



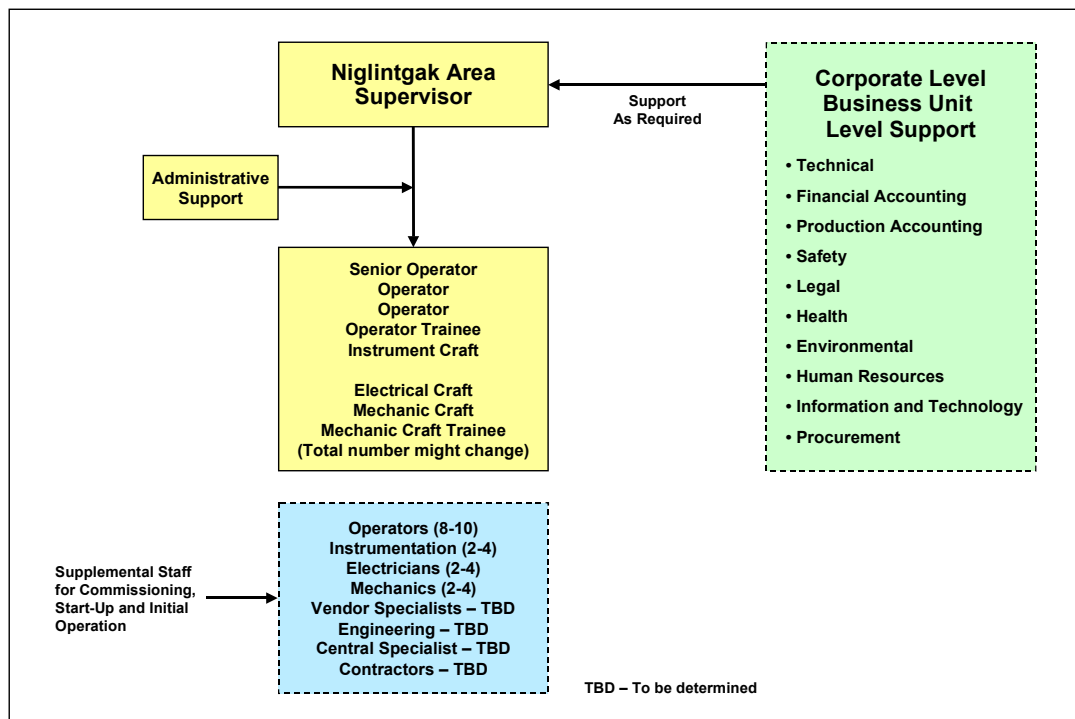
## OPERATIONS AND MAINTENANCE

APPLICATION FOR APPROVAL  
OF THE DEVELOPMENT PLAN FOR  
NIGLINTGAK FIELD  
PROJECT DESCRIPTION

## ORGANIZATION AND STAFFING

## 10.1.1 OPERATIONS AND MAINTENANCE ORGANIZATION

Niglntgak's operations will be based in the Inuvik area. Operations staff for Niglntgak will report to Shell's existing operations organization (see Figure 10-1).



**Figure 10-1: Niglntgak Operations and Maintenance Organization**

An area supervisor will lead Niglntgak operations staff, which will consist of:

- operators
- maintenance personnel
- administrative support staff

Niglntgak operations will also be supported by Shell staff located off site. Business and corporate support services will be provided in the following areas:

**10.1.1 OPERATIONS AND MAINTENANCE ORGANIZATION (cont'd)**

- technical
- health, safety and environment
- financial
- legal
- human resources

As required, the off-site staff will travel to Inuvik.

**10.1.2 STAFFING**

The Niglintgak facilities will be designed for normally unattended operation. The facilities will be designed to be controlled either remotely from the Inuvik area control centre or from the Niglintgak gas conditioning facility.

Staffing levels for Niglintgak will vary as operational stability and operating experience is achieved. The operations staffing plan for Niglintgak will cover the following operational activities:

- commissioning and start-up
- initial operations
- steady-state operations

**10.1.2.1 Commissioning and Start-Up**

The Niglintgak start-up organization will consist of the Niglintgak operations staff required for steady-state operations, supplemented with other experienced staff from operations, maintenance and engineering.

Before commissioning, supplemental staff will be integrated into the Niglintgak operations team to help develop:

- training materials
- operating, maintenance and safety procedures and practices
- commissioning and start-up plans
- training plans

As part of their training, the Niglintgak staff will assist with in-shop and on-site inspections of facilities and equipment.

During commissioning, the Niglintgak start-up organization will be supplemented by various additional resources, including:

- equipment and process specialists from the original equipment vendors
- engineering contractors' support staff
- Shell technical staff

During commissioning and start-up, work activities will change from scheduled days only to having the facilities staffed 24 hours a day, seven days a week in preparation for:

- starting up the facilities
- starting up the wells
- introducing well effluent for processing

#### **10.1.2.2 Initial Operation**

For initial operation, the Niglintgak operations staff, including supplemental staff, will be assigned to one of four operating teams or a day-support team. During start-up and initial operations, the work schedules for the teams will likely be:

- four operating teams on scheduled rotation to provide operations coverage 24 hours a day, seven days a week
- one day-support operations team on scheduled day shift to provide primarily maintenance and technical support

As operational stability and experience increase, supplemental staffing requirements will be reduced. Initially, the day-support team supplemental staff will be reduced. Then, over a period of up to 24 months, the operating teams will change from providing coverage 24 hours a day, seven days a week, to providing scheduled day coverage.

As these changes take place, the supplemental staff from the operating teams will be reduced until the team consists exclusively of Niglintgak operations staff.

#### **10.1.2.3 Steady-State Operation**

In steady-state operation, the Niglintgak facilities will normally be operated and controlled remotely from the Inuvik area control centre. The operating team will consist exclusively of Niglintgak operations staff. The Niglintgak facilities will be staffed for:

- scheduled operating and maintenance activities
- unscheduled operational issues that cannot be resolved remotely
- major maintenance interventions, such as scheduled maintenance shutdowns and facility modifications





**APPLICATION FOR APPROVAL  
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NIGLINTGAK FIELD  
PROJECT DESCRIPTION**

**PROCEDURE DEVELOPMENT**

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**10.2.1 SOTIS SYSTEM**

**10.2.1.1 Purpose**

The operating and maintenance procedures for Niglintgak operations will be developed, validated and documented using Shell's Operations Training and Information System (SOTIS). This is a competency-based training system that:

- establishes the knowledge and skill requirements for an activity or task
- provides a learning method for that skill or knowledge
- provides an evaluation method and a method for making up any deficiencies

The SOTIS system is computer-based and the information, procedures and practices stored in SOTIS will be available to all Niglintgak staff electronically or in printed form.

**10.2.1.2 Scope**

The SOTIS system provides a systematic standard approach to employee training and development for:

- safety skills for operations personnel
- site-specific operating skills
- site-specific maintenance skills
- integrating business, relational and other skills to support business needs

This program provides training and information to:

- ensure compliance with legal, regulatory and corporate requirements
- protect employees, contractors and the community
- protect the environment
- develop employees to meet business needs and help employees reach their potential through continuous learning
- enhance operational facility reliability

**10.2.1.2 Scope (cont'd)**

- protect Shell's operating assets
- optimize revenue and reduce operating costs

The SOTIS program has established requirements for developing all information that is contained in SOTIS. In the case of procedures, this ensures:

- clarity in format and instructions
- clarity in training requirements and the timing of requalification
- review and approval by subject specialists
- review and approval by appropriate levels of management
- current documentation

**10.2.2 SITE-SPECIFIC PROCEDURES**

The Niglintgak site-specific procedures and practices will be developed from Shell's existing policies, procedures and practices. The Niglintgak-specific procedures and practices will be developed and implemented before commissioning, start-up and operations. All the Niglintgak staff will be trained in the required material before commissioning. Some site-specific and task-specific procedures and practices will be developed by Niglintgak operations, while others will be developed by subject-matter specialists within Shell.

These procedures and practices will:

- ensure that all operating activities meet or exceed all applicable regulatory, code, licence or permit-to-operate conditions
- comply with Shell's existing policies, procedures and practices
- cover
  - engineering
  - contracting and procurement
  - health, safety and environment
  - legal and finance
  - human resources
  - information and technology
  - operations

Niglintgak-specific procedures and practices will include:

- safety and health:
  - general and task-specific safety rules and training
  - general and task-specific rules about health
  - emergency response and mutual aid response

- regulatory and environmental:
  - responsibilities, operational limits and reporting requirements
  - spill and leak response and mutual aid response
- operations and maintenance:
  - equipment, process and system design basis and operating limits
  - routine equipment, process, system start-up, operation and shutdown
  - nonroutine equipment, process, system start-up, operation and shutdown
  - emergency equipment, process and system shutdown
  - critical task-specific maintenance instructions
  - critical task-specific operating instructions
  - routine and critical alarm response
  - maintenance practices for identified equipment
  - corrosion mitigation and inspection plans for identified process systems

### 10.2.3 TRAINING

#### 10.2.3.1 Purpose

Training for Niglintgak staff will consist of pre-start-up and ongoing training for the life of the field. All training will follow Shell's operator training system. Each Niglintgak employee will have a training plan outlining the training and level of competency required before the Niglintgak facilities start-up, as well as the ongoing training requirements to maintain competency.

#### 10.2.3.2 Pre-Start-Up Training

During design and construction of the Niglintgak project, Shell and contract staff will develop training materials for operating and maintaining Niglintgak facilities. Niglintgak staff will also participate in developing some of these training materials under the direction of experienced staff. The training will consist of:

- participating in formal in-house classroom and hands-on training
- participating in walk-through or dry-run training
- demonstrating skill and knowledge by leading dry-run training
- participating in specialty training from equipment vendors and training schools

When Niglintgak facilities are completed, hands-on training will take place. During commissioning and start-up, improvements will be incorporated into training materials through the Operations Training System (OTS) update and improvement process.

#### 10.2.3.3 Ongoing Training

Niglintgak staff will maintain or increase their level of competency by:

**10.2.3.3 Ongoing Training (cont'd)**

- using OTS materials for planning operations and maintenance tasks
- reviewing mandatory rules and procedures
- completing time-based requalification of specific tasks
- reviewing training materials when the materials' content changes
- completing assigned OTS training modules

**OPERATIONS AND MAINTENANCE****APPLICATION FOR APPROVAL  
OF THE DEVELOPMENT PLAN FOR  
NIGLINTGAK FIELD  
PROJECT DESCRIPTION****DOWNTIME AND WELL INTERVENTIONS**

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**10.3.1 PRODUCTION DOWNTIME****10.3.1.1 Target Availability**

To maximize throughput and minimize costs, the Niglntgak development will be designed to have high operational availability, to reduce production downtime. The target is to have at least 95% operational availability.

**10.3.1.2 Design Factors**

To achieve this goal, the engineering and design process group will consider such factors as:

- number of wells and well location for reservoir drainage
- well subsurface design for water and sand control
- well pad design for subsurface well maintenance
- well pad layout for concurrent operations and well maintenance or drilling
- surface facilities design and layout for operations and maintenance
- operations response time
- 100% redundant equipment in critical applications
- warehouse spares for critical equipment

The engineering and design process group will also consider the remote capabilities for start-up, control, monitoring and shutdown.

**10.3.1.3 Maintenance**

The facilities will be designed to enable much of the routine operation, maintenance and in-service inspection functions to be safely performed without process shutdown. Routine maintenance that requires process shutdown will be scheduled to minimize production interruptions. Power generation equipment will be designed and sized to provide excess capacity.

At initial start-up, the maximum combined capacity of the Niglntgak wells will exceed the processing capacity of the gas conditioning facility, so shutting down any single well will not affect total production. The well pads will be designed for concurrent operation, including production operations and well workovers or production operations and drilling.

**10.3.1.3 Maintenance (cont'd)**

Major maintenance shutdowns will be scheduled over the life of the field, based on regulatory requirements and equipment status, as determined by routine maintenance and inspection. To minimize the loss of production, these shutdowns will be coordinated with the other anchor field operators and the pipeline operator.

**10.3.1.4 Operations**

A process and equipment surveillance system will be incorporated into the Niglintgak facility as part of Shell's Operations Integrity Assurance (OIA) process. The surveillance system will continuously monitor well, facility and equipment parameters and automatically report any deviations from established performance criteria. This continuous monitoring helps to maximize operational availability by providing:

- real-time monitoring and feedback to the operations team to allow continuous process optimization
- operations and technical specialists access to trended and historical data of equipment and process operating parameters to aid in optimizing and scheduling maintenance
- data for determining the cause of production downtime

With this information, corrective action can be taken to minimize or avoid production downtime or to prevent reoccurrence.

Shell's OIA process will further help to minimize production downtime through a structured approach, which ensures that:

- critical information and data is identified and available
- key performance indicators and associated targets are identified
- work roles and responsibilities are clear
- compliance audits are scheduled regularly
- flare events are reduced

**10.3.2 WELL INTERVENTIONS AND WORKOVERS****10.3.2.1 Purpose**

Well interventions and workovers will be required periodically to maintain production reliability and to monitor and optimize the performance of the producing reservoir zones.

Well intervention and workover programs will be developed and the work will be done under the direction of Shell's production engineering or well completions group.

Well interventions are classified as either minor or major.

#### 10.3.2.2 Minor Workovers

Minor workovers do not require removing the production wellhead or using a service rig. They include such operations as:

- production logging and testing to monitor reservoir flow performance
- cleaning sand or other material from the wellbore
- testing the SSSVs
- testing mechanical wellbore integrity
- running tools to isolate or open selected reservoir intervals or zones to optimize gas recovery

Equipment required to do minor workovers includes:

- wireline and logging units
- coiled tubing units
- nitrogen pumping units
- fluid pumping units
- well test equipment

Drilling and production pads will be large enough to accommodate minor well service operations during any season. If production reliability and other considerations require that well interventions and workovers be done during spring, summer or fall, the equipment required for minor workovers could be transported to the site by helicopter.

#### 10.3.2.3 Major Workovers

Major workovers require removing the production wellhead and usually require using a service rig. They include such operations as:

- repairing or replacing the production tubing or other downhole equipment
- recompleting the well in alternative reservoir intervals or zones

Where possible, major workovers that require transporting heavy equipment, including service rigs, to the site will be done in winter when vehicles can travel over winter roads to access the site.

Major well interventions are not expected to be routinely required during ongoing operations. However, if a major intervention is necessary, it can be done without interrupting the production from the other wells.



**OPERATIONS AND MAINTENANCE****APPLICATION FOR APPROVAL  
OF THE DEVELOPMENT PLAN FOR  
NIGLINTGAK FIELD  
PROJECT DESCRIPTION****LOGISTICS AND COMMUNICATION**

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**10.4.1 LOGISTICS****10.4.1.1 Scope**

Logistical support plans for the operations phase of the Niglintgak project will be finalized during detailed engineering. These plans will include:

- transportation of personnel
- transportation of equipment and materials
- critical spare and routine consumables requirements
- warehousing requirements
- infrastructure

Other logistical support will include supporting major maintenance activities, well work and drilling activities concurrent with operations. Details of this logistical support will continue to be developed throughout ongoing engineering design activities.

**10.4.1.2 Transportation**

Normally, people will be transported into the Inuvik area by commercially available air transportation. The methods used to transport people from the Inuvik area to the Niglintgak gas conditioning facility will vary, depending on the season and level of activity. Staff will be transported to the Niglintgak gas conditioning facility by helicopter or ice road in winter. In summer, they will be transported by helicopter or barge. Transportation to the well pads will primarily be by helicopter. Transportation alternatives will be further evaluated throughout the Project Definition Phase.

Ice roads to Niglintgak will be required during the first few winters of the field's life, when transportation will be key to supporting initial operations. Ice road access will also be considered in later years, when major winter maintenance activities, well drilling or major well work activities are planned.

Major supplies for the Niglintgak operations at the Inuvik area control centre and the Niglintgak gas conditioning facility will be transported during the summer by supply barge. Commercially available ground transportation will also be used to deliver freight to the Inuvik area.

**10.4.1.3 Warehousing**

Warehouse storage for the Niglintgak operations will be provided at a warehousing centre in the Inuvik area. Storage will be required for:

- routine consumables
- critical spare parts
- long-lead-time items

The Niglintgak gas conditioning facility will also have storage for some parts and materials.

**10.4.1.4 Infrastructure**

The Niglintgak gas conditioning facility and each of the well pads will be designed for access by helicopter. Detailed design of the helicopter facilities will take into account the weather and seasonal conditions for the area.

The Niglintgak gas conditioning facility will be equipped with:

- living quarters
- kitchen and recreation facilities
- limited office space
- a control room
- supply barge docking and unloading facilities
- a temporary refuge

Each of the well pads will be equipped with emergency shelters.

The Inuvik area control centre will contain office space, warehousing and a maintenance area. The office area will be used for maintenance and operations planning, safety meetings, employee training and business meetings. The maintenance area will be used for:

- repairing individual components
- calibrating and testing components
- staging tools and equipment before they are transported to the gas conditioning facility or well pads

Shell's existing Camp Farewell facilities are expected to be used as a support base for certain drilling, well work and major maintenance activities. The camp will typically be used for storage and additional accommodation.

**10.4.2 COMMUNICATION****10.4.2.1 Voice and Data Communication**

A voice communication system among the Niglintgak gas conditioning facility, Inuvik and Calgary offices, as well as outside communication, will be installed. A voice radio system will be considered for communications among the well pads, the gas conditioning facility and, possibly, the Inuvik area control centre.

A data communication system will link the well pads, gas conditioning facility, Inuvik area control centre and Shell's head office. The data system will provide these sites with:

- e-mail
- production accounting data
- financial accounting data
- business data
- production and operations monitoring data





APPLICATION FOR APPROVAL  
OF THE DEVELOPMENT PLAN FOR  
NIGLINTGAK FIELD  
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CONTROL AND MONITORING SYSTEMS

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10.5.1 SYSTEM DESIGN

The control and monitoring system for the Niglintgak facilities will provide fully automated control, alarm, surveillance and emergency shutdown capability. The system design will:

- allow control from either the Inuvik area control centre or the Niglintgak gas conditioning facility
- support normally unattended operation of the Niglintgak gas conditioning facility
- provide remote, real-time equipment condition monitoring and process data
- use proven technology with known high reliability
- be capable of remote support for programming and diagnostics

10.5.2 REMOTE OPERATING AND MONITORING

The Niglintgak facilities will be designed to be operated and monitored remotely from the Inuvik area control centre when the facilities are unattended.

The control and monitoring system will be fail-safe. Communication loss between well pads, or the gas conditioning facility and Inuvik area control centre, will not result in an automatic shutdown of the operation. If communications are lost, all shutdown and safety systems will remain active and function, if required, without input from the control or monitoring system.

The control and monitoring system will include operator terminals at the gas conditioning facility and the Inuvik area control centre. These terminals can be used by operators to monitor and control the operation.

The control and monitoring system will automatically:

- monitor process and equipment parameters from the wells, well pad facilities, flow lines and gas conditioning facility
- monitor the status and condition of safety systems

**10.5.2 REMOTE OPERATING AND MONITORING (cont'd)**

- electronically store the data for regulatory reporting and for equipment and process performance analysis
- initiate an alarm to alert the operations staff of a condition or event that requires attention, or if the required changes in operating parameters are outside allowable limits
- initiate an alarm if the control and monitoring system is not operating correctly
- initiate process and equipment shutdown

The control and monitoring system will also adjust specific operating parameters within established allowable limits. Operating parameters typically controlled by the control and monitoring system include:

- pressure
- flow rate
- temperature
- level
- operating speed
- starting and stopping equipment
- opening and closing valves

**10.5.3 FLOW LINE CONTROL**

The flow line system used to gather wet gas from the Niglintgak well sites consists of above-ground pipelines. A corrosion mitigation and inspection program will be developed and implemented for this system. Operating conditions of the flow lines will be monitored and controlled within allowable design limits. If required, chemicals for hydrate control and corrosion inhibition will be added and monitored.

Flow line operation and control will be one of the training topics for the Niglintgak operations staff.

**10.5.4 LEAK MONITORING AND DETECTION**

During detailed engineering, a leak detection plan for the Niglintgak facilities will be developed. For flow line leak detection, the plan will include monitoring by:

- pressure and flow monitoring systems and alarms
- scheduled external visual inspection of the flow lines
- scheduled external on-line inspection
- condition-based scheduled internal inspection

The well pad facilities and the gas conditioning facility will be equipped with strategically placed hydrocarbon gas detection equipment. This equipment continuously monitors the area for hydrocarbon vapours and will alarm at concentrations well below hazardous levels.

Operations staff will be trained on and equipped with portable hydrocarbon gas detection equipment for use during maintenance and operations tasks.

Liquid leak detection systems and containment systems will be included in the well pad and gas conditioning facilities designs.





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OF THE DEVELOPMENT PLAN FOR  
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**ABANDONMENT AND RECLAMATION**

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**10.6.1 SCOPE**

The Niglintgak development will operate for about 25 years. When the area reserves are depleted, the development lands will be decommissioned and restored to a capability similar to the surrounding lands. The success of land remediation at the end of operations will depend on the success of reducing or remediating land disturbance that occurred during drilling, construction and operations.

Reclamation will be coordinated with construction activities to allow soils and disturbed materials to be managed properly. Where possible, the need for reclamation will be reduced by avoiding disturbing land in the first place.

The plan to decommission and reclaim the disturbed lands from the Niglintgak development includes:

- well pads
- flow lines
- the remote disposal sump
- the gas conditioning facility

Abandonment and reclamation impacts have been considered in the development plan, and mitigation plans will continue to be developed during detailed design.

**10.6.2 REGULATORY GUIDELINES**

The Niglintgak development will be on crown land. Approvals to abandon and reclaim the lands will be required from INAC. NEB regulations and industry guidelines in place during construction and reclamation will be used to design the reclamation process.

**10.6.3 DRILLING AREAS AND FLOW LINES**

**10.6.3.1 Well Abandonment**

NEB regulations and industry guidelines will be used for well abandonment. Typically, the following procedure is used to decommission production and disposal wells:

**10.6.3.1 Well Abandonment (cont'd)**

1. Install bridge plugs or cement squeezes to isolate all reservoir formation contacts. This will prevent materials from reaching the surface via the well.
2. Remove the wellheads.
3. Cut off the casings and conductor below ground surface.
4. Cap the casing with a steel plate and cement plug.

**10.6.3.2 Well Pads**

The well pads will be decommissioned by removing the structural steel and processing equipment. This material will be recycled or reused to the extent possible at the time of decommissioning, to reduce the need for disposal. Materials that cannot be reused or recycled will be removed to a suitable site and disposed of.

Steel support piles will either be cut off below ground and capped with native materials or pulled out of the ground.

Any disturbed soils will be graded and contoured to match existing landforms. Where feasible, granular material will be recycled and reused. Much of the low-lying areas of the Niglintgak field are subject to flooding and natural sedimentation, which will assist in site reclamation.

**10.6.3.3 Remote Disposal Sump**

A new remote disposal sump will be built off site at the start of each of the three winter drilling programs. This sump will be used to dispose of drilling cuttings and fluids. At the end of each drilling season, the sump will be capped, decommissioned and reclaimed. During operations, the drilling sump will be monitored to confirm its integrity, and any necessary remediation activities will be implemented and monitored.

**10.6.3.4 Flow Line Reclamation**

The above-ground flow lines for Niglintgak will be supported by vertical steel supports set into the permafrost. During reclamation activities, the above-ground portions of the flow lines, except for the supports, will be removed and the materials will either be recycled or reused elsewhere. The steel supports will either be cut off below ground and capped with native materials or pulled out of the ground.

Any below-ground flow lines, such as the Kumak Channel crossing section, will be abandoned in place. Before abandonment, the lines will:

- be purged and flushed to remove all hydrocarbons
- have steel caps welded to either end to secure them

**10.6.4 GAS CONDITIONING FACILITY**

When operations are complete, the gas conditioning facility will be decommissioned. The gas conditioning facility will be excavated from its location in the Kumak Channel, refloated and towed out of the Mackenzie Delta area for recycling or disposal. Associated piping and equipment, such as the emergency shelter, bridge structures and structural piles, will be removed and recycled or disposed of off site. Disturbed ground associated with the gas conditioning facility will be contoured and restored. Where feasible, granular material will be recycled and reused.

