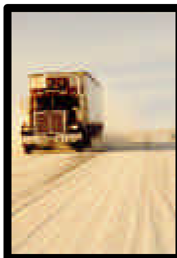
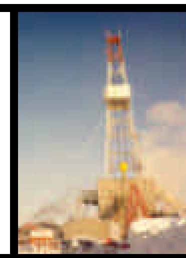
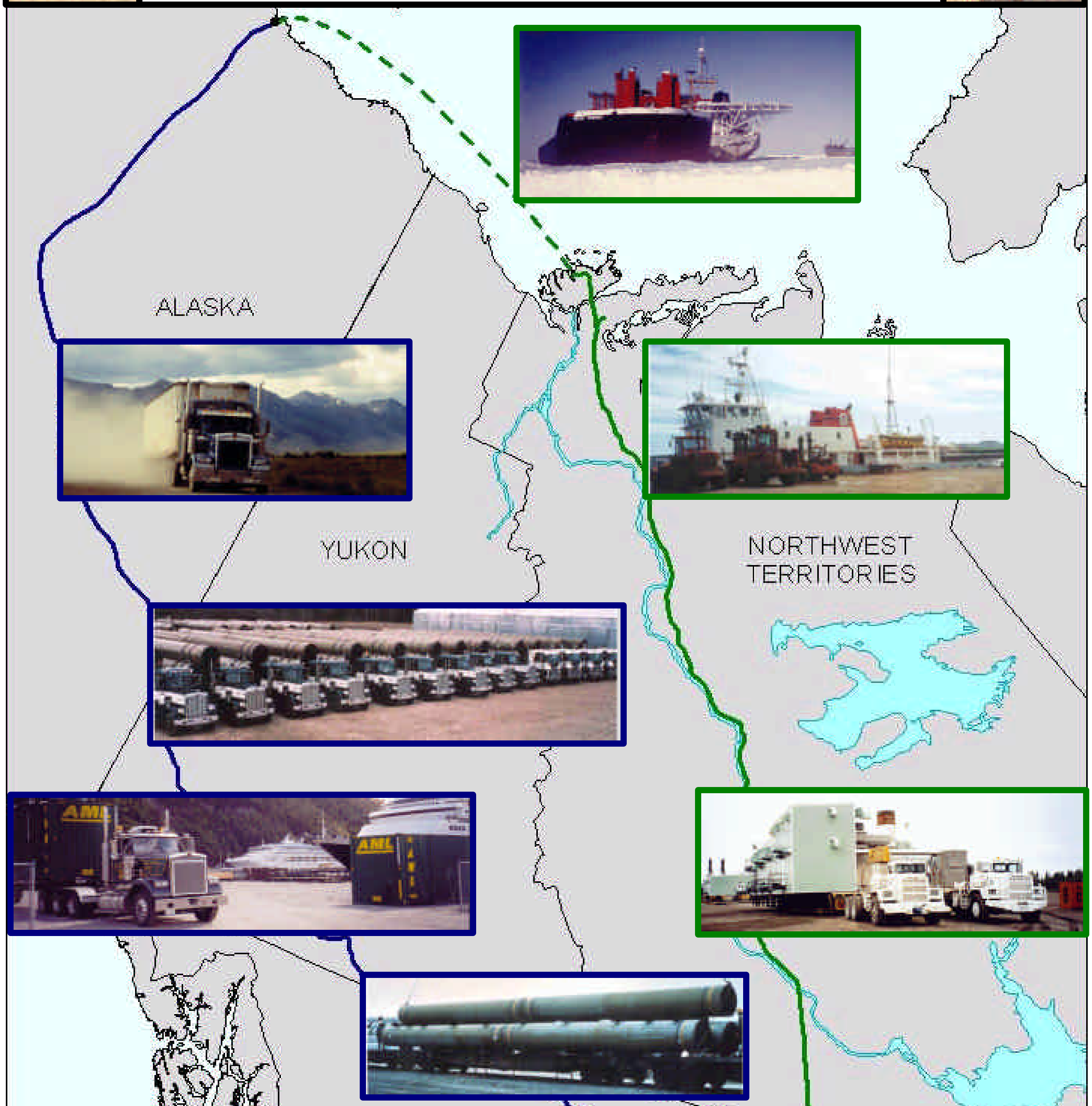


ARCTIC GAS PIPELINE CONSTRUCTION IMPACTS ON NORTHERN TRANSPORTATION





The Van Horne Institute

PRO LOG
Canada Inc.

January 2003

ARCTIC GAS PIPELINE CONSTRUCTION IMPACTS ON NORTHERN TRANSPORTATION

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ARCTIC GAS PIPELINE CONSTRUCTION IMPACTS ON NORTHERN TRANSPORTATION

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ARCTIC GAS PIPELINE CONSTRUCTION IMPACTS ON NORTHERN TRANSPORTATION

1.0 SUMMARY AND INTRODUCTION

The objective of this study is to assess the impact on northern transportation systems of logistics requirements for arctic gas pipeline construction. That objective is met in two steps:

- First, Alaska Highway and Mackenzie Valley pipeline scenarios are identified for personnel and material movement requirements along with sourcing, routing, timing and destination delivery assumptions.

- Second, these construction logistics requirements are combined with baseline freight flows into the Northwest Territories and Yukon to assess potential impacts on northern transportation systems.

This report completes a uniquely comprehensive comparison of four major arctic gas pipeline proposals from a northern transportation impact perspective:

- We have developed personnel and material movement data bases in a consistent approach that facilitates accurate evaluation across all pipeline scenarios;

- We have integrated these project logistics requirements with baseline transportation flows previously developed by PROLOG; and,

- We have time phased resulting Total Transportation System Impacts in generic "Project Years" to allow ongoing assessment as construction timing is firmed up.

We have determined that despite massive manpower mobilization requirements, no project will create unmanageable personnel movement problems. However, large-scale logistics operations to complete project material movements within construction schedule constraints, pose the potential for significant impacts.

Map 1 shows the pipeline routes and material quantities that will move across the northern transportation system under four project scenarios.

Generally, we summarize the potential impact of those material movements as follows:

- In Yukon, Alaska Highway Pipeline project logistics will primarily impact the highway system and, especially in summer, project trucks may not mix well with tourists and other travellers.
- In the Northwest Territories, Mackenzie Valley Pipeline project logistics will be constrained by winter road and summer barge seasons, but the majority of material movements will be from rail to river without a major highway impact.

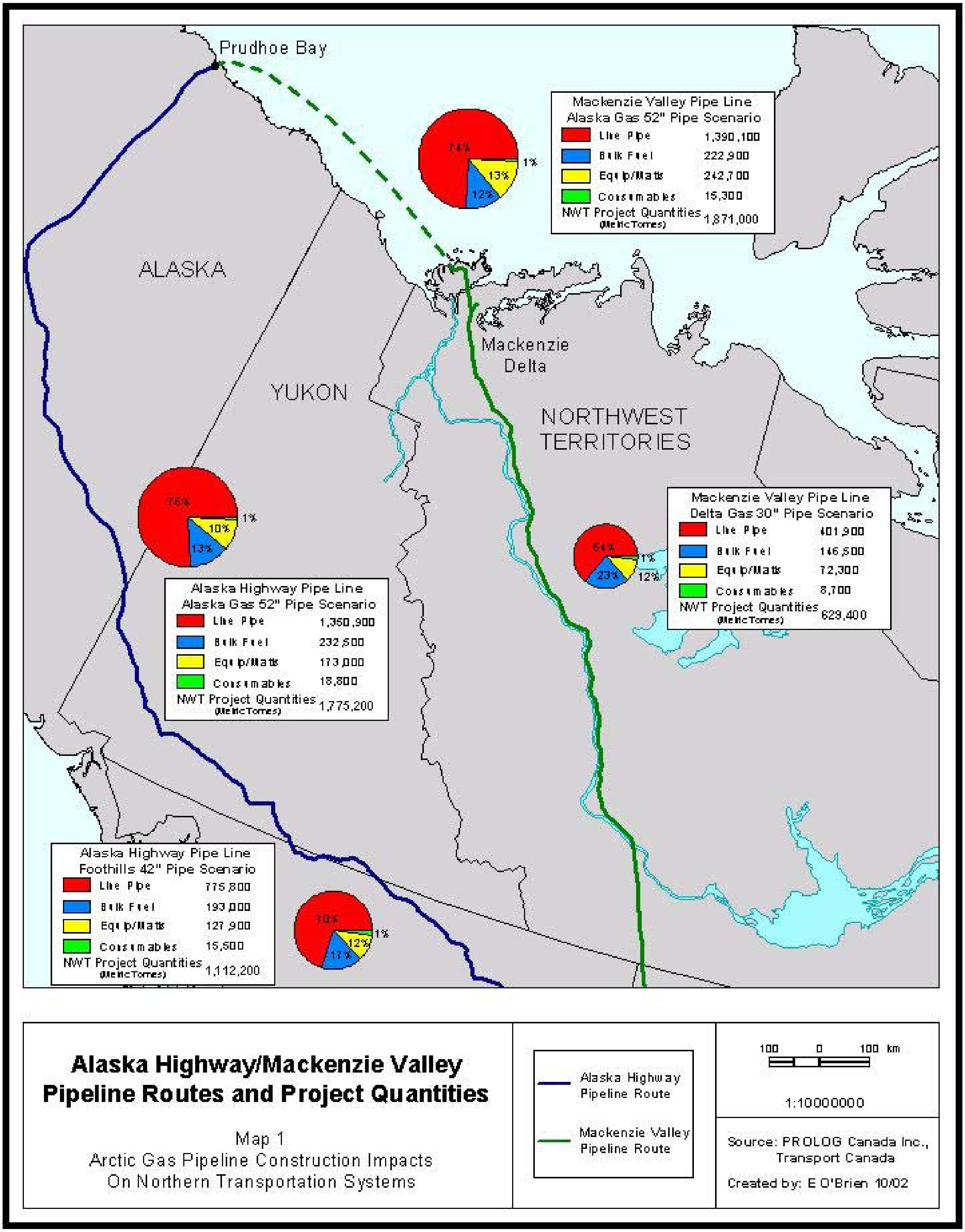
Specifically, we predict the potential for project induced transportation bottlenecks as follows:

- At the Fort Nelson BC Rail/Truck Gateway a peak of up to 50 truckloads per day transferred from BC Rail is anticipated.
- At the Hay River NWT Rail/Truck Gateway peak offloading between 24 and 44 railcars per day and outloading between 2 and 5 barges per day is anticipated.

As well, we identify the following potential impacts from ocean vessel operations:

- At the Inside Passage Port of Skagway, offloading of Yukon destined project cargo may conflict with over 400 cruise ship calls carrying some 600,000 passengers each summer.
- Along the Canadian Western Arctic Coast, between 20 and 40 deep draft Beaufort Sealift vessels may be required to discharge project cargoes.

We conclude that overall Alaska Highway Pipeline project logistics impacts on the Yukon transportation system are manageable. We also conclude that overall Mackenzie Valley Pipeline project logistics impacts on the Northwest Territories transportation system are manageable at the low end of the range as set by a Delta Gas project; but overwhelming at the high end of the range as set by an Alaska Gas Pipeline project.


Prudhoe Bay
ALASKA
YUKON
Mackenzie Delta
NORTHWEST TERRITORIES
Mackenzie Valley Pipe Line
Alaska Gas 52" Pipe Scenario
Line Pipe 1,390,100
Bulk Fuel 222,900
Equip/Matls 242,700
Consumables 15,300
NWT Project Quantities (Metric Tonnes) 1,871,000
74%
1%
13%
12%
Mackenzie Valley Pipe Line
Delta Gas 30" Pipe Scenario
Line Pipe 401,900
Bulk Fuel 146,500
Equip/Matls 72,300
Consumables 8,700
NWT Project Quantities (Metric Tonnes) 629,400
64%
1%
23%
12%
Alaska Highway Pipe Line
Alaska Gas 52" Pipe Scenario
Line Pipe 1,350,900
Bulk Fuel 232,500
Equip/Matls 173,000
Consumables 18,800
NWT Project Quantities (Metric Tonnes) 1,775,200
76%
1%
10%
13%
Alaska Highway Pipe Line
Foothills 42" Pipe Scenario
Line Pipe 775,800
Bulk Fuel 193,000
Equip/Matls 127,900
Consumables 15,500
NWT Project Quantities (Metric Tonnes) 1,112,200
70%
1%
12%
17%
Alaska Highway/Mackenzie Valley
Pipeline Routes and Project Quantities
Map 1
Arctic Gas Pipeline Construction Impacts
On Northern Transportation Systems
Alaska Highway Pipeline Route
Mackenzie Valley Pipeline Route
100 0 100 km
1:10000000
Source: PROLOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

2.0 PIPELINE CONSTRUCTION SCENARIOS

A multitude of pipeline alternatives have been proposed to move Arctic Gas to southern markets. We have selected the most prominent of these proposals to establish a range of transportation system impacts within two principal pipeline corridors - the Alaska Highway Corridor and the Mackenzie Valley Corridor.

In each pipeline corridor, we have analyzed two pipeline options for a total of four arctic gas pipeline scenarios. Our logistics analysis is conducted without prejudice toward either corridor and makes no assessment of the financial feasibility for any pipeline option.

The pipeline scenarios which set the scope of this assessment are:

- **In the Alaska Highway Corridor**
    - Foothills Pipe Lines Proposal for a 42" Diameter Pipeline
    - Alaska Gas Producers Proposal for a 52" Diameter Pipeline
- **In the Mackenzie Valley Corridor**
    - Delta Gas Producers Proposal for a 30" Diameter Pipeline
    - Alaska Gas Producers Proposal for a 52" Diameter Pipeline

Foothills Pipe Lines is currently updating plans for the Alaska Highway Gas Pipeline which it originally proposed in accordance with the 1977 "Agreement on Principals" between the United States and Canada (still in effect).

The Alaska Gas Producers Group completed a US$ 125 million study during 2001 which compared both the Alaska Highway and Mackenzie Valley Corridors as alternate pipeline routes for Alaska Gas.

The Delta Producers Group announced a CA$ 250 million permit application program in 2002 to study the Mackenzie Valley route as follow-on to positive results from initial feasibility review.

2.1 Alaska Highway Pipeline Route

In the Alaska Highway Corridor, both the Foothills Pipe Lines and Alaska Gas Producers proposals are to move Alaska Gas from Prudhoe Bay. However, beyond that common element, they are significantly different proposals, due primarily to a major difference in pipe size.

Foothills Pipe Lines 42" Scenario. The Foothills Pipe Lines Proposal is essentially sized to provide the most cost effective project from an initial investment perspective. Project criteria provided by Foothills Pipe Lines and used by PROLOG in this scenario are as follows:

Foothills 42" Alaska Highway Pipeline Scenario

Pipeline Route

From	Prudhoe Bay, Alaska
To	Gordondale, Alberta[1]

Via	Alaska Highway Corridor
Yukon Portion	832 km (517 miles)
British Columbia Portion	720 km (448 miles)
Alberta Portion	65 km (40 miles)
Length in Canada	1,617 km (1,005 miles)
Plus Alaska Portion	1,199 km (745 miles)
Total Project Length	2,816 km (1,750 miles)

Pipeline Design

Initial Throughput	2.5 billion cubic feet per day
Expansion Potential To	4.5 billion cubic feet per day
Operating Pressure	2050 psi
Initial Compressor Stations	12 total (7 in Canada)
Pipe Steel Grade	X-80 Carbon Steel
Pipeline Diameter	1067 mm (42 inches)
Pipe Wall Thickness	19 mm (.75 inches)

Construction Strategy

Pipeline Spreads	3 pipeline spread contractors in Canada
Pipeline Camps	3 (850-1000 man) camps at 12 campsites in Canada
Peak Work Force	2,500 construction personnel in Canada
Construction Duration	2 years (plus 1 year advance site prep/logistics)
Construction Seasons	winter (+/- 50 days) and summer (+/- 60 days)
Pipeline Capital Cost	US$ 7.5 billion

[1] Connection with existing TransCanada Pipelines System

Alaska Gas Producers 52" Scenario. Alaska Gas producers have proposed a pipeline that is sized to provide the most cost effective future expansion potential at a substantial initial investment premium[2] Project information obtained from the Alaska Gas Producer Group has been supplemented with PROLOG assumptions as noted below.

Alaska Gas Producers 52" Alaska Highway Pipeline Scenario

Pipeline Route

From	Prudhoe Bay, Alaska
To	Edmonton, Alberta[3]
Via	Alaska Highway Corridor
Yukon Portion	832 km (517 miles)
British Columbia Portion	720 km (448 miles)
Alberta Portion	714 km (444 miles)
Length in Canada	2,266 km (1,408 miles)
Plus Alaska Portion	1,178 km (732 miles)
Total Project Length	3,444 km (2,140 miles)

Pipeline Design

Initial Throughput	4.5 billion cubic feet per day
Expansion Potential To	5.6 billion cubic feet per day
Max. Operating Pressure	2500 psi
Initial Compressor Stations	24 total
Pipe Steel Grade	X-80 Carbon Steel
Pipeline Diameter	1320 mm (52 inches)
Pipe Wall Thickness	28.6 mm (1.125 inches)

Construction Strategy

Pipeline Spreads	4 Canadian spreads out of 8 total Alaska to Alberta
Pipeline Camps	4 (1000-1200 man) camps in Canada
Peak Work Force	4,800 construction personnel in Canada
Construction Duration	Seeking to compress schedule from3 to 2 years.
Construction Seasons	most winter but more summer if 2 year construction
Pipeline Capital Cost	US$ 11.6 billion

[2] US$ 4 billion over the equivalent Foothills pipeline construction cost estimate (also includes longer Alberta leg).
[3] Fort Saskatchewan area petrochemical complex for liquids extraction and connection with US market pipelines.

2.2 Mackenzie Valley Pipeline Route

In the Mackenzie Valley Corridor, there are two pipeline proposals: one to move Mackenzie Delta Gas on a stand-alone basis and the other to move Alaska Gas with an undersea pipeline link from Prudhoe Bay to the Mackenzie Delta. The much smaller Delta Gas resource results in a much smaller pipeline proposal than for Alaska Gas.

Delta Gas 30" Mackenzie Valley Scenario. The Mackenzie Delta Gas Producers Group is evaluating a number of design optionsincluding a 500 km dual phase natural gas and liquids pipeline to Norman Wells; liquids extraction and injection into the existing Enbridge Oil Pipeline at Norman Wells; and a parallel 800 km single phase pipeline to carry dry natural gas from Norman Wells.[4] Project information provided by the Mackenzie Delta Producers Group and used by PROLOG to develop this scenario includes the following:

Delta Gas 30" Mackenzie Valley Pipeline Scenario

Pipeline Route

From	Taglu, Northwest Territories
To	Bootis Hill, Alberta[5]
Via	Mackenzie Valley Corridor
Pipeline Length	1,285 km (798 miles)

Pipeline Design

Initial Throughput	1 billion cubic feet per day
Expansion Potential To	1.5 billion cubic feet per day[6]
Operating Pressure	2050 psi
Compressor Stations	4 stations initially
Pipe Steel Grade	X-80 Carbon Steel
Pipeline Diameter	762 mm (30 inches)
Pipe Wall Thickness	15.8mm (.625 inch)

Construction Strategy

Pipeline Spreads	4 pipeline spread contractors
Pipeline Camps	4 - 800 man camps (positioned at 8 campsites)
Peak Work Force	4,000 construction personnel
Construction Duration	2 years (plus 1 year advance site prep/logistics)
Construction Season	winter (+/- 50 days)
Pipeline Capital Cost	CA$ 3.3 billion

---

[4] Other options include larger diameter pipe and/or separate gas and liquids lines to Norman Wells.
[5] Connection with existing TransCanada Pipelines System
[6] An MOU with the Aboriginal Pipeline Group allows for up to 1/3 of total capacity to be allocated to APG.

Alaska Gas 52" Mackenzie Valley Scenario. Alaska Gas producers have proposed a pipeline from Prudhoe Bay via the Mackenzie Valley Corridor as a "Northern Route" alternative to the Alaska Highway "Southern Route". This scenario includes some 250 kms of subsea pipeline off the Western Arctic Coast of Canada. Project information obtained from the Alaska Gas Producer Group has been supplemented with PROLOG assumptions as noted below.

Alaska Gas 52" Mackenzie Valley Scenario

Pipeline Route

From	Prudhoe Bay, Alaska
To	Edmonton, Alberta[7]
Via	Mackenzie Valley Corridor
Mackenzie Valley/Alberta	2,320 km (1,442 miles)
Canadian Subsea	250 km (155 miles)
Length in Canada	2,570 km (1,597 miles)
Plus Alaska Portion	330 km (205 miles)
Total Project Length	2,900 km (1,802 miles)

Pipeline Design

Initial Throughput	4.5 billion cubic feet per day
Expansion Potential To	5.6 billion cubic feet per day
Max. Operating Pressure	2500 psi
Initial Compressor Stations	28 total
Pipe Steel Grade	X-80 Carbon Steel
Pipeline Diameter	1320 mm (52 inches)
Pipe Wall Thickness	28.6 mm (1.125 inches)

Construction Strategy

Pipeline Spreads	8 spread plus subsea contracts Alaska to Alberta
Pipeline Camps	4 - 1200 man camps
Peak Work Force	4,800 construction personnel
Construction Duration	Seeking to compress schedule from3 to 2 years.
Construction Seasons	Summer subsea and winter Mackenzie Valley
Pipeline Capital Cost	US$ 10.8 billion

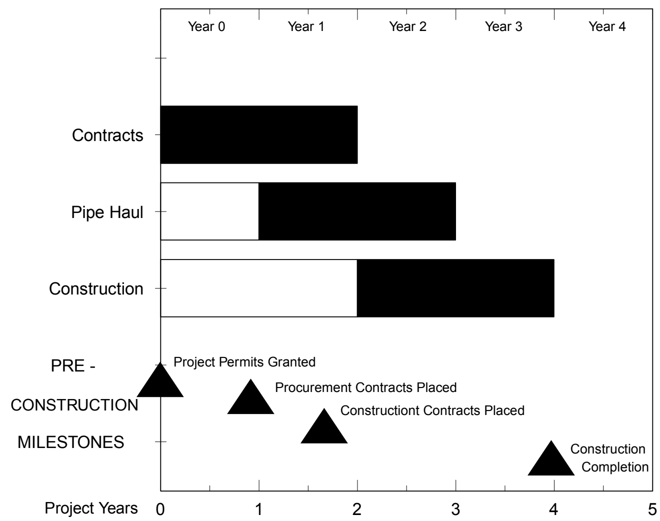
[7] Fort Saskatchewan area petrochemical complex for liquids extraction and connection with US market pipelines.

For each pipeline scenario, we have assumed similar logistics and construction activity timing within a four year project scheduling envelope. A two year construction schedule backs off from project completion at end of Year 3 for construction start at beginning of Year 2. A two year pipe haul program starts in Year 1 overlapping initial construction in Year 2. The balance of material and personnel movements continue through construction completion in Year 3.

We assume a 1 year lag between project permitting and pipe haul start-up for finalizing placement of major procurement, transportation and ancillary construction contracts during Year 0; and continuing through to construction start at the end of Year 1 for the balance of compressor station and pipeline installation contracts.

NORTHERN PIPELINE PROJECT
LOGISTICS IMPACT ASSESSESSMENT

Project Activity Timing



Our project activity timing assumptions are consistent with the two year construction schedules planned by both Foothills Pipe Lines in the Alaska Highway Corridor and by the Delta Gas Producers in the Mackenzie Valley Corridor. We have also assumed a two year construction schedule for the Alaska Gas Producers proposals, with a larger diameter 52" pipeline setting an extreme upper range to our transportation system impact analysis for both pipeline corridors.[8]

Map 2 on the following page, identifies current Northern Transportation Infrastructure which will be impacted by construction logistics to support one or more of these pipeline scenarios. (A full transportation system inventory and analysis is available in the *Northern Territories Transportation Systems Study* completed by PROLOG for Transport Canada in 1998.)

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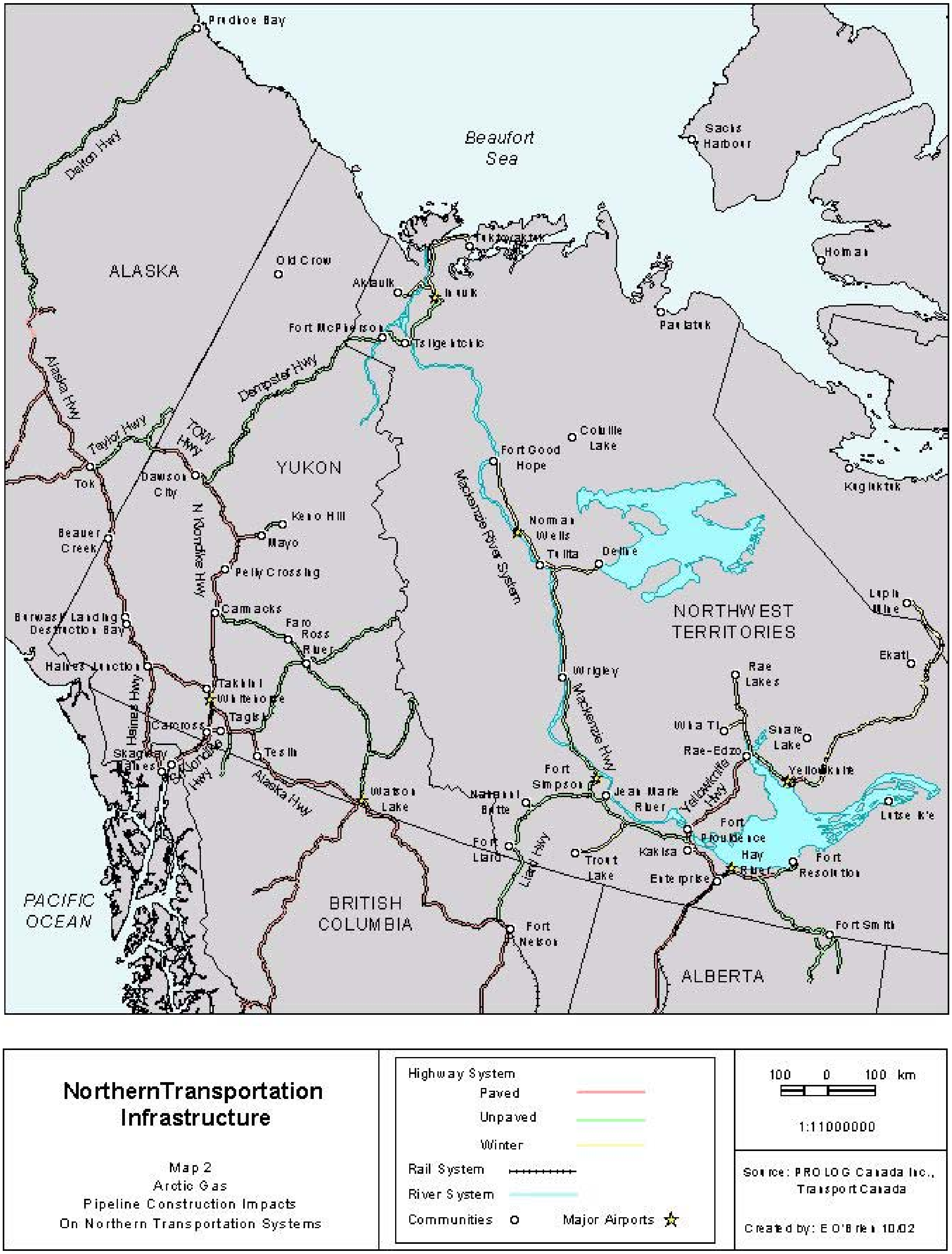
[8] Although the Alaska Gas Producers Group is optimistically targeting two year construction feasibility, their project definition is presently based on 3 construction years.


Beaufort Sea
ALASKA
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
PACIFIC OCEAN
Prudhoe Bay
Dalton Hwy
Alaska Hwy
Taylor Hwy
Dempster Hwy
Old Crow
Aklavik
Inuvik
Fort McPherson
Tsiigehtchic
Tok
Dawson City
Beaver Creek
Keno Hill
Mayo
Pelly Crossing
Carmacks
Faro
Ross River
Whitehorse
Teslin
Watson Lake
Fort Good Hope
Colville Lake
Norman Wells
Tulita
Deline
Wrigley
Fort Simpson
Fort Liard
Fort Nelson
Trout Lake
Kakisa
Enterprise
Hay River
Fort Resolution
Fort Smith
Fort Providence
Yellowknife
Rae Lakes
Snare Lake
Rae-Edzo
Paulatuk
Sachs Harbour
Holman
Kugluktuk
Lupin Mine
Ekati
Mackenzie River System
Mackenzie Hwy
Yellowknife Hwy
Liard Hwy
Northern Transportation Infrastructure
Map 2
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Highway System
Paved
Unpaved
Winter
Rail System
River System
Communities
Major Airports
100 0 100 km
1:11000000
Source: PRO LOG Canada Inc., Transport Canada

3.0 PERSONNEL MOVEMENT PLANS

This section of the report defines construction workforce levels and from them develops project personnel movement requirements. These are incorporated in conceptual personnel logistics plans for both the Alaska Highway and Mackenzie Valley pipeline routes.

The capability of the existing northern transportation infrastructure to support these personnel movement plans is reviewed for all four pipeline scenarios (in the Alaska Highway Corridor a Foothills Pipe Lines 42" pipeline and an Alaska Gas Producers 52" pipeline; and in the Mackenzie Valley Corridor a Delta Gas 30" pipeline and an Alaska Gas 52" pipeline 'over-the-top'). This provides a basis for identifying infrastructure improvements that might be required should any of the pipeline proposals proceed to the construction stage.

The following assessment is concentrated on those pipeline segments located within Canada north of the 60th Parallel. Although pipeline personnel will move to and from the construction sites by various combinations of air and surface transportation, because of the remoteness of the sites and the inherent limitations of surface transportation in the North, the aviation mode will be a major focus.

It is recognized that there will also be a need for air cargo support for perishable goods and high priority items. However, we assume that this need will be adequately met within the envelope of aviation facilities and services that will support personnel movements.

In conducting our assessment we relied on information from the Governments of Yukon and Northwest Territories, the principal operators of airports along the proposed pipeline rights-of-way. We also relied on the producers and the pipeline companies for information on manpower planning and facilitation, although in some cases the information was not fully developed and it was necessary to offset these gaps with reasonable assumptions. Finally, we relied on Transport Canada because of its planning, policy and regulatory role in air transportation.

3.1 Project Passenger Transportation Systems

Map 3 shows the scope of personnel movement operations to support pipeline construction in both the Alaska Highway Corridor and in the Mackenzie Valley Corridor. Features and capabilities of airports located along potential pipeline rights-of-way are provided in Appendix A. We assume that the existing system of winter and all-season roads is generally capable of supporting the transport of personnel between the airports and the campsites on both the Alaska Highway and Mackenzie Valley Routes.

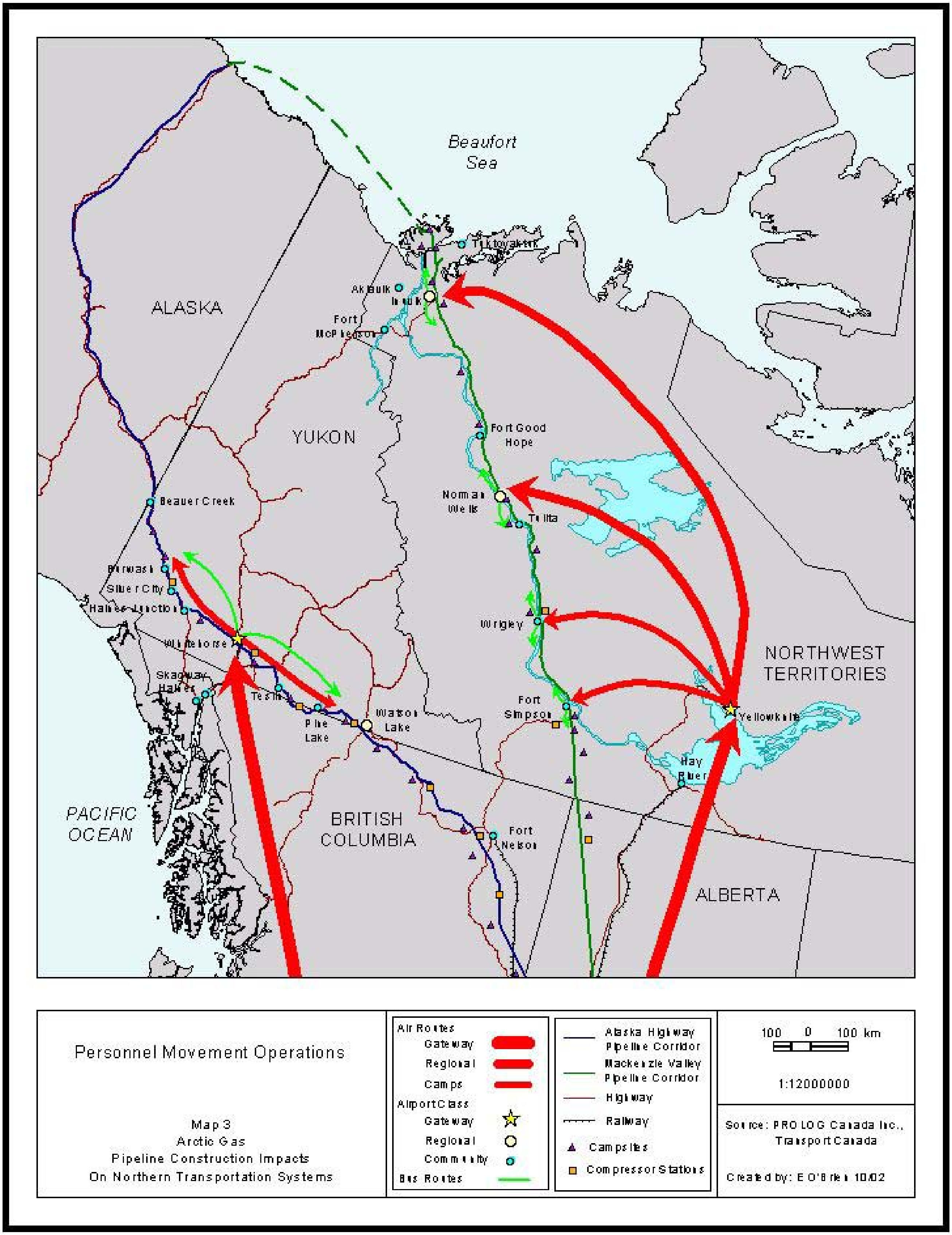
3.1.1 Alaska Highway Corridor Passenger System

The Yukon segment of the Alaska Highway Pipeline route is approximately 800 kms in length and closely follows the alignment of the all-weather Alaska Highway. There are eight existing airports located along its length and in close proximity to the highway and the pipeline right-of-way. From northwest to southeast these airports are Beaver Creek, Burwash, Silver City, Haines Junction, Whitehorse International, Teslin, Pine Lake and Watson Lake.

Whitehorse International Airport, a well-developed facility, is the major passenger hub for the Yukon and is located about midway along the pipeline right-of-way. Watson Lake Airport is also developed to a reasonable standard and is located near the southeastern end of the Yukon segment and at the beginning of the B.C. segment. Both have asphalt runways.

The other six airports are located at regular intervals along the pipeline right-of-way, have gravel runways of varying lengths and are developed to a lesser standard. As well, there are airports at Skagway and Haines, Alaska, which can provide air access to these potential port gateways for offshore project logistics.

Air Canada operates scheduled service between Whitehorse and Vancouver and Air North operates service between Whitehorse and Vancouver and between Whitehorse and Calgary/Edmonton, all with B-737 aircraft. Air North also provides service between Whitehorse and Juneau and Fairbanks, Alaska.


Beaufort Sea
ALASKA
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
PACIFIC OCEAN
Tuktoyaktuk
Aklavik
Inuvik
Fort McPherson
Fort Good Hope
Norman Wells
Tulita
Wrigley
Fort Simpson
Yellowknife
Hay River
Fort Nelson
Watson Lake
Pine Lake
Teslin
Whitehorse
Skagway
Haines
Haines Junction
Silver City
Burwash
Beaver Creek
Personnel Movement Operations
Map 3
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Air Routes
Gateway
Regional
Camps
Airport Class
Gateway
Regional
Community
Bus Routes
Alaska Highway Pipeline Corridor
Mackenzie Valley Pipeline Corridor
Highway
Railway
Campsites
Compressor Stations
100 0 100 km
1:12000000
Source: PRO LOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

First Air operates service between Whitehorse and Fort Simpson/Yellowknife with an ATR-42. Alaska-based Era Aviation operates seasonal summer service between Anchorage and Whitehorse using Dash-8 aircraft and Condor of Germany operates summer service between Frankfurt and Whitehorse with B-767's.

3.1.2 Mackenzie Valley Corridor Passenger System

The Mackenzie Valley route is approximately 1,200 kms from the Mackenzie Delta to the Alberta border. The all-weather Mackenzie Highway extends as far north as Wrigley and the all-weather Dempster Highway is completed from the Yukon highway system to Inuvik. A good winter road is generally available between Wrigley and Fort Good Hope from early December to mid-April; a winter road of questionable standard is available between Fort Good Hope and Inuvik from early December to mid-May. A winter ice road is available between Inuvik and Tuktoyaktuk from mid-January to mid-May.

There are six existing airports located along the length of the proposed Mackenzie Valley Pipeline right-of-way. From the north these are Inuvik, Fort Good Hope, Norman Wells, Tulita, Wrigley, and Fort Simpson. There is also a well-developed airport at Yellowknife and a smaller facility at Hay River, neither of which is located on the pipeline right-of-way but will likely serve as important staging points for personnel and air shipments during pipeline construction. Inuvik, Norman Wells, Fort Simpson, Hay River and Yellowknife all have asphalt runways of 6,000 feet or more. Fort Good Hope, Tulita and Wrigley have gravel runways of much shorter length.

Yellowknife is served on a scheduled basis by Canadian North, First Air, Buffalo Airways, Northwest Air Lease, Air Tindi and North-Wright Airways. The airport currently experiences about 45 scheduled departures daily and both Canadian North and First Air operate B-737 aircraft. Canadian North operates scheduled service to Norman Wells using B-737's. North-Wright Airways also provides scheduled service with Cessna Caravan 208 and Beech 99 aircraft.

Inuvik is a base for a number of rotary and fixed-winged operators and is served by Canadian North and First Air, both of which operate scheduled service using B-737 aircraft. First Air operates scheduled service to Fort Simpson using the 46-passenger ATR-42 and the airport is capable of supporting the B-737.

The proposed Alaska Gas 52" pipeline also follows a Mackenzie Valley alignment but extends - "over the top" - along the arctic coast to Prudhoe Bay. Fort McPherson, Aklavik and Tuktoyaktuk are other airports in this general area that could support pipeline construction. All have gravel runways of varying length. The all-weather Dempster Highway runs north through Fort McPherson and Tsiigehtchic to connect with Inuvik.

For the 'over-the-top' section of the Northern Route the Dempster Highway provides access to Fort McPherson and Inuvik and there is a winter ice road available seasonally between Inuvik and Tuktoyaktuk. Subsea installation of pipe (See Appendix F) will be supported by marine equipment which construction personnel will board at coastal communities in Alaska and Canada or by helicopter from these communities (e.g. Tuktoyaktuk).

The ability of existing airports to efficiently support the air transport of pipeline personnel will depend on a number of factors including runway characteristics, navigational aids, fuel availability and ground handling facilities. It may also be influenced by emerging changes in aircraft emergency intervention procedures (CAR 308) and airport security measures in the aftermath of September 11th.

3.2 Pipeline Construction Personnel Logistics

From a manpower standpoint the transportation impact of the proposed pipelines will be determined by the size and location of the construction camps and the ability of existing infrastructure to support travel in and out.

Air transport will play a major role in the movement of personnel, particularly from the south. Although construction personnel will be transported as much as possible on scheduled flights, where scheduled services do not exist there will be a need to obtain charter services.

There will also be a need to have smaller fixed-wing and rotary-wing aircraft available on permanent stand-by to conduct unforeseen high-priority flights related to medical evacuations, VIP transport and the movement of time-critical parts and supplies.

Where roads are available along the pipeline rights-of-way it is assumed that construction workers will be moved as much as possible by surface transport. The extent to which workers are permitted to bring their own vehicles to the construction camps (where physically possible) may have important implications in terms of safety, workforce efficiency and demand on the local road system.

Owing to the limited size of the northern labour pool and the demands of other northern projects, it is assumed that a large proportion of the workforce for the construction phase will come from outside the territories. However, it is recognized that 'northern hire' policies may stipulate specific requirements to access northern labour pools and first nations groups, thus potentially reducing impacts on the transportation system under our estimated peak mobilization scenarios.

Employment in pipeline construction will likely be governed by project labour agreements that will contain 'transportation clauses' that will, in turn, influence how the transportation system is impacted. These agreements may include provisions governing primary travel to and from the project, crew rotations and emergency evacuation. Construction personnel may be marshalled at Whitehorse, Yellowknife or some other location(s) for project orientation and connecting travel to the job site. In addition, travel to and from the job site may be phased over several days in order to minimize overall impacts on transportation system capacity.

It is recognized that pipeline construction will give rise to other forms of traffic that are not directly related to pipeline construction but will, nevertheless, place an added demand on northern transportation infrastructure. These include travel related to government services and project induced additional trade in consumer goods and services.

Although our capacity estimates are based on personnel movements and normal allowances for baggage, it is recognized that additional capacity may at times be required to accommodate equipment and tools that workers bring to the project.

For the purpose of this analysis we have relied heavily on existing manpower planning scenarios prepared by the pipeline proponents.

3.2.1 Alaska Highway Pipeline Personnel Logistics

The Alaska Highway Pipeline will be completed over a 3-year period from pre-construction to final completion. Pipeline construction will take place in both summer and winter during project years two and three.

The project will consist of six conventional pipeline spreads and the Kluane Lake crossing spread, which will be supported from six campsites. There will be three compressor stations completed during the initial two-year construction period plus provision for five more in conjunction with future pipeline expansions. It is pipeline construction, not the compressor stations, that will create peak demand for the northern transportation system.

From northwest to southeast, Alaska Highway Pipeline construction campsites are:

	Pipeline Camps	Compressor Stations
SPD 1210 (Winter; 109.3 kms)	KP 61.3	KP 97.5 (Future)
SPD 1220 (Winter; 109.6 kms)	KP 180.0	KP 213.3
SPD 1230 (Summer; 6.8 kms)		
SPD 1240 (Summer; 149.1 kms)	KP 300.0	KP 294.1 (Future)
		KP 371.7 (Future)
SPD 2210 (Summer; 180.7 kms)	KP 467.4	KP 455.9
SPD 2220 (Winter; 131.7 kms)	KP 620.2	KP 554.4 (Future)
		KP 650.7
SPD 2230 (Summer; 144.3 kms)	KP 770.0	KP 741.2 (Future)

For the Alaska Highway route detailed workforce information for both summer and winter spreads was provided to PROLOG by Foothills Pipe Lines. This information indicates that for summer and winter the number of positions per spread will be 1,122 and 1,198, respectively. We were also advised by Foothills that a 10% allowance should be made for employee turnover and miscellaneous short-term personnel. Accordingly, we have averaged summer and winter personnel, added a 10 percent turnover factor and arrived at an average workforce for each spread of 1,276 workers.

Winter spreads will last seven weeks; summer spreads will last eight or nine weeks. No crew rotations are anticipated because of the relatively short construction seasons.

Assuming each worker makes one round-trip in and out of the camp, it is estimated that there will be 2,552 inbound/outbound trips for each camp during a full construction season. This translates into 128 passenger loads on a 20-seat Twin Otter, 51 passenger loads on a 50-seat HS-748 or 21 passenger loads on a 120-seat B-737-200. In both directions, there will be twice that number of actual flights with a high degree of empty backhauls due to predominately one-way camp mobilization and demobilization moves.

Project work force and personnel movement requirements are summarized as follows:

Total workforce per camp:	**1,276**
	x
One-way trips/person:	2
	=
Inbound/outbound person-trips per camp:	**2,552**
Passenger loads per camp-season:	
20 Passenger aircraft:	**128**
or	
50 Passenger aircraft:	**51**
or	
120 Passenger aircraft:	**21**

Owing to the proximity of the all-weather Alaska Highway to the pipeline right-of-way, workers will be transported as close as possible to the campsite by air and then moved the rest of the way by bus. For the surface component, 2,552 person-trips is equivalent to 51 bus loads.

In the interests of scheduling flexibility and minimizing the number of flights and the need for special charters, it will be more cost-effective to rely as much as possible on existing scheduled jet service and to make only one transfer enroute to and from the campsite. Our analysis assumes that Whitehorse International Airport will be the marshalling and transfer point for workforce mobilization - and subsequently for moving in and out of camps.

Whitehorse International Airport is Yukon's major scheduled jet-port and it is located midway along the pipeline right-of-way, about 400 kms from both the Alaska border to the northwest and the northern B.C. border intersect to the southeast. Accordingly, over half the right-of-way is readily accessible by surface transport on an all-weather road within a three-hour radius of Whitehorse.

For those campsites where surface travel from Whitehorse is considered excessive (e.g. near the Alaska border), smaller aircraft could do the final transfer to existing gravel airstrips situated along the pipeline right-of-way. It is even possible that an older series B-737 equipped with gravel kits could fly into an airstrip like Burwash.

Watson Lake is a jet-capable airport that could receive flights, perhaps directly from the south, for pipeline construction in southeastern Yukon and even northern B.C.

For the 52" version of the Alaska Highway Pipeline we have increased the manpower figures for the 42" line by 20 percent. This results in 3,062 person-trips per camp and proportionately higher impacts on the transportation infrastructure.

3.2.2 Mackenzie Valley Pipeline Personnel Logistics

The Mackenzie Valley Pipeline will be completed over a 3-year period from pre-construction to final completion. However, actual construction will take place during two winter seasons of three to four months each. Owing to permafrost and weather conditions the construction season will be shorter as construction moves from north to south.

The project will consist of eight pipeline spreads ranging in length from 130 kms on the north end to 210 kms in the south.

Pipeline construction will be supported from five campsites with an average camp capacity of 800 men. There will also be camps of 10 to 55 men each to support the construction of eight compressor stations, some of which will be co-located with the pipeline camps. In any event, again, it is pipeline construction, not the compressor stations, that will create peak demand conditions for the transportation system.

The location of the campsites from north to south is shown as follows:

	Pipeline Camps	**Compressor Camps**
Camp #1 (Inuvik)	KP130	KP130
Camp #2	KP315	KP315
Camp #3 (Norman Wells)	KP558	KP505
Camp #3a		KP655
Camp #4		KP795
Camp #5 (Wrigley)	KP940	KP940
Camp #6 (Jean Marie River)	KP1185	KP1090/1240

It is assumed that there will be the equivalent of one crew rotation during each construction season. In other words, for each position there will be two round-trips in and out of the construction camp. As well, personnel turnover is anticipated for workers who will leave the job early for various reasons and whose positions will have to be filled again from the outside.

In effect basic manpower loading at mobilization will be augmented by interim workforce additions. To account for these interim additions, we have applied a factor of 1.25 to the average camp size (800) to yield a workforce total for each pipeline camp of 1,000 men.

Based on the foregoing, it is estimated that there will be 4,000 person-trips in and out of each pipeline camp over the course of a season. This equates to 200 passenger loads on a 20-seat Twin Otter, 80 passenger loads on a 50-seat HS-748 or 33 passenger loads on a 120-seat B-737-200. Note that there will be many more actual flights than represented by these passenger loads owing to an inability to balance loads into and out of the camps, especially with the largely empty backhauls resulting from one-way mobilization and demobilization moves.

Project workforce and personnel movement requirements are summarized as follows:

Camp capacity:	**800**
	x
Interim employment factor:	1.25
	=
Total workforce per camp:	**1,000**
	x
Crew rotation factor:	2
	x
One-way trips/person:	2
	=
Inbound/outbound trips per camp:	**4,000**
Passenger loads per camp-season:	
20 Passenger aircraft:	**200**
or	
50 Passenger aircraft:	**80**
or	
120 Passenger aircraft:	**33**

For transportation to and from the camps it is assumed that personnel will flow over Yellowknife and it is planned that existing airports will be used at Fort Simpson, Wrigley, Norman Wells and Inuvik. It is also anticipated that a temporary winter airstrip will be required at Camp #2.

A conceptual personnel movement plan for Mackenzie Valley Pipeline access to camps includes:

Camp #1, KP 130 (Inuvik): Air to Inuvik.
Camp #2, KP 315: Air to Inuvik; small aircraft to camp airstrip.
Camp #3, KP 558 (Norman Wells): Air to Norman Wells
Camp #3A, KP 655: Air to Norman Wells; 100 kms by winter road.
Camp #4, KP 795: Air to Wrigley; 75 kms by winter road.
Camp #5, KP 940 (Wrigley): Air to Wrigley; 20 kms by all-weather road.
Camp #6, KP 1185 (Jean Marie River): Air to Fort Simpson; 65-100 kms by all-weather road.

For the surface component, 4,000 person-trips is equivalent to 80 bus loads averaging 50 seats.

To estimate personnel logistics for an Alaska Gas 52" Mackenzie Valley pipeline "over-the-top", we have increased Delta Gas 30" pipeline requirements by 20 percent. This results in 4,800 person-trips per camp and correspondingly higher impacts on the transportation infrastructure.

3.3 Passenger Transportation System Impacts

In this section we quantify the impact of pipeline construction by estimating the increase in passenger traffic that will occur at Yellowknife and Whitehorse during the windows of activity, assuming that most of the traffic for all the proposed pipelines will flow over one or the other gateway airport. For all the proposed routes we have estimated the impacts of pre-construction during Year 1 (Logistics Traffic) and actual pipeline construction during Years 2 and 3 (Construction Traffic).

In 2001, Whitehorse International Airport handled 154,000 enplaned/deplaned passengers, with the heavy traffic months occurring during the summer. In the same year Yellowknife Airport handled about 300,000 passengers but traffic was spread more evenly throughout the year.

For the Alaska Highway Route we have estimated the incremental peak Project Year 2 impact of pipeline traffic on passenger flows at Whitehorse during a two-month period in both summer and winter, assuming two crews and no crew rotations.

Compared to an equivalent two month Yukon Baseline Travel period, during the winter season it is estimated that pipeline construction will result in a 27 percent increase in traffic for a 42" line and a 33 percent increase for a 52" line. During the summer season it is estimated that the corresponding increases in traffic will be 12 percent and 14 percent, owing to a higher base level of traffic.

A full personnel movement forecast, assuming two winter and two summer project activity months in each of three project years for both Alaska Highway Pipeline scenarios and comparable Yukon Baseline Travel, is provided in Table 1.

Table 1

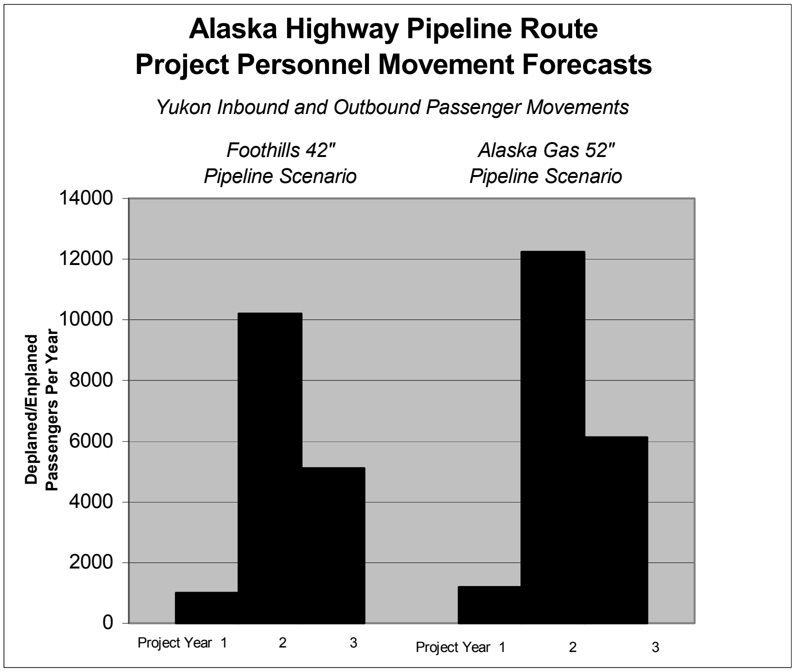
Alaska Highway Pipeline Route
Project Personnel Movements
Yukon Deplaned/Enplaned Passengers

	Project Year 1			**Project Year 2**			**Project Year 3**		
	Pre-Construction Travel	Yukon Baseline Travel	Total Yukon Travel	Project Construction Travel	Yukon Baseline Travel	Total Yukon Travel	Project Construction Travel	Yukon Baseline Travel	Total Yukon Travel
Foothills Pipe Lines 42" Pipeline									
Winter	500	18,653	19,153	5,104	18,653	23,757	2,552	18,653	21,205
Summer	500	43,219	43,719	5,104	43,219	48,323	2,552	43,219	45,771
Total	1000	61,872	62,872	10,208	61,872	72,080	5,104	61,872	66,976
Alaska Gas Producers 52" Pipeline									
Winter	600	18,653	19,253	6,125	18,653	24,778	3,062	18,653	21,715
Summer	600	43,219	43,819	6,125	43,219	49,344	3,062	43,219	46,281
Total	1,200	61,872	63,072	12,250	61,872	74,122	6,124	61,872	67,996

Note: Both summer and winter are assumed as approximatley 2 month construction seasons with no crew rotation.
It is assumed that 2 pipeline spread construction crews will work in Yukon during Project Year 1
and 1 crew will work in Yukon during Project Year 2.

Figure 1 profiles Alaska Highway Pipeline personnel movement requirements for each project year.

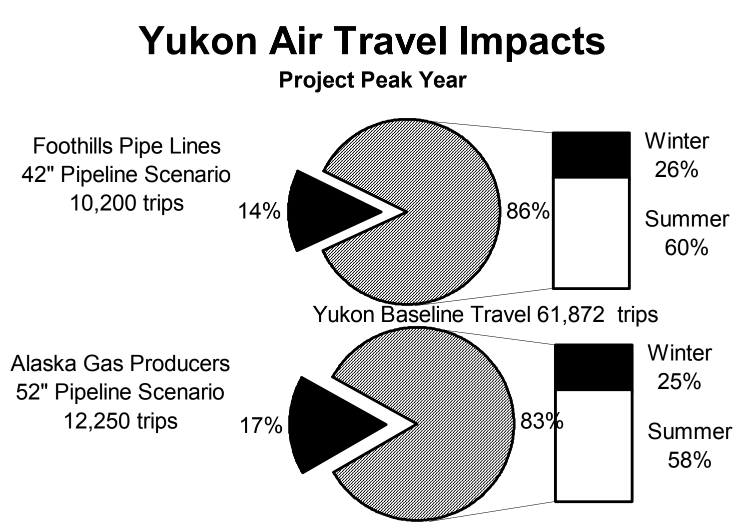
Figure 1



During Year 3 construction there will only be one crew working in both summer and winter on the Yukon section. Accordingly, the traffic impacts will only be half as great as in Year 2.

Figure 2 shows Alaska Highway Pipeline project travel as a percent of total air travel during the four project months of the peak year.

Figure 2



The full peak year impact is 14% to 17% of total baseline plus project air travel in Yukon. It is assumed that this level of peak demand can be accommodated with minor short term operational adjustments, especially in winter which accounts for only a quarter of annual baseline travel.

For the Mackenzie Valley and Northern routes we have estimated the pipeline impact over two consecutive years at Yellowknife during a four-month period in winter only,[9] assuming four crews and one crew rotation. Compared to an equivalent four month NWT Baseline Travel period, it is estimated that pipeline construction will result in a 15 percent increase in traffic for a 30" Mackenzie Valley line and an 18 percent increase for the 52" Northern Route.

A full personnel movement forecast, assuming four project activity months in each of three project years for both Mackenzie Valley Pipeline Scenarios and comparable NWT Baseline Travel, is provided in Table 2.

Table 2

Mackenzie Valley Pipeline Route
Project Personnel Movements
NWT Deplaned/Enplaned Passengers

	Project Year 1			**Project Year 2**			**Project Year 3**		
	Pre-Construction Travel	NWT Baseline Travel	Total NWT Travel	Project Construction Travel	NWT Baseline Travel	Total NWT Travel	Project Construction Travel	NWT Baseline Travel	Total NWT Travel
Delta Gas 30" Pipeline									
	1,600	104,000	105,600	16,000	104,000	120,000	16,000	104,000	120,000
Alaska Gas 52" Pipeline									
	1,900	104,000	105,900	19,200	104,000	123,200	19,200	104,000	123,200

Note: A 4 month winter construction season is assumed with 4 pipeline spreads and one crew rotation per season.

[9] excludes extended summer season subsea pipeline construction requirements.

Figures 3 profiles Mackenzie Valley Pipeline personnel movement requirements for each project year.

Figure 3

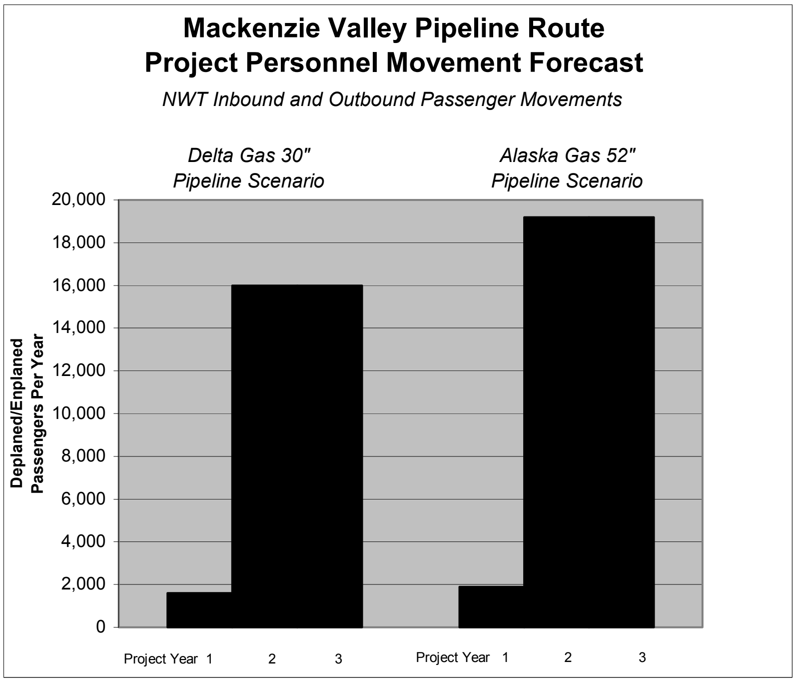
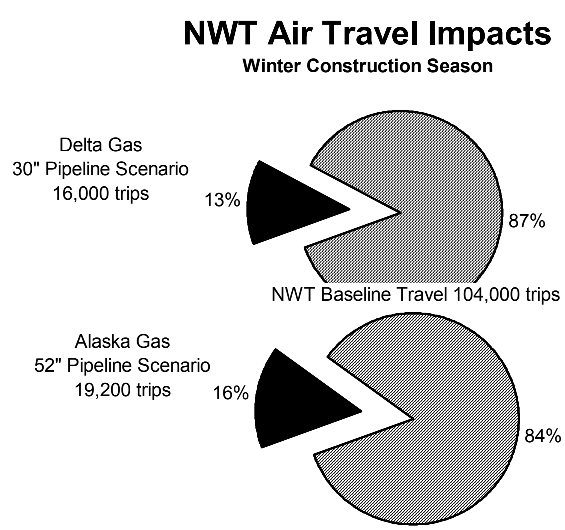


Figure 4 shows Mackenzie Valley Pipeline project travel as a percent of total air travel during four construction activity months in each of the two peak project years.

The peak year impact is 13% to 16% of total baseline plus project air travel in the NWT and, as with Yukon, it is assumed that this level of peak demand can be accommodated with minor short term operational adjustments.

Figure 4



The balance of this section provides an assessment of specific transportation system impacts on *airport infrastructure/operations*, *passenger airlift capacity* and *surface passenger transport*.

3.3.1 Airport Infrastructure/Operations Impacts

A number of overall factors were considered in assessing airport impacts along the pipeline rights-of-way, for which the following general observations are provided:

- Wherever gravel airstrips are a factor, depending on runway condition and aircraft type there may be a need to undertake some re-surfacing.
- There does not appear to be a major need to up-grade airport navigational aids to facilitate the short-term transfer of pipeline personnel.
- There will be a need to have helicopter landing areas at camps and airports to facilitate the transfer of people and goods on a high-priority basis (e.g. air medevac) or for transport to otherwise inaccessible locations (e.g. for survey crews).
- There will be a need to have appropriate fuel supplies positioned at airports and heliports for local operations.

As well there may be impacts specific to each pipeline corridor as discussed below.

Alaska Highway Pipeline

The proponents of the Alaska Highway Pipeline propose using Whitehorse International Airport as the major staging point for crew movements because of its role as an established jet-port and the flexibility and cost-effectiveness offered by existing scheduled services.

For the most part personnel will be transferred between Whitehorse and the campsites by bus along the all-weather Alaska Highway. For those construction camps beyond a reasonable driving distance of Whitehorse (e.g. 250 kms+), personnel could be transferred by smaller aircraft to existing airstrips along the pipeline right-of-way.

The Yukon Government has completed studies that have assessed the expected impact of pipeline construction on the aviation system. It is estimated that during pipeline construction aircraft movements at Whitehorse will increase 20 percent and passenger traffic through the airport will increase 30 percent, which corresponds with our own estimate.

However, it is expected that existing airport facilities will be capable of accommodating the temporary increase in traffic and, in fact, the Yukon Government has suggested delaying planned airport improvements at Whitehorse until after pipeline construction so as not to inconvenience the travelling public.

Depending on demand there may be a need for increased runway maintenance, air terminal upkeep, emergency response services and pre-board security, although airport management assures us that Whitehorse Airport is more than compliant with respect to the latter two elements.

For the outlying pipeline destinations, our conceptual impact assessment assumes a reasonable distance based split between air and surface transport modes. However, regardless of routine personal movement modes, it is quite likely that construction spread access to efficient air facilities will become an essential requirement for project management, government inspection and emergency medevac requirements.

The following improvements have been identified as possible requirements:

- Expanded aircraft parking aprons at Beaver Creek, Burwash, Haines Junction and Teslin to handle the potential for larger aircraft (e.g. HS-748, Hercules). Also, concrete run-up pads at these four airports to avoid damage from flying rocks.
- New snow removal equipment at Beaver Creek, Burwash, Haines Junction and Teslin to maintain the proposed larger aprons.
- The addition of gravel helipads (40' x 40') at Beaver Creek, Burwash, Haines Junction and Teslin to prevent conflicts with fixed-wing aircraft.
- Rehabilitation of the runway at Silver City.
- The introduction of Aircraft Emergency Intervention Service at Watson Lake if scheduled service returns to the airport in sufficient volume.
- Depending on demand increased runway maintenance, security and air terminal maintenance at Watson Lake.
- Increased summer maintenance on gravel runways, taxiways and aprons.
- Increased winter maintenance at Pine Lake and Silver City.
- Extended hours of service for CARS at Beaver Creek, Burwash and Teslin.
- New fuel facilities at Burwash and Beaver Creek.

Mackenzie Valley Pipeline

Generally speaking, airports along the Mackenzie Valley Pipeline route are developed to a higher standard than those along the Alaska Highway route, largely owing to the under-developed all-weather road system and a consequent heavier reliance on air transportation.

For the Mackenzie Valley route it is expected that Yellowknife Airport will serve as the primary gateway for construction personnel since it is a jet-capable facility and already receives scheduled service from several carriers. It is assumed that, to the extent possible, pipeline personnel will move through the airport on existing scheduled services (with extra sections) and that arrivals and departures will be spread over several days so as not to over-tax existing airport facilities.

Discussions with Yellowknife Airport and the GNWT indicate that the present level of airport development along the pipeline right-of-way is generally adequate to accommodate personnel movements during pipeline construction. It is noteworthy that Yellowknife already experiences significant short-term bumps of up to 400 passengers when crew rotations occur at mining operations in the region. This compares to pipeline traffic of 600 passengers per day during crew mobilization and de-mobilization and a two-way flow of twice this volume during crew rotations.

At Yellowknife, it is expected that the present and proposed level of airport development will be able to accommodate the orderly flow of pipeline personnel through the facility. On the airside, the main ramp is capable of parking six B737-200 aircraft and one 50-passenger aircraft like the ATR-42 or the HS-748. While some crowding can occur inside the terminal during peak traffic periods, this is not considered a major problem for the short-term movement of pipeline construction personnel. A major terminal expansion is being considered for the longer-term.

Although passengers arriving from more northerly points must already clear security at Yellowknife (including trace detection), plans are currently underway to re-configure and expand the present screening area inside the terminal. Airport management does not anticipate a need to increase the level of Aircraft Emergency Intervention Service (AEIS) to meet the heightened demand during pipeline construction, even under new regulations.

For the onward movement of construction personnel to individual camps, four existing airports have been identified in the logistics planning. Two of these airports, Inuvik and Norman Wells, already receive scheduled B-737 service. A third airport, Fort Simpson, receives scheduled service using 46-passenger ATR-42 aircraft and is capable of handling larger jet aircraft.

A review of development plans for these three airports indicates that, although longer term improvements are envisioned, no short term improvements are required to specifically accommodate the movement of pipeline construction personnel.

The fourth airport, Wrigley, will also be important and will support crew movements for both pipeline and compressor station construction. It has a 3,500 foot gravel runway and does not currently have scheduled service. Wrigley is fully capable of supporting the movement of personnel using smaller aircraft operating at higher frequencies. Although runway up-grades would facilitate the use of larger aircraft operating at a lower frequency, such a capital expenditure may not be justified in the circumstances.

No changes to the level of AEIS is identified due specifically to the movement of pipeline personnel.

A winter airstrip will be required in at least one of the camps to support the movement of workers transferring to and from Inuvik.

For the over-the-top section it is again assumed that Yellowknife would serve as the primary airport gateway for construction personnel. For the onward movement of personnel, local airports that could be accessed include Inuvik, Tuktoyaktuk, Aklavik and Fort McPherson.

Although Aklavik and Fort McPherson are limited by runway length, the runways at Inuvik and Tuktoyaktuk are both capable of handling larger aircraft.

3.3.2 Passenger Airlift Capacity Impacts

It is expected that air travel to and from the camps at the beginning and end of each construction season and during crew rotations will occur over a period of several days so as not to place an undue burden on airline and airport capacity. However, by moving personnel on regular and extra sections of scheduled flights and operating during both peak and off-peak periods it is expected that the entire manpower complement for a full construction season could be transferred within one week.

We have estimated the additional airlift capacity that would be required to mobilize pipeline personnel from the south into the two staging points, Yellowknife and Whitehorse, over a one-week period. It is assumed that the same added capacity would be required in the southbound direction during the de-mobilization phase.

We have determined existing scheduled capacity (ex Calgary, Edmonton, Vancouver) and then calculated the number of extra sections that would be required to move the respective workforces into Yellowknife and Whitehorse. It is assumed that pipeline personnel would occupy 50 percent of existing scheduled capacity and 100 percent of the capacity on extra sections.

Assuming the use of B737-200 aircraft of 120 seats, for Yellowknife it is estimated that 17 extra sections would be required to accommodate excess pipeline demand over the course of a week. For Whitehorse the comparable figure would be 10 extra sections.

Airlift capacity impacts are summarized in the following table.

	Existing Capacity (seats/week)	Excess Pipeline Demand (pax)	Extra Sections (flights/week)
To: Yellowknife (ex Cal/Edm)	**3,955**	**2,023**	**17**
To: Whitehorse (ex Cal/Edm/Van)	**2,632**	**1,236**	**10**

For airlift beyond the two staging points pipeline traffic would be broken into smaller groups for transport to the individual camps. Beyond Yellowknife, the transfer of workers to/from Fort Simpson could be accomplished within a week on 46-passenger ATR-42 aircraft with extra sections. Larger gauge aircraft (e.g. B737-200) could also be introduced temporarily. Wrigley has a shorter gravel runway and no scheduled service and, therefore, the transfer would likely be accomplished with 50-passenger charter aircraft. Inuvik and Norman Wells already enjoy scheduled B737 service and extra sections could be added.

Beyond Whitehorse workers would be transported mainly by bus, which is easily manageable on the Alaska Highway. Where bus transport is not considered practical, workers would be moved forward to airstrips near the camps on charter aircraft of 50 seats or more.

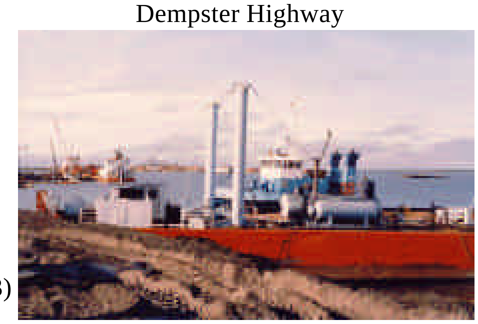
During crew rotations on the Mackenzie Valley route there would be a two-way flow of pipeline traffic. That should allow more effective flight scheduling to minimize the extent of empty backhaul moves on extra sections otherwise unavoidable during camp mobilization and demobilization.

3.3.3 Surface Passenger Transport Impacts

For both the Mackenzie Valley and Alaska Highway routes the existing winter and all-weather road system is, for the most part, capable of supporting the movement of personnel between the airports and the construction camps. It is envisioned that personnel movements alone will not impose the kind of impacts that will require major improvements to the road system.

Inuvik Airport Dempster Highway

Western Arctic/ Mackenzie Delta Gateway



Tuktoyaktuk Harbour (circa 1983)

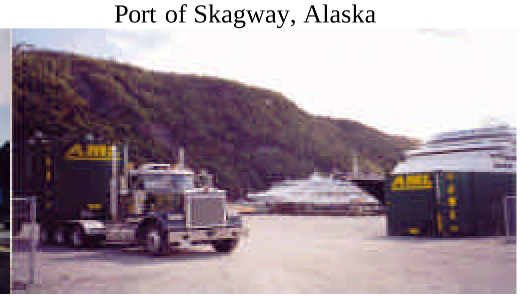
Hay River Barge Terminal

Alaska Oilfield Production Modules Loading at Hay River

Hay River/ Mackenzie Valley Gateway

Port of Haines, Alaska

Port of Skagway, Alaska



Alaska Inside Passage Gateway To Yukon

4.0 MATERIAL MOVEMENT PLANS

This section of the report provides detailed destination quantity estimates and construction schedule movement requirements for project materials. Tonnage take-offs, delivery requirements, sourcing and routing strategies have been developed from project sponsor interviews and supplemented with pragmatic assumptions based on PROLOG experience.

These project logistics plans are applied in a straightforward, static model of destination spreads, alternate routes, gateways and transfer points for each pipeline construction scenario in the Northwest Territories and Yukon. Material data bases have been incorporated for Mainline Pipe, Bulk Fuel, Equipment, Camps and Miscellaneous Materials. Destination spread locations have been identified with an alpha designation from North to South and required delivery periods have been identified within a 3 year project schedule (Construction Years 2 and 3, preceded by Year 1 advanced stockpiling logistics).

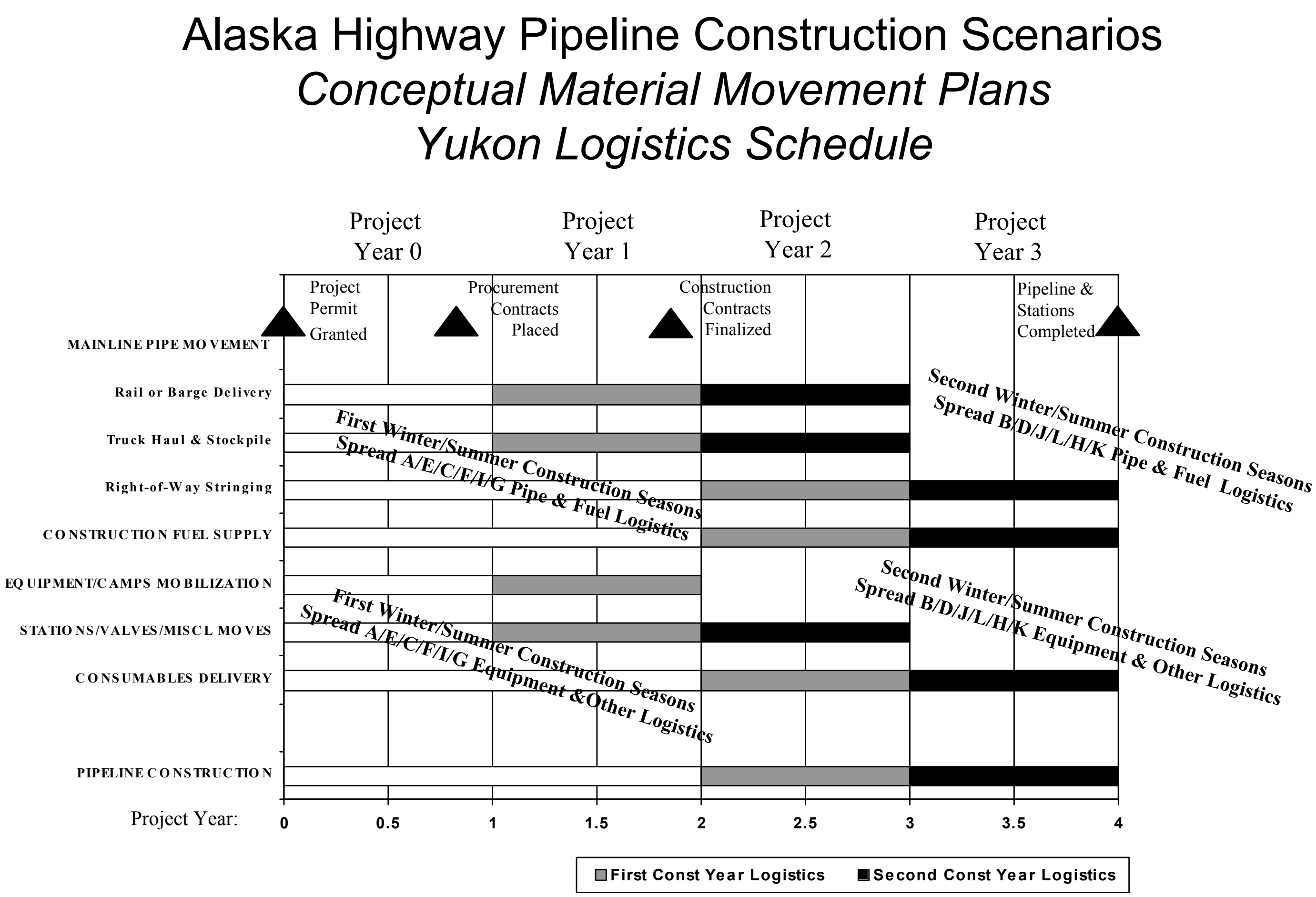
In this and subsequent sections of the report, all figures are based on the data tables provided. Please note that data manipulation and model output uses metric tonnes as a common unit of measure for all modes and load configurations. Equivalent truck, rail, barge and ship *loads*, provided to simplify interpretation of tonnage data, may not always be precisely displayed.

4.1 Yukon Construction Material Logistics.

Alaska Highway Corridor logistics models have been developed for Yukon stockpile sites and transportation gateways. As a major gateway to Yukon is the Fort Nelson railhead, British Columbia material movements beyond Fort Nelson, which will also use that gateway, have been included as well.

A conceptual master schedule for Yukon material movement plans is provided in Figure 5. We have assumed the same two year construction schedule for both the Foothills 42" Pipeline Scenario and the Alaska Gas Producers 52" Pipeline Scenario. Although the Alaska Gas Producers project definition is currently based on three construction years, we believe that they are targeting two year construction and that this is reasonable given year around right-of-way access in the Alaska Highway Corridor.

Figure 5


Alaska Highway Pipeline Construction Scenarios
Conceptual Material Movement Plans
Yukon Logistics Schedule
Project Year 0
Project Year 1
Project Year 2
Project Year 3
Project Permit Granted
Procurement Contracts Placed
Construction Contracts Finalized
Pipeline & Stations Completed
MAINLINE PIPE MOVEMENT
Rail or Barge Delivery
Truck Haul & Stockpile
Right-of-Way Stringing
CONSTRUCTION FUEL SUPPLY
EQUIPMENT/CAMPS MOBILIZATION
STATIONS/VALVES/MISCL MOVES
CONSUMABLES DELIVERY
PIPELINE CONSTRUCTION
First Winter/Summer Construction Seasons
Spread A/E/C/F/I/G Pipe & Fuel Logistics
Second Winter/Summer Construction Seasons
Spread B/D/J/L/H/K Pipe & Fuel Logistics
First Winter/Summer Construction Seasons
Spread A/E/C/F/I/G Equipment &Other Logistics
Second Winter/Summer Construction Seasons
Spread B/D/J/L/H/K Equipment & Other Logistics
Project Year:
0
0.5
1
1.5
2
2.5
3
3.5
4
First Const Year Logistics
Second Const Year Logistics

4.1.1 Foothills Pipe Lines 42" Pipeline Material Logistics

Conceptual Yukon and British Columbia Project Logistics Operations developed for a Foothills 42" pipeline scenario are displayed in a destination delivery density map (see Map 4). This map shows total project logistics tonnage flows to each pipeline spread and the commodity split of major project material groups (pipe, fuel, equipment/materials and consumables).

Conceptual material movement plans are focussed on BC rail and truck movements via Fort Nelson. This logistics strategy is driven by the availability of rail delivery to Fort Nelson for North American produced pipe and Edmonton sourced fuel. At Fort Nelson rail shipments are transferred to trucks for movement to stockpile sites located within each Northern B.C. and Yukon construction spread.

The exception is fuel for Yukon construction which can be sourced on the westcoast, barged via the Inside Passage to Skagway and Haines, Alaska; then distributed to Yukon spreads by truck.

The balance of inland originating equipment, materials and consumables would be trucked via the Alaska Highway direct to spread destinations in BC and Yukon.

For these conceptual material movement plans, Figure 6 forecasts stockpile delivery completion according to destination requirements in each construction season. One third of project materials, over 300,000 tonnes, will be delivered with over 12,000 truckloads by the First Construction Winter (Winter Project Year 2). By the summer of that same year (Summer Project Year 2), almost two thirds of total project deliveries will have been completed with an additional 11,000 plus truckloads.

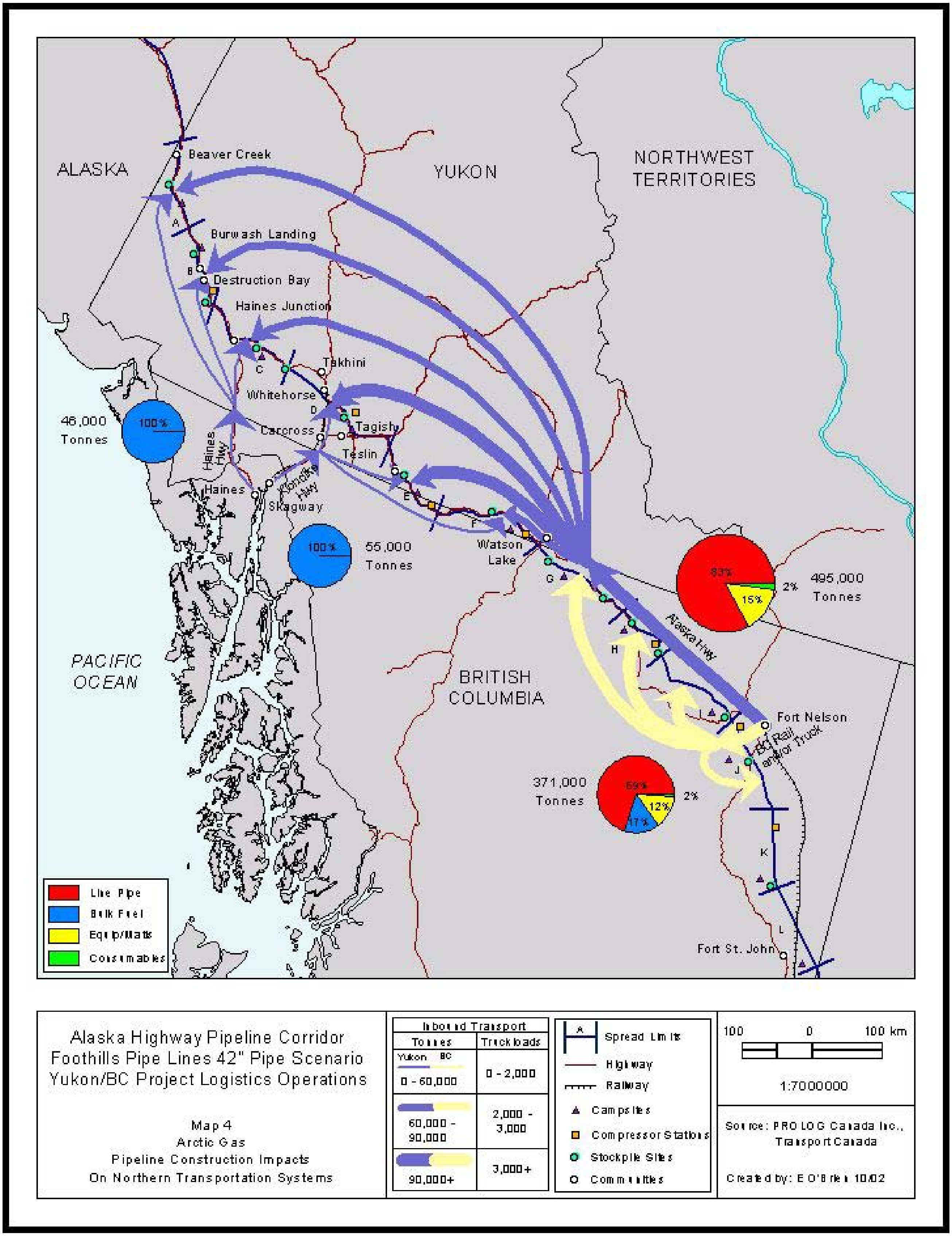
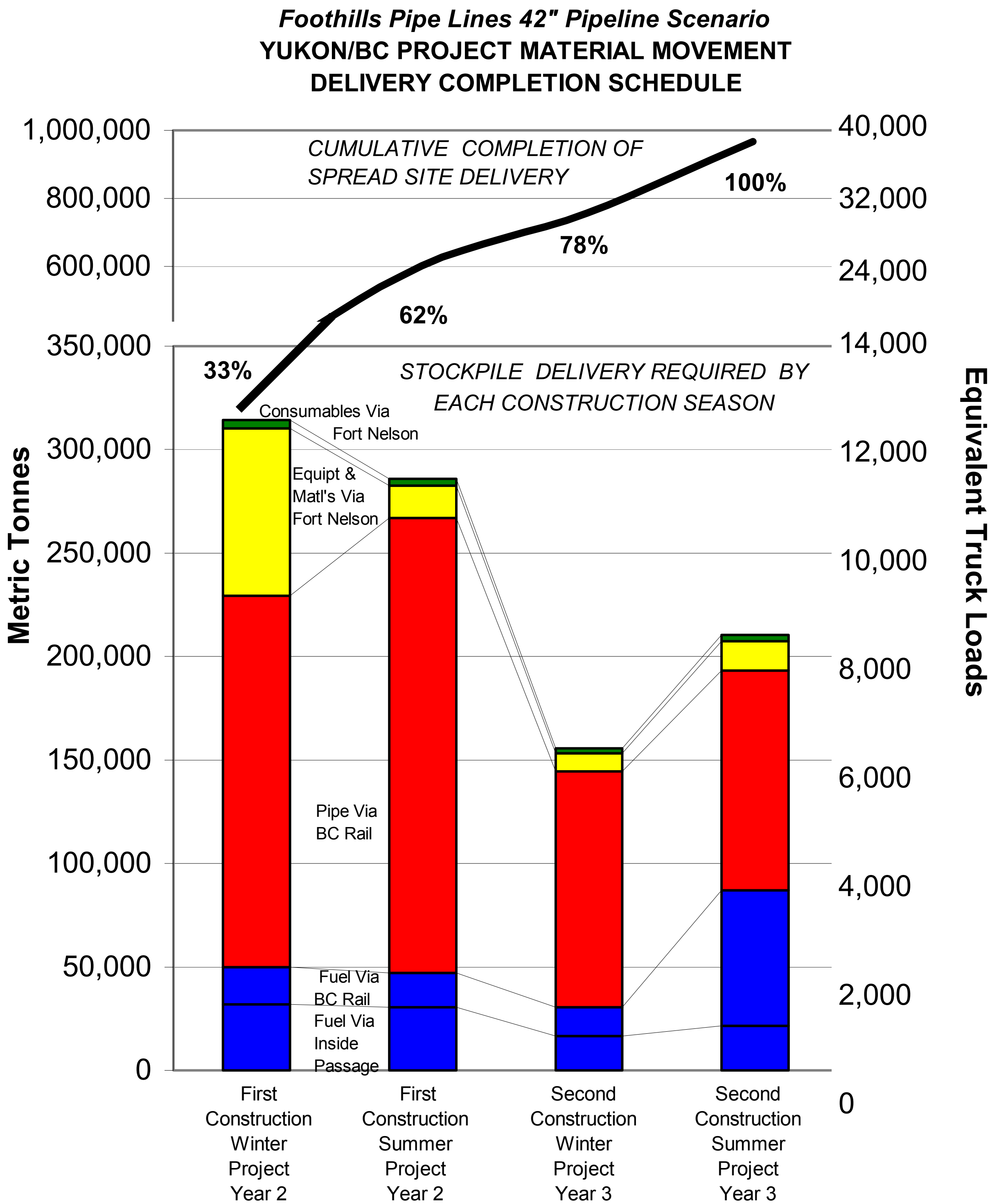

ALASKA
YUKON
NORTHWEST
TERRITORIES
BRITISH
COLUMBIA
PACIFIC
OCEAN
Beaver Creek
Burwash Landing
Destruction Bay
Haines Junction
Takhini
Whitehorse
Carcross
Tagish
Teslin
Haines
Skagway
Haines Hwy
Klondike Hwy
Watson
Lake
Alaska Hwy
Fort Nelson
BC Rail and/or Truck
Fort St. John
46,000
Tonnes
100%
55,000
Tonnes
100%
495,000
Tonnes
83%
15%
2%
371,000
Tonnes
59%
17%
12%
2%
Line Pipe
Bulk Fuel
Equip/Mat'ls
Consumables
Alaska Highway Pipeline Corridor
Foothills Pipe Lines 42" Pipe Scenario
Yukon/BC Project Logistics Operations
Map 4
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
Yukon
BC
0 - 60,000
0 - 2,000
60,000 -
90,000
2,000 -
3,000
90,000+
3,000+
Spread Limits
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100
0
100 km
1:7000000
Source: PRO LOG Canada Inc.,
Transport Canada
Created by: E O'Brien 10/02

Figure 6


Foothills Pipe Lines 42" Pipeline Scenario
YUKON/BC PROJECT MATERIAL MOVEMENT
DELIVERY COMPLETION SCHEDULE
CUMULATIVE COMPLETION OF
SPREAD SITE DELIVERY
STOCKPILE DELIVERY REQUIRED BY
EACH CONSTRUCTION SEASON
33%
62%
78%
100%
Consumables Via
Fort Nelson
Equipt &
Matl's Via
Fort Nelson
Pipe Via
BC Rail
Fuel Via
BC Rail
Fuel Via
Inside
Passage
Metric Tonnes
Equivalent Truck Loads
1,000,000
800,000
600,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
40,000
32,000
24,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
First Construction Winter Project Year 2
First Construction Summer Project Year 2
Second Construction Winter Project Year 3
Second Construction Summer Project Year 3

These forecasts are based on material movement data bases for the Foothills 42" pipeline scenario that have been applied to an Alaska Highway Corridor logistics model in Tables 3 and 4 following. These tables show major material movement quantities (tonnes) for each construction spread and the construction season by which delivery is required.

Material quantities total over half a million tonnes in each of Yukon and BC for a project total in both jurisdictions exceeding 1 million tones. (Note that while we have documented all BC movement requirements including spreads which would be supported out of Fort St. John, our analysis is confined to those B.C. spreads beyond Fort Nelson that combine with Yukon requirements to impact the Fort Nelson/Alaska Highway gateway.)

Delivery seasons shown in Figure 6 and in Tables 3 and 4 are the construction schedule periods by which spread site deliveries must be completed. Logistics activities culminating in delivery completion are advanced into pre-construction time frames according to the unique requirements for each material movement plan.

Conceptual material movement plans are outlined in the balance of this section based on methodology and assumptions detailed in Appendix B.

Table 3

Foothills Pipe Lines ALASKA HIGHWAY 42" Pipeline Scenario

YUKON PROJECT LOGISTICS OPERATIONS

Metric Tonnes Inbound

Required Delivery By: To:	Winter 2 Spread A KP0-109	Winter 2 Spread E KP555-687 & CS #3	Summer 2 Spread C KP226-375 & KLX	Summer 2 Spread F KP687-832)	**YEAR 2 TOTAL**	Winter 3 Spread B KP109-226 & CS #1	Summer 3 Spread D KP375-555 & CS #2	**YEAR 3 TOTAL**	**PROJECT TOTAL**
Destination Quantities									
LINE PIPE	54,200	65,300	78,400	71,600	**269,500**	54,400	89,600	**144,000**	**413,500**
BULK FUEL	12,800	19,100	16,300	14,200	**62,400**	16,500	21,600	**38,100**	**100,500**
Const. Equipment Mobilization	16,600	17,300	repositioned	repositioned	**33,900**	repositioned	repositioned	**demobilized**	
Pipeline Camps Mobilization	4,400	5,100	repositioned	repositioned	**9,500**	repositioned	repositioned	**demobilized**	
Stations/Valves/Miscl.	2,700	6,400	5,400	3,600	**18,100**	5,800	7,600	**13,400**	
EQUIPMENT/MATERIALS	23,700	28,800	5,400	3600	**61,500**	5,800	7,600	**13,400**	**74,900**
CAMP CONSUMABLES	600	1700	700	900	**3,900**	1500	1500	**3000**	**6,900**
PROJECT TOTAL	91,300	114,900	100,800	90,300	**397,300**	78,200	120,300	**198,500**	**595,800**
Origin Gateway/Routings									
ALASKA INSIDE PSG:									
Via Klondike Highway									
Ex Skagway Marine									
LINE PIPE					**0**			**0**	**0**
BULK FUEL		19,100		14,200	**33,300**		21,600	**21,600**	**54,900**
EQUIP/MATLS					**0**			**0**	**0**
CONSUMABLES					**0**			**0**	**0**
PROJECT TOTAL					**33,300**			**21,600**	**54,900**
Via Haines Highway									
Ex Haines Marine									
LINE PIPE					**0**			**0**	**0**
BULK FUEL	12,800		16,300		**29,100**	16,500		**16,500**	**45,600**
EQUIP/MATLS					**0**			**0**	**0**
CONSUMABLES					**0**			**0**	**0**
PROJECT TOTAL	12,800		16,300		**29,100**	16,500		**16,500**	**45,600**
INTERIOR ALASKA HWY:									
Via BC Rail/Truck									
Ex Fort Nelson									
LINE PIPE	54,200	65,300	78,400	71,600	**269,500**	54,400	89,600	**144,000**	**413,500**
BULK FUEL					**0**			**0**	**0**
EQUIP/MATLS	23,700	28,800	5,400	3,600	**61,500**	5,800	7,600	**13,400**	**74,900**
CONSUMABLES	600	1,700	700	900	**3,900**	1,500	1,500	**3,000**	**6,900**
PROJECT TOTAL	78,500	95,800	84,500	76,100	**334,900**	61,700	98,700	**160,400**	**495,300**

Table 4

Foothills Pipe Lines ALASKA HIGHWAY 42" Pipeline Scenario
NORTH B.C. PROJECT LOGISTICS OPERATIONS
Metric Tonnes Inbound

Required Delivery By: / To:	Winter 2 Spread I KP1095-1216 & CS #6	Summer 2 Spread G K832-963 & CS #4	**YEAR 2 TOTAL**	Winter 3 Spread J KP1216-1336	Winter 3 Spread L KP1435-1552	Summer 3 Spread H KP963-1095 & CS #5	Summer 3 Spread K KP1336-1435 & CS #7	**YEAR 3 TOTAL**	**PROJECT TOTAL**
Destination Quantities									
LINE PIPE	60,000	70,000	**130,000**	59,500	58,300	65,400	49,100	**232,300**	**362,300**
BULK FUEL	17,900	16,600	**34,500**	14,100	13,800	16,700	13,400	**58,000**	**92,500**
Const. Equipment Mobilization	17,300	repositioned	**17,300**	repositioned	repositioned	repositioned	repositioned	**demobilized**	
Pipeline Camps Mobilization	5,100	repositioned	**5,100**	repositioned	repositioned	repositioned	repositioned	**demobilized**	
Stations/Valves/Miscl.	6,100	6,600	**12,700**	3,000	2,900	6,400	5,600	**17,900**	
EQUIPMENT/MATERIALS	28,500	6,600	**35,100**	3,000	2,900	6,400	5,600	**17,900**	**53,000**
CAMP CONSUMABLES	1,700	1,700	**3,400**	900	900	1,700	1,700	**5,200**	**8,600**
PROJECT TOTAL	108,100	94,900	**203,000**	77,500	75,900	90,200	69,800	**313,400**	**516,400**
Gateway/Routings									
INTERIOR ALASKA HWY:									
Via BC Rail and/or Truck									
Ex Fort Nelson									
LINE PIPE	60,000	70,000	**130,000**	59,500		65,400		**124,900**	**254,900**
BULK FUEL	17,900	16,600	**34,500**	14,100		16,700		**30,800**	**65,300**
EQUIP/MATLS	28,500	6,600	**35,100**	3,000		6,400		**9,400**	**44,500**
CONSUMABLES	1,700	1,700	**3,400**	900		1,700		**2,600**	**6,000**
PROJECT TOTAL	108,100	94,900	**203,000**	77,500		90,200		**167,700**	**370,700**
Via BC Rail and/or Truck									
Ex Ft St John									
LINE PIPE					58,300		49,100	**107,400**	**107,400**
BULK FUEL					13,800		13,400	**27,200**	**27,200**
EQUIP/MATLS					2,900		5,600	**8,500**	**8,500**
CONSUMABLES					900		1,700	**2,600**	**2,600**
PROJECT TOTAL					75,900		69,800	**145,700**	**145,700**

PIPE MOVEMENT PLAN:

Yukon Portion	**413,500 tonnes**
B.C. Portion	**362,300 tonnes**
Total	**775,800 tonnes**

Canadian and U.S. pipe mills have the capability of producing 42 inch diameter pipe and the assumption is that 100% of the project requirements in Yukon and B.C. would be sourced on the continent. Contending mills are located in Alberta, Saskatchewan, Ontario and Florida. Pipe will be double jointed and coated at the mill.

Transportation will be primarily by rail to Fort Nelson, B.C., where pipe will be transferred to trucks and delivered to Yukon and B.C. project stockpile sites adjacent to the Alaska Highway. An alternative to this plan for mills with marine access could include ocean shipments to Skagway or Haines, AK and trucked beyond.

Rail Transport:

- 89 foot railway flatcars will be loaded with 7 double jointed 80 foot pipe lengths each.
- A total of 9,392 carloads will be transferred to trucks at Fort Nelson.

Truck Transport:

- Trucks will be loaded with two double-jointed 80 foot pipe lengths each.
- A total of 32,870 truckloads will be required.

It is likely that the motor carrier industry can mobilize sufficient power units for the pipe hauls. Specially designed trailer units, however, will likely have to be designed, financed and manufactured (See Appendix H).

First construction season (Winter Year 2) shipments should be completed to project stockpile sites by September or November (latest) of Project Year 1.

FUEL MOVEMENT PLAN:	**Yukon Portion**	**100,500 tonnes**
	B.C. Portion	**92,500 tonnes**
	Total	**193,000 tonnes**

Diesel-grade fuel will be used for pipeline and compressor station construction equipment, camp heating and electrical power generation[10]. Small volumes of gasoline and propane will also be required. 100% of the fuel requirements, including propane, can be sourced from inland Canadian or westcoast refineries for both Yukon and B.C. segments of the pipeline. Contending refinery/shipping sources are Edmonton, Vancouver and Puget Sound.

Fuel will be staged into the project through marine terminals at Haines and Skagway, AK, and the rail served oil company tank farms at Fort Nelson, B.C. Adequate tankage and rail off-loading, and truck loading capacity exists at the current facilities at these locations, providing rail, marine supply and truck lifting scheduling is properly coordinated.

Terminal Storage:

- Fort Nelson has combined storage for approximately 4.2 million litres (just under 1 million gallons) operated by four oil company agents.
- Skagway has over 5 million gallons of storage and Whitehorse has substantial additional storage with truck load-out facilities operated by agents of major oil companies[11].
- Over 5 million gallons of storage exists at Haines operated by Delta Western.

Yukon/BC Distribution:

- Northernmost Yukon spreads A to C, including the Kluane Lake crossing summer project will be supplied fuel trucked from Haines.
- Yukon Spreads D, E and F to the B.C. border will be supplied fuel trucked from Skagway.
- Six B.C. spreads (G to K) will be supplied fuel staged at the Fort Nelson rail terminals operated by oil company agents.

Transportation:

- ***Barge*** - Coastal fuel barges supply marine terminals at Skagway and Haines. Barge loads are typically up to 1 million gallons (4.5 million litres), but are capable of carrying up to 2 million gallons (9 million litres) per delivery. Barges can be supplied with Canadian-sourced fuel at Vancouver, B.C. Existing barge fleets can handle incremental project fuel requirements adequately.
- ***Rail* -** Standard sized (75,000 litres) and jumbo (108,000 litres) tank cars from existing fleets will be used to supply the Fort Nelson terminal agents over the B.C.Rail system, from the Edmonton refineries and the Husky facility at Prince George, B.C.
- ***Truck* -** Accommodation of Yukon motor vehicle size and weight laws has been made between the Alaska, B.C. and Yukon governments in past fuel supply contracts into Yukon from Haines and Skagway. Full "B" Trains carrying approximately 48,000 litres of diesel fuel are typical. The project will require approximately 5,000 truckloads to service the project spreads and compressor stations in both jurisdictions.

[10] Note that motor carrier truck fuel is not included in project fuel requirements.
[11] These assets were once part of the pipeline system supplying fuel to Yukon from the marine terminal at Skagway.

EQUIPMENT/MATERIALS MOVEMENT PLAN:

[Including Construction Equipment/Camps, Station Equipment and Valves]

Yukon Portion	**74,900 tonnes**
B.C. Portion	**53,000 tonnes**
Total	**127,900 tonnes**

Canadian contractors will use a mix of their existing and new equipment. All equipment will be moved to the various construction spreads by truck alone, direct from storage yards in the south (e.g., Finning Canada ex Edmonton, AB or Vancouver, B.C.).

Pickup trucks and other mobile equipment to be used on construction sites will be moved to the site by automotive, flat deck and lowboy trailers. Tonnages provided are one time northbound only and exclude demobilization movements at the completion of the project, and intra-project moves by contractors at the completion of a spread.

CAMPS

Each 49 person dormitory is made up of 8 modules (one per truckload), which includes a washcar. ATCO units are modules generally 12 ft. wide, 10.5 ft. high, and 56 – 60 ft. in length.

Camp mobilization requirements are estimated at 14,600 tonnes requiring over 1,000 truckloads to deliver camp units directly to campsites in Yukon and B.C. A typical 850 man camp is comprised of the following units:

Truckloads

Dormitories (18)	144
Kitchen/dining (16)	26
1st Aid (2)	2
Offices (30)	30
Corridors, Chambers (20)	20
Utility Skids (29)	29
Gym/Recreational (10)	10
Storage (15)	15
Power Generation (5)	5
Total Truckloads	281

CONSUMABLES

Yukon:	**6,900 tonnes**
B.C.	**8,600 tonnes**
Total	**15,500 tonnes**

Total tonnage was calculated from manpower resource requirements based on 1.5 cubic feet of total "consumables" per person per day. The mix of goods is usually palletized by the suppliers and a full truckload will contain 2000 cu. ft. of consumables weighing 40,000 lbs. (18 tonnes). Consumable freight will be sourced from southern Canada and 100% of the volume transported by truck directly to the camps.

4.1.2 Alaska Gas Producers 52" Pipeline Material Logistics

As with the Foothills 42" pipeline scenario, conceptual Yukon and BC Project Logistics Operations have been developed for an Alaska Gas 52" pipeline scenario and are displayed in a destination delivery density map (see Map 5). This map shows total project logistics tonnage flows to each pipeline spread and the commodity split of major project material groups (pipe, fuel, equipment/materials and consumables).

In contrast to the Foothills 42" pipeline scenario, the Alaska Gas 52" pipeline will require sourcing from offshore pipe mills. In addition to Yukon fuel already supplied by marine transport from the westcoast, this shifts a significant portion of Yukon pipe shipments to Alaska Inside Passage ports.

However, under the much larger 52" pipe scenario, Fort Nelson remains a major gateway for rail shipments of pipe and fuel to B.C. spreads. As well, most inland originating equipment, materials and consumables would still be trucked via the Alaska Highway direct to spread destinations in BC and Yukon.

For these conceptual material movement plans, Figure 7 forecasts stockpile delivery completion according to destination requirements in each construction season. Close to a half million tonnes (equivalent to 20,000 truckloads) must be delivered by the first winter construction season and that will be almost matched in the following summer. Almost two thirds of the total spread site delivery requirements will have been completed within the first Construction Year (Project Year 2).

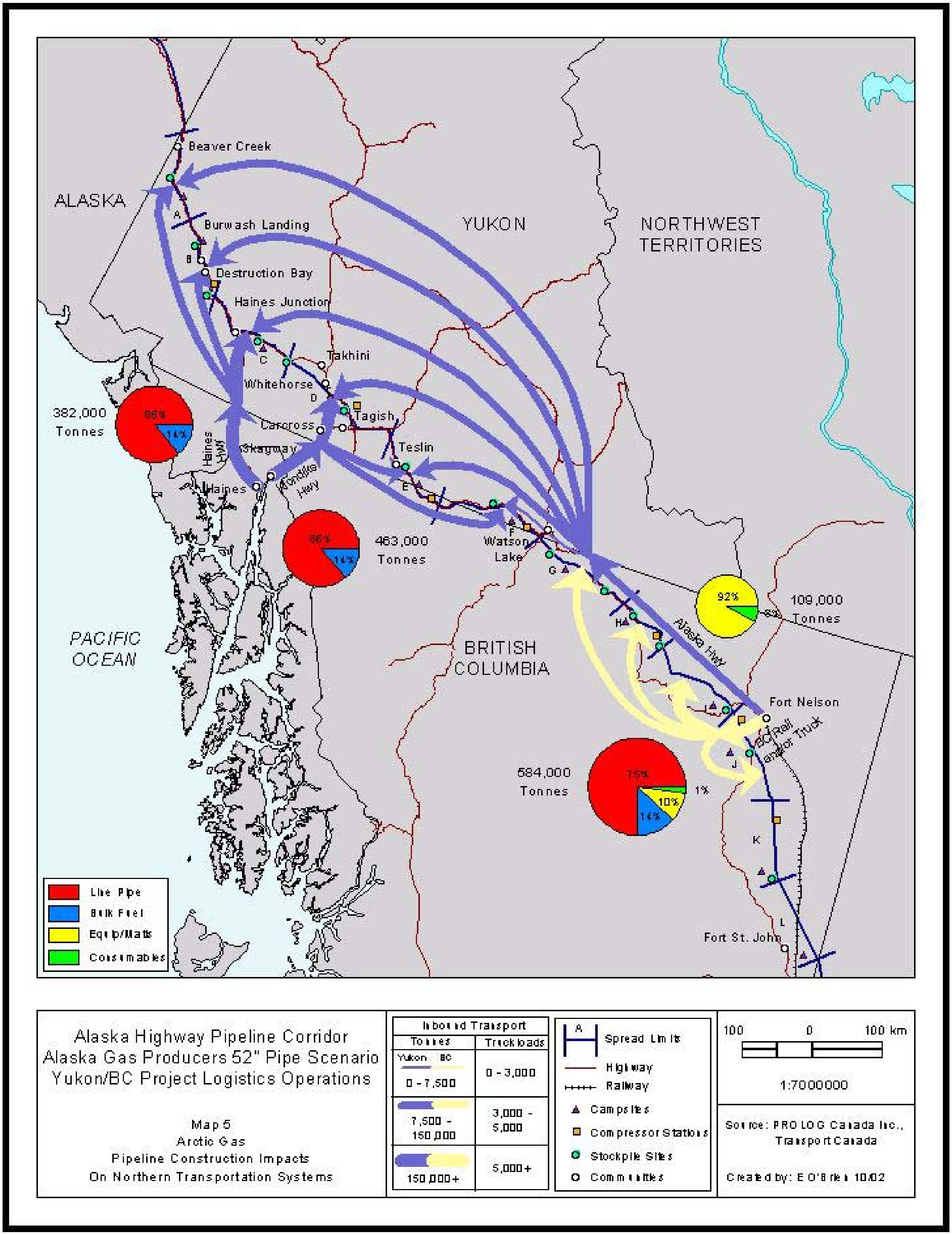
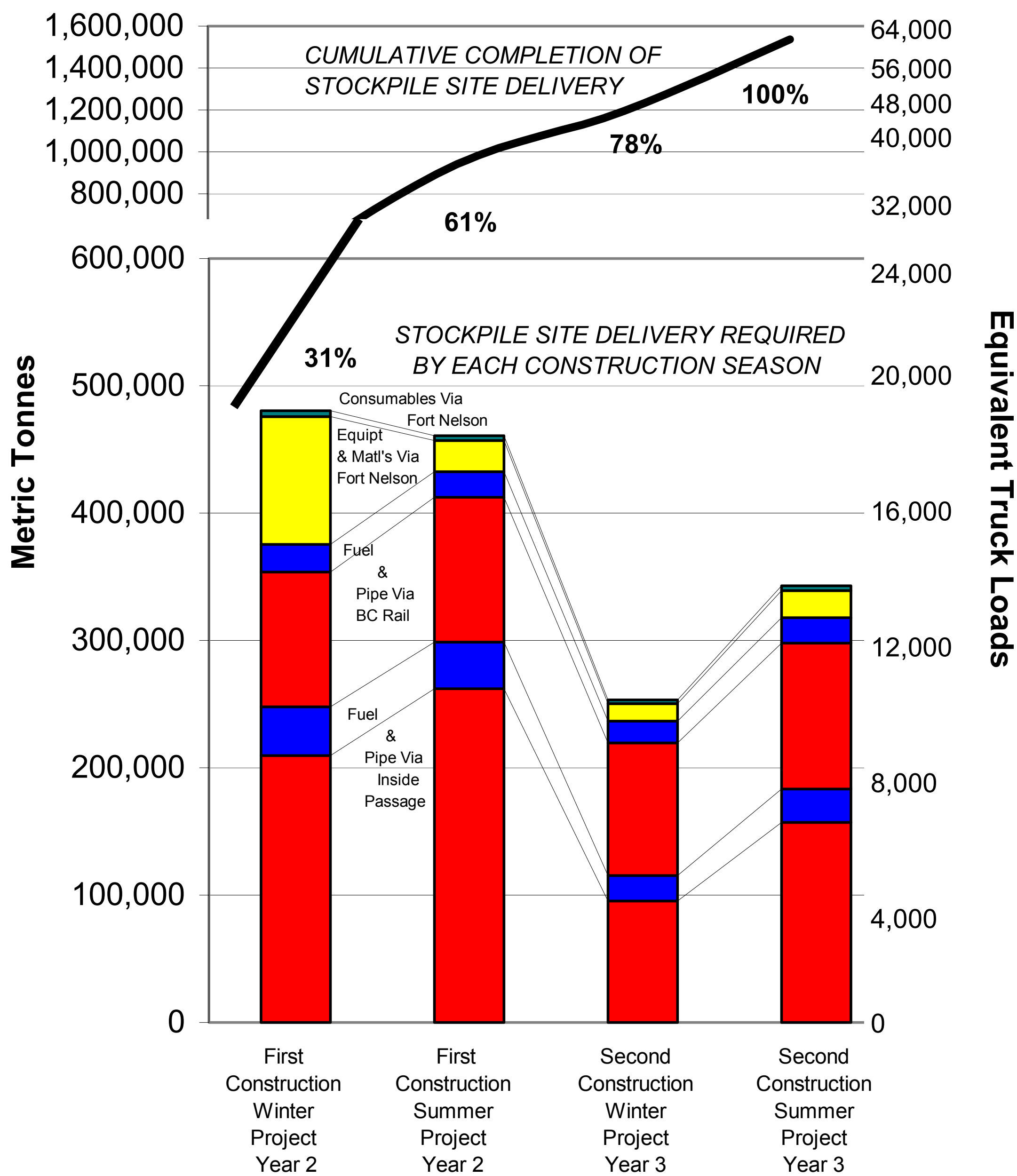

ALASKA
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
PACIFIC OCEAN
Beaver Creek
Burwash Landing
Destruction Bay
Haines Junction
Takhini
Whitehorse
Tagish
Carcross
Skagway
Haines
Teslin
Watson Lake
Fort Nelson
Fort St. John
Haines Hwy
Klondike Hwy
Alaska Hwy
BC Rail and/or Truck
382,000 Tonnes
86%
14%
463,000 Tonnes
86%
14%
109,000 Tonnes
92%
8%
584,000 Tonnes
75%
10%
14%
1%
Line Pipe
Bulk Fuel
Equip/Mat'ls
Consumables
Alaska Highway Pipeline Corridor
Alaska Gas Producers 52" Pipe Scenario
Yukon/BC Project Logistics Operations
Map 5
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
Yukon BC
0 - 7,500
0 - 3,000
7,500 - 150,000
3,000 - 5,000
150,000+
5,000+
Spread Limits
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100 0 100 km
1:7000000
Source: PRO LOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

Figure 7

Alaska Gas 52" Pipeline Scenario
YUKON/BC MATERIAL MOVEMENT FORECAST
For Stockpile Delivery Completion



These forecasts are based on material movement data bases for the Alaska Gas Producers 52" pipeline scenario that have been applied to an Alaska Highway Corridor logistics model in Tables 5 and 6. These tables show major material movement quantities (tonnes) for each construction spread and the construction season by which delivery is required.

Material quantities approach a million tonnes in each of Yukon and BC for a project total in both jurisdictions exceeding 1.75 million tones. (Please note again that while we have documented all B.C. movement requirements including spreads which would be supported out of Fort St. John, our analysis is confined to those B.C. spreads beyond Fort Nelson that combine with Yukon requirements to impact the Fort Nelson/Alaska Highway gateway.)

Again, as with the previous Foothills 42" pipe scenario, delivery seasons shown in Figure 7 and in Tables 5 and 6 are the construction schedule periods by which spread site deliveries must be completed. Logistics activities culminating in delivery completion are advanced into pre-construction time frames according to the unique requirements for each material movement plan.

Conceptual material movement plans are outlined in the balance of this section based on methodology and assumptions detailed in Appendix C.

Table 5

Alaska Gas Producers ALASKA HIGHWAY 52" Pipeline Scenario

YUKON PROJECT LOGISTICS OPERATIONS

Metric Tonnes Inbound

Required Delivery By: / To:	Winter 2 Spread A KP0-109	Winter 2 Spread E KP555-687 & CS #3	Summer 2 Spread C KP226-375 & KLX	Summer 2 Spread F KP687-832	**YEAR 2 TOTAL**	Winter 3 Spread B KP109-226 & CS #1	Summer 3 Spread D KP375-555 & CS #2	**YEAR 3 TOTAL**	**PROJECT TOTAL**
Destination Quantities									
LINE PIPE	95,000	114,500	136,500	125,500	**471,500**	95,300	157,100	**252,400**	**723,900**
BULK FUEL	15,400	23,100	19,600	17,000	**75,100**	20,000	26,100	**46,100**	**121,200**
Const. Equipment Mobilization	19,500	20,300	repositioned	repositioned	**39,800**	repositioned	repositioned	**demobilized**	
Pipeline Camps Mobilization	5,100	5,900	repositioned	repositioned	**11,000**	repositioned	repositioned	**demobilized**	
Stations/Valves/Miscl.	4,800	9,500	8,600	6,300	**29,200**	8,600	11,700	**20,300**	
EQUIPMENT/MATERIALS	29,400	35,700	8,600	6,300	**80,000**	8,600	11,700	**20,300**	**100,300**
CAMP CONSUMABLES	900	2,000	1,000	1,100	**5,000**	1,800	1,800	**3600**	**8,600**
PROJECT TOTAL	140,700	175,300	165,700	149,900	**631,600**	125,700	196,700	**322,400**	**954,000**
Origin Gateway/Routings									
ALASKA INSIDE PSG:									
Via Klondike Highway									
Ex Skagway Marine									
LINE PIPE		114,500		125,500	**240,000**		157,100	**157,100**	**397,100**
BULK FUEL		23,100		17,000	**40,100**		26,100	**26,100**	**66,200**
EQUIP/MATLS					**0**			**0**	**0**
CONSUMABLES					**0**			**0**	**0**
PROJECT TOTAL		137,600		142,500	**280,100**		183,200	**183,200**	**463,300**
Via Haines Highway									
Ex Haines Marine									
LINE PIPE	95,000		136,500		**231,500**	95,300		**95,300**	**326,800**
BULK FUEL	15,400		19,600		**35,000**	20,000		**20,000**	**55,000**
EQUIP/MATLS					**0**			**0**	**0**
CONSUMABLES					**0**			**0**	**0**
PROJECT TOTAL	110,400		156,100		**266,500**	115,300		**115,300**	**381,800**
INTERIOR ALASKA HWY:									
Via BC Rail/Truck									
Ex Fort Nelson									
LINE PIPE					**0**			**0**	**0**
BULK FUEL					**0**			**0**	**0**
EQUIP/MATLS	29,400	35,700	8,600	6,300	**80,000**	8,600	11,700	**20,300**	**100,300**
CONSUMABLES	900	2,000	1,000	1,100	**5,000**	1,800	1,800	**3,600**	**8,600**
PROJECT TOTAL	30,300	37,700	9,600	7,400	**85,000**	10,400	13,500	**23,900**	**108,900**

Table 6

Alaska Gas Producers ALASKA HIGHWAY 52" Pipeline Scenario

NORTH B.C. PROJECT LOGISTICS OPERATIONS

Metric Tonnes Inbound

Required Delivery By:	Winter 2	Summer 2	**YEAR 2**	Winter 3	Winter 3	Summer 3	Summer 3	**YEAR 3**	**PROJECT**
To:	Spread I	Spread G	**TOTAL**	Spread J	Spread L	Spread H	Spread K	**TOTAL**	**TOTAL**
	KP1095-1216	KP832-963		KP1216-1336	KP1435-1552	KP963-1095	KP1336-1435		
	& CS #6	& CS #4				& CS #5	& CS #7		
Destination Quantities									
LINE PIPE	105,800	113,900	**219,700**	104,300	102,200	114,700	86,100	**407,300**	**627,000**
BULK FUEL	21,500	20,000	**41,500**	16,900	16,600	20,100	16,200	**69,800**	**111,300**
Const. Equipment Mobilization	21,800	repositioned	**21,800**	repositioned	repositioned	repositioned	repositioned	**demobilized**	
Pipeline Camps Mobilization	6,900	repositioned	**6,900**	repositioned	repositioned	repositioned	repositioned	**demobilized**	
Stations/Valves/Miscl.	6,600	9,500	**16,100**	5,200	5,100	9,500	8,100	**27,900**	
EQUIPMENT/MATERIALS	35,300	9,500	**44,800**	5200	5,100	9,500	8,100	**27,900**	**72,700**
CAMP CONSUMABLES	2,000	2,000	**4000**	1,100	1,100	2,000	2,000	**6,200**	**10,200**
PROJECT TOTAL	164,600	145,400	**310,000**	127,500	125,000	146,300	112,400	**511,200**	**821,200**
Origin Gateway/Routings									
INTERIOR ALASKA HWY:									
Via BC Rail and/or Truck									
Ex Fort Nelson									
LINE PIPE	105,800	113,900	**219,700**	104,300		114,700		**219,000**	**438,700**
BULK FUEL	21,500	20,000	**41,500**	16,900		20,100		**37,000**	**78,500**
EQUIP/MATLS	35,300	9,500	**44,800**	5,200		9,500		**14,700**	**59,500**
CONSUMABLES	2,000	2,000	**4,000**	1,100		2,000		**3,100**	**7,100**
PROJECT TOTAL	164,600	145,400	**310,000**	127,500		146,300		**273,800**	**583,800**
Via BC Rail and/or Truck									
Ex Ft St John									
LINE PIPE					102,200		86,100	**188,300**	**188,300**
BULK FUEL					16,600		16,200	**32,800**	**32,800**
EQUIP/MATLS					5,100		8,100	**13,200**	**13,200**
CONSUMABLES					1,100		2,000	**3,100**	**3,100**
PROJECT TOTAL					125,000		112,400	**237,400**	**237,400**

PIPE MOVEMENT PLAN:	**Yukon Portion**	**723,900 tonnes**
	B.C. Portion	**627,000 tonnes**
	Total	**1,350,900 tonnes**

There are currently no pipe mills in the U.S. or Canada that can produce the pipe specification for a 52" Alaska Gas Pipeline. Japan and Germany are likely sources of pipe under this project scenario:

- For Yukon spreads, pipe will be transported from Asian mills by ship, commonly of 30,000 Dead Weight Tonnage, to either or both of Skagway and Haines, Alaska.
- For B.C. spreads pipe will be transported by a combination of ocean shipping from Europe to east coast ports (e.g., Halifax or Newport News) and rail to Fort Nelson.

Each vessel can handle some 1,900 - 60 foot joints, off-loaded at the port for coating, wrapping and furtherance by rail or truck:

- *Inside Passage Ports* - discharging pipe for Yukon spreads can anticipate approximately 24 ship calls during Project Years 1 and 2.
- *BC Rail Shipments* - from eastcoast ports for B.C.spreads will be loaded with five 60' pipe lengths per car generating some 8,000 carloads during Project Years 1 and 2.
- *Truck Transfers* - from Fort Nelson and Inside Passage Ports will carry two pipe joints generating some 42,000 truckloads.

Canada should not be impacted by pipe deliveries for the Alaska portion of the project, which will be routed to Prudhoe Bay or through Seward to the Alaska Railroad.

Yukon pipe deliveries through the Inside Passage Ports of Skagway and Haines, Alaska can be made 12 months per year. However, scheduling around cruise ship arrivals may be a critical concern in summer at Skagway.

FUEL MOVEMENT PLAN:	**Yukon Portion**	**121,200 tonnes**
	B.C. Portion	**111,300 tonnes**
	Total	**232,500 tonnes**

Project fuel requirements for Canadian sections of the project are again assumed to be sourced from inland Canadian or westcoast refineries for both Yukon and B.C. segments of the pipeline. Contending refinery/shipping sources are Edmonton, Vancouver and Puget Sound.

While similar logistics to the 42" Foothills scenario apply for the 52 " Alaska Gas project, the scale of each segment increases due to the higher volume and weight of pipe. Additional equipment is required, requiring more fuel, more men to construct the pipeline and compressor stations, and correspondingly more camps and consumables.

The project will require approximately 6,000 truckloads of fuel to service the project spreads and compressor stations in both jurisdictions.

EQUIPMENT MOVEMENT PLAN (Includes Camp Buildings/Modules):

Yukon Portion	**100,300**	**tonnes**
B.C. Portion	**72,700**	**tonnes**
Total	**173,000**	**tonnes**

As with the Foothills 42" scenario, Canadian contractors for the 52" pipeline scenario will use a mix of their existing and new equipment. All equipment will be moved to the various construction spreads by truck direct from storage yards in the south (e.g., Finning (Canada), Edmonton, AB or Vancouver, B.C.).

However, some of the heavier equipment required for a 52" pipeline (e.g., pipelayers) is not currently available in Canada and will likely be imported new from Japan. Although it has been assumed that such new purchase equipment would first be marshalled at contractors southern storage yards, *it is possible* that new project equipment fleets would be shipped in vessel load quantities direct to Inside Passage ports.

Pickup trucks and other mobile equipment to be used on construction sites will be moved to the site by automotive, flat deck and lowboy trailers on the same basis as for the 42" pipeline scenario.

Camp mobilization requirements are estimated at 17,900 tonnes requiring over 1,200 truckloads to deliver camp units directly to campsites in Yukon and B.C.

As a reminder to the reader, tonnages provided include one time, inbound camps and equipment mobilization. Demobilization movements at the completion of the project, and intra-project moves by contractors at the completion of a spread are not included.

CONSUMABLES:

Yukon	**8,600**	**tonnes**
B.C.	**10,200**	**tonnes**
Total	**18,800**	**tonnes**

Total consumables tonnage is adjusted for the larger 52" pipeline scenario workforce and, as with the 42" pipeline scenario, calculated on the basis of 1.5 cubic feet of total “consumables” per person per day transported by truck directly to the camps.

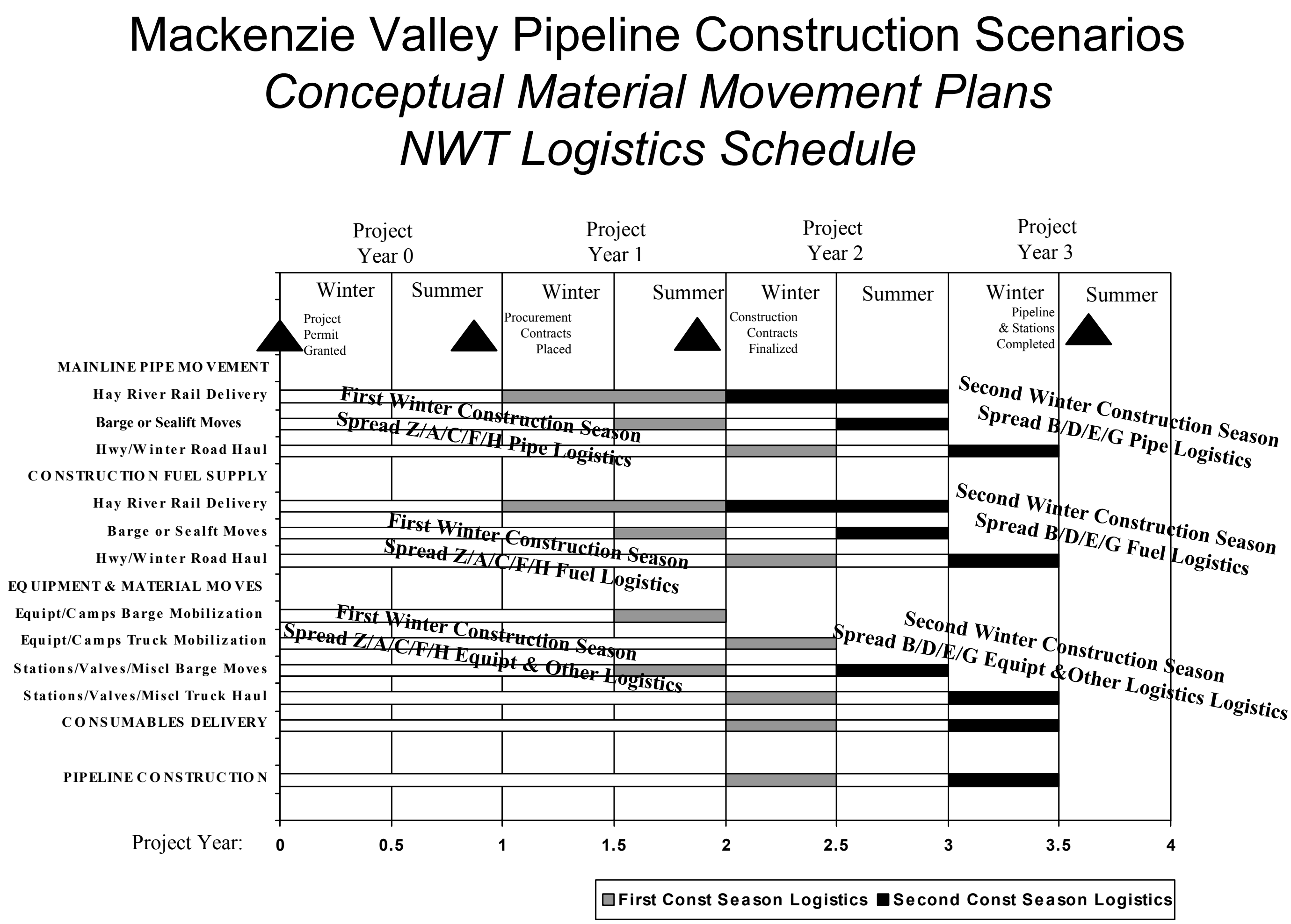
4.2 NWT Construction Material Logistics

Winter construction will require a combination of summer barge and winter road deliveries to reach pipeline stockpile sites which for the most part are not accessible by all-weather highway. In most cases, material movement plans must be substantially advanced to insure that construction progress will not be compromised by delivery delays in a seasonally constrained transportation system.

A conceptual logistics schedule for NWT material movement plans is provided in Figure 8 following. This sets a winter construction schedule context for Mackenzie Valley Corridor logistics models that we have developed to analyze freight flows through NWT transportation gateways to pipeline construction spread sites.

We have assumed the same two year construction schedule for both pipeline scenarios in the Mackenzie Valley. However, while we believe the Alaska Gas Producers Group are targeting a two year 52" pipeline construction scenario, their project definition is based on 3 construction years (and our logistics analysis will show even that to be overly optimistic with current transportation system constraints in the Mackenzie Valley).

Figure 8


Mackenzie Valley Pipeline Construction Scenarios
Conceptual Material Movement Plans
NWT Logistics Schedule
Project Year 0
Project Year 1
Project Year 2
Project Year 3
Winter
Summer
Project Permit Granted
Procurement Contracts Placed
Construction Contracts Finalized
Pipeline & Stations Completed
MAINLINE PIPE MOVEMENT
Hay River Rail Delivery
Barge or Sealift Moves
Hwy/Winter Road Haul
CONSTRUCTION FUEL SUPPLY
Hay River Rail Delivery
Barge or Sealft Moves
Hwy/Winter Road Haul
EQUIPMENT & MATERIAL MOVES
Equipt/Camps Barge Mobilization
Equipt/Camps Truck Mobilization
Stations/Valves/Miscl Barge Moves
Stations/Valves/Miscl Truck Haul
CONSUMABLES DELIVERY
PIPELINE CONSTRUCTION
First Winter Construction Season
Spread Z/A/C/F/H Pipe Logistics
Second Winter Construction Season
Spread B/D/E/G Pipe Logistics
First Winter Construction Season
Spread Z/A/C/F/H Fuel Logistics
Second Winter Construction Season
Spread B/D/E/G Fuel Logistics
First Winter Construction Season
Spread Z/A/C/F/H Equipt & Other Logistics
Second Winter Construction Season
Spread B/D/E/G Equipt &Other Logistics Logistics
Project Year:
0
0.5
1
1.5
2
2.5
3
3.5
4
First Const Season Logistics
Second Const Season Logistics

4.2.1 Delta Gas Producers 30" Pipeline Material Logistics

Conceptual NWT Project Logistics Operations developed for a Delta Gas 30" pipeline scenario are displayed in a destination delivery density map (see Map 6). This map shows total project logistics tonnage flows to each pipeline spread and the commodity split of major project material groups (pipe, fuel, equipment/materials and consumables).

Conceptual material movement plans are focussed on rail, barge and truck transfers at the Hay River/Enterprise Gateway for Mackenzie Highway, Mackenzie River and Mackenzie Northern Railway operations. Major movements of pipe and fuel are staged by rail through this gateway and, for much of the pipeline, are transferred direct to barge without any impact on the public highway system.

Truck movements are largely confined to pipeline stockpile sites south of Wrigley which are either accessible by all-weather highway or winter road. Otherwise through truck deliveries of consumables and miscellaneous expedited shipments are anticipated during construction by a combination of all-weather and winter roads via both the Mackenzie Highway and the Dempster Highway.

For these conceptual material movement plans, Figure 9 forecasts stockpile delivery completion according to destination requirements in each construction season:

- During the Project Year 1 Summer prior to the Project Year 2 first winter construction season, over one third of major materials, almost a quarter million tonnes, will be delivered with some 230 barge loads for river accessible stockpiles.

- During the Project Year 2 winter season, distribution of an additional 100,000 tonnes of major materials will start in advance of construction and complete during construction with some 5,400 truckload deliveries to all-weather and winter road accessible stockpiles.

- During the Project Year 2 summer barge season and during the Project Year 3 winter trucking season, similar logistics operations will complete spread site deliveries for the second winter construction season.

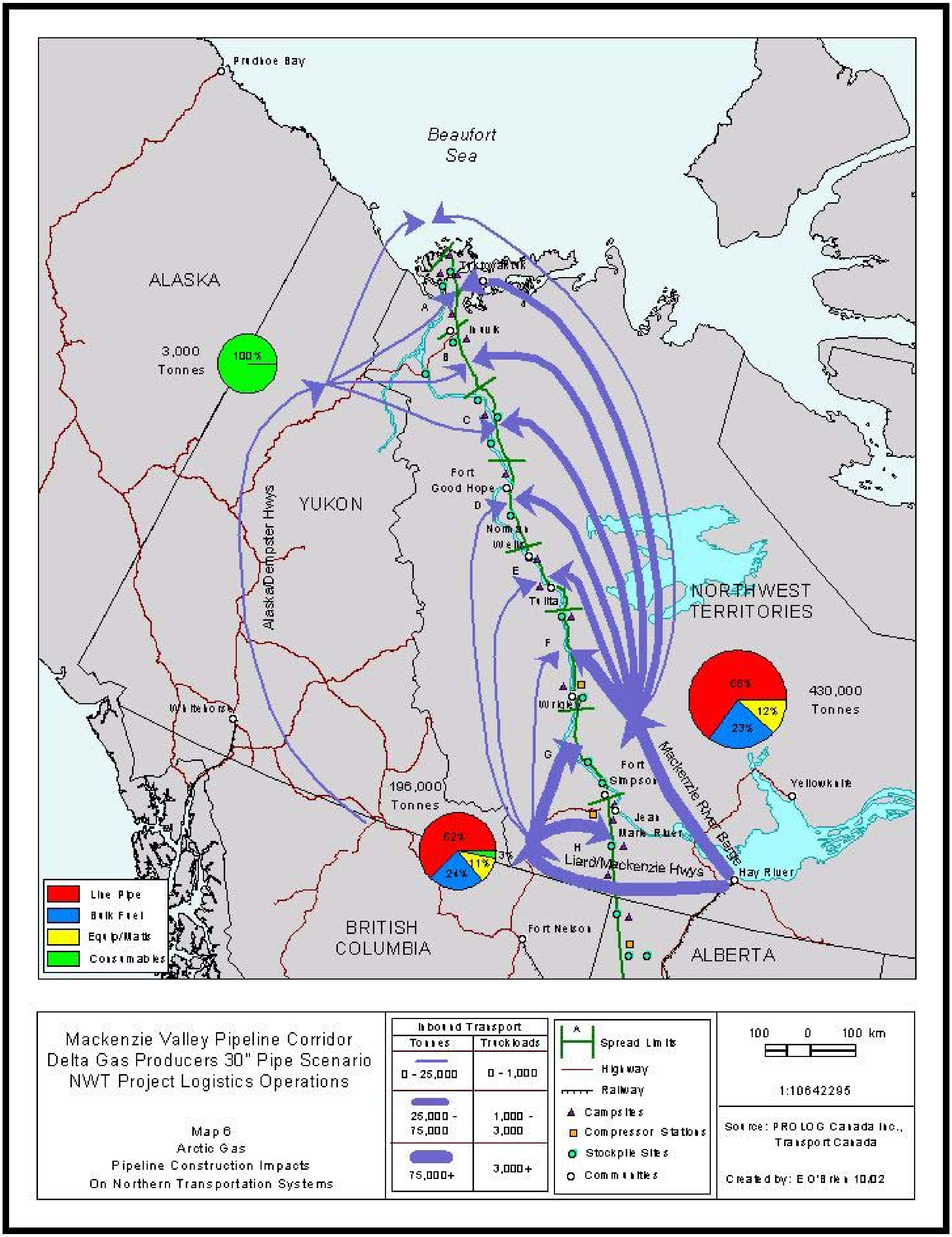
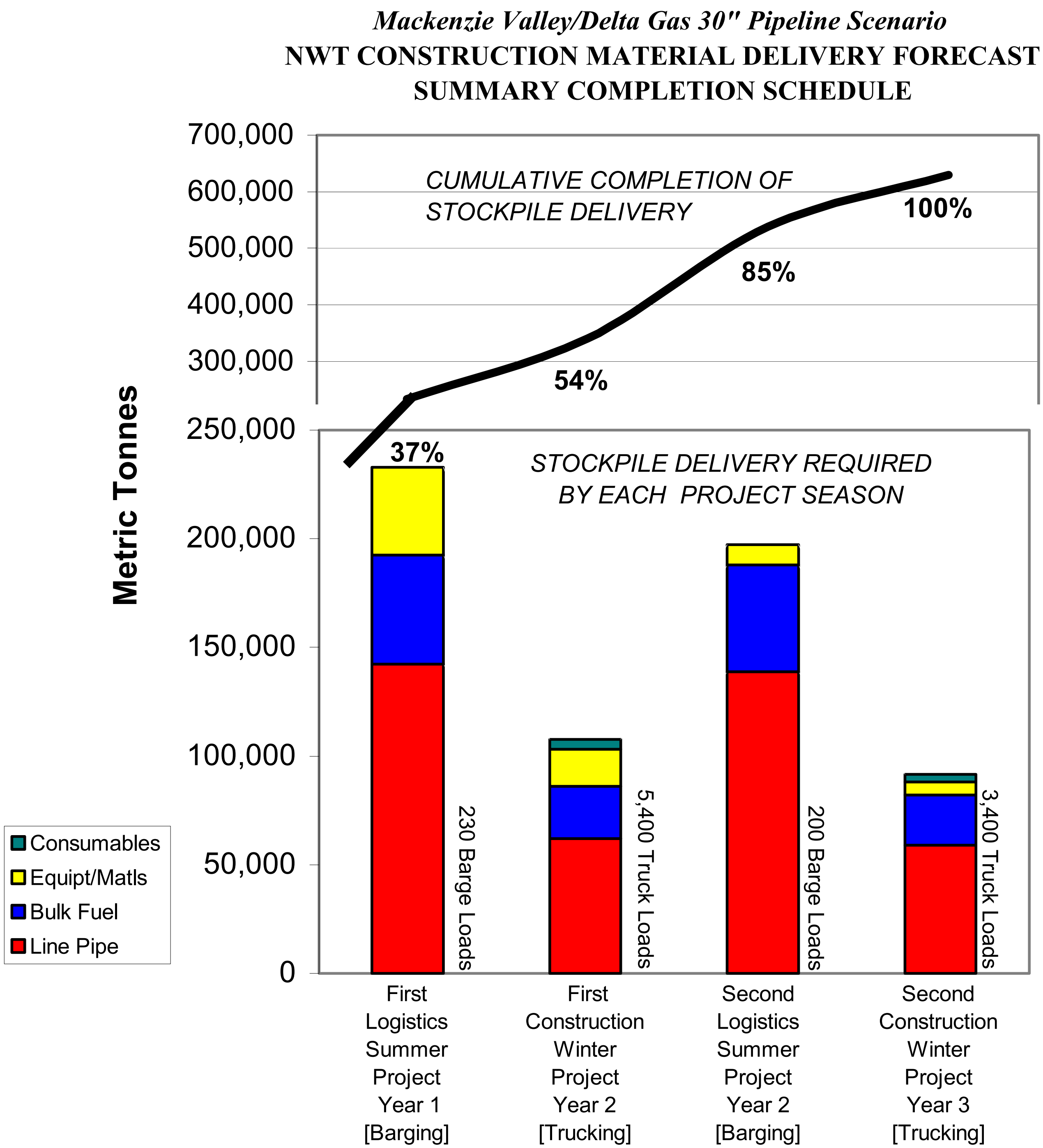

Prudhoe Bay
Beaufort Sea
ALASKA
3,000 Tonnes
100%
Tuktoyaktuk
Inuvik
A
B
C
D
E
F
G
H
Fort Good Hope
Norman Wells
Tulita
Wrigley
Fort Simpson
Jean Marie River
YUKON
Alaska/Dempster Hwys
NORTHWEST TERRITORIES
65%
12%
23%
430,000 Tonnes
Mackenzie River Barge
Yellowknife
Hay River
Liard/Mackenzie Hwys
Whitehorse
196,000 Tonnes
62%
24%
11%
3%
BRITISH COLUMBIA
Fort Nelson
ALBERTA
Line Pipe
Bulk Fuel
Equip/Mat'ls
Consumables
Mackenzie Valley Pipeline Corridor
Delta Gas Producers 30" Pipe Scenario
NWT Project Logistics Operations
Map 6
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
0 - 25,000
0 - 1,000
25,000 - 75,000
1,000 - 3,000
75,000+
3,000+
Spread Limits
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100 0 100 km
1:10642295
Source: PROLOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

Figure 9


Mackenzie Valley/Delta Gas 30" Pipeline Scenario
NWT CONSTRUCTION MATERIAL DELIVERY FORECAST
SUMMARY COMPLETION SCHEDULE
700,000
600,000
500,000
400,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Metric Tonnes
CUMULATIVE COMPLETION OF STOCKPILE DELIVERY
37%
54%
85%
100%
STOCKPILE DELIVERY REQUIRED BY EACH PROJECT SEASON
230 Barge Loads
5,400 Truck Loads
200 Barge Loads
3,400 Truck Loads
Consumables
Equipt/Matls
Bulk Fuel
Line Pipe
First Logistics Summer Project Year 1 [Barging]
First Construction Winter Project Year 2 [Trucking]
Second Logistics Summer Project Year 2 [Barging]
Second Construction Winter Project Year 3 [Trucking]

These forecasts are based on material movement data bases for the Delta Gas 30" pipeline scenario that have been applied to a Mackenzie Valley Corridor logistics model in Table 7. This table shows major material movement quantities (tonnes) for each construction spread and the construction season by which delivery is required. Total material quantities exceed half a million tonnes.

Delivery seasons shown in Figure 9 and Table 7 are the construction schedule periods by which spread site deliveries must be completed. Logistics activities culminating in delivery completion are advanced into pre-construction time frames according to the unique requirements for each material movement plan.

Conceptual material movement plans are outlined in the balance of this section based on methodology and assumptions detailed in Appendix D.

Table 7

Delta Gas Producers MACKENZIE VALLEY 30" Pipeline Scenario

NWT PROJECT LOGISTICS OPERATIONS

Metric Tonnes Inbound

Required Delivery By: To:	Winter 2 Spread Z Gathering System	Winter 2 Spread A KP0-130 & CS #1	Winter 2 Spread C KP270-420	Winter 2 Spread F KP750-940	Winter 2 Spread H KP1140-1350 & CS #4	Year 2 Total	Winter 3 Spread B KP130-270	Winter 3 Spread D KP420-485	Winter 3 Spread E KP585-750 & CS #2	Winter 3 Spread G KP940-1140 & CS #3	Year 3 Total	Project Total
Destination Quantities												
LINE PIPE	3,700	38,300	44,200	56,000	62,000	**204,200**	41,300	48,700	48,700	59,000	**197,700**	**401,900**
BULK FUEL	1,000	16,300	14,500	18,400	24,100	**74,300**	13,600	16,000	19,600	23,000	**72,200**	**146,500**
Const.Eqpt.Mobilization	800	4,900	6,000	6,400	7,500	25,600	repositioned	repositioned	repositioned	repositioned	demobilized	
P/L Camps Mobilization	700	4,100	4,100	4,100	4,100	17,100	repositioned	repositioned	repositioned	repositioned	demobilized	
Stations/Valves/Miscl.	200	4,300	2,200	2,800	5,500	15,000	2,100	2,400	4,800	5,300	14,600	
EQPT/MATLS	1,700	13,300	12,300	13,300	17,100	**57,700**	2,100	2,400	4,800	5,300	**14,600**	**72,300**
CONSUMABLES	100	1,400	800	800	1,400	**4,500**	800	800	1,300	1,300	**4,200**	**8,700**
PROJECT TOTAL	6,500	69,300	71,800	88,500	104,600	**340,700**	57,800	67,900	74,400	88,600	**288,700**	**629,400**
Origin Gateway/Routings												
Mackenzie Valley Gateway												
Via Mackenzie/Liard Highways												
LINE PIPE					62,000	**62,000**				59,000	**59,000**	**121,000**
BULK FUEL					24,100	**24,100**				23,000	**23,000**	**47,100**
EQUIP/MATLS					17,100	**17,100**				5,300	**5,300**	**22,400**
CONSUMABLES				800	1,400	**2,200**		800	1,300	1,300	**3,400**	**5,600**
PROJECT TOTAL	0	0	0	800	104,600	**105,400**	0	800	1,300	88,600	**90,700**	**196,100**
Via Mackenzie River Barge												
LINE PIPE	3,700	38,300	44,200	56,000		**142,200**	41,300	48,700	48,700		**138,700**	**280,900**
BULK FUEL	1,000	16,300	14,500	18,400		**50,200**	13,600	16,000	19,600		**49,200**	**99,400**
EQUIP/MATLS	1,700	13,300	12,300	13,300		**40,600**	2,100	2,400	4,800		**9,300**	**49,900**
CONSUMABLES						**0**					**0**	**0**
PROJECT TOTAL	6,400	67,900	71,000	87,700		**233,000**	57,000	67,100	73,100		**197,200**	**430,200**
Mackenzie Delta Gateway												
Via Western Arctic Sealift												
LINE PIPE												
BULK FUEL												
EQUIP/MATLS												
CONSUMABLES												
PROJECT TOTAL												
Via Alaska/Dempster Hwy												
LINE PIPE						**0**					**0**	**0**
BULK FUEL						**0**					**0**	**0**
EQUIP/MATLS						**0**					**0**	**0**
CONSUMABLES	100	1,400	800			**2,300**	800				**800**	**3,100**
PROJECT TOTAL	100	1,400	800			**2,300**	800				**800**	**3,100**

PIPE MOVEMENT PLAN:	**North of Wrigley**	**281,000 tonnes**
	South of Wrigley	**120,900 tonnes**
	Total Pipe	**401,900 tonnes**

Canadian and U.S. pipe mills have 30 inch, heavy wall pipe manufacturing capability and it is assumed that 100% of the project requirements will be sourced in North America. Contending mills are in Alberta, Saskatchewan, Ontario and Florida.

Pipe will be shipped from the mills by mainline railways connecting to the Mackenzie Northern Railway at Smith, Alberta. Movement on the Mackenzie Northern Railway will continue to its northern terminus at Hay River or Enterprise, NWT.

Pipe will be staged at these sites for subsequent transfer to barges and trucks:

- Pipe required from Wrigley north will be barged to river access stockpile sites strategically located near the pipeline right-of-way.

- Pipe required south of Wrigley will be trucked to winter road and/or all-weather highway accessible stockpile sites.

The criteria for pipe movement most compatible with rail, barge and truck capabilities in the NWT is presently anticipated to comprise:

- ***rail -*** eleven 60 foot pipe lengths per car maximizing the load envelope at 60 tonnes payload and generating some 6,700 carloads.

- ***barge -*** an average of 1000 tonnes of pipe per barge will require a total of 281 barge loads in 47 sailings to river access points north of Wrigley.

- ***truck*** - four 60 foot pipe lengths per truck generating some 5,700 truckloads (note that 5 pipe lengths per load may be permitted).

For highway delivery, specially designed trailers and support bunks may be manufactured by the pipeline owners and supplied to truckers (See Appendix H).

For barge delivery, some operational adjustments may be required to accommodate both ongoing community resupply and project material movements considering a nominal capacity reported to be around 260,000 tonnes per season. Alternatively, pipe may be shipped by Beaufort Sealift through the Bering Straits, stockpiled at Tuktoyaktuk and trucked south by winter road - or barged *up* the Mackenzie River - to pipeline spread stockpile sites south of Tuktoyaktuk.

FUEL MOVEMENT PLAN:

North of Wrigley	**99,400 tonnes**
South of Wrigley	**47,100 tonnes**
Total Fuel	**146,500 tonnes**

All fuel will be sourced in Canada, likely from Edmonton area refineries which can meet the Canadian Government's sulphur content spec for automotive fuel.

Diesel grade (50 degree pour point spec) distillate will be used for pipeline and compressor station construction, camp heating and electrical power generation. Small volumes of gasoline and propane will also be required.

North of Wrigley Fuel will be delivered to Hay River by tank car over the Mackenzie Northern Railway. Northern Transportation Company Limited (the barge operator) and Imperial Oil have a supply arrangement and barges are loaded out at the Imperial Oil bulk plant. Scheduling is often timed to pump directly from the tank cars to the barges. 11 million litres of storage capacity is available at the terminal. Petro-Canada has additional storage capable of serving barge traffic.

Existing storage capacity can receive barge deliveries of fuel for the pipeline project at Norman Wells, Inuvik, and Tuktoyaktuk. Much of this tankage is owned directly by the NWT Government and can be made available to the project. "Portable" storage tanks will be located at the stockpile sites, as required.

South of Wrigley Fuel will be transferred to large "B" Train trucks at Hay River oil company terminals and trucked directly to project storage facilities.

Transportation criteria:

- ***rail -*** current weight-on-rail restrictions between High Level, Alberta and Hay River (220,000 lbs. gross weight on rail) preclude jumbo 100,000 litre tank car operations. Using standard sized tank cars carrying 75,000 litres of diesel fuel at 60 tonne net loads will require almost 2500 tank carloads to complete project fuel deliveries. Upgrading the system to 286,000 lbs. heavy haul standard (from 263,000 lbs. south of High Level) on the entire Mackenzie Northern Railway would accommodate regular jumbo tank cars carrying a minimum of 95,000 litres of diesel fuel.

- ***barge -*** barges will each carry 1000 tonnes of fuel as an average payload over a full season. Heavier barge loading is possible early to mid-season when river levels are at their peak. Some 97 barge loads will be required to complete fuel supply delivery north of Wrigley.

- ***truck -*** Full "B" Trains carrying 48,000 litres per load will be utilized to supply fuel to the project stockpile/storage facilities south of Wrigley. A total of 1300 loads will be required for this program over the life of the project.

EQUIPMENT/MATERIALS MOVEMENT PLAN
[Including Construction Equipment/Camps, Station Equipment and Valves]

North of Wrigley	**49,900 tonnes**
South of Wrigley	**22,400 tonnes**
Total Equipment/Materials	**72,300 tonnes**

This group of project materials includes all construction equipment, camp units, compressor and meter station materials and valves as well as ancillary materials and supplies. It is anticipated that these will be trucked to Hay River for barge deliveries to the project spreads north of Wrigley, and trucked directly from the south to the spreads south of Wrigley. There is a possibility that some project equipment for construction work will be supplied by contractors in the north (e.g., Yellowknife). This will not be a significant component of the total.

Note that tonnages provided are one time northbound only and exclude demobilization and intra-project moves by contractors from one spread to another.

Camps

An 800 man camp is anticipated for each 30 inch pipeline spread and a 100 man camp for construction of each compressor station. Each camp also provided space for inspectors, supervisors, camp staff and visitors.

Some 1200 camp units (16,500 tonnes) will be mobilized to each of four camp sites at approximately 300 units per camp (see Foothills 42" scenario for typical camp breakdown). These camp units will be repositioned during the second winter construction season and demobilized at project completion.

CONSUMABLES Total Volume - 8,700 tonnes

Transportation of consumables is anticipated direct to all camps by winter road and/or all-weather highway.

4.2.2 Alaska Gas Producers 52” Pipeline Materials Logistics

Conceptual NWT Project Logistics Operations developed for an Alaska Gas 52” pipeline scenario are displayed in a destination delivery density map (see Map 7). This map shows total project logistics tonnage flows to each pipeline spread and the commodity split of major project material groups (pipe, fuel, equipment/materials and consumables).

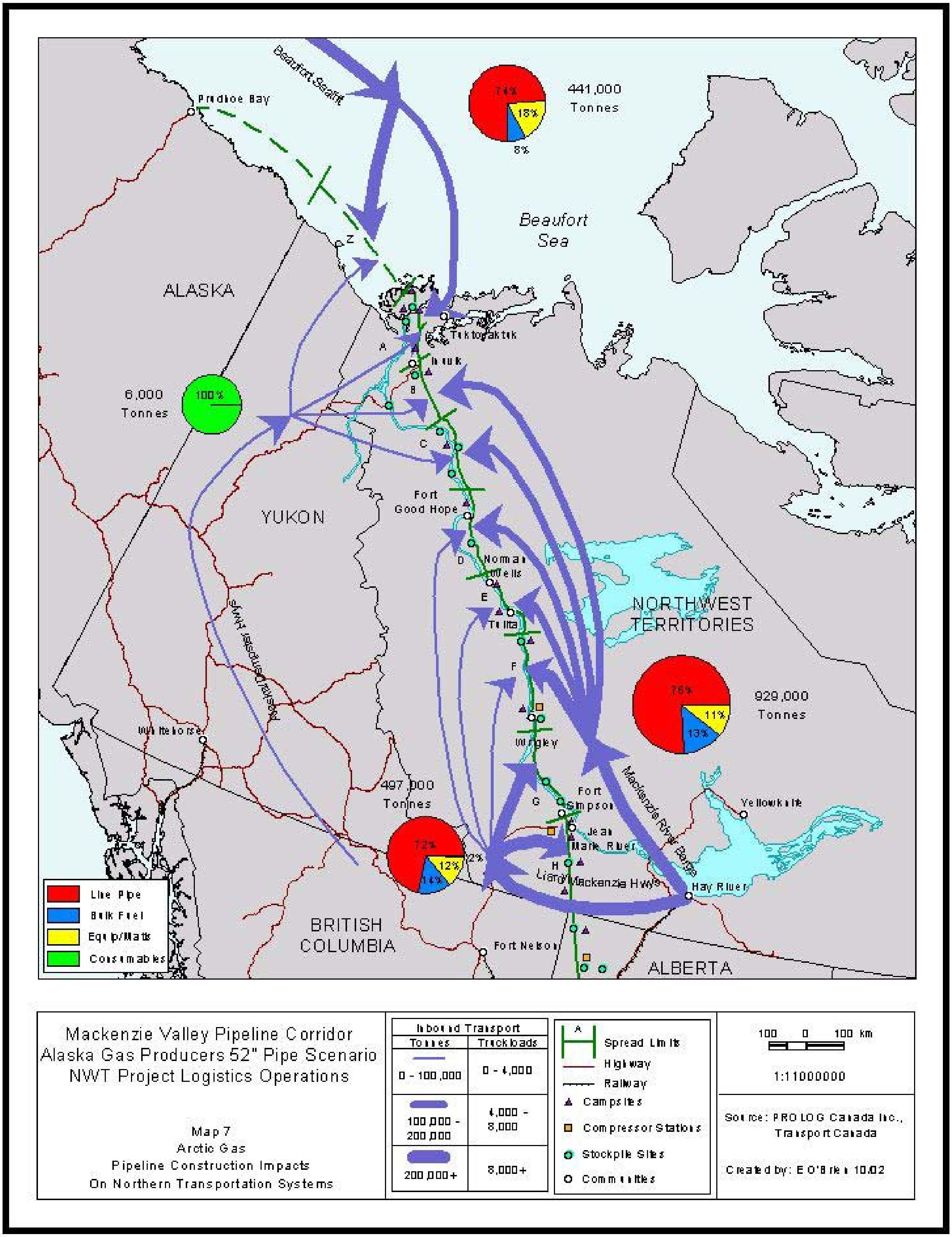
Conceptual material movement plans incorporate two major NWT gateways:

- The Mackenzie Valley Gateway - focussed on rail, barge and truck transfers at Hay River/Enterprise for Mackenzie Highway, Mackenzie River and Mackenzie Northern Railway operations. Major movements of pipe and fuel are staged by rail through this gateway and for, much of the pipeline, are transferred direct to barge in summer without any impact on the public highway system.

- The Mackenzie Delta Gateway - focussed on Beaufort Sealift through the Bering Straits into the Canadian Western Arctic; as well as the all-weather Dempster Highway connection through Yukon. Summer Sealift movement of major project materials is required for offshore marine pipelaying operations and is also an alternative for conventional pipeline spreads in the Mackenzie Delta.

Truck movements are largely confined to pipeline stockpile sites south of Wrigley which are either accessible by all-weather highway or winter road.

Otherwise through truck deliveries of consumables and miscellaneous expedited shipments are anticipated during construction by a combination of all-weather and winter roads via both the Mackenzie Highway and the Dempster Highway.


Beaufort Sea
Beaufort Sealift
Prudhoe Bay
74%
18%
8%
441,000
Tonnes
ALASKA
6,000
Tonnes
100%
Tuktoyaktuk
Inuvik
Fort
Good Hope
YUKON
Norman
Wells
Tulita
NORTHWEST
TERRITORIES
76%
11%
13%
929,000
Tonnes
Whitehorse
Wrigley
497,000
Tonnes
72%
12%
14%
2%
Fort
Simpson
Jean
Marie River
Mackenzie River Barge
Yellowknife
Liard
Mackenzie Hwy
Hay River
BRITISH
COLUMBIA
Fort Nelson
ALBERTA
Line Pipe
Bulk Fuel
Equip/Mat'ls
Consumables
Mackenzie Valley Pipeline Corridor
Alaska Gas Producers 52" Pipe Scenario
NWT Project Logistics Operations
Map 7
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
0 - 100,000
0 - 4,000
100,000 - 200,000
4,000 - 8,000
200,000+
8,000+
Spread Limits
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100 0 100 km
1:11000000
Source: PRO LOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

For these conceptual material movement plans, Figure 10 forecasts stockpile delivery completion according to destination requirements in each construction season:

- During the Project Year 1 Summer prior to Project Year 2 first winter construction season, almost half of all major material movements, close to a million tonnes, will be completed with a combination of 420 barge loads for river accessible stockpiles and 38 sealift sailings for Beaufort offshore marine pipelaying as well as Mackenzie Delta stockpile sites.

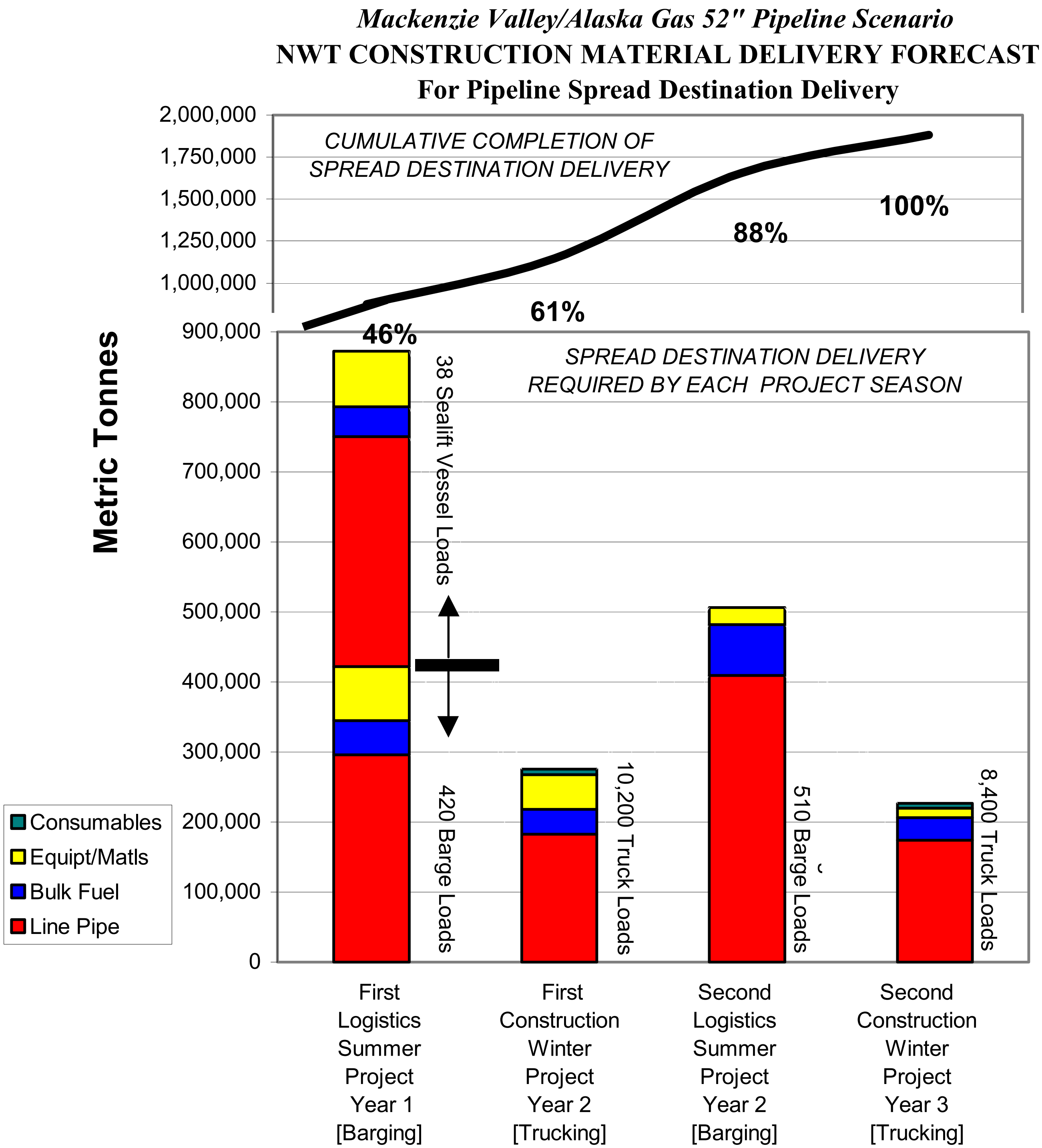
- During the Project Year 2 winter season, distribution of an additional quarter million tonnes of major materials will start in advance of construction, and complete during construction, with some 10,000 truckload deliveries to all-weather and winter road accessible stockpiles.

- During the Project Year 2 summer barge season and during the Project Year 3 winter trucking season, similar logistics operations will complete spread site deliveries for the second winter construction season. A second summer sealift is not planned but remains available as a contingency capability.

Under this scenario, construction of an Alaska Gas 52" pipeline is assumed to follow completion of a Delta Gas 30" pipeline in the Mackenzie Valley. The 30" pipeline right-of-way, stockpile sites, compressor stations, etc. will facilitate expansion to accommodate the larger Alaska Gas pipeline project.

Alaska Gas Producer Group project definition includes an undersea pipeline from the North Slope of Alaska that would come ashore west of the Mackenzie Delta. However, we have assumed that this subsea pipeline link would tie-in at Taglu to maximize synergies with a Delta Gas Pipeline. Although logistics support under this scenario has been based upon offshore marine pipelaying operations in moving pack ice (see Appendix F), more conventional pipelaying through the closer-in shorefast ice may be a feasible alternative.

Figure 10


Mackenzie Valley/Alaska Gas 52" Pipeline Scenario
NWT CONSTRUCTION MATERIAL DELIVERY FORECAST
For Pipeline Spread Destination Delivery
Metric Tonnes
2,000,000
1,750,000
1,500,000
1,250,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
CUMULATIVE COMPLETION OF
SPREAD DESTINATION DELIVERY
46%
61%
88%
100%
SPREAD DESTINATION DELIVERY
REQUIRED BY EACH PROJECT SEASON
38 Sealift Vessel Loads
420 Barge Loads
10,200 Truck Loads
510 Barge Loads
8,400 Truck Loads
Consumables
Equipt/Matls
Bulk Fuel
Line Pipe
First Logistics Summer Project Year 1 [Barging]
First Construction Winter Project Year 2 [Trucking]
Second Logistics Summer Project Year 2 [Barging]
Second Construction Winter Project Year 3 [Trucking]

The forecasts in Figure 10 are based on material movement data bases for the Delta Gas 52" pipeline scenario that have been applied to a Mackenzie Valley Corridor logistics model in Table 8. This table shows major material movement quantities (tonnes) for each construction spread and the construction season by which delivery is required. Total material quantities exceed half a million tonnes.

Delivery seasons shown in Figure 10 and Table 8 are the construction schedule periods by which spread site deliveries must be completed. Logistics activities culminating in delivery completion are advanced into pre-construction time frames according to the unique requirements for each material movement plan.

Conceptual material movement plans are outlined in the balance of this section based on methodology and assumptions detailed in Appendix E.

Table 8

Alaska Gas Producers MACKENZIE VALLEY 52" Pipeline Scenario

NWT PROJECT LOGISTICS OPERATIONS

Metric Tonnes Inbound

Required Delivery By: / To:	Summer 2 Spread Z Undersea Pipeline	Winter 2 Spread A KP0-130 & CS #1	Winter 2 Spread C KP270-420	Winter 2 Spread F KP750-940	Winter 2 Spread H KP1140-1350 & CS #4	Year 2 Total	Winter 3 Spread B KP130-270	Winter 3 Spread D KP420-485	Winter 3 Spread E KP585-750 & CS #2	Winter 3 Spread G KP940-1140 & CS #3	Year 3 Total	Project Total
Destination Quantities												
LINE PIPE	215,100	113,100	130,500	165,200	182,900	**806,800**	121,900	143,700	143,700	174,000	**583,300**	**1,390,100**
BULK FUEL	10,000	23,100	21,800	27,600	35,100	**117,600**	20,300	24,000	28,500	32,500	**105,300**	**222,900**
Const.Eqpt.Mobilization	9 vessels	19,500	24,000	25,600	30,000	99,100	reposition	reposition	reposition	reposition	demobilized	
P/L Camps Mobilization		6,200	6,200	6,200	6,200	24,800	reposition	reposition	reposition	reposition	demobilized	
Stations/Valves/Miscl.	10,800	9,700	6,500	8,300	13,200	48,500	6,100	7,200	11,200	12,800	37,300	
Cement	33,000					33,000						
EQPT/MATLS	43,800	35,400	36,700	40,100	49,400	**205,400**	6,100	7,200	11,200	12,800	**37,300**	**242,700**
CONSUMABLES	500	2,400	1,300	1,300	2,400	**7,900**	1,300	1,300	2,400	2,400	**7,400**	**15,300**
PROJECT TOTAL	269,400	174,000	190,300	234,200	269,800	**1,137,700**	149,600	176,200	185,800	221,700	**733,300**	**1,871,000**
Origin Gateway/Routings												
Mackenzie Valley Gateway												
Via Mackenzie/Liard Highways												
LINE PIPE					182,900	**182900**				174,000	**174000**	**356900**
BULK FUEL					35,100	**35100**				32,500	**32500**	**67600**
EQUIP/MATLS					49,400	**49400**				12,800	**12800**	**62200**
CONSUMABLES				1300	2400	**3700**		1300	2400	2400	**6100**	**9800**
PROJECT TOTAL	0	0	0	1300	269800	**271100**	0	1300	2400	221700	**225400**	**496500**
Via Mackenzie River Barge												
LINE PIPE			130,500	165,200		**295,700**	121,900	143,700	143,700		**409,300**	**705000**
BULK FUEL			21,800	27,600		**49,400**	20,300	24,000	28,500		**72,800**	**122200**
EQUIP/MATLS			36,700	40,100		**76,800**	6,100	7,200	11,200		**24,500**	**101300**
CONSUMABLES						**0**					**0**	**0**
PROJECT TOTAL	0	0	189,000	232,900	0	**421,900**	148,300	174,900	183,400	0	**506,600**	**928500**
Mackenzie Delta Gateway												
Via Western Arctic Sealift												
LINE PIPE	215,100	113,100				**328,200**					**0**	**328,200**
BULK FUEL	20,000	23,100				**43,100**					**0**	**43,100**
EQUIP/MATLS	43,800	35,400				**79,200**					**0**	**79,200**
CONSUMABLES						**0**					**0**	**0**
PROJECT TOTAL	278,900	171,600	0	0	0	**450,500**	**0**	**0**	**0**	**0**	**0**	**450,500**
Via Alaska/Dempster Hwy												
LINE PIPE						**0**					**0**	**0**
BULK FUEL						**0**					**0**	**0**
EQUIP/MATLS						**0**					**0**	**0**
CONSUMABLES	500	2,400	1,300			**4,200**	1,300				**1,300**	**5,500**
PROJECT TOTAL	500	2,400	1,300			**4,200**	1,300				**1,300**	**5,500**

PIPE MOVEMENT PLAN:

Via Mackenzie River (North of Wrigley)	**705,000 tonnes**
Via Mackenzie Highway (South of Wrigley)	**356,900 tonnes**
Via Mackenzie Northern Railway	**1,061,900 tonnes**
Via Western Arctic/Beaufort Sealift	**328,200 tonnes**
Total Pipe	**1,390,100 tonnes**

Alaska Gas 52 inch pipe requirements for this project will be sourced offshore from Asia and Europe. Pipe for construction spreads south of Inuvik will be discharged at North American Ports (e.g., Halifax and Newport News) and delivered by rail to, and staged from, Hay River/Enterprise. This pipe will be:

- transferred to barges for river access points between Wrigley and Inuvik, and
- transferred to trucks for all-weather or winter road access stockpiles south of Wrigley.

Pipe for construction spreads north of Inuvik in the Mackenzie Delta and for subsea pipe laying in the Beaufort will be delivered by ice breaking cargo ships (See Appendix F) or deep draft barges in sealift service.

This pipe will be:

- discharged at sea directly to a lay vessel operation with no stockpiling required, or
- transferred to river barges for southbound movement to river access points, or
- lightered to onshore staging areas for subsequent winter/ice road delivery to spread sites.

The extent to which sealift operations extend to stockpile sites further south along the Mackenzie River will be determined by seasonal productivity constraints on conventional Hay River based barge operations.

Transportation Via Hay River/Enterprise:

- ***rail -*** five 60 foot pipe lengths per car maximizes the loading envelope at 80 tonnes payload generating over 13,000 carloads.

- ***barge -*** an average of 1000 tonnes of pipe per barge will require a total of 705 barge loads in 118 sailings to river access points between Wrigley and Inuvik.

- ***truck*** - two 60 foot pipe lengths per truck generating over 11,000 truckloads (note that special permits would be required for this truck load).

Transportation Via Western Arctic/Beaufort Sealift will require a total of 38 sailings, each discharging 12,000 tonnes of project cargo, 75% of which will be pipe.

New (or relocated) tugs and barges and highway pipe trailers will likely be required, particularly if the project is built out over two construction seasons rather than three.

FUEL MOVEMENT PLAN:

Via Mackenzie River (North of Wrigley)	**122,200 tonnes**
Via Mackenzie Highway (South of Wrigley)	**67,600 tonnes**
Via Mackenzie Northern Railway	**189,800 tonnes**
Via Western Arctic/Beaufort Sealift	**43,100 tonnes**
Total Fuel	**232,900 tonnes**

Fuel for pipeline installation both offshore in the Beaufort and onshore in the Mackenzie Delta will approximate 10% of the cargo transported by sealift ships or barges. Project fuel will be discharged directly to marine pipelaying operations, to supply boats shuttling to those operations, or to the Tuktoyaktuk tank farm.

The balance of project fuel supply will be similar to, but on a larger scale than, the Delta Gas 30 inch pipeline project:

Transportation criteria:

- ***rail -*** Using standard sized tank cars carrying 75,000 litres of diesel fuel at 60 tonne net loads will require over 3,000 carloads to complete project fuel deliveries. As with the Delta Gas pipeline scenario, this could be substantially reduced with Jumbo 100,000 litre tank cars if the Mackenzie Northern Railway is brought up to a mainline standard 286,000 lbs. weight-on-rail capability.

- ***barge -*** barges will each carry 1000 tonnes of fuel as an average payload over a full season. Heavier barge loading is possible early to mid-season when river levels are at their peak. Some 122 barge loads will be required to complete fuel supply delivery north of Wrigley.

- ***truck -*** Full "B" Trains carrying 48,000 litres per load will be utilized to supply fuel to the project stockpile/storage facilities south of Wrigley. A total of over 1700 loads will be required for this program over the life of the project.

EQUIPMENT/MATERIALS MOVEMENT PLAN
[Including Construction Equipment/Camps, Station Equipment and Valves]

Via Mackenzie River (North of Wrigley)	**101,300 tonnes**
Via Mackenzie Highway (South of Wrigley)	**62,200 tonnes**
Via Western Arctic/Beaufort Sealift	**79,200 tonnes**
Total Equipment/Materials	**242,700 tonnes**

As with the Delta Gas 30" pipeline scenario, this group of project materials includes all construction equipment, camp units, compressor and meter station materials and valves as well as ancillary materials and supplies. It is anticipated that these will be trucked to Hay River for barge deliveries to the project spreads north of Wrigley, and trucked directly from the south to the spreads south of Wrigley.

There is a possibility that some project equipment for construction work will be supplied by contractors in the north (e.g., Yellowknife). This will not be a significant component of the total. (Again, note that tonnages provided are one time northbound only and exclude demobilization and intra-project moves by contractors from one spread to another.)

In addition, cranes, welding units, concrete coating equipment and all other equipment/material requirements for subsea pipelaying will be consolidated at a southern port for Beaufort Sealift delivery through the Bering Straits into the Canadian Western Arctic.

Camp Buildings/Modules - Four 1200 man camps (5,920 tonnes each) are anticipated to support each winter construction season for Alaska Gas 52" pipeline installation in the Mackenzie Valley. A total of almost 24,000 tonnes of camps cargo will delivered by barge to sites north of Wrigley and by truck to sites south of Wrigley (see Foothills 42" scenario for typical camp breakdown).

Due to the greatly increased freight volumes of the 52 inch pipeline, investment in new barge and truck trailer transportation equipment is certain.

CONSUMABLES MOVEMENT PLAN

Total 15,300 tonnes

Transportation of all consumables will be by truck direct to pipeline and station camps by winter road and/or all-weather highway.

5.0 TRANSPORTATION SYSTEMS IMPACTS

This section of the report establishes baseline freight flows against which are imposed construction logistics scenarios developed in previous sections of the report. The resulting northern transportation system impacts are assessed and alternative mitigative measures suggested.

Material movement models from the previous section are augmented with the baseline freight flows in this section. Year 2000 baselines were established by PROLOG in separate analyses of Yukon and NWT inbound freight flows. These were developed from a combination of carrier surveys and weigh scale statistics.

Integrating project material movement models with ongoing baseline freight flows allows us to predict northern transportation impacts. We then focus our assessment where these impacts may cause capacity, congestion or interference issues. The total logistics models we have developed allow us to test each construction logistics plan and set a quantitative framework within which to objectively complete an impact assessment.

In each pipeline corridor, we have applied the material movement requirements for two pipeline scenarios that have actually been proposed to set a realistic range of potential transportation system impacts. While modification of throughput design and pipe specifications will continue into the permitting phase for each pipeline, we are confident that the final design will fall between upper and lower limits of the range we have defined for mid-term planning purposes.

In this section, we use the model framework to screen potential transportation risks with respect to fleet capacity, infrastructure capability, gateway congestion and terminal throughput. As a result, we have isolated higher risks areas for contingency planning of impact mitigation measures.

For most major impacts identified in the following sections, contingency alternatives are available to mitigate those impacts on the northern transportation systems.

5.1 Yukon Transportation System Impacts

The Year 2000 baseline freight flows for Yukon are detailed in Table 9 and summarized in a highway density map on the following page.

Table 9

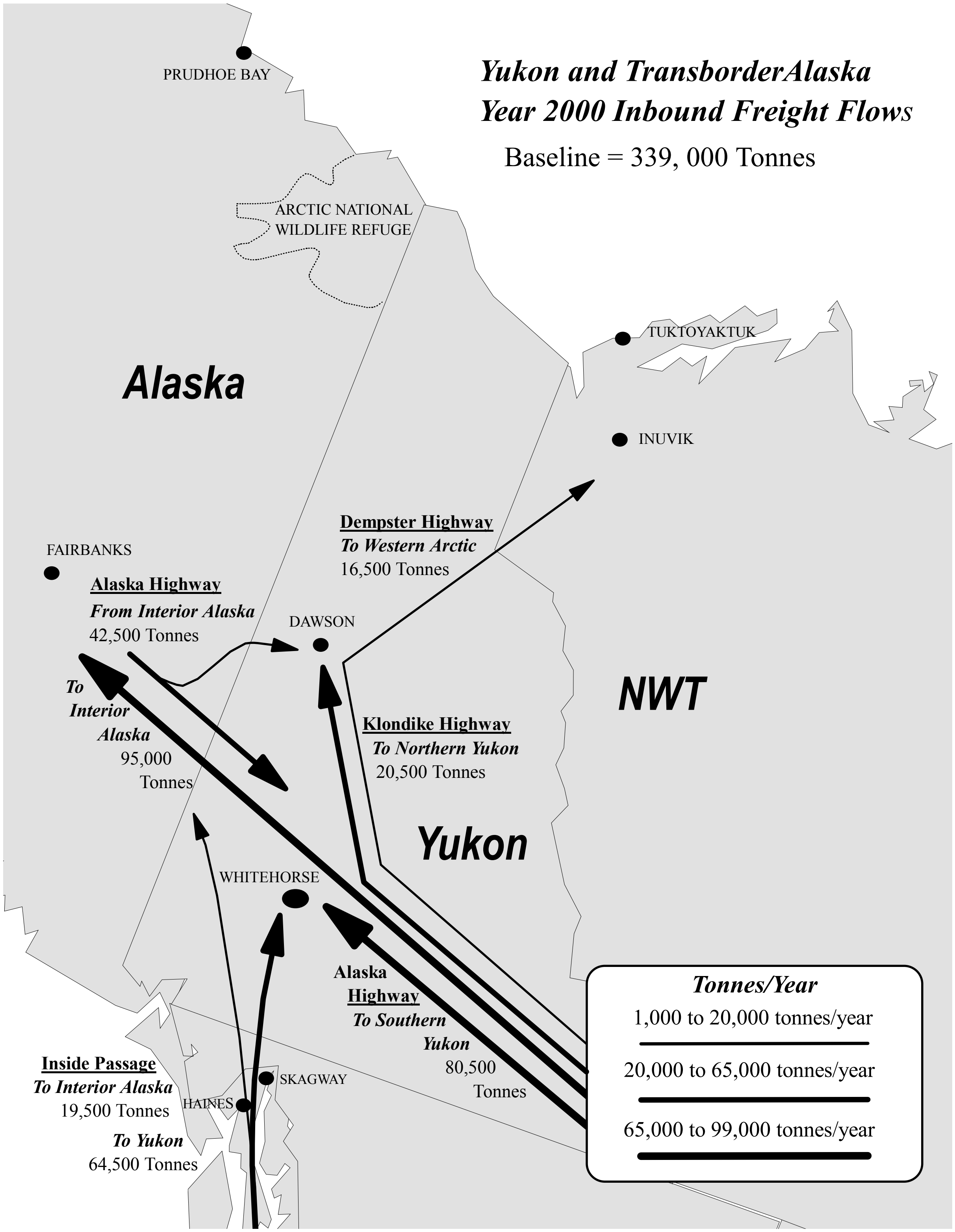
YEAR 2000 YUKON BASELINE

Inbound Freight Flows in Tonnes

Modal Gateway/Routing	Destination	BULK FUEL	DEVLPMT TRAFFIC	GENERAL FREIGHT	TOTAL TONNES	TRUCK LOADS
Alaska Inside Passage Gateways						
Via Haines Highway Ex Haines	To Alaska		930	18,420	19,350	648
Via Haines Highway Ex Haines	To Yukon	11,815	390	0	12,205	371
Via Haines Highway Ex Haines	SUBTOTAL	11,815	1,320	18,420	31,555	1,019
Via Klondike Highway Ex Skagway	To Yukon	36,541	1,420	14,244	52,205	1,367
Alaska Inside Passage Gateways	TOTAL	48,356	2,740	32,664	83,760	2,386
Interior Alaska Highway Gateways						
Via Alaska Highway Ex Alta/BC	To Yukon	34,905	19,281	47,115	101,301	5,168
Via Alaska Highway Ex Alta/BC	To Alaska	3,967	19,237	71,594	94,798	5,758
Via Alaska Highway Ex Alta/BC	To NWT	2,699	3,975	9,534	16,208	781
Alaska Highway Northbound	SUBTOTAL	41,571	42,493	128,243	212,307	11,707
Alaska Highway Southbound	To Yukon	41,095	1,435		42,530	1,084
Interior Alaska Highway Gateways	TOTAL	82,666	43,928	128,243	254,837	12,791
YUKON INBOUND	TOTAL	131,022	46,668	160,907	338,597	15,177

Note: Due to Watson Lake location at the B.C./Yukon border, these statistics include Yukon traffic moving through but not to Watson Lake.

Source: PROLOG Canada Inc., *Northern Transportation Freight Flow Analysis for the Western Arctic, Transborder Alaska & Yukon*, March 2001

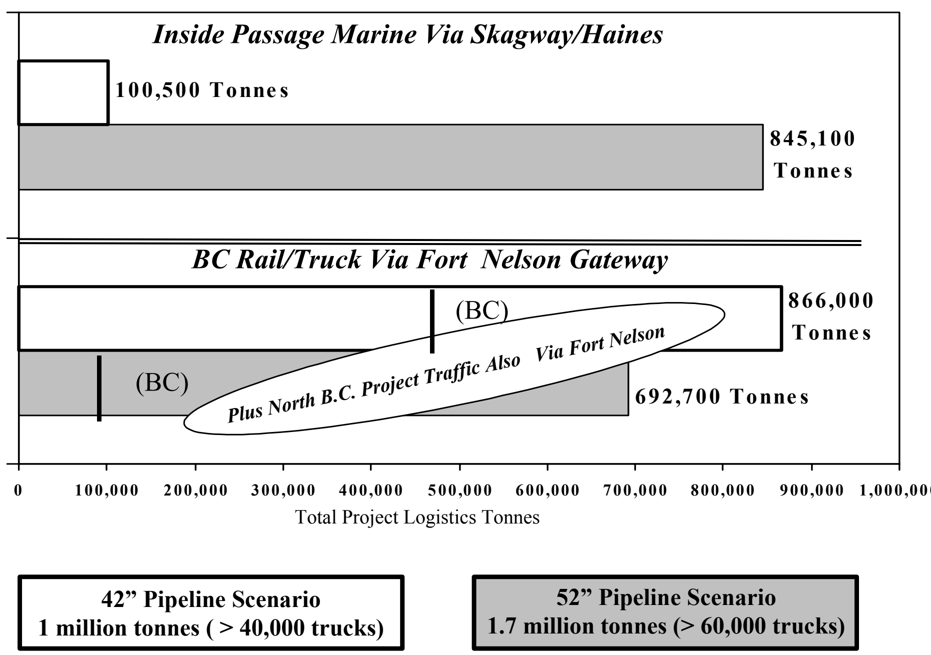

Yukon and TransborderAlaska
Year 2000 Inbound Freight Flows
Baseline = 339, 000 Tonnes
PRUDHOE BAY
ARCTIC NATIONAL
WILDLIFE REFUGE
TUKTOYAKTUK
INUVIK
Alaska
NWT
Yukon
FAIRBANKS
DAWSON
WHITEHORSE
SKAGWAY
HAINES
Dempster Highway
To Western Arctic
16,500 Tonnes
Alaska Highway
From Interior Alaska
42,500 Tonnes
To
Interior
Alaska
95,000
Tonnes
Klondike Highway
To Northern Yukon
20,500 Tonnes
Alaska
Highway
To Southern
Yukon
80,500
Tonnes
Inside Passage
To Interior Alaska
19,500 Tonnes
To Yukon
64,500 Tonnes
Tonnes/Year
1,000 to 20,000 tonnes/year
20,000 to 65,000 tonnes/year
65,000 to 99,000 tonnes/year

The construction logistics requirements for each Alaska Highway pipeline scenario establish a range of potential Yukon transportation system impacts. As the Fort Nelson railhead is a major gateway to Yukon, material movement requirements in British Columbia have also been considered.

The range of project logistics impacts for the two primary Yukon transportation gateways is identified Figure 11.

Figure 11

Alaska Highway Route
Yukon (and BC) Project Logistics Impacts
Inside Passage Ports Vs Fort Nelson Gateway



In Figure 11, the white bars show 42" pipeline project impacts that are concentrated on the Fort Nelson Gateway. The gray bars show that the much greater project tonnage associated with a 52" pipeline scenario will significantly impact both the Fort Nelson and Inside Passage Gateway.

Note that in the lower half of the figure, both bars have a second segment. This is Northern BC project traffic which, in addition to Yukon project traffic, must also move through Fort Nelson.

Total Yukon and B.C. project logistics traffic will approximate a range between 1 million tonnes for the 42" pipe scenario and 1.7 million tones for the 52" Pipe Scenario.

Under both scenarios, project proponents will seek intensive use of BC Rail to Fort Nelson. This is because BC Rail provides:

- The farthest north rail delivery point to Yukon and B.C. pipeline spreads for domestic North American produced 42" pipe
- And the closest rail extension to B.C. pipeline spreads from southern ports for offshore produced 52" pipe.

As a result, BC Rail will either handle a lower tonnage of all 42" pipe or a large part of higher tonnage 52" pipe. Either way the total impact at Fort Nelson will range between 700,000 tonnes and 870,000 tonnes over a 2-3 year construction logistics program. (In addition to rail movement of fuel as well as pipe, this includes the balance of project equipment and materials some or all of which may move into Northern B.C. by truck)

Conversely, the Inside Passage Gateway to Yukon should only see intensive use as the closest tidewater access to Yukon pipeline spreads for offshore produced 52" pipe. Under a 42" pipeline scenario, it is anticipated that, as at present, Inside Passage ports would serve primarily for bulk fuel delivery to Yukon.

The full range of Yukon transportation system impacts is developed in Tables 10 and 11 which integrate baseline annual freight flows with time phased project logistics requirements.

Table 10

Foothills Pipe Lines ALASKA HIGHWAY 42" Pipeline Scenario

YUKON TRANSPORTATION SYSTEM IMPACTS

Metric Tonnes Inbound

	Project Year 1			**Project Year 2**			**Project Year 3**		
	Project Logistics Freight	Baseline Freight Flows	**Total Yukon Freight**	Project Logistics Freight	Baseline Freight Flows	**Total Yukon Freight**	Project Logistics Freight	Baseline Freight Flows	**Total Yukon Freight**
Alaska Inside Passage Gateways									
Via Klondike Highway Ex Skagway									
LINE PIPE	0		**0**	0		**0**			**0**
BULK FUEL		36,500	**36,500**	33,300	36,500	**69,800**	21,600	36,500	**58,100**
EQUIP/MATLS		1,400	**1,400**		1,400	**1,400**		1,400	**1,400**
CONSUMABLES		14,200	**14,200**		14,200	**14,200**		14,200	**14,200**
Subtotal	0	52,100	**52,100**	33,300	52,100	**85,400**	21,600	52,100	**73,700**
Via Haines Highway Ex Haines									
LINE PIPE	0		**0**	0		**0**			**0**
BULK FUEL		11,800	**11,800**	29,100	11,800	**40,900**	16,500	11,800	**28,300**
EQUIP/MATLS		1,300	**1,300**		1,300	**1,300**		1,300	**1,300**
CONSUMABLES		18,400	**18,400**		18,400	**18,400**		18,400	**18,400**
Subtotal	0	31,500	**31,500**	29,100	31,500	**60,600**	16,500	31,500	**48,000**
Interior Alaska Highway Gateways									
Via BC Rail and/or Truck									
LINE PIPE	269,500		**269,500**	144,000		**144,000**			**0**
BULK FUEL		41,600	**41,600**		41,600	**41,600**		41,600	**41,600**
EQUIP/MATLS	61,500	42,500	**104,000**	13,400	42,500	**55,900**		42,500	**42,500**
CONSUMABLES		128,200	**128,200**	3,900	128,200	**132,100**	3,000	128,200	**131,200**
Subtotal	331000	212,300	**543,300**	161,300	212,300	**373,600**	3,000	212,300	**215,300**
Via Alaska Truck Ex Beaver Creek									
LINE PIPE			**0**			**0**			**0**
BULK FUEL		41,100	**41,100**		41,100	**41,100**		41,100	**41,100**
EQUIP/MATLS		1,500	**1,500**		1,500	**1,500**		1,500	**1,500**
CONSUMABLES		0	**0**		0	**0**		0	**0**
Subtotal		42,600	**42,600**		42,600	**42,600**		42,600	**42,600**
Yukon Transport System Total									
LINE PIPE	269,500		**269,500**	144,000		**144,000**	0		**0**
BULK FUEL	0	131,000	**131,000**	62,400	131,000	**193,400**	38,100	131,000	**169,100**
EQUIP/MATLS	61,500	46,700	**108,200**	13,400	46,700	**60,100**	0	46,700	**46,700**
CONSUMABLES	0	160,800	**160,800**	3,900	160,800	**164,700**	3,000	160,800	**163,800**
TOTAL TONNES INBOUND	331,000	338,500	**669,500**	223,700	338,500	**562,200**	41,100	338,500	**379,600**
Equivalent Truckload Summary									
Inbound Truckloads Via:									
SOUTH KLONDIKE HIGHWAY	0	2,340	**2,340**	860	2,340	**3,200**	560	2,340	**2,900**
HAINES HIGHWAY	0	1,410	**1,410**	750	1,410	**2,160**	430	1,410	**1,840**
ALASKA HIGHWAY	14,490	11,430	**25,920**	6,990	11,430	**18,420**	170	11,430	**11,600**
TOTAL TRUCKLOADS INBOUND	14,490	15,180	**29,670**	8,600	15,180	**23,780**	1,160	15,180	**16,340**

Table 11

Alaska Gas Producers ALASKA HIGHWAY 52" Pipeline Scenario

YUKON TRANSPORTATION SYSTEM IMPACTS

Metric Tonnes Inbound

	Project Year 1			**Project Year 2**			**Project Year 3**		
	Project Logistics Freight	Baseline Freight Flows	**Total Yukon Freight**	Project Logistics Freight	Baseline Freight Flows	**Total Yukon Freight**	Project Logistics Freight	Baseline Freight Flows	**Total Yukon Freight**
Alaska Inside Passage Gateways									
Via Klondike Highway Ex Skagway									
LINE PIPE	240,000		**240,000**	157,100		**157,100**			**0**
BULK FUEL		36,500	**36,500**	40,100	36,500	**76,600**	26,100	36,500	**62,600**
EQUIP/MATLS		1,400	**1,400**		1,400	**1,400**		1,400	**1,400**
CONSUMABLES		14,200	**14,200**		14,200	**14,200**		14,200	**14,200**
Subtotal Inbound Tonnes	240,000	52,100	**292,100**	197,200	52,100	**249,300**	26,100	52,100	**78,200**
Via Haines Highway Ex Haines									
LINE PIPE	231,500		**231,500**	95,300		**95,300**			**0**
BULK FUEL		11,800	**11,800**	35,000	11,800	**46,800**	20,000	11,800	**31,800**
EQUIP/MATLS		1,300	**1,300**		1,300	**1,300**		1,300	**1,300**
CONSUMABLES		18,400	**18,400**		18,400	**18,400**		18,400	**18,400**
Subtotal Inbound Tonnes	231,500	31,500	**263,000**	130,300	31,500	**161,800**	20,000	31,500	**51,500**
Interior Alaska Highway Gateways									
Via BC Rail and/or Truck									
LINE PIPE	0		**0**	0		**0**			**0**
BULK FUEL		41,600	**41,600**		41,600	**41,600**		41,600	**41,600**
EQUIP/MATLS	80,000	42,500	**122,500**	20,300	42,500	**62,800**		42,500	**42,500**
CONSUMABLES		128,200	**128,200**	5,000	128,200	**133,200**	3,600	128,200	**131,800**
Subtotal Inbound Tonnes	80000	212,300	**292,300**	25300	212,300	**237,600**	3,600	212,300	**215,900**
Via Alaska Truck Ex Beaver Creek									
LINE PIPE			**0**			**0**			**0**
BULK FUEL		41,100	**41,100**		41,100	**41,100**		41,100	**41,100**
EQUIP/MATLS		1,500	**1,500**		1,500	**1,500**		1,500	**1,500**
CONSUMABLES		0	**0**		0	**0**		0	**0**
Subtotal Inbound Tonnes		42,600	**42,600**		42,600	**42,600**		42,600	**42,600**
Yukon Transport System Total									
LINE PIPE	471,500	0	**471,500**	252,400	0	**252,400**	0	0	**0**
BULK FUEL	0	131,000	**131,000**	75,100	131,000	**206,100**	46,100	131,000	**177,100**
EQUIP/MATLS	80,000	46,700	**126,700**	20,300	46,700	**67,000**	0	46,700	**46,700**
CONSUMABLES	0	160,800	**160,800**	5,000	160,800	**165,800**	3,600	160,800	**164,400**
Total Inbound Tonnes	551,500	338,500	**890,000**	352,800	338,500	**691,300**	49,700	338,500	**388,200**
Equivalent Truckload Summary									
Inbound Truckloads Via:									
South Klondike Highway	*7,570*	*2,340*	***9,910***	*5,990*	*2,340*	***8,330***	*670*	*2,340*	***3,010***
Haines Highway	*7,300*	*1,410*	***8,710***	*3,910*	*1,410*	***5,320***	*520*	*1,410*	***1,930***
Alaska Highway	*4,000*	*11,430*	***15,430***	*1,290*	*11,430*	***12,720***	*200*	*11,430*	***11,630***
Total Inbound Truckloads	*18,870*	*15,180*	***34,050***	*11,190*	*15,180*	***26,370***	*1,390*	*15,180*	***16,570***

Yukon transportation system impacts peak during Project Year 1 for both the Foothills 42" pipeline scenario and for the Alaska Gas 52" pipeline scenario. The following traffic density map combines project logistics movements with baseline freight flows to provide a comparison of full transportation system impacts under either pipeline scenario (See Map 8).

Map 8 makes clear where the most significant transportation impacts will occur under both scenarios. It highlights the dynamics of traffic shifts from the Fort Nelson Rail/Truck gateway to the Inside Passage Gateway ports of Skagway and Haines with an Alaska Gas 52" pipeline.

The balance of this section provides a closer look at the corresponding transportation impact areas: *Fort Nelson Rail/Truck Impact*, *Inside Passage Impact* and *Yukon Highway Impact.*

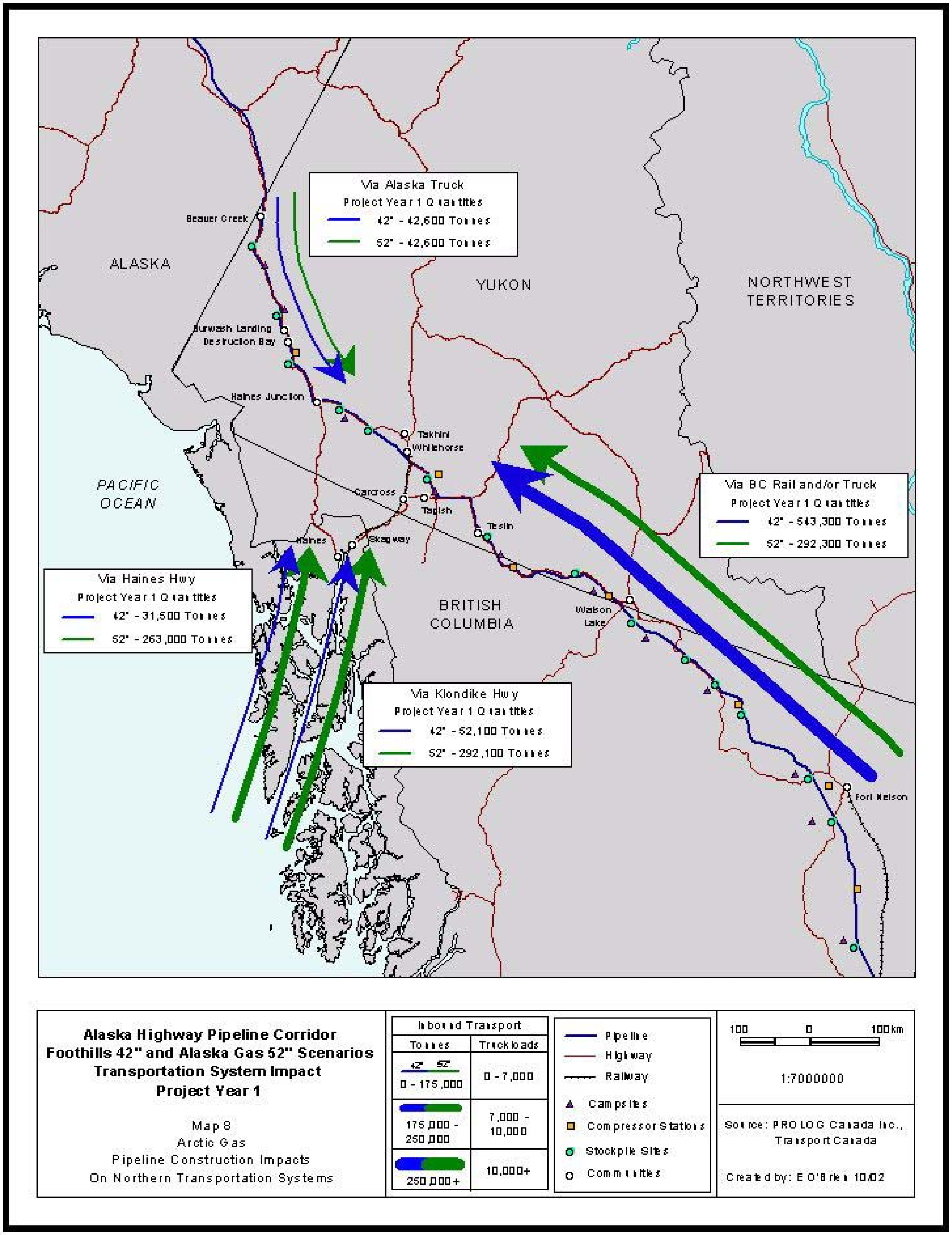
5.1.1 Fort Nelson BC Rail/Truck Impact

Fort Nelson is the North American railhead for the Alaska Highway Corridor. Project materials for both Yukon and B.C. will be funnelled through Fort Nelson by rail and truck. At Fort Nelson project materials that are not already on trucks (e.g., pipe and fuel), will be transferred from rail to trucks.

Transportation system impacts we anticipate are twofold:

- First, the influx of project rail traffic will require railway rehabilitation investment or maintenance expense increases - or both.

- Second, highway activity at Fort Nelson will become intense with the combination of rail loads transferred to trucks joining through truck traffic already on the Alaska Highway.

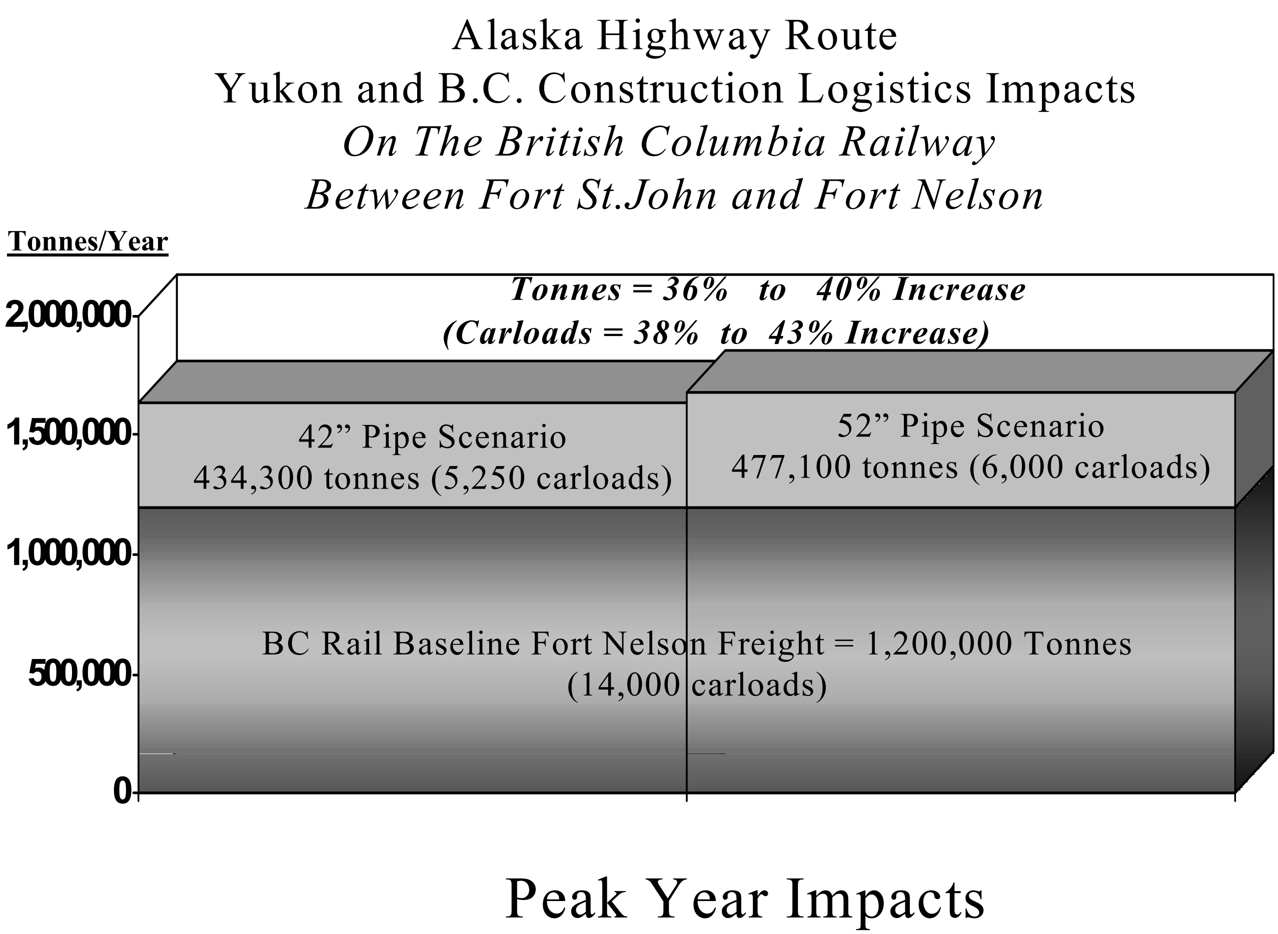


Via Alaska Truck
Project Year 1 Quantities
42" - 42,600 Tonnes
52" - 42,600 Tonnes
Beaver Creek
ALASKA
YUKON
NORTHWEST TERRITORIES
Burwash Landing
Destruction Bay
Haines Junction
Takhini
Whitehorse
PACIFIC OCEAN
Carcross
Tagish
Teslin
Via BC Rail and/or Truck
Project Year 1 Quantities
42" - 543,300 Tonnes
52" - 292,300 Tonnes
Haines
Skagway
Via Haines Hwy
Project Year 1 Quantities
42" - 31,500 Tonnes
52" - 263,000 Tonnes
BRITISH COLUMBIA
Watson Lake
Via Klondike Hwy
Project Year 1 Quantities
42" - 52,100 Tonnes
52" - 292,100 Tonnes
Fort Nelson
Alaska Highway Pipeline Corridor
Foothills 42" and Alaska Gas 52" Scenarios
Transportation System Impact
Project Year 1
Map 8
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
42" 52"
0 - 175,000
0 - 7,000
175,000 - 250,000
7,000 - 10,000
250,000+
10,000+
Pipeline
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100 0 100km
1:7000000
Source: PRO LOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

BC Rail Impact - Material movement plans under both Alaska Highway pipeline scenarios rely extensively on the BC Rail connection to Fort Nelson. This rail line links Fort Nelson directly to the Port of Vancouver. Canadian National Railway connections at Prince George to the Port of Prince Rupert and at Dawson Creek (via Alberta Railnet) to points east and south are also available.

Current Fort Nelson traffic is approximately 14,000 carloads/year (over 1 million tonnes/year). Peak pipe and fuel rail movements for either project scenario increase BC Rail traffic on the Fort Nelson subdivision by approximately 40% (See Figure 12). Note that to fully address the BC rail impacts we have included project traffic to pipeline spreads close to the railway between Fort St. John and Fort Nelson as well as rail traffic transferred to truck at Fort Nelson.

Figure 12



While rail capacity would not normally limit this level of traffic increase, BC Rail has some special circumstances to consider:

- The condition of the rail roadbed requires that heavy loads (e.g. gravel trains) run in winter as much as possible to minimize summer maintenance requirements.
- Typically traffic is handled with 3 trains per week in summer (1 north and 1 south on alternating days); and with 6 trains per week in winter (when the roadbed is frozen solid).
- The few sidings between Fort St. John and Fort Nelson can pass one train each way per day - but more than that can cause problems (Trains take 11 hours over the road).

Technically, BC Rail accommodation of construction logistics traffic should not be an issue. However, as a practical matter, under present operating procedures, BC Rail is currently at capacity to Fort Nelson in winter.

Sufficient lead time will be required for BC Rail to be upgraded in terms of both roadbed and track structure rehabilitation. This will be necessary to maximize rail use in summer as well as winter without incurring prohibitive track maintenance expense. (Note that the current weight-on-rail restriction remains 263,000 lbs. versus a transcontinental mainline standard of 286,000 lbs.) As well, a combination of revised operating procedures and passing siding optimization will be required for increased track system capacity to operate several trains daily.

Unfortunately the prospect of Alaska Highway Pipeline construction raises the requirement for increased investment and/or operating expense at a time of transition for BC Rail. The British Columbia Railway is a provincial crown corporation which is currently being restructured. The Fort Nelson Subdivision (from Fort St. John) has been offered for sale as a shortline property and the entire railway may well be sold off by the Provincial Government before the pipeline project starts.

Fort Nelson Impact - The combination of through trucks and railcar transfer to trucks at Fort Nelson will inevitably create regional highway congestion. The following table provides an indication of how truck congestion will peak under either project scenario.

Peak Project Loads Plus Empty Return Per Day

At Fort Nelson	42" Pipeline	52" Pipeline
Inbound Rail Carloads	15	10
Transferred to Trucks	50	23
Through Truckloads	15	19
Total Truckloads	65	42
Loaded+EmptyTrucks	**130**	**84**

Source: See Appendix G

Under a Foothills 42" pipeline scenario, average project traffic will peak at about 130 trucks per day. This traffic will thin out as project materials are distributed to stockpile sites adjacent to the Alaska Highway north along the pipeline route (refer back to Map 4). By Watson Lake, peak project traffic on the Alaska Highway will be less than two thirds that at Fort Nelson[12].

At Fort Nelson, however, pipeline traffic will compete for transport capacity with Northeast B.C. oilfield and forest products traffic plus community resupply and summer Alaska Highway tourism. In short, Fort Nelson will be a bottleneck for an Alaska Highway Pipeline project.

Impact Mitigation. To the extent that project material movements can be concentrated in winter, the BC rail roadbed will be more capable of handling heavier traffic without proportionately increased maintenance costs. As well, truck traffic and tourism conflicts will be minimized in winter. The trade-off will be increased project logistics resource requirements for dedicated rail and truck fleets within a shorter delivery window.

Alaska Highway congestion can be reduced by encouraging through truck rerouting via Cassiar Highway 37, bypassing Fort Nelson to Watson Lake. Also, as with the 52" pipeline scenario, more extensive use of the Alaska Inside Passage for Yukon destined pipe, especially through the Port of Haines, may become an attractive option for 42" pipe as well.

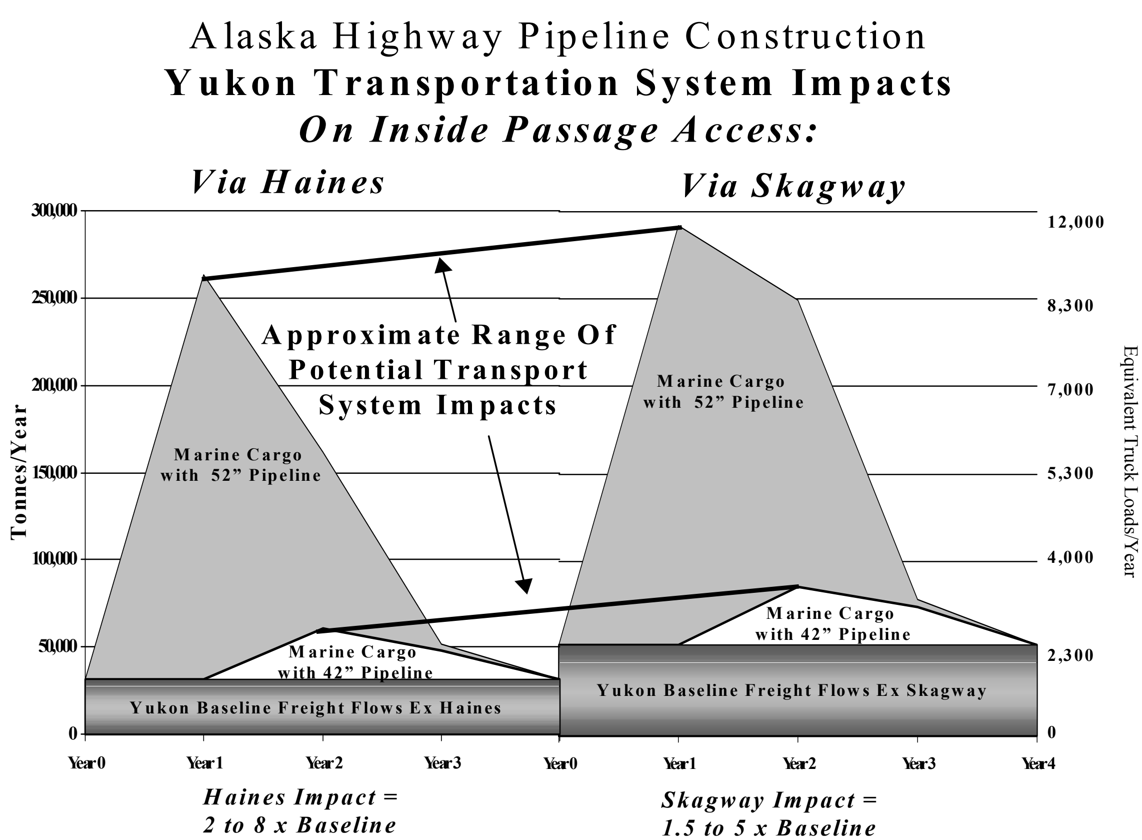
[12] With a larger 52" pipeline, BC Rail impacts are slightly greater (including all Fort St. John – Fort Nelson traffic) and trucking impacts are actually less with Yukon pipe moved via Inside Passage Gateways instead of Fort Nelson.

5.1.2 Alaska Inside Passage Impact

A huge variance in potential Inside Passage port impacts is primarily a function of pipe sourcing. To the extent that pipe is sourced from domestic North American mills, rail delivery via the Fort Nelson gateway would be maximized and the Inside Passage gateway used primarily for barge delivery of fuel. However, to the extent that pipe is sourced from offshore mills, marine delivery to Inside Passage ports will minimize inland transportation to Yukon spreads.

In Figure 13, the combined impact of project logistics and baseline freight flows is shown for both Haines and Skagway. The lower level of 42" pipeline logistics freight is combined with baseline freight flows in the white area of the graph, illustrating a peak in Year 2 with primarily bulk fuel cargoes. A much higher level of combined project logistics and baseline freight flows in the gray shaded area of the graph is driven by offshore sourced 52" pipe which peaks with pre-construction pipe cargoes in Year 1.

Figure 13



Haines Impact. At Haines, the impact on Yukon port access is at least twice baseline freight flows with a 42" pipeline and as much as 8 times baseline freight flows for a 52" pipeline. However, port capacity at Haines is not considered a critical constraint, even at peak 52" pipe requirements exceeding a quarter million tonnes in Year 1. A minimal level of marine operations at Haines currently consists of tanker barge service once a month (Delta Western), container barge service once a week (Alaska Marine Lines) and Alaska ferry service several times per week.

All Haines marine cargo operations take place at the Lutak City Dock which has a 600 foot (183 meter) dockface. One third of the dock is dedicated to Alaska Marine Highway ferry operations. The balance of the facility accommodates commercial cargo operations and includes a roll-on/roll-off ramp and pipeline headers to an adjacent 3 million gallon tank farm.

During 2002 a US$ 2 million port improvement program was undertaken to reconstruct the dock face, resurface the cargo apron and increase water depth alongside. These vessel handling improvements coupled with current minimal cargo activity offer substantial year round excess capacity to handle any project logistics requirements.

Skagway Impact. At Skagway, the impact on Yukon port access is at least 50% more than baseline freight flows with a 42" pipeline and as much as 5.5 times baseline freight flows for a 52" pipeline. The relative impact of project logistics operations compared to baseline freight flows is less than at Haines and port capacity is greater - but that capacity is all but used up by summer cruise ship calls.

During 2002 over 400 cruise ships carrying some 600,000 passengers called at Skagway.

In contrast to intensive cruise ship operations, minimal marine cargo operations are virtually identical to those at Haines. Monthly tanker barge sailings (Petro-marine) discharge bulk fuel through pipeline headers at the northernmost berth of the Ore Dock to an adjacent 2 million gallon tank farm. Weekly Alaska Marine Lines service discharges containers in a "pass-pass" operation at the head of the Ore Dock basin. Alaska Ferry service several times per week is handled at the city owned floating dock which formerly handled container barge cargo as well.

In addition to current marine operations at existing facilities, potential port improvements may offer increased cargo capabilities at Skagway. The Skagway Ore Dock is now owned by the Alaska International Export and Development Authority and, due to the environmental liability from residual ore dust as well as deteriorated structural integrity, will likely be dismantled.

The City of Skagway has prepared plans to convert a portion of the remaining dock area for general cargo operations. In the same berthing basin, the new Alaska Marine Lines dock face can support a roll-on/roll-off ramp. As well, the northern berth of the former White Pass railroad dock is reinforced for heavy cargo handling and the city owned floating ferry dock was also designed for cargo operations.

Although almost all berthing space at Skagway is made available for cruise ships and ferries in summer, during the balance of the year (October through April), the port is virtually vacant. White Pass has indicated a willingness to coordinate cargo vessel operations for pipeline construction logistics and suggests that even in summer there may be some limited flexibility to provide additional cargo vessel berthing space[13].

In short, Inside Passage impacts are inconsequential at Haines, but could see serious scheduling conflicts with cruise ships calling at Skagway in summer.

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[13] White Pass has even gone so far as to suggest that the tourist railroad operated for cruise ship passengers, could be used at night to move pipe as far as Carcross, Yukon. The railroad successfully ran a test load of three 75 foot lengths of 56" pipe for Foothills Pipe Lines over the White Pass summit in the 1980's. However, the condition of 60 White Pass flatcars stored at Bennett, and not used since that time, requires confirmation.

Impact Mitigation. Under a Foothills 42" pipeline scenario, moving pipe for Yukon spreads through the Fort Nelson BC Rail/Truck gateway will minimize impacts on Inside Passage ports.

Increased marine cargo handled at these ports will be primarily limited to construction fuel supply for Yukon spreads. This is a cargo easily accommodated at Skagway or Haines with no additional capacity and little additional highway congestion (a peak averaging only 3 to 4 truckloads per day from each port - See Appendix G).

Under the Alaska Gas Producers 52" pipeline proposal, with pipe as well as fuel moving through Inside Passage Ports, huge increases projected over current cargo activity can likely be accommodated at either port - *in winter*. However, scheduling constraints may well result from extensive summer cruise ship operations at Skagway.

At present the only facility in Skagway capable of efficiently discharging a cargo ship is the farthest north berth of the White Pass Railroad Dock[14]. Use of this facility may be unacceptable in summer as it would not only take away a cruise ship berth otherwise in fulltime use, but also place pipe discharge operations in the path of passengers from other cruise ships on the same dock and require continuous shuttle truck operations through the tourist crowded main streets of Skagway.

Accordingly, strategic procurement and logistics planning should avoid summer use of Skagway. As a practical matter, though, short-run, tactical adjustments to meet inevitable schedule slippage means that summer movements must be assumed and other mitigative measures considered on a contingency basis.

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[14] The city owned floating ferry dock is also available for general cargo operations and has been used in the past by Alaska Marine Lines to discharge containers. However, for heavy pipe discharge the dock surface available to maneuver and load shuttle trucks is extremely limited and must compete with multiple daily ferry operations in summer.

To the extent that project cargo destined for pipeline spreads between Whitehorse and Watson Lake must be discharged in summer, contingency planning should include:

- *Diverting some or all Skagway summer marine cargo operations to Haines*
- *Discharging pipe cargo at night and shifting off berth to anchorage during daytime.*
- *Supplementing winter truck haul with summer rail movement to Carcross at night.*

Cargo vessels discharging pipe at Skagway in summer could take more than a week working around cruise ship operations at the railroad dock. Alternatively, pre-project investment in the proposed new general cargo area at the existing ore dock could expedite summer pipe discharge operations.

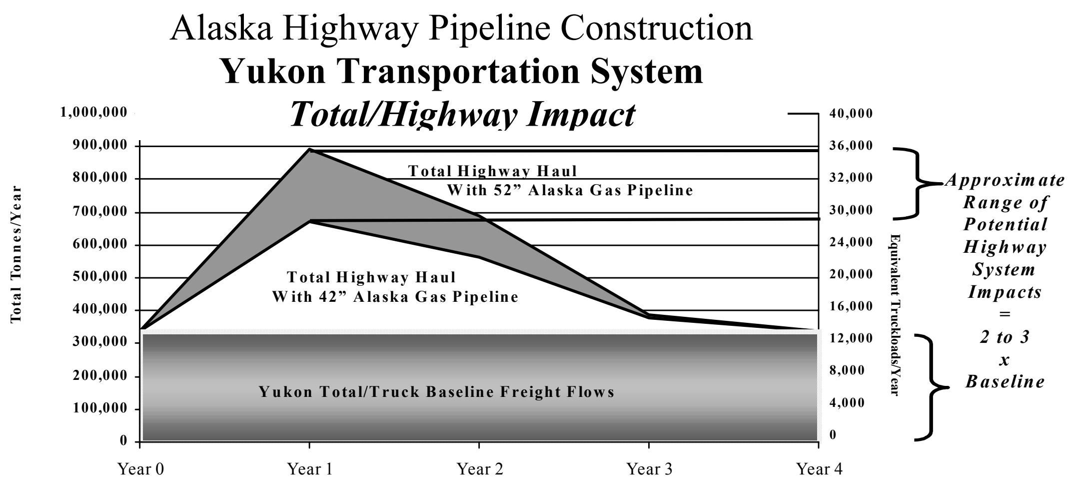
5.1.3 Yukon Highway System Impact

Regardless of the rail or marine transportation gateway through which project materials are routed to Yukon, within Yukon there is no alternative to highway delivery by truck. Figure 14 following shows that the total construction logistics impact will peak during Year 1 ranging from 2 to 3 times baseline freight flows inbound to Yukon on trucks.

The white area of the graph shows the cumulative impact of 42" pipeline construction logistics on top of baseline freight flows into Yukon. The gray shaded area of the graph shows the greater impact of 52" pipeline construction logistics combined with baseline freight flows.

Under the smaller 42” pipeline scenario (the white area on the graph), most of the trucking impact will be concentrated on the Alaska Highway from Fort Nelson. However under the large 52” pipeline scenario (the gray area on the graph), much of the trucking impact will be imposed on the South Klondike and Haines Highway connections to Inside Passage Ports.

Figure 14



While this level of truck transport should not pose a problem during winter when highway travel is minimal, the potential for heavy truck traffic to interfere with summer tourism and light vehicle travel is significant - perhaps not so much in terms of technical road capacity as of an unpleasant trip for tourists.

As a benchmark for potential Yukon highway tourism and travel impacts, we have documented baseline (Year 2000) border crossing traffic for comparison with peak year total truckload traffic from Tables 10 and 11.

Alaska Border Crossing Traffic Counts

(Year 2000 Baseline)

Highway:	**Alaska Highway**	**Haines Highway**	**S Klondike Hwy**
Border Crossing:	Alcan/Beaver Creek	Poker Crk/Pleasant Camp	Skagway/Fraser
CARS			
Entering U.S.	49,649	19,855	39,061
Entering Canada	48,090	18,115	37,356
Total North and South	**97,739**	**37,970**	**76,417**
BUSSES			
Entering U.S.	507	285	8,579
Entering Canada	691	211	1,626
Total North and South	**1,198**	**496**	**10,205**
TRUCKS(loaded & empty)			
Entering U.S.	7,608	954	2,144
Entering Canada	6,359	1,071	1,753
Total North and South	**13,967**	**2,025**	**3,897**

Source: U.S. Customs and Canada Customs traffic counts at indicated border crossing ports of entry.

Alaska Highway Travel Impacts. We assume that trans-border automobile traffic at the Alcan/Beaver Creek crossing consists of Alaskan travelers (residents and tourists) driving either the entire Alaska Highway or the connecting Haines Highway to the Alaska Ferry. Reducing 98,000 Alaska Highway vehicles at Alcan/Beaver Creek by 38,000 Haines Highway vehicles at Poker Creek/Pleasant Camp leaves 60,000 cars (and recreational vehicles) traveling the entire Alaska Highway through British Columbia and Yukon.

Compare this baseline for tourism and travel to Alaska:	60,000 personal vehicles
With	
Peak year 42" pipeline and baseline freight to Yukon:	30,000 truckloads
Total loaded and empty trucks (truckloads x2):	60,000 trucks
Or With	
Peak year 52" pipeline and baseline freight to Yukon:	34,000 truckloads
Total loaded and empty trucks (truckloads x2):	68,000 trucks

Care must be taken before drawing dramatic conclusions from such a comparison crafted with inconsistent sources and broad assumptions. In addition to Alaska travelers, there will be travelers to and within Yukon. In addition to inbound truckloads, there will be local construction and delivery trucks.

Between 60,000 and 70,000 trucks per year is less than 200 trucks per day and only one truck every 5 or 10 minutes on average. By southern standards this would not be an overwhelming transportation impact. However, it could well impair the tourist experience and discourage Alaska Highway travel.

South Klondike Highway Travel Impacts. The popularity of South Klondike Highway travel might also appear impaired by peak 52" pipeline project and baseline freight traffic of almost 10,000 truckloads or 20,000 total loaded and empty trucks. With 76,000 personal vehicle trips between Yukon and Alaska concentrated in the summer months, and some 4,000 current annual truck trips projected to increase fivefold, there is potential for interference with tourist travel on a steep mountain highway.

Again, though, this is not so much an issue of technical highway capacity. As recently as 1996, when Yukon mines were still exporting half a million tonnes/year of concentrate through Skagway, an equivalent 10,000 truckloads or a total of 20,000 loaded and empty ore trucks successfully shared the South Klondike Highway without a noticeable decline in tourism travel.

Highway Travel Impact Mitigation. Over 85% of Alaska tourism and travel documented at border crossings on both the Alaska Highway and the South Klondike Highway occurs in the six month period May through October. Scheduling project procurement and logistics to maximize winter use of the highway system will minimize summer tourist travel impacts.

Otherwise, an aggressive public relations campaign to better influence the actions of both truck drivers and highway travelers can be mutually beneficially. This can include disciplined dispatching to maintain intervals between trucks and/or mandatory use of pull-outs to allow passing when trucks do bunch up. It can also include promotion of, and improvement to, alternate routes for tourists to avoid heavy truck traffic.

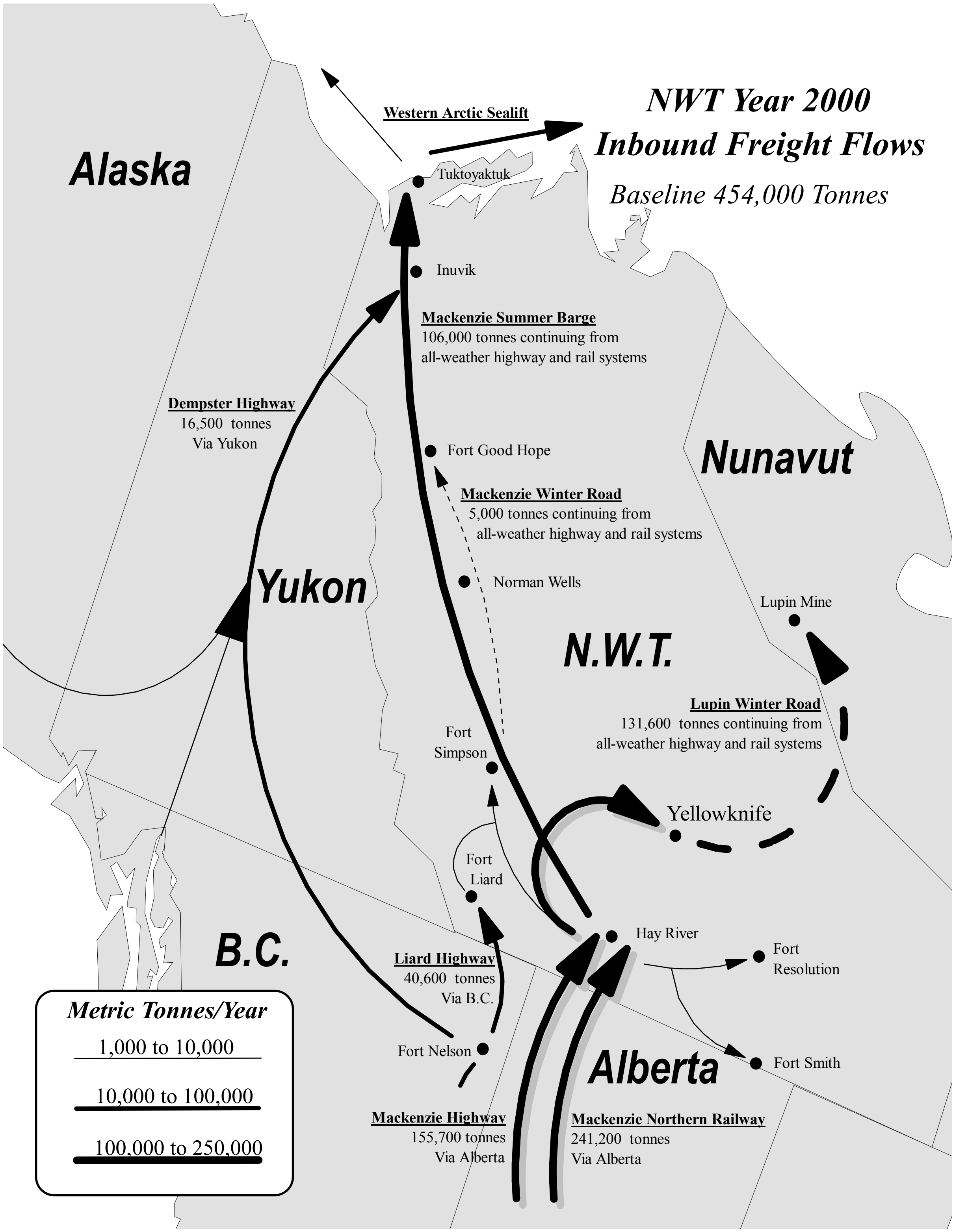
5.2 NWT Transportation System Impacts

Year 2000 baseline freight flows for NWT are detailed in Table 12 and summarized in a highway density map on the following page.

Table 12

Year 2000 Inbound to NORTHWEST TERRITORIES Freight Flows in TONNES

				DRY FREIGHT/DECK CARGO			
MODAL SYSTEMS	ORIGIN	DESTINATION	BULK FUEL	Development Traffic	Community General Frt	TOTAL TONNES	TOTAL TRIPS
NWT Railway System							Carloads
Hay RIver Transfer To Truck	Alberta	NWT Highway System	158,373			158,373	
Hay River Transfer To Barge	Alberta	NWT Marine System	84,600			84,600	
System Total Inbound	Alberta	Hay River Transfer	242,973			242,973	3,798
NWT Marine System							Sailings
Northern Transportation	Hay River	Yellowknife	13,500			13,500	2
Northern Transportation	Hay River	Mackenzie Valley	43,200	4,850	2,250	50,300	4
Cooper Barging Service	Fort Simpson	Mackenzie Valley		3,000	3,500	6,500	9
Northern Transportation	Hay River	Western Arctic-NWT	27,900	4,850	2,250	35,000	10
System Total Inbound			84,600	12,700	8,000	105,300	25
NWT Highway System							Truckloads
Mackenzie Hwy 1	Alberta	Fort Simpson-Wrigley	6,410	6,383	7,017	19,810	663
Hay River Hwy 2 (5&6)	Alberta	Hay River-Fort Smith	25,201	2,888	29,689	57,778	1,932
Yellowknife Hwy 3	Alberta	Providence-Yellowknife	124,962	56,464	53,222	234,648	7,848
Liard Hwy 7 (1&3)	BC	Fort Liard-Fort Simpson	1,800	35,000	3,750	40,550	1,600
	SOUTHERN HIGHWAY Subtotal		158,373	100,735	93,678	352,786	12,043
Dempster Hwy 8	Alberta	Mackenzie Delta	2,699	3,975	9,534	16,208	777
Dempster Hwy 8	Alaska	Mackenzie Delta	169	95		264	14
	NORTHERN HIGHWAY Subtotal		2,868	4,070	9,534	16,472	791
System Total Inbound			161,241	104,805	103,212	369,258	12,834
NWT INBOUND TOTAL	(Inbound entering NWT = all rail and highway freight flows less rail transfer to truck)					453,858	
MODAL GATEWAYS:							
Dempster Highway/Mackenzie Delta			2,868	4,070	9,534	16,472	
Mackenzie and Liard Highways				100,735	93,678	194,413	
Mackenzie Northern Railway			242,973			242,973	
Total All Gateways			245,841	104,805	103,212	453,858	


NWT Year 2000
Inbound Freight Flows
Baseline 454,000 Tonnes
Western Arctic Sealift
Alaska
Tuktoyaktuk
Inuvik
Mackenzie Summer Barge
106,000 tonnes continuing from
all-weather highway and rail systems
Dempster Highway
16,500 tonnes
Via Yukon
Fort Good Hope
Nunavut
Mackenzie Winter Road
5,000 tonnes continuing from
all-weather highway and rail systems
Norman Wells
Yukon
Lupin Mine
N.W.T.
Lupin Winter Road
131,600 tonnes continuing from
all-weather highway and rail systems
Fort
Simpson
Yellowknife
Fort
Liard
Hay River
Fort
Resolution
B.C.
Liard Highway
40,600 tonnes
Via B.C.
Metric Tonnes/Year
1,000 to 10,000
10,000 to 100,000
100,000 to 250,000
Fort Nelson
Alberta
Fort Smith
Mackenzie Highway
155,700 tonnes
Via Alberta
Mackenzie Northern Railway
241,200 tonnes
Via Alberta

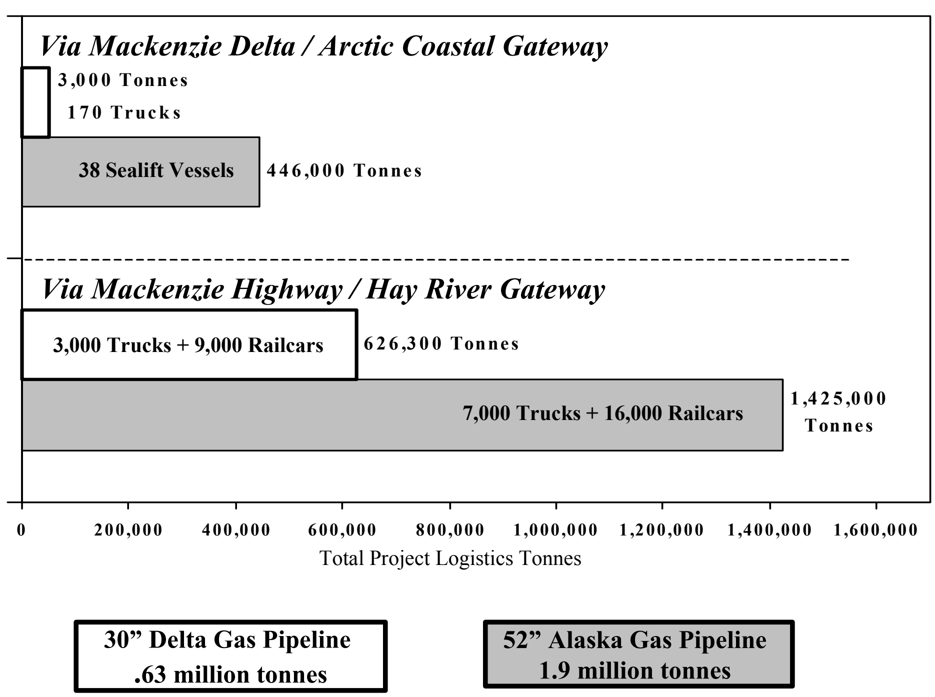
The construction logistics requirements for each Mackenzie Valley pipeline scenario establish a range of potential NWT transportation system impacts. The NWT is accessed by two multi-modal gateways:

- *The Mackenzie Delta is a northern gateway for both summer Sealift and all-weather Dempster Highway access to the Western Arctic.*
- *The Mackenzie Highway Corridor is a southern gateway with rail/truck/ barge transfers at Hay River and the Liard Highway link from Fort Nelson.*

The range of project logistics impacts for these two NWT transportation gateways is identified in Figure 15.

Figure 15

Mackenzie Valley Route
NWT Construction Logistics Impacts
Northern Vs. Southern Transportation Gateways



Total NWT project logistics traffic will range between just over a half million tonnes for the 42" pipe scenario and just under 2 million tonnes for the 52" Pipe Scenario.

Under either scenario, project proponents will maximize rail and truck transfers to barge through the Southern Mackenzie Highway/Hay River Gateway to access stockpiles sites north of Wrigley where the all-weather road ends. The overwhelming impact on this gateway with a 52" pipe scenario will be only partially offset by a huge Beaufort Sealift to the Northern Mackenzie Delta Gateway.

While in Yukon the highway system will receive the full impact of construction logistics traffic, that is not the case in the NWT. For the most part the Mackenzie Valley pipeline route is not even accessible by highway. North of Wrigley access is primarily by summer barge service along the Mackenzie River or by Arctic Sealift to the Mackenzie Delta. Otherwise winter road connections from the Mackenzie and Dempster Highways are the only way to access stockpile sites.

As a result, public all-weather highway impacts will generally be limited to the winter road season posing little potential for interference with summer recreational highway travel. As well anticipated rail routing for at least the high volume pipe and fuel movements, will reduce inbound highway congestion as far as the Hay River railhead. At Hay River, the majority of project logistics traffic will be transferred to Mackenzie River barges - and never hit the highway.

The full range of NWT Transportation system impacts is developed in Tables 13 and 14 which integrate baseline annual freight flows with time phased project logistics requirements.

Table 13

Delta Gas Producers MACKENZIE VALLEY 30" Pipeline Scenario

NWT TRANSPORTATION SYSTEM IMPACTS

Metric Tonnes Inbound

	Project Year 1			Project Year 2			Project Year 3		
	Project Logistics Freight	Baseline Freight Flows	Total NWT Freight	Project Logistics Freight	Baseline Freight Flows	Total NWT Freight	Project Logistics Freight	Baseline Freight Flows	Total NWT Freight
GATEWAY IMPACTS ENTERING NWT:									
Via Mackenzie Hwy/Hay River Gateway									
Rail to Barge Transfer	192,400	84,600	277,000	187,900	84,600	272,500	0	84,600	84,600
Rail to Truck Transfer	0	158,400	158,400	86,100	158,400	244,500	82,000	158,400	240,400
Total Entering NWT by Rail	**192,400**	**243,000**	**435,400**	**274,000**	**243,000**	**517,000**	**82,000**	**243,000**	**325,000**
Truck to Barge Transfer	40,600	21,200	61,800	9,300	21,200	30,500	0	21,200	21,200
Through Truck Transport	0	173,200	173,200	19,300	173,200	192,500	8,700	173,200	181,900
Total Entering NWT by Truck	**40,600**	**194,400**	**235,000**	**28,600**	**194,400**	**223,000**	**8,700**	**194,400**	**203,100**
Via Mackenzie Delta/Coastal Gateway									
Beaufort Sealift			0			0			0
Dempster Hwy Truck	**0**	**16,500**	**16,500**	**2,300**	**16,500**	**18,800**	**800**	**16,500**	**17,300**
Total Inbound Tonnes (All Gateways)	**233,000**	**453,900**	**686,900**	**304,900**	**453,900**	**758,800**	**91,500**	**453,900**	**545,400**
MULTI-MODAL IMPACTS WITHIN NWT:									
Via Mackenzie River Barge (a+b)	*233,000*	*105,800*	*338,800*	*197,200*	*105,800*	*303,000*	*0*	*105,800*	*105,800*
a) RAIL/BARGE	**192,400**	**84,600**	**277,000**	**187,900**	**84,600**	**272,500**	**0**	**84,600**	**84,600**
LINE PIPE	142,200		142,200	138,700		138,700	0		0
BULK FUEL	50,200	84,600	134,800	49,200	84,600	133,800	0	84,600	84,600
b) TRUCK/BARGE	**40,600**	**21,200**	**61,800**	**9,300**	**21,200**	**30,500**	**0**	**21,200**	**21,200**
EQUIP/MATLS	40,600	12,700	53,300	9,300	12,700	22,000	0	12,700	12,700
CONSUMABLES	0	8,500	8,500	0	8,500	8,500	0	8,500	8,500
c) RAIL/TRUCK	**0**	**158,400**	**158,400**	**86,100**	**158,400**	**244,500**	**82,000**	**158,400**	**240,400**
LINE PIPE	0		0	62,000		62,000	59,000		59,000
BULK FUEL	0	158,400	158,400	24,100	158,400	182,500	23,000	158,400	181,400
d) ALL TRUCK (To South NWT)	**0**	**173,200**	**173,200**	**19,300**	**173,200**	**192,500**	**8,700**	**173,200**	**181,900**
EQUIP/MATLS	0	88,000	88,000	17,100	88,000	105,100	5,300	88,000	93,300
CONSUMABLES	0	85,200	85,200	2,200	85,200	87,400	3,400	85,200	88,600
Via Mackenzie Highway Truck (b+c+d)	*40,600*	*352,800*	*393,400*	*114,700*	*352,800*	*467,500*	*90,700*	*352,800*	*443,500*
e) DEMPSTER HWY TRUCK	**0**	**16,500**	**16,500**	**2,300**	**16,500**	**18,800**	**800**	**16,500**	**17,300**
BULK FUEL		2,900	2,900	0	2,900	2,900	0	2,900	2,900
EQUIP/MATLS		4,100	4,100	0	4,100	4,100	0	4,100	4,100
CONSUMABLES		9,500	9,500	2,300	9,500	11,800	800	9,500	10,300
(a+b+c+d+e=f)									
f) TOTAL INBOUND TONNES	**233,000**	**453,900**	**686,900**	**304,900**	**453,900**	**758,800**	**91,500**	**453,900**	**545,400**
LINE PIPE	142,200	0	142,200	200,700	0	200,700	59,000	0	59,000
BULK FUEL	50,200	245,900	296,100	73,300	245,900	319,200	23,000	245,900	268,900
EQUIP/MATLS	40,600	104,800	145,400	26,400	104,800	131,200	5,300	104,800	110,100
CONSUMABLES	0	103,200	103,200	4,500	103,200	107,700	4,200	103,200	107,400
EQUIVALENT INBOUND LOADS:									
Mackenzie Northern Railway (car loads)	*3,200*	*4,000*	*7,200*	*4,600*	*4,000*	*8,600*	*1,400*	*4,000*	*5,400*
Mackenzie River System (barge loads)	*230*	*106*	*336*	*200*	*106*	*306*	*0*	*106*	*106*
Mackenzie Highway (truck loads)	*2030*	*12,040*	*14,070*	*4390*	*12,040*	*16,430*	*3260*	*12,040*	*15,300*
Dempster Highway (truck loads)	*0*	*790*	*790*	*130*	*790*	*920*	*40*	*790*	*830*

Table 14

Alaska Gas Producers MACKENZIE VALLEY 52" Pipeline Scenario

NWT TRANSPORTATION SYSTEM IMPACTS

Metric Tonnes Inbound

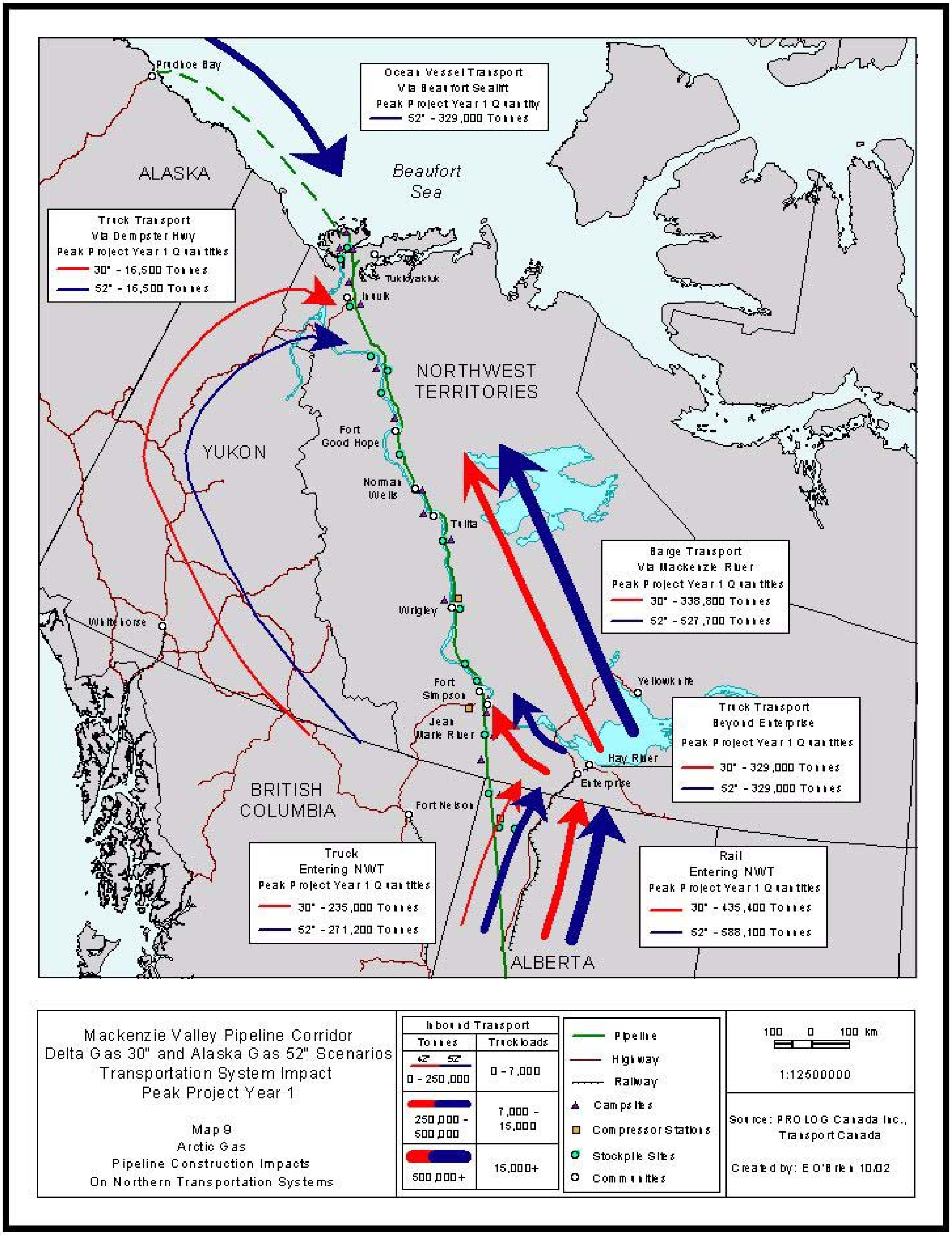
	Project Year 1			Project Year 2			Project Year 3		
	Project Logistics Freight	Baseline Freight Flows	Total NWT Freight	Project Logistics Freight	Baseline Freight Flows	Total NWT Freight	Project Logistics Freight	Baseline Freight Flows	Total NWT Freight
GATEWAY IMPACTS ENTERING NWT:									
Via Mackenzie Hwy/Hay River Gateway									
Rail to Barge Transfer	345,100	84,600	429,700	482,100	84,600	566,700	0	84,600	84,600
Rail to Truck Transfer	0	158,400	158,400	218,000	158,400	376,400	206,500	158,400	364,900
Total Entering NWT by Rail	**345,100**	**243,000**	**588,100**	**700,100**	**243,000**	**943,100**	**206,500**	**243,000**	**449,500**
Truck to Barge Transfer	76,800	21,200	98,000	24,500	21,200	45,700	0	21,200	21,200
Through Truck Transport	0	173,200	173,200	53,100	173,200	226,300	18,900	173,200	192,100
Total Entering NWT by Truck	**76,800**	**194,400**	**271,200**	**77,600**	**194,400**	**272,000**	**18,900**	**194,400**	**213,300**
Via Mackenzie Delta/Coastal Gateway									
Dempster Hwy Truck	**0**	**16,500**	**16,500**	**4,200**	**16,500**	**20,700**	**1,300**	**16,500**	**17,800**
Beaufort Sealift	**450,500**	0	**450,500**	0	0	0	0	0	0
Total Inbound Tonnes (All Gateways)	**872,400**	**453,900**	**1,326,300**	**781,900**	**453,900**	**1,235,800**	**226,700**	**453,900**	**680,600**
MULTI-MODAL IMPACTS WITHIN NWT:									
Via Mackenzie River Barge (a+b)	*421,900*	*105,800*	*527,700*	*506,600*	*105,800*	*612,400*	*0*	*105,800*	*105,800*
a) RAIL/BARGE	**345,100**	**84,600**	**429,700**	**482,100**	**84,600**	**566,700**	**0**	**84,600**	**84,600**
LINE PIPE	295,700		295,700	409,300		409,300			0
BULK FUEL	49,400	84,600	134,000	72,800	84,600	157,400		84,600	84,600
b) TRUCK/BARGE	**76,800**	**21,200**	**98,000**	**24,500**	**21,200**	**45,700**	**0**	**21,200**	**21,200**
EQUIP/MATLS	76,800	12,700	89,500	24,500	12,700	37,200		12,700	12,700
CONSUMABLES	0	8,500	8,500	0	8,500	8,500	0	8,500	8,500
c) RAIL/TRUCK	**0**	**158,400**	**158,400**	**218,000**	**158,400**	**376,400**	**206,500**	**158,400**	**364,900**
LINE PIPE			0	182,900		182,900	174,000		174,000
BULK FUEL		158,400	158,400	35,100	158,400	193,500	32,500	158,400	190,900
d) ALL TRUCK (To South NWT)	**0**	**173,200**	**173,200**	**53,100**	**173,200**	**226,300**	**18,900**	**173,200**	**192,100**
EQUIP/MATLS		88,000	88,000	49,400	88,000	137,400	12,800	88,000	100,800
CONSUMABLES		85,200	85,200	3,700	85,200	88,900	6,100	85,200	91,300
Via Mackenzie Hwy Truck (b+c+d)	*76,800*	*352,800*	*429,600*	*295,600*	*352,800*	*648,400*	*225,400*	*352,800*	*578,200*
e) DEMPSTER HWY TRUCK	**0**	**16,500**	**16,500**	**4,200**	**16,500**	**20,700**	**1,300**	**16,500**	**17,800**
BULK FUEL		2,900	2,900		2,900	2,900		2,900	2,900
EQUIP/MATLS		4,100	4,100		4,100	4,100		4,100	4,100
CONSUMABLES		9,500	9,500	4,200	9,500	13,700	1,300	9,500	10,800
f) BEAUFORT SEALIFT	**450,500**	**0**	**450,500**	0	0	0	0	0	0
LINE PIPE	328,200		328,200						
BULK FUEL	43,100		43,100						
EQUIP/MATLS	79,200		79,200						
(a+b+c+d+e+f=g)									
g) TOTAL INBOUND TONNES	**872,400**	**453,900**	**1,326,300**	**781,900**	**453,900**	**1,235,800**	**226,700**	**453,900**	**680,600**
LINE PIPE	623,900	0	623,900	592,200	0	592,200	174,000	0	174,000
BULK FUEL	92,500	245,900	338,400	107,900	245,900	353,800	32,500	245,900	278,400
EQUIP/MATLS	156,000	104,800	260,800	73,900	104,800	178,700	12,800	104,800	117,600
CONSUMABLES	0	103,200	103,200	7,900	103,200	111,100	7,400	103,200	110,600
EQUIVALENT INBOUND LOADS:									
Mackenzie Northern Railway (car loads)	*4,500*	*4,000*	*8,500*	*9,200*	*4,000*	*13,200*	*2,700*	*4,000*	*6,700*
Mackenzie River System (barge loads)	*420*	*106*	*526*	*510*	*106*	*616*	*0*	*106*	*106*
Mackenzie Highway (truck loads)	*3840*	*12,040*	*15,880*	*10600*	*12,040*	*22,640*	*7330*	*12,040*	*19,370*
Dempster Highway (truck loads)	*0*	*790*	*790*	*230*	*790*	*1,020*	*70*	*790*	*860*
Beaufort Sealift (vessel loads)	*38*	*0*	*38*	*0*	*0*	*0*	*0*	*0*	*0*

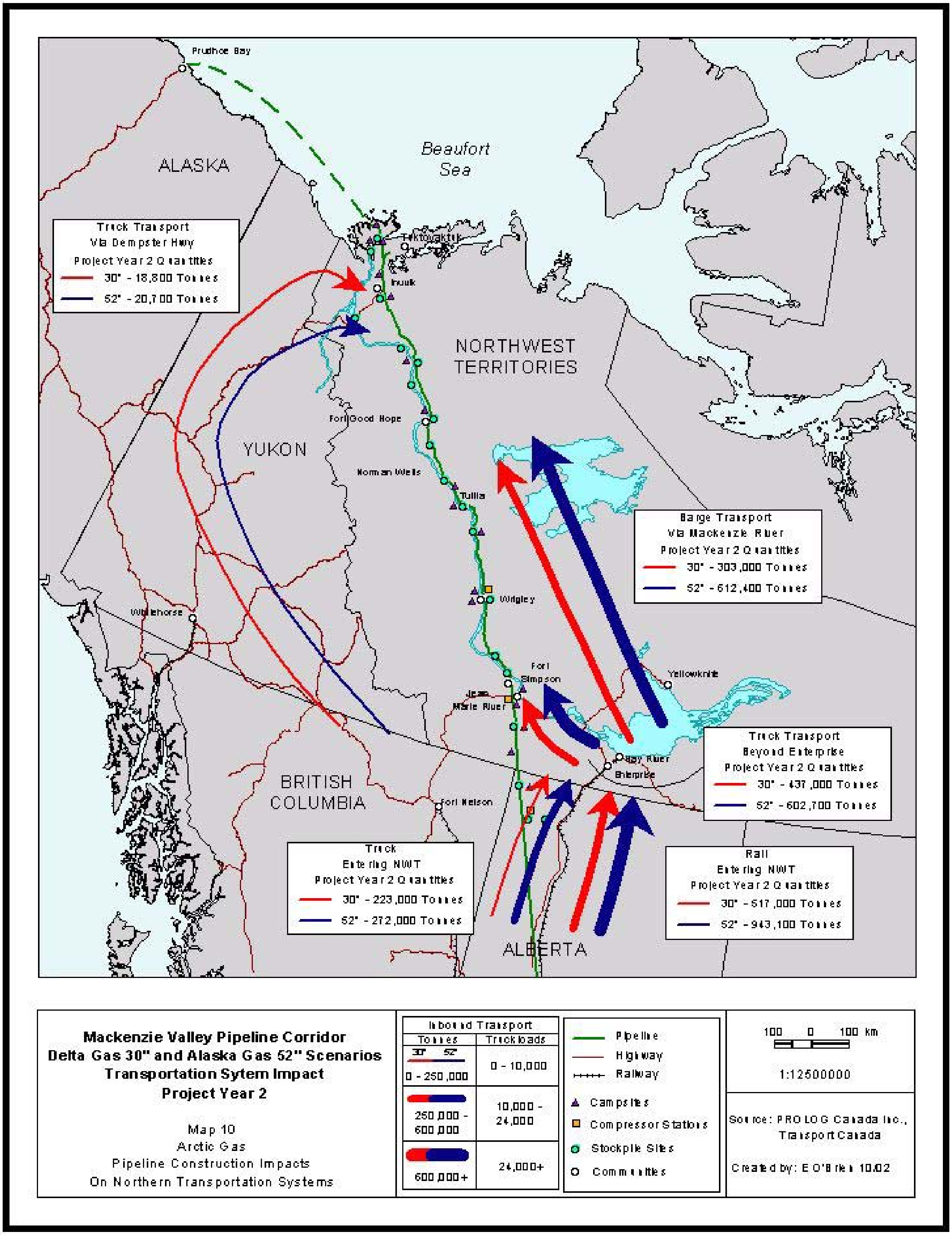
NWT transportation system impacts peak in Project Year 1 for the Alaska Gas 52" pipeline scenario and in Project Year 2 for the Delta Gas 30" pipeline scenario. The traffic density arrows on Maps 9 and 10 (overleaf) combine project logistics movements with baseline freight flows to provide a comparison of full transportation system impacts for the peak year of each pipeline scenario.

Together both maps show how transportation dynamics shift between the two pipeline scenarios. Map 9 shows a Beaufort Sealift in Project Year 1 diverting over half of project traffic for an Alaska Gas pipeline (one third of total traffic). Map 10 shows that in Project Year 2 - without a Beaufort Sealift - the Mackenzie River System and the Mackenzie Northern Railway would have to move about twice as much tonnage for an Alaska Gas pipeline as for a Delta Gas pipeline. For both pipeline scenarios, reliance on rail and marine systems is much greater relative to highway transportation.

The NWT rail and marine systems are inherently high capacity transport modes which can normally be expected to scale up operations within existing infrastructure capabilities without uncontrollable congestion . However, that assumes operating adjustments can increase equipment productivity to meet combined project and baseline demand.

In order to test this assumption, the following subsections outline the range and magnitude of potential impacts on both the rail and marine systems.

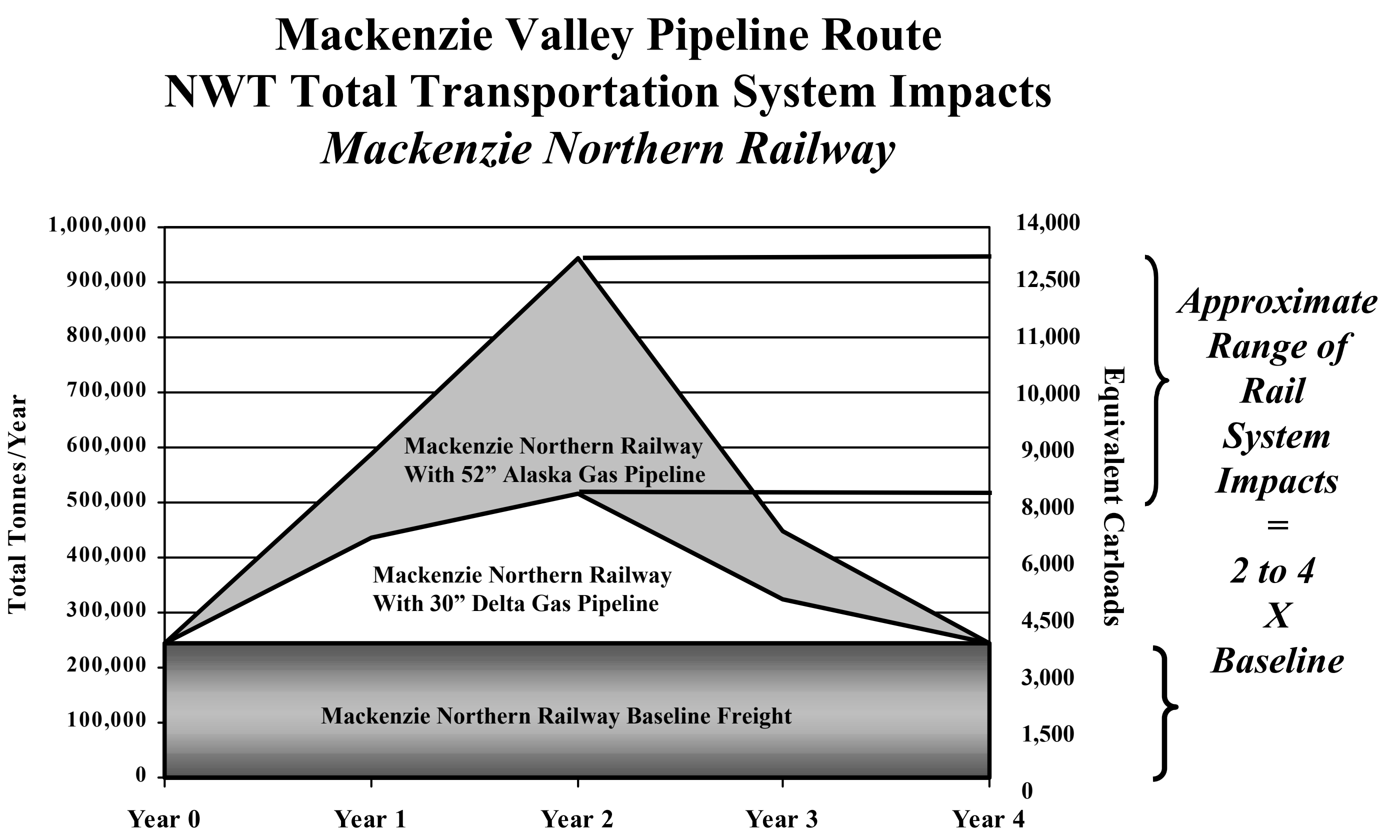

Prudhoe Bay
Ocean Vessel Transport
Via Beaufort Sealift
Peak Project Year 1 Quantity
52" - 329,000 Tonnes
Beaufort Sea
ALASKA
Truck Transport
Via Dempster Hwy
Peak Project Year 1 Quantities
30" - 16,500 Tonnes
52" - 16,500 Tonnes
Tuktoyaktuk
Inuvik
NORTHWEST TERRITORIES
YUKON
Fort Good Hope
Norman Wells
Tulita
Barge Transport
Via Mackenzie River
Peak Project Year 1 Quantities
30" - 338,800 Tonnes
52" - 527,700 Tonnes
Wrigley
Whitehorse
Yellowknife
Fort Simpson
Jean Marie River
Hay River
Enterprise
Truck Transport
Beyond Enterprise
Peak Project Year 1 Quantities
30" - 329,000 Tonnes
52" - 329,000 Tonnes
BRITISH COLUMBIA
Fort Nelson
Truck
Entering NWT
Peak Project Year 1 Quantities
30" - 235,000 Tonnes
52" - 271,200 Tonnes
Rail
Entering NWT
Peak Project Year 1 Quantities
30" - 435,400 Tonnes
52" - 588,100 Tonnes
ALBERTA
Mackenzie Valley Pipeline Corridor
Delta Gas 30" and Alaska Gas 52" Scenarios
Transportation System Impact
Peak Project Year 1
Map 9
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
0 - 250,000
0 - 7,000
250,000 - 500,000
7,000 - 15,000
500,000+
15,000+
Pipeline
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100 0 100 km
1:12500000
Source: PROLOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02


Prudhoe Bay
Beaufort Sea
ALASKA
Truck Transport
Via Dempster Hwy
Project Year 2 Quantities
30" - 18,800 Tonnes
52" - 20,700 Tonnes
Tuktoyaktuk
Inuvik
NORTHWEST TERRITORIES
Fort Good Hope
YUKON
Norman Wells
Tulita
Barge Transport
Via Mackenzie River
Project Year 2 Quantities
30" - 303,000 Tonnes
52" - 612,400 Tonnes
Wrigley
Whitehorse
Fort Simpson
Jean Marie River
Yellowknife
Truck Transport
Beyond Enterprise
Project Year 2 Quantities
30" - 437,000 Tonnes
52" - 602,700 Tonnes
Hay River
Enterprise
BRITISH COLUMBIA
Fort Nelson
Truck
Entering NWT
Project Year 2 Quantities
30" - 223,000 Tonnes
52" - 272,000 Tonnes
Rail
Entering NWT
Project Year 2 Quantities
30" - 517,000 Tonnes
52" - 943,100 Tonnes
ALBERTA
Mackenzie Valley Pipeline Corridor
Delta Gas 30" and Alaska Gas 52" Scenarios
Transportation Sytem Impact
Project Year 2
Map 10
Arctic Gas
Pipeline Construction Impacts
On Northern Transportation Systems
Inbound Transport
Tonnes
Truckloads
30" 52"
0 - 250,000
0 - 10,000
250,000 - 600,000
10,000 - 24,000
600,000+
24,000+
Pipeline
Highway
Railway
Campsites
Compressor Stations
Stockpile Sites
Communities
100 0 100 km
1:12500000
Source: PROLOG Canada Inc., Transport Canada
Created by: E O'Brien 10/02

5.2.1 Hay River NWT Rail/Transfer Impact.

The combined impact of project logistics and baseline freight flows for the Mackenzie Northern Railway is shown in Figure 16.

Figure 16



The lower level of 30" pipeline logistics freight is combined with baseline freight flows in the white area of the graph. The much higher level of 52" pipeline logistics freight is combined with baseline freight flows in the gray shaded area of the graph.

Mackenzie Northern Railway Impacts. Rail movements will peak during Year 2 between half a million tonnes (30" pipe scenario) and almost 1 million tonnes (52" pipe scenario) - 2 to 4 times baseline freight flows approaching a quarter million tonnes. While the impact appears large, it is important to distinguish between capacity concerns for the track infrastructure versus the trains operating on it.

The Mackenzie Northern Railway is a 1,046 km regional rail system owned by RailAmerica and connected to the North American railway network through interchange with Canadian National at Smith, Alberta. At present, the last 311 km of the railway from High Level to Hay River is almost exclusively in service to carry some 4,000 carloads of NWT fuel.

This traffic peaks in winter with one train every other day transferring mine development fuel to winter road trucks. Doubling current traffic to support a Delta Gas pipeline would not be a track capacity problem as the line was originally built with sufficient sidings to handle frequent trains from the Pine Point mine (now closed).

However, RailAmerica management reports that extensive rebuilding of the track structure would be required at the traffic levels projected under either Mackenzie Valley Pipeline scenario. The railway remains at a 263,000 lb. weight-on-rail restriction (compared to the transcontinental mainline standard 286,000 lbs.) and north of High Level that restriction is reduced to just 220,000 lbs., constraining maximum carloadings.

The required work would include systemwide rail and tie replacement and bridge work. At least one summer lead-time is needed to complete rail line rehabilitation before the influx of project pipe and fuel traffic.

As well, car supply and terminal turnaround will be critical operating concerns at rail traffic levels that are doubled or quadrupled. A fleet of some 240 flatcars for pipe and 100 tank cars for fuel will be required for a Delta Gas 30" pipeline. Fleet requirements will jump to 500 flatcars and 150 tank cars for an Alaska Gas 52" pipeline. (See Appendix G.)

Under either scenario, terminal congestion would delay transfer operations, increase car fleet requirements and jeopardize seasonal constrained deliveries for both project freight and community resupply.

Hay River Terminal Impacts. Rail transfers to the barge system will start during the Year 1 summer prior to the first year of winter construction. Then, under either scenario, Year 2 will result in peak rail transfers to the winter road system for southern spread sites during the first construction season; as well as continuing transfers to the river system for summer delivery preceding the final winter construction season in the Mackenzie Valley.

The following tables quantify the peak Project Year 2 impact for both scenarios of combined project and baseline terminal transfers that will take place at Hay River (and Enterprise).

Delta Gas 30" Mackenzie Valley Pipeline
(Data Developed from Table 13)

Transfers	Tonnes	Trucks/Day	Cars/Day	Barges/Day
Rail to Truck	244,500	43.4	11.3	
Rail to Barge	272,500		12.6	2.3
Truck to Barge	30,500	5.4		.3
Through Trucks	192,500	34.1		
TOTAL	**740,000**	**83**	**24**	**2.5**

Alaska Gas 52" Mackenzie Valley Pipeline
(Data Developed from Table 14)

Transfers	Tonnes	Trucks/Day	Cars/Day	Barges/Day
Rail to Truck	376,400	48.0	17.4	
Rail to Barge	566,700		26.2	4.7
Truck to Barge	45,700	9.5		.4
Through Trucks	226,300	47.1		
TOTAL	**1,215,100**	**105**	**44**	**5**

Peak terminal activity at Hay River will require between:

- 2 and 5 barges loaded each day;
- 24 and 44 railcars offloaded each day;
- 83 and 105 trucks loaded, offloaded or running through each day.

Northern Transportation Company Limited controls ample rail accessed, river front vacant land to expand rail transfer and barge loading capacity at Hay River and we do not view physical terminal capacity as a constraint. However, the anticipated activity levels exceed any previous traffic peaks and will have to be carefully planned and managed to minimize bottleneck congestion consequences.

Maximum Highway traffic in and out of Hay River and at Enterprise will range between:

- 5 and 10 trucks per day loading equipment and materials to barges;
- 43 and 48 trucks per day loading fuel from rail cars;
- 34 and 47 through trucks per day at Enterprise;

The total of this truck traffic will average between 83 and 105 truckloads per day. Considering empty as well as loaded trucks, between 166 and 210 trucks per day will pass Enterprise on average. (Note that this is the daily average over a year and, notwithstanding year around cargo staging, traffic will likely peak at a higher level during the summer barge season.) This is the maximum impact that will be imposed on NWT Highways - one truck every 5 to 10 minutes - but it is not as severe as it might seem.

Although all these trucks must pass through Enterprise, trucks from the south transferring loads to barges go no further north; trucks loading fuel for the north go no further south; and through trucks do not even go into Hay River. Nevertheless, over the short distance between Enterprise and Hay River, Highway 2 will be an extremely busy road - especially at the junction with Mackenzie Highway 1.

By way of comparison, mine development and supply traffic moving through Hay River/Enterprise to the Lupin Winter Road over a 2.5 month season was approximately 4,000 truckloads in 2000 and 8,000 truckloads in 2001. On a daily average basis that is equivalent to some 50 to 100 truckloads per day or between 100 and 200 truck movements in both loaded and empty directions.

Mine Development and Supply
Lupin Winter Road Comparison

Year	2000		2001
Tonnes	131,500		256,915
Trucks	3,959		8,168
Per Day	approx 50	to	100
Both Ways	approx 100	to	200

The Lupin Winter Road comparison provides a convenient project impact benchmark. Diavik Diamond Mine construction caused traffic to double in 2001 coincident with ongoing Ekati Diamond Mine supply, reactivation of the Lupin Gold Mine and other mining exploration support in the Slave Geologic Province. At the higher level of traffic imposed by Diavik construction, the NWT Highway System has already accommodated the anticipated peak daily pipeline project impact - including NWT baseline traffic. Note that at the lower level of mining traffic 132,000 tonnes (4,000 truckloads) of Lupin Winter Road traffic is included with all other traffic in the Total NWT Year 2000 Baseline.

The impact if another major mine project and a Mackenzie Valley Pipeline were constructed simultaneously could become a concern. However, these projects would largely rely on diverging transportation corridors that are seasonally complementary (i.e., Lupin Winter Road versus Mackenzie Summer Barge). Beyond a potentially overlapping requirement for common use of Hay River terminal facilities, primarily for rail to truck fuel transfer, we would not anticipate unworkable competition for transportation resources.

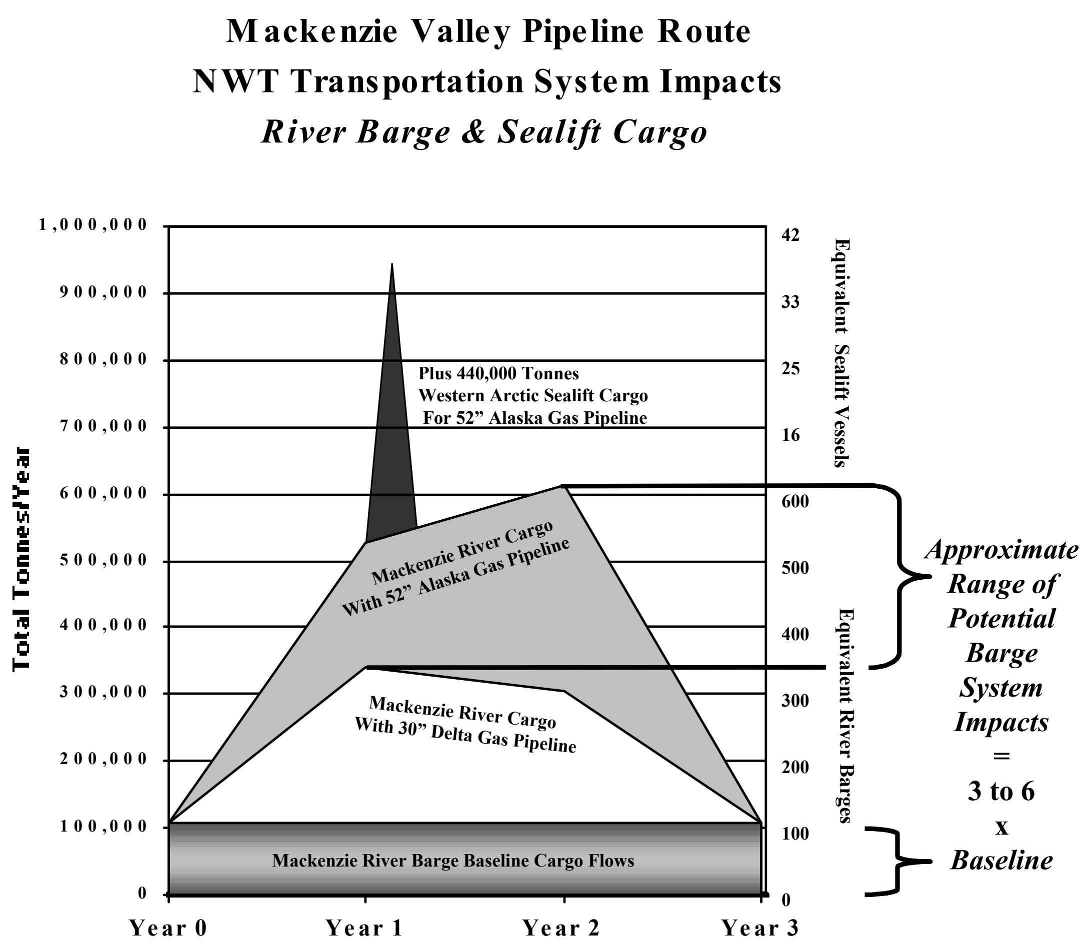
Hay River Rail/Transfer Impact Mitigation. If sufficient lead time is not available to upgrade the Mackenzie Northern Railway to 286,000 lb. weight-on-rail standard or if Hay River terminal congestion is set to compromise connecting barge and truck deliveries, alternate routings will have to be considered. To relieve pressure on the Mackenzie Northern Railway or the Hay River terminal, project material movements destined to all-weather highway and winter road accessible stockpiles south of Wrigley could be diverted to the Fort Nelson BC Rail/Truck Gateway.

Assuming that an Alaska Highway Pipeline is not under construction at the same time, Mackenzie Valley Pipeline truck delivery materials could easily divert through this gateway which is virtually the same trucking distance to stockpile destinations as from Hay River. As well, some portion of barge deliveries might be routed through this gateway and staged in the Fort Simpson area (south of the Liard River) to allow an early-season barge cycle not otherwise possible from Hay River.

5.2.2 NWT Marine System Impacts.

The combined impact of project logistics and baseline freight flows for NWT marine transport systems is shown in Figure 17 following.

Figure 17



Mackenzie River Barge Impacts. For Mackenzie River Barge, the lower level of 30" pipeline logistics freight is combined with baseline freight flows in the white area of the graph; and the much higher level of 52" pipeline logistics freight is combined with baseline freight flows in the grey shaded area of the graph.

The total impact will exceed 300,000 tonnes at the low end and 600,000 tonnes at the high end in each year of a 2 summer barge delivery program supporting a 2 winter pipeline construction schedule. (In addition to movement of fuel as well as pipe, this includes the balance of project equipment and materials all of which must be delivered by barge in the summer of each year before winter construction.) By any measure the Mackenzie River barge system will have to operate well above a nominal capacity of a quarter million tonnes per season with an in-service fleet of five 4500 hp tugs. This is the peak traffic level that was reached in 1985. As well, barge system capacity is always subject to the risk that low water may reduce barge load limits.

Under a Delta Gas 30" pipeline scenario, we believe from discussions with Northern Transportation Company Limited, that operating adjustments and innovations which they may undertake can accommodate the influx of barge traffic - but it will be a challenge.

Under an Alaska Gas 52" pipeline scenario, we believe the Mackenzie River System will be overwhelmed. Even if the Alaska Gas Producers Group maintain a 3 year construction schedule (instead of the 2 year schedule we have assumed), combined project and baseline barge traffic will exceed 380,000 tonnes per season.

Western Arctic/Beaufort Sealift Impacts. The black spike in Figure 17 shows the impact of Beaufort Sealift operations which will come into play under a 52” scenario. A Year 1 Sealift will support logistics staging in advance of Year 2 for first winter construction at pipeline spreads in the Mackenzie Delta as well as first summer subsea pipe laying in the Western Arctic.

Beaufort Sealift movement of pipe, fuel, equipment and materials approaching a half million tonnes will relieve some of the pressure on Mackenzie River system capacity. However, a record Beaufort Sealift into the Canadian Western Arctic will be required. This could involve the equivalent of some 38 Russian Ice Breaking SA 15 Cargo Shiploads with 12,000 deadweight tonnes capacity; as well as a purpose built fleet of subsea pipeline marine equipment operating over an extended summer season (see Appendix F).

Subsea Pipeline Marine Fleet

[1] Plough Ship Ice Class 7
[1] Pipe Lay Ship Ice Class 4
[2] Supply Boats Ice Class 4
[2] Crew Boats Ice Class 3
[2] Ice Management Boats
[1] Ice Breaking Cargo Ship
(one always on station)

Alternatively, Prudhoe Bay experience has proven summer sealift barging reliability that is undoubtedly transferable to the Canadian side of the Beaufort Sea. However, that is not to marginalize the critical level of marine cargo operations planning and management that will be required to complete sealift discharge within a draft limited, ice constrained, rudimentary port environment.

Marine Impacts Mitigation.

In the short term, contingency alternatives to mitigate potential marine capacity constraints could include:

- Staging an early season barge cycle from the Fort Simpson Area south of the Liard River.
- Diverting some rail traffic to a BC Rail Fort Nelson gateway for truck delivery spreads.
- Opening a Mackenzie Delta/Deep Draft Sealift Gateway for 30" pipe as well as 52" pipe.
- Allocating some pipe to Inside Passage Marine/Dempster Highway haul to Mackenzie Delta.

Over a longer term planning horizon, it is apparent from our traffic assessment that Mackenzie River barging support of an Alaska Gas 52" Pipeline is all but impossible for an overlapping two year logistics and construction schedule within a three year envelope. Alaska gas producers will have to stick with a 4 year schedule - at least from the barge logistics perspective of almost 1 million tonnes of project cargo before even considering community resupply.

This may even be true for a smaller diameter Delta Gas Pipeline with only half as much project cargo. A three season barge delivery program would keep 30" pipeline project cargo, in combination with baseline barge freight, at a more manageable level just under 250,000 tonnes per year.

Alternatively, additional marine equipment may be acquired to increase current fleet capacity for a two season barge delivery program. However, a one-year lead-time will be required for new-construction and/or to bring vessels into the Western Arctic/Mackenzie River system.

Either way, then, lengthening to a four year project schedule incorporating 3 barge seasons to ease river transportation impacts could be necessary because:

- A 2 season barge delivery program may require fleet augmentation which will require a one year lead-time; or
- A 3 season barge delivery program may be required to ensure project deliveries on schedule within current fleet capabilities.

In discussion with Northern Transportation Company Limited, a longer range, strategic planning perspective was apparent with regard to the broader potential for repositioning of marine assets in the Western Arctic/Mackenzie River system. The context for northern marine resupply is shifting with proposals for new transportation infrastructure and operations. A Bathurst Inlet Port and Road Project, for example, could completely realign resupply routes, perhaps relieving some of the current capacity concerns for conventional Mackenzie River barge project logistics support.

NORTHERN RESOURCE DEVELOPMENT LOGISTICS

Arctic Tarsiut at Tuktoyaktuk

South Klondike Highway Concentrate Haul

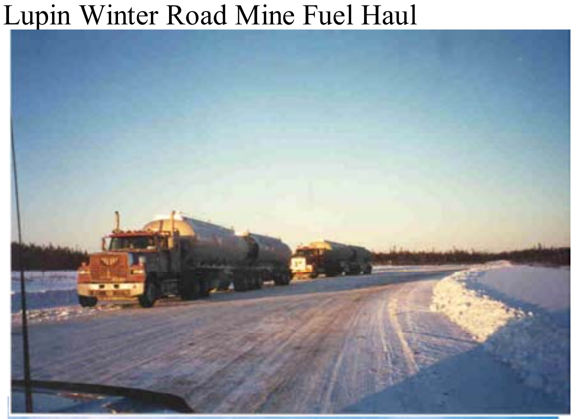
Canmar Supply Yard at Tuktoyaktuk

Mackenzie River East Channel Ice Road

Norman Wells Winter Road

Early Season Staging At Hay River Barge Terminal

Lupin Winter Road Mine Fuel Haul



Hay River Barge Terminal

Foothills 56" Pipe Test Load at Whitehorse

6.0 SUGGESTIONS AND CONCLUSIONS

In Yukon, construction logistics for Alaska Highway pipeline proposals will be unavoidably imposed on the highway system beyond British Columbia and Alaska gateways. In the NWT, construction logistics for Mackenzie Valley pipeline proposals will rely much more on rail and marine modes. However, the NWT transportation system is seasonally constrained by winter roads and summer barging, while the Yukon transportation system is seasonally constrained only by summer tourist travel.

This report determines that the potential for significant transportation system impacts includes:

In the Alaska Highway Corridor

- The BC Rail/Truck Gateway at Fort Nelson;
- The Inside Passage Marine/Truck Gateway at Skagway; and
- The overall level of truck traffic on the Yukon Highway System.

In the Mackenzie Valley Corridor

- Car supply for NWT Rail movements;
- Rail/truck/barge terminal transfer congestion at Hay River;
- Barge fleet capacity on the Mackenzie River; and
- Sealift offload capability in the Western Arctic.

Within this broad context, we have completed a quantitative framework from which are drawn the following specific conclusions and practical suggestions for both the Alaska Highway Pipeline Corridor and the Mackenzie Valley Pipeline Corridor.

6.1 Alaska Highway Pipeline Corridor

The results of our impact assessment establish a range of potential impacts that is set by the extremes of the smaller 42" diameter pipeline proposed by Foothills Pipe Lines and the larger 52" diameter pipeline proposed by the Alaska Gas Producers.

This report has quantified, in total tonnes, the dramatic increase in logistics impacts from the difference in pipe specifications for the two proposals. There will be a correspondingly dramatic difference in terms of load configuration, fleet size and trips imposed on the northern transportation system.

This is especially significant in Yukon as there is no modal alternative to relieve the full impact that will be imposed on the highway system. For Alaska Highway Pipeline construction, project procurement and delivery that de-emphasizes major material movements in summer, can minimize northern transportation system impacts.

Accordingly we suggest that, project scheduling criteria mandate material movements in winter as an overall strategy to mitigate northern transportation systems impacts.

However, as a practical matter, short run tactical adjustments to meet inevitable schedule slippage, avoid terminal congestion and level fleet peaks - means that summer movements must be assumed and other mitigative measures considered on a contingency basis.

While within Yukon there is no modal alternative to highway hauls, Inside Passage ports at Skagway and Haines, Alaska provide an alternative to the BC Rail/Truck Gateway at Fort Nelson.

This underutilized Yukon gateway will become an important alternative for consideration:

- If all North American produced pipe and materials are funneled to the BC Railway for Yukon as well as BC construction (for which there is no gateway alternative); and
- If BC Rail rehabilitation investment to accommodate heavier train traffic between Fort St. John and Fort Nelson becomes an issue; or
- If Alaska Highway congestion will create an unacceptable level of interference with summer travelers between Fort Nelson and Watson Lake.

On the other hand, the Inside Passage Gateway and connecting Yukon highways could be impacted by intense marine cargo activity associated with large 52" diameter pipe shipments from offshore mills - or with smaller 42" diameter pipe shipments optionally routed through the Panama Canal from domestic mills with ocean access.

Under either scenario, we recommend that contingency plans be developed to:

- *Divert a significant portion of Yukon destined project materials to Inside Passage Marine transportation via Skagway and Haines, Alaska.*
- *Limit summer use of Skagway and the South Klondike Highway during the cruise ship/tourist season and maximize winter use to access southern Yukon spreads.*
- *Shift to Haines summer marine cargo operations conflicting with cruise ship berthing at Skagway and maximize winter use of Haines to access northern Yukon spreads.*

Under either pipeline scenario, careful consideration must be given to the mitigation of highway travel impacts that will be unavoidable in Yukon. In addition to inbound personnel and material movement impacts which this report has identified, there will be a huge influx of intra-Yukon highway activity for local goods and personnel movements related to pipeline construction.

For the Yukon (and northern B.C.) public highway system, these will include:

- direct project transportation (long distance trucks)
- materials staging and redistribution (local trucks)
- construction crew work site travel (busses)
- project management travel (pick-up trucks)
- indirect project transportation
  - contractor servicing and repositioning (construction equipment)
  - local vendor purchases (delivery vans)
- induced project transportation
  - camp commuting and recreational travel (light vehicles)
  - economic spin-off travel and transportation. (all vehicles)

Public experience with the Alyeska Pipeline project points to highway safety issues resulting as much from increased light-vehicle trips as from heavy truck traffic. These will be a year around impact for two season construction on the Alaska Highway Pipeline route, but they will be of even greater concern during the summer tourist months.

We suggest that long distance detours for summer travel be developed during the three year project preparation and construction period. The State of Alaska should be solicited to jointly improve and promote an alternate travel route which could include some or all of the following:

- *Cassiar Highway to avoid Northern B.C. construction as far as Watson Lake.*
- *Robert Campbell and North Klondike Highways to avoid construction in Yukon.*
- *Top-of-the World and Taylor Highways to complete a detour to Anchorage at Tok.*

We conclude that, with careful contingency planning, project logistics impacts on the Yukon Transportation system will be manageable under either pipeline scenario.

6.2 Mackenzie Valley Pipeline Corridor

The results of our assessment establish a range of potential impacts that is set by the extremes of the smaller 30" diameter pipeline proposed by Delta Gas Producers and the much larger 52" diameter pipeline proposed by Alaska Gas Producers. The range of results is much greater than with the Alaska Highway Route due to the much greater difference in proposed pipe sizes.

As well for Alaska Gas, while a southern Alaska Highway Pipeline would include approximately 1200 kilometers in Alaska, a northern pipeline route via the Mackenzie Valley Corridor would be almost entirely in Canada and would impose the greatest logistics impact of the project on the Northwest Territories Transportation System. Even if an Alaska Gas Pipeline was built over three years instead of the two year construction period we have assumed, project logistics traffic in <u>each year</u> would equal the total of all logistics traffic in two years for a Delta Gas Pipeline!

With a Northern Mackenzie Corridor Route for an Alaska Gas 52" Pipeline, we conclude that the existing marine transportation system would be overwhelmed:

- *An unprecedented Sealift fleet of some 20 to 40 deep draft vessels (depending on a one or two summer sealift program) will be required to discharge almost half a million tonnes of project cargo to the Canadian Arctic Coast within a limited ice-free shipping window.*

- *Without new equipment acquisition, the Mackenzie River System cannot accommodate full material movement requirements even if extended to a three year logistics program.*

We have assumed that pipeline spreads in the Mackenzie Delta can be supported logistically by Western Arctic Beaufort Sealift to relieve pressure on the Mackenzie River system. However for a 52" Alaska Gas pipeline almost one million tonnes of project cargo must still be moved by river barge in two (or possibly three seasons); and current river barge fleet capacity for a full shipping season at normal water levels is reported to approximate a quarter million tonnes.

Although a much lower limit to the potential range of impacts is set with a Delta Gas pipeline project in the same corridor, the combination of baseline and project traffic will still exceed a nominal barge fleet capacity of a quarter million tonnes per season.

Under either pipeline scenario in the Mackenzie Corridor, we suggest mitigating seasonally constrained marine cargo capability with contingency planning to:

- *Stage additional early season barge cycles as feasible from the Fort Simpson Area south of the Liard River to increase Mackenzie River system fleet productivity.*

- *Verify and/or improve deep draft marine cargo discharge capability in the Western Arctic to relieve capacity pressure on the Mackenzie River system.*

- *Utilize ice-free Inside Passage Ports for all-season Mackenzie Delta access via the Dempster Highway to deliver Mackenzie system and/or Sealift marine cargo that may miss the summer shipping window.*

Public highway impacts in the Northwest Territories are not nearly the concern posed in Yukon and B.C. That is because for the most part, major material movements never hit the highway. Pipe and fuel are transferred from rail to barge at Hay River or delivered directly to the Mackenzie Delta by Western Arctic Sealift.

The irony of Mackenzie Valley pipeline options is that a winter constrained construction project also minimizes interference with the traveling public. Much of the pipeline will only be accessible by winter roads and during winter personal vehicle travel is typically at a minimum anyway. Project personnel will transfer to local air shuttle services at the Yellowknife gateway airport which is already accommodating, without any negative impact, similar crew rotations from NWT Mining development and operations.

New approaches proposed for northern transportation infrastructure and operations may change the nature of northern resupply coincident with construction of a Mackenzie Valley Pipeline.

We suggest a comprehensive review of shifting northern resupply dynamics that may be driven by new technology, restructured marine operations and/or port and highway infrastructure investments.

We conclude that project logistics impacts on the NWT Transportation System will be manageable at the low end of the range as set by a Delta Gas project; but overwhelming at the high end of the range as set by an Alaska Gas Pipeline project.

APPENDIX A

Airport Infrastructure

1. Mackenzie Valley Pipeline

For the Mackenzie Valley Route four airports have already been specifically identified in the logistics planning: Inuvik, Norman Wells, Wrigley and Fort Simpson. Although Yellowknife Airport is not located on the pipeline right-of-way, it will likely serve as the primary airport gateway for construction personnel.

1.1 Inuvik:

Inuvik Airport is located 12 kms east of the community and in 2000 it handled 16,555 aircraft movements.

- Runway 05/23: Asphalt; 6,000' x 150'
- Air Terminal Building (23,640 s.f.)
- Fire Hall
- Aviation Fuel – Available
- Air Traffic Services: Flight Service Station (24/7)
- Visual Aids/Navaids: ILS; NDB; VOR/DME; VASIS; Strobe Beacon; High Intensity Airfield Lighting; High Intensity Approach Lights; Runway Visual Range; Windsock

Inuvik is a base for a number of rotary and fixed-winged operators and is served by Canadian North and First Air, both of which operate scheduled service using B-737 aircraft.

1.2 Norman Wells:

Norman Wells Airport is located immediately north of the community and in 2000 it handled 14,690 aircraft movements.

- Runway 09/27: Asphalt; 6,000' x 150'
- Air Terminal Building (18,913 s.f.)
- Aviation Fuel – Available
- Air Traffic Services: Flight Service Station (24/7)
- Visual Aids/Navaids: Medium Intensity Airfield Lighting; Low Intensity Approach Lighting; Precision Approach Path Indicator; NDB; VOR/DME; Windsock

Canadian North operates scheduled service to Norman Wells using B-737's. North-Wright Airways also provides scheduled service with Cessna Caravan 208 and Beech 99 aircraft.

1.3 Wrigley:

Wrigley Airport is located 2.7 kms from the community and in 2000 it handled 677 aircraft movements.

- Runway 10/28: Gravel; 3,500' x 100'
- Air Terminal Building (915 s.f.)
- Apron Run-up Pad
- Aviation Fuel – Not Available
- Visual Aids/Navaids: Low Intensity Airfield Lighting; VASIS; Runway Edge Illuminated Lighting; Strobe Beacon; NDB; VOR/DME; Windsock

There is currently no scheduled air service at Wrigley. The critical aircraft is shown as the DHC-6 Twin Otter.

1.4 Fort Simpson:

Fort Simpson Airport is located 16 kms south of the community and in 2000 it handled 3,238 aircraft movements.

- Runway 13/31: Asphalt; 6,000' x 150'
- Air Terminal Building (8,438 s.f.)
- Aviation Fuel – Available
- Air Traffic Services: CARS (24/7)
- Visual Aids/Navaids: Medium Intensity Airfield Lighting; NDB; Precision Approach Path Indicator; VOR/DME; Windsock

First Air operates scheduled service to Fort Simpson using the 46-passenger ATR-42 and the airport is capable of supporting the B-737.

1.5 Yellowknife:

Yellowknife Airport is located 6.0 kms from the community and in 2000 it handled 58,359 aircraft movements.

- Runway 15/33: Asphalt; 7,500' x 150'
- Runway 09/27: Asphalt; 5,000' x 150'
- Air Terminal Building (38,832 s.f.)
- Fire Hall
- Aviation Fuel – Available
- Air Traffic Services: FSS; FIC; Tower
- Visual Aids/Navaids: ILS; NDB; VASIS; Strobe Beacon; Runway Visual Range; Precision Approach Path Indicator; High Intensity Approach Lights; High and Medium Intensity Airfield Lighting.

Yellowknife is currently served on a scheduled basis by Canadian North, First Air, Buffalo Airways, Northwest Air Lease, Air Tindi and North-Wright Airways. The airport currently experiences about 45 scheduled departures daily and both Canadian North and First Air operate B-737 aircraft.

1.6 Over-the-Top Segment

Apart from Inuvik, there are three other existing airports that could support an over-the-top extension of the Mackenzie Valley route: Fort McPherson, Aklavik and Tuktoyaktuk.

1.6.1 Fort McPherson:

The Fort McPherson airport is located 3.2 kms south of the community and in 2000 it handled 494 aircraft movements.

- Runway 11/29: Gravel; 3,500' x 100'
- Air Terminal Building (1,016 s.f.)
- Aviation Fuel – Not Available
- Apron Run-up Pads
- Air Traffic Services: CARS (65 hours/week)
- Visual Aids/Navaids: Low Intensity Airfield Lighting; NDB; VASIS; Strobe Beacon; Runway End Identification Lighting; Windsock

Currently Fort McPherson has no scheduled air service. The critical aircraft is the Beech 99.

1.6.2 Aklavik:

The Aklavik airport is located adjacent to the community and in 2000 it handled 1,658 aircraft movements.

- Ruway 12/30: Gravel; 3,000' x 75'
- Air Terminal Building (893 s.f.)
- Apron Run-up Pad
- Aviation Fuel – Not Available
- Air Traffic Services: CARS (65 hours/week)
- Visual Aids/Navaids: Low Intensity Airfield Lighting; VASIS; Strobe Beacon; NDB; Windsock; Runway End Identification Lighting

Aklavik is currently served on a scheduled basis by Arctic Wings and Stage Air, operating Cessna 205, 206 and 207 aircraft.

1.6.3 Tuktoyaktuk:

Tuktoyaktuk airport is located 3.2 kms southeast of the community and in 2000 handled 4,158 aircraft movements.

- Runway 09/27: Gravel; 5,000' x 150'
- Air Terminal Building (4,532 s.f.)
- Apron Run-up Pads
- Aviation Fuel – Not Available
- Air Traffic Services: CARS (161 hours/week)
- Visual Aids/Navaids: Medium Intensity Airfield Lighting; VASIS; Runway Edge Illuminated Lighting; NDB; Windsock

Tuktoyaktuk is currently served on a scheduled basis by Aklak Air and Arctic Wings. Although the critical aircraft is shown as the Beech 99, it appears that larger jet aircraft can be readily accommodated.

2. Alaska Highway Pipeline

For the Alaska Highway Pipeline there are eight airports located along the pipeline right-of-way: Beaver Creek, Burwash, Silver City, Haines Junction, Whitehorse International, Teslin, Pine Lake and Watson Lake. As well, there are airports at the Alaska port communities of Skagway and Haines that provide tidewater access to the Yukon.

2.1 Beaver Creek:

The Beaver Creek airport is located near the Yukon/Alaska border and currently handles 800 aircraft movements a year.

- Runway 13/31: Gravel; 3,740' x 100'
- Air Terminal Building (1,291 s.f.)
- Air Traffic Services: CARS (Limited Hours)
- Aviation Fuel: Not Available.
- Critical Aircraft: Hercules
- Other: Canada Customs; Year-round Maintenance

2.2 Burwash:

The Burwash airport is located 180 kms east of the Yukon/Alaska border and 220 kms west of Whitehorse. It currently handles 1,400 aircraft movements a year.

- Runway 10/28: Gravel; 5,000’ x 100’
- Air Terminal Building (1,937 s.f.)
- Air Traffic Services: CARS (Limited Hours)
- Aviation Fuel: Not Available
- Critical Aircraft: Hercules
- Other: Year-round Maintenance

2.3 Silver City:

The Silver City airstrip is located on the eastside of Kluane Lake and currently handles about 500 aircraft movements a year.

- Runway 18/36: Sand & Gravel; 3,000’ x 75’
- Aviation Fuel: Not Available
- Air Terminal Building: None
- Critical Aircraft: Twin Otter
- Other: Limited Maintenance

2.4 Haines Junction:

The Haines Junction airport is located 150 kms west of Whitehorse and currently handles 1,000 aircraft movements a year.

- Runway 04/22: Gravel; 5,000’ x 100’
- Air Terminal Building (3,841 s.f.)
- Aviation Fuel: Available
- Critical Aircraft: Hercules
- Other: Year-round Maintenance

2.5 Whitehorse International Airport:

Whitehorse International Airport is located next to the community. It currently handles 32,000 aircraft movements a year.

- Runway 13R/31L: Asphalt; 9,500' x 150'
- Runway 13L/31R: Asphalt; 4,000' x 100'
- Runway 01/19: Asphalt; 2,075' x 75'
- Air Terminal Building (55,974 s.f.)
- Aviation Fuel: Available
- Air Traffic Services: Flight Service Station; Tower
- Visual Aids/Navaids: ILS; NDB; VOR/DME
- Critical Aircraft: B-737
- Other: Canada Customs; Year-round Maintenance

Air Canada operates scheduled service between Whitehorse and Vancouver and Air North operates service between Whitehorse and Vancouver and between Whitehorse and Calgary/Edmonton, both with B-737 aircraft. Air North also provides service between Whitehorse and Juneau and Fairbanks, Alaska. First Air operates service between Whitehorse and Fort Simpson/Yellowknife with an ATR-42. Alaska-based Era Aviation operates summer seasonal service between Anchorage and Whitehorse using Dash-8 aircraft and Condor of Germany operates summer service between Frankfurt and Whitehorse with B-767's.

2.6 Teslin:

The Teslin airport is located 170 kms east of Whitehorse and currently handles 800 aircraft movements a year.

- Runway 08/26: Gravel; 5,000' x 100'
- Air Terminal Building (1,291 s.f.)
- Aviation Fuel: Available
- Air Traffic Services: CARS (Limited Hours)
- Critical Aircraft: Hercules
- Other: Year-round Maintenance

2.7 Pine Lake:

The Pine Lake airport is located 270 kms east of Whitehorse and currently handles less than 50 aircraft movements a year.

- Runway 16/34: Gravel; 3,000' x 100'
- Air Terminal Building: None
- Aviation Fuel: Not Available
- Critical Aircraft: Twin Otter
- Other: Limited Summer Maintenance; No Winter Maintenance

2.8 Watson Lake:

Watson Lake airport is located 390 kms east of Whitehorse and currently handles 5,800 aircraft movements a year.

- Runway 08/26: Asphalt; 5,500' x 150'
- Air Terminal Building (7,554 s.f.)
- Aviation Fuel: Available
- Air Traffic Services: CARS (Limited Hours)
- Critical Aircraft: Hercules
- Other: Year-round maintenance

Watson Lake does not presently enjoy scheduled service. However, it is fully capable of handling aircraft like the B-737 and, in fact, serves as an alternate to Whitehorse for this kind of traffic.

2.9 Skagway and Haines Airports (Alaska):

The Skagway and Haines airports are located near tidewater in the state of Alaska. Skagway Airport is located one mile from town and offers aviation fuel and a paved runway of 3,700 feet.

The airport at Haines is located three miles west of town and offers a paved and lighted runway of 4,000 feet, a full-service terminal, aviation fuel and car rentals. Both airports offer U.S. Customs service upon prior arrangement.

APPENDIX B

Foothills Pipe Lines
Alaska Highway 42" Pipeline Scenario

Major Material Movements
Methodology and Assumptions

PIPE:

Yukon Portion	**413,500 tonnes**
B.C. Portion	**362,300 tonnes**
Total	**775,800 tonnes**

Assumptions and Methodology

1. Canadian and U.S. pipe mills have the capability of producing 42 inch diameter pipe and the assumption was made that 100% of the project requirements in Yukon and B.C. would be sourced on the continent. Contending mills are located in Alberta, Saskatchewan, Ontario and Florida.

2. Pipe specifications assumed:
   - i. 42 inch diameter (NPS 42), X80 grade
   - ii. 2050 psig operating pressure
   - iii. 0.75 inch wall thickness
   - iv. joints – 24 metre length
   - v. weight – 491 kgs per metre; 11,784 kgs/joint (11.8 tonnes) (Ref: Foothills Pipe Lines Ltd.)

3. Handling:
   - i. pipe will be double joined and coated at the mill(s)
   - ii. pipe to be transferred to truck at rail head

4. Transportation:
   - i. pipe transportation will be by rail to Fort Nelson, B.C., and trucked to Yukon and B.C. project stockpile sites. Alternatively, if pipe is sourced from the Florida mill, it could be shipped via the Panama Canal to Skagway or Haines, AK and trucked beyond.
   - ii. **rail:** 7 joints/car; 82.6 MT/car; 20 day round trip (SK, AB) 30 day round trip (ON, FL); Total rail car trips required – 9,392; flat cars – 89 ft. long, 86,000 kg payload capacity, 30 car "block" trains
   - iii. **truck:** 2 joints/truck; 23.6 MT/load; 40 hr round trip to Spread "A" near AK border (e.g.); Total truck trips required – 32,870
     80 ft. tractor/tridem trailer; over length permit required;
   - iv. **schedule:** 1st shipments to be completed to project stockpile sites by September, November (latest), - year 0.
   - v. **Investment requirements:** It is probable that the motor carrier industry can mobilize sufficient power units for the pipe hauls. Specially designed trailer units, however, will likely have to be designed, financed and manufactured.

FUEL:	**Yukon Portion:**	**100,500 tonnes**
	B.C. Portion:	**92,500 tonnes**
	Total	**193,000 tonnes**

Assumptions and Methodology

100% of the fuel requirements, including propane is assumed to be sourced from Canadian refineries for both Yukon and B.C. segments of the pipeline Contending refinery/shipping sources are assumed to be Edmonton and Vancouver.

1. Diesel-grade (50 degree pour point spec) fuel will be used for pipeline and compressor station construction equipment, camp heating, camp electrical power generation. Small volumes of gasoline and propane will also be required. The Canadian government's diesel fuel sulphur specification may restrict refinery sourcing.

2. Construction equipment fuel volumes were estimated by totaling the amount of fuel consumed by each piece of equipment identified on the equipment schedules (provided by Foothills Pipe Lines Ltd.) for each of a winter spread, and summer spread for two different contractors. Similarly, an equipment list was prepared for compressor station construction. An allowance was made for winter idle time for the 12 hour shut down periods for equipment on the pipeline right-of-way during the coldest periods. Fuel consumption estimates were obtained from Arnett&Burgess (pipeline contractors) and verified by Finning (Canada), a Caterpillar dealer, for each equipment type on the project.

3. Camp fuel for heating was calculated using estimates provided by ATCO Structures and are based on 1 ½ gallons of fuel per man-day. Camp sizes for the mix of spreads were either 850, or 1000-man camps depending on the spread size. Manpower loadings were also provided by Foothills as were the construction period lengths.

4. Camp fuel for diesel-powered electrical generator sets was estimated at 1300 gallons/day by ATCO, with five units required for an 850 man camp, and six for a 1000 man camp.

5. Staging/Storage:
   i. Fuel will be staged into the project through marine terminals at Haines and Skagway, AK, and the rail served oil company tank farms at Fort Nelson, B.C. Adequate tankage and rail off-loading, and truck loading capacity exists at the current facilities at these locations, providing rail, marine supply and truck lifting scheduling is properly coordinated. Over 5 million gallons of storage capacity exists at Haines, and another 5 million gallons at Skagway.
   ii. Substantial additional storage capacity and truck load-out facilities exist at Whitehorse, YT, operated by agents of major oil companies. These assets were once part of the pipeline system supplying Yukon destined fuel from the marine terminal at Skagway.
   iii. The four oil company agents at Fort Nelson have a combined storage capacity of approximately 4.2 million litres (just under 1 million gallons).

6. Pipe Transportation:

i. Northernmost Yukon spreads A to C, including the Kluane Lake crossing summer project will be supplied fuel trucked from Haines.

ii. Yukon Spreads D, E and F to the B.C. border are assumed to be supplied fuel trucked from Skagway.

iii. Six B.C. spreads (G to K) will be supplied fuel staged at the Fort Nelson rail terminals operated by oil company agents.

iv. **Barge:** Coastal fuel barges supply marine terminals at Skagway and Haines. Barge loads are typically up to 1 million gallons (4.5 million litres), but are capable of carrying up to 2 million gallons (9 million litres) per delivery. Barges can be supplied with Canadian-sourced fuel at Vancouver, B.C. existing fleets can handle incremental project fuel requirements adequately.

v. **Rail:** Standard sized (75,000 litres) and jumbo (108,000 litres) tank cars from existing fleets will be used to supply the Fort Nelson terminal agents over the B.C.Rail system, from the Edmonton refineries and the Husky facility at Prince George, B.C.

vi. **Truck:** Accommodation of Yukon motor vehicle size and weight laws has been made between the Alaska, B.C. and Yukon governments in past fuel supply contracts into Yukon from Haines and Skagway. Full "B" Trains carrying approximately 48,000 litres of diesel fuel are typical. The project will require approximately 5,000 truckloads to service the project spreads and compressor stations in both jurisdictions.

EQUIPMENT (Includes Camp Buildings/Modules):

Yukon Portion	**74,900 tonnes**
B.C. Portion	**53,000 tonnes**
Total	**127,900 tonnes**

Assumptions and Methodology

1. Foothills Pipe Lines provided a detailed equipment list for a summer and winter spread.

2. The list was reviewed with Arnett & Burgess pipeline construction specialists and the number of truck loads calculated for the entire equipment complement for all spreads.

3. Equipment weight was determined and verified by Finning (Canada), Caterpillar dealer. An average 20 tonne payload was used to determine total tonnages for project segments.

4. Transportation:

   i. The Canadian portions of the pipeline are assumed to be constructed by Canadian contractors who will use a mix of their existing and new equipment. All equipment will be moved to the various construction spreads by truck alone, direct from storage yards in the southern provinces (e.g., Finning (Canada), Edmonton, AB or Vancouver, B.C.). 20 tonnes per load was used throughout.

   ii. Pickup trucks and other mobile equipment to be used on construction sites are assumed to be moved to the site by automotive, flat deck and lowboy trailers.

   iii. Tonnages provided are one time northbound only and exclude demobilization movements at the completion of the project, and intra-project moves by contractors at the completion of a spread.

CAMPS

Assumptions and Methodology

A. Camp Buildings and Modules

1. Foothills Pipe Lines Ltd. provided PROLOG with manpower resource reports, histograms (manpower scheduling), and pipeline construction strategy schedules for each spread from the Alaska/Yukon border to the B.C./Alberta border. Total camp size was determined from the spread manpower resource reports and factoring in additional capacity for senior management, camp staff, inspectors, supplier reps, other visitors, etc.

2. ATCO Structures provided PROLOG with camp layout designs and details on the facility makeup.
    i. Camp Size: The spread manpower buildups called for two sizes of camps, for 850 and 1000 persons. 49 person dormitories for "union" classification camps were selected.
    ii. Camp Design: Each 49 person dormitory is made up of 8 modules (one per truckload), which includes a washcar. ATCO units are modules generally 12 ft. wide, 10.5 ft. high, and 56 – 60 ft. in length. Each 850 man camp consists of the following units:

Truckloads

Dormitories (18)	144
kitchen/dining (16)	26
1st Aid (2)	2
Offices (30)	30
Corridors, Chambers (20)	20
Utility Skids (29)	29
Gym/Recreational (10)	10
Storage (15)	15
Power Generation (5)	5
Total Truckloads	281

Similarly, the 1000 person camp would have a proportional design and require 330 truckloads to transport the camp to its first spread site.

3. Transportation:
    i. The average truck payload for the mix of units constituting a camp is 30,000 lbs. (14 tonnes)
    ii. 10% of the total volume of freight is added to each camp to account for miscellaneous parts, materials and supplies for each camp.
    iii. An 850 man camp move would total – **4400 tonnes**.
    A 1000 man camp move would total – **5100 tonnes**.

B. Consumables

1.The volume of Consumables was determined through discussions with caterers and ATCO personnel, for northern construction operations. Total tonnage presented was calculated from manpower resource reports provided by Foothills, and their production schedules.

2. Consumption numbers are based on 1.5 cubic feet of total "consumables" per person per day. Histograms reporting time-sequenced man days for construction workers, grossed up by 15% to include supervisors, camp staff, inspectors and visitors, provided the total anticipated manpower compliment for each spread and compressor station site.

3.Transportation:

i. The mix of goods is usually palletized by the suppliers and a full truckload is assumed to contain 2000 cu. ft. of consumables. An average load weighs 40,000 lbs. (18 tonnes).

ii. For both jurisdictions, consumable freight was assumed sourced in southern Canada and 100% of the volume transported by truck, directly to the camps.

iii. Volumes calculated for each jurisdictions are:

Yukon:	**6,900 tonnes**
B.C.	**8,600 tonnes**

APPENDIX C

Alaska Gas
Alaska Highway 52" Pipeline Scenario

Major Material Movements
Methodology and Assumptions

PIPE:	**Yukon Portion**	**723,900 tonnes**
	B.C. Portion	**627,000 tonnes**
	Total	**1,350,900 tonnes**

Assumptions and Methodology

1. There are currently no pipe mills in the U.S. or Canada that can produce 52 inch diameter pipe. Japan and/or Germany are the likely sources of pipe if this project proceeds.

2. The spreads and compressor station sites for this project were assumed the same as the 42 inch Foothills project.

3. Pipe Specifications assumed:
   i. 52 inch diameter, X80 grade steel pipe
   ii. 2500 psig operating pressure
   iii. 1 1/8 (1.125) inch wall thickness (in Canada). 1 ½ inch in Alaska
   iv. joints – 60 feet long each from mill into ship
   v. weight: 861 kgs per metre; 18.3 metres – 15,738 kgs or (say) 15.8 tonnes each (Ref: Alaska Producer's Group)

4. Handling:
   i. pipe will be coated and wrapped at the point of off-loading from ships.
   ii. pipe to be transferred to truck after coating, and transported to project stockpile sites.

5. Transportation:
   Pipe will be transported from Asian mills by ship, commonly of 30,000 DWT size, to either or both of Skagway and Haines, AK for the Yukon section. The B.C. portion will likely involve a combination of ocean shipping from Europe to east coast ports (e.g., Halifax or Newport News) and rail to Fort Nelson. (Canada should not be impacted by pipe deliveries for the Alaska portion of the project, which will likely be routed to Prudhoe Bay or through Seward to the Alaska Railroad.) Direct deliveries to Skagway and Haines can be made 12 months per year. However, scheduling around cruise ship arrivals is seen as critical by port operators, particularly at Skagway.
   i. Shipping: Each vessel can handle some 1,900 - 60 foot joints, off-loaded at the port for coating, wrapping and furtherance by truck.
   ii. Trucking: Trucks will carry two joints with a total payload of 31.8 tonnes per load. An over weight permit will be necessary for the tridem trailer combination to be used. Some 42,000 truckloads will be necessary – a huge logistical task.

(Other comments re: scheduling and financing as per the 42" project previously described.)

FUEL:

Yukon Portion	**121,200 tonnes**
B.C. Portion	**111,300 tonnes**
Total	**232,500 tonnes**

Assumptions and Methodology

Project fuel requirements for the Canadian sections of the project are again assumed to be sourced in Canada. (See comments for 42 inch Foothills Pipe Lines Ltd. project for logistics assumptions and methodology).

1. While similar logistics for the 42 inch Foothills system apply for the 52 inch project, the scale of each segment increases due to the much higher volume and weight of pipe. Additional equipment is required, requiring more fuel, more men to construct the pipeline and compressor stations, and therefore more camps and consumables.

2. Transportation:
   The project will require approximately 6,000 truckloads of fuel to service the project spreads and compressor stations in both jurisdictions.

EQUIPMENT (Includes Camp Buildings/Modules):

Yukon Portion:	**100,300 tonnes**
B.C. Portion:	**72,700 tonnes**
Total	**173,000 tonnes**

Assumptions and Methodology

1. The Alaska Producer's Group were unable to provide any details on equipment resources planned, or manpower buildups. Discussions with contractors and equipment suppliers provided information used to "scale up" the equipment type, size and numbers of the Foothills resource requirements, to facilitate construction of the larger 52 inch pipeline.

2. See the 42 inch Alaska Highway project description for logistics assumptions and methodology, - used for the 52 inch throughout except as noted.

CAMPS:

Assumptions and Methodology

Camp Buildings and Modules:

1. The increased scope of the 52 inch project requires a larger camp for each of the spreads. The 850 man camps identified for the 42 inch project were increased to 1000 man camps for the 52 inch pipeline, The 1000 man camps were increased to 1200 man camps.

2. Accordingly, 384 truckloads are required to transport the building modules and skid units for the 1200 man camps. The 1000 man camps are assumed to require the same logistics as for the Foothills project.

CONSUMABLES:

1. The volume of consumables was determined by calculating the manpower loadings for the new camp sizes discussed above.

2. All calculations were made using the same methodology and logistics assumptions as for the 42 inch Foothills projects, adjusted for the scope of the 52 inch pipeline.

Yukon:	**8,600**	**tonnes**
B.C.	**10,200**	**tonnes**

APPENDIX D

Delta Gas
Mackenzie Valley 30” Pipeline Scenario

Major Material Movements
Methodology and Assumptions

PIPE: Total Pipe 401,900 tonnes

Assumptions and Methodology

1. Canadian and U.S. pipe mills have 30 inch, heavy wall pipe manufacturing capability and it is assumed that 100% of the project requirements will be sourced in North America. Contending mills are in Alberta, Saskatchewan, Ontario and Florida.

2. Pipe specifications assumed:
   - i. 30 inch diameter (NPS 30), X80 grade
   - ii. 2050 psig operating pressure
   - iii. 0.625 inch wall thickness
   - iv. joints 60 feet in length (18.29 metres)
   - v. weight: 292 kgs per metre; 5.34 tonnes per joint. (Ref: Delta Producer Group)

3. Handling:
   - i. pipe will be double jointed and coated at the mill(s).
   - ii. pipe to be railed to a staging site at Hay River, NT. Pipe requirements for the section south of Wrigley may be stockpiled at the rail yards located at Enterprise, NT on Highway 1, and trucked to the project .
   - iii. Pipe requirements from Wrigley north will be barged from Hay River to stockpile sites strategically located near the pipeline ROW.
   - iv. If the barge company cannot produce sufficient capacity to handle pipe transportation north of Wrigley, pipe could alternatively be shipped by the Point Barrow ocean route; stockpiled at Tuktoyuktuk, and trucked south to spread stockpile sites or barged up the Mackenzie to the project.

4. Transportation:
   - i. **pipe transportation:** will be by rail to Hay River or Enterprise via the Mackenzie Northern Railway, from Canadian mills.
   - ii. **rail:** 11 x 60 ft. joints per car maximizes the envelope. 60 tonnes payload per car (Ref: CPR). 6,698 carloads required, likely supplied in 30 car "block" trains
   - iii. **barge:** use 1500 series NTCL barges. Assume an average of 1000 tonnes of pipe per barge over the season. 281,000 tonnes to be shipped to the northern section of the pipeline. 281 barges at six barges per trip, - 47 trips over the project's total delivery schedule. Consider this a challenge for NTCL considering their current stated capacity of 260,000 tonnes per season for community re-supply.
   - iv. **truck: 4** joints per truck; 21.4 tonnes per load. May be permitted to allow 5 joints per load (26.7 tonnes); total truckloads required (@4 per trailer) – shoulder seasons. Assumes all-weather and/or winter road access from Highway 1 to ROW stockpile sites. 5,700 loads
   - v. **schedule:** 12 month access to stockpile sites south of Wrigley, constrained only be seasonal truck weight restrictions and ferry crossing
   - vi. **investment considerations**: specially designed trailers and support cribs will likely be manufactured by the pipeline owners and supplied to truckers.

FUEL: Total Fuel 146,500 tonnes

Assumptions and Methodology

1. All fuel will be sourced in Canada, likely from Edmonton area refineries which can meet the Canadian Government's sulphur content spec for automotive fuel.

2. Diesel grade (50 degree pour point spec) distillate will be used for pipeline and compressor station construction, camp heating and electrical power generation. Small volumes of gasoline and propane will also be required.

3. As with the Alaska Highway projects, fuel requirements for pipeline and compressor station construction was determined by calculating operating and idle consumption values from an equipment resource listing prepared by TransCanada PipeLines for a typical spread.

4. Camp fuel for heating and power generation was estimated using the same consumption rates as for the Alaska Highway winter spreads, adjusting for an 800 man "typical" camp size as provided in the TCPL work.

5. Staging/Storage:
   i. Fuel will be delivered to Hay River by tank car over the Mackenzie Northern Railway. NTCL and Imperial Oil have a supply arrangement and barges are loaded out at the IO bulk plant. Scheduling is often timed to pump directly from the tank cars to the barges. 11 million litres of storage capacity is available at the terminal. Petro Canada has additional storage capable of serving barge traffic.
   ii. South of Wrigley, large "B" Train trucks will be loaded out at the oil company terminal(s) at Hay River and trucked directly to project storage facilities.
   iii. Existing storage capacity exists to receive barge deliveries of fuel for the pipeline project at Norman Wells, Inuvik, and Tuk. Much of this tankage is owned directly by the NWTG and can be made available to the project. "Portable" storage tanks will be located at the stockpile sites, as required.

6. Transportation:
   North of Wrigley, fuel will be barged to pipeline spreads, compressor stations and Delta tie-in lines. South of Wrigley, fuel will be trucked to project storage facilities from Hay River.
   i. rail: currently tank cars carry 75,000 litres, being constrained by the current weight-on –rail restriction (263,000#). Upgrading the system to heavy haul standard (286,000#)would accommodate regular jumbo tank cars carrying a minimum of 95,000 litres of diesel fuel. The pumping rate will also be upgraded shortly, rail to barge.
   ii. barge: assume barges will each carry 1000 tonnes of fuel each as their average payload over the full season. Heavier barge loading is possible early to mid-season when river levels are at their peak. Some 97 barge loads will be required to complete the fuel supply system north of Wrigley.
   iii. truck: Full "B" Trains carrying 48,000 litres per load will be utilized to supply fuel to the project stockpile/storage facilities south of Wrigley. A total of 1300 loads will be required for this program over the life of the project.

EQUIPMENT (Includes Camp Buildings/Modules)

Total Equipment 72,300 tonnes

Assumptions And Methodology

1. The Trans Canada Pipe Lines "typical' spread equipment resource report data was used to estimate the total volumes of equipment and camps to be shipped to the stockpile sites. Truck loading estimates were made with the assistance of Arnett & Burgess, pipeline contractors. It was assumed that equipment would be trucked to Hay River for barge deliveries to the project spreads north of Wrigley, and trucked directly from the south to the spreads south of Wrigley.

2. Camp truck logistics for module movements were based on similar analysis of the Alaska Highway projects, adjusted for camp size. Data sources were also the same.

3. Transportation:
   - i. All equipment, materials and camp module units and skids will be trucked from southern supply points to Hay River for furtherance by barge to the project stockpile sites north of Wrigley. There is a possibility that some project equipment for construction work will be supplied by contractors in the north (e.g., Yellowknife). This will not be a significant component of the total.
   - ii. For the section south of Wrigley, all equipment, materials and camp units will be trucked directly to spread stockpile sites along the ROW.
   - iii. Tonnages provided are one time northbound only and exclude demobilization and intra-project moves by contractors from one spread to another.
   - iv. Compressor stations were each made up of 14 modules, at 25 tonnes each. Ancillary materials and supplies (fencing, cement, lighting, etc.) were estimated at 10 truckloads/containers per station.
   - v. 38 meter stations were included in the system design. Delivery of each was assumed as one skid-mounted module weighing 25 tonnes.

Camp Buildings And Modules

Assumptions and Methodology

1. Total camp size was determined by referring to the TCPL logistics analysis which provide manpower buildups and task scheduling for a "typical" spread. An 800 man camp was selected to facilitate the pipeline construction for each spread, and a 100 man camp for construction of the compressor stations. Each camp also provided space for inspectors, supervisors, camp staff and visitors.

2. Camp design and makeup was scaled proportionately to the camps analyzed in the Alaska Highway projects. For trucking it was assumed that each load averaged 14 tonnes, and a "typical" camp for a pipeline spread involved 295 truckloads.

4. Total volume of camp units per spread for an 800 man camp - **4130 tonnes**

Consumables

1. The volume of consumables for the 30 inch project was calculated using the same methodology as for the Alaska Highway projects.

2. Transportation of all consumables is assumed to be directly trucked to spread camps by highway or winter road, from southern supply points.

3. Total volume - 8,700 tonnes

APPENDIX E

Alaska Gas
Mackenzie Valley 52" Pipeline Scenario

Major Material Movements
Methodology and Assumptions

PIPE: Total Pipe: 1,390,100 tonnes

Assumptions and Methodology

1. The most likely scenario for the "over the top" 52 inch Alaska gas project is that it will be constructed after the Delta Producer's 30 inch Canadian pipeline is in place and operational. The 30 inch project ROW, stockpile sites, compressor stations, etc. will all come into play and be used to facilitate the larger Alaska Prudhoe Bay gas pipeline project. PROLOG assumes probability that the 52 inch line will come ashore at Taglu, as opposed to the current plan (for an independent pipeline) to begin its southbound, onshore portion west of the Mackenzie Delta. 52 inch pipe requirements for this project is all assumed to be sourced offshore, Japan or Germany.

2. The spread locations, construction schedule, stockpile and compressor station sites and river access points were all assumed to be similar to the Delta producer's 30 inch Mackenzie Valley pipeline project (Ref: TCPL's 10/1999 Report).

3. Pipe Specifications assumed:
   - i. 52 inch diameter, X80 grade steel pipe
   - ii. 2500 psig operating pressure
   - iii. 1 1/8 (1.125) inch wall thickness (in Canada), 1 ½ inch in Alaska
   - iv. joints – 60 feet long
   - v. weight: 861 kgs per metre; 18.3 metres – 15,738 kgs or (say) 15.8 tonnes each

4. Handling:
   - i. Pipe will be coated and wrapped at intermediate rail and/or marine transfer points.
   - ii At North American ports-of-entry pipe will be transferred to rail for furtherance to Hay River/Enterprise. In the Western Arctic, pipe will be transferred from deep-draft sealift vessels to lighter barges or staged for winter road delivery.
   - iii Pipe for the section of the pipeline south of Inuvik is assumed to be delivered by rail to, and staged from, Hay River/Enterprise. The segment south of Wrigley will receive pipe by truck; the section between Wrigley and Inuvik will receive pipe by barge.
   - iv. If the barge capacity is challenged on its northbound service, the possibility exists to ship pipe brought in by ocean freighters and stockpiled at Tuk, using southbound barges (normally empty) for river stockpile sites south of Inuvik.

5. Pipe Transportation

i. **conventional marine:** ocean transport from Asian mills will be by ship, commonly of the 30,000 dwt capacity carrying some 1900 - 60 foot pipe lengths, presumably to Vancouver, B.C., or possibly to Prince Rupert, for furtherance by rail to Hay River/Enterprise.

ii. **rail transport:** pipe from European mills would be shipped by rail from east coast ports (e.g., Halifax and Newport News). During the St. Lawrence Seaway shipping season, pipe could be shipped via Thunder Bay for transfer to rail.

iii. **arctic sealift:** pipe for the Beaufort Sea offshore section and northern Mackenzie Valley segments will be transported to the Western Arctic Coast by ocean vessels in sealift service.

iv. **trucking:** two 60 foot pipe lengths per truckload, as assumed for the Alaska Highway 52 inch project. Two 52 inch 60 foot long pipe joints would weigh 31.6 and require special permitting.

v. **river barge:** assuming 1000 tonne average loads, each 1500 series NTCL barge will carry 60 – 70 joints on each barge, or 360 – 420 per barge train.

vi. **marine pipelaying:** an ice-strengthened, subsea pipe laying vessel will be serviced by at least two supply boats moving men, materials (including pipe and cement for undersea anchoring) from suitable ocean vessels or arctic coastal stockpile sites, to the lay vessel as it moves across the Beaufort Sea.

vii. **schedule and investment considerations** – as per Mackenzie Valley 30 inch pipeline project scenario. New (or relocated) tugs and barges and pipe highway trailers will likely be required, particularly if the project is built out over two construction seasons rather than three.

FUEL: Total Fuel – 222,900 tonnes

<u>Assumptions and Methodology</u>

1. Fuel for construction of the Beaufort Sea underwater portion of the pipeline is assumed to be sourced from the Canadian or U.S. West Coast or Alaskan refineries, and transported by ocean barges to service vessels or the tank farm at Tuktoyaktuk, NWT.

2. The balance of the project up the Mackenzie Valley will be as per the 30 inch project assumptions and methodologies covering fuel. Equipment fuel consumption was based on equipment complements for similar or pro-rated winter spreads on the Alaska Highway 52 inch project.

3. Fuel for compressor and valve station construction was assumed to be similar to the Alaska Highway equivalent, adjusted for Mackenzie Valley station spacing.

4. Camp fuel for heating and power generation was estimated using similar consumption rates for the Alaska Highway winter construction spreads, adjusted for the larger camp size required for the 52 inch project.

5. All handling and storage of fuel will be as assumed for Mackenzie Valley 30 inch project. Additional portable tanks will be required at river staging sites for the much larger volumes where existing tank farms cannot be utilized, such as the facilities at Norman Wells, Inuvik and Tuktoyaktuk.

EQUIPMENT:

Total Equipment (Includes Camp Buildings/Modules) - 242,700 tonnes

Assumptions and Methodology

1. Equipment and Camp module logistics were based on comparable Alaska Highway 52 inch winter spread construction requirements increased by 20% in the Mackenzie Valley to provide for contingencies associated with the remoteness of the ROW; lack of all-weather access; weather itself, and additional logistics activity between river staging sites and spread camps.

2. The "Over the Top" 250 km portion of the pipeline into Taglu is assumed to be serviced by a dedicated mobile 400 man (max.) camp barge.

3. Compressor and valve station design and logistics assumptions were also assumed to be similar to the 52 inch Alaska Highway equivalent, modified to the Mackenzie Valley 30 inch spread and station locations.

4. Transportation:
   i. Cranes, welding, concrete coating equipment and all other "Over the Top" construction activities and attendant freight volumes are all considered "packaged" for, and barged around Pt. Barrow for, the 250 km marine segment of the project.
   ii. Logistics for equipment and camp modules for the Mackenzie Valley portion of the project will be provided as per the 30 inch pipeline project detailed herein, i.e., barged to stockpile sites north of Wrigley, and trucked to the ROW south of Wrigley.
   iii. Due to the greatly increased freight volumes of the 52 inch project, investment requirement in barge and truck trailer transportation equipment is certain.

Camp Buildings/Modules

Assumptions and Methodology

1. As described above, a 52 inch Alaska Highway project winter spread camp was used as the basis for logistics calculations, increased by 20%. The selected spread was similar in length to the Mackenzie Valley project spread lengths.

2. Transportation load sizes, handling and delivery programs for camp buildings, modules and skids are assumed to be the same as those for the 30 inch Mackenzie Valley project. The significantly increased volumes will dramatically affect the existing transportation system and will require plans and investment in equipment to properly facilitate the project logistics needs.

3. Total freight volumes of camp units per spread for a 1200 man camp. - **5,920 tonnes**

Consumables

Assumptions and Methodology

1. The volume of consumables for the 52 inch project was calculated using the same methodology as for the Alaska Highway 52 inch project equivalent.

2. Transportation of all consumables is assumed to be directly trucked to spread and station camps by highway or winter road, from southern supply sources over primary staging sites. Truck load factors for consumables as per all other project logistics.

3. Total Volume Consumables - 15,300 tonnes

APPENDIX F

Alaska Gas
Beaufort Undersea Scenario

Methodology and Assumptions

Marine Logistics Support for Undersea Pipeline Installation

A northern route for Alaska Gas is assumed to be incorporated in the Mackenzie Valley pipeline route with a Beaufort undersea link from Point Thompson on the North Slope of Alaska. This will require an extensive marine pipe laying operation in the Beaufort Sea over one or possibly two construction seasons.

While the open water season in the Beaufort is just some 6 weeks long, this scenario contemplates a undersea pipe installation extending from July into December and encountering significant ice conditions for much of that period. Several new construction vessels will be purpose built to specifications suitable for the anticipated ice conditions:

- A large 60,000 hp ice class 7 plough ship will prepare the 4 to 5 metre deep trench in front of the lay vessel. It will be fitted with azimuth directional thrusters as well to maintain an accurate course along the ROW.

- The main lay vessel anticipated is ice class 4 with a structure and propulsion systems that can reliably maintain dynamic positioning over the pipe trench. This lay vessel will have a production rate of up to1 ½ miles per day.

- Two ice class 4 supply boats will be used to shuttle pipe and other construction materials from sealift cargo ships or from shore to the lay vessel. These will be styled after the Finnish supply vessels and the ships used in the Beaudrill operations in the Canadian Beaufort a few years ago.

- Two class 3 shuttle vessels will be included in the fleet, to be used to move crews and supplies to/from the construction point.

- Two specially-designed ice breaking supply boats (e.g., with azimuth side thrusters) will be dedicated to ice management around the main lay barge operation.

Each of the vessels will provide their own staffing quarters. The pipeline workers will be housed on the lay vessel itself. 200 men will make up the active work force. Crews of 70 - 80 on each boat could increase the total compliment on the project at any one time to 600 plus people.

Pipe will be transported into the Beaufort by Russian SA-15 Ice Breaking Cargo Ships. The length of these vessels is 174 meters, with 9 meters draught and 14,700 tonnes deadweight capacity. These vessels also have 2,000 cubic meters of bulk fuel carrying capacity. Actual dry cargo capacity is 12,200 tonnes on a weight basis.

Pipe will be shipped from offshore mills either directly into the Beaufort or staged at a westcoast port (e.g., Prince Rupert). An SA-15 will remain on station with the lay barge and there should be no need to stockpile pipe ashore.

A total fleet of 9 vessels will be dedicated to the marine pipe laying operation. In addition some 24 sealift sailings into the Beaufort will deliver project materials to the offshore marine operations. (Note that we have also assumed 14 additional sealift sailings to support conventional pipeline construction in the Mackenzie Delta.)

APPENDIX G

Peak Project Logistics Requirements

Foothills Pipe Lines ALASKA HIGHWAY 42" Pipeline Scenario PEAK PROJECT LOGISTICS REQUIREMENTS								
Movement Plan	Equipment Type	Payload (Tonnes)	Total Loads	Season Days	Cycle Days(avg)	Equipt. Cycles	Equipt. Fleets	Loads/ Day (avg)
Pipe								
Rail (Yukon)	Flat cars	82.6	3,263	360	25	15	227	9
(BC)	Flat cars	82.6	1,574	360	25	15	109	4.4
Truck (Yukon)	Semi/crib	23.6	11,420	360	1.25	272	40	32
(BC)	Semi/crib	23.6	5,508	360	.5	689	8	15
Fuel								
Rail (BC)	Tankcar	86.4	400	250	15	17	24	1.6
Truck (BC)	Tanker trailer	38.4	899	250	.5	450	2	3.6
Barge (Yukon)	Tug/barge	7000	9	250	21	9	1	.1
Haines truck	B train trailer	38.4	758	250	.5	379	2	3
Skagway truck	B train trailer	38.4	867	250	.5	434	2	3.5
Equip't/Mat'ls								
Truck (Yukon)	Semi-trailer	20	3,075	360	2.5	140	22	8.5
(BC)	Semi-trailer	20	1,775	360	1.75	195	9	4.9
Consumables								
Truck (Yukon)	Semi-trailer	18	216	250	**1.25**	**108**	**2**	**.9**
(BC)	Semi-trailer	18	189	250	**.5**	**189**	**1**	**.8**

Alaska Gas Producers ALASKA HIGHWAY 52" Pipeline Scenario PEAK PROJECT LOGISTICS REQUIREMENTS								
Movement Plan **Pipe**	Equipment Type	Payload (tonnes)	Total Loads	Season Days	Cycle Days (avg)	Equipt. Cycles	Equipt. Fleets	Loads/ Day (avg)
Marine (Yukon)	Freighters	30,000	16					
Haines truck	Tridem trailer	31.8	7,120	360	.5	728	10	20
Skagway truck	Tridem trailer	31.8	7,548	240	.5	420	18	31.5
Rail (BC)	flat cars	80	2,747	365	15	25	113	7.5
Truck (BC)	Tridem trailer	31.8	6,909	360	.5	691	10	19.2
Fuel								
Marine (Yukon)	tug/barge	7000	11	250	21	11	1	
Haines truck	B train trailer	38.4	1,085	250	.6	361	3	4.3
Skagway truck	B train trailer	38.4	1,045	250	.6	348	3	4.2
Rail (BC)	tank cars	86.4	481	250	15	16	30	1.9
Truck (BC)	B train trailer	38.4	1,081	250	.5	361	3	4.3
Equip/Mat"ls								
Truck(Yukon)	Semi-trailer	20	4,000	360	2.5	143	28	11.1
Truck (BC)	Semi-trailer	20	2,240	360	1.75	364	11	6.2
Consumables								
Truck(Yukon)	semi-trailer	18	278	250	1.25	139	2	1.1
Truck (BC)	semi-trailer	18	223	250	.5	223	1	.9

Delta Gas MACKENZIE VALLEY 30" Pipeline Scenario
PEAK PROJECT LOGISTICS REQUIREMENTS

Movement Plan	Equipment Type	Payload (Tonnes)	Total Loads	Season Days	Cycle Days(avg)	Equipt Cycles	Equipt Fleets	Loads/ Day(avg)
Pipe								
Rail	Flat Cars	60	3,403	360	25	14	236	10
Truck	Tridem Trailers	21.4	2,757	240	.6	345	8	12
Barge	River Barges	1000	142	120	14	8	18	1.2
Fuel								
Rail	Tank Cars	60	837	120	15	86	105	7
Truck	B train trailers	38.4	600	100	.75	120	5	6
Barge	River Barges	1000	50	120	14	8	6	.4
Equip't/Mat'ls								
Truck	Semi-Trailers	20	855	240	1.7	122	7	3.6
Barge	River Barges	1000	40	120	18	7	6	.3
Consumables								
Truck	Semi-Trailers	18	122	100	1.7	61	2	1.2

Alaska Gas MACKENZIE VALLEY 52" Pipeline Scenario
PEAK PROJECT LOGISTICS REQUIREMENTS

Movement Plan	Equipment Type	Payload (Tonnes)	Season Days	Total Loads	Cycle Days(avg)	Equipt Cycles	Equipt Fleets	Loads/ Day(avg)
Pipe								
Rail	Flat Cars	60	360	7,293	25	14	506	20
Truck	Tridem Trailers	31.8	240	5,472	.6	365	15	22.8
Barge	River Barges	1000	120	410	14	9	48	3.4
Sealift	Ocean Vessels	12,000	180	37				
Fuel								
Rail	Tank Cars	80	120	1214	15	8	150	10.1
Truck	B Train Trailers	38.4	100	847	.75	121	7	8.5
Barge	River Barges	1000	120	73	14	9	8	.6
Equip't/Mat'ls								
Truck	Semi-Trailers	20	240	2,470	1.7	146	17	10.3
Barge	Barge Trains	1000	120	77	18	7	12	.6
Consumables								
Truck	Semi-Trailers	18	100	206	1.7	103	2	2.1

APPENDIX H

Prototype Self-Steering Pipe Trailer

Background: Foothills Pipe Lines Ltd. commissioned this single purpose highway trailer design and prototype manufacture project in the seventies. After completion, the unit was highway tested between Langley and Hope, BC. A second permit was received for winter trials in the Yukon, and full operational tests were carried out. The builder invested approximately $200,000 in the project.

Manufacturer: Knight Trailers Ltd. constructed the prototype unit. The Company became K-Line Trailers Ltd. in 1994. Located in Langley, BC, and working from a 30,000 sq. ft. plant, the firm specializes in custom-designed highway trailers for heavy-haul resource product transportation movements. Customers include Trimac Ltd., Cominco, Arrow Transport, Lomak, Bulk Systems, etc., and their equipment is in use around the world. Contact: Les Knight – ph: (604) 856-7899.

Description: The "system" includes free-standing double tandem axle dolly to support the back of the 3 pipe joint nest, and a small front pipe "bunk" mounted over the tractor's fifth wheel to support the front of the pipe joint nest over the power unit's rear tandem axle group. (See drawing and photos following). The main dolly is fitted with a fifth wheel arrangement itself, which in turn supports the rear pipe crib, which is hinged. The self-steering feature is accomplished by a shaft/linkage mechanism between the pipe crib and the articulated front tandem axle arrangement on the dolly.

Materials: The unit is constructed with 100,000 psi high-tensile steel, painted grey to protect against road salt and corrosion. Mr. Knight mentioned that the units would likely be built using 130,000 psi tensile steel, now available.

Legal/Permits: Loaded with 3 x 80 foot long, 56 inch diameter, Schedule 40 pipe for trials, the unit met all weight regulations (BC/Yukon Bridge Loading Formulas), and required an over length permit. Mr. Knight said the unit was non-conforming by its axle arrangement at the time, but would comply with prevailing axle grouping regulations today.

Drivability/Handling: A video of the unit from a helicopter showed a loaded unit successfully negotiate a 90 degree urban corner, - admittedly with an experienced and competent driver! The pipe joints rest on 1 inch wooden pads, meeting the spec that required no damage to be inflicted on the pipe surface finish. A suitably sized crane with spread bar accomplishes loading. The same crane (or front end loader if handy) is used to lift the front of the dolly on to a hitch located on the rear of the tractor, so the truck returns to its pipe staging yard with only the rear axles of the dolly riding on the road surface.

PROTOTYPE SELF-STEERING PIPE TRAILER

With Foothills Pipe Lines Test Load

[3 x 56 inch diameter 80 foot pipe lengths]