3 Project Description, Engineering and Economics

3.1 General Information

Gateway proposes to construct and operate an export oil pipeline and an import condensate pipeline between the terminalling facilities near Edmonton and a new marine terminal near Kitimat, British Columbia. Gateway also proposes to construct and operate marine infrastructure at tidewater to accommodate loading and unloading oil and condensate tankers. Discussion of these components, from a construction and engineering design perspective, follows.

Ongoing commercial negotiations are being held with shippers and suppliers. These negotiations will eventually lead to contract specifications regarding volumes, commodity types and other factors influencing Project design. Ongoing stakeholder consultation, results of the ESA and regulatory review will also influence Project engineering design. Therefore, specific Project details (e.g., size, volume, pressure, throughput, routes, stations and sites, and construction and inspection methods) may change from those described in this document. The information in this section reflects preliminary Project design.

Figure 3-1 shows the overall schedule for the Project.

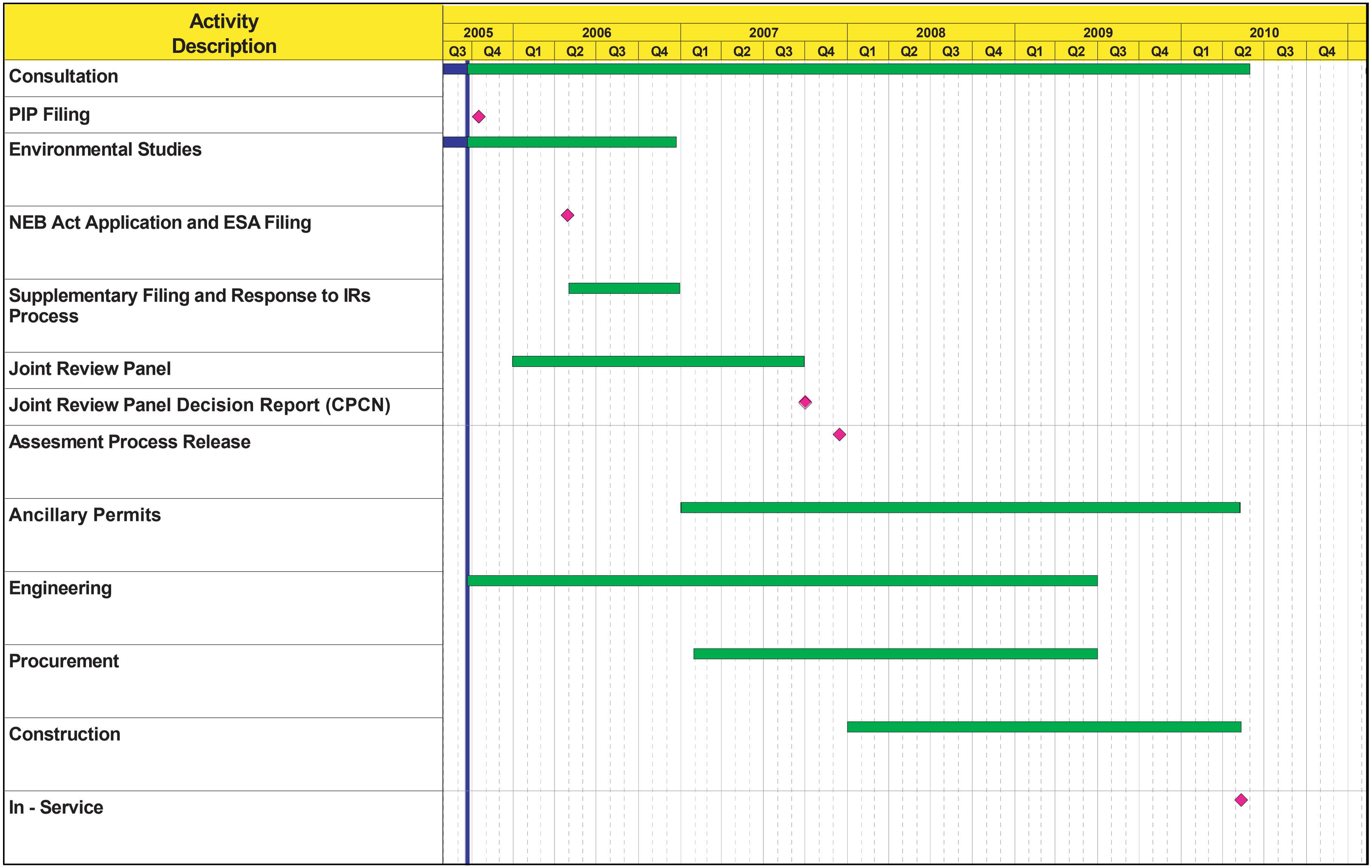

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FIGURE NO.

3-1

Proposed Gateway Pipeline Schedule

DRAFT DATE 12/10/2005

REVISION DATE 24/10/2005

PREPARED FOR ENBRIDGE

3.2 Terminalling Operations

3.2.1 Location and Configuration

Terminalling and tankage requirements at Edmonton are currently being evaluated. Options include constructing new terminal facilities as a part of the Project or accessing an existing facility. A decision will be made before the application is filed with the NEB. New facilities constructed as a part of the Project will be included in the NEB application and scope of the Project for the ESA.

3.3 Pipelines

3.3.1 Routing

An initial feasibility assessment of the Project identified several routing corridors for a potential pipeline between Alberta and a coastal port facility in British Columbia. A preferred siting and routing option was developed for the components of the Project and is discussed as follows.

The two proposed pipelines will be located in a common RoW, crossing east to west from the Edmonton area to the Gateway marine terminal at Kitimat. The terrain is varied, from level, industrial, commercial and agricultural lands in the area around Edmonton to timbered regions of the Alberta Plateau, across the primarily timbered and often rugged terrain of the continental divide south of Tumbler Ridge before crossing the central Fraser Plateau region of British Columbia. Continuing west, the pipeline route ascends and crosses the rugged Coast Mountain range before descending into the Kitimat River valley and finally terminating on the west side of Kitimat Arm.

The criteria and factors used to evaluate and compare the alternative pipeline routes included:

- minimizing construction and operations issues by avoiding complex and difficult terrain or areas posing reclamation difficulties
- minimizing community and pipeline security concerns
- avoiding or minimizing the use of areas designated as environmentally sensitive, such as parks, protected areas and special areas
- minimizing, where possible, the number of river, stream, highway, road, rail and utility crossings and optimizing the crossing locations
- paralleling existing pipeline rights-of-way, where appropriate
- using other rights-of-way, whenever possible, as temporary working space for pipeline access and construction to minimize environmental and land use effects
- practicing cost effective design, location, operations and maintenance

The pipeline route will be subject to further refinement as detailed engineering continues and input from stakeholders is received and considered.

3.3.2 Facility Details

3.3.2.1 Pipeline Specifications

The pipeline systems are based on a maximum allowable operating pressure (MAOP) of 11,663 kPa, but detailed engineering may justify a higher pressure rating.

The oil pipeline is currently being designed with an annual throughput capacity of 400,000 barrels per day (bpd) and the condensate pipeline is currently being designed with an annual throughput capacity of 150,000 bpd (Table 3-1). The pipeline depth of cover (measured from the top of the pipe) will vary depending on location and will range between 0.6 m in bedrock to 1.2 m in agricultural lands. Depth of pipe burial at river crossings, road and rail crossings will be deeper and will be determined during the detailed engineering design phase.

The cathodic protection system for the pipelines will be designed and installed according to codes and regulations and Enbridge procedures and operating practices.

Table 3-1 Preliminary Pipeline System Design Parameters

Design Parameter	Pipelines	
	Oil Pipeline	**Condensate Pipeline**
Proposed pipeline length (km)	1,150	
Proposed pipeline diameter (mm OD [outside diameter])	762	508
Maximum allowable operating pressure	11,663 kPa	
Annual average throughput (bpd)	400,000	150,000
Ambient design temperature	-40°C to 60°C	
Operating temperature	5°C to 30°C	

Right-of-Way Configuration

The two proposed pipelines (oil and condensate) will be installed within a legally surveyed, permanent RoW, currently proposed to be approximately 30 m wide. In certain areas (e.g., aerial crossings), there may be a requirement for additional permanent RoW width to accommodate structures and supports. Where possible and without compromising the safety of the pipeline operation, a narrower permanent RoW may be acquired.

During construction, approximately 15 m of temporary workspace will also be required along the entire length of the pipeline route. There will be areas where temporary extra workspace will be required (e.g., at river, road and rail crossings and areas where there are steep slopes and side hills). The specific areas requiring temporary extra workspace will be determined at a later date. The pipeline RoW during construction is required to have sufficient space for topsoil and spoil placement, pipe trench and staging (for two pipelines) and equipment movement.

In some locations, pipes will be installed in a common trench. In other locations, pipelines will be in their own, separate trench. In still other specific locations (e.g., river crossings, aerial and horizontal directional drilling crossings), pipeline separation will be determined during the detailed design phase. These variations will result in other RoW configurations.

3.3.2.2 Pump Stations and Mainline Valves

Table 3-2 lists the pump and initiation and pressure-reduction station locations. The location of the stations is an approximation at this stage of Project design. The majority of stations will likely be on Crown lands; however, the siting of these facilities on private lands will also be investigated. The location of these sites is dependent on both pipeline sizes and pressure ratings. If commercial requirements change, the locations of these stations may also change.

Table 3-2 Pump Stations and Power Supply – Proposed Location

Station Identification		Oil Pump Station		Condensate Pump Station		Available Access
		Approximate Location (KP)	**Power Source**	**Approximate Location** (KP)	**Power Source**	
1	Initiating station (oil)	0.0	Electric (25 kV)	–	–	Existing with minor upgrade
2	Station 2	150.0	Electric (25 kV)	–	–	Existing with minor upgrade
3	Station 3	288.0	Electric (25 kV)	–	–	Existing with minor upgrade
4	Station 4	425.5	Electric (25 kV)	425.5	Electric (25 kV)	Approx. 4 km of new road from west along ROW
5	Station 5	551.5	Electric (25 kV)	–	–	Existing with minor upgrade
6	Station 6	690.0	Electric (25 kV)	690.0	Electric (25 kV)	Existing with minor upgrade
7	Station 7	800.2	Electric (25 kV)	–	–	Existing (Hwy #27) to within 1 km
8	Station 8	896.0	Electric (25 kV)	–	–	Existing with minor upgrade
9	Station 9	971.0	Electric (25 kV)	971.0	Electric (25 kV)	Existing with minor upgrade
10	Pressure reduction (oil)	1074.0	–	–	–	Existing access will need upgrading
11	Initiation station (condensate)	–	–	1144.0	Electric (25 kV)	Existing access will need upgrading

Pump stations will need permanent, all-weather road access and electrical power for operations, workers and safety.

Pump stations (Photo 3-1) will be designed to PN 150 rating. Preliminary designs indicate that each oil pump station will incorporate multiple electric powered pumps in series configuration. Estimated power for each oil pump will be 5000 hp (up to 5700 hp). The condensate pump station will also have multiple electric pumps in series configuration. Estimated power for each condensate pump will be 2500 hp. For major pump station design parameters, see Table 3-3.

Pipeline block (sectionalizing) valves will be installed at the pump stations, on either side of major river crossings, and at additional locations identified during detailed engineering (according to CSA Z662 Oil and Gas Pipeline Systems, clause 4.4.3) and environmental protection planning. Pigging facilities will be installed at both ends of the pipeline systems. Additional, intermediate pigging facilities may be installed, based on operational and inspection requirements. Electrical power for the block valves will be provided by commercial sources, if available, or by alternate power sources (such as solar panels and propane fuelled thermo-electric generators). In remote locations, valve sites and pump stations are proposed to be equipped with satellite telecommunications.

Photo 3-1 Pump Station – Example

Photo Source: Enbridge

Table 3-3 Proposed Pump Station Design Parameters

Proposed Design Parameter	Pump Stations	
	Oil	**Condensate**
Number of stations	9	4
Pressure reducing stations	1	0
Pump station size (ha)	2 ha, plus additional space, as needed, for firebreak and buffer	
Annual average flow rate (bpd)	400,000	150,000

3.3.3 Construction

For an aerial view of laying pipeline in a mountain landscape, see Photo 3-2. A description of the steps follows.

Photo 3-2 Pipeline – Laying

3.3.3.1 Mainline Construction

It is anticipated that the pipeline portion of the Project will be divided into several segments (or spreads) to break the work into manageable sizes for the winter and summer construction periods and to produce an effective and competitive contractor bidding process. It is expected that three construction spreads will be employed in each of the four construction seasons (two summer, two winter) for a total of 12 spreads. The final number of pipeline construction spreads will be based on productivity estimates; therefore, the number (12) may change as more detailed engineering and environmental details become known. Construction spreads will range in length between 70 km and 190 km.

The successful prime contractor on each spread will provide all of the necessary construction resources and will secure subcontractors for items such as blasting, specialized river crossing techniques, pipe hauling and stringing and final testing.

A comprehensive project and construction management and inspection procedure will be implemented. Qualified personnel will inspect critical construction activities to confirm that the contractor's operations comply with applicable specifications and regulations. Each spread will have a resident construction supervisor responsible for technical matters and reporting to the construction manager. An inspection team, responsible for construction, safety and relevant environmental and archaeological matters, will support the resident construction supervisor.

Pipeline construction comprises five major parts:

1. RoW preparation
2. grading and soil handling
3. stringing, ditching, pipe welding, installation and backfilling
4. hydrostatic testing
5. clean-up and re-vegetation

Right-of-way Preparation

RoW preparation generally occurs in the following order:

1. RoW boundaries are cleared, including temporary and extra workspaces.
2. Required RoW access is established.
3. Merchantable timber is salvaged and removed according to line list and approved logging plan and applicable licences.
4. Woody debris is cleared and disposed according to specifications and licences.
5. Timber and woody slash debris—in designated areas—is retained for use as access control.
6. Temporary access to and along the RoW is established, including the installation of culverts or bridges at stream crossings to accommodate construction vehicles.

Grading and Soil Handling

Grading will be minimized, but will be required along portions of the route to safely accommodate pipe installation and equipment travel. Grading involves:

- stripping the RoW of topsoil or duff layer, which will then be windrowed to the edge of the RoW, or stockpiled in extra work areas
- excavating rock by ripper-equipped crawler tractors or hydraulic excavators, and blasting, which will be done according to applicable regulations for explosives handling
- storing spoils onsite and, if the spoils are acid-producing, taking measures to identify and manage any acid drainage

Stringing, Ditching, Pipe Welding, Installation and Backfilling

Dedicated crews generally complete the stringing, ditching, pipe welding, installation and backfilling activities. Specialized crews will also be employed for road crossings, water crossings and construction in difficult terrain areas. The normal sequence follows:

1. Pipe is hauled from the stockpile sites to start stringing activities.
2. Pipe bending is done according to specifications.
3. Individual pipe joints are lined up, clamped in place and welded using either automated techniques or, in some areas, manual (stick welding) techniques.

4. Hydraulic excavators or ditching machines are used for ditching depending on terrain and ground conditions (i.e., ditch depth should equal the depth-of-cover design requirements identified in the specifications, drawings and line list).
5. Welds are visually inspected during the welding process and, after completion, each weld is non-destructively examined to determine conformity with specifications.
6. After each weld is accepted, it is cleaned and coated with a field-applied coating to prevent external abrasion and possible corrosion.
7. The pipe is scanned to identify any uncoated or damaged areas in the pipe coating that require repair or recoating.
8. The ditch bottom is checked for rocks and debris to prevent damage to pipe and coatings as the pipe is lowered into the ditch (Photo 3-3).
9. In areas of blast or abrasive materials, the bottom of the trench might be padded with select backfill material or the pipe might be coated with concrete or other protective coating.
10. After the pipe has been lowered, it is shaded with select backfill material from the ditch excavation to entirely cover the pipe, following which the remaining ditch spoil is used to fill the balance of the trench.
11. The various sections of the pipeline are tied in by a tie-in crew to form continuous pipeline sections and are then tested.

Photo 3-3 Typical Pipeline Construction – Lowering

Photo Source: Enbridge

Cleaning and Testing

The completed pipeline will be cleaned and tested before the new pipeline sections are put into service. Pipeline cleaning is done with inline devices called pigs. Manifolds are installed on either end of sections of pipe and the pigs are propelled through the pipeline. Liquid and solid wastes that have collected in the pipeline during construction are directed to an open end where they are collected and disposed according to regulations.

After cleaning, the pipeline will be pressure tested using hydrostatic or pneumatic methods. During hydrostatic testing, water is pumped into the pipeline, held at a high-pressure and monitored for leaks. At test completion, the pressure is released and the water is removed from the pipeline by pushing a pig through the pipe with air. Additional pig runs are made to remove any residual water from the line. The test water will be discharged according to applicable regulations and approvals.

During pneumatic testing, air is pumped into the line and compressed, held at high-pressure and monitored for leaks. At test completion, the compressed air in the pipeline is released to the atmosphere or other test sections and the pipeline will be dried.

Clean-up and Revegetation

Preliminary cleanup will normally proceed following pipeline testing. During this phase, the RoW is restored to a stable condition to prevent soil erosion. Excess rock from blasting and grading may be used to:

- provide access control
- stabilize and reinforce stream channels and banks
- crib and armour slopes
- provide a foundation and ballast for roads and access

After testing has been satisfactorily completed, final cleanup will be done. This will include deactivating temporary construction access, replacing the topsoil or duff layer, and installing cross-berms and surface water control. Because of the remoteness of several sections of the RoW, it is expected that the Project design will include an access management plan. Project needs for access during operations will be factored into such a plan. Gateway will consult with all interested parties to address issues related to access control.

At water crossings, bank restoration and revegetation will be done according to specifications developed in the environmental protection plan of the ESA. The RoW will be reseeded with native seed mixtures determined in consultation with and approved by Alberta Land and Forest and British Columbia Ministry of Forests, or with agronomic seed mixes on agricultural land determined through consultation with landowners. Seeding will start as soon as practical upon completion of cleanup. Additional cleanup might be required after the first winter following commissioning. Revegetation will be monitored and assessed following construction.

3.3.3.2 Pipeline Water Crossings

The proposed oil and condensate pipelines will cross hundreds of watercourses, the majority of which are unnamed, minor and ephemeral drainages. However, the pipeline does cross several large rivers and important watercourses.

Environmental and engineering studies are currently being done for the Project's watercourse crossings. Crossing techniques haven't been finalized. The following criteria are being considered during this review:

- fisheries, habitat and water quality issues
- approvals, codes and regulations
- design and constructability issues
- operational requirements

A variety of crossing techniques will be used during the construction of the pipeline. They include conventional trenched crossings, trenchless crossings (i.e., horizontal directional drilling, tunnelling or boring), isolated crossings and, in several unique locations, aerial crossings.

Horizontal directional drilling crossings work best for large waterbodies in areas with exceptionally vulnerable (water quality, fisheries and habitat) ecosystems and where geotechnical and hydrological conditions are favourable. The criteria for selecting crossings for horizontal directional drilling include:

- presence of highly sensitive fish species, life stages or habitats
- exceptionally steep approach slopes in a river valley
- presence of extensive existing pipeline infrastructure at the crossing

Isolated crossing techniques are best suited for streams and rivers with narrow channel widths and with lower flow rates. With isolated crossing techniques, the main flow of the stream is isolated from the construction area while a trench is excavated and the pipe installed. The stream is stabilized and allowed to return to its bed. There are three main methods of diverting stream flow in an isolation-type crossing:

- dam the stream and convey the water across the site by pumping
- dam the stream and install a culvert (flume)
- dam the stream and install a superflume for high-flow watercourses

In an aerial crossing, the pipeline is installed over the watercourse, supported by an existing or new bridge structure. This method is recommended under certain conditions, including:

- where there is a narrow, steeply inclined river valley that would be difficult or expensive to cross beneath the stream bed
- where environmental sensitivities and engineering difficulties preclude any other crossing method
- where the area is sparsely populated and risk of third-party damage is low

3.3.3.3 Highway, Railroad and Third Party Pipeline Crossings

The Project will cross a number of highways, roads, railways and third party pipelines. Generally, major highways, paved roads and railways will either be bored or tunnelled to avoid disruption of service. Pipeline specifications may be modified in these locations to address potential load concerns related to road and rail traffic.

Depending on the location and structure of certain roads, they may be open cut and backfilled to existing or better standards. Safety of the traveling public will be a goal during this crossing activity. Third party pipelines will be crossed using several techniques, including boring, tunnelling and open cut. Third party pipelines will be located and exposed before any excavation. The approximate number of crossings is listed on Table 3-4.

Table 3-4 Approximate Number of Crossings

Parameter	Approximate Number
Major river and watercourse crossings	50
Highway crossings	29
Minor road crossings	249
Railway crossings	15
Third party pipeline crossings	232

3.3.4 Operations

Gateway will operate and maintain the pipelines for their integrity. The pipeline RoW will be monitored on a routine basis by aerial patrol and will be clearly marked with signs and post markings at public roads, watercourse crossings and other areas, as required, to reduce the possibility of damage or interference resulting from third party activity. Vehicle access may be created for maintenance activities as needed.

Typical maintenance for the pipelines and RoW will include:

- electronic inspections using pigs
- periodic surface inspections of the RoW
- cathodic protection and monitoring
- valve monitoring and servicing
- vegetation control
- investigation and control of encroachment from third parties
- encroachments and crossings from third parties
- maintenance of above grade facilities

3.4 Gateway Marine Terminal and Marine Infrastructure

3.4.1 Location

The marine terminal and infrastructure site consists of a 1500-m stretch of uplands and shoreline on the west side of the Kitimat Arm section of Douglas Channel and generally runs in a northeast to southwest direction.

3.4.1.1 Uplands

The uplands area for the marine terminal site covers about 282 ha and is heavily forested with the northern portion of the site having steeper slopes than the southern portion. The hills along the water rise to an elevation of about 150 to 180 m. Tankage will be situated on relatively flat benchlands at the top of the hills and will be interconnected with the berthing facilities at shoreline via short pipelines.

3.4.1.2 Shoreline

At the waterline, the shoreline is narrow and rocky. The tree line is about 20 to 30 m from the shoreline and has rock outcrops at certain locations.

The bathymetric contours run approximately parallel to the shoreline and are relatively closely and evenly spaced, especially in the northern portion of the site. The contours show that the channel bottom drops off fairly steeply and consistently from the shoreline down to a level of about -40 m. Below this level, the channel bottom tends to be steeper along the northern half of the proposed site and less steep in the southern half. The bathymetry suggests that the proposed VLCC class vessels will be able to berth relatively close to shore without the need for dredging. To provide enough underkeel clearance for the "design ships," the -25 m to -30 m contour will likely represent the fender line of the new marine berth. This contour lies about 25 m to 40 m offshore in the northern area of the site and about 50 m to 75 m in the southern area.

3.4.2 Facility Details

3.4.2.1 Terminal Design

Table 3-5 provides the details of the proposed tankage. The proposed capacity considers pipeline throughput, tanker loading and unloading times and contingency spare capacity in the event of a delayed arrival or departure of a vessel and pipeline flow-through interruption.

Table 3-5 Proposed Tank Terminal Design Parameters – Kitimat

Proposed Design Parameter	Tank Terminal Kitimat
Total onsite tank capacity (bbl)	5,500,000
Terminal size (ha)	282.5
Annual average flow rate (bpd)	150,000 (Condensate) 400,000 (Oil)

All tankage will be designed to standards prescribed by:

- *Onshore Pipeline Regulations*, 1999 (OPR-99) (NEB)
- CSA Z662-03 Oil and Gas Pipeline Systems (Canadian Standards Association)
- API Standard 650 Welded Steel Tanks for Oil Storage (American Petroleum Institute)
- *Environmental Code of Practice for Aboveground Storage Tank Systems (AST) Containing Petroleum Products* (Canadian Council of Ministers of the Environment [CCME])

All tanks will be equipped with a below-grade collection sump and surrounding secondary containment system to allow for localized containment and easy recovery of release of product.

The terminal will be equipped with independent fire fighting systems. To the extent practical, Gateway will strive to coordinate fire fighting and emergency response planning with local resources. Tanks and piping infrastructure will be protected by an impressed cathodic protection system.

3.4.2.2 Tanker Berths

At this stage in the Project design development, two separate, dedicated tanker berths are planned for the Gateway marine terminal. One berth will be used to load oil and the other will be used to offload condensate. The oil berth will be designed to handle VLCCs up to 320,000 deadweight tonnes and the condensate berth will handle Suezmax class vessels up to 160,000 deadweight tonnes. Dimensions of typical vessels in this class are shown on Table 3-6.

Table 3-6 Marine, Loading and Offloading Facilities – Design Parameters

Design Parameters	Oil	Condensate
Vessel class	VLCC	Suezmax
Deadweight tonnes	320,000	160,000
Length (m)	343	274
Beam (m)	58	48
Loaded draft (m)	23	17
Hull type	double	double
Cargo capacity (bbl)	2.3 million	1.1 million
Number of cargo pumps	3	3
Pump capacity (tonnes/hr)	15,000	12,000

The proposed Gateway marine facilities include structures to safely berth and moor the vessel and structures that provide the interface between the vessel and the shore to safely and efficiently load and offload cargo. The marine loading and offloading berths will have similar features:

- loading and unloading the platform
- breasting dolphins (up to four, depending on range of design vessels)
- mooring dolphins (up to six, depending on range of design vessels)
- gangway tower (for crew access to the dock)
- walkway bridges between platform and breasting dolphins
- utility boat floating dock with wave protection
- deployment system with storage platforms
- cathodic protection
- fire fighting systems

The vessel characteristics described in Table 3-6 were used to develop the preliminary design parameters for the marine infrastructure.

Loading and Unloading Platform

The tanker berth platform's main function is to support the loading and unloading arm and equipment. A typical platform size is about 20 m by 30 m. About 60 percent of the platform area is taken up by piping, loading arms and equipment. The remaining 40 percent is an open area to allow for mobile crane or small truck access, parking and turnaround.

Tanker berth platforms are typically accessed from shore by a pile-supported trestle. Access trestles support the piping and, usually, a single lane roadway. For the Kitimat site, with deep water so close to shore, an access trestle may not be required.

Loading and unloading platforms are typically pile-supported structures; however, in areas with large tidal fluctuations, floating platforms are sometimes used. Both concepts will be studied during the design development phase of the Project.

Breasting Dolphins

Breasting dolphins are usually independent structures and are located on both sides of the loading and unloading platform. The primary functions of the breasting dolphins are to absorb the energy of the berthing vessel, provide contact points for the moored vessel and provide a structure to support the hardware used to secure some of the vessel's mooring lines.

These structures are typically about 8 to 10 m^2 and are usually pile supported. Where space is at a premium on the loading and unloading platform, the access gangway structure can be located on one of the breasting dolphins.

Mooring Dolphins

Mooring dolphins are used to secure the fore and aft breasting lines and the bow and stern lines from the vessel. They are equipped with mooring hardware and are set back from the berth fender line, usually about 40 m to 50 m. Similar to breasting dolphins, mooring dolphins are typically built over the water and are supported by piles. Walkway bridges from the breasting dolphins are used to access mooring dolphins.

The mooring dolphins at the Kitimat site will likely be constructed on land, as a concrete foundation using conventional land-based construction equipment. The mooring dolphins will be about 5 to 10 m^2.

Fire Fighting

The marine terminal facilities will be equipped with independent fire fighting systems. Each vessel's fire fighting equipment, including main and emergency fire pumps, will be kept ready for immediate use with at least one fire pump maintaining pressure on the deck fire main.

3.4.2.3 Ancillary Marine Facilities

Tug Berthing Facilities

The location of the tug berth will depend on whether or not the tug service will be shared among various shipping terminals in Kitimat Arm.

Anchorages

Anchorages may be required for tankers calling at the Gateway marine terminal. Based on preliminary discussions with the British Columbia Pilot's Authority, there are anchorages at Browning Entrance and an anchorage near Kitimat harbour. The requirements for anchorages will be further evaluated as part of marine transportation planning for the TERMPOL Review Process.

Ballast Water

Tankers visiting the Gateway marine terminal are required to comply with the *Canada Shipping Act, Guidelines for the Control of Ballast Water Discharge from Ships in Waters under Canadian Jurisdiction*. These guidelines require that all ships (including tankers) must discharge 100 percent of the ballast water taken at the previous port and replace it with mid-ocean seawater in waters deeper than 2000 m. This activity is recorded in the ballast management plan, which would be available for inspection.

3.4.3 Construction

3.4.3.1 Dredging

Because of the natural deep water close to shore, dredging to provide adequate underkeel clearance for the vessels will not be required. There may be a requirement to bench and sidecast spoil material in selected areas of the underwater slope to provide a level base for installing piles. If this procedure is required, it will be a localized excavation of the seabed.

3.4.3.2 Marine Construction

Construction of the marine terminal infrastructure for loading and unloading oil and condensate cargoes will require marine construction activities throughout the year. Specific requirements for excavation, site levelling, piling, fabrication and equipment will be determined once a final site for the Gateway marine terminal and marine infrastructure is selected.

3.4.4 Operations

3.4.4.1 Marine Tank Terminal

Terminal operations will consist of custody transfer measurement of receipt and delivery volumes and non-custody transfer tank gauging. Monitoring, preventative maintenance and routine equipment upgrades will also be performed along with regularly scheduled safety and security inspections.

3.4.4.2 Tanker Loading and Unloading Facilities

Marine terminal operations can be divided into four general categories: 1) berthing procedures, 2) preloading/unloading operations, 3) cargo operations, and 4) departure operations.

Arrival Manoeuvring and Berthing Operations

Condensate vessels arriving full will stop some distance from the shore before being pushed port side-to on the berth (bow pointing north). Turning the vessel will occur as a departure manoeuvre. Oil tankers coming in ballasted will most likely be turned on arrival so they don't need to be turned at departure when they are fully laden. Oil tankers will probably berth starboard side (bow pointing south).

The tankers will be pushed onto breasting dolphins using two to three tugs (tug operations are likely to be a contracted service) and then all mooring lines will be secured. After mooring lines are secure, Gateway terminal personnel will deploy the hydraulic shore and ship gangway.

Preloading and Unloading Procedures

The terminal will typically hold a pre-operational meeting between Gateway personnel and the ship's master or the officer in charge (or both) of the cargo and ballast operations, including completing a safety checklist. Arrival documents (as required by the ship's agent and terminal) will be completed before cargo operations begin.

In coordination with the vessel's cargo officer, loading arms will be manoeuvred into position and connected to the ship's manifold. Before arrival, the tanker crew will prepare the manifold connections to match loading arm size.

Vessels will be required to follow procedures as recommended in the latest version of the International Safety Guide for Oil Tankers and Terminals.

Cargo Operations

Cargo operations typically take 18 to 24 hours, depending on vessel size and flow rate. Terminal personnel will monitor cargo operations from the marine control building. A terminal employee may also be assigned to the vessel's cargo control room.

Ship-to-shore communications are maintained throughout the entire process using handheld radios. The ship will typically give terminal personnel 30-minute, 10-minute and 1-minute notices before completing loading and unloading. After loading and unloading operations are completed, terminal personnel will drain and disconnect the arms.

Departure Operations

Final departure paperwork will be completed and departure procedures will be discussed and agreed on by the ship's crew and terminal personnel. In coordination with the ship's deck crew, the shore-side mooring crew will release the mooring hooks as directed by the vessel's master. Mooring lines will be reeled in using the vessel's deck winches.

Tugs will then be used to assist the vessel off the berth. For oil tankers, the vessel can depart without turning around. Condensate tankers will be turned by tugs. Tugs will be used as escort vessels, as required, for the oil and condensate tankers while they are in Principe Channel, Caamano Sound, Douglas Channel and Kitimat Arm.

3.4.4.3 Ship Criteria and Consideration

Ships calling on the Gateway terminal will include vessels such as VLCCs and Suezmax-class condensate tankers. It is estimated that vessel traffic will be six to seven VLCCs per month and four to six condensate tankers per month, with tugs escorting, as necessary, laden tankers, while they are in Principe Channel, Caamano Sound, Douglas Channel and Kitimat Arm. Gateway will develop and operate the berths for the vessels involved in oil and condensate transportation.

Tankers will be from the worldwide fleet. Tankers are classed and certified by independent certifying agencies. Regardless of ownership, this fleet operates according to International Marine Organisation (IMO) standards and conventions, including the IMO International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). IMO conventions and agreements are adopted by IMO members and, in the case of Canada, are reflected in regulations and guidance pursuant to the *Canada Shipping Act*. In Canadian waters, regardless of flag or ownership, all vessels must comply with Canadian legislation, including the *Canada Shipping Act.*

In addition, on April 5, 2005, amendments to Annex I of MARPOL 73/78, adopted by IMO's Marine Environment Protection Committee (MEPC) by resolution MEPC.111(50) in December 2003, were entered into force for all parties to the MARPOL Convention. These amendments will see the phase-out of all single-hulled tankers by 2015.

In its capacity as marine terminal operator, Gateway will develop a vetting process to accept only safe, structurally competent ships for oil and condensate shipments. This process will include ship design and operational specifications required for docking privileges at the Gateway Kitimat berth. Gateway expects to establish criteria requiring double-hulled tankers for its operations.

3.5 System Protection, Control and Communication

Release and leak prevention and system reliability techniques will be considered during the detailed engineering design, including:

- pressure controlling or relieving valves
- leak detection systems
- regularly scheduled preventative maintenance programs
- cathodic protection to mitigate external corrosion and corrosion inhibitor to mitigate internal corrosion
- line markers to clearly define pipeline RoW crossings of roads, rivers and streams and routine aerial patrols to monitor the RoW
- periodic inspections using an internal inspection tool and associated verification and investigation programs
- remotely operated block valves at pump stations and at crossings of major rivers, sensitive receiving environments and other critical locations, as needed
- valves to control back-flow in the event of a release

In addition to prevention techniques, the pipeline, pump station, terminal tankage and marine facilities will have a 24-hour manned pipeline control centre. Pump stations will each have pressure control valves and facility monitoring and control will be facilitated by satellite and ground station communication system. A pressure reduction station will be installed at KP 1074 (see Table 3-2). The pump stations and terminal tankage will be designed to provide secondary containment and to control surface runoff and drainage.

Consistent with similar Enbridge facilities, the Enbridge Gateway operations will include proactive contractor and third party awareness and education programs, as well as ongoing public awareness and emergency response preparedness programs.

3.6 Resource and Material Requirements

Civil engineering activities will be required to clear, grade, install drainage control and prepare the sites (terminals, pipeline RoW, pump stations and marine facilities) for construction and handling and storing materials.

The major materials that will be required for the Project include steel pipe and plate, concrete, aggregate, timber and dunnage, buildings, pumps, motors and generators, valves, machinery and switching gear. Fuel, transportation (trucks, rail, vehicles and air transport), water and electrical power will be required during the construction and operational phases of the Project. Quantities and locations for these materials will be a part of final planning and engineering design.

3.7 Waste Management

Constructing and operating the pipelines, pump stations, tank terminal sites and marine facilities will generate garbage, liquid and solid waste and minor amounts of hazardous waste. During construction, individual contractors will be responsible for disposing these wastes according to local, regional and provincial regulations and measures specified in the environmental protection plan. Gateway will develop specific procedures for managing wastes generated during operations.

3.8 Contingency Management

Gateway's contingency plans will include:

- an environmental protection plan that addresses possible releases during construction
- an emergency response plan that addresses NEB requirements to minimize risk of releases and to implement effective response procedures to mitigate environmental effects during operations
- a security plan that addresses security measures for the pipelines, pump stations, terminal tankage and marine infrastructure

Gateway contract specifications will specify that contractor fuel and lubricant storage be designed according to the applicable CCME code of practice for underground and aboveground tanks.

The Minister of Transport designates oil handling facilities through the Canada Gazette per subsection 660.2(8) of the *Canada Shipping Act*. The proposed Gateway marine terminal would likely be classified as a Level 4 Oil Handling Facility, assuming it has a maximum oil transfer rate greater than 2000 m^3/h.

As an oil handling facility, the Gateway marine terminal will have requirements for preventing oil and condensate releases, response planning and capability development. An oil pollution emergency plan and oil pollution prevention plan will be required per the *Canada Shipping Act*.

The marine terminal will have the necessary equipment onsite to respond to a release of oil and condensate at the terminal, assuming designation as a Level 4 Oil Handling Facility by Transport Canada. Under the *Canada Shipping Act*, the requirement for having equipment onsite is dictated by the volumes handled and trajectory models of release scenarios. The terminal will be required to provide details of its operational response plan for approval by Transport Canada, including on-site clean-up equipment to be available for use.

In addition, Transport Canada may designate the area as a Primary Area of Response, if it determines that the oil handling volume is greater than 500,000 tonnes per year plus vessel traffic convergence. Therefore, it is expected that Gateway, in its capacity as terminal operator, would need to demonstrate the capability to respond to larger releases of oil, either through additional equipment or through a contract arrangement with a certified Response Organization, which would be required to undertake additional planning work in a Primary Area of Response. All tankers transiting in Canadian waters are required to have a contract in place with a certified Response Organization.

3.9 Project Costs and Opportunities, Economics, Construction and Operations

3.9.1 Capital Costs

The project has an estimated capital cost of approximately $4 billion (2005 Canadian dollars) and will generate substantial economic benefits at the local, regional, provincial and national levels during both construction and operations.

3.9.2 Employment Requirements

Once the Project has received regulatory approval, it is expected to create new direct jobs during the peak construction period, expected to occur between 2008 and 2010. Gateway expects over 75 long-term employee jobs focused on pipeline and related facilities operations once construction is complete. Local maintenance and construction support service contractors (such as excavators, brushers and welders) may also be required.

Project construction and operations will deliver economic and social benefits to local communities in Alberta and British Columbia. Gateway is committed to working with stakeholders (including First Nations and Métis in Alberta and British Columbia) so that local individuals, communities and businesses have an opportunity to benefit from this Project.

Figure 3-2 is an approximate forecast of peak labour requirements during construction. Actual requirements will be determined as more detailed engineering work progresses.

Labour and service requirements and their associated influence on communities and infrastructure will be greatest during construction of the pipeline and the Gateway marine terminal and marine facilities. Pipeline activity will proceed rapidly over the two years of construction, with peak requirements for goods and services during summer and winter months.

About 600 to 1400 workers will be required for each construction spread. There will be up to 12 spreads of work over the two-year construction period, or three spreads working concurrently during the year (three summer and three winter spreads). There will be up to 40 people working throughout the year on each of the pump stations when initial access and site clearing is complete. It is currently estimated that terminal construction will require a work force of about 300 people and that the marine infrastructure construction will employ about 150 people.

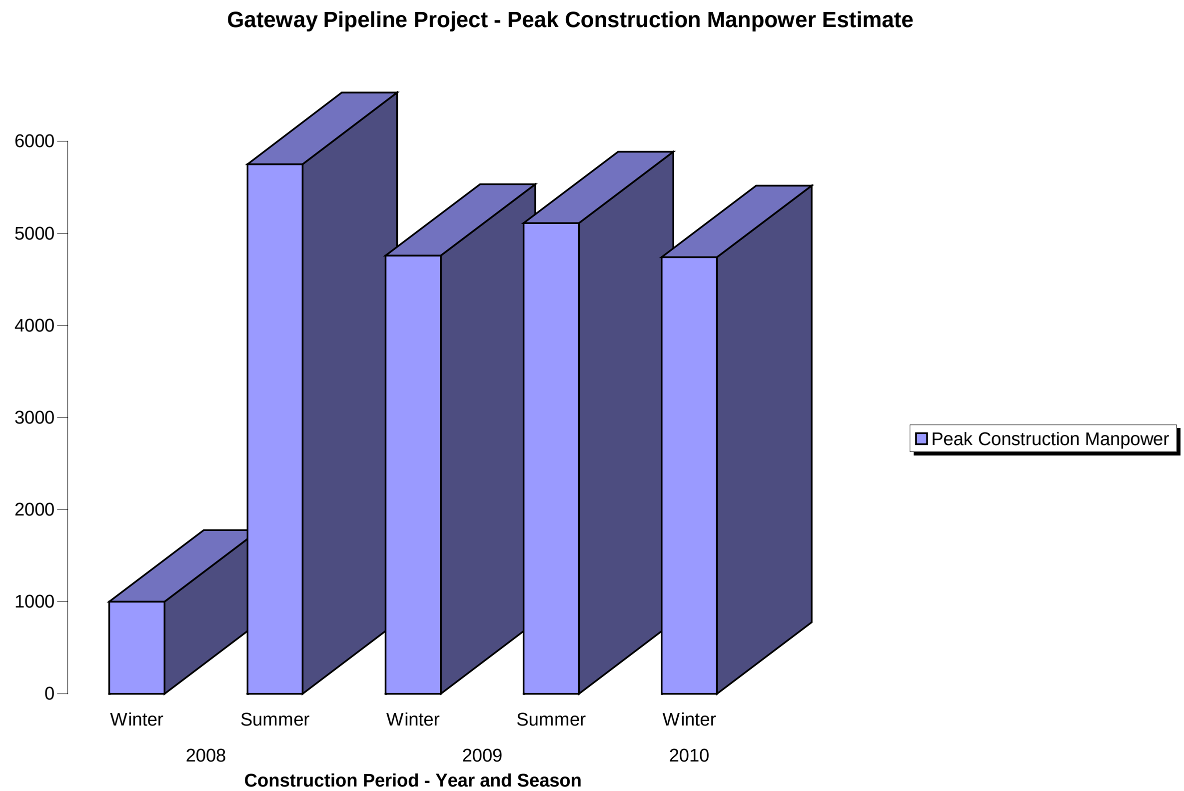

Figure 3-2 Forecast of Peak Labour Requirements

3.9.3 Community Supply and Services Opportunities

Local and regional business opportunities (Aboriginal and non-Aboriginal) for pipeline-related work are estimated to be about $150 million. Additional opportunities associated with pump stations and terminal construction are estimated to be about $15 million.

Local and regional business opportunities are expected to include:

- civil works
- electrical and mechanical contracting
- transportation, including:
  - air charters
  - trucking
- services, including:
  - camps and catering
  - hotel and motel accommodation
  - restaurant purchases
  - fuel (gasoline, diesel, propane) and lubricants

- supplies, including:
  - concrete products
  - gravel supply
  - skids and swamp mats
  - building materials and supplies
  - heavy equipment supplies and services
  - small engine and equipment supply and service
  - industrial rental supplies and services
- clearing, logging and salvage
- site restoration
- security

In addition to supply and service opportunities, the Project may create short-term demands on community and regional services and infrastructure such as:

- health services
- police and public safety services
- roads (access to and from the Project and logistic support for equipment and materials)
- railway infrastructure
- airports
- regional landfills

The Project crosses a combination of rural and remote areas. Therefore, personnel will use:

- commercial accommodations in local communities, where commuting distances are manageable
- accommodations in camp settings, where long commute distances would be required. Transportation from camps to the work site will be by crew buses on existing provincial, municipal and resource roads.

The Project is not expected to noticeably affect medical personnel and facilities or cause delays or disruptions to the level of medical service presently available to area residents because there will be trained personnel, equipment and vehicles at the pipeline work sites to provide emergency medical treatment and transportation to the nearest doctor and medical facility.

Community interactions will be experienced during operations, but at a lower level. Inspection and maintenance during Project operations typically involve fewer people and demands on community services and infrastructure are usually less.