3.3.3.3 Fish and Fish Habitat Summary

The water bodies within the footprint of the Project do not appear to be fish-bearing and the lack of sport fishing in these water bodies suggests the same. Two of the four streams to intersect the planned route for the access road were fish-bearing. During construction of the access road, each stream crossing, whether fishing-bear or not, will be crossed with a DFO-approved culvert design, so potential affects on fish habitat are mitigated.

3.3.4 Waterfowl and Terrestrial Birds

3.3.4.1 Field Methodology

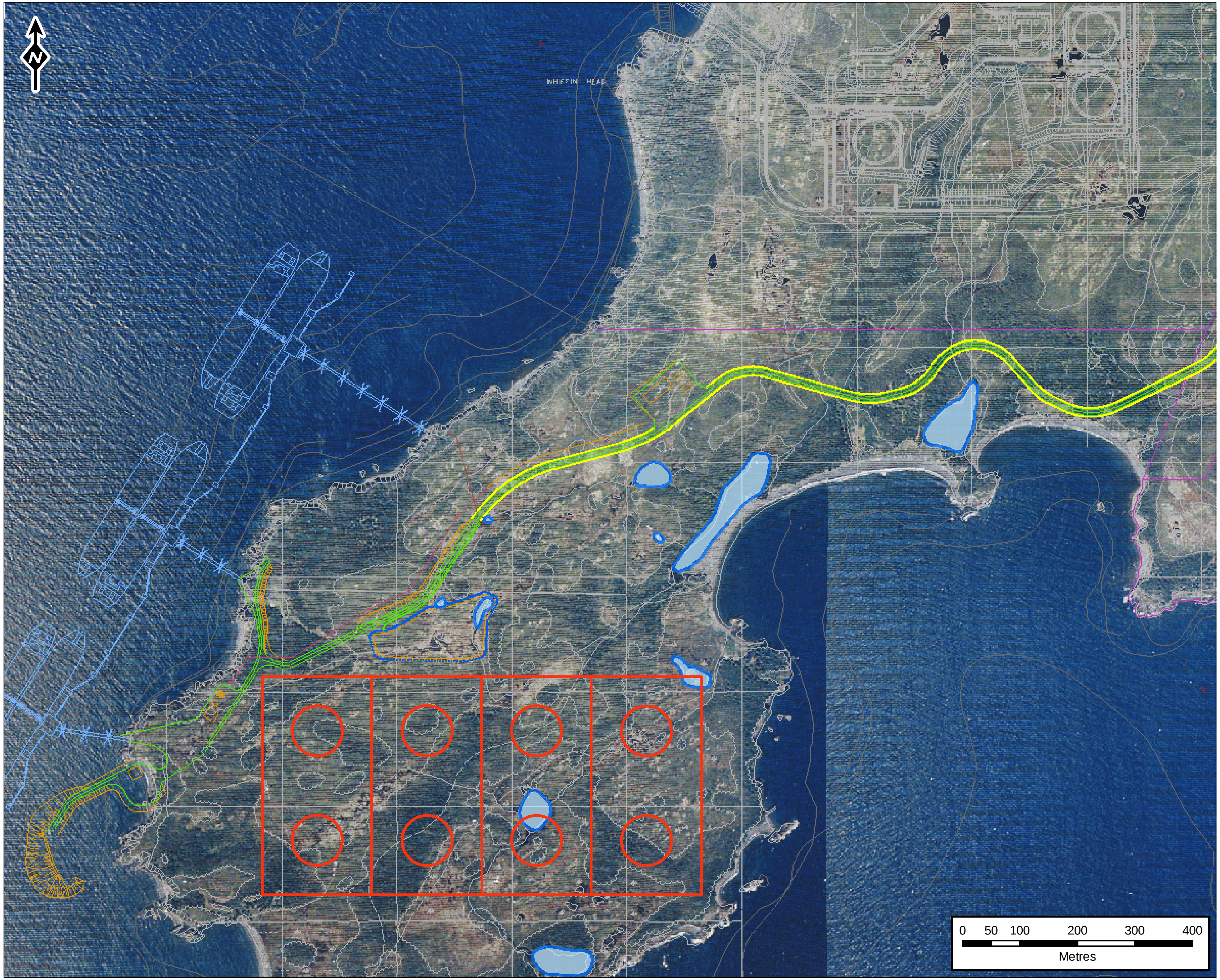
Within the Study Area, late spring waterfowl surveys were conducted from early morning until evening on May 19 to 21, 2006, from 1000 to 1700 hours on August 10 and 11, 2006 and September 8, 2006, from 1200 to 1800 hours on September 11, 2006, and from 0900 to 1700 hours on October 19 and 20, 2006. Weather and survey conditions were ideal on all survey days (i.e., sunny with good visibility and minimal wind). The census involved a visit to each open water wetland and the vicinity of each, and also the coast adjacent to the Study Area (Figure 3.22). Audubon Equinox (10 x 42) binoculars were used to scan the areas, including grassy areas and shorelines for waterfowl and other birds. Locations of each waterfowl species were recorded. Flyover species were also recorded. Point counts were done on May 22, 2006, from 0430 to 1000 hours in the morning and from 1630 hours until dark in the evening. Due to heavy rain, the evening survey had to be prematurely cancelled. Point counts were of 10 minutes duration each. Bird species heard or seen were recorded, as were habitat characteristics. Between each point count, additional birds and mammals were also noted.

3.3.4.2 Results

No waterfowl species were recorded during the May surveys. Three species of waterfowl were observed in the Study Area on August 10 and 11, 2006; American Black Duck (*Anas rubripes*), Common Loon (*Gavia immer*), and Double-crested Cormorant (*Phalacrocorax auritus*) were all found within or near the Study Area. Two American Black Duck were found on Otter Pond, near the coast. On the October 20, 2006 survey, four American Black Ducks were foraging on Otter Pond. No waterfowl species were found in the Study Area during the September 8 or 11 census.

A total of 28 point counts were conducted; 13 on the western and central areas of Grassy Point and 15 along the eastern and southern areas. Twenty-six bird species were seen during the morning and evening surveys on May 22, 2006: 19 Passerine, 5 seabirds, 1 raptor and 1 shorebird. No waterfowl nesting or otherwise were observed on the point count surveys; however, these surveys are not designed to detect waterfowl or raptors. Of raptor species, only Bald Eagles (*Haliaeetus leucocephalus*) were observed during the point count surveys. Merlins (*Falco columbarius*) were detected on a later survey and breeding was confirmed for this species with the presence of a fledged chick and extremely agitated parents.

Marine birds were not intensely surveyed during the waterfowl census, as they wouldn’t typically be found using the terrestrial Study Area. However, several gulls were observed flying over the Study Area, and on a small island east of Wild Cove Head, 127+ pairs of Herring Gull (*Larus argentatus*) and 120+ pairs of Black-legged Kittiwake (*Rissa tridactyla*) were seen nesting.



LEGEND

Open Water

NOTES:
1. DO NOT SCALE FROM DRAWING.
2. @ JACQUES WHITFORD, 2006.

CLIENT:

NEWFOUNDLAND LNG LIMITED

PROJECT TITLE:

REGISTRATION / PROJECT DESCRIPTION

DRAWING TITLE:

WATERBODIES WITHIN STUDY AREA

FIGURE 3.22

Jacques Whitford

SCALE: 1:7,000	DATE: NOV. 15, 2006
DRAWN BY: SAR	CHECKED BY:
EDITED BY: -	REV. No.
DRAWING No.:	
MAP FILE: 1015846_Waterbodies.MXD	

DD/MM/YEAR

Many of the passerine species observed are coniferous habitat specialists in Newfoundland. These included: Ruby-crowned Kinglet (*Regulus calendula*), Black-throated Green Warbler (*Dendroica virens*), Blackpoll Warbler (*D. striata*), Yellow-rumped Warbler (*D. coronata*) and Fox Sparrow (*Passerella iliaca*). All five of these species migrate south from Newfoundland in winter. Other species specialize in bog habitats and bog-edge habitats and included these migrants: Yellow-bellied Flycatcher (*Empidonax flaviventris*), Northern Waterthrush (*Seiurus novaeboracensis*), Wilson's Warbler (*Wilsonia pusilla*), and Swamp Sparrow (*Melospiza giorgina*). Generalist species are able to exploit a variety of habitat types. Generalists detected on the point count surveys included: American Crow (*Corvus brachyrhynchos*), Common Raven (*C. corax*), Black-capped Chickadee (*Poecile atricapilla*), American Robin (*Turdus migratorius*), White-throated Sparrow (*Zonotrichia albicollis*), and Dark-eyed Junco (*Junco hyemalis*) (Birds of North America Online 2006). Most of these species will overwinter in Newfoundland, but many American Robins and White-throated Sparrows may migrate to warmer southern climes.

Several species were not observed on the point count surveys but were detected by passive observation on other surveys including the waterfowl survey. These species included the coniferous forest specialists like the Black-backed Woodpecker (*Picoides arcticus*), Boreal Chickadee (Poecile *hudsonica*), Red-breasted Nuthatch (*Sitta Canadensis*), Golden-crowned Kinglet (*Regulus satrapa*), Magnolia Warbler (*Dendroica magnolia*), Palm Warbler (*D. palmarum*), Lincoln's Sparrow (*Melospiza lincolnii*), Pine Siskin (*Carduelis pinus*), and Pine Grosbeak (*Pinicola enucleator*); the generalist Blue Jay (*Cyanocitta cristata*) and Song Sparrow (*Melospiza melodia*) (Birds of North American Online 2006); and a single observation of the provincially endangered Gray-cheeked Thrush (*Catharus minimus*). It is unknown whether Gray-cheeked Thrush is breeding in the Study Area as the observation was in late summer, when the bird may have started migration. Bird species are summarized in Table 3.6.

Table 3.6 Avian Species Observed on Grassy Point, NL, Study Area During Waterfowl and Point Count Surveys in 2006

Latin Name	Common Name	AOU Species Code
Tringa melanoleuca	Greater Yellowlegs	GRYE
Gallinago delicata	Wilson's Snipe	WISN
Alle alle	Dovekie	DOVE
Haliaeetus leucocephalus	Bald Eagle	BAEA
Actitis macularia	Spotted Sandpiper	SPSA
Larus delawarensis	Ring-billed Gull	RBGU
Larus argentatus	Herring Gull	HERG
Larus Marinus	Great Black-backed Gull	GBBG
Rissa tridactyla	Black-legged Kittiwake	BLKI
Sterna hirundo	Common Tern	COTE
Empidonax flaviventris	Yellow-bellied Flycatcher	YBFL
Ceryle alcyon	Belted Kingfisher	BEKI
Picoides villosus	Hairy Woodpecker	HAWO
Picoides arcticus	Black-backed Woodpecker	BBWO
Cyanocitta cristata	Blue Jay	BLJA
Corvus brachyrhynchos	American Crow	AMCR
Corvus corax	Common Raven	CORA
Poecile atricapilla	Black-capped Chickadee	BCCH
Poecile hudsonica	Boreal Chickadee	BOCH
Regulus satrapa	Golden-crowned Kinglet	GCKI
Regulus calendula	Ruby-crowned Kinglet	RCKI
Sitta canadensis	Red-breasted Nuthatch	RBNU
Bombycilla cedrorum	Cedar Waxwing	CEDW
Vireo solitarius	Blue-headed Vireo	BHVI

Latin Name	Common Name	AOU Species Code
Catharus guttatus	Hermit Thrush	HETH
Catharus minimus	Gray-cheeked Thrush	GCTH
Catharus ustulatus	Swainson's Thrush	SWTH
Turdus migratorius	American Robin	AMRO
Dendroica petechia	Yellow Warbler	YEWA
Dendroica coronata	Yellow-rumped Warbler	YRWA
Dendroica virens	Black-throated Green Warbler	BTNW
Dendrioca striata	Blackpoll Warbler	BLPW
Dendroica magnolia	Magnolia Warbler	MAWA
Dendroica palmarum	Palm Warbler	PAWA
Seiurus noveboracensis	Northern Waterthrush	NOWA
Wilsonia pusilla	Wilson's Warbler	WIWA
Spizella passerina	Chipping Sparrow	CHSP
Passerculus sandwichensis	Savannah Sparrow	SASP
Passerella iliaca	Fox Sparrow	FOSP
Melospiza giorgiana	Swamp Sparrow	SWSP
Zonotrichia albicollis	White-throated Sparrow	WTSP
Junco hyemalis	Dark-eyed Junco	DEJU
Melospiza melodia	Song Sparrow	SOSP
Melospiza lincolnii	Lincoln's Sparrow	LISP
Carduelis pinus	Pine Siskin	PISI
Pinicola enucleator	Pine Grosbeak	PIGR

3.3.5 Historic Resources

In October 2006, a Stage 1 Historic Resources Assessment was conducted at Grassy Point, Placentia Bay. The research was carried out in accordance with provincial guidelines and focused on: a) identifying and assessing the historic resources/archaeological potential or sensitivity in areas of proposed development; and b) recommending the appropriate methodology and scope for further detailed impact studies in Stage 2, if indicated. The assessment included background research, a field study and preparation of the necessary reports.

3.3.5.1 Methods

Background research involved a review of literature related to a number of archaeological surveys and excavations conducted in the vicinity of the Study Area. Sources examined included reports and documentary information on file at the Provincial Archaeology Office (PAO) and at Memorial University of Newfoundland. As well, the Newfoundland and Labrador Archaeological Site Record Inventory and Site Record Forms were reviewed to obtain details on any archaeological sites registered for the region. The Project Archaeologist also spoke with individuals knowledgeable about land use and whether any archaeological sites or artifacts had been discovered within or adjacent to the Study Area. Aerial photographs and NTS topographic maps were examined to identify landforms and vegetation patterns that could indicate zones of historic resources potential.

The field component of the Stage 1 involved a walkover and thorough visual inspection of the principal area of interest at Grassy Point, and subsurface testing of any locations considered to hold potential for either prehistoric or historic remains. Where appropriate, rows of shovel test pits were dug along cut-lines and paths, and along natural linear features such as the shoreline, terrace edges and any dry, level areas suitable for human settlement. In areas where cultural materials were recorded, limited shovel testing was conducted to establish cultural affiliation, the time period involved and the physical extent of the remains. Limited testing prevented any unnecessary site disturbance until appropriate mitigation measures are approved by the PAO.

The Final Report for the assessment will include a discussion of the study methods and techniques, a detailed summary of results, and maps showing survey areas and the location of all sites observed and recorded. Recommendations for mitigation and further research will be provided where appropriate.

3.3.5.2 Stage 1 Results

Background research indicated that two prehistoric sites are registered with the PAO for the south of Grassy Point toward Bordeaux. Due to erosion at the site referred to as CkAm-04, no accurate dating of remains was possible; however, stone artifacts did confirm it to be Late-Paleoeskimo in origin. Charcoal remains collected a second PaleoEskimo site (CkAm-05) confirmed that it dated to approximately 850 AD. These two prehistoric sites registered with the Province were visited during the current field study. Based on their location near Bordeaux Pond, south of the Grassy Point Study Area, no Project-related interaction with these cultural resources is anticipated.

Local knowledge suggests that prior to the 19^{th} century, certain parts of Bordeaux Head had been used as a seasonal shore stations by Basque and French fisherman to process their catch. From the early 19^{th} century to approximately the 1960s, the community of Bordeaux, situated to the south of Grassy Point, was used for farming and fisheries activities. Informant interviews conducted as part of the background research suggest that no sustained occupation had occurred at Grassy Point where construction of the Project is proposed.

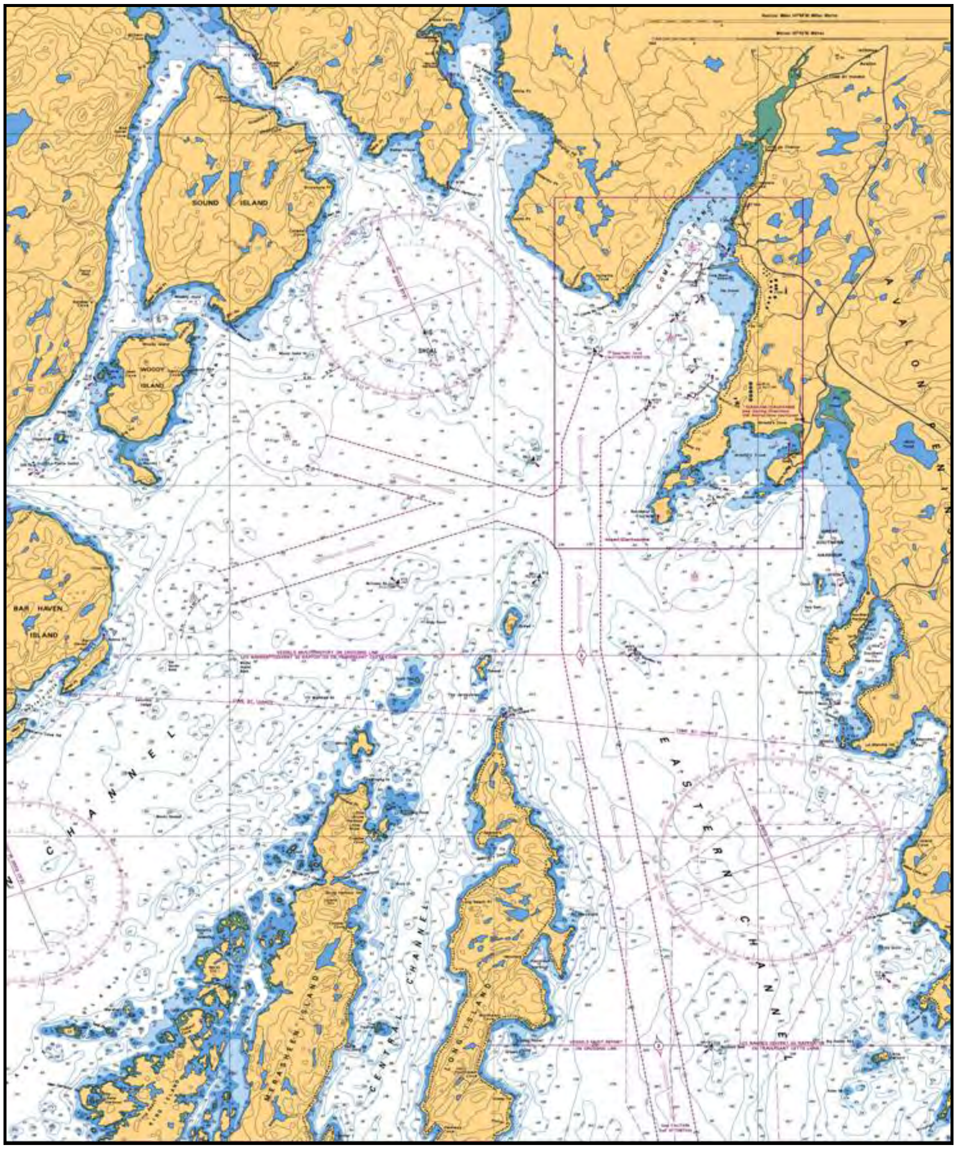
Three locations were identified where small-scale agriculture had taken place in the past. Two locations are near the coast between Bordeaux Cove and Grassy Point, outside the footprint of the Project. The third location is near the planned access road route, north of Labours Cove Pond. Despite test pitting at each location, no evidence of dwellings or buildings, or materials predating the mid-19^{th} century, were located. Consultation will take place to determine what, if any, mitigation measures are warranted for the sites.

3.3.6 Vessel Traffic

Vessel traffic in Placentia Bay is strictly controlled by the CCG Marine Communications and Traffic Services (MCTS) Centre located at Argentia. The MCTS centre uses state-of-the-art electronic equipment, including a network of radar facilities at Arnold's Cove, Argentia, and Cuslett on the eastern side of Placentia Bay.

Vessel routing is divided into published inbound and outbound traffic lanes, commencing 10 to 15 nautical miles (18.5 to 27.8 km) southwest of Cape St. Mary's at the mouth of Placentia Bay and leading up the Eastern Channel of the bay to the port at Come By Chance Harbour (Figure 3.23). The navigable portion of the bay is divided into zones for the purposes of pilotage. In Zone A at the head of the bay, pilotage is compulsory for all commercial vessels. In Zone B in the Eastern Channel, pilotage is compulsory for all vessels greater than 223 m in length. In the open area in the mouth of the Bay, vessels are regulated by MCTS but pilotage is not compulsory. Vessels in the system must report their positions to MCTS at 10 prescribed points along the defined traffic routes.

Figure 3.23 Shipping Lanes at the Head of Placentia Bay



In 2005, 293 tanker vessels visits were recorded at the Newfoundland Transshipment Limited (NTL) facility. This does not include extra movements to or from anchorage. In 2006, 223 tanker vessels visits are projected at NTL. At North Atlantic Refining Limited, 243 tanker visits were recorded in 2005, and a similar number is expected for 2006. In addition, during the main fishing season, (May to October), fishing vessels frequently cross the traffic lanes and fishing gear, particularly crab pots, may be close to those lanes. Some recreational and ferry traffic may be encountered during the summer.

When fully operational, the proposed Project will have a baseload capacity of 1.3 million m^3. In order to sustain supply and transship to northeastern US markets, up to 400 ships per year will be required phased in over the five years of Project execution. The exact number of vessels will depend on the size profile of the incoming vessels up to the larger Q-Max tankers and the size of the smaller outbound shuttle tankers (Table 3.7). Transport Canada and CCG have suggested that additional vessel traffic can be managed and modifications to the existing system may be required. A South Coast Risk Analysis commissioned by Transport Canada in 2005 and due in January 2007, will be referenced to address the concerns regarding increased traffic. Newfoundland LNG Ltd. will also work with existing committees, including the Placentia Bay Traffic Committee chaired by the CCG.

Table 3.7 LNG Tanker Specifications

Specification	Q-Max Tankers	Shuttle Tankers
L.O.A. (m)	345	277
Draft (m)	12.5	12.12
Beam (m)	55	43.4
DWT (ton)	115,400	77,822
Capacity (m^3)	265,000	140,000

While additional traffic is anticipated in Placentia Bay, Newfoundland LNG Ltd. is designing the marine terminal and three jetties to ensure there is adequate capacity at the terminal site to minimize or preclude the use of anchorages.

Any exclusion zones required by LNG tankers entering or leaving the Placentia Bay area will be designated by Transport Canada. However, changes are not anticipated to existing approved shipping lanes/zones or anchorages in support of this Project.

Newfoundland LNG Ltd. will ensure all necessary aids to navigation are in place. The tug boat basin and three jetties will require six or eight pipestands, complete with three nautical mile flashing lights. Light colour and flash characteristics will be determined under the guidance of CCG. A site visit to the completed facility will be required for complete recommendations. Radio communication equipment will consist of a whip antenna affixed to the facility control building. The control building will be situated more than 30 m from a water body and will not release a polluting substance into a water body. There will be a requirement to update existing nautical products (paper and electronic charts, electronic navigating charts, etc) to depict these new marine facilities. It is anticipated that this work will be completed by September 2008. Newfoundland LNG Ltd. will advise the Canadian Hydrographic Service (CHS) as to when the appropriate nautical products should be updated.

3.3.7 Weather

3.3.7.1 Air Temperature

Mean daily temperatures in the Arnold's Cove area usually range from -5°C to 15°C, but can be -9°C in January and February and 19°C in July and August. The annual average daily temperature is approximately 5°C. Water temperature near surface can be expected to range from 0.5°C in March to 15°C in August.

3.3.7.2 Precipitation

Monthly total precipitation in the Arnold's Cove area is approximately 60 to 90 mm in the winter and 90 to 125 mm in the summer. Mean monthly snowfall totals range from 20 to 50 cm in the winter months from December to March. Annual precipitation totals (which include the water equivalent of snow, usually taken as the measured amount divided by 10) of approximately 1,300 mm may be expected. Annual snowfall totals are 120 to 170 cm. Daily rainfall totals as high as 100 mm are possible. The greatest daily snowfall ranges between 30 and 70 cm. From May to November, rainfalls greater than 0.2 mm can be expected at least 10 days each month. Snowfall greater than 0.2 cm can be expected from three to five days each month in the winter.

3.3.7.3 Wind

Winds in the Arnold's Cove Area are predominantly from the southwest for most months. On an annual basis, approximately 28 percent of the winds are from the southwest and 15 to 20 percent are from each of the northeast, south and northwest; northeast winds are slightly more prevalent in winter. Monthly mean hourly wind speeds range from about 5 m/s in July to 7 m/s in December (based on conditions measured at nearby Arnold's Cove). Maximum wind speeds range from 18 to 22 m/s in the spring and summer and from 23 m/s to just less than 26 m/s during the fall and winter. The upper 95 percent wind speed limit ranges from 8.6 m/s in July to 14.2 m/s in December.

3.4 Construction

The development and construction of the Project is planned in a three stages process, commencing with simple berthing providing little land-based support (Stage 1) and evolving into a fully functional, integrated transshipment and storage facility with multiple berths and multiple storage tanks (Stage 3).

- Stage 1: construction of a jetty (which will allow a LNG tanker to directly connect with a second-leg/shuttle tanker for LNG transfer) and a tug basin;
- Stage 2: construction of a second berth; temporary storage vessel will hold product transferred from an LNG tanker for future transfer to a second-leg/shuttle tanker; and/or possible construction of onshore tanks, and;
- Stage 3: construction of a third berth and construction of onshore tanks to a maximum of 8.

The design philosophies applicable to all design stages include the following:

- the facility must be safe and meet all regulatory requirements;
- the design must be flexible and expandable to accommodate a wide-range of customer requirements;
- all BOG generated from storage and / or transshipment operations will be re-liquefied and returned to storage using a land-based reliquefaction system or otherwise used for power generation;
- the facility must be robust in capacity of berthing, offloading operations and storage; and
- the facility must be economical over the lifecycle of the facility with equal focus upon capital and operating cost control.

The layout of the facility will comply with LNG tank design information and LNG storage tank spacing as required by the latest Canadian Standards Association (CSA) Z276-01 Code requirements. All structures including tanks, buildings and marine works will be designed for seismic loads in accordance with the latest addition of the *National Building Code of Canada*.

3.4.1 Site Preparation

The site is partially tree covered and is covered by shallow overburden. Trees will be cut, merchantable timber salvaged, and the slash mulched. The site grading will require removal of the overburden by bulldozer and excavator. This material will be loaded in trucks and removed to the overburden stockpile sites. The stockpiles will be trimmed and leveled as required. The stockpile will be reclaimed and redeposited over developed areas in the future, as required.

Site development requires the excavation of rock, which will be deposited in fill areas to complete any site grading. This work will involve drilling and blasting using pneumatic or hydraulic rock drills as per conventional rock excavation techniques. The explosives to be used will be stored in an approved, secure magazine. Licensed blasters under direct supervision of a professional engineer will undertake blasting. The following measures will be implemented to minimize the impact of the use of explosives and blasting:

- explosives will be used in a manner that will minimize damage or defacement of landscape features, trees and other surrounding objects by controlling through the best methods possible (including time-delay blast cycles) the scatter of blasted material beyond the limits of activity;
- blasting patterns and procedures, which minimize shock or instantaneous peak noise levels, will be used;
- blasting will not occur in the vicinity of fuel storage facilities; and
- blasting in or near a water body will be undertaken following existing guidelines and only after appropriate regulatory approval has been obtained.

An access road for equipment, materials and general access will be constructed overland, for a distance of approximately 1.5 km (see Figure 3.4). The road will be a minimum width of 6 m with 1 m shoulders but remain on public or Newfoundland LNG owned land. Access will become secure and restricted at the Grassy Point LNG gatehouse. Perimeter fencing will be 2.4 m high galvanized chain link topped with 3 strands of barbed wire.

3.4.2 Stage 1 – Single Berth with Side-by-Side Mooring

Stage 1 consists of a single berth capable of mooring two LNG carriers in a side-by-side (SBS) arrangement and with one of the vessels being a Q-Max size (265,000 m^3). This minimum facility provides a lay-up site for vessels and the opportunity to perform ship-to-ship LNG transfer while docked. All BOG will be handled aboard the ships. There will be no unloading arms for the vessels.

Stage 1 requires limited support from shore-based facilities. The shore-based infrastructure would be limited to a small office building for mooring personnel with power from the local grid and self-contained sanitary systems. The site will be prepared for future expansion with rough grading for all potential tank locations. A heavy haul road will be required to bring materials to the site.

This stage has a very short lead-time to operational status. Newfoundland LNG Ltd. will supply and operate Project-specific tugs, beginning in Stage 1 of the Project. The tug basin would therefore be built to berth the dedicated tugs assigned to the facility.

Additional information on the construction and procurement requirements for construction and development of a Stage 1 facility is provided in Table 1, Appendix A

3.4.3 Stage 2 – Vessel-based LNG Storage

Stage 2 would provide a second dock to the south of Berth 1 and connected to Berth 1 with LNG and vapour headers and walkways. Both berths would be equipped with standard hard LNG loading arms. The piping would be designed such that LNG can be transferred between ships at flow rates up to 15,000 m^3 / hr.

Stage 2 would have the ability to use a dedicated LNG storage vessel, a vessel designed specifically to be moored at a berth to receive LNG and store it for transshipment to another vessel. To further clarify, there maybe one vessel berthed at the facility operating as a floating storage vessel while the shore-based tanks are under construction. This vessel would be sea worthy and capable of steaming at any time. This self-sufficient vessel may be equipped with a reliquefaction system capable of handling all BOG generated during its operations and/or onboard power generation.

Additional information on the construction and procurement requirements for construction and development of a Stage 2 facility can be found in Table 2, Appendix A.

An onshore BOG system for the berthed ships, capable of capturing all BOG and returning the LNG back to the carriers, may be initiated in Stage 2, if required. This shore-based system would become part of the permanent facility and expanded in subsequent stages to handle the greater BOG volume when multiple land-based tanks are in operation. Small-diameter cryogenic headers would be installed from the docks to shore for the BOG vapour and for the re-liquefied LNG returning to the ships. Onsite vapourization and power generation may also be implemented at this stage.

3.4.4 Stage 3 – Land-based LNG Storage

A third berth would be added to the north of Berth 1, thereby allowing ships time to berth and cool-down before actual transfer commences. This would save time in switchover from one vessel to another. Additional piping would be installed from dock to shore for a second parallel cryogenic header system, enabling concurrent transshipment operations. All headers would be extended to Berth 3 such that all LNG moving to shore flows across the Berth 1 trestle. The second BOG system would be a duplicate of the first and interconnected such that any tank could transfer with any berth. The total BOG volume would be set for a transshipment flow rate of 2 x 15,000 = 30,000 m^3/hr, enabling one ship to be offloading while another is loading – or both loading or unloading.

Considerable rough and final grading and general site work would be done prior to installation of the storage tanks. The access road would be run to the site along a route that would keep it off the NTL property to the north and would be prepared for the entire site as tanks are constructed. Access on the east side of the site should enable those tanks and connecting piping to be constructed with little interruption to ongoing operations.

The shore–based infrastructure would be expanded to include a warehouse, shops, meeting rooms and offices. Fire and safety systems would be installed to assure full compliance with code. It is expected that the fire water system would be deluge in nature with water onsite storage.

Up to eight 160,000 m^3 LNG storage tanks are planned to be constructed. Tank construction would occur in stages, as market demand dictates. The layout and spacing of the tanks would be designed to meet CSA Code Z276-01 requirements for single containment LNG storage tanks of 265,000 m^3. Therefore, the spacing between the planned 160,000 m^3 tanks would exceed the requirements of CSA.

The use of a temporary LNG storage vessel remains a viable option in this stage. The vessel could offload a larger vessel into both the LNG tank and into the storage vessel. It is planned to use 160,000 m^3 single containment tanks, since those match well with the majority of LNG vessels, and multiple suppliers of this design are available. Additional information on the construction and procurement requirements for construction and development of a Stage 3 facility can be found in Tables 3, 3B, 3C and 3D in Appendix A.

The BOG system would be sized for the vapour developed from the LNG design flow rate of 15,000 m^3/hr. Small surge tanks would be installed initially with the BOG system to receive the re-liquefied LNG prior to putting it back into the vessel or the tank. LNG booster pumps would be installed to assure the LNG can reach the furthest tank from Berth 2 (longest piping run).

A summary of the development stages for the Grassy Point LNG Transshipment and Storage Terminal is provided in Table 3.8.

Table 3.8 Development Stages for Grassy Point LNG Transshipment and Storage Terminal

Stage	Description	Highlights
1	Single Berth with SBS mooring	Provide minimalist facility; lay-up berth; no shore-based support or BOG system
2	Two berths with SBS mooring at one; vessel-based LNG storage; all BOG offshore	Provide vessel-based storage as interim to shore-based tanks being commissioned; all BOG handled offshore
3	Three berths with SBS mooring at one; shore-based LNG storage in up to eight 160,000 m^3 single containment tanks; land-based BOG; two concurrent transshipping operations	Provide first shore-based tank in conjunction with optional vessel-based storage and two concurrent transshipping operations.
Stage 3 Design Option	Three concurrent transshipping operations	A third concurrent transshipment operation is provided with separate cryogenic header to shore; separate BOG system to dedicated tanks

3.4.5 Potential Sources of Pollution during Construction

The potential sources of pollution during construction are typical for any earth-moving project, and will be within regulatory standards, using standard control technologies. Emissions will be limited to those generated by normal operation of machinery and vessels. There will be no effluent discharge to land or water during construction. Marine habitat disturbance will be contained to within the area necessary to construct the tug basin, since each pier of the terminal is set on piles. Suspended sediments and particulate may be generated during the installation of the piles and construction of the rock causeway at the tug basin. On land, terrestrial habitat will be altered within the footprint of the area of tank construction and road.

3.4.5.1 Effluent

Storm water management during construction will include control facilities such as runoff control ponds and site drainage ditches. Site run-off water will be directed to vegetated areas within the site, which will filter suspended solids. All water releases will meet the regulatory requirements of the *Fisheries Act* and the Newfoundland and Labrador *Environmental Control (Water and Sewage) Regulations*, as well as Provincial and Federal permits.

Quarry sites for aggregate will be planned and operated to minimize impacts to water quality and the surrounding terrain. The extraction of materials will be planned to facilitate rehabilitation and avoid erosion. Aggregate quarrying will adhere to all federal, provincial and municipal laws and regulations and be conducted in compliance with permits obtained from the Newfoundland and Labrador Department of Natural Resources (NLDNR).

All fuel handling and storage will comply with the *Certificate of Approval for Storage and Handling of Gasoline and Associated Products*. All waste oil generated at the construction site will be disposed of by a licensed disposal agent. Spills kits will be maintained near fuelling facilities.

3.4.5.2 Recyclables and Litter

Solid wastes generated during construction of the Project include scrap metals, scrap lumber and general debris. Waste generated on site will be collected, stored and disposed of at approved facilities for such materials, according to the applicable regulations of Newfoundland and Labrador. An emphasis will be placed on opportunities for reduction, reuse and recycling of waste materials.

Combustible waste generated during construction and/or operation will be collected and stored in covered containers. All waste will be disposed in an approved manner.

3.4.5.3 Hazardous Wastes

Hazardous waste (limited to used oil and oil filters) will be collected and disposed of off-site in an approved manner. All areas where spillage may occur will have drip pans and collection sumps installed. Gasoline will be stored in approved containers. Waste diesel fuel, transmission oils, hydraulic oils and motor oil will be stored for off-site disposal by a licensed disposal company. Spent oil filters will be drained, stored in drums and sent to an off-site licensed disposal facility.

3.4.5.4 Septic Wastes

During construction, sanitary wastes will be handled by portable restrooms. These are self-contained units and will not require additional water. The portable restrooms located at the site will conform with the *Canada Occupational Health and Safety Regulations* (SOR/86-304). Waste will be disposed of by a licensed contractor.

3.4.5.5 Air Emissions

Air emissions will be limited to vehicle and equipment emissions and dust. All equipment will have the appropriate emission-control features. Emissions will also be generated from burning of unmerchantable timber, slashings and brush on site.

The construction vehicles and equipment that may be required on site include:

- bull-dozer;
- back-hoe crawler;
- dump truck;
- scrapper-pan;
- grader;
- rubber tire back-hoe;
- back-hoe front-end loader rubber;
- roller-compactor;
- asphalt pavers; and
- pick-up civil (job-site use).

The use of construction equipment and other heavy machinery during construction has the potential to create dust. Dust will also be generated through routine construction activities and materials handling. Dust control measures (i.e., water application) will be applied as required for vehicle traffic on the access road and other site areas during construction as required.

Stream crossings for the site access road will be constructed of galvanized corrugated metal pipe (CMP). The CMP diameter will be selected based on the stream flows. The length of culvert will be dictated by the topography of the stream crossing. Typically, the culvert will be a minimum of 10 m in length to account for road width (6 m), shoulder (1 m) and slope of fill material.

3.4.5.6 Noise

The potential sources of noise during construction are vehicle traffic at site and on the access road, on-site equipment, and other construction activities, including blasting, that may be required to achieve grade requirements. The estimated noise levels for equipment types are provided in Table 3.9.

Table 3.9 Typical Construction Equipment Noise

Equipment Powered By Internal Combustion Engines	Noise Level dB_A at 4.5 m
Earth Moving	
Compactors (Rollers)	75-87
Front Loaders	72-93
Backhoes	72-99
Tractors	76-96
Scrapers, Graders	80-94
Pavers	86-88
Trucks	82-94
Materials Handling	
Asphalt Paver	80-86
Concrete Mixers	77-85
Concrete Pumps	82-84
Cranes (Moveable)	75-86
Cranes (Derrick)	86-88
Stationary	
Pumps	68-72
Generators	72-82
Compressors	75-91
Impact Equipment	
Jack Hammers and Rock Drills	82-98
Crusher	97
Impact Pile Drivers (Peaks)	95-105
Sources: May 1978; Cowan 1999.	

3.4.6 Water Requirements

Potable water requirements during construction will be trucked to site or obtained from a bottled source. The batch plant for concrete production is planned to be an existing offsite operation. A water source for the hydrostatic testing of the tanks is currently being evaluated. Hydrostatic testing may be conducted using seawater, followed by a chemical rinse; a desalination plant, or a nearby surface freshwater supply may be required. All options are currently being evaluated

3.4.7 Potential Resource Conflicts during Construction

Current resource use of the Grassy Point area is likely restricted to small game hunting (otter trapping and duck hunting), fishing, berry harvesting and domestic wood cutting. Commercial fishing will be restricted near Grassy Point during construction of the marine facilities.

3.5 Operation

3.5.1 Terminal Operation

The Project will provide the following basic functions:

- The berthing of LNG vessels of up to 265,000 m^3 cargo capacity. The LNG facility will provide one berth capable of having a second smaller vessel (140,000 to 152,000 m^3) moored in a SBS arrangement. The LNG facility design allows for the installation of three berths, for a total of four vessels in port. This function includes the required tug support for safe manoeuvring of LNG vessels. Tug boats will be sized appropriately for handling LNG tankers up to 265,000 m^3 or 115, 400 DWT.
- The offloading and loading of LNG cargos using industry-proven methods to load or unload LNG carriers at flow rates typical of industry needs and practices. This function includes the necessary systems and equipment to move the LNG and the vapour return between the vessels and storage.
- The storage of LNG cargos by the provision of LNG storage tanks capable of holding full or partial cargos in a manner where customers can retain control over their inventory. The storage can be for transshipment operations and/or for seasonal demand and peak use.
- The BOG reliquefaction function with the capture of the BOG generated from tank boil-off, transshipment operations and from vessels laid-up at port and reliquefied for return to inventory or use for onsite power generation.
- Provide infrastructure support including the provision of fire safety, security and control of the operations and required utility systems.

The Project will provide four basic forms of operations:

- receive LNG and transfer to another vessel;
- receive LNG and move to storage;
- store LNG; and
- move LNG from storage to a vessel.

These four operations define the equipment and systems necessary to function. The equipment must be capable of bi-directional LNG and vapour flow, with the capability of each berth to pipe to, or receive from any storage tank.

Upon mooring at the berth with the aid of facility tugs, the vessel will commence its connection, cool down and safety check. Any BOG generated during this operation is handled by the facility BOG system. Upon completion of the preparatory steps, the vessel unloading pumps will move the LNG from one vessel to another vessel. Displaced vapour from each vessel will be routed back to the market-bound vessel assisted by a low-pressure blower. Any excess vapour will be captured by the BOG system, re-liquefied and returned to storage or one of the vessels or otherwise used for onsite power generation.

Between transshipping operations, the facility will store the LNG and reclaim any BOG for reliquefaction and return to storage or consumption for local power generation and industrial uses. A separate liquid line will bring re-liquefied LNG from the shore to the dockside header for loading onto the vessel. The

LNG tank pumps move the LNG from the storage tank to the vessel, with the displaced vapour being returned to the tank with the assistance of a low-pressure blower.

The process design for a LNG transshipment terminal differs from that of a traditional LNG receiving terminal in several key aspects. The design is focused primarily on minimal heat gain and BOG management. The BOG created by heat transfer and mechanical action during transshipment operations is collected, re-liquefied and/or used for power generation versus being compressed and sent to a gas pipeline for send-out to market.

The overall build-out plan and facility layout meets regulatory and design codes, with the key criteria being thermal radiance zones and the allowable proximity between tanks, between tanks and other buildings on site and to adjacent property. The Grassy Point facility is approximately 800 m from the property boundary of NTL and approximately 1,200 m from the NTL tanks. The Project facility will be approximately 1,500 m from the nearest house in Arnold's Cove. Preliminary computer modelling calculated the actual distances based upon the size of the storage tanks (160,000 m^3 single containment tanks), setting the northern-most tank location to keep thermal radiance zones off the NTL property to the north. The modelling results, based upon straight-walled concrete dike design, reveal the actual tank-to-tank spacing is set at the size of the dike required for each tank. A conservative approach is taken for these tank spacing calculations, using a theoretical larger tank of 265,000 m^3 capacity.

At each stage of the build-out, the shore-based infrastructure will be incrementally expanded to meet the specific needs of the facility to include office/control building, warehouse, shops, control and safety systems and a site-wide security. The facility will be equipped with the latest communication systems for contact with all vessels and the CCG, the current designs for emergency disconnect devices on the loading arms, a fully redundant detection and alarm system for all safety related factors and a site-wide security system. A security fence will run from the NTL property boundary, south to the waters of Arnold's Cove.

3.5.2 Site Drainage

The entire facility site will be graded to direct stormwater and snowmelt from the site through a series of perimeter ditching and culverts.

Stormwater and snowmelt within the LNG tank containment system will be controlled by directing the water from the containment structure into an engineered stormwater retention pond. The purpose of this pond is to control the volume of run-off during peak storm and snowmelt periods. This will prevent washouts and control sedimentation run-off and maintain the quality of discharge water entering the marine environment.

The final size of the pond will be determined based on storm events specified by the Newfoundland and Labrador Department of Environment and Conservation (NLDOEC). The pond will consist of a perimeter till berm, inlet and outlet. A stabilized inlet will prevent erosion at the pond entrance. The outlet will consist of an overflow weir with an emergency spillway to control unexpected storms. The outlet channel will be lined to prevent erosion down gradient of the outlet.

3.5.3 Offloading and Loading Systems

The systems for moving the LNG, the displacement vapour and the BOG between the vessels and the storage tanks include the LNG hard arms for connecting to the vessels, the header piping and the blowers and pumps. All systems and headers for this terminal are designed for bi-directional flow. The design LNG flow rate is up to 15,000 m^3/hr to service the larger LNG vessels (i.e., Q-Max) being planned for international trade routes.

The LNG and vapour flow path with the vessels is accomplished with standard 400 mm (16-inch) arms typical of the industry (Figure 3.24). The 15,000 m^3/hr flow rate will require the use of five arms. Three arms will be dedicated for LNG flow and one for vapour return. One will be dual liquid/gas service. The 400 mm arms will interface directly with typical LNG vessels and will be fitted with 500 x 400 mm reducers if the Q-Max vessels are, in fact, fitted with 500-mm (20-inch) headers.

Figure 3.24 Typical LNG Loading Arms

Each berth will have five arms, together with its hydraulic power unit and emergency disconnected devices/ couplings. Automated alignment systems are included to improve safety and reduce preparation time at berth.

Two major bi-directional header systems will be installed; the dock headers and the dock-to-shore headers. The dock header system No. 1 consists of the 915-mm (36-inch) LNG header No. 1 and 760-mm (30-inch) BOG Header No. 1, to be installed in Stage 2 to accommodate ship-to-ship LNG transfer between Berth 1 and Berth 2. These headers will be sized for full flow (15,000 m^3/hr) to handle the liquid LNG and the BOG. The headers will run the length of both berths being supported by extensions to the mooring dolphins.

In Stage 3, the dock-to-shore header system will be attached at the blind flanges on the dock header connecting the vessels with all shore-based equipment (i.e., storage tank(s), the reliquefaction system, the surge tanks and pumps and to the tanks, reliquefaction system and the blowers for the vapour line).

Dock header system No. 2 (LNG and BOG headers) will be installed on the docks at the same time the second dock-to-shore header system is installed, to permit concurrent transshipment operations. The No. 2 dock system will be a duplicate of and interconnected with the No. 1 system and both will connect to the LNG storage tanks.

Risks associated with ship-to-ship (STS) transfers has been thoroughly analyzed by one of the proponent's clients. A hazard and operability analysis (HAZOP) study undertook a detailed examination of the STS system, utilities and operations, on a line-by-line basis, in compliance with the formal HAZOP procedure. Lloyds Register EMEA determined that none of the conditions were unusual or posed a level of risk which is higher from typical LNG terminal or liquefied petroleum gas STS offloading systems.

While the Society of International Gas Tankers and Terminal Operators (SIGTTO) is reviewing STS Operations Guidelines, a seaborne STS transfer was conducted in the Gulf of Mexico on August 24, 2006, and overseen by Bureau Veritas, (operational criteria), Lloyd's Register (HAZOP), Skaugen/Yokohama (Numerical Simulation), US Coast Guard and TECTO (Structural Verification).

3.5.4 Reliquefaction of Boil-off-gas

Capturing and re-liquefying boil-off gas is an important component to this project. Since this terminal will not be sending out gas via pipeline, the traditional approach of compressing all BOG for the pipeline is not feasible. Many of the LNG carriers will likely not have reliquefaction systems on board. Some of the newer and larger vessels may have BOG systems to capture the gas and re-liquefy to LNG for return to the cargo.

The design and power consumption of the liquefier is significantly affected by the composition of the BOG, especially its nitrogen content. A conservative assumption has been made that the base LNG composition is that as listed in Table 3.10, with approximately 1.8 percent nitrogen by volume, such that the BOG, enriched in the light components, will be approximately 30 percent nitrogen.

Table 3.10 Base LNG Composition

Component	Mol %
Molecular Hydrogen (H_2)	0.00
Helium (He)	0.00
Nitrogen (N_2)	0.57
Carbon Dioxide (CO_2)	0.00
Sulphide (H_2S	0.00
Methane (C_1)	91.25
Ethane (C_2)	6.01
Propane (C_3)	1.35
Iso-Butane (I-C_4)	0.26
Butane (C_4)	0.26
Iso-Pentane (I-C_5)	0.11
Pentane (C_5)	0.07
Hexane (C_6)	0.07
Heptane (C_7+)	0.08

These assumptions provide the basis for calculating the BOG that must be re-liquefied in each of the design stages. The total LNG produced by reliquefaction of BOG generated within each stage by each stage is summarized in Table 3.11.

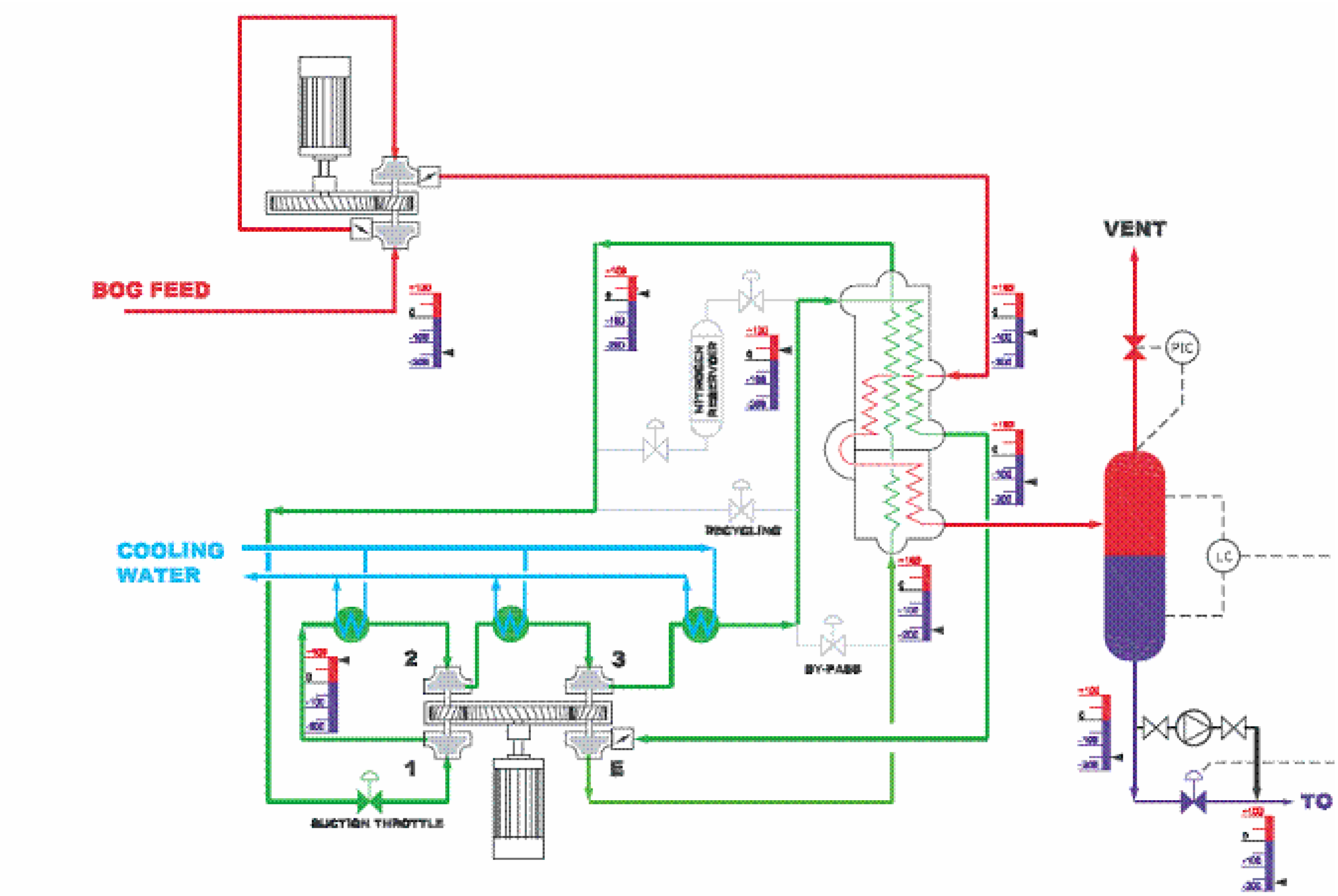
Table 3.11 Boil-off-gas Volume

Stage	Volume Of LNG Produced From Reliquefied Bog
Stage 1	Nil
Stage 2	48.6 tonne / hr
Stage 3	50.5 to 102 tonne / hr

BOG typically consists of methane and nitrogen, since nitrogen has a much higher concentration in the vapor than in the equilibrium liquid; 70 percent CH_4 and 30 percent N_2 is taken as typical. BOG typically reports to the BOG reliquefaction system at 15 to 16 psi saturated (-261ºF) and is compressed to 70 psi using a two stage compressor. The compression raises the temperature to around -141ºF.

The compressed BOG and the expanded, clean source gas join and are sent to a plate-fin exchanger, in which the material is cooled and LNG condenses. The LNG and uncondensed gas are sent to a flash vessel, from which the LNG is pumped to storage and from which the non-condensable gas is vented. The liquid is sent to storage via an additional drum and condensed hydrocarbons are mixed with the LNG. The resulting stream is significantly hotter than LNG; consequently, some gas flashes and is routed to the BOG compressor suction (Figure 3.25).

Figure 3.25 Boil-off-gas Reliquefaction System



Refrigeration for the BOG reliquefaction system is provided by a nitrogen refrigeration system, which consists of a three-stage nitrogen compressor operating at ambient temperature and an expander operating at the cold end. Nitrogen passes through the plate fin exchanger so that the plate fin exchanger effectively has three zones:

1) a warm zone in which warm nitrogen is cooled down against cold nitrogen returning to compressor suction;
2) a zone in which hydrocarbon gas and nitrogen are both cooled (in separate passages), against cold nitrogen; and
3) a cold zone in which hydrocarbon gas is cooled and condensed against cold nitrogen, which typically will enter with a small amount of liquid present.

3.5.5 Mechanical Equipment

3.5.5.1 Blowers

The vapour side of the LNG storage system will operate at very low pressures, requiring blowers to assist in the movement of BOG and displaced vapour to and from the vessels and tanks. These are designed to operate at a maximum of 2 to 2.5 psi. A dock-side blower will move vapour to shore and a shore-based blower will move the vapour to the vessel.

3.5.5.2 LNG Booster Pumps

The topography dictates the LNG storage tanks may be as much as 20 m above sea level. The elevation difference can create a head pressure large enough that some older vessels may not have pump pressure to move the LNG to the tanks at the rated flow. The topography and soil conditions may enable some leeway in how far the tank sides are above the vessel rail but early hydraulic examination indicates a possible need for booster pumps.

3.5.5.3 Reliquefaction Systems

The reliquefaction systems will be packaged units of up to 70 tonnes per hour of LNG production capacity, taking as feed the BOG generated from transshipment operations and from heat gain into the tanks and pipelines. The reliquefaction systems will be pre-tested skid mounted units powered by the local gid or onsite power generation.

3.5.5.4 Power Requirement

The peak power requirement for the reliquefaction units will be approximately 60 to 96 megawatts during transshipment operations. This power will come from the local power grid via an overhead transmission line to the site or on site power generation. A diesel generator set will provide emergency back-up power for navigation, communication, security and safety systems.

When tank BOG is being processed, power requirements are reduced to approximately 10 to 15 percent of the peak demand.

The power requirements (from preliminary calculations) for each stage of build-out utility are summarized in Table 3.12.

Table 3.12 Power Requirements per Build-out Stage

Preliminary	Power
Stage 1	150 kW
Stage 2	40 to 60 mW
Stage 3	60 to 96 mW

3.5.5.5 Potable Water

During operations, it is anticipated that between 15 to 24 personnel will be at the site at any one time. The domestic water demand can therefore be achieved by an on-site drilled artesian well. Alternatively, if sufficient water can not be found on site, a domestic water line can be taken off the existing water service to the Town of Arnold’s Cove.

3.5.5.6 Sanitation

The sanitary system at the facility will be self-contained and will be serviced by a local company or developed with the installation of a packaged closed system.

3.5.6 Safety and Security

3.5.6.1 Control Room

The control room will be located with the offices in a structure suitable for the safety of the equipment and personnel. The control room will have a Distributed Control System (DCS), an Emergency Shutdown System (ESD) and independent alarm systems. The main communication systems will be located in the control room. The security office for the facility will be located in the control room. The office portion of the building will provide space for operations, maintenance, mooring and security personnel.

3.5.6.2 Security Systems

Transport Canada is the designated authority for administration of the *International Ship and Port Facility Security (ISPS) Code*. The ISPS Code came into effect on July 1, 2004, and is a comprehensive security regime that establishes a framework of cooperation between governments, agencies, shipping and port industries to detect and take preventative measures against security incidents affecting ships or port facilities used in international trade (Transport Canada 2006). The Project will comply with the ISPS Code.

Specifically, the ISPS Code requires that port facilities conduct a Port Facility Security Assessment and develop a Port Facility Security Plan. Under the ISPS Code, Transport Canada is responsible for setting security levels at port facilities, approving Port Facility Security Plans, ensuring completion and approval of Port Facility Security Assessments and determining which ports require designation of a Port Facility Security Officer (Transport Canada 2006).

The Port Facility Security Assessment is an essential part in developing and updating the Security Plan. It includes the identification of important assets and infrastructure, possible threats to assets/ infrastructure and likelihood of occurrence, counter-measures and procedural changes and their level of effectiveness in reducing vulnerability and weaknesses in the infrastructure, policies and procedures. The assessment is periodically reviewed and updated to account for changing threats and minor changes to the port facility.

The Port Facility Security Plan is developed for each port facility on the basis of the Port Facility Security Assessment. The plan must address, but is not limited to, the following:

- measures designed to prevent unauthorized access to the port facility, moored ships and to restricted areas of the facility;
- procedures for responding to security threats or breaches of security, including provisions for maintaining critical operations of the facility or ship/port interface, evacuation and reporting of incidents;
- procedures for responding to security instructions from Transport Canada;
- duties of port facility personnel assigned specific security responsibilities and of other facility personnel on facility aspects;
- procedure for interacting with ship security activities;

- procedures for periodic audits and reviews and updating the Port Facility Security Plan, and measures to ensure security of the information in the Plan;
- measures to ensure the effective security of cargo (LNG) and the cargo handling equipment at the facility;
- procedures for responding to the ship security alert system of a moored ship, if activated; and
- procedures for facilitating shore leave for ship personnel and access to ships for visitors, including representatives of seafarers welfare and labour organizations.

A Port Facility Security Officer, if required by Transport Canada, is responsible for conducting the initial comprehensive security survey of the port facility, taking into account the Security Assessment and the development and maintenance of the Security Plan. They are also responsible for training of personnel, reporting to Transport Canada and coordination of security activities with ship security personnel (Transport Canada 2006).

3.5.6.3 Safety Systems

LNG storage facilities have extensive monitoring and control systems that make an incident involving a release unlikely. The consequences of most potential incidents would be contained on-site and dealt with before significant damage occurred. Given the extensive safety and security measures at all stages of the LNG supply chain, there is a low probability of a serious incident occurring at any LNG facility, including a storage facility.

The entire Project complex will be designed to meet all applicable design and operation codes. Full fire detection and control systems will be provided to assure protection of personnel and equipment. Diesel fire pumps, jockey pumps, spray monitors, hydrocarbon detectors, ultra-violet detectors, infra-red detectors and fire water tanks will be installed on site as required. Fire monitor nozzles, fire and hydrocarbon detection systems and dry foam systems will be located at each berth/loading arm as required.

During the Front-end Engineering and Design (FEED) phase of the Project, a detailed hazard analysis will be conducted to ensure all standard and code requirements are met and that appropriate prevention, mitigation and protection systems are properly included in the Project design. The CSA standard requires that all areas having a potential for combustible gas concentrations due to leakage of LNG or flammable refrigerants be monitored for combustible gas concentrations. Control and monitoring of the Project will be performed by an integrated programmable logic controller (PLC) control system, consisting of packaged units with local control panels, numerous field mounted instruments connected to remote input/output (I/O) cabinets and operator interface stations located in the control rooms. An independent Safety Instrumental System (SIS) will be installed to allow the safe, sequential shutdown and isolation of rotating equipment, fired equipment and LNG storage facilities. Other codes include the *National Fire Protection Association* (*NFPA*) *59 A, Code of Federal Regulations* (CFR) 127.

The facility will include a wide range of “passive and active” hazard mitigation features and provisions to afford thorough protection for the facility and employees. Systems include:

- underground firewater distribution piping system serving hydrants, firewater monitors, hose reels, water spray (deluge) and sprinkler systems, properly valved to minimize system impairment due to maintenance or repair;
- freshwater and seawater firewater pumps;

- fixed high expansion foam system;
- fixed dry chemical systems;
- portable and wheeled fire extinguishers employing dry chemical and CO_2, the latter intended for energized electrical equipment;
- audible and visual alarms;
- closed circuit television system monitors installed in security office, main control room, main gate, piers, etcs;
- fire protection in buildings, (i.e., smoke detectors and portable fire extinguishers); and
- sprinkler systems.

Marine LNG transfer and storage terminals have fixed sensors that continuously monitor for natural gas vapours. Each transfer system has an emergency shutdown system that can be activated manually or automatically when gas or LNG is detected. Multiple fire detectors are required for the marine transfer area.

LNG storage facilities have strict design requirements to prevent releases or spills. Facilities are also designed such that if a release were to occur, it could be contained. Liquid would accumulate in catch basins, where it would evaporate, and emergency shutdown systems built into the storage tanks and piping systems would isolate leaks. All parts of LNG storage containers that are normally in contact with the LNG and all materials used in contact with the LNG or cold LNG vapours (vapours below -29°C) must be physically and chemically compatible with LNG and intended for use at temperatures below -168°C (CSA 2003).

LNG storage tanks are typically double-walled. The space between the inner walls of the tank and the outer shell contains insulation that must be compatible with LNG and natural gas and be non-combustible. The insulation must be of a form that a fire external to the outer shell cannot cause significant deterioration to the thermal conductivity of the insulation by melting or settling. Any insulation exposed to the environment must be non-combustible, contain or be a vapour barrier, be water-free and resist dislodging by fire hose streams (CSA 2003).

For safety and security reasons, some coastal administrations around the world have implemented exclusion zones around LNG carriers while in transit and at berth. The requirements and size of any exclusion zone will likely be the decision of Transport Canada. The security of the site will be in accordance with ISPS and other international codes for port and terminal safety. These codes prohibit public access and require fencing. The shore-based facilities will be restricted access only.

3.5.6.4 Personnel Training

The CSA requires that all personnel engaged in the production, handling and storage of LNG must be trained in the hazards and properties of LNG and in safe practices for its handling. Operators are required to maintain a written training plan. This plan is used to instruct all personnel about carrying out emergency procedures related to their duties, fire prevention, security and first aid (CSA 2003).

3.5.6.5 Emergency Procedures

Each LNG Storage site is required by CSA (2003) to maintain a Manual of Operating Procedures that contains the emergency procedures in the event of an accident. At a minimum, these procedures must include operating instructions in the event of malfunctions, structural compromise, personnel error, forces of nature and activities conducted adjacent to the storage site. Consideration must include, but is not limited to the following:

- procedures for responding to controllable emergencies such as notification of personnel, use of equipment, shutdown of various pieces of equipment;
- procedures for recognizing an uncontrollable emergency and taking action that will minimize harm to personnel and the public; and
- procedures to coordinate with local officials in preparation of an emergency evacuation plan to protect the public in the event of an emergency.

3.5.6.6 Tanker Safety Record

The safety record of LNG ships far exceeds any other sector of the shipping industry with more than 40,000 deliveries. Over the past 40 years, there have been no collisions, fires, explosions, or hull failures resulting in a loss of containment for LNG ships in port or at sea.

Worldwide, there are currently 13 countries that export LNG. There are approximately 40 LNG import terminals, with many more planned. LNG import terminals exist in Japan, South Korea and Europe, as well as in the United States, which currently has five import terminals. Today, more than 150 LNG ocean tankers safely transport more than 110 million tonnes of LNG annually to ports around the world. This is more than all American homes consume each year. In 2000, one LNG cargo entered Tokyo Bay every 20 hours, and one entered Boston harbor every week. Japan relies exclusively on imported LNG for its natural gas.

LNG has been shipped globally for over 60 years and has a 40-year record of safe operations in North America. LNG tankers have made more than 40,000 trips covering more than 96 million km (60 million miles) without a major incident, either in port or at sea. There have been few accidents or incidents since the first converted freighter delivered LNG from Louisiana to the United Kingdom in 1959. The only fatality from a storage facility occurred in the US in the 1940s and there have been no storage-related incidents in North America since. One incident involving ‘rollover’ or sudden increase in pressure while offloading from tanker to storage tank occurred in Italy in 1971. There were no injuries or fatalities, only slight damage to the storage tank.

The few incidents that have occurred on LNG ships are typical of the incidents of all types of ships (i.e., not related to either the LNG cargo or the fact that the ship was an LNG carrier). Incidents have included minor piping leakage (non-LNG) and an occasional venting of a tank. According to the US Department of Energy, over the life of the industry, eight marine incidents worldwide have resulted in accidental spillage of LNG. In these cases, only minor hull damage occurred and there were no cargo fires. Seven additional marine-related incidents have occurred with no significant cargo loss. No explosions or fatalities have ever occurred.

LNG is transported in double-hulled ships designed to prevent leakage or rupture in an accident. LNG is stored in either double membrane containment systems made of special materials and located within the ship's inner hull or special ¾-inch-thick spherical tanks. For membrane containment systems, a secondary containment system surrounds the primary container. The insulation space between the two has sensing equipment able to detect even the smallest presence of methane (the main component of natural gas), possibly indicating a leak of LNG.

In addition, some LNG ships use velocity meters to ensure safe speeds when berthing. When moored, an automatic line monitor helps keep ships secure. When connected to the onshore system, the instrument systems and the shore-ship LNG transfer system act as one, allowing emergency shutdowns of the entire system both from ship and from shore.

3.5.7 Potential Sources of Pollution during Operation

The Project is an LNG storage and handling facility. There will be no substantive processing or regasification of LNG; hence, there will be no significant generation of hydrocarbon by-products, emissions or effluents. Substantive emissions are not expected to result from the routine operation of the LNG facility due to boil-off control systems. The level of land-based vehicle traffic during operation is anticipated to be negligible and will not result in substantive emissions. The only potential release of LNG would be due to an accident, malfunction or unplanned event (including operational upset). LNG is non-toxic to fish and will float if spilled on water for several minutes prior to evaporation. The environmental risk comes from a sudden decrease in water temperature in the surface water layer.

3.5.7.1 Effluent

Liquid wastes generated at the facility will include oily wastewater and sanitary wastewater. Wastewater that has the potential for oil contamination, including building floor drains and equipment drains, will be collected in sumps located throughout the process area. This system will be designed so that separated oily waste can be collected, removed and disposed off-site at an approved facility. Separated wastewater will be collected on as-needed basis by a vacuum truck.

Control of stormwater and snowmelt within the LNG tank containment system will be controlled by directing the water from the containment structure into a stormwater retention pond. The purpose of this pond is to control the volume of run-off during peak storm and snowmelt periods. This will prevent washouts and control sedimentation run-off and maintain the quality of discharge water entering the marine environment. The pond will consist of a perimeter till berm, inlet and outlet. A stabilized inlet will prevent erosion at the pond entrance. The outlet will consist of an overflow weir with an emergency spillway to control storm levels. The outlet channel will be lined to prevent erosion downgradient of the outlet.

Water from the storm water retention pond will be discharged to the sea in compliance with provincial and federal requirements. No deleterious substances will be discharged. Seawater may be used for cooling in the BOG reliquefaction system. The seawater will be returned to the marine environment at a slight difference in ambient temperature.

3.5.7.2 Solid Waste

Solid wastes will be collected and disposal in an approved manner. Combustible waste generated during construction and/or operation will be collected and stored in covered containers. An emphasis will be placed on opportunities for reduction, reuse and recycling of waste materials.

3.5.7.3 Septic Wastes

The sanitary system at the facility will be self-contained and serviced by a local company or developed with the installation of a packaged closed system. Alternatively, connection to the local municipal system may be appropriate and will be investigated.

3.5.7.4 Air Emissions

The BOG generated during transshipment and storage of LNG will be re-liquefied and returned to the tanks (see Section 3.5.4). Natural gas will not be emitted under normal operations. Since there is no processing of LNG at the terminal, there will no resulting carbon dioxide or hydrogen sulphide emissions. The only infrastructure related to the BOG systems that could potentially result in air emissions would be the auxiliary generators.

Chlorofluocarbons (CFCs) will not be used at the facility.

LNG vessels are natural gas-fired, thus making them among the lowest emitting transport vessels at sea. Diesel is used for back-up and vessels may use No. 2 or No. 6 fuel while approaching, offloading and leaving the terminal. Conventional air contaminants and greenhouse gases will be limited to those from marine vessels during approach, tugboats and vehicles. Vehicles and equipment will have appropriate emission control features.

3.5.7.5 Noise

Noise may result during operation from vehicle traffic to and from the site, on-site from process equipment such as pumps and compressors, and from marine vessels maneuvering in the harbour as well as from unloading activities. The use of enclosures for process equipment will minimize sound pressure levels from the process area. Vehicles and marine vessels will be equipped with appropriate mufflers to minimize noise.

3.5.8 Potential Resource Conflicts during Operation

For safety and security reasons, the Project facility will be restricted access only. The security of the site will be in accordance with the ISPS and other international codes for port and terminal safety. These codes prohibit public access and require fencing. Exclusion zones around LNG carriers while in transit and at berth will likely be required. The extent of any exclusion zone will be determined by Transport Canada.

3.5.9 Decommissioning/Rehabilitation

The facility will be designed, built, and maintained to operate efficiently for at least its anticipated life span of 50 years. Eventually, the facility will be decommissioned and abandoned. A decommissioning and abandonment plan will be developed prior to decommissioning. The plan will have a contingency to allow for shutdown at any time during the anticipated Project life and will contain measures to achieve targeted environmental goals.

At that time, all surface buildings and structures may be dismantled and removed from the site. Any hazardous materials will be collected and disposed of at a government-approved hazardous material disposal site. Disturbed areas will be landscaped and revegetated. In the event of decommissioning, a more detailed plan will be developed in accordance with applicable regulations.

3.6 Occupations

Newfoundland LNG Ltd. is committed to hiring residents of Newfoundland and Labrador for all stages of the Project. If the Project is sanctioned, hiring plans and policies will be put in place to ensure that first consideration for training and employment opportunities are to the residents of Newfoundland and

Labrador. Newfoundland LNG is also committed to equity employment. An Employment Equity Plan will also be developed for the Project.

Most of the contractors used for the construction of the Project will be from Newfoundland and Labrador. There may be a few contractors that are not from Newfoundland and Labrador; however, this is dependent upon the availability and skill set of the contractors at the time of the site construction. A breakdown of the number of anticipated occupations during design, construction and operations phases of the Project are provided in Tables 3.13 to 3.15, respectively.

Table 3.13 Occupations Anticipated for Engineering and Design Phase

Occupation	NOC Code	# of People
Process Engineers	2134	4
Mechanical Engineer	2132	3
Civil/Structural Engineer	2231	4
Control Systems & Instrumentation Engineer	2133	2
Electrical Engineer	2133	2
Loss Prevention, Safety Engineer	2141	1
Designer (Drawing Office)	2252	8
CAD Operator	2253	12
Buyer (procurement)	0113	1
Expeditor (Procurement)	1473	1
Document Controller	1413	1
Secretary	1241	2
Engineering Management	0211	4
Engineering Technologist	2232	12
HSEQ	2263	1
Project Management	0711	2
Project Controls	2131	2
Administration	1221	2
Total	**-**	**64**

Table 3.14 Occupations Anticipated for the Construction Phase

Occupation	NOC Code	# of People
Pipefitter	7252	12
Millwright	7311	10
Construction Management	0711	6
Labourer	7611	30
Electrician	7242	6
Equipment Operator	7421	25
Pipe Welder	7265	6
Insulator	7293	6
Painter	9496	4
Carpenter	7271	20
Surveyors		4
Plumbers		2
Ironworker	7264	20
Welder- Structural	7265	7
Concrete Finisher	7282	2
Total	-	160

Table 3.15 Occupations Anticipated for the Operation Phase

Occupation		NOC Code	# of People
Management	Plant Manager	9212	1
	Maintenance Manager	0721	1
	SH&E Manager	2263	1
Corporate Services	Accounting	1431	1
Planning & Technical Services	Operations Scheduling	9212	1
	Operations Support Engineering	9212	4
	Technical Services & Projects	9212	6
	Marine	2232	4
Total	-	-	19

3.7 Project-related Documents

The following documents have been produced in relation to the site selection and design of the Project:

1) Project Overview and Site Selection for "LNG GO North" Transshipment and Storage Terminal; A report by North Atlantic Pipeline Partners. April 2006.
2) Grassy Point LNG Transshipment and Storage Terminal Project Description. A Project summary prepared by Jacques Whitford. June 2006.
3) Grassy Point LNG Transshipment and Storage Terminal Build-Out Plan. A report by SNC-Lavalin GDS Inc. for LNG Partners. July 2006.

4.0 APPROVAL OF THE UNDERTAKING

The Project is subject to the *Canadian Environmental Assessment Act* (CEAA) and the Newfoundland and Labrador *Environmental Protection Act* (EPA). The filing of this document initiates the environmental assessment under both Acts.

It is expected that Transport Canada and DFO may have federal regulatory responsibilities pursuant to CEAA by virtue of *Law List Regulation* triggers that apply to the Project. These Responsible Authorities (RAs) ensure that an environmental assessment is conducted prior to the issuance of federal permits and authorizations, if required, for the Project.

The following *Law List Regulations* triggers may apply to the Project:

- issuance of a permit by Transport Canada for the construction of the marine jetty pursuant to sub-section 5(1) of the *Navigable Waters Protection Act*; and
- issuance of authorization by DFO for work related to the construction of the jetty with the potential for harmful alteration, disruption or destruction of fish habitat pursuant to sub-section 35(2) of the *Fisheries Act*.

4.1 Communications and Consultations

To introduce the Project, Newfoundland LNG Ltd. met with key individuals in regulatory agencies, other federal and provincial government departments and municipal governments, as well as business and community leaders.

Each meeting began with a presentation by Newfoundland LNG Ltd. to explain their plans for the Project. A round-table discussion followed, which included topics such as project scoping, regulatory process, permits required, public consultation and business opportunities. Meetings were held with the following groups, departments, governments and agencies:

- Transport Canada;
- DFO;
- Environment Canada;
- CEA Agency;
- NLDOEC;
- Newfoundland and Labrador Department of Tourism, Culture and Recreation (NLDTCR);
- Town of Arnold's Cove;
- Town of Come By Chance;
- Fishers of North Harbour, Come By Chance, Arnold's Cove, Southern Harbour and Little Harbour;
- Fish, Food and Allied Workers Union;
- Discovery Regional Development Board;
- Natural History Society of Newfoundland and Labrador;

- Sierra Club of Canada;
- Risk Management Research Institute;
- Harbours and Port - Transport Canada;
- CHS;
- Atlantic Pilotage Authority;
- CCG;
- Arnold's Cove Chamber of Commerce; and
- Placentia Bay Traffic Committee.

Consultations and discussions will be ongoing with these and other groups. Open house meetings will be held in Arnold's Cove and Clarenville. Each of these will last an afternoon and evening, and allow the public to view and discuss panels of information about the Project. Representatives of Newfoundland LNG Ltd. will be present at each of the meetings. Issues raised by attendees will be recorded and included in a consultation report.

A fishermen's liaison committee will be established by the fishermen of Placentia Bay affected by the construction and operation of the terminal facility. The committee will serve as a direct contact between the fishermen and Newfoundland LNG Ltd. to discuss the Project's implications on fishing near the terminal during construction and operation of the facility. Meetings with the fishermen liaison committee will occur quarterly or as required during construction and operation phases of the Project.

Newfoundland LNG Ltd. commits to consult with local communities and interested stakeholders.

4.2 TERMPOL Review Process

TERMPOL is a voluntary review process administered by Transport Canada. Originally considered for use with determining the navigational risks associated with the location and operation of marine oil terminals, the applicability was expanded, on a voluntary basis, to include LNG terminals.

The only TERMPOL to be completed on the island of Newfoundland was associated with the Newfoundland Transshipment Limited (NTL) in the late 1990s – the facility adjacent to the proposed Project site. This study was completed after the NTL facility became operational. As the TERMPOL study area and function virtually matches that of the proposed LNG terminal and given that this study is very current, the Proponent proposes working with Transport Canada to determine what may be required to update and/or augment the NTL TERMPOL for the proposed Project.

The last three major proposed marine terminal projects in Atlantic Canada - Irving Canaport LNG, New Brunswick Power Coleson Cove Refurbishment Project and Bear Head LNG - did not conduct TERMPOLs. Bear Head LNG did volunteer to conduct a TERMPOL in 2004; however, no study was completed.

4.3 Standards

The primary Code for the LNG storage tanks is CSA Z276-01 *Liquefied Natural Gas (LNG)-Production, Storage and Handling*. Also important is the US code NFPA 59A that is used to define the fire safety and prevention aspects of the facility design. A list of applicable codes is provided in Tables 4.1 to 4.3.

Table 4.1 Primary Canadian Codes and Regulations

Code	Edition	Description
CSAZ276-01	2001	Liquefied Natural Gas (LNG)-Production, Storage, and Handling
NFPA 59A	2001	Standard for the Production, Storage and Handling of Liquefied Natural Gas
SIGTTO	1996	Society of International Gas Tanker and Terminal Operators
A23.I-00/A23.2-00		Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete
A23.3-94	R2000	Design of Concrete Structures
A23.4-00/A251-00		Precast Concrete – Materials of Construction/ Qualification code for Architectural and Structural Precast concrete products
B51-97		Boiler, Pressure Vessel, and Pressure Piping Code
B149.1-00		Natural Gas and Propane Installation Code
C22.1098		Canadian Electrical Code, Part 1
CSAZ299 series		
CSAZ299.0-86		Guide for selecting and implementing Quality assurance program standards
CSAZ299.1/2/3/4		Quality Assurance Program
Key Acronyms: CSA – Canadian Standards Association NFPA – National Fire Protection Association SIGTTO – Society of International Gas Tanker and Terminal Operators		

Table 4.2 Primary USA Codes and Regulations

Code	Edition	Description
NFPA 70	2002	National Electric Code
API 620 App. Q	10th. Add. 1	Design and Construction of Large, Welded, Low-Pressure Storage Tanks
ASME Section VIII	2001	Boiler & Pressure Vessel Code, Division 1 & 2
ASME Section IX	2001	Boiler & Pressure Vessel Code – Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
ASME B31.3	1999	Chemical Plant and Petroleum Refinery Piping
ACI 318	1999	Building Code Requirements for Reinforced Concrete
AISC	Latest	American Institute of Steel Construction – Manual of Steel Construction
Key Acronyms: SIGTTO – Society of International Gas Tanker and Terminal Operators AMSE – American Society of Mechanical Engineers API – American Petroleum Institute ACI – American Concrete Institute AISC – American Institute of Steel Construction		

Table 4.3 Other Applicable Codes and Regulations

Code	Edition	Description
ASME – Section IV	2001	Boiler Code
ASME – Section VIII	2001	Pressure Vessel Code
TEMA	1999 8th edition	Standards of Tubular Exchanger Manufacturers Association
ASCE 7	1998	Minimum Design Loads for Buildings and Other Structures
ISA	1998	Standards & Practices for Instrumentation
IBC	2000	International Building Code
NFPA 10	1998	Standard for Portable Fire Extinguishers
NFPA 20	1999	Standard for the Installation of Centrifugal Pumps
NFPA 24	1995	Installation of Private Fire Service Mains
NFPA 30	1996	Flammable and Combustible Liquids Code
NFPA 37	2002	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 54	1999	National Fuel Gas Code
NFPA 72	1999	National Fire Alarm Code
NFPA 780		Lighting Protection Code
NFPA 1221	1999	Standard for the Installation, Maintenance and USE of Public Fire Service Communication Systems
IEEE		Grounding

Key Acronyms:
ASME – American Society of Mechanical Engineers
NFPA – National Fire Protection Association
TEMA – Tubular Exchanger Manufacturers Association
ASCE – American Society of Civil Engineers
ISA – Instrument Society of America
IBC – International Building Code
IEEE – Institute of Electrical and Electronics Engineers

The key portions of the code affect tank spacing and, hence, land usage, which are determined by the thermal radiance and vapour cloud dispersion modelling. The thermal radiance modelling has been used in the design of the Project to determine tank position and spacing. Both thermal radiance and vapour cloud dispersion modelling scenarios will be conducted in accordance with and in addition to the CSA Standard Z276-01 for purposes of the environmental assessment.

Design and construction shall conform to the following Codes and Regulations, as applicable. The following tables outline the primary Canadian and American Codes, as well as the secondary American Codes that are applicable to the Project.

The four primary documents that will guide the design and subsequent operation of Grassy Point LNG facility are:

- CSA Z276-01 – *Liquefied Natural Gas (LNG) Production, Storage and Handling*;
- *National Building Code of Canada* (2005);
- NFPA 59A – (US) *Standard for the Production, Storage and Handling of Liquefied Natural Gas*; and
- SIGTTO.

Additionally, the following entities will be adhered to where standards or codes exist and apply:

- *National Fire Code* (Canada);
- American Society of Mechanical Engineers (ASME);

- American Petroleum Institute (API);
- American Concrete Institute (ACI);
- American Institute of Steel Construction (AISC);
- American Society of Civil Engineer (ASCE);
- Instrument Society of America (ISA);
- International Building Code (IBC); and
- Institute of Electrical and Electronics Engineers (IEEE).

4.4 Permits Required

The permits and approvals that may be required for the Project are listed in Table 4.4.

Table 4.4 Permits and Approvals that May Be Required for the Project

Permit, Authorization, Approval	Agency
Release under the CEAA	Various Federal Departments
Authorization for Works or Undertakings Affecting Fish Habitat (HADD)	DFO
Permit for Construction within Navigable Waters	Transport Canada
Application for a Water Lease	Transport Canada
Notification to Handle or Transport Dangerous Goods	Transport Canada
Transportation of Dangerous Goods	Transport Canada
Approval for Vessel Admission	Canada Customs and National Revenue
Temporary Magazine License	Natural Resources Canada
Radio Station License	Industry Canada Communications
Application to Import Natural Gas/LNG	National Energy Board
Release under the NL *EPA*	NLDOEC – Environmental Assessment Division
Certificate of Approval for any Industrial Processing Facility	NLDOEC – Pollution Prevention Division
Certificate of Environmental Approval for any Alteration to a Body of Water	NLDOEC – Water Resources Division
Application for Water Use License	NLDOEC - Water Resources Division
Shoreline Reservation	NLDOEC – Lands Division
Letter of Advice of New Construction Project or Industrial Enterprise	Newfoundland and Labrador Department of Government Services (NLDGS) - Occupational Health and Safety Services
Application for Water and Sewage Works	NLDOEC – Water Resources Division
Permit for Access off any Highway	Newfoundland and Labrador Department of Municipal Affairs (NLDMA)
Authorization to Handle or Transport Dangerous Goods	Newfoundland and Labrador Department of Transportation and Works (NLDTW) - Transportation Regulation Enforcement
Borrow and Quarry Permit	NLDNR – Mines and Energy Division
Authorization to Control Nuisance Animals	NLDNR - Forest Resources Division
Permit to Burn	NLDNR - Forest Resources Division
Commercial Cutting Permit	NLDNR - Forest Resources Division
Operating Permit/Fire Season	NLDNR - Forest Resources Division
Certificate of Approval for Storage and Handling of Gasoline and Associated Products	NLDOEC
Certificate of Approval – Septic System (>4,500 L/day)	Newfoundland and Labrador Department of Health and Community Services
Review of Building/Fire/Life Safety	NLDMA - Office of the Fire Commissioner
Permit for Flammable and Combustible Liquid Storage and Dispensing and for Bulk Storage	NLDMA - Office of the Fire Commissioner
Building Accessibility	NLDGS - Occupational Health and Safety Division
Permit for Archaeological Investigations	NLDTCR - PAO
Approval for Waste Disposal	Arnold's Cove Town Council

5.0 SCHEDULE

The current construction schedule is outlined in Table 5.1.

Table 5.1 Proposed Schedule of Site Activities

Activity	Date
Detailed Design Stages	Jan 2006 to May 2008
Procurement of Equipment	May 2007 to June 2009
Site Preparation	May 2007 to September 2007
Construction	June 2007 to October 2009
Berth Construction	June 2007 to June 2008
Tank Construction	October 2007 to September 2009
Mechanical Completion	October 2009
On Stream	January 2010

6.0 FUNDING

The Project will be primarily funded by Newfoundland LNG Ltd. Newfoundland LNG Ltd. owned jointly by North Atlantic Pipeline Partners LP and LNG Partners LLC. North Atlantic Pipeline Partners is a Canadian Limited Partnership formed in 1996. LNG Partners is a Delaware Limited Liability Company formed in 2000. No government funding will be required for the proposed Project. The intent of Newfoundland LNG Ltd. is to finance the Project through capital contributions from its shareholders and direct financing supported by client subscription in the form of Terminal Use and LNG Storage Agreements

7.0 SUBMISSION

Nov 22, 2006
Date

M Turner
Name: Mark Turner
Position: President and COO

APPENDIX A

Design Plan Details

Table 1 Construction and Procurement Requirements for Stage 1 Grassy Point LNG Transsshipment and Storage Terminal

Stage 1 Requirements	Construction/Procurement Activities
Stage 1 Infrastructure	
Road Access and Site Preparation	New heavy-haul road from Tower Road at a point to the east of the NTL boundary; then routed south and west to Grassy Point property and to process area location. Locations for office, warehouse and parking will be prepared.
Construction Dock	Construction dock to receive materials and equipment will be built near south end of Berth 2 and also serves as tug basin.
Security Fencing to Meet Code for LNG Facilities	3.5 m Chain Link with gate at north end of property; appropriate signs for safety; access control; security.
Gate House	Unstaffed; remote video and control to office.
Centralized Control House / Office	Modular design safe-haven shelter; phone communication; emergency battery back-up; washroom facilities; offices; meeting room; control room; Emergency Shut Down System; International Ship/Shore Connection (some redundancy required); Portable VHF/UHF Transceivers. Appropriate lighting at gatehouse; building exteriors, and security cameras.
Warehouse; Maintenance	Minimal support facility; most maintenance service and spares from local region by code.
Firefighting Systems Equipment	Diesel fire pump, jockey pump; spray monitors; HC/UV/IR detectors; fire water tank as required.
Stage 1 Utilities	
Sanitary System	Self-contained chemical system.
Potable Water	Purchased / bottled water.
Power Line from Local Sources	Minimal 150 kW service for lighting, navigation aids, pumps.
Stage 1 Berth Preparation	
Single Berth	One berth capable of mooring two ships SBS. Access Trestle to shore; minimal shore support; berth control house includes alarm system, communication, heat, lighting, water closet for line handlers.
Safety and Navigation Systems	Firewater systems; fire/HC detection systems; jockey pump; fire pump; fire water tank HC/UV/IR detectors.
Tug Support	Conceptual Study indicates dedicated tugs will be needed since all other resources are dedicated to other terminals. Numbers and size of tugs to be verified via maneuvering study in pre-FEED. Tug basin for up to three tugs; offices with pilot accommodations; communication systems; back-up power generator to be located at south end of site. Functions as construction dock for equipment and materials. Tug boats will be sized appropriately for handling LNG tankers up to 265,000 m^3 or 115,400 DWT.

Table 2 Construction and Procurement Requirements for Stage 2 Grassy Point LNG Transshipment and Storage Terminal

Stage 2 Requirements	Construction/Procurement Activities
Stage 2 Infrastructure	
Foundations for Fixed Structures	Buildings; BOG system and Surge Tank.
Stage 2 Utilities	
Sanitary System	Septic or portable serviced units.
Potable Water	From local supply / artesian wells.
Power Line to/ from Local Sources	400 kW minimal service for lighting.
Vapourization and Power Generation	Consider onsite alternative
Stage 2 Berth Preparation	
400 mm (16-inch) LNG loading arms	Five per berth. Complete with hydraulic power unit (HPU), emergency disconnect devices, automated alignment systems
LNG Piping @ Berth	ITP-Interpipe, VIP.
Cryogenic Berth Headers	304 L or 316 L stainless steel with foam glass insulation.
Main LNG Header	4 x 400 mm (16-inch) x 20 m tie into 1 x 900 mm (36-inch) LNG bi-directional header that runs from Berth 2 to Berth 1. Tie into to blind flange for connection to 1 x 900 mm (36-inch) header pipeline to shore future land-based.
Vapor Return Header	1 x 750 mm (30-inch) bi-directional header runs to both berths; connections to two arms; flanged connection for future header.
Nitrogen Purge Lines	50 mm (2-inch) stainless steel purge lines to each arm with ball valve for cold.
Reliquefied BOG Liquid Service Lines	1 x 300 mm (12-inch) 316 L stainless steel line connection for future to shore-based BOG reliquefaction.
Two Berths	**One- sided Berthing Operation**
Two berth with access trestle from each to shore for light duty vehicle access	Two berths w/ Berth 1 capable of mooring two ship (SBS). Shared mooring with walkway connection. Trestle from each berth to shore with Berth 1 trestle expanded to serve as full vehicle access and pipe.
Safety Systems; Navigation Systems	Fire monitor nozzles; Fire / HC detection systems; dry foam system for LNG loading arm area all as required.
Shore-Based BOG System	
BOG System	Single train at 48 tons/hr; equal to 46 million scf of gas / day.
Reliquefaction System Inlet Gas Specification	Gas compressed to 4 bar for inlet to BOG reliquefaction.
Power Source for Reliquefaction	1 x 100% GT systems = 40 mW.
Cooling Water System	Seawater pump and piping; For 40 mt/hr approximately 24,000 gpm @ 10°F temperature rise. Dual 200 hp slow speed seawater pumps.
Cooling Water Piping	Inlet screen, FRP piping; outlet diffuser.
Additions to Berth for Shore Based BOG system – (Option Under Consideration)	
BOG Vapour Line to Shore-Based BOG System	316 L stainless steel insulated 200 mm (12-inch) vapour line.
Reliquefied BOG Liquid Return Line	316 L stainless steel insulated 200 mm (12-inch) liquid line from shore to connection into berth LNG header at top of trestle.
LNG Surge Tank	0.5 hr equivalent volume = 8,000 gal LNG.

Table 3 Construction and Procurement Requirements for Stage 3 Grassy Point LNG Transshipment and Storage Terminal

Stage 3 Requirements	Construction/Procurement Activities
Stage 3 Utilities	
Power Line	1 x 100% GT for 55 mW total.
Fuel Gas for Primary Power System	Non-condensable off-gas from reliquefaction system.
Instrument Air	1 x 200 scfm @ 125 psi for berth usage.
Vapourization and Power Generation	Consider onsite alternative
Stage 3 Berth Preparation	
400 mm (16-inch) LNG loading arms	Five per berth. To achieve 15,000 m^3/hr flow rates and retaining 400 mm (16-inch) arms, four arms will be used for liquid transfer, one dedicated as vapour return. Includes HPU, controls, emergency disconnect device and automated alignment system.
LNG Piping @ Berth	**Marine Piping Systems**
Specification for Cryogenic Piping	316 L or 304 L stainless steel with foam glass insulation.
Main LNG Header Between Berths and to Shore	4 x 400 mm (16-inch) from arms to 900 mm (36-inch) headers that run from Berth 2 to Berth 1 and to shore.
Header Inter-Connection to Facilitate Circulation / Draining	LNG header and re-liquefied BOG liquid line are interconnected to provide circulation between transshipment operations and for draining during inspection / repair.
Vapour Return Header	1 x 760 mm (30-inch) header runs between berths.
Re-Liquefied BOG Header	1 x 300 mm (12-inch) line from top of trestle to connection with BOG reliquefaction system.
Two Berths	**One-sided Berthing Operation**
Two berth with access trestle from each to shore for light duty vehicle access	Two berths w/ Berth 1 capable of mooring two ships SBS. Shared mooring dolphins with walkway connection. Trestle from each berth to shore with Berth1 trestle expanded to serve as full vehicle access and pipe rack.
Safety Systems; Navigation Systems	Fire monitor nozzles; Fire / HC detection systems; dry foam system for LNG loading arm; control pulpit.
Shore-Based BOG System	
BOG System	Single train at 50 mt/hr (2.4 mm scf/hr) to handle estimated 50 mt/hr. Packaged systems from Kryopak; Cryostar, Chart, Northstar Industries system.
BOG Power Requirement	48 mW load for BOG.
Reliquefaction System Inlet Gas Specification	BOG vapour @ 1.1 bar compressed to 4 bar @ BOG.
LNG Compression Cooling Water System	Seawater pump and piping; for 50 mt/hr about 24,000 gpm @ 10°F temperature rise. 2 x 200 hp slow speed seawater pumps.
Shore-Based Cyrogenic System	**BOG System, Piping and Tanks**
Vapour Return Line	1 x 750 mm (30-inch) 316 L stainless steel insulated vapor line from shore to top of trestle.
LNG Return Line from BOG Reliquefaction System	1 x 300 mm (12-inch) 316 L stainless steel insulated liquid line from shore to top of trestle. Retained for BOG service only.

Stage 3 Requirements	Construction/Procurement Activities
LNG Header – Berths to Tanks	1 x 900 mm (36-inch) header lines – allows up to 15,000 m^3/hr with minimal pressure drop. This header and the BOG liquid return line allow re-circulation to keep critical piping cold between transshipments.
LNG Booster Pump	Calculations indicate a marginal operation due to elevation of tanks. Land-based booster pumps have been included to assure full flow.
Vapour Return Blowers (to / from ship)	High volume, low pressure blowers to move displacement vapour through vapour return line to / from ships and to move BOG to the reliquefaction system between transshipment operations.
Vent System	1 x 400 mm (16-inch) cold vent for upsets and startup; minimize venting through reliquefaction.
LNG Storage Tank	Each 160,000 single containment field erected within vertical 8 m high dike; air gap foundation; LNG inlet /outlet valves; vapour return valves; level instruments; pressure gauges; relief system; spray nozzles; temperature gauges; internal submerged pumps with foot valve.
LNG Surge tank	1 x 380 m^3 (100,000 gal) vacuum insulated manufactured tanks shipped to site for booster pumps; 1 x 100 m^3 for BOG reliquefaction surge.
Primary Cryogenic Piping	316 L or 304 L with foam glass insulation.
Nitrogen System	For purging and inerting during inspections and repairs; uses LN2 as source.

Table 3B Additional Construction and Procurement Requirements for Stage 3B Newfoundland LNG Transshipment and Storage Terminal

Stage 3B Requirements	Construction/Procurement Activities
Stage 3B Utilities	
Potable Water	Bottled source or onsite artesian wells.
Power Line	1 x 100% GT for 88 mW total.
LNG Piping @ Berth	**Marine Piping Systems**
Vapour Return Header	2 x 760 mm (30-inch) header runs between berths.
Re-Liquefied BOG Header	2 x 300 mm (12-inch) line from top of trestle to connection with BOG reliquefaction system.
Stage 3B Shore-Based BOG System	
BOG Power Requirement	85 mW combined load for dual.
LNG Compression Cooling Water System	Seawater pump and piping; For 100 mt/hr about 48,000 gpm @ 10°F temperature rise. 4 x 200 hp slow speed seawater pumps
Stage 3B Shore-based Cyrogenic System	BOG System, Piping and Tanks.
Vapor Return Line	2 x 750 mm (30-inch) 316 L stainless steel insulated vapor line from shore to top of trestle.
LNG Return Line from BOG Reliquefaction System	2 x 300 mm (12-inch) 316 L stainless steel insulated liquid line from shore to top of trestle. Retained for BOG service only.
LNG Header – Berths to Tanks	2 x 900 mm (36-inch) header lines – allows up to 15,000 m^3/hr with minimal pressure drop. This header and the BOG liquid return line allow recirculation to keep critical piping cold between transshipments.
Vapour Return Blowers (to / from ship)	High volume, low pressure blowers to move displacement vapour through vapour return line to / from ships and to move BOG to the reliquefaction system between transshipment operations.
Vent System	2 x 400 mm (16-inch) cold vent for upsets and start-up; minimize venting through reliquefaction.
LNG Storage Tank	Each 160,000 single containment field erected within vertical 8 m high dike; air gap foundation; LNG inlet /outlet valves; vapour return valves; level instruments; pressure gauges; relief system; spray nozzles; temperature gauges; internal submerged pumps with foot valves.
LNG Surge tank	2 x 380 m^3 (100,000 gal) vacuum insulated manufactured tanks shipped to site for booster pumps; 2 x 100 m^3 for BOG reliquefaction surge.

Table 3C Additional Construction and Procurement Requirements for Stage 3C Grassy Point LNG Transshipment and Storage Terminal

Stage 3C Requirements	Construction/Procurement Activities
LNG Piping @ Berth	**Marine Piping Systems**
Vapour Return Header	2 x 760 mm (30-inch) header runs between berths.
Reliquefied BOG Header	2 x 300 mm (12-inch) line from top of trestle to connection with BOG reliquefaction system.
Stage 3C Shore-Based BOG System	
BOG System	Dual trains at 50 mt/hr (2.4 mm scf/hr) to handle 96 mt/hr. Packaged systems from Hamworthy, Kryopak, Cryostar, Chart, and Northstar Industries.
BOG Power Requirement	88 mW combined load for dual.
Stage 3C Shore-Based Cyrogenic System	**BOG System, Piping and Tanks**
LNG Storage Tank	6 x 160,000 single containment field erected within vertical 8 m high dike; air gap foundation; LNG inlet /outlet valves; vapour return valves; level instruments; pressure gauges; relief system; spray nozzles; temperature gauges; internal submerged pumps with foot valves.
Loading Arms	
400 mm (16-inch) LNG loading arms	Five per berth. To achieve 15,000 m^3/hr flow rates and retaining 400 mm (16-inch) arms, four arms will be used for liquid transfer; one dedicated as vapour return. Includes HPU, controls, emergency disconnect device and automated alignment system.
Three Berths	**One-Sided Berthing Operation**
Three Berths with Access Trestle from each to shore for light duty vehicle access	Three berths w/ Berth 1 capable of mooring two ships SBS. Shared mooring dolphins with walkway connection. Trestle from each berth to shore with Berth 1 trestle expanded to serve as full vehicle access and pipe rack.

Table 3D Additional Construction and Procurement Requirements for Stage 3D Grassy Point LNG Transshipment and Storage Terminal

Stage 3D Requirements	Construction/Procurement Activities
Stage 3D Shore-Based BOG System	
BOG System	Dual trains at nominal 50 mt/hr (2.4 mm scf/hr) to handle 102 mt/hr. Packaged systems from Hamworthy, Kryopak, Cryostar, Chart, and Northstar Industries.
BOG Power Requirement	92 mW combined load for dual.
Stage 3D: Shore-Based System	**BOG System, Piping and Tanks**
LNG Storage Tank	8 x 160,000 single containment field erected within vertical 8 m high dike; air gap foundation; LNG inlet /outlet valves; vapour return valves; level instruments; pressure gauges; relief system; spray nozzles; temperature gauges; internal submerged pumps with foot valves.
Stage 3D Utilities	
Power	2 x 100% GT for 96 mW total.

APPENDIX B

Stream Crossing Survey Data Sheets

BASELINE INFORMATION		
Crossing ID#: 01	Date (dd/mm/yyyy): 08/09/2006	Time (24 hr): 1435
Latitude: 47° 45’ 57.1’’	Longitude: 54° 00’ 01.8’’	Datum:
Stream: S01	Watershed:	
FISH HABITAT INFORMATION		
Upstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: Bog	Flow Type: N/A	
Substrate Type: fines with some cobble		
Wetted Width (m): < 0.25	Channel Width (m): < 0.5	Bankfull Width (m): <1.0
Depth (cm): 1 10	2. 10	3. 10
Velocity (m/s): 1. 0.1	2. 0.1	3. 0.1
Crossing Location (Directly at proposed crossing, georeference this site in above fields)		
Habitat Type: Bog	Flow Type: N/A	
Substrate Type: fines with some cobble		
Wetted Width (m): 0.25	Channel Width (m): 0.5	Bankfull Width (m): 0.75 (max)
Depth (cm): 1. 10	2. 15	3. 10
Velocity (m/s): 1. 0.1	2. 0.2	3. 0.25
Downstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: IV	Flow Type: Sluggish to slow riffle	
Substrate Type: Fines with occasional cobble/ rubble		
Wetted Width (m): 0.4	Channel Width (m): 0.5	Bankfull Width (m): 0.75 (max)
Depth (cm): 1. 9	2. 15	3. 10
Velocity (m/s): 1. 0.2	2. 0.25	3. 0.1
FISH INFORMATION		
Fish Species/Life Stage: Downstream 25 m sections surveyed by electrofish sampling: 6 brook trout; standard lengths - 9 cm; 4 cm; 7 cm; 8 cm; 9 cm; 4 cm.		

BASELINE INFORMATION		
Crossing ID#: 02	Date (dd/mm/yyyy): 08/09/2006	Time (24 hr): 1540
Latitude: 47° 45’ 59.0’’	Longitude: 54° 00’ 18.5’’	Datum:
Stream: S02	Watershed:	
FISH HABITAT INFORMATION		
Upstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: apparent type II	Flow Type: riffle	
Substrate Type:		
Wetted Width (m):	Channel Width (m):	Bankfull Width (m):
Depth (cm): 1	2.	3.
Velocity (m/s): 1.	2.	3.
Crossing Location (Directly at proposed crossing, georeference this site in above fields)		
Habitat Type: II	Flow Type: riffle	
Substrate Type: gravel/cobble		
Wetted Width (m): 1.0	Channel Width (m): 1.5	Bankfull Width (m): 2.0
Depth (cm): 1. 25	2. 50	3. 25
Velocity (m/s): 1. 1.0	2. 0.75	3. 1.0
Downstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: II	Flow Type: Riffle	
Substrate Type: Cobble/gravel		
Wetted Width (m): 0.5	Channel Width (m): 1.0	Bankfull Width (m): 1.0
Depth (cm): 1. 5	2. 10	3. 5
Velocity (m/s): 1. 0.25	2. 0.2	3. 0.2
FISH INFORMATION		

Fish Species/Life Stage:

Crossing and lower 25 m sections surveyed by electrofish sampling:

7 brook trout; standard lengths – 15 cm; 13 cm; 12 cm; 6 cm; 5.5 cm; 6 cm.
1 stickleback; standard lengths – 4 cm

Most of the three sections were 100 % canopy covered.

BASELINE INFORMATION		
Crossing ID#: 03 DS section	Date (dd/mm/yyyy): 11/09/2006	Time (24 hr): 1735
Latitude: 47° 45' 51.2''	Longitude: 54° 00' 48.4''	Datum:
Stream: S03 DS section	Watershed:	
FISH HABITAT INFORMATION		
Upstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: none visible	Flow Type:	
Substrate Type:		
Wetted Width (m):	Channel Width (m):	Bankfull Width (m):
Depth (cm): 1	2.	3.
Velocity (m/s): 1.	2.	3.
Crossing Location (Directly at proposed crossing, georeference this site in above fields)		
Habitat Type: none visible	Flow Type:	
Substrate Type:		
Wetted Width (m):	Channel Width (m):	Bankfull Width (m):
Depth (cm): 1.	2.	3.
Velocity (m/s): 1.	2.	3.
Downstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: IV	Flow Type: steady	
Substrate Type: fines occasional rubble		
Wetted Width (m): 2.0	Channel Width (m): 2.0	Bankfull Width (m): 2.0
Depth (cm): 1. 1.0	2. 0.5	3. 0.75
Velocity (m/s): 1. 0.25	2. 0.25	3. 0.25
FISH INFORMATION		
Fish Species/Life Stage: 1- Downstream 25 m section surveyed by electrofish sampling: 0 fish observed		

BASELINE INFORMATION		
Crossing ID# 04	Date (dd/mm/yyyy): 11/09/2006	Time (24 hr): 1800
Latitude: 47° 45’ 57.2’’	Longitude: 54° 00’ 34.5’’	Datum:
Stream: S04	Watershed:	
FISH HABITAT INFORMATION		
Upstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: bog	Flow Type:	
Substrate Type: fines with occasional cobble/rubble		
Wetted Width (m): 0.25	Channel Width (m): 0.25	Bankfull Width (m): 0.25
Depth (cm): 1 10	2. 15	3. 10
Velocity (m/s): 1. 0.1	2. 0.1	3. 0.2
Crossing Location (Directly at proposed crossing, georeference this site in above fields)		
Habitat Type: not accessible	Flow Type:	
Substrate Type:		
Wetted Width (m):	Channel Width (m):	Bankfull Width (m):
Depth (cm): 1.	2.	3.
Velocity (m/s): 1.	2.	3.
Downstream Habitat Section (select 1 representative cross section within 25m of crossing location for collection of the following)		
Habitat Type: not accessible	Flow Type:	
Substrate Type:		
Wetted Width (m):	Channel Width (m):	Bankfull Width (m):
Depth (cm): 1.	2.	3.
Velocity (m/s): 1.	2.	3.
FISH INFORMATION		
Fish Species/Life Stage: 1- 25 m section surveyed by electrofish sampling: 0 fish observed		