Mackenzie Delta Gas Hydrate Research and Development Project

Project Description Prepared for Indian & Northern Affairs Canada, and The Environmental Impact Screening Committee

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March, 2001

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EXECUTIVE SUMMARY

Gas hydrates are icy compounds of methane and water. They represent a substantial reservoir of natural gas in many arctic and marine settings. It has been estimated that the gas reserves found in the form of hydrates exceed all known conventional gas reserves. The viability of commercial production of gas hydrates however, is unknown. Inadequacies in the current state of knowledge include a lack of detailed in situ observations, geophysical techniques for quantification of gas hydrate concentrations, and information about their production characteristics. Japex Canada Limited, acting on behalf of the Japan National Oil Corporation (JNOC), the Geological Survey of Canada (GSC) and others, proposes to continue conducting their earlier gas hydrate research in the Mackenzie Delta with the primary objective of investigating the production potential of a gas hydrate deposit. The Mallik wellsite, where a successful JAPEX/JNOC/GSC gas hydrate research project (Mallik 2L-38), was completed in 1998, has been selected as the site for the continuation of this research. The knowledge obtained from this new research project can be applied to other hydrate deposits worldwide and, as a result, the project has attracted international interest. The partners in this project include the Japan National Oil Company (JNOC), the Geological Survey of Canada (GSC), Germany's GeoForschungsZentrum (GFZ), the International Continental Drilling Program (ICDP), the US Department of Energy (DOE) and the US Geological Survey (USGC). Should the technology for producing gas from a hydrate deposit be proven successful, the size of known gas reserves would increase substantially. This could be of significant benefit to Northern Canada as there are large deposits of gas hydrates in the Mackenzie Delta region.

The prime element of the research program will be to conduct a drilling program, designated Mallik 3L-38, at the site of the earlier Mallik L-38 (Imperial Oil Limited, 1972) and Mallik 2L-38 (Japex, JNOC, GSC, 1998) wells. Previous drilling has shown that the Mallik site contains hydrate deposits between depths of approximately 830 and 1100 metres below the surface. It is the thickest presently known strata of gas hydrate in the Mackenzie Delta. The drilling program is designed to drill three wells, in a straight line, approximately 50 metres apart. The central well will include a core through the gas hydrate section and an extensive well logging program. The two outer wells, designated as observation wells, will not be cored but will be logged for the purpose of obtaining additional research data. The two observation wells will allow close monitoring of how gas hydrates respond to the production testing activities that are planned for the central well. This will be accomplished through in situ temperature/pressure observations and an extensive cross-hole tomograph survey logging program conducted prior to and during the production testing operations. As in the 1998 research project, Japex Canada Limited will be the well operator.

CONTACT NAME AND ADDRESS

The project is being managed on behalf of Japex Canada Limited, by Canadian Petroleum Engineering Inc. All correspondence should be addressed to:

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REGULATORY APPROVALS

Additional approvals and permits from several agencies are being sought in conjunction with this project. The project will comply with any requirements and restrictions imposed by these agencies in the execution of the project.

Environmental Impact Screening Committee

Review and Project Approval; submitted March 25, 2001

Contact: Ms. Linda Graf; Secretary EISC; (867) 777-2828; eisceirb@jointsec.nt.ca

National Energy Board

One Project Authorization and 3 Drilling Program Applications: to be submitted in April, 2001

Contact: Mr. Chris Knoechel; Petroleum Engineering Specialist; (403) 299-3866; cknoechel@neb.gc.ca

Indian and Northern Affairs Canada

Land Use Permit; to be submitted in April, 2001

Contact: Rudy Cockney; District Manager; (867) 777-3361; cockney@inac.gc.ca

Environment Canada

Migratory Bird Area Permit to be submitted in April, 2001

Contact: Paul Latour; Habitat Biologist; (867) 669-4769; PaulLatour@ec.gc.ca

GNWT Water Board

Type B Water License to be submitted in April, 2001

Contact: Sevn Bohnet, Regional Coordinator; (867) 669-2696; bohnets@inac.gc.ca

TITLE

Mackenzie Delta Gas Hydrate Research Drilling Project

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DEVELOPMENT SUMMARY

The research project will require the drilling of three 1200 metre wells adjacent to the Imperial Mallik L-38 and Mallik 2L-38 locations during the winter of 2001/2002. If it becomes necessary to deviate from the plan as described below, the proponent will first contact the appropriate regulatory agencies to obtain their approval. The program is planned according to the following steps:

1. Staging the Drilling Rig

A small conventional oilfield drilling rig, with a rated capacity of 1800 to 2000 metres, will be used to conduct the drilling. The drilling rig, well consumables, construction equipment, and a 55-man camp will be transported down the Mackenzie River by barge to the Taglu staging site (see Figure 1) in August and September 2001.

2. Access Road Construction

Approximately 20 km of ice road will be constructed northward from Taglu to reach the Mallik site. The road will follow the Harry Channel in the Delta (see Figures 1 and 2, pages 11 and 12).

The ice road will also be extended southward from Taglu to the Middle Channel where it will intersect any existing ice road (see Figure 1). If no other ice roads have yet been established in the Middle Channel, ice road construction will continue along the Middle Channel until it reaches Tununuk and the Inuvik/Tuk ice road. The construction of the ice road will take place after freeze-up, in November and December 2001. There are several weeks of contingency within the planned schedule in order to accommodate a delayed freeze-up date. The ice road will make use of existing routes as much as possible.

Operations to establish the ice roads include ice profiling, flooding of thin ice sections and the initial snow plowing required for opening the road. Snow and ice will be piled up to form ramps for crossing riverbanks. No banks will be cut to access the river. Maintenance snow plowing of the road will take place to enable vehicle access for the remaining duration of the project.

3. Wellsite Preparation

The well location (see Figure 3, page 13) will be prepared after freeze-up in early December 2001 in order to meet a scheduled spud date of January 1 2002. A short snow/ice road will provide access across the shoreline to the wellsite. No riverbank will be cut to access the site from the ice road. The

wellsite will be covered with a snow/ice pad and surrounded by a snow/ice containment berm. Snow blades on construction equipment at the wellsite will be fitted with mushroom shoes in order to minimize damage to the vegetation and soil cover during construction.

4. Rig and Camp Mobilization

The rig and camp will be mobilized from the staging area to the wellsite by truck in early December. The rig and camp will be placed on rig matting on top of the snow/ice pad. This procedure, which has been used in the past, will protect the ice pad from melting. All stationary fuel tanks will be double walled or will be located within a self-berm skid. Refueling of vehicles will take place using approved conventional fuel transfer equipment. The camp and drilling facilities will be set back from the water line by at several hundred metres. This will ensure effective control and cleanup in the event of any small spill. In order to support local businesses, construction and support equipment, camp accommodation, catering services, supplies, and fuel will be procured locally, to the greatest extent possible, and transported from Inuvik or Tuk to Mallik using the ice road. The rig move from the staging area will utilize truck transportation on the ice road. Construction personnel for the wellsite preparation and the rig move will be accommodated in one 10 to 12 man sleigh-mounted camp. The camp will be self-contained. Sanitary wastes will be pumped out for disposal in an approved manner.

5. Drilling and Testing Program

Drilling: A 1200 metre main test well will be drilled. The well will consist of: 15 m of 508 mm (20") diameter conductor pipe cemented to the surface; approximately 110 m of 339 mm (13 3/8") diameter surface casing cemented to surface; approximately 680 m of 244 mm (9 5/8") diameter surface casing cemented to the surface; and 1200 m of 178 mm (7") diameter production casing stage cemented to the surface.

The drilling program for the main well will take approximately 26.5 days beginning in mid January 2002. This includes approximately 10 days planned for coring the gas hydrates and conducting an extensive logging program.

Two 1200 metre observation wells, approximately 50 metres to either side of the main test well, will be drilled. Each of these wells will consist of: 20 m of 269 mm (11 3/4") diameter conductor pipe cemented to the surface: approximately 350 m of 219 mm (8 5/8") diameter surface casing cemented to surface; and1200 m of 140 mm (5 1/2") diameter production casing stage cemented to the surface.

Each of the observation wells will take approximately 13 days. No coring program and only limited logging will be conducted at the observation wells as they are in close proximity to the main well coring site.

The drilling program will utilize equipment that can operate with a minimal need for drilling sumps. Only a small sump is planned for the location next to the drilling rig. This sump will be excavated into the permafrost. Only approved biodegradable mud products and chemicals will be used in order to prevent environmental damage from the well fluids or cuttings. No oil-based drilling muds will be used. The surface level of the sump fluids will not be allowed to rise to within one metre of the ground level. The sump will be monitored to ensure that it does not contain any deleterious material.

Testing: The main test objective is to gain direct measurement of the rate at which dissociation of the gas hydrate occurs through pressure drawdown and thermal stimulation. The final test interval(s) has not yet been determined, however the planned procedure described below is independent of the interval properties.

The planned test procedure includes the following elements:

1. An initial closed chamber test in the hydrate zone to measure the rate of hydrate dissociation under pressure depletion.
2. A period on constant rate and temperature circulation to measure the rate of hydrate dissociation by initiating an aggressive thermal signal into the hydrate.
3. (optional) A final closed chamber test to measure the hydrate dissociation rate under pressure depletion (in this second case with a larger surface contact area due to the thermal stimulation)
4. (optional) A closed chamber and/or flow test of the underlying free gas zone below the hydrate interval by using through-tubing perforating techniques, and commingling production from the free gas and hydrate zones

The hydrate test interval will be perforated overbalanced using wireline conveyed casing guns prior to running and setting of the DST test tools. The completion/circulation fluid type has not been finalized, but will it probably be freeze-depressed brine.

The hydrate gas dissociation flow rate under simple pressure depletion is expected to very low. The thermal stimulation procedure will use hot brine circulated through coiled tubing. Heat loss to the uphole wellbore will be minimized by utilizing an insulating packer fluid, or alternately insulated tubing. Fracturing in combination with the circulation procedure may also be attempted. During this thermal stimulation process, produced gas from the hydrate will be entrained within the fluid returns circulated out of the wellbore. This fluid will be processed through a standard surface well test package with one or two levels of separation, and possibly through a Vacuum Recovery Unit. Each stage of separation will include equipment for low rate gas measurement. On-line gas chromatograph analysis may be utilized to characterize dissociated gas throughout the system. Extensive sampling of gas at each stage of separation will also be included. Pressure and temperature observation wells, depending upon proximity to the production

well, may also be used to detect gas hydrate dissociation during the thermal stimulation process. All produced gas will be flared, and any produced liquids retained in tanks for later disposal. Gas and liquid samples will be collected for all tests. All tests are expected to produce no H_2S and approximately 0.03% CO_2. Isotope identification may enhance the detection of gas that originates from gas hydrate dissociation. Hydrate formation within the wellbore can be eliminated by maintaining flow at low pressures, and/or by chemically lowering the hydrate formation temperature with the addition of methanol inhibitor. Special safety procedures and clear operating instructions have been included in this program addressing these issues. The coil-tubing unit will provide a hydrate removal contingency and the ability to displace accumulated wellbore fluids or solids with nitrogen.

Based on the simulation work performed to date, the free gas zone in the Mallik 3L-38 well will produce at a rate of ~ 28,000 m^3/d average (1.0 MM scf/d) over a one day flow period. During a direct thermal stimulation of a hydrate zone, the predicted gas production rate will be 0.15 – 0.30 $X10^3 m^3/d$ (0.005 – 0.010 MM scf/d). Assuming a 10 day thermal stimulation period, the expected hydrate gas production will be a maximum of 2.8 10^3m3 (0.10 MMscf). Total expected gas production during the planned testing at Mallik will therefore probably be less than ~ 40,000m^3 (~1.5 MM scf). All gas will be flared through an approved flare stack, except for the small volumes collected for laboratory analyses.

Expected production of formation water (both saline and fresh water) during all production testing is less than 20 m^3 (300 bbls). Water produced during the flow test of the free gas zone will be collected in storage tanks on the surface. Water produced during the thermal stimulation of the hydrate zone will be diluted into the water based heating fluid.

All produced fluids as well as completion products (NaCl or CaCl completion brines, gelled packer fluids, methanol, etc.) will be disposed of in an approved manner, either in a downhole disposal zone, or through surface treatment.

The entire testing program is estimated to take 18 days.

6. Demobilizing the Drilling Rig

On completion of the project, the rig and camp will be demobilized via the ice road to Inuvik or further south, unless another operator contracts it.

7. Cleanup, Reclamation and Disposal

Upon removal of the equipment from the site, all remaining combustible wastes will be burned in a smokeless incinerator. Non-combustible wastes will be trucked to approved disposal sites. Before backfilling, the cuttings sump will be checked to verify that it does not contain any deleterious materials. The sump will be backfilled with the original material which was excavated during its construction. The surface elevation of the backfilled sump will be a minimum of 1 metre above the ground level. Except for the sump, and the area within about one metre of the wellhead, the remainder of

the soils at the operating site will remain undisturbed under the ice pad for the duration of the project. Before the construction equipment is released at the end of the project, the ice pad will be scored in order to accelerate its melting in the spring.

ALTERNATIVES

Mallik is the preferred location for a hydrate research project. The site is well known from previous drilling activity. The geology is well understood and no significant surprises in the drilling or testing programs are anticipated. It is known that no conventional hydrocarbons will be encountered during this program.

A summer program was considered and rejected because it would have exposed the operation to flooding. A summer operation would have required more soil disturbance to elevate the site in order to ensure that the operations remained above the high-water mark during the entire program. Winter drilling allows the operation to take place from an ice pad and thereby minimize the disturbance to the frozen soil surface.

Trucking equipment in by ice road from the Taglu staging site to Mallik will minimize environmental impact. This activity is anticipated to occur in early to mid-December 2001 but may be delayed in the event of a late freeze-up. Sufficient contingency has been incorporated into the schedule to accommodate several weeks of delay without affecting the spud date for the drilling program. An alternative plan was to barge the equipment all the way to Mallik. This was rejected because it would have resulted in disturbance of the unfrozen soils and storage of the equipment with a risk of flooding due to storm surges.

CUMULATIVE EFFECTS

The Mallik 3L-38 site is characterized by soft sandy soils. It is only a few hundred metres from the shoreline and approximately three metres above sea level. Almost all signs of previous drilling operations at this site have been obliterated within several seasons. Similarly, no significant lasting effects from the Mallik 3L-38 operation are expected.

To the best of the proponent's knowledge, there are no other drilling operations being planned within at least 30 kilometres of the Mallik site during the 2001/2002 winter drilling season. In the event that another operator plans to conduct drilling, seismic or other operations in the area, the proponent is committed to meeting with that operator in order to develop ways by which the cumulative environmental impact of both operations can

be mitigated, to the satisfaction of the local communities. The Petro-Canada gravel quarry operations at Devil's Lake and Swimming Point are not in the same area and their environmental impact will not be cumulative with the Mallik operation. The Mallik operation will not be making use of any quarry gravel.

The proposed project will make use of local infrastructure support from Inuvik and Tuktoyaktuk. The use of local contractors will reduce the need for bringing in outside workers who might be unfamiliar with working in the Delta area.

All workers on the project will be housed at the worksite. Only a few (2 or 3) of the most senior managers will live in Inuvik while assigned to the project. This will reduce the social impact of outside personnel on the local communities to a minimum.

The proposed gas hydrate well is not a commercial project. It is strictly a scientific research project and does not entail continuing long-term development. As a result, long-term, cumulative impacts on the environment, or on surrounding communities, are expected to be minimal. Nevertheless, depending on the success of the proposed research program, there is a possibility that scientists may wish to return to the site, at some later date, to conduct further gas hydrate research.

LOCATION

The research and development program is planned for the Mallik 3L-38 site, located on the west side of Mallik Bay, on Richards Island in the Mackenzie Delta of the Northwest Territories of Canada. The site is adjacent to the Mallik L-38 and Mallik 2L-38 sites, located at Latitude 69° 27' 41" North and Longitude 134° 39' 30" West as shown on Figures 1,2 and 3. The location is approximately 80 kilometres north by ice road from Tununuk Point. Figure 1 shows the well location, the Taglu staging site and the proposed ice road that will connect them. Figure 2 illustrates the general area. Figure 3 is a detailed layout of the Mallik drilling site. The entire area of operations is within the Inuvialuit Settlement Region.

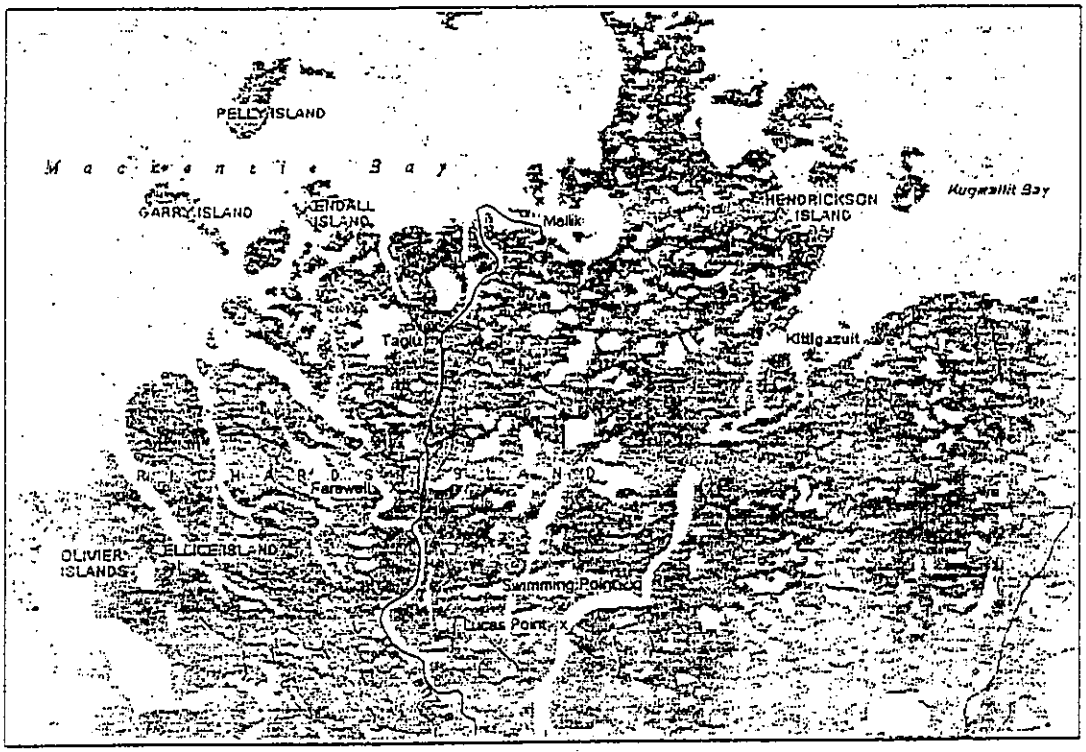


FIGURE 1
MALLIK LOCATION AND SUPPLY ROUTE

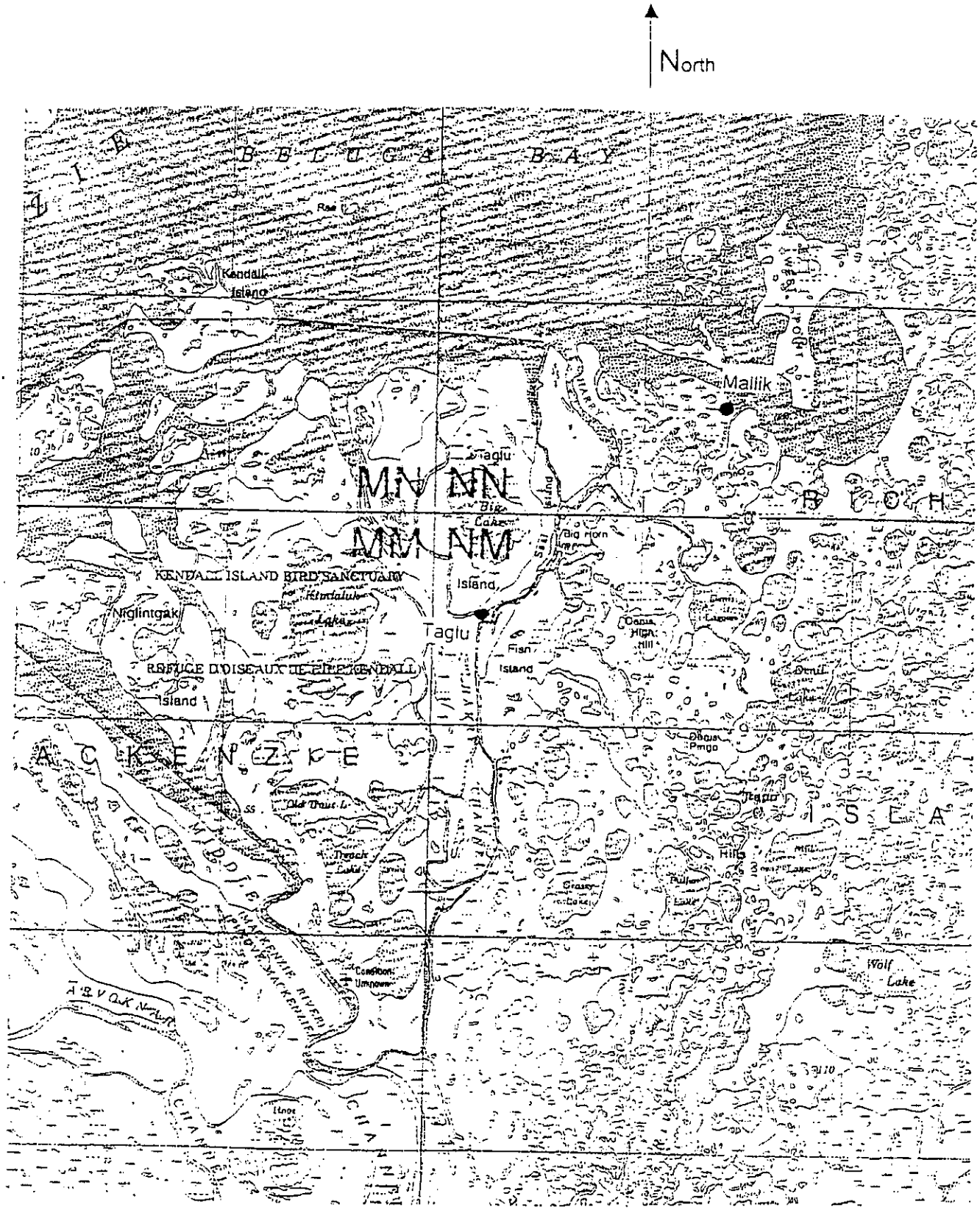


FIGURE 2
THE MALLIK AREA

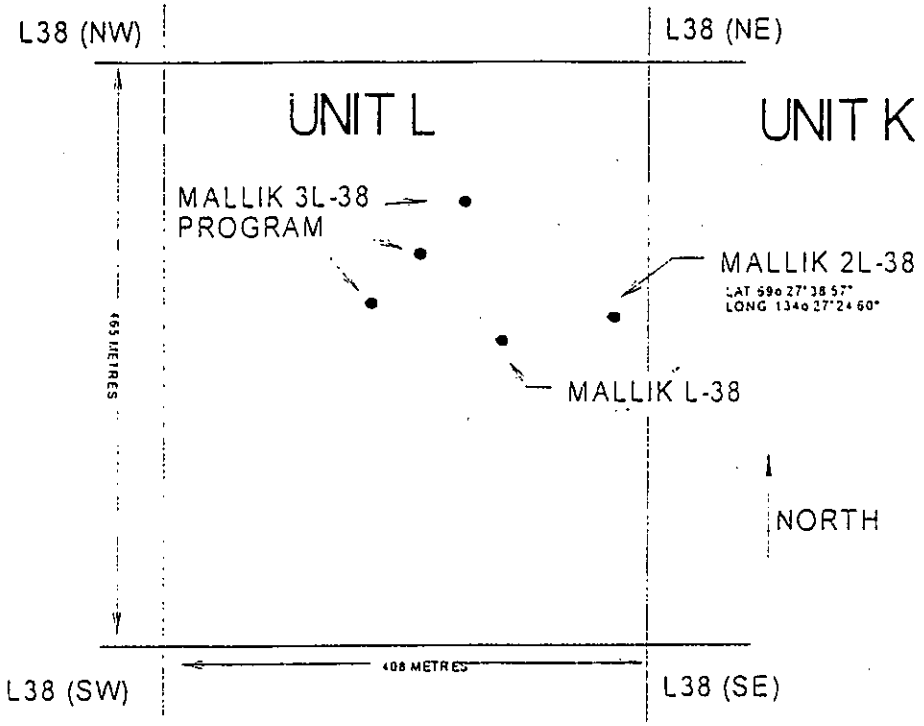


FIGURE 3
MALLIK WELLSITE MAP

TRADITIONAL AND OTHER LAND USES

Lands and waters of the outer Mackenzie Delta in the general vicinity of Mallik Bay are important to the resource harvesting activities of the residents of Aklavik, Inuvik, and Tuktoyaktuk. These activities are traditionally associated with a subsistence economy based on hunting, fishing, trapping, and gathering, and remain central to both the subsistence and cash economies of the area. The most important mammal of the outer Mackenzie Delta is the white whale or beluga, which is harvested by local residents. Several thousand enter West Mackenzie Bay and Shallow Bay each summer but shallow water prevents them from coming close to Mallik Bay. The Mallik site may be used for bird hunting and trapping.

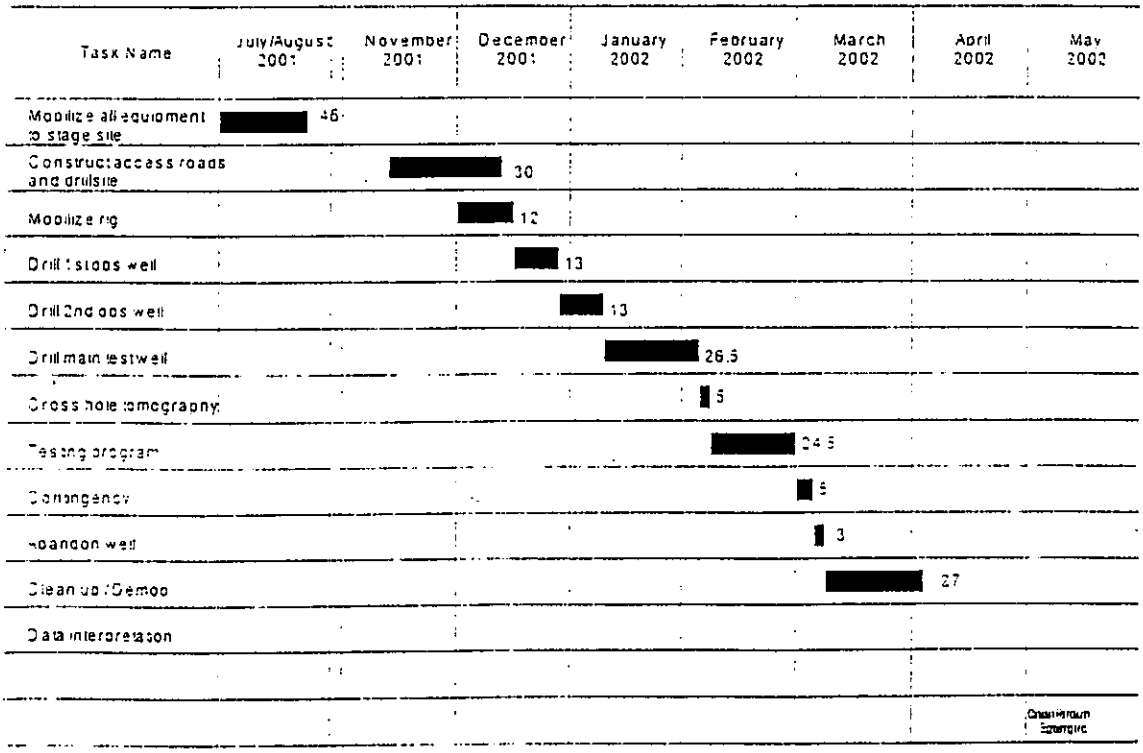
Archaeological sites have not been recorded at the Mallik L-38. Special areas of significance within the general area include the Kendall Island Migratory Bird Sanctuary and priority areas for protection of beluga and fish. A listing is provided in Table 1. The area is within land use Category C.

DEVELOPMENT TIMETABLE

A schedule for the proposed program is shown in Figure 4. The drilling rig, camp and other required heavy equipment will be barged to the Taglu staging site in August and September, 2001 to wait until after freeze-up. The equipment will be trucked from the staging site to Mallik 3L-38 in early to mid December 2001 where it will be assembled for use. Drilling is scheduled to commence on December 15, 2001. Total depth for the first observation well is scheduled for December 29. The second observation well is scheduled for completion by January 13. The main test well will be drilled, cored, logged and cased by mid February in preparation for testing during late February and early March. Completion of all operations is scheduled for March 15 if the early start date is achievable. In either case, the rig will be released no later than the end of March, 2002. Prior to the release of the rig, the three wells will be plugged and abandoned. The rig and camp will be dismantled, and the ice pad will be scoured to accelerate melting. At the completion of this work, all equipment will be demobilized to Inuvik, or to an alternate destination for which it is contracted.

Figure 4

Jacobs et al Mallik 3L-38
Project Timetable



There is sufficient contingency built into the above schedule that would allow the ice road construction to be delayed by several weeks due to a late freeze-up and still meet the planned spud date. It is currently planned that the well will be abandoned before the end of March. As final clean-up of the wellsite is expected to take less than a week, there will be ample time to ensure that all of the equipment will be demobilized on the ice road before it becomes unusable in late April.

NEW TECHNOLOGY

The Mallik wellsite has been drilled on two previous occasions and the well properties are well understood. At all times during the drilling program, the well will be kept under control using conventional technology and prudent drilling practices. Chilled mud will be used throughout the program to control well stability through the permafrost section as well as for controlling thermal disturbance during coring operations in the gas hydrate section. There will be no new or untried technology utilized during drilling operations. New technology may be employed in the testing phase. It is anticipated that the research program will examine the effects of injected hot water or other production stimulation on the separation of gas from the solid hydrate. When it is finalized, the testing program will be submitted to the National Energy Board for final approval prior to the commencement of testing operations.

ENVIRONMENTAL OVERVIEW

Landforms & Vegetation

The Mallik L-38 wellsite is located immediately adjacent to the shoreline of Mallik Bay and consists entirely of floodplain and beach deposits supporting sedge-dominated plant communities. The two previous Mallik sites are naturally flat with an elevation that varies from 1 to 2 metres above sea level. The new site is on higher ground, with an elevation of approximately 3 metres above sea level. Permafrost occurs in the area to a depth of approximately 600 metres, however polygons are not common in the area. This suggests that there are no large ice lenses near the wellsite.

Hydrology

The Mallik L-38 hydrologic regime is greatly influenced by water movement into and out of Mackenzie Bay, which is dominated by wind direction. Mallik Bay is relatively isolated from the fresh water influence of the river, however winds from the Northeast can push fresh water into the bay resulting in variable water salinities. The Mallik site is susceptible to flooding during the spring run-off of the Mackenzie River and to storm surges during the summer months. Lakes in the vicinity of the site are generally floodplain-salt lakes.

Freeze-up in Mackenzie Bay usually begins in mid-October and is complete by early November. Breakup usually occurs during mid May to early June.

Fishes

The aquatic habitats of the Mackenzie Delta support a diverse assemblage of freshwater, coastal marine, and anadromous fish species. The intricate network of lakes, connecting river channels, and estuarine areas represent important migratory corridors, rearing, and over-wintering habitat for twenty five (25) major species of fish. Of the eighteen (18) species of freshwater and anadromous fish, eight are used for commercial or domestic purposes. The least cisco is the most abundant. The most important, the broad whitefish, is taken commercially and has sustained a traditional domestic fishery.

Six (6) species of coregonids, or whitefishes, frequent the general area; inconnu, least cisco, Arctic cisco, broad whitefish, round whitefish, and humpback whitefish. Anadromous species, such as the coregonids, spawn and overwinter either in freshwater or in the brackish waters of river deltas or deep coastal embayments. They enter coastal waters at spring breakup, and in late summer, retreat to freshwater or brackish habitats for overwintering.

The anadromous form of the Arctic char spawns in autumn, migrating primarily through the west channels of the Delta during summer and fall (July-September).

The floodplain lakes in the Mallik area support least cisco, humpback and round whitefish, inconnu, pike, burbot and fourhorn sculpin.

Mallik Bay supports cisco, inconnu, broad and humpback whitefish, fourhorn sculpin and pleuronectids and arctic cisco.

Birds

The outer Delta supports a diverse bird fauna in summer, but is most noted for its importance to seventeen (17) species of geese, swans, and ducks. Waterfowl breed throughout the Delta, but the outer coast, including the Kendall Island Bird Sanctuary to the West of the Mallik site provides critical habitat. Four (4) species of geese (lesser snow goose, brant, white-fronted goose, and Canada goose) use the area for nesting, molting, brood rearing,

and staging. The area is also important to the tundra swan, plus various species of dabbling and diving ducks, loons, and shorebirds.

Swan Island supports a large number of non-breeding adult swans in summer, more during years of poor reproduction. Numbers build as the summer progresses. Lowlands around Bird Island serve the same function but the uplands support mainly breeding passerines and shorebirds. Adult and young snow geese from the Kendall Island nesting colony sometimes drift into the area of the well site during late summer. Coastal levees are important summer nesting and feeding areas for non-breeding and unsuccessful adult whitefronts, mallards, and pintails, where they spend their flightless period.

In the outer Delta, flocks of swans, geese, cranes, and some ducks arrive before the area is clear of snow and spend time in non-nesting habitats before dispersing. Arrival times vary from early to late May, depending on species and the onset of spring. Sedge-herb levee and mud bar habitats along channels are important at this time. Swans and other water birds use flooded habitats and upland lakes and ponds, generally arriving later when the ice has melted. Shorebirds arrive in the last week of May and the first week of June, using coastal areas and shallow pools.

Autumn migration is a more drawn out process than spring migration, but staging numbers are larger. Shorebirds use the coastline in August. Snow, Canada, and white-fronted geese, augmented by northern arrivals, congregate in large flocks throughout the foreshore area prior to departure in August and September.

Birds in the Mallik area are predominantly waterfowl and shorebird species. Flocks of black brant and snow are present in both the spring and the fall, and moulting concentrations of swans and dabbling ducks have been observed during the summer.

Mammals

At least thirty-three (33) species of terrestrial mammals are known to occur in the Delta. Of these, only a few frequent the Mallik wellsite in significant numbers. The few reindeer now in the outer Delta are probably remnants of the main herd that once grazed there. Polar bears could occur in winter. An estimated 30 - 40 grizzlies frequent the outer Delta and adjacent hills, where active dens are found in upland soils. In June and July, grizzlies are seen in areas characterized by an interspersion of fluvial lowlands, meadows, and uplands.

Coloured foxes occur commonly in upland terrain throughout the area. Arctic foxes are most common during winter near the coast, on floodplain habitats, and barrier islands. Muskrats are abundant in the Delta but decrease in numbers north of the treeline. Preferred habitat for beaver is generally restricted to areas of poplar and willow, not found near the Mallik area.

The most important mammal of the outer Delta is the white whale or beluga. Several thousand visit West Mackenzie Bay and Shallow Bay each summer, attracted to the estuary by warm water temperatures.

Special Designated Lands in the General Vicinity of Mallik L-38[1]
Land Use Category - Category C: "lands where cultural or renewable resources of some significance and sensitivity occur during specific times of the year. These lands shall be managed so as to guarantee the conservation of the resources."
Beluga Management Plan Zone 2 - all Mackenzie Shelf (Estuary) waters shallower than 20 m. Industrial activities are conducted in a controlled and responsible manner and may be permitted if they do not adversely affect the beluga, their habitat and their hunting.
Beluga Management Plan Zone 1A - beluga harvesting areas (3), of which one segment includes waters adjacent to Bird Island (Garry G-07) on its north and northwest sides. No interference with hunting activities will be accepted.
Kendall Island Harvesting Site - an area of foreshore that includes both P-04 and G-07, identified by all Inuvialuit communities as an important subsistence harvesting area. Also important as breeding habitat for birds, denning habitat for grizzly and polar bear, plus beluga feeding.
Garry and Pelly Islands IBP Site - Garry and Pelly Islands and surrounding waters, including those adjacent to P-04 and G-07 wellsite locations. Recommended for eventual protection as ecological reserves.
Central Mackenzie Estuary Fisheries Priority area (DFO) - nearshore estuarine waters including those around Swan and Bird Islands. Identified as important to beluga (feeding and traveling); overwintering and nursery areas for a variety of fish; and used extensively by feeding anadromous coregonids.
Kendall Island Bird Sanctuary - includes those islands upon which P-04 and G-07 are located. Administered by the Canadian Wildlife Service with permits needed for access and overflights during open water season.
Key Migratory Bird Terrestrial Habitats - nearshore area, including sites P-04 and G-07, identified as key habitat during breeding and migration periods for birds.

Table 1 - Land Use and Special Areas

[1]Community of Inuvik, 1993. Inuvik Inuvialuit Community Conservation Plan. Inuvik, N.W.T.

PROPOSED MITIGATION AND ANTICIPATED ENVIRONMENTAL IMPACTS

The operator is aware of the environmental issues in the operating area and is committed to ensuring that no significant environmental impacts arise from the proposed project. The operations will be carried out during the winter season during the absence of most of the wildlife noted above. No operation will be undertaken which would contravene the "Conduct of Operations" outlined in Section 19 of the ILA Rules and Regulations, Appendix G.

In order to ensure safe operations and minimal environmental impact, top priority will be given to utilizing Arctic experienced and reputable personnel for the project. Care will be taken to ensure that all personnel on the site will be familiar with procedures for safe working habits, handling of fuel, site cleanliness and respect for the environment.

The environmental impact of travel between the staging location and the wellsite will be mitigated by the use of ice roads. The ice road from Taglu to Mallik will be constructed on frozen river channels in the Delta. The route will make use of existing routes as much as possible. Snow and ice will be piled up to form ramps for crossing riverbanks. No banks will be cut to access river crossings. Access from the ice road to the wellsite will utilize previous access routes. Surface travel will take place well after freeze-up and will ensure minimal disturbance of the soil and vegetation where the roadway crosses onto the land.

Taking place after freeze-up, the mobilization activities on the ice road are expected to have minimal impact on the bird population of the area. Staging activities for the autumn migration will be long over by this time.

To minimize soil disturbance, the drilling operation will be conducted from an ice pad. The bladed vehicles and equipment used for construction of the ice pad will be fitted with "mushroom shoes" in order to minimize damage to the vegetation or soil surface beneath the snow. Heat loss from the rig to the pad will be minimized through the use of a double set of matting that is arranged to allow the flow of ambient air beneath the rig substructure. Drilling operations will use chilled mud to avoid disturbance of the permafrost or frozen gas hydrates.

During previous operations at Mallik in 1997/98, little wildlife was reported in the vicinity of the worksite.

Only a limited amount of water will be required to mix drilling mud. It will be drawn from the river using a small pipe fitted with a screen to avoid entraining fish. The same mud will be used for drilling all three wells.

The mud sump level will be kept a minimum of one metre below ground level during operations. Only approved biodegradable mud products and chemicals will be used in order to prevent environmental damage from well fluids or cuttings. No oil-based drilling muds will be used. All used muds and cuttings will be disposed of in a mud sump. The mud sump will be monitored

to ensure that it does not contain any toxic materials prior to being filled and capped.

The subsurface geology and pressure gradient is well known. The well reports from the 1972 Imperial Oil operations at the Mallik L-38 wellsite state that "...a low gas backgrounds and absence of significant gas kicks, indicates a lack of hydrocarbon bearing reserves" in the depths to be drilled.

All facilities, wastes, sewage and fuel tanks, as well as the sump will be set back several hundred metres from the shore and this would provide adequate opportunity for clean-up in the event of any small spill. All fuel and oil tanks will be double walled or will be constructed within a self-contained berm. A reasonable worst-case fuel spill scenario would be an incident with a truck tanker, capacity 14,000 litres of diesel. Any spillage will be reported immediately and cleaned up with absorbents. Any contaminated material would be disposed of by transport to a facility in Tuktoyaktuk or Inuvik for incineration.

Upon completion of the project and release of the drilling equipment, any remaining combustible wastes will be burned in a smokeless incinerator. Non-combustible wastes will be trucked to an approved disposal site. The mud sump will be backfilled with the original material excavated during its construction. Except for the mud sump, the remainder of the soils at the operating site will have remained virtually undisturbed under the ice pad. The ice pad will be scored in order to accelerate its melting in the spring.

With the demobilization of the remaining equipment, the snow/ice ramps used to access the ice road will be V-notched to ensure that they do not impede water flow during spring break-up.

None of the work will take place within Area 1A of the Beluga Management Plan.

EMERGENCY RESPONSE PLANS

A site specific Emergency Response Plan is included in Appendix A. The plan (including oil spill response measures) will be in force at all times during the operation. The plan is based on the one developed for Mallik 2L-38 in 1998 and has been updated to reflect current requirements and standards.

A remotely operated diverter, blewey line and flare tank will be installed at the start of the well to divert and collect any fluids that might be expelled during an unexpected gas kick. A flare gun will be kept on site to ignite any diverted gas. Sufficient kill mud will be on hand to combat any kick. Fire drills and gas kick drills will be carried out throughout the drilling and testing program. Appropriate fire fighting equipment and gas detectors as specified by the Occupational Safety and Health standards will be used. Personnel will be properly trained in fire fighting and reactive drilling practices.

All fuel tanks will be double walled or will be constructed within a self-contained berm. An auxiliary fuel tank will be kept on site in order to provide for safe storage of the contents of the main fuel tank in the event that it should develop a leak. All spills will be reported and cleaned up with absorbents or burned off. Sufficient absorbent materials will be kept on site for this purpose. Any remaining contaminated snow; ice or soil would be removed from the site and trucked to Inuvik for disposal as directed by the NEB or other affected regulators.

The site will have a medic at all times. A short airstrip, planned for the ice adjacent to the wellsite, could be used for medivacs, emergency supplies or emergency services should these be required. If no airstrip is built, arrangements will be made to have access to a helicopter for these purposes.

A bear monitor will remain on site while operations at the well site are underway.

CLEANUP, RECLAMATION, DISPOSAL AND DECOMMISSIONING PLAN

The rig will be released no later than the end of March in order to demobilize it south, or to supply it to another operator in the area.

The Mallik 3L-38 site is naturally flat and no advance preparation of the soil surface will be required. To minimize the environmental impact, the drilling operations will take place from an ice pad. Soil disturbance will be limited to an excavation for a small cutting sump.

On completion of the drilling and testing program, the well will be abandoned or suspended in accordance with Part VIII of the Canada Oil and Gas Drilling regulations. A permanent cement plug will be placed across the casing stub and the wellhead will be appropriately marked for future identification.

Upon removal of the equipment from the site, all remaining combustible wastes will be burned in a smokeless incinerator. Non-combustible wastes will be trucked to approved disposal sites. The cuttings sump will be backfilled with the original material which was excavated during its construction. The surface elevation of the backfilled sump will be a minimum of one metre above the ground level. Except for the sump, and the area within about one metre of the wellhead, the remainder of the soils at the operating site will remain undisturbed under the ice pad for the duration of the project. Before the construction equipment is released at the end of the project, the ice pad will be scored in order to accelerate its melting in the spring.

OTHER ENVIRONMENTAL ASSESSMENT

The proposed operations will be taking place adjacent to the Mallik L-38 site which was first drilled by Imperial Oil Limited between December 24, 1971 and January 26, 1972. Drilling operations at this site took place again during the Japex/JNOC/GSC research project in 1998. Both of those earlier wells have been plugged and abandoned and the site continues to pass all subsequent land inspections.

COMMUNITY CONSULTATION

The Hunters and Trappers Committees of Tuktoyaktuk, Inuvik and Aklavik will be contacted in April and a project description will be forwarded to each Committee. The Committees will be asked if they wish to make comments or to meet with the proponent. Any feedback will be documented and presented to the Environmental Impact Screening Committee prior to the screening of the project.

APPENDIX – THE EMERGENCY RESPONSE PLAN FOR MALLIK