathing system and a sprinkler system, complete with suitable davits.

Other safety equipment includes:

1) Eight Beaufort-type inflatable liferafts for a total capacity of 152 persons

2) MK 3 Zodiac Rescue Launch complete with outboard motor 40 hp in launch cradle.

3) Ten Aer-o-Buoy life buoys

4) 174 life jackets

5) Fixed fire extinguishers are located as follows:

Paint Locker	2 - 12 lb Halon
Emergency generator room	1 - 30 lb Dry Chemical 1 - 20 lb CO_2
Thruster space	2 - 30 lb Dry Chemical 2 - 20 lb CO_2
Galley	1 - 30 lb Dry Chemical 1 - 20 lb CO_2
CO_2 room	60 - 100 lb bottles
SCR	1 - 20 lb CO_2 1 - 9 lb CO_2
Mud pit room	750 lb Dry Chemical foam
Mud pump room	3 - 30 lb Dry Chemical
Auxiliary engine room	2 - 20 lb CO_2 2 - 30 lb Ansul 20 - 50 lb CO_2
Moon Pool	spray system
Boiler Rooms	18 - 50 lb CO_2
Main engine room	1 - 150 lb Dry Chemical 2 - 20 lb CO_2 6 - 30 lb Dry Chemical 18 - 50 lb CO_2
Helicopter deck	2 - 300 lb Dry Chemical foam system

6) Portable Fire Extinguishers include:

2 - 300 lb Dry Chemical

2 - 150 lb Dry Chemical

68 - 30 lb Dry Chemical

8 - 20 lb CO_2

62 - 50 lb CO_2
1 - HIPRESS Fire Pump - Petters Type PH2WR
1 - Emergency Pump - SVANHOY - Type MM508

7) Breathing Apparatus includes:

22 - Scott Air Packs
16 - Spare Bottles

8) 155 - Mustang Immersion Suits

Additional fire and safety equipment will be installed during the winter of 1988-1989 in order to meet current USCG regulations.

A.18 Diving Equipment

The diving equipment is all C.G. Doris allowing for saturation diving in depths to 1,000 feet. Diving equipment includes a T3 Diving Bell S/N 40065, Almo winch S/N 21988, and a Quincy air compressor Model 5120 S/N 2210765. Additional diving equipment includes:

1) Two Doris Booster Pumps
2) Two Doris Air Scrubbers
3) Two Decompression Chambers
4) Camera Winch - Ingersol Rand 12000 lb
5) Two Each Air Lift Systems including:
   16 ea. air lift pipe 10 inches x 20 ft
   2 ea. Discharge heads 10 inches x 3 ft
   2 ea. Swivels 10 inches
   2 ea. Suction Heads 10 inches

A.19 Communications

The following communications and navigation equipment will be maintained onboard the Canmar Explorer III:

Equipment	Purpose
Aircraft Radio - VHF-AM Transceiver	Rig to helicopter voice communications
Non-directional beacon transmitter	IFR instrumentation for helicopters
Telephone/Teletype Communications Terminal Satellite Communications	Voice and data communication
Standard Communication UHF hand-held transceiver hands	Voice communications between crane operators and deck on supply boat
Single Side Band	Marine voice communications
Telecopier	Data transmission
Wind S/D Indicator and Transmitter	Wind speed and direction indicator and transmitter
VHF-FM Portable Standard Transceiver	Voice communications (hand held)
Intercommunication System	Onboard Intercom
Echo Sounder	
Two Decca Marine Radars One Derrick Top Radar for ice management	
Two Gyro Compasses, a Gyropilot and all other navigation aids as required by the regulatory agencies	
Satellite portable navigation system available	
All navigation aids as required by the regulatory agencies	

The operator (SWEPI) will install specialized satellite voice and data communications equipment during the winter 1988-1989 season. This equipment will be primarily for company proprietary communication.

APPENDIX

B

APPENDIX B. CANMAR EXPLORER III DRILLING EQUIPMENT

B.1 Derrick and Crown

The Pyramid Dynamic Derrick is 160 ft high with a 44 ft 4 inch x 36 ft base and a 23 ft 4 inch x 18 ft top. The derrick is a bolted beam leg design using A-36 and A-441 steel and has an API rated static hook load capacity of 500 tons with 12 lines and a gross nominal capacity of 665 tons.

It is designed for 100 mph wind, 3 degree list, 10 degree roll at 10 second interval, or 3 degree pitch at 12 second interval, 12 ft heave (total) at 8 second interval, and hook load of 755,000 lb.

The derrick is being modified with a VARCO top drive in Victoria B.C. Canada prior to startup of the first exploratory well.

B.2 Pyramid Custom Design Substructure

The substructure is designed for 26 ft clear height under floor girders to accommodate six each 80,000 lb riser tensioners and four each 16,000 lb guideline tensioners.

B.3 Draw Works

The draw works is a National Model 1625-DE with two 800 hp motors equipped as follows:

1) Sandline 9/16 inch 6 x 7 IPS sandline.
2) Grooved 1-1/2 inch drill line.
3) National Type A-1 breakout and makeup catheads.
4) Baylor-Elmagco Model 7838 auxiliary brake.
5) Model 75-00002 Crown-o-Matic Safety device.
6) Remote National Drilling Console.

B.4 Rotary Table and Attachments

The National C-375 rotary table has a 37-1/2 inch opening driven by a 800 hp motor consisting of:

1) Varco Model 27HDP3650-52 Kelly bushing and a Varco Model MPCH master bushing. Casing insert bushings for 20 inch, 16 inch, 13-3/8 inch and 9-5/8 inch.
2) Varco type MPCH No. 1, No. 2 and No. 3 insert bowls.
3) National Type D-1, 237-T-two speed rotary transmission.

B.5 Pipe Handling System

The pipe handling system includes:

1) Byron Jackson vertical pipe racker, Type V powered by BJ Hydraulic unit with commercial pumps.
2) Three pumps Model P37X378BYOK22 - 7FOK22-1 with two 200 hp electric motors.

B.6 Heave Compensator

The drilling unit has the following systems:

1) IHC crown block heave compensator with a maximum capacity of 220 tons and a 15 ft stroke modified with Omsted hydraulic locking valves and Vetco control.
2) Two Ingersol Rand Model 15T4 Air Compressors, maximum workings pressure of 3500 psi.
3) One Vetco Model 990103 high pressure air dryer.

B.7 Hook and Block

The unit has a BJ 5500 Dynaplex hook with a BJ Block Retractor, non-rotating air ring for air operated elevators. The Travelling Block is a National 660 H500, 500 ton.

B.8 Swivel

The swivel is a National Model P-500 500 ton swivel.

B.9 Stand Pipe Manifold

The unit has dual 5 inch mud standpipes and manifold with a 5,000 psi working pressure.

B.10 Rotary Hoses

The unit has dual 3-1/2 inch Goodall 10,000 lb test rotary hoses with 4 inch unions and safety clamps.

B.11 Kelly

The kelly is a 55 ft, 5-1/4 inch hexagon Kelly complete with one Omsco 15,000 psi flap type kelly cock, 4-1/2 IF pin. Although the top drive system will be used as the primary system, the kelly and swivel will be onboard and rigged for immediate use as a backup system.

B.12 Wireline Unit

The wireline unit onboard is an Abcor Model Concord 3-H. It has a hydraulic drive motor, variable speed transmission, skidder brake, type "D" measuring device, 20,000 ft of 0.092 inch regular wireline installed on drum, neoprene cover, and hay pulley.

B.13 Air Winches

Air winches onboard include:

1) One Ingersol Rand VW-50-A-30
2) Two Ingersol Rand ODR A 24 at moon pool
3) Three Ingersol Rand (K6UL, K6UA and ODR 100 A 24) on the rig floor
4) One Ingersol Rand RUL at forward catwalk

5) One Ingersol Rand RUL on poopdeck to guide aft burner boom

6) One Ingersol Rand JU40 at aft catwalk

B.14 Rig Floor Instrumentation

Rig floor instrumentation includes the following:

1) Martin Decker Type AWE9-1 weight indicator, Type E and E-80 sensor.
2) National Type EB wireline anchor.
3) Totco Electric M.V.T. Control Box with gain/loss, total volume, mud flow gauges and digital S.P.M. complete with 12 channel ability. Comes with eight each M.V.T. probes and Delaval-Wagner floats.
4) One console consisting of rotary RPM gauge, two pump pressure gauges and one rotary torque gauge, pump stroke counters.
5) Totco Mud flow sensor complete with Chart Recorder and High and Low Alarm and digital readout.
6) Totco electric rotary torque system.
7) Totco M.V.T. volume recorder.
8) Totco six-pen record-o-graf, housed within the driller's control house.

B.15 Kelly Spinner and Pipe Spinner

The unit includes:

1) International Tool Co. Model A-6C-2 Kelly spinner.
2) One Weatherford Spinner Hawk Model 13000 J29 pipe spinner plus one Varco Pipe Spinner.

B.16 Tongs

The tong system includes the following:

1) 20 inch Eckel power tongs with jaws for 20 inch, 16 inch and 13-3/8 inch casing.

2) 13-3/8 inch Eckel power tongs with jaws for 13-3/8 in., 9-5/8 inch and 7 inch casing.

3) One Lister Diesel 50 hp, 18,000 rpm and one Denison hydraulic pump

4) Make up and breakout manual tongs complete with dies including:

- 2 - BJ Type C Tongs complete
- 2 - BJ extended Type B CSG Tongs
- 2 - BJ Type B Tongs complete with jaws for 3-1/2 inch to 13-3/8 inch casing and drillpipe
- 2 - BJ type SSD Tongs complete with jaws for 4 inch to 12 inch casing and drillpipe

B.17 Elevators and Slips

There is a complete selection of elevators and slips onboard to handle all casing, drillpipe, and drill collar sizes and weights which will be used.

B.18 Mud Saver

The unit has a mud saver Gavels 5 inch pipe and 3-1/2 inch pipe rubber inserts.

B.19 Bit Breakers

The unit has 4-1/8 inch, 6 inch, 8-1/2 inch, 12-1/4 inch, 17-1/2 inch, 26 inch bit breakers.

B.20 Drillstring and Downhole Tools

The unit has the following drillstring and downhole tools:

1) Drillpipe:

8000 ft of 5 inch drill pipe, grade E, 19.5 lb/ft with Reed 4-1/2 IF tool joints.

450 ft Heviwater drill pipe, 50 lb/ft with Drilco 6-3/8 inch tool joints, 4-1/2 IF connector.

Drill pipe pup joints:

1 - 5 inch x 5 ft Grade "C" 25.5 lb/ft

1 - 5 inch x 9 ft Grade "C" Heavy wt. 50 lb/ft

1 - 5 inch x 12 ft Grade "C" Heavy wt. 50 lb/ft

2) Drill Collars:

30 - 6-3/4 inch Spiral - 4-1/2 IF

30 - 8 inch Spiral - 6-5/8 Reg.

4 - 9 inch Spiral - 7-5/8 Reg.

1 - 9 inch Bottom Hole Short - 7-5/8 Reg.

1 - 8 inch Slick Short D/C - 6-5/8 Reg.

1 - 6-3/4 inch Spiral Short D/C - 4-1/2 IF

3) Fishing Jars and Bumper Subs:

1 - 7-3/4 inch OD - API 6-5/8 Reg. connections (mechanical).

1 - 6-1/2 inch OD - API 4-1/2 IF connections (mechanical).

1 - 4-3/4 inch OD - API 3-1/2 IF connections (mechanical).

4) Glory Hole Bit:

20 foot diameter bit

Hydraulic System

Air System

Riser and Spill System

Torque Arrester System

5) Under Reamers and Parts:

1 - 15000 Series Under Reamers with 26 inch arms, 6-5/8 reg. connections

2 - 11700 Series Under Reamers with 17-1/2 inch arms, 6-5/8 reg. connections

3 - Set spare 26 inch arms

3 - Set spare 21 inch arms

1 - Set hinge pins for 11700 Series Under Reamers

1 - Set spare 17-1/2 inch arms

6) Stabilizers:

1 ea. - 36 in. Blade Stabilizer 7-5/8 Reg.
1 ea. - Servco 36 in. 7-5/8 Reg.
2 ea. - Servco 26 in. 7-5/8 Reg.
3 ea. - Servco 17-1/2 in. 6-5/8 Reg.
2 ea. - Servco 12-1/4 in. 6-5/8 Reg.
2 ea. - Servco 8-1/2 in. 4-1/2 IF (two only).
1 ea. - Servco 8-1/2 in. near bit 4-1/2 IF (one only).
2 ea. - Drilco 8 in. non-rotating 6-5/8 Reg.

Additional stabilization equipment will be supplied by the operator as required.

7) Hole Openers:

1 - 36 inch Reed hole opener
1 - 26 inch Reed hole opener

8) Fishing Tools:

A complete inventory of fishing tools dressed for both contractor and operator downhole tools will be maintained on board.

9) Miscellaneous:

A complete inventory of floats and drop-in subs, bit subs, crossover subs, and junk subs is maintained on board.

The operator will provide specialized downhole equipment such as mud tools, mud motors, bent subs, etc. as required.

B.21 Sub Sea and Surface BOP Equipment

The unit has the following sub sea and surface BOP equipment:

1) Regan Diverter:

Type KFDS nominal 24 inch with permanent flow line connections with nominal 24 inch ball joint and Ricker Shaffer Riser Box, complete with Regan rotating head and Type HT2 handling tool.

2) Vetco Slip Joint:

Type A 22 inch riser x 0.500 inch inner wall with 55 ft stroke, 26 ft CD outer barrel x 1/2 inch wall and three 3-1/2 inch ID K/C lines integral with riser section.

3) Vetco Riser:

Type A 22 inch riser with Vetco MR6C box and pin connectors, with three 3-1/16 inch 10,000 psi working pressure (WP) kill/choke/booster/jet lines, 1/2 inch wall thickness x 22 inch OD x X-52 steel, 6 joints x 45 ft x one each of 25 ft, 15 ft and 10 ft joints.

4) Riser Tensioners:

Six IHC Riser Tensioners, max. line tension 80,000 lb, max. line travel 40 ft, 1-3/4 inch wire rope.

5) Guide Line Tensioners:

Four Western Gear Guideline Tensioners, max. line tension 16,000 lb, max. line travel 40 ft, 3/4 inch diameter wire rope.

Two Western Gear Podline Tensioners 16,000 lb, Max. line travel 40 ft, 3/4 inch dia. wire rope. Included with each is a Ingersol Rand Tugger with capacity for 900 ft of 3/4 inch wire.

6) Vetco Ball Joint:

Two 18-3/4 inch bore pressure balanced single ball with butt weld preparation up and a 5,000 psi 6-BX flange down.

7) Cameron Hub:

18-3/4 inch Cameron 10,000 psi Hubs and Clamp between top of annular and ball joint.

8) Shaffer Spherical:

18-3/4 inch double spherical BOP, 5,000 psi working pressure, 10,000 psi test pressure; 5,000 psi stud up and 10,000 psi stud down.

9) Vetco Flex Loops:

2-1/2 inch ID with flange connection each down and butt weld preparation up, and Cameron Hubs and Clamps for fast nipple up.

10) Vetco Stack Connector:

Two H-4 connector 18-3/4 inch for wellhead and ball joint 10,000 psi W.P., Style E hydraulic section BX 164 stainless steel ring groove and 18-3/4 in. x 10,000 psi 6-BX flange. Primary and secondary hydraulic system.

10,000 psi x 18-3/4 inch Type E H-4 pin with VX ring groove top and 18-3/4 inch 10,000 psi APE 6-BX flange BX 164 ringed groove bottom.

11) Test Stump:

One 18-3/4 inch x 10,000 psi W.P. Style E Vetco H-4 pin profile top stainless steel lined VX groove, 4-1/2 IF box with "O" ring seal for drill pipe mounted to base plate.

12) Shaffer Triple BOP Type LWS:

Two 18-3/4 inch bore x 10,000 psi, studded top and bottom with BX 164 stainless steel ring grooves, poslocks, with ram blocks for 5 inch and 3-1/2 inch; 9-5/8 inch and 7 inch rams available.

13) Shaffer Single BOP Type LW:

Two 18-3/4 inch bore x 10,000 psi studded top and flanged bottom with BX 164, poslocks, one set spare shear rams.

14) Rucker Shaffer Fail Safe Valves:

Type 3-1/8 inch x 10,000 psi WP with BX 154 ring gasket with flanged ends and Type B hydraulic operator angle body H_2S trim.

Three Type B 3-1/8 inch x 10,000 psi WP with BX 154 ring gasket with flanged end and Type B hydraulic operator. Straight body H_2S trim.

15) Shaffer Angle Connector:

To enable kill line to tie into second kill line above failsafe valves.

16) Shaffer Guide Structure:

18-3/4 inch BOP with 4-1/2 inch posts and four 8 inch top guide posts on 6 ft radius, including standard control pod receptacles, choke and kill line male stab mounting brackets, and all shuttle valves and hoses.

17) Shaffer Guide Frame:

Heavy duty guide frame to guide lower marine riser package to BOP arms on 6 ft radius to fit 8 inch post.

18) Control Pods:

Koomey RHPS 14-21-7-DF retrievable control pods, double female.

19) Hose Reels, Koomey:

Air operated with control for four functions (two each).

20) Battery and Transformer Power Pack:

With built-in battery charger.

21) Koomey Hose:

Nylon core tube exceeding SAE 100 RS specifications. Burst and bend strength SAE 100 R2 specifications including:

1 - 1 inch hose
15 - 3/16 inch hose
26 - 1/4 inch hose complete with hose sheaves - 760 ft long.

22) Koomey Mixing System:

For mixing Koomey K50 fluid
For mixing ethylene glycol

23) Main Manifold Koomey:

For control of all functions with separator type accumulators 2 x 20 gallon (U.S.) mounted at back of fluid reservoir 3,000 psi WP and 10 x 10 gallon (U.S.).

24) Accumulator Skid:

With 6 x 80 gallon (U.S.) separator type accumulators 480 gallons (U.S.) at 3,000 psi for a total of 580 gallons (U.S.).

25) Electric Pumps:

Two Type 360 Triplex 13.7 GPM at 3,000 psi, 30 hp 230/460 volt, 3 phase; explosion proof complete with pressure switches; section trainers - relief valves discharge; strainers and check valves.

26) Air Pumps:

Two Model 88660, 60:1 ratio, 9.2 GPM at 2,000 psi and 7.2 GPM at 3,000 psi.

27) Stewart and Stevenson Electric Master Panel:

Includes all functions: readback gauges and air regulator control.

28) Stewart and Stevenson Electric Mini Panel:

Controls all BOP functions.

29) Diverter Control Panel:

Controls slip joint pressures and diverter operation including direction valves, complete with two 11-gallon (U.S.) 3,000 psi accumulators and one air pump.

30) Weco Hydraulic Flow Valves:

12 inch gate valves with hydraulic control for mud flow diversion.

31) Raytheon Acoustic BOP Control System Model 4110-26

32) High Pressure Portable Test Unit:

With chart readout attached including 11:1 ratio air operated pump and 140:1 ratio air operated pump.

33) Vetco Running Tools:

Temp guide base running tool - J Type
30 inch wellhead housing left-hand thread running tool
20 inch wellhead housing left hand thread running tool
18-3/4 inch seat protector and wear bushing running and retrieving tool
18-3/4 inch x 16 inch casing hanger running and test tool
18-3/4 inch universal direct drive casing hanger running and test tool.

34) Vetco Test Tools:

18-3/4 inch 10,000 psi multi-purpose test plug complete with modified seal sleeve guide nut.

35) Remedial Tools:

18-3/4 inch Type T pack off running and retrieving tool
18-3/4 inch tape and flush tool.

36) Hang Off Tools:

Vetco emergency drill pipe hang off tool, complete.

37) BOP and LRP Carts:

Talbot, Jackson and Associates, Ltd. Hydraulic BOP and LMRP carts with worm gear drive.

38) Vetco Hydraulic Latch:

Vetco Hydraulic Latch for 30 inch wellhead housing complete with riser connector, ball joint, and Koomey mini reel.

39) Torque Wrench:

Select-A-Torque for B.O.P.'s

One Ingersol Rand 12-1/2 inch drive impact wrench, Model 5820LA1 with torque rating of 7500 ft/lb.

40) Choke and Kill Hoses:

Dual 2-1/2 inch x 50 ft test choke and kill Coflex line hose with Barney coupling.

41) Choke and Kill Manifold:

Cameron and kill manifold 10,000 psi WP 3 inch nominal with two remote manual drilling chokes, two manual adjustable chokes, 3-1/16 inch 10,000 psi flanged gate valves.

Three Ingersol Rand Model 10T2 air compressors supply the necessary high pressure air, maximum working pressures-5000 psi.

B.22 Drilling Fluid System

The drilling fluid system includes the following:

1) Mud Pumps:

Two National mud pumps, Model 12P160, 10-3/4 inch OD suction, 4 inch discharge, two Hydril K-20 pulsator dampeners 5000 psi, powered by two 800 hp AEG motors. Cameron Type B Relief Valves 1500 - 5000 psi, 3 inch.

2) Liners and Pistons:

5-1/2 inch and 7 inch liners and pistons available.

3) Shale Shakers:

Three Derrick FloLine shale shakers.

4) Centrifuge:

Model Sigma 150 Pioneer centrifuging equipment consisting of one direct drive electric centrifuge complete with independent pump assembly, 150 gallon (U.S.) per minute 50 hp electric motor.

5) Degassers:

Swaco degassing unit, vacuum type
Welco Poor Boy degasser, 500 gallon (U.S.)

6) Mud Capacity Below Deck:

6) Mud Capacity Below Deck:

Tank #11 -	440 bbl
Tank #12 -	440 bbl
Tank #10 - Mix Tank	170 bbl
Tank #9 - Chemical Tank	44 bbl
Total	1094 bbl

7) Mud Capacity Above Deck:

Tank #1 - Sand trap	52.2 bbl
Tank #2 - Degasser Tank	76.7 bbl
Tank #3 - Desander Tank	76.7 bbl
Tank #4 - Mud Cleaner Tank	61.0 bbl
Tank #5 - Mud Cooler Tank	261.6 bbl
Tank #6 - Mud Mixing Tank	265.4 bbl
Tank #7 - Suction Tank	238.4 bbl
Trip Tank	32.0 bbl
Total	1064.0 bbl

8) Mud Mixers:

One Lightning Model 75020 mud mixer
Two Sidewinder Mixers.

9) Mud Agitators:

One Lightning chemical agitator, Model 73Q75
Eight Lightning mud agitators, Model 74Q15
Two AEG Mixers
Four Agitators, Model 71Q5.

10) Mixing and Transfer Pumps:

(a) Three Mission 5 inch x 6 inch liquid mud transfer pumps, 75 hp each.

One Mission 2 inch x 3 inch chemical transfer pump.

One Mission Magnum 5 inch x 6 inch on desander,

Two Mission Magnum 5 inch 6 inch on mixing pumps, 56 kw (75 hp) each.

(b) One 5 inch x 6 inch 50 hp pump. This pump works as fluid makeup for drilling mud when required. It also can be routed through the mud cooler as backup, rated capacity 1200 GPM.

(c) Hole fill system 2 inch x 3 inch centrifugal 25 hp electric motor. 30 bbl trip tank with fluid level indicator

(d) One Mission Magnum 5 inch x 6 inch pump, 75 hp, for mud cleaners.

(e) One Mission Magnum 5 inch x 6 inch pump, 75 hp, for Swaco degasser.

(f) One Mission Magnum 5 inch x 6 inch pump, 75 hp, for mud coolers.

(g) One TRW Pleuger submersible pump to supply the heat exchanger with seawater. This is discharged through dilution system.

(h) Three Magikist MH-32C Wash Pumps.

(i) One Howaldtswerke Deutsche Wekft Oil Water Separator Capacity Type TS5F 1300 gal/hr.

11) Desander:

Pioneer T-6-6 6 inch Cones.

12) Injection BBL:

WADECO Injection BBL.

13) Chemical Mixer:

One Thompson Chemical Mixer.

14) Mud Cleaners:

Two Sweco Model J1279SC eight to four-inch cones, 400 GPM ea., for mud cleaners.

15) Mud Cooler:

One Supercharger Model UX-416-HP-260 drilling mud heat exchanger. Six ft^3, 100 psi WP.

B.23 Auxiliary Equipment

Auxiliary equipment includes:

1) Cement Unit:

One Dowell electric driven Model TLO, 5000 psi WP.
One Dowell electric driven Model TLO, 1000 psi WP.

2) Flare Booms:

Two 75 ft flare booms without burners.

APPENDIX C

APPENDIX C. SUPPORT VESSEL DESCRIPTIONS

The Canmar Explorer III drillship will be supported by three arctic class icebreaking supply vessels of Canadian registry. Specifications of the support vessel fleet are described below.

C.1 M/V Robert Lemeur

Specifications for the M/V Robert Lemeur are as follows:

1) General Information:

Vessel type	Icebreaker/Supply Vessel
Date Commissioned	1982
Classification	Lloyds + 100 A1 Icebreaking Supply Vessel, ASPPR Arctic Class 3
Dimensions	LOA 271.65 ft Beam 59.08 ft Draft (Lightship) 11.52 ft Draft (Winter load) 18.04 ft Draft (Summer load) 18.60 ft
Tonnage (ST)	3504.98 gross 1651.54 net
Displacement	Lightship = 3162.90 tons Winter load = 5620.90 tons Summer load = 5853.40 tons
Accommodations	Total 26 (16 single cabins, 5 double cabins) Galley with seating for 18
Crew size	16

2) Power:

Main Propulsion	Two Krupp M.A.K. 12M453AK 12-cylinder turbo-charged diesel engines developing 4800 bhp each at 600 rpm
Total BHP	9600
Propellers	Two 9.64 ft diameter, controllable pitch, four bladed propellers in nozzles
Auxiliary Power	Four CAT 16VD399, each 800 KW, 600V AC/3 phase One Stamford emergency generator powered by CAT 3304, 75KW, 600V AC/3 phase/60 cycle
Thrusters	Two bow and afterbow Maritime Industries 900II tunnel type, four blade fixed pitch 900 bhp each
Air Bubbler System	Ampower Canada CA-10-22 1590 ft^3/min at 800 rpm

3) Capacities:

Clear Deck Space	5619 ft^2 (118.11 ft x 47.57 ft)
Total Cargo Deadweight at max. draft	2690 tons
Max. deck cargo capacity	605 tons
Bulk mud and cement capacity (per day)	Nine tanks at 206 ft^3 ea Total = 1855 ft^3
Fuel	556,384 gallons U.S. (13,247 bbls) at 100%
Potable Water	31,704 gallons U.S. (775 bbls) at 100%
Drill/Ballast Water	566,260 gallons U.S. (13,482 bbls) at 100%

4) Performance:

Speed and Fuel Consumption	13.0 knots at 9511 gpd (maximum) 10.5 knots at 7398 gpd (cruising) 3.0 knots at 1982 gpd (standby)
Bollard Pull	113 tons, designed

5) Auxiliary Equipment:

Water Maker	Two Weir MX Size D, 200 gal/hr ea.
Sewage Treatment	Red Fox RF-100-M, 30 person system capacity
Oily Water Separator	HDW Turbo-Type TE-5-F, 1300 gal/hr at 8 ppm max.
Pumping Systems	Ballast water, fire pumps, and dry cargo lube oil, glycol, etc.
Deck Equipment	Four tugger winches and one marine crane

6) Firefighting Equipment:

Fire Detection System	Pyr-A-Larm EA-35 smoke detection and alarm systems
Engine Room Smothering System	Chubb Halon 1301 fixed fire extinguishing system consisting of six 30 lb cylinders
Paint Locker System	Chubb CO_2 system consisting of one 50 lb CO_2 cylinder
Emergency Generator	Chubb CO_2 system consisting of one 100 lb CO_2 cylinder, Kidde HDR 25 DC
Galley System	Kidde HDR 25 DC
Foam Monitors	SKUM MK 150 (remote) 15,850 ft^3/hr at 375 ft/HD, SKUM MK100 manual)
Hydrants	Three 1-1/2 inch, eleven 2 inch

Hoses	Three 1-1/2 inch x 50 ft, six 2 inch x 50 ft, five 2 inch x 60 ft
Nozzles	14 combination nozzles
Fog Applicators	Three
Fire Extinguishers	Two 20 gal portable foam generators Seven 10 lb CO_2, 32 x 20 lb Dry Chemical
Fire Suits	Two M.S.A. Fireman's Suits
Fire Buckets	Four
Fire Axes	Three
Breathing Apparatus	Four M.S.A. S.C.B.A. (two with Fireman's Suits)
Fire Blankets	Two

7) Lifesaving Equipment:

Lifesaving Class	Class IX
Lifeboat	One Schat Viking 20-person F-Class motorized lifeboat powered by Saab GA 108-78 12 hp on gravity davit
Liferafts	Six 25-person
Lifejackets	150 standard DOT adult
Survival/Immersion Suits	26 Fitzwright
Liferings	Two equipped with smoke floats Four equipped with lights Four equipped with lifelines
Scramble Nets	Two manilla
Rescue Hooks	Four
Additional Equipment	Four embarkation ladders 12 Type A distress rockets Two Schermuly speedlines Two lifelines on davit span
Rescue Boat	One Lucas Hurricane 600 high-speed semi-rigid inflatable Two Mariner 40 hp outboard motors Three Mustang floatsuits (crew) Two wooden paddles

One 3/4 inch manila towing bridle and rope
One toolkit for outboard motors
One patching kit
Two 5-gallon fuel tanks
Two foot pumps for inflating chambers
Two 12V starting batteries
One combination flood/ searchlight with rechargeable battery
Standard DOT/S.O.L.A.S. equipment

8) Bridge and Wheelhouse Equipment:

One central forward console on raised plinth for all normal navigation and most icebreaking. All associated instruments clustered on port and starboard sections of central console. Radios slung from deckhead.

Major functions such as port and starboard engine controls, bow-thrusters, helm, compass, engine gauges, VHF radio and single searchlight, are duplicated in the port and starboard aft wings.

The foam monitor remote control is situated on the port aft control station.

9) Navigation and Communication Equipment:

One Airchime EP90 ice-breaking siren
Two John Lilley and Gilley Type SR2 magnetic compasses
Two Arma Brown MK-10 gyro compasses
Two Canadian Marconi CH150 SSB transceivers
Two Canadian Marconi SM100 distress tone generators
Two Raytheon RAY55 VHF/FM radiotelephones
Two Raytheon RAY55 slave radiotelephones
One Magnavox MX3102 satellite navigator
One Alden Marinefax IV facsimile receiver

One Genave/Alpha 270 air-to-ground radio

One Simrad RW 105 watch alarm receiver

One Taiyo Musen Co. ADF Model TD-A20ZB

One Raytheon OSN-450 Doppler sonar navigator

One Elac Honeywell depth sounder Type LAZ 51 BT

One Canadian Marconi "Survivor 3" survival craft emergency radio

One Raytheon Mariners Pathfinder RAYCAS radar with 16 inch P.P.I., inter-switchable "X" band and "S" band

One Raytheon mariners Pathfinder Time Motion Radar with 12 inch P.P.I., inter-switchable "X" and "S" band

One Panasonic Multi-band Receiver Model ON RF 4900.

C.2 M/V Supplier III and M/V Supplier IV

Specifications for the M/V Supplier III and M/V Supplier IV are as follows:

1) General Information:

Vessel Type	Anchor Handling, Icebreaker/ Supply Vessel
Date Commissioned	1975
Classification	Lloyds + 100 A1 Class 1, ASPPR Arctic Class 2
Dimensions	LOA 204.98 ft Width 45.01 ft Draft Lightship 9.35 ft Draft Winter load 13.92 ft Draft Summer load 14.21 ft
Tonnage	387.07 net 1190.42 gross
Displacement	Lightship = 1334.59 tons Winter load = 2306.32 tons Summer load = 2377.44 tons
Accomodations	Total 16 (8 single cabins, Galley with eight double cabins
Crew Size	13

2) Power:

Main Propulsion	Two GM EMD 20-645-E7 20-cylinder turbo-charged diesel engines each developing 3600 bhp at 900 rpm
Total BHP	7200
Propellers	Two 10.17 ft diameter, controllable pitch, four-bladed propellers
Auxiliary Power	Two CAT D343TA diesel generators, 200 KW 460V AC/3 phase/60 cycle
Thrusters	Brodr Brunvoll Model SPK-350 driven by CAT D343, tunnel type 350 bhp, 3.13 T thrust

3) Capacities:

Clear Deck Space	3615.95 ft^2 (98.42 ft x 36.75 ft)
Total Cargo Deadweight at max. draft	1042.83 tons
Max. deck cargo capacity	711.20 tons
Bulk mud and cement capacity (dry)	Three tanks at 121 ft^3 ea Total = 363 ft^3
Fuel	124,259 gallons U.S. (2959 bbls) at 100%
Potable Water	57,189 gallons U.S. (1362 bbls) at 100%
Drill/Ballast Water	176,736 gallons U.S. (4,208 bbls) at 100%

4) Performance:

Speed and Fuel Consumption	15.5 knots at 6077 gpd (maximum) 12.5 knots at 4227 gpd (cruising) 3.0 knots at 793 gpd (standby)
Bollard Pull	81.28 tons

5) Auxiliary Equipment:

Water Maker	Maxim HJ20A, Capacity 1057 gpd
Sewage Treatment	Omnipure 6M412-14, USCG approved 800, gal/day
Oily Water Separator	Sigma, 428 gal/hr throughput, at 15 ppm or less, USCG approved
Pumping Systems	Ballast water, fire pumps, wet and dry cargo, lube oil, glycol, etc.

6) Deck Equipment:

Anchor Handling and Towing Wench	Belair double-drum waterfall type drum dia. = 3 ft, capacity 3500 ft at 2-1/4" wire Line pull = 136 tons on first wrap Low Speed = 136 tons at 19 fpm High Speed = 9 tons at 450 fpm
Stern Roller	12 ft long, 6 ft dia. Working load = 150 tons
Power Capstans	Two Nolan Lowe Power Corp. Model C-20-150, 7.5 T line pull
Tugger Winches	Two Nolan Lowe Power Corp. 5T line pull
Crane	One 20 ft Service Boom Minimum Radius: 5 ft at 3 tons Maximum Radius: 20 ft at 0.5 tons

7) Firefighting Equipment:

Fire Detection System	Pyrotronics System 3 smoke detection and alarm system
Engine Room Smothering System	Pyrene fixed CO_2 firefighting system consisting of fourteen 100 lb cylinders
Hydrants	Six
Hoses	Six 50 ft x 1-1/2 inch

Nozzles	Four fog Two combination-type
Fire Extinguishers	Two 10 lb CO_2, 2 ea x 20 lb Dry Chemical Two 20 lb CO_2, 14 ea x 10 lb Dry Chemical
Fire Suits	One in winch house
Fire Buckets	Four
Fire Axes	Three
Breathing Apparatus	Three Scott Air Packs with spare bottles
Additional Equipment	One diesel-driven emergency fire pump

8) Lifesaving Equipment:

Lifesaving Class	IX
Lifeboat	One Davidson Model 6778, 169 ft^3, 11-person powered by Lister SRZ 12 hp at 2000 rpm
Liferafts	One 10-man Beaufort Two 20-man Beaufort One 25-man Beaufort
Lifejackets	48 standard DOT adult
Survival/Immersion Suits	16 Fitzwright
Liferings	Four equipped with lifelines Two equipped with lights Two equipped with smoke floats
Scramble Nets	Two
Additional Equipment	Two embarkation ladders 12 Type A distress rockets Two Schermuly speedlines
Rescue Boat	One Lucas Hurricane 500 high-speed semi-rigid inflatable, 2 ea. 30 hp outboards

9) Bridge and Wheelhouse Equipment:

One Sperry MK37 gyro compass

One Henry Brown and Sons 10 inch SESTRAL magnetic compass

One Carlisle and Finch searchlight

One Decca AC1226C radar

One Carlisle and Finch searchlight

One Decca AC1226C radar

One Decca RM1230C radar

One Canadian Marconi CH150 SSB transceiver with BH30 1500 kw transmitter

One Motorola Triton 40S SSB transceiver

One Raytheon RAY55 VHF/FM radiotelephone

One Simrad EN echo sounder

One Simrad IC echo sounder

One Simrad Taiyo TKL-110 ADF

One Gundry-Bilmac 500 search initiator buoy

Two Survivor II lifeboat radios

One Johnson AM air-to-ground radio

One J.R.C. Jax 25 facsimile receiver

One Internal airphone system with stations

One Marconi 1-way talkback system

One Hose McCann sound-powered telephone system.

C.3 Oil Spill Response Barge and Tug

The oil spill response barge and tug will be U.S. flag vessels and will carry additional fuel below decks for on-site refueling of the drillship and Canmar support vessels, as necessary. Design and deck layout data of the oil spill response barge and tug are presented in detail in Exhibit 2-1, Oil Spill Contingency Plan.

EXPLORATION PLAN

LIST OF ATTACHMENTS

Tab No.	Title
1	Geological and Geohazards Information
2	Oil Spill Contingency Plan
3	Lease Stipulations
4	Drilling Fluids
5	Hydrogen Sulfide Contingency Plan
6	New or Unusual Technology
7	Support Facilities
8	Onshore Support
9	Discharges
10	Meteorology
11	Oceanography
12	Biological Resources
13	Environmentally Sensitive Areas
14	Use Conflicts
15	Archaeology and Cultural Resources
16	Environmental Data Monitoring
17	Direct and Cumulative Impacts
18	Coastal Zone Consistency
19	Air Quality
20	SWEPI Contacts
21	Other Information

ATTACHMENT

1

1. GEOLOGICAL AND GEOHAZARDS INFORMATION

This Exploration Plan covers eleven prospects as indicated on Figure 1-1 and listed in Table 1-1.

General geological information requested under 30 CFR 250.33(b)(1)(i-viii) for the eleven prospects covered under this Exploration Plan are provided as Exhibit 1-1. Additional information will be provided as necessary.

Available geohazards reports as requested under 30 CFR 250.33(b)(1)(ix) for the eleven prospects covered under this Exploration Plan will be provided as they become available.

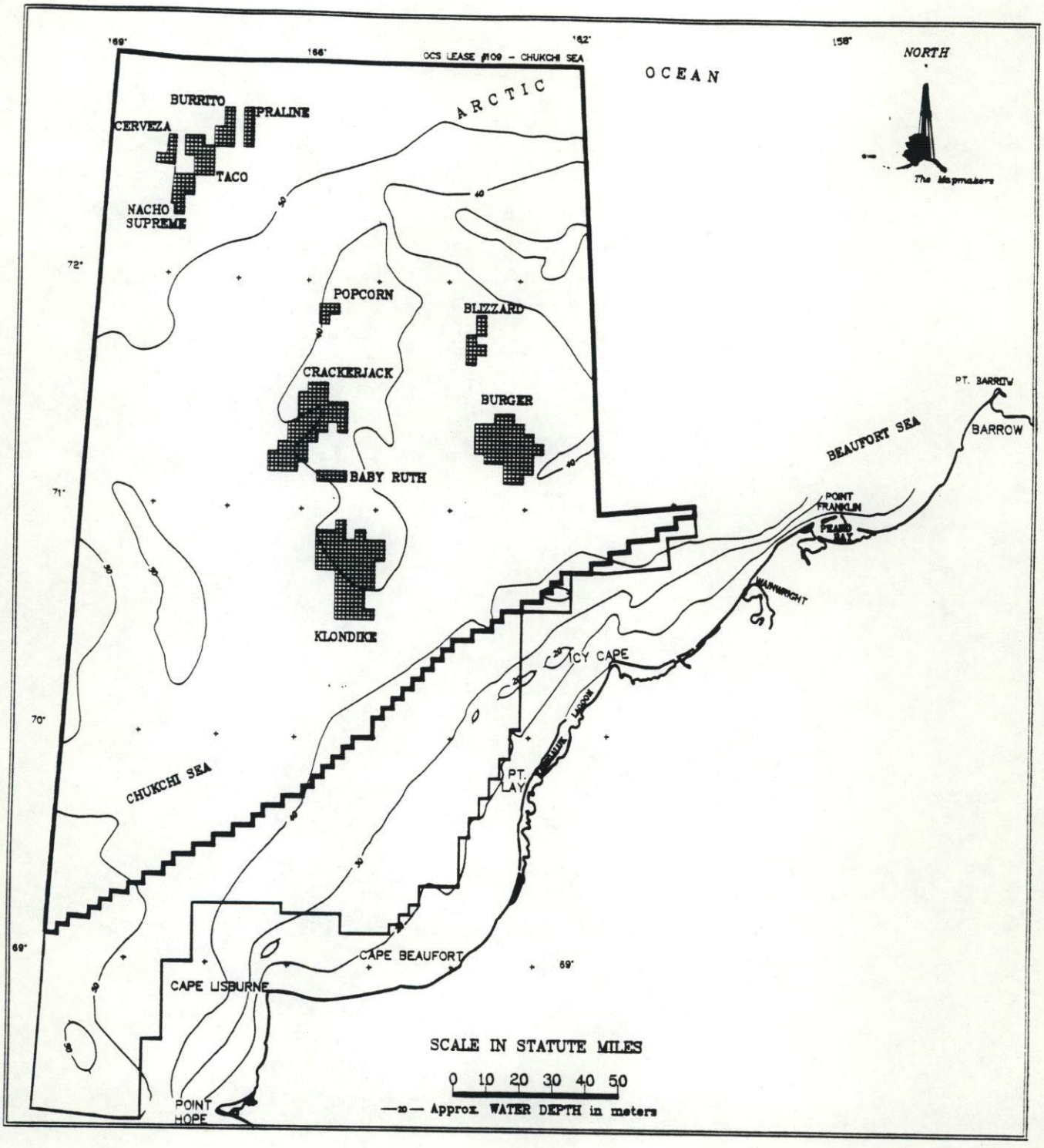


FIGURE 1-1. LOCATION MAP FOR SWEPI'S REMOTE OFFSHORE AREA PROSPECTS

TABLE 1-1

Prospect and Lease Block Summary

Prospect	Blocks
Baby Ruth	1365, 1366, 1367
Blizzard	1382, 1386, 1389, 1391, 1392, 1393
Burger	1395, 1396, 1397, 1398, 1399, 1400, 1401, 1403, 1404, 1405, 1406, 1407, 1408, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1420, 1421, 1422, 1423, 1424, 1429, 1430, 1431, 1436, 1437
Burrito	1183, 1185, 1187, 1188, 1192, 1193
Cerveza	1176, 1177, 1178, 1179
Crackerjack	1300, 1301, 1303, 1304, 1305, 1306, 1310, 1311, 1312, 1313, 1314, 1317, 1318, 1319, 1320, 1321, 1325, 1326, 1327, 1328, 1330, 1334, 1335, 1336, 1342, 1343, 1344, 1349, 1350, 1351, 1352, 1357, 1358, 1359
Klondike	1447, 1454, 1455, 1456, 1458, 1461, 1462, 1463, 1464, 1465, 1466, 1468, 1469, 1470, 1471, 1472, 1473, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1485, 1486, 1487, 1488, 1489, 1490, 1491, 1493, 1494, 1495, 1496, 1497, 1498, 1499, 1503, 1504
Nacho Supreme	1180, 1202, 1203, 1204, 1205, 1207, 1210
Popcorn	1264, 1265, 1275
Praline	1184, 1186, 1189, 1194
Taco	1190, 1191, 1195, 1196, 1197, 1198, 1199, 1200, 1201

ATTACHMENT

2

2. OIL SPILL CONTINGENCY PLAN

An Oil Spill Contingency Plan (OSCP) has been prepared in conformance with 30 CFR 250.42. This Plan is provided separately as Exhibit 2-1.

ATTACHMENT

3

3. LEASE STIPULATIONS

Stipulation No. 1 - Protection of Archaeological Resources

Available side-scan sonar records from geophysical surveys conducted in 1988 have been reviewed and evidence of potential archaeological resources (including shipwrecks) were not observed in any of the records. In addition, no indication was provided in the EIS that archaeological resources will occur in any of the lease blocks to be drilled. SWEPI will continue to review new side scan sonar records from future surveys for archaeological resources as these records become available.

North Slope Borough, state, and federal records have been reviewed and no record has been found of archaeological resources at onshore staging and logistical support sites that will be disturbed by proposed activities.

Stipulation No. 2 - Orientation Program

SWEPI's proposed orientation program includes a video presentation and a pocket environmental guide. The orientation program, including video presentation, is currently in production and should be available early in 1989.

The video program will be viewed at least once a year by all personnel involved in onsite exploration or development and production activities and by all supervisory and managerial personnel involved in lease activities.

Stipulation No. 3 - Transportation of Hydrocarbons

Commercial transport of hydrocarbons is not anticipated as part of the proposed exploration activities. Consequently, this stipulation is not applicable.

Stipulation No. 4 - Oil Spill Response Preparedness

The Oil Spill Contingency Plan (Exhibit 2-1) outlines the appropriate activities planned to demonstrate SWEPI's oil spill response preparedness.

Stipulation No. 5 - Protection of Biological Resources

The Regional Supervisor of Field Operations (RSFO) has not yet determined if biological surveys are required. If required, SWEPI will be prepared to conduct underwater television (UTV) surveys in the immediate vicinity of the site prior to placement of the drilling unit.

Stipulation No. 6 - Industry Site-Specific Bowhead Whale Monitoring Program

This stipulation does not apply. The REMOTE OFFSHORE PROSPECTS are not within the lease blocks requiring this stipulation. In addition, the proposed exploration activities will not occur during the period of spring migration for bowhead whales (April 1 to May 31).

Stipulation No. 7 - Density Restriction for Protection of Bowhead Whales from Potential Effects of Noise

This stipulation does not apply. The REMOTE OFFSHORE PROSPECTS are not within the lease blocks requiring this stipulation. In addition, the proposed exploration activities will not occur during the period of April 15 through May 15.

Stipulation No. 8 - Subsistence Whaling and Other Subsistence Activities

Subsistence whaling communities of Wainwright, Barrow, Point Hope, and Point Lay and representatives of the Alaska Eskimo Whaling Commission have been consulted as to effects of the proposed exploration activities on their subsistence activities. Documentation required under this stipulation is provided as Exhibit 3-2.

ATTACHMENT 4

4. DRILLING FLUIDS

Only EPA approved generic muds and specialty additives will be discharged from the proposed exploratory operations. It is currently anticipated that Type 2 muds, seawater lignosulfonate muds, will be used for the proposed activities (see Table 4-1). Other authorized mud types and specialty additives contained in Tables 4-1 and 4-2 may be required depending on actual drilling conditions encountered.

All drilling muds and cuttings will be discharged through a single downpipe located mid-ship. The downpipe is a 16 inch diameter pipe which extends approximately 3 feet below the water surface at drilling draft.

An estimated 5,000 barrels of drilling mud and cuttings will be discharged from a single exploratory well. The maximum discharge rate would be 500 barrels per hour (bbl/hr) for wells in water depths of 5 to 20 m, 750 bbl/hr for wells in water depths of 20 to 40 m, and 1000 bbl/hr for wells in water depths greater than 40 m. All discharges of drilling muds would be prediluted 9:1 with ambient seawater.

Mineral oil pills, if required, will consist of components authorized by EPA and indicated in Table 4-3. Mineral oil pills and drilling muds potentially contaminated with mineral oil will be handled in a manner consistent with the General NPDES Permit.

All other requirements as covered in the General EPA Permit No. AKG288000 will also be strictly adhered to.

TABLE 4-1

Authorized Drill Mud Types

Components	Maximum Allowable Concentration (lb/bbl)
1. Seawater/Freshwater/Potassium/Polymer Mud	
KCl	50
Starch	12
Cellulose Polymer	5
Xanthum Gum Polymer	2
Drilled Solids	100
Caustic	3
Barite	575
Seawater/Freshwater	As needed
2. Seawater/Lignosulfonate Mud	
Bentonite*	50
Lignosulfonate, Chrome or Ferrochrome	15
Lignite, Untreated or Chrome-treated	10
Caustic	5
Lime	2
Barite	575
Drilled Solids	100
Soda Ash/Sodium Bicarbonate	2
Cellulose Polymer	5
Seawater/Freshwater	As needed
3. Lime Mud	
Lime	20
Bentonite*	50
Lignosulfonate, Chrome or Ferrochrome	15
Lignite, Untreated or Chrome-treated	10
Caustic	5
Barite	575
Drilled Solids	100
Soda Ash/Sodium Bicarbonate	2
Seawater/Freshwater	As needed
4. Non-Dispersed Mud	
Bentonite*	50
Acrylic Polymer	2
Lime	2
Barite	180
Drilled Solids	70
Seawater/Freshwater	As needed
5. Spud Mud	
Lime	2
Bentonite*	50
Caustic	2
Barite	50
Soda Ash/Sodium Bicarbonate	2
Seawater	As needed
6. Seawater/Freshwater Gel Mud	
Lime	2
Bentonite*	50
Caustic	3
Barite	50
Drilled Solids	100
Soda Ash/Sodium Bicarbonate	2
Cellulose Polymer	2
Seawater/Freshwater	As needed

* Attapulgite, sepialite, or montmorillonite may be substituted for bentonite.

NOTE: Table 1 may be updated by EPA, Region 10, during the effective period of the permit. If so, the latest updated version will supersede all earlier versions. Updated versions will be mailed to permittees at the time that the updates become effective. They will be available to other parties upon request.

TABLE 4-2

Authorized Mud Components/Specialty Additives

Product Name	Generic Description*	Maximum Allowable Concentration (lb/bbl, unless otherwise noted)**
Aktaflo-S	Aqueous solution of non-ionic modified phenol (equivalent of DMS)	3 (3)**
Aluminum stearate	----	0.2+
Ammonium nitrate	----	200 mg/l nitrate or 0.05 lb/bbl
Aqua-Spot	Sulfonated vegetable ester formulation	1% by vol.
Bara Brine Defoam	Dimethyl polysiloxane in an aqueous emulsion	0.1
Ben-Ex	Vinyl acetate/maleic anhydride copolymer	1 (1)**
Bit Lube II	Fatty acid esters and alkyl phenolic sulfides in a solvent base	2
Calcium carbide	----	As needed+
Cellophane flakes	----	As needed+
Chemtrol-X	Polymer treated humate	5 (4)**
Con Det	Water solution of anionic surfactants	0.4 (0.25)**
D-D	Blend of surfactants	0.5 (0.25)**
DMS	Aqueous solution of nonionic modified phenol	3 (3)**
Desco	Chrome-free organic mud thinner containing sulfomethylated tannin	0.5
Duovis	Xanthan gum	2
Durenex	Lignite/resin blend	2
Flakes of silicate mineral mica	----	45+
Gelex	Sodium polyacrylate and polyacrylamide	1 (1)**

NOTE: Any of the additives listed above may be discharged in generic muds 2 through 6. Only those additives marked "+" may be discharged in generic mud 1.

TABLE 4-2 (Cont'd)

Authorized Mud Components/Specialty Additives

Product Name	Generic Description*	Maximum Allowable Concentration (lb/bbl, unless otherwise noted)**
Glass beads	----	8+
LD-8	Aluminum stearate in propoxylated oleylalcohol	10 gal/1500 bbl
Lube-106	Oleates in mixed alcohols	2
Lubri-Sal	Vegetable ester formulation	2.0% (by vol)
MD (IMCO)	Fatty acid ester	0.25 (0.25)**
Milchem MD	Ethoxylated alcohol formulation	0.4 gal/bbl or 0.3 (0.25) lb/bbl**
Mil-Gard	Basic zinc carbonate	As needed+
Nut hulls, crushed granular	----	As needed+
Phosphoric acid esters and triethanolamine	----	0.4
Plastic spheres	----	8+
Poly RX	Polymer treated humate	4 (4)**
Resinex	Reacted phenol-formaldehyde-urea resin containing no free phenol, urea, or formaldehyde	4 (4)**
Salec-Floc	High molecular weight poly-acrylamide polymer packaged in light mineral oil	0.25
Soldium chloride	----	50,000 mg/l chloride
Sodium nitrate	----	200 mg/l nitrate or 0.05 lb/bbl
Sodium polyphosphate	----	0.5+
Soltex	Sulfonated asphalt residuum	6
Sulf-X ES	Zinc oxide	As needed
Therma Check	Sulfono-acrylamide copolymer	1
Therma Thin	Polycarboxylic acid salt	4

NOTE: Any of the additives listed below may be discharged in generic muds 2 through 6. Only those additives marked "+" may be discharged in generic mud 1.

TABLE 4-2 (Cont'd)

Authorized Mud Components/Specialty Additives

Product Name	Generic Description*	Maximum Allowable Concentration (lb/bbl, unless otherwise noted)**
Torq-Trim II	Liquid triglycerides in vegetable oil	6
Vegetable plus polymer fibers, flakes, and granules	----	50+
VG-69	Organophilic clay	12
XC Polymer	Xanthan gum polymer	2
XO_2	Ammonium bisulfite	0.5
Zinc carbonate and lime	-----	As needed+

NOTE: Any of the additives listed above may be discharged in generic muds 2 through 6. Only those additives marked "+" may be discharged in generic mud 1.

* Any proprietary formulation that contains a substance which is an intentional component of the formulation, other than those specifically described, must be authorized by the Director.

** If a listed product will be used in combination with other functionally equivalent products, the maximum allowable concentration (MAC) for the sum of all of the products is the lowest MAC for any of the individual products. Four examples of functionally equivalent products are: (1) Aktaflo-S and DMS, MAC = 3 lb/bbl; (2) Ben-Ex and Gelex, MAC = 1 lb/bbl; (3) Chemtrol-X, Durenex, Poly RX, and Resinex, MAC = 4 lb/bbl; and (4) Con Det, D-D, MD (IMCO), and Milchem MD, MAC = 0.25 lb/bbl. For these examples, the MAC for any combination of the products is given in parentheses. For guidance on whether other products are considered to be functional equivalents, contact the regional office of EPA.

TABLE 4-3

Authorized Mineral Oil Pill Components

List A - Spotting Compounds

Black Magic SFT
EZ Spot[NT]
Kenol ES
Kwikspot
Pipelax SF
Halliburton Pill*
    Halliburton MO-55
    Halliburton MO-56
    Hyflow IV
    Mineral oil from List B

List B - Mineral Oil Products

Conoco LVT
DOS 3
Gulf Mineral Seal Oil
LVT 35
Mentor 28
Vista ODC

Pre-Mixed Mineral Oil Pills

Black Magic LT**

---

* The Halliburton Pill has been authorized according to the formulation listed above.

** Black Magic LT is a complete mineral oil pill that is pre-mixed.

NOTES:

1. These lists were compiled by Region 10 based on the products requested and authorized under previous general permits for the Alaskan OCS.

2. None of the listed products may be discharged in generic mud 1. Refer to sections II.8.1.e and f of the permit for discharge requirements.

3. One product from List A and one product from List B may be combined to formulate a mineral oil pill. Products from List B may also be used individually as a spot.

4. Any mineral oil pill components not listed below must be authorized by Region 10 prior to discharge.

ATTACHMENT

5

5. HYDROGEN SULFIDE PLAN

The probability of H_2S at the proposed drilling sites is currently unknown, however, based on regional considerations, H_2S is not expected. In any event, an H_2S Contingency Plan has been prepared in accordance with 30 CFR 250.67 and is provided as Exhibit 5-1.

ATTACHMENT

6

6. NEW OR UNUSUAL TECHNOLOGY

Equipment and technology proposed for the drilling operations have been in use in arctic conditions for the past decade and are considered to be neither new nor unusual.

Certain operational procedures manuals and data available to SWEPI or its contractors are considered proprietary. Specifically these include:

1. Canmar Explorer III, Operations Manual (Exhibit 6-1)

2. Canmar Explorer III, Critical Operations and Curtailment Plan (Exhibit 6-2)

3. Chukchi Area Geological Data (Exhibit 1-1)

4. Chukchi Area Geohazards Survey Data (Exhibit 1-2)

ATTACHMENT

7

7. SUPPORT FACILITIES

7.1 General

Exploration drilling activities will be directed from the Shell Western E&P Inc. office located at 601 West Fifth Avenue, Suite 810, Anchorage, Alaska. Drilling operations will be supported by both aviation and marine logistics activities. Operations will be supported entirely using existing facilities and no new facilities will need to be constructed.

7.2 Aviation Logistics Activities

Crews and other support personnel and supplies will be flown to Barrow (Wiley Post/Will Rogers Memorial Airport) using available commercial or chartered aircraft from Anchorage, Fairbanks, Deadhorse or Canada. Personnel and equipment will then be transferred by available local ground transportation to the existing UIC-NARL Camp for helicopter transport to the drill site. Should helicopter operations be delayed by weather or other factors, personnel will be temporarily housed in the 88-bed UIC-NARL Camp.

Aviation support will be accomplished with two helicopters based at the existing UIC-NARL facility. Although the final helicopter selection has not yet been made, they will likely be Super Puma's or their equivalent. These helicopters can accommodate 12 to 18 passengers, have the required range, fly at 120 to 130 knots, and are instrument rated aircraft.

Helicopter flights will average one to two times per day for handling crew changes and hauling food and other incidental or expendable supplies to the drillship. Flight patterns used will follow a direct route between the UIC-NARL and the drill sites as indicated on Figure 7-1. Estimated distances and flying times are summarized on Table 7-1.

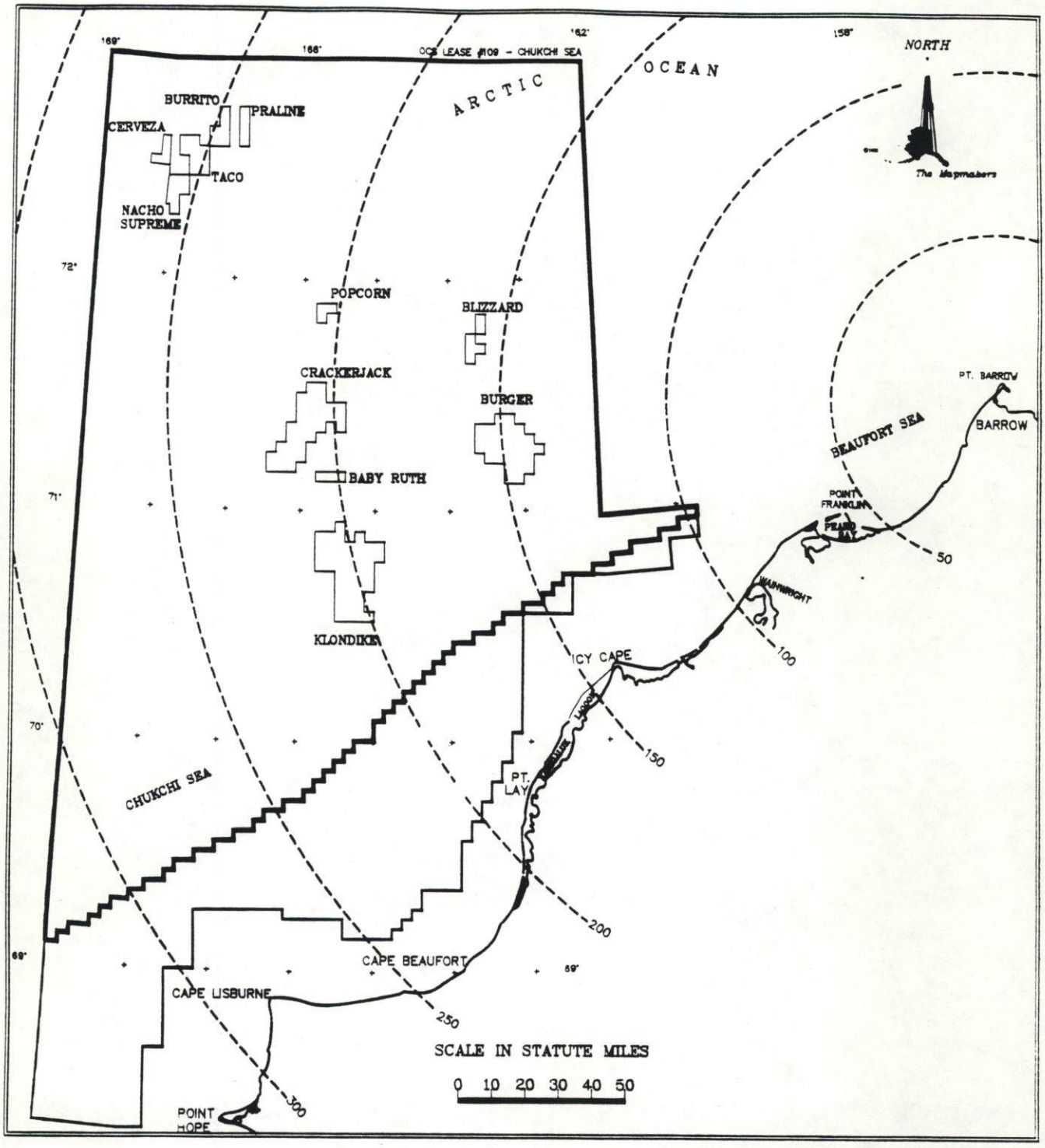


FIGURE 7-1. FLIGHT DISTANCES FROM BARROW, ALASKA

TABLE 7-1

Estimated Distances and Helicopter Travel Times
from Barrow, Alaska

Prospect	Distance (statute miles)	Flying Time (hours)
Baby Ruth	200 - 210	1.3 - 1.5
Blizzard	155 - 165	1.0 - 1.2
Burger	140 - 160	0.9 - 1.2
Burrito	250 - 255	1.7 - 1.8
Cerveza	265 - 270	1.8 - 2.0
Crackerjack	195 - 220	1.3 - 1.6
Klondike	190 - 210	1.3 - 1.5
Nacho Supreme	255 - 260	1.7 - 1.9
Popcorn	205 - 210	1.4 - 1.5
Praline	240 - 250	1.6 - 1.8
Taco	250 - 265	1.7 - 1.9

The helicopter operations will include a crew of approximately 10 to 12 persons at any one time and include primarily pilots and mechanics. This support staff would be lodged at the UIC-NARL camp. Hanger and other storage facilities are also available at the UIC-NARL camp to support the helicopter operations.

The UIC-NARL camp near Barrow is designated as the principal base-of-operations for aviation logistics to drill sites. However, to accommodate the uncertainty of weather conditions along the flight corridor, Kuparuk, Deadhorse, and Umiat are designated as potential alternative helicopter landing sites. Existing facilities at Uniat include a 5,400 foot gravel airstrip, aircraft parking aprons, and IFR approach control. A dedicated temporary helicopter fuel tank may be required at Umiat, depending upon aircraft type. Kuparuk and Deadhorse have extensive existing facilities and a scheduled and charter fixed-wing aircraft routing schedules.

7.3 Marine Logistics Activities

It is anticipated that most drilling supplies (including fuel) necessary to complete the activities will be stored onboard the drillship and support vessels. Should additional fuel, or other items which are too large for helicopter transport be required, these items will be hauled either from Red Dog Mine, Nome, Kotzebue or Dutch Harbor using available U.S. flag vessels. Kotzebue is the preferred resupply base.

Resupply vessels will follow fairly direct routes between the resupply point and drillsite as indicated on Figure 7-2. Resupply of diesel fuel will likely be required during the wells.

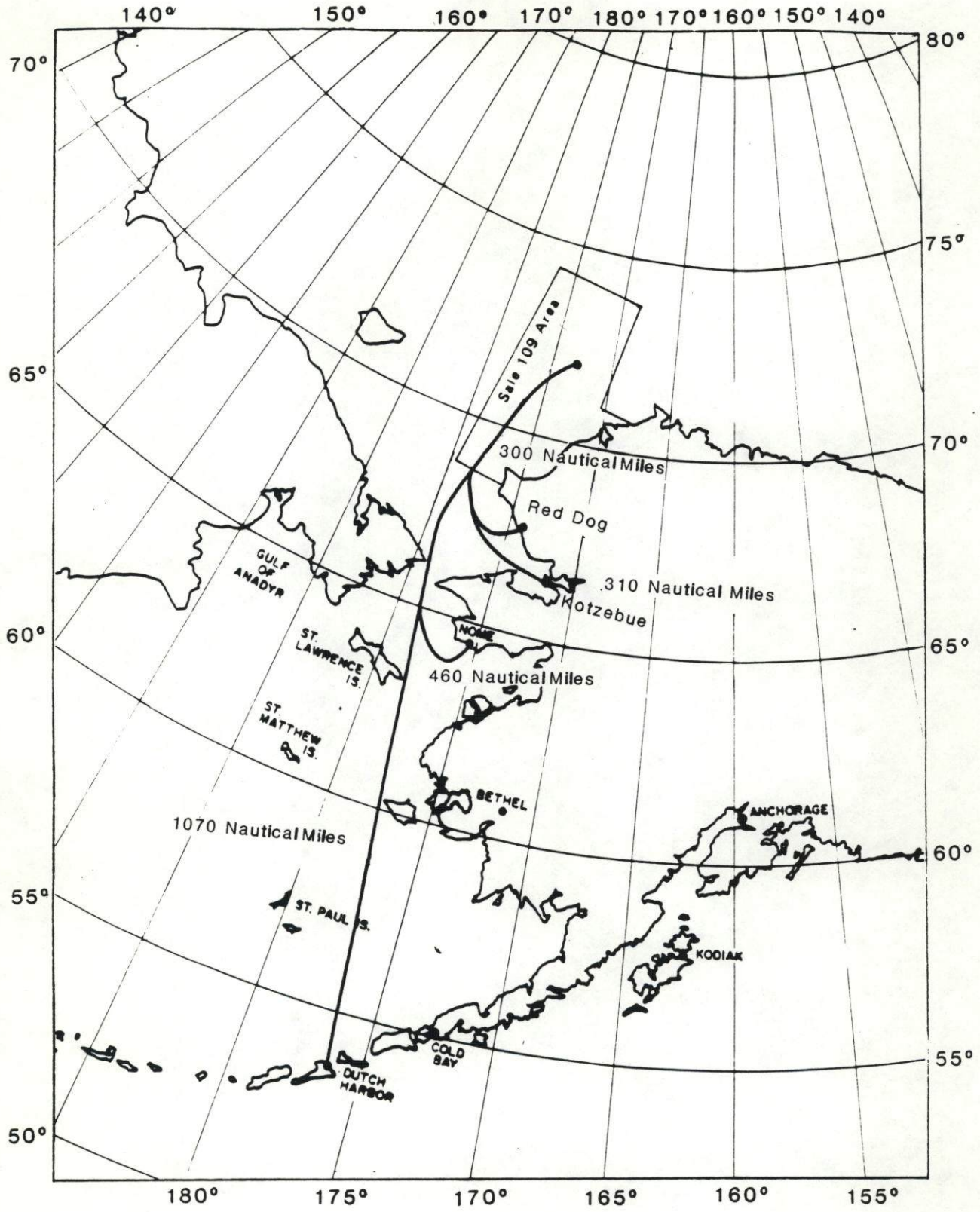


Figure 7-2. Marine resupply routes.

ATTACHMENT 8

8. ONSHORE SUPPORT

Onshore support facilities will use existing facilities; construction of new facilities is not expected. The onshore facilities for this project will consist primarily of logistical support for manpower transfer, resupply of perishable goods, and staging for helicopter resupply of expendable materials used in support of exploration drilling activities.

The SWEPI exploration activities will be based at the UIC-NARL Camp near Barrow, Alaska (see enclosed brochure). This existing complex is fully operational and will accommodate the anticipated needs for onshore support logistics including:

- Helicopter fuel storage
- Maintenance hanger
- Helicopter support crew and pilot housing
- Access to local fixed or rotary wing charter aircraft and scheduled commercial flights
- Support housing for drilling crew, visitors, and other support personnel

The use of the existing UIC-NARL facility will not require the acquisition, expansion, or construction of additional onshore support facilities for the proposed operations.

The marine-based onshore support facilities are available at established operations at Red Dog, Kotzebue, Nome and Dutch Harbor. SWEPI is currently planning to base most marine operations out of Kotzebue using existing facilities operated by Crowley Maritime Corporation, and support facilities in Kotzebue will use existing employees of Crowley. In addition, SWEPI is currently considering offering four native residents from each of the four local villages training and employment opportunities for various drillship, support vessel, and oil spill response duties.

The onshore support operations at UIC-NARL will require five to ten people for camp operation, all of whom will be local North Slope Borough residents. Major supplies anticipated at the facility will be normal camp maintenance items, except for helicopter fuel.

Air emissions from the operation of the onshore support facilities are not expected to vary significantly during the operations period from those air emissions produced during routine camp operations.

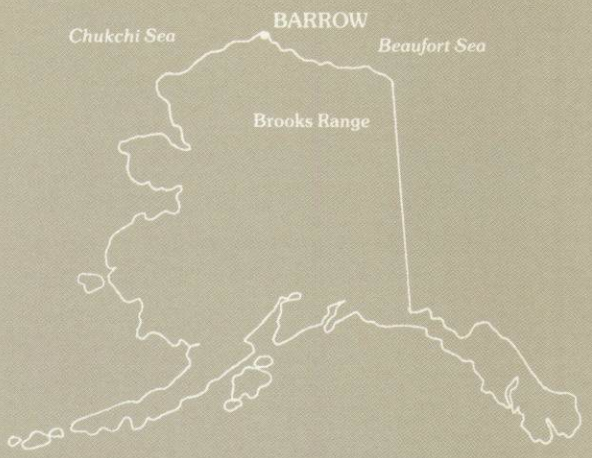
Laboratory at the Top of the World

BARROW, ALASKA

UIC-NARL

UKPEAGVIK INUPIAT CORPORATION-NATIONAL ARCTIC RESEARCH LABORATORY

Laboratory at the Top of the World



The Former Naval Arctic Research Laboratory, (NARL) has been reactivated in support of scientific research, education and industrial development by its new owner, the Ukpeagvik Inupiat Corporation (UIC). Owned and operated by the private sector, the facility is now known as UIC-NARL. It is cost competitive, offering logistical support services, including laboratory, office and warehouse space as well as hotel and cafeteria service.

The UIC-NARL facility has a rich tradition in support of arctic research. NARL was the principal site of the Tundra Biome Study of the International Biological Program and has provided support for other programs such as the Arctic Ice Dynamics Joint Experiment and many aspects of the Outer Continental Shelf Environmental Assessment Program, as well as many smaller studies. Our unique location and capabilities have enabled UIC-NARL to provide support services for government agencies such as the U.S. Geological Survey, U.S. Air Force, NOAA, and Alaska's North Slope Borough, as well as private institutions. UIC-NARL's location provides ready access to tundra, tundra lakes, riverene systems, lagoons, and the adjacent Chukchi and Beaufort Seas.

COFFEE/TELEVISION LOUNGE

MAIN LOBBY & MUSEUM

Remote Site Support

If your research activities require you to use UIC-NARL as a base camp for work in the field we can provide total support for your operations. Our people know the arctic — we live here — and stand ready to provide complete logistical support for activities both offshore and onshore. UIC-NARL can coordinate transportation from local sources, such as aircraft operations, all terrain vehicles and snow machine rentals, four-wheel drive vehicle rental, and vessel charter services. We also will assist with your local resource person needs.

CAFETERIA

RECREATION ROOM

STANDARD ROOM

The Facilities

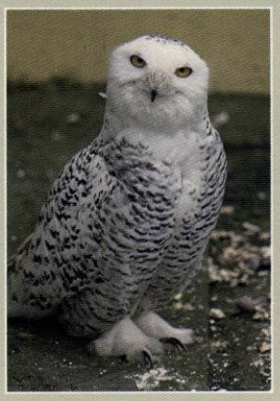
In the Main Laboratory (Bldg 360), we have an 88 bed hotel, conference rooms, offices, recreation room, TV/coffee lounge, cafeteria, commissary, and of course, laboratories. These labs are equipped with benches, cabinets, running water, butane, compressed air, 110 & 220 VAC, 60 HZ. Our offices, large or small, are completely furnished and include housekeeping services. These offices and labs are conveniently connected to the living quarters within the Main Laboratory building.

Our VIP Suites include two separate bedrooms, living room and private bath with shower. Our standard rooms are available for single or double occupancy, with community restrooms and showers. All rooms include daily towel and maid service, weekly linen service, and use of the recreation equipment, coffee/television lounge, racquetball court, and weight room.

Cafeteria style meals are served from our new kitchen three times per day. In the hearty tradition of North Slope camps, you have several entrees per meal to chose from. The new kitchen is connected to the main lab building, just a few steps away from your office or room.

On the security patrolled UIC-NARL complex we have staging areas, warm or cold warehouse and storage space available to accommodate a variety of uses from heavy equipment maintenance shops to short and long term storage of equipment used on field projects. These warehouses are equipped with concrete flooring and abundant lighting. We have complete shop facilities, and a full time maintenance crew available to provide assistance.

Barrow is served daily by commercial airlines jet service from Fairbanks and Anchorage. Jet service to Prudhoe Bay is available on a daily basis from Barrow as well.



For More Information

If you are interested in the use
or our facilities, or would like to be on our
mailing list, please contact
the UIC-NARL Project Coordinator at:

P.O. Box UIC-NARL
Barrow, Alaska 99723

Telephone
(907) 852-7800

ATTACHMENT 9

9. DISCHARGES

9.1 General

The solid and liquid wastes likely to be generated by the offshore and onshore operations as well as the transportation operations are presented under two categories: 1) NPDES regulated discharge from drilling activity and 2) other wastes generated by drilling activity support operations. These are summarized in the following sections.

9.2 Offshore Drilling Discharges

The regulated drilling discharges have been presented under Section 4.0, Drilling Fluids and will not be discussed under Section 9.0. Drilling muds and cuttings are considered the major discharges associated with exploratory drilling activities. Other discharges, such as sanitary waste, greywater waste, desalination wastewater, boiler blowdown, well test fluids (no-oil), ballast or bilge water, deck drainage, etc. are considered minor discharges.

Of the minor discharges, deck drainage is expected to be a large volume discharge at an estimated average of 13,000 to 25,000 gallons per day (GPD). Grey water discharges are estimated at 7,000 to 8,000 GPD and sanitary discharges estimated at 2,000 to 4,000 GPD. Other large volume discharges include desalination, at an estimated 150,000 GPD of seawater with higher than ambient seawater salinity. Other small volume discharges are considered insignificant (i.e., ballast or bilge waste discharges).

In any event, all offshore discharges from exploratory drilling support operations will be monitored under the provisions of the General NPDES Permit, including chemical inventory, testing, monitoring, and reporting.

9.3 Offshore Transportation Discharges

Marine transportation carriers will produce domestic (grey water), sanitary, and non-contact cooling water liquid wastes. These marine carriers, ice-management vessels, and fuel tenders will maintain the discharge of liquid wastes by onboard treatment and discharge in accordance with currently mandated legislation.

Solid wastes will be generated on the marine support vessels and the Explorer III. Solid wastes are classified as combustible and non-combustible. The Explorer III and ice-management support vessels are expected to produce 350 to 500 pounds per day of combustible and non-combustible solid wastes in addition to solid waste drilling discharges. It must be noted that intermittent increases in daily amounts will occur, particularly during rig setup, demobilization, and during the use of specialty crated drilling muds.

All solid wastes not incinerated onboard will be transported to shore for proper disposal in existing landfills. No solid wastes will be discharged offshore.

9.4 Onshore Discharges

Onshore discharges will primarily be confined to the camp facilities, which are currently serviced by existing utility systems and package treatment plants. Helicopter maintenance items, such as solvents and oils, will be segregated at the shop facility and stored for proper treatment and disposal in accordance with current regulations.

Solid wastes associated with onshore facilities are expected to produce 75 to 150 pounds per day, but may experience daily fluctuations. Onshore operations are fully capable of supporting solid waste disposal in Barrow, Alaska.

ATTACHMENT 10

10. METEOROLOGY

10.1 General Weather Patterns

The general climatic conditions along the Alaskan arctic coast are characterized by relatively strong winds, cold temperatures during the winter and summer, and small annual precipitation (Searby and Hunter, 1971).

During the winter, the general air mass circulation patterns over the northeastern part of the Chukchi Sea are dominated by semi-stable, high atmospheric pressure systems that may extend from eastern Siberia to the eastern Beaufort Sea (Barry, 1979). High-pressure systems, which force the air to flow in a spiral fashion toward areas of low pressure, produce strong easterly, northeasterly, and northerly winds in the northeastern Chukchi Sea. This winter regime also produces intense cold, low cloudiness, and light snow along the coast.

The centers of most of the eastward-moving western Pacific storms, low atmospheric pressure systems that pass into the Bering Sea, remain south of 60°N latitude. Low pressure systems that occasionally move northeasterly through the Bering and Chukchi Seas into the Arctic basin bring unseasonably warm air to the region. Strong southeasterly winds are associated with low pressure systems along the northwest coast of Alaska.

During the summer, the atmospheric pressure patterns are more numerous and varied than the winter patterns (Barry, 1979). Western Pacific low pressure systems are more common north of 60°N latitude. These systems move northeasterly through the Bering Sea into the Chukchi Sea, where they follow the northwestern Alaska coast. Low pressure systems generally bring cloudy skies, frequent precipitation, and southwesterly winds. Low pressure systems may also develop over northern Siberia (Reed and Kunkel, 1960).

10.2 Air Temperatures and Precipitation

Air temperatures and precipitation vary somewhat along the coastline adjacent to the lease area. At Cape Lisburne, near the southern edge of the lease area, mean monthly air temperatures range from approximately -6°F in February to 45°F in July (Table 10-1). At Barrow, located northeast of the lease area, air temperatures correspondingly range from -20°F in February to 39°F in July (Table 10-2). During the months of June through October when drilling may occur, air temperatures average 38°F at Cape Lisburne and 31°F at Barrow. Extreme temperatures during this five month period range from -12 to 74°F at Cape Lisburne and from -32 to 76°F at Barrow.

Precipitation along the coast of the Chukchi Sea is generally low. At Cape Lisburne, mean monthly precipitation ranges from 0.26 inches in March to 2.79 inches in August (Table 10-1). At Barrow, precipitation ranges from 0.15 inches in March to 0.99 inches in August (Table 10-2).

Weather conditions offshore are summarized by the U.S. Naval Weather Service for the period of June through September and these data are provided on Tables 10-3 through 10-6. Data are presented for two separate marine areas which encompass the Chukchi Sea Lease Area. The Cape Lisburne Area includes that area between latitude 66 and 70°N, and from the coast to longitude 170°W. The Barrow Area includes that area between latitude 70 and 74°N and between longitude 154 and 170°W.

10.3 Winds

Surface winds along the coast between Point Lay and Barrow blow most commonly from the east and northeast; at Cape Lisburne, winds from the east and southeast prevail (Brower, et al., 1977). The velocity of coastal winds is usually within the range of 8 to 16 knots. Winds greater than 16 knots occur less than 4 percent

of the time (Wise, et al., 1981). Sustained winds of 50 to 56 knots, with higher gusts, have been recorded (Wilson, et al., 1982).

Offshore winds are also reported by the U.S. Naval Weather Service and are summarized on Tables 10-7 through 10-10 for the months of June through September. During the early summer (June and July) winds typically are out of either a general northerly or southerly direction. During August and September, they are more commonly out of the northeast. Mean speed are typically in the range of 10 to 15 knots.

10.4 Storm Occurrences

In the Chukchi Sea lease area, storm events are possible throughout the entire open water period from mid-June through November. October is the month of the most frequent storms in the Chukchi Sea. Storm movement is generally parallel to the Chukchi Sea coastline moving from the Bering Sea towards the Beaufort Sea.

Thirteen storm surges have been documented (Brower, et al., 1977) between 1960 and 1977 for the Chukchi and Beaufort Seas. The most severe recorded storm in the vicinity of Barrow produced westerly winds with sustained speeds of 42 knots and gusts to 64 knots, waves to 10 feet high, and a storm surge of 10 feet.

10.5 Visibility and Ceiling

Fog may be present in the Sale 109 area at anytime throughout the year (Brower, et al., 1977). During the period when sea ice covers the Chukchi Sea, fog occurs about 10 percent of the time. However, during open-water periods, fog becomes more common. In May through September, fog may occur between 20 and 30 percent of the time. Tables 10-11 through 10-14 provide a summary of visibility and ceiling data for the offshore areas during the months of June through September.

TABLE 10-1

Summary of Climatic Data for Cape Lisburne (AEIDC, 1986)

	TEMPERATURE (DEGREES F)											PRECIPITATION (INCHES)								
	MEANS			EXTREMES			MEAN # DAYS				HEAT DEGREE DAYS						SNOW		
							MAX		MIN			MEAN			MEAN # DAYS				
MTH	MAX	MIN	MTH	REC HI	YR	REC LO	YR	70+	32-	0-	32-	MTH MEAN	MTH TOT	MAX DAY	YR	PRECIP 0.5	EXCEEDED .25	0.1	MTH TOT	MAX MTH	YR	DAYS 1.0
JAN	4.1	-6.8	-1.1	41.0	61	-42.0	68	0.0	29.0	21.3	30.8	2051.6	0.53	0.56	62	0.1		1.2	5.4	45.0	55	31.0
FEB	-4.2	-14.3	-9.3	45.0	80	-47.0	55	0.0	26.9	23.8	28.1	2108.3	0.28	0.56	58	0.0		0.7	2.9	44.0	55	26.0
MAR	-0.6	-11.1	-5.9	44.0	54	-39.0	55	0.0	30.1	26.7	30.9	2201.7	0.26	0.27	55	0.0		0.7	3.0	34.0	55	23.2
APR	11.5	0.7	6.1	46.0	76	-26.0	84	0.0	27.0	17.3	29.7	1764.1	0.39	0.51	58	0.0		1.3	3.8	34.0	55	25.4
MAY	30.1	21.5	25.7	54.0	69	-11.0	84	0.0	18.7	0.5	29.1	1208.0	0.35	1.60	67	0.0		0.9	1.9	34.0	60	19.8
JUN	42.6	33.5	38.1	65.0	59	20.0	74	0.0	1.5	0.0	13.3	801.4	0.63	0.85	60	0.1		2.0	0.6	10.0	55	1.5
JUL	49.8	40.5	45.2	73.0	72	29.0	56	0.3	0.0	0.0	1.7	607.9	1.96	1.70	84	1.2		5.0	0.5	1.0	76	0.1
AUG	48.5	41.3	44.9	74.0	68	29.0	55	0.2	0.0	0.0	1.3	616.0	2.79	1.84	60	1.6		7.0	0.4	3.0	55	0.0
SEP	40.1	34.4	37.3	64.0	74	15.0	75	0.0	3.3	0.0	10.8	825.4	2.01	1.01	59	0.9		6.1	3.4	7.0	68	2.7
OCT	26.1	19.8	23.0	57.0	54	-12.0	70	0.0	24.2	1.0	29.0	1295.6	1.11	0.64	73	0.1		3.7	9.2	19.0	55	20.4
NOV	12.8	4.8	8.8	42.0	70	-23.0	74	0.0	28.0	12.4	29.8	1683.0	0.77	1.11	54	0.1		2.1	7.3	18.0	68	28.1
DEC	2.6	-6.4	-1.9	47.0	83	-40.0	74	0.0	29.5	23.1	30.7	2076.2	0.33	0.55	54	0.0		0.7	3.5	23.0	54	28.8
YEAR	AVE 22.0	AVE 13.2	AVE 17.6	REC 74.0		REC -47.0		TOT 0.5	TOT 218.4	TOT 126.1	TOT 265.2	TOT 17239.3	TOT 11.41	REC 1.84		TOT 4.3	TOT	TOT 31.5	TOT 41.9	REC 45.0		TOT 206.9

TABLE 10-2

Summary of Climatic Data for Barrow (AEIDC, 1986)

	TEMPERATURE (DEGREES F)											PRECIPITATION (INCHES)								
	MEANS			EXTREMES			MEAN # DAYS				HEAT DEGREE DAYS				MEAN # DAYS			SNOW		
							MAX		MIN			MEAN			PRECIP EXCEEDED			MEAN		MEAN
MTH	MAX	MIN	MTH	REC HI	YR	REC LO	YR	70+	32-	0-	32-	MTH MEAN	MTH TOT	MAX DAY	YR	.5	.25	.1	MTH TOT	MAX MTH	YR	DAYS 1.0
JAN	-7.4	-20.2	-13.9	36.0	74	-53.0	51	0.0	30.9	28.7	31.0	2456.7	0.21	0.47	62	0.0		0.4	2.4	22.0	62	31.0
FEB	-13.6	-25.4	-19.5	36.0	82	-54.0	64	0.0	28.2	27.3	28.3	2391.8	0.18	0.30	59	0.0		0.4	2.2	29.0	62	28.4
MAR	-9.4	-21.6	-15.5	33.0	67	-52.0	71	0.0	31.0	30.1	31.0	2504.3	0.15	0.70	63	0.0		0.3	1.9	30.0	62	31.0
APR	5.1	-8.6	-1.9	38.0	67	-36.0	84	0.0	29.3	23.2	30.0	2004.1	0.21	0.42	63	0.0		0.6	2.6	30.0	62	30.0
MAY	23.6	13.8	18.8	43.0	79	-19.0	84	0.0	27.5	3.1	30.9	1427.6	0.16	0.29	62	0.0		0.2	2.0	25.0	63	30.1
JUN	37.6	29.4	33.6	63.0	61	4.0	69	0.0	5.0	0.0	24.1	936.8	0.36	0.82	55	0.0	1.0	1.0	0.7	14.0	50	5.9
JUL	44.6	33.3	39.0	75.0	60	26.0	56	0.1	0.1	0.0	15.1	800.3	0.85	0.68	54	0.2	0.0	2.7	0.4	1.0	61	0.0
AUG	42.2	33.2	37.8	76.0	68	21.0	56	0.1	2.5	0.0	15.8	837.5	0.99	0.83	60	0.1	0.0	3.4	0.7	2.0	55	0.4
SEP	33.7	27.2	30.5	62.0	57	1.0	57	0.0	13.2	0.0	25.1	1032.0	0.60	0.56	59	0.0	1.5	1.8	3.5	5.0	60	6.5
OCT	18.9	9.7	14.3	43.0	54	-32.0	70	0.0	28.8	7.6	30.8	1573.8	0.52	0.45	72	0.0	0.0	1.2	6.4	12.0	64	28.3
NOV	4.8	-6.2	-0.7	37.0	50	-38.0	56	0.0	29.9	21.6	30.0	1977.8	0.28	0.39	58	0.0	0.0	0.7	3.5	14.0	51	30.0
DEC	-6.4	-17.9	-12.2	32.0	72	-51.0	74	0.0	31.0	29.1	31.0	2399.0	0.17	0.21	67	0.0	0.0	0.3	2.1	16.0	65	31.0
YEAR	AVE 14.5	AVE 3.9	AVE 9.2	REC 76.0		REC -54.0		TOT 0.2	TOT 257.4	TOT 170.6	TOT 323.1	TOT 20341.7	TOT 4.70	REC 0.83		TOT 0.4	TOT 2.5	TOT 12.8	TOT 28.3	REC 30.0		TOT 252.5

TABLE 10-3

Percent Frequency of Weather by Wind Direction during June
(U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

DATA NOT REPORTED

B. Cape Lisburne Area (66-70°N)

	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA					
WND DIR	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG WO PCPN	SMOKE HAZE	DUST BLWG BLWG	DUST SNOW	NO SIG WEA	TOTAL OBS
N	.0	.0	4.5	.0	.0	.0	.0	4.5	1	.0	.0	.0	.0	9.1	3	
NNE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
NE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	4.5	1	
ENE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
E	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	4.5	1	
ESE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	9.1	2	
SE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
SSE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
S	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	4.5	1	
SSW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	4.5	.0	.0	13.6	4	
SW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
WSW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	4.5	1	
W	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	9.1	2	
WNW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	4.5	1	
NW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	4.5	.0	.0	4.5	2	
NNW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
CALM	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	9.1	.0	.0	9.1	4	
TOT OBS	0	0	1	0	0	0	0		1	0	4	0	0	17	22	
TOT PCT	.0	.0	4.5	.0	.0	.0	.0	4.5		.0	18.2	.0	.0	77.3	100.0	

TABLE 10-4

Percent Frequency of Weather by Wind Direction during July
(U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA						
WND DIR	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG WD PCPN	SMOKE HAZE	DUST BLWG	DUST BLWG SNOW	NO SIG WEA	TOTAL OBS
N	.5	.1	.2	.0	.1	.0	.0	1.0	15	.0	4.3	.0		.0	1.8	108
NNE	.3	.0	.2	.0	.2	.0	.0	.7	10	.0	3.7	.0		.0	2.8	110
NE	.5	.1	.5	.0	.2	.0	.0	1.2	18	.1	3.5	.1		.0	4.7	146
ENE	.3	.0	.1	.0	.3	.0	.0	.8	12	.0	3.1	.3		.0	3.3	114
E	1.0	.2	.2	.1	.1	.0	.0	1.6	25	.0	6.9	.2		.0	4.1	197
ESE	.2	.5	.2	.0	.0	.0	.0	.9	13	.0	2.8	.2		.0	1.7	85
SE	.1	.1	.1	.0	.0	.0	.0	.3	4	.0	3.2	.0		.0	.3	58
SSE	.0	.0	.4	.0	.0	.0	.0	.4	6	.0	1.0	.0		.0	.7	33
S	.4	.0	1.0	.0	.0	.0	.0	1.4	22	.0	1.2	.2		.0	.7	54
SSW	.6	.0	.3	.0	.0	.0	.0	.9	13	.0	.7	.0		.0	1.0	40
SW	.5	.0	1.0	.0	.1	.0	.0	1.5	23	.0	2.6	.1		.0	3.4	117
WSW	.6	.2	1.0	.0	.2	.1	.0	2.1	32	.0	3.2	.1		.0	2.8	124
W	.3	.0	.5	.0	.5	.0	.0	1.3	20	.0	3.3	.1		.0	2.9	115
WNW	.0	.0	.1	.0	1.2	.1	.0	1.4	21	.0	1.6	.0		.0	1.7	71
NW	.0	.0	.1	.0	.3	.0	.0	.5	7	.0	1.6	.0		.0	.8	44
NNW	.3	.0	.3	.0	.1	.0	.0	.7	11	.0	1.0	.0		.0	.3	31
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0		.0	.0	0
CALM	.4	.0	.8	.0	.1	.0	.0	1.3	20	.0	2.5	.0		.0	1.4	79
TOT OBS	90	19	108	2	54	2	0		272	1	709	19		0	525	1526
TOT PCT	5.9	1.2	7.1	.1	3.5	.1	.0	17.8		.1	46.5	1.2		.0	34.4	100.0

B. Cape Lisburne Area (66-70°N)

	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA						
WND DIR	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG WD PCPN	SMOKE HAZE	DUST BLWG	DUST BLWG SNOW	NO SIG WEA	TOTAL OBS
N	2.2	.0	.1	.0	.0	.0	.0	2.4	19	.0	3.6	.2		.0	6.3	101
NNE	1.1	.0	.2	.0	.0	.0	.0	1.2	10	.0	2.6	.0		.0	4.7	69
NE	.0	.0	.2	.0	.0	.0	.0	.2	2	.0	2.1	.0		.0	4.2	53
ENE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.2	.0		.0	1.5	14
E	.4	.0	.2	.0	.0	.0	.0	.5	4	.0	.6	.0		.0	1.1	18
ESE	.9	.0	.1	.0	.0	.0	.0	1.0	8	.0	.5	.1		.0	1.2	23
SE	1.0	.0	.1	.0	.0	.0	.0	1.1	9	.0	.2	.1		.0	1.6	25
SSE	2.4	.1	.1	.0	.0	.0	.0	2.5	20	.0	1.9	.1		.0	2.2	54
S	2.1	.1	1.1	.0	.0	.0	.0	3.4	27	.0	9.6	.1		.0	7.7	167
SSW	.1	.0	.5	.0	.5	.0	.0	1.1	9	.0	3.7	.0		.0	5.7	85
SW	.0	.0	.1	.0	.0	.0	.0	.1	1	.0	.9	.1		.0	3.0	33
WSW	.2	.0	.0	.0	.4	.0	.0	.6	5	.0	.2	.1		.0	2.2	26
W	.2	.0	.6	.0	.0	.0	.0	.7	6	.0	1.4	.5		.0	1.9	36
WNW	.0	.0	.2	.0	.7	.0	.0	1.0	8	.0	.4	.1		.0	1.4	23
NW	.4	.0	.0	.0	.5	.0	.0	.9	7	.0	1.0	.0		.0	2.2	33
NNW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.9	.0		.0	2.4	26
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0		.0	.0	0
CALM	.1	.0	.1	.0	.0	.0	.0	.2	2	.0	.4	.0		.0	1.7	19
TOT OBS	90	2	32	0	17	0	0		137	0	243	13		0	412	805
TOT PCT	11.2	.2	4.0	.0	2.1	.0	.0	17.0		.0	30.2	1.6		.0	51.2	100.0

TABLE 10-5

Percent Frequency of Weather by Wind Direction during August
(U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA					
WND DIR	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG WO PCPN	SMOKE HAZE	DUST BLWG BLWG	DUST SNOW	NO SIG WEA	TOTAL OBS
N	.5	*	.3	*	.6	.0	.0	1.4	42	.0	2.6	.2	.0	1.3		162
NNE	.8	.0	.6	.1	1.1	*	.0	2.5	74	.0	2.8	.1	.0	1.1		195
NE	1.7	*	1.3	.1	1.9	.3	.0	5.3	159	.0	3.7	.1	.0	2.7		351
ENE	.5	.1	.4	.2	2.0	.2	*	3.5	103	.0	3.0	.2	.0	3.7		309
E	.4	.0	1.0	.0	.9	.0	.0	2.3	68	.0	6.6	.1	.0	5.4		429
ESE	.5	*	.3	.0	.1	.0	.0	1.0	29	.0	2.7	*	.0	2.3		181
SE	.6	.0	.3	.0	*	.0	.0	.9	28	.0	1.2	.0	.0	1.2		98
SSE	.4	.0	.3	.0	.0	.0	.0	.5	16	.0	.7	.0	.0	.6		56
S	.8	.0	.4	.0	.0	.0	.0	1.2	35	.0	.8	.0	.0	1.2		95
SSW	.8	.0	.4	.0	.1	.0	.0	1.2	36	.0	.4	.0	.0	.7		68
SW	1.5	.0	.8	.0	.1	.0	.0	2.1	63	.0	1.3	*	.0	1.3		141
WSW	.9	*	.6	.0	.6	.1	*	2.1	64	.0	1.3	*	.0	1.0		135
W	.9	*	.6	.0	.9	.1	.0	2.5	76	.0	2.4	.1	.0	3.5		256
WNW	.2	.0	.6	.0	.7	.0	.0	1.4	41	.0	1.5	.0	.0	1.6		134
NW	.2	.1	.4	.0	.6	.1	.0	1.3	38	.0	2.4	.0	*	1.8		165
NNW	.3	.0	.2	.0	.4	.1	.0	1.0	31	.0	1.9	.1	.1	1.3		132
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0		0
CALM	.2	.0	.3	.0	.1	.0	.0	.5	16	.0	1.2	.0	.0	.8		77
TOT OBS	337	9	264	15	301	24	2		919	0	1088	28	3	946		2984
TOT PCT	11.3	.3	8.8	.5	10.1	.8	.1	30.8		.0	36.5	.9	.1	31.7		100.0

B. Cape Lisburne Area (66-70°N)

	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA					
WND DIR	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG WO PCPN	SMOKE HAZE	DUST BLWG BLWG	DUST SNOW	NO SIG WEA	TOTAL OBS
N	1.6	.0	1.6	.0	.3	.0	.0	2.9	22	.0	1.6	.1	.0	7.2		89
NNE	.7	.0	.8	.0	.0	.0	.0	1.5	11	.0	1.2	.1	.0	3.5		47
NE	.7	.0	.3	.0	.0	.0	.0	.9	7	.0	1.3	.0	.0	5.8		60
ENE	.3	.1	.3	.0	.0	.0	.0	.7	5	.0	.8	.1	.0	2.9		34
E	.8	.1	.3	.0	.0	.0	.0	1.2	9	.0	.9	.0	.0	2.7		36
ESE	.5	.1	.4	.0	.0	.0	.0	.8	6	.0	.3	.0	.0	.8		14
SE	.1	.0	.1	.0	.0	.0	.0	.3	2	.0	.7	.0	.0	1.3		17
SSE	1.7	.0	1.3	.0	.0	.0	.0	2.4	18	.0	.8	.1	.0	2.4		43
S	2.4	.0	3.2	.0	.0	.0	.0	5.0	37	.0	3.8	.3	.0	3.6		94
SSW	1.3	.0	1.3	.0	.0	.0	.0	2.0	15	.0	2.7	.0	.0	3.1		58
SW	.4	.0	.1	.0	.0	.0	.0	.4	3	.0	2.0	.0	.0	3.9		47
WSW	.0	.0	.1	.0	.0	.0	.0	.1	1	.0	.7	.1	.0	1.1		15
W	.1	.3	.8	.0	.0	.0	.0	1.1	8	.0	.8	.0	.1	4.3		47
WNW	.3	.3	1.1	.0	.1	.0	.0	1.7	13	.0	1.1	.0	.0	2.0		36
NW	1.2	.3	1.6	.0	.0	.0	.0	2.0	15	.0	1.1	.0	.0	4.4		56
NNW	.4	.0	.4	.0	.3	.0	.0	.9	7	.0	1.7	.3	.0	2.3		39
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0		0
CALM	.3	.0	.0	.0	.0	.0	.0	.3	2	.0	.1	.0	.0	1.5		14
TOT OBS	96	9	103	0	5	0	0		181	0	161	9	1	394		746
TOT PCT	12.9	1.2	13.8	.0	.7	.0	.0	24.3		.0	21.6	1.2	.1	52.8		100.0

TABLE 10-6

Percent Frequency of Weather by Wind Direction during September
(U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

WND DIR	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA					
	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG W/O PCPN	SMOKE HAZE	DUST BLWG BLWG	DUST SNOW	NO SIG WEA	TOTAL OBS
N	.0	.0	.2	.1	.5	.5	.0	1.2	15	.0	2.8	.0	.0	2.3	80	
NNE	.3	.0	.5	.2	2.5	.0	.0	3.5	44	.0	1.9	.0	.0	2.8	103	
NE	.2	.0	.2	.7	.9	.1	.2	2.1	27	.0	2.4	.0	.0	2.7	91	
ENE	.7	.0	.3	.4	1.4	.0	.0	2.8	36	.0	3.0	.0	.1	3.5	119	
E	.7	.0	.4	1.0	3.8	2.0	.0	7.9	100	.0	5.1	.0	.0	5.9	240	
ESE	.6	.0	.1	.6	1.8	.7	.0	3.7	47	.0	1.3	.0	.0	1.7	86	
SE	.2	.0	.0	.0	1.3	.1	.0	1.6	20	.0	.9	.0	.0	1.2	47	
SSE	.2	.0	.2	.0	.9	.0	.0	1.3	16	.0	.4	.0	.0	1.5	40	
S	.2	.0	.1	.0	1.3	.0	.0	1.6	20	.0	.9	.0	.0	1.7	53	
SSW	.3	.0	.0	.0	1.3	.1	.0	1.7	21	.0	.6	.0	.0	1.3	45	
SW	.1	.0	.2	.1	2.4	.0	.0	2.8	36	.0	2.1	.0	.1	2.4	94	
WSW	.2	.0	.1	.0	.5	.1	.0	.8	10	.0	1.3	.0	.0	1.6	47	
W	.1	.0	.1	.2	1.9	.1	.0	2.3	29	.0	1.3	.0	.0	2.1	72	
WNW	.2	.0	.0	.0	.7	.0	.0	.9	11	.0	.6	.0	.0	1.3	36	
NW	.1	.0	.0	.0	.8	.0	.0	.9	11	.0	.9	.1	.0	2.0	48	
NNW	.0	.0	.0	.0	.6	.1	.0	.7	9	.0	.5	.0	.0	1.6	35	
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
CALM	.2	.0	.0	.0	.3	.0	.0	.5	6	.0	.9	.0	.0	.9	30	
TOT OBS	53	0	28	40	291	46	2		458	0	343	1	2	462	1266	
TOT PCT	4.2	.0	2.2	3.2	23.0	3.6	.2	36.2		.0	27.1	.1	.2	36.5	100.0	

B. Cape Lisburne Area (66-70°N)

WND DIR	PRECIPITATION TYPE									OTHER WEATHER PHENOMENA					
	RAIN	RAIN SHWR	DRZL	FRZG PCPN	SNOW	OTHER FRZN PCPN	HAIL	PCT FREQ PCPN AT OB TIME	TOTAL PCPN OBS	THDR LTNG	FOG W/O PCPN	SMOKE HAZE	DUST BLWG BLWG	DUST SNOW	NO SIG WEA	TOTAL OBS
N	1.5	.0	.5	.0	.7	.0	.0	2.7	16	.0	.7	.2	.0	6.4	59	
NNE	1.0	.0	.0	.0	.0	.0	.0	1.0	6	.0	.7	.0	.0	6.0	46	
NE	2.0	.0	.3	.0	.3	.0	.0	2.7	16	.0	.7	.0	.0	6.4	58	
ENE	1.7	.0	.5	.0	.0	.0	.0	2.2	13	.0	.8	.0	.0	4.4	44	
E	.8	.0	.5	.0	.2	.2	.0	1.7	10	.0	.3	.0	.0	4.9	41	
ESE	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.7	4	
SE	.8	.3	1.2	.0	.5	.0	.0	2.9	17	.0	.5	.0	.0	2.2	33	
SSE	.8	.0	.3	.0	.3	.0	.0	1.5	9	.0	.2	.0	.0	2.3	24	
S	2.7	.0	1.3	.0	.0	.0	.0	4.0	24	.0	3.9	.0	.0	4.7	75	
SSW	1.8	.0	2.7	.0	.3	.0	.0	4.9	29	.0	1.2	.0	.0	2.0	48	
SW	2.2	.3	1.2	.0	.0	.0	.0	3.7	22	.0	1.3	.0	.0	2.7	46	
WSW	.2	.0	.3	.0	.0	.0	.0	.5	3	.0	.5	.0	.0	2.0	18	
W	.0	.0	.0	.0	.7	.0	.0	.7	4	.0	.3	.0	.0	2.0	18	
WNW	.7	.2	.0	.0	.2	.0	.0	1.0	6	.0	.3	.0	.0	2.0	20	
NW	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.5	.0	.0	3.4	23	
NNW	.3	.0	.0	.0	.2	.0	.0	.5	3	.0	.5	.0	.0	2.7	22	
VAR	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	0	
CALM	.2	.0	.2	.0	.0	.0	.0	.3	2	.0	.5	.0	.0	2.0	17	
TOT OBS	100	5	54	0	20	1	0		180	0	77	1	0	338	596	
TOT PCT	16.8	.8	9.1	.0	3.4	.2	.0	30.2		.0	12.9	.2	.0	56.7	100.0	

TABLE 10-7

Percent Frequency of Wind Direction by Speed during June (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

DATA NOT RECORDED

B. Cape Lisburne Area (66-70°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	4.5	9.1	.0	.0	.0	.0	3	13.6	4.7
NNE	.0	.0	.0	.0	.0	.0	0	.0	.0
NE	.0	4.5	.0	.0	.0	.0	1	4.5	5.0
ENE	.0	.0	.0	.0	.0	.0	0	.0	.0
E	.0	4.5	.0	.0	.0	.0	1	4.5	4.0
ESE	.0	9.1	.0	.0	.0	.0	2	9.1	5.0
SE	.0	.0	.0	.0	.0	.0	0	.0	.0
SSE	.0	.0	.0	.0	.0	.0	0	.0	.0
S	.0	4.5	.0	.0	.0	.0	1	4.5	10.0
SSW	.0	9.1	9.1	.0	.0	.0	4	18.2	11.3
SW	.0	.0	.0	.0	.0	.0	0	.0	.0
WSW	.0	4.5	.0	.0	.0	.0	1	4.5	10.0
W	4.5	4.5	.0	.0	.0	.0	2	9.1	4.0
WNW	.0	4.5	.0	.0	.0	.0	1	4.5	6.0
NW	.0	9.1	.0	.0	.0	.0	2	9.1	6.0
NNW	.0	.0	.0	.0	.0	.0	0	.0	.0
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	18.2						4	18.2	.0
TOT OBS	6	14	2	0	0	0	22		5.6
TOT PCT	27.3	63.6	9.1	.0	.0	.0		100.0	

TABLE 10-8

Percent Frequency of Wind Direction by Speed during July (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.7	3.5	1.8	.1	.0	.0	157	6.0	9.0
NNE	.5	4.2	4.2	.6	.0	.0	246	9.5	11.5
NE	.4	5.9	5.5	.4	.0	.0	318	12.2	11.3
ENE	.5	3.6	4.0	.4	.0	.0	220	8.5	11.6
E	.7	6.9	4.2	.8	.0	.0	325	12.5	10.5
ESE	.2	2.8	1.7	.3	.0	.0	129	5.0	11.0
SE	.1	2.3	.7	.2	.0	.0	85	3.3	9.2
SSE	.1	1.0	.6	.1	.0	.0	48	1.8	9.6
S	.0	1.6	1.1	.2	.0	.0	74	2.8	11.4
SSW	*	.6	1.1	1.1	.1	.0	74	2.8	19.6
SW	.0	1.3	4.3	2.5	.2	.0	216	8.3	18.1
WSW	.0	1.0	4.0	1.2	*	.0	164	6.3	16.4
W	.2	2.7	2.8	1.0	.3	.0	181	7.0	14.4
WNW	.2	1.9	1.2	.5	.3	.0	110	4.2	13.8
NW	.1	1.7	.9	.2	.0	.0	74	2.8	10.8
NNW	.3	1.2	.7	.1	.0	.0	56	2.2	9.8
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	4.7						123	4.7	.0
TOT OBS	228	1094	1004	251	23	0	2600		11.9
TOT PCT	8.8	42.1	38.6	9.7	.9	.0		100.0	

B. Cape Lisburne Area (66-70°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.2	2.9	6.2	3.6	.2	.0	159	13.1	16.5
NNE	.2	3.1	4.0	.9	.0	.0	100	8.3	13.0
NE	.2	2.7	3.2	1.0	.0	.0	87	7.2	13.4
ENE	.2	1.0	1.0	.0	.0	.0	26	2.1	10.5
E	.2	1.2	1.0	.2	.0	.0	31	2.6	10.5
ESE	.2	1.2	.7	.2	.0	.0	29	2.4	11.4
SE	.2	1.0	1.2	.2	.2	.0	35	2.9	14.8
SSE	.0	1.1	2.8	1.7	.2	.0	70	5.8	18.9
S	.6	1.6	12.6	5.2	.5	.1	249	20.6	18.2
SSW	.0	1.7	6.1	2.8	.6	.0	135	11.1	19.1
SW	.3	.6	1.6	1.2	.3	.0	48	4.0	18.1
WSW	.2	.9	1.4	.2	.1	.0	34	2.8	13.3
W	.2	1.4	1.8	.4	.1	.0	48	4.0	13.1
WNW	.1	.9	1.4	.2	.0	.0	32	2.6	13.8
NW	.1	2.1	1.7	.1	.0	.0	48	4.0	11.3
NNW	.2	2.1	1.9	.1	.1	.0	53	4.4	11.5
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	2.2						27	2.2	.0
TOT OBS	66	308	589	219	28	1	1211		15.3
TOT PCT	5.5	25.4	48.6	18.1	2.3	.1		100.0	

TABLE 10-9

Percent Frequency of Wind Direction by Speed during August (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.5	2.9	1.5	.2	.0	.0	297	5.0	9.4
NNE	.5	2.6	2.4	.2	.0	.0	334	5.7	10.7
NE	.6	3.2	4.9	1.6	*	.0	606	10.3	13.8
ENE	.8	3.0	5.5	2.1	.1	.0	674	11.5	14.6
E	1.1	6.2	7.1	1.9	.1	.0	966	16.4	12.9
ESE	.6	2.6	3.0	.3	.0	.0	383	6.5	11.3
SE	.4	1.6	1.3	.1	.0	.0	198	3.4	9.9
SSE	.3	1.1	.7	.1	.0	.0	123	2.1	9.7
S	.4	1.4	1.4	.1	.0	.0	196	3.3	10.6
SSW	.2	.9	1.2	.2	*	.0	150	2.5	12.6
SW	.2	1.4	2.0	.8	.2	*	269	4.6	15.3
WSW	.2	1.4	1.8	.6	.3	.0	257	4.4	15.5
W	.9	2.9	3.2	.6	*	.0	448	7.6	11.5
WNW	.4	2.5	1.6	.2	.0	.0	276	4.7	10.2
NW	.7	3.0	1.7	.2	.0	.0	326	5.5	9.2
NNW	.6	2.0	1.1	.3	.0	.0	233	4.0	9.8
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	2.5						149	2.5	.0
TOT OBS	630	2269	2382	561	42	1	5885		11.9
TOT PCT	10.7	38.6	40.5	9.5	.7	*		100.0	

B. Cape Lisburne Area (66-70°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.3	3.4	4.4	2.0	.0	.0	107	10.1	15.0
NNE	.5	1.4	2.5	1.2	.0	.0	60	5.6	14.5
NE	.4	3.3	2.2	1.1	.4	.0	78	7.3	13.8
ENE	.3	1.3	1.6	.9	.3	.0	47	4.4	15.5
E	.1	2.8	1.7	.8	.0	.0	58	5.5	11.5
ESE	.2	1.1	1.1	.0	.0	.0	26	2.4	10.6
SE	.2	1.0	1.5	.1	.0	.0	30	2.8	10.8
SSE	.2	1.5	2.9	.6	.0	.0	55	5.2	13.6
S	.1	3.4	7.8	2.2	.0	.0	143	13.5	15.4
SSW	.2	2.2	3.6	1.6	.3	.0	83	7.8	17.0
SW	.6	2.8	1.5	.6	.1	.1	60	5.6	11.7
WSW	.3	1.4	.9	.0	.1	.1	30	2.8	12.5
W	.5	2.5	2.8	.6	.4	.0	72	6.8	13.4
WNW	.2	2.1	2.0	.5	.2	.0	52	4.9	12.5
NW	.3	3.2	2.6	1.3	.1	.0	80	7.5	13.9
NNW	.3	2.4	2.5	.5	.0	.0	60	5.6	11.5
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	2.1						22	2.1	.0
TOT OBS	69	381	444	148	19	2	1063		13.5
TOT PCT	6.5	35.8	41.8	13.9	1.8	.2		100.0	

TABLE 10-10

Percent Frequency of Wind Direction by Speed during September (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.3	3.2	1.8	.7	.1	.0	142	6.1	12.1
NNE	.6	4.1	2.1	1.2	.0	.0	184	8.0	12.2
NE	.3	3.7	3.6	1.0	.4	.0	210	9.1	14.1
ENE	.4	2.3	5.8	.6	.3	.0	219	9.5	14.6
E	.6	3.9	11.3	1.8	.1	.0	411	17.8	14.6
ESE	.2	1.9	2.9	.7	.0	.0	133	5.8	13.6
SE	.3	1.4	1.8	.1	.0	.0	84	3.6	10.5
SSE	.3	1.4	1.1	.3	.0	.0	73	3.2	11.5
S	.6	2.4	1.0	.1	.0	.0	95	4.1	8.6
SSW	.6	1.6	1.3	.1	.0	.0	82	3.5	9.1
SW	.2	3.2	3.2	.1	.0	.0	154	6.7	11.5
WSW	.5	1.8	1.6	.1	.0	.0	91	3.9	9.8
W	1.0	2.6	2.0	.1	.0	.0	131	5.7	9.0
WNW	.3	1.8	.6	.3	*	.0	70	3.0	10.4
NW	.5	2.2	1.1	.3	.0	.0	96	4.2	10.1
NNW	.1	1.3	1.4	*	*	.0	67	2.9	11.2
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	3.1						71	3.1	.0
TOT OBS	235	895	984	176	23	0	2313		11.9
TOT PCT	10.2	38.7	42.5	7.6	1.0	.0		100.0	

B. Cape Lisburne Area (66-70°N)

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.3	2.5	5.6	1.2	.3	.0	89	9.9	15.3
NNE	.1	1.7	4.1	3.0	.1	.0	81	9.0	17.9
NE	.1	3.9	5.1	2.6	.3	.0	108	12.1	16.2
ENE	.0	2.3	3.0	1.8	.1	.0	65	7.3	16.0
E	.3	1.8	3.3	1.3	.0	.0	61	6.8	14.6
ESE	.0	.6	.7	.2	.0	.0	13	1.5	14.9
SE	.3	1.6	2.2	.3	.1	.0	41	4.6	12.8
SSE	.1	.8	2.0	.4	.0	.0	30	3.3	12.9
S	.1	3.2	6.8	1.0	.0	.0	100	11.2	14.1
SSW	.2	1.5	3.6	1.1	.0	.0	57	6.4	16.0
SW	.0	1.2	4.1	1.1	.0	.0	58	6.5	15.8
WSW	.2	1.2	1.2	.2	.0	.0	26	2.9	11.7
W	.1	.8	1.1	.2	.1	.0	21	2.3	13.7
WNW	.1	1.8	1.5	.3	.0	.0	33	3.7	10.8
NW	.2	3.0	1.9	.2	.0	.0	48	5.4	10.5
NNW	.2	.8	2.2	.2	.0	.0	31	3.5	13.3
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	3.8						34	3.8	.0
TOT OBS	57	256	435	138	10	0	896		14.2
TOT PCT	6.4	28.6	48.5	15.4	1.1	.0		100.0	

TABLE 10-11

Cumulative Percent Frequency of Simultaneous Occurrence of Ceiling Height and Visibility during June (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

DATA NOT REPORTED

B. Cape Lisburne Area (66-70°N)

CEILING (FEET)	VSBY (NM) ≥10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	.0	.0	.0	.0	.0	.0	.0	.0
≥5000	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
≥3500	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
≥2000	9.5	14.3	14.3	14.3	14.3	14.3	14.3	14.3
≥1000	9.5	19.0	23.8	23.8	23.8	23.8	23.8	23.8
≥600	9.5	19.0	28.6	28.6	28.6	28.6	28.6	28.6
≥300	9.5	19.0	28.6	28.6	28.6	28.6	28.6	28.6
≥150	9.5	23.8	33.3	33.3	33.3	33.3	33.3	33.3
≥ 0	9.5	23.8	33.3	33.3	33.3	33.3	33.3	33.3
TOTAL	2	5	7	7	7	7	7	7

TOTAL NUMBER OF OBS: 21 PCT FREQ NH <5/8: 66.7

Note: NH <5/8 indicates less than 5/8 cloud cover and ceiling height determination is not applicable.

TABLE 10-12

Cumulative Percent Frequency of Simultaneous Occurrence of Ceiling Height and Visibility during July (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

CEILING (FEET)	VSBY (NM) ≥10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	5.8	7.9	8.1	8.7	9.2	9.6	10.0	10.0
≥5000	7.8	10.4	10.7	11.3	12.1	12.7	13.1	13.1
≥3500	9.4	12.4	12.8	13.6	14.5	15.0	15.4	15.4
≥2000	11.7	16.3	17.2	18.1	19.4	20.0	20.4	20.4
≥1000	16.5	24.8	25.9	27.1	28.6	29.4	29.8	29.8
≥600	17.6	27.7	29.1	30.4	32.1	32.9	33.3	33.3
≥300	17.9	28.5	30.5	32.2	34.0	35.0	35.5	35.5
≥150	18.0	28.9	31.3	33.3	35.5	36.6	37.2	37.2
≥ 0	18.0	28.9	31.4	33.8	36.9	40.2	43.4	43.9
TOTAL	334	535	582	626	684	746	804	814

TOTAL NUMBER OF OBS: 1854 PCT FREQ NH <5/8: 56.1

B. Cape Lisburne Area (66-70°N)

CEILING (FEET)	VSBY (NM) ≥10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	3.9	7.2	7.9	8.7	9.2	9.2	9.3	9.3
≥5000	5.0	8.7	9.4	10.2	10.7	10.7	10.8	10.8
≥3500	7.2	11.7	12.6	13.3	13.8	13.8	13.9	13.9
≥2000	14.3	22.2	23.7	24.6	25.1	25.3	25.5	25.5
≥1000	20.4	34.0	36.4	37.3	38.1	38.2	38.4	38.4
≥600	23.6	40.5	44.0	45.2	46.2	46.4	46.6	46.6
≥300	24.4	42.3	46.6	49.0	50.4	50.6	51.0	51.0
≥150	24.4	42.3	46.7	49.6	51.0	51.4	51.9	51.9
≥ 0	24.4	42.3	47.0	50.4	53.9	55.9	58.7	59.0
TOTAL	194	337	374	401	429	445	467	470

TOTAL NUMBER OF OBS: 796 PCT FREQ NH <5/8: 41.0

Note: NH <5/8 indicates less than 5/8 cloud cover and ceiling height determination is not applicable.

TABLE 10-13

Cumulative Percent Frequency of Simultaneous Occurrence of Ceiling Height and Visibility during August (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

CEILING (FEET)	VSBY (NM) ≥10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	5.7	7.6	9.1	10.7	11.4	12.0	12.0	12.1
≥5000	6.5	8.5	10.1	11.7	12.4	13.0	13.0	13.0
≥3500	7.8	10.3	11.8	13.4	14.1	14.7	14.8	14.8
≥2000	13.2	17.7	19.4	21.1	21.8	22.4	22.4	22.5
≥1000	22.4	34.1	36.8	39.0	39.9	40.6	40.6	40.7
≥600	26.4	43.5	47.2	49.8	50.7	51.4	51.5	51.6
≥300	28.5	47.0	51.1	53.9	54.9	55.7	55.7	55.8
≥150	29.0	47.9	52.1	55.1	56.2	57.0	57.1	57.1
≥ 0	29.0	48.0	52.4	55.9	57.9	59.0	60.0	60.7
TOTAL	1012	1673	1829	1949	2020	2060	2094	2117

TOTAL NUMBER OF OBS: 3489 PCT FREQ NH <5/8: 39.3

B. Cape Lisburne Area (66-70°N)

CEILING (FEET)	VSBY (NM) ≥10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	.8	.9	1.1	1.1	1.1	1.1	1.1	1.2
≥5000	1.4	1.9	2.0	2.0	2.0	2.0	2.0	2.2
≥3500	3.1	4.7	4.8	4.8	4.8	4.8	4.8	5.0
≥2000	9.7	15.4	16.5	16.5	16.7	16.8	16.8	17.0
≥1000	21.2	36.8	39.6	39.7	40.0	40.3	40.3	40.5
≥600	26.9	47.7	51.1	51.7	52.0	52.3	52.3	52.5
≥300	29.4	52.2	56.1	57.3	57.9	58.6	58.7	58.9
≥150	29.6	52.5	56.7	58.1	58.7	59.3	59.7	59.8
≥ 0	29.6	52.6	57.2	59.7	62.3	64.2	67.1	68.1
TOTAL	190	338	367	383	400	412	431	437

TOTAL NUMBER OF OBS: 642 PCT FREQ NH <5/8: 31.9

Note: NH <5/8 indicates less than 5/8 cloud cover and ceiling height determination is not applicable.

TABLE 10-14

Cumulative Percent Frequency of Simultaneous Occurrence of Ceiling Height and Visibility during September (U.S. Naval Weather Service, 1970)

A. Barrow Area (70-74°N)

CEILING (FEET)	VSBY (NM) ≥10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	1.0	4.8	7.9	9.7	10.3	10.3	10.4	10.5
≥5000	1.3	5.3	8.4	10.2	10.8	10.8	10.9	11.0
≥3500	2.3	6.7	9.8	11.6	12.3	12.3	12.4	12.5
≥2000	11.2	20.6	24.2	26.3	27.1	27.3	27.4	27.5
≥1000	19.9	40.2	45.5	48.5	49.8	49.9	50.1	50.1
≥600	25.6	52.1	58.3	61.5	63.0	63.1	63.3	63.4
≥300	26.3	54.0	60.6	64.2	65.8	65.9	66.2	66.3
≥150	26.3	54.0	60.9	64.5	66.1	66.2	66.5	66.6
≥ 0	26.3	54.1	61.0	65.1	67.9	69.0	70.8	71.1
TOTAL	371	764	862	919	959	974	999	1004

TOTAL NUMBER OF OBS: 1412 PCT FREQ NH <5/8: 28.9

B. Cape Lisburne Area (66-70°N)

CEILING (FEET)	VSBY (NM) >10	≥5	≥2	≥1	≥1/2	≥1/4	≥50YD	≥0
≥6500	1.0	3.0	5.9	6.4	6.9	6.9	7.1	7.1
≥5000	1.6	3.8	6.7	7.2	7.7	7.7	7.9	7.9
≥3500	3.2	5.4	8.3	9.0	9.5	9.5	9.6	9.6
≥2000	14.3	21.6	24.7	25.3	25.8	25.8	26.0	26.0
≥1000	25.2	42.9	47.1	47.9	48.7	48.7	48.9	48.9
≥600	28.5	50.3	55.3	56.4	57.4	57.4	57.5	57.5
≥300	30.4	53.5	59.3	60.6	61.5	61.5	61.9	61.9
≥150	31.1	54.5	60.3	61.5	62.5	62.5	62.8	62.8
≥ 0	31.1	54.6	60.7	62.0	63.6	64.4	65.9	65.9
TOTAL	194	341	379	387	397	402	411	411

TOTAL NUMBER OF OBS: 624 PCT FREQ NH <5/8: 34.1

Note: NH <5/8 indicates less than 5/8 cloud cover and ceiling height determination is not applicable.

ATTACHMENT 11

11. OCEANOGRAPHY

11.1 General

The Chukchi Sea is a broad, relatively shallow marine shelf adjoining the Arctic Ocean to the north and the Bering Sea to the south. Oceanographic conditions are dominated by the large northward discharge of the north Pacific Ocean through the Bering Strait which introduces relatively warm nutrient rich waters into the Arctic Ocean and provides a migratory pathway for marine mammals between the Arctic and Pacific Oceans. In the summer, this flow has the effect of causing the Chukchi Sea to become ice-free earlier than would otherwise be the case and extends the ice-free season later into the fall. Seasonal ice cover, the atmospheric pressure system, and surface water runoff are also important influences on the circulation.

11.2 Currents

Water flowing through the Bering Sea can be resolved into two main water masses. The saline Bering Sea waters comprise the westward component of the northerly flow, entering the arctic in the vicinity of Herald Island.

The easterly component of this flow is the less saline Alaskan coastal waters which diverge from the Bering Sea waters in the vicinity of Point Hope and travel northeasterly to enter the Arctic Ocean in the vicinity of Pt. Franklin. Enroute they encounter and undergo limited mixing with the resident Chukchi waters which are a combination of near freezing water remaining on the shelf from the previous winter and intrusions from the Arctic Ocean. Surface circulation is shown in Figure 11-1 and bottom circulation in Figure 11-2.

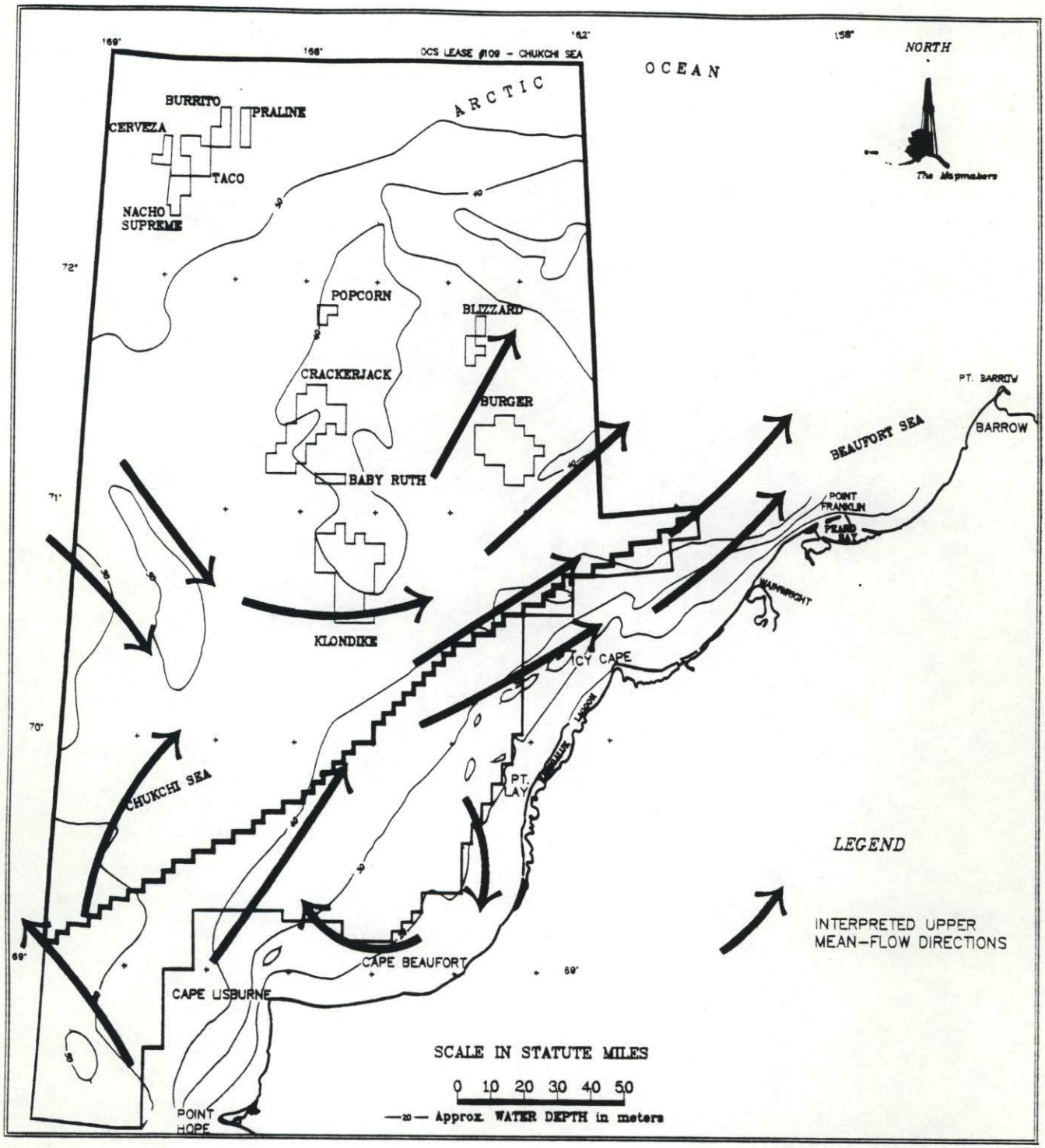


FIGURE 11-1. UPPER LAYER CURRENTS IN THE CHUKCHI SEA, USDOI/MMS (1987)

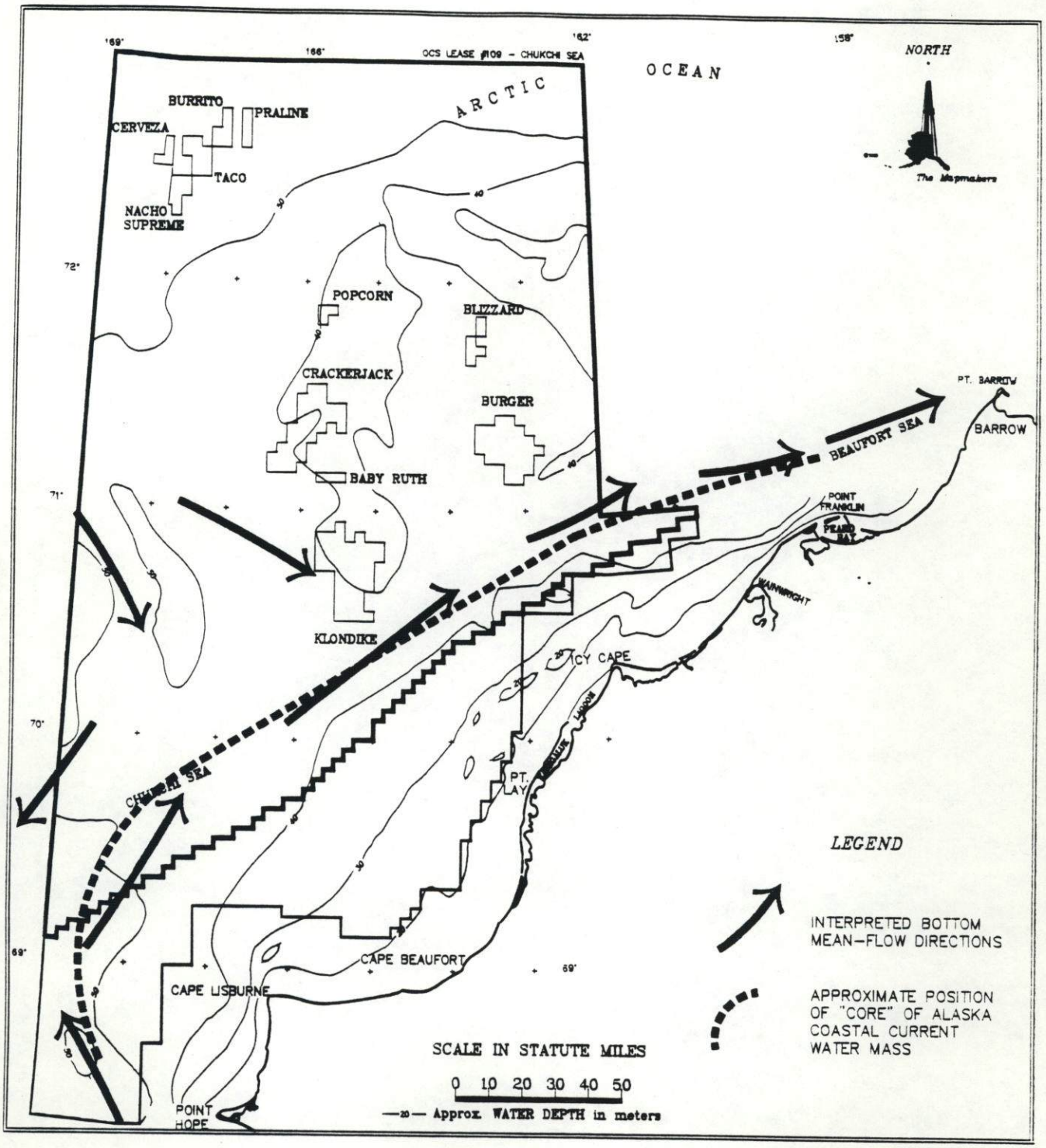


FIGURE 11-2. BOTTOM WATER MOVEMENT IN THE CHUKCHI SEA, USDOI/MMS (1987)

SWEPI's REMOTE OFFSHORE LEASES fall along the western edge of these northward flowing Alaskan coastal waters, and lie outside the region of high currents generated within 25 miles of the coast.

These currents appear to be directly related to the wind-driven seasonal cycle, with summer transport through the Bering Strait about 50% greater than during the winter (Aagaard, 1987). Variability in transport through the strait is related to the large scale variability of the atmospheric circulation over the north Pacific. The Alaskan coastal waters can be absent in areas along the coast for substantial periods of time, especially under strong northerly wind conditions.

Current speeds of 0.4 to 0.6 knots are characteristic of the eastern Chukchi Sea (Mountain et al., 1976).

11.3 Temperature and Salinity

Bering Sea waters are stratified north of the Bering Strait (Bourke, 1983). A 15 to 30 foot thick upper layer is separated from the lower layer by a strong thermocline. Upper layer temperatures reach 7 to 10°C in mid-summer and the salinity is about 31 ppt. The lower layer is cooler and more saline.

In the winter, water temperature and salinity properties are acquired by cooling and sea ice formation, resulting in a vertically homogenous upper layer. The density of the underlying layer is increased by salt rejection from the formation of sea ice.

In the spring, relatively warm Bering Sea waters interact with Chukchi Sea waters and sea ice in a band which may vary in width from 15 to about 150 miles depending upon local winds and currents (Bourke, 1983). A thermohaline front is generated when the temperature and salinity of the warm Bering Sea waters are

lowered by the melting sea ice. Surface waters lying close or behind the ice edge are cold (-1.6°C to -1.7°C), saline (32.8 to 33.6 ppt), and near the equilibrium freezing point. A second thermohaline front develops in the lower layer between the resident Chukchi waters and the Bering Sea waters.

11.4 Tides

Tides at all three sites are classified as mixed and have both diurnal and semidiurnal components. Chukchi Sea tides are small and the range is generally less than 1 foot.

11.5 Sea States

Wave data for the months of June through September are provided on Tables 11-1 through 11-4. Wind generated waves are limited to the open water period. Waves with heights of less than 3 feet and periods of less than 6 seconds are most frequently observed. Towards the end of the open water season, waves tend to be higher during storm events due to the increased fetch. Storms during the summer and fall months usually result in winds from the southwest that move across the Chukchi Sea. Waves and currents generated by the storms may erode shallower seafloor sediments and transport large quantities of the eroded material along the coast (USDOI/MMS, 1987).

11.6 Ice and Icing Conditions

The pack ice in the lease area begins to move northward in June; however, ice may be present north of 70°N as late as September (Stringer and Groves, 1988). Frequencies of summertime sea ice intrusions in the Chukchi Sea have been summarized (LaBelle et al, 1983).

Sea ice usually begins to form in the lease area in late September or early October. All of the lease area is usually ice covered by mid-November or early December (LaBelle et al., 1983).

By mid-October, polar pack ice has moved as far south as Barrow. Figures 11-3 through 11-8 show the usual location of the sea ice edge from June to November.

Sea spray ice is the most common and dangerous form of vessel and equipment icing. It can be caused by heavy sea spray, freezing rain, or fog. It can occur when the air temperature falls below the freezing temperature of sea water (-2°C) and when sea surface temperatures are below 5°C. These conditions can be expected in the Chukchi Sea any time during the open water period (July-September).

11.7 Water Quality

The waters of the lease area have not been impacted by industrial activity; water quality is pristine. Concentrations of suspended particulate material, trace metals, and hydrocarbons are all low. Dissolved oxygen concentrations are at or above saturation level (USDOI/MMS, 1987).

TABLE 11-1

Percent Frequency of Wave Height by Wave Period during June (U.S. Naval Weather Services, 1970).

A. Barrow Area (70-74°N)

NO DATA REPORTED

B. Cape Lisburne Area (66-70°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	50.0	50.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6	1
6-7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
8-9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
TOTAL	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1
PCT	50.0	50.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	100.0	

TABLE 11-2

Percent Frequency of Wave Height by Wave Period during July (U.S. Naval Weather Services, 1970).

A. Barrow Area (70-74°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	20.3	8.7	2.9	1.4	.0	.0	1.4	1.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	25	1
6-7	.0	1.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	2
8-9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	62.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
TOTAL	57	7	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	43	0
PCT	82.6	10.1	2.9	1.4	.0	.0	1.4	1.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	69	0
																			.0	100.0	

B. Cape Lisburne Area (66-70°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	15.6	14.9	26.0	7.8	.6	1.3	.6	.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	104	2
6-7	.0	4.5	5.2	3.2	.6	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	23	3
8-9	.0	1.3	.6	.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4	3
10-11	.0	.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	2
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	12.3	.6	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	22	0
TOTAL	43	34	49	20	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	154	2
PCT	27.9	22.1	31.8	13.0	1.3	2.6	.6	.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	100.0	

TABLE 11-3

Percent Frequency of Wave Height by Wave Period during August (U.S. Naval Weather Services, 1970).

A. Barrow Area (70-74°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	30.7	17.3	8.0	2.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	44	1
6-7	.0	.0	2.7	2.7	2.7	2.7	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	9	6
8-9	.0	.0	.0	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	7
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	28.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
TOTAL	44	13	8	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	.0	21	0
PCT	58.7	17.3	10.7	5.3	4.0	2.7	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	75	1
																			.0	100.0	

B. Cape Lisburne Area (66-70°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	8.0	22.7	17.3	5.3	2.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	42	2
6-7	.0	1.3	4.0	1.3	4.0	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	9	5
8-9	.0	.0	.0	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	7
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	16
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	29.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
TOTAL	28	18	16	5	6	0	1	0	0	1	0	0	0	0	0	0	0	0	.0	22	0
PCT	37.3	24.0	21.3	6.7	8.0	.0	1.3	.0	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	75	2
																			.0	100.0	

TABLE 11-4

Percent Frequency of Wave Height by Wave Period during September (U.S. Naval Weather Services, 1970).

A. Barrow Area (70-74°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	23.4	19.5	15.6	3.9	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	49	1
6-7	.0	2.6	2.6	1.3	5.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	9	4
8-9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
10-11	.0	.0	.0	.0	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	8
12-13	.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1	2
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	22.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	17	0
TOTAL	35	18	14	4	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	77	1
PCT	45.5	23.4	18.2	5.2	6.5	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	100.0	

B. Cape Lisburne Area (66-70°N)

PERIOD (SEC)	WAVE HEIGHT (FT) <1	1-2	3-4	5-6	7	8-9	10-11	12	13-16	17-19	20-22	23-25	26-32	33-40	41-48	49-60	61-70	71-86	87+	TOTAL	MEAN HGT
<6	1.8	26.5	28.3	8.0	.9	1.8	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	77	3
6-7	.0	1.8	4.4	4.4	6.2	1.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	21	5
8-9	.0	.9	.0	1.8	.9	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5	5
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	
INDET	8.0	.0	.0	.0	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	10	0
TOTAL	11	33	37	16	10	5	1	0	0	0	0	0	0	0	0	0	0	0	0	113	3
PCT	9.7	29.2	32.7	14.2	8.8	4.4	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	100.0	

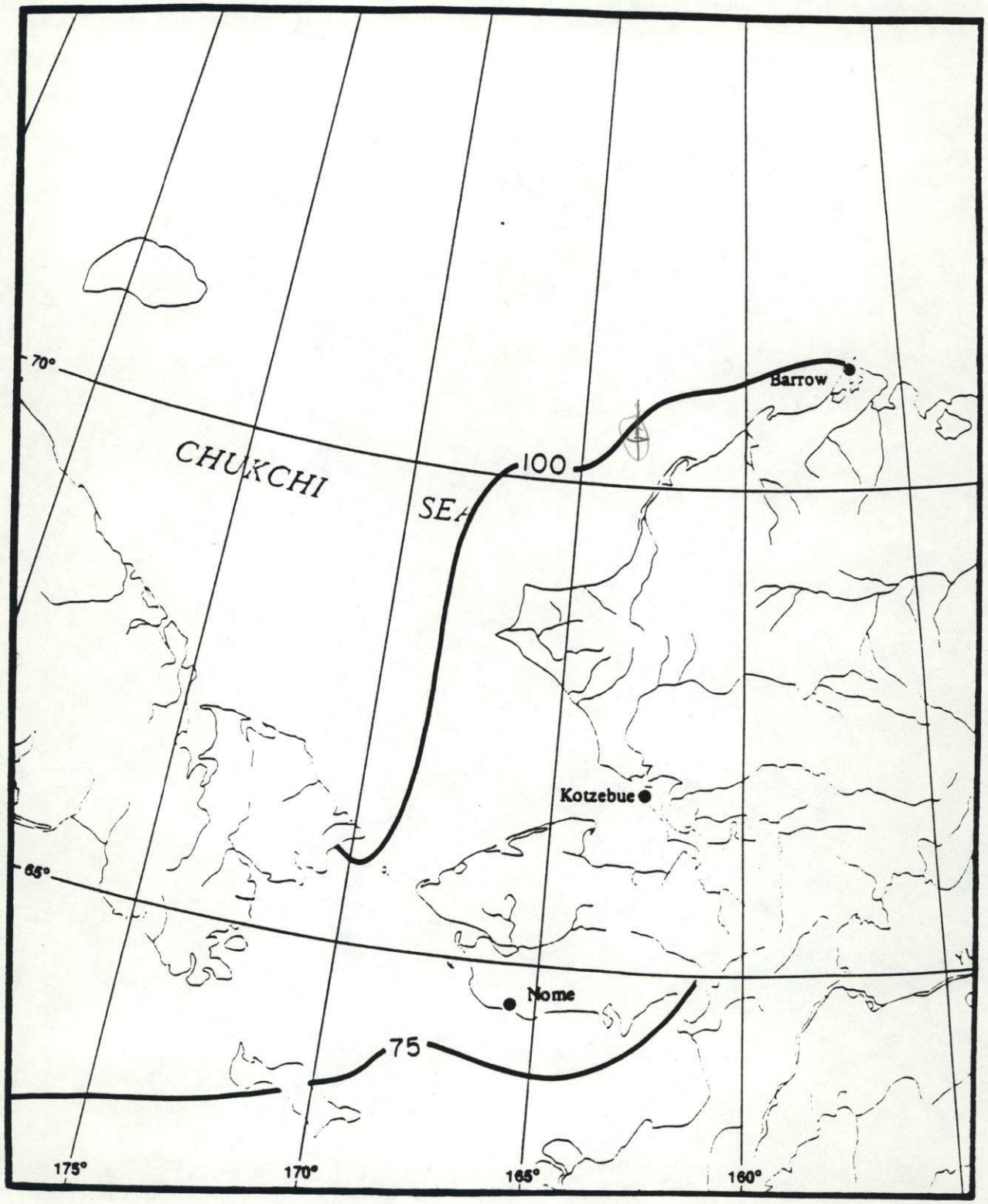


Figure 11-3. Probabilities in percent of the ice edge location on June 1 (LaBelle, 1983).

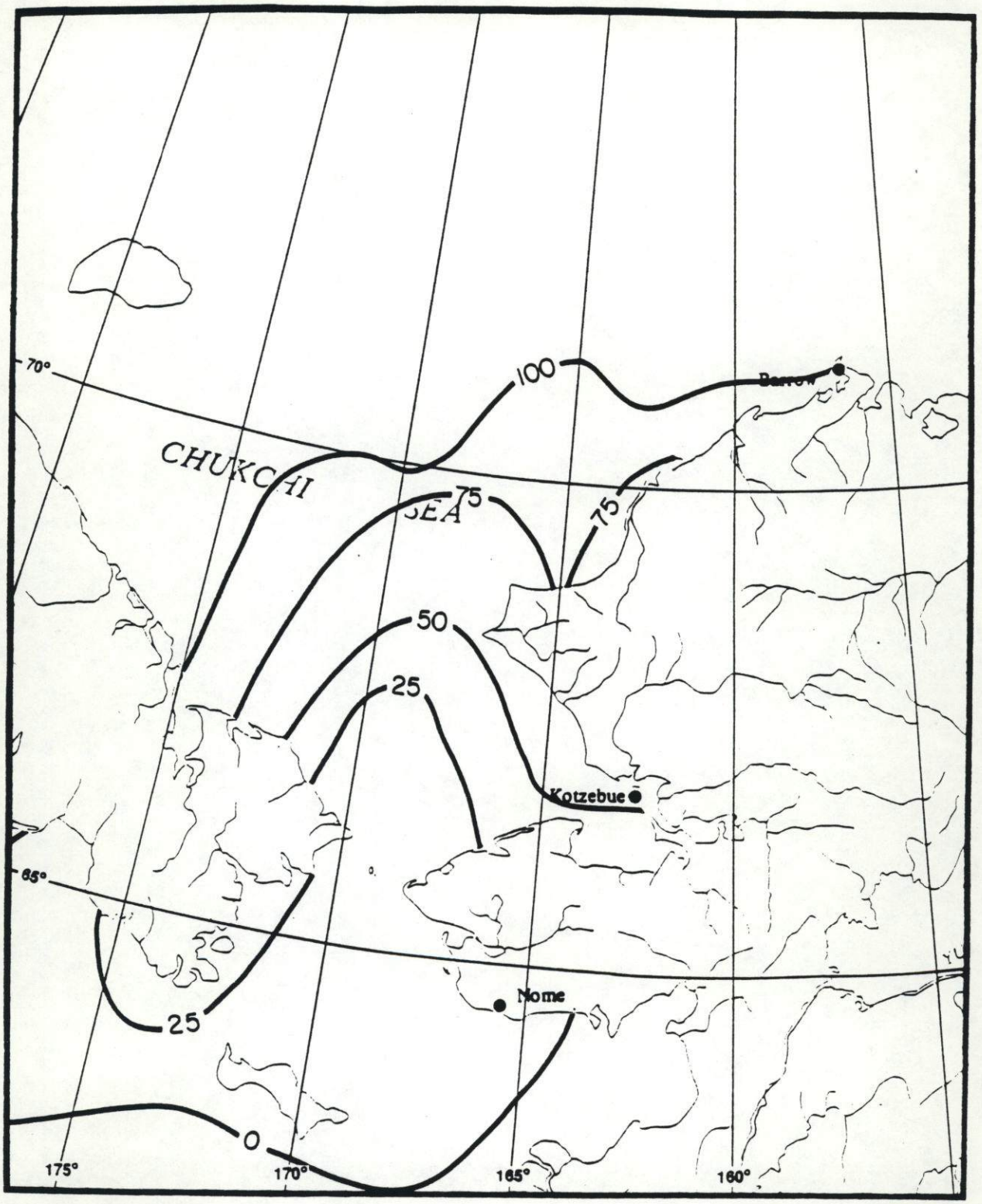


Figure 11-4. Probabilities in percent of the ice edge location on July 1 (LaBelle, 1983).

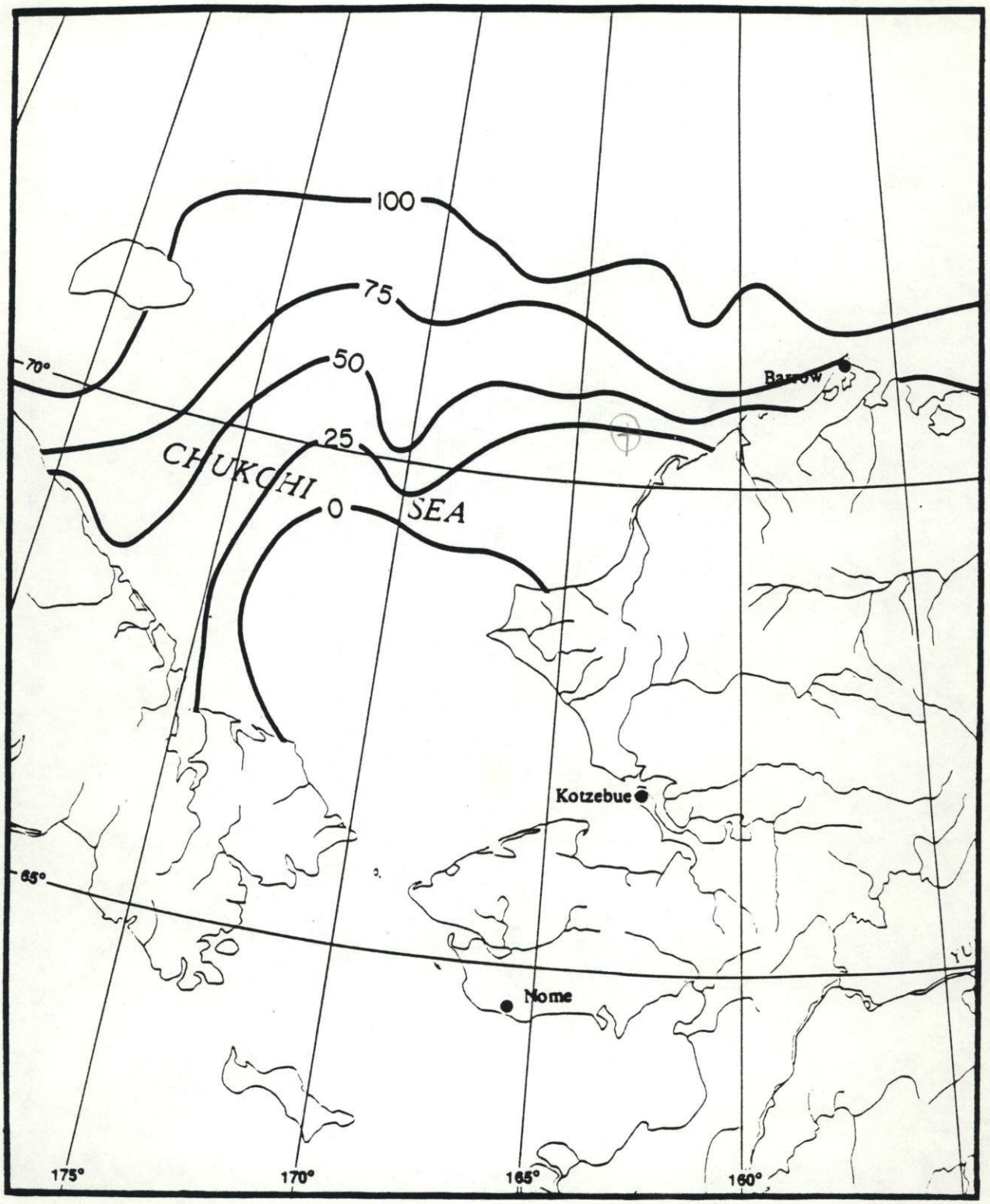


Figure 11-5. Probabilities in percent of the ice edge location on August 1 (LaBelle, 1983).

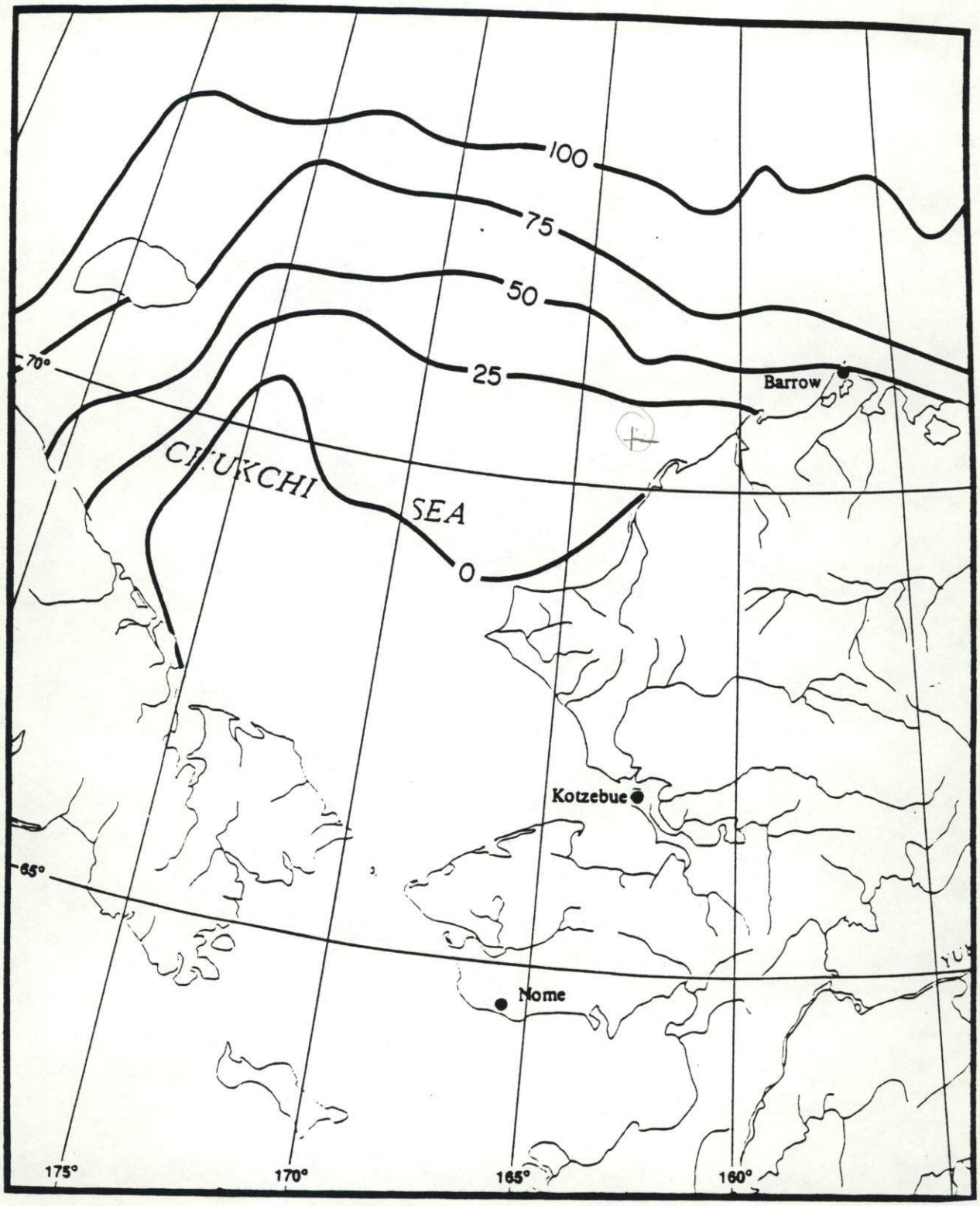


Figure 11-6. Probabilities in percent of the ice edge location on September 1 (LaBelle, 1983).

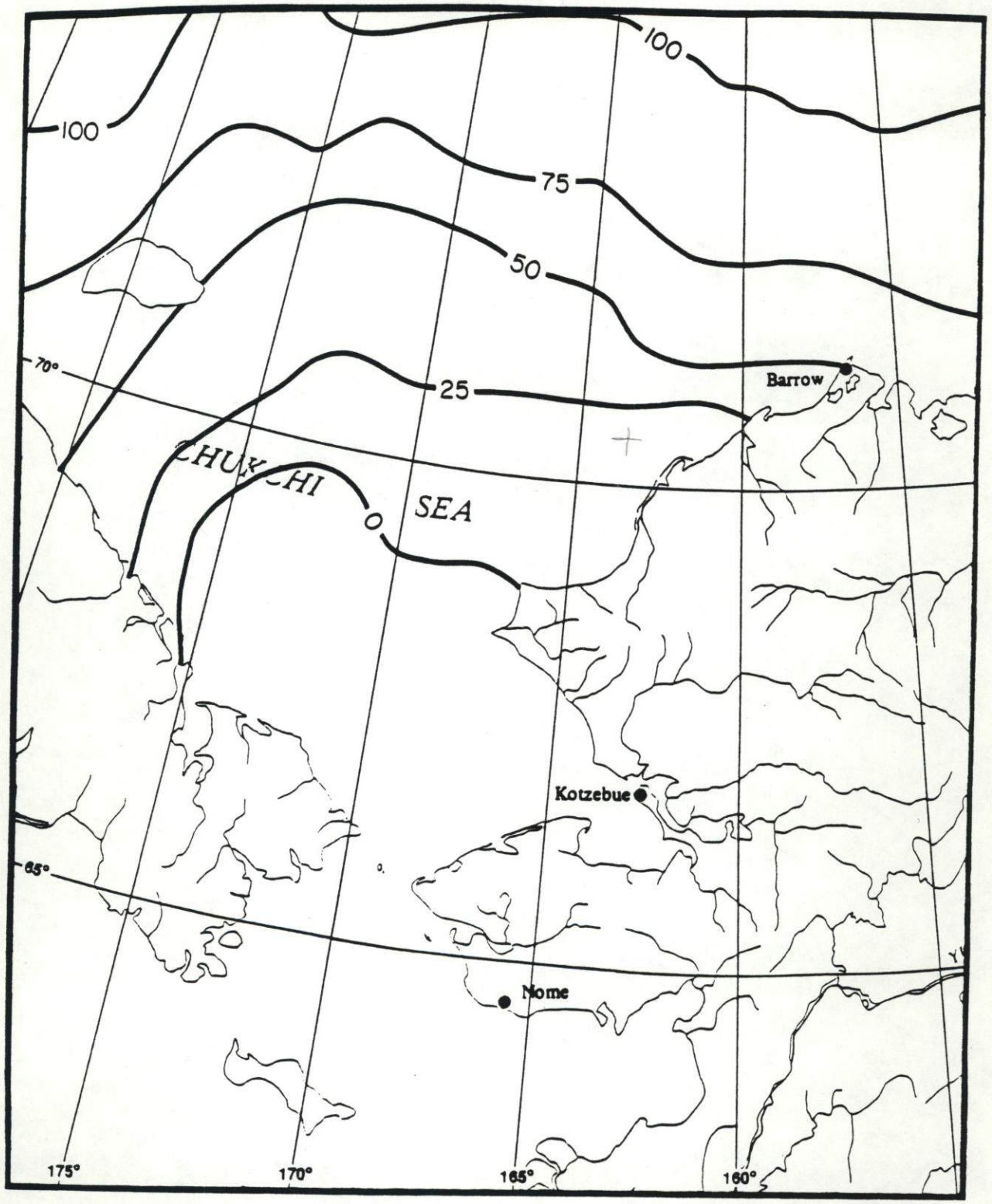


Figure 11-7. Probabilities in percent of the ice edge location on October 1 (LaBelle, 1983).

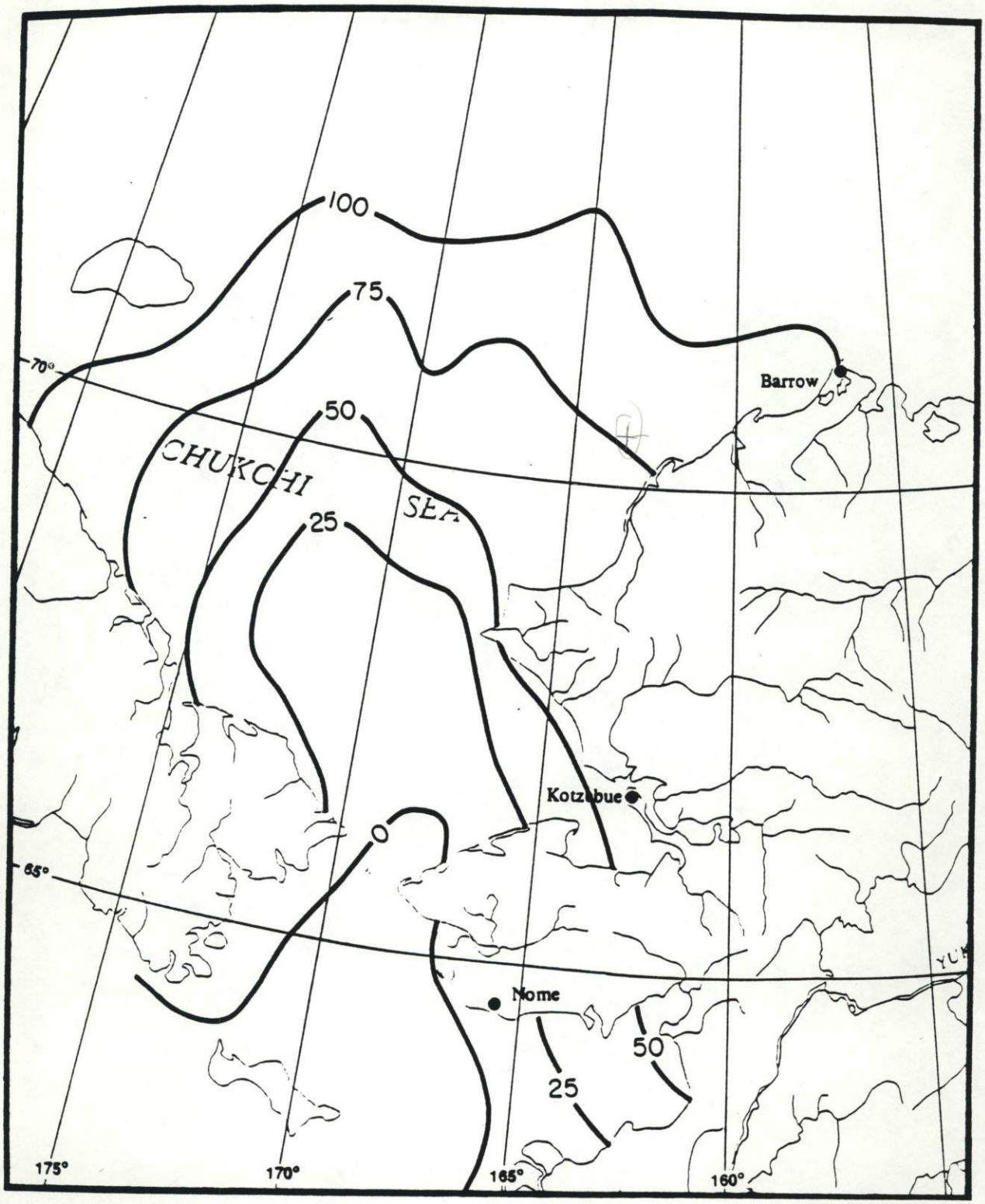


Figure 11-8. Probabilities in percent of the ice edge location on November 1 (LaBelle, 1983).

REFERENCES

Aagaard, K., 1987. Physical oceanography of the Chukchi Sea: an overview. In Chukchi Sea Information Update. OCSEAP, USDOC, NOAA, and USDOI, MMS.

Bourke, R. H., 1983. Currents, fronts and fine structure in the marginal ice zone of the Chukchi Sea. Polar Record 21(135):569-575.

LaBelle, J. C., J. L. Wise, R. P. Voelker, R. H. Schulze and G. M. Wohl, 1983. Alaska marine ice atlas. Anchorage, AK: University of Alaska, AEIDC.

Mountain, D. G., L. K. Coachman and K. Aagaard, 1976. On the flow through Barrow Canyon. Journal of Physical Oceanography 6(4):461-476.

Pease, C. H., 1987. Meteorology of the Chukchi Sea: An overview. In Chukchi Sea Information Update. OCSEAP, USAOC, NOAA, and USDOI, MMS.

Stringer, W. J. and J. E. Groves, 1988. Summertime sea ice intrusions in the Chukchi Sea. In Beaufort Sea Information Update. OCSEAP, USDOC, NOAA and USDOI, MMS.

U.S. Department of the Interior/Minerals Management Service. 1987. Alaska Outer Continental Shelf Chukchi Sea Oil and Gas Lease Sale 109. Final Environmental Impact Statement. Alaska OCS Region. Vol 1 and 2.

USEPA, 1988. Ocean Discharge Criteria Evaluation for Chukchi Sea OCS Oil and Gas Lease Offering 109; Final. U.S. Environmental Protection Agency, Region X; Seattle, Washington, August 1988.

ATTACHMENT 12

12. BIOLOGICAL RESOURCES

12.1 General

Discussions of biological resources that follow are based primarily on data provided in USDOI/MMS (1987). The original literature citations are provided here for convenience.

12.2 Pelagic Environment

The pelagic or open water environment of the Chukchi Sea is inhabited by diverse assemblages of phytoplankton, zooplankton, micronekton, anadromous and marine fishes, and marine mammals. In addition, this environment provides a habitat for many seabird species. The interactions among these species form complex food webs and nutrient cycles. For example, zooplankton consume phytoplankton; fish, marine mammals and sea birds feed on zooplankton; and sea bird guano is a nutrient source for phytoplankton.

12.2.1 Phytoplankton

Primary production by phytoplankton in the Chukcki Sea is determined by a variety of factors, including ice cover, light, water temperature, and the amount of nutrients present in the water. Upwelling of nutrient-rich water from the Gulf of Anadyr in the northwestern Bering Sea through the Bering Strait and into the southern Chukchi Sea provides for some of the highest annual primary production levels in the arctic (Sambrotto et al., 1984). This intense productivity creates organic matter, some of which supports a high zooplankton biomass, and some, by enrichment of sediments, supports a high biomass of benthic invertebrates in the area. This high productivity exhibits a decreasing trend from the Bering Strait northward (Figure 12-1).

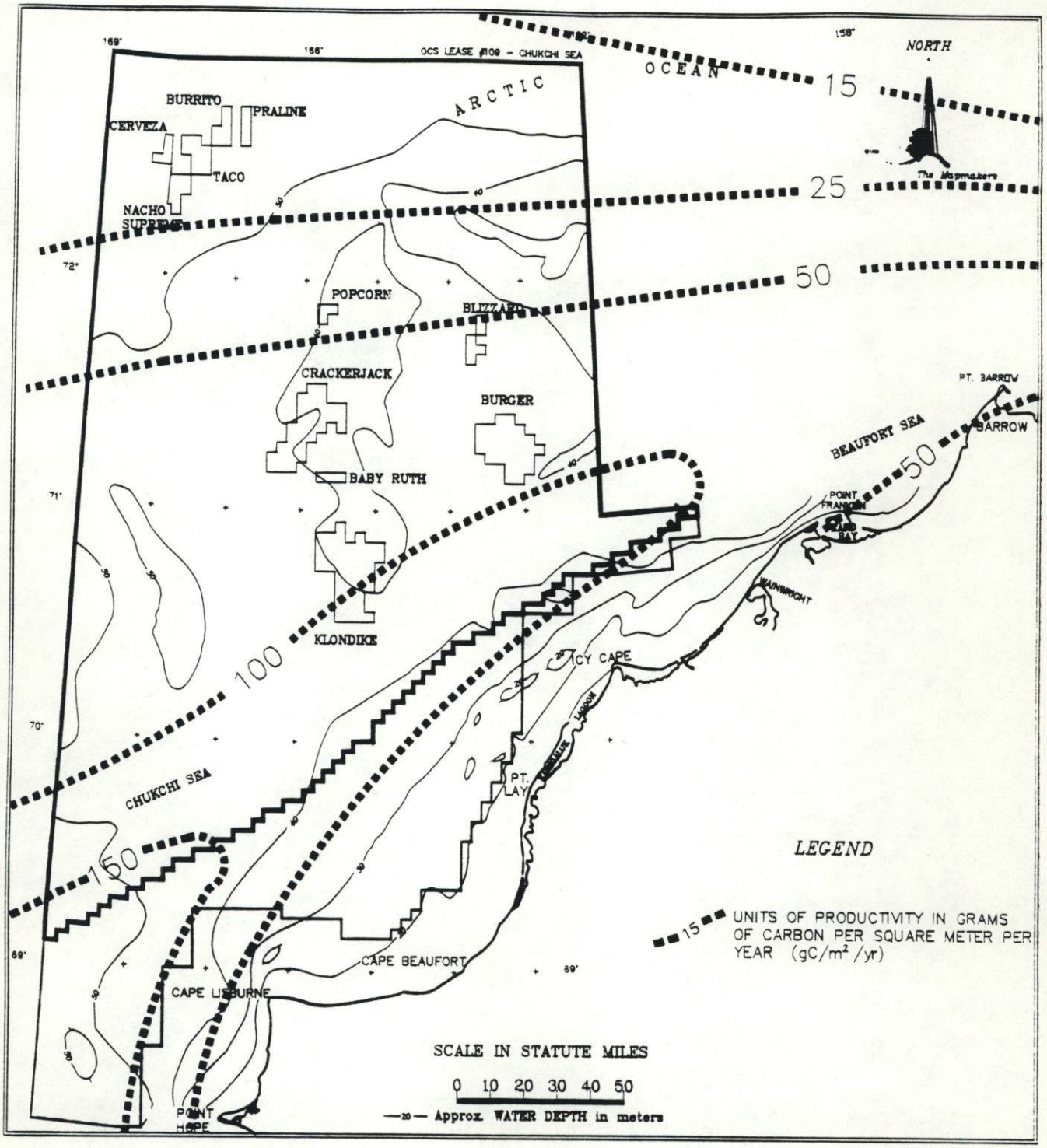


FIGURE 12-1. CONTOURS OF ANNUAL PRIMARY PRODUCTION, USDOI/MMS (1987)

The phytoplankton species of the Chukchi Sea reportedly have widespread distributions in high latitudes (Carey, 1978). The diatoms Nitzschia seriata and Chaetoceros debilis are dominant phytoplankton species of the Alaskan coastal waters (Schell, 1986). Dinoflagellates, including Ceratium longipes, C. lineatum, and Peridinium spp., are reported as major constituents in coastal waters of the Gulf of Anadyr, near the Bering Strait. Other phytoplankton diatoms such as Chaetoceros, Coscinodiscus, and Thalassiosira are reported as being components of the Bering shelf water flowing north (English, 1966).

12.2.2 Zooplankton/Micronekton

The movement of water masses from the Bering Sea into the Chukchi Sea transports zooplankton and micronekton, as well as nutrients and phytoplankton. As a result, the zooplankton and micronekton species found in the Chukchi Sea are similar to those found in the Bering Sea (USDOI/MMS, 1987). Coastal zooplankton communities are comprised of the copepods Eurytemora pacifica and Acartia clausi, and the cladoceran Evadne normani. Offshore areas are characterized by copepods such as Metridia lucens, Calanus plumchrus, and Eucalanus bungii. Zooplankton abundances in the Chukchi Sea are reportedly lower than those found in adjacent areas, and may be less important as a food source to large consumers such as bowhead whales (Coyle, 1981).

Other components of the zooplankton and micronekton communities in the Chukchi Sea include coelenterates, nematodes, annelids, mollusks, tunicates, decapod crustaceans, barnacles, and other animals with planktonic life stages. Larval forms of benthic organisms (meroplankton) can be an important component of the zooplankton also.

12.2.3 Anadromous Fishes

The anadromous fishes of the Chukchi Sea include Pacific salmon, arctic char, ciscoes, whitefishes, and rainbow smelt. Pink and chum salmon are the most common Pacific salmon species found in the area. Sockeye, coho, and chinook salmon are occasionally caught in coastal waters, but are generally restricted to the south of Cape Lisburne (USDOI/MMS, 1987). Some anadromous species migrate as juveniles from freshwater to mature at sea in offshore areas, and as adults return to freshwater to spawn. These species include the salmon and rainbow smelt. Other anadromous species enter the brackish or offshore marine environment only during the summer, spending the remainder of the year in freshwater lakes and rivers. Although the importance of warm, brackish, nearshore waters to anadromous fishes has been indicated for the Beaufort Sea and Norton Sound, differences in oceanography and fish populations may deem the offshore marine environment more important for anadromous fishes in the Chukchi Sea (Craig and Skvorc, 1982; USDOI/MMS, 1987).

12.2.4 Marine Fishes

The marine fishes of the Chukchi Sea are primarily arctic species, with some input of more southern species through the Bering Strait (Craig, 1984). Typical species include arctic staghorn, fourhorn, shorthorn, and twohorn sculpin, arctic cod, Canadian eelpout, arctic flounder, and saffron cod. A taxonomic list of marine fishes caught during the 1983 Discoverer cruise of the northeastern Chukchi Sea is provided in Table 12-1.

The distribution of marine species in the Chukchi Sea is influenced by temperature and salinity, with yellowfin sole and saffron cod occupying the shallower, warmer waters, while arctic cod, arctic staghorn, sculpin, and flounder are found in deeper, colder waters. Many of the species apparently maintain recruitment of eggs and larvae by transport from the Bering Sea

TABLE 12-1

Species caught during the 1983 Discoverer cruise
(Source: Fechhelm et al., 1984)

CLUPEIFORMES

- Clupeidae
  - Pacific herring - Clupea harangus pallasi

SALMONIFORMES

- Salmonidae
  - Arctic char - Salvelinus alpinus
- Osmeridae
  - Boreal smelt - Osmerus mordax

GADIFORMES

- Gadidae
  - Arctic cod - Boreogadus saida
  - Saffron cod - Eleginus gracilis
  - Walleye pollock - Theragra chalacogramma
- Zoarcidae
  - Fish doctor - Gymnelis viridis
  - Polar eelpout - Lycodes polaris
  - Arctic eelpout - L. reticulatus
  - Saddled eelpout - L. muscosus

PERCIFORMES

- Stichaeidae
  - Fourline snakeblenny - Eumesogrammus praecisus
  - Slender eelblenny - Lumpenus fabricii
  - Arctic shanny - Stichaeus punctatus
- Ammodytidae
  - Sandlance - Ammodytes hexapterus
- Hexogrammidae
  - Whitespotted greenling - Hexogrammos stelleri
- Cottidae
  - Hamecon - Artediellus scaber
  - Spatulate sculpin - Icelus spatula
  - Antlered sculpin - Enophrys diceraus
  - Arctic staghorn sculpin - Gymnocanthus tricuspis
  - Fourhorn sculpin - Myoxocephalus quadricornis
  - Shorthorn sculpin - M. scorpius
  - Eyeshade sculpin - Nautichthys pribilovius
  - Ribbed sculpin - Triglops pingeli
- Agonidae
  - Sturgeon seapoacher - Agonus acipenserinus
  - Arctic alligatorfish - Aspidophoroides olriki
- Cyclopteridae
  - Snailfish - Liparis spp.

PLEURINECTIFORMES

- Pleuronectidae
  - Alaska plaice - Pleuronectes quadrituberculatus
  - Arctic flounder - Liopsetta glacialis
  - Yellowfin sole - Limanda aspera
  - Longhead dab - Limanda proboscidea

by the Alaska Coastal Current (Craig, 1984). Fishes which probably maintain resident breeding stock include arctic cod, saffron cod, sand lance, capelin, sculpins, and some of the flounders. The majority of marine fishes found in the Chukchi Sea are demersal as adults.

Pacific herring, capelin, and Pacific sand lance are considered pelagic as adults (Morris, 1981a). A comparison of fyke-net catches for fish species caught during nearshore summer surveys in the Beaufort and Chukchi Seas is provided in Table 12-2.

The exploitation of the Chukchi Sea fishery may be limited due to the smaller size and lower densities of commercially important species as compared to areas farther south. This is likely a result of environmental constraints upon population sizes and growth patterns of marine fishes of the area (USDOI/MMS, 1987).

12.2.5 Marine Mammals

Species in this group are the pinnipeds (ringed, bearded, and spotted seals, and Pacific walrus), the polar bear, and beluga, bowhead, gray, fin, and humpback whales. Important breeding habitats and migration routes of marine mammals are discussed in Section 12.4, Important Breeding Habitats and Migration Routes. All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972. Polar bears and their habitats are also protected by the International Agreement on the Conservation of Polar Bears of 1976.

The ringed seal (Phoca hispida) is the most abundant seal in the Chukchi Sea, with a winter population estimated at 300,000 to 450,000 and a summer population estimated at 1 to 2 million seals in ice habitats (Burns, 1981). Ringed seal densities may depend upon such factors as food availability, proximity to human disturbance, water depth, and ice stability. Although ringed

TABLE 12-2

Fyke-Net Catch Summary for Fish Species
Caught During Nearshore Summer Surveys in the Beaufort and Chukchi Seas*

	Beaufort Sea								Chukchi Sea			
	Simpson Lagoon				Prudhoe Bay		Sagavanirktok Delta		Point Lay		Peard Bay	
	1977		1978		1981		1982		1983		1983	
Arctic cod	7.6	(6.5)**	77.9	(1607.1)	49.2	(179.8)	27.9	(147.7)	39.0	(183.1)	69.5	(413.5)
Fourhorn sculpin	69.6	(59.1)	17.9	(369.3)	23.7	(86.4)	27.7	(146.9)	19.8	(93.0)	23.7	(140.8)
Arctic cisco	14.7	(12.5)	0.8	(16.5)	15.0	(54.7)	29.1	(154.4)	0.0	(0.0)	0.0	(0.0)
Least cisco	2.3	(1.9)	1.2	(24.8)	6.6	(24.0)	2.3	(12.5)	0.01	(0.07)	0.15	(0.9)
Arctic char	3.8	(3.2)	0.9	(18.6)	2.3	(8.5)	5.1	(27.8)	0.01	(0.1)	0.0	(0.0)
Broad whitefish	0.1	(0.8)	0.2	(3.1)	0.9	(3.1)	5.6	(29.7)	0.0	(0.0)	0.0	(0.0)
Others	1.9		1.1		2.3		2.3		41.2		6.65	

Sources: Craig and Haldorson 1981 (Simpson Lagoon); Griffiths and Gallaway 1982 (Prudhoe Bay); Griffiths et al., 1983 (Sagavanirktok Delta); Fechhelm et al., 1984 (Point Lay); Kinney, 1985 (Peard Bay).

* Values are presented as a percentage of total catch.

** Figures in parentheses present catch per fyke-net day.

seals do not occur in large herds, aggregations of tens or hundreds of animals may be associated with areas of abundant prey. Ringed seals may feed upon such prey as cod, amphipods, mysids, euphausiids, and small pelagic fishes. Arctic cod are an important source of food during the winter season. Ringed seals are a major resource for subsistence harvest, with over 14,000 taken each year in northwestern and western Alaska (Moulton and Bowden, 1981).

The bearded seal (Erignathus barbatus) is circumpolar in distribution and generally prefers areas of seasonal, broken sea ice in waters less than 60 feet deep. An estimated population of 300,000 to 450,000 animals occur in Alaska OCS areas in the Bering and Chukchi Seas (Braham et al., 1977). The winter population of bearded seals in the Chukchi Sea is estimated at 120,000 (Burns, 1981). The summer population is estimated to be substantially larger. This species feeds mostly on benthic and epibenthic invertebrate prey such as shrimps, crabs, and bivalve mollusks; fish are considered as secondary prey. This seal is relatively important as a subsistence harvest species; more than 6,000 bearded seals are harvested each year (Moulton and Bowden, 1981).

Spotted seals (Phoca largha) are common seasonal residents of the Chukchi Sea, occupying the coastal areas from June through October. Populations during the summer are estimated between 30,000 and 37,500 animals (Burns, 1981). This seal commonly hauls out on land, and is known to enter estuaries in search of prey. Important haulout and concentration areas within the sale area include Icy Cape-Kasegaluk Lagoon, the Kuk River mouth, and Peard Bay. Prey items include pelagic fishes, octopuses, and crustaceans. Spotted seals are also an important subsistence resource, with more than 7,000 harvested each year, mostly in the northern Bering Sea (ADF&G, 1981).

The walrus (Odobenus rosmarus) population of the North Pacific is estimated at about 250,000 animals. Most of these are associated with the moving ice pack, spending the winter season in the Bering Sea. An estimated 150,000 individuals summer in the Chukchi Sea (Burns, 1981). Walruses are benthic feeders, utilizing bivalve mollusks primarily, and polychaetes, snails, and crustaceans secondarily. Walruses are an important subsistence resource; annual Alaskan harvests yielded about 1,000 to 3,000 animals in the last 15 years (Fay, 1982).

The total population of polar bears (Ursus maritimus) in Alaska is estimated at 3,000 to 5,000 animals (Amstrup 1983). Two separate populations are believed to exist in the Alaskan arctic, one of which occurs primarily in the Chukchi Sea. Distributions of polar bears exhibit substantial annual variation in the Chukchi Sea; average density appears to be about one bear for every 30 to 50 square miles. The drifting pack ice off the coast of the Chukchi Sea probably supports the greatest number of bears in the area due to the abundance and availability of subadult seals in this habitat (Smith, 1980). When ice conditions permit, bears may move onto the land. Polar bears off the Alaskan coast feed primarily on ringed seals, bearded seals, walruses, carrion, and human refuse when available.

Beluga whales (Delphinapterus leucas) feed and calve in the nearshore habitats of the Chukchi Sea during the summer season. An estimated 2,500 to 3,000 belugas are found in bays and estuaries of Kotzebue Sound and along the northern Chukchi Sea coast during open-water season (Seaman et al., 1985). Prey include various marine vertebrates and invertebrates such as capelin, cod, herring, squid, and crustaceans. Beluga whales are an important subsistence resource, with over 185 animals taken annually in western and northwestern Alaska (Moulton and Bowden, 1981).

Bowhead Whale

The western stock of bowhead whales is estimated at 7,800 individuals [International Whaling Commission (in press)]. During spring and fall migrations, all of the individuals are believed to move through the sale area. There appears to be four migrational pulses in the spring from March to June when bowhead whales, wintering in the area between St. Lawrence and St. Matthew Islands, move northward through the Chukchi Sea using flaws created by the breaking pack ice. Bowhead whales follow open leads up to 25 miles offshore, and the majority pass Cape Lisburne by mid-May (Gusey, 1983). Past Barrow, approaching the Beaufort Sea, the whales tend to move further offshore as the ice breaks become more predictable. Most feeding activity occurs in the Canadian Beaufort Sea; although, opportunistic feeding occurs in the Chukchi Sea during the spring migration. The earliest fall migration out of the Beaufort Sea begins in mid-August, peaks in September, and can last into November. After passing Barrow, the migrating bowheads disperse westward in the Chukchi Sea to the USSR and then south through the Chukchi Sea and Bering Strait, reaching the Bering Sea in November and December. Varying ice conditions may cause some bowhead whales to move southwest along the northwest coast of Alaska instead. Commercial whalers in the last half of the nineteenth century reported harvesting bowhead whales from the Chukchi Sea in the summer months of June, July, and August. These Chukchi Sea, summer-feeding bowhead whales appear to have been completely harvested by these earlier whaling activities or they moved to the Beaufort Sea. There is no confirming evidence that bowhead whales have remained or returned to a Chukchi Sea summer-feeding pattern.

During their spring migration and while in the Chukchi Sea, bowheads are calving and lactating. The peak breeding period is in April and May while they are waiting for a break in the pack

ice commencing the northward spring migration. The gestation period is 12 to 13 months, one young is produced every three to five years, and weaning probably occurs after five to six months.

The bowhead whale, one of the largest whales in the world, is a baleen whale feeding primarily on zooplankton filtered from the water, and its enormous head can break ice up to 2 feet thick. Prey species of bowhead whales include euphausiids, copepods, hyperiid and gammarid amphipods (Lowery and Frost, 1984). Modern bowhead hunting occurs in the spring, and to a lesser extent the fall, from the villages of Barrow, Point Hope, Wainwright, Gambell, Savoonga, Kavilina, Nuiqsut, and Kaktovik. Annually, around 30 bowhead are harvested by Natives (Gusey, 1983).

Gray Whales

The current eastern North Pacific stock of gray whales is estimated at 17,000 individuals (Rugh, 1984). The northern boundary of the migration route of the gray whale extends to Point Barrow, with the whales passing through and feeding in the sale area during summer and fall. This eastern population calves while wintering along the west coast of Baja California and the southern Gulf of California. Young whales are dependent on their mothers for approximately one year before being weaned (Morris, personal communication 1988). Another western population once wintered near the coast of Korea and is now thought to be extinct (Lewbel, 1983). From late February to May, they migrate north and spend summer feeding in the shallow waters of the northern Bering Sea and Chukchi Sea. They enter through the Bering Strait as the pack ice breaks. Twenty-five to sixty percent of the migratory whales reach the Chukchi Sea by June (USDOI/MMS, 1987). As many as 200 whales have been reported in one sighting in the vicinity of Point Belcher during the summer. From 1982 to 1984, during July through October, 323 gray whales were seen generally within 8.5 miles of shore, feeding between Wainwright and Point Barrow. The farthest offshore sighting was of three feeding gray

whales approximately 105 miles northwest of Barrow in August. All cow/calf pairs were seen in July between Wainwright and Point Barrow and Cape Lisburne and Point Lay, within 2.5 miles of shore. These sightings may be an example of cow/calf segregation on the northern range, as has been reported on their southern range and along their migration route. The sale area appears to be important as a calf-rearing area. The southbound migration generally begins in mid-October. Although the distribution may vary from year to year, most gray whale sightings in the Chukchi Sea occur along the coast of the Chukchi Peninsula (Lewbel, 1983).

Gray whales are known to feed mainly on infaunal benthic amphipods, particularly Ampelisia macrocephala, in relatively shallow waters, and these feeding grounds usually contain extensive amphipod communities. The area between St. Lawrence Island and the Bering Strait is probably the most important feeding habitat for the eastern gray whale population (Lewbel, 1983). Gray whales are harvested by Soviets in the southwest Chukchi Sea and are occasionally harvested by Alaskans from Hope Basin, Wales, and Little Diomede.

Fin Whale

The North Pacific population of fin whales is estimated at 17,000 to 21,000 individuals, of which approximately 5,000 enter the Bering Sea during the summer (Morris, 1981b). The sale area is reported to be near the northern edge of the fin whale's known range. A total of 80 fin whales were sighted in the Gulf of Anadyr, the Bering Strait, and the Chukchi Sea between 1969 and 1978 (Votrogov and Ivashin, 1980). Fin whales feed in upwelling areas where prey species such as euphausiids, copepods, fish, and squid tend to concentrate.

Humpback Whale

The present North Pacific population of humpback whales is estimated to be 1,200 to 1,600 (Morris, 1981b). Occasional observations in the Chukchi Sea have been made during the ice-free summer months. As with the fin whale, the sale area is near the northern edge of the humpback whale's range. A total of 60 humpback whales were sighted in the Gulf of Anadyr, the Bering Strait, and the Chukchi Sea between 1969 and 1978 (Votrogov and Ivashin, 1980). Humpbacks feed on euphausiids, copepods, mysids, and small, schooling fishes.

12.2.6 Birds

Numerous species of seabirds, waterfowl, shorebirds, passerines, and raptors occur on the North Slope, adjacent to the sale area. Most of these species occur seasonally in the arctic from May through September. The most abundant of these include black-legged kittiwakes, arctic terns, glaucous gulls, Ross's gulls, common eiders, Pacific brant, oldsquaw, northern pintails, red phalaropes, semipalmated sandpipers, pectoral sandpipers, and dunlins. Gyrfalcons, ravens, and snowy owls are common along the coastal plain.

Offshore-feeding marine birds, including arctic terns, murres, guillemots, kittiwakes, and some gulls, prey mostly upon fish, and to a lesser extent, pelagic crustaceans. Nearshore feeders prey on various invertebrate fauna or graze on emergent vegetation. During nesting season, waterfowl and shorebirds feed in coastal salt marshes and tundra ponds.

One threatened bird species, the arctic peregrine falcon, occurs on the coastal area of the northern Chukchi Sea adjacent to the eastern boundary of the sale area during the summer season. The nearest known nest sites are south of Pt. Hope, south of the sale area. Peregrines have been observed at Capes Lisburne and

Sabine, and have been observed migrating in the area of Point Lay. Most peregrines in coastal northern Alaska occur east of the mouth of the Colville River. Peregrines in this area feed mostly on seabirds and shorebirds.

Important breeding habitats and migration routes of marine and coastal birds are discussed in Section 12.5, Important Breeding Habitats and Migration Routes.

12.3 Benthic Environment

The benthic environment of the Chukchi Sea is inhabited by communities of macroscopic algae or seaweeds, benthic microalgae, and benthic invertebrates. Benthic organisms are important components in the trophic interactions of the Chukchi Sea. Stands of macroscopic algae, such as kelp beds, can be important sources of primary production and provide a three-dimensional environment which supports a high diversity of organisms. Both infauna and epifauna serve as prey to higher-order consumers, including walruses, seals, whales, fishes and birds. A simplified food web of the Chukchi Sea coastal ecosystem is provided in Figure 12-2.

12.3.1 Macroscopic Algae

The limited information describing macroscopic algal communities in the Chukchi Sea indicate that at least two kelp beds are present along the nearshore coast. One is located about 12 miles northeast of Peard Bay, near Skull Cliff, and the other about 15 miles southwest of Wainwright in water depths of 35 to 50 feet. With the exception of these two, kelp beds are probably not common in the Chukchi Sea (USDOI/MMS, 1987). Species decribed from the kelp bed near Skull Cliff include Phyllaria dermatodea, Laminaria saccharina, Desmarestia viridis, and species of red

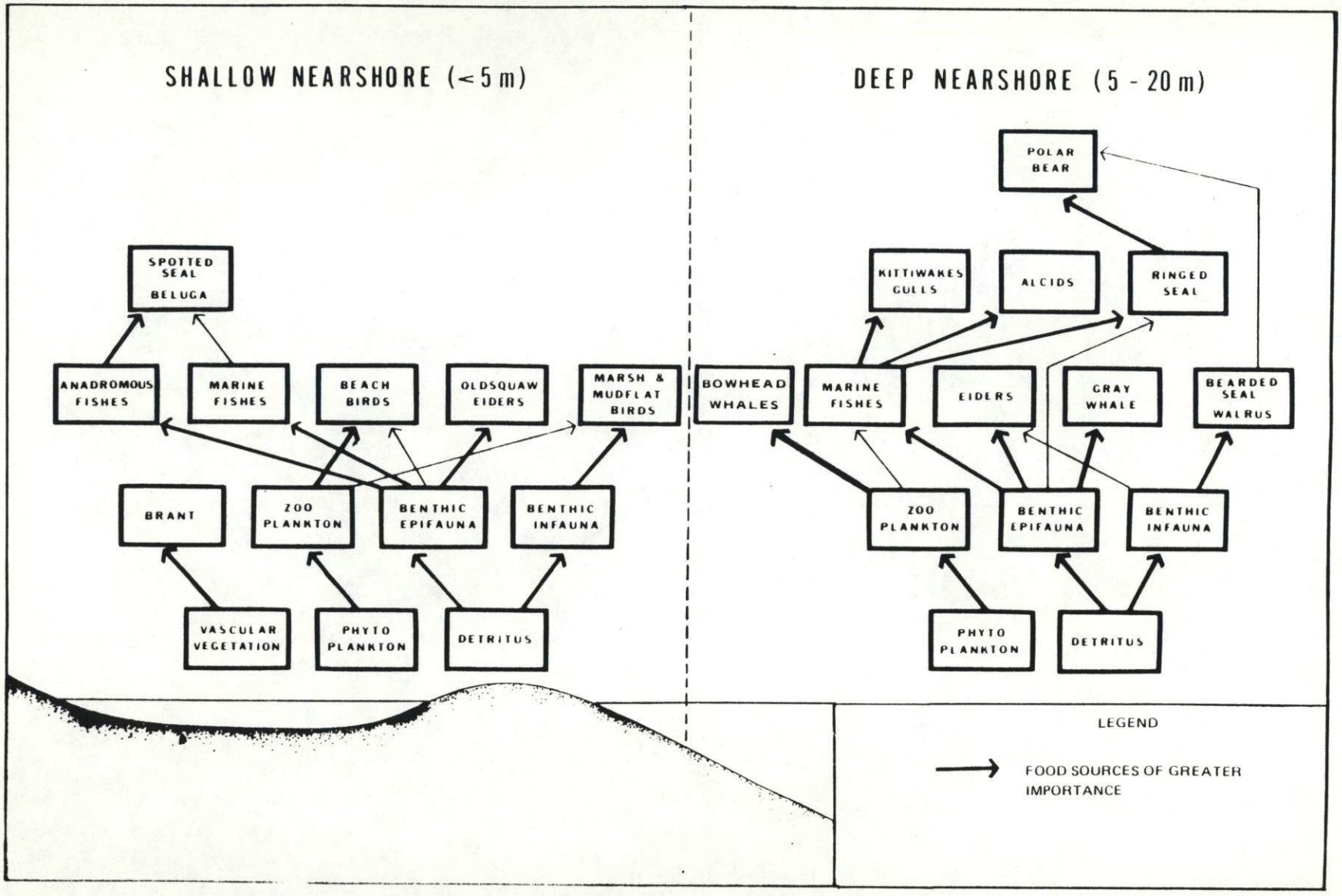


Figure 12-2. Simplified food web of the Chukchi Sea coastal ecosystem (USDOI/MMS 1987).

algae. The lack of appropriate substrates, such as rock and cobble, in the nearshore areas of the Chukchi Sea probably limits colonization by these organisms.

12.3.2 Benthic Microalgae

Benthic microalgae can be an important additional source of primary production, particularly when ice algae and phytoplankton communities are inactive. In the Chukchi Sea, benthic microalgae consist primarily of diatoms, some of which may be associated with ice algal assemblages (Matheke and Horner, 1974).

12.3.3 Benthic Invertebrates

The benthic invertebrate communities of the Chukchi Sea reportedly contain components of both the Bering Sea and the Beaufort Sea. Currents flowing northward through the Bering Strait carry larval forms (meroplankton) into the Chukchi Sea. Also in the northern Chukchi Sea, current reversals can bring in larvae and food from the Beaufort Sea (Kinney, 1985). Stoker (1981) reports greater biomass of benthic invertebrates in the most southerly region of the sale area and increasing species diversity with increasing latitude. These differences are apparently due to food availability. Sampling by Frost and Lowry (1983) in the northeastern Chukchi Sea indicated epifaunal communities dominated by brittle stars (Ophiura sarsi), along with soft corals (Eunephthya spp.) and sea cucumbers (Psolus sp.) in areas of muddy substrates, whereas rocky substrates supported other types of communities. Samples taken north of Point Hope included various echinoderms (starfish, echinoids, brittle stars, and sea cucumbers), gastropods, annelids, barnacles, decapod crustaceans, and tunicates (Sparks and Pereyra, 1966). The dominant epibenthic species of Peard Bay Lagoon noted by Kinney (1985) were isopods, mysids, and amphipods. Dominant infaunal species included bivalves in the deeper water, whereas polychaetes were abundant in the shallower areas. Patterns of

similarity of benthic fauna were analyzed by Stoker (1981), and two different statistical groups were indicated for the northeastern Chukchi Sea. The distribution of these groups is illustrated in Figure 12-3. One group (indicated as "Group VI" in Figure 12-3) was characterized by polychaete worms (Maldane sarsi), brittle stars (Ophiura sarsi), peanut worms (Golfingia margaritica), and clams (Astarte borealis). The second group (indicated as "Group VIII") was characterized by clams (Macoma calcarea, Nucula tenuis, Yoldia hyperborea) and amphipods (Pontoporeia femorata).

12.4 Endangered and Threatened Species

Several endangered or threatened species, as listed by the Federal Government, may occur in or adjacent to the sale area. These include the endangered bowhead whale (Balaena mysticetus), gray whale (Eschrichtius robustus), fin whale (Balaenoptera physalus), and humpback whale (Megaptera novaeangliae), and the threatened arctic peregrine falcon (Falco peregrinus tundrius). There are no listed endangered plant species in areas adjacent to the sale area.

12.5 Important Breeding Habitats and Migration Routes

Most, if not all, of the birds and marine mammals discussed in the previous sections utilize the sale area for breeding habitats, migration routes, or both. The following discussions summarize important areas where breeding habitats occur in the sale area, and times of the year when these areas are utilized. Also, migration routes of marine and coastal birds, and marine mammals which transect the sale area, are outlined.

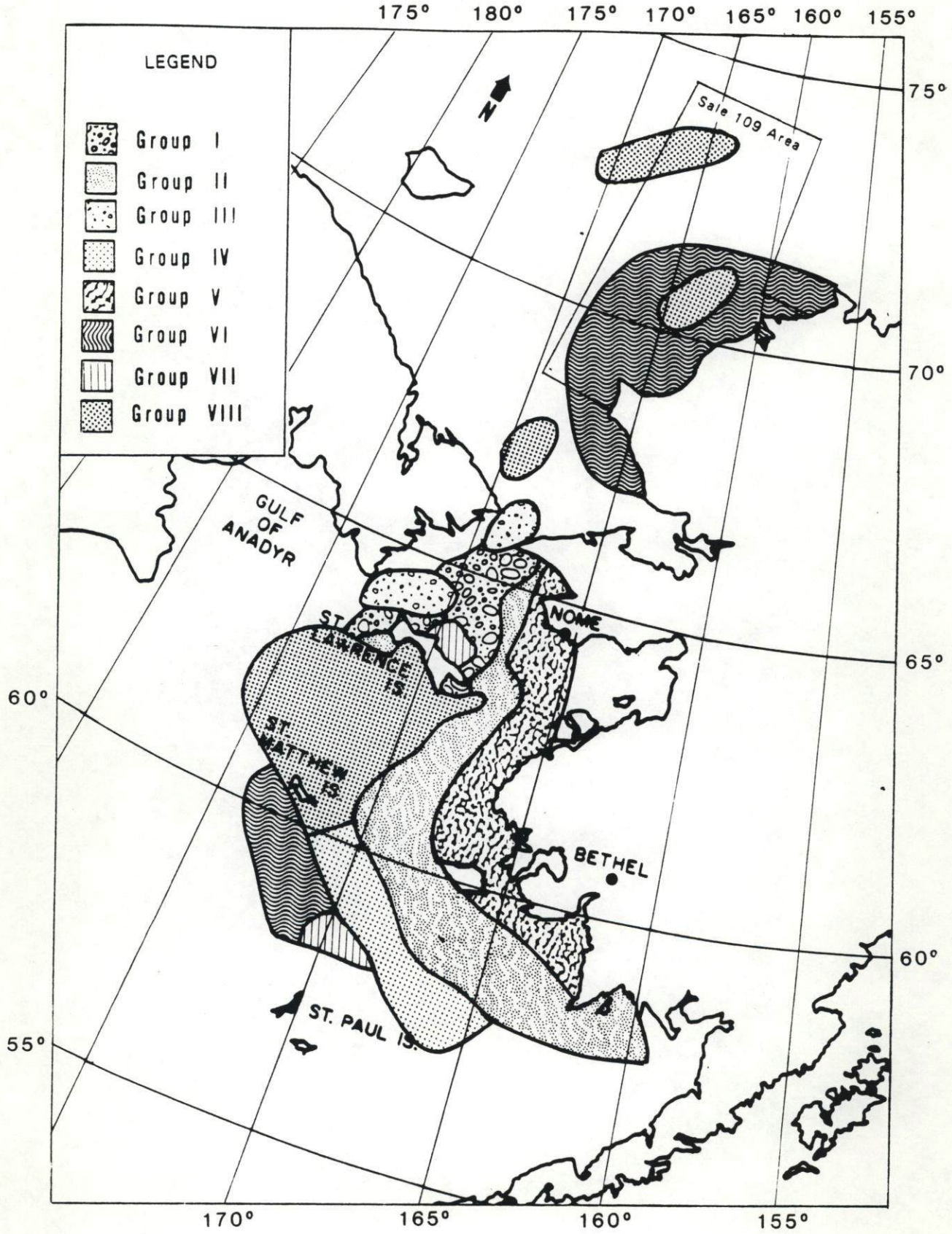


Figure 12-3. Patterns of similarity of benthic faunal groups (USDOI/MMS 1987).

12.5.1 Marine and Coastal Birds

Large concentrations of foraging seabirds are found within the southern portion of the sale area near the Cape Lisburne area. More than half a million seabirds nest along the Cape Lisburne to Pt. Hope area (Figure 12-4). The majority of nesting birds in this area are murres and kittiwakes. Cape Lisburne area, Kasegaluk Lagoon barrier islands, Icy Cape, Point Franklin, and Peard Bay barrier islands are part of the Alaska Maritime National Wildlife Refuge (Figure 12-4).

From July through September at Kasegaluk Lagoon, the Kuk River mouth, and Peard Bay, large concentrations of feeding and staging waterfowl and shorebirds are present (Conners et al., 1981; Lehnhausen and Quinlan, 1981; Gill et al,. 1985). Migration of waterfowl and shorebirds to the North Slope and the northern Chukchi Sea generally occurs from late May through June (Lehnhausen and Quinlan, 1981). A variety of offshore, coastal, and inland routes are used by various birds, depending upon spring ice conditions. The timing of migration is influenced by wind direction and the availability of open-water leads (Divoky, 1983). Waterfowl, such as Pacific brant and pintails, use the salt marshes in the Icy Cape area for feeding and resting during spring migration. Murres and kittiwakes frequent the Cape Lisburne area by mid-May. After spring migration, most shorebirds and waterfowl seek nesting grounds located on tundra and marshlands of the arctic slope. Barrier islands, such as Solivik Island along Kasegaluk Lagoon near Icy Cape and the Seahorse Islands of Peard Bay, are important areas for nesting arctic terns, common eiders, and black guillemots (Divoky, 1978).

Coastal routes are more common during fall migration in late August and September. Kasegaluk Lagoon and Peard Bay are important feeding and molting areas for waterfowl such as oldsquaw, common eiders, and Pacific brant prior to and during fall migration. The barrier island and spit beaches are

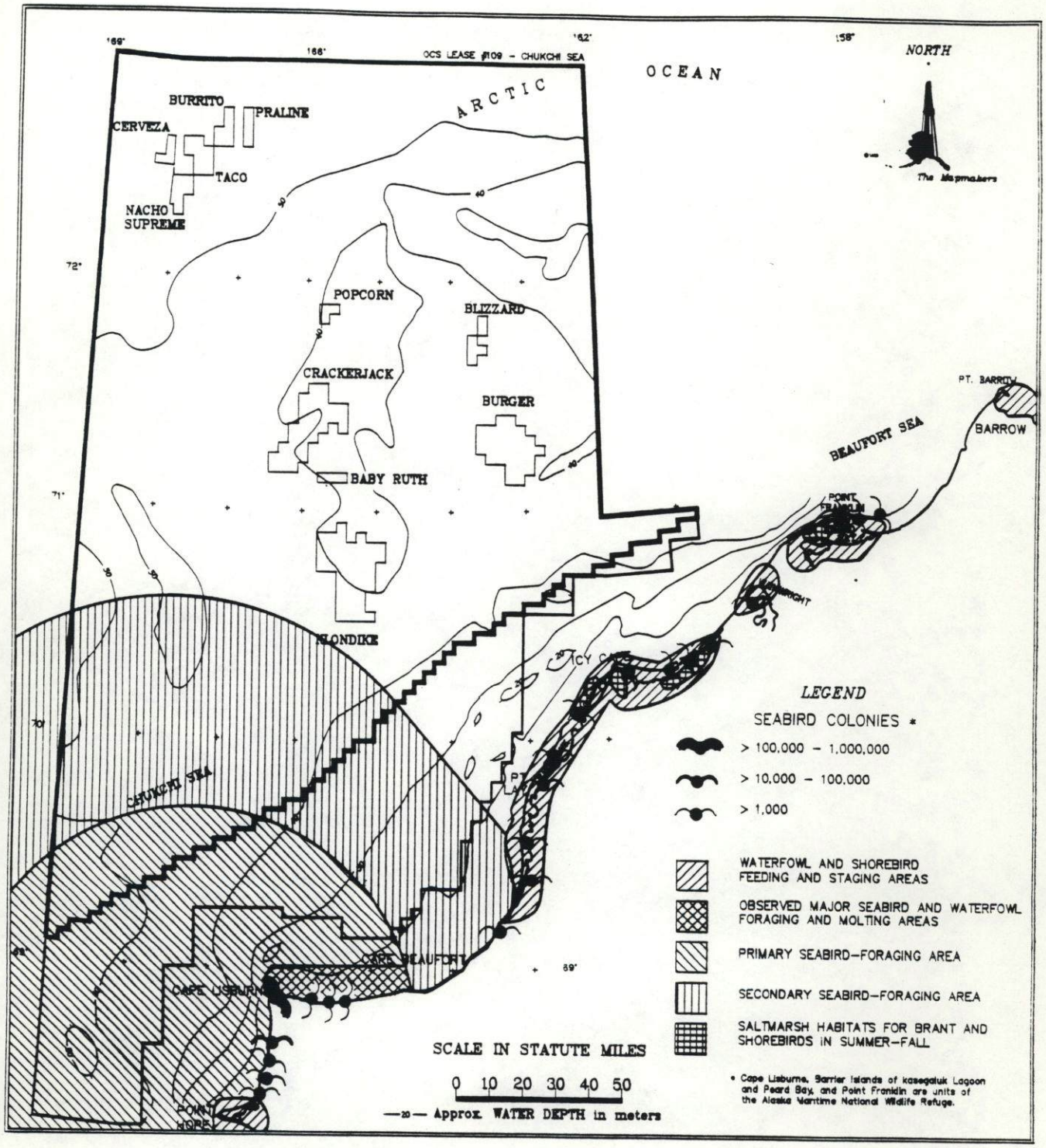


FIGURE 12-4. IMPORTANT HABITATS OF MARINE AND COASTAL BIRDS, USDOI/MMS (1987)

important staging and feeding areas for red phalaropes, arctic terns, and oldsquaw (Lehnhausen and Quinlan, 1981). Large numbers of murres raft on the water near Cape Lisburne prior to moving south.

12.5.2 Ringed Seal

Ringed seal abundance in the coastal areas of the Chukchi Sea is associated with the stability and extent of shorefast ice. This area is utilized as pupping habitat by the seals during spring. Pups are usually born in late March or April, followed by four to six weeks of nursing (Burns et al., 1981). During May, June, and early July, ringed seals molt--a period in which the seals are relatively inactive and spend much time basking on the ice (Eley and Lowry, 1978).

12.5.3 Bearded Seal

Bearded seals are generally found associated with ice throughout the year. Pupping occurs from late March through May on the ice, followed by twelve to eighteen days of nursing.

12.5.4 Spotted Seal

Spotted seals are found along the Chukchi Sea coast from June through October, migrating out of the area in the fall as the shorefast ice reforms and the pack ice advances (Figure 12-5). They spend winter and spring along the ice front in the Bering Sea where breeding, pupping, and molting occur (Frost et al., 1983).

12.5.5 Pacific Walrus

Most of the North Pacific walrus population follow the moving pack ice, migrating into the Chukchi Sea during the summer (Fay 1982). Spring migration usually begins in April, with most of

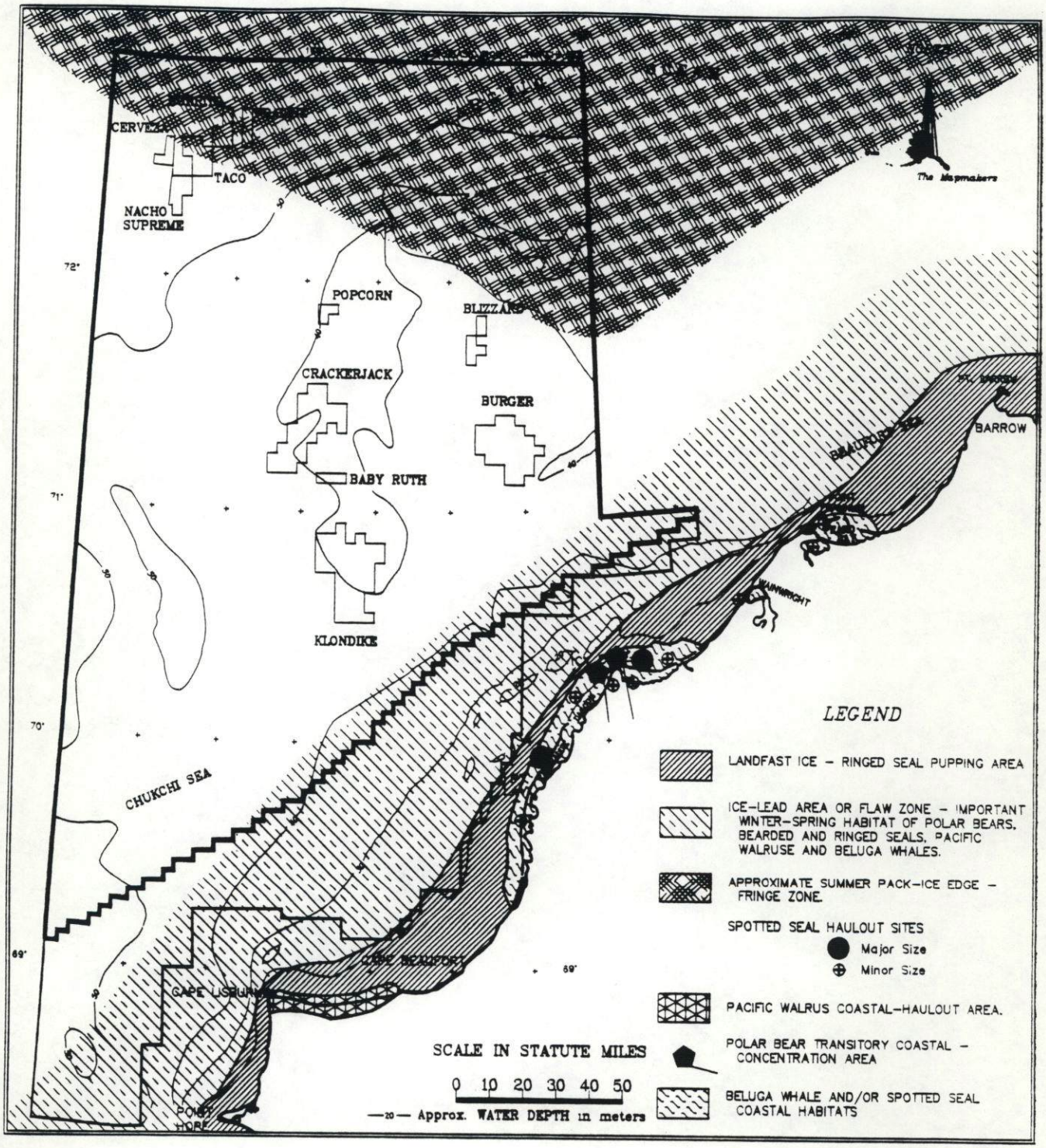


FIGURE 12-5. IMPORTANT HABITATS OF PINNIPEDS, POLAR BEARS, AND BELUGA WHALES, USDOI/MMS (1987)

the walrus moving through the Bering Strait by late June. The Chukchi Sea is summer feeding habitat for all adult females with calves. A few hundred walrus are reported to occasionally haul-out on land between Capes Lisburne and Beaufort during the summer and fall (Figure 12-5). As the pack ice advances south during October through December, most of the population migrates south of the Bering Strait. Solitary walrus may overwinter in the Chukchi Sea and the eastern Beaufort Sea (Fay, 1982).

12.5.6 Polar Bear

The seasonal distribution and local abundance of polar bears in the Chukchi Sea undergoes substantial variation, as influenced by sea ice and food availability (Figure 12-5). From October to March, polar bears generally can be found along the shore of the Chukchi Sea, when shorefast ice allows travel from the pack ice to the beach. Since polar bears can swim several miles in open water, they can be found in coastal areas year-round. Two polar bear concentrations are located at Icy Cape and Point Franklin (Davis and Thomson, 1984). Polar bear dens are typically found on offshore islands and some mainland areas. Pregnant females come to denning areas in late October or November. Offspring are born from early December to late January (Lentfer and Hensel 1977). Females and cubs break out of the dens in March and April.

12.5.7 Beluga Whale

An estimated 11,500 beluga whales migrate through the Chukchi Sea sale area between March and July. Most of the migration routes through ice leads are similar to those of the bowhead whale. Kasegaluk Lagoon is an important beluga whale habitat area adjacent to the sale area (Figure 12-5). Some calving may occur here during the summer. During fall migration in September and

October, belugas pass through the Chukchi Sea. The nearshore habitats of the Chukchi Sea serve as feeding and calving areas (Moulton and Bowden, 1981).

12.5.8 Bowhead Whale

The western arctic stock of bowhead whales migrate through the sale area during March through June, then again during fall migration in September through November. Spring migration routes follow ice leads in the flaw zone. Fall migration generally follows the shoreline between Point Barrow and Wainwright, or from Point Barrow across the Chukchi Sea toward Wrangel Island (Figure 12-6). Bowheads may also calve, mate, and feed within the sale area. Calving occurs from March through August (USDOI/MMS, 1987).

12.5.9 Gray Whale

Gray whales pass through the sale area during the summer and fall migrations (Figure 12-7). In spring, most individuals pass through the Chukchi Sea area by June (Berzin, 1984). Feeding whales have been reported between Point Hope and Point Barrow during July through October (Moore et al., 1986). All cow/calf pairs have been seen between Wainwright and Point Barrow, and Cape Lisburne and Point Lay, within 2.5 miles of shore. The sale area is reportedly an important calf-rearing area for the gray whale (Johnson et al., 1981).

The location of preferred feeding areas in the northeastern Chukchi Sea is not known. Studies have indicated that particular substrate types and high concentrations of Ampeliscid amphipods correspond to the summer distribution of gray whales. These areas are characterized by burrows or pits in the seafloor formed by feeding whales (Johnson et al., 1983).

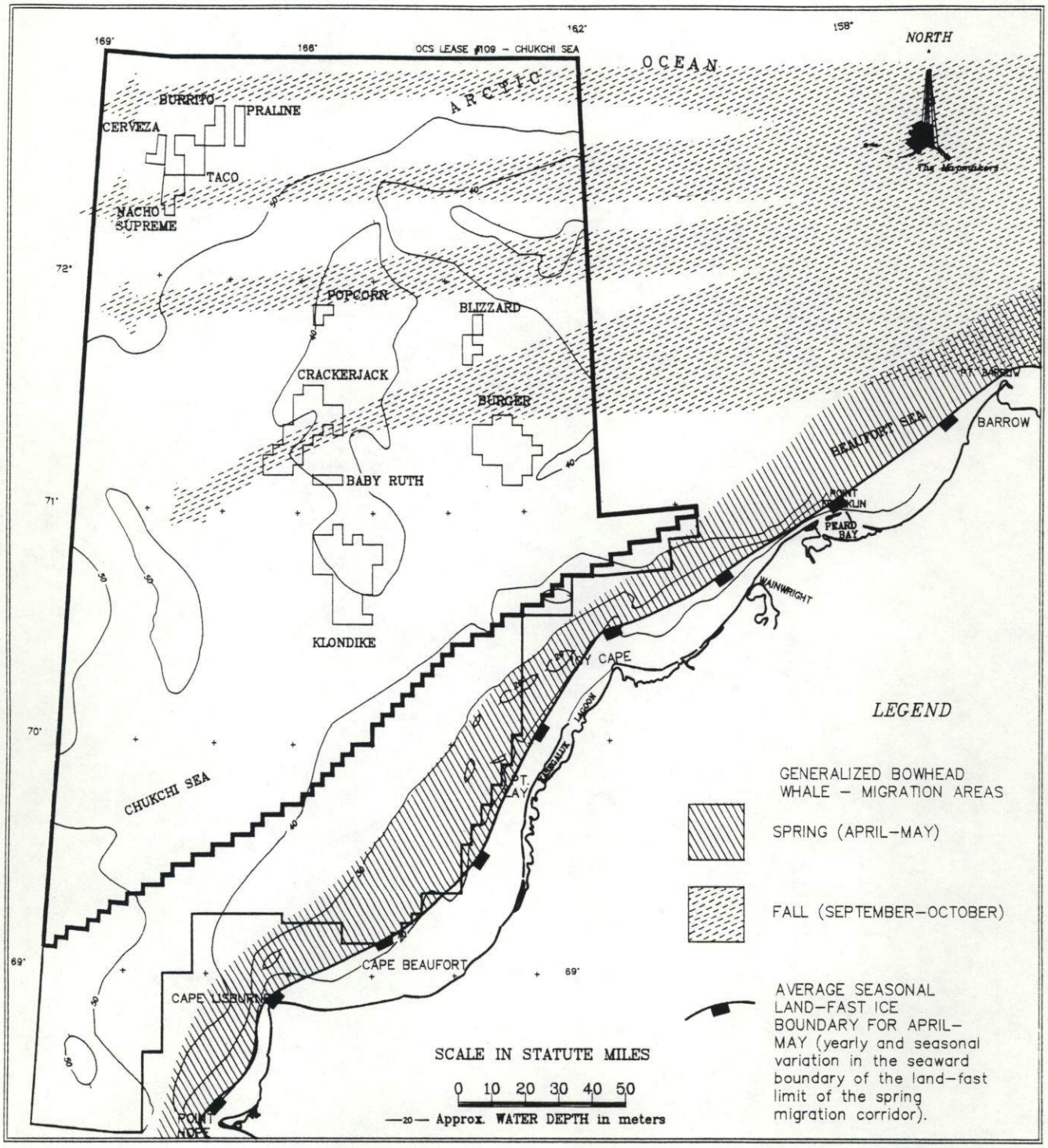


FIGURE 12-6. BOWHEAD WHALE MIGRATION AREAS

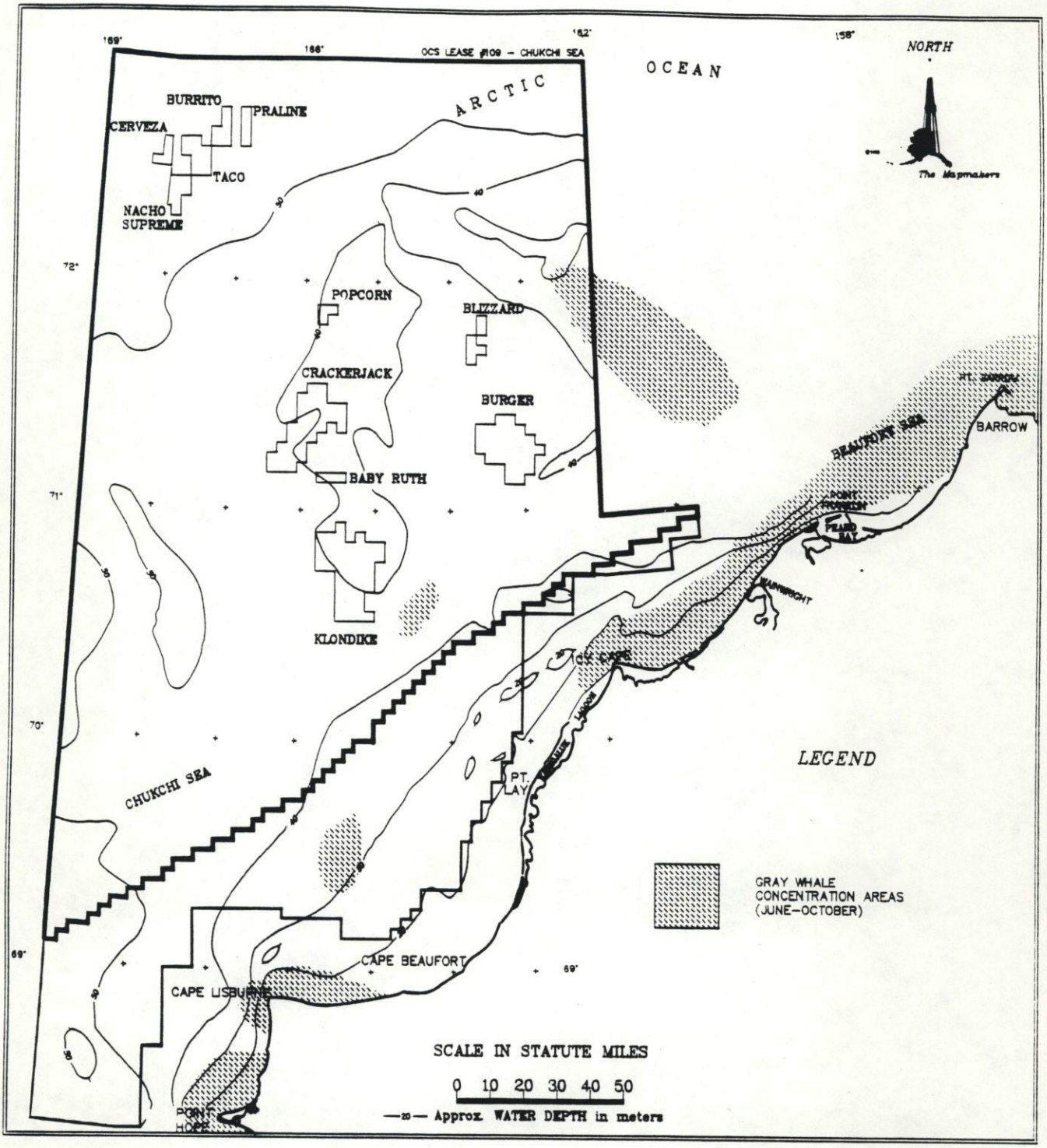


FIGURE 12-7. GRAY WHALE CONCENTRATION AREAS, USDOI/MMS (1987)

12.5.10 Fin Whale

Fin whales have occasionally been observed in the Chukchi Sea during the ice-free summer months of late June through October. The sale area is reported to be the approximate northern edge of their range.

12.5.11 Humpback Whale

Humpback whales have also been observed in the Chukchi Sea on occasion during the ice-free summer months. Again, this area is reportedly the northern boundary of their range.

REFERENCES

ADF&G. 1981. Biological Resource Information - Barrow Arch Planning Area.

Amstrup, S. C. 1983. Marine Mammals--Polar Bears. In: Proceedings of a Synthesis Meeting: Beaufort Sea (Sale 87), Chena Hot Springs, AK, January 25-28, 1983, W. M. Sackinger, G. Weller, and S. T. Zimmerman, eds. Anchorage, AK: USDOC, NOAA, OCSEAP, and USDOI, MMS.

Berzin, A. A. 1984. Soviet Studies of the Distribution and Numbers of the Gray Whale in the Bering and Chukchi Seas, 1968-1982. In: The Gray Whale (Eschrichtius robustus), J. L. Jones, S. L. Swartz, and S. Leatherwood, eds. New York, NY: Academic Press, Inc.

Braham, H. W., C. Fiscus, and D. Rugh. 1977. Marine Mammals of the Bering and Southern Chukchi Seas, Vol. 1., Receptors-Mammals. Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators. Boulder, CO: USDOC, NOAA, OCSEAP, pp. 1-92.

Burns, J. J. 1981. Population Status of Certain Marine Mammals in Waters Adjacent to Alaska. Unpublished report prepared by the State of Alaska, ADF&G, Div. of Game, Marine Mammals Coordinator.

Burns, J. J., B. P. Kelly, and K. J. Frost. 1981. Studies of Ringed Seals in the Beaufort Sea During Winter. Environmental Assessment of the Alaskan Continental Shelf. Executive Summary, Biological Studies, RU 232. Boulder, CO: USDOC, NOAA, OCSEAP.

Carey, A. G., ed. 1978. Marine Biota (Plankton/Benthos/Fish). Interim Synthesis: Beaufort/Chukchi. Environmental Assessment of the Alaskan Continental Shelf. Boulder, CO: USDOC, NOAA, OCSEAP, pp. 174-237.

Connors, P. G., C. S. Connors, and K. G. Smith. 1981. Shorebird Littoral Zone Ecology of the Alaskan Beaufort Sea Coast. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, Vol. I., Biological Studies, RU 172. Boulder, CO: USDOC, NOAA, OCSEAP.

Coyle, K. O. 1981. The Oceanographic Results of the Cooperative Soviet-American Cruise to the Chukchi and East Siberian Seas Aboard the Soviet Whaling Ship Razyashchii, September-October 1980. University of Alaska, Institute of Marine Science Report, 13 pp.

Craig, P. C. 1984. Fish Resources. In: Proceedings of a Synthesis Meeting: The Barrow Arch Environment and Possible Consequences of Planned Offshore Oil and Gas Development, Girdwood, Alaska, October 30-November 1, 1983. Anchorage, AK: USDOC, NOAA, OCSEAP, and USDOI, MMS, pp. 240-266.

Craig, P. C. and P. Skvorc. 1982. Fish Resources of the Chukchi Sea, Status of Existing Information and Field Program Design. Prepared for USDOC, NOAA, OCSEAP, Arctic Project Office, Fairbanks, AK, 56 pp.

Davis, R. A. and D. H. Thomson. 1984. Marine Mammals. Chapter 4. In: Proceedings of a Synthesis Meeting: The Barrow Arch Environment and Possible Consequences of Planned Offshore Oil and USDOC, NOAA, OCSEAP, and USDOI, MMS, pp. 47-79.

Divoky, G. J. 1978. Breeding Bird Use of Barrier Island in North Chukchi and Beaufort Seas. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, RU 3/4. Boulder, CO: USDOC, NOAA, OCSEAP, and USDOI, BLM.

Divoky, G. J. 1983. The Pelagic and Nearshore Birds of the Alaskan Beaufort Sea. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, RU 196. USDOC, NOAA, OCSEAP, and USDOI, MMS.

Eley, T. and L. Lowry. 1978. Marine Mammals. In: Interim Synthesis, Beaufort/Chukchi. Environmental Assessment of the Alaskan Continental Shelf. Boulder, CO: USDOC, NOAA, OCSEAP.

English, T. S. 1966. Net Plankton Volumes in the Chukchi Sea. In: Environment of the Cape Thompson Region, Alaska, N. J. Willimovsky and J. N. Wolfe, eds. Oak Ridge, TN: USDOC, Atomic Energy Commission, Div. of Technical Information, pp. 809-815.

Fay, F. H. 1982. Ecology and Biology of the Pacific Walrus, Odobenus rosmarus divergens Illiger. North American Fauna (74). USDOI, FWS, 277 pp.

Fechhelm, R. G., P. C. Craig, J. S. Baker, and B. J. Gallaway. 1984. Fish Distribution and Use of Nearshore Waters in the Northeastern Chukchi Sea. Bryan, TX: LGL Ecological Research Associates, Inc.

Frost, K. J., L. F. Lowry, and J. J. Burns. 1983. Distribution of Marine Mammals in the Coastal Zone of the Eastern Chukchi Sea During Summer and Autumn. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, RU 613. Boulder, CO: USDOC, NOAA, OCSEAP, and USDOI, MMS.

Gill, R., C. Handel, and P. Connors. 1985. Bird Utilization of Peard Bay and Vicinity. In: Environmental Characterization and Biological Utilization of Peard Bay, P. Kinney, ed. Prepared for USDOC, NOAA, OCSEAP, and USDOI, MMS, by Kinnetic Labs, Inc., Anchorage, AK.

Gusey, W. F. 1983. Bowhead. Environmental Affairs, Shell Oil Company, Houston, Texas.

International Whaling Commission. In Press (1988). Report to the International Whaling Commission, Report of Scientific Committee of Proceedings.

Johnson, J. H., H. W. Braham, B. D. Krogman, W. M. Marquette, R. M. Sonntag, and D. J. Rugh. 1981. Bowhead Whale Research: June 1979 to June 1980. Report of the International Whaling Commission 31:461-475.

Johnson, K. W., C. H. Nelson, and H. L. Mitchell. 1983. Assessment of gray whale feeding grounds and sea floor interaction in the northeastern Bering Sea. NOAA. U.S. Department of Commerce. OCSEAP Final Report. 43(1986):1-161.

Kinney, P. J. ed. 1985. Environmental Characterization and Utilization of Peard Bay. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators for the year ending December 1985, Vol. 35, RU 641. Anchorage, AK: USDOC, NOAA, OCSEAP, pp. 97-440.

Lehnhausen, W. A. and S. E. Quinlan. 1981. Bird Migration and Habitat Use at Icy Cape, Alaska. USDOI, FWS, Office of Special Studies, Anchorage, AK. Unpublished manuscript.

Lentfer, J. and R. Hensel. 1977. Alaska Polar Bear Denning. In: Papers Presented at Fourth International Conference on Bear Research and Management.

Lewbel, G. S. (ed.). 1983. Bering Sea Biology: An evaluation of the environment database related to Bering Sea oil and gas exploration and development. LGL Alaska Research Associates, Inc., Anchorage, Alaska and SOHIO Alaska Petroleum Company, Anchorage, Alaska.

Lowry, L. F. and K. J. Frost. 1984. Foods and Feeding of Bowhead Whales in Western and Northern Alaska. Scientific Reports of the Whales Research Institute 35:1-16.

Matheke, G. and R. Horner. 1974. Primary Productivity of Benthic Microalgae in the Chukchi Sea Near Barrow, Alaska. Journal of the Fisheries Research Board of Canada 31:1,779-1,786.

Moore, S. E., J. T. Clarke, and D. K. Ljungblad. 1986. A Comparison of Gray Whale (Eschrichtius robustus) and Bowhead Whale (Balaena mysticetus) Distribution, Abundance, Habitat Preference and Behavior in the Northeastern Chukchi Sea, 1982-1984. Report of the International Whaling Commission 36:273-279.

Morris, B. F. 1981a. Living Marine Resources of the Chukchi Sea: A Resource Report for the Chukchi Sea Oil and Gas Lease Sale No. 85. NOAA Technical Memo NMFS F/AKR-2. Anchorage, AK: USDOC, NOAA, NMFS.

Morris, B. F. 1981b. An Assessment of the Living Marine Resources of the Central Bering Sea and Potential Resource Use Conflicts Between Commercial Fisheries and Petroleum Development in the Navarin Basin, Proposed Sale No. 83. NOAA Technical Memo NMFS F/AKR-4. Anchorage, AK: USDOC, NOAA, NMFS.

Morris, B. F. 1988. National Marine Fisheries Service, Anchorage, Alaska. Personal Communication October 12.

Moulton, L. L. and C. F. Bowden. 1981. Resource Report for the Proposed Chukchi Basin OCS Oil and Gas Lease Sale 85. State of Alaska, ADF&G, Marine/Coastal Habitat Management.

Rugh, D. J. 1984. Census of Gray Whales at Unimak Pass, Alaska: November-December 1977-1979. In: The Gray Whale (Eschrichtius robustus), J. L. Jones, S. L. Swartz, and S. Leatherwood, eds. New York, NY: Academic Press, Inc.

Sambrotto, R. N., J. J. Goering, and C. P. McRoy. 1984. Large Yearly Production of Phytoplankton in the Western Bering Strait. Science 255:1,147-1,150.

Seaman, G. A., K. J. Frost, and L. F. Lowry. 1985. Investigations of Belukha Whales in Coastal Waters of Western and Northern Alaska. Part I: Distribution, Abundance and Movements. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, RU-612. Prepared for USDOC, NOAA, and USDOI, MMS, 60 pp.

Schell, D. M. 1986. Primary Production and Nutrient Dynamics in the Chukchi Sea. Brief report for the Chukchi Sea Update Meeting, March 27, 1986. Unpublished.

Smith, T. G. 1980. Polar Bear Predation of Ringed and Bearded Seals in the Landfast Sea Ice Habitat. Canadian Journal of Zoology 58:2,201-2,209.

Sparks, A. K. and W. T. Pereyra. 1966. Benthic Invertebrates of the Southeastern Chukchi Sea. In: Environment of the Cape Thompson Region, Alaska, N. J. Wilimovsky and J. N. Wolfe, eds. USDOC, Atomic Energy Commission, Div. of Technical Information, Oak Ridge, TN, pp. 817-838.

Stoker, S. W. 1981. Benthic Invertebrate Macrofauna of the Eastern Bering/Chukchi Continental Shelf. In: The Eastern Bering Sea Shelf: Oceanography and Resources, Vol. 1, D. W. Hood and J. A. Calder, eds. USDOC, NOAA, Office of Marine Pollution Assessment. Seattle, WA: Distributed by the University of Washington Press, pp. 1,069-1,090.

U.S. Department of the Interior/Minerals Management Service. 1987. Alaska Outer Continental Shelf Chukchi Sea Oil and Gas Lease Sale 109. Final Environmental Impact Statement. Alaska OCS Region. Vol. 1 and 2.

Votrogov, L. M. and M. V. Ivashin. 1980. Sightings of Fin and Humpback Whales in the Bering and Chukchi Seas. Report of the International Whaling Commission 30:247-248, SC/31/Doc 20.

ATTACHMENT 13

13. ENVIRONMENTALLY SENSITIVE AREAS

13.1 General

Environmentally sensitive areas are categorized into two sections: 1) identified preserves set aside by statute and 2) sensitive areas recognized by areawide studies not segregated by statute. Both areas are discussed below.

13.2 Statute Mandated Areas

These areas are recognized sensitive areas with defined geographic boundaries established by various statutes. The OCS Lease Sale Area 109, Chukchi Sea, Alaska identifies three such areas; the Cape Krusenstern National Monument, the Alaska Maritime National Wildlife Refuge, and the Bering Land Bridge National Preserve. These areas lie well outside the proposed SWEPI activity zones, and thus will be impacted minimally by the proposed activities.

13.3 Areawide Study Areas

These areas are characterized by observed biological activity occurring over relatively undefined geographic boundaries. Examples include:

- Bowhead whale spring and fall migration routes
- Gray whale migration and feeding grounds
- Beluga whale migration, feeding, and calving areas
- Seal, walrus, and polar bear migration areas
- Migratory bird nesting areas.

Less defined environmentally sensitive areas include the barrier island groups and the wetland areas.

The proposed SWEPI offshore and onshore exploration activities are expected to have a minimal impact on these less geographically defined environmentally sensitive areas. A detailed discussion of these areas is presented under Section 12 and in the Environmental Impact Statement prepared by the Minerals Management Service for the OCS Lease Sale Area 109, Chukchi Sea, Alaska.

REFERENCES

U.S. Fish and Wildlife Service. 1988. Alaska Maritime National Wildlife Refuge Summary. Final Comprehensive Plan and Environmental Impact Statement. Anchorage, Alaska.

ATTACHMENT 14

14. USE CONFLICTS

Exploration activities in the proposed REMOTE OFFSHORE PROSPECTS are not anticipated to impact subsistence hunting and fishing, due primarily to the extreme remoteness of the lease blocks from traditional subsistence harvest areas. Air support operations from Barrow will occur during summer and early fall in subsistence harvest areas immediately adjacent to Barrow. Accordingly, flight operations schedules will be prepared which will limit impact by maintaining a minimum 1,500 foot operating limit and, where possible, a one-mile horizontal separation from specific harvest areas.

Other on-site uses such as commercial fishing, recreation, mineral exploration, and military use were not found to occur at the proposed drilling sites.

Exploration activities are expected to occur during late June through early November, which coincides with traditional harvest periods for most groups of marine mammals and migratory waterfowl. Owing to the remoteness of the REMOTE OFFSHORE PROSPECTS to traditional subsistence hunting areas used by the local coastal residents, individual and cumulative impacts are considered minimal. However, SWEPI proposes to undertake measures to reduce even minimal impacts, as presented in Attachment 15, Archaeological and Cultural Resources.

ATTACHMENT

15

15. ARCHAEOLOGICAL AND CULTURAL RESOURCES

15.1 Archaeological Resources

Archaeological resources in the lease area include objects or factors generally man-made or modified by human activity, are usually older than 50, years and are classified as either historic or prehistoric. The lease area is subdivided into two resource areas: a) offshore - i.e., seaward from the three-geographical-mile line and b) onshore - i.e., landward from the three-geographical-mile line.

Offshore historical archaeological resources within the lease area could include shipwrecks, abandoned whaling-era equipment and, possibly, Eskimo artifacts. A review of the available side scan sonar records indicate that no features suggestive of archaeological sites (i.e., ship wrecks) are present within SWEPI's REMOTE OFFSHORE PROSPECTS examined to date. Side scan sonar records for additional exploration sites will be reviewed for archaeological resources as the data become available.

Onshore archaeological sites are numerous adjacent to the operations area. They occur particularly along coastal areas, inland along rivers, and at selected upland areas. The proposed onshore support facilities will be stationed at existing camp facilities and, as such, no adverse impact to local identified archaeological sites would be incurred.

15.2 Cultural Resources

Cultural resources involve the Inupiat Eskimo's relationship with natural resources (particularly game animals), their nuclear and extended families, and spiritual beliefs (particularly animal spirits). The cultural resources comprise a tightly woven interdependency among the people, the land, the sea, and the animal life.

Impacts to cultural resources can be geographically centralized to the major areas of operation: 1) offshore drilling; 2) onshore support; and 3) support transportation, both aerial and marine.

Much concern has been raised over the years regarding the possible adverse impacts of offshore oil and gas exploration on the traditional cultural resources of the area. The largest single concern regards the impact to subsistence whaling activities. Secondly, concerns may also include impacts to fisheries, cultural land use areas, and land mammal migrations.

Comprehensive analysis of the Beaufort offshore exploration activities has served as a model for expected Chukchi Sea offshore exploration activities. Minimal impact to seasonal whale migration and feeding zones is anticipated as a direct result of exploratory drilling activities (USEPA, 1988). Consequently, the cultural impacts, particularly those related to subsistence whaling, are considered to be minimal. However, SWEPI has taken further steps to reduce even minimal adverse impacts. These steps include:

- Barrow's existing facilities will be used for all primary air logistics support.
- Kotzebue will provide marine support when required.
- Kuparuk, Deadhorse, and Umiat will be utilized as secondary air logistics support bases.
- Except for emergencies, no direct support facilities are planned at Wainwright, Point Hope, and Point Lay. This will minimize onshore activities near all identified environmentally sensitive areas.
- Air and marine transportation routes will be selected to minimize adverse effects on subsistence resources and activities.
- Drilling and seismic activities will be conducted from June through November. This will postpone rig startup until after the spring bowhead migration.

- Exploration activities will be minimized within identified beluga, walrus and other marine mammal feeding grounds.

- The drilling support vessels will employ a state-of-the-art ice management procedures.

- A life-saving capability will exist through the availability of the medic on the drillship and helicopter support.

- Offering four native residents from each of the four villages training and employment opportunities for various drillship, support vessel, and oil spill response duties.

SWEPI recognizes the critical importance of local cultural resources and has taken early steps to identify key local cultural resource concerns and has prepared exploration plans with strong considerations for North Slope resident concerns.

REFERENCES

U.S. Environmental Protection Agency (USEPA), 1988. Ocean Discharge Criteria Evaluation for Chukchi Sea OCS Oil and Gas Lease Offering 109. Final Report prepared by USEPA-Region X, Cooper Consultants, Inc., and Envirosphere Company.

ATTACHMENT 16

16. ENVIRONMENTAL DATA MONITORING

SWEPI will monitor and report data on meteorological, oceanographic, and vessel response as specified in the Notice to Leasors (NTL). These monitoring activities, as outlined on Table 16-1, will be conducted at no greater than 3-hour intervals, with the exception of ice condition and current. Ice conditions will be reported daily. Current speed and direction will, at a minimum, be monitored hourly for a 12-hour period during each month of operation. Trained observers and calibrated instrumentation will be used.

Any weather, sea conditions, or ice conditions exerting severe or unusual impact on performance parameters, as well as those aspects of performance affected, will be reported.

Logs such as illustrated on Figure 16-1 (Minerals Management Service reporting form) and Figure 16-2 (National Weather Service Form MF1-10C) and data printouts will be submitted to the Regional Supervisor, Field Operations (RSFO) on a weekly basis. Practical performance data, and other data which are considered confidential, will be submitted separately.

A summary report, containing all meteorological, oceanographic, and performance information, will be submitted to the RSFO within 30 days following completion of the well.

Table 16-1. Summary of parameters for environmental monitoring.

Type of Parameter	Parameters	Units	Measurement Interval
Meteorology	Wind direction	°True	3 hr
	Average wind speed	knots	3 hr
	Maximum wind gust	knots	3 hr
	Barometric pressure	mb,in	3 hr
	Wet bulb temperature	°F	3 hr
	Dry bulb temperature	°F	3 hr
	Dewpoint	°F	3 hr
	Relative humidity	%	3 hr
	Precipitation type	-	3 hr
	Precipitation amount	inch	3 hr
	Percent cloud cover and type	%	3 hr
	Ceiling elevation	ft	3 hr
	Visibility range	mi	3 hr
	Visibility obstructions	-	3 hr
Oceanography	Significant wave height	ft	3 hr
	Maximum wave height	ft	3 hr
	Wave period	sec	3 hr
	Sea direction	°True	3 hr
	Current speed	knots	Monthly
	Current direction	°True	Monthly
	Ice type	-	Daily
	Percent ice coverage	%	Daily
	Ice thickness	ft	Daily
	Ice pressures	psi	Daily
	Ice movement direction	°True	Daily
	Ice movement speed	knots	Daily
Vessel Performance	Vessel heave	ft	3 hr
	Vessel pitch	deg	3 hr
	Vessel roll	deg	3 hr
	Vessel offset	deg,ft	3 hr
	Anchor tensions (8)	kips	3 hr
	Vessel center of gravity	-	3 hr
	Vessel draft	ft	3 hr
	Vessel heading	°True	3 hr

SUGGESTED METEOROLOGICAL, OCEANOGRAPHIC & VESSEL PERFORMANCE DATA FORM

(24 HOURS)

Operator Shell Western E & P Inc.

Location _____

Lease & Well No. _____

Rig Canmar Explorer III

Date _____

Vessel Heading _____

	BAR PRES	AIR TEMP	WIND			CLOUD COVER	SURF VIS	SEA SURF TEMP	PRE-CIP	WAVES				SWELL				ICE COND	VESSEL MOTION					ANCHOR TENSIONS								BALLAST DEPTH	KG
			SPD	DIR	GUST					SIG	MAX	DIR*	PER*	HT	DIR*	PER*			HEAVE	PITCH	ROLL	% OFF-SET	RISER ANG	1	2	3	4	5	6	7	8		
	*	*	*	*	*	*	*	*																Av/Max**	Av/Max**	Av/Max**	Av/Max**	Av/Max**	Av/Max**	Av/Max**	Av/Max**		
0300																																	
0600																																	
0900																																	
1200																																	
1500																																	
1800																																	
2100																																	
2400																																	
	IN HG	°F	MPH	COMP HEAD	MPH	0-10	MILES	°F	IN	FT	FT	COM HD	SEC	FT	COM HD	SEC	DESCR	FT	DEG	DEG	% OF WATER DEPTH	DEG	KIPS									

* Instantaneous Maximum for One Minute

** Record Maxima and Three-Hour Average

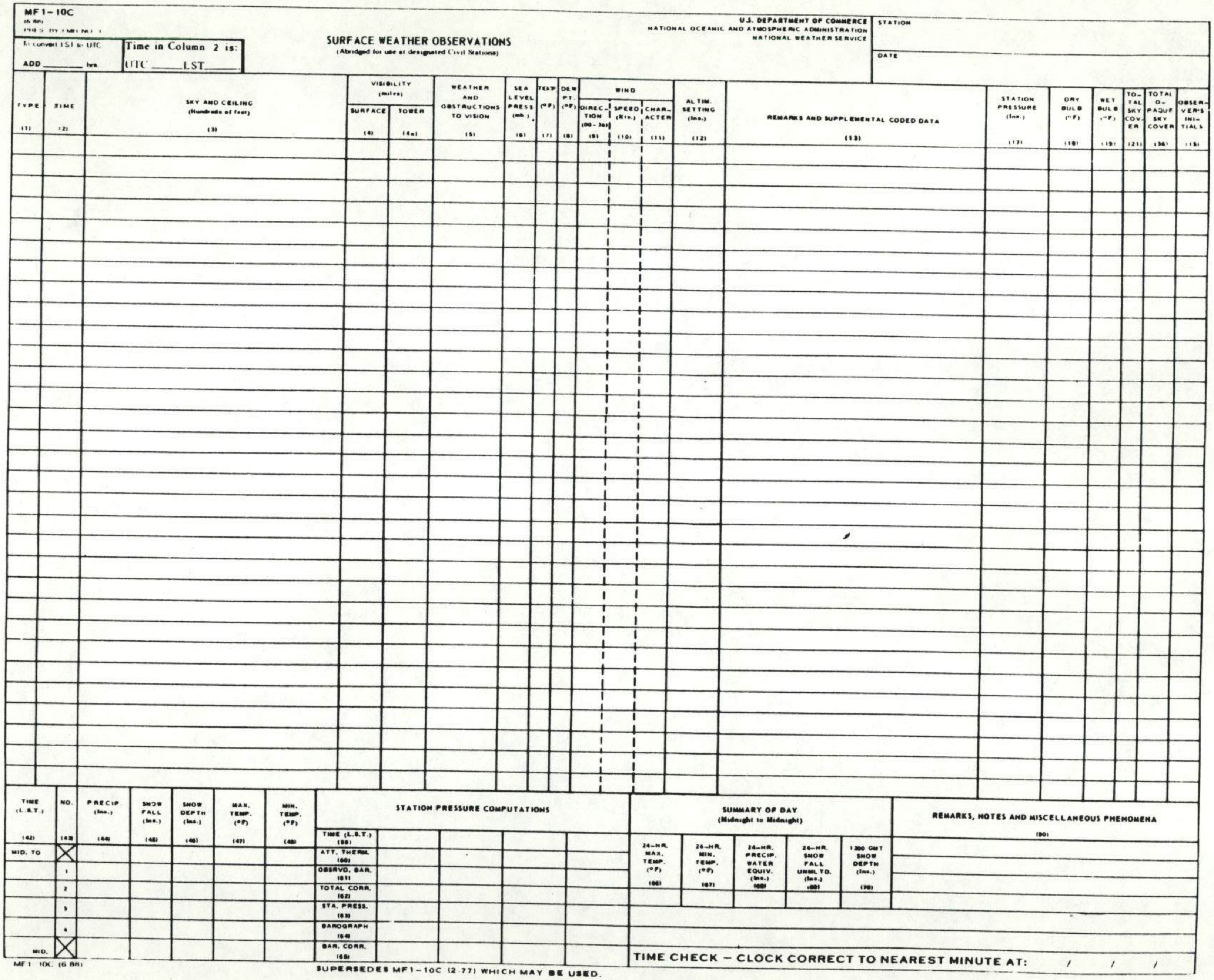
Anchor Pattern Sketch:

Remarks _____

_____

_____

Figure 16-1. Minerals Management Service Data Reporting Form.



MF1-10C
(6-88)

To convert LST to UTC ADD ______ hrs.

Time in Column 2 is: UTC ______ LST ______

SURFACE WEATHER OBSERVATIONS
(Abridged for use at designated Civil Stations)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

STATION

DATE

TYPE (1)	TIME (2)	SKY AND CEILING (Hundreds of feet) (3)	VISIBILITY (miles) SURFACE (4)	TOWER (4a)	WEATHER AND OBSTRUCTIONS TO VISION (5)	SEA LEVEL PRESS (mb.) (6)	TEMP (°F) (7)	DEW PT. (°F) (8)	WIND DIREC-TION (00-36) (9)	SPEED (Kts.) (10)	CHAR-ACTER (11)	ALTIM. SETTING (Ins.) (12)	REMARKS AND SUPPLEMENTAL CODED DATA (13)	STATION PRESSURE (Ins.) (17)	DRY BULB (°F) (18)	WET BULB (°F) (19)	TO-TAL SKY COV-ER (21)	TOTAL O-PAQUE SKY COVER (36)	OBSER-VER'S INI-TIALS (15)

TIME (L.S.T.) (42)	NO. (43)	PRECIP. (Ins.) (44)	SNOW FALL (Ins.) (45)	SNOW DEPTH (Ins.) (46)	MAX. TEMP. (°F) (47)	MIN. TEMP. (°F) (48)
MID. TO	X					
	1					
	2					
	3					
	4					
MID.	X					

STATION PRESSURE COMPUTATIONS

TIME (L.S.T.) (59)
ATT. THERM. (60)
OBSRVD. BAR. (61)
TOTAL CORR. (62)
STA. PRESS. (63)
BAROGRAPH (64)
BAR. CORR. (65)

SUMMARY OF DAY (Midnight to Midnight)

24-HR. MAX. TEMP. (°F) (66)	24-HR. MIN. TEMP. (°F) (67)	24-HR. PRECIP. WATER EQUIV. (Ins.) (68)	24-HR. SNOW FALL UNMLTD. (Ins.) (69)	1200 GMT SNOW DEPTH (Ins.) (70)

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA (90)

TIME CHECK – CLOCK CORRECT TO NEAREST MINUTE AT: / / /

MF1-10C (6-88)

SUPERSEDES MF1-10C (2-77) WHICH MAY BE USED.

*U.S. GPO: 1988 554 006 81012

Figure 16-2. National Weather Service Data Reporting Form.

ATTACHMENT 17

17. DIRECT AND CUMULATIVE IMPACTS

Direct and cumulative impacts which are identified in the Final Environmental Impact Statement for the OCS Lease Sale Area 109, Chukchi Sea, Alaska (USDOI/MMS, 1987) are summarized on Table 17-1. Moderate or major effects are predicted to occur with effects on water quality, fishes, marine and coastal birds, bowhead and gray whales, harvest patterns, sociocultural systems, and land use plans/ coastal management programs. Many of these effects are associated with actual oil and gas production operations rather than exploration activities, and it is important to note the difference between these effects and the effects attributable to the proposed exploration activities. In general, cumulative impacts encompass exploration, delineation, and production operations from a variety of operators. This exploration plan is proposed specifically for the use and impacts associated with limited exploration drilling operations as presented by SWEPI.

An expanded discussion of direct and cumulative impacts is provided on Table 17-2. Direct impacts summarized reflect only those impacts anticipated for SWEPI's proposed operation, and in most cases are of less magnitude than those predicted in the EIS (as summarized on Table 17-1). Cumulative impacts presented are generally as indicated in the EIS and have not been modified to reflect effects only from exploration activities. As a general summary, most direct impacts will be of short duration, occurring only during the period of active exploration activities (June-October). For at least the exploration phase, none of the impacts identified are expected to be irreversible.

At present SWEPI is the only industry operator currently known to have definite plans for immediate exploration in the OCS Lease Sale Area 109, Chukchi Sea, Alaska. Although we understand that one other operator is currently considering exploration activities, their plans have not yet been formalized. Cumulative

impacts from a single, or even two, exploratory drilling operations in the OCS Lease Sale Area 109, Chukchi Sea, Alaska are believed to be minimal, especially since the activities will be relatively self sufficient and limited in duration. As a conservative estimate, the combined effects from both operations will likely be no greater than double that required of SWEPI's proposed operation. For the most part, both activities can be supported using existing facilities available in Barrow.

TABLE 17-1

Summary of Direct and Cumulative Impacts

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Air Quality		
Standards	Minor	Minor
Other	Minor	Minor
Water Quality	Minor	Moderate
Lower-Trophic-Level Organisms	Minor	Minor
Fishes	Minor	Moderate
Marine and Coastal Birds	Minor	Moderate
Pinnipeds, Polar Bears, and Beluga Wales	Negligible	Minor
Endangered and Threatened Species		
Bowhead Whales	Negligible	Moderate
Gray Whales	Negligible	Moderate
Fin Whales	Negligible	Negligible
Humpback Whales	Negligible	Negligible
Arctic Peregrine Falcons	Negligible	Minor
Caribou	Negligible	Moderate
Economy of the North Slope Borough	Negligible	Minor
Subsistence-Harvest Patterns		
Barrow	Minor	Major
Wainwright	Minor	Major
Point Lay	Minor	Moderate
Point Hope	Minor	Moderate
Sociocultural Systems	Minor	Major
Archaeological Resources	Negligible	Minor
Land Use Plans and Coastal Management Programs	Minor	Major

* Possible impacts from activities described in this exploration plan.

** Possible impacts for the entire lease area development including oil and gas production as estimated in the EIS.

TABLE 17-2

Description of Direct and Cumulative Impacts

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Air Quality	Air emissions from the drilling operations will result in short-term (June - October) and unavoidable degradation of air quality. As described in Attachment 19, pollutant concentrations at the shoreline do not exceed maximum levels permitted by federal standards for ambient and/or incremental air quality.	DOI exemption criteria could be exceeded. Pollutant concentrations at the shoreline will not exceed the maximum levels permitted by federal standards for ambient and/or incremental air quality.
Water Quality	Short term (June - October) unavoidable and measurable degradation of water quality may occur locally as a result of drilling effluent discharges. These discharges are identified in Attachments 4 and 9 and water quality impacts are described in the ODCE for the Chukchi Sea (USEPA, 1988).	Regional short-term, measurable degradation may occur primarily from drilling effluent discharges.
Lower-Trophic-Level Organisms	Benthic habitat may be locally affected by drilling the glory hole and by solids deposition from drilling effluent discharges. These impacts are local, short-termed and unavoidable but not irreversible. Impacts of bottom deposition are described in the ODCE for the Chukchi Sea (USEPA, 1988).	A specific group of individuals of a population in a localized area and/or over a short time period (one generation or less) is affected. The regional population is not affected.

TABLE 17-2

Description of Direct and Cumulative Impacts (Cont'd)

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Fishes	Due to the limited scope of activities during exploration phases, impacts to fishes will be negligible. Short-term (June - October), local (<100 m), and unavoidable effects may result from drilling effluent discharges. Minor changes in population could result from an oil spill (USEPA, 1988).	A portion of a regional population may change in abundance and/or distribution over more than one generation but the change is unlikely to affect the regional population.
Marine and Coastal Birds	Short term (June - October) effects may results primarily from disturbances from helicopter and/or vessel traffic. These effects are considered to be negligible to minor and mitigative measures such as avoiding sensitive areas and maintaining vertical separation will be employed.	A portion of a regional population changes in abundance and/or distribution over more than one generation but the change is unlikely to affect the regional population.
Pinnipeds, Polar Bears and Beluga Whales	Short term (June - October), local and unavoidable effects may result from helicopter and/or vessel operations in the lease area. Effects are expected to be negligible.	A specific group of individuals of a population in a localized area and/or over a short time period (one generation or less) is affected; the regional population is not affected.

TABLE 17-2

Description of Direct and Cumulative Impacts (Cont'd)

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Bowhead Whales	Drilling operations (June - October) avoid the spring migration. During outmigration bowheads are dispersed throughout the lease area. These impacts are short-termed (October) and unavoidable.	A portion of a regional bowhead population may change in abundance and/or distribution over more than one generation but the change is unlikely to affect the regional population.
Gray Whales	Drilling operations would occur when gray whales are present but negligible impacts may results from vessel traffic (noise). These impacts are short termed (June-October) and unavoidable.	A portion of a regional gray whale population may change in abundance and/or distribution over more than one generation but the change is unlikely to affect the regional population.
Fin Whales	The northern margins of the fin whale range lie within the Chukchi Sea but these whales are not normally present within the sale area. Noise impacts are considered to be negligible.	No measurable short-term or long-term change in numbers or distribution of fin whales will likely occur in the population.
Humpback Whales	The humpback whale range lie within the Chukchi Sea but these whales are not normally present within the sale area. Noise impacts are considered to be negligible.	No measurable short-term or long-term change in numbers or distribution of humpback whales will likely occur in the population.

TABLE 17-2

Description of Direct and Cumulative Impacts (Cont'd)

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Arctic Peregrine Falcons	Exploration activities should not overlap with any Arctic peregrine falcon habitat and impacts are expected to be negligible to non-existent.	A specific group of individuals of a population in a localized area and/or over a short time period (one generation or less) is affected; the regional population is not affected.
Caribou	Short-term (June - October), local and unavoidable disturbances may occur with caribou primarily from helicopter operations. As most helicopter operations will be in area of low caribou usage, impacts are expected to be negligible.	A portion of a regional caribou population may change in abundance and/or distribution but the change is unlikely to affect the regional population.
Economy of the North Slope Borough	The proposed operations will use existing facilities and will have positive short-term (June - October) impacts on the local economy at Barrow and Kotzebue. Mitigative measures include use of existing facilities and a commitment to local hire.	Economic effects occur which may require slight marginal changes in governmental policies, planning, or budgeting, or may marginally affect the economic well-being of residents of the area.

TABLE 17-2

Description of Direct and Cumulative Impacts (Cont'd)

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Subsistence-Harvest Patterns	Subsistence use areas generally do not overlap with areas proposed for exploration. As such impacts, should they occur, will be short term (June - October) and likely be minor. SWEPI's efforts to mitigate and/or avoid conflicts are summarized in Exhibit 3-2.	One or more important subsistence resources would become locally unavailable for a period of time exceeding 1 year.
Archaeological Resources	There are no known archaeological resources which will be impacted by SWEPI's exploration program (see Attachment 15). Mitigative measures will include continued examination of sidescan sonar records to ensure potential sites will be identified and avoided.	Few archaeological resources are expected to be present and disturbed.
Land Use Plans and Coastal Management Programs	Short-term (June - October) and unavoidable conflicts with traditional subsistence use areas will occur. For exploration activities, these impacts can be considered as minor.	Activities and developments lead to displacement of existing or proposed land uses for which no reasonable alternative location is possible or high incompatibility with existing or proposed land uses; or they conflict with four or more policies of local, state, or federal coastal programs and land use plans.

TABLE 17-2

Description of Direct and Cumulative Impacts (Cont'd)

Resource Category	Direct Impacts* (SWEPI Exploration)	Cumulative Impacts** (EIS Predicted)
Sociocultural Systems	Exploration activities will require the use of support facilities in Barrow and Kotzebue which will increase the interaction between native and non-native groups. Impacts will be minor and of short duration (June - October). As mitigative measures, SWEPI will avoid interaction with native communities where appropriate (also see Exhibit 3-2 and Attachment 15).	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs with a tendency toward the displacement of existing institutions.

* Possible impacts from activities described in this exploration plan.

** Possible impacts for the entire lease area development including oil and gas production as estimated in the EIS (includes activity by SWEPI and other operators).

REFERENCES

U.S. Department of the Interior/Minerals Management Service. 1987. Alaska Outer Continental Shelf Chukchi Sea Oil and Gas Lease Sale 109. Final Environmental Impact Statement Alaska OCS Region. Vol 1 and 2.

USEPA, 1988. Ocean Discharge Criteria Evaluation for Chukchi Sea OCS Oil and Gas Lease Offering 109; Final. U.S. Environmental Protection Agency, Region X; Seattle, Washington, August 1988.

ATTACHMENT 18

Coastal Project Questionnaire and Certification Statement

Please answer all questions. Include maps or plan drawings with your packet. An incomplete questionnaire may be returned and will delay the review of your packet.

APPLICANT INFORMATION

1. Shell Western E&P, Inc.
Name of Applicant
601 West Fifth Avenue, Suite 810
Address
Anchorage , Alaska 99501
City State Zip Code
(907) 263-9613
Phone

2. Ms. Susan Brown-Maunder
Contact Person
Same
Address
Same
City State Zip Code
Same
Phone

PROJECT INFORMATION

1. Provide a brief description of your project and ALL associated facilities (caretaker facilities, etc.):

Conduct petroleum exploration drilling activities at offshore prospects in the Chukchi Sea Lease 109 area. In oil and gas. Included are helicopter base operations in Barrow, Alaska.

Starting Date for Project June, 1989 Ending Date for Project November 1998

PROJECT LOCATION

1. Please give location of project. (Include nearest community or identifiable body of land or water.)

Chukchi Sea OCS Lease Area 109, Approximately Latitude Longitude

Township ____ Range ____ Meridian ____ Section ____ Aliquot Parts ____ USGS Map ____

2. Is the project on: *(please mark with ✓)*

State Land ____ Federal Land X Private Land ____ Municipal Land ____

3. Project is located in which region of the state (see attached map):

Northern X Southcentral ____ Southeast ____

PERMIT APPROVALS

1. Do you currently have any State or federal approvals for this project? If yes, please list below. (Note: *approval* means permit or any other form of authorization.) Yes ☐ No ☒

Approval Type	Approval #	Expiration Date

FEDERAL APPROVALS

1. Will you be placing structures or fills in any of the following: tidal waters, streams, lakes, or wetlands*? Yes ☐ No ☒

** If you are uncertain whether your proposed project area is in a wetland, contact the Corps of Engineers, Regulatory Branch at (907) 753-2720 for a wetlands determination. If you are outside the Anchorage area, call toll free 1-800-478-2712.*

If yes, have you applied for or do you intend to apply for a U.S. Army Corps of Engineers (COE) permit? Please indicate at right and describe below. Anchor notification required (Not a Permit). Yes ☐ No ☒

2. Have you applied for or do you intend to apply for a U.S. Environmental Protection Agency National Pollution Discharge Elimination System (NPDES) permit? Please indicate at right and describe below. (Note: Any wastewater discharge requires an NPDES permit.) Yes [X] No [ ]

3. Have you applied for or do you intend to apply for permits from any other federal agency? If yes, please list below. Yes [X] No [ ]

Agency	Approval Type	Date submitted (or intend to submit)
USEPA	NPDES, General Permit-Chukchi OCS	December 1988
NMFS	Whale take permit	February, 1988
MMS	Permits to Drill	Periodically on prospect by prospect basis

DEPARTMENT OF NATURAL RESOURCES APPROVALS

1. Is the proposed project on state-owned land or will you need to cross State lands for access? Yes [ ] No [X]

2. Is any portion of your project placed below the ordinary high water line of a stream, river, lake or other water body? Yes [ ] No [X]

3. Will you be dredging? If yes, location of dredging is: Yes [ ] No [X]
   Township ____ Range ____ Meridian ____ Section ____

   • Location of disposal site for dredged materials:
   Township ____ Range ____ Meridian ____ Section ____

4. Will you be filling with rock, sand or gravel? If yes, amount? ____ Yes [ ] No [X]
   • Location of source: Township ____ Range ____ Meridian ____ Section ____
   • Location of area to be filled: Township ____ Range ____ Meridian ____ Section ____

5. Do you plan to use any of the following state-owned resources? Yes [ ] No [X]

   Timber
   • If yes, amount? ____
   • Location of source: Township ____ Range ____ Meridian ____ Section ____

   Other Materials
   • If yes, what material? ____
   (peat, building stone, silt, overburden, etc.)
   • Location of source: Township ____ Range ____ Meridian ____ Section ____

6. Are you planning to use any fresh water? Yes [ ] No [X]
   • If yes, amount (gallons per day)? 15,000 GPD
   • Source? Desalination Units onboard Drill Ship

7. Will you be building or altering a dam? Yes [ ] No [X]

8. Do you plan to drill a geothermal well? [ ] [X]

9. Will you be exploring for or extracting coal? [ ] [X]

10. Will you be exploring for or extracting minerals on state-owned land? [ ] [X]

11. Will you be exploring for or extracting oil and gas on state-owned land? [ ] [X]

12. Will you be harvesting timber from 10 or more acres? [ ] [X]

13. Will you be investigating or removing historical or archaeological resources on state-owned land? Yes [ ] No [X]

14. Will the project be located in a unit of the Alaska State Park System? Yes ☐ No ☒

If you answered NO to all questions in this section, you do not need an approval from the Alaska Department of Natural Resources (DNR). Continue to the next section.

If you answered YES to ANY questions in this section, contact DNR to identify and obtain necessary application forms.

Based on your discussion with DNR, please list (below) the approval type needed and date submitted.

Approval Type	Date Submitted (or intend to submit)

Have you paid the filing fees required for the DNR permits? Yes ☐ No ☐

If you are not applying for DNR permits, indicate reason below:

____ a. _____ (DNR contact) told me on _____ (date) that no DNR approvals or permits were required on this project.

____ b. Other: _____

DEPARTMENT OF FISH AND GAME APPROVALS

1. Will you be working in a stream, river, or lake? (This includes running water or on ice, within the acive floodplain, on islands, the face of the banks, or the stream tideflats down to mean low tide.) Yes ☐ No ☒

Name of stream or river: _____ Name of lake: _____

If you answered "no", proceed to question #2.

If "yes", will you be doing any of the following:

	Yes	No
a) Building a dam, river training structure or instream impoundment?	☐	☐
b) Using the water?	☐	☐
c) Diverting or altering the natural channel stream?	☐	☐
d) Blocking or damming the stream, (temporarily or permanently)?	☐	☐
e) Changing the flow of the water or changing the bed?	☐	☐
f) Pumping water out of the stream or lake?	☐	☐
g) Introducing silt, gravel, rock, petroleum products, debris, chemicals or wastes of any type into the water?	☐	☐
h) Using the stream as a road (even when frozen), or crossing the stream with tracked or wheeled vehicles, log-dragging or excavation equipment (backhoes, bulldozers, etc.)?	☐	☐
i) Altering or stabilizing the banks?	☐	☐
j) Mining or digging in the beds or banks?	☐	☐
k) Using explosives?	☐	☐
l) Building a bridge (including an ice bridge)?	☐	☐
m) Installing a culvert or other drainage structure?	☐	☐
n) Constructing a weir?	☐	☐

	Yes	No
o) Other in-stream structure not mentioned above?	☐	☐
2. Is your project located in a State Game Refuge, Critical Habitat Area, or State Game Sanctuary?	☐	☒
3. Does your project include the construction and operation of a salmon hatchery?	☐	☒
4. Does your project affect or is it related to a previously permitted salmon hatchery?	☐	☒
5. Does your project include the construction of a shellfish or sea vegetable farm?	☐	☒

If you answered NO to all questions in this section, you do not need an approval from the Alaska Department of Fish and Game (DFG). Continue to the next section.

If you answered YES to any of the questions under 1 or 2, contact the Regional DFG Habitat Division Office for information and application forms.

If you answered YES to questions 3, 4 or 5, contact the DFG Private Nonprofit Hatchery Office at the F.R.E.D. division headquarters for information and application forms.

Based on your discussion with DFG, please list (below) the approval type needed and date submitted. Yes ☐ No ☐

Approval Type	Date Submitted (or intend to submit)

If you are not applying for permits, indicate reason below:

____ a. _____ (DFG contact) told me on _____(date) that no DFG approvals or permits were required on this project.

____ b. Other: _____

DEPARTMENT OF ENVIRONMENTAL CONSERVATION APPROVALS

	Yes	No
1. Will a discharge of wastewater from industrial or commercial operations occur? (See #2 in "Federal Permits" section)	☒	☐
2. Will your project generate air emissions from the following:	☒	☐
a) Diesel generators totaling more than 10,000 hp?	☒	☐
b) Other fossil fuel-fired electric generator, furnace, or boiler totaling greater than 10,000 hp, or 9,000 kWh, or 100,000,000 btu/hr?	☐	☒
c) Asphalt plant?	☐	☒
d) Incinerator burning more than 1000 lbs. per hour?	☐	☒
e) Industrial process?	☐	☒
3. Will a drinking water supply be developed that serves more than a single-family residence?	☒	☐
4. Will you be processing seafood?	☐	☒
5. Will food service be provided to the public or workers?	☒	☐
6. Will the project result in dredging or disposal of fill in wetlands or placement of a structure in waterways? (Note: your application for this activity to the Corps of Engineers will also serve as your application to DEC.)	☐	☒
7. Is sewage or greywater disposal involved or necessary?	☒	☐

8. Will your project result in the development of a currently unpermitted facility for the disposal of domestic or industrial solid waste? ☐ ☒

9. Will your project require offshore drilling or vessel transport of oil, or other petroleum products as cargo, or include onshore facilities with an effective storage capacity of greater than 10,000 barrels of such products? ☒ ☐

10. Will your project require the application of oil or pesticides to the surface of the land? ☐ ☒

If you answered NO to all questions in this section, you do not need a permit or approval from the Alaska Department of Environmental Conservation (DEC). Please continue to the next section.

If you answered YES to any of these questions (see #6 Note), contact the DEC Regional Office for information and application forms.

Based on your discussion with DEC, please list (below) the approval type needed and date submitted.

Approval Type	Date Submitted (or intend to submit)

If you are not applying for permits, indicate reason below:

____ a. _____ (DEC contact) told me on _____(date) that no DEC approvals or permits were required on this project.

____ b. Other: _____

Certification Statement

The information contained herein is true and complete to the best of my knowledge. I certify that the proposed activity complies with, and will be conducted in a manner consistent with, the Alaska Coastal Management Program.

Wayne F. Simpson — Signature of Applicant or Agent

12/8/88 — Date

To complete your packet, please attach your state permit applications and copies of your federal applications to this questionnaire.

ATTACHMENT 19

19. AIR QUALITY

SWEPI has proposed to use the Canmar Explorer III drillship with ice management vessels, a Crowley tug and oil spill/storage barge and two helicopters. Additional emissions may occur if gas and/or oil flaring is required. Emissions from these various sources are discussed in the following paragraphs.

The Explorer III, ice management vessels, and other support vessels are expected to produce the largest air emissions. The Explorer III and support vessels will produce relatively constant air emissions from onboard prime mover power systems. Tables 19-1 through 19-3 provide engine specifications for the Explorer III and Canmar support vessels. Although the Crowley tug for the oil spill/storage barge has not yet been identified, it will have approximately 4,500 BHP and its emissions should be less than those for the Canmar Supplier III or IV. All major sources will use diesel fuel and its specifications are provided on Table 19-4.

The drillship and support vessels are expected to produce carbon monoxide (CO), nitrogen oxide (NO_x), sulphur dioxide (SO_2), volatile organic compounds (VOC), and total suspended particulates (TSP). Formal determination of air emissions from the proposed exploration activity was performed in accordance with MMS guidelines with design information received from Canmar. Predicted emissions from the major components are indicated in Table 19-5 as are the calculated USDOI exemption levels for shoreline air quality.

Short period air emissions may also be produced from gas and/or oil flaring associated with testing of exploration wells. Emissions from these sources are summarized on Table 19-6.

TABLE 19-1

Engine Specifications for the Canmar Explorer III

Main Engines (5)

Make - S.A.C.M.
Model - AGO V16 ES HR
Bore - 240 mm
Stroke - Master Rod 220 mm, Linkrod 232 mm
No. of Cylinders - 16 ea
RPM - 1200
BHP - 3400 ea
Usage - three engines required during drilling operations (maximum)

Emergency Generator (1)

Make - SAAB - Scanica
Model - DS11R 40 ANV
Power - 150 kVa
Usage - Emergency use only

Harbor Generator (1)

Make - S.A.C.M-V-12
Model-MGOV23B7SHR
Power - 950 hp
Usage - Used when vessel in port only

Anchor Winches (4)

Make - Detroit Diesel
Model - 8V71
Power - 450 hp ea
Usage - Used for running and retrieving anchors only

Emissions Location

Location - Midship
No. of Stacks - 2
Approximate elevation - 50 feet

TABLE 19-2

Engine Specifications for the M/V Canmar Supplier III and IV

Main Engines (2)

Type - General Motors
Model - 29-645-E7
Bore - 9.06 inch
Stroke - 10 inch
No. of Cylinders - 20 ea
RPM - 900
BHP - 3600 ea
Usage - Both operating 24 hours per day

Generators (3)

Type - Caterpillar
Model - D343
Bore - 5.4 inch
Stroke - 6.5 inch
No. of Cylinders - 6 ea
RPM - 1800
BHP - 335
Usage - one operating 24 hrs/day, one operating 12 hrs/day, one off

Emergency Fire Pump (1)

Type - Lister
Model - SR2
Bore - 3.5 inch
Stroke - 3.5 inch
No. of Cylinders - 2
RPM - 1800
BHP - 12
Usage - Intermittent use only

Emissions Location

Location - Midship
No. of Stacks - 2
Approximate elevation - 40 feet

TABLE 19-3

Engine Specifications for the M/V Robert LeMeur

Main Engines (2)

Type - Krupp M.A.K.
Model - 12M 453 AK
Bore - 320 mm
Stroke - 420 mm
No. of Cylinders - 12 ea
RPM - 600
BHP - 4800 ea
Usage - Both operating 24 hours per day

Generators (4)

Type - Caterpillar
Model - D399
Bore - 6.25 inch
Stroke - 8 inch
No. of Cylinders - 16 ea
RPM - 1200
BHP - 1089 ea
Usage - two operating 24 hrs/day, one operating 12 hrs/day, one off

Emergency Generator (1)

Type - Caterpillar
Model - 3304
Bore - 4.75 inch
Stroke - 6 inch
No. of Cylinders - 4
RPM - 1800
BHP - 102
Usage - Intermittent use only

Emissions Location

Location - Midship
No. of Stacks - 2
Approximate elevation - 80 feet

Based on this information, calculated air emissions from REMOTE OFFSHORE PROSPECTS will not exceed the USDOI calculated exemption levels. Thus, additional air quality monitoring and/or controls are not expected.

TABLE 19-4

Fuel Specifications

Grade	Gulf diesel fuel 20x
Gravity	37 API
Specific Gravity	.8398
Flash point	76°C
Sulphur	0.14%
Cloud point	-12°C
Pour point	-15°C
Ash	.02%
Crane Index	52.0
BTU Gross/Pound	19,650
BTU Net/Pound	18,430
BTU Gross/Gallon	165,000
BTU Net/Gallon	154,800

TABLE 19-5

Estimated Vessel Emissions and USDOI Exemption Levels

	Pollutant (tons per year)*				
	CO	NO_x	TSP	SO_2	VOC
Canmar Explorer III	70	267	27	32	7
Canmar Supplier III & IV	53	205	20	23	7
Robert LeMeur	79	309	29	34	12
Crowley Tug**	53	205	20	23	7
Helicopter	3	2	<1	<1	1
Exemption Levels***	54,965	2,165	2,165	2,165	2,165

* NO_x = Nitrogen Oxides
TSP = Total Suspended Particulates
SO_2 = Sulfur Dioxide
CO = Carbon Monoxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)
Loading assumes 90 days of operation

** Tug is for oil spill/storage barge and, although not yet specified, will be approximately 4,500 BHP. Emissions of similar to that of the Canmar Supplier II and IV have been assumed as a conservative estimate.

*** Calculated per 250.45 (d) assuming a minimum distance of 65 statute miles for the Klondike Prospects. All other Offshore Prospects are greater than 65 statute miles from nearest land.

NOTE: Each vessel is considered as a separate point source for air emission calculations. Cumulative totals are not considered in accordance with USDOI/MMS guidelines.

TABLE 19-6

Estimated Emissions from Flaring

Source**	Pollutant (tons per year)*				
	CO	NO_x	TSP	SO_2	VOC
Natural Gas Flaring	.2	.7	.2	<.1	.1
Crude Oil Flaring	225	10	358	237	1

* NO_x = Nitrogen Oxides
TSP = Total Suspended Particulates
SO_2 = Sulfur Dioxide
CO = Carbon Monoxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)
Loading assumes 120 hours total duration

** Assumed rate is 2,500,000 ft^3/day of natural gas and 5,000 barrels per day of crude oil. Pollutant loadings derived from values provided for blowout emissions as presented in the EIS (USDOI, 1987).

NOTE: Each vessel is considered as a separate point source for air emission calculations. Cumulative totals are not considered in accordance with USDOI/MMS guidelines.

ATTACHMENT 20

20. SWEPI CONTACTS

The primary contact for Shell Western E&P Inc. is:

Ms. Susan Brown - Maunder
Shell Western E&P Inc.
601 West Fifth Avenue, Suite 810
Anchorage, Alaska 99501

Direct Work Phone: (907) 263-9613
Main Work Phone: (907) 276-2545

The alternate contact for Shell Western E&P Inc. is:

Mr. Wayne F. Simpson
Manager of Regulatory Affairs
Shell Western E&P Inc.
601 West Fifth Avenue, Suite 810
Anchorage, Alaska 99501

Direct Work Phone: (907) 263-9645
Main Work Phone: (907) 276-2545

ATTACHMENT

21

21. OTHER INFORMATION

No other information has been requested by the MMS Regional Supervisor.