4.1.1 OBJECTIVES

The objectives of the route and site selection process included:

- avoiding sensitive environmental and cultural areas
- reducing disturbance to communities and the landscape
- satisfying engineering and construction requirements
- reducing cost

4.1.2 SELECTION PROCESS

Multidisciplinary teams were established, including engineering, construction and environmental specialists, to assess potential pipeline routes and facility sites. Previous studies and pipeline proposals were reviewed to assess available information and to determine the potential for using these previously proposed routes and site locations for the project. The gas pipeline route and facility sites were selected using a process that included:

- establishing route and site selection criteria
- identifying preliminary pipeline routes, sites and alternatives
- conducting field investigations involving community representatives
- revising preliminary site and route locations based on field investigations
- consulting with communities on sites and routes
- revising site and route locations, where practical, based on community input

This process was also used to select infrastructure sites, such as barge landings, camps and borrow sites necessary to support construction and operations.

4.1.3 ROUTE SELECTION

The route selection process for the gas pipeline began in 2001 (see Figure 4-1) and involved:

- identifying a preliminary route for further study
- refining the preliminary route by assessing the results of field investigations and considering community input
- identifying the proposed route for the pipeline

4.1.3 ROUTE SELECTION (cont'd)

The selected preliminary route for the gathering, NGL and gas pipelines followed the alignment of the 1984 Polar Gas Project application route from the Mackenzie Delta to Norman Wells, and paralleled the existing Enbridge pipeline from Norman Wells to the Northwest Territories–Alberta boundary. These routes were selected for initial project planning because extensive data was available and the routes were suitably aligned for the project. A 1-km-wide corridor centred on the preliminary route was identified as the study area for the 2001 and 2002 environmental baseline studies.

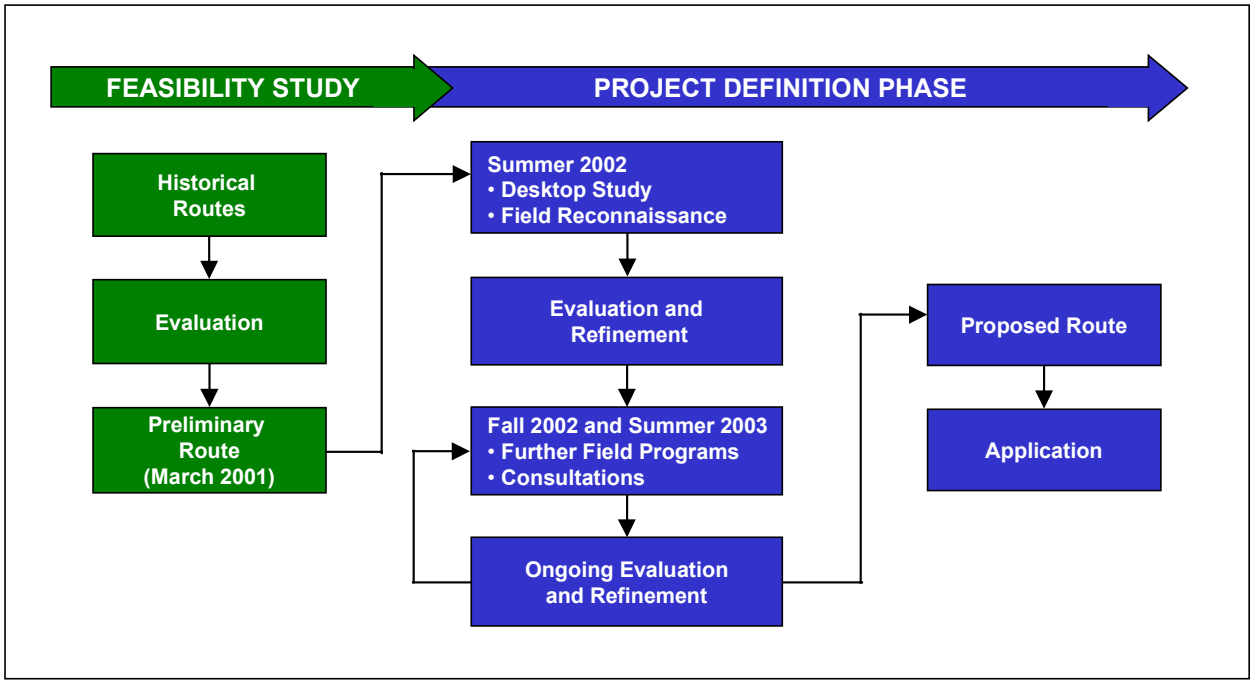

Figure 4-1: Route Development Process

4.1.4 ROUTE EVALUATION AND SELECTION

Evaluation criteria were developed (see Table 4-1) during a desktop study, and alternative routes were identified for field reconnaissance. The preliminary route and alternatives were divided into 36 segments for evaluation, of which 29 segments are applicable to the gas pipeline:

- eight segments from Inuvik to the Norman Wells area
- 21 segments from Norman Wells to northern Alberta

The first phase of field reconnaissance was conducted in early August 2002.

Based on the results of the reconnaissance, further refinements were made that:

- recognized route issues, such as the severity of sidehill slopes that were not evident during the desktop study
- took advantage of more favourable terrain, such as better approaches to water crossings
- used other features, such as cutlines

Table 4-1: Pipeline Route Evaluation Criteria

Criteria	Consideration

Route placement	• Reducing pipeline length
	• Locating the right-of-way:
	  • close to existing infrastructure
	  • parallel to, or using, existing linear disturbances
	  • to avoid encroaching on existing habitation
	• Considering facility sites during route selection

Watercourse crossings	• Reducing number, complexity and width of crossings
Geotechnical	• Avoiding steep, ice-rich or unstable slopes • Avoiding springs and perched aquifers • Considering distribution of discontinuous permafrost
Environmental (biophysical and socio-economic concerns)	• Considering land use plans • Reducing pipeline length in proximity to site-specific critical wildlife habitat and important cultural or archaeological sites • Considering socio-economic concerns
Construction	• Reducing the length of steep, longitudinal and sidehill slopes • Reducing pipeline length through muskeg and fen areas • Reducing amount of grading required • Considering access • Avoiding difficult ground conditions, such as boulder-rich terrain and bedrock • Reducing the number of pipeline, winter road and highway crossings • Providing adequate workspace
Community interests	• Considering community feedback
Cost	• Considering the relative costs of the route alternatives

Local community representatives provided local knowledge related to cultural resources and land use. Some representatives provided input to the route evaluation teams, which was used in route selection. This input was based on personal experience with the Mackenzie Highway, the winter road, construction of the Norman Wells pipeline and local resource use.

A second reconnaissance was conducted in late August and early September 2002 to assess the larger watercourse crossings and refine their locations, where warranted.

4.1.4 ROUTE EVALUATION AND SELECTION (cont'd)

A third reconnaissance in late July and August 2003 was conducted to confirm the refined route mapping and to align the route with the proposed pipeline facility sites.

4.2.1 PROPOSED ROUTE

The proposed route for the 1,220 km gas pipeline generally follows the Mackenzie Valley from the Inuvik area facility to a pig receiver adjacent to the NGTL interconnect facility located south of the Northwest Territories–Alberta boundary. The route passes through the Gwich'in and Sahtu Settlement Areas and the Deh Cho Region (see Table 4-2).

The proposed route parallels existing linear disturbances, such as cutlines, the winter road, the Mackenzie Highway and the Enbridge pipeline right-of-way for about 45% of its length.

Table 4-2: Gas Pipeline Lengths by Region

Region	Total Length (km)	Private Lands (km)
Gwich'in Settlement Area	186.3	110.0
Sahtu Settlement Area, K'ahsho Got'ine District	231.0	109.2
Sahtu Settlement Area, Tulita District	270.7	104.6
Deh Cho Region	532.3	10.4
Alberta	0.015	0

The route of the gas pipeline is shown in the application for the *Mackenzie Valley Pipeline, Volume 5: Gas Pipeline Route Maps*. The pipeline will be located within the identified corridor, which is 1 km wide, except in localized areas, such as watercourse crossings. This route might be revised as a result of additional engineering studies and further community consultation.

4.2.2 INUVIK TO NORMAN WELLS

4.2.2.1 Route

The Inuvik area facility will be the terminus of the gathering pipelines. From there, the gas pipeline and NGL pipeline will share a common right-of-way, which will trend south-southeast, crossing gently undulating terrain and passing on the east side of Travaillant Lake to Thunder River.

From Thunder River, the route will parallel the Mackenzie River to the Fort Good Hope area. South of Fort Good Hope, the route will continue south-southeast, towards Gibson Gap between the eastern slopes of the Franklin

4.2.2.1 Route (cont'd)

Mountains and the Mackenzie River. From Gibson Gap, the route will follow the bench of the Norman Range to Norman Wells. The NGL pipeline will terminate at Norman Wells, where it will interconnect with the Enbridge pipeline.

For an overview of this pipeline segment, see Figure 4-2. For larger scale gas pipeline route maps, see the application for the *Mackenzie Valley Pipeline, Volume 5: Gas Pipeline Route Maps*.

4.2.2.2 Topography

The topography varies from flat to rolling, with elevations ranging from 10 m, near Campbell Lake, to 300 m where the route crosses the Travaillant uplands north of the Thunder River and where the route crosses the Ramparts Plateau north of Fort Good Hope.

4.2.2.3 Ecoregion

The route will cross from the Southern Arctic ecoregion near Inuvik to the North Taiga Plains ecoregion. The forest consists of black and white spruce and white birch. Tree size and forest density increase from north to south.

4.2.3 NORMAN WELLS TO WILLOWLAKE RIVER

4.2.3.1 Route

The gas pipeline south of Norman Wells will continue south-southeast, generally parallel to the east side of the Mackenzie River. The route will cross the Great Bear River about 7 km upstream from its confluence with the Mackenzie River near Tulita. The route will continue south-southeast, passing east of Wrigley, and will extend south to the Willowlake River.

Along this section, the route will generally be parallel to the Enbridge pipeline right-of-way and the winter road (see Figure 4-3).

4.2.3.2 Topography

The topography is level to gently undulating across the relatively flat glaciofluvial beach deposits at the base of the Norman Range. Streams in the area from Norman Wells to the Great Bear River are deeply incised. Elevations range from 50 m near Norman Wells to 300 m near Bear Rock and 200 m near Willowlake River.

South of the Great Bear River, the topography is level to gently undulating, as the route traverses a glaciolacustrine plain at the base of the McConnell Range. Numerous thermokarst ponds and lakes occur, usually surrounded by fens.

Figure 4.2 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.2.3.3 Ecoregion

The route will traverse the North Taiga Plains to the South Taiga Plains ecoregion, where forests consist of black and white spruce, occasional white birch and alder.

4.2.4 WILLOWLAKE RIVER TO NORTHWESTERN ALBERTA

4.2.4.1 Route

From Willowlake River, the route will deviate from the Enbridge pipeline and highway corridor and will continue southeast along the west flank of the Ebbutt Hills. The route will cross the Mackenzie River east of Fort Simpson about 4 km upstream of the Enbridge crossing. South of Mackenzie River, the route will be parallel to the Enbridge right-of-way until about 30 km north of the Northwest Territories–Alberta boundary. There, it will turn due south to terminate just south of the Northwest Territories–Alberta boundary, where the pipeline will connect with an extension of NGTL's existing pipeline system (see Figure 4-4).

4.2.4.2 Topography

The terrain is level at an elevation of about 200 m at Willowlake River, with a gently undulating moraine landform with numerous thermokarst ponds and peat bogs. South of the Mackenzie River crossing near Trout River, the route will gently ascend onto the Alberta plateau, reaching an elevation of almost 700 m east of Trainor Lake. The route will cross flat to gently rolling terrain on a glaciolacustrine plain with extensive, poorly drained peat bogs.

4.2.4.3 Ecoregion

The route will traverse the South Taiga Plains where forests consist of black spruce with tamarack.

Figure 4.3 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 4.4 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.3.1 ROUTES EVALUATED IN 2002

The proposed pipeline route has evolved from a preliminary 1 km corridor selected in March 2001, and has been revised, based on:

- desktop studies
- field reconnaissance
- community consultation

The preliminary route for the gas pipeline was divided into 29 segments to assist with the assessment and selection process. A route within each segment was selected and formed the basis for the next phase of reconnaissance and consultation. The 1-km-wide study corridor, centred on the preliminary route, was expanded or moved to accommodate the route refinements.

Table 4-3 identifies, for each route segment, the number of routes assessed and the rationale for the route selected. This revised route formed the basis of community consultation in late 2002.

Route evaluations with multiple alternatives or community interest included:

- Travaillant Lake (see Section 4.4)
- Bear Rock to the Great Bear River (see Section 4.5)
- Wrigley (see Section 4.6)
- Willowlake River (see Section 4.7)
- Ebbutt Hills (see Section 4.8)
- Mackenzie River Crossing (see Section 4.9)
- the Alberta boundary (see Section 4.10)

4.3.2 ROUTES EVALUATED IN 2003

During a meeting in Fort Simpson on January 31, 2003, the project proponents reviewed the 2002 pipeline route with representatives of the Deh Cho First Nation and Indian and Northern Affairs Canada (INAC). This meeting was in support of the Deh Cho interim land withdrawal process regarding the location and size of a potential pipeline corridor across the Deh Cho region. Subsequently, the Deh Cho interim land withdrawal process established a 2.5-km-wide corridor on the east side of the Enbridge right-of-way near Trainor Lake. A 2-km-wide corridor was also included on the east side of the Enbridge right-of-way near Headwater Pond (Deep Lake). The route alignment along these segments was

4.3.2 ROUTES EVALUATED IN 2003 (cont'd)

shifted from the west side of the Enbridge right-of-way to the east side of the Enbridge right-of-way near Trainor Lake.

Several additional refinements to the route were suggested and assessed as a result of additional public consultation, facility site selection and route reconnaissance in 2003, including:

- Willowlake River (see Section 4.7)
- Ochre River
- Trainor Lake

Table 4-3: Route Refinement by Route Segment – 2002

Route Segment	Initial Segment Length (km)	Routes Assessed	Rationale for Route Selection
Travaillant Lake area	224.2	7	• Is substantially shorter than most of the other route alternatives, although 1 km longer than one alternative • Is the least costly alternative • Avoids difficult terrain in the Travaillant upland • Reduces the number of sidehill slopes crossed • Reduces the steepness and length of the longitudinal slopes crossed • Provides better access during construction, as it is closer to existing linear disturbances and the Mackenzie River
Ramparts Plateau area	103.9	2	• Is 1 km shorter than the preliminary route • Reduces the length and severity of the sidehill slopes encountered • Is less costly • Allows for simpler watercourse crossings • Eliminates a costly gully crossing
Hare Indian River Valley area (Rabbitskin River)	17.4	4	• Avoids known archaeological sites and sidehill slopes • Parallels existing linear disturbances for much of its length • Is farther from Fort Good Hope • Improves the Hare Indian River crossing • Avoids difficult terrain at the Fort Good Hope esker crossing • Eliminates three crossings of the winter road • Is less costly
Tsintu River and Chick Lake area	53.5	2	• Is straighter and runs parallel to, or uses, existing disturbances • Is less costly • Eliminates a lake crossing • Provides a less steep north approach to the Donnelly River • Reduces the number of sidehill slopes crossed

Table 4-3: Route Refinement by Route Segment – 2002 (cont'd)

Route Segment	Initial Segment Length (km)	Routes Assessed	Rationale for Route Selection
Gibson Ridge area	7.2	4	• Encounters fewer sidehill slopes than another alternative and avoids a narrow ridge traversed by the preliminary route • Is required to link the route in the adjacent pipeline segment
Gibson Gap area	6.5	3	• Is straighter, shorter and less costly than the alternatives • Runs parallel to, or uses, existing linear disturbances for its entire length • Eliminates a lake crossing, three winter road crossings and a proposed Mackenzie Highway crossing • Avoids two crossings of unnamed tributaries to the Hanna River
Paige Mountain area	18.4	3	• Is straighter and runs parallel to, or uses, existing linear disturbances for some of its length, and is less costly • Reduces the amount of bedrock encountered • Is farther away from Norman Range and an area of large historical rockfalls and rock slides • Eliminates one crossing of a winter road and the proposed Mackenzie Highway corridor • Avoids an unstable area on the south bank of the Hanna River • Avoids a narrow passage between two lakes and traversing a lakeshore • Reduces the number of springs crossed
Oscar Creek area	49.1	4	• Avoids areas with bedrock and numerous small drainages and springs • Offers a more easily constructed crossing of Oscar Creek • Avoids sidehill slopes and a large lake • Is less costly
Norman Wells area	18.3	3	• Offers a more easily constructed crossing of Bosworth Creek • Avoids areas of conflicting land use • Parallels existing linear disturbances
Seven Creeks	30.2	3	• Avoids moderate to severe sidehill slopes • Provides gentler approaches to crossings of seven named watercourses
Bear Rock to Great Bear River area	49.3	2	• Is about 2.5 km shorter and less costly than the preliminary route • Eliminates numerous tight side bends and crosses fewer ice-rich slopes • Avoids areas of inadequate workspace on the north slope of Bear Rock • Avoids sidehill slopes on the southern flanks of Bear Rock • Provides adequate workspace at the Great Bear River crossing

Table 4-3: Route Refinement by Route Segment – 2002 (cont'd)

Route Segment	Initial Segment Length (km)	Routes Assessed	Rationale for Route Selection
Wetland – West	20.8	2	• Eliminates numerous tight side bends to avoid waterbodies and crossings of ice-rich slopes • Reduces the number of areas with limited workspace as a result of encroachment by the winter road • Reduces the number of Enbridge pipeline crossings necessary to avoid areas of inadequate workspace created by waterbodies and the winter road
Wetland – East	12.7	2	• Is a straighter, more direct route that eliminates the tight side bends common along the preliminary route • Is less costly • Avoids the waterbodies and steep, sandy slopes crossed by the preliminary route
Big Smith Creek	13.1	2	• Reduces the number and severity of side bends • Avoids areas of inadequate workspace along the preliminary route • Avoids standing water and steep unstable slopes • Avoids known archaeological sites near the Big Smith Creek crossing
Little Smith Creek	22.1	2	• Avoids areas of inadequate workspace • Reduces the amount of wet terrain crossed • Crosses the Little Smith Creek valley at a more suitable location
Seagrams Creek, Saline River area	16.3	3	• Eliminates crossing severe sidehill slopes • Has a gentler approach to the Saline River Valley crossing • Reduces the likelihood of encountering bedrock • Provides a greater setback (1 km versus 0.2 km) from a peregrine falcon nesting area on a ridge
South Saline East	11.8	3	• Avoids crossing a deeply incised valley • Eliminates issues that would have impeded construction, such as heavy grading, hot bends, lengthy temporary roads and extensive slope stabilization and restoration
Steep Creek	16.4	2	• Eliminates crossing steep, ice-rich slopes at an unnamed creek valley
Sahtu – Deh Cho boundary	10.2	3	• Avoids wet terrain, and is drier and shorter by about 1.4 km • Is less costly • Eliminates two crossings of the Enbridge Pipeline • Avoids areas of inadequate workspace
Blackwater River	48.2	2	• Eliminates oblique watercourse crossing angles • Avoids steep slopes and sidehill slopes
White Sand Creek, Ochre River	26.6	3	• Eliminates three watercourse crossings • Avoids four moderately steep, ice-rich slopes

Table 4-3: Route Refinement by Route Segment – 2002 (cont'd)

Route Segment	Initial Segment Length (km)	Routes Assessed	Rationale for Route Selection
Hodgson Creek area	18.0	2	• Crosses Hodgson Creek at a right angle, for increased pipeline integrity
Wrigley Bypass	13.7	3	• Reduces sidehill slopes • Crosses four medium-sized watercourses at locations with gentler approach slopes, eliminating the need for substantial grading, slope stabilization and thermal protection measures, which would result in construction delays and maintenance requirements • Eliminates crossing 12 small, unnamed watercourses
River Between Two Mountains	45.5	2	• Avoids severe sidehill slopes adjacent to the Enbridge Pipeline • Reduces the amount of steep terrain crossed • Has gentler approach slopes
Willowlake River area	18.5	3	• Avoids areas of inadequate workspace • Reduces the length of sidehill slopes encountered • Reduces the number and angle of side bends and, consequently, facilitates construction
Ebbutt Hills area	135.9	2	• Is about 5.5 km shorter than the preliminary route • Has five fewer substantial watercourse crossings • Is less costly • Avoids encroaching upon hunting and trapping areas close to the Mackenzie River, identified by community representatives • Eliminates numerous tight side bends
Mackenzie River crossing	31.1	3	• Avoids numerous tight side bends requiring hot bends • Avoids encroaching upon a residence • Crosses the Mackenzie River at a location about 500 m narrower and more conducive to horizontal directional drilling
South Deh Cho	164.4	2	• Allows watercourse crossings at right angles, and avoids infrastructure and terrain features
Alberta boundary	98.7	3	• Is the shortest route to the Northwest Territories–Alberta boundary and the interconnection with NGTL • Eliminates a crossing of the Kakisa River

4.3.3 ROUTE REFINEMENTS

The route was also adjusted based on facility site selection activities. This included selecting valve sites for potential future compression stations. Table 4-4 summarizes the route refinements resulting from this evaluation process.

4.3.4 OCHRE RIVER CROSSING ROUTE

The preferred method for crossing the Ochre River is a horizontal directionally drilled crossing at kilometre post (KP) 759. In 2003, about 4.5 km of the route

4.3.4 OCHRE RIVER CROSSING ROUTE (cont'd)

was realigned to accommodate a crossing of the Ochre River using this method. If the horizontal directionally drilled crossing is not successful, and a trenched crossing is necessary, the preliminary route would be used because of the bank and approach slope characteristics.

4.3.5 TRAINOR LAKE REROUTE

The Deh Cho interim withdrawal process established a 2.5 km corridor on the east side of the Enbridge right-of-way near Trainor Lake. During further consultation, the Trout Lake community indicated a preference for the route to be aligned at the maximum distance from Trainor Lake. Consequently, in 2003, the proposed route was moved 2.5 km east to the eastern boundary of this corridor for 39 km in the Trainor Lake area.

Table 4-4: Route Refinements to Connect Project Facilities

Facility	Length of Reroute (km)	Rationale for Route Alignment
Norman Wells	3	• Gas pipeline route realigned up to 0.7 km east to connect with the proposed compressor station. The NGL pipeline will be constructed in a separate right-of-way to the Enbridge interconnect in this segment.
Great Bear River	8	• Route realigned up to 0.2 km east to avoid University of Alberta research plot and tie in the proposed valve site
Blackwater River	3.6	• Route realigned 0.2 km west to tie in the proposed compressor station site
Trail River	6	• Route realigned up to 0.4 km east to tie in the proposed compressor station site
Manners Creek	8	• Route realigned up to 0.4 km east to tie in the proposed valve site
NGTL interconnect facility	6	• Route realigned up to 1.6 km west to tie in the proposed facility site interconnection with NGTL

4.4.1 ROUTE CONSIDERATIONS

The Gwich'in communities have identified the area around Travaillant Lake as having important social, cultural and environmental significance, which must be considered in the route selection process. Considerations along this segment of the route included:

- reducing the proximity to waterbodies
- avoiding known archaeological sites
- avoiding or reducing the pipeline corridor length within the Travaillant Lake Gwich'in Protected Area
- reducing the overall pipeline length
- reducing the number of sidehill slopes
- reducing the amount of difficult terrain crossed
- reducing the number and complexity of major watercourse crossings
- increasing the length of existing linear disturbances followed

4.4.2 ALTERNATIVE ROUTES CONSIDERED

The following seven route alternatives were assessed in August and September 2002:

- the preliminary route
- an adjusted preliminary route
- Travaillant Lake Route 1
- Travaillant Lake Route 2
- the Mackenzie Highway alternative
- the Dempster Highway alternative
- the Polar Gas east alternative

During consultation in late 2002, the route evaluation team, with input from representatives of the community of Tsiigehtchic, developed an eighth alternative route, known as the Tsiigehtchic alternative route. This route was selected as the

4.4.2 ALTERNATIVE ROUTES CONSIDERED (cont'd)

proposed route for this segment of the pipeline. For the location of these alternatives, see Figure 4-5.

4.4.3 PRELIMINARY ROUTE

The preliminary route segment originates south of Noell Lake in the Inuvialuit Settlement Region and extends south 224.2 km through the Gwich'in Settlement Area to the Little Chicago area in the Sahtu Settlement Area. This route encounters:

- 17 longitudinal slopes and 10 sidehill slopes
- moderately steep approach slopes at the deeply incised Thunder River valley
- high ice content terrain
- crossings of the Travaillant and Thunder rivers and many minor watercourses
- about 26 km of the Travaillant Lake Gwich'in Protected Area
- lakeshores

4.4.4 ADJUSTED PRELIMINARY ROUTE

The 224.2 km adjusted preliminary route parallels existing disturbance for 16 km and encounters the same features as the preliminary route, except for lakeshores.

The adjusted preliminary route was selected for consultation and further study, as it:

- is shorter than the other route alternatives, except for the Polar Gas east route
- is less costly than the other alternatives
- avoids difficult terrain in the Travaillant Lake upland area
- reduces the number of sidehill slopes crossed and has substantially fewer steep slopes to be crossed than the other route alternatives
- has better access, as it is closer to existing linear disturbances and the Mackenzie River

4.4.5 TRAVAILLANT LAKE ROUTE 1

The 235 km Travaillant Lake Route 1 parallels existing disturbance for 7 km and avoids the Travaillant Lake Gwich'in Protected Area. This route encounters:

- 32 longitudinal slopes and 20 sidehill slopes
- one moderately steep approach slope at the tributary to the Thunder River
- the lowest amount of high ice content terrain
- many minor watercourses

Figure 4.5 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.4.6 TRAVAILLANT LAKE ROUTE 2

The 233.6 km Travaillant Lake Route 2 avoids the Travaillant Lake Gwich'in Protected Area and encounters:

- 34 longitudinal slopes and 17 sidehill slopes
- one moderately steep approach slope at the tributary to the Thunder River
- a low amount of high ice content terrain
- many minor watercourses

4.4.7 MACKENZIE HIGHWAY ALTERNATIVE

The 274 km Mackenzie Highway alternative parallels existing disturbance for 25 km and is longer than the shortest routes by about 50 km. This route is within the Travaillant Lake Gwich'in Protected Area for about 57 km, and is close to known archaeological sites. The route encounters:

- 19 longitudinal slopes and 18 sidehill slopes
- moderately steep approach slopes at the Thunder River and Caribou Creek
- a low amount of high ice content terrain
- many minor watercourses

4.4.8 DEMPSTER HIGHWAY ALTERNATIVE

The 312.2 km Dempster Highway alternative parallels existing disturbance for 53.5 km and is the longest route. This route avoids the Travaillant Lake Gwich'in Protected Area and passes close to the community of Tsiigehtchic.

The Dempster Highway alternative encounters:

- 37 longitudinal slopes and 12 sidehill slopes
- a moderately steep, potentially unstable approach slope at the Mackenzie River and Caribou Creek, which could result in longer term integrity issues
- the highest amount of high ice content terrain
- many minor watercourse crossings
- three difficult watercourse crossings, including two Mackenzie River crossings

4.4.9 POLAR GAS EAST ALTERNATIVE

The 223.3 km Polar Gas east alternative crosses 11 km of the Travaillant Lake Gwich'in Protected Area, is close to known archaeological sites, and does not parallel any existing linear disturbances. This alternative encounters:

- 45 longitudinal slopes and 29 sidehill slopes (the most slopes of any alternative)
- a moderately steep approach slope at the Thunder River
- many minor watercourses
- the most lakes and lakeshores of all route alternatives and, therefore, the highest probability of longer term integrity problems because of lakeshore instability

4.4.10 TSIIGEHTCHIC ALTERNATIVE

The Tsiigehtchic alternative has been selected for the proposed route. This alternative is about 25 km long and is located east of the adjusted preliminary route.

The Tsiigehtchic alternative added about 3 km to the adjusted preliminary route, but addressed the main concerns expressed by members of the community. This route is farther away from Travaillant Lake and also avoids gravesites that are understood to be near the adjusted preliminary route.

In addition, as compared to the adjusted preliminary route, this alternative:

- is 2 km shorter within the Travaillant Lake Gwich'in Protected Area
- encounters more side slopes and more ice-rich terrain
- parallels 2.5 km less of existing linear disturbances

The Travaillant Lake area was of particular interest to the Tsiigehtchic community and is important because of its social, cultural and environmental significance. Discussions with the community have been ongoing since the start of the project, to ensure that the Travaillant Lake segment selected for the application is the best possible route.

4.5.1 ALTERNATIVE ROUTES CONSIDERED

Two route alternatives across Bear Rock and the Great Bear River were assessed (see Figure 4-6):

- a preliminary route (adjacent to the Enbridge pipeline)
- a low pass alternative

4.5.2 PRELIMINARY ROUTE

The preliminary route was considered unfeasible because of the:

- inadequate workspace resulting from the lake and rock bluffs on the north ascent of Bear Rock
- moderate sidehill slopes and numerous tight side bends on the northern portion
- lack of available workspace at the Great Bear River crossing
- numerous wetlands, small lakes and low, sandy, ice-rich slopes south of the river

4.5.3 LOW PASS ALTERNATIVE

The low pass alternative route was chosen because it addressed all of the specific concerns associated with the preliminary route.

The low pass route crosses:

- a low pass on Bear Rock, about 1.3 km east of the Enbridge pipeline
- the Great Bear River, about 6 km upstream of the Enbridge pipeline river crossing

Figure 4.6 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.6.1 ALTERNATIVE ROUTES CONSIDERED

Three route alternatives (see Figure 4-7) were assessed along the Wrigley segment:

- a preliminary route
- an eastern alternative
- a western alternative

4.6.2 PRELIMINARY ROUTE

The preliminary route encounters moderate sidehill slopes and crosses Smith Creek and four medium-sized and 12 small, unnamed watercourses. This route is adjacent to the existing Enbridge pipeline.

4.6.3 EASTERN ALTERNATIVE

The eastern alternative encounters rugged, mountainous terrain and exposed bedrock, four moderate to steep ice-rich slopes and seven minor water crossings.

4.6.4 WESTERN ALTERNATIVE

The western alternative runs along the base of a large ridge of the McConnell Range. At its nearest point, the western alternative is about 1.5 km from Wrigley, compared to the preliminary route, which is about 3 km from Wrigley. The western alternative was chosen as the proposed route because it:

- avoids sidehill slopes
- crosses Smith Creek and four medium-sized watercourses also crossed by the preliminary route, at locations with gentler approaches. This eliminates the construction delays and maintenance associated with:
  - substantial grading
  - slope stabilization
  - thermal protection
- avoids crossing 12 small unnamed creeks crossed by the preliminary route

Figure 4.7 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.7.1 2002 ALTERNATIVE ROUTES CONSIDERED

The northern portion of the Willowlake River segment is located on the moderately steep slopes of the western flanks of Bell Ridge. Most of the central and all of the southern portions of this route segment are located on relatively level topography. Several residences are located at the mouth of the Willowlake River. Known archaeological sites are located near the Willowlake River and elsewhere along this segment. The Willowlake River corridor, about 3 km wide, and roughly centred on the Mackenzie Highway, extends for this entire route segment.

In 2002, two route alternatives (see Figure 4-8) were assessed along the Willowlake River route segment during this phase of the route selection process:

- a preliminary route
- a western alternative

4.7.1.1 Preliminary Route

The preliminary route is located on the east side of the Mackenzie Highway and the west side of the Enbridge pipeline right-of-way. It encounters:

- moderate to severe sidehill slopes and shallow bedrock along much of the northern portion
- some areas of limited workspace
- several known archaeological sites near the Willowlake River crossing
- a pond and a sand ridge on the south side of the river crossing

The Willowlake River crossing is suitable for a horizontal directionally drilled or an open cut method.

4.7.1.2 Western Alternative

The western alternative is located on the west side of the Mackenzie Highway and descends the slopes of Bell Ridge on the fall line. The river crossing, located about 1 km upstream from several residences, is considered suitable for either a horizontal directionally drilled or open cut method.

This alternative was selected as the route in 2002 because it:

4.7.1.2 Western Alternative (cont'd)

- avoids areas of inadequate workspace
- reduces the length and severity of the sidehill slopes encountered
- reduces the number and angle of side bends, which facilitates construction progress

4.7.2 2003 ALTERNATIVE ROUTES CONSIDERED

Through a series of community consultations, a request was made to:

- align the proposed route onto the east side of the Mackenzie Highway
- avoid encroaching upon the residences near the river mouth
- avoid disturbing areas of level terrain on the west side of the highway that are considered to have high archaeological potential
- avoid disturbing springs that have historically been used as mineral licks by big game

As a result, three additional alternatives (see Figure 4-8) were assessed in 2003:

- a western alternative with a central river crossing
- a western alternative with an eastern river crossing
- an eastern alternative

4.7.2.1 Western Alternative with a Central River Crossing

The northern and central portions of the western alternative route with a central river crossing are the same as for the western alternative route. The Willowlake River crossing along this alternative is located about 500 m to the east of the crossing along the western alternative. Consequently, it is farther from the residences. If the river is open cut along this alignment, an alternative crossing might be needed because of the old oxbow lakes south of the crossing. No known archaeological sites are located in the immediate vicinity of this alternative. This alignment requires two crossings of the Mackenzie Highway.

4.7.2.2 Western Alternative with an Eastern River Crossing

The northern and central portions of the western alternative route with an eastern river crossing are the same as for the western alternative route. However, the river crossing is located on the east side of the Mackenzie Highway adjacent to the Enbridge pipeline crossing. The river crossing and the remainder of the route follow the same alignment as the eastern alternative route.

Figure 4.8 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.7.2.3 Eastern Alternative

The eastern alternative was selected as the proposed route. It is located on the east side of the highway for its entire length and is about 100 to 300 m east of the Enbridge pipeline right-of-way along the northern and central portions of the route. Moderate to severe sidehill slopes and shallow bedrock are encountered along much of the northern portion of this alternative. Adequate workspace is available along the entire route. The southern portion of the eastern alternative follows the same alignment as the preliminary route.

The eastern alternative was selected because it:

- accommodates requests made during community consultations
- provides adequate workspace

4.8.1 ALTERNATIVE ROUTES CONSIDERED

Two route alternatives (see Figure 4-9) were assessed along the Ebbutt Hills segment:

- a preliminary route
- an eastern alternative

4.8.2 PRELIMINARY ROUTE

The preliminary route parallels the Enbridge pipeline. The northern portion encounters slight to moderate sidehill slopes. The central and southern portions encounter numerous low sand ridges and small to moderately sized, poorly drained lands. Numerous tight side bends are required, which would slow construction and require hot bends.

As part of the Deh Cho Process, an interim land withdrawal process has been completed and a pipeline corridor has been included along the existing Enbridge pipeline right-of-way. However, community representatives have noted that hunting and trapping areas are located close to the Mackenzie River. Therefore, the representatives prefer a more easterly alignment.

4.8.3 EASTERN ALTERNATIVE

The eastern alternative, which traverses the flanks of Ebbutt Hills, is located about 12 km east of the preliminary route. The central portion of the route follows the abandoned Canadian National Telephone right-of-way before turning southwest to rejoin the preliminary route. Extending this route alternative so that it rejoined the preliminary route at a more southerly location was also considered. This route was rejected because the extension is extremely wet in this area. Access to the eastern alternative is poor for its entire length. The Deh Cho interim land withdrawal process includes a 5-km-wide pipeline corridor along the eastern alternative.

The eastern alternative was chosen because it:

- is about 5.5 km shorter than the preliminary route
- has five fewer substantial watercourse crossings
- eliminates numerous tight side bends
- avoids encroaching upon a hunting and trapping area along the Mackenzie River

Figure 4.9 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.9.1 ALTERNATIVE ROUTES CONSIDERED

Three route options were assessed within the Mackenzie River crossing route segment (see Figure 4-10):

- a preliminary route
- a central alternative
- an eastern alternative

4.9.2 PRELIMINARY ROUTE

The Mackenzie River crossing along the preliminary route is about 1.1 km wide with banks less than 10 m high, and a relatively gentle, ice-rich south approach slope. This crossing is suitable for an open cut crossing. The width of the crossing would create substantial difficulty for a horizontal directionally drilled crossing of a large diameter pipeline. The preliminary route requires tight side bends that would slow construction through areas of sand dunes and poorly drained terrain. During consultation in Fort Simpson, the project proponents were asked to avoid encroaching upon a residence near the preliminary route and the Liard River ferry landing.

4.9.3 CENTRAL ALTERNATIVE

The central alternative deviates from the eastern alternative south of the Enbridge river crossing and follows a cutline for about 7 km through wet terrain until it joins the preliminary route.

This route was not selected because of the wet terrain. It is also about 4 km longer than the proposed route.

4.9.4 EASTERN ALTERNATIVE

The river crossing along the eastern alternative is about 0.6 km wide and located about 3.5 km upstream of the Enbridge pipeline river crossing. The banks at the eastern alternative crossing are gently to moderately sloped, and the south approach to the river has a long, moderately steep descent. South of the river, the eastern alternative generally follows a cutline and crosses knob and kettle terrain with occasional sand dunes in upland areas and wet sites in low areas.

4.9.4 EASTERN ALTERNATIVE (cont'd)

The eastern alternative was selected because:

- it can be crossed using either a horizontal directionally drilled or, depending upon the river flow characteristics and bottom profile, an open cut method
- the Mackenzie River crossing is about 500 m narrower and would present less difficulty to cross using a horizontal directionally drilled crossing
- it avoids numerous tight side bends requiring hot bends
- it avoids encroaching upon a residence near the Liard River ferry landing

Figure 4.10 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.10.1 ALTERNATIVE ROUTES CONSIDERED

The route evaluation team worked with NGTL to develop the initial route to support environmental assessment requirements for the Mackenzie Gas Project. The Mackenzie Valley pipeline component of the project will extend just south of the Northwest Territories–Alberta boundary. NGTL will extend its pipeline from its existing facilities at Bootis Hill Junction to the NGTL interconnect facility.

Three route alternatives (see Figure 4-11) were assessed:

- a preliminary route
- a western alternative
- an eastern alternative

4.10.2 PRELIMINARY ROUTE

The preliminary route follows the Enbridge pipeline to Zama, Alberta. An initial alignment for the Mackenzie Valley pipeline extended about 67 km into Alberta to the NGTL Bootis Hill junction to interconnect with the NGTL system. Subsequently, the end point of the Mackenzie Valley pipeline was located at a point immediately south of the Northwest Territories–Alberta boundary. NOVA Gas Transmission Ltd. would extend its Alberta system to this point.

4.10.3 EASTERN ALTERNATIVE

The eastern alignment was considered to maximize the length parallel to the Enbridge pipeline right-of-way. The portion within the Northwest Territories is similar to the preliminary route. This route follows existing cut lines, avoids small lakes, and reduces the length through poorly drained lands. The route crosses the Petitot River valley at a location with long, moderately steep approach slopes. It has two crossings of the Kakisa River and is about 1 km longer than the preliminary route.

The eastern alternative was not selected because it:

- is a longer route to the NGTL system at Bootis Hill
- is a longer route to the Northwest Territories–Alberta boundary
- has one additional crossing of the Kakisa River

4.10.4 WESTERN ALTERNATIVE

The western alternative deviates from the preliminary route and generally follows a cutline in a southerly direction, increasing use of drier terrain and connecting to the NGTL interconnect facility. The facility site along the western route is located about 11.5 km west of the boundary crossing on the preliminary route.

The western alternative was chosen as the route for the Alberta boundary segment for this phase of the route selection process because it:

- allows for a shorter route to the Northwest Territories–Alberta boundary and a shorter tie-in for the NGTL extension from the existing NGTL system at the Bootis Hill junction to the gas pipeline near the boundary
- eliminates a crossing of the Kakisa River

Figure 4.11 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

4.11.1 SCOPE

Sites were evaluated for the following facilities required to operate the gas pipeline:

- compressor stations, including pig launching and receiving facilities
- a heater station
- valve sites

4.11.2 SITE SELECTION PROCESS

The pipeline facility sites were selected using a process that included:

- establishing site selection criteria
- identifying preliminary sites and alternatives
- conducting field investigations involving community representatives
- revising preliminary site locations based on field investigations
- consulting with communities on sites
- revising site locations, where practical, based on community input

Facility locations were initially identified within a 5 km target area determined by a hydraulic analysis of the gas pipeline. Facility site alternatives were then identified within this target area (see Figure 4-12), considering the:

- hydraulic requirements
- proximity to the proposed pipeline route within the 1-km-wide pipeline corridor
- site-specific conditions

These alternatives included locations:

- at the optimal hydraulic point along the route, for initial and future compressor stations
- within 2.5 km upstream or downstream of the optimal points along the route, to avoid adversely affecting system hydraulic efficiency
- within 2.5 km upstream or downstream of the optimal points within the 1 km width of the pipeline corridor, but not on the route

4.11.2 SITE SELECTION PROCESS (cont'd)

- outside the target areas

Additional specific evaluation criteria for these facility sites included:

- impact on pipeline route and hydraulics
- site-specific environmental considerations, such as proximity to waterbodies
- site-specific construction considerations, such as drainage and slopes
- operations and maintenance requirements, including access

The assessment of gas pipeline valve sites along the route included considering the requirements for potential future compressor stations, using the same criteria as for the initial facility sites.

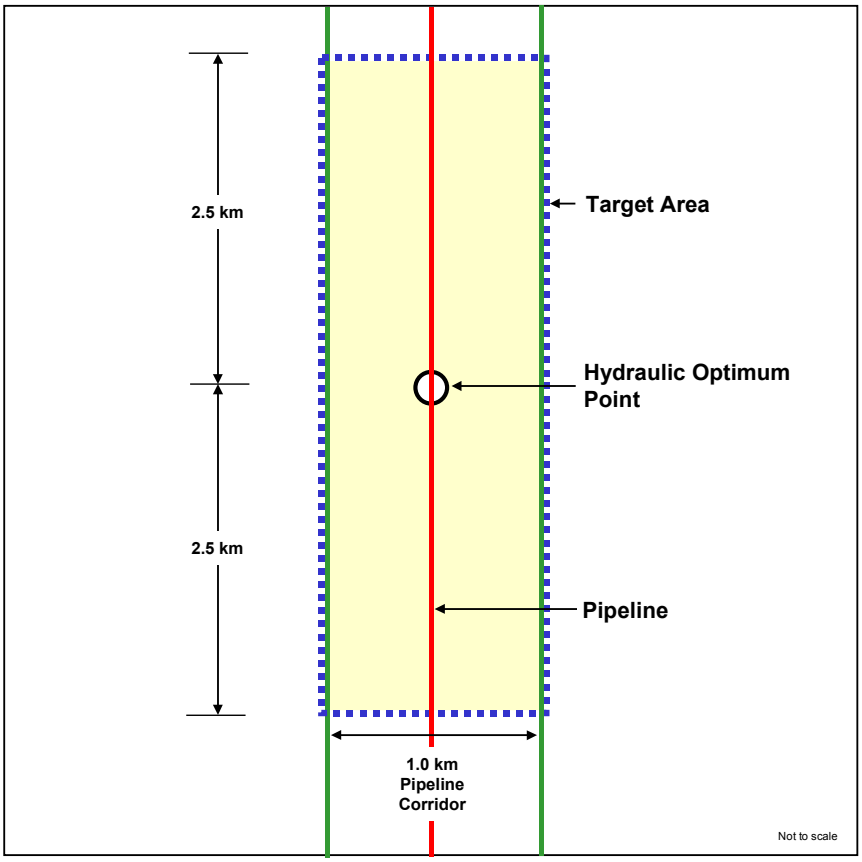

Figure 4-12: Facility Site Selection Schematic

4.11.3 SITE LOCATIONS AND ALTERNATIVES

Table 4-5 identifies the proposed facility site locations, the number of alternative locations assessed, and the rationale for selecting the proposed site.

Table 4-6 identifies the number of alternative sites assessed for each valve station on the gas pipeline.

Table 4-5: Proposed Sites for the Gas Pipeline Facilities

Facility Type	Total Locations Assessed	Facility Name	Proposed Location				Rationale for Proposed Site
				UTM			
			KP	Easting	Northing	Zone	
Meter station	N/A	Inuvik area facility	0	568,815	7,589,867	8	• Based on requested receipt point
Compressor station	6	Little Chicago	226	458,306	7,436,221	9	• Is well drained • Is relatively flat, which reduces grading and gravel requirements • Avoids encroaching upon lakes
	4	Norman Wells	476	597,861	7,242,892	9	• Is relatively flat, which reduces grading and gravel requirements • Avoids encroaching upon existing Imperial Oil and Enbridge facilities • Has shorter access than other alternatives
	4	Blackwater River	702	444,821	7,088,998	10	• Is relatively flat, which reduces grading and gravel requirements • Is well drained • Avoids an existing borrow site
	7	Trail River	928	543,528	6,900,468	10	• Reduces pipeline length to tie in the station • Avoids standing water and muskeg areas • Offers most stable ground within target area
Heater station	2	Trout River	1124	637,594	6,744,273	10	• Is relatively flat, which reduces grading and gravel requirements • Is well drained

Table 4-6: Proposed Gas Block Valve Sites

Total Locations Assessed	Facility Name	Proposed Location				Rationale for Proposed Site
		KP	UTM Easting	UTM Northing	UTM Zone	
4	Fish Trap Lake	70	612,245	7,539,833	8	• Avoids encroaching upon lakes • Is relatively dry and flat
4	Thunder River	157	422,448	7,491,953	9	• Provides shorter access from south side of river • Is flat, well drained and reduces gravel requirements
3	Loon River	310	510,155	7,372,962	9	• Is relatively flat and dry, and reduces gravel requirements • Avoids encroaching upon a lake and unnamed creek
4	Chick Lake	391	542,684	7,301,352	9	• Is the farthest site from the lake • Has least amount of slope • Avoids encroaching upon a creek and the winter road
4	Great Bear River	551	379,372	7,208,214	10	• Is the best drained site • Is relatively flat
3	Little Smith Creek	623	414,863	7,155,503	10	• Is driest site with the best drainage • Avoids encroaching upon a lake
4	Hodgson Creek	774	475,739	7,026,955	10	• Is flat, dry and well drained • Avoids encroaching upon drainages
4	Willowlake River	857	496,172	6,950,414	10	• Avoids encroaching upon residences • Is flat and relatively well drained • Avoids disturbing the river bank
2	Manners Creek	1,010	600,806	6,848,968	10	• Is the best drained site in the target area
3	Deep Lake	1,086	625,362	6,780,042	10	• Is relatively flat and well drained
N/A	NGTL interconnect facility	1,220	333,419	6,655,108	11	• Based on NGTL delivery point