New Business

P40

Introduced by: Council Member Kent Harding
Date: February 14, 2012
Action:
Vote:

CITY OF BETHEL, ALASKA

Resolution # 12-05

A RESOLUTION BY THE BETHEL CITY COUNCIL REQUESTING THE GOVERNOR AND LEGISLATURE TO APPROPRIATE UP TO $20,000,000 FOR THE CONSTUCTION AND IMPROVMENTS TO THE SEWAGE LAGOON

WHEREAS, the Bethel City Council believes that properly planned, constructed, installed, operated, and maintained wastewater treatment systems are essential to the health and safety of the Bethel residents;

WHEREAS, adequate sanitation facilities promote the health and welfare of the citizens of this city by preventing the pollution of ground and surface water;

WHEREAS, a properly constructed and maintained sewage lagoon will prevent a public nuisance of discharge overflow onto ground surface water and odor being emitted from an outdated facility;

WHEREAS, by definition, a Wastewater Sewage Lagoon is a shallow body of water in which organic wastes are decomposed by bacteria in the presence of free oxygen;

WHEREAS, strengthening and expanding the outdated sewer lagoon has been a number one priority for the City of Bethel since 1992;

Whereas, the Bethel City Council desires to eliminate hazards to the public health by minimizing pollution of water supplies and hazards to recreational areas and to minimize disease transmission potential;

Whereas, the Bethel City Council is requesting assistance from the Alaska Legislature to eliminate and prevent health and safety hazards by providing funds for the design, construction, installation, operation, and maintenance of on-site wastewater treatment systems;

NOW, THEREFORE, BE IT RESOLVED that the Bethel City Council hereby requests the Governor and Legislature to appropriate up to $20,000,000 (Twenty Million Dollars) for FY 2013 construction and improvement to the sewage lagoon as outlined in the City of Bethel Water and Sewer Facilities Master Plan.

Introduced by: Council Member Kent Harding
Date: February 14, 2012
Action:
Vote:

ENACTED THIS 14TH DAY OF FEBRUARY 2012 BY A VOTE OF _ IN FAVOR AND _OPPOSED.

____
Joseph A. Klejka, Mayor

ATTEST:

____
Lori Strickler, City Clerk

Similar to Water Loop C, water leakage at the pitoriface connections is estimated to be reduced, which means that a large quantity of water will not need to be heated, treated and pumped. Maintenance call outs for this Loop should also be greatly reduced. Cost savings due to the reduced leakage and reduced callouts are estimated to be $60,000 per year and $12,000 per year, respectively. By reducing the Water Loop A into two loops, pumping power will also be reduced, resulting in an annual power savings and associated O&M cost savings.

6.3. WASTEWATER TREATMENT UPGRADES

6.3.1. *Project Need*

The existing wastewater treatment system consists of two unlined stabilization ponds; a primary cell and secondary cell with a combined area of 60 acres. Presently, this volume is adequate for current usage, as well as for the 20 year horizon based on population projections. However, these ponds are reaching their hydraulic capacity due to infiltration of surrounding groundwater and the accumulation of sludge.

Currently, the stabilization pond effluent is pumped to the tundra twice a year. Once before freeze up and once immediately after the Spring thaw. This is done to maximize the storage capacity of the ponds in order to hold the Winter wastewater load. Despite pumping the ponds nearly dry in the Fall, the ponds need to be pumped before the Spring thaw in order to prevent the ponds from overflowing in an uncontrolled manner and possibly collapsing the containment berm.

In the past, the City's "end of pipe" effluent quality data for years 2005 and 2006 exceeded the EPA's and State of Alaska's maximum levels for Total Suspended Solids (TSS), Biological Oxygen Demand (BOD) and Fecal Coliforms. Additional usable storage volume is needed to hold this wastewater for a longer time in the Spring so that biological degradation can occur. In addition, the installation of seasonal aeration units will ensure more rapid and effective wastewater treatment since oxygen is needed by the bacteria to allow their respiration reactions to proceed more rapidly.

In addition to the problem of insufficient storage volume, the effluent is presently discharged to the tundra north of the existing stabilization ponds in a drainage system that eventually makes its way to Brown's Slough, which runs through Bethel. A more controlled treatment scheme is warranted to provide a higher level of treatment and/or the effluent should be routed through a different drainage basin.

6.3.2. *Project Alternatives*

Several types of wastewater treatment concepts have been developed in the past. Foremost is a Membrane Biological Reactor (MBR) treatment plant. Another concept to improve treatment by mechanically aerating the stabilization ponds has been investigated. These project costs have been estimated by others in past years and have been considered in this report with the costs converted to 2010 dollars to account for inflation. This report also considers an alternative involving a new stabilization pond to provide usable storage and a wetlands treatment system to provide additional treatment of the effluent as well as the option of increasing the existing usable volume by lining the berms and dredging the accumulated sludge.

A summary of these alternatives and estimates of their costs are shown in Table 6.4-1. Compared to the previously mentioned alternatives, rehabilitating the existing stabilization ponds and utilizing the existing wetland treatment system is expected to be less costly in terms of both capital costs and annual operations and maintenance. However, acquiring the land to the north will need to be negotiated and completed, which is an unknown at this time.

TABLE 6.4-1 Preliminary Evaluation of Wastewater Treatment Alternatives

Alternative	Environmental Impacts	Land Requirements	Capital Cost (Million $)	Annual O&M Costs (Million $)	Present Worth (2030) (Million $)	Advantages	Disadvantages
MBR	Effluent meeting all standards is discharged to river. APDES permit required.	Minimal. Can be located on existing land owned by the City of Bethel.	$19.685	$0.885	$58.409	Effluent quality can be higher than other alternatives	Capital and O&M costs are highest of all alternatives. Possible failure and by-pass of system if not operated and maintained properly.
Mechanical Lagoon Aeration	Energy is used to run the aerator motors.	Minimal. Can be located on existing land owned by the City of Bethel.	$17.335	$0.564	$45.709	Somewhat improved treatment performance can be expected at the lagoon discharge point.	On its own, aeration does not solve the problem of insufficient storage over the winter months.
New tundra pond and wetlands treatment	Discharge point to the environment varies	Land will need to be acquired for this alternative.	$11	$0.01-$0.02	$22.4	Lower capital and O&M costs.	

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systems	depending upon which wetland treatment option is pursued. New or revised APDES permit will be needed in either case.					Pumping is required to transfer effluent to the new stabilization pond. Significant land area is required. Land acquisition may be time-consuming and possibly unsuccessful. It may be technically challenging to define the rational basis of design to the satisfaction of ADEC.
Rehabilitate existing lagoons, purchase and enhance existing wetlands area to north, add wind powered aeration units, line berms and dredge the ponds	Effluent meeting all standards is discharged to river. APDES permit required.	Land will need to be acquired for this alternative.	$7.0	0.0075	14.2	Significant land area is required. Land acquisition may be time-consuming and possibly unsuccessful. It may be technically challenging to define the rational basis of design to the satisfaction of ADEC.

Appendix E contains a life- cycle cost analysis for project alternatives.

6.3.3. *Project Description*

At this time, the preliminary order-of-magnitude cost estimates indicate that increasing the usable volume in the existing lagoons and utilizing the existing wetland treatment system would be the most economical alternative assuming the land acquisition challenges can be overcome. The concept of a lined pond was not pursued because of the likely presence of permafrost and the settling and tearing of the liner that may occur in thaw-unstable soils. A summary of the design criteria for a new stabilization pond and wetland treatment system are shown in Table 6.4-2, below.

TABLE 6.4-2 General Wastewater Design Criteria

2008 Population		5,665
2030 Design Population		6,650
Design Per Capita Wastewater Flow	gal / cap · day	50
Design Per Capita BOD Load	lbs BOD / cap · day	0.15
Design Wastewater Flow	gpd	332,500
Design BOD Load	lbs BOD / day	1,000
Stabilization Pond Sizing Criteria		
Design BOD Load	lbs BOD / acre · day	20
Design Hydraulic Detention Time	days	8 months
Design Pond Area	acres	50
Existing Total Pond Area	acres	60
Additional Pond Area Required	acres	0
Design Usable Storage Volume	gal	121.4 million
Existing Usable Volume	gal	under evaluation < 90 million
Additional Usable Volume Required	gal	under evaluation
Wetland Treatment System Design Criteria		
Design Hydraulic Load	gal / acre · day	under evaluation

This report identifies three potential options for locating a new stabilization pond/wetland system as shown in Drawing 4 and outlined in Table 6.4-3. The least costly option in terms of O&M costs is Option 1 – utilizing the existing natural wetlands just to the north of the existing stabilization ponds. Option 3 is the most costly in terms of O&M as the effluent has to be pumped some 8,000 feet to this location. A preliminary review of the land ownership information is provided in Drawing 3, in Appendix F.

Table 6.4-3 Preliminary Evaluation of Stabilization Pond/Wetland Treatment Sites

Alternative	Environ-mental Impacts	Land Requirements	Capital Cost (Million $)	Annual O&M Costs (Million $)	Present Worth (2030) (Million $)	Advantages / Disadvantages
Option 1	Located on land that is presently subject to sewage discharge.	Land acquisition required. See Drawing 4 and Appendix F	7 Estimate is order of magnitude only. Cost for land acquisition has been estimated.	.01	11.5	Advantages: Located closest to existing wastewater ponds. Minimal pumping distance to the new pond and wetland treatment system. Disadvantages: Effluent from treatment system continues to discharge to Brown's Slough and run through Bethel.
Option 2	Loss of natural tundra.	Land acquisition required. See Drawing 4 and Appendix F	11 Estimate is order of magnitude only. Cost for land acquisition has been estimated.	0.015	13.3	Advantages: Discharge drains away from the City of Bethel. Disadvantages: Discharge is more directly to the Kuskokwim River.
Option 3	Loss of natural tundra.	Land acquisition required. See Drawing 4 and Appendix F	12 Estimate is order of magnitude only. Cost for land acquisition has been estimated.	0.02	15.0	Advantages: Discharge drains away from the City of Bethel. Disadvantages: Located furthest from the existing ponds and requires an 8,000-foot long force main. Discharge is more directly to the Kuskokwim River.

The main purpose of rehabilitating the existing ponds is to provide more usable storage. In addition, these improvements will serve to improve the effluent quality as well. In combination with a wetland treatment system, the improvement in effluent quality would be significant.

Operationally, the existing stabilization pond/wetland treatment system would function in a manner similar to the present system except the pond effluent would be pumped constantly through the summer and at a slower rate than the present Fall/Spring pumping approach. Wetland treatment systems can be adapted from an existing natural wetland or a constructed wetland. Constructed wetlands have performed in the Lower 48 states for 30 years without signs of diminished treatment capability and recent projects in Alaska are proving as durable. In Alaska, constructed wetlands must cope with slower treatment rates due to the cooler and shorter duration summers. Nonetheless, wetland treatment systems can and do function in this environment, typically as an additional step associated with a stabilization pond. Construction is straightforward, incorporating a bentonite liner between non-woven geotextiles covered by topsoil. This creates a root zone for cattails, softstem bulrush, calla lily, and sedges, all indigenous to Alaska.

In addition, an analysis of the possibility of power generation using wind turbines or other alternative options to provide power for the new sewage effluent pumps has been prepared and is attached in Appendix D. Wind energy is a pollution-free, sustainable, and inexhaustible form of energy. It does not use fuel, it does not produce greenhouse gasses, and it does not produce toxic or radioactive waste.

6.3.4. *Scope and Cost Estimate*

The existing stabilization ponds are in a dynamic equilibrium with the surrounding tundra. When the ponds are pumped to a level below the natural water level of the surrounding tundra, the groundwater seeps in. When the water level in the pond is above that of the surrounding tundra, the pond water seeps out. The situation may be complicated by the presence or absence of seasonal frost and permafrost. The actual usable storage for holding winter wastewater can change depending on a variety of natural and operational factors which are still under evaluation at this time.

The scope of this project includes rehabilitation of the existing stabilization ponds and utilization of a wetlands treatment system at one of the three possible sites tentatively identified for land acquisition. For Options 2 and 3, a new pump station is anticipated to transfer effluent to this wetlands treatment area. These pumps would be from 5 to 20 horsepower depending upon which site is selected for development. Option 3 is furthest away and requires larger pumps and more pumping energy. For this preliminary estimate, it is assumed that these will be electrically-driven pumps and that an extension of the existing power supply from the existing Bethel Utility Company will be required. The pumps would be located near the location of the existing discharge structure near the secondary (lower) stabilization pond.

Stand-alone wind powered pumps and a utility interface system for wind powered pumps are being investigated. However, the preliminary data (not shown) suggests that an electrical power extension would be most cost effective.

A preliminary construction cost estimate for the Wastewater Treatment Upgrades is approximately $6,200,000. In addition, approximately $862,000 has been estimated for bid phase services, project administration and site surveillance. See Appendix G for more detailed cost estimates. Maintenance call outs for the lagoon will be lowest for this option and should also be reduced from the current system. Cost savings due to reduced callouts are estimated to be $10,000 per year.

6.4. SUMMARY OF OPERATIONS AND MAINTENANCE COSTS

The operations and maintenance cost impacts of the proposed water and sewer projects are summarized below in Table 6.4-1.

Table 6.4-1 Summary of Operations and Maintenance Costs

No.	Project Description	Annual O&M Cost Impact
6.1	Water Loop C	$60,000
6.2	Water Loop A & B Replacement	$72,000
6.3	Sewage Lagoon Upgrade	$10,000
	TOTAL O&M COST IMPACT	$142,000

As can be seen in this summary, a compelling impact of the proposed projects is to reduce operations and maintenance costs for the City's water and sewer facilities.

6.5. DESIGN CRITERIA AND REGULATORY REQUIREMENTS

There are several relevant performance requirements which can be expressed as design criteria, as follows:

GENERAL:

Design Year and Population. For this project, the designs should be based on high end populations and flows projected at least to the year 2030, which have been estimated at 6,633.

Mean Annual Temperature: 29.1° F.

Mean Minimum Temperature: 0° F.

99% Design Temperature: -46°F.

Mean Annual Precipitation: 16 inches.

Mean Annual Snowfall: 55 inches.

Design Thawing Index: 3,200 ° F -days.

Design Freezing Index: 4,400 ° F -days.

Design Wind Speed (3 sec gust): 120 miles per hour

Seismic Load: Per current edition of International Building Code.

Ground Snow Load: 40 PSF.

Active Layer Depth: 2 to 7 feet.

Presence of, Permafrost: Generally continuous.

WATER PROJECTS:

Materials of Construction. All materials for the water systems must be NSF 61 approved. To the maximum extent possible all pipelines are to be HDPE arctic pipe with a minimum of 3 inches of insulation. All materials and design features are to be carefully chosen to be appropriate for arctic conditions.

Flow Capacity. The new pipelines and pumping systems must have sufficient capacity to handle peak flows in the design year. For water distribution, the design shall avoid major pressure deviation from average operating pressures.

Maximum Pressure. Maximum pressures shall not exceed the pressure class for the pipes selected. Normal piping for water systems is rated for 150 psi. HDPE water piping is to be supplied as SDR 11, with a maximum pressure rating of 160 psi at 70 degrees F. For engineering and design purposes, 150 psi will be used for the maximum water pressure. Maximum pressure will typically only be a concern when evaluating fire flows or pressures for hydro-testing.

Residual Pressure. Minimum residual pressures shall not be lower than 20 PSI.

Minimum Flow Velocity. The average flow velocity in the new pipelines must be sufficient to operate the pit orifice systems used to provide added heat to each service connection. The minimum velocity for this requirement is mentioned in "Cold Regions Utilities Monograph, Third Edition" as being between 1 and 2 feet per second. Both ends of this range will be investigated during engineering design. Final design should result in average design velocities in this range.

Separation Between Water Pipes and Sewers. In accordance with ADEC requirements, all new water lines and sewers shall be designed and constructed with a minimum horizontal separation between water and sewer pipelines of 10 feet and a minimum vertical separation of 1.5 feet. Any deviation from this requirement shall be identified and reported to ADEC, together with a written explanation and request for a waiver of this requirement.

Fire Flow Capacity. 2-hr. duration at 500 gpm, minimum.

Hydrant Spacing. 500 feet per International Fire Code recommendations.

Water Consumption. Piped Water: 65 gallons per capita per day (65 gcpd). Haul water: 26 gpcd

SEWER PROJECTS:

Sewer Flow Velocities. Sewer design slopes and sizing shall be based on a minimum full flow velocity of 2 feet per second.

6.6. Unique Environmental Impacts

Water and sewer construction activities will naturally entail the usual impacts of noise, dust, traffic and community disruptions at times. Project design work shall address any specific environmental impacts which are identified during the design process.

All projects which involve excavation work involve the risk of encountering archaeological artifacts from the older cultures which have inhabited the land on which Bethel is built. However, the Alaska State Historic Preservation Office has determined that there should not be any historic properties affected.

Nonetheless, should any artifacts be unearthed as a result of project excavations, work at that location must cease immediately and the proper authorities must be notified of the situation, in accordance with the agreed SHPPO requirements.

6.7. Land Requirements and Easements

The existing water distribution loops and sewer lines lie primarily in an established right-of-way. In some locations, the pipelines cross properties where easements were never officially established. These locations have been identified and easements will need to be officially obtained by the City of Bethel wherever needed for new pipeline installation. All new water loop or sewer pipe alignments will be either in the public streets rights of way or along established or new easements where necessary.

Additionally, effluent that is pumped from the existing sewage lagoons currently runs through a natural wetlands system located on private property to the north of the lagoons. As such, land acquisition will be required for this project.

6.8. Construction Constraints

All construction work must take place prior to the winter season when excavation, backfilling and compaction activities become challenging. In addition, some of the service lines in this area serve important City institutions. Water and sewer service functioning cannot be disturbed for longer than a couple of hours at a time. The maximum time duration of service interruptions and hours of shut down shall be defined by the construction contract.

We do not anticipate any hazardous materials, however any contaminated soils encountered must be transported to an approved site for storage and the appropriate treatment to neutralize or remove the contamination.

6.9. Impacts to Existing Infrastructure

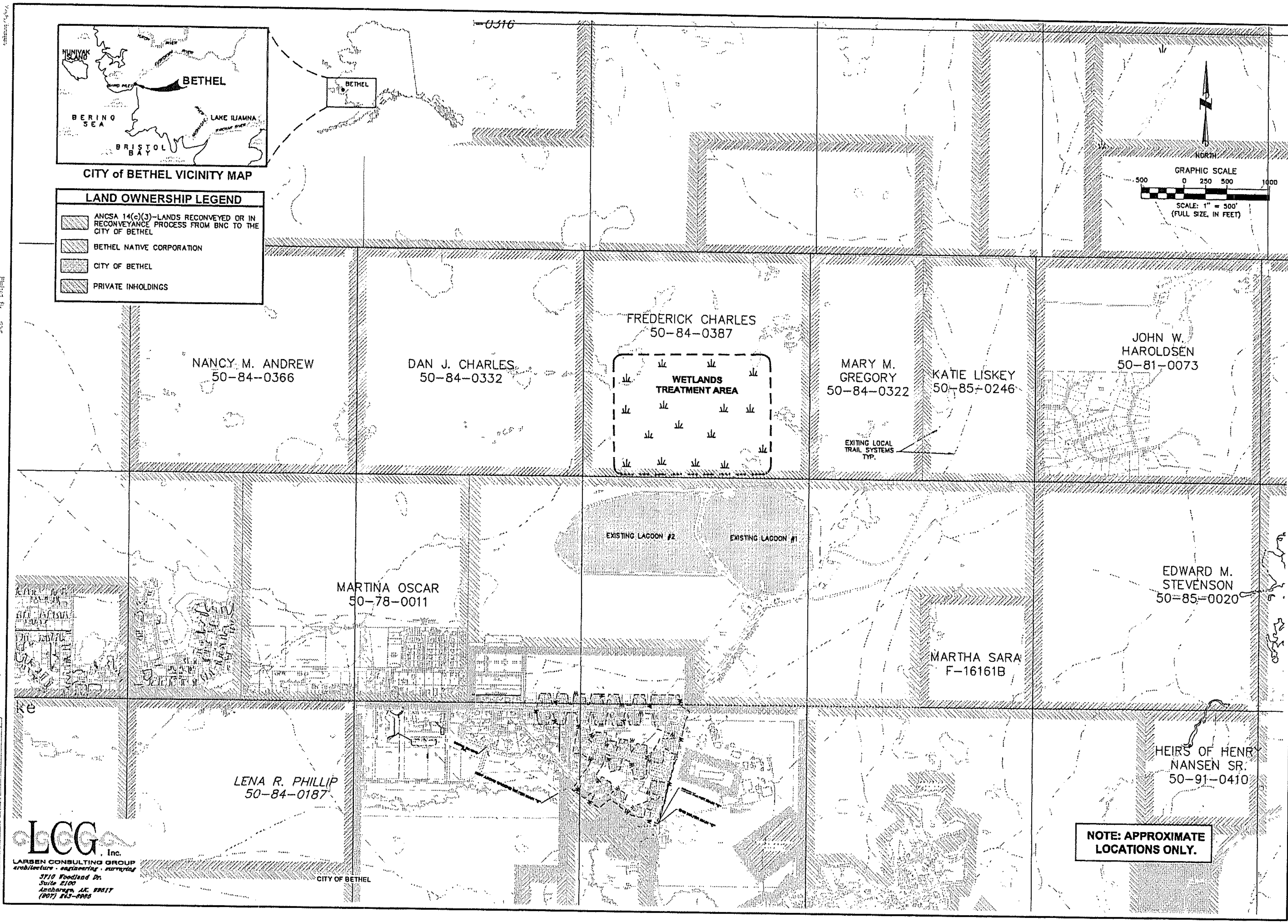
The construction of water and sewer lines in the City will inevitably require digging in the street rights of way and excavations crossing roadways, both for pipelines and for service connections. Tightly specified materials for compaction and roadway restoration is the only way to limit this impact in the short term. Improperly restored road excavations will become evident within a few weeks or months of normal traffic use. In such cases, the contract may be written to hold the contractor liable for rectification of such problems within one year from the date of the work (the warranty period).

There will also be short term impacts to the level of service enjoyed by water and sewer service customers. Also, during any prolonged water service interruptions, the contractor shall provide advance public notices to the affected houses and alternative water supply in the form of a water truck, bottled water, or similar. For any sewer service interruptions, the contractor shall provide advance public notices to the affected houses.

6.10. Cost Estimate

The proposed projects are anticipated to be accomplished over a period of four years. Detailed construction cost estimates for these projects are included in Appendix G.

This estimate is a budgetary type of estimate, which is prepared by taking an informed estimate of the quantities of work or services required and applying current known or estimated unit rates to the work or services. On top of this estimated amount, a contingency of 10% to 20% is added to cover inaccuracies in both the work and unit cost estimate, as well as unknown fluctuations on the construction market.



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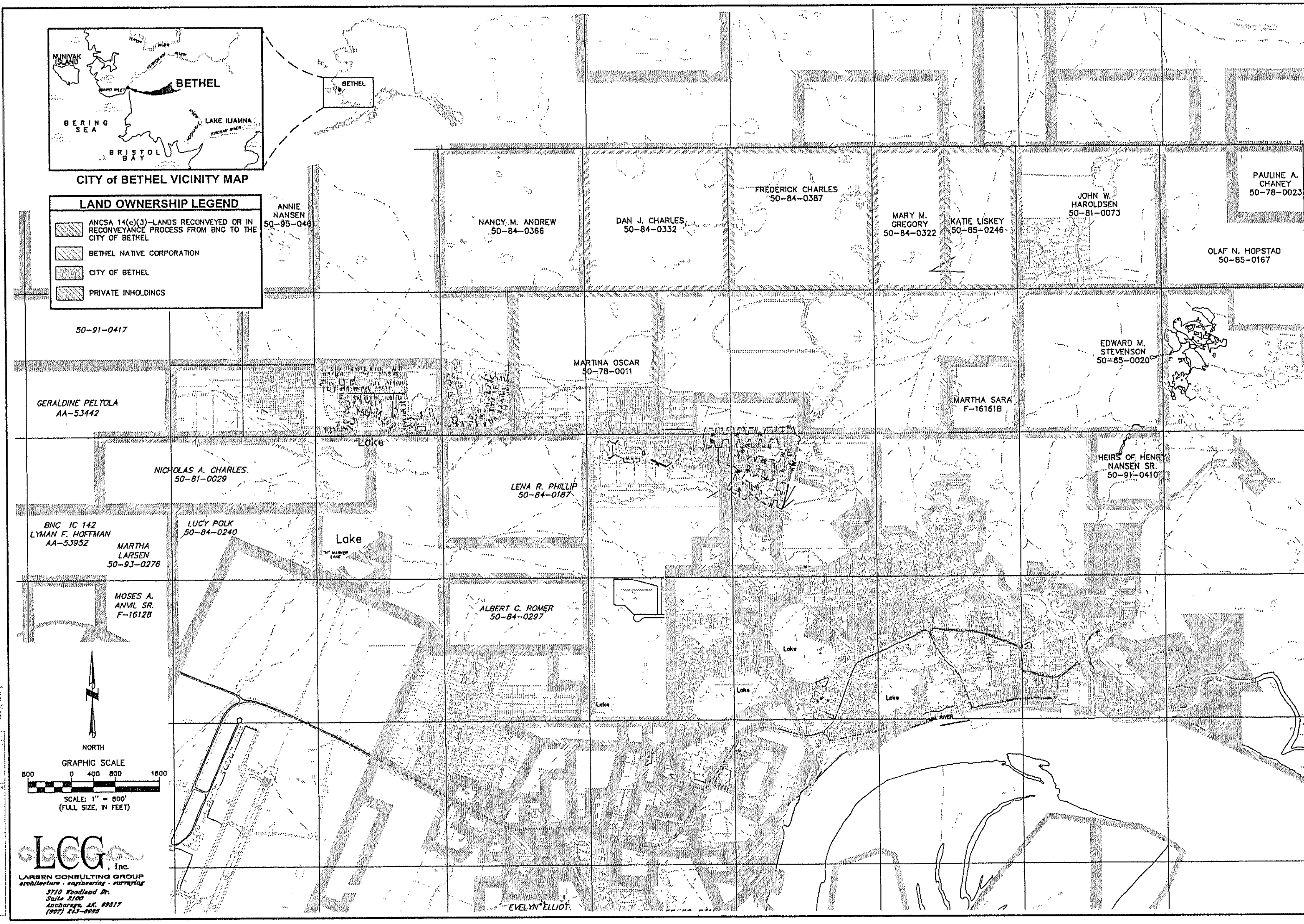
CITY OF BETHEL

CITY OF BETHEL
DRAWING 2
SITE FOR WASTEWATER
TREATMENT SYSTEM

NO.	DATE	BY	REVISION

SCALE: AS SHOWN
DESIGNED BY: JDC
DRAWN BY: JDO
CHECKED BY: AWS
DATE: 03/08/10
FILE NO. 624.01
SHEET NUMBER
2 of 3

P52



NO.	DATE	BY	REVISION

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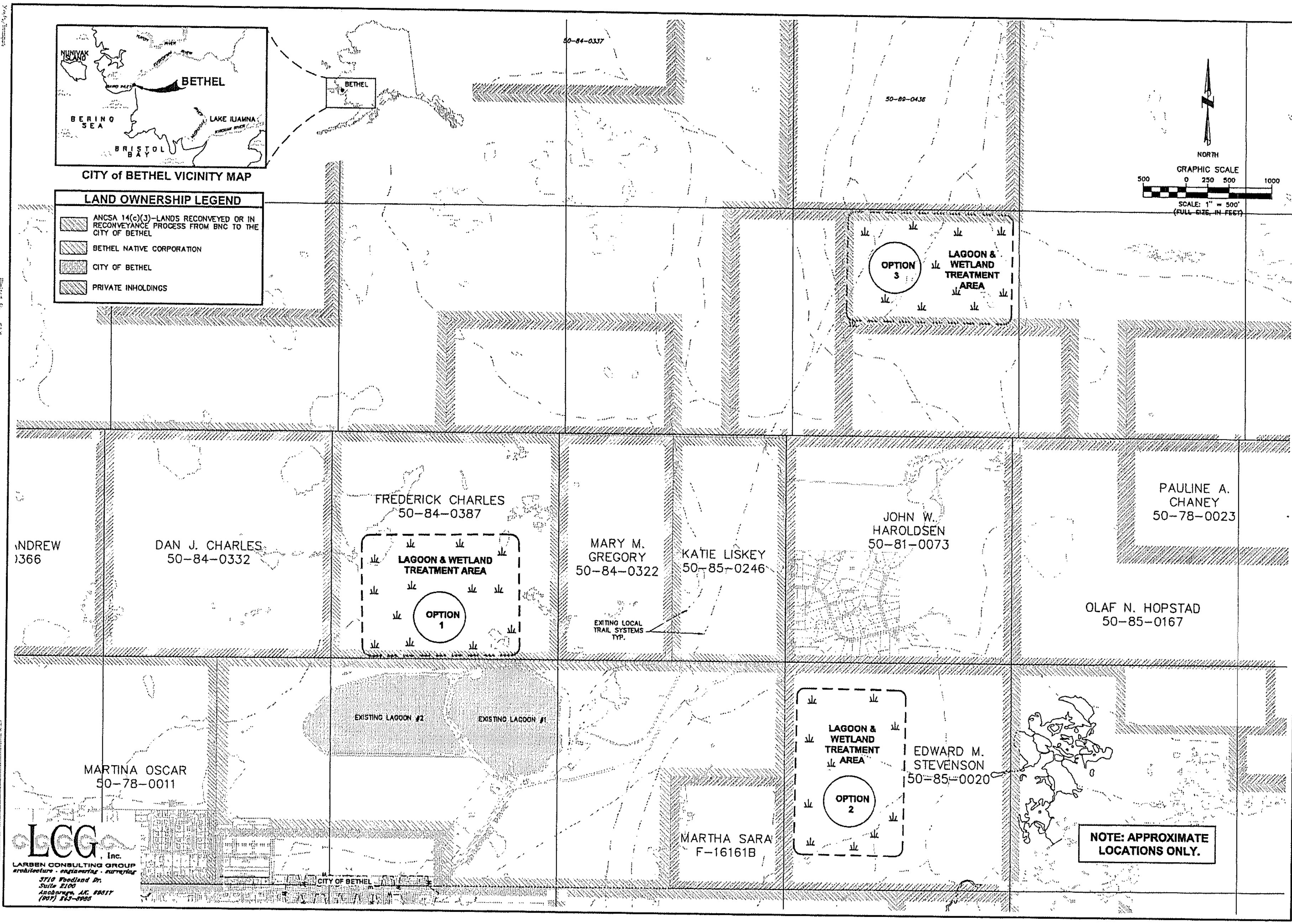
CITY OF BETHEL

CITY OF BETHEL
DRAWING 3
LAND STATUS & PROPERTY LOCATION

SCALE: AS SHOWN
DESIGNED BY: DM
DRAWN BY: DM
CHECKED BY: AWS
DATE: 11/7/09
FILE NO. 824.01
SHEET NUMBER 3 of 3

P54



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CITY OF BETHEL

NO.	DATE	BY	REVISION

CITY OF BETHEL
DRAWING 4
SITE OPTIONS FOR WASTEWATER TREATMENT SYSTEM

SCALE:	AS SHOWN
DESIGNED BY:	JDG
DRAWN BY:	JDG
CHECKED BY:	AWS
DATE:	03/08/10
FILE NO.	824.01

SHEET NUMBER
1 of 1

LEGEND

EXISTING	DESCRIPTION
◑	FOUND 2" ALCAP ON 5/8"x 30" REBAR
⊘	FOUND 3.25" BRASS CAP ON 5/8"x 30" REBAR
⊕BM	PROJECT BENCH MARK LOCATION
— — —	NON-SURVEYED LOT LINE

SURVEY CONTROL

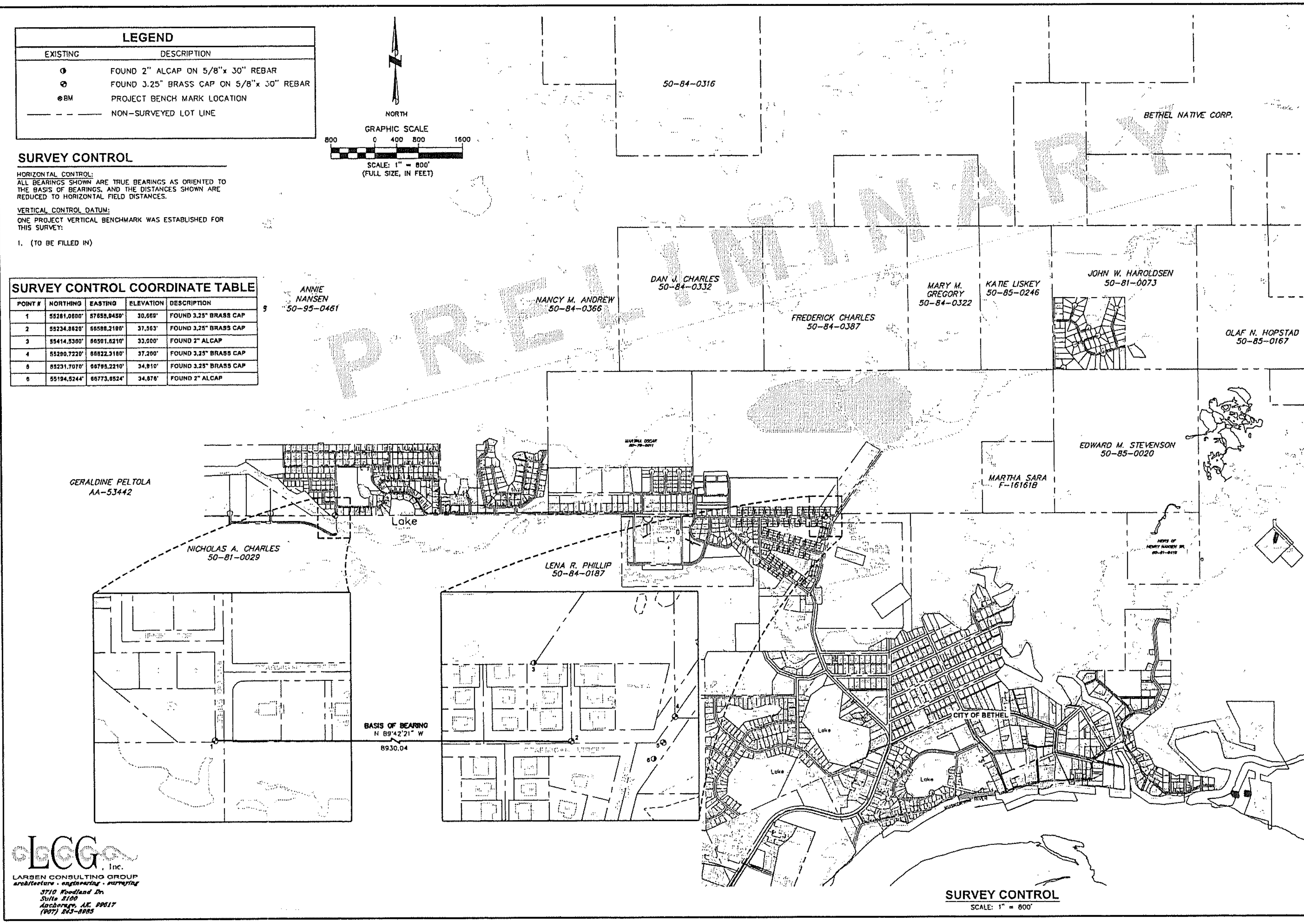
HORIZONTAL CONTROL:
ALL BEARINGS SHOWN ARE TRUE BEARINGS AS ORIENTED TO THE BASIS OF BEARINGS, AND THE DISTANCES SHOWN ARE REDUCED TO HORIZONTAL FIELD DISTANCES.

VERTICAL CONTROL DATUM:
ONE PROJECT VERTICAL BENCHMARK WAS ESTABLISHED FOR THIS SURVEY:

1. (TO BE FILLED IN)

SURVEY CONTROL COORDINATE TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	55281.0800'	57658.9459'	30.669'	FOUND 3.25" BRASS CAP
2	55234.8820'	66588.2180'	37.563'	FOUND 3.25" BRASS CAP
3	55414.5360'	66561.6210'	33.000'	FOUND 2" ALCAP
4	55290.7220'	66822.3180'	37.200'	FOUND 3.25" BRASS CAP
5	55231.7070'	66795.2210'	34.910'	FOUND 3.25" BRASS CAP
6	55194.5244'	66773.6524'	34.876'	FOUND 2" ALCAP



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SURVEY CONTROL
SCALE: 1" = 800'

NO.	DATE	BY	REVISION

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CITY OF BETHEL

CITY OF BETHEL
WASTEWATER LAGOON
SURVEY CONTROL

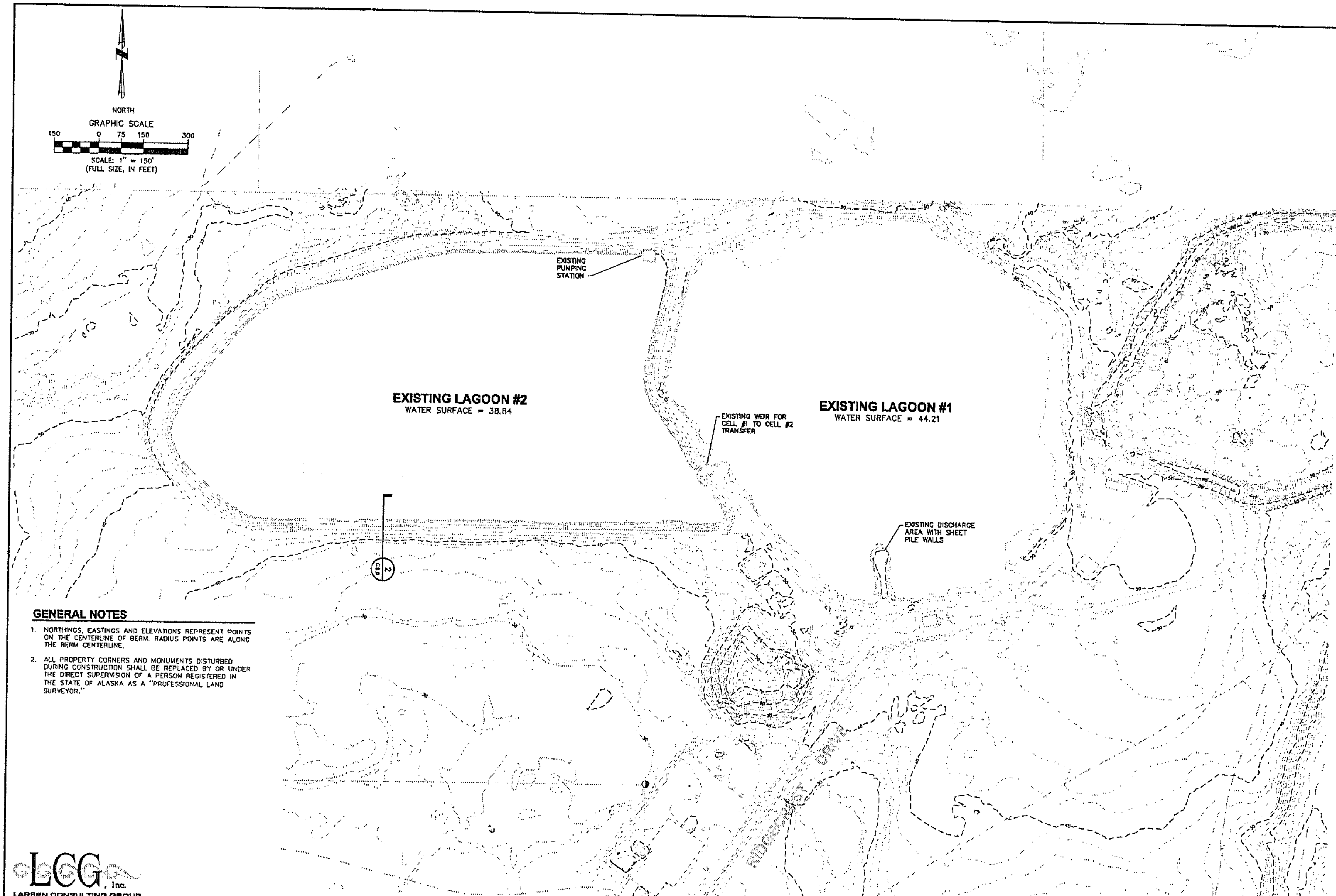
SCALE:	AS SHOWN
DESIGNED BY:	JDG
DRAWN BY:	BED
CHECKED BY:	AWS
DATE:	01/07/10
FILE NO.	824.02

SHEET NUMBER
V3.0 of

Xrefs/Images:

Plotted By: brion
Date/Time: 12 Feb 2010 12:27 pm
Layout: V1.0 SURVEY CONTROL
Filename: Y:\CIVIL PROJECTS\824.04 COB WASTEWATER LAGOON\824.04_SRVY_CTRL_BETHEL_Wastewater Lagoon.dwg

Submittals: 1 X X



GENERAL NOTES

1. NORTHINGS, EASTINGS AND ELEVATIONS REPRESENT POINTS ON THE CENTERLINE OF BERM. RADIUS POINTS ARE ALONG THE BERM CENTERLINE.
2. ALL PROPERTY CORNERS AND MONUMENTS DISTURBED DURING CONSTRUCTION SHALL BE REPLACED BY OR UNDER THE DIRECT SUPERVISION OF A PERSON REGISTERED IN THE STATE OF ALASKA AS A "PROFESSIONAL LAND SURVEYOR."

EXISTING LAGOON SITE PLAN
SCALE: 1"= 150'

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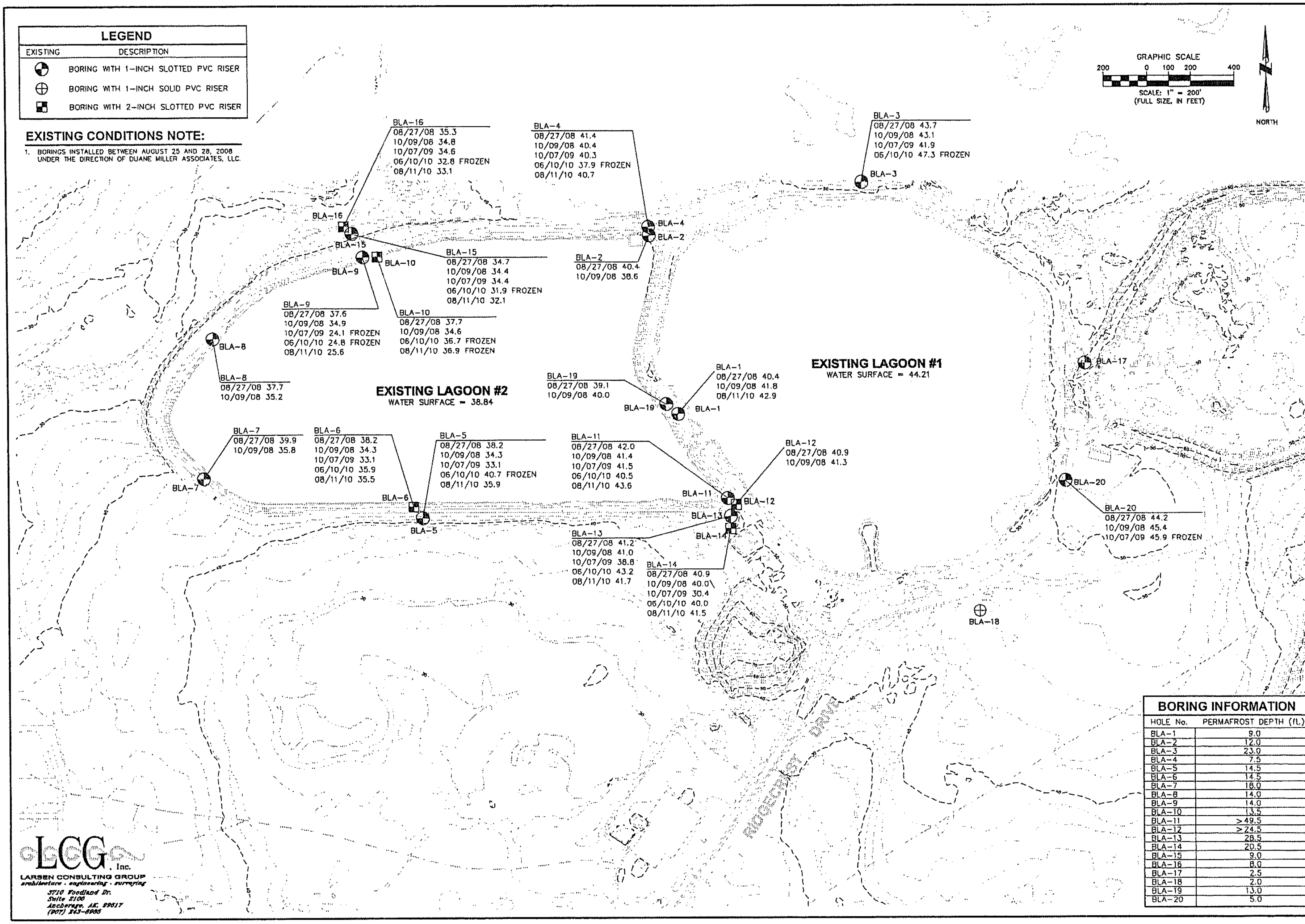
CITY OF BETHEL

2010 WATER & SEWER SYSTEM IMPROVEMENTS
WASTEWATER LAGOON
EXISTING LAGOON SITE PLAN

NO.	DATE	BY	REVISION

SCALE: 1" = 150'
DESIGNED BY: AWS
DRAWN BY: DM
CHECKED BY: AWS
DATE: 02/11/10
FILE NO. 824.04
SHEET NUMBER
C7.0 OF

P56



BORING INFORMATION

HOLE No.	PERMAFROST DEPTH (ft.)
BLA-1	9.0
BLA-2	12.0
BLA-3	23.0
BLA-4	7.5
BLA-5	14.5
BLA-6	14.5
BLA-7	18.0
BLA-8	14.0
BLA-9	14.0
BLA-10	13.5
BLA-11	>49.5
BLA-12	>24.5
BLA-13	28.5
BLA-14	20.5
BLA-15	9.0
BLA-16	8.0
BLA-17	2.5
BLA-18	2.0
BLA-19	13.0
BLA-20	5.0

NO.	DATE	BY	REVISION

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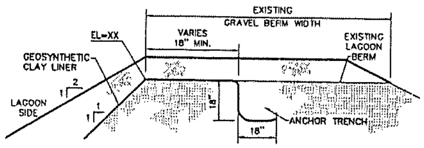
CITY OF BETHEL

2010 WATER & SEWER SYSTEM IMPROVEMENTS

WASTEWATER LAGOON
LAGOON BORING MAP

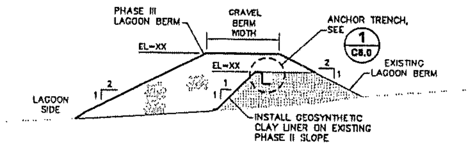
SCALE: AS SHOWN
DESIGNED BY: AWS
DRAWN BY: DM/JDO
CHECKED BY: AWS
DATE: 02/11/10
FILE NO. 824.04
SHEET NUMBER
C7.1 OF



1 / C8.0 **TYPICAL ANCHOR TRENCH DETAIL**
SCALE: N.T.S.

CONSTRUCTION NOTES

1. IMPERMEABLE GEOSYNTHETIC CLAY LINER (GCL) IS TYPE CETCO BENTOMAT DN, 14.5 FT. WIDE BY 150 FT. LONG PANELS. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
2. PLACE GCL ON PREPARED SUBGRADE SURFACE THAT IS FREE OF SHARP EDGED ROCK OR DEBRIS. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
3. UPPER EDGE OF GCL SHALL BE KEYED INTO EMBANKMENT AS SHOWN. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
4. GCL SHALL BE INSTALLED ONLY IN DRY CONDITIONS AND SHALL BE PROTECTED FROM MOISTURE UNTIL FULLY COVERED BY COMPACTED FILL MATERIAL.



2 / C8.0 **BERM SECTION**
SCALE: 1"= 10'

NO.	DATE	BY	REVISION

LCG LARSEN CONSULTING GROUP, Inc.
architecture · engineering · surveying
3710 Woodland Dr.
Suite 2100
Anchorage, AK. 99517
(907) 243-8985

CITY OF BETHEL

2010 WATER & SEWER
SYSTEM IMPROVEMENTS
WASTEWATER LAGOON
CIVIL LAGOON DETAILS

SCALE: AS SHOWN
DESIGNED BY: AWS
DRAWN BY: JDC
CHECKED BY: AWS
DATE: 02/11/10
FILE NO. 824.04
SHEET NUMBER
C8.0 of

discoloration from old pipes that need to be replaced, occasional unwillingness of customers to pay the electricity costs associated with keeping circulation pumps going (to keep pipes from freezing in winter), and conflicts with traditional trail routes (pipes are located above-ground for cost savings and ease of maintenance). Property owners receiving piped water service (or living within 1,000 feet of a fire hydrant connected to the piped system) enjoy lower insurance rates, but also tend to use more water than customers receiving hauled water. Residents have also complained that the above-ground pipes are ugly ("Nobody wants them in their yards.") and inconveniently block some trails.

Though high, rates for water and sewer services have not always kept up with the costs of providing these services. During public planning discussions, residents expressed equity concerns about the division of customers paying by volume (piped metered and hauled) versus those on the piped system (un-metered), and suggested that all customers on the piped system be metered and charged by volume of water used. As one resident pointed out, "We have people going to a relative's house to do laundry because they're on the piped system, so it doesn't matter how much water they use. That isn't right." To address these concerns, a priority for the City should be to conduct a rate study to determine the most equitable and fiscally responsible rate structure, and to provide a clear explanation of these results with the general public.

Priority Projects Underway

1. **Sewer force main and service lift station upgrades.** Force main upgrades along Chief Eddie Hoffman Highway, at City Subdivision, and the utility corridor from 7th Avenue to the sewer lagoon, and upgrades to lift stations QFC #2, the Trailer Court, and QFC Store. Paid for with USDA Rural Development funding. This project is nearly complete. Contractor: CH2MHill.

2. **City Complex manholes.** Some of the manholes near the Courthouse are sinking and tearing apart the piping connected to them. Public Works will pull them above ground. Estimated to cost about $275,000, this project is scheduled for this coming summer and will be paid for with City funds.

3. **Bethel Heights piped water distribution upgrades.** Pipes for A, B, and C loop will have to be replaced to address the high iron content in the water. Estimated to cost over $2 million. This project is on hold until funding is secured.

4. **Wastewater lagoon.** The lagoon is the Public Works Department's highest future priority; USDA Rural Development has refused to fund any other Bethel projects until completed. The project is currently in the planning stage, and will probably take two to three years to construct due to Bethel's short construction window (4-5 months). The project is estimated to cost about $20 million. Contractor: Larsen Engineering.

5. **Bethel Institutional Corridor piped water distribution upgrades.** The Bethel Institutional Corridor Water System Phases 1 and 2 is the second highest priority after the Bethel wastewater lagoon. A feasibility study for piped water was recently done for the Bethel Institutional Corridor, in the City Subdivision area serving multiple institutions along the Chief Eddie Hoffman Highway (Contractor: Larsen Engineering). A full cost analysis and rate study will be needed before further action is taken on this project.

CITY OF BETHEL

P.O. Box 388 • Bethel, Alaska 99559

543-2297—Area Code 907

RESOLUTION #703

WHEREAS, health concerns are of the highest priority in the thinking and work of the Bethel City Council, and

WHEREAS, the maintenance and continued functioning of the Sewer Lagoon is essential to the health and safety of the entire Community of Bethel, and

WHEREAS, we have experienced failures recently in the Sewer Lagoon, and

WHEREAS, there is a construction program designed to strengthen the existing Sewer Lagoon and protect against further failures as well as expand the capacity of the Lagoon to accommodate our needs, as projected, well into the next century, and

WHEREAS, there is need to acquire land for the expansion of the Lagoon and that land is presently in control of the Bethel Native Corporation, and

WHEREAS, Bethel Native Corporation has indicated a willingness to assist the City of Bethel in the Sewer Lagoon project by making the desired land available, and

NOW THEREFORE BE IT RESOLVED that the City of Bethel formally requests the assistance of the Bethel Native Corporation to convey the needed land under the provisions of 14(c)(3) of the Alaska Native Land Claims Settlement Act.

PASSED AND APPROVED THIS 24th DAY OF March, 1992.

Vote: Unanimous approval

James H. Feaster III
James H. Feaster III, Mayor

ATTEST:

Jane Elam
Jane Elam, City Clerk

"Deep Sea Port and Transportation Center of the Kuskokwim"

CITY OF BETHEL
P.O. Box 388 • Bethel, Alaska 99559
543-2297—Area Code 907

RESOLUTION #715

A RESOLUTION REQUESTING CAPITAL FUNDING THROUGH THE STATE OF ALASKA, VILLAGE SAFE WATER PROGRAM.

WHEREAS, The City of Bethel City Council hereinafter called the Council, is the governing body of Bethel, Alaska, and

WHEREAS, The Council desires to provide adequate sanitation facilities for the residents of Bethel, Alaska, and has determined the sewer lagoon project to be the Number 1 priority for the community, and

WHEREAS, The Department of Environmental Conversation/Village Safe Water Program, hereinafter called VSW, can provide the technical assistance necessary to improve the sewer lagoon problem, and

NOW THEREFORE BE IT RESOLVED, that the Council hereby requests the Governor appropriate $1,850,000 through the VSW Program to design and build the sewer lagoon expansion project,

BE IT FURTHER RESOLVED, that the Council hereby authorizes VSW or its representatives to enter upon or cross Community Land for the purposes of assisting the City in carrying out this sewer lagoon project.

I, the undersigned, hereby certify that the Council is composed of seven (7) members, of whom seven constituting a quorum were present and that the foregoing resolution was

PASSED AND APPROVED by the Council of Bethel, Alaska, this 22nd day of September, 1992.

VOTE: 7 Yeas; 0 Nays

James H. Feaster, III
Mayor

ATTEST:

Jane Elam, City Clerk

Council Member

"Deep Sea Port and Transportation Center of the Kuskokwim"

CITY OF BETHEL

P O Box 388 · Bethel, Alaska 99559
907-543-2087
FAX # 543-4171

Presented by: City Manager Hunter
Date: February 14, 1995
Action: Passed
Vote: 5-Yes, 0-No

RESOLUTION #95-10

A RESOLUTION OF THE BETHEL CITY COUNCIL ACCEPTING A GRANT FOR SEWAGE LAGOON CONSTRUCTION COMPLETION

WHEREAS, the City of Bethel requested an appropriation from the 1994 Alaska State Legislature through the Village Safe Water Program for funds to apply toward financing the completion of construction the sewage lagoon; and

WHEREAS, the Alaska State Legislature made an appropriation in the amount of $500,000 (five hundred thousand dollars) for this project; and

WHEREAS, the Village Safe Water Program has made these grant funds available to the City of Bethel through Grant Number 16715.

NOW, THEREFORE, BE IT RESOLVED that the Bethel City Council hereby accepts Grant Number 16715 in the amount of $500,000 for funds to apply toward financing the completion of construction of the sewage lagoon; and

BE IT FURTHER RESOLVED that the Bethel City Council hereby authorizes the City Manager to sign all grant documents and administer the grant in accordance with its conditions on behalf of the City.

PASSED AND APPROVED THIS 14TH DAY OF FEBRUARY, 1995.

Allan Wintersteen, Mayor

ATTEST:

Connie Tucker, City Clerk

"Deep Sea Port and Transportation Center of the Kuskokwim"

Introduced by: City Manager Herron
Date: August 31, 2004
Action: Adopted
Vote: 4-2 (Williams, Rodgers)

CITY OF BETHEL, ALASKA

RESOLUTION # 04-32

A RESOLUTION REQUESTING CAPITAL FUNDING THROUGH THE STATE OF ALASKA, VILLAGE SAFE WATER PROGRAM, SFY2006 CAPITAL CONSTRUCTION QUESTIONNAIRE

WHEREAS, the Bethel Council, hereinafter called the Council, is the governing body of the City of Bethel, Alaska;

WHEREAS, the Council desires to provide adequate sanitation facilities for the residents of Bethel, Alaska and has determined the project to be number one priority for the community;

WHEREAS, the Department of Environmental Conservation/Village Safe Water Program, hereinafter, called VSW, can provide the technical assistance necessary to improve the sanitation facilities' problem;

NOW THEREFORE BE IT RESOLVED that the Council hereby requests the Governor and Legislature to appropriate up to $10,000,000 included in SFY2006 Capital Construction Questionnaire through the VSW Program to design and build Bethel Water and Sewer Improvements (Service construction management and administrative services for the water and sewer improvement projects in the City of Bethel Water and Sewer Facilities Master Plan Update, dated July 2, 1996).

BE IT FURTHER RESOLVED that the Council hereby authorizes VSW or its representatives to enter upon or cross community land for the purposes of assisting the Council in carrying out this sanitation facilities' improvement project.

BE IT FURTHER RESOLVED that the Council will cooperate with the provisions of needed agreements entered into between the Council and VSW, and that said provisions will be duly carried out by City of Bethel's Administration.

PASSED AND APPROVED THIS 31st DAY OF AUGUST 2004.

R. Thor Williams, Vice- Mayor

ATTEST:

Selena Malone, City Clerk

Introduced by: City Manager Baird
Date November 8, 2006
Action: Passed
Vote: Unanimous

CITY OF BETHEL, ALASKA

RESOLUTION #06-29

A RESOLUTION ACCEPTING VILLAGE SAFE WATER FUNDING FROM DEPARTMENT OF ENVIRONMENTAL CONSERVATION DIVISION OF WATER IN THE AMOUNT OF $8,500,000 AS PART OF GRANT OFFER #07E156

WHEREAS, the City of Bethel wishes to accept Grant Offer #07E156 from the State of Alaska Department of Environmental Conservation in the amount of $8,500,000 as provided for by the Village Safe Water Act (AS46.07);

WHEREAS, this grant will be used to finance the construction of the QFC #2 lift station, installation of approximately 3,170 linear feet above ground force from main lift station to the existing sewage lagoon, and the remodeling of both the standby generator building and the second floor of the Bethel Heights water treatment facility;

WHEREAS, the scope of work also provides for a portion of the design and construction of the sewage treatment facility;

WHEREAS, the resulting water and sewer improvements are valuable for the overall quality of life for the citizens of Bethel.

NOW, THEREFORE, BE IT RESOLVED that the Bethel City Council accepts the Village Safe Water Grant Agreement #07E156 in the amount of $8,500,000 for the City of Bethel from the Department of Environmental Conservation Division of Water in support of the cooperative efforts to develop sustainable sanitation facilities.

PASSED AND APPROVED THIS 8th DAY OF NOVEMBER 2006, BY A UNANIMOUS VOTE IN FAVOR.

Daniel C. Leinberger, Mayor

ATTEST:

Sandra Modigh, City Clerk

Introduced By: City Manager Baird
Date: May 22, 2007
Action: Passed
Vote: 5-0

CITY OF BETHEL, ALASKA

RESOLUTION #07-21

A RESOLUTION REQUESTING CAPITAL IMPROVEMENT PROJECT (CIP) FUNDING THROUGH THE STATE OF ALASKA, VILLAGE SAFE WATER PROGRAM.

WHEREAS, the City of Bethel Council, hereinafter called the Council, is governing the body of Bethel, Alaska,

WHEREAS, the Department of Environmental Conservation/Village Safe Water Program, hereinafter called VSW, may provide assistance necessary to address the following sanitation facility construction needs in the community: Mechanical Wastewater Treatment Facility Improvements,

WHEREAS, the Council desires to provide adequate sanitation facilities for residents of the community and has determined the above reference project to be the highest priority for sanitation facility planning for the community.

NOW, THEREFORE, BE IT RESOLVED that the Council hereby requests the Governor and Legislature appropriate $10,000,000.00 through the VSW Program to complete the construction project identified above.

BE IT FURTHER RESOLVED that Wally Baird, City Manager is hereby authorized to negotiate, execute, and administer any and all documents, contracts and agreements required for granting funds to the City of Bethel and managing funds on behalf of this entity, including any subsequent amendments to said agreements.

BE IT FURTHER RESOLVED that the Council hereby authorizes VSW or its representatives to enter upon or cross community land for the purposes of assisting the Council in carrying out this construction project.

BE IT FURTHER RESOLVED that the Council will cooperate with the provisions of needed agreements entered into between the Council and VSW, and that said provisions will be duly carried out.

PASSED AND APPROVED THIS 22nd DAY OF MAY, 2007.

____
Daniel C. Leinberger, Mayor

ATTEST:
____
Sandra Modigh, City Clerk

Introduced by: Council Member Middlebrook
Introduction Date: July 10, 2007
July 24, 2007
August 14, 2007
Action: Passed
Vote: 6-0

CITY OF BETHEL, ALASKA

Resolution # 07-24

A RESOLUTION BY THE BETHEL CITY COUNCIL CHOOSING TO PURSUE CONVENTIONAL WASTE WATER TREATMENT FACILITIES

WHEREAS, the high price of utilities is burdensome and detrimental to most of the citizens of Bethel;

WHEREAS, it is not the desire of the city to have the citizens of Bethel pay the price for producing higher than regulatory compliant effluent;

WHEREAS, it is simply the desire of the city to produce regulatory compliant effluent at the lowest possible operating and maintenance costs;

NOW, THEREFORE, BE IT RESOLVED that the City shall not pursue the MBR (Membrane Bioreactor) mechanical wastewater treatment plant at this time.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the City will pursue a plan to use any available treatment processes to produce regulatory compliant effluent at the lowest operating and maintenance costs. Because of volatile energy costs, total energy usage is to be a consideration in any possible designs. The design and operation of other treatment facilities such as those in Kodiak, Anchorage and other Alaskan communities may be used as examples of how such facilities can and do work.

ENACTED THIS 14th DAY OF AUGUST, 2007 BY A VOTE OF 6 IN FAVOR AND 0 OPPOSED.

Daniel C. Leinberger, Mayor

ATTEST:

Sandra Modigh, City Clerk

Introduced by: Don W. Baird,
City Manager
Date: July 24, 2007
Action: *None*
Vote:

CITY OF BETHEL, ALASKA

Resolution #07-26

A RESOLUTION BY THE BETHEL CITY COUNCIL APPROVING THE WASTE WATER TREATMENT FACILITY AS A PART OF THE BACKBONE WATER & SEWER IMPROVEMENT PROGRAM OF THE CITY OF BETHEL FINAL BUSINESS PLAN

WHEREAS, the State of Alaska Department of Environmental conservation, Division of Water, Village Safe Water (VSW) Program is currently funding the City of Bethel's Water & Sewer Capital Improvement Program;

WHEREAS, the Bethel Water and Sewer Facilities Master Plan Update, April 2005, outlines water and sewer improvement development plan that is recommended by the City of Bethel Public Works Committee and the Finance Committee;

WHEREAS, the City is currently upgrading the community's backbone water & sewer infrastructure, improvements are anticipated to be completed in 2010;

WHEREAS, the final "backbone" facility needing to be upgraded is construction of a mechanical wastewater treatment facility to replace the deficient facultative sewage lagoon;

WHEREAS, replacing the facultative sewage lagoon with a mechanical wastewater treatment facility will have an increase in operations and maintenance costs;

THEREFORE, BE IT RESOLVED THAT the Bethel City Council hereby approves and accepts the City of Bethel Business Plan that includes the increased operations and maintenance costs of the mechanical wastewater treatment facility.

PASSED AND APPROVED THIS_____ DAY OF APRIL ________, BY A ___________VOTE.

____
Daniel C. Leinberger, Mayor

ATTEST:

____
Sandra Modigh, City Clerk

Introduced by: City Manager Foley
Date: August 11, 2009
Action: Passed
Vote: 4-0

CITY OF BETHEL, ALASKA

Resolution # 09-33

A RESOLUTION TO ADOPT A PHASED APPROACH TO INCREASING WATER AND SEWER RATES AND REDUCE OPERATON AND MAINTENANCE EXPENSES AND PAY FOR WATER AND SEWER ENTERPRISE FUNDING SHORTFALLS WITH GENERAL FUNDS

WHEREAS, the City of Bethel "City" will comply with conditions set forth by the USDA/RD Office in order to obtain grant funding for water and sewer infrastructure development;

WHEREAS, the City will pursue a phased development of its rate structure to charge rates reflective of cost;

WHEREAS, general funds will be used in lieu of increased rates until such time that water and sewer enterprise revenues cover all the costs;

NOW, THEREFORE, BE IT RESOLVED that the Bethel City Council hereby supports a phased approach to increasing water and sewer rates and reducing operation and maintenance expenses and will use general funds to pay for the water and sewer funding shortfall until such time that the rates cover the costs.

ENACTED THIS 14 DAY OF AUGUST 2009 BY A VOTE OF 4 IN FAVOR AND 0 OPPOSED.

Joe Klejka, Mayor

ATTEST:

Lori Strickler, City Clerk

Introduced by:	Finance Committee
Date:	July 14, 2009
Action:	Passed
Vote:	7-0

CITY OF BETHEL, ALASKA
Resolution #09-30

INCREASING THE CONTRACT WATER RATES.

WHEREAS, the City of Bethel currently has established in 2007 a monthly rate of $.016 per gallon; and

WHEREAS, the cost to produce a gallon of water in 2009 is $.0246 per gallon; and

WHEREAS, The Water and Sewer Enterprise Fund is operating at a loss in 2009 due to increased costs; and

WHEREAS, continued operation with contract rates below cost will result in further cash losses in the Water and Sewer Enterprise Fund; and

WHEREAS, the City Council has authority to move and direct the City Administration to revise the contract water rate once per calendar year; and

WHEREAS, the Finance Committee seeks to provide solutions to help minimize the funding shortfall in the Water and Sewer Enterprise Fund.

NOW, THEREFORE, BE IT RESOLVED, that the Bethel Finance Committee recommends the Bethel City Council take action to direct the City Administration to revise the Memorandum of Agreement(s) pertaining to bulk water purchases to reflect a monthly rate of $.03 per gallon.

ENACTED THIS 14th DAY OF JULY 2009 BY A VOTE OF 7 IN FAVOR AND 0 OPPOSED.

ATTEST:

Joseph Klejka, Mayor

Lori Strickler, City Clerk

P80

Introduced by: Lee Foley, City Manager
Date: February 14, 2012
Action:
Vote:

CITY OF BETHEL, ALASKA

Resolution # 12-03 Substitute

CITY OF BETHEL'S REVISED PARTICIPATION IN FY 2012 DENALI COMMISSION'S TRANSPORTATION PROGRAM—WATERFRONT PROJECT NOMINATION

WHEREAS, the Denali Commission informed the City of Bethel that its FY 2012 Waterfront Project Nomination to Denali Commission's Transportation Program requesting $1,000,000 to dredge the Bethel Small Boat Harbor mooring basin would not be supported due to lack of full funding to dredge the entire basin and entrance channel;

WHEREAS, the Denali Commission recommended that the City revise its request and instead pursue $1,000,000 in funding to replace the north and south boat launch ramps and scour both ramps at the Bethel Small Boat Harbor;

WHEREAS, the purpose of Resolution #12-03 Substitute is to replace the previous Resolution 12-03 in order to request $1,000,000 from the FY 2012 Denali Commission's Transportation Program in order to pay for construction and installation of the north boat launch ramp and the south boat launch ramp at the Bethel Small Boat Harbor;

WHEREAS, the City's request for funding would also cover the cost to scour the toe of the north and south boat launch ramps, as needed, to ensure maximum ramp performance once installed;

WHEREAS, City Port Director Peter Williams estimated the cost to construct the north and south boat launch ramps and scour the toes at approximately $1,500,000;

WHEREAS, the remaining $500,000 to complete this boat launch ramp construction project will come from the following sources: $100,000 in FY 2012 City of Bethel Adopted Annual Budget - "Denali Commission cash match" line item, and $400,000 from Port of Bethel unrestricted fund balance;

WHEREAS, the Bethel City Council, in conjunction with the City Finance Department, hereby commits the $500,000 in cash matching funds identified in the prior section to the construction of the north and south boat launch ramps and related scouring at the Bethel Small Boat Harbor;

Introduced by: Lee Foley, City Manager
Date: February 14, 2012
Action:
Vote:

WHEREAS, the City of Bethel pledges to maintain the north and south boat launch ramps such that they remain functional throughout their expected service life;

WHEREAS, the City of Bethel certifies that it has acquired the real property interests required by the Department of the Army, and otherwise is vested with sufficient title and interest in lands to support construction of a Denali Commission-funded project at the Bethel Small Boat Harbor in Bethel, Alaska;

WHEREAS, the City of Bethel authorizes the Department of the Army, its agents, employees and contractors, on behalf of the Denali Commission, to enter upon portions of the City of Bethel lands encompassing the Bethel Small Boat Harbor and its City-owned environs, to construct and install the north and south boat launch ramps and scour the ramp toes, as defined in the work plan approved by the City, Denali Commission, and U.S. Army Corps of Engineers—Alaska District Office, JBER, Alaska;

NOW, THEREFORE, BE IT RESOLVED that the Bethel City Council supports and approves the U.S. Army Corps of Engineers—Alaska District's completion of the FY 2012 Denali Commission Transportation Program nomination form on behalf of the City of Bethel and the Denali Commission's change in the request to pursue $1,000,000 in funding to construct and install two boat launch ramps and scour the toe of each;

BE IT FURTHER RESOLVED, that the Bethel City Council commits $500,000 in cash match to the north and south boat launch construction project, provided the U.S. Army Corps of Engineers is awarded the grant from the Denali Commission;

BE IT FURTHER RESOLVED, that the Bethel City Council hereby authorizes City Manager Lee M. Foley to sign the *Authorization for Entry for Construction* form that permits the Department of the Army to enter upon City land and complete the Bethel Small Boat Harbor boat launch ramp construction project.

ENACTED THIS 14TH DAY OF FEBRUARY 2012 BY A VOTE OF __ IN FAVOR AND __ OPPOSED.

Joseph A. Klejka, Mayor

ATTEST:

Lori Strickler, City Clerk

Introduced by: Lee Foley, City Manager
Date: January 10, 2012
Action: Passed
Vote: 6-0

CITY OF BETHEL, ALASKA

Resolution # 12-03

CITY OF BETHEL'S REVISED PARTICIPATION IN FY 2012 DENALI COMMISSION'S TRANSPORTATION PROGRAM—WATERFRONT PROJECT NOMINATION

WHEREAS, the Denali Commission informed the City of Bethel that its FY 2012 Waterfront Project Nomination to Denali Commission's Transportation Program requesting $1,000,000 to dredge the Bethel Small Boat Harbor mooring basin would not be supported due to lack of full funding to dredge the entire basin and entrance channel;

WHEREAS, the Denali Commission recommended that the City revise its request and instead pursue $1,000,000 in funding to replace the north and south boat launch ramps and scour both ramps at the Bethel Small Boat Harbor;

WHEREAS, the purpose of Resolution #12-03 is to replace and rescind Resolution #11-35 in order to request $1,000,000 from the FY 2012 Denali Commission's Transportation Program in order to pay for construction and installation of the north boat launch ramp and the south boat launch ramp at the Bethel Small Boat Harbor;

WHEREAS, the City's request for funding would also cover the cost to scour the foot of the north and south boat launch ramps, as needed, to ensure maximum ramp performance;

WHEREAS, the U.S. Army Corps of Engineers—Alaska District estimated the cost to construct the north and south boat launch ramps and scour the toes at approximately $1,800,000, the same cost as the previously requested dredging project;

WHEREAS, the remaining $800,000 to complete this boat launch ramp construction project will come from the following sources: $300,000 in left over dredging design money awarded by Denali Commission to Corps of Engineers in 2009, $100,000 in FY 2012 City of Bethel Adopted Annual Budget - "Denali Commission cash match" line item, and $400,000 from Port of Bethel unrestricted fund balance;

WHEREAS, the Bethel City Council, in conjunction with the City Finance Department, hereby commits the $500,000 in cash matching funds identified in the prior section to the construction of the north and south boat launch ramps at the Bethel Small Boat Harbor;

Introduced by: Lee Foley, City Manager
Date: January 10, 2012
Action: Passed
Vote: 6-0

WHEREAS, the City of Bethel pledges to maintain the north and south boat launch ramps such that they remain functional throughout their expected service life;

NOW, THEREFORE, BE IT RESOLVED that the Bethel City Council supports and approves the U.S. Army Corps of Engineers—Alaska District's completion of the FY 2012 Denali Commission Transportation Program nomination form on behalf of the City of Bethel and the Denali Commission's change in the request to pursue $1,000,000 in funding to construct and install two boat launch ramps and scour the toe of each;

BE IT FURTHER RESOLVED, that the Bethel City Council commits $500,000 in cash match to the north and south boat launch construction project, provided the U.S. Army Corps of Engineers is awarded the grant from the Denali Commission, and the City's previous commitment to use $500,000 in cash match for the dredging project proposed to Denali Commission is hereby deobligated;

ENACTED THIS 10TH DAY OF JANUARY 2012 BY A VOTE OF 6 IN FAVOR AND 0 OPPOSED.

____
Joseph A. Klejka, Mayor

ATTEST:

____
Lori Strickler, City Clerk

Introduced by: City Manager Lee Foley
Introduction Date February 14, 2012
Public Hearing:
Action:
Vote:

CITY OF BETHEL, ALASKA

Ordinance #12-03

AN ORDINANCE AMENDING THE BETHEL MUNICIPAL CODE SECTION 1.08 GENERAL PENALTIES

BE IT ORDAINED by the City Council of Bethel, Alaska, that:

SECTION 1. Classification. This ordinance is of permanent nature and shall be codified within the Bethel Municipal Code.

SECTION 2. Amendment. Section 1.08 of the Bethel Municipal Code, is amended as follows (new language is underlined and old language is stricken out).

1.08 General Penalties

Sections:

~~1.08.010 Designated.~~

~~1.08.020 Penalty surcharge authorization and collection.~~

~~1.08.010 Designated.~~

~~Unless otherwise provided, any person, firm or corporation who shall violate any provision of this code shall upon conviction thereof be fined in any sum not to exceed five hundred dollars ($500) or be imprisoned in the city jail for a period not to exceed thirty (30) days, or both such fine and imprisonment.~~

~~1.08.020 Penalty surcharge authorization and collection.~~

~~The surcharge required to be imposed pursuant to AS 12.55.039 is authorized and shall be imposed as a surcharge on penalties imposed for the violation of an ordinance, code provision, or regulation of the city brought under a citation or criminal complaint that would require a proceeding in the Alaska Court System if the defendant were to enter a plea of not guilty. The court may impose and collect the surcharge on all penalties imposed by the court where fines and bail forfeitures are paid to the court. For all criminal proceedings in which the fine or bail forfeiture is collected by the city, the surcharge imposed shall be collected by the city with the payment of the fine or forfeited bail and regularly paid over to the appropriate agency of the state less any collection and administration fee or reimbursement authorized by the state to be retained by the city.~~

1.08.010 General penalty.

A. Penalty. Unless another penalty is specifically provided by this code for the violation of any particular provision, any person who violates any of the provisions or fails to comply with any of the mandatory requirements of this code, upon conviction, shall be punished by a fine not to exceed three hundred dollars ($300.00) and the violation shall be treated as an infraction.
B. Procedure. The charge for the violation of a code provision may be brought by a city police officer, or that city official responsible for the administration and enforcement of the code provision which has been violated. A person charged by dispose of an infraction offense by paying the fine set for the violation charged and pleading "no contact" in person or by mail, or may appear in court to contest the charge. As an infraction, trial is by the court without a jury, and there is no right to court-appointed defense council.
C. Separate Violations. Each day of a continuing violation of this code shall constitute a separate offense.
D. Civil Action Alternatives. In addition to any other remedies or penalties which may be provided in this code, or may otherwise be available, the city or any aggrieved person may institute a civil action against a person who violates any provision of the code. In addition to injunctive and compensatory relief, a civil penalty not to exceed one thousand dollars ($1,000.00) may be imposed for each violation. An action to enjoin a violation may be brought notwithstanding the availability of any other remedy. On application for injunctive relief and a finding of violation or threatened violation, the superior court shall grant the injunction.

1.08.020 Penalty surcharge authorization and collection.

The surcharge required to be imposed pursuant to AS 12.55.039 is authorized and shall be imposed as a surcharge on penalties imposed for the violation of an ordinance, code provision, or regulation of the city brought under citation or criminal complaint that would require a preceding in the Alaska Court system if the defendant were to enter a plea of not guilty. This surcharge is imposed in addition to any other fine or other penalty provided by law. The court may impose and collect the surcharge on all penalties imposed by the court or fines and bail forfeitures that are paid to the court. The surcharge shall be deposited into the general fund of the state of Alaska in accordance with AS 29.25.072.

Introduced by: City Manager Lee Foley
Introduction Date February 14, 2012
Public Hearing:
Action:
Vote:

<u>Section 3. Effective Date</u>. This ordinance shall become effective immediately, upon passage by the City Council.

ENACTED THIS _DAY OF _ 2012, BY A VOTE OF _ IN FAVOR AND _ OPPOSED.

ATTEST:

____
Joseph A. Klejka, Mayor

____
Lori Strickler, City Clerk

City of Bethel Action Memorandum

Action memorandum No.	12-09		
Date action introduced:	2-14-12	Introduced by:	Mayor Klejka
Date action taken:		▒ Approved	▒ Denied
Confirmed by:			

SUBJECT/ACTION: *Approve Mayor Klejka's re-appointment of Abe Palacios to the Planning Commission.*

Route to:	Department/Individual:	Initials:	Remarks:
X	City Manager		
X	Planning Director		

Attachment(s): Application

Amount of fiscal impact		Account information:
X	No fiscal impact	
	Funds are budgeted for.	
	Funds are not budgeted. Budget modification is required. Affected account number:	

Action memorandum 12-9 is sponsored by Mayor Klejka at the request of the City Clerk.

Abe Palacios has requested re-appointment to the Planning Commission. If appointed, he would be appointed to a term of three years.

Office of the City Clerk
City of Bethel
300 State Highway
Bethel, AK 99559-1388
Phone: (907)-543-1384
Fax: (907)-543-3817

APPLICATION FOR APPOINTMENT TO A COMMITTEE OR COMMISSION

Committee(s)/Commission(s) of interest:

__ Energy Committee
__ Parks and Recreation Committee
__ Finance Committee
__ Public Works Committee
__ Port Commission
__ Public Safety and Transportation Commission
X Planning Commission

All Planning Commissioners are required to provide an Alaska Public Offices Commission (APOC) Statement to the City Clerk's Office within 30 days of appointment. Commissioners must continue to provide an updated APOC statement to the clerk's office by the 15th of March annually.

NAME: Abe M. Palacios

MAILING ADDRESS: P.O. Box

RESIDENCE ADDRESS:

HOME PHONE:

WORK PHONE:

CELL PHONE:

E-MAIL:

OCCUPATION: Planning Manager

EMPLOYER: AVCP RHA

1. Do you (or an immediate family member) currently own or operate a business in the City of Bethel? If so please provide the name and the type of business. No.

2. Are you (or an immediate family member) a member of a board of directors, officer of, or hold a management position with, an organization that has financial dealings of one thousand dollars or more in value with the city of Bethel? If so please provide the name and the type of business.

N/A

3. Do you currently have a direct or indirect financial of business interest with the City of Bethel, to include contracting, leaseholder, employee? If so please provide the name and the type of business.

NO.

4. Are you a resident of the City of Bethel? X Yes __ No If so, for how long? 23 yrs.

5. Does your schedule permit you to regularly attend required meetings: X Yes __ No

I understand that this is a voluntary, appointed position to be confirmed by the Bethel City Council. I further understand that this application is public information and the merits of my appointment may be discussed at a public forum. In addition, my name may be published in a newspaper or other media outlet.

I have read Chapter 2.05 of the Bethel Municipal Code regarding Responsibilities of city council members, municipal officers, appointed officials and employees-conflict of interest. I agree to comply with the code and understand that my tenure as a commission/committee member requires such compliance.

I certify that the information in this application is true and accurate.

Signature of Applicant: [signature] Date: 1-05-12

FOR OFFICE USE ONLY

Date Received: 1-5-2012

Date of Council Approval: Action Memorandum Number: 12-09

Date Applicant Notified:

Term Expiration: 12-31-2015

Registered voter of the City X Yes __ No

City of Bethel Action Memorandum

Action memorandum No.	12-10		
Date action introduced:	February 14, 2012	Introduced by:	City Manager Foley
Date action taken:		Approved	Denied
Confirmed by:			

SUBJECT/ACTION: Acceptance of the Army National Guard Armory Building and land in its entirety while providing office rental space to the Army National Guard.

Route to:	Department/Individual:	Initials:	Remarks:
X	Public Works Director		
X	Finance Director		
X	Planning Director		

Attachment(s): None

Amount of fiscal impact		Account information:
	No fiscal impact	
	Funds are budgeted for.	
X	Funds are not budgeted. Budget modification is required. Affected account number:	A new account will need to be established as well as an estimate for operations of the facility.

The Guard has now determined that they do not have a need to retain any of the property, or outbuildings, and would like to turn the entire facility over to the City intact. When notified of this development, the Administration met with BG Bridges and his staff to discuss the disposition in-depth and jointly tour the facilities.

The following information and data is germane:

- Affiliated Appraisers of Alaska conducted an investigation and analyses of the property on February 10, 2009, with the following conclusions:
  1. The Bethel ARNG Armory Building's estimated market value is $1,500,000.00 (Cost to build was $580K).
  2. The estimated market value of the FMA Maintenance Building is $95,000.00.
  3. The estimated market value of the OMS-FMS Building is $235,000.00.
  4. The Cold Storage Building situated on Lot 11, Block 7 has an estimated market value of $55,000.00.
  5. The Cold Storage Building situated on Lot 15, Block 7 has an estimated market value of $145,000.00.
- Major performed since 1986 is as follows:
  1. **Main Armory Building:**
     a. The roof and membrane were replaced in 1986. Water stains noted in earlier inspection were the result of not being cleaned up. The latest inspection by Public Works personnel noted zero evidence of leakage.
     b. $32,705.00 was expended on sewer repairs in 2008.

Action memorandum No.	12-10		
Date action introduced:	February 14, 2012	Introduced by:	City Manager Foley
Date action taken:		▒ Approved	▒ Denied
Confirmed by:			

  c. In 2010, pilings in front of the overhead door were removed at a cost of $5,000.00.
  d. The fire escape on the front of the building was replaced in 2010 at a cost of $19,000.00.
  e. Side stairways were replaces in 2010 at a cost of $19,000.00.
  f. In 2011, $48,375.00 was expended to replace the 3000 gallon fuel tank.

2. **OMS-FMS (Garage) Building:**
  a. The fuel tank was replaced by Alaska Borealis in 2010 at a cost of $51,727.00
  b. In 2010, the freeze pilings were tested by Arctic Foundation at a cost of $4,432.00.
  c. This building is fully equipped, heated, and would be ideal for light vehicle maintenance, either in-house, or as a rented facility.

3. **Metal Storage Building:**
  a. Arctic Foundation tested the freeze pilings in 2010 at a cost of $5,000.00.

- **Diesel Oil Spill:**
  1. Cleanup and reclamation is almost complete. The NG will complete this project and have it approved before transferring facility to the City.
- **Well Log:**
  1. NG will provide; document on site.

The NG would also like to return to the City the property on Chief Eddie Hoffman Highway that was initially granted to them for their new Armory.

They are also willing contribute up to $140,000.00 toward the creation of an Alaska Territorial Guard Memorial (the Administration is already immersed in the planning stages for this project and it will eventually be brought before the Council for consideration).

Obtaining all of the property instead of just the main building, offers the opportunity for space should the City elect to move forward with a seasonal pool while funding is solicited for the YK Regional Aquatic Health & Safety Center.

Following council's initial approval of this transfer via this Action Memorandum, Administration will draft a non-codified Ordinance outlining the details of the transfer as well as the property descriptions, as outlined in BMC 4.08.

City of Bethel Action Memorandum

Action memorandum No.	12-11		
Date action introduced:	2-14-12	Introduced by:	Mayor Klejka
Date action taken:		▒ Approved	▒ Denied
Confirmed by:			

SUBJECT/ACTION: *Approve The Training And Travel Request For The City Clerk To Attend The International Institute Of Municipal Clerk's Annual Conference.*

Route to:	Department/Individual:	Initials:	Remarks:
X	City Manager		
X	Finance Director		

Attachment(s):

Amount of fiscal impact		Account information:
	No fiscal impact	
$3,500	Funds are budgeted for.	10-52-545
	Funds are not budgeted. Budget modification is required. Affected account number:	

Action memorandum 12-11 is sponsored by Mayor Klejka at the request of the City Clerk.

The City Clerk is requesting training and travel approval to attend the IIMC Conference which will provide the City Clerk training specific to the Clerk's Office. Additionally, this conference would provide continuing education points to the City Clerk as she works on obtaining her Master Municipal Clerk designation.

If approved this training opportunity would interfere with the May 22nd Regular City Council Meeting. The City Clerk's Assistant will be available for the council meeting as well as general day to day duties.

City of Bethel Action Memorandum

Action memorandum No.	12-12		
Date action introduced:	2-14-12	Introduced by:	Mayor Klejka
Date action taken:		☐ Approved	☐ Denied
Confirmed by:			

SUBJECT/ACTION: *Approve Mayor Klejka's appointment of Pat Jennings to the Port Commission.*

Route to:	Department/Individual:	Initials:	Remarks:
X	City Manager		
X	Port Director		

Attachment(s): Application

Amount of fiscal impact		Account information:
X	No fiscal impact	
	Funds are budgeted for.	
	Funds are not budgeted. Budget modification is required. Affected account number:	

Action memorandum 12-12 is sponsored by Mayor Klejka at the request of the City Clerk.

Pat Jennings has requested appointment to the City's Port Commission. If appointed Mr. Jennings would fill one of four Commission vacancies for a term of three years.

Office of the City Clerk
City of Bethel
300 State Highway
Bethel, AK 99559-1388
Phone: (907)-543-1384
Fax: (907)-543-3817

APPLICATION FOR APPOINTMENT TO A COMMITTEE OR COMMISSION

Committee(s)/Commission(s) of interest:

__ Energy Committee
__ Parks and Recreation Committee
__ Finance Committee
__ Public Works Committee
X Port Commission
X Public Safety and Transportation Commission
__ Planning Commission

All Planning Commissioners are required to provide an Alaska Public Offices Commission (APOC) Statement to the City Clerk's Office within 30 days of appointment. Commissioners must continue to provide an updated APOC statement to the clerk's office by the 15th of March annually.

NAME: Pat Jennings

MAILING ADDRESS: Box

RESIDENCE ADDRESS:

HOME PHONE:

WORK PHONE:

CELL PHONE:

E-MAIL:

OCCUPATION: Maint. Supervisor

EMPLOYER: Swansons

1. Do you (or an immediate family member) currently own or operate a business in the City of Bethel? If so please provide the name and the type of business.

N/A

2. Are you (or an immediate family member) a member of a board of directors, officer of, or hold a management position with, an organization that has financial dealings of one thousand dollars or more in value with the city of Bethel? If so please provide the name and the type of business.

N/A

3. Do you currently have a direct or indirect financial of business interest with the City of Bethel, to include contracting, leaseholder, employee? If so please provide the name and the type of business.

N/A

4. Are you a resident of the City of Bethel? __ Yes √ No If so, for how long? 36 Yrs

5. Does your schedule permit you to regularly attend required meetings: X Yes __ No

I understand that this is a voluntary, appointed position to be confirmed by the Bethel City Council. I further understand that this application is public information and the merits of my appointment may be discussed at a public forum. In addition, my name may be published in a newspaper or other media outlet.

I have read Chapter 2.05 of the Bethel Municipal Code regarding Responsibilities of city council members, municipal officers, appointed officials and employees-conflict of interest. I agree to comply with the code and understand that my tenure as a commission/committee member requires such compliance.

I certify that the information in this application is true and accurate.

Signature of Applicant: [signature] Date: 3/1/12

FOR OFFICE USE ONLY

Date Received:

Date of Council Approval: Action Memorandum Number:

Date Applicant Notified:

Term Expiration:

Registered voter of the City __Yes __ No

Return completed application to the Office of the City Clerk.

City of Bethel Action Memorandum

Action memorandum No.	12-13		
Date action introduced:	2-14-2012	Introduced by:	Mayor Joseph Klejka
Date action taken:		Approved	Denied
Confirmed by:			

SUBJECT/ACTION: Approve The Preliminary Grant Application Submission Regarding The Liquefied Natural Gas (LNG) Project.

Route to:	Department/Individual:	Initials:	Remarks:
X	City Manager		
X	Finance		

Attachment(s): Phase 1 Application for Emerging Energy Technology Grant to Alaska Energy Authority AEA-11-027; Potential Benefits to Alaskans from State-Owned Gasline/LNG Project.

Amount of fiscal impact		Account information:
No fiscal impact at this point in the project. If approved, minimal staff time would need to be provided.	No fiscal impact.	
	Funds are budgeted for.	
	Funds are not budgeted. Budget modification is required.	

Description of the Project

PDC Harris Group LLC, is interested in working with the City of Bethel to bring Liquefied Compressed Natural Gas (LCNG) to this region. The collaborated effort would first consist of PDC Harris Group applying for an Emerging Energy Technology Grant (EETG) which is due the first part of March 2012 and would require the approval of the council. Following the competitive review of the application, the Alaska Energy Authority may award a grant to perform the first stage of the project, which consists of capital cost estimate, operating costs estimates and a consumer gas pricing structure.

After the completion of step or stage one, PDC Harris Group and the City of Bethel would look for additional funding through state and federal granting options to perform stage two. Stage two would include Proof of Concept Demonstration and Confirmation of Economics (grant 3). This stage would include a LNG Storage depot, barge, gasification and offloading systems, storage vessels, pressure letdown stations and low/medium pressure distribution piping. Also during this stage one or more home furnaces or boilers would need to be converted to gas-firing and a diesel engine-generator converted to gas/diesel blending with appropriate metering. Additionally, it is the intent of this project to use City facilities as part of the test project meaning conversion of some city owned facilities.

Action memorandum No.	12-13		
Date action introduced:	2-14-2012	Introduced by:	Mayor Joseph Klejka
Date action taken:		Approved	Denied
Confirmed by:			

The third stage of the project is expected to be funded by additional state or federal grants or through municipal bonds. This stage would be large scale development and further build-out in Bethel and to the satellite villages.

Application History

In 2009, the Denali Commission released a public solicitation entitled the Emerging Energy Technology Grant (EETG). This competitive solicitation, with a total funding opportunity of $4M, (which has grown to 8.5 M for the 2012 application period) targeted alternative and renewable emerging energy technology proposals such as Liquefied Natural Gas (LNG) from Alaska applicants. The goal was to develop technology having the potential of widespread deployment in Alaska to reduce energy costs for all. A maximum of 1.5M is awarded by the Alaska Energy Authority, per project.

In 2009 Council approved Resolution 9-26 supporting a joint application for a liquefied and compressed natural gas pilot study and projects as a bridge solution to high energy process in rural Alaska.

In 2009 the application was not considered due to a technicality. PDC Harris Group LLC, also issued an application in 2011 on behalf of the joint collaboration which was approved by the Bethel City Council through AM 11-15. During the 2011 round of applications, over 50 applications were submitted. The application process for 2011 was put on hold until March of 2012.

City of Bethel Contribution

If the current council determined to move forward with the partnership, the City should expect to designate one employee who would work with PDC Harris Group a few hours every month. The City would also be responsible for the flow of funds however PDC Harris Group would prepare the reporting document and present them to the City of Bethel for submission.

General Information

On behalf of PDC Harris Group, Mike Moora would be willing to meet with the council to provide additional information on the history of the project as well as the benefits in moving forward. This however could not take place until late March.

IM No. 11-03

Introduced by:	City Manager		
Date introduced:	02-22-11	Date action taken	
Amended actions:			
Verified by:			

CITY OF BETHEL CITY COUNCIL INFORMATIVE MEMORANDUM

TITLE: **Emerging Energy Technology Grant (EETG)**

Agenda Introduction Date:2/22/2011
Originator: City Manager Foley

Routed to:	Department	Signature/Date

REVIEWED BY MAYOR ERIC MIDDLEBROOK: ______________________________

FISCAL IMPACT: ▒ yes $________ X▒ no no   FUNDS AVAILABLE ▒ yes ▒

Account name/number: ____

Attachments:____

SUMMARY STATEMENT:

In 2009, the Denali Commission released a public solicitation entitled the Emerging Energy Technology Grant (EETG). This competitive solicitation, with a total funding opportunity of $4M, targeted alternative and renewable emerging energy technology proposals such as Liquefied Natural Gas (LNG) from Alaskan applicants. The goal was to develop technology having the potential of widespread deployment in Alaska to reduce energy costs for all. Council approved Resolution 09-26 in June 2009 in support of a liquefied and compressed natural gas pilot study and project as a bridge solution to high energy prices in rural Alaska. A copy of that resolution is attached to this IM. Alaska Senate Bill 220 passed in 2010 established the EETG that is administered by the Alaska Energy Authority and is funded from a wide variety of sources. In

Introduced by:	City Manager		
Date introduced:	02-22-11	Date action taken	
Amended actions:			
Verified by:			

order to receive grants from the fund, the benefitting project must be for the research, development, or demonstration of a new energy, or conservation technology, or the improvement of an existing technology, with the reasonable expectation the technology will be commercially viable within 5 year. The deadline for submission of applications for the second round of grant consideration is March 2, 2011. Although the City is not prepared at this time to move forward, this IM is meant to keep Council members up-to-date on the program and to allow for consideration of participation in future rounds.

Introduced by: Vice-Mayor Middlebrook
Date: June 09, 2009
Action: Passed
Vote: 6-0

CITY OF BETHEL, ALASKA

Resolution 09-26

A RESOLUTION IN SUPPORT OF A LIQUIFIED AND COMPRESSED NATURAL GAS PILOT STUDY AND PROJECT AS A BRIDGE SOLUTION TO HIGH ENERGY PRICES IN RURAL ALASKA

WHEREAS: The supply of affordable energy across the board for heating, transportation, electrical production and other uses is one of the most essential resources for a healthy, prosperous community and region;

WHEREAS: The current situation in the YK Delta concerning energy can be described as desperate;

WHEREAS: Given that current wind-diesel projects have demonstrated penetrations of around 25% of electrical usage in the form of displaced fuel. Continued work and development is needed to achieve very high penetrations, and to alleviate the need to keep 100% of diesel back up available on a moment's notice;

WHEREAS: It will be many years before alternative energy sources can provide significant energy relief across the board to the community and the region for heating, transportation and other needs;

WHEREAS: A bridge solution to go from our current energy situation to a sustainable long term energy solution is desperately needed

NOW THEREFORE BE IT RESOLVED: That the City of Bethel supports a liquefied and compressed natural gas pilot project such as has been proposed by the PDC Harris Group in its grant application (AEA-09-004) to the Alaska Energy Authority.

ENACTED THIS 9th DAY OF JUNE 2009, BY A VOTE OF 6 IN FAVOR AND 0 OPPOSED.

Joseph Klejka, Mayor

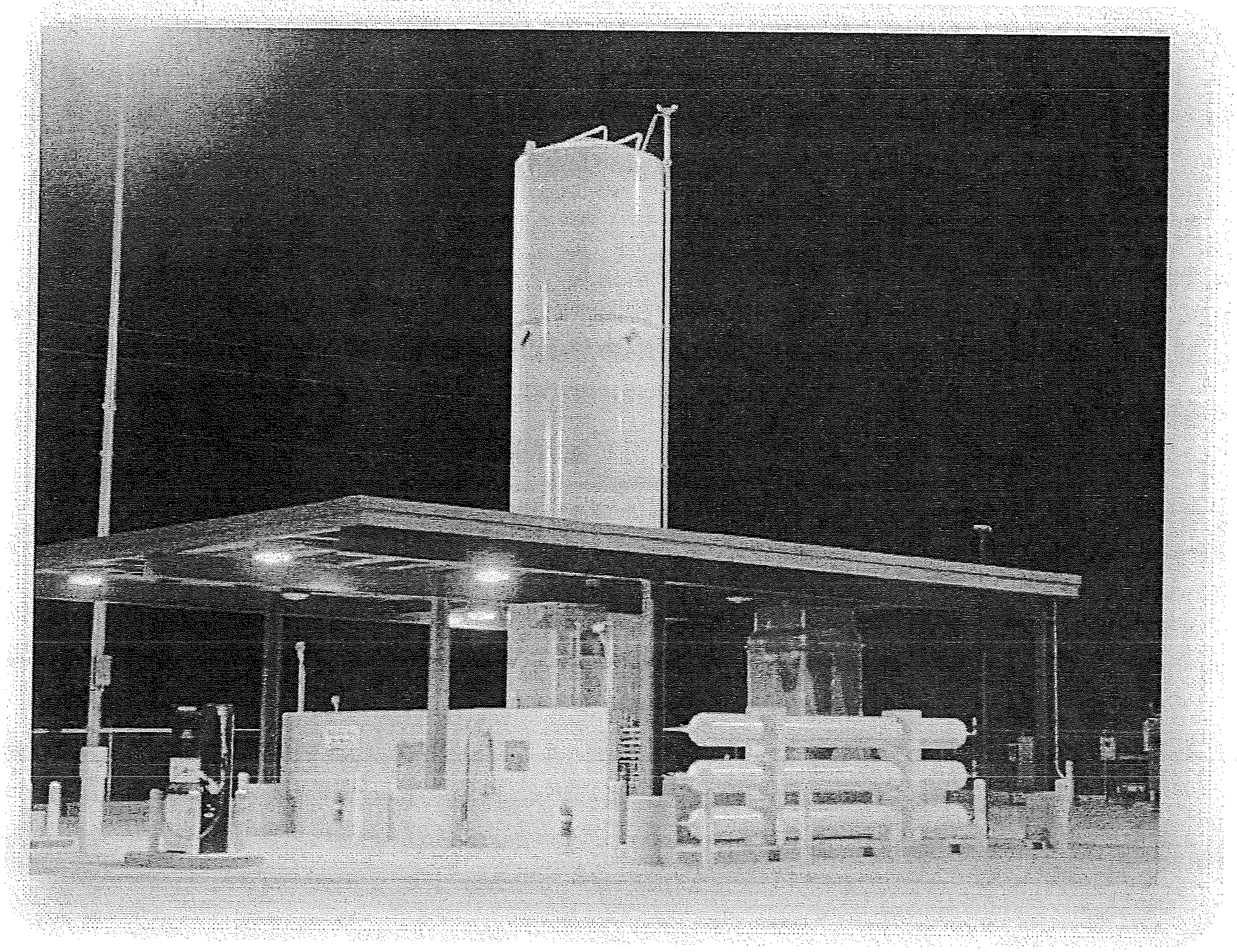
ATTEST:

Lori Strickler, City Clerk

Liquefied & Compressed Natural Gas (LCNG) as a Bridge to Reducing Energy Prices in Rural Alaska

Phase 1 Application for Emerging Energy Technology Grant
to Alaska Energy Authority AEA-11-027

Submitted by: City of Bethel & PDC Harris Group LLC
17 March 2011



El Paso's Sun Metro LCNG fueling station completed 2002 (North Star)

LCNG as a Bridge to Reducing Energy Costs Prices in Rural Alaska[1]

Table of Contents

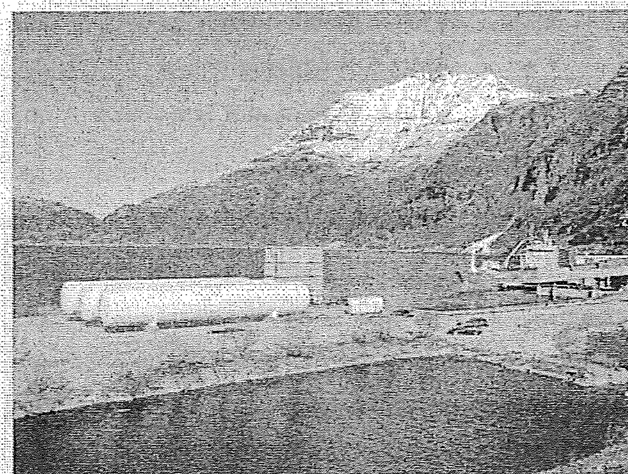
[1] Page count discussed with AEA Program Manager and approved as necessary to develop project narrative.

P108

TITLE PAGE

PROJECT TITLE:

Liquefied & Compressed Natural Gas (LCNG) as a Bridge Solution to Reducing Energy Costs in Rural Alaska



LNG storage and re-gasification unit in Norway. (Chart Industries)

FUND GRANTEE:

City of Bethel, Alaska

ENGINEERING CONTRACTOR:

PDC Harris Group LLC

CONTACT INFORMATION:

Eric Middlebrook, Mayor
City of Bethel
PO Box 1388
Bethel, AK 99559
(907) 543-4075
emiddlebrook@cityofbethel.net

Michael W. Moora, General Manager
PDC Harris Group LLC
2700 Gambell St, Suite 500
Anchorage, AK 99503
(907) 743.3263
mikemoora@pdceng.com

PROJECT COST INFORMATION:

Requested Amount:	$ 635,161
Matched Amount:	$ 214,434
Total Amount:	$ 849,595
% Match:	25.2%

PREVIOUS APPLICATION TO AEA OR DENALI COMMISSION

An earlier version of this project application was submitted in 2008 under AEA-09-004, for the Renewable Energy Grant Program. At that time, PDC Harris Group and Orutsararmuit Native Council were the applicants. As this application involved natural gas in Bethel, it was eliminated due to the presence of renewable resources in Bethel (wind).

1.0 TECHNICAL SUMMARY

1.1 Introduction & Project Description

❖ *"Provide a 1-2 paragraph description of the project"*

Our proposed project addresses the largest contributor to sky-rocketing fuel costs in remote Alaskan communities – petroleum derived diesel fuel and fuel oil – by substituting lower priced and more environmentally acceptable natural gas. As stated in the project title, we envision this fuel substitution concept as a bridge to longer-term renewable solutions for remote Alaska communities. Renewable energy projects in Alaska's villages have the potential for reducing a crucial reliance on petroleum distillates, but not eliminating it. Our team proposes to conduct concept design and feasibility level analysis in Bethel to demonstrate the economic feasibility of transporting Liquefied Natural Gas (LNG) to a remote community, storing the fuel as Compressed Natural Gas (CNG) in commercially available pressure vessels on-site, and distributing the gas for use in existing furnaces, boilers and a diesel engine-electric generator set via low pressure piping, much like that used within in lower 48 communities and Anchorage. Since LCNG[2] storage, delivery and dispensing technology is commercially available, Phase 1 of the project involves developing a firm understanding of the supply chain economics for this initiative.

1.2 Innovation & Technical Concept

❖ *"Explain how the project is a viable innovation in Alaska"*

The LCNG technology described here is commercially-proven, robust and expanding at a rapid pace outside of Alaska. It requires low developmental risk to bring it to Alaska's remote communities for use in space heating and power generation. Bringing this technology to Alaska is a logical extension of the present system of barging liquid fuels to dozens of remote villages. LNG is a commodity traded world-wide, in a vibrant high-growth market. There is currently a surplus of natural gas in the U.S., and it is likely that future export of LNG to the world market may become a reality, both for the lower 48 and Alaska. Taking advantage of a commodity with significantly lower pricing pressure than petroleum-based fuels represents the primary innovation of this initiative.

Likewise, CNG technology is commercially viable and used extensively in many parts of the world for taxi cabs, short-haul trucks, buses and even locomotives. CNG is dispensed in over 30 states in the US. While not proposed as part of this project, CNG as a motor fuel for rural Alaska may be significant game-change, in terms of cost savings, and emissions reductions.

The innovation associated with this project is based on the combination of the following elements.

Bridge Solution: LCNG conversion is a bridge solution; offering a short term solution to high energy prices before long-term alternative solutions can be placed on-line. LCNG further enables wind or solar-based projects, which must have firm back-up capacity for periods where the primary resource is unavailable.

Operating cost savings: Based on very significant disparities in pricing between natural gas and petroleum-derived distillate fuels, there is an opportunity to deliver a substantially less expensive substitute fuel to remote communities. Not only is this cost advantage expected to last for decades, but may grow with

---

[2] Defined as the integrated use of liquefied natural gas (LNG) & compressed natural gas (CNG).

time[3]. CNG dispensed in the lower 48 on a limited basis is already approximately 50% lower per unit of energy than gasoline and diesel fuels. (Refer to the analysis presented in Appendix A)

Low Retrofit Costs in Alaska's Villages: Existing furnaces, boilers and even diesel-fueled engine-generators can be converted to run on natural gas; potentially saving significant capital expenditures over other technologies.

Scale-able Statewide: The economic and technical findings from this project are directly applicable to larger or smaller applications. Hardware components that are commercially available for this 'Pilot Scale' Bethel system, are applicable for a 'Semi-Commercial' scale for the surrounding regional communities, and then to 'Full-Scale' service to remote villages throughout Alaska.

GHG Emissions Reduction: This substitute fuel is cleaner burning (compared with diesel and fuel oil), with a significantly lower carbon footprint. Natural gas combustion emits approximately 40% less CO_2 than an equivalent heat release from gasoline.

1.3 Technical Readiness & Intellectual Property

❖ *"Please provide evidence to assign a Technical Readiness Level (TRL)..."*

The following table summarizes the commercial readiness of the LCNG technology to be used for the project. A simple average of the estimated TRL values shown yields an overall value of 8.8. There is no doubt that all technical elements of this project are commercially-demonstrated, and can be applied in a remote Alaskan setting.

Component	Commercial Readiness	Estimated TRL No.
LNG production and market size	Fully-commercialized for ~50 years	9
LNG storage & transport	Fully-commercialized for ~50 years	9
LNG-CNG conversion	Wide-spread world-wide, over 200 stations in CA.	9
CNG storage	Same as other merchant gases, ~90 years	9
Conversion of burners, oil to gas	Fully-commercialized for ~30 years	9
Conversion of diesel engines to gas/diesel mixture	Commercially developed to moderate market, proven viable	8

With the possible exception of the technology for diesel engine conversion, there are no anticipated barriers to deployment with regard to intellectual property rights. The diesel technology can be licensed from a variety of suppliers. The development strategy for this project does not identify the production of intellectual property, and it will not be necessary to develop specific technology for use of LCNG in Alaska.

1.4 Economic Readiness

While demonstrating the technical feasibility of supplying LCNG to a remote Alaskan location is not necessary, the same claim cannot be made for the economics of this initiative. As noted in Section 1.2, the

[3] Eroding natural gas pricing, even prior to the recent economic downturn, is indicative of an increasing surplus of natural gas in the lower 48, which will likely increase the disparity in $ per BTU between these commodities for many years.

pricing advantage of LNG versus diesel fuel is obvious, but this comparison is based on data specific to bulk volumes of LNG delivered to locations that do not represent the supply chain for this application. The initial phase of project development therefore focuses on identifying the capital and operating costs of this chain, and translating these estimates to a realistic business perspective – return on investment (ROI). An appropriate ROI is the key to attracting investment capital and creating a sustainable business. Phase 1 of the project is aimed at characterizing ROI for demonstration-scale development in Bethel, as well as the magnitude of fuel cost savings.

2.0 PROJECT METHODOLOGY

2.1 Objectives

- *"Explain the project objectives and how they will be achieved"*

The project will be developed in three (3) phases, as described in the following paragraphs. Funding for first phase is the subject of this application.

2.1.1 Phase 1 – Concept Design & Supply Chain Economic Model

This phase entails developing concept level design components for the demonstration scale system described in Phase 2. The design will be developed to the extent necessary to solicit vendor quotations for major equipment services, and develop a parametric (factored) capital cost estimate. This estimate, along with estimated operating costs will be used as the basis for developing pro forma rates of return driven by inputs of a) consumer gas pricing structure, and b) LNG purchase price. The basis for transportation costs from point of LNG custody transfer will be Bethel. Preliminary assessment and long-lead project permitting will also be conducted in Phase 1.

From the standpoint of AEA's project phasing (developed in Section 2 of the RFA), this phase is considered to be Phase 1, Pre-Deployment Activities. A Commercialization Plan will be developed to encompass the findings from the economic model and the path forward for Phase 2. Additional activities for this phase of development will include preliminary negotiation of an LNG purchase agreement, site assessment for LNG depot facilities and storage facilities in Bethel, initiating long lead permit applications, and developing a Financing Plan for the subsequent Phase.

2.1.2 Phase 2 – Proof of Concept Demonstration & Confirmation of Economics

Initial Phase 2 tasks are considered Phase II/TRL 9 using the AEA project phasing classifications. LCNG hardware components (to be installed in Bethel) will include a) LNG storage depot[4], b) CNG storage vessels, c) CNG pressure letdown stations and low/medium pressure distribution piping, d) space heating furnaces or boilers converted to gas-firing and e) a diesel engine-generator converted to gas/diesel blending with appropriate metering. A suitably-sized LNG supply barge, capable of serving communities that receive diesel/fuel oil by barge, will also be built.

The Phase 1 cost estimates and economic models will be updated with actual costs as LNG is purchased, larger volume agreements are negotiated, and the commercial-scale equipment is installed and operated in Bethel. Based on the revised ROI for large scale development, the Commercialization and Financing Plans will be updated as they apply to Phase 3 enhanced scale development. A report will be generated following a suitable operating period, providing validation detail identified in AEA's Phase III Post Deployment.

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[4] LNG storage may be located remotely from Bethel, depending upon permit restrictions and safety considerations. CNG storage will be provided as part of the infrastructure in Bethel.

2.1.3 Phase 3 – Large Scale Development

As with the prior phase, if the economics for further development prove feasible, and sufficient funding is acquired, the next phase will be undertaken. Phase 3 will involve further build-out in Bethel both to more users in Bethel, and to advance CNG distribution to satellite villages, to demonstrate a hub distribution model.

2.2 Schedule

Refer to Appendix B for the preliminary project schedule.

2.3 Site & Facilities

2.3.1 Location

- *"Explain where the work will be accomplished."*

Bethel will be the primary basis for each of the three (3) phases of the project. Phase 1 will consist primarily of engineering, permit application and economic modeling and will take place primarily in Anchorage. Phase 3 will involve expansion from Bethel as a hub to satellite village users, as well as possible other applications, depending on the success of commercializing the technology.

2.3.1 Site Suitability

- *"Show that the site has the requisite infrastructure and technical resources..."*

The site of Bethel is an ideal location for demonstrating the LCNG concepts described, since a) it is remote and barge accessible, b) is dependent on petroleum-based fuels for which pricing history is well known, c) the city council has indicated their commitment to participation, and willingness to donate land for storage, and d) satellite villages in the surrounding area can serve as a platform for demonstrating hub-satellite economics for LCNG deployment.

2.3.2 Environmental Permitting & Code Analysis

- *"Indicate the permits needed...and the potential permitting hurdles."*

LNG transport and commerce is highly regulated, based on the risk associated with the large volumes transported internationally. The Department of Homeland Security, US Coast Guard (USCG) is responsible for regulatory authority of ports, waterfront facilities and navigable waterways as they apply to LNG operations. State regulations involving a Coastal Zone Consistency Determination will also likely require a permitting effort. Additionally, there are regulations that may be directly applicable as promulgated by the US EPA, US DOT, Federal Energy Regulatory Commission, Fish and Wildlife Service, US Army Corps of Engineers, or Bureau of Ocean Energy Management, Regulation and Enforcement. There may also be a Right of Way permit, if an LNG pipeline must cross private property. A significant portion of our Phase 1 budget is dedicated to identifying the regulations and guidance to formulate a permitting plan. Long lead permitting will be initiated during the latter portion of Phase 1, and carry over to Phase 2.

2.3.3 Site Control

As stated previously, the project does not involve hardware installation until Phase 2; no land is required for the first phase work. The City of Bethel owns/operates real estate, buildings and combustion equipment necessary to demonstrate the technology for fuel conversion. Diesel engine conversion will be demonstrated on a small unit which will be installed on city-designated property. Appendix C provides an indication of the city's commitment to this project.

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3.0 PROJECT TEAM CAPABILITIES

3.1 Team Composition

❖ *"Briefly relate the qualifications of the team and their respective responsibilities"*

3.1.1 Organization

The project team for Phase 1 is comprised of project managers, engineers, designers, cost estimators and permitting personnel. Refer to Appendix D for the preliminary project organizational structure. The City of Bethel will provide one part-time project manager to support the project, and represent city interests. PDC Harris Group will provide the project management, design expertise, cost estimating and the economic modeling developer. Steigers Corporation will be responsible for project permit acquisition. We will also contract with Messrs. Jeff Lowenfels and Wayne Lewis as special consultants for permit acquisition and LNG purchase agreements. Both Wayne and Jeff were instrumental in developing and permitting Yukon Pacific's planned LNG liquefaction and export terminal in Valdez. Appendix D also provides key staff resumes.

3.1.2 Qualifications

Refer to Appendix D for summary-level resumes for the team identified in the organizational chart. Additional information regarding experience is available at www.pdcharrisgroup.com and www.steigers.com.

4.0 FINANCING PLAN

❖ *"Provide a short narrative to explain how the project will be financed."*

As stated, this grant application applies only to Phase 1 of the LCNG project. The corresponding Budget Form is provided in Appendix E. The project team will provide matching funds of **$214,434** during Phase 1 of the project. Additionally, the project participants will apply for federal or other 3rd party financing upon award of an AEA grant to offset these in-kind donations.

Assuming Phase 1 economic modeling indicates an acceptable ROI for negotiated ranges of LNG cost, and also gives a clear indication of reduced consumer energy costs, Phase 2 of the project will be financed with a combination of state and federal grants, and the private debt and equity markets. Depending on the condition of the municipal bond market at the time, the feasibility of issuing bonds for the demonstration project or the formation of a city owned utility may be investigated at that time. Additionally state and federal incentives in the form of tax credits or reduced rates will be sought. It is hypothesized that funding for Phase 3, assuming it is shown to be feasible, will be financed from a combination of bond, private equity or debt markets.

Both Phase 2 and 3 financing plans will depend on the outcome of financial modeling in Phase 1, as well as on market conditions. In aggregate, the volume of LNG to supply rural Alaskan villages is insignificant when compared with outside markets, and commercialization will likely involve a combination of private financing and government incentives.

4.1 Project Match

Matching funds commitments are presented in Appendices E and F.

5.0 MARKET & BENEFITS

5.1 Market Definition & Size

The ultimate market focus for the project is any Alaskan community which is not on the state road system, and relies on barge delivery of diesel and fuel oil. This includes communities that currently (or in the future) rely on wind generated power with diesel-fired backup capacity. Initially Bethel will represent a typical community where the technology will be deployed to demonstrate proof of concept for typical fuel users, and provide realistic supply chain cost data. Attractive findings in Phases 1 and 2 may lead to expansion of LCNG state-wide to the conversion of boilers, furnaces and diesel generators which rely on high-priced petroleum based fuels.

5.2 Potential Public Benefit

Appendix A emphasizes the potential cost savings that may be transferred to residential customers, communities, or rural utilities. The magnitude of fuel cost reductions for space heating, and power generation will be assessed during Phase 1 of the project.

The potential for rapid implementation relative to other renewable alternatives makes the LCNG concept more attractive. Enhanced reliability of burner and engine components, following conversion to natural gas is also an economic benefit.

Indirectly, should LCNG technology spread beyond Bethel, the demand associated with increased use of LNG will foster the economies of scale associated with bulk purchase, i.e. lowered costs to all users. Future interior mining projects, reliant on large power generation systems may also benefit.

Public health will benefit from the applications of LCNG technology, based on a reduction in primary air pollutants SO_2, hydrocarbons, metals (e.g. mercury, lead), and particulates. Reductions in CO_2 emissions will assist in meeting future climate change goals, and may also result in valuable emissions credits as future revenues.

Conversion on a larger regional or state-wide scale may be assumed to result in the conversion of tug or barge drive systems from diesel to natural gas, yielding additional public health and climate change benefits. Elimination of diesel/fuel oil spills are also a benefit to local residents, as the quality of ground water and surface water are protected.

6.0 PROOF OF ELIGIBILITY

The City of Bethel qualifies as a local government entity. Appendix G contains a copy of PDC Harris Group's Alaska business license.

7.0 APPENDICES

Appendix A – Comparison of LNG and Diesel Fuel Pricing Data

Appendix B – Preliminary Project Schedule

Appendix C – City of Bethel Resolution & Action Memorandum

Appendix D – Organization Chart & Key Resumes

Appendix E – Budget Form

Appendix F – Certification of Matching Funds

Appendix G – PDC Harris Group Business License

Appendix A

Comparison of LNG and Diesel Fuel Pricing Data

Appendix A

Comparison of LNG & Diesel Fuel Pricing Data

1. Bethel Energy Supply Considerations

Presently Bethel is supplied energy in the form of No. 1 fuel oil, by periodic barge shipments handled by Crowley Marine. Pricing of fuel oil for Bethel and surrounding communities has been volatile since 2008, owing to the instability in world financial markets, and a general economic recession. Quoted prices reported for 2008, during which time crude oil peaked to $147/barrel, indicate a delivered price for No. 1 heating oil of $4.78 ($4.12 FOB refinery) to $5.91 ($5.04 FOB refinery) per gallon, of which approximately $0.66 to $0.87 per gallon was attributed to transportation cost1.

A more recent analysis[2] indicates a 2009 range of $3.95 ($2.78 FOB refinery) to $6.14 ($4.57 FOB refinery) per gallon, with transportation contributing $1.17 to $1.87/gallon. During this period, crude oil was trading between $58 and $70/barrel. While the fuel price lifted at Alaska's refineries declined approximately 55% from '08 to '09, the cost of transporting it to Bethel doubled.

2. Comparison of Diesel and LNG, US and World-Wide

Table 1 provides a recent snapshot of the dramatic differences in pricing between diesel fuel and LNG, when both fuels are placed on the same basis ($/million BTU).

TABLE 1
COMPARISON OF RECENT DIESEL AND LNG PRICING, $/MILLION BTU

	Diesel *(FOB US & AK)*		**LNG** (landed @ destination)			
	Diesel Wholesale, US Average	*Diesel, Wholesale FOB Anchorage*	S. Korea Imports Average	China Imports Average	US Imports, Average	Alaska Landed in Japan
Date	*Oct-2010*	*Oct-2010*	Sep-2010	Sep-2010	Oct-2010	Oct-2010
$/MM BTU	***17.35***	***19.91***	**10.41**	**6.61**	**3.98**	**11.94**
Comparison	***0.87***	*1.00*	**0.52**	**0.33**	**0.20**	**0.60**

Several points regarding the data in Table 1 should be emphasized:

- The diesel fuel costs quoted for both US average wholesale, and Anchorage wholesale are not on a landed basis (i.e. delivered to buyer's destination), while the LNG values represent the landed price at the stated destination. Thus the diesel prices should be increased by $1.00 to $2.00/gallon (approximately $7.50 to $15.00 per million BTU) to reflect recent shipping costs from Alaskan refineries to Bethel users.

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[1] Northstar Gas, 'White Paper, Rural Alaska Fuel Logistics' undated
[2] Ibid.

- The highest priced LNG, delivered to So. Korea and Japan, is between 52% and 60% of the wholesale diesel price for the corresponding period, FOB Anchorage, i.e. not delivered.
- The lowest priced LNG, delivered to the US during this period, is approximately 20% of the cost of Alaska diesel. This decline in US pricing reflects the remarkable impact of shale gas development, with LNG near price parity with that of pipeline gas for the first time.
- Europe and many parts of Asia are also benefiting from declining LNG pricing. Apparently LNG purchase contracts in the latter region are indexed to a greater extent to petroleum pricing than the remaining market.

Monthly pricing trends for wholesale diesel FOB Anchorage between March 2003 and November 2010 are plotted in Figure 1, following. These data were acquired from the Energy Information Agency, in units of \$/gallon and converted to \$/MMBtu. Obviously the steep increases in petroleum derived fuels during the Middle East/Northern Africa cultural upheaval beginning in February 2011 are not captured by these data.

Figure 2 includes the addition of pricing data for AK LNG (Nikiski liquefaction plant) landed in Japan. LNG pricing (for Japan) did not respond to the needle peak of diesel pricing in 2008, though the trend clearly indicates a price increase that more closely tracks that of diesel fuel beginning in March 2009. The latter is likely explained by a renegotiated contract, with enhanced indexing to petroleum pricing.

Figure 3 adds a synthesized trend[3] for the pricing of diesel/fuel oil delivered to Bethel, based on data supplied by Alaska Department of Commerce, Community and Economic Development (DCCED), as well as Northstar Gas Company (local Bethel distributor). Certainly it is recognized that pricing for large volumes of LNG landed in Japan does not address the true supply chain cost for bringing small volumes to Bethel. The comparison nonetheless points to the potential for large savings for substituting LCNG for diesel in rural Alaska.

Figure 4 differs from Figure 3 by the addition of average pricing for LNG landed in the lower 48, from liquefaction plants in Trinidad, Egypt, Qatar, Peru, Norway, Yemen, and Nigeria. Significant pricing differences between US exported LNG (landed in Japan) and US imported LNG are not noted until March 2009, which probably arises from the combined impacts of a renegotiated export contract, and the declining US market for LNG importation.

> There is an apparent opportunity to deliver a substantially less expensive substitute fuel to remote Alaskan communities in the form of LCNG. Quantifying the real project economics, determining a price range to provide a reasonable return on investment, and identifying supply options are the primary objectives of this project.

[3] EIA monthly data for wholesale diesel fuel FOB Anchorage were manipulated to transportation, local distribution and local distributor profit based on DCCED data.

Figure 1
Trended Fuel Prices, Alaska Diesel
Wholesale & FOB Refinery

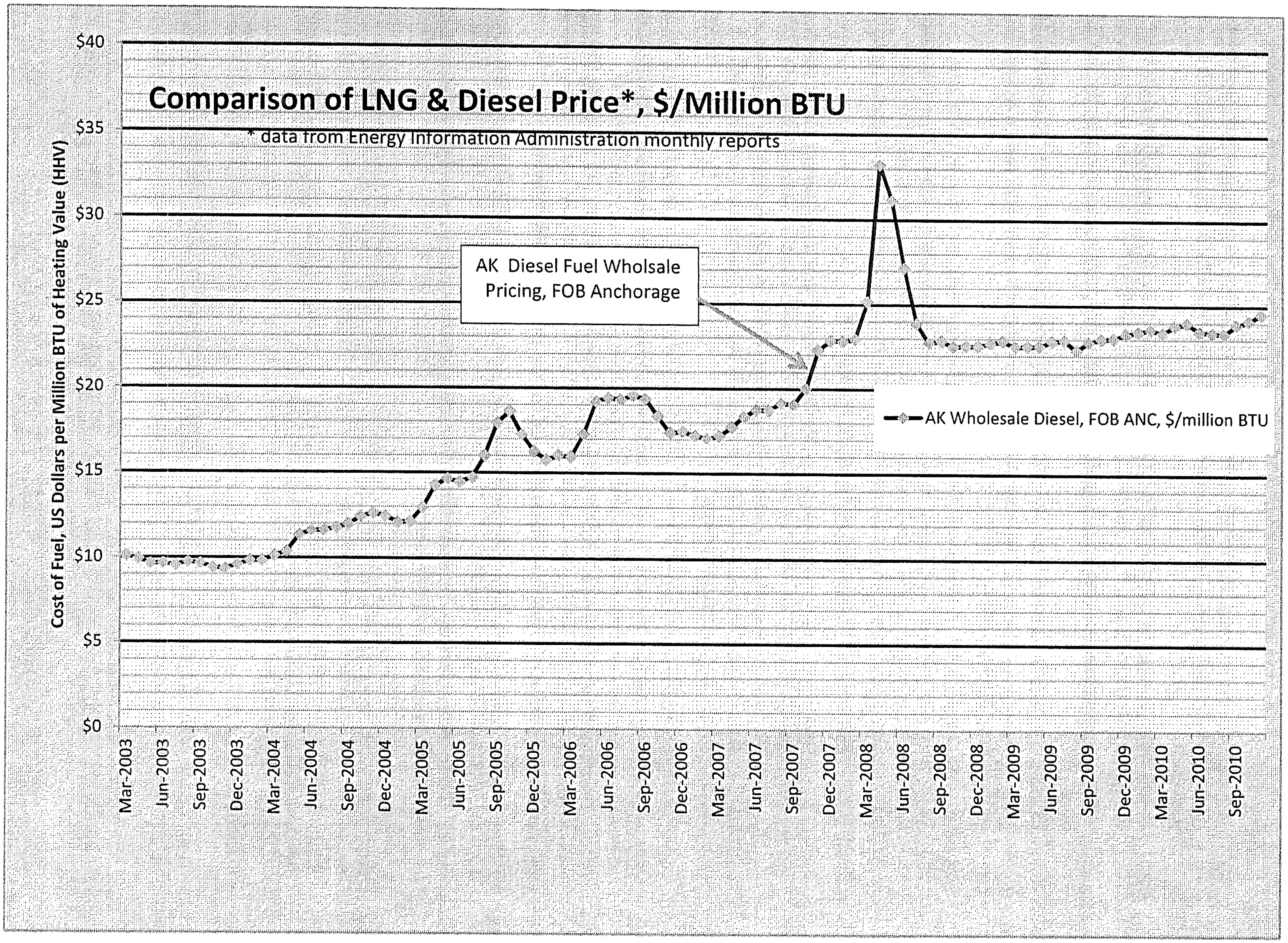


Figure 2
Trended Fuel Prices, Alaska Diesel
Pricing from Fig 1 & AK LNG Landed in Japan

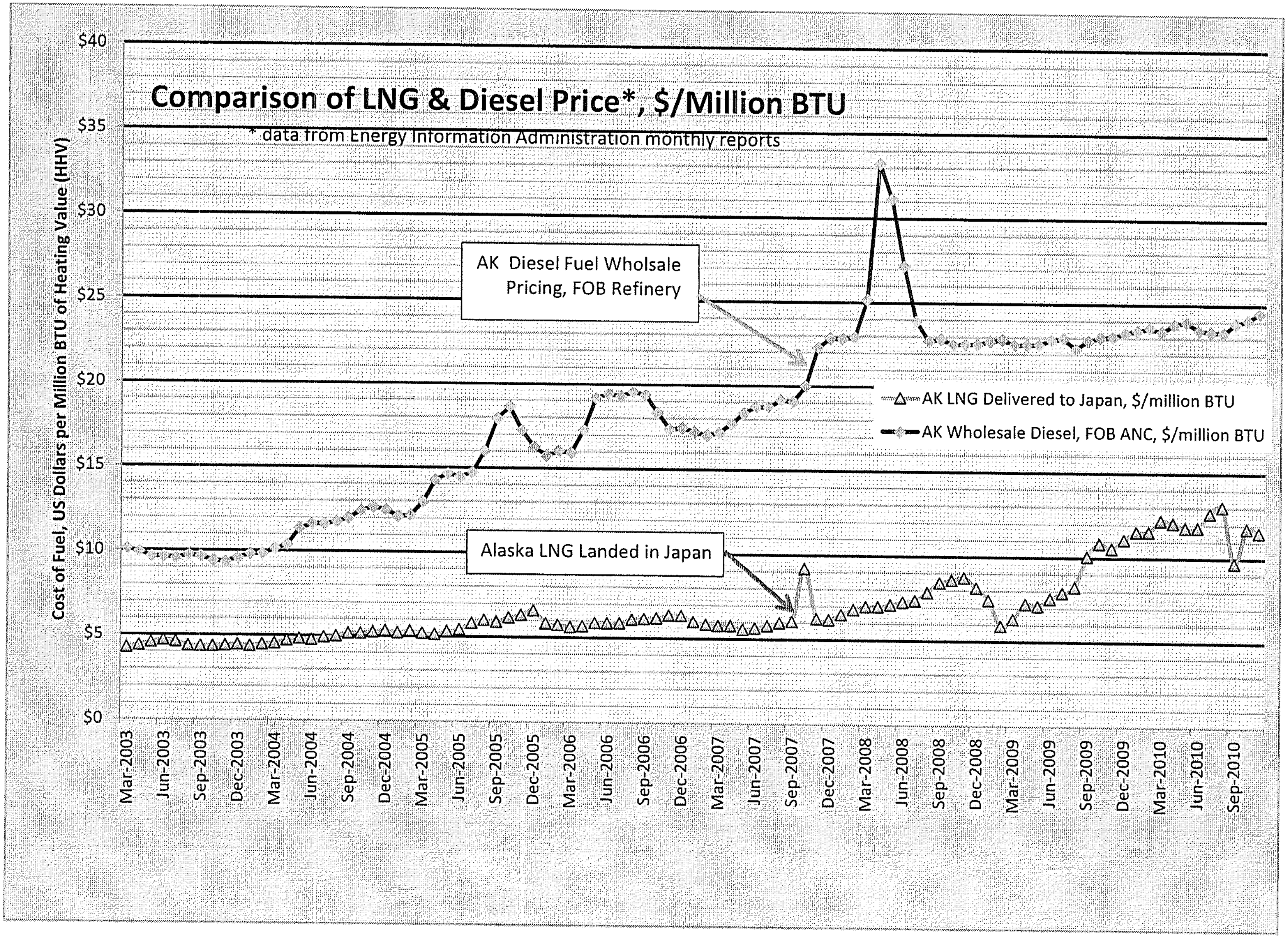


Figure 3
Trended Fuel Prices, Alaska Diesel
& LNG Pricing from Fig 2 & Adjusted Pricing
For Delivery to Bethel

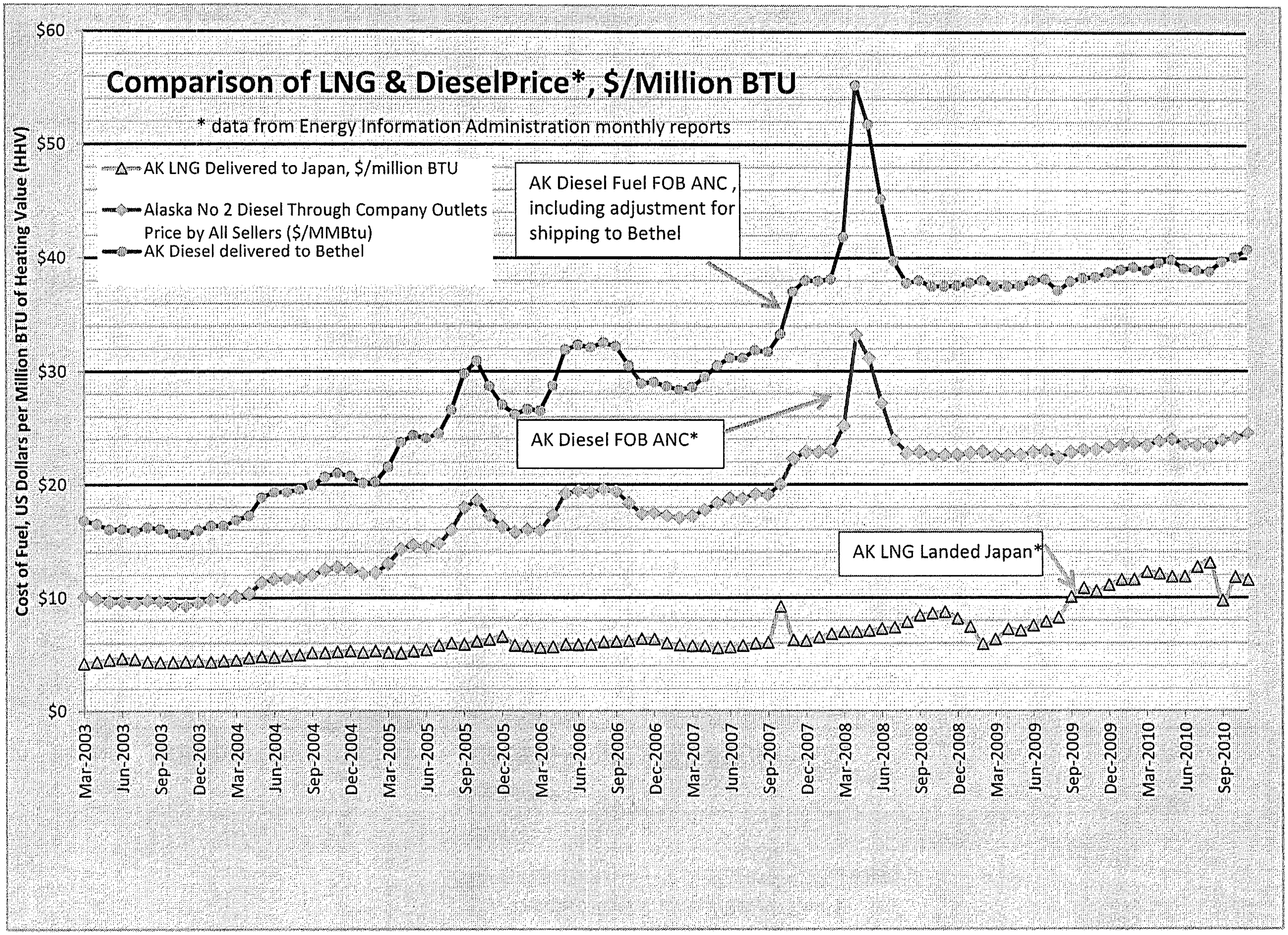
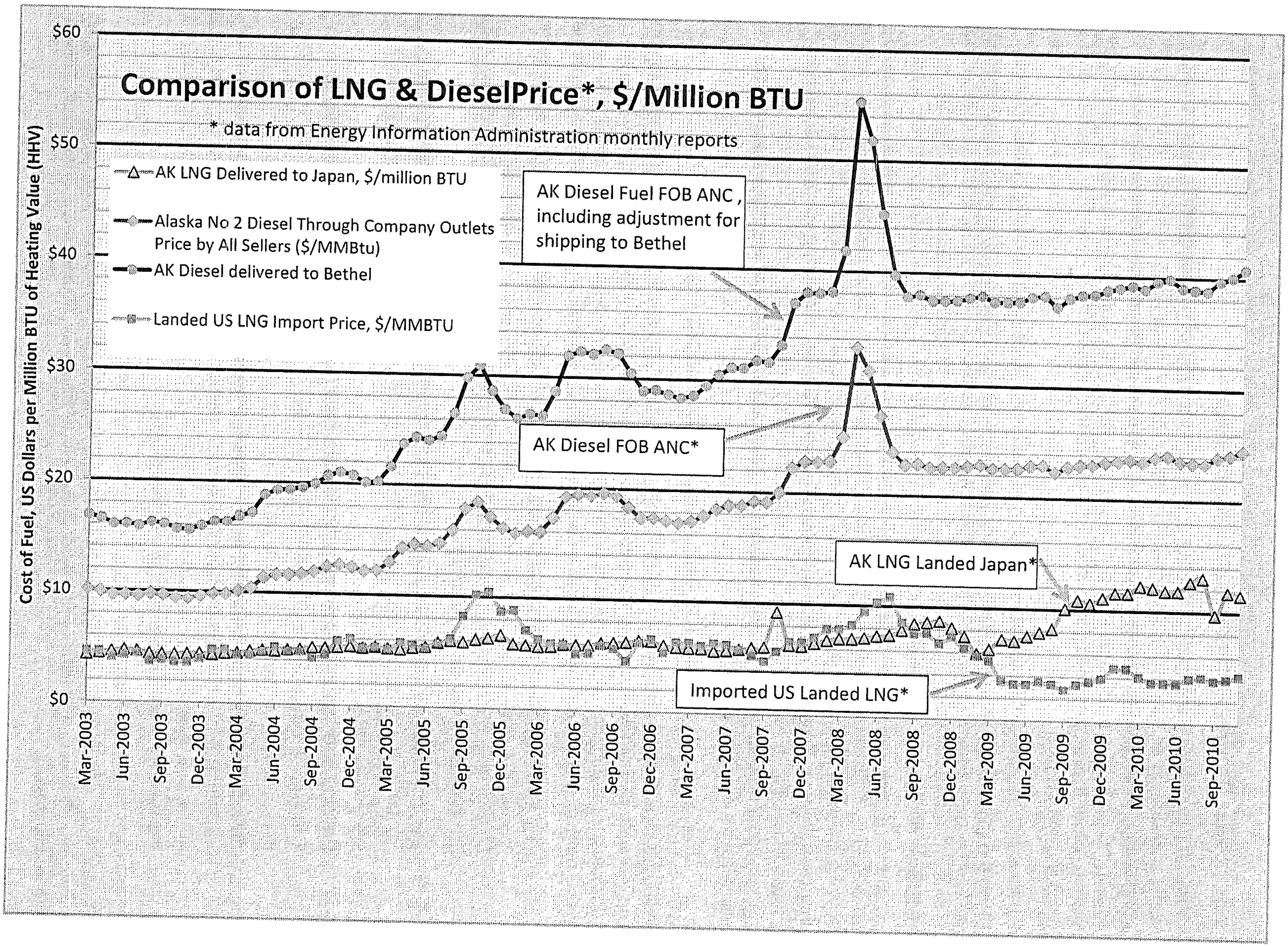


Figure 4
Trended Fuel Prices, Alaska Diesel
& LNG Pricing from Fig 3 & LNG Landed in US



1.3 LCNG – Is There a Hidden Cost Disadvantage?

Critics of this concept will likely point out a logical weakness of our preliminary plan; that a comparison such as that in Figure above figures does not adequately represent the costs of purchasing, transporting, and storing LCNG on a scale that represents low volume use in dispersed Alaskan communities. This may be true, but points back to the question of what is known about these costs. Very little is known about the supply chain, and this substantiates the need for this project.

Consider one approach to addressing the real costs of shipping and storing LCNG: Based upon the published costs of imported LNG landed in the US, assume that LNG is transferred via barge from a point in Anchorage, much the same as diesel and fuel oil are transported now. Using published data from both EIA, for wholesale diesel pricing in Alaska, and DCCED, for delivered diesel pricing in Bethel, determine the $/gallon of liquid fuel which is incrementally added to handle and transport diesel from Anchorage to Bethel. This value, which averaged $1.34/gal in 2006-2007[4], can then be added to the landed price of imported LNG, to provide a very approximate picture of the commodity pricing that could be expected if imported LNG was 'handled twice' in order to transfer smaller volumes to Bethel. These trends are presented in Figure 5, following. As will be noted for the trends representing the last 2 to 3 years, the hypothetical delivered cost of LNG in Bethel is approximately 50% of the equivalent BTUs supplied as diesel or fuel oil.

1.4 What is the Future of LNG versus Petroleum-Derived Fuel Pricing?

Will the price disparity between natural gas (LCNG) and petroleum distillates continue? Given the volatility of fuel prices during the period that this application was prepared, no one can make such predictions with confidence. However, the applicants believe that over the longer term, natural gas will remain a bargain compared with diesel/fuel oil, for the following reasons:

- The lower 48 states now enjoy a huge surplus of natural gas, primarily as a result of developing tight sands and shale completion technologies. It is estimated that this surplus and the reserves brought on-line to replace declining wells will be adequate for the next 25 years, as a minimum.
- The cost to produce and transport LNG is declining world-wide. Stranded natural gas reserves are located in numerous tidewater locations, thus ensuring adequate LNG supply for the long term.
- Political and cultural tensions in the Middle East and North Africa are not likely to subside for many years, heightening the impact of an already tight petroleum market.
- Development of US off-shore/Outer Continental Shelf petroleum reserves is currently stalled, and will likely be permitted in selected areas only; placing further pressure on petroleum and its derived fuels. World-wide demand for diesel fuel is strong, and supply surplus is tight. Pricing for gasoline, diesel, fuel oil and other distillates are not likely to experience advantages relative to natural gas.

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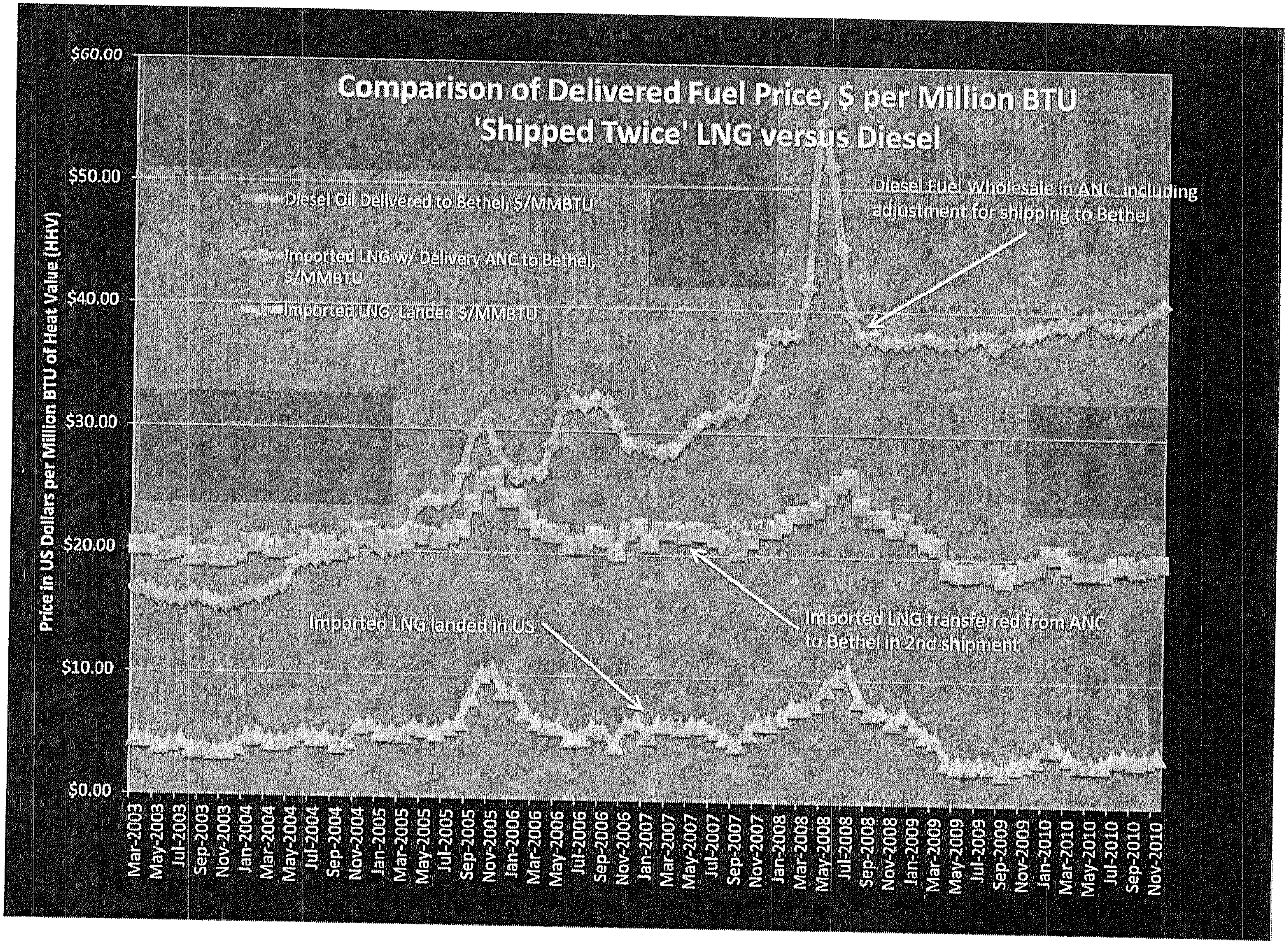
[4] Wilson et al, "Components of Delivered Fuel Prices in Alaska" AEA June 2008 report incremental cost increases in Bethel during 2007 of $1.70 per gallon of fuel oil, attributable to transfer, transport, storage and dealer markup.

& US Imported LNG + Adjustment to Ship to Bethel

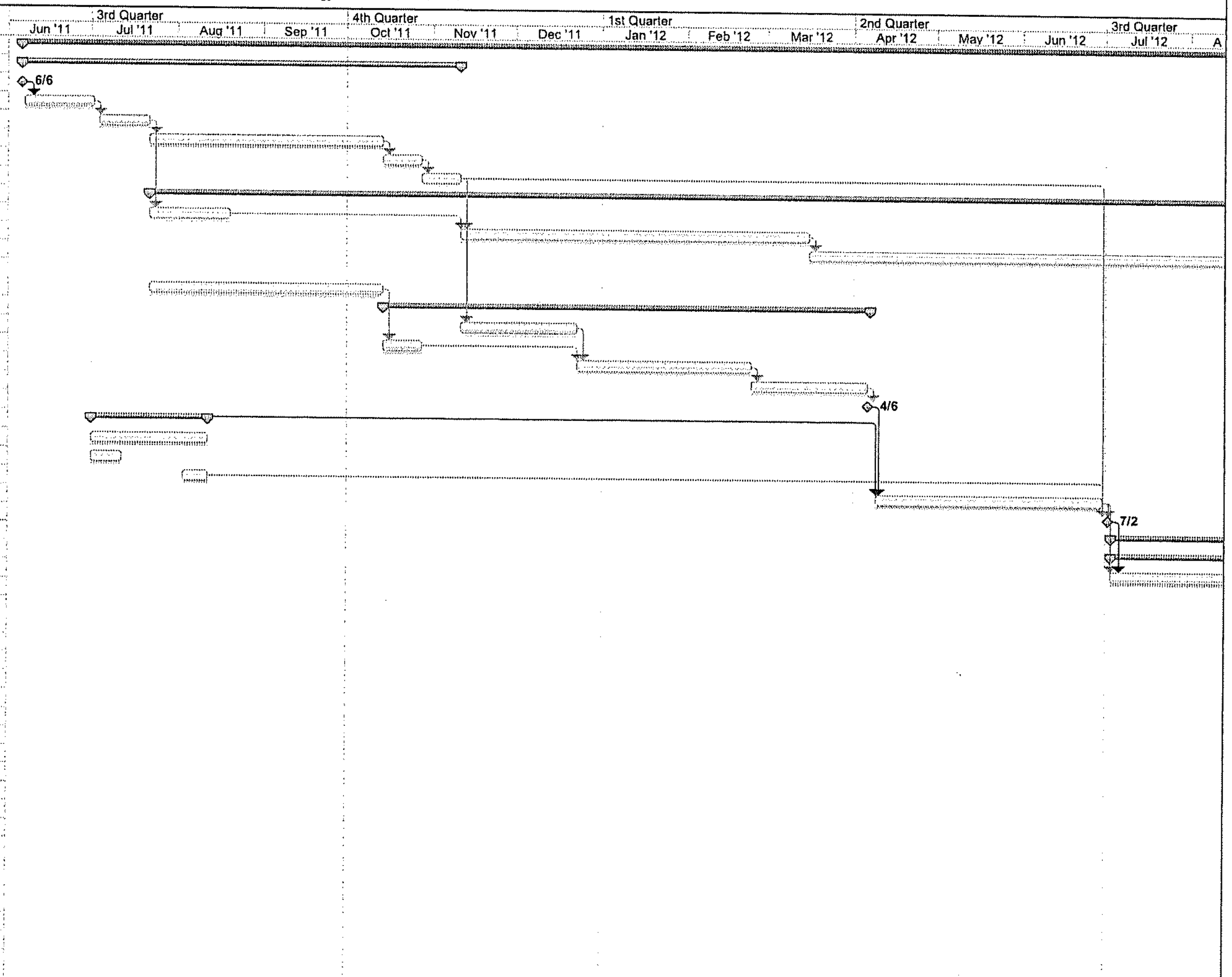


Appendix B

Preliminary Project Schedule

AEA Emerging Technology Grant Application
Preliminary Schedule
LCNG - A Bridge to Reduced Energy Costs for Rural Alaska

ID	Task Name	Duration	Predecessors
1	**Phase 1 - Pre-Deployment**	**468 days?**	
2	**System Design**	**114 days**	
3	Project Kickoff	1 day	
4	On-Site Survey and Field Data Processing	19 days	3
5	Develop Design Basis Memo	14 days	4
6	Develop Discipline Specific Design Packages	60 days	5
7	Design Review	10 days	6
8	Finalize Initial Design	10 days	7
9	**Permitting**	**434 days**	
10	Long Lead Permit Assessment	21 days	5
11	Long Lead Permit Application	90 days	10,8
12	Permit Application Review and Processing	263 days	11
13	Permit Granted	1 day	12
14	Engage Energy Suppliers/Begin Preliminary Negotiations	60 days	
15	**Project Financing Plan**	**126 days?**	
16	Prepare Construction Cost Estimates	30 days	8
17	Estimate O&M and Fuel Costs	10 days	14
18	Proforma Model (ROI), Test and Run	45 days	16,17
19	Prepare Project Financing Plan	30 days	18
20	Project Financing Plan Complete	1 day?	19
21	**Commercialization Plan**	**30 days**	
22	Engage Partners - construction contractors. Suppliers, etc	30 days	
23	Risk Analysis	7 days	
24	Complete Plan	7 days	
25	Project Funding and Capitalization (Prelim)	60 days	20,21
26	Phase 1 Wrapup	1 day	24,8,25
27	**Phase 2 - Deployment**	**593 days?**	
28	**Design and Bid Activities**	**121 days?**	
29	LCNG Facility Detailed Design	4 mons	25,26
30	Bid Packages, Fabrication	30 days	29
31	Bid Packages, Construction	30 days	29
32	Procure Equipment	1 day?	
33	Award Construction	1 day?	31
34	**Construct Pilot Scale Plant in Bethel**	**132 days**	13
35	Kick-Off Meeting	1 day	
36	Construction of Pilot LCNG Systems	6 mons	35
37	Commission and Checkout	2 wks	35,36
38	Commence Operation	1 day	37
39	Plant Performance and Cost Monitoring	52 wks	38
40	Update Financing Plan	7 days	39
41	Update Commercialization Plan	7 days	38FS+1 day,40
42	**Phase 3 - Post Deployment**	**362 days**	41
43	Design/Bid Hub/Satellite System	120 days	41
44	Construct Hub/Satellite System	150 days	43
45	Complete Commercialization Plan	30 days	44
46	Continued Performance Monitoring	52 wks	
47	**Conclusions & Recommendations**	**62 days**	
48	Develop Draft Report	30 days	45
49	Present to AEA & Stakeholders	1 day	48
50	Finalize Report	30 days	49
51	Issue Final Report	1 day	50



Project: AEA Grant Sched 3_14_2011
Date: Mon 3/14/11

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External MileTask | Split

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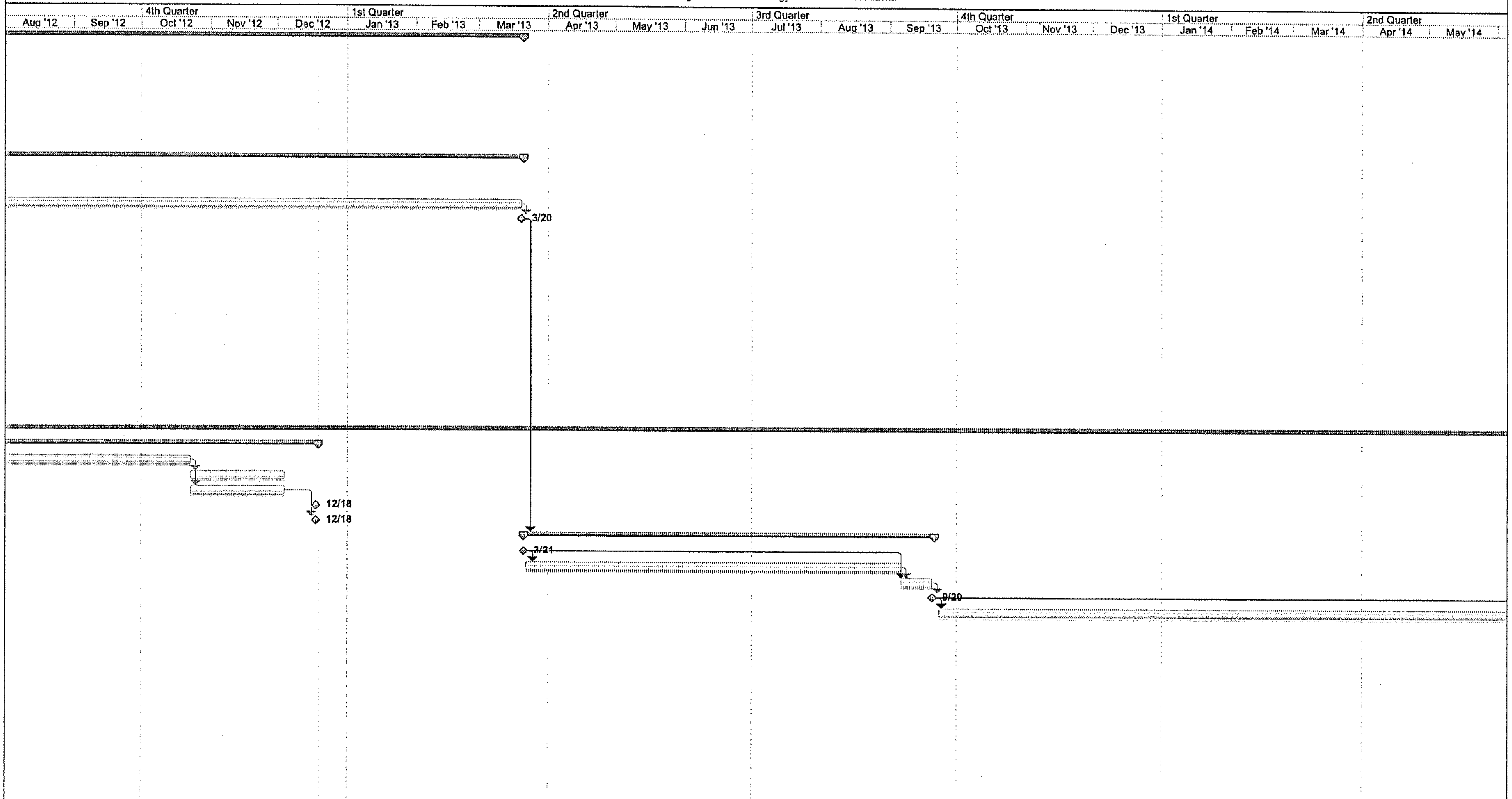
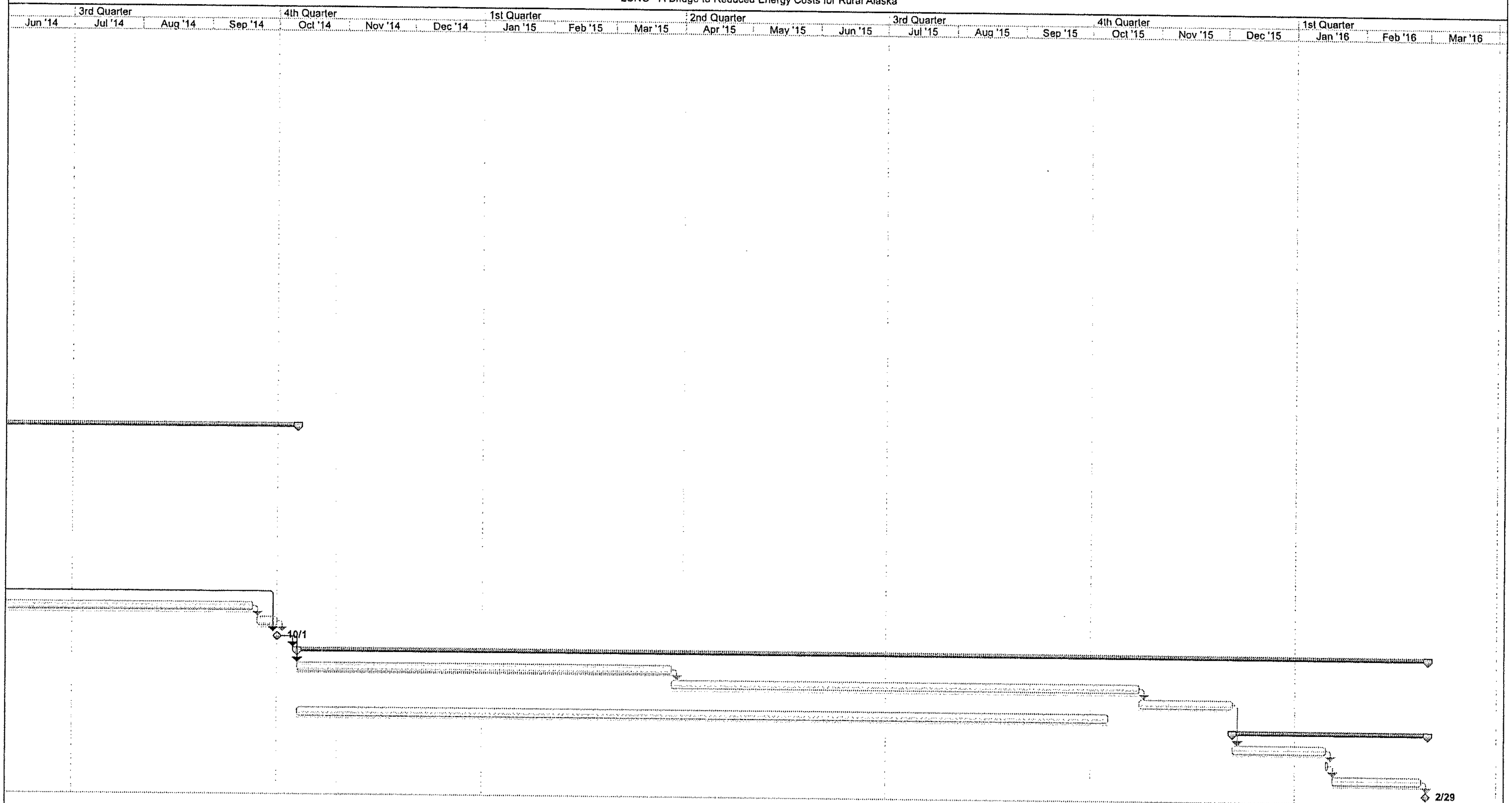
AEA Emerging Technology Grant Application
Preliminary Schedule
LCNG - A Bridge to Reduced Energy Costs for Rural Alaska



Project: AEA Grant Sched 3_14_2011 Date: Mon 3/14/11	Task		Progress		Summary		External Tasks		Split
	Split		Milestone	◆	Project Summary		External MileTask	◇	

AEA Emerging Technology Grant Application
Preliminary Schedule
LCNG - A Bridge to Reduced Energy Costs for Rural Alaska



Project: AEA Grant Sched 3_14_2011 Date: Mon 3/14/11	Task		Progress		Summary		External Tasks		Split
	Split		Milestone		Project Summary		External MileTask		

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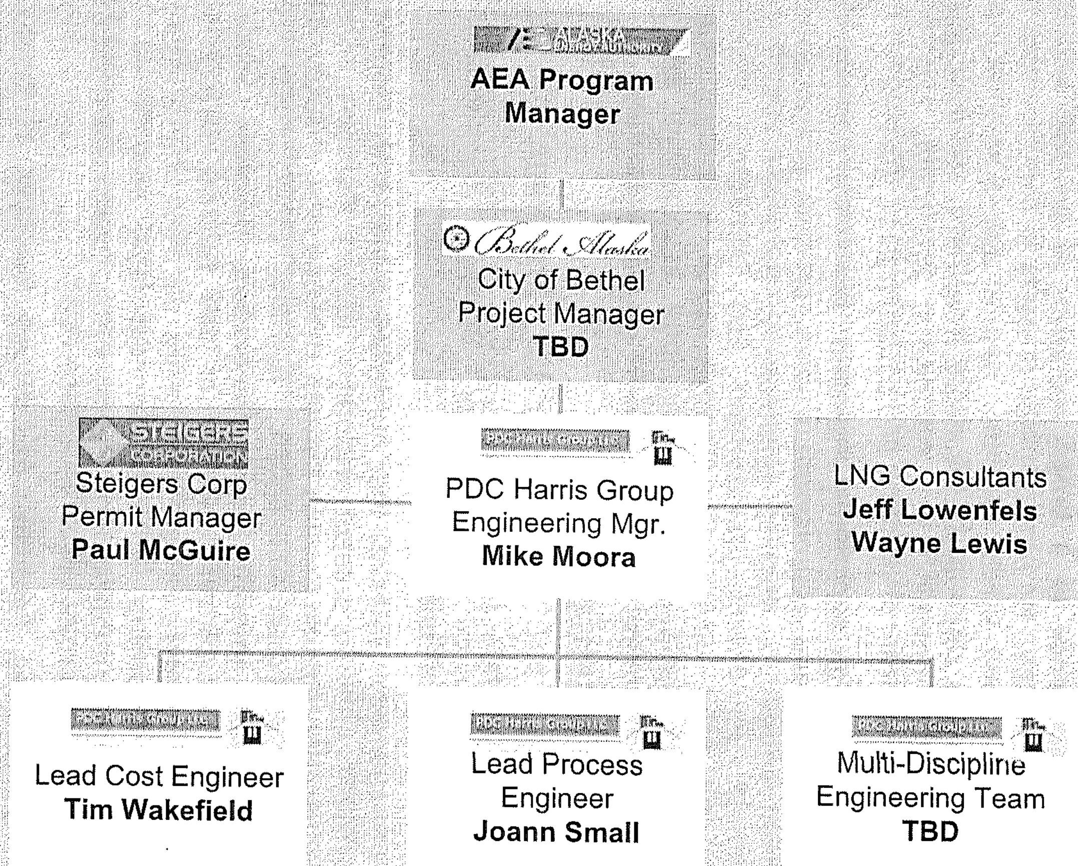
Appendix C

City of Bethel Resolution & Action Memorandum

Appendix D – Organization Chart

LCNG Stage 1 Project Organization



MICHAEL W. MOORA, P.E.

PROCESS ENGINEER

University of Utah, MS Fuels & Chemical Engineering

Drexel University, MS Environmental Engineering

Rutgers University, BS Mechanical/Aerospace Engineering

BACKGROUND

Mike Moora is a registered Process Engineer and Project Manager with over 30 years of experience in a broad spectrum of process and environmental remediation industries. He has executed projects in diverse areas such as North Slope production and utility systems, natural gas treatment, synthesis gas production, flue gas cleanup, RCRA waste treatment, remedial designs/actions, radioactive waste immobilization, wastewater treatment, synthetic fuels pilot development, chemicals production and biotechnology development.

Mr. Moora has design experience including: Feasibility and economic analysis, conceptual design and optimization studies, process design development and flow sheet simulation, detailed engineering, purchase specifications, project management, equipment procurement and fabrication inspection, HAZOP analysis and relief valve design/documentation, operating manuals/operator training, facility commissioning, technology assessment and due diligence investigations, air emissions control and air quality permitting.

SELECTED EXPERIENCE

General Manager, PDC Harris Group LLC, Anchorage, AK. Responsible for business development, project management and operations support for this energy business-sector joint venture. Business development and project management work included:

- BP Exploration (Alaska) Inc: numerous power and resource development projects 2006 to present, including: Project Manager, Liberty Rig Power Generation Module Cooling System Modifications. Project Sponsor, Central North Slope Power Generation – Appraise Stage Study. Project Sponsor, Milne Point Interim Power Generation Appraise Stage Engineering Services. Pre-concept analysis of gas turbine generator alternatives. Project Manager, Milne Point Heavy Oil Pilot Power Generation Select Stage Engineering Services. Concept level analysis of 1 to 1.5 MW transportable/modular power generation. Project Manager for a generator replacement project at BPXA's Milne Point.
- Doyon Utilities, Fairbanks AK: Project Manager, Ft Greely Boiler steam blow temporary piping design. Piping design, stress analysis, support design and selection of steam silencer. Project Manager, Ft. Greely Boiler Upgrade and SCADA system design.
- Municipality of Anchorage, Municipal Light & Power, PIC for Generation Engineering Term Contract. Numerous task orders including: Principal in Charge, Plant 1 Black Start Generator concept and detailed design

services. Project Manager/Lead Process Engineer for Waste Heat Recovery Project involving rejection of heat from existing and new generation assets to Anchorage Water and Wastewater utility. Project Manager/Lead Process Engineer for Unit 3 Fuel Gas Booster Compressor improvements. Project Manager for feasibility and concept level engineering development of a 2 x 1 GE 6FA combustion turbine power generation system.

- Chugach Electric Association: Project Manager, South-central Project Waste Heat Recovery Assessment. Lead specifications development to support the upgrade of the turbine control system for Unit 5 gas turbine system at Beluga River Station. Project Manager for Bernice Lake Power Plant Water Injection System.

LICENSES AND CERTIFICATION

— Professional Engineer Registration, Colorado

— Registered Environmental Manager

— University of Alaska, Arctic Engineering Short Course, November 2001

— Currently enrolled in Project Management Institute training for PMP

TECHNICAL PAPERS

"The Design of a Commercial RCRA Incinerator - Where the Regulations Are Taking Us", Presented at the Colorado Hazardous Waste Management Society, Fall 1991, Denver, CO.

"Design and Environmental Permitting Challenges for the Ft. Wainwright, Alaska Power Plant Fabric Filter System", Presented at the Air and Waste Management Association Conference, Orlando FL, June 24 - 28 2001.

R Fedich, D McCaffrey, M Moora and R Ungs, *"Upgrade Your Tail Gas Treating Unit With FLEXSORB SE Plus",* Paper presented at the 2003 Brimstone Sulfur Recovery Symposia, Vail Colorado, September 2003.

"LCNG – A Bridge Solution to High Energy Costs in Rural Alaska", Presentation to the Cold Regions Design Forum, Fairbanks, AK, February 2011.

Jo Ann R. Small
Senior Process Engineer, PE

Texas A & M University, BS – Chemical Engineering

BACKGROUND

Jo Ann Small has over 22 years of experience in process engineering. Her experience includes the detailed design of grassroots and retrofit projects involving Sulfur Recovery Units (SRU), Tail Gas Treating Units (TGTU), Sour Water Strippers (SWS), Amine Units (ARU), petrochemical process units, upstream oil and gas and industrial facilities.

Ms. Small's responsibilities have included computer simulation, proposal development, heat and material balance, process flow diagrams, piping and instrument diagrams, equipment sizing, refractory material specification, hydraulic calculations, utilities and chemical/catalyst summaries and safety systems.

SELECTED EXPERIENCE

Oil & Gas (Upstream)

Zhaikkunai: Process evaluation of Gas Treatment Plant (Stabilizer, Amine, SRU, Glycol, Deethanizer and Debutanizer) for alternate feeds.

EnCana Oil & Gas (USA) Inc.: Process evaluation of 3 phase separator and associated piping.
Chevron Mid-Continent Business Unit: Equipment & Line sizing. Equipment to include
2 & 3-phase separators, heater treaters, tankage and pumps.

Petroleum Refining

Premcor: Schedule A design of new SRU and TGTU Process Engineer.

Marathon Ashland Petroleum: Sour Water Stripper Expansion Study.

Rayong, Thailand: Evaluation of existing SRUs and TGTUs

Lucky Engineering Co., Ltd: Schedule A design of Amine Regeneration Unit.

Koch Refining: Evaluation of existing TGTU with specialty solvent.

Suncor: Schedule A design of new SRU and TGTU.

Premcor: Flare study for possible expansion.

SRM International: Process Design of 10,000 gpd Biodiesel unit. Including PFDs heat and material balance and equipment data sheets.

ConocoPhillips: Process Design of Sulfur Recovery Unit and Tail Gas Treating Unit.

Monsanto, Nitro, WV – Expansion of a sulfur recovery unit from a two reactor unit to a three reactor unit.

Du Pont Company, Deer Park, TX – Process evaluation of an existing sulfur recovery unit for a new feed.

Allied Corporation, Anacortes, WA – Process study of an existing sulfur recovery unit for a new feed.

Total Petroleum, Ardmore, OK – Process evaluation of an existing sulfur recovery unit for a new feed.

CITGO Petroleum Corp., Lake Charles, LA – Process design for the conversion of a Stretford to a 400 LTD SULFTEN) System.

Valero Refining Co., Corpus Christi, TX – Process design fro a 280 LTD grassroots SULFTEN System.

Amoco, Whiting, IN – Process design for the conversion of a Stretford to a SULFTEN System.

Texaco, Wilmington, CA – Process design for the conversion of a Stretford a SULFTEN System.

Exxon, Big Escambia Creek, AL – Process design of a grassroots SULFTEN System.

Champlin Petroleum Co., Wilmington, CA – Process design for the conversion of a Stretford to a SULFTEN System.

Champlin Petroleum Co., Corpus Christi, TX – Process design of an 80 LTD SCOT Unit.

Husky Oil, Cheyenne, WY – Process study of two existing amine units for new feeds.

Champlin Petroleum Co., Wilmington, CA – Process evaluation of amine unit expansion 120 to 200 LTD.

PROFESSIONAL/TECHNICAL TRAINING

CO_2 Surface Facilities Course, HYSYS, BR&E, TSWEET, ProSim, ProMax, STX & ACX,
Tray Design Software

PROFESSIONAL REGISTRATIONS

Texas – No. 55281

TIMOTHY L. WAKEFIELD, JR.
PROJECT CONTROLS SPECIALIST

Colorado State University, BS Industrial Construction Management

BACKGROUND

Tim Wakefield has over 30 years of experience in project control and management of minerals, power, natural gas and pharmaceutical projects. His background includes preparation of detailed cost estimates, procurement, expediting, construction inspections, accounting, subcontract administration, warehousing, forecasts, cash flows, development and maintenance of schedules, cost trends, and cost and commitment reporting systems. He has been involved in a variety of projects including gold, silver, copper, uranium, nickel, lead, iodine, coal, soda ash, power, natural gas and pharmaceuticals in Australia, Argentina, Chile, Peru, Guatemala, Namibia, Kazakhstan, Uzbekistan, Siberia, Tajikistan, Canada, Florida, Indiana, Kansas, Kentucky, New York, South Carolina, and western United States, including Alaska and Hawaii. Services were provided in the home office and at numerous job sites.

SELECTED EXPERIENCE

- Project Controls Specialist responsible for planning and cost control for a new power plant in Indiana. The plant utilizes six LM6000 combustion turbine generators in simple cycle. Scope also included support to construction and on-site engineering and administrative services.
- Project Controls Specialist responsible for preparation of estimates and cash flow forecasts for two proposals to DOE in response to the Clean Coal Power Initiative Program Solicitation.
- Project Controls Specialist responsible for the capital cost estimate for a 500 MW power plant in California. The plant utilizes two Frame 7FA natural gas combustion turbine generators in combined cycle.
- Project Controls Specialist responsible for the estimated capital costs and cash flow forecast included in a study for both new construction and retrofitting of coal-fired utility power plants. The study included emissions controls, including SO_X, NO_X and mercury environmental controls.
- Project Controls Specialist responsible for planning, cost control and capital cost estimating for the design and construction of two peaker power plants located on Staten Island, New York, approximately one-half mile apart in the Bloomfield area and interconnecting with a Consolidated Edison switchyard a few miles away by way of a single new 138-kV power line. The power plants are simple-cycle facilities fired on natural gas, each using a Pratt & Whitney TwinPac combustion-turbine generator plus a Pratt & Whitney PowerPac

combustion-turbine generator, both with selective catalytic reduction ("SCR"). The combined output at each site is approximately 80 MW.

PROFESSIONAL AFFILIATIONS

The Association for the Advancement of Cost Engineering
Sigma Lambda Chi (National Construction Honorary)

EMPLOYMENT

Bateman Engineering, Inc.
Davy McKee Corporation

STEIGERS
CORPORATION

DIRECTOR OF PROJECTS

Senior Environmental Scientist

PAUL W. McGUIRE

CREDENTIALS

EDUCATION

BS Resource Conservation; 1993
University of Montana
Wetland Soils and Hydrology Training; 2001
Wetland Training Institute
Wetland Delineation Certification Training; 2001, Wetland Training Institute
NEPA Training Course; 2003
Federal Highways Administration
Project Management Training; 2004
Wynlee Crisp, P.E.
Writing Effective NEPA Documents, 2006
The Shipley Group
Managing the NEPA Process, 2006
The Shipley Group
NEPA Process, Endangered Species Act, Section 106, 2009
The Shipley Group

SPECIALIZATION

Environmental Permitting and Compliance
Planning/Due Diligence
Wetlands/Mitigation
Wastewater
Air Quality
Stream Restoration
Land Management
Threatened and Endangered Species
Biological Data Collection
NEPA

PROFESSIONAL SUMMARY

Mr. McGuire has over 15 years of experience in the environmental field, during which time he has managed and developed environmental programs for mining, transportation, power generation and transmission, land management, land development, corridor, and water resources projects. Mr. McGuire is experienced in the management, coordination, and development of environmental studies, impact assessments, feasibility and fatal flaw analyses, wetland assessments, air quality assessments, and preparation of a wide variety of federal, state, and local environmental permits. Mr. McGuire's responsibilities currently include the management and oversight of Steigers Corporation Project Operations. Mr. McGuire's experience allows him to quickly address issues and to develop programs, permits, and documents to meet specific project needs. These skills have made him a successful representative of the client's interests while meeting the requirements of the regulatory agencies.

PROFESSIONAL HISTORY

2010 to Present, Steigers Corporation
Director of Projects
2002 - 2010, Morrison-Maierle, Inc.
Natural Resources Market Group Leader
1999-2002, Steigers Corporation
Environmental Scientist
1993-1994, N.A. Resource Management
Environmental Scientist

RELEVANT EXPERIENCE

Rainbow Redevelopment Project, PPL Montana, Great Falls, MT. Senior Project Manager responsible for management, oversight, technical review, and development of the environmental compliance program for the redevelopment of a 100-year-old 60-MW Hydropower facility located on the Missouri River. Project redevelopment included replacement of all power generating infrastructure excluding dam replacement or alteration. The environmental regulatory program included compliance with all federal, state, and local requirements, including Federal Energy Regulatory Commission license; Section 401, 402, and 404 Clean Water Act; Section 10 of the Rivers and Harbors Act; Threatened and Endangered and State-listed sensitive species, coordination with Montana Fish, Wildlife and Parks regarding an existing conservation easement; coordination for compliance with Section 106 of the National Historic Preservation Act; as well as compliance with several Montana Department of Environmental Quality, County, and other regulatory requirements. Provided oversight and technical review for all biological data collection, report preparation, and permit application preparation. Provided client coordination between the owner, engineer, and multiple subconsultants. Responsible for ongoing environmental compliance during project construction, including site inspections and monitoring and assisting the contractor and PPL with permit modifications and renewals, and new applications for unanticipated project requirements.

Hyalite Transmission Main and Raw Water Intake Project, Bozeman, MT. Project Manager responsible for coordinating, scheduling, and assisting with the environmental regulatory program for replacement of an instream municipal drinking water intake structure, design and construction of a fish ladder on the existing dam within U.S. Forest Service land, and construction of a 3.5-mile-long raw water transmission line for the City of Bozeman. The project included a comprehensive evaluation of four independent proposed routes. Coordinated and assisted with the evaluation and QA/QC of the data collected. Coordinated and assisted with the development of final project reports. Provided assessment of regulatory requirements associated with pipeline, fish ladder and intake structure construction. Developed documentation to complete the Section 404 and 124 permitting process. Coordinated approval from the U.S. Forest Service specialists, including the landscape architect, wildlife biologist, fisheries biologist, botanist, recreation coordinator, and NEPA coordinator. Developed a Decision Memo for the U.S. Forest Service for NEPA compliance.

Permitability/Fatal Flaw Assessments, Seward, AK, Healy, AK, Bearcreek, MT, Pinckneyville, IL, Somerset, CO. Coordinated and prepared several permitting and environmental assessments and fatal flaw analyses for a variety of power generating facilities. These documents varied in detail and length to meet the needs of each client. However, each study included an assessment of all major permits or approvals required for development and a detailed assessment of the NEPA process These evaluations included development of preliminary environmental information volumes to assess applicability of NEPA. Prepared brief reviews for a 12-MW coal-fired power plant in Seward, Alaska and a 125-MW coal-fired power plant in Bearcreek, Montana. Also prepared lengthy studies for a 45-MW gas-fired power plant in Anchorage, Alaska, a 1,500-MW coal-fired power plant in Pinckneyville, Illinois, a 200-MW coal-fired power plant in Healy, Alaska, and a coalmine methane energy recover project in Somerset, Colorado. These evaluations included an assessment of permitting requirements, difficulty, cost, and schedule.

RELEVANT EXPERIENCE cont.

Knik Arm Power Plant Repowering Project, Anchorage, AK. Project Coordinator responsible for the environmental compliance effort for repowering a natural-gas-fired cogeneration power facility in Anchorage Alaska. Acted as principle contact and liaison between client and federal, state, and local agencies. Developed permit applications in accordance with applicable permitting requirements, including Air Quality Construction permit application, National Pollutant Discharge Elimination System Industrial Wastewater Discharge permit application, Alaska Department of Fish and Game Fish Habitat permit application. Coordinated with the U.S. Army Corps of Engineers to determine the applicability of Section 404 and Section 10 permitting requirements and to minimize those requirements. Completed a NEPA review, which included developing a preliminary environmental information volume to assess NEPA requirements. This project also required completing a wetlands delineation; coordinating a site remediation project; preparing, coordinating, and overseeing a contaminated sediment sample collection and testing program (including Alaska Department of Fish and Game and U.S. Army Corps of Engineers permitting); preparing a Site Investigation Report to evaluate the results of the sediment sample laboratory analysis; evaluating water rights; and completing an Alaska Division of Governmental Coordination Coastal Zone Consistency Review to meet the requirements of the Coastal Zone Management Act. Extensive study of potential impacts to salmonids (thermal impacts, fish passage, entrainment, spawning habitat, in-stream flows), impacts to regional airports (exhaust plume), dam safety, geologic stability of the site, public safety, and extensive public involvement were some of the more significant issues addressed during the management of this project.

Yankee Gulch Sodium Minerals Project, Parachute, CO. Assisted with the development of a nahcolite solution mining operation that included a 1,200-acre 30-year mine facility on Bureau of Land Management property, a 44-mile-long buried two circuit product pipeline, a processing and calcining facility, and a railspur for product distribution. Developed, or assisted with the development of the following: Colorado Division of Minerals and Geology Mining and Reclamation permit (including a reclamation plan), county special use permits for two counties, a state National Pollutant Discharge Elimination System permit, Class I, Class III, and Class V Underground Injection Control permits, Bureau of Land Management Mine Plan and revised Mine Plan, Emergency Response Plan, Pipeline Plan of Development, a Section 404 Nationwide 12 permit for the 44-mile-long pipeline, county and Public Utilities Commission approval for installation of several railroad crossings, application for several rights-of-way, and NEPA environmental information support documentation. Prepared and completed environmental evaluations to meet requirements for NEPA compliance. Provided document preparation assistance for development of an Environmental Impact Statement. Also developed, or assisted with the development of the following support documentation: Groundwater and Surface Water monitoring Plan; Subsidence Monitoring Plan; Wildlife Monitoring and Mitigation Plan; Stormwater Pollution Prevention Plan; Spill Prevention, Control, and Countermeasure Plan; and Environmental Compliance Document preparation.

Great Falls Area 100kV Generation Interconnection Replacement Project, PPL Montana, Great Falls, MT. Senior Project Manager responsible for the environmental compliance program of a 13.1-mile 100kV transmission line. The transmission line corridor is part of five hydro facilities on the Missouri River. Developed a comprehensive environmental plan to meet all federal, state, and local regulatory requirements, including Clean Water Act Section 401 and Section 404 and Rivers and Harbors Act Section 10. Managed and assisted in the preparation, technical review, and submittal of supporting environmental documentation and permit applications for federal, state, and local requirements, including FERC compliance. Project development included close coordination with the project owner, design engineer and other contractors to develop a design plan that met project objectives while minimizing compliance requirements.

Mystic Lake FERC Compliance, West Rosebud Creek, MT. Senior Project manager responsible for the ongoing Federal Energy Regulatory Commission license compliance requirements for the Mystic Lake hydroelectric facility. Compliance requirements to date have included coordination with U.S. Forest Service to develop and complete a riparian vegetation study, a weed infestation study, a bald and golden eagle study, and a harlequin duck survey.

Seep Ridge Road Environmental Assessment, Vernal, UT. Senior Project Manager responsible for the coordination, oversight, and technical review for the preparation of an Environmental Assessment for NEPA compliance for a 46-mile-long road reconstruction project. Management oversight included the completion of biological review, development of project alternatives, agency coordination, and cumulative impacts analysis. Coordinated the development of design alternatives and mitigation measures to meet the requirements of the Bureau of Land Management, U.S. Fish and Wildlife Service, and the State Division of Wildlife Resources for impacts to vegetation, wildlife, livestock and grazing, Threatened and Endangered species, and aquatic resources.

Kalispell Armory Phase I and Phase II, Kalispell, MT. Staff Supervisor responsible for completion of a Phase I Environmental Property Assessment using the ASTM 1527 Standard. Provided project oversight, QA, and coordination. Following preparation of the Phase I, it was concluded that a petroleum release was likely located within the property. Completed a Phase II with continued biannual monitoring, data collection and evaluation, and reporting.

Appendix E

Budget Form

Appendix E – Grant Budget Form

Emerging Energy Technology Fund

LCNG as a Bridge to Reduced Energy Pricing in Rural AK

Milestone or Task	Anticipated Completion Date	EET Fund Grant Funds	Grantee Matching Funds	Source of Matching Funds: Cash/In Kind/Federal Grants Other/State Grants/ Other	TOTALS
Phase 1 Predeployment					
GRANTEE MANAGEMENT					
Weekly Oversight Participation	n/a	$4,070	$4,070	In Kind	$8,140
SYSTEM DESIGN					
Project Kickoff & Field Survey	1-Jul-11	$20,033	$6,678	In Kind	$26,711
Design Basis Document	21-Jul-11	$41,526	$13,842	In Kind	$55,367
Process Flow Sheets + Equip Sizing	19-Aug-11	$34,910	$11,637	In Kind	$46,547
Equipment Layout	16-Sep-11	$29,202	$9,734	In Kind	$38,936
Equipment Lists + Vendor Quotes	13-Oct-11	$25,250	$8,417	In Kind	$33,667
Capital & Operating Cost Estimates	22-Dec-11	$35,128	$11,709	In Kind	$46,837
Emissions Calculations	18-Nov-11	$11,195	$3,732	In Kind	$14,927
PERMITTING PLAN & LONG LEAD APPLICATIONS					
Assessment Study	19-Aug-11	$60,549	$20,183	In Kind	$80,732
Permit Preparation, FERC & Coast Guard					
Planning & Permit Applications	19-Mar-13	$225,251	$75,084	In Kind	$300,335
PROJECT FINANCING PLAN	6-Apr-12	$70,109	$23,370	In Kind	$93,478
COMMERCIALIZATION PLAN	29-Jun-12	$59,825	$19,942	In Kind	$79,767
TRAVEL, PHASE 1	various	$18,113	$6,038	Cash	$24,150
TOTALS:		**$635,161**	**$214,434**		**$849,595**
Budget Categories					
Direct Labor & Benefits		$4,070	$4,070	In-Kind	$8,140
Travel & Per Diem		$18,113	$6,038	Cash	$24,150
Equipment		$0	$0		$0
Materials and Supplies		$0	$0		$0
Contractual Services		$612,979	$204,326	In Kind	$817,305
Other		$0	$0		$0
TOTALS:		**$635,161**	**$214,434**		**$849,595**

Appendix F

Certification of Matching Funds

Appendix F

Matching Funds Certification

The undersigned do hereby certify that the matching funds specified in the application for AEA's Emerging Energy Technology Fund (AEA-11-027) will be provided by PDC Harris Group LLC, as engineering contractor to the City of Bethel.

3/16/11

Steven M. Theno, Executive Director Date

William E Ward III 3/15/11

William E. Ward, Executive Director Date

Appendix G

PDC Harris Group Business License

Alaska Business License # 714078

Alaska Department of Commerce, Community, and Economic Development
Division of Corporations, Business and Professional Licensing
P.O. Box 110806, Juneau, Alaska 99811-0806

This is to certify that

PDC HARRIS GROUP LLC

2700 GAMBELL STREET, STE 500 ANCHORAGE AK 99503

owned by

PDC HARRIS GROUP LLC

is licensed by the department to conduct business for the period

October 13, 2010 through December 31, 2011
for the following line of business:

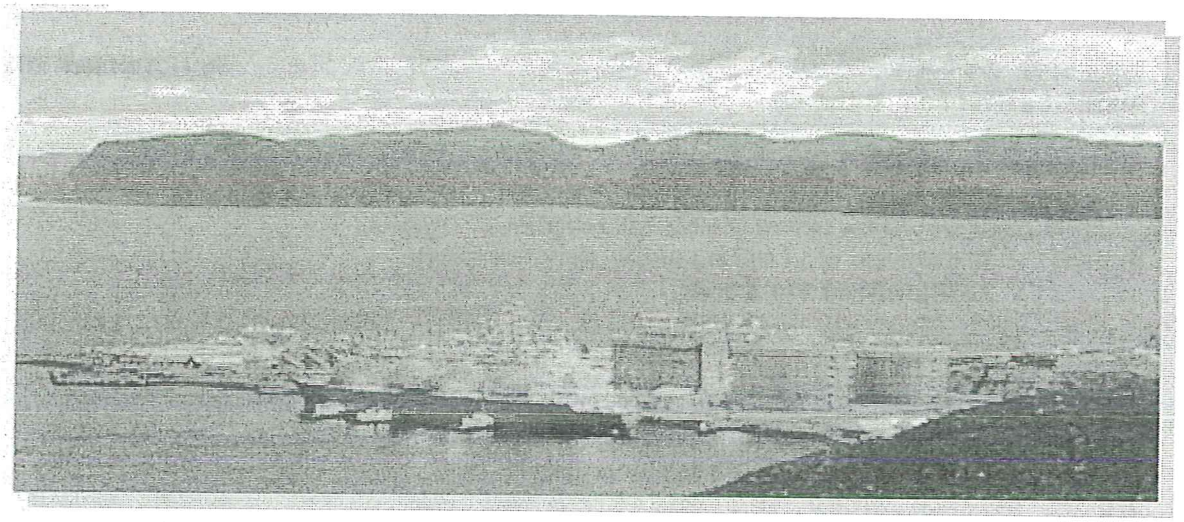
54 - Professional, Scientific and Technical Services

This license shall not be taken as permission to do business in the state without having complied with the other requirements of the laws of the State or of the United States.

This license must be posted in a conspicuous place at the business location. It is not transferable or assignable.

Susan K. Bell
Commissioner

1,28



Snovit LNG plant, Norway – Compliments of Statoil

Potential Benefits to Alaskans from a State-Owned Gasline/LNG Project

30 November 2011

PDC Harris Group LLC

Prepared by: PDC Harris Group LLC
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PDC Harris Group LLC

2700 Gambell Street, Suite 500
Anchorage, Alaska 99503
907-644-4716 (voice)
907-743-3295 (fax)

William M. Walker
Alaska Gasline Port Authority
731 N Street
Anchorage, AK 99501

30 November 2011

Subject: Transmittal of LCNG Economic Benefits Study
Transmitted via Email

Dear Mr. Walker:

Attached is Revision 4 of the subject study. If you have any questions or comments, please contact me at (907) 743-3263 or email mikemoora@pdceng.com .

Best Regards,

Michael W. Moora

Digitally signed by Michael W. Moora
DN: cn=Michael W. Moora, o=PDC Harris Group LLC, ou, email=mikemoora@pdceng.com, c=US
Date: 2011.11.30 16:07:00 -09'00'

Michael W. Moora
General Manager
PDC Harris Group LLC

Attachments: 1. "Potential Benefits to Rural Alaskans From AGPA's Gasline & LNG Project" Rev 4, 30 November 2011.

C: W Ward
S Theno
AGPA-11.01.01

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This preliminary study was conducted to provide an order-of-magnitude assessment of the benefits to Alaska communities of switching their primary fuel for space heating and electric generation from petroleum-derived diesel fuel to natural gas. For the study, natural gas was assumed to be delivered from a future liquefaction plant in Valdez aboard barges as LNG[1].

Bethel was selected as a representative community for developing cost models predicting the future retail cost of LNG-derived gas. This community is currently dependent on barge deliveries of diesel fuel. Bethel has historically experienced relatively high-cost retail fuels, based upon its remote location, and seasonal accessibility.

In addition to the work conducted on Bethel, the city gate wholesale cost of natural gas was estimated for Fairbanks, as an indicator of the approximate savings available when compared with wholesale diesel/fuel FOB[2] refinery loading rack.

Five case studies were conducted for Bethel to test the sensitivity of forecasted LNG and diesel pricing to the following parameters:

- ✓ Wholesale LNG cost, FOB Valdez
- ✓ Method of estimating LNG transport cost & retail markup
- ✓ Future wholesale diesel pricing, moderate vs. high perspective vs. worst case[3] future crude oil price @ $75/barrel

The Bethel costing model forecasts that conversion to an integrated LNG-CNG fuel, hereafter designated LCNG, will save approximately 25% to 65% over diesel for cases where a) LNG wholesale cost is equal to that defined by a recent Wood Mackenzie study[4] and b) the wholesale cost of diesel fuel remains within the 'medium' to 'high' ranges, as predicted by Alaskan economists[5]. The savings range from $229 million to $886 million over the period 2021 through 2051, when assuming 100% displacement of petroleum distillates used for space heating and power generation. The Net Present Value (NPV) of these cost savings range from $102 million to $397 million accrued over the same period.

One of the Bethel modeling scenarios, aimed at identifying sensitivity to crude oil pricing, examined retail diesel fuel costs equivalent to crude priced at $75 per

---

[1] For Fairbanks delivery, natural gas will be supplied by a regional off-take.
[2] Freight On Board, indicating buyer is responsible for transport costs.
[3] A worst case from the perspective of the lowest crude price studied by Wood Mackenzie, and therefore resulting in lower-priced diesel.
[4] Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.
[5] Fay, Saylor & Foster, "Alaska Fuel Price Projections 2011-2030" Institute of Social and Economic Research, Univ. of Alaska, 2010.

barrel (in 2021) resulted in a retail cost advantage for LCNG, between 21% to nearly 42% below predicted retail diesel fuel cost.

Another scenario was modeled where LNG wholesale cost in Valdez is determined in a similar manner to Wood Mackenzie's built-up model, but with an additional well-head gas value of $1.00 per million BTU added to the FOB Valdez cost. In this case, the savings remain significant, with a predicted nominal value of approximately $335 million (NPV = $146 million).

A wholesale natural gas cost at a city gate take-off for Fairbanks was estimated @ $5.29 per million BTU, as compared to a predicted diesel fuel cost of $27.23 per million BTU in 2021, representing a savings of approximately 80%. Based on the number of oil-fired furnaces and boilers identified in the city by a 2010 survey, and the average fuel usage per year noted in the same study, and assuming that 100% of these furnaces/boilers are converted to natural gas, the predicted total value of the fuel savings from 2021 through 2051 is estimated at over $2.4 billion (NPV of $1.1 billion).

In addition to cost savings, significant reductions in air emissions will result from converting from diesel/fuel-oil (or wood fuels in the case of Fairbanks) to LNG-derived natural gas. On a per fired BTU basis, natural gas is estimated to reduce emission rates approximately 99% for SO_2[6], 29% for NO_x, 99% for PM_{10}[7], and 24% for CO_2, when comparing EPA published emission factors for natural gas versus fuel oil.

The modeling assumptions for LNG wholesale costs, which duplicate those of the referenced Wood Mackenzie study for the majority of the case studies, result in widening cost advantages for LNG over diesel/fuel oil in later years. The model assumes that the more significant cost components of the built-up LNG cost do not escalate, resulting in a relatively stable LNG cost over the life of the study duration. The diesel fuel cost forecasts assume escalation. Thus the model predicts the difference between forecasted future retail diesel prices and LNG increase from initiation in 2021 to completion in 2051.

2. INTRODUCTION

2.1 Rural Alaska's Energy Challenge

From the lean days of 2002, when a barrel of oil averaged approximately $22, to the maximum of nearly $145 per barrel observed during the summer of 2008, fuel pricing in remote Alaskan communities increased as dramatically, causing fear, anger and frustration. During 2008, the summer's fuel barge deliveries to interior

[6] Based upon a fuel oil sulfur content of 500 ppm.
[7] Defined as particulate matter with aerodynamic diameter less than 10 microns.

Alaskan villages brought unheard of prices, up $3 to $4 per gallon since the last year's delivery, to $7.50 to $8.00 per gallon[8].

The result - astounding increases in home heating and electrical costs to rural villagers – is tied not only to increased wholesale pricing of petroleum-based distillate, but also the fuel-burning transport ships or air tankers that haul it. Single family fuel costs, for space heating and cooking range from $300 to $900 per month, representing an average of 40% of a typical family's income[5]. Low per capita village income, coupled with increased fuel prices of the last several years have reached the tipping point for some; out-migrating residents from their life-time home to urban settings in Anchorage, Fairbanks and other less rural communities, in a struggle to reach economic balance.

2.2 The State Gas Line & LNG Project

The Alaska Gasline Port Authority (AGPA) has encouraged a state-owned project for transporting and liquefying 2.7 BCFD of North Slope (NS) gas to serve Alaskans and the Asian liquefied natural gas (LNG) markets. The integrated project includes a gas conditioning plant on the North Slope, a large bore gas transmission pipeline system between the North Slope (NS) and Valdez, a liquefaction and export facility in Valdez, upstream gas off-take points to serve multiple Alaska communities, military bases, as well as a lateral pipeline to augment the supply of natural gas to South Central AK.

2.2.1 Wood Mackenzie Competitiveness Study

A recent study conducted by Wood Mackenzie[9] indicates a favorable ANS gas to LNG cost structure relative to competing projects to supply the Asian market, either planned or underway in Australia, western Canada and the Lower 48. The following summarizes findings that signal an attractive pipeline to Valdez for export of LNG.

- ✓ *"Proposed LNG exports have a substantial cost advantage relative to possible competing LNG supply Projects."*
- ✓ *"Alaskan LNG exports have a delivered cost structure below $10/MMBtu....Alaskan LNG could be priced DES between $18.00 - $46.00/MMBtu through 2050."*
- ✓ *"The Pacific Basin market is short of proximate LNG and a number of projects will compete for long term supply requirements (including Alaska LNG)."*

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[8] Anchorage Daily News, June 4, 2008.
[9] Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

- ✓ *"Royalties (12.5%) and state taxes (starting at 25% post royalties) could yield $2.4 to $24 billion per year."*

2.2.2 Project Schedule

The Wood Mackenzie study assumes project startup in 2021, which may provide ample time to align the stakeholders, bring together the myriad of technical and financial components required to reach an investment decision, and then design and build this world-class project.

The challenges for LNG developers include many considerations, and "bringing these elements together to enable the investments and contractual commitments along the chain to be sanctioned simultaneously demands dedicated resources over long periods and unity of purpose by the proponents"[10]. Wood-Mackenzie recognizes these challenges in the statement: "Economics are important, but commercial issues such as the scale of value chain requirements (pipes, storage, etc.), buyer risk tolerance, financing arrangements, etc. are critical".

PDC Harris Group offers no opinion on Wood Mackenzie's ten year window, and whether it is sufficient to bring this large-scale project on-stream. It is nonetheless evident that to do so will take a fully-aligned and focused team of stakeholders; an initiative which requires numerous enabling steps in order to facilitate this complex process. It may be possible to pre-build the gas treatment plant (GTP) and gas pipeline, with the intention of supplying Alaska take-off points with natural gas, prior to startup of the liquefaction plant in Valdez. However this operational scenario will require additional engineering analysis, to determine GTP turndown capacity and alternatively the line pack volume available for Alaska users, prior to ramp-up of LNG exports.

2.3 In-State Benefits of the Alaska LNG Project

Besides the attractive Wood Mackenzie forecasts for Alaska, including substantial netbacks to NS producers, the development of a large-scale pipeline/LNG project in Alaska offers another benefit:

- ✓ *A cost competitive supply of Alaska liquefied natural gas, produced at tidewater offers fuel cost savings to rural communities accessible by barge, currently contending with high diesel/fuel oil pricing.*

The referenced fuel savings have heretofore been inferred based on significant differences in the wholesale price of a BTU of LNG relative to diesel or fuel oil[11].

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[10] Gas Strategies, "Potential LNG Production From North Slope Gas, May 2008.
[11] Petroleum News, "Could LCNG Cut Cost of Rural Energy?" 28 February 2010.

Subsequent sections of this report quantify expected savings. Other benefits to Alaska communities include:

- ✓ *Reduction of diesel/fuel oil tank farm inventories, and therefore a corresponding reduction in spill and contamination risks*
- ✓ *For each displaced volume of diesel/fuel oil, significant reductions in combustion emissions result (SO_2, NOx, unburned hydrocarbons, fine particulate matter, and CO_2)*
- ✓ *For hybrid (integrated) wind-diesel electric generation projects, switching the backup generation fuel from diesel to LNG-derived gas yields additional savings relative to diesel fuel firing[12],[13].*
- ✓ *Conversion of users from fuel oil to gas requires minor capital expense; replacement of boilers and generator drives is generally not required[14].*

The wholesale price difference between diesel/fuel oil lifted from Alaska refineries, and Cook Inlet LNG are attractive[15], but without an LNG supply infrastructure specific to small-volume, remote Alaskan users, the real cost structure remains unknown, and hence these savings have been characterized as potential. This study represents a preliminary step in defining an LNG supply chain to an Alaska community, examining wholesale gas costs for Fairbanks, and quantifying the relative incremental costs for supplying these communities with substitute fuel.

3. STUDY DESCRIPTION

3.1 LNG Implementation in Rural Alaska

The concept for supplying remote communities with LNG-derived gas involves the integration of liquefied and compressed natural gas (LCNG). The liquid form (LNG) of natural gas is approximately 600 times more dense than conventional pipeline gas distributed at low pressure to residences, and is the optimal phase for transport in its most energy-dense form over long distances. In this instance, LNG will be transported from the export docks adjoining the Valdez liquefaction plant, to various hub or larger village locations for off-loading and storage. Barges with double-walled and vacuum insulated LNG tanks will be placed in service for this leg

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[12] Renewable generation capacity must be accompanied by firm generation capacity from a non-renewable source. To date this backup has generally been diesel generation in rural Alaska.
[13] Existing diesel engines can be converted to operate on a blend of approximately 90 volume % natural gas without the need for a spark ignition system.
[14] Residential forced air furnaces operating on fuel oil may need complete replacement to handle the conversion, which would not be a minor expense from the perspective of a homeowner. Conversion of higher output boilers and furnaces are likely to involve a simpler change in burner components. Refer to Schwörer & Fay, 'Economic Feasibility of North Slope Propane Productions and Distribution to Select Alaska Communities, UAA ISER, June 2010.
[15] Refer to Appendix A for a comparison of market pricing for these commodities.

of the supply chain, and hauled with tugs; which is logistically similar to the existing mid-scale line-haul barge system used for moving petroleum distillates to rural Alaska.

A disadvantage of LNG transport is its energy density relative to conventional petroleum distillates. LNG is only 60% the energy density of typical diesel fuel, thus requiring 1.67 volumes of LNG to supply the energy in 1.00 volume of diesel oil. This disadvantage must be offset by LNG's wholesale pricing advantage in order to be a feasible candidate replacing rural Alaska's primary fuel.

Once an LNG barge reaches a destination port, generally a hub community with line-haul barge accessibility, the liquid will be off-loaded via centrifugal pump to pressurized LNG storage tanks (Refer to Appendix B for a flow sheet depicting the off-load and storage alternatives). Stored LNG, contained at a pressure sufficient for distribution, will be vaporized using staged heat exchangers and gas-fired heaters to deliver low pressure gas to nearby residential, commercial or utility users.

Direct pumping and warming the LNG to the compressed natural gas (CNG) phase may also take place, to charge a shore-based CNG storage facility. Pumping the cryogenic liquid to high pressure, followed by vaporization with multi-stage heat exchangers is an efficient conversion process, and allows the charging of storage cylinders without the need for less efficient gas compressors. The on-shore pressure vessels will receive and store the CNG at pressures up to 3600 PSIG. The stored high pressure natural gas will then be available for:

- ✓ Charging of transportable gas cylinders for use beyond the immediate hub location, including bulk transport to surrounding villages.
- ✓ Refueling of CNG powered vehicles at a metered fueling station.

While the storage volume for CNG is approximately 400% of that required for the same mass of LNG[16], storage in this form requires minimal maintenance or operator attention. Storage as LNG may not be the optimum choice for relatively small volumes of gas in a rural setting. It is relatively expensive, and is more operator intensive, and may require vapor recovery refrigeration or compression to capture normal boil-off. Nonetheless, there are advantages of LNG versus CNG storage, and further study is required to determine specific LNG and CNG storage strategies, when a rural project progresses to the design phase.

For the purposes of this study, it is assumed the LNG is pumped to on-shore LNG storage as part of the off-loading process. Refer to Appendix B which depicts a line-haul barge delivery and storage facility.

[16] The density of CNG at 3600 psig is 12.1 lb/ft^3 compared with LNG at 45 to 46 lb/ft^3

3.2 Objectives

PDC Harris Group has been requested to quantify potential fuel cost savings when substituting LCNG-derived gas (or pipeline gas in the case of Fairbanks) for existing diesel/fuel in representative Alaskan communities. Our experience in this involves developing a pilot program for substituting liquefied and compressed natural gas (LCNG) in the City of Bethel[17].

Specific objectives of this study are as follows,

- ✓ Use Wood Mackenzie cost predictions as the FOB Valdez LNG cost basis.
- ✓ Develop feasibility-level cost models forecasting the retail pricing and cost savings for substitution of LCNG-derived natural gas in Bethel
- ✓ Exercise retail pricing model to assess sensitivity to various input changes such as crude oil price, FOB Valdez LNG cost and other variables.
- ✓ Estimate the wholesale cost of gas provided to Fairbanks for a representative city gate off-take. Compare these costs with those forecasted for wholesale diesel/fuel oil.

3.3 Case Study Communities

Bethel was used to establish the retail LNG pricing forecasts. It is important to note the Bethel case study is developed as a 'shared' capital project, in terms of the LNG loading or transport equipment. Facilities or equipment are assumed to be shared by three (3) additional communities, and therefore the capital and operating costs for same are borne 25% by a single community. This assumption can be considered valid for a pilot or small commercial operation involving a region, but would not adequately represent the real costs of a single community, or a start-up of a pilot facility. Greater supply chain cost benefits would of course accrue to users as an LCNG supply chain expands.

3.3.1 Bethel

Located in Western Alaska, Bethel's lengthy fuel supply chain is a common denominator for scores of other villages throughout the state; distant from supplies produced in Alaskan refineries, and subject to sea ice restrictions for much of the year. The community is a good example of a remote Western Alaska hub city which is handicapped by winter ice, and distance from fuel sources. Diesel/fuel-oil prices in the city are approximately 80% higher than the

[17] City of Bethel and PDC Harris Group LLC, "Liquefied & Compressed Natural Gas as a Bridge to Reducing Energy Prices in Rural Alaska" 17 March 2011, application for grant funding to Alaska Energy Authority RFP AEA-11-027.

wholesale refinery rack rates, attributable to delivery (20% of wholesale), sales tax (flat 6%, or 10% of wholesale), and retail markup (50% of wholesale)[18].

Bethel supports a network of 56 villages in the Yukon-Kuskokwim delta, in terms of the distribution of food, fuel, medical, and other services. Most of the surrounding villages receive barged delivery of liquid fuels at a twice per year frequency using smaller barges that are loaded from larger line-haul barges arriving from Anchorage. Fuel pricing increases with distance for the various Bethel satellite villages, and no simple pricing structure can be used to represent retail pricing in each individual village.

Bethel has approximately 1800 residences, and space heating of residences and community structures is predominately by fuel-oil fired furnaces and boilers. Electricity is provided by a private utility using diesel-fired engine generators. Tank farms for liquid fuels, owned primarily by Yukon Fuel and Crowley Marine, have approximately 15 million gallons of capacity. Significant area exists along Bethel's river wall for additional storage capacity.

3.3.2 Fairbanks

Fairbanks, like rural Alaska communities also suffers from geographic disparities in energy supplies and costs, based upon a dependency on petroleum-derived fuel for space heating and electricity production. "A sustained spike in oil prices this year has aggravated that disparity, increasing the cost of living in Interior and rural Alaska faster than in Southcentral Alaska. Fairbanks mayors have suggested the situation cripples any chance at economic development. Estimates suggest space heating represents two-thirds of the average Fairbanks businesses' or household's total energy costs, and local mayors and assembly members have lobbied for state assistance on a number of fronts"[19].

There are approximately 31,200 people, and 12,000 occupied residences in the city[20]. The Fairbanks Northstar Borough (FNSB) population is approximately 92,600. Owing to the proximity of Fairbanks to the Flint Hills Resources and PetroStar refineries in North Pole Township, fuel oil prices are low by comparison to rural, off-road Alaska communities.

4. LCNG CASE STUDY, BASIS & ASSUMPTIONS

For the Bethel LCNG case study, the following sections detail the development of the retail cost models, summarize assumptions, and describe different study cases.

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[18] Szymoniak et al, "Components of Alaska Fuel Costs: An Analysis of Market Factors and Characteristics that Influence Rural Fuel Prices", Institute of Social and Economic Research (ISER), Univ. of Alaska, February 2010

[19] Fairbanks News-Miner, May 19 2011.

[20] www.factfinder.census.gov, Source: U.S. Census Bureau, 2005-2009 American Community Survey

Refer to Section 5 for a discussion of the basis and assumptions for the case studies developed for natural gas in the Fairbanks market.

4.1 LNG Source

Description of Assumption	*Case Study Variation*
LNG for Alaska markets is loaded in barges @ the 2.7 BCF/day Valdez LNG export terminal	*Applicable to all cases*

To leverage the cost competitiveness of large-scale NS gas processing, transport and subsequent LNG liquefaction, this study assumes that LNG destined for Alaska users is lifted from a 2.7 BCFD liquefaction plant at the port of Valdez. Small volumes of LNG for Alaskan use will be loaded on barges[21] on an irregular basis, and would have no significant impact on the operations of the continuous multi-train LNG plant; a facility whose revenue will be tied to long term oil-indexed agreements with Asian buyers.

4.2 LNG Cost, FOB Valdez

Description of Assumption	*Case Study Variation*
Wholesale LNG, FOB Valdez from Wood Mackenzie 'Greenfield Alaska LNG Cost Build Up'	*Base Case*
Wholesale LNG, FOB Valdez Wood Mackenzie 'Greenfield Alaska LNG Cost Build Up' with wellhead cost set @ $1.00/million BTU	*Alternate Case*

The Base Case model was developed on the assumption that LNG loaded at Valdez is valued pursuant to the Wood Mackenzie cost buildup[22]. An alternative case was developed based on a more conservative assumption that value of LNG FOB Valdez is valued using the Wood Mackenzie cost build-up with the addition of a wellhead value of $1.00/million BTU[23].

[21] Low capacity in comparison to marine LNG tankers, carrying approximately 2-3 million gallons (5600 to 8400 metric ton).
[22] Wood Mackenzie, IBID, page 15.
[23] This value was selected based upon current gas sales from Prudhoe Bay gas conditioning facilities to Alyeska' s Pump Station No. 1.

4.3 LNG Transport Costs

Description of Assumption	*Case Study Variation*
Cost to transport and unload LNG is factored based on published data of $/gal of diesel fuel, w/ adjustment for lower LNG energy content/volume.	*Base Case*
Cost to transport and unload LNG is developed from order of magnitude capital and operating cost for new barges and Valdez loading facilities.	*Alternate Case*

Transportation costs include marine line-haul transport from the Valdez export terminal, as well as loading, unloading, working capital, administration and insurance costs. The sum of these components equals the landed wholesale price at the destination terminal, which for Bethel's current diesel/fuel oil represents approximately 70% to 75% of the total retail price.

Published data[24] specifically addressing the cost of shipping diesel/fuel oil from refinery loading terminal to the destinations' tank farm were used as the basis for estimating shipping of LNG by barge for the Base Case. In this simplified approach, the published diesel shipping costs are corrected to account for LNG energy density, i.e. the need to transport the same energy content in more gallons of LNG.

As an alternative case study, more rigorous capital and operating costs were developed for a) LNG transfer and loading equipment at Valdez, and b) two(2) line-haul barges. The capital costs were further assumed to apply 25% to the destination, i.e. the assets are shared with three other potential communities as part of a larger line-hauling route. Likewise, the operating costs for the LNG barge berth, pumps and loading arms are 25% allocated to the individual case study community. The following assumptions apply to the Bethel LNG case study:

- ✓ Capital cost two (2) LNG barges: $40 million x 25% = $10 million (2021 $)
- ✓ Capital cost Valdez loading facility (Alaska barge use only): $30 million x 25% = $7.5 million (2021 $)
- ✓ Capital recovery factor: 10%/year
- ✓ Operating cost, Valdez loading facility: $1.5 million/year x 25% = 0.38 million/year (2021)
- ✓ Operating cost, barge & tug set, $30,000/day[25] (2010)

[24] Szymoniak et al, "Components of Alaska Fuel Costs: An Analysis of Market Factors and Characteristics that Influence Rural Fuel Prices", Institute of Social and Economic Research (ISER), Univ. of Alaska, February 2010.
[25] Szymoniak et al, IBID.

4.4 Retail Markup

Description of Assumption	*Case Study Variation*
Factored from diesel/fuel oil cost data published by ISER	*Base Case*
Calculated from capital and operating cost estimates for new on-shore storage and distribution system, with contributions from overhead, working capital and profit.	*Alternative Cases.*

In Bethel, the retail markup from wholesale delivered liquid fuels currently comprises 25% to 30% of the total retail cost for these fuels. A simplified approach to estimating the retail markup for LCNG is possible by converting the diesel/fuel-oil markup reported by ISER[26] from units of $/gal to $/million BTU, and assuming the same value for LCNG, as was assumed for the base case transport cost.

A more rigorous approach to estimating retail markup involves estimating the capital and operating costs associated with the LCNG storage and distribution systems which will be installed to store sufficient inventory for the community between deliveries. For Bethel, where winter ice limits the periods when tug and barge sets can operate, a nine month inventory is necessary. In ice-free ports, such as Unalaska, only two to three months of inventory is required.

Capital (Capex) and operating costs (Opex) were developed for the following components of retail mark-up in Bethel.

4.4.1 Storage & Distribution System Capital Amortization

A new CNG storage facility is expected to have higher capital amortization charges, relative to existing diesel systems in Bethel, based on the increased volume and pressure rating required to store the equivalent energy as LCNG. This relative increase may be offset by reduced maintenance requirements associated with LCNG.

Factors from the open literature for LNG storage tank costs in $/volume were used as the initial basis of generating order of magnitude capital costs storage capacity in Bethel[27].

Resulting capital cost estimates for on-site storage are as follows. A capital recovery factor of 10%/year was used to estimate debt service.

[26] Szymoniak et al, IBID.

[27] Capital cost factor from J Powell, "LNG - Market Challenges & Opportunities for Innovation" Hydrocarbon World, 2007 states $400 per m^3. This study used 300% of this factor, to account for a small scale remote application.

- ✓ Bethel storage Capex: $26.9 million (2021 $)

Distribution system capital for low pressure piping, metering and residential tie-in were estimated as follows:

- ✓ Bethel distribution Capex: $3.9 million (2021 $)

4.4.2 Storage/Distribution System Operation & Maintenance Costs

Operating costs may be expected to be comparable between compressed natural gas storage and distribution versus the current diesel system. Maintenance costs should be considerably reduced, as less rotating equipment is required to deliver CNG-based fuel, and storage vessel maintenance and routine cleaning will be essentially absent for a gas-based system.

The following was assumed for operating and maintenance budgets for Bethel

- ✓ Operating: $1 million/year (2021)
- ✓ Maintenance: 1.5% of capital/year
- ✓ Working Capital: 50% of storage volume, interest @ 7.5%/year

4.4.3 Profit & Overhead

This category includes many of the elements common to the transport sector of the supply chain; overhead labor, regulatory compliance, insurance, and profit are examples.

- ✓ Profit assumed for both locations: 10% of Capex + Opex

4.5 Future Price of Diesel & Fuel-Oil in Rural Alaska

ISER developed estimated fuel cost rural forecasts for ~170 Alaska rural communities, for the period 2011 through 2030[28] for the Alaska Energy Authority (AEA). These forecasts were developed for three scenarios: low, medium and high ranges. This study employed the 'medium' cost data for all cases except two; one each for the two different locations used the 'high' range data.

4.7 Fuel Displacement in Representative Communities

Data published by AEA[29] and PND[30] were used to establish baseline diesel fuel use in Bethel. These data apply to space heating and electric generation, and do not include significant use for marine vessels. The baseline fuel consumption was escalated by 0.5% per year over the duration of the study period of 2021 to 2051.

[28] Fay, Saylor & Foster, "Alaska Fuel Price Projections 2011-2030" Institute of Social and Economic Research, Univ. of Alaska, 2010. Post 2030 inflation rate of 2.4%/yr. was assumed.
[29] AEA, "Statistical Report of the Power Equalization Program, Fiscal Year 2010", 22nd Edition, March 2011.
[30] PND, "Feasibility Study of Propane Distribution Throughout Coastal Alaska", August 2005.

For this study, it was assumed that 100% of these volumes were replaced by natural gas derived from LCNG. This approach is overly simplistic, since neither 100% of the diesel for heating, nor 100% of the diesel for power generation would realistically be displaced by natural gas during the early years of retrofitting. Therefore the study overstates community-wide fuel cost savings during the initial stages of conversion from diesel to LCNG/natural gas.

Another contribution attributable to displacing existing diesel/fuel oil use with LCNG is worthy of consideration. As conversion to the latter occurs in a community, and the volumes of imported diesel and fuel oil decline, it is likely that their unit costs will be driven disproportionally higher, based on the inefficiencies of transporting and dispensing the reduced volumes. This study does not address this potential cost increase for diesel/fuel-oil users in a community undergoing conversion to LCNG.

5. FAIRBANKS CASE STUDIES, BASIS & ASSUMPTIONS

5.1 Future Cost of Diesel & Fuel-Oil in Fairbanks

Energy Information Administration (EIA) predictions[31] for wholesale distillate fuel oil (diesel) pricing in the lower 48 for the years 2021 -2035 were used as the basis for developing comparable values for Fairbanks. An Alaska market surcharge was added to the forecasted lower 48 costs, based on EIA historical wholesale cost data (approximately $.23/gallon in 2021). Values for future lower 48 diesel costs for the years 2036-2051 were estimated based on an annual inflation rate of 2.4% per year.

5.2 Future Cost of Natural Gas in Fairbanks

Wholesale natural gas pricing at a city gate take-off on the 2.7 BCF/day Alaska Gas Pipeline was estimated using the built-up cost assumptions developed in the Wood Mackenzie study, with the following adjustments:

- ✓ Liquefaction, LNG losses and liquids credit contributions set to zero
- ✓ Pipeline transport cost prorated based on distance to Fairbanks, adjusted tariff ~$1.15/million BTU

[31] http://www.eia.gov/oiaf/aeo/tablebrowser/ . 2021 - 2035 EIA Petroleum Products forecast, "Reference Case" and "High Economic case values used for Transportation Fuel, Distillate Fuel Oil (Diesel Oil).

5.3 Quantity of Fuel Oil Displaced by Natural Gas

A study conducted in 2010 for the Alaska Department of Environmental Protection (ADEC)[32] surveyed residential home owners to compile data on type of heating equipment employed, and the average quantity of fuel used. The purpose of the study, from ADEC's perspective was to trend the level of wood use for residential heating. We used the data gathered on fuel-oil fired furnaces and boilers to estimate the quantity of fuel that potentially could be displaced by natural gas. The following factors were used to estimate future displaced fuel quantities.

- ✓ Residences w/ central oil furnaces or boilers in Fairbanks, total: 21,134
- ✓ Average oil consumption, gallons/year-residence: 938 gal/yr.

6. MODEL RESULTS

6.1 Bethel Case Designations

The results of the LNG pricing and energy cost savings forecasts are summarized in the following sections. Table 1 summarizes these cases in matrix format. Subsequent sub-sections provide a summary of results.

Table 1
Case Study Matrix

Case Name	LNG $ FOB Valdez	LNG Transport $	Retail Markup $	Future Diesel $/gal.
Bethel Cases				
B1 (Base)	Wood Mac build-up	Factored from diesel $/million BTU	Factored from diesel $/million BTU	AEA/ISER medium forecast
B2	Wood Mac build-up	Estimated: capex $ and opex $	Estimated: capex $ and opex $	AEA/ISER medium forecast
B3	Wood Mac build-up	Estimated: capex $ and opex $	Estimated: capex $ and opex $	AEA/ISER high forecast
B4	Wood Mac build-up	Estimated: capex $ and opex $	Estimated: capex $ and opex $	From crude @ $75/bbl and 1.18 crack ratio[33]
B5	Wood Mac build-up w/ $1/million BTU wellhead cost	Estimated: capex $ and opex $	Estimated: capex $ and opex $	AEA medium forecast

[32] Sierra Research Inc,, "Report No. SR2010-06-01, 2010 Fairbanks Home Heating Survey, June 21, 2010

[33] Crack ratio: ($ diesel/gallon) / ($/barrel crude x 42 gallons/barrel crude), here a historical average value of 1.18 was determined from cost databases supplied by EIA.

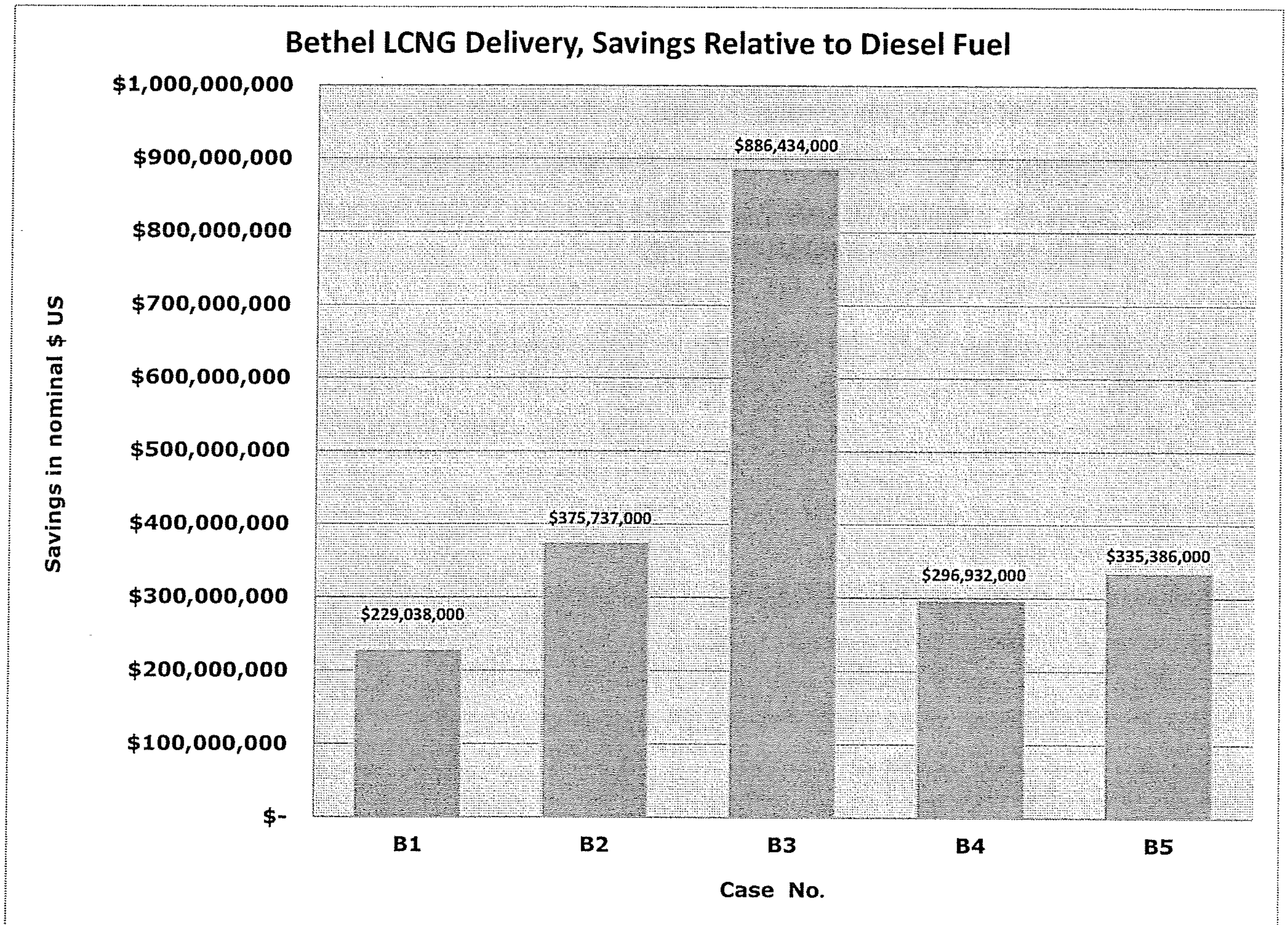
6.2 Bethel Case Studies

As detailed in Table 1, five (5) cases were developed to assess the impacts of the following variables on the predicted retail cost savings of LCNG versus diesel/fuel-oil.

- ✓ LNG Cost, FOB Valdez
- ✓ Basis for estimating LNG transport cost from Valdez to Bethel
- ✓ Basis for estimating retail mark-up
- ✓ Assumed future retail cost of diesel in Bethel

The summary results for all five cases are presented graphically in , as the total of annual fuel savings over the life of the project (years 2021 to 2051)

Figure 1



All five cases modeled predict significant fuel savings when substituting LCNG for diesel and fuel-oil in Bethel. Additional discussion of the case study results are provided in the following sections.

6.2.1 Case B1

This is considered the Base Case for the Bethel analysis. It is based on a) LNG cost FOB Valdez from the Wood Mackenzie built-up value, b) a transport cost factored from 2009-2010 ISER data for diesel/fuel oil, c) a retail markup factored from the same ISER data for diesel/fuel oil, and d) 'medium range' future diesel/fuel oil retail Bethel pricing predictions by ISER. Case B1 representative model output is provided in Figure 2.

The model predicts annual savings from switching to LCNG of 21% to 28% relative to diesel fuel.

Conversion of the predicted future retail pricing of diesel/fuel oil from a $ per gallon basis to $ per million BTU (gal/E6 BTU), using the higher heating value (HHV) of typical diesel fuel, puts the pricing on a comparable basis to that estimated for the retail price LCNG. As reported for the initial year of operation (2021) the predicted retail price for LCNG is $8.88/million BTU lower than the diesel fuel. With Bethel's forecasted consumption of Btu's for space heating and electrical generation (595,215 million BTU/yr. or approximately 4.6 million gallons diesel/yr.) in 2021, this per million BTU savings equates to annual savings of nearly $5.3 million/year. The total estimated savings over a 30 year period beginning in 2021 is approximately $229 million.

6.2.2 Case B2

Case B2 differs from B1 in the approach to estimating the transport cost from Valdez to Bethel, as well as how the retail markup is estimated.

As noted in Section 4.3, the more detailed transport cost estimate entails an estimate of capital costs (primarily transport barges and loading facilities at the liquefaction facility) and operating costs for representative supply chain elements for transporting LNG[34]. Capital recovery charges and operating costs for LNG transport are then divided by the annual BTU requirements estimated for Bethel in each future year, resulting in an estimated $/million BTU charge for transport.

In a similar manner, the retail mark-up estimate includes capital and operating estimates representing the costs accrued by a Bethel storage and distribution operation, as described in Section 4.4.

The result of the more rigorous treatment of both LCNG transport and retail markup is a) the forecasted transport cost in $/million BTU increases slightly (~7%) relative to the Base Case (B1) while b) the retail markup is reduced by about 29% of the base case[35]. The overall result is an increased savings for Case B2 over Case B1.

6.2.3 Case B3

Case B3 replicates Case B2 with one major exception; the predicted future pricing of diesel fuel has been increased to the AEA/ISER study 'high' price range for Bethel. A portion of the model output for this case is provided in Figure 4.

[34] For the purposes of this study, two barges were assumed to be shared with 3 other communities, i.e. the capital requirements are 25% assigned to Bethel's economic model.
[35] Both comparisons are for the initial operating year only.

The dramatic increase in projected retail fuel savings over the prior cases is attributable to not only the significantly higher diesel pricing, which increases annually, but an LNG price which remains relatively low, with a price that is not tied insignificantly to inflation.

6.2.4 Case B4

This case is based on replicating Case B2 with the following exception:

- ✓ Wholesale diesel fuel pricing (FOB refinery) is set based on a West Texas Intermediate (WTI) crude oil price of $75/bbl, corresponding to Wood Mackenzie's 'worst case' scenario. To develop the corresponding wholesale diesel price from the crude price, an annual average crack ratio of 1.18 was assumed.

Refer to Figure 5 for an excerpt from this case model output. According to the model, with the 2021 retail diesel price in Bethel predicted to be approximately $3.93 per gallon, and inflated annually at 2.4% thereafter, sufficient savings are still available to generate savings of approximately $297 million over the life of the project. This can be attributed to the fact that LNG wholesale cost is not affected appreciably by changes in crude oil pricing.

This same model, using the historical crude crack spread to predict retail diesel fuel pricing in Bethel, can be used to determine an approximate WTI crude price which results in retail diesel pricing which is competitive with LCNG, on a $ per million BTU basis. Using a trail and error approach, this value was found be approximately $36/bbl., for 2021 WTI crude.

6.2.5 Case B5

Case B5 examines the impact of incrementing the Valdez wholesale LNG cost by $1/million BTU, to apply a defensible wellhead gas value based on historical sales to Alyeska Pipeline. Other assumptions remain the same as Case B2. Refer to Figure 6 following, for an excerpt of the model output.

As with the other Bethel cases, B5 predicts a significant savings over the life of the project in line with cases B1, B2 and B4.

Figure 2
Excerpt of B1 (Base Case) Model

		Start-up	1	2	3	4	5		28	29	30
DIESEL		2021	2022	2023	2024	2025	2026		2049	2050	2051
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$4.74	$4.79	$4.85	$4.90	$4.96	$5.00		$8.27	$8.47	$8.67
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$34.19	$34.57	$34.99	$35.37	$35.79	$36.10		$59.70	$61.13	$62.60
LNG & CNG	(b)										
WH-Processing (invariant)		0.26	0.26	0.26	0.26	0.26	0.26		0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24		5.60	5.73	5.87
Transport (invariant)		1.70	1.70	1.70	1.70	1.70	1.70		1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.58		1.01	1.03	1.06
Liquefaction (invariant)		4.00	4.00	4.00	4.00	4.00	4.00		4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-0.98		-1.69	-1.73	-1.77
LNG FOB Valdez, $/E6 BTU		**8.49**	**8.55**	**8.61**	**8.68**	**8.74**	**8.81**		**10.88**	**11.00**	**11.12**
LNG & CNG Price Stack											
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	8.81		10.88	11.00	11.12
Delivery & Offload, $/E6 BTU (HHV)	(d)	4.69	4.80	4.91	5.03	5.15	5.28		9.10	9.32	9.55
Sales Tax @ 6% of FOB + Delivery		0.79	0.80	0.81	0.82	0.83	0.85		1.20	1.22	1.24
Retail Markup	(f)	11.34	11.61	11.89	12.18	12.47	12.77		22.03	22.56	23.10
Retail Price LNG/CNG, $/E6 BTU		25.31	25.77	26.23	26.71	27.20	27.70		43.21	44.10	45.01
SAVINGS											
Savings, Diesel - LNG, $/E6 BTU (HHV)		$8.88	$8.80	$8.75	$8.65	$8.59	$8.40		$16.48	$17.03	$17.59
% Savings		25.98%	25.46%	25.02%	24.47%	24.00%	23.27%		27.61%	27.86%	28.10%
Annual Savings, $/yr		$ 5,287,494	$ 5,264,385	$ 5,263,199	$ 5,229,347	$ 5,215,926	$ 5,127,705		$ 11,282,722	$ 11,714,950	$ 12,160,903
Total Savings, Project Life, $		$ 229,038,410									
Present Value of Savings (2021)	(g)	$101,895,709									
ENERGY DEMAND											
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	610245		684422	687844	691283

Figure 3
Excerpt of Case B2 Model

		Start-up	1	2	3	4		27	28	29	30
DIESEL		2021	2022	2023	2024	2025		2048	2049	2050	2051
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$4.74	$4.79	$4.85	$4.90	$4.96		$8.07	$8.27	$8.47	$8.67
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$34.19	$34.57	$34.99	$35.37	$35.79		$58.30	$59.70	$61.13	$62.60
LNG & CNG	(b)										
WH-Processing		0.26	0.26	0.26	0.26	0.26		0.26	0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17		5.47	5.60	5.73	5.87
Transport		1.70	1.70	1.70	1.70	1.70		1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57		0.99	1.01	1.03	1.06
Liquefaction		4.00	4.00	4.00	4.00	4.00		4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96		-1.65	-1.69	-1.73	-1.77
LNG FOB Valdez, $/E6 BTU		**8.49**	**8.55**	**8.61**	**8.68**	**8.74**		**10.76**	**10.88**	**11.00**	**11.12**
LNG & CNG Price Stack											
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74		10.76	10.88	11.00	11.12
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43		11.33	11.71	12.11	12.53
Sales Tax @ 6% of FOB + Delivery		0.81	0.82	0.83	0.84	0.85		1.33	1.36	1.39	1.42
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11		8.57	8.60	8.64	8.68
Retail Price LNG/CNG, $/E6 BTU		22.41	22.58	22.75	22.94	23.13		31.99	32.55	33.13	33.74
SAVINGS											
Savings, Diesel - LNG, $/E6 BTU (HHV)		$11.78	$11.99	$12.23	$12.43	$12.66		$26.31	$27.15	$28.00	$28.86
% Savings		34.46%	34.68%	34.97%	35.15%	35.38%		45.13%	45.48%	45.80%	46.11%
Annual Savings, $/yr		$ 7,013,712	$ 7,171,338	$ 7,354,842	$ 7,569,595	$ 7,689,008		$ 17,917,587	$ 18,581,464	$ 19,259,281	$ 19,951,152
Total Savings, Project Life, $		$ 375,737,136									
Present Value of Savings (2011)	(g)	$163,926,539									
ENERGY DEMAND											
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209		681017	684422	687844	691283

Figure 4
Excerpt of Case B3 Model

		Start-up	1	2	3	4	27	28	29	30
DIESEL		2021	2022	2023	2024	2025	2048	2049	2050	2051
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$7.44	$7.53	$7.63	$7.70	$7.79	$12.57	$12.88	$13.19	$13.50
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$53.72	$54.38	$55.07	$55.56	$56.22	$90.80	$92.98	$95.21	$97.49
LNG & CNG	(b)									
WH-Processing		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17	5.47	5.60	5.73	5.87
Transport		1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.99	1.01	1.03	1.06
Liquefaction		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-1.65	-1.69	-1.73	-1.77
LNG FOB Valdez, $/E6 BTU		**8.49**	**8.55**	**8.61**	**8.68**	**8.74**	**10.76**	**10.88**	**11.00**	**11.12**
LNG & CNG Price Stack										
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	10.76	10.88	11.00	11.12
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	11.33	11.71	12.11	12.53
Sales Tax @ 6% of FOB + Delivery		0.81	0.82	0.83	0.84	0.85	1.33	1.36	1.39	1.42
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.57	8.60	8.64	8.68
Retail Price LNG/CNG, $/E6 BTU		$ 22.41	$ 22.58	$ 22.75	$ 22.94	$ 23.13	$ 31.99	$ 32.55	$ 33.13	$ 33.74
SAVINGS										
Savings, Diesel - LNG, $/E6 BTU (HHV)		$31.31	$31.80	$32.32	$32.63	$33.09	$58.81	$60.43	$62.08	$63.76
% Savings		58.28%	58.48%	58.69%	58.72%	58.86%	64.77%	64.99%	65.20%	65.40%
Annual Savings, $/yr		$ 18,633,504	$ 19,021,078	$ 19,430,465	$ 19,713,550	$ 20,093,775	$ 40,050,251	$ 41,358,632	$ 42,699,720	$ 44,074,176
Total Savings, Project Life, $		$ 886,433,544								
Present Value of Savings (2011)	(g)	$397,184,212								
ENERGY DEMAND										
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	681017	684422	687844	691283

Figure 5
Excerpt of Case B4 Model

		Start-up	1	2	3	4	27	28	29	30
		2021	2022	2023	2024	2025	2048	2049	2050	2051
DIESEL										
Calculated Price, Retail Bethel, $/gal	(a)	$3.93	$4.03	$4.12	$4.22	$4.33	$7.46	$7.64	$7.83	$8.01
$/E6 BTU (HHV), Bethel Diesel Retail		$28.40	$29.08	$29.78	$30.50	$31.23	$53.88	$55.18	$56.50	$57.86
$/E6 BTU (LHV), Bethel Diesel Retail		$30.38	$31.11	$31.85	$32.62	$33.40	$57.63	$59.01	$60.43	$61.88
LNG & CNG										
Wood Mackenzie Model Duplication (HHV)										
Nominal WTI Oil Price, $/bbl	(b)	$75.00	$76.80	$78.64	$80.53	$82.46	$142.29	$145.70	$149.20	$152.78
Calculated WTI Oil, $/E6 BTU		12.50	12.80	13.11	13.42	13.74	23.71	24.28	24.87	25.46
Asia LNG $/E6 BTU, DES basis	(c)	11.73	11.82	12.10	12.39	12.69	21.90	22.42	22.96	23.51
Less infl. Shipping, $/E6 BTU		0.59	$0.60	$0.62	$0.63	$0.65	$1.12	$1.15	$1.17	$1.20
Less pipe transportation, $/E6 BTU		4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
Less liquefaction, $/E6 BTU		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Wellhead netback, $/E6 BTU		2.96	3.04	3.30	3.58	3.86	12.60	13.10	13.61	14.13
LNG & CNG Price Stack										
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	10.76	10.88	11.00	11.12
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	11.33	11.71	12.11	12.53
Sales Tax @ 6% of FOB + Delivery		0.81	0.82	0.83	0.84	0.85	1.33	1.36	1.39	1.42
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.57	8.60	8.64	8.68
Retail Price LNG/CNG, $/E6 BTU		22.41	22.58	22.75	22.94	23.13	31.99	32.55	33.13	33.74
SAVINGS										
Savings, Diesel - LNG, $/E6 BTU (HHV)		$5.99	$6.51	$7.03	$7.56	$8.10	$21.90	$22.63	$23.37	$24.12
% Savings		21.10%	22.37%	23.60%	24.79%	25.95%	40.64%	41.01%	41.36%	41.69%
Annual Savings, $/yr		$ 3,567,490	$ 3,892,542	$ 4,226,205	$ 4,568,666	$ 4,920,114	$ 14,912,067	$ 15,488,424	$ 16,076,171	$ 16,675,350
Total Savings, Project Life, $		$ 296,991,968								
Present Value of Savings (2011)	(g)	$124,303,820								
ENERGY DEMAND										
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	681017	684422	687844	691283

Figure 6
Excerpt of Case B5 Model

		Start-up	1	2	3	4	27	28	29	30
DIESEL		2021	2022	2023	2024	2025	2048	2049	2050	2051
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$4.74	$4.79	$4.85	$4.90	$4.96	$8.07	$8.27	$8.47	$8.67
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$34.19	$34.57	$34.99	$35.37	$35.79	$58.30	$59.70	$61.13	$62.60
LNG & CNG	(b)									
Wellhead Value (inflation adjusted)		1.30	1.33	1.36	1.39	1.43	2.46	2.52	2.58	2.64
WH-Processing		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (Inflation adjusted)		2.88	2.95	3.02	3.09	3.17	5.47	5.60	5.73	5.87
Transport		1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.99	1.01	1.03	1.06
Liquefaction		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-1.65	-1.69	-1.73	-1.77
LNG FOB Valdez, $/E6 BTU		**9.79**	**9.88**	**9.98**	**10.07**	**10.17**	**13.22**	**13.40**	**13.58**	**13.76**
LNG & CNG Price Stack										
LNG Price FOB Valdez, $/E6 BTU (HHV)		9.79	9.88	9.98	10.07	10.17	13.22	13.40	13.58	13.76
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	11.33	11.71	12.11	12.53
Sales Tax @ 6% of FOB + Delivery		0.89	0.90	0.91	0.92	0.94	1.47	1.51	1.54	1.58
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.57	8.60	8.64	8.68
Retail Price LNG/CNG, $/E6 BTU		23.79	23.99	24.20	24.41	24.64	34.60	35.22	35.87	36.54
SAVINGS										
Savings, Diesel - LNG, $/E6 BTU (HHV)		$10.41	$10.58	$10.79	$10.95	$11.15	$23.70	$24.48	$25.26	$26.06
% Savings		30.44%	30.61%	30.84%	30.97%	31.15%	40.65%	41.00%	41.33%	41.63%
Annual Savings, $/yr		$ 6,194,721	$ 6,328,497	$ 6,487,458	$ 6,616,942	$ 6,770,372	$ 16,139,872	$ 16,751,983	$ 17,376,525	$ 18,013,570
Total Savings, Project Life, $		$ 335,386,438								
Present Value of Savings (2011)	(g)	$145,746,753								
ENERGY DEMAND										
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	681017	684422	687844	691283

6.3 Fairbanks Case Studies

Two case studies were run for the Fairbanks cost model, representing EIA-forecasted data for future wholesale diesel/fuel-oil pricing for a 'reference case' or baseline, and for a 'high economic growth case'. The same procedure for predicting wholesale natural gas pricing was used for both model runs; each for city-gate price corresponding to a take-off point along a large, high pressure pipeline transporting gas to liquefaction facilities at Valdez.

6.3.1 Cost Savings

To provide an approximate quantification of the savings available to the residents of Fairbanks from converting to natural gas, it was assumed that 100% of residences currently using fuel oil for space heating are converted to natural gas. This assumption is overly simplistic, since not all homeowner would be converted en masse. Nonetheless, the assumption was deemed adequate for the purpose of providing an order of magnitude annual savings which might be achieved in later years of a conversion program.

Annual savings based on the above assumption range from approximately $59 million/year to $118 million/year, depending on the assumed fuel oil pricing model, and the year from inception of the switchover to natural gas. The approximate savings in nominal $ US over the course of the project (2021 – 2051) for the two models developed are $2.41 billion, and $2.58 billion, as shown in Figure 7. Refer also to excerpts of the two models in Figure 14 and Figure 15, following.

6.3.2 Emissions Reductions

Conversion to natural gas will reduce the air emissions from home furnaces or boilers significantly for sulfur oxides (SO_2 and SO_3), oxides of nitrogen (NO and NO_2), particulate matter less 10 microns in diameter (PM-10) and carbon dioxide (CO_2). These reductions are presented graphically in the following figures[36,37].

[36] Emission factors are based on US EPA AP-42 Emission Factors, May 2010.

[37] Sulfur oxide emissions from fuel oil are based on 95% of the ADEC regulatory limitation for fuel oil of 5000 ppm.

Figure 7

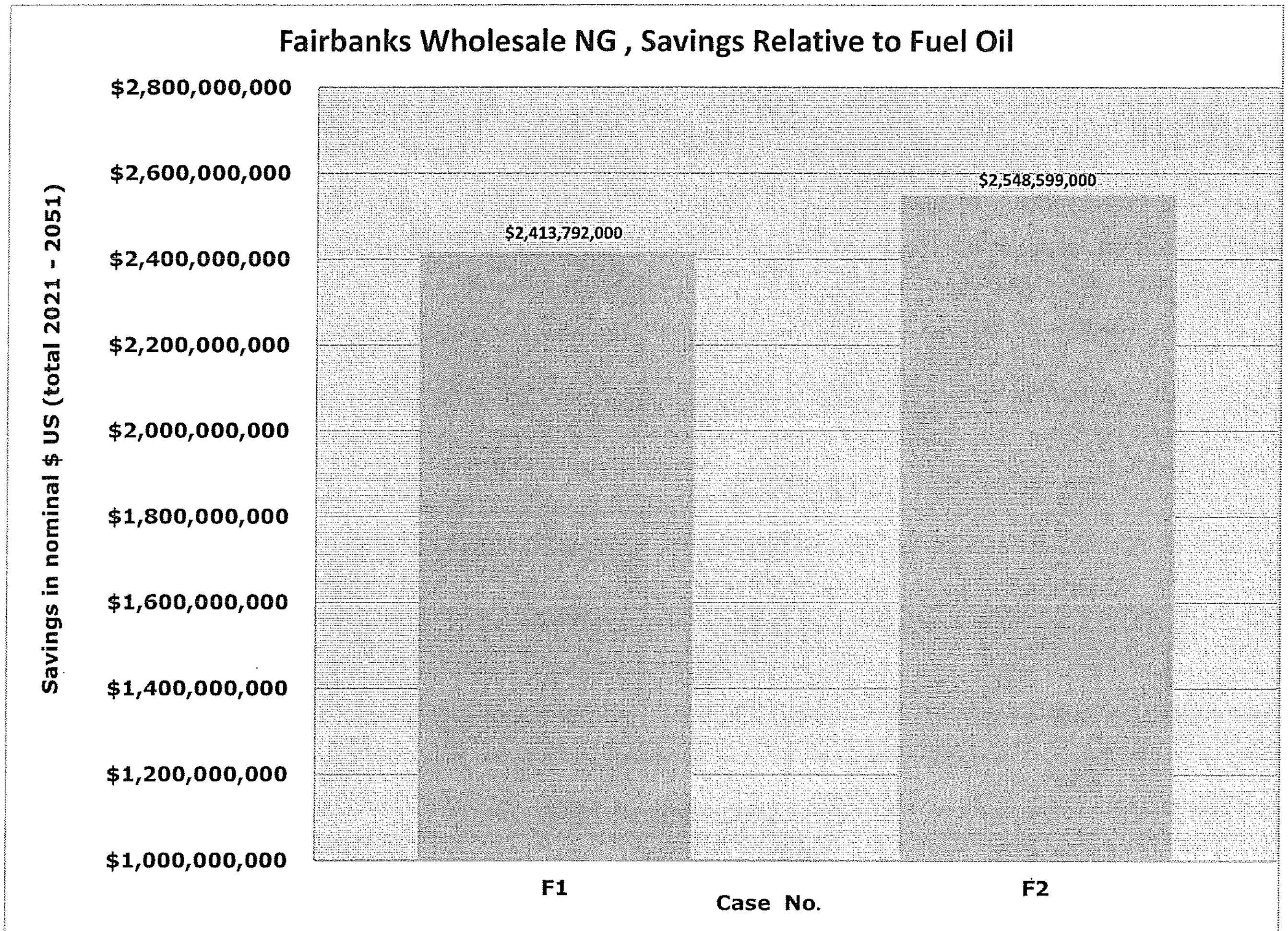

Fairbanks Wholesale NG , Savings Relative to Fuel Oil
$2,800,000,000
$2,600,000,000
$2,400,000,000
$2,200,000,000
$2,000,000,000
$1,800,000,000
$1,600,000,000
$1,400,000,000
$1,200,000,000
$1,000,000,000
Savings in nominal $ US (total 2021 - 2051)
$2,413,792,000
$2,548,599,000
F1
F2
Case No.

Figure 8
Comparison of SO_2 Emissions per BTU Fired –
Fuel Oil, Wood, and Natural Gas

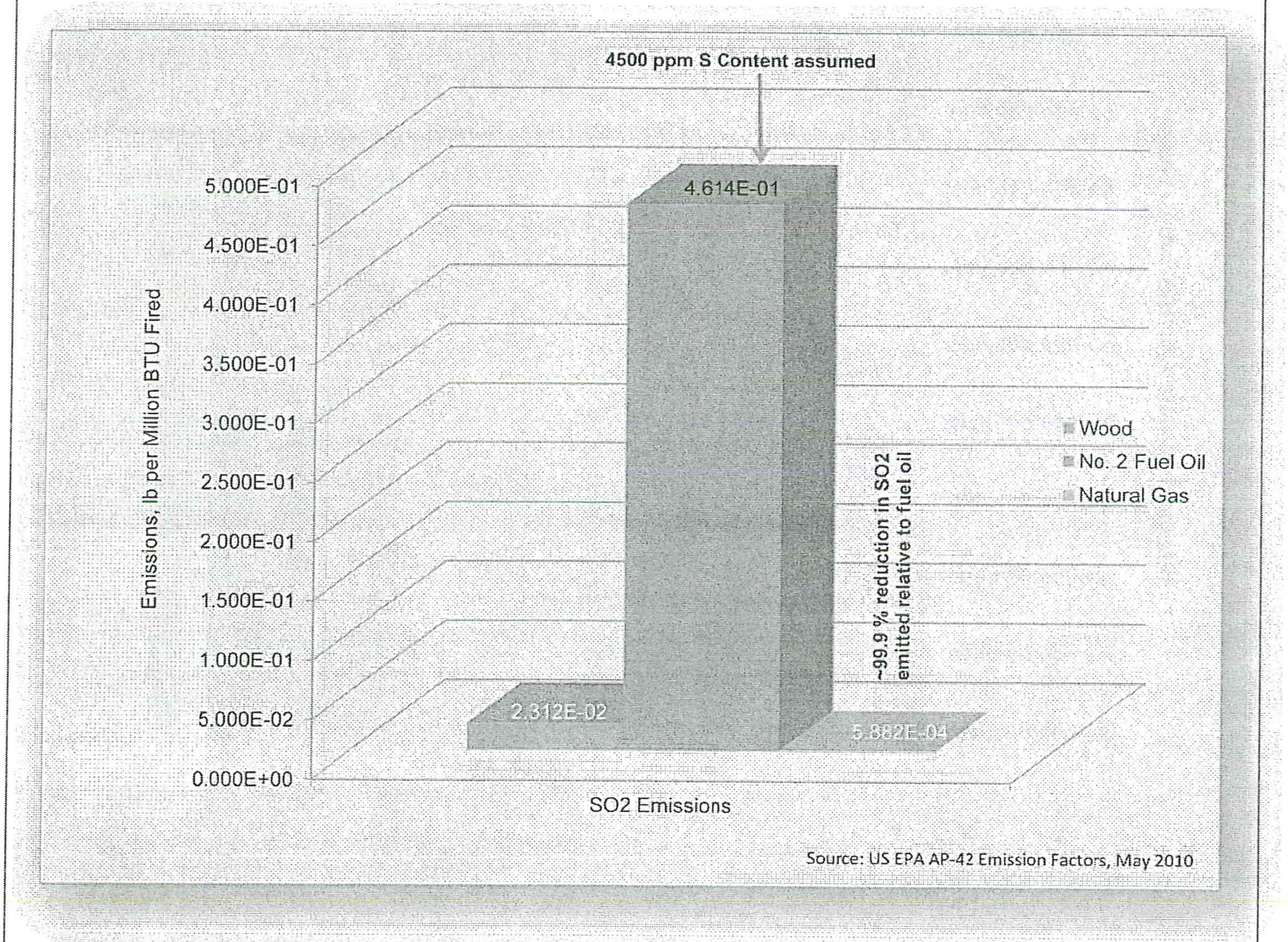


Figure 9
Comparison of NO_X Emissions per BTU
Fired - Fuel Oil, Wood, and Natural Gas

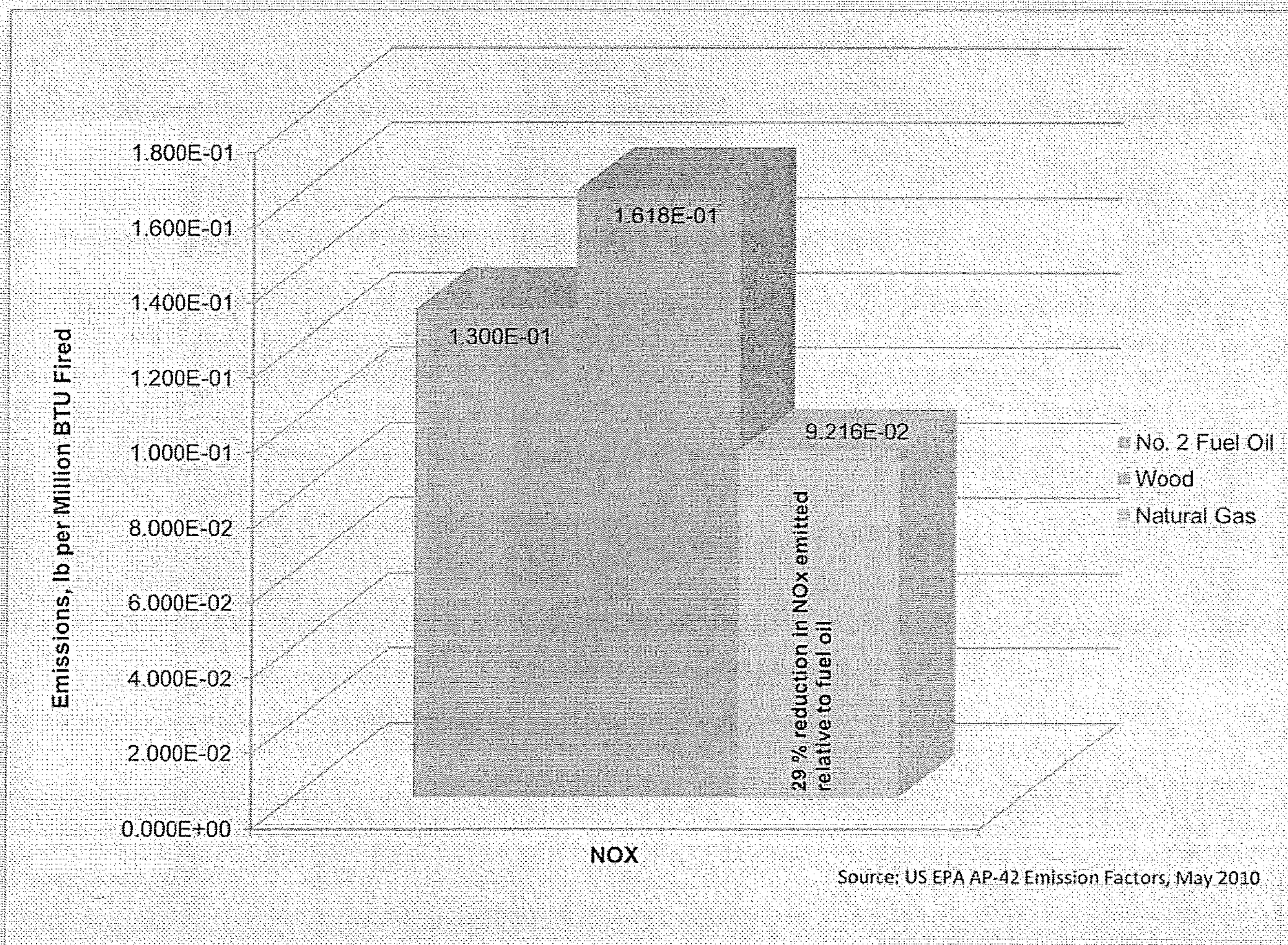


Figure 10
Comparison of Particulate Matter (PM_{10}) Emissions per BTU Fired - Fuel Oil, Wood, and Natural Gas

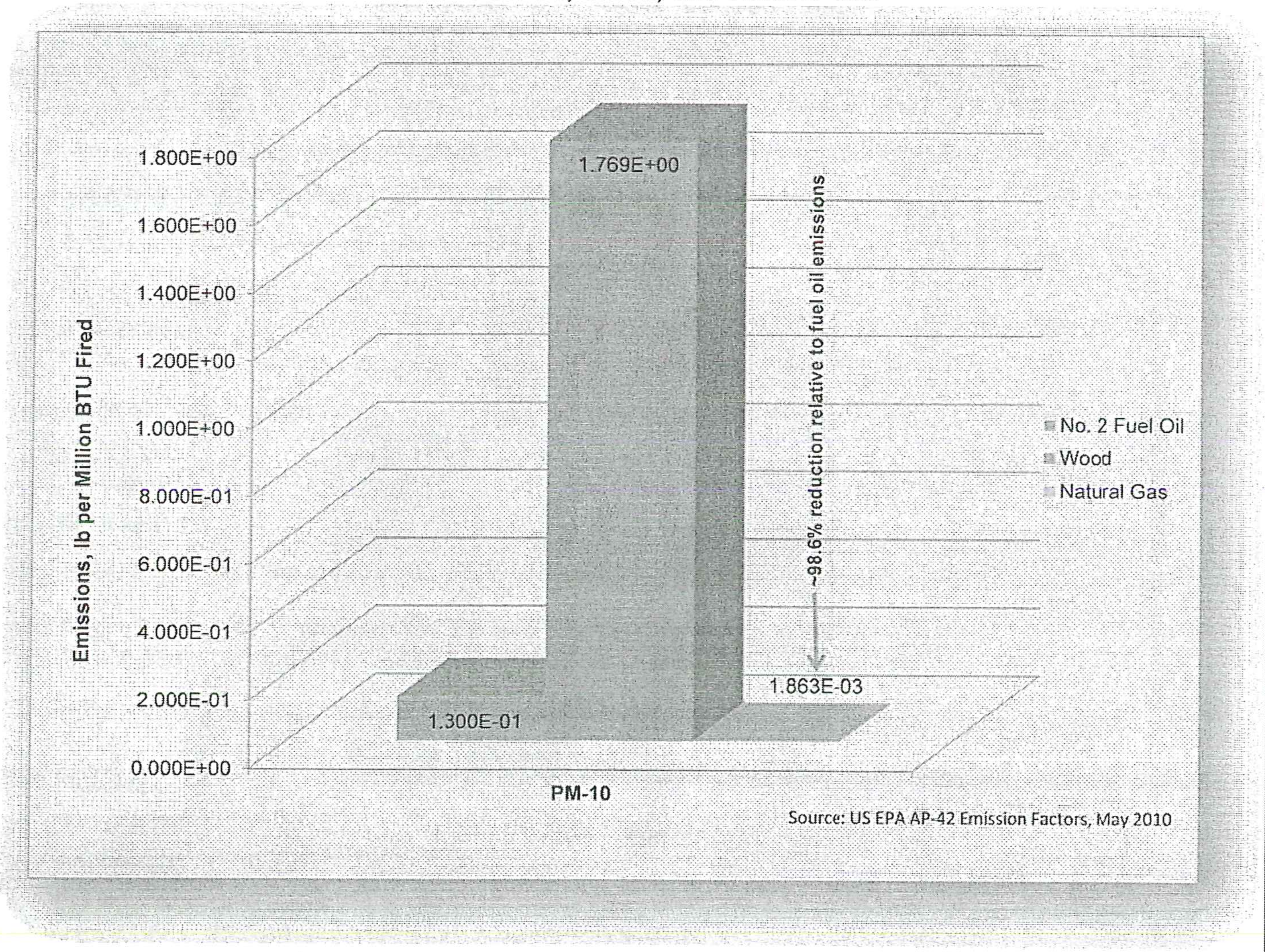


Figure 11
Comparison of Carbon Monoxide (CO) Emissions per BTU Fired - Fuel Oil, Wood, and Natural Gas

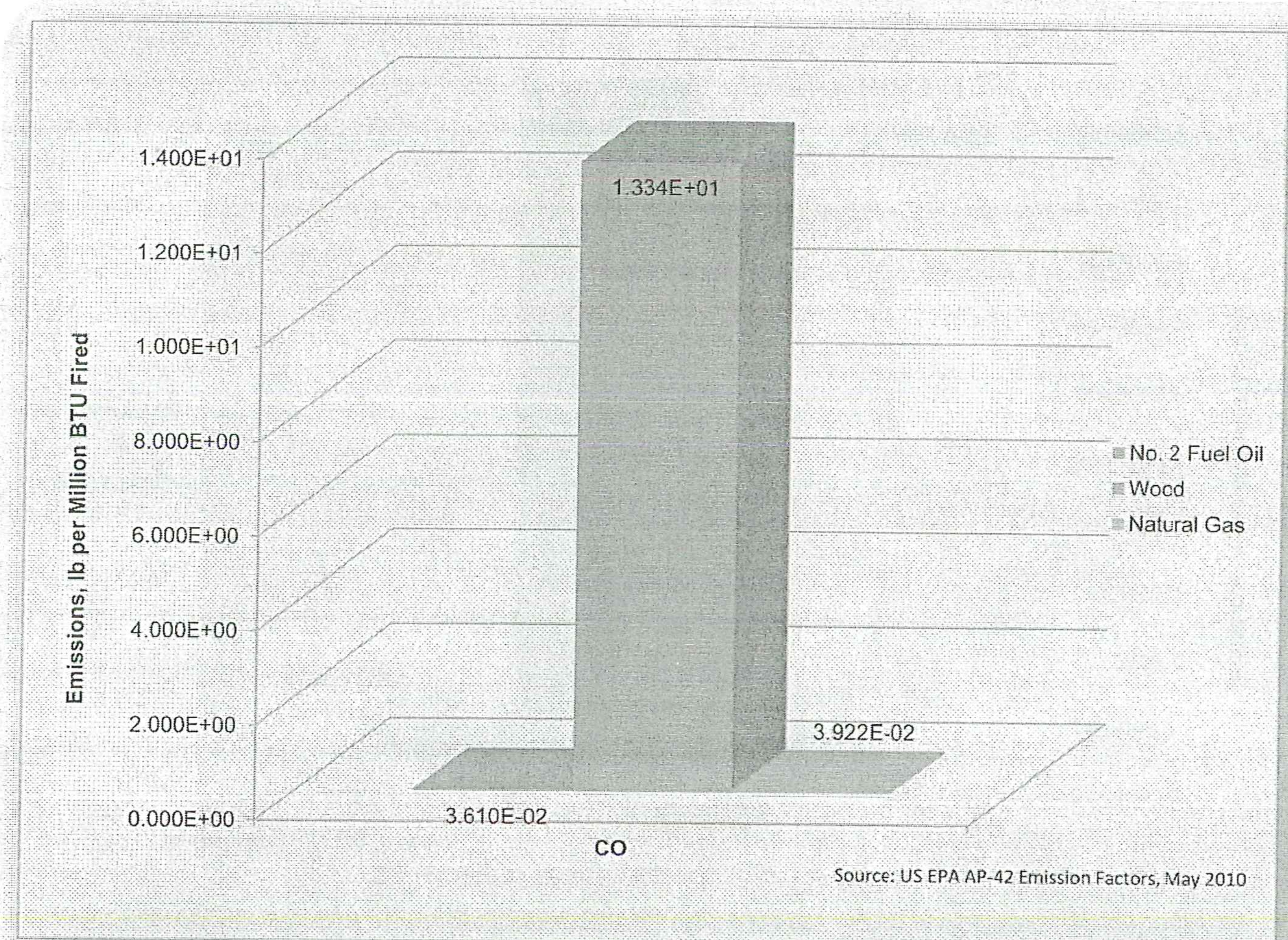


Figure 12
Comparison of Total Organic Carbon (TOC) Emissions per BTU Fired - Fuel Oil, Wood, and Natural Gas

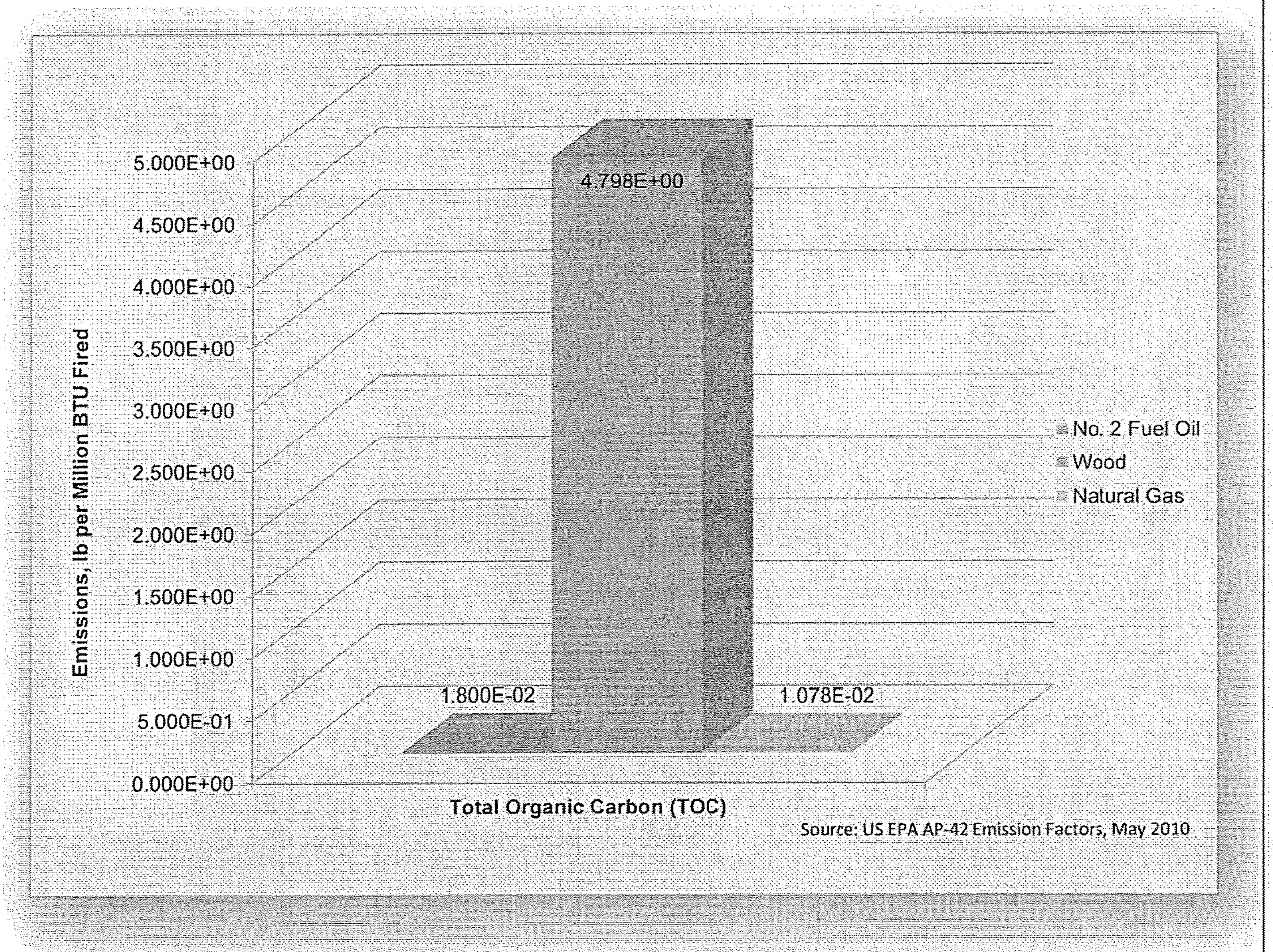
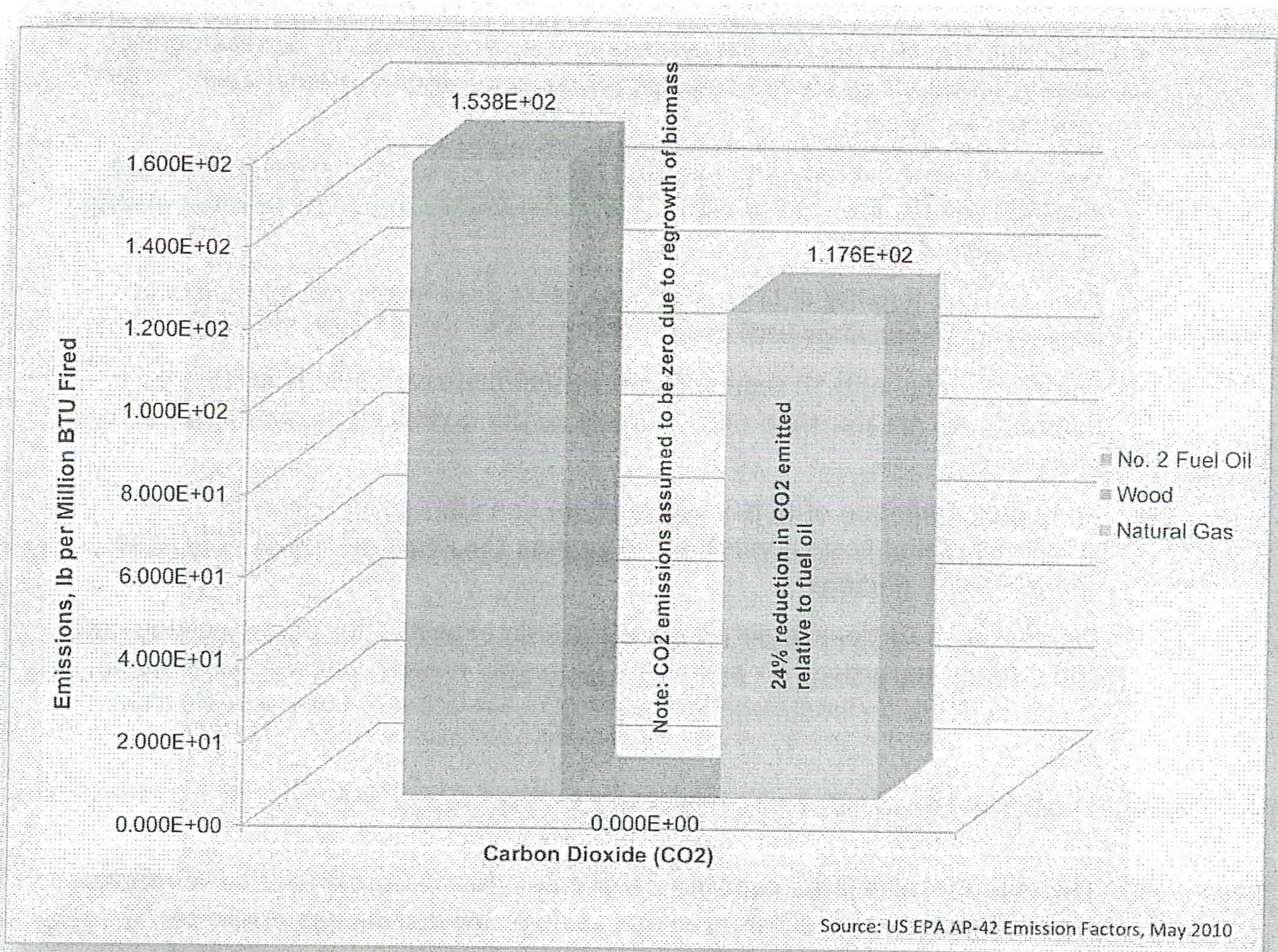


Figure 13
Comparison of Carbon Dioxide (CO_2) Emissions per BTU Fired - Fuel Oil, Wood, and Natural Gas



7. CONCLUSIONS & RECOMMENDATIONS

7.1 Bethel LCNG Substitution

- ✓ Preliminary cost modeling indicates favorable economics for replacement of diesel/fuel-oil for space heating and power generation in Bethel as a standalone project.
- ✓ The extent that capital and operating costs for transport barges and Valdez loading facilities are shared with other communities impacts the retail pricing advantages of LCNG.
- ✓ The inherent stability of LNG wholesale costs used in the model results in increasing fuel savings with time.
- ✓ The primary benefits to residents are annual fuel cost savings of 25% as a minimum, to greater than 65%, subject to the qualifications and assumptions presented.
- ✓ Additional definition of LCNG supply chain and storage/distribution components and costs is necessary to refine the retail pricing of LCNG and confirm these findings.
- ✓ Significant reductions in air emissions can be expected for priority pollutants (SO_2, NOx), hazardous air pollutants (primarily metals, and various organic compounds) and climate change gases (CO_2) relative to current fuels (fuel-oil).

7.2 Fairbanks Natural Gas Substitution

- ✓ The potential of a large capacity natural gas pipeline proximate to Fairbanks offers residents very substantial fuel savings. Wholesale gas priced at approximately $0.75 per diesel equivalent gallon speaks strongly of the benefits that residents in Railbelt communities potentially could expect from this project.
- ✓ Significant reductions in air emissions can be expected for priority pollutants (SO_2, NOx, CO and PM) and hazardous air pollutants (metals, and poly-aromatic compounds) and climate change gases (CO_2) relative to current fuels (fuel-oil and wood).

8. DISCLAIMER

This study was prepared for AGPA by PDC Harris Group using the referenced sources, and internally developed knowledge and data. Data from external sources has not been verified, and therefore we do not warrant the accuracy of conclusions drawn based on this information. Any opinions expressed are those of PDC Harris Group.

9. APPENDICES

Appendix A – Cost Comparison of Wholesale Diesel and LNG

Appendix B – Schematic Diagram, Transport & Storage of LCNG for Rural Setting

Appendix C – Model Spreadsheets, Bethel

Appendix E – Model Spreadsheets, Fairbanks

Figure 14
Excerpt from Fairbanks Model F1

		Start-up	1	2	3	4		28	29	30
DIESEL		2021	2022	2023	2024	2025		2049	2050	2051
Predicted Diesel Price, Wholesale Lower 48 Ave., $/gal	(a)	$3.54	$3.61	$3.63	$3.71	$3.73		$5.42	$5.55	$5.69
Alaska Wholesale Price Surcharge, $/gal		$0.23	$0.24	$0.24	$0.24	$0.25		$0.36	$0.37	$0.37
Predicted Diesel Price, Wholesale Fairbanks Ave., $/gal		$3.77	$3.85	$3.87	$3.95	$3.97		$5.78	$5.92	$6.06
Predicted $/E6 BTU (HHV), FAI Diesel Wholesale		**$27.23**	**$27.80**	**$27.94**	**$28.54**	**$28.67**		**$41.72**	**$42.73**	**$43.75**
Wholesale Natural Gas										
Wellhead Value		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
WH-Processing (Invariant)		0.26	0.26	0.26	0.26	0.26		0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17		5.60	5.73	5.87
Transport (invariant)		1.15	1.15	1.15	1.15	1.15		1.15	1.15	1.15
LNG Losses (inflation adjusted)		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
Liquefaction (invariant)		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
Liquids Credit (inflation adjusted)		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
NG FAI City Gate, $/E6 BTU		**5.29**	**5.36**	**5.43**	**5.50**	**5.58**		**8.01**	**8.14**	**8.28**
Equivalent gas price, $/Diesel gallon equivalent		0.73	0.74	0.75	0.76	0.77		1.11	1.13	1.15
SAVINGS										
Savings, Diesel - LNG, $/E6 BTU (HHV)		$21.94	$22.44	$22.51	$23.03	$23.10		$33.72	$34.59	$35.47
% Savings		80.57%	80.72%	80.57%	80.72%	80.55%		80.81%	80.95%	81.08%
Annual Savings, $/yr		$ 59,489,382	$ 61,150,326	$ 61,662,578	$ 63,402,358	$ 65,897,135		$ 105,140,010	$ 108,382,754	$ 111,720,833
Total Savings, Project Life, $		$ 2,413,791,936								
Present Value of Savings (2021)	(g)	$1,124,440,765								
ENERGY DEMAND										
Heating Fuel Use,E6 BTU/yr	(e)	2711736	2725295	2738921	2752616	2766379		3118151	3133742	3149411

Figure 15
Excerpt from Fairbanks Model F2

		Start-up	1	2	3	4		28	29	30
DIESEL		2021	2022	2023	2024	2025		2049	2050	2051
Predicted Diesel Price, Wholesale Lower 48 Ave., $/gal	(a)	$3.67	$3.73	$3.79	$3.84	$3.90		$5.70	$5.83	$5.97
Alaska Wholesale Price Surcharge, $/gal		$0.23	$0.24	$0.24	$0.24	$0.25		$0.36	$0.37	$0.38
Predicted Diesel Price, Wholesale Fairbanks Ave., $/gal		$3.90	$3.97	$4.03	$4.09	$4.15		$6.06	$6.20	$6.35
Predicted $/E6 BTU (HHV), FAI Diesel Wholesale		**$28.17**	**$28.66**	**$29.10**	**$29.52**	**$29.93**		**$43.73**	**$44.78**	**$45.86**
Wholesale Natural Gas										
Wellhead Value		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
WH-Processing (invariant)		0.26	0.26	0.26	0.26	0.26		0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17		5.60	5.73	5.87
Transport (Invariant)		1.15	1.15	1.15	1.15	1.15		1.15	1.15	1.15
LNG Losses (inflation adjusted)		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
Liquefaction (invariant)		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
Liquids Credit (inflation adjusted)		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
NG FAI City Gate, $/E6 BTU		**5.29**	**5.36**	**5.43**	**5.50**	**5.58**		**8.01**	**8.14**	**8.28**
Equivalent gas price, $/Diesel gallon equivalent		0.73	0.74	0.75	0.76	0.77		1.11	1.13	1.15
SAVINGS										
Savings, Diesel - LNG, $/E6 BTU (HHV)		$22.88	$23.30	$23.67	$24.02	$24.36		$35.73	$36.64	$37.58
% Savings		81.22%	81.30%	81.34%	81.36%	81.37%		81.69%	81.82%	81.95%
Annual Savings, $/yr		$ 62,034,878	$ 63,495,887	$ 64,839,219	$ 66,105,173	$ 67,377,350		$ 111,396,478	$ 114,821,411	$ 118,346,984
Total Savings, Project Life, $		$ 2,548,598,605								
Present Value of Savings (2021)	(g)	$1,184,320,513								
ENERGY DEMAND										
Heating Fuel Use,E6 BTU/yr	(e)	2711736	2725295	2738921	2752616	2766379		3118151	3133742	3149411

Appendix A
Cost Comparison of Wholesale
Diesel and LNG

Appendix A

Comparison of LNG & Diesel Historical Pricing Data

1. Comparison of Diesel and LNG, US and World-Wide

Table 1 provides a recent snapshot of the dramatic differences in pricing between diesel fuel and LNG, when both fuels are placed on the same basis ($/million BTU).

TABLE 1

COMPARISON OF RECENT DIESEL AND LNG PRICING, $/MILLION BTU

	Diesel (FOB US & AK)		**LNG** (landed @ destination)			
	Diesel Wholesale, US Average	Alaska Diesel, Wholesale FOB Refinery	S. Korea Imports Average	China Imports Average	US Imports, Average	Alaska Landed in Japan
Date	Feb-2011	Feb-2011	Sep-2010	Sep-2010	Feb-2011	Feb-2011
$/MM BTU	**20.96**	**22.64**	**10.41**	**6.61**	**4.16**	**12.64**
Comparison	**0.93**	1.00	**0.46**	**0.29**	**0.18**	**0.56**

Several points regarding the data in Table 1 should be emphasized:

- The diesel fuel costs quoted for both US average wholesale, and Anchorage wholesale are not on a landed basis (i.e. delivered to buyer's receiving destination), while the LNG values represent the landed price at the stated destination. Thus the diesel prices should be increased by $1.00 to $2.00/gallon (approximately $7.50 to $15.00 per million BTU) to reflect recent shipping costs from Alaskan refineries to Bethel users.

- The highest priced LNG, delivered to So. Korea and Japan, and purchased under long term contracts which are indexed to the price of crude oil, is between 46% and 56% of the wholesale diesel price for the corresponding period, FOB Anchorage, i.e. not delivered.
- The lowest priced LNG, purchased on a spot basis, and delivered to the US during this period, is approximately 18% of the cost of Alaska diesel. This decline in US pricing reflects the remarkable impact of shale gas development, with LNG near price parity with that of pipeline gas for the first time.

Monthly pricing trends for wholesale diesel FOB Anchorage between March 2003 and November 2010 are plotted in Figure 1, following. These data were acquired from the Energy Information Agency, in units of $/gallon and converted to $/MMBtu. Obviously the steep increases in petroleum derived fuels during the Middle East/Northern Africa cultural upheaval beginning in February 2011 are not captured by these data.

Figure 2 includes the addition of pricing data for AK LNG (Nikiski liquefaction plant) landed in Japan. LNG pricing (for Japan) did not respond to the needle peak of diesel pricing in 2008, though the trend clearly indicates a price increase that more closely tracks that of diesel fuel beginning in March 2009. The latter is likely explained by a renegotiated contract, with enhanced indexing to petroleum pricing.

Figure 3 adds a synthesized trend[1] for the pricing of diesel/fuel oil delivered to Bethel, based on data supplied by Alaska Department of Commerce, Community and Economic Development (DCCED), as well as Northstar Gas Company (local Bethel distributor). Certainly it is recognized that pricing for large volumes of LNG landed in Japan does not address the true supply chain cost for bringing small volumes to Bethel. The comparison nonetheless points to the potential for large savings for substituting LCNG for diesel in rural Alaska.

Figure 4 differs from Figure 3 by the addition of average pricing for LNG landed in the lower 48, from liquefaction plants in Trinidad, Egypt, Qatar, Peru, Norway, Yemen, and Nigeria. Significant pricing differences between US exported LNG (landed in Japan) and US imported LNG are not noted until March 2009, which probably arises from the combined impacts of a renegotiated export contract, and the declining US market for LNG importation.

[1] EIA monthly data for wholesale diesel fuel FOB Anchorage were manipulated to transportation, local distribution and local distributor profit based on DCCED data.

Figure 1
Trended Fuel Prices, Alaska Diesel
Wholesale & FOB Refinery

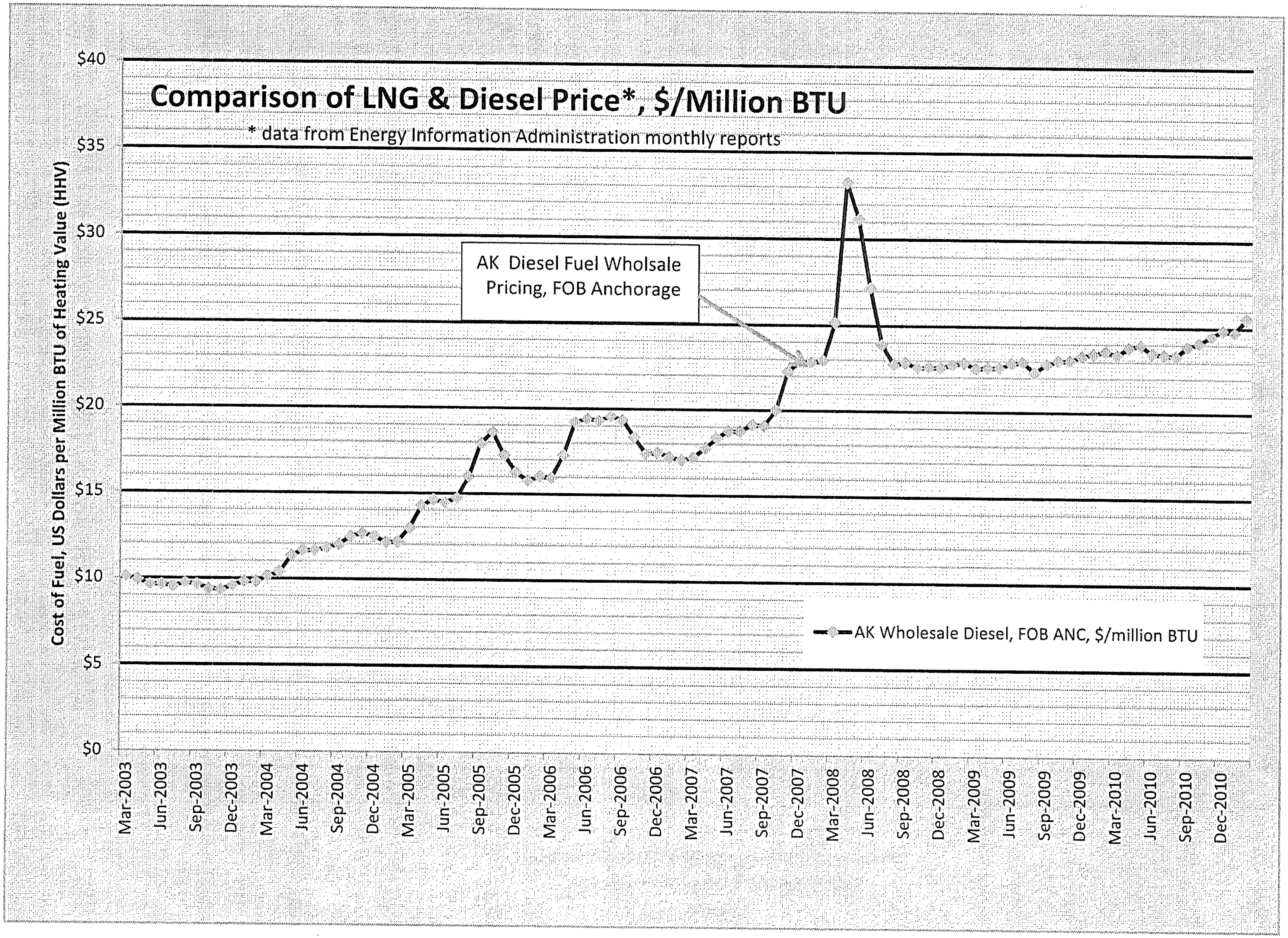


Figure 2
Trended Fuel Prices, Alaska Diesel
Pricing from Fig 1 & AK LNG Landed in Japan

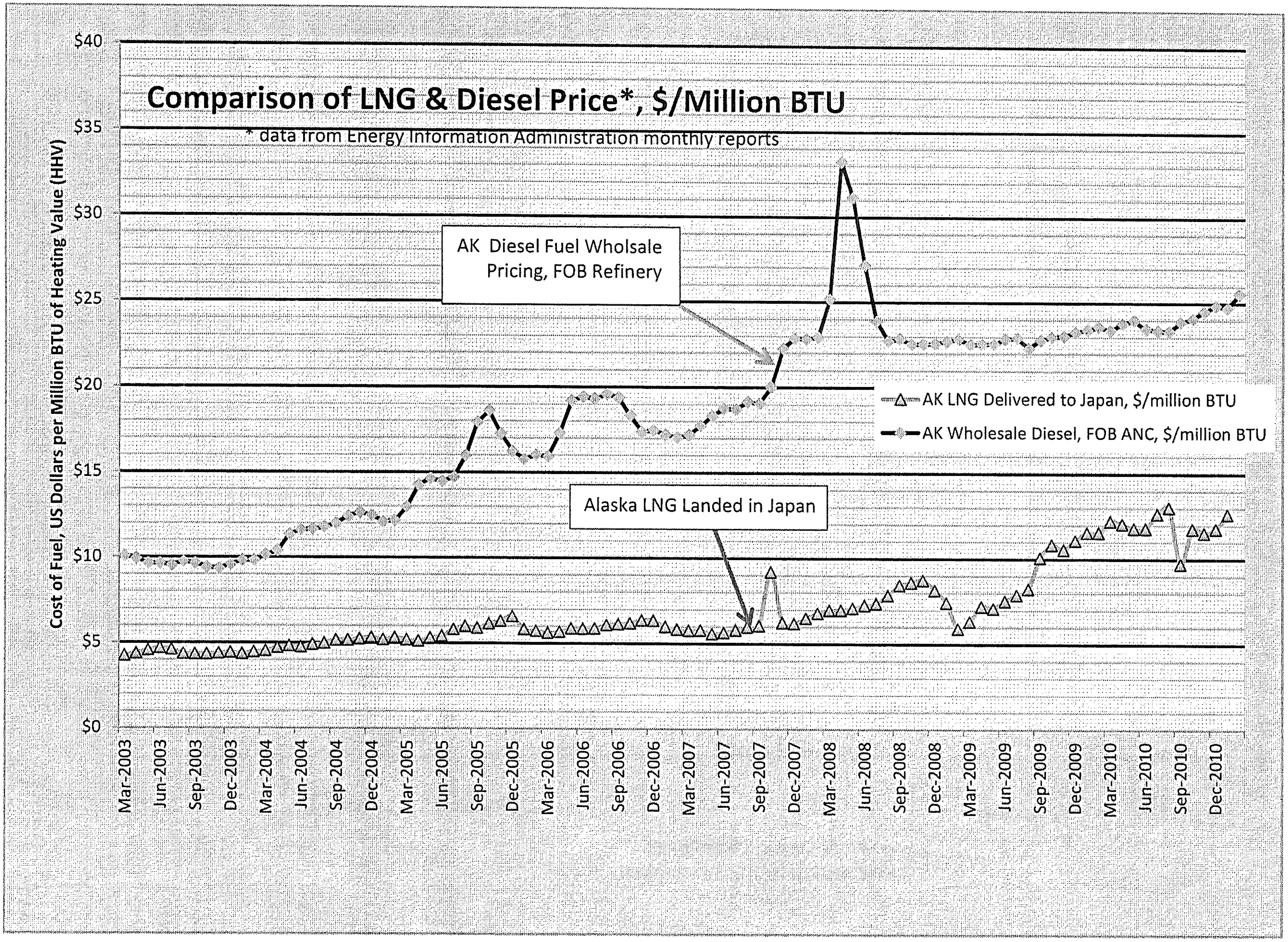


Figure 3
Trended Fuel Prices, Alaska Diesel
& LNG Pricing from Fig 2 & Adjusted Pricing
For Delivery to Bethel

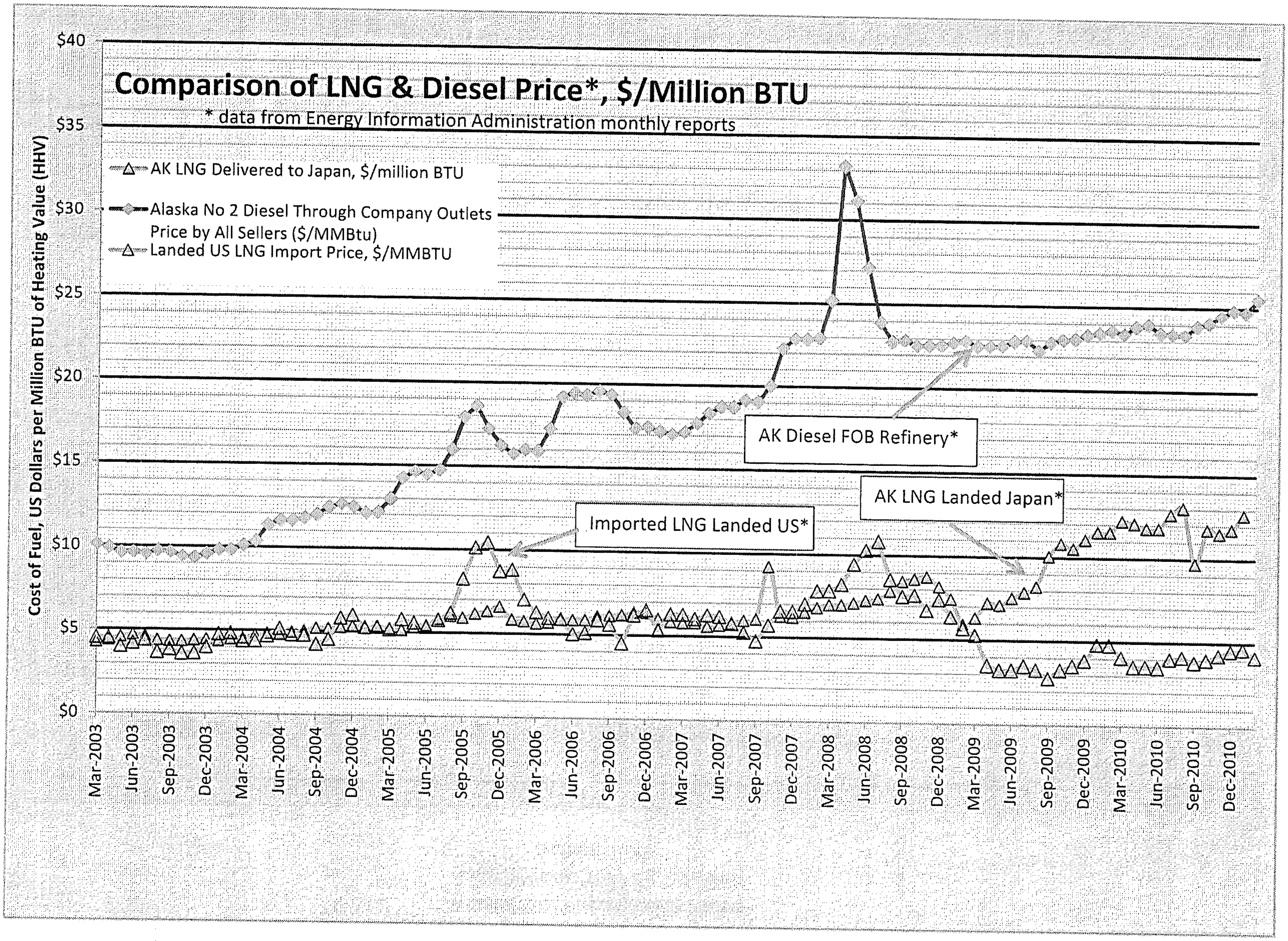
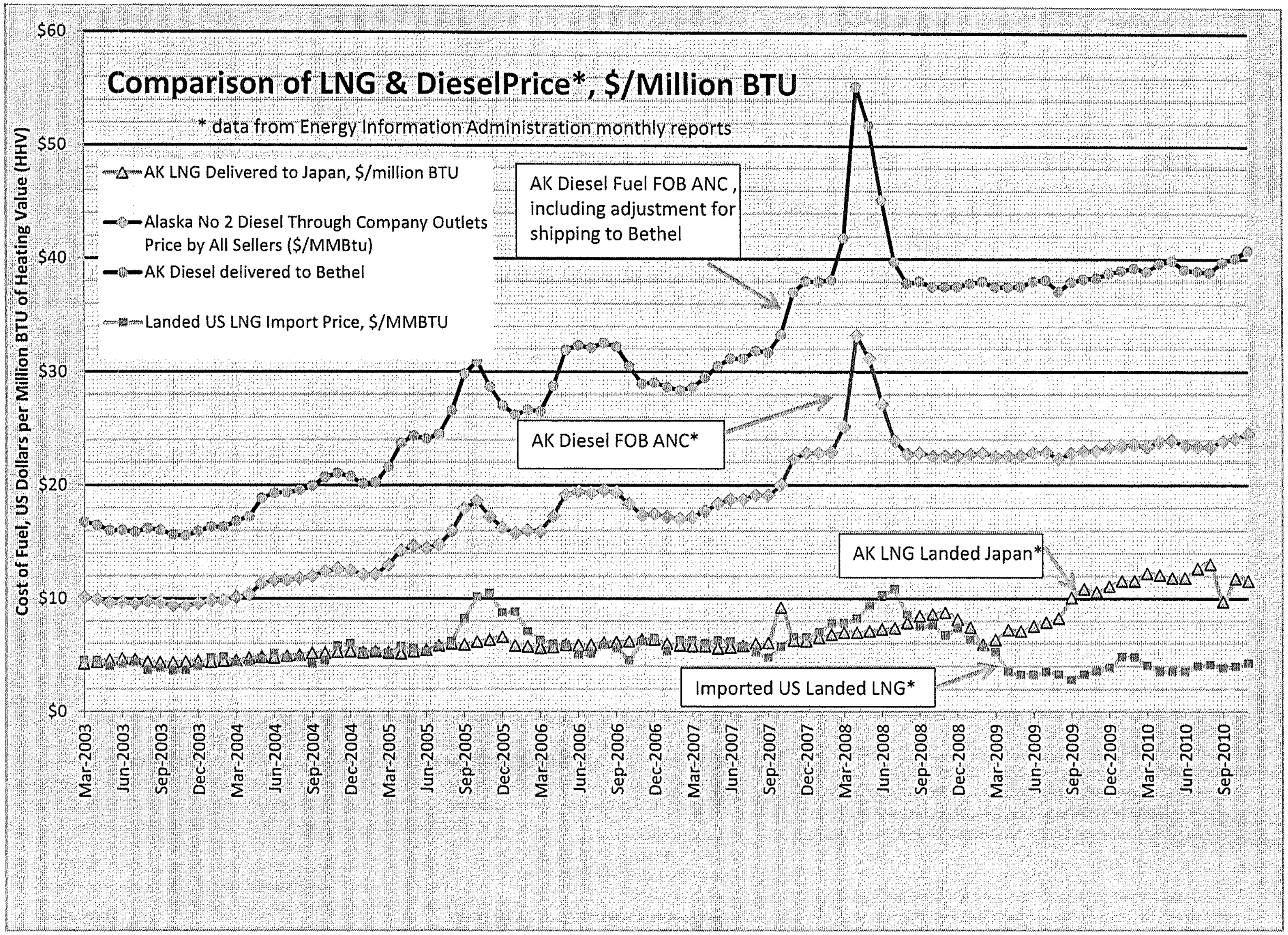


Figure 4
Trended Fuel Prices, Alaska Diesel
& LNG Pricing from Fig 3 & LNG
Landed in US



1.4 What is the Future of LNG versus Petroleum-Derived Fuel Pricing?

Will the price disparity between natural gas (LCNG) and petroleum distillates continue? Given the volatility of fuel prices during the period that this document was prepared, no one can make such predictions with confidence. However, we believe that over the longer term, natural gas will remain a bargain compared with diesel/fuel oil, for the following reasons:

- The lower 48 states now enjoy a huge surplus of natural gas, primarily as a result of developing tight sands and shale completion technologies. It is estimated that this surplus and the reserves brought on-line to replace declining wells will be adequate for the next 25 years, as a minimum.

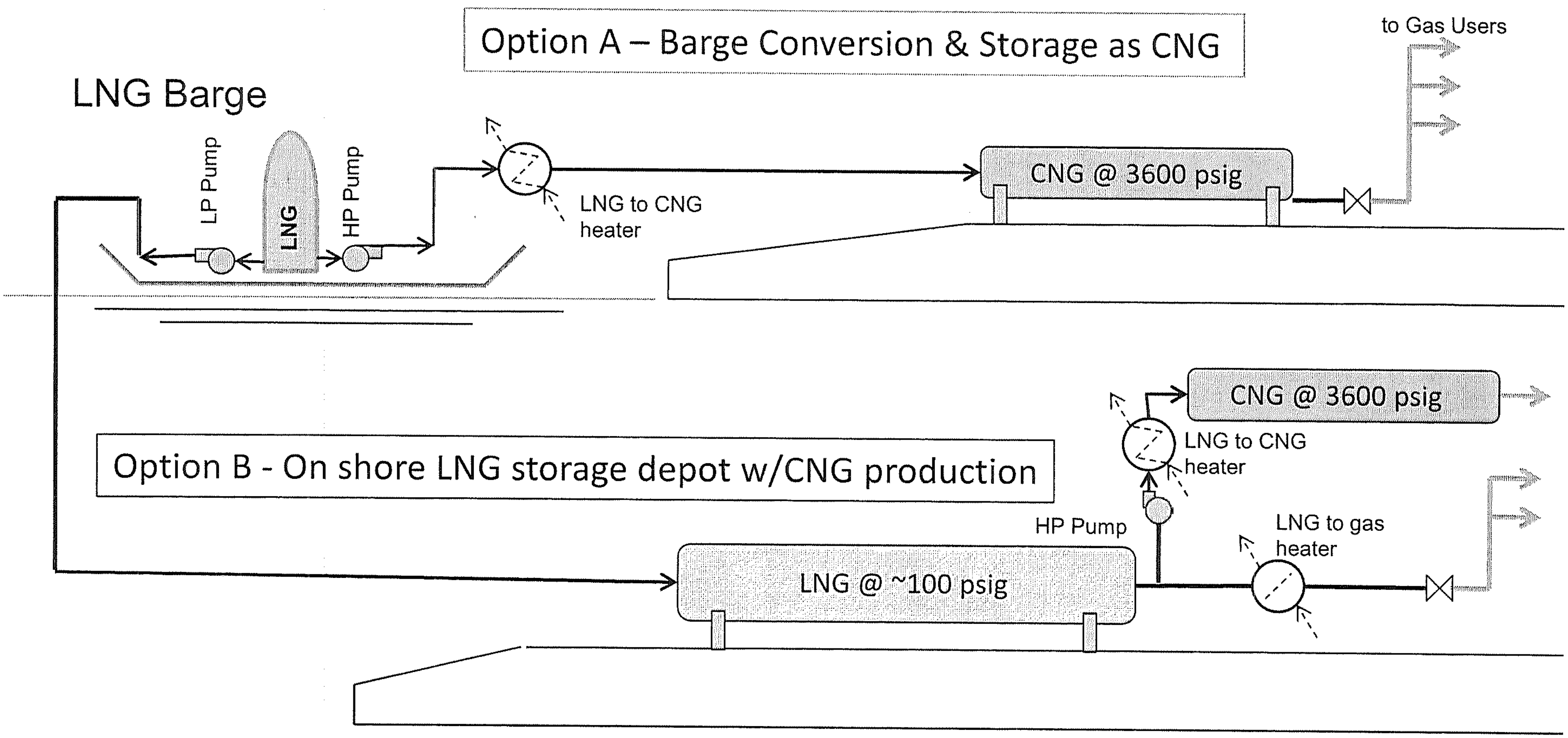
- The cost to produce and transport LNG is declining world-wide. Stranded natural gas reserves are located in numerous tidewater locations, thus ensuring adequate LNG supply for the long term.

- Political and cultural tensions in the Middle East and North Africa are not likely to subside for many years, heightening the impact of an already tight petroleum market.

- Development of US off-shore/Outer Continental Shelf petroleum reserves is currently stalled, and will likely be permitted in selected areas only; placing further pressure on petroleum and its derived fuels. World-wide demand for diesel fuel is strong, and supply surplus is tight. Pricing for gasoline, diesel, fuel oil and other distillates are not likely to experience advantages relative to natural gas.

Appendix B
Schematic Diagram, Transport & Storage of
LCNG for Rural Setting

Rural Alaska LCNG Concept



Appendix C
Model Spreadsheets, Bethel

B1

Bethel delivery. LNG FOB Valdez is based on Wood Mac (note i) Cost Buildup. Same nominal delivery and retail markup in $/gal as diesel

Report Reference: Figure 1, Case B1

LNG Cost Buildup, Wood Mac Study, pg. 15	
WH Processing	0.26
Processing & Shrinkage	2.22
Transport	1.70
LNG Losses	0.4
Liquefaction	4.00
Liquids Credit	-0.67
LNG FOB Valdez, $/E6 BTU	7.91
Basis Year	2010
Annual Inflation:	1.024

Properties			
Diesel HHV, BTU/gal.	138490	100.00%	
Diesel LHV, BTU/gal.	129490	93.50%	
WTI Oil BTU/gal.	6.00E+06		
	min	max	mean
LNG Vaporized, BTU/std ft^3 (enriched for Asia)	1060	1130	1095
LNG density, lb/ft^3	45.04	47.13	46.085
LNG HHV, BTU/gal		86213	85300
LNG LHV, BTU/gal			75437
CNG density @ 3600 psig, lb/ft^3			12.1

Transport & Markup Diesel to Bethel (2009-2010 Season)

	$/gal Individual (j)	$/gal Cumulative	% Individual	% Cumulative	$/E6 BTU (HHV) Individual	$/E6 BTU (HHV) Cumulative
Fuel, FOB Refinery	2.40	2.40	54.92%	54.92%	17.33	17.33
Delivery & Offload	0.50	2.90	11.44%	66.36%	3.61	20.94
Sales Tax @ 6%	0.26	3.16	5.95%	72.31%	1.88	22.82
Retail Markup	1.21	4.37	27.69%	100.00%	8.74	31.55

	Note	Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$4.74	$4.79	$4.85	$4.90	$4.96	$5.00	$5.06	$5.13	$5.21	$5.27	$5.39	$5.52	$5.66
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$34.19	$34.57	$34.99	$35.37	$35.79	$36.10	$36.56	$37.03	$37.62	$38.04	$38.95	$39.89	$40.85
LNG & CNG	(b)													
WH-Processing (Invariant)		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83
Transport (Invariant)		1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.58	0.60	0.61	0.63	0.64	0.66	0.67	0.69
Liquefaction (Invariant)		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-0.98	-1.00	-1.03	-1.05	-1.08	-1.10	-1.13	-1.16
LNG FOB Valdez, $/E6 BTU		**8.49**	**8.55**	**8.61**	**8.68**	**8.74**	**8.81**	**8.88**	**8.95**	**9.02**	**9.09**	**9.17**	**9.25**	**9.32**
LNG & CNG Price Stack														
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	8.81	8.88	8.95	9.02	9.09	9.17	9.25	9.32
Delivery & Offload, $/E6 BTU (HHV)	(d)	4.69	4.80	4.91	5.03	5.15	5.28	5.40	5.53	5.67	5.80	5.94	6.08	6.23
Sales Tax @ 6% of FOB + Delivery		0.79	0.80	0.81	0.82	0.83	0.85	0.86	0.87	0.88	0.89	0.91	0.92	0.93
Retail Markup	(f)	11.34	11.61	11.89	12.18	12.47	12.77	13.08	13.39	13.71	14.04	14.38	14.72	15.08
Retail Price LNG/CNG, $/E6 BTU		25.31	25.77	26.23	26.71	27.20	27.70	28.21	28.74	29.28	29.83	30.39	30.97	31.56
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$8.88	$8.80	$8.75	$8.65	$8.59	$8.40	$8.34	$8.29	$8.34	$8.21	$8.56	$8.92	$9.28
% Savings		25.98%	25.46%	25.02%	24.47%	24.00%	23.27%	22.82%	22.38%	22.17%	21.59%	21.98%	22.36%	22.73%
Annual Savings, $/yr		$ 5,287,494	$ 5,264,395	[illegible]	$ 5,229,247	[illegible]	$ 5,127,705	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 5,602,700	[illegible]
Total Savings, Project Life, $		$ 229,039,410												
Present Value of Savings (2021)	(g)	$101,895,700												
ENERGY DEMAND														
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	610245	613296	616363	619445	622542	625655	628783	631927
INFLATION FACTORS														
No. of years from 2010		11	12	13	14	15	16	17	18	19	20	21	22	23
Inflation factor	(h)	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73

NOTES:

(a) 2021 - 2030 values from AEA projection, medium pricing (Saylor & Foster, ISER, 2010). Post 2030 assumes 2.4% inflation

(b) Assumes LNG Base Year Value = $8.50/E6 BTU DES Asia less $0.59/E6 BTU per page 15 Wood Mac

(d) Based on diesel delivery cost per gallon (2010), with 2.4% inflation from 2010, and penalty for LNG energy density.

(e) Assumes 0.5% annual growth due to population growth + higher per capita use.

(f) Using same $/E6 BTU as diesel/fuel oil in 2010, with inflation adjustment.

(g) Discount rate = 5.0%

(h) Inflation constant @ 2.4%/yr.

(i) Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

(j) Szymoniak et al, "Components of Alaska Fuel Costs: An Analysis of Market Factors and Characteristics that Influence Rural Fuel Prices", Institute of Social and Economic Research (ISER), Univ. of Alaska, February 2010.

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$5.79	$5.93	$6.07	$6.22	$6.37	$6.52	$6.68	$6.84	$7.00	$7.17	$7.34	$7.52	$7.70	$7.88	$8.07	$8.27	$8.47	$8.67
$41.83	$42.83	$43.86	$44.91	$45.99	$47.09	$48.22	$49.38	$50.57	$51.78	$53.02	$54.29	$55.60	$56.93	$58.30	$59.70	$61.13	$62.60
0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.92	4.02	4.11	4.21	4.31	4.42	4.52	4.63	4.74	4.86	4.97	5.09	5.21	5.34	5.47	5.60	5.73	5.87
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
0.71	0.72	0.74	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.90	0.92	0.94	0.96	0.99	1.01	1.03	1.06
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
-1.18	-1.21	-1.24	-1.27	-1.30	-1.33	-1.36	-1.40	-1.43	-1.47	-1.50	-1.54	-1.57	-1.61	-1.65	-1.69	-1.73	-1.77
9.41	**9.49**	**9.57**	**9.66**	**9.75**	**9.84**	**9.93**	**10.03**	**10.13**	**10.23**	**10.33**	**10.43**	**10.54**	**10.65**	**10.76**	**10.88**	**11.00**	**11.12**
9.41	9.49	9.57	9.66	9.75	9.84	9.93	10.03	10.13	10.23	10.33	10.43	10.54	10.65	10.76	10.88	11.00	11.12
6.38	6.53	6.69	6.85	7.01	7.18	7.35	7.53	7.71	7.90	8.09	8.28	8.48	8.68	8.89	9.10	9.32	9.55
0.95	0.96	0.98	0.99	1.01	1.02	1.04	1.05	1.07	1.09	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24
15.44	15.81	16.19	16.58	16.97	17.38	17.80	18.22	18.66	19.11	19.57	20.04	20.52	21.01	21.52	22.03	22.56	23.10
32.17	32.79	33.42	34.07	34.74	35.42	36.12	36.84	37.57	38.32	39.09	39.87	40.68	41.50	42.35	43.21	44.10	45.01
$9.66	$10.04	$10.43	$10.84	$11.25	$11.67	$12.10	$12.54	$13.00	$13.46	$13.93	$14.42	$14.92	$15.43	$15.95	$16.48	$17.03	$17.59
23.09%	23.45%	23.79%	24.13%	24.46%	24.78%	25.09%	25.40%	25.70%	25.99%	26.28%	26.56%	26.83%	27.10%	27.36%	27.61%	27.86%	28.10%
$ 6,133,945	$ 6,409,340	$ 6,698,339	$ 6,986,811	$ 7,287,554	$ 7,598,092	$ 7,918,979	$ 8,249,294	$ 8,589,727	$ 8,940,574	$ 9,302,141	$ 9,674,743	$ 10,053,204	$ 10,454,367	$ 10,862,046	$ 11,282,127	$ 11,714,960	$ 12,160,904
635086	638262	641453	644660	647884	651123	654379	657651	660939	664244	667565	670903	674257	677628	681017	684422	687844	691283

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64

B2 Same as Case B1, with cost estimate basis for LNG Delivery & Retail Markup (reference Wood Mac Study, note i)

Report Reference: Figure 1, Case B2

Properties

Diesel HHV, BTU/gal.	138490	100.00%	
Diesel LHV, BTU/gal.	129490	93.50%	
WTI Oil BTU/gal.	6.00E+06		
	min	max	mean
LNG Vaporized, BTU/std ft^3 (enriched for Asia)	1060	1130	1095
LNG density, lb/ft^3	45.04	47.13	46.085
LNG HHV, BTU/gal		86213	85300
LNG LHV, BTU/gal			75437

LNG Cost Buildup, Wood Mac Study, pg. 15 (2010 $/E6 BTU)

WH Processing	0.26
Processing & Shrinkage	2.22
Transport	1.70
LNG Losses	0.4
Liquefaction	4.00
Liquids Credit	-0.67
LNG FOB Valdez	**7.91**
Basis Year	2010
Annual Inflation:	1.024

Transport & Markup Diesel to Bethel (2009-2010 Season)

	$/gal		%		$/E6 BTU (LHV)	
	Individual	Cumulative	Individual	Cumulative	Individual	Cumulative
Fuel, FOB Refinery	2.40	2.40	54.92%	54.92%	18.53	18.53
Delivery & Offload	0.50	2.90	11.44%	66.36%	3.86	22.40
Sales Tax @ 6%	0.26	3.16	5.95%	72.31%	2.01	24.40
Retail Markup	1.21	4.37	27.69%	100.00%	9.34	33.75

		Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$4.74	$4.79	$4.85	$4.90	$4.96	$5.00	$5.06	$5.13	$5.21	$5.27	$5.39	$5.52	$5.66
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$34.19	$34.57	$34.99	$35.37	$35.79	$36.10	$36.56	$37.03	$37.62	$38.04	$38.95	$39.89	$40.85
LNG & CNG	(b)													
WH-Processing		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83
Transport		1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.58	0.60	0.61	0.63	0.64	0.66	0.67	0.69
Liquefaction		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-0.98	-1.00	-1.03	-1.05	-1.08	-1.10	-1.13	-1.16
LNG FOB Valdez, $/E6 BTU		**8.49**	**8.55**	**8.61**	**8.68**	**8.74**	**8.81**	**8.88**	**8.95**	**9.02**	**9.09**	**9.17**	**9.25**	**9.32**
LNG & CNG Price Stack														
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	8.81	8.88	8.95	9.02	9.09	9.17	9.25	9.32
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	5.54	5.66	5.78	5.91	6.04	6.19	6.33	6.49
Sales Tax @ 6% of FOB + Delivery		0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.90	0.91	0.92	0.93	0.95
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.12	8.13	8.14	8.15	8.16	8.18	8.19	8.21
Retail Price LNG/CNG, $/E6 BTU		22.41	22.58	22.75	22.94	23.13	23.33	23.53	23.75	23.97	24.21	24.45	24.71	24.97
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$11.78	$11.99	$12.23	$12.43	$12.66	$12.78	$13.02	$13.28	$13.64	$13.83	$14.50	$15.18	$15.88
% Savings		34.46%	34.68%	34.97%	35.15%	35.38%	35.39%	35.63%	35.86%	36.27%	36.36%	37.23%	38.06%	38.87%
Annual Savings, $/yr		$ 7,013,712	$ 7,171,338	$ 7,354,842	$ 7,509,385	$ 7,683,003	$ 7,797,626	$ 7,987,899	$ 8,183,881	$ 8,450,491	$ 8,611,658	$ 9,073,283	$ 9,546,780	$ 10,032,393
Total Savings, Project Life, $		$ 375,737,136												
Present Value of Savings (2011)	(g)	$163,926,539												
ENERGY DEMAND														
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	610245	613296	616363	619445	622542	625655	628783	631927
INFLATION FACTORS														
No. of years from 2010		11	12	13	14	15	16	17	18	19	20	21	22	23
Inflation factor	(h)	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73

NOTES:

(a) 2021 - 2030 values from AEA projection, 'medium pricing' (Saylor & Foster, ISER, 2010). Post 2030 assumes 2.4% Inflation

(b) Assumes LNG Base Year Value = $8.50/E6 BTU DES Asia less $0.59/E6 BTU per page 15 Wood Mac

(d) Derived on "Case B, Delivery Estimate" worksheet.

(e) Assumes 0.5% annual growth due to population growth + higher per capita use.

(f) Developed on Retail Markup Worksheet

(g) Discount rate = 5.0%

(h) Inflation constant @ 2.4%/yr.

(i) Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$5.79	$5.93	$6.07	$6.22	$6.37	$6.52	$6.68	$6.84	$7.00	$7.17	$7.34	$7.52	$7.70	$7.88	$8.07	$8.27	$8.47	$8.67
$41.83	$42.83	$43.86	$44.91	$45.99	$47.09	$48.22	$49.38	$50.57	$51.78	$53.02	$54.29	$55.60	$56.93	$58.30	$59.70	$61.13	$62.60
0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.92	4.02	4.11	4.21	4.31	4.42	4.52	4.63	4.74	4.86	4.97	5.09	5.21	5.34	5.47	5.60	5.73	5.87
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
0.71	0.72	0.74	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.90	0.92	0.94	0.96	0.99	1.01	1.03	1.06
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
-1.18	-1.21	-1.24	-1.27	-1.30	-1.33	-1.36	-1.40	-1.43	-1.47	-1.50	-1.54	-1.57	-1.61	-1.65	-1.69	-1.73	-1.77
9.41	**9.49**	**9.57**	**9.66**	**9.75**	**9.84**	**9.93**	**10.03**	**10.13**	**10.23**	**10.33**	**10.43**	**10.54**	**10.65**	**10.76**	**10.88**	**11.00**	**11.12**
9.41	9.49	9.57	9.66	9.75	9.84	9.93	10.03	10.13	10.23	10.33	10.43	10.54	10.65	10.76	10.88	11.00	11.12
6.65	6.82	7.00	7.19	7.39	7.59	7.80	8.03	9.36	9.65	9.96	10.28	10.61	10.96	11.33	11.71	12.11	12.53
0.96	0.98	0.99	1.01	1.03	1.05	1.06	1.08	1.17	1.19	1.22	1.24	1.27	1.30	1.33	1.36	1.39	1.42
8.22	8.24	8.26	8.28	8.30	8.32	8.35	8.37	8.40	8.42	8.45	8.48	8.51	8.54	8.57	8.60	8.64	8.68
25.25	25.53	25.83	26.14	26.46	26.80	27.15	27.51	29.05	29.49	29.95	30.43	30.93	31.45	31.99	32.55	33.13	33.74
$16.58	$17.30	$18.03	$18.77	$19.53	$20.29	$21.08	$21.87	$21.51	$22.28	$23.07	$23.86	$24.67	$25.48	$26.31	$27.15	$28.00	$28.86
39.64%	40.39%	41.11%	41.80%	42.46%	43.10%	43.71%	44.29%	42.55%	43.04%	43.50%	43.95%	44.37%	44.76%	45.13%	45.48%	45.80%	46.11%
$ 10,580,370	$ 11,040,957	$ 11,581,408	$ 12,100,958	$ 12,650,894	$ 13,211,448	$ 13,791,854	$ 14,393,396	$ 14,119,459	$ 14,802,615	$ 15,398,240	$ 16,003,297	$ 16,631,141	$ 17,262,523	$ 17,917,587	$ 18,581,460	$ 19,259,281	$ 19,951,192
635086	638262	641453	644660	647884	651123	654379	657651	660939	664244	667565	670903	674257	677628	681017	684422	687844	691283

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64

B3 Same as Case B2, with predicted Diesel pricing using ISER 'HIGH' range forecast (reference Wood Mac Study, note i)

Report Reference: Figure 1, Case B3

Properties			
Diesel HHV, BTU/gal.	138490	100.00%	
Diesel LHV, BTU/gal.	129490	93.50%	
WTI Oil BTU/gal.	6.00E+06		
	min	max	mean
LNG Vaporized, BTU/std ft^3 (enriched for Asia)	1060	1130	1095
LNG density, lb/ft^3	45.04	47.13	46.085
LNG HHV, BTU/gal		86213	85300
LNG LHV, BTU/gal			75437

LNG Cost Buildup, Wood Mac Study, pg. 15 (2010 $/E6 BTU)

WH Processing	0.26
Processing & Shrinkage	2.22
Transport	1.70
LNG Losses	0.4
Liquefaction	4.00
Liquids Credit	-0.67
LNG FOB Valdez	7.91
Basis Year	2010
Annual Inflation:	1.024

Transport & Markup Diesel to Bethel (2009-2010 Season)

	$/gal Individual	$/gal Cumulative	% Individual	% Cumulative	$/E6 BTU (LHV) Individual	$/E6 BTU (LHV) Cumulative
Fuel, FOB Refinery	2.40	2.40	54.87%	54.87%	18.53	18.53
Delivery & Offload	0.50	2.90	11.43%	66.30%	3.86	22.40
Sales Tax @ 6%	0.17	3.07	3.98%	70.28%	1.34	23.74
Retail Markup	1.30	4.37	29.72%	100.00%	10.04	33.78

		Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$7.44	$7.53	$7.63	$7.70	$7.79	$7.87	$7.94	$8.03	$8.13	$8.21	$8.40	$8.60	$8.81
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$53.72	$54.38	$55.07	$55.56	$56.22	$56.84	$57.37	$58.00	$58.68	$59.25	$60.67	$62.13	$63.62
LNG & CNG	(b)													
WH-Processing		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83
Transport		1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.58	0.60	0.61	0.63	0.64	0.66	0.67	0.69
Liquefaction		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-0.98	-1.00	-1.03	-1.05	-1.08	-1.10	-1.13	-1.16
LNG FOB Valdez, $/E6 BTU		**8.49**	**8.55**	**8.61**	**8.68**	**8.74**	**8.81**	**8.88**	**8.95**	**9.02**	**9.09**	**9.17**	**9.25**	**9.32**
LNG & CNG Price Stack														
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	8.81	8.88	8.95	9.02	9.09	9.17	9.25	9.32
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	5.54	5.66	5.78	5.91	6.04	6.19	6.33	6.49
Sales Tax @ 6% of FOB + Delivery		0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.90	0.91	0.92	0.93	0.95
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.12	8.13	8.14	8.15	8.16	8.18	8.19	8.21
Retail Price LNG/CNG, $/E6 BTU		$ 22.41	$ 22.58	$ 22.75	$ 22.94	$ 23.13	$ 23.33	$ 23.53	$ 23.75	$ 23.97	$ 24.21	$ 24.45	$ 24.71	$ 24.97
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$31.31	$31.80	$32.32	$32.63	$33.09	$33.52	$33.83	$34.25	$34.71	$35.04	$36.22	$37.42	$38.65
% Savings		58.28%	58.48%	58.69%	58.72%	58.86%	58.96%	58.98%	59.05%	59.14%	59.14%	59.70%	60.23%	60.75%
Annual Savings, $/yr		[illegible]	[illegible]	[illegible]	$ 19,712,550	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Savings, Project Life, $		[illegible]												
Present Value of Savings (2011)	(g)	[illegible]												
ENERGY DEMAND														
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	610245	613296	616363	619445	622542	625655	628783	631927
INFLATION FACTORS														
No. of years from 2010		11	12	13	14	15	16	17	18	19	20	21	22	23
Inflation factor	(h)	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73

NOTES:

(a) 2021 - 2030 values from AEA projection, 'high pricing' (Saylor & Foster, ISER, 2010). Post 2030 assumes 2.4% inflation
(b) Assumes LNG Base Year Value = $8.50/E6 BTU DES Asia less $0.59/E6 BTU per page 15 Wood Mac
(d) Derived on "Case B, Delivery Estimate" worksheet.
(e) Assumes 0.5% annual growth due to population growth + higher per capita use.
(f) Developed on Retail Markup Worksheet
(g) Discount rate = 5.0%
(h) Inflation constant @ 2.4%/yr.

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$9.02	$9.24	$9.46	$9.69	$9.92	$10.16	$10.40	$10.65	$10.91	$11.17	$11.44	$11.71	$11.99	$12.28	$12.57	$12.88	$13.19	$13.50
$65.14	$66.71	$68.31	$69.95	$71.63	$73.35	$75.11	$76.91	$78.75	$80.64	$82.58	$84.56	$86.59	$88.67	$90.80	$92.98	$95.21	$97.49
0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.92	4.02	4.11	4.21	4.31	4.42	4.52	4.63	4.74	4.86	4.97	5.09	5.21	5.34	5.47	5.60	5.73	5.87
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
0.71	0.72	0.74	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.90	0.92	0.94	0.96	0.99	1.01	1.03	1.06
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
-1.18	-1.21	-1.24	-1.27	-1.30	-1.33	-1.36	-1.40	-1.43	-1.47	-1.50	-1.54	-1.57	-1.61	-1.65	-1.69	-1.73	-1.77
9.41	**9.49**	**9.57**	**9.66**	**9.75**	**9.84**	**9.93**	**10.03**	**10.13**	**10.23**	**10.33**	**10.43**	**10.54**	**10.65**	**10.76**	**10.88**	**11.00**	**11.12**
9.41	9.49	9.57	9.66	9.75	9.84	9.93	10.03	10.13	10.23	10.33	10.43	10.54	10.65	10.76	10.88	11.00	11.12
6.65	6.82	7.00	7.19	7.39	7.59	7.80	8.03	9.36	9.65	9.96	10.28	10.61	10.96	11.33	11.71	12.11	12.53
0.96	0.98	0.99	1.01	1.03	1.05	1.06	1.08	1.17	1.19	1.22	1.24	1.27	1.30	1.33	1.36	1.39	1.42
8.22	8.24	8.26	8.28	8.30	8.32	8.35	8.37	8.40	8.42	8.45	8.48	8.51	8.54	8.57	8.60	8.64	8.68
$ 25.25	$ 25.53	$ 25.83	$ 26.14	$ 26.46	$ 26.80	$ 27.15	$ 27.51	$ 29.05	$ 29.49	$ 29.95	$ 30.43	$ 30.93	$ 31.45	$ 31.99	$ 32.55	$ 33.13	$ 33.74
$39.90	$41.18	$42.48	$43.81	$45.16	$46.55	$47.96	$49.40	$49.70	$51.15	$52.63	$54.13	$55.66	$57.22	$58.81	$60.43	$62.08	$63.76
61.25%	61.73%	62.19%	62.63%	63.05%	63.46%	63.86%	64.23%	63.11%	63.43%	63.73%	64.01%	64.28%	64.53%	64.77%	64.99%	65.20%	65.40%
[illegible]	[illegible]	[illegible]	$ 28,231,115	$ 29,261,043	$ 30,300,274	[illegible]	[illegible]	$ 32,650,520	$ 33,976,213	$ 35,130,774	[illegible]	$ 37,520,894	[illegible]	$ 40,050,251	[illegible]	$ 42,609,720	[illegible]
635086	638262	641453	644660	647884	651123	654379	657651	660939	664244	667565	670903	674257	677628	681017	684422	687844	691283

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64

B4

Report Reference, Case B4 Figure 1

Wood Mac (note j) "Worst Case", $75/bbl WTI oil, LNG Retail Pricing same as B1 and B2.

Properties				
Diesel HHV, BTU/gal.		138490	100.00%	
Diesel LHV, BTU/gal.		129490	93.50%	
WTI Oil BTU/gal.		6.00E+06		
		min	max	mean
LNG Vaporized, BTU/std ft^3 (enriched for Asia)		1060	1130	1095
LNG density, lb/ft^3		45.04	47.13	46.085
LNG HHV, BTU/gal			86213	85300
LNG LHV, BTU/gal				75437
Average Crack Ratio	(i)			1.18

Estimate Transport & Markup Diesel to Bethel	$/gal Individual	$/gal Cumulative	% Individual	% Cumulative	$/E6 BTU (LHV) Individual	$/E6 BTU (LHV) Cumulative
Base LNG $/E6 BTU	7.91					
Basis Year 2010						
Annual Inflation:	1.024					
Fuel, FOB Refinery	2.11	2.11	53.57%	53.57%	16.27	16.27
Delivery & Offload	0.50	2.61	12.71%	66.28%	3.86	20.13
Sales Tax @ 6%	0.16	2.76	3.98%	70.26%	1.21	21.34
Retail Markup	1.17	3.93	29.74%	100.00%	9.04	30.38
TOTAL	3.93					

		Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Calculated Price, Retail Bethel, $/gal	(a)	$3.93	$4.03	$4.12	$4.22	$4.33	$4.43	$4.54	$4.64	$4.76	$4.87	$4.99	$5.11	$5.23
$/E6 BTU (HHV), Bethel Diesel Retail		$28.40	$29.08	$29.78	$30.50	$31.23	$31.98	$32.75	$33.53	$34.34	$35.16	$36.01	$36.87	$37.75
$/E6 BTU (LHV), Bethel Diesel Retail		$30.38	$31.11	$31.85	$32.62	$33.40	$34.20	$35.02	$35.86	$36.72	$37.61	$38.51	$39.43	$40.38
LNG & CNG														
Wood Mackenzie Model Duplication (HHV)														
Nominal WTI Oil Price, $/bbl	(b)	$75.00	$76.80	$78.64	$80.53	$82.46	$84.44	$86.47	$88.54	$90.67	$92.85	$95.07	$97.36	$99.69
Calculated WTI Oil, $/E6 BTU		12.50	12.80	13.11	13.42	13.74	14.07	14.41	14.76	15.11	15.47	15.85	16.23	16.62
Asia LNG $/E6 BTU, DES basis	(c)	11.73	11.82	12.10	12.39	12.69	13.00	13.31	13.63	13.95	14.29	14.63	14.98	15.34
Less infl. Shipping, $/E6 BTU		0.59	$0.60	$0.62	$0.63	$0.65	$0.66	$0.68	$0.70	$0.71	$0.73	$0.75	$0.77	$0.78
Less pipe transportation, $/E6 BTU		4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
Less liquefaction, $/E6 BTU		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Wellhead netback, $/E6 BTU		2.96	3.04	3.30	3.58	3.86	4.15	4.45	4.75	5.06	5.38	5.70	6.04	6.38
LNG & CNG Price Stack														
LNG Price FOB Valdez, $/E6 BTU (HHV)		8.49	8.55	8.61	8.68	8.74	8.81	8.88	8.95	9.02	9.09	9.17	9.25	9.32
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	5.54	5.66	5.78	5.91	6.04	6.19	6.33	6.49
Sales Tax @ 6% of FOB + Delivery		0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.90	0.91	0.92	0.93	0.95
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.12	8.13	8.14	8.15	8.16	8.18	8.19	8.21
Retail Price LNG/CNG, $/E6 BTU		22.41	22.58	22.75	22.94	23.13	23.33	23.53	23.75	23.97	24.21	24.45	24.71	24.97
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$5.99	$6.51	$7.03	$7.56	$8.10	$8.65	$9.21	$9.78	$10.36	$10.95	$11.55	$12.16	$12.78
% Savings		21.10%	22.37%	23.60%	24.79%	25.95%	27.06%	28.14%	29.18%	30.18%	31.15%	32.09%	32.99%	33.86%
Annual Savings, $/yr		$ 3,567,090	$ 3,892,542	$ 4,226,205	$ 4,568,666	$ 4,920,114	$ 5,280,737	$ 5,650,729	$ 6,030,283	$ 6,419,595	$ 6,818,861	$ 7,228,279	$ 7,648,049	$ 8,078,372
Total Savings, Project Life, $		$ 296,931,968												
Present Value of Savings (2011)	(g)	$124,303,870												
ENERGY DEMAND														
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	610245	613296	616363	619445	622542	625655	628783	631927

NOTES:

(a) Uses historical crack spread to estimate wholesale diesel price, transport @ $0.50/gal, and markup at approx. 29.7% of total from Case A. Subsequent years inflate at 2.4%/yr.

(b) 2021 Value from Wood MacKenzie, "Alaska LNG Exports Competitiveness Study" NY strip scenario (base case), thereafter assumes 2.4% inflation

(c) Indexation of 0.1539 from Wood Mackenzie model

(d) Based on diesel delivery cost per gallon (2010), with 2.4% inflation from 2010, and penalty for LNG energy density.

(e) Assumes 0.5% annual growth due to population growth + higher per capita use.

(f) Developed on Retail Markup Worksheet

(g) Discount rate = 5.0%

(h) Inflation constant @ 2.4%/yr.

(i) From Thies & Brown, "What Drives Fuel Prices" Federal Reserve Bank of Dallas, Economic Letter, Vol. 4, No. 9, Chart 4.

(j) Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$5.35	$5.48	$5.61	$5.75	$5.89	$6.03	$6.17	$6.32	$6.47	$6.63	$6.79	$6.95	$7.12	$7.29	$7.46	$7.64	$7.83	$8.01
$38.66	$39.59	$40.54	$41.51	$42.51	$43.53	$44.57	$45.64	$46.74	$47.86	$49.01	$50.18	$51.39	$52.62	$53.88	$55.18	$56.50	$57.86
$41.35	$42.34	$43.36	$44.40	$45.46	$46.55	$47.67	$48.81	$49.99	$51.19	$52.41	$53.67	$54.96	$56.28	$57.63	$59.01	$60.43	$61.88
$102.08	$104.53	$107.04	$109.61	$112.24	$114.94	$117.70	$120.52	$123.41	$126.37	$129.41	$132.51	$135.69	$138.95	$142.29	$145.70	$149.20	$152.78
17.01	17.42	17.84	18.27	18.71	19.16	19.62	20.09	20.57	21.06	21.57	22.09	22.62	23.16	23.71	24.28	24.87	25.46
15.71	16.09	16.47	16.87	17.27	17.69	18.11	18.55	18.99	19.45	19.92	20.39	20.88	21.38	21.90	22.42	22.96	23.51
$0.80	$0.82	$0.84	$0.86	$0.88	$0.90	$0.93	$0.95	$0.97	$0.99	$1.02	$1.04	$1.07	$1.09	$1.12	$1.15	$1.17	$1.20
4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
6.73	7.09	7.45	7.83	8.21	8.60	9.01	9.42	9.84	10.27	10.72	11.17	11.64	12.11	12.60	13.10	13.61	14.13
9.41	9.49	9.57	9.66	9.75	9.84	9.93	10.03	10.13	10.23	10.33	10.43	10.54	10.65	10.76	10.88	11.00	11.12
6.65	6.82	7.00	7.19	7.39	7.59	7.80	8.03	9.36	9.65	9.96	10.28	10.61	10.96	11.33	11.71	12.11	12.53
0.96	0.98	0.99	1.01	1.03	1.05	1.06	1.08	1.17	1.19	1.22	1.24	1.27	1.30	1.33	1.36	1.39	1.42
8.22	8.24	8.26	8.28	8.30	8.32	8.35	8.37	8.40	8.42	8.45	8.48	8.51	8.54	8.57	8.60	8.64	8.68
25.25	25.53	25.83	26.14	26.46	26.80	27.15	27.51	29.05	29.49	29.95	30.43	30.93	31.45	31.99	32.55	33.13	33.74
$13.41	$14.06	$14.71	$15.37	$16.05	$16.73	$17.43	$18.13	$17.69	$18.37	$19.05	$19.75	$20.46	$21.17	$21.90	$22.63	$23.37	$24.12
34.70%	35.51%	36.28%	37.03%	37.75%	38.43%	39.10%	39.73%	37.84%	38.37%	38.88%	39.36%	39.81%	40.23%	40.64%	41.01%	41.36%	41.69%
$ 8,519,447	$ 8,971,477	$ 9,434,661	$ 9,909,206	$ 10,395,394	$ 10,893,169	$ 11,402,990	$ 11,924,967	$ 11,689,443	$ 12,198,921	$ 12,719,330	$ 13,250,759	$ 13,793,304	$ 14,347,048	$ 14,912,063	$ 15,488,424	$ 16,076,171	$ 16,675,330
635086	638262	641453	644660	647884	651123	654379	657651	660939	664244	667565	670903	674257	677628	681017	684422	687844	691283

B5

Same as Case B2, with cost estimate basis for LNG Delivery & Retail Markup. Add $1/E6 Btu to wellhead value. (reference Wood Mac Study, n

Report Reference: Figure 1, Case B5

Properties			
Diesel HHV, BTU/gal.	138490	100.00%	
Diesel LHV, BTU/gal.	129490	93.50%	
WTI Oil BTU/gal.	6.00E+06		
	min	max	mean
LNG Vaporized, BTU/std ft^3 (enriched for Asia)	1060	1130	1095
LNG density, lb/ft^3	45.04	47.13	46.085
LNG HHV, BTU/gal		86213	85300
LNG LHV, BTU/gal			75437

LNG Cost Buildup, Wood Mac Study, pg. 15 (2010 $/E6 BTU)	
WH Processing	0.26
Processing & Shrinkage	2.22
Transport	1.70
LNG Losses	0.4
Liquefaction	4.00
Liquids Credit	-0.67
LNG FOB Valdez	7.91
Basis Year	2010
Annual Inflation:	1.024

Transport & Markup Diesel to Bethel (2009-2010 Season)	$/gal		%		$/E6 BTU (LHV)	
	Individual	Cumulative	Individual	Cumulative	Individual	Cumulative
Fuel, FOB Refinery	2.40	2.40	54.92%	54.92%	18.53	18.53
Delivery & Offload	0.50	2.90	11.44%	66.36%	3.86	22.40
Sales Tax @ 6%	0.26	3.16	5.95%	72.31%	2.01	24.40
Retail Markup	1.21	4.37	27.69%	100.00%	9.34	33.75

		Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Predicted Diesel Price, Retail Bethel, $/gal	(a)	$4.74	$4.79	$4.85	$4.90	$4.96	$5.00	$5.06	$5.13	$5.21	$5.27	$5.39	$5.52	$5.66
Predicted $/E6 BTU (HHV), Bethel Diesel Retail		$34.19	$34.57	$34.99	$35.37	$35.79	$36.10	$36.56	$37.03	$37.62	$38.04	$38.95	$39.89	$40.85
LNG & CNG	(b)													
Wellhead Value (inflation adjusted)		1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73
WH-Processing		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83
Transport		1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
LNG Losses (inflation adjusted)		0.52	0.53	0.54	0.56	0.57	0.58	0.60	0.61	0.63	0.64	0.66	0.67	0.69
Liquefaction		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Liquids Credit (inflation adjusted)		-0.87	-0.89	-0.91	-0.93	-0.96	-0.98	-1.00	-1.03	-1.05	-1.08	-1.10	-1.13	-1.16
LNG FOB Valdez, $/E6 BTU		**9.79**	**9.88**	**9.98**	**10.07**	**10.17**	**10.27**	**10.37**	**10.48**	**10.59**	**10.70**	**10.81**	**10.93**	**11.05**
LNG & CNG Price Stack														
LNG Price FOB Valdez, $/E6 BTU (HHV)		9.79	9.88	9.98	10.07	10.17	10.27	10.37	10.48	10.59	10.70	10.81	10.93	11.05
Delivery & Offload, $/E6 BTU (HHV)	(d)	5.03	5.12	5.22	5.32	5.43	5.54	5.66	5.78	5.91	6.04	6.19	6.33	6.49
Sales Tax @ 6% of FOB + Delivery		0.89	0.90	0.91	0.92	0.94	0.95	0.96	0.98	0.99	1.00	1.02	1.04	1.05
Retail Markup	(f)	8.08	8.08	8.09	8.10	8.11	8.12	8.13	8.14	8.15	8.16	8.18	8.19	8.21
Retail Price LNG/CNG, $/E6 BTU		23.79	23.99	24.20	24.41	24.64	24.87	25.12	25.37	25.64	25.91	26.20	26.49	26.80
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$10.41	$10.58	$10.79	$10.95	$11.15	$11.23	$11.44	$11.65	$11.98	$12.13	$12.76	$13.40	$14.05
% Savings		30.44%	30.61%	30.84%	30.97%	31.15%	31.10%	31.29%	31.47%	31.84%	31.89%	32.75%	33.59%	34.39%
Annual Savings, $/yr		$ 6,194,721	[illegible]	[illegible]	$ 6,616,945	$ 6,770,372	[illegible]	[illegible]	$ 7,182,634	$ 7,420,087	$ 7,551,746	[illegible]	[illegible]	$ 8,976,622
Total Savings, Project Life, $		$ 235,386,438												
Present Value of Savings (2011)	(g)	$145,746,755												
ENERGY DEMAND														
Heating + Electrical Use,E6 BTU/yr	(e)	595215	598191	601182	604188	607209	610245	613296	616363	619445	622542	625655	628783	631927
INFLATION FACTORS														
No. of years from 2010		11	12	13	14	15	16	17	18	19	20	21	22	23
Inflation factor	(h)	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73

NOTES:

(a) 2021 - 2030 values from AEA projection, 'medium pricing' (Saylor & Foster, ISER, 2010). Post 2030 assumes 2.4% inflation

(b) Assumes LNG Base Year Value = $8.50/E6 BTU DES Asia less $0.59/E6 BTU per page 15 Wood Mac

(d) Derived on "Case B, Delivery Estimate" worksheet.

(e) Assumes 0.5% annual growth due to population growth + higher per capita use.

(f) Developed on Retail Markup Worksheet

(g) Discount rate = 5.0%

(h) Inflation constant @ 2.4%/yr.

(i) Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

ote i) .

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$5.79	$5.93	$6.07	$6.22	$6.37	$6.52	$6.68	$6.84	$7.00	$7.17	$7.34	$7.52	$7.70	$7.88	$8.07	$8.27	$8.47	$8.67
$41.83	$42.83	$43.86	$44.91	$45.99	$47.09	$48.22	$49.38	$50.57	$51.78	$53.02	$54.29	$55.60	$56.93	$58.30	$59.70	$61.13	$62.60
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64
0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.92	4.02	4.11	4.21	4.31	4.42	4.52	4.63	4.74	4.86	4.97	5.09	5.21	5.34	5.47	5.60	5.73	5.87
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
0.71	0.72	0.74	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.90	0.92	0.94	0.96	0.99	1.01	1.03	1.06
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
-1.18	-1.21	-1.24	-1.27	-1.30	-1.33	-1.36	-1.40	-1.43	-1.47	-1.50	-1.54	-1.57	-1.61	-1.65	-1.69	-1.73	-1.77
11.17	**11.30**	**11.43**	**11.56**	**11.69**	**11.83**	**11.97**	**12.11**	**12.26**	**12.41**	**12.57**	**12.73**	**12.89**	**13.05**	**13.22**	**13.40**	**13.58**	**13.76**
11.17	11.30	11.43	11.56	11.69	11.83	11.97	12.11	12.26	12.41	12.57	12.73	12.89	13.05	13.22	13.40	13.58	13.76
6.65	6.82	7.00	7.19	7.39	7.59	7.80	8.03	9.36	9.65	9.96	10.28	10.61	10.96	11.33	11.71	12.11	12.53
1.07	1.09	1.11	1.12	1.14	1.17	1.19	1.21	1.30	1.32	1.35	1.38	1.41	1.44	1.47	1.51	1.54	1.58
8.22	8.24	8.26	8.28	8.30	8.32	8.35	8.37	8.40	8.42	8.45	8.48	8.51	8.54	8.57	8.60	8.64	8.68
27.12	27.45	27.79	28.15	28.52	28.91	29.31	29.72	31.32	31.81	32.33	32.86	33.42	34.00	34.60	35.22	35.87	36.54
$14.71	$15.38	$16.06	$16.76	$17.47	$18.19	$18.92	$19.66	$19.25	$19.97	$20.69	$21.43	$22.18	$22.93	$23.70	$24.48	$25.26	$26.06
35.16%	35.91%	36.63%	37.32%	37.98%	38.62%	39.23%	39.81%	38.07%	38.56%	39.03%	39.47%	39.89%	40.28%	40.65%	41.00%	41.33%	41.63%
$ 9,840,943	$ 9,916,897	$ 10,394,699	$ 10,904,578	$ 11,316,759	$ 11,841,447	$ 12,378,891	$ 12,929,276	$ 12,722,996	$ 13,262,576	$ 13,813,955	$ 14,377,260	$ 14,952,008	$ 15,540,112	$ 16,139,872	$ 16,751,988	$ 17,376,625	$ 18,013,570
635086	638262	641453	644660	647884	651123	654379	657651	660939	664244	667565	670903	674257	677628	681017	684422	687844	691283

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64

Appendix D

Model Spreadsheets, Fairbanks

F1

Fairbanks Wholesale Comparison, IEA Reference Diesel costs w/ adjustment to AK wholesale & $1.00/E6 BTU wellhead gas value

Report Reference: Figure 3, Case F1

Lower 48 Wholesale Diesel price, $/E6 BTY (Feb 2011)	20.96 (d)			
AK Wholesale Diesel price, $/E6 BTY (Feb 2011)	22.64 (d)			
Properties				
Diesel HHV, BTU/gal.		138490	100.00%	
Diesel LHV, BTU/gal.		129490	93.50%	
WTI Oil BTU/gal.		6.00E+06		
		min	max	mean
LNG Vaporized, BTU/std ft^3 (enriched for Asia)		1060	1130	1095
LNG density, lb/ft^3		45.04	47.13	46.085
LNG HHV, BTU/gal			86213	85300
LNG LHV, BTU/gal				75437
CNG density @ 3600 psig, lb/ft^3				12.1

NG Wholesale Cost Buildup, based on Wood Mac Study, pg. 15 (i).

Wellhead Value	1.00			
WH Processing	0.26			
Processing & Shrinkage	2.22			
Transport	1.15	Transport to Valdez		$ 1.70
LNG Losses	0.00	Miles to Valdez		800
Liquefaction	0.00	Miles to Fairbanks		540
Liquids Credit	0.00	Ratio FAI miles/Valdez Miles		0.675
NG Wholesale City Gate FAI, $/	4.63	Central Oil Furnaces in FAI	(b)	21134
Basis Year 2010		Ave Oil Furnace consump.	(b)	938
Annual Inflation:	1.024	FAI Oil Furnace Use, BTU/yr		2.567E+12
Annual demand growth	1.005			

		Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Predicted Diesel Price, Wholesale Lower 48 Ave., $/gal	(a)	$3.54	$3.61	$3.63	$3.71	$3.73	$3.75	$3.80	$3.82	$3.87	$3.83	$3.84	$3.85	$3.85
Alaska Wholesale Price Surcharge, $/gal		$0.23	$0.24	$0.24	$0.24	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25
Predicted Diesel Price, Wholesale Fairbanks Ave., $/gal		$3.77	$3.85	$3.87	$3.95	$3.97	$4.00	$4.05	$4.07	$4.12	$4.09	$4.09	$4.10	$4.10
Predicted $/E6 BTU (HHV), FAI Diesel Wholesale		**$27.23**	**$27.80**	**$27.94**	**$28.54**	**$28.67**	**$28.87**	**$29.26**	**$29.39**	**$29.77**	**$29.50**	**$29.55**	**$29.60**	**$29.64**
Wholesale Natural Gas														
Wellhead Value		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WH-Processing (Invariant)		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (Inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83
Transport (Invariant)		1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
LNG Losses (Inflation adjusted)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefaction (Invariant)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquids Credit (Inflation adjusted)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NG FAI City Gate, $/E6 BTU		**5.29**	**5.36**	**5.43**	**5.50**	**5.58**	**5.65**	**5.73**	**5.81**	**5.89**	**5.97**	**6.06**	**6.15**	**6.24**
Equivalent gas price, $/Diesel gallon equivalent		0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.82	0.83	0.84	0.85	0.86
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$21.94	$22.44	$22.51	$23.03	$23.10	$23.21	$23.53	$23.58	$23.88	$23.53	$23.49	$23.46	$23.40
% Savings		80.57%	80.72%	80.57%	80.72%	80.55%	80.42%	80.42%	80.23%	80.21%	79.75%	79.49%	79.23%	78.95%
Annual Savings, $/yr		$ 59,430,382	$ 61,190,326	$ 61,662,578	$ 63,403,868	$ 63,937,135	$ 64,540,096	[illegible]	$ 66,213,997	$ 67,400,531	$ 66,736,462	$ 66,957,717	$ 67,193,620	$ 67,364,805
Total Savings, Project Life, $		$ 2,313,791,946												
Present Value of Savings (2021)	(g)	$1,124,040,265												
ENERGY DEMAND														
Heating Fuel Use,E6 BTU/yr	(e)	2711736	2725295	2738921	2752616	2766379	2780211	2794112	2808083	2822123	2836234	2850415	2864667	2878990
INFLATION FACTORS														
No. of years from 2010		11	12	13	14	15	16	17	18	19	20	21	22	23
Inflation factor	(h)	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73
Energy growth factor		1.06												

(a) 2021 - 2035 from EIA Petroleum Products forecast, "Reference Case" (data for: "Transportation Fuel, Diesel Fuel (distillate fuel oil) 6/" . 2036 thru 2050 Inflation factor =2.4%/yr.

(b) Sierra Research, '2010 Fairbanks Home Heating Survey', June 2010

(d) EIA data and PDC Harris Group fuel cost Snapshot June 2011.docx,

(e) Calculated from 2010 Fairbanks Home Heating Survey. Assumes 0.5% annual growth due to population growth + higher per capita use.

(f)

(g) Discount rate = 5.0%

(h) Inflation constant @ 2.4%/yr.

(i) Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

(j) Szymoniak et al, "Components of Alaska Fuel Costs: An Analysis of Market Factors and Characteristics that Influence Rural Fuel Prices", Institute of Social and Economic Research (ISER), Univ. of Alaska, February 2010.

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$3.87	$3.89	$3.98	$4.08	$4.18	$4.28	$4.38	$4.48	$4.59	$4.70	$4.82	$4.93	$5.05	$5.17	$5.29	$5.42	$5.55	$5.69
$0.25	$0.26	$0.26	$0.27	$0.27	$0.28	$0.29	$0.29	$0.30	$0.31	$0.32	$0.32	$0.33	$0.34	$0.35	$0.36	$0.37	$0.37
$4.13	$4.15	$4.25	$4.35	$4.45	$4.56	$4.67	$4.78	$4.89	$5.01	$5.13	$5.26	$5.38	$5.51	$5.64	$5.78	$5.92	$6.06
$29.80	**$29.94**	**$30.65**	**$31.39**	**$32.14**	**$32.91**	**$33.70**	**$34.51**	**$35.34**	**$36.19**	**$37.06**	**$37.95**	**$38.86**	**$39.79**	**$40.75**	**$41.72**	**$42.73**	**$43.75**
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.92	4.02	4.11	4.21	4.31	4.42	4.52	4.63	4.74	4.86	4.97	5.09	5.21	5.34	5.47	5.60	5.73	5.87
1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.33	**6.42**	**6.52**	**6.62**	**6.72**	**6.82**	**6.93**	**7.04**	**7.15**	**7.26**	**7.38**	**7.50**	**7.62**	**7.75**	**7.87**	**8.01**	**8.14**	**8.28**
0.88	0.89	0.90	0.92	0.93	0.95	0.96	0.97	0.99	1.01	1.02	1.04	1.06	1.07	1.09	1.11	1.13	1.15
$23.48	$23.51	$24.13	$24.77	$25.42	$26.09	$26.78	$27.48	$28.19	$28.93	$29.68	$30.45	$31.24	$32.05	$32.87	$33.72	$34.59	$35.47
78.76%	78.54%	78.73%	78.91%	79.09%	79.27%	79.44%	79.61%	79.77%	79.93%	80.09%	80.24%	80.39%	80.53%	80.67%	80.81%	80.95%	81.08%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2893385	2907852	2922391	2937003	2951688	2966447	2981279	2996185	3011166	3026222	3041353	3056560	3071843	3087202	3102638	3118151	3133742	3149411

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64

F2

Fairbanks Wholesale Comparison, IEA 'High Economic Growth' Diesel costs w/ adjustment to AK wholesale & $1.00/E6 BTU wellhead gas value

Report Reference: Figure 1, Case B1

Lower 48 Wholesale Diesel price, $/E6 BTY (Feb 2011)	20.96 (d)	
AK Wholesale Diesel price, $/E6 BTY (Feb 2011)	22.64 (d)	

Properties

	min	max	mean
Diesel HHV, BTU/gal.	138490	100.00%	
Diesel LHV, BTU/gal.	129490	93.50%	
WTI Oil BTU/gal.	6.00E+06		
LNG Vaporized, BTU/std ft^3 (enriched for Asia)	1060	1130	1095
LNG density, lb/ft^3	45.04	47.13	46.085
LNG HHV, BTU/gal		86213	85300
LNG LHV, BTU/gal			75437
CNG density @ 3600 psig, lb/ft^3			12.1

NG Cost Buildup, Wood Mac Study, pg. 15

Wellhead Value	1.00			
WH Processing	0.26			
Processing & Shrinkage	2.22			
Transport	1.15	Transport to Valdez		$ 1.70
LNG Losses	0.00	Miles to Valdez		800
Liquefaction	0.00	Miles to Fairbanks		540
Liquids Credit	0.00	Ratio FAI miles/Valdez Miles		0.675
NG Wholesale City Gate FAI, $/	4.63	Central Oil Furnaces in FAI	(b)	21134
Basis Year 2010		Ave Oil Furnace consump.	(b)	938
Annual Inflation:	1.024	FAI Oil Furnace Use, BTU/yr		2.567E+12
Annual demand growth	1.005			

		Start-up	1	2	3	4	5	6	7	8	9	10	11	12
DIESEL		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Predicted Diesel Price, Wholesale Lower 48 Ave., $/gal	(a)	$3.67	$3.73	$3.79	$3.84	$3.90	$3.93	$3.93	$3.95	$3.98	$3.98	$4.02	$4.05	$4.05
Alaska Wholesale Price Surcharge, $/gal		$0.23	$0.24	$0.24	$0.24	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.26	$0.26
Predicted Diesel Price, Wholesale Fairbanks Ave., $/gal		$3.90	$3.97	$4.03	$4.09	$4.15	$4.18	$4.18	$4.20	$4.23	$4.24	$4.27	$4.30	$4.30
Predicted $/E6 BTU (HHV), FAI Diesel Wholesale		**$28.17**	**$28.66**	**$29.10**	**$29.52**	**$29.93**	**$30.20**	**$30.16**	**$30.32**	**$30.57**	**$30.59**	**$30.84**	**$31.07**	**$31.07**
Wholesale Natural Gas														
Wellhead Value		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WH-Processing (Invariant)		0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Processing & Shrinkage (Inflation adjusted)		2.88	2.95	3.02	3.09	3.17	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83
Transport (Invariant)		1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
LNG Losses (Inflation adjusted)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefaction (Invariant)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquids Credit (Inflation adjusted)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NG FAI City Gate, $/E6 BTU		**5.29**	**5.36**	**5.43**	**5.50**	**5.58**	**5.65**	**5.73**	**5.81**	**5.89**	**5.97**	**6.06**	**6.15**	**6.24**
Equivalent gas price, $/Diesel gallon equivalent		0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.82	0.83	0.84	0.85	0.86
SAVINGS														
Savings, Diesel - LNG, $/E6 BTU (HHV)		$22.88	$23.30	$23.67	$24.02	$24.36	$24.55	$24.43	$24.51	$24.68	$24.62	$24.78	$24.92	$24.83
% Savings		81.22%	81.30%	81.34%	81.36%	81.37%	81.28%	81.00%	80.84%	80.73%	80.47%	80.35%	80.21%	79.92%
Annual Savings, $/yr		$ 62,034,873	$ 63,495,887	$ 64,839,219	$ 66,105,173	$ 67,377,180	$ 68,250,018	$ 68,265,417	$ 68,815,091	$ 69,642,859	$ 69,820,774	$ 70,625,234	$ 71,387,622	$ 71,426,094
Total Savings, Project Life, $		$ 2,548,598,605												
Present Value of Savings (2021)	(g)	$1,184,320,513												
ENERGY DEMAND														
Heating Fuel Use,E6 BTU/yr	(e)	2711736	2725295	2738921	2752616	2766379	2780211	2794112	2808083	2822123	2836234	2850415	2864667	2878990
INFLATION FACTORS														
No. of years from 2010		11	12	13	14	15	16	17	18	19	20	21	22	23
Inflation factor	(h)	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61	1.65	1.68	1.73
Energy growth factor		1.06												

NOTES:

(a) 2021 - 2030 from EIA Petroleum Products forecast, Reference Case (data for: "Transportation Fuel, Diesel Fuel (distillate fuel oil) 6/"

(b) Sierra Research, '2010 Fairbanks Home Heating Survey', June 2010

(d) EIA data and PDC Harris Group fuel cost Snapshot June 2011.docx,

(e) Calculated from 2010 Fairbanks Home Heating Survey. Assumes 0.5% annual growth due to population growth + higher per capita use.

(f)

(g) Discount rate = 5.0%

(h) Inflation constant @ 2.4%/yr.

(i) Wood Mackenzie, "Alaskan LNG Exports Competitiveness Study" 27 July 2011.

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
$4.06	$4.09	$4.18	$4.28	$4.39	$4.49	$4.60	$4.71	$4.82	$4.94	$5.06	$5.18	$5.30	$5.43	$5.56	$5.70	$5.83	$5.97
$0.26	$0.26	$0.27	$0.27	$0.28	$0.28	$0.29	$0.30	$0.31	$0.31	$0.32	$0.33	$0.34	$0.34	$0.35	$0.36	$0.37	$0.38
$4.32	$4.35	$4.45	$4.56	$4.67	$4.78	$4.89	$5.01	$5.13	$5.25	$5.38	$5.51	$5.64	$5.78	$5.91	$6.06	$6.20	$6.35
$31.18	**$31.38**	**$32.13**	**$32.90**	**$33.69**	**$34.50**	**$35.33**	**$36.17**	**$37.04**	**$37.93**	**$38.84**	**$39.77**	**$40.73**	**$41.71**	**$42.71**	**$43.73**	**$44.78**	**$45.86**
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
3.92	4.02	4.11	4.21	4.31	4.42	4.52	4.63	4.74	4.86	4.97	5.09	5.21	5.34	5.47	5.60	5.73	5.87
1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.33	**6.42**	**6.52**	**6.62**	**6.72**	**6.82**	**6.93**	**7.04**	**7.15**	**7.26**	**7.38**	**7.50**	**7.62**	**7.75**	**7.87**	**8.01**	**8.14**	**8.28**
0.88	0.89	0.90	0.92	0.93	0.95	0.96	0.97	0.99	1.01	1.02	1.04	1.06	1.07	1.09	1.11	1.13	1.15
$24.85	$24.95	$25.61	$26.28	$26.97	$27.67	$28.40	$29.14	$29.89	$30.67	$31.46	$32.27	$33.11	$33.96	$34.83	$35.73	$36.64	$37.58
79.70%	79.53%	79.71%	79.88%	80.05%	80.22%	80.38%	80.54%	80.70%	80.85%	81.00%	81.15%	81.29%	81.43%	81.56%	81.69%	81.82%	81.95%
$ 71,910,796	$ 72,554,829	$ 74,836,481	$ 77,185,420	$ 79,503,608	$ 83,093,066	$ 84,655,804	$ 87,294,173	$ 90,010,165	$ 92,800,116	$ 95,684,329	$ 98,847,296	$ 101,697,396	$ 104,887,203	$ 108,069,333	$ 111,396,478	$ 114,851,411	$ 118,346,984
2893385	2907852	2922391	2937003	2951688	2966447	2981279	2996185	3011166	3026222	3041353	3056560	3071843	3087202	3102638	3118151	3133742	3149411
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.77	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.46	2.52	2.58	2.64

MICHAEL W. MOORA, P.E.

BUSINESS SECTOR MANAGER, PROJECT MANAGER,

& PROCESS ENGINEER

University of Utah
Master of Science, Fuels & Chemical Engineering

Drexel University
Master of Science, Environmental Engineering

Rutgers University
Bachelor of Science, Mechanical/Aerospace Engineering

BACKGROUND

Mike Moora is a registered Process Engineer and Project Manager with over 30 years of experience in a broad spectrum of process and environmental remediation industries. He has executed projects in diverse areas such as North Slope production and utility systems, natural gas treatment, synthesis gas production, flue gas cleanup, RCRA waste treatment, remedial designs/actions, radioactive waste immobilization, wastewater treatment, synthetic fuels pilot development, chemicals production and biotechnology development.

Mr. Moora has design experience including:

— Feasibility and economic analysis
— Conceptual design and optimization studies
— Process design development and flow sheet simulation
— Detailed engineering - equipment/instrument data sheets and purchase specifications
— Project management - deliverables and schedule management, costs, and change orders
— Equipment procurement and fabrication inspection
— HAZOP analysis and relief valve design/documentation
— Operating manuals/operator training, facility commissioning and start-up
— Technology assessment and due diligence investigations
— Air emissions control and air quality permitting

EXPERIENCE

— General Manager, PDC Harris Group LLC, Anchorage, AK. Responsible for business development, project management and operations support for this energy business-sector joint venture. Business development and project management work included:

- BP Exploration (Alaska) Inc:

  - ➢ Project Sponsor, Heavy Oil Team Mobile Laboratory RFP Package. Preparation of bid package for a heavy oil sample preparation laboratory for the Milne Point S Pad.

  - ➢ Project Manager, Liberty Rig Power Generation Module Cooling System Modifications. Detailed design and preparation of IFC packages for retrofitting controls valves, piping and control system modifications to bring tighter process control of diesel engine coolant system.

  - ➢ Project Sponsor, Central North Slope Power Generation – Appraise Stage Study. Concept engineering and capital cost estimating services for this staged 250 MWe to 750 MWe project to bring more efficient combined cycle generation to support future area-wide production.

  - ➢ Project Sponsor, Greater Prudhoe Bay ULSD Storage Procurement Services. Project entailed troubleshooting of BPXA and contractor procurement system to expedite delivery of key equipment services.

  - ➢ Project Sponsor, Milne Point Interim Power Generation Appraise Stage Engineering Services. Pre-concept analysis of gas turbine generator alternatives.

  - ➢ Project Manager, Milne Point Heavy Oil Pilot Power Generation Select Stage Engineering Services. Concept level analysis of 1 to 1.5 MW transportable/modular power generation

  - ➢ Project Manager, Milne Point S Pad Heater Repair Define & Execute Stage Engineering Services. Procurement and submittal if IFC packages thru BPXA Documentum system. Addressing construction phase RFI's, and assisting with system commissioning.

  - ➢ Project Manager for a fast-track detailed design for a major slab on grade compressor building at the Milne Point Unit. Extremely rapid development of concepts for a stick-built, custom engineered building employing a passive foundation supporting a 15,000 horsepower reciprocating gas compressor.

- Project Manager for a generator replacement project at BPXA's Milne Point. Involved development of a detailed specification to provide an upgraded 25 MVA generator capable of retrofit within tight confines of an off-shore enclosure.

- Project Manager for developing a specification for modular camp design for North Slope deployment. Responsible for architectural, mechanical, electrical, foundation and fire protection.

- Doyon Utilities, Fairbanks AK:

  - Project Manager, Ft Greely Boiler steam blow temporary piping design. Piping design, stress analysis, support design and selection of steam silencer.

  - Preparation of qualifications and detailed proposals resulting in the award of ~$1.5 million engineering services contracts in support of Doyon's privatization takeover of multiple power generation and related utility systems at three DOD bases.

  - Project Manager, Ft. Greely Boiler Upgrade and SCADA system design.

- City of Bethel, Alaska, Development of LCNG Technology Application for Fuel Substitution. Formed partnership with Bethel tribal officials and compiled application to Alaska Energy Authority (AEA).

- Municipality of Anchorage, Municipal Light & Power:

  - Project Sponsor, Plant 1 Black Start Generator concept and detailed design services. Concept design led to optimum configuration of diesel generator system. Detailed design involved the preparation of CSI format specifications and detailed multi-discipline drawing package for a nominal 2 MWe diesel system including a custom enclosure, remote heat exchanger and power distribution sytem.

  - Project Manager/Lead Process Engineer for Waste Heat Recovery Project involving rejection of heat from existing and new generation assets to Anchorage Water and Wastewater utility.

  - Project Manager/Lead Process Engineer for Unit 3 Fuel Gas Booster Compressor improvements. Work involved selection of new relief valves, analysis of recycle gas system, vent silencer assessment, and lube oil cooling system upgrades.

- Project Manager for (Select Stage) concept design and capital cost estimate to retrofit Units 5 and 7 combined cycle combustion turbines with selective catalytic reduction (SCR) NOx reactors integrated within the existing heat recovery steam generators (HRSG).

- Project Manager detailed analysis of Chugach Electric's Southcentral Alaska 2x1 CTG siting study.

- Project Manager for feasibility and concept level engineering development of a 2 x 1 GE 6FA combustion turbine power generation system. Responsible for all aspects of this 236 MWe power plant, including engineering deliverables, contracting plan, risk management plan, procurement plan, technical studies, and customer liaison.

- Project engineer for Unit 5 heat balance study examining retrofitting of GE LM2500+ and LM6000 to replace existing Westinghouse W251B-3 gas turbine.

• Questar Gas Management Co., Salt Lake City:

  - Project Manager, Vermillion Gas Plant Sulfur Removal Study. Conducted concept designs and cost estimating services to assess process alternatives for removal of H2S from NGL stream.

  - Lead Process Engineer for the development of a detailed ASPEN HYSYS simulator package for the Blacks Fork Gas Processing Plant. Following refinement of model, used to debottleneck fractionation train for enhancing the production of NGLs.

• Army Corps of Engineers, Alaska District:

  - Process Engineer, Eielson AFG Boiler Replacement Project. Developed concept design alternatives for emissions control system for retrofit coal-fired boilers. Developed design basis, flow sheets and system specifications.

  - Process Engineer supporting field check-out and commissioning of an air-cooled condenser system at Ft Wainwright, AK. This retrofit project entailed a 3 bay system for condensing turbine exhaust steam from 3 x 5 MW steam turbines to alleviate the formation of ice-fog from the plant cooling pond.

- Chugach Electric Association:
    - Project Manager, South-central Project Waste Heat Recovery Assessment. Study investigated the technical and economic feasibility of low level waste heat conversion to electric power or export for space heating and snow melt. Provided system sizing for a hypothetical circulating glycol-water system, with economic analysis based upon simple payout times for commercial sale of waste heat.
    - Lead specifications development to support the upgrade of the turbine control system for Unit 5 gas turbine system at Beluga River Station.
    - Project Manager for Bernice Lake Power Plant Water Injection System. This fast-track detailed design focused on design and procurement services for a de-ionized water injection system to mitigate NOx formation on two GE Frame 5 gas turbines.
    - Project Manager/Lead Process Engineer: Southcentral Power Project heat recovery project. Managed a study to assess the technical and economic feasibility of large scale heat rejection to various users in the vicinity of the SPP site.
- HC&S Company, Maui, Hawaii: Project manager for a structural assessment and modifications to support structure and foundations for Boiler No. 3 stack, venturi scrubber and separator.
- Chevron Alaska (formerly UNOCAL Alaska): Negotiation and development of a general engineering services agreement.
- Aurora Energy: Management of technical and economic feasibility studies aimed at bringing the Chena Plant into compliance with recent ADEC Notice of Violation (PM-10), while providing enhanced power sales revenues.
- Winstar Petroleum: Detailed design of oil production system at Oliktok Point State No. 1; tie-in to existing ConcoPhillips (CPAI) manifold and test separator at drillpad 3R. Design integration with CPAI engineering standards, and including gated & phased project development methodology.
- Forest Oil Corporation: Detailed design of oil production systems for Osprey Platform Well Room No. 2 and gas production for Well Room No.3. This project involved process design of relief devices, high pressure flowline piping, associated field-mounted instruments/valves, structural steel design, and electrical systems to support downhole electric submersible pumps.

- Alaska District of the US Army Corps of Engineers: Construction administration services in support of the Ft Wainwright Central Heat and Power Plant Emissions Reduction Project. Responsibilities for this major baghouse collector construction project included vendor data review, review and approval of contractor commissioning and compliance plans, as well as gathering commissioning data and compiling performance evaluations.

- Golden Valley Electric Association: Preparation of proposal documents to execute fast-track engineering at GVEA's North Pole Station for the addition of LM6000 combustion turbines, HRSG and related combined-cycle equipment. Evaluation led to making the short-list of candidate engineering-design contractors.

— Process Engineer and Project Manager for the process design optimization, air quality permitting requirements identification, capital and operating cost estimates for the air-cooled condensers at Ft. Wainwright AK Central Heating and Power Plan (CHPP). These dry coolers are intended to condense steam turbine exhaust from four CHPP turbines, and eliminate the use of the present cooling pond – a source of ice fog and conventional fog.

— Project Manager developing heat and material balances for El Paso Energy's Sturgis Amine Unit. HYSYS simulation of the amine unit was used to generate the multiple balances for acid gas removal from raw natural gas. He was also responsible for developing a Process Flow Diagram (PFD), developing the heat and material balance, submittal of related engineering deliverables

— Project Manager for the preparation of engineering documents and bid package components for Eielson AFB, AK Emissions Reduction Project. The system design included baghouse collector design and specification for the removal of flyash from the flue gas generated from six (6) coal-fired spreader stoker boilers. Responsibilities also included the preparation of Compliance Assurance Monitoring (CAM) Plan for the baghouse collectors, and developing a strategy for avoiding New Source Performance Standards (NSPS), as well as avoiding regulatory applicability of Prevention of Significant Deterioration (PSD) and New Source Review (NSR) requirements.

— Project Manager and Lead Investigator for a multi-source Air Quality Construction Permit Application to the Alaska Department of Environmental Conservation for Ft. Wainwright Army Base. Mr. Moora was responsible for all aspects of this application covering four (4) modifications to Ft. Wainwright's emissions inventory, including a coal-fired boiler upgrade, the addition of fabric filters to the Central Heat and Power Plant, a new 32 hospital and the air emissions from on-going CERCLA clean-up of contaminated soil and groundwater. Mr. Moora developed the permit strategy resulting in avoiding a detailed Prevention of Significant Deterioration (PSD), and New Source Review (NSR) application process.

— Project Manager/Lead Engineer for a detailed design review and quality assurance check of steam generator refurbishment package developed for Ft. Wainwright Central Heating and Power Plant.

— Project Manager/Lead Engineer for conceptual design, detailed design and specification of fabric filter collectors and related systems on 6 coal-fired steam generators at Ft. Wainwright, AK, Army base. Responsibilities included the development of engineering conditions of service, P&IDs, military specifications. Project also included preparation of environmental documents including CAM Plan and air quality regulatory survey.

— Lead Process Engineer for field investigation of internal pipeline corrosion and related NGL processing problems caused by Sulfate Reducing Bacteria. Developed field sampling and monitoring program to identify/quantify extent of problem in 100+ mile pipeline in Wyoming.

— Lead Process Engineer/Project Manager for technical & economic feasibility analysis for application of amine-based tail gas unit retrofit for the following facilities. Work resulted in the execution of a Technical Services Agreement with ExxonMobil Research & Engineering in support of their FLEXSORB solvent technology.

- Chevron (now ChevronTexaco) Products Inc., Pascagoula MS Refinery
- Chevron USA, Carter Creek Gas Plant, Evanston, WY
- TOSCO (now ConocoPhillips) Corp., Wilmington CA Refinery
- TOSCO Corp., San Francisco Area Refinery
- Valero Energy, Paulsboro NJ Refinery
- Clark Oil Co., Blue Island IL Refinery

— Lead Process Engineer on landfill gas supply and processing investigation. Field investigation aimed at identification of supply interruptions associated with gas compressors, and SELEXOL acid gas removal.

— Lead Process Engineer and Project Manager for technical assessment of mechanical vapor compression process for desalination of seawater. Responsible for process simulation, heat and material balances, thermodynamics analysis, heat transfer system analysis, market study and risk analysis.

— Lead Process Engineer for process engineering operations assistance study for ExxonMobil's sour, high CO_2 natural gas processing plant in southwest Wyoming. Responsible for process modification investigations involving triethylene glycol dehydration unit to boost throughput, reduce glycol contamination, and absorber carryover losses.

- Lead Process Engineer for chiller alternatives study associated with a batch biotechnology process. Quantified future refrigeration loads, selected optimum coolant and temperature, and identified process design alternatives for facility expansion.

- Senior Engineer. Responsible for scale-up and design development for Molten Metal Technology's proprietary technology for treatment of various waste types. Execution of conceptual and detailed design projects, both in-house and within E&C contractor offices; checkout and start-up of commercial facilities and management of technology development teams. Successful assignments included:

  - Managed development team of engineers and technicians running demonstration-scale platforms for tapping molten liquids from MMT's Catalytic Extraction Process. Successfully demonstrated concepts using induction heated valves and sacrificial materials for deinventory/intermittent liquid phase removal.

  - Prepared proposal and accompanying engineering documents for DOE's largest privatized remediation project at the Hanford Reservation, in partnership with Lockheed Martin Corp. Developed process design package including reactor, gas injection, contaminated iron preparation, pneumatic transfer, hydraulic system configuration, NaOH recovery, glass/metal tapping and glass annealing systems.

  - Prepared process engineering package and permitting documents for the design, procurement and construction of a pilot unit to treat Hanford waste surrogate materials.

- Provided consulting services including:

  - Engineering consulting services for preparation of air quality permit documents and emission inventories under the 1990 Amendments to the Clean Air Act.

  - Retained to assist in final design, start-up and operation of RUST's soil washing pilot plant at WMX Technologies R&D headquarters in Senior Engineer and Manager of Permitting with Waste-Tech Services, a wholly-owned subsidiary of Amoco Oil Corporation. Responsible for process design and the securing of RCRA and Air Quality permits for a grass-roots regional incinerator project in Florida.

- Assistant Manager of Commissioning responsible for checkout and start-up of a world-class natural gas processing plant in southwestern Wyoming for Exxon USA. Mr. Moora supervised the daily activities of approximately 25 engineers and designers in all technical disciplines. He was also responsible for checkout and commissioning of systems involving

TEG dehydration, produced water handling and injection, hydraulic systems for larger ROVs, slug catchers and sour gas compressors.

- Lead Process Engineer, Exxon LaBarge Dehydration Facility. Responsible for detailed process design documents for a 500 MMSCFD glycol dehydration plant for high CO_2 natural gas. Plant included triethylene glycol dehydration process, utility systems, corrosion inhibitor storage and transmission systems, as well as a unique low-BTU flare stack with combustion assist gas.

- Lead Process Engineer, Petroleum and Petrochemicals Division. Supervision of process engineers during conceptual design and detailed design of various gas treating, chemical, energy, pollution abatement and other projects. Responsible for compiling process conditions of service, flow sheets, equipment specifications, operating manuals and emissions estimates for environmental permits. Also responsible for client interaction involving design approval and monitoring of monthly progress.

EMPLOYMENT

- Molten Metals Technology, Inc.
- Camp, Dresser & McKee
- MWM Consulting Services
- Clearflow Inc.
- Waste-Tech Services, Inc. (adba: Ecova Corp.)
- Vista Laboratories, Inc (now Analytica Group)
- Stearns-Roger Engineering Corp. (adba: Stearns-Catalytic, United Engineers, Raytheon Engineers and Constructors, Washington Group, URS)
- Catalytic, Inc.

LICENSES AND CERTIFICATION

- Professional Engineer Registration, Colorado
- Registered Environmental Manager
- University of Alaska, Arctic Engineering Short Course, November 2001
- Currently enrolled in Project Management Institute training for PMP certification

PROFESSIONAL AFFILIATIONS

- Gas Processors Association
- Project Management Institute
- Society of Petroleum Engineers

TECHNICAL PAPERS

"The Design of a Commercial RCRA Incinerator - Where the Regulations Are Taking Us", Presented at the Colorado Hazardous Waste Management Society, Fall 1991, Denver, CO.

"Design and Environmental Permitting Challenges for the Ft. Wainwright, Alaska Power Plant Fabric Filter System", Presented at the Air and Waste Management Association Conference, Orlando FL, June 24 - 28 2001.

R Fedich, D McCaffrey, M Moora and R Ungs, *"Upgrade Your Tail Gas Treating Unit With FLEXSORB SE Plus",* Paper presented at the 2003 Brimstone Sulfur Recovery Symposia, Vail Colorado, September 2003.

"LCNG – A Bridge Solution to High Energy Costs in Rural Alaska", Presentation to the Cold Regions Design Forum, Fairbanks, AK, February 2011.

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City of Bethel Action Memorandum

Action memorandum No.	12-14		
Date action introduced:	2-14-12	Introduced by:	Mayor Klejka
Date action taken:		▒ Approved	▒ Denied
Confirmed by:			

SUBJECT/ACTION: *Approve Mayor Klejka's appointment of John Dickens to the Port Commission.*

Route to:	Department/Individual:	Initials:	Remarks:
X	City Manager		
X	Port Director		

Attachment(s): Application

Amount of fiscal impact		Account information:
X	No fiscal impact	
	Funds are budgeted for.	
	Funds are not budgeted. Budget modification is required. Affected account number:	

Action memorandum 12-14 is sponsored by Mayor Klejka at the request of the City Clerk.

John Dickens has requested appointment to the City's Port Commission. If appointed Mr. Dickens would fill one of four Commission vacancies for a term of three years.

Office of the City Clerk
City of Bethel
300 State Highway
Bethel, AK 99559-1388
Phone: (907)-543-1384
Fax: (907)-543-3817

APPLICATION FOR APPOINTMENT TO A COMMITTEE OR COMMISSION

Committee(s)/Commission(s) of interest:

- __ Energy Committee
- __ Parks and Recreation Committee
- __ Finance Committee
- __ Public Works Committee
- X Port Commission
- __ Public Safety and Transportation Commission
- __ Planning Commission

All Planning Commissioners are required to provide an Alaska Public Offices Commission (APOC) Statement to the City Clerk's Office within 30 days of appointment. Commissioners must continue to provide an updated APOC statement to the clerk's office by the 15th of March annually.

NAME: John Armand Dickens

MAILING ADDRESS: P.O. Box Bethel AK 99559-0453

RESIDENCE ADDRESS: Bethel AK 99559

HOME PHONE: 907-

WORK PHONE: 907-

CELL PHONE: 907-

E-MAIL:

OCCUPATION: Safety officer

EMPLOYER: GRANT AVIATION

1. Do you (or an immediate family member) currently own or operate a business in the City of Bethel? If so please provide the name and the type of business.

   NO

2. Are you (or an immediate family member) a member of a board of directors, officer of, or hold a management position with, an organization that has financial dealings of one thousand dollars or more in value with the city of Bethel? If so please provide the name and the type of business.

No

3. Do you currently have a direct or indirect financial of business interest with the City of Bethel, to include contracting, leaseholder, employee? If so please provide the name and the type of business.

No

4. Are you a resident of the City of Bethel? X Yes __ No If so, for how long? Since AuGust 11 1997 Dec 2005 April 2009 to present

5. Does your schedule permit you to regularly attend required meetings: X Yes __ No

I understand that this is a voluntary, appointed position to be confirmed by the Bethel City Council. I further understand that this application is public information and the merits of my appointment may be discussed at a public forum. In addition, my name may be published in a newspaper or other media outlet.

I have read Chapter 2.05 of the Bethel Municipal Code regarding Responsibilities of city council members, municipal officers, appointed officials and employees-conflict of interest. I agree to comply with the code and understand that my tenure as a commission/committee member requires such compliance.

I certify that the information in this application is true and accurate.

Signature of Applicant: [signature] Date: 1/20/2012

FOR OFFICE USE ONLY

Date Received: 1-24-2012

Date of Council Approval: Action Memorandum Number:

Date Applicant Notified:

Term Expiration:

Registered voter of the City X Yes __ No