3. SUPPLEMENTAL INFORMATION [18 AAC 75.425(e)(3)]

3.1 FACILITY DESCRIPTION AND OPERATIONAL OVERVIEW [18 AAC 75.425(e)(3)(A)]

3.1.1 Facility Ownership, Location, and General Description

The ownership of the Point Thomson Gas Cycling Project is as follows:

- ExxonMobil 36%
- BP Exploration (Alaska) Inc. 31%
- ChevronTexaco 25%
- ConocoPhillips 5%

Twenty other owners have a combined working interest of 3 percent. ExxonMobil is the operator of the Point Thomson Unit.

The summary of the condensate and reservoir characteristics for the Thomson Sand reservoir is presented in Table 3-1.

TABLE 3-1
CONDENSATE AND RESERVOIR CHARACTERISTICS

PRODUCTION WELLS AT RESERVOIR DEPTH	VALUE
Avg. Depth (subsea)	12,750 feet
Avg. Temperature	230°F
Avg. Initial Pressure	10,250 psi
Avg. Production per Well	100-150 mmscf/d
Avg. Gas-to-Oil Ratio	17,250 scf/bbl (equates to 58 barrels per million standard cubic feet gas [BPMSCF])
CONDENSATE	
Percentage water (sales)	Basic sediment and water (BS&W) <0.35%
API gravity	39
Pour point ºF	Approximately 1ºF[1]
Percentage sulfur	0%

[1] Pour point will be re-determined after initial well testing.

Point Thomson is located on the North Slope of Alaska immediately west of the Staines River. The Thomson Sand reservoir, the development objective for Point Thomson, is a deep (-12,750 feet sub-sea), high-pressure gas condensate reservoir that was discovered in 1977. It is estimated to contain more than 8 trillion cubic feet of gas in-place and approximately 400 million barrels of recoverable condensate. The reservoir lies approximately 60 miles east of Prudhoe Bay, approximately 22 miles from the nearest infrastructure at Badami. Although most of the reserves are offshore, they will be produced from onshore well pads along the coastline.

The Point Thomson owners are proposing to develop this reservoir as a “gas cycling” project. A gathering pipeline system will collect production from well pads located on the eastern and western margins of the reservoir and deliver the three-phase stream to the CPF. Gas, water, and condensate will be separated from the three-phase stream at the CPF. Residue gas will be re-injected into the reservoir at the CWP located near the CPF. A small amount of the gas will be used to supply fuel for the facility. Produced water will be re-injected into one or more disposal wells at the CWP.

Condensate is the hydrocarbon liquid that condenses from the gas as the pressure and temperature fall below original reservoir conditions during production and surface handling (gathering and processing facilities). The separated condensate will be dehydrated and stabilized at the CPF to meet pipeline specifications.

An airstrip will be built south of the CPF, and a dock will be constructed adjacent to the CWP because no permanent roads exist between Point Thomson and Prudhoe Bay.

The recovered hydrocarbon condensate will be shipped to market through a new 22-mile export pipeline that will extend from Point Thomson to the Badami Development, where it will tie into the existing Badami and Endicott sales oil pipelines, with ultimate delivery to Pump Station 1 on the Trans Alaska Pipeline System (TAPS).

3.1.2 Facility Storage Containers [18 AAC 75.425(e)(3)(A)(i) and (ii)]

Appendix B and Section 2.1.10 provide a summary of the major features of the proposed oil storage containers.

Oil storage start-up is expected to occur in Spring 2005.

3.1.3 Transfer Procedures [18 AAC 75.425(e)(3)(A)(v)]

Fuel transfer procedures are discussed in Section 2.1.5 and Appendix A.

3.1.4 Description and Operation of Production Facilities [18 AAC 75.425(e)(3)(A)(vi)]

See Section 1.8 for diagrams of facilities.

Central Well Pad

The CWP will accommodate the initial drilling operations and drilling storage to support work at the east and west pads. The pad will also be suitable for ongoing well maintenance and service rig access, future drilling activities, and equipment and facilities for gas injection. A pad extension will be provided for a temporary flare to be used during drilling operations. Flaring requirements during facility operations will be handled by the main flare at the adjacent CPF. The drilling rig will have access to electric wireline and slickline units. The rig will employ a closed mud system with no reserve pit or discharges. Cuttings storage capability will be provided among the drilling pads. There will be mobile grind and inject facility with the rig.

Facilities on the CWP will include a separator and fuel gas treating skid for providing early fuel gas and fuel gas for a plant black start. A mud plant, tubular storage, diesel storage, warehouse, and lined cutting storage pit will also be located on the CWP. In cases of white-out storms, the drilling rig contractor will be able to provide temporary facilities for drilling personnel on the eastern and western pads.

Central Processing Facility

The CPF pad layout will accommodate the CPF modules and equipment, temporary and permanent construction and drilling camp and associated water and waste disposal facilities, the camp utility module, the office, warehouse, and shop space, the power generation modules, the control room, the communications tower and building, fuel, water, diesel, methanol, and chemical storage, a cold storage area and associated pipe racks, cable racks, and associated storage equipment, and treatment systems for potable and effluent water. A microwave tower will tie Point Thomson back to the Prudhoe Bay/North Slope communications infrastructure by relay through a Badami microwave tower. In addition, the CPF pad will accommodate the high-and low-pressure flares. Camp housing and catering for drilling personnel will be located at the CPF and supplied by project contractors.

The three-phase production delivered to the CPF will be directed to several process modules. In these process modules, the condensate will be separated and stabilized before it is metered and pumped into the export pipeline. Produced water will be separated and injected into the Class I disposal well on the adjacent CWP. Separated gas will be compressed and injected into injection wells on the CWP (Figures 3-1 and 3-2).

Fuel gas prior to startup of the facility is necessary to provide power to the drilling rigs and construction activities on each pad. The initial two wells on each pad will be drilled using diesel for rig fuel. In order to minimize on-site diesel storage requirements, subsequent wells on each pad will be drilled using natural gas produced from the Thomson Sand through the first well. The condensate associated with this gas will be separated at the surface and re-injected into the Thomson Sand through the second well. Alternative methods under consideration for disposing of the condensate include injection into the tubing by casing annulus, injection into the top of the pre-Mississippian formation, and disposal down the Class I disposal well. Condensate produced during well testing activities will be reinjected in a similar manner.

The permanent CPF power-generating equipment will include four gas turbine-driven Solar-Taurus 70 generator sets. These generator sets will be installed with the three diesel engine-driven essential generators and related switchgear. Transformers and buried transmission cables (13.8 kiloVolt [kV]) also will be installed in the gravel roads to deliver power to the three well pads and the airstrip. This supply will provide power during construction, and power for the operating facilities during normal operations.

Producing Well Pads

Gravel well pads will be constructed at either end of the field. Seven producing wells are currently planned for the east pad and six wells in the west (Table 3-2). Permanent facilities on the pads will include well control and metering equipment, and manifold and gathering pipeline pig launchers. Methanol storage and injection facilities will be provided to allow for cold startups and freeze protection. Space will also be provided on the pad to allow for drilling rig and related support equipment.

Individual well production rates will average 100 mmscf/d and range up to 150 mmscf/d, with variations based on well performance, water content, and operational demands.

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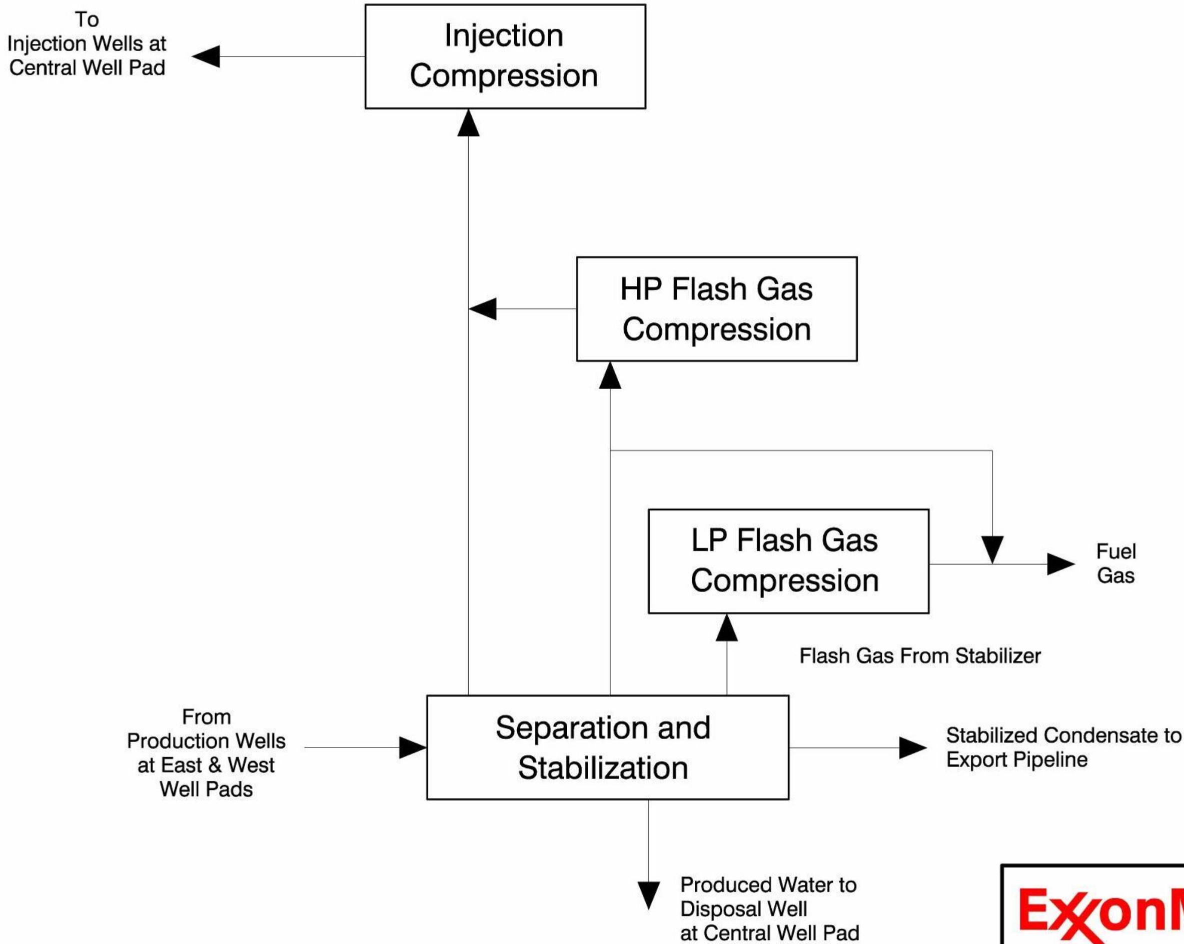
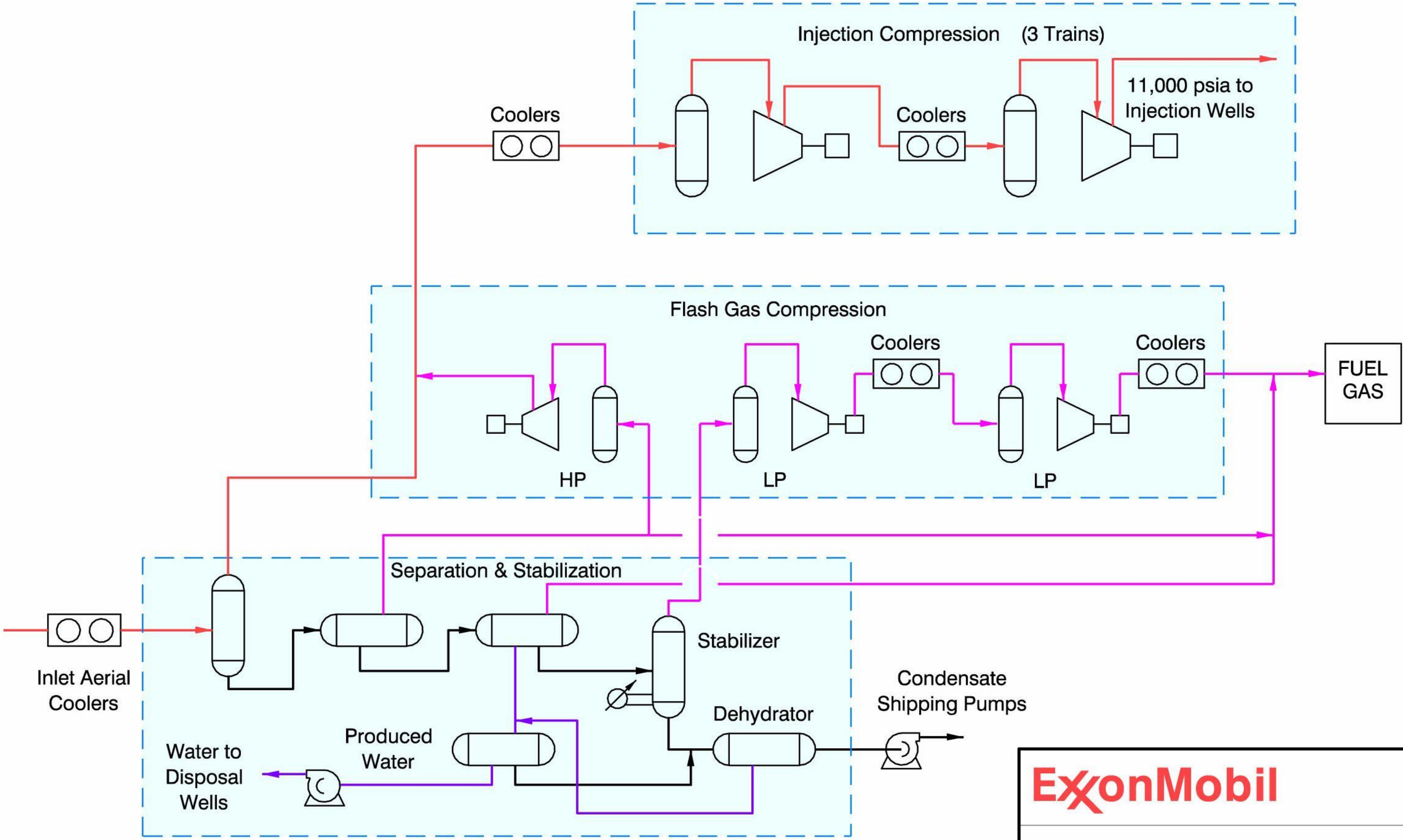


ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
SIMPLIFIED FLOW DIAGRAM

DATE:	SCALE:	FIGURE:
April 2003	Not to Scale	3 - 1



ExxonMobil

POINT THOMSON GAS CYCLING PROJECT
THREE TRAIN INJECTION CASE

DATE:	SCALE:	FIGURE:
April 2003	Not to Scale	3 - 2

TABLE 3-2
WELL COUNTS

PAD	NUMBER OF WELLS
West Well Pad	6 Production + 2 potential future wells
Central Well Pad	8 Injection + 2 potential future injection wells and one Class 1 Disposal Well + 2 potential future Disposal Wells
East Well Pad	7 Production + 2 potential future wells
Total	**21 Injection and Production + 1 Disposal, up to 30 wells**

Wellhead pressures will initially be approximately 8,300 psi gauge (psig) at 32ºF at shut-in conditions. Pressures will decline with time as gas and liquids are removed from the reservoir. Production flow rates and downstream pressures will be controlled using automated choke valves. Overriding pressure/flow control and emergency shutdown systems will ensure that flowing pressures remain below the gathering pipeline maximum operating pressure of approximately 3,540 psi-absolute (psia).

Wellhead facilities will consist of the wellhead valving, an automated choke valve, and a well line interconnecting the well to the production manifold. To facilitate production measurement and the testing of well streams, individual three-phase meters will be provided for each producing well.

The produced gas will contain 4 to 5 percent carbon dioxide (CO_2) and will be water-saturated at reservoir conditions. To minimize corrosion, the production well tubing, wellhead, valving, headers, and gathering pipelines will be made of duplex stainless steel (2205) or other suitable corrosion-resistant alloy (CRA).

Point Thomson drilling and completion-related data are as follows:

- Reservoir thickness: up to 350 feet
- Initial Reservoir pressure: 10,250 psi
- Flowing wellhead temperature: approximately 200ºF
- Injection wellhead temperature: approximately 155ºF
- Formation fluid: natural gas, 0% H2S, 4.5% CO2

Thomson Sand well completions will be equipped with a Class V wellhead with control line ports for downhole pressure and temperature gauges, chemical injection, and SCSSVs. The trees will be equipped with two master valves, two wing valves, and a crown valve, and the upper master and outside wing valves will be equipped with actuators. The producers employ 7 1/6-inch, 10,000 psi gas-rated trees. The gas injectors will have 7 1/16-inch, 15,000 psi gas-rated trees. The operating temperature range for wellheads and "Christmas trees" is –75ºF to +250ºF.

A 13 5/8-inch, 10,000 psi-rated four-ram and one 10,000 psi-rated annular BOP stack (ExxonMobil Type 5-A) and a 10,000 psi-rated choke manifold will be employed for open-hole operations below the surface hole.

Wells will be 40 feet apart.

Condensate Export Pipeline

The Point Thomson export condensate pipeline will be designed, built, and operated as a common carrier system according to proven North Slope design criteria and applicable DOT standards. The export system will consist of a carbon steel pipeline approximately 22-miles-long to transport condensate from the CPF to a connection point with the existing Badami pipeline. The pipeline will have a maximum allowable operating pressure (MAOP) of approximately 2,060 psig. Pig launchers and receivers will be included on this pipeline. From the tie-in point, the existing 12-inch Badami pipeline extends another 25 miles to tie in with the Endicott pipeline, which extends another 10 miles before connecting to TAPS Pump Station 1 in Prudhoe Bay.

The proposed Point Thomson condensate pipeline will be supported on VSMs and will be configured with "Z" type offsets and/or expansion loops to allow for thermal effects. The VSMs will be designed and installed with clearance between the bottom of the pipe and the tundra surface. Design and installation of the VSMs will be completed using standard ExxonMobil and North Slope pipeline specifications and procedures. The VSM design will be performed during the pipeline detailed design. Table 3-4 provides the engineering data as developed to date for the condensate pipeline.

An internal protective coating is not necessary for the pipeline because condensate transported in the line will have low water content and thus would not cause corrosion of the inside wall of the pipeline.

Multi-Phase Gathering Pipelines

Approximately 13 miles of gathering pipelines will carry three-phase production from the producing well pads to the CPF (Table 3-3).

Produced gas from both the east and west well pads will be piped from the well manifolds to the multi-phase gathering pipelines and then to the CPF. The gathering pipelines will be configured with a pig launcher on the well pad end and a pig receiver on the plant end. They will be constructed of corrosion-resistant piping material (e.g., duplex stainless steel [2205]) and run above the tundra on VSMs to the plant. The pipelines will be routed on the inland side of the access roads so the road can act as a containment barrier in the event of a gathering pipeline leak. Adequate spacing will be maintained between the road and the gathering pipelines to avoid hampering caribou movement. This spacing will generally be greater than 200 feet, except where the road and lines converge at the pads.

The well flow rate and inlet pressure to the gathering pipelines will be controlled at about 3,540 psia or lower so that the minimum delivery pressure at the plant is approximately 3,040 psia. Normal flowing temperatures in the gathering pipelines will be over 170^{o}F with temperature drops of 10^{o}F or less. The produced gas will have a hydrate point at flowing pressure of approximately 80^{o}F. Therefore, the gathering pipelines will be insulated to reduce the rate of cooling of the pipeline to ambient conditions when the flow is stopped or restricted. This will allow additional time to resolve operating problems and resume flow before the pipeline must be depressurized to avoid potential hydrate formation and associated problems.

TABLE 3-3
SUMMARY OF CONDENSATE PRODUCTION PIPELINES

VARIABLE	WELL LINES	PRODUCED 3-PHASE GATHERING PIPELINES	CONDENSATE SALES PIPELINE
Transported Substance	Sweet gas and condensate, 4.5% CO_2 and water-saturated.	Sweet gas and condensate, 4.5% CO_2 and water-saturated.	Sweet condensate per TAPS specification: True vapor pressure limit = 14.2 psia at 105ºF and BS&W < 0.35%
Specific Gravity	Not applicable	Not applicable	0.7 to 0.9 (water = 1.0)
Pressure	10,000 psig at flowing wellhead conditions.	4270 psig East Design Pressures Line and 4675 psig - West Line (ANSI 2500#)	2,060 psig maximum operating pressure.
Length	Less than or equal to 1 mile	6 miles East Line 7 miles West Line	22 miles
Facilities	Individual 3-phase meter for each well.	Pig launchers and receivers.	Three 50% duty shipping pumps at Point Thompson CPF. Aerial cooling stations at Point Thomson CPF to cool condensate to pipeline operating temperature. Custody transfer turbine meter at Point Thomson CPF.
Access	Above ground on gravel pad by vehicle and by foot.	Above ground by foot and ATVs.	Above ground by ATVs and helicopter.
Pipeline Design Maximum Throughput	150 million standard cubic feet per day (mmscf/day) nominal design, however, well line throughput will only be limited by gathering line capacity.	1.2 billion standard cubic feet per day (BSCFD) - East Line 1.0 BSCFD - West Line	100,000 bopd
Pipeline Design Temperatures	Maximum: 220°F Minimum: -50°F	Maximum: 220°F Minimum: -50°F	Maximum: 200°F Minimum: -50°F
Pipeline Construction Modes	Wells to production header on well pads.	North Slope VSMs, minimum 5-foot clearance between bottom of pipe and tundra and water crossings. Buried casing in road bed gravel placed on tundra.	Mainline: VSMs, minimum 5-foot clearance between bottom of pipe and tundra surface. Road Crossings: In culverts or casings through road bed gravel placed on the tundra. Creek and Water Crossings: VSMs.
Outside Diameter	8.625 inches	18 inches – East Line 16 inches – West Line	12.750 inches
Wall Thickness	1.125 inches	0.821 inch – East Line 0.799 inch – West Line	Mainline: 0.281 inches Station piping and valve and trap sites: 0.375 inches

TABLE 3-3 (CONTINUED)
SUMMARY OF CONDENSATE PRODUCTION PIPELINES

VARIABLE	WELL LINES	PRODUCED 3-PHASE GATHERING PIPELINES	CONDENSATE SALES PIPELINE
Inside Diameter	6.375 inches	16.36 inches – East Line 14.4 inches – West Line	12.2 inches on mainline
Material Grade	CRA, e.g., duplex stainless steel (2205).	CRA, e.g., duplex stainless steel (2205).	American Petroleum Institute (API) 5L Grade X65 carbon steel.
Covering	Above ground: 2-inch polyurethane (PU) foam insulation with galvanized metal jacket.	Above ground: 2-inch PU foam insulation with galvanized metal jacket.	Mainline: 2-inch PU insulation with galvanized metal jacket. Buried road crossings: As main line plus fusion-bonded epoxy.
Inspection Piggable	No.	Yes. Pig launcher on the well pad end and a pig receiver on the plant end.	Yes. Pipeline will be provided with in-line inspection capability by pig launcher and receivers.
Minimum Hydrostatic Test Pressure and Duration	125% of design pressure for 1 hour.	4 hours at minimum pressures of 125% MAOP and 4 hours at 110% MAOP in accordance with American Society of Mechanical Engineers (ASME) B31.8.	4 hours at minimum pressure of 125% MAOP and 4 hours at minimum pressure of 110% MAOP in accordance with DOT (49 CFR 195).
Valve	Wellhead valves and automated choke valve.	Actuated isolation valves at the inlet and outlet of each gathering line.	Mainline: Actuated isolation valves at the inlet and outlet of the pipeline. Check Valves: None.
Design Code and Regulation	ASME B31.8	ASME B31.8	ASME B31.4 and 49 CFR 195.

Gas Injection System

Gas discharged from the re-injection gas compressors will be piped directly to the CWP and injected down the designated injection wells. The injection lines will extend from the CPF to the injection wells on the CWP. They will have maximum working pressures of approximately 12,500 psig and will be only about 1,000 feet long. Because of the proximity of the CWP to the CPF, all injection lines will run on VSMs or on a pipe rack from the compressor area to the injection manifold. Because the gas is relatively dry and warm at injection conditions, carbon steel piping will be used.

Compressor discharge pressures will vary between 8,500 psig and 10,500 psig, depending on well availability and injection flow rate. Design pressure is assumed at 12,100 psig to allow for overpressure during abnormal conditions (relief). Piping will be designed in accordance with American Society of Mechanical Engineers (ASME) B31.8 using a design factor of 0.5 and high-strength piping 5LX 65 or 70.

Dock

The Point Thomson dock will serve a critical role in both construction and operating phases of the project. The 750-foot-long dock will reach to water 9 feet deep and have the capability to land barges carrying sealift modules weighing up to approximately 6,000 tons. It will facilitate the landing of the CPF process modules during the sea lift before startup. The dock will also provide a means of mobilizing drilling rigs and drilling equipment and materials the year before startup. During construction and drilling, and during the operating phase of the project, the dock will support the resupply by barge of heavy and bulk materials that are not practical to deliver by air or ice road. For example, the dock will berth resupply barges from Prudhoe Bay or Hay River. The dock will also provide launching for response vessels during the summer broken-ice season.

Airstrip

The airstrip at Point Thomson will be used for crew changes year round and equipment and material resupply when ice roads and sea traffic are not available. Regular flights will use Twin Otters, Beachcraft 1900, and similar-sized aircraft, but the airstrip will also handle an aircraft the size of a Hercules C-130, and will be used for well control response equipment, emergency evacuation or for MEDEVAC (medical evacuation) if required. The airstrip facility will include communication and instrumentation for navigational aid.

3.2 RECEIVING ENVIRONMENT [18 AAC 75.425(e)(3)(B)]

ACS *Technical Manual Vol. 2 Map Atlas* Sheets 91 through 105

The receiving environment consists of the shorelines down-slope of oil pipelines, wells and tanks, and the marine waters and shorelines of the Beaufort Sea.

3.2.1 Water and Weather

The Arctic Coastal Plain has an arctic maritime climate that is very cold. The Arctic Ocean moderates extreme summer temperatures near the coast. Summer fog is common. Maximum summer temperatures reach 71ºF to 74ºF and the minimum winter temperatures drop below –50ºF. The mean annual air temperature at Barter Island is 9.8ºF, where it ranges from a mean maximum of 45.1ºF during summer months to a mean minimum of –26.6ºF during winter months. Table 3-4 presents historical ambient temperatures at Barter Island.

TABLE 3-4
BARTER ISLAND AVERAGE AMBIENT TEMPERATURE (ºF)

MONTH	MONTHLY MEAN	MAXIMUM DAILY AVERAGE	EXTREME MAXIMUM	MINIMUM DAILY AVERAGE	EXTREME MINIMUM
January	-14.2	-8.0	37.5	-20.5	-53.5
February	-19.2	-13.1	36.5	-25.2	-57.5
March	-15.7	-9.3	34.5	-22.1	-51.5
April	-1.6	-5.9	42.5	-8.9	-43.0
May	20.1	25.2	44.0	15.0	-17.5
June	34.0	38.2	69.5	29.9	8.5
July	39.6	45.2	78.5	34.1	23.0
August	38.5	43.0	74.0	33.8	20.0
September	31.0	34.4	64.0	27.4	2.5
October	14.4	19.3	44.5	9.5	-29.0
November	-1.0	4.6	38.0	-6.5	-45.5
December	-12.1	-6.0	35.5	-18.2	-53.0

Table 3-5 presents the yearly probability of temperature occurrence. The data are based on statistical analysis of 20-plus years of weather data collected at Prudhoe Bay and are used as a basis for approximating annual average available horsepower for turbine-driven equipment. Annual average capacity is calculated by weight-averaging the maximum instantaneous capacities by the likelihood of occurrence for each ambient temperature. Likelihood of occurrence is based on statistical analysis of 16 years of hourly temperature data from Prudhoe Bay. The likelihood of occurrence for –40ºF is the fraction of the hourly readings that fall below –35ºF. The likelihood of occurrence for –30ºF is the fraction of the hourly readings that fall between –35ºF and –25ºF, and so on. The likelihood of occurrence for 70ºF is the fraction of the readings that fall above 65ºF.

TABLE 3-5
PRUDHOE BAY YEARLY PROBABILITY OF TEMPERATURE OCCURRENCE

TEMPERATURE (˚F)	PERCENTAGE OF OCCURRENCE
-40	3.3
-30	7.3
-20	10.2
-10	11.4
0	10.6
10	9.7
20	9.3
30	17.2
40	13.9
50	5.0
60	1.7
70	0.4
Average 10.7ºF	-

Winds are generally from the east-northeast (N70ºE), but wind shifts to the west or northwest are common throughout the summer. Strong westerly and southwesterly winds can occur during storms (Figure 3-3 and Table 3-6).

FIGURE 3-3
WIND DIRECTION FREQUENCIES AT BARTER ISLAND

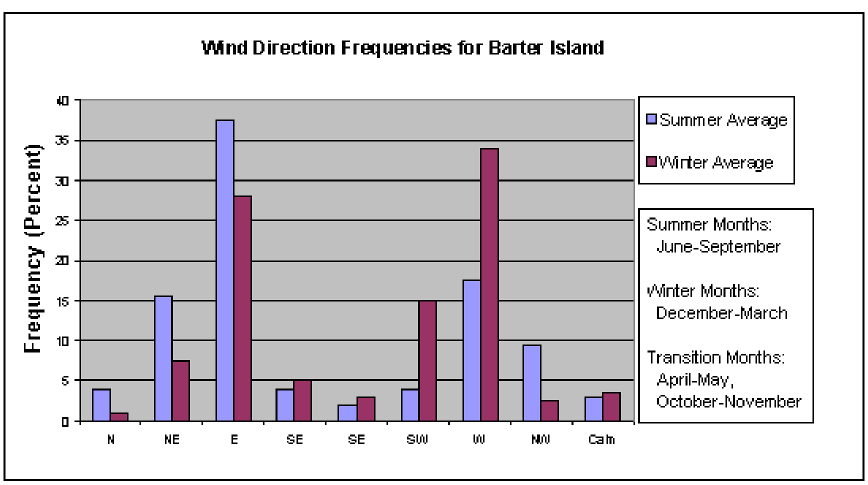


TABLE 3-6
MEAN AND INSTANTANEOUS WIND

MONTH	MEAN SPEED WIND (MPH)[1]	PREVAILING WIND DIRECTION	MAXIMUM HOURLY WIND AVERAGE SPEED (MPH)[2]	MAXIMUM INSTANTANEOUS WIND [3]	
				SPEED (MPH)	DIRECTION
January	14.7	ENE	30.8	81.0	W
February	13.7	WSW	31.2	63.0	W
March	13.3	WSW	25.9	77.0	WNW
April	12.4	ENE	30.4	52.0	W
May	13.7	ENE	28.2	55.0	WSW
June	13.3	E	23.7	38.0	W
July	12.9	ENE	27.3	40.0	SW
August	11.9	ENE	29.5	44.0	W
September	13.1	ENE	28.8	78.0	W
October	13.6	ENE	29.3	58.0	W
November	13.8	ENE	35.7	81.0	WSW
December	13.2	WSW	30.4	72.0	W

[1] Deadhorse Airport
[2] Prudhoe Bay Unit (PBU) Pad A Monitoring Site
[3] Barter Island, National Weather Service Station

Data recorded at Barter Island are representative of conditions along the Arctic coast. Weather data derived for the Yukon Gold No. 1 well site, south of the Point Thomson facilities area, are representative of conditions further from the coast (Table 3-7). Inland locations tend to have more sunshine, less fog, and higher summer temperatures. Because inland areas are warmer than coastal sites, the calculated mean maximum summer temperatures are higher inland, and there is a longer thawing period.

TABLE 3-7
CLIMATE DATA FOR YUKON GOLD ICE PAD AREA (INLAND) AND BARTER ISLAND (COASTAL)

CLIMATE VARIABLES	DERIVED YUKON GOLD ICE PAD AREA CLIMATE DATA	RECORDED BARTER ISLAND CLIMATE DATA
Average air temperature	11.0ºF	14.2ºF
Mean maximum air temperature	46.5ºF	45.1ºF
Mean minimum air temperature	-19.1ºF	-26.5ºF
Thawing index	1,025ºF-days	570ºF-days
Freezing index	8,620ºF-days	8,400ºF-days
Length of thawing season	92 days	92 days
Average snow depth	0.5 feet	0.9 feet
Average wind speed	13.5 mph	13.3 mph

Notes:
Thawing ºF day: degree days above 32ºF
Freezing ºF day: degree days below 32ºF

At Point Thomson, precipitation yields 5 to 7 inches water equivalent per year. Average visibility is less than 2.5 miles 1 to 4 days per month from October to April and 8 to 16 days per month from May through September.

Oceanography

The principal marine environment within the Point Thomson Development area is a relatively shallow marine lagoon south of a Barrier Islands complex. The lagoon has a width of approximately three to four miles and water depths of typically 5 to 13 feet. The Barrier Islands complex parallels the coast and extends approximately 18 miles from Challenge Island on the west to Flaxman Island on the east, and these are part of the Barrier Islands that separates the lagoon from the Beaufort Sea. Passes or gaps between the Barrier Islands connect the lagoon waters with the Beaufort Sea, and thus, waves, storm surges, and other regional oceanographic processes influence the lagoon waters.

It was noted that the nearshore Beaufort Sea ice season can be categorized into five periods (Dickins, 2002 personal communication):

- Onset of ice overflood leading to initial deterioration of ice nearshore (May/June);
- Progression of ice clearing, leading to initial open water conditions (June/July);
- Summer open water period (July to September);
- Progression of freeze-up leading to stable fast ice cover (October/November); and
- Winter stable ice (December/May).

From year to year, the duration of the open-water season is variable. While freeze-up offshore generally occurs by mid-October, open water caused by storms has been observed as late as February. When freeze-up occurs late, strong early winter storms can produce large waves as winds blow over expanses of open water.

Table 3-8 summarizes the likelihood of extreme open-water physical conditions that could occur yearly and on a 100-year return period.

TABLE 3-8
OCEANOGRAPHIC DATA SUMMARY

VARIABLE	1-YEAR RETURN PERIOD (TYPICAL PERIOD)	100-YEAR RETURN PERIOD
Seawater temperature	29ºF to 35ºF	40ºF
Surface currents (preliminary estimates) at Mary Sachs Entrance	2 knots (2.3 mph) for east and west	3 to 4 knots (3.4 to 4.6 mph), (east or west)
Storm surges and water level (preliminary estimates): East wind set-down, West wind set-up	-1 foot mean sea level (MSL) +23 feet MSL	-2 feet MSL +6.7 feet MSL (lagoon)

Bathymetry

The Barrier Islands complex shelters much of the lagoon within the Point Thomson development area from exposure to storm waves generated in the Beaufort Sea during the open-water periods. Mary Sachs Entrance, a broad 2.25-mile pass between Point Thomson and Flaxman Islands, divides the lagoon. The lagoon east of Mary Sachs Entrance is shallow and is protected by Flaxman Island. West of Mary Sachs Entrance lies a deeper and wider lagoon open to the west.

Water depth in the eastern part of the lagoon near Point Thomson proper is shallow. Shoals are common near the mouth of the Staines River and western distributary of the Canning River and extend toward Brownlow Point. The pass between the east-end of Flaxman Island and Brownlow Point is narrow (1,200 feet) and relatively deep (26 feet). Historical soundings by National Oceanic and Atmospheric Administration (NOAA Chart No. 16045) suggest that the lagoon is asymmetrical with deeper waters near the mainland shore and a gentle slope from the mid-channel north of Flaxman Island. Water depths within the lagoon gently increase toward the west to a depth of 8 feet, approximately mid-length of Flaxman Island, and reach 11 feet immediately northeast of Point Thomson.

Mary Sachs Entrance is a broad and relatively deep pass with a northeast/southwest- oriented channel that extends toward Point Thomson. Water depths within the channel are typically 9 to 11 feet with the 10-foot isobath approximately 2,400 feet north of the mainland shore in the vicinity of Point Thomson. Mary Sachs Entrance provides a break in the protection offered by the Barrier Islands, exposing the shoreline adjacent to and east of Point Thomson to offshore storm events. The increased exposure to waves is evidenced by the well-developed spit and bar formation along the mainland shore.

The western portion of the lagoon is protected by a group of barrier islands known as the Maguire Islands (Challenge, Alaska, Duchess, and North Star Islands). This portion of the lagoon widens from 1.5 miles at Point Thomson to 3.5 miles near Challenge Island. Water depths adjacent to the mainland between Point Thomson and Point Hopson are typically 7 to 10 feet and gently increase to 16 feet at the west-end of the lagoon.

The bathymetry chart available for the area is based on the 1949 and 1950 surveys conducted by the National Ocean Service Coast Survey with additional data from the State of Alaska, U.S. Geological Survey, and the USCG.

In June 1998 and August 2002, Coastal Frontiers Corporation performed a bathymetric reconnaissance, measuring water depths along a potential barge route within the lagoon including Mary Sachs Entrance. The data included a route from Mary Sachs Entrance to the proposed Point Thomson dock.

Tides and Storm Surges

As with other areas along the Beaufort Sea, coast tidal ranges are less than the ranges for storm surges. The tide range is slight, about 0.7 foot, but the range of sea level rise and fall due to major storms (storm surge) can be as much as 8 feet at the shore.

The Coriolis effect is pronounced in high latitudes, causing moving seas to be deflected to the right in the Northern Hemisphere. Therefore, westerly winds tend to force water onto the shore causing an increase in sea level or set-up. Conversely, easterly winds tend to force water away from the coast resulting in a lowered water level or set-down.

Waves

Storm waves in the shallow lagoon waters are smaller than storm waves generated in the deeper Beaufort Sea waters north of the barrier islands complex. Passes between the barrier islands allow higher wave energies to enter the lagoon system as evidenced by the shoreline near Point Thomson, an exposed portion of the lagoon shoreline immediately south of Mary Sachs Entrance.

Based on National Weather Service records, the longest storm duration (wind speed exceeding 30 knots) was 42 hours for a westerly storm (September 1954) and 66 hours for an easterly storm (September 1979).

Nearshore Currents

The nearshore Beaufort Sea has been studied intensively for nearly two decades, so the oceanography of the region is well understood. As with most shallow seas, the dynamics of the Beaufort Sea are governed almost exclusively by the wind. The currents in shallow water align generally with the wind direction, i.e., east winds produce westward currents and west winds produce eastward currents.

Three forces drive the circulation of the coastal ocean: wind stress, horizontal pressure gradients, and tides. Along the Beaufort Sea coast, astronomical tides are small (less than 0.7 feet) with associated currents that are less than 0.1 knot, except in the narrow passes between barrier islands. Winds are almost always parallel to the coast, with easterlies prevailing about 60 percent of the open-water season, July through September.

Site-specific current measurements were made in a 40-day period throughout August and early September 1997 in the passes on each end of Flaxman Island. Typically, currents within Mary Sachs Entrance were less than 0.6 knots, however at the peak of a severe easterly storm during late August, current speeds were measured at almost 1 knot. Tidal currents observed in Mary Sachs Entrance were typically between 0.01 to 0.2 knots. Active sediment transport was evident with the burial of the current mooring anchor.

Water movement through the narrow channel between Brownlow Point and the east end of Flaxman Island typically reached speeds in excess of 1.2 knots with a maximum-recorded value of 1.7 knots. However, the mooring was fouled prior to a late August storm event in which higher current speeds would have been observed.

Snowmelt River Floods

On the streams flowing into the lagoon, snowmelt floods occur every year. During the long winter, an average of about 5 inches of precipitation falls in the form of snow. A substantial portion of the precipitation is lost to sublimation. For small drainages in the project area, an average of about 3 inches of water generally remains on the ground in the form of snowmelt.

Because of the transport of snow by drifting, the actual amount available in a particular small drainage basin can vary widely depending on the ability of the local relief to trap snowdrifts. During spring snowmelt, the first run-off occurs as sheet flow over the ground surface; because the ground is frozen, infiltration is practically nonexistent. When break-up commences, the first snowmelt runs over the frozen surface of small streams and ponds behind snowdrifts. As break-up progresses, the small drifts are overtopped, and the accumulated meltwater is released to flow downstream until it again ponds behind a larger snowdrift in a larger stream or river. The storage and release process results in an extremely peaked run-off hydrograph. Flow during break-up is both unsteady and non-uniform.

Once the break-up crest has passed a particular point on a stream, the recession is rapid. Typically, the flow on a small stream two weeks after the break-up crest is less than 1 percent of the peak flow, and the smallest drainages can be completely dry within two weeks. During break-up, the bed and banks of small drainages tend to remain frozen, and erosion is limited.

Flood Timing

Floods on small streams have historically occurred as a result of snowmelt, which responds to a rapid, seasonal increase in temperature. As a result, snowmelt floods on a given stream tend to occur at about the same time each year. Rivers originating in the Brooks Range flood about the first week of June, while smaller Arctic Coastal Plain streams crest about one week later than the large rivers. The largest floods tend to be associated with later break-ups. Small streams near the coast tend to be the last to break up.

In general, the year-to-year time lag between the earliest and the latest break-up on a stream is approximately two weeks. The small, un-named coastal streams that cross under the Point Thomson condensate export oil pipeline typically break up two weeks after the mid-May break-up of the Sagavanirktok River.

Seventeen streams flow under the Point Thomson condensate export pipeline east of Badami, as indicated on ACS *Technical Manual, Volume 2, Map Atlas* maps. Six of the streams were studied by Dames and Moore (1983) and Hydrocon (1982). The largest is East Badami Creek, labeled by Dames and Moore (1983) and Hydrocon (1982) as the "un-named creek at milepost 31.8." Four other streams flow under the multi-phase flowline between the Point Thomson East Pad and the CPF.

ACS *Technical Manual, Volume 2*

Studies of two creeks provide examples of break-up during the first week of June, as follows:

East Badami Creek originates in the foothills and discharges into Mikkelsen Bay (Dames and Moore, 1983). The creek was still snow-covered without signs of break-up on May 30, 1983. On June 2, some sheet flow and open water were noted. The next day, the water had risen one foot and flooded the banks. Some anchored (bottom-fast) ice was lifting. On June 4, 80 percent of the channel bottom was covered by anchored ice and most of the water flowed over it. On June 7, open water flowed at 3.5 feet per second (2.4 mph); ice floes were up to 2 feet thick and 5 to 10 feet wide and stationary in the creek. Most of the bottom-fast ice was still in place.

On July 14, 1982, the East Badami Creek discharge was measured as less than 2 cubic feet per second (cfs) (Hydrocon, 1982). On July 15, 1983, the flow was 2.5 cfs, on August 22 it was less than 1 cfs, and on September 15 it was 23 cfs (Dames and Moore, 1983).

The un-named creek 2 miles east of Bullen Point drains 12 square miles of the Arctic Coastal Plain and discharges into Mikkelsen Bay. On June 1, 1983, the stream was still snow-covered and showed no indications of break-up. On June 4 and 5, the banks were flooding and small ice pieces were floating at 4 feet per second (2.7 mph). By June 7, the stream was completely open and all the bottom-fast ice had lifted and drifted downstream. On July 15, 1983, the discharge was less than 1 cfs. On August 22 the flow was zero. On September 15, it was 4 cfs (Dames and Moore, 1983).

Rainfall Floods

Summer floods are not anticipated to produce design floods for the Arctic Coastal Plain streams because the rainfall intensity is low and tundra and thaw lakes have a relatively large capacity to absorb and retard resultant run-off. However, summer floods resulting from unusually large rainstorms in the Brooks Range occur on rivers originating in the Brooks Range, such as the Sagavanirktok River. These floods are not frequent but may be larger than typical break-up floods.

3.2.2 Sea Ice

Descriptions of nearshore ice conditions in this section are a communication from DF Dickins and Associates (2002). This description provides a guide to ice conditions affecting marine operations that support the Point Thomson development. The emphasis here is the typical annual ice cycle from break-up to freeze-up.

Numerous industry and government references describe general ice conditions in the Alaskan Beaufort Sea and along the North Slope. Much of this material deals with the morphology and dynamics of the floating fast ice; shear zone, and seasonal pack ice in water depths well beyond 6 feet, corresponding to the approximate seaward limit of the bottom-fast or grounded-fast ice zone.

The limited number of reports dealing with nearshore observations and the lagoon areas often focus on the density and location of strudel scours affecting the integrity of buried pipelines.

This section describes the nearshore ice environment near the Point Thomson Development, encompassing the following geographic areas:

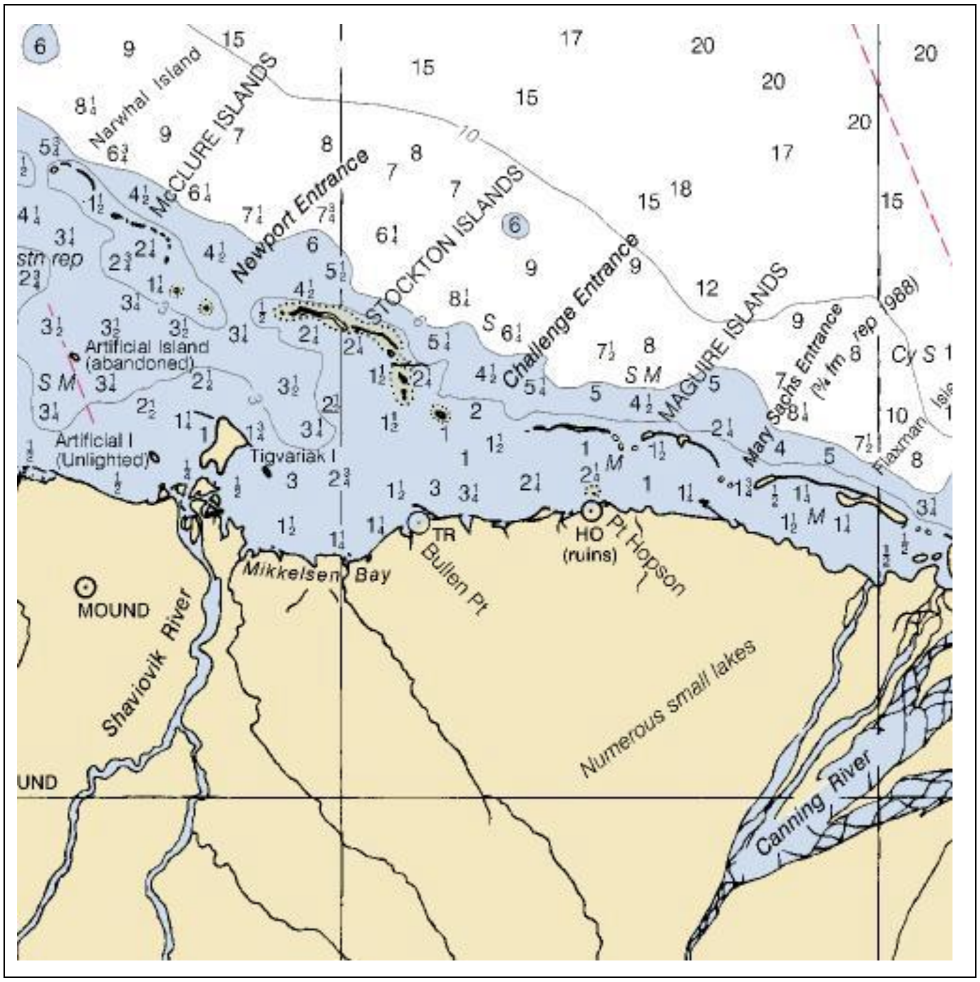
- Lagoon areas inside the barrier islands from the mouth of the Canning River westward through Lion Bay into Mikkelsen Bay.
- Beaufort Sea up to 3 miles offshore (40-50 feet of water) of the barrier islands from north of the mouth of the Canning River westward to Challenge Island.

In addition, the timing and pattern of nearshore ice clearing in Foggy Island Bay is mentioned as it relates to the regional clearing along the coast from Brownlow Point to Prudhoe Bay/West Dock. Figure 3-4 shows the nearshore lagoon and immediate offshore region out to approximately 50 feet of water (just inshore of the 10-fathom contour shown on the chart). In most years, the entire area falls within the stable landfast ice zone, with the mobile pack ice typically found in water depths beyond 60 feet.

In this description, satellite images were used to visualize the typical sequence of break-up and clearing along shore, following the spring overflood. These images include several recent color scenes acquired by the Landsat 7 between 1999 and 2002, and a series of historical black and white Landsat images from the period 1973 to 1986. This description also draws on a number of available references in the pubic domain. Published sources include:

- *Beaufort Sea Ice Atlas* prepared by Dickins Associates for SOHIO (1984), and the *Alaska Marine Ice Atlas* prepared by LaBelle and Wise (1983). The ice maps in these atlases tend to cover too large a scale to be of much value in describing local conditions but they provide an indication of overall trends in freeze-up and clearing dates and duration of open water.
- Joint-industry studies: principally a series of reports covering freeze-up and break-up along the North Slope in the period 1980 to 1985 by Vaudrey & Associates (tabled as public documents in the preparation of the Northstar Environmental Impact Statement [EIS]; U.S. Army Corps of Engineers, 1998);

FIGURE 3-4
GENERAL LOCATION MAP SHOWING THE ICE DISCUSSION AREA



- Comprehensive descriptions of the ice environment at particular coastal sites prepared by Vaudrey & Associates as part of the "Oil Spills in Ice Discussion Paper" (2000).
- A comparative study by Atwater of historical break-up and freeze-up patterns off the major river deltas in the Prudhoe Bay area (including the Canning River) completed in 1991 as part of the 1989 and 1990 Endicott Environmental Monitoring Programs.

The following sections describe the ice environment sequentially through a typical season, starting with the first onset of ice overflood and closing with the establishment of a stable winter ice cover in November.

Ice Overflood and Initial Open Water (May/June)

The transition from a stable, growing winter ice cover to first ice deterioration begins in late April or early May with longer daylight hours and warmer air temperatures. By early-to-mid May, the ice sheet loses much of its bearing capacity, to the point that ice roads may be unsuitable for heavy loads or conventional wheeled vehicles.

Warm air temperatures in June lead to the formation of melt ponds on the top of the landfast ice, especially where the surface is contaminated with dirt either left from drainage of overflood waters, or windblown off the nearby land. In late May or early June at the time of river overflood, melt ponds usually cover less than 10 percent of the landfast ice area beyond the overflood limits. Many melt ponds develop holes all the way through the sheet ice due to enlargement of brine drainage channels.

For a brief period, the sea ice can appear almost totally flooded by snow meltwater. A Landsat image from June 4, 1983 shows almost the entire lagoon area from Brownlow Point to Badami as flooded ice. The ice appears as open water at first glance, but submerged ice under the meltwater is just visible on the imagery. Only one week earlier, a May 28 image shows overflood just starting with no water on the ice apart from immediately off the river deltas. The change in ice appearance in this case is linked to snowmelt on the sea ice, not river overflood. Historical records point to 1983 as a year with an unusually early river overflood, followed by drainage of water on the ice one week to 10 days ahead of normal drainage (Atwater, 1991).

The surface ice appearance changes dramatically over a few days as the meltwater from snow or river overflood drains through the deteriorating sheet. By late June just before break-up, the number of melt ponds has increased dramatically, covering approximately 40 percent to 50 percent of the sheet ice surface. Ice thickness at the time of break-up nearshore is variable because of the melt pool topography but averages between 3 and 4 feet depending on where the measurement is taken (2 to 3 feet less than the end-of-winter thickness).

The progression of break-up at many operating fields along the North Slope is largely controlled by the timing and extent of river outflow (e.g., Point McIntyre PM1, Endicott). The transition from the winter to summer ice season in these areas begins with the break-up of ice in upland rivers triggered by snowmelt in the upland drainage basins, and overflooding of the bottom-fast and floating sea ice just offshore of the river deltas (Kuparuk and Sagavanirktok) during late May or early June. During late May or early June, the rapidly rising stage levels float the river ice off the bottom in the river channels. A wave of rapidly building meltwater moves downstream to flow out on top of the still solid sea ice frozen to the seafloor along the delta fronts (i.e., bottom-fast ice) and out onto the floating fast ice.

The river overflood water reaches depths of 2 to 5 feet on top of the nearshore sea ice. Off the major rivers (e.g., Colville, Kuparuk), this fresh water flood boundary often extends out to deeper water where it has an opportunity to drain through the floating fast ice in water depths of 6 to 30 feet. However, near Point Thomson the overflood from a small river such as the Staines is localized in shallow water within the lagoon and does not have an opportunity to spread onto the floating ice beyond the barrier islands.

Eventually, the overflood water loosens the bottom-fast ice, allowing it to pop up to the surface. Within the overflood zone, the top of the now floating drained ice is usually left covered with a layer of silt deposited by the floodwater. Typically by mid- to late-June, about two to three weeks after the river flooding has ceased, most of the landfast ice within the overflood zone melts in place from a combination of the fresh, relatively warm water and the increased heat absorption by the dirty ice.

This overflood effect from the two major rivers (Sagavanirktok and Kuparuk) leads to the rapid clearing of over 100 square miles of fast ice between Endicott and Oliktok (Dickins et al., 2001). However, in the Point Thomson area, the localized overfloods from smaller rivers and creeks are not sufficient to control the ice clearing within Leffingwell lagoon (south of Flaxman

Island). A combined overflood from the west channel of the Canning River discharging to the west of Brownlow Point, and the Staines River is largely confined in a local area less than a few miles in extent. An even smaller overflood occurs in Mikkelsen Bay off the mouth of East Badami Creek (see observations from satellite images described below).

Although too small in extent to show on historical satellite images (less than 100 meters), localized minor overfloods likely occur at the mouths of numerous creeks that drain sections of the Arctic Coastal Plain. Typical watersheds are in the order of tens of square miles. Not all of these streams or creeks have sufficient discharge to flood the coastal sea ice but some could produce local overflooding out to distances of a few hundred feet from shore. In some cases, these events may not occur every year.

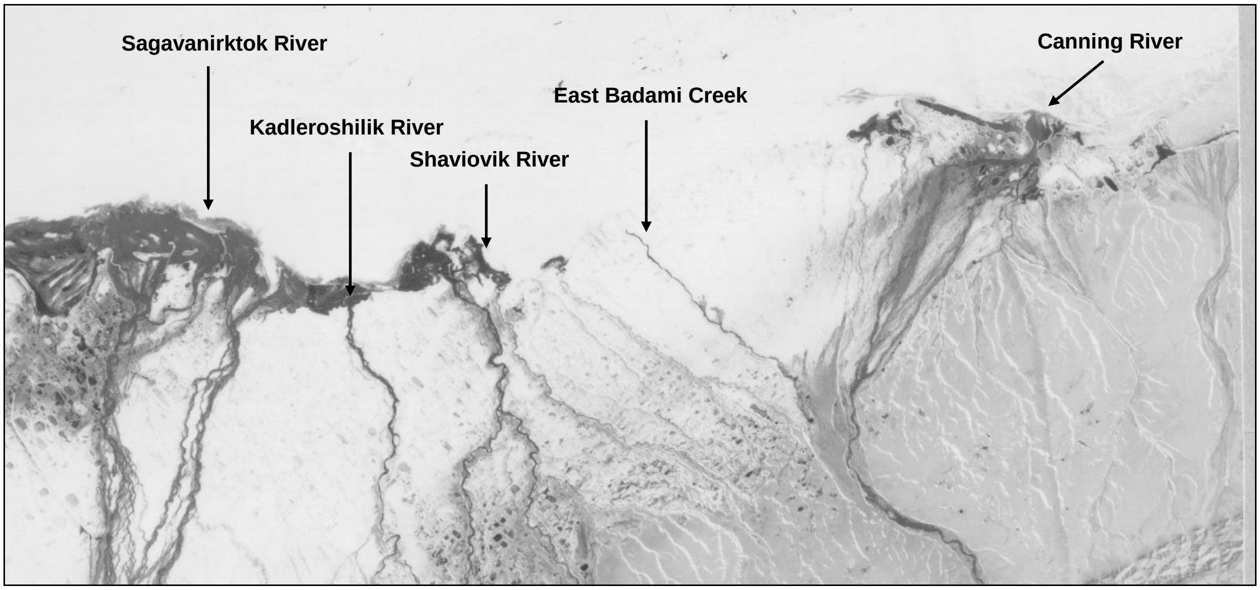
As an example of overflooding in the study area, a Landsat image from May 29, 1981, shows the overflood from East Badami Creek extending approximately 3,000 feet offshore and to the east. To the west, a narrow (few hundred feet) band of open water spread alongshore as far as the current dock. The No-Name River to the west of Badami (ACS Map Sheet 91) was also overflooding onto the ice, independently of the much larger Shaviovik overflood. Historically, the timing of river overflood (using the Canning as a baseline) in 1981 was within a few days of the long-term mean (Atwater, 1991).

A Landsat image (June 1981) shows rotting but still continuous ice throughout the lagoon area. The only visible signs of ice clearing in the study area were a small patch of open water between the mouth of the Staines River and the west channel of the Canning River (3,000 to 4,500 feet in extent), as well as the localized overflood already noted off East Badami Creek at the end of May (unchanged in extent).

Figure 3-5 is a Landsat 4 scene showing conditions 48 hours after drainage of floodwaters from the major rivers (left to right, the Sagavanirktok, Shaviovik, and Canning rivers) in 1986. The dark areas off the large deltas include a mix of still flooded bottom-fast ice and areas of drained ice with sediment deposited by the overflood. Also clearly visible are the still flooded nearshore areas immediately off the mouth of the Staines River, No-Name River west of Badami, and East Badami Creek. In addition, the un-named stream emptying into the ocean at Bullen Point is open and flowing (dark) to within a few miles of the coast.

In summary, the timing of the main overfloods affecting the Point Thomson development area (Staines and Shaviovik) mimic, within a few days, the progression of the nearby Canning River which discharges large volumes predominantly into the west side of Camden Bay. Initially, most of the overflood area off the Canning River is isolated from the lagoon areas to the west by Brownlow Point. Eventually, the initial clearing associated with the Staines River and West Canning overflood expands around Brownlow Point to become contiguous with the much larger clearing off the Canning Delta. This connection generally occurs in late June. By this time, the open water areas, which initially formed off the Shaviovik, Kadleroshilik, and Sagavanirktok Rivers, have also become continuous. The last area to clear (one to two weeks later) tends to be the coastal section between Point Thomson and Bullen Point (an area not directly impacted by river overflood).

FIGURE 3-5
LANDSAT 4 IMAGE JUNE 13, 1986, SHOWING COASTAL ICE CONDITIONS APPROXIMATELY 48 HOURS FOLLOWING FLOODWATER DRAINAGE FROM THE MAJOR RIVERS



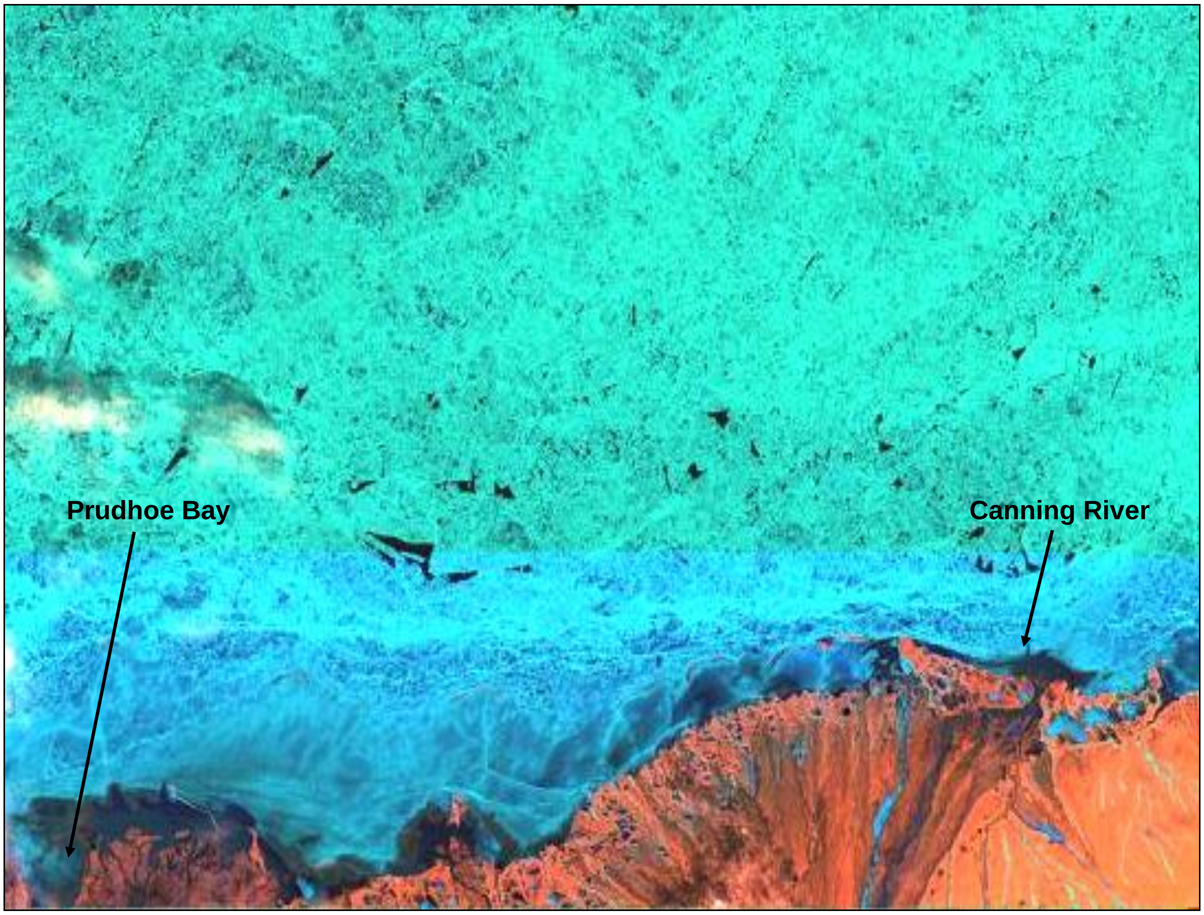
Atwater (1991) documents the historical record of overflood development and initial ice clearing off the deltas of the major river systems in the Prudhoe Bay area. Her data show minor differences between the onset of river flooding from the different river systems, with the Sagavanirktok River tending to flood first (mean May 20), followed by the Canning River three days later and the Kuparuk River four days later still. Specific years could see reversals in this pattern. As the closest large river to the study area, the historical break-up record for the Canning River is summarized in Table 3-9 from Atwater's analysis. Timing of break-up events is variable from year to year, depending on a range of climatic factors. Early and late clearing could occur from 10 to 20 days before or after the averages shown.

TABLE 3-9
HISTORICAL BREAK-UP SEQUENCE FOR THE CANNING RIVER, 1974-1990 (ATWATER 1991)

MILESTONE EVENT	AVERAGE DATE
River Channel Swelling	16 - May
Major Flooding	23 - May
Floodwater Drainage	06 - June
Open Water in the Delta	20 - June
Break-up of Floating Fast Ice (Camden Bay)	30 - June
Ice Free Conditions	21 - July

Figure 3-6 shows a Landsat 7 browse image (reduced resolution) acquired on June 18, 2000. This scene captures the nearshore ice in the final stages of deterioration before wide-scale clearing in the lagoon areas. Notice local open water areas near the larger river delta and near Point Thomson shoreline.

FIGURE 3-6
DETERIORATED ICE IN THE LAGOON AREAS



Progression of Break-up Leading to Open Water

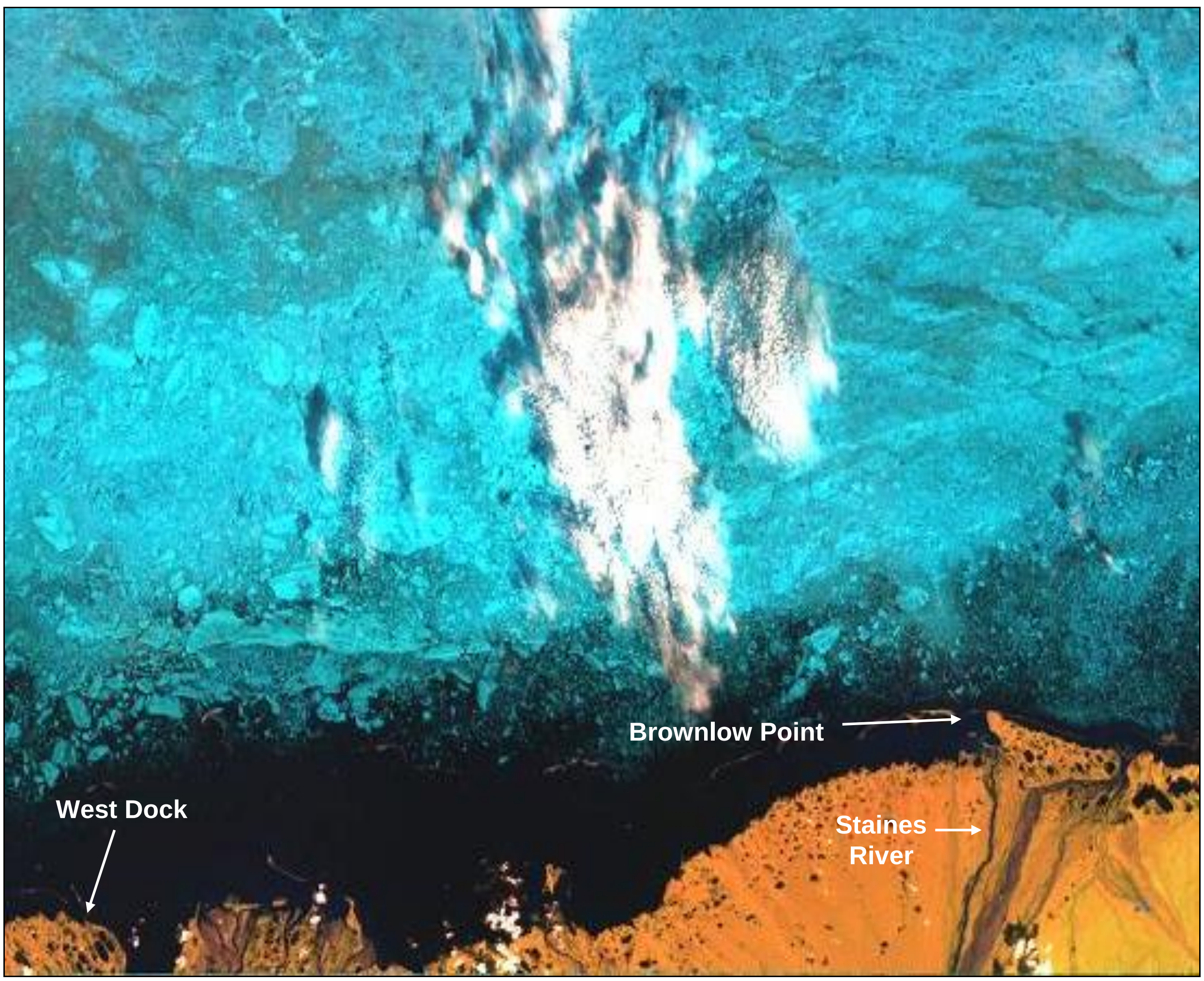
While the lagoon areas open up through a combination of river overflood and *in situ* melting (aided by sediment on the ice and the influx of relatively warm fresh water), the floating fast ice outside the barrier islands continues to melt in place from the surface down. The initiation of break-up offshore is related to lines of weakness that tend to develop along a series of melt ponds or old thermal or stress cracks (Vaudrey, 2000).

By the first week in July, open water is typically present in an arc around Brownlow Point, encompassing the very shallow lagoon area east of Point Thomson, bounded by Flaxman Island to the north. At this time, a second expanse of open water usually stretches in a broad arc from the south shore of Mikkelsen Sound (vicinity of Badami) across Foggy Island, around the Sagavanirktok Delta (encompassing Endicott) and stretching as far as Oliktok within Simpson Lagoon, and into the Colville River Delta. These are typical or median conditions; delayed or early melt or overflood affect nearshore ice clearing dates by up to 15 days.

By mid-to-late June, the remaining floating fast ice in central Mikkelsen Bay is usually still intact but reduced to 3 to 4 feet in thickness, with many cracks and through-melt holes. Break-up of the remaining nearshore fast ice occurs between the third week in June and the first week of July, with a median date of July 1 and a standard deviation of 6 days. The length of the broken ice period near Badami was estimated by Vaudrey (1998) as typically 7 to 10 days (3 weeks maximum).

Once the lagoon ice has cleared, the deteriorated offshore fast ice begins to fracture and becomes mobile in early July, usually triggered by a wind event. Concentrations steadily diminish through melting and wave and floe interactions over a period of two to three weeks. Remaining broken ice at this time moves back and forth in response to wind shifts, in belts and patches of varying concentrations (expressed as tenths coverage). By the end of July or the first week of August, the study area typically becomes open water (defined as less than 1/10 ice concentration) out to water depths in the 40- to 60-foot range more than 3 miles off the Barrier Islands. Figure 3-7 shows fairly typical conditions for late July in the study area with substantial patches of rotting ice and isolated heavy floes still present in deep water north of the Barrier Islands, but almost complete clearing and open water along the coast to Prudhoe Bay and beyond into Harrison Bay. Figure 3-7 is a Landsat 7 image taken July 23, 2001. It shows the area from Brownlow Point westward to West Dock at Prudhoe Bay.

FIGURE 3-7
LANDSAT 7 JULY 23, 2001, SHOWING OPEN WATER ALONG THE COAST FROM BROWNLOW POINT TO WEST DOCK



Once established, open water conditions prevail until freeze-up (see below). There have never been any instances of drift ice entering the lagoon area between Brownlow and Bullen Points during the summer months in concentrations greater than 1/10 (August/September). The median duration of open water in the lagoon area is 12 weeks, with a variability of up to two weeks representing summers better or worse than average in terms of break-up and freeze-up (Dickins, 1984). Immediately outside of the Barrier Islands (out to the 50 foot water depth) the duration of open water drops by about two weeks and, in some summers, is reduced by several weeks through temporary pack ice invasions.

Vaudrey's annual break-up studies along the Beaufort Sea coast in the 1980s provide a valuable record of the patterns and variability of ice clearing. A number of these observations are summarized below for the years 1984 and 1985 using reports tabled publicly in the Northstar EIS process (US Army Corps of Engineers, 1998).

The following summary is paraphrased from Vaudrey (1986a) reporting on the 1985 break-up.

> *June 1, 1985:* Entire study area still 10/10. Shaviovik River overflood boundary reaches as far as Badami in Mikkelsen Bay. Canning West branch overflood reaches as far as the Staines River mouth.
>
> *June 25-July 2, 1985:* Study area still 10/10 ice with open water within the area previously flooded by the Canning and Staines Rivers - no expansion of open water west of the Staines River. No opening in Mikkelsen Bay. Foggy Island Bay is open from Point Brower to the Kad River.
>
> *July 3-7, 1985:* Open water at the eastern end of lagoon has spread as far as Point Thomson Unit # 3 and out to Flaxman Island. Mikkelsen Bay is open from the north shore of Tigvariak Island to Bullen Point and to the west off the Sagavanirktok Delta and Prudhoe to West Dock. The rest of the inshore lagoon area from Point Thomson to Bullen Point is 5-6/10 rotting fast ice. Offshore area north of Flaxman is still 7-8/10 ice covered out to 30 feet of water, with 9/10 ice beyond.
>
> *July 24, 1985:* Entire study area inside the islands is open water. To the north of the islands (Flaxman to Challenge Entrance) concentrations range from 2-4/10 out to 30 feet of water and 9/10 beyond. To the west (as far as Harrison Bay) the entire area inside of 30-40 feet of water is open water.

The following summary is paraphrased from Vaudrey (1985a) reporting on the 1984 break-up.

> *July 7, 1984:* Open water stretches around Brownlow Point and as far as the East tip of Flaxman. Lagoon areas off Point Thomson mobile 8-9/10 ice, with Mikkelsen Bay still 10/10 ice past Bullen Point. Offshore area outside of the Barrier Islands open out to 30 feet of water with 7-8/10 in deeper water. Open water out to about 20 feet of water off Foggy Island Bay and around the Sagavanirktok Delta to include all of West Dock.
>
> *July 17, 1984:* Open water in the lagoon area south of Flaxman. Lagoon areas from Point Thomson west to Bullen Point 7-9/10 ice reducing to 4-5/10 in north Mikkelsen Bay. Southern part of the Bay from Tigvariak Island across to Bullen Point is open. From west of the Shaviovik River to West Dock, the entire coast is clear out to 30 feet of water.

Progression of Freeze-up Leading to Stable Ice Cover

The initiation of freeze-up along the coast between Badami and Point Thomson ranges from mid-September to the last week in October, with a median date of October 5 and a standard deviation of 8 days. Moving broken ice is rarely encountered nearshore in this area (Vaudrey, 1998). Most of Mikkelsen Bay and the lagoon areas to the east become entirely ice-covered within 7 to 10 days after freeze-up begins. This young first-year ice (4 to 10 inches thick) may be susceptible to movement and deformation by storm winds during this period.

After the sheet ice reaches a thickness greater than 8 inches, typically by mid-to-late October, the ice cover in the lagoon shallow areas becomes relatively stable, confined by the island chain stretching west from Brownlow Point. In Mikkelsen Bay, with the broader expanse of ice inside the Islands, the sheet may take slightly longer (up to five days) to stabilize, but this entire area is characterized by static smooth ice throughout the winter (9 years in 10). No movements of the young sheet ice in Mikkelsen Bay were observed or measured after November 1 during the past 20 years (Vaudrey, 1998).

In terms of coastal susceptibility to early winter ice ride-up or pile-up when the sheet ice is less than two feet (Oct/Nov), the area inshore of the barrier islands from the Canning River to Point Thomson was rated as "0" (no events observed). The coast from Point Thomson west to Bullen Point was rated as "1" (one event observed over three years). Mikkelsen Bay and Foggy Island Bay were rated as "0". The seaward facing shorelines of the barrier islands were rated as "1" for Flaxman (infrequent or inconsequential), and "2" for Maguire Islands (moderate or 2-3 events observed) (Vaudrey 1985c).

Vaudrey's annual freeze-up studies along the Beaufort Sea coast in the 1980s provide a valuable record of the timing and character of the initial ice formation and expansion of the fast ice out from shore. A number of observations are summarized below for the years 1984 and 1985 using reports tabled publicly as part of the Northstar EIS process (U.S. Army Corps of Engineers, 1998).

The following summary is paraphrased from Vaudrey (1985b) reporting on the 1984 freeze-up.

> *October 23, 1984:* Young fast ice edge in 30 to 40 feet of water north of Flaxman Island. Two-mile-wide open lead running along the ice edge with 9/10 of young and new ice offshore. Large area of grounded multi-year ice off seaward side of Stockton and McClure Islands (Vaudrey, 1985).

The following summary is paraphrased from Vaudrey (1986b) reporting on the 1985 freeze-up.

> *October 8. 1985:* 8-9/10 new ice in the lagoon areas with open water offshore. Large area of grounded old ice north of Stockton Islands in 30 to 40 feet of water.
>
> *October 30, 1985:* Ice edge along the 30-foot water depth one mile off Flaxman Island, bordered by a one to two-mile lead — 8-9/10 new and young ice forming further offshore.
>
> *November 15, 1985:* Ice edge falls along the north side of Flaxman Island with an 8-10 mile lead further out. Solid ice in the lagoon areas. Large ice pileups on the north side of Alaska Island and off the northeast tip of Flaxman Island. Inshore ice protected from any deformation.

> *December 1-2, 1985:* Ice edge close inshore for this time of year — approximately 1 mile off Flaxman Island in 30 feet of water. 20-foot-high shear wall along the edge of the fast ice with 30 to 40-mile-wide lead of mostly open water and some new ice to seaward.

Winter Ice Conditions (November to May)

The winter period is characterized by stable landfast (also called shorefast) ice throughout the study area. The sheet ice grows to an average maximum thickness of 6 to 7 feet by the end of May. This means that ice in the shallow waters throughout most of the lagoon between Point Thomson and Brownlow Point becomes frozen to the sea floor at the end of the ice growth cycle.

Leffingwell Lagoon as well as Foggy Island Bay, Prudhoe Bay and Simpson Lagoon are characterized by Vaudrey (1985c) as First-year Morphology Zone I:

> "First-year sheet ice usually remains intact after initial formation at freeze-up. Very smooth with no ridging. Water depths such that sheet ice is bottom fast by end of winter."

The area immediately offshore of the Barrier Islands out to 3 miles off Flaxman Island (60 feet of water) was characterized as Zone III:

> "Landfast ice susceptible to movement until the ice becomes 2-3 feet thick sometime in December. Earlier ice movements during freeze-up may create rubble piles or grounded ridges up to heights of 20 to 30 feet. Sheet ice may be relatively smooth just north of the Barrier Islands but heavily deformed ridges and rubble piles often occur at the offshore boundary of this zone."

Once the nearshore ice is established and stable, the seaward fast ice remains close to the 60-foot water depth in most years. Satellite analysis by Dickins (1985 unpublished) showed that the average water depths at the ice edge were approximately 30 feet in November, 45 to 50 feet from December to March, and out to 75 feet in April and May. Off Flaxman Island, these water depths correspond to distances of 5 to 6 miles from shore in the November/December period, 7 to 8 miles from January to March, and 11 to 12 miles from April to May. The June ice edge tends to be a few miles closer to shore than the late winter maximum.

3.2.3 Potential Routes of Discharges [18 AAC 75.425(e)(3)(B)(i)]

The ACS *Technical Manual*, *Volume 2, Map Atlas* contains maps and information on the potential routes of spilled oil, identifies containment sites, distinguishes sensitive receiving environments, and shows the latitude and longitude coordinates.

ACS *Technical Manual, Volume 2, Map Atlas,* Sheets 91 and 96 through 105

Potential routes of discharge are as follows: shorelines down-slope of oil pipelines, wells and tanks; and marine waters and shorelines of the Beaufort Sea adjacent to the industrialized North Slope.

3.2.4 Estimate of RPS Volume to Reach Open Water [18 AAC 75.425(e)(3)(B)(ii)]

None of the condensate from the winter blowout scenario is expected to reach open water. The percentage of a summer well blowout RPS volume that would enter open water is illustrated in Section 1.6.14. One hundred percent of the condensate that might fall from pipeline leaks directly over streams could reach open water. No diesel from a tank spill would reach open water because the fuel would be retained by the secondary containment area and gravel pad. Site-specific descriptions of routes of travel and measures to prevent oil from reaching open water are provided in Section 1.6.14.

3.3 COMMAND SYSTEM [18 AAC 75.425(e)(3)(C)]

Incident Command System

ACS *Technical Manual, Volume 3*

The organization for oil spill response at Point Thomson will be an Incident Command System (ICS). It will provide clear definition of roles and lines of command with the flexibility for expansion or contraction of the organization as necessary. Personnel with roles in the ICS will comprise the Point Thomson IMT and are listed in Section 1.2. Point Thomson's proposed IMT is compatible with the state's oil spill response structure outlined in the Federal/State/Tribal Unified Plan for Alaska.

In most Level I incidents, the Point Thomson SRT will have the capabilities to effectively control the incident.

ACS Tactic L-8

Level II and III responses will be initiated by the Incident Commander. The IMT may be activated by the Incident Commander to support the field responders and to coordinate the collection and distribution of information.

ACS Tactics A-1, A-2 and A-3

ACS will be activated to stand by for spills until an assessment is performed. Once the assessment is complete, ACS will be either released or mobilized. For Level II and III responses, ACS will provide manpower and equipment resources from Point Thomson and Deadhorse to assist in spill containment and recovery. The North Slope operators coordinate with ACS to ensure that a reserve of trained staff is available for an extended spill response.

Unified Command

ACS *Technical Manual*, *Volume 3*

Leadership of the proposed ExxonMobil Point Thomson IMT comprises a Unified Command for Level II and III events. The Unified Command members will be ExxonMobil's Incident Commander, the FOSC, the SOSC, and the Local On-Scene Coordinator (LOSC), as outlined in the ARRT's Unified Plan for Alaska. Details of the management structure in a spill response are provided in the ACS *Technical Manual*, *Volume 3*. Section 2 in Volume 3 discusses the escalation of the IMT. Appendix B of Volume 3 contains a description of position responsibilities and checklists. Note that the proposed Point Thomson SRT fulfills functions of the Tactical Response Team discussed in ACS *Technical Manual*, *Volume 3*.

The primary responsibilities of the Unified Commanders are as follows:

- Establish objectives and priorities.
- Review and approve tactical plans developed to address objectives and priorities.
- Ensure the full integration of response resources.
- Resolve conflicts.

The responsibilities are typically exercised through periodic, highly focused Unified Command meetings.

The Unified Command structure is established and superimposed at the top of the IMT. The Unified Command provides overall direction by establishing strategic objectives, and response priorities to be addressed by the IMT through the planning process. Moreover, it reviews and approves the products of the planning process (i.e., Incident Action Plans) developed by the IMT to address the objectives and priorities.

This position at the top of the IMT also facilitates the integration of response resources. For the agency representatives, it allows them to determine the appropriate roles for agency personnel and to position their staff optimally within the IMT. For the Responsible Party, it ensures that members of the IMT have access to expertise without diluting their ability to manage response operations.

The role of the agency representatives in the Unified Command is to fulfill their legal responsibilities (i.e., to direct and/or monitor response operations), while allowing the Responsible Party to manage the emergency response operations.

3.4 REALISTIC MAXIMUM RESPONSE OPERATING LIMITATIONS [18 AAC 75.425(e)(3)(D)]

The realistic maximum response operating limitations (RMROLs) are described in the ACS *Technical Manual*. Environmental conditions can sometimes limit response work. Some limitations are based on safety, and others concern equipment effectiveness. The ACS *Technical Manual* lists the percentage of time some variables reduce effectiveness of response for planning purposes.

ACS Tactic L-7

The single most limiting factor of mechanical containment and response effectiveness is broken ice conditions. However, broken ice conditions can aid oil spill cleanup by *in situ* burning because the ice provides natural containment. For an oil spill on a continuous sheet of sea ice, the ice provides a barrier between the oil and the underlying water column.

Shallow nearshore water also constrains response equipment. ACS maintains several shallow-draft vessels and skimmers to operate in shallow water.

ACS Tactic L-6

Weather can wield significant influence over oil spill cleanup operations. Although weather can impair work efficiency, planning and advance preparation can still facilitate an effective response. For example, arctic clothing is required. The resulting bulk from the arctic clothing hampers worker movement, and cleanup personnel may not be able to tolerate long periods of exposure to the cold. This can be overcome by planning for personnel limitations and providing adequate shelter and opportunities to get warm. To compensate for the lower productivity, additional personnel can be used. One potential problem that could result due to cold weather is equipment failures. However, the use of equipment rated for arctic use, along with the proper equipment operating procedures, can minimize these effects.

Oil spills are also affected by temperature. As temperature decreases, the viscosity of oil increases. Increased viscosity may enhance spill cleanup efforts by slowing the spread of oil. The increasing viscosity at lower temperatures also means that the equilibrium thickness of oil on water is greater than at warmer temperatures. Thus, oil may be recovered with greater efficiency at low temperatures because contaminated areas are smaller and thicker oil facilitates rapid recovery. This is particularly true for recovery with rope mop and weir skimmers.

Wind may affect oil spill cleanup operations. In addition to its effect on worker efficiency through chilling, wind reduces the capability of oil spill containment booms to perform as designed. To contain oil from offshore spills, booms must maintain adequate freeboard to prevent overtopping by waves and must conform to the water surface to prevent oil from escaping underneath the boom. Winds greater than 16 knots will begin to limit the use of containment booming, aerial igniters, and aerial dispersant application.

3.5 LOGISTICAL SUPPORT [18 AAC 75.425(e)(3)(E)]

ExxonMobil will have a logistical support infrastructure for operations with its North Slope partners. Transportation equipment, coordination procedures, and maintenance procedures will be in place under normal operations. Furthermore, ExxonMobil will have contracts for operational logistical support to aid in a spill response through ACS and contracting companies.

ACS Tactics L-1 through L-4

3.6 RESPONSE EQUIPMENT [18 AAC 75.425(e)(3)(F)]

3.6.1 Equipment Lists

North Slope spill response equipment will be available for oil spill responses at Point Thomson through the ACS charter (see ACS *Technical Manual*, Tactics L-4, L-6, L-8, L-9, and L-10). ACS equipment for Point Thomson will be warehoused at the CPF, pre-staged in containers near the pipeline right-of-way, and stored in containers at the west and east well pads. The location and status of ACS equipment is listed in the Master Equipment List maintained by ACS, which is available upon request. Spill response equipment for Point Thomson will include, at a minimum, equipment listed in Tables 3-10 through 3-12.

ACS Tactics L-4, L-6, L-8, L-9, and L-10; ACS Map Atlas

3.6.2 Maintenance and Inspection of Response Equipment

Response equipment will be maintained so that it can be deployed rapidly and in condition for immediate use. The on-site response equipment will be routinely inspected and tested by ACS. In addition, ACS performs routine inspection and maintenance of its response equipment.

ACS Tactic L-6

ACS has the following USCG OSRO classifications:

- River/Canal - MM, W1, W2, W3
- Inland - MM, W1, W2, W3
- Open Ocean - W2
- Offshore - W2

ACS has fulfilled the equipment maintenance and testing criteria that these classifications require.

3.6.3 Pre-Deployed Equipment

Pre-deployed boom is not planned for Point Thomson.

TABLE 3-10
SPILL RESPONSE EQUIPMENT

EQUIPMENT DESCRIPTION	QUANTITY	SIZE	WHEN MOBILIZED[1]
Exploration Pad Near Bullen Point			
Anchor Systems	4	-	D
Bird Scare Cannon	2	-	C
Boom, Delta	2000 feet	8-inch x 6-inch	D
Boom, Skor Sorbent	400 LF	4-inch	D
Boom, Skor Sorbent	400 LF	8-inch	D
Connex for Delta Boom	1	8 feet x 20 feet	D
Connex for Sorbent Material	1	8 feet x 20 feet	C
Fold-a-Tanks	2	1500-gallon	D
Propane Cylinders	2	20-lb	C
Skimmer, Drum/Brush Combination	1	36-inch x 24-inch	D
Sorbent Pads 3M	20	36-inch x 36-inch	C
Sorbent Rolls	10	36-inch x 150 feet	C
Tank, Bladder	1	10,000-gallon	D
East Well Pad			
Anchor Systems	4	-	D
Boom, Delta	2000 feet	8-inch x 6-inch	D
Boom, Skor Sorbent	400 LF	4-inch	D
Boom, Skor Sorbent	400 LF	8-inch	D
Connex for Delta Boom	1	8 feet x 20 feet	D
Connex for Sorbent Materials	1	8 feet x 20 feet	C
Sorbent Pads 3M	20	36-inch x 36-inch	C
Sorbent Rolls	10	36-inch x 150 feet	C
West Well Pad			
Anchor Systems	4	-	D
Boom, Delta	2000 feet	8-inch x 6-inch	D
Boom, Skor Sorbent	400 LF	4-inch	D
Boom, Skor Sorbent	400 LF	8-inch	D
Connex for Delta Boom	1	8 feet x 20 feet	D
Connex for Sorbent Materials	1	8 feet x 20 feet	C
Sorbent Pads 3M	20	36-inch x 36-inch	C
Sorbent Rolls	10	36-inch x 150 feet	C
Central Pad			
ATV (6-Wheeler)	1	-	C
Boom Bags, NOFI	2	-	D
Anchor Systems	4	-	D
Bird Scare Cannon	4	-	C
Boom, Delta	2000 feet	8-inch x 6-inch	D
Boom, Fire	950 feet	12-inch x 18-inch	D

TABLE 3-10 (CONTINUED)
SPILL RESPONSE EQUIPMENT

EQUIPMENT DESCRIPTION	QUANTITY	SIZE	WHEN MOBILIZED[1]
Boom, Light Ocean, Collapsible with Reel	1000 feet	30-inch	D
Boom, Skor Sorbent	400 LF	4-inch	D
Boom, Skor Sorbent	400 LF	8-inch	D
Cam lock Kit	2	Various	D
Chainsaw with Rube Witch	2	36-inch	C
Connex	4	8 feet x 20 feet	C
Connex for Delta Boom	1	8 feet x 20 feet	D
Connex for Fire boom	1	1000 feet	D
Connex for Sorbent Material	1	8 feet x 20 feet	C
Decon Trailer	1	8 feet x 26 feet	C
Discharge Hose	10	2-inch x 50 feet	C
Discharge Hose	10	3-inch x 50 feet	C
Discharge Hose	4	4-inch x 50 feet	C
Desmi Oil Pump (DOP) 160, Pump with Power Pack	2	-	C
Drum Vacuum	1	-	C
Enclosed Snow Machine Trailer	1	8 feet x 24 feet	C
Fold-a-Tanks	3	1500-gallon	D
Gasoline Fuel Trailer	1	500-gallon	C
Generator	2	2 KW	C
Generator	1	5 KW	C
Hand Held GPS	4	N/A	C
Ice Auger with Extensions	2	6-inch	D
Jackhammer (Non-impact) with Attachments	2	40-lb	D
Loader, Bobcat with Attachments/Trailer	1	9 feet x 16 feet	D
Manta Ray Skimmer	2	4 feet x 4 feet	C
Net Launcher with Net	1	-	C
Office Training, Documentation, Miscellaneous		-	D
Propane Cylinders	8	20-lb	C
Pump, Diaphragm (Diesel)	2	3-inch	C
Pump, Peristaltic (Diesel)	2	2-inch	C
Pump, Sandpiper	1	1-inch	C
Pump, Trash (Diesel)	1	4-inch	C
Pump, Trash (Diesel)	2	2-inch	D
Safety and PPE Supplies	Various	Various	C
Skimmer, Drum Vacuum	1	-	D
Skimmer, Drum/Brush Combination	1	4 feet x 4 feet	D
Skimmer, Horizontal Rope Mop System Elec.	1	4-inch	D
Snow Blower	1	-	C
Snow Machine (Long Track) 4-Stroke	2	N/A	C
Sorbent Pads 3M	20	36-inch x 36-inch	C
Sorbent Rolls	10	36-inch x 150 feet	C
Suction Hose	6	3-inch x 20 feet	C
Suction Hose	2	4-inch x 20 feet	C

TABLE 3-10 (CONTINUED)
SPILL RESPONSE EQUIPMENT

EQUIPMENT DESCRIPTION	QUANTITY	SIZE	WHEN MOBILIZED[1]
Suction Hose	10	2-inch x 20 feet	C
Toilet, Portable, Handicap-Accessible	2	-	C
Tools/Shop Materials and Miscellaneous Equipment	-	Assorted	C
Trimmer Attachment for Bobcat	1	-	D
Tucker Snow Cat with Trailer	1	-	D
Utility Trailer (ATV)	1	-	C
Utility Trailer (Snow Machine)	2	-	C
Warm-up Trailer	1	8 feet x 26 feet	C
Weather Port	1	10 feet x 12 feet	C
Wildlife Capture Kit	1	4-foot x 4-foot Tote	C
Wildlife Hazing Kit	2	4-foot x 4-foot Tote	C

[1] When mobilized on-site. C = Construction; D = Drilling

TABLE 3-11
OTHER EQUIPMENT POSITIONED AT POINT THOMSON

EQUIPMENT DESCRIPTION	QUANTITY (MINIMUM QTY OF 1)	WHEN MOBILIZED[1]
Enclosed Response Trailer	1	C
Light Plants	2	C
Shop Forklift	1	C
Tioga Heaters, Trailer-Mounted	2	C
Air Compressor for Jackhammers	1	C
30 KW Generator	1	C
Van with Steam Pressure Washer	1	C
Vacuum Truck	2	C
Super Sucker	1	C
Dump Truck	1	C
Snow Melter	1	C
Challenger (or equivalent Loader)	2	C
Grader	1	C

[1] When mobilized on-site. C = Construction; D = Drilling

TABLE 3-12
ON-WATER MARINE EQUIPMENT POSITIONED AT POINT THOMSON

EQUIPMENT DESCRIPTION	QUANTITY	SIZE	WHEN MOBILIZED[1]
Island Class Vessel with Winter Cover and Trailer	1	25 feet x 12 feet	D
Skimming Vessel/Built-in Recovery System and Onboard Storage and Trailer; <18 in. draft empty, crew of 2	1	32 to 42 feet	D
Shallow Water Boom-Towing Skiff with Trailer	2	20-foot to 24-foot Class	D
Airboat with Trailer	2	20 feet	D
Freighter Airboat with Trailer	1	30 feet	D
Mini-Barge with Trailer	2	40 feet x 15 feet	D

[1] When mobilized on-site. C = Construction; D = Drilling

3.7 NONMECHANICAL RESPONSE INFORMATION [18 AAC 75.425(e)(3)(G)]

Nonmechanical response information is provided in the ACS *Technical Manual, Volume 1*, "B" tactics.

ACS Tactics B-1 through B-7

The Heli-torch ignition system would be used to ignite thick patches of un-evaporated condensate on water (ACS Tactic B-3). Multiple passes with the ignition would likely be required due to the discontinuities of the slick (ACS Tactic B-3).

Condensate remaining after the burning operation and residue from the burns would drift with the wind. If significant unburned condensate remains, burning in conjunction with the shallow-draft fire booms could be attempted while the oil is drifting.

Remaining oil and residue would eventually collect against the shorelines. It would be recovered with a combination of portable skimmers, manual recovery, and sorbent materials.

ACS Tactic B-6

3.8 RESPONSE CONTRACTOR INFORMATION [18 AAC 75.425(e)(3)(H)]

ExxonMobil will activate ACS and the North Slope operators to provide the initial personnel and resources required to respond to a large or lengthy spill response. Contact information for ACS is shown in Table 1-2. If additional resources are required, they will be accessed through Master Service Agreements maintained by ACS. A signed copy of ExxonMobil's Statement of Contractual Terms with ACS for Point Thomson will be provided prior to construction.

3.9 TRAINING AND DRILLS [18 AAC 75.425(e)(3)(I)

3.9.1 NSSRT Training

The NSSRT consists of workers who volunteer as emergency spill response technicians. Each team member has initial HAZWOPER emergency response training and annual refresher training, which meets or exceeds the requirements in the HAZWOPER regulations,

ACS Tactic A-3

29 CFR 1910.120(q). Annual requirements for HAZWOPER refreshers, medical physicals, and respiratory fit tests are tracked by ACS through weekly reports from the database (Section 3.9.4, Record Keeping). The NSSRT training program is provided to responders from all production units on the North Slope. Responders are classified into five categories, each with minimum training requirements as noted below. The NSSRT maintains a minimum staffing level designed to ensure response capability in compliance with all North Slope ODPCP response scenarios. The minimum staffing level, illustrated in Table 3-13, represents the largest NSSRT demand for each responder classification derived from all North Slope ODPCP scenarios and therefore exceeds the total personnel requirements of any single scenario.

TABLE 3-13
NORTH SLOPE SPILL RESPONSE TEAM MINIMUM STAFFING LEVELS

RESPONDER CLASSIFICATION	MINIMUM NUMBER REQUIRED
General Laborer	48
Skilled Technician	30
Team Leader	12
Vessel Operator-Nearshore	9
Vessel Operator-Offshore	6
Total Responders	105

Active Member Requirements

NSSRT members have completed the following minimum annual training activities to become an active member of the NSSRT:

- 8-hour HAZWOPER refresher certification
- Plan review
- 5 equipment proficiency checks

ACS Tactic A-4

The NSSRT training program offers weekly classes at each field. The classes emphasize hands-on experience, field exercises, and team-building drills. The courses are selected by the facility ACS Lead Technician with field management and use ExxonMobil, ACS, and external training consultants. The ACS *Technical Manual* lists typical NSSRT training courses. Because of operational time constraints, many of the courses are divided by subject area and taught in the 2- or 3-hour timeframe of an NSSRT meeting. Training and attendance are documented and available for review at ACS Base in Deadhorse. The yearly training schedule is also available at the facility and ACS Base. Current NSSRT training schedules are posted on the ACS website. Descriptions of the five responder categories and training requirements for each are provided in the ACS *Technical Manual*.

General Laborer

The General Laborer is a responder with minimal or no field experience in spill response. Duties are associated with mobilization, deployment, and support functions for the response. Support tasks such as deployment of boom sections, assembly of anchors systems, assembly of temporary storage devices, loading and unloading equipment, and decontamination of equipment are typical tasks undertaken by this responder classification.

Responders in this classification must have documentation of compliance with the following minimum training requirements:

- Current 24-hour (or higher) HAZWOPER Certificate
- H_2S Training
- NSTC Academy, including spill prevention and spill notification

Over time, the NSSRT training program will bring each NSSRT member from his or her entry point as a General Laborer to at least the Skilled Technician level.

Skilled Technician

The Skilled Technician is a responder who has experience in spill response activities at a higher level through having received specific training, performed related activities as part of regular employment, or having participated in spill response incidents. Tasks such as the operation of skimmers, powerpacks, and transfer pumps are typical tasks undertaken by this responder. Responders in this classification must have documentation of compliance with the following minimum training requirements:

- Must meet the minimum training requirements for the General Laborer
- Completion of a minimum of 16 hours of training or equivalent experience in any combination of the following categories:
  - Response equipment deployment and use
  - Response tactics and equipment requirements
  - Incident Command System
  - Staging area management and support
  - Boat safety, navigation, or operations
  - Contingency plan familiarization
- Completion of a minimum of 16 hours of actual spill response, response exercise, or field deployment time in any combination of the following positions:
  - Operation of recovery equipment systems
  - Operation of transfer and storage equipment systems
  - Deployment and use of containment systems
  - Decontamination procedures
  - Wildlife hazing, capture, and stabilization
- Minimum of 10 completed equipment proficiency checks

Team Leader

Team Leader roles may include such categories as Task Force Leader, Containment or Recovery Site Team Leader, or Staging Area Manager. A Team Leader is described as an individual who has attended additional training in the actions, responsibilities, and tasks associated with managing portions of an incident. Responders in this classification must have documentation of compliance with the following minimum training requirements:

- Must meet the minimum training requirements for the General Laborer
- Must meet the minimum training requirements for the Skilled Technician
- Current 8-hour (or higher) HAZWOPER Supervisor Certificate
- Minimum of 20 completed equipment proficiency checks

Vessel Operator-Nearshore

Responders qualified as Vessel Operator-Nearshore are tasked with safe operation of vessels less than 30 feet in length. These vessels have a hull design and electronics primarily intended for operation in nearshore environments or occasionally, in conjunction with larger vessels, in an offshore response. Typical duties include, towing and placement of containment booms, setting and tending anchors, and movement of equipment to remote sites. Responders in this classification must have documentation of compliance with the following minimum training requirements:

- Must meet the minimum training requirements for the General Laborer
- Must meet the criteria for any one of the following categories:
  - Completion of the ACS, Captain and Crew, or Boat Safety and Handling Training Programs
  - Completion of 40 hours of equivalent training or experience on vessels smaller or greater than 30 feet, including navigation, charting, vessel electronics and docking and maneuvering procedures
  - Current USCG Operator Uninspected Passenger Vessel, or higher, license
- Completion of Nearshore Vessel proficiency check

Vessel Operator-Offshore

Responders qualified as Vessel Operator-Offshore are tasked with the safe operation of vessels larger than 30 feet in length. These vessels have a hull design and electronics capable of sustaining operations in an offshore environment. Typical duties include the towing of containment booms, working in conjunction with barge containment operations, towing mini-barges, operating skimmers to recover oil, providing ice management support, and providing logistical support to offshore operations. Responders in this classification must have documentation of compliance with the following minimum training requirements:

- Must meet the minimum training requirements of the General Laborer
- Must meet the criteria for any one of the following:
  - Completion of the ACS Captain and Crew Training Program
  - Completion of 40 hours of equivalent training or experience on vessels larger than 30 feet, including navigation, anchoring, vessel electronics, and docking and maneuvering procedures
  - Current USCG 25-ton Near Coastal, or larger, license
- Completion of Offshore Vessel proficiency check

3.9.2 Incident Management Team Training

ACS provides IMT training for its own personnel. Similar training will be provided for the ExxonMobil North Slope IMT personnel. This training includes an introduction to the ICS, ICS position-specific training at section chief level, tabletop exercises, and deployment drills. As new training needs are identified, they are developed and incorporated into the training program. A description of the North Slope IMT training program is provided in the ACS *Technical Manual.*

ACS *Technical Manual, Volume 3,* Section 6; and Volume 1, Tactic A-4

3.9.3 Auxiliary Contract Response Team

ACS Tactic A-4

ACS maintains and operates an ADEC-approved training and response program to ensure North Slope plan holders have the ability to provide the personnel required to support a long-term response. The program consists of contracts and agreements with numerous Response Action Contractors (RACs) and OSROs and provides assurance that a host of trained and qualified responders are available to respond to oil spills on the North Slope. A list of typical courses is provided in the ACS *Technical Manual* and in Table 3-14.

3.9.4 Record Keeping

ExxonMobil, or its designee, will maintain a database as a record of the courses taken by each employee. Records will be kept for a minimum of three years or for the entire time that the employee is assigned responsibilities under this plan. The database will provide a brief description of the course and the date completed. Current training status of employees will be available on computer printouts or by calling the ExxonMobil office in Anchorage. Full training records of response team members will be maintained and available for inspection at the ACS Base. Contractor companies will keep their own spill response training records.

3.9.5 Spill Response Exercise

ExxonMobil has adopted the National Preparedness for Response Exercise Program (NPREP) guidelines as the structure for the Point Thomson training program and procedures. The NPREP guidelines were developed to establish a workable exercise program that meets the intent of OPA 90 for spill response preparedness. Participation in the NPREP ensures the federal exercise requirements mandated by OPA 90 are met.

Internal Exercises

Internal exercises are those which will be conducted wholly within ExxonMobil and are designed to test the various components of this plan to ensure it is adequate for response to a spill. Internal exercises will include:

- **Quarterly Qualified Individual Notification Drills:** To ensure the QI is able to be reached on a 24-hour basis in a spill response emergency and carry out assigned duties.
- **Annual Spill Management Team Tabletop Exercises:** To ensure personnel are familiar with the contents of this plan, including the DOT Information Summary, the ICS, crisis response procedures, mitigating measures, notification numbers and procedures, and individual roles in the response structure.
- **Semi-Annual Equipment Deployment Exercises:** To ensure internal and contractor-operated response equipment is fully functional and can be deployed in an efficient and productive manner.
- **Annual Unannounced Exercise for NPREP Requirements:** ExxonMobil Emergency Services is responsible for ensuring that an unannounced exercise meeting NPREP requirements occurs annually. The Planning Section Chief is responsible for documenting actions taken during an actual event for NPREP credit if it involves one of the following – use of emergency procedures to mitigate or prevent a discharge or threat of discharge, activation of the field IMT or deployment of spill response equipment
- **Triennial Exercise of Entire Plan including worst case discharge scenario**

TABLE 3-14
TYPICAL NORTH SLOPE SPILL RESPONSE TEAM TRAINING COURSES

CATEGORY	COURSE TITLE
COMMUNICATION	ICS Basic Radio Procedures
DECONTAMINATION	Decontamination Procedures
ENVIRONMENTAL	Environmental Awareness Wildlife Hazing
EQUIPMENT	Basic Hydraulics For Spill Responders Boom Construction and Design Fastanks and Bladders Skimmer Types and Application Snow Machines and ATV Operations 90+ Spill Response Equipment Proficiency Checks
MANAGEMENT	Incident Command System Management and Leadership During an Oil Spill Quarterly Drill and Exercises Staging Area Management
MISCELLANEOUS	Global Positioning System
RESPONSE TACTICS	ISB Nearshore Operations Winter Oil Spill Operations
	Winter Response Tactics
SAFETY/SURVIVAL	Arctic Cold Weather Survival
	Arctic Safety
	HAZWOPER
	Spill Site Safety
	Weather Port and Survival Equipment
VESSEL-RELATED	Arctic Cold Water Survival
	Airboat Operations
	Boat Safety and Handling
	Boom Deployment On Rivers
	Captain/Crewman Vessel Training
	Charting and Navigation
	Deckhand/Knot Tying
	River Response School
	Swiftwater Survival

With the exception of government-initiated unannounced exercises, the internal exercises will be self-evaluated and self-certified. Documentation, including a description of the exercise, objectives met, and results of evaluations, will be maintained for a minimum of three years. Exercise documentation will be in written form for each exercise, signed by the Point Thomson Environmental Specialist or SHE Lead, and available for review on request.

The Point Thomson SHE Lead, or designee, will be responsible for the scheduling, development, and evaluation of training programs and exercises, and for ensuring that regulatory requirements are met.

External Exercises

External exercises will involve efforts outside of ExxonMobil to test the interaction between ExxonMobil and the response community. The external exercises will also test the plan and the coordination between ExxonMobil and the response community, including the OSRO (ACS), state, federal, and local agencies, and local community representatives.

Point Thomson will participate in an annual Mutual Aid Drill (MAD). In addition to actively participating in the MAD, federal, state, and local agencies are involved in the development and evaluation of the drill. Every year, equipment is deployed at the MAD according to NPREP guidelines. The MAD exercise satisfies the NPREP requirements to exercise all aspects of the response plan at least every three years. Following are the components that are tested through the MAD exercise:

Organizational Design

- Notifications (includes training on 24-hour notifications and reporting to the National Response Center)
- Staff mobilization
- Ability to operate within the response management system described in the plan

Operational Response

- Discharge control
- Assessment of discharge
- Containment of discharge
- Recovery of spilled material
- Protection of economically and environmentally sensitive areas
- Disposal of recovered product

Response Support

- Communications
- Transportation
- Personnel support
- Equipment maintenance and support
- Procurement
- Documentation

3.10 PROTECTION OF ENVIRONMENTALLY SENSITIVE AREAS [18 AAC 75.425(e)(3)(J)]

ACS Maps 91, 94 to 105; ACS TM Tactics W-1 through W-6

Priority protection sites, sensitivities, surface water flow directions, wildlife protection strategies, and natural resources are described in the ACS *Technical Manual,* and are subject to confirmation by the resource agencies.

3.11 ADDITIONAL INFORMATION [18 AAC 75.425(e)(3)(K)]

Not applicable.

3.12 BIBLIOGRAPHY [18 AAC 75.425(e)(3)(L)]

Alaska Clean Seas. 2001. *Alaska Clean Seas Technical Manual*, Volumes 1, 2, and 3. Prudhoe Bay, Alaska.

Alaska Drilling and Wells. 2002. *Arctic Well Control Contingency Plan*. BP Exploration (Alaska), Inc.

Alaska Regional Response Team. 1999. *Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases*, Annex F, Appendix I.

Alyeska Pipeline Service Company*. 1998. Prince William Sound Tanker Oil Discharge Prevention and Contingency Plan*, Part 3, SID#1, Section 7.

ANSI/ASME B31G-1984, *Manual for Determining the Remaining Strength of Corroded Pipelines, A Supplement to ANSI/ASME B31 Code for Pressure Piping.*

Atwater, S.G. 1991. 1*990 Endicott Environmental Monitoring Program Final Report: Ice Break-up and Freeze-up*. Prepared by SAIC for the U.S. Army Corps of Engineers, Anchorage AK.

BP Exploration (Alaska) Inc. and Phillips Alaska, Inc. 2001. *North Slope Environmental Field Handbook.* 80 pages.

Dames & Moore, 1983. Point Thomson Development, Alaska 1983 Hydrology Program. Prepared for Exxon Company, U.S.A., Thousand Oaks, CA.

DF Dickins Associates Ltd., 1984. Ala*skan Beaufort Sea Ice Atlas.* Prepared for SOHIO Petroleum Company, Dallas TX.

Dickins, D.F., Hearon G. and K. Vaudrey. 2001. *Sea Ice Overflood in Stefansson Sound, Alaskan Beaufort Sea.* In: Proceedings 16th International Conference on Port and Ocean Engineering Under Arctic Conditions, Vol. I, Ottawa, pp. 193-202.

EPA. 1995a. *SCREEN3 Model User's Guide.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division, Research Triangle Park, NC, September 1995.

EPA. 1995b. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources.* U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1995.

ExxonMobil Development Company. 2002. *Drilling OIMS Manual, Second Edition*. Houston, Texas, January 2002.

ExxonMobil Development Company. 2001. *Emergency Response Guide*. Houston, Texas, April 2001.

ExxonMobil Development Company. 2000. *Safety Manual*. Houston, Texas, September 2000.

Hydrocon Engineering (Continental) LTD., 1982. Point Thomson Development Hydrologic Studies. Prepared for Exxon Company, U.S.A., Los Angeles, CA.

LaBelle, J.C. and J.L. Wise, 1983. *Alaska Marine Ice Atlas*. Produced by the Arctic Information and Data Center, University of Alaska, Anchorage AK.

North Slope Unified Operating Procedures, May 29, 1999.

Phillips Alaska, BP Exploration (Alaska), Inc., and Alyeska Pipeline Service Company. 2002. *Alaska Safety Handbook*. 196 pages.

Titan. 2003. *SCIPUFF Model.* Information available at http://www.titan.com/appliedtech/Pages/TRT/scipuff/scipuff.htm. Titan Research and Technology, Princeton, NJ.

U.S. Army, Corps of Engineers. June 1999. *Environmental Impact Statement: Beaufort Sea Oil and Gas Development/Northstar Project. Vol. III Chapter 5 - Affected Physical Environment.*

Vaudrey, K. June 27, 1998. *Broken Ice Periods for Selected Production Sites Along the Alaskan Beaufort Sea.* Memo from Vaudrey & Associates, Inc. to B. McKenzie, BP Exploration Alaska, Anchorage (unpublished).

Vaudrey, K., 1985a. *1984 Breakup Study of the Alaskan Beaufort and Upper Chukchi Seas. AOGA Project 274,* Vaudrey & Associates, Inc., San Luis Obispo, CA.

Vaudrey, K., 1985b. *1984 Freezeup Study of the Alaskan Beaufort and Upper Chukchi Seas. AOGA Project 282,* Vaudrey & Associates, Inc., San Luis Obispo, CA.

Vaudrey, K., 1985c. *Historical Summary of 1980-82 Freeze-up Seasons and 1981-83 Break-up Seasons* (Vol. 1 of 2). Prepared for Chevron, Marathon, Phillips, Shell and SOHIO. AOGA Project 275, by Vaudrey & Associates, Inc., San Luis Obispo, CA.

Vaudrey, K., 1986a. *1985 Breakup Study of the Alaskan Beaufort and Upper Chukchi Seas. AOGA Project 319*, Vaudrey & Associates, Inc., San Luis Obispo, CA.

Vaudrey, K., 1986b. *1985 Freezeup Study of the Alaskan Beaufort and Upper Chukchi Seas. AOGA Project 327,* Vaudrey & Associates, Inc., San Luis Obispo, CA.

Vaudrey, K., 2000. Part II: *Description of the Ice Conditions. In: Oil Spills in Ice Discussion Paper.* Prepared by DF Dickins Associates Ltd., Vaudrey & Associates Inc., and SL Ross Environmental Research Limited for Alaska Clean Seas, Prudhoe Bay, AK.

STATEMENT OF CONTRACTUAL TERMS

AS REQUIRED UNDER AS 46.04.30, AS 46.04.035 and 18 AAC 75.445(l)(1) in fulfillment of a requirement for registration of primary response action contractors and for approval of an Oil Discharge Prevention and Contingency Plan.

PLAN TITLE: Point Thomson Oil Discharge Prevention and Contingency Plan

PLAN HOLDER: ExxonMobil Development Company on behalf of Exxon Mobil Corporation

This statement is a certification to the Alaska Department of Environmental Conservation summarizing the contract between ExxonMobil the oil discharge prevention and contingency plan holder (hereinafter "PLAN HOLDER") and Alaska Clean Seas, the oil spill primary response action contractor or a holder of an approved oil discharge prevention and contingency plan under contract (hereinafter "CONTRACTOR"), executed ______________, and the original of which is located at Alaska Clean Seas, Spine Road, Prudhoe Bay, Alaska 99734-0022, as evidence of the PLAN HOLDER's access to the containment, control and/or cleanup resources required under standards at AS 46.04.030 and 18 AAC 75.495. The PLAN HOLDER and the CONTRACTOR attest to the Department that the provisions of this written contract clearly obligate the CONTRACTOR to:

(A) provide the response services and equipment listed for the CONTRACTOR in the contingency plan;

(B) respond if a discharge occurs;

(C) notify the PLAN HOLDER immediately if the CONTRACTOR cannot carry out the response actions specified in this contract or the contingency plan;

(D) give written notice at least 30 days before terminating this contract with the PLAN HOLDER;

(E) respond to a Department-conducted discharge exercise required of the PLAN HOLDER; and

(F) continuously maintain in a state of readiness, in accordance with industry standards, the equipment and other spill response resources to be provided by the CONTRACTOR under the contingency plan.

I hereby certify that as a representative of the PLAN HOLDER, I have the authority to legally bind the PLAN HOLDER in this matter. I am aware that false statements, representations, or certifications may be punishable as civil or criminal violations of law.

____

Signature Date

Name: Randy F. Buckley, Project Manager

Title: __________________________________

For: ExxonMobil Development Company on behalf of Exxon Mobil Corporation
PLAN HOLDER

I hereby certify that as a representative of the CONTRACTOR, I have the authority to legally bind the CONTRACTOR in this matter. I am aware that false statements, representations, or certifications may be punishable as civil or criminal violations of law.

____

Signature Date

Name: Brad Hahn

Title: General Manager

For: Alaska Clean Seas
CONTRACTOR

TABLE OF CONTENTS FOR SECTION 3

LIST OF FIGURES

LIST OF TABLES