LCG, Inc.

LARSEN CONSULTING GROUP

INSTITUTIONAL CORRIDOR WATER SYSTEM

BETHEL, ALASKA

FEASIBILITY STUDY

MARCH 08, 2010

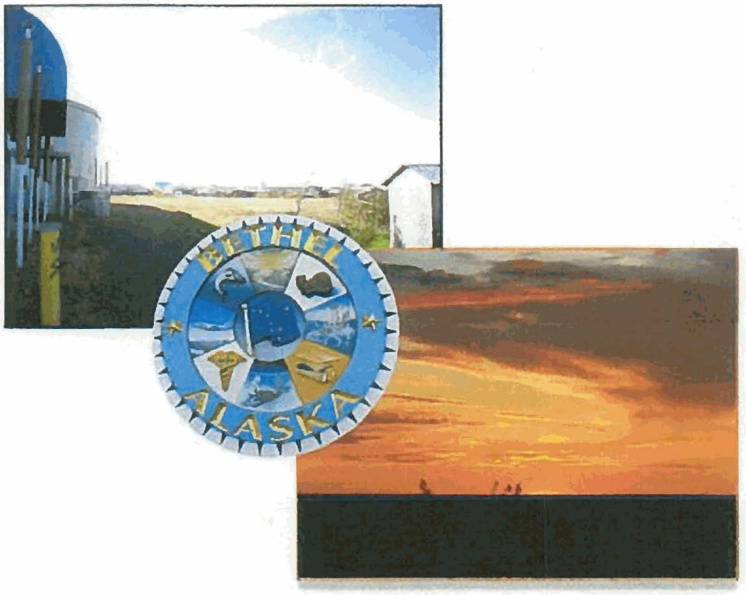

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TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY/INTRODUCTION 1
- 1.1. PROJECT OVERVIEW 1
- 1.2. COST ESTIMATE 1

2.0 BACKGROUND 2
- 2.1. CITY SUBDIVISION WATER TREATMENT PLANT (CSWTP) 2
  - 2.1.1. Water Source 2
  - 2.1.2. Treatment Methodology 2
  - 2.1.3. Plant Capacity 2
  - 2.1.4. Water Storage 3
  - 2.1.5. Electrical Systems 3
  - 2.1.6. Boiler Equipment 3
- 2.2. TRUCK HAUL FACILITIES 4
- 2.3. EXISTING DISTRIBUTION 4

3.0 INSTITUTIONAL CORRIDOR 5
- 3.1. COMMERCIAL INSTITUTIONS 5
- 3.2. WATER USAGE 6
- 3.3. SUMMARY OF EXISTING EASEMENTS AND ROWS ALONG THE CORRIDOR 8

4.0 CONCEPTUAL ALTERNATIVES 9
- 4.1. WATER MAIN LOOP 9
- 4.2. WATER SERVICES 10
- 4.3. PILE FOUNDATIONS 12
- 4.4. WATER STORAGE 12
- 4.5. WATER TREATMENT PLANT RENOVATIONS 14
- 4.6. BOOSTER PUMP STATION 15
- 4.7. MECHANICAL CONSIDERATIONS 15
  - 4.7.1. Plumbing 16
  - 4.7.2. Heating 16
  - 4.7.3. Ventilation 17
  - 4.7.4. Controls 17
  - 4.7.5. Testing and Balancing 18
  - 4.7.6. Equipment 18
- 4.8. ELECTRICAL CONSIDERATIONS 21

4.8.1. Power Distribution 21
4.8.2. Lighting 21
4.8.3. Telecommunication 21
5.0 DESIGN CONSIDERATIONS 22
5.1. GEOTECHNICAL INVESTIGATIONS 22
5.2. SURVEYING 23
5.3. PERMITTING REQUIREMENTS 23
5.3.1. OPMP Coastal Project Questionnaire 23
5.3.2. ADEC Approval to Construct and Operate 24
5.3.3. ADOT/PF Utility permit 24
5.4. DESIGN CRITERIA 24
6.0 ENGINEER'S COST ESTIMATE 26
7.0 CONCLUSIONS AND RECOMMENDATIONS 27
7.1. GENERAL 27
7.2. MASTER PLAN COMPATIBILITY 27
7.3. RECOMMENDED ALTERNATIVE 27
8.0 APPENDICES
A. PROPOSED UTILITY LAYOUT AND DETAILS
B. PLATS AND EASEMENTS
C. EXISTING WATER USAGE
D. HYDRAULIC MODELING
E. ENGINEERING CALCULATIONS
F. ENGINEER'S COST ESTIMATE
G. GEOTECHNICAL REPORT
H. EQUIPMENT DATA/CUT SHEETS
I. BIBLIOGRAPHY

1.0 EXECUTIVE SUMMARY/INTRODUCTION

1.1. PROJECT OVERVIEW

Larsen Consulting Group, Inc. (LCG) was retained by the City of Bethel to prepare a design study report (DSR) evaluating the feasibility of extending the water main system in the City Subdivision area to serve multiple institutions along the Chief Eddie Hoffman Highway.

By including the City's major institutions located on the Institutional Corridor as customers in the community water system, the City stands to gain additional revenue while the institutions can eliminate costly operation and maintenance expenses for their individual on-site water systems. The additional revenue gained by the City could help reallocate the cost of operating the water system among a wider base of customers, increase operating and maintenance efficiency and make it more affordable for all.

The purpose of this Concept Design Report is to present background project information, initial survey research, conceptual level plans, design considerations, and a preliminary cost estimate for constructing a new water main loop and associated booster pump station and water storage tank in order to serve the Institutional Corridor along Chief Eddie Hoffman Highway.

1.2. COST ESTIMATE

A preliminary cost evaluation, based on the concept level plan layouts, was performed for two preferred alternatives, both of which provide water service to the Institutional Corridor. The primary difference between the two alternatives considered is the size of the water storage tank and booster pump station. Alternative #1 consists of a 355,000 gallon storage tank and a 1,200 square foot booster pump station designed for the immediate water services associated with the Institutional Corridor. The second Alternative (#2) looks at installing the infrastructure needed to support the long term expansion into this area of the City, with a 655,000 gallon water service tank and a 3,000 square foot booster pump station.

The cost evaluation summary, found in Appendix F, includes project administration, engineering design, construction management and a 20% contingency on construction cost. The total estimated project cost in Year 2010 dollars for the recommended alternatives are as follows:

- Alternative #1: 355,000 gallon water tank and 1,200 ft2 booster station = $11,708,450
- Alternative #2: 655,000 gallon water tank and 3,000 ft2 booster station = $14,417,880

2.0 BACKGROUND

The City of Bethel currently bills approximately 1,631 customers for water and sewer services (1,376 hauled and 255 piped) and operates two water treatment facilities. Existing components associated with expansion into the Institutional Corr idor include the following:

2.1. CITY SUBDIVISION WATER TREATMENT PLANT (CSWTP)

The City Subdivision Water Treatment Plant (CSWTP) currently provides water for the City's water truck-haul operations, the City's governmental offices, and piped services to 180 properties within City Subdivision through three Loops (A, B & C). The City Center Water Treatment Plant (CCWTP), originally constructed to support the City's governmental offices, was decommissioned and replaced by the City Subdivision piped water and sewer system when it became operable.

2.1.1. *Water Source*

The CSWTP utilizes a groundwater source for its raw water supply, with the wellhead located inside the building. The well, comprised of a 10-inch diameter steel casing, was drilled to a depth of approximately 500 feet. Within the casing, a Grundfos 385-S400-4 6-inch diameter 40 HP submersible turbine pump was installed at about 210 BGS and can supply water at about 400 GPM. The City Subdivision WTP was intended to have an exterior back-up well but no water was found at the drill rig's maximum depth so the well was eventually filled with sand, plugged with grout, capped, and abandoned. No other back-up well sources have been implemented.

2.1.2. *Treatment Methodology*

The City Subdivision WTP was constructed in 1999. Water treatment primarily targets the removal of iron and manganese and provides disinfection. Raw water from the well is heated and mixed with potassium permanganate before being filtered, chlorinated and fluoridated. The plant has three 9' diameter greensand pressure filters, two 30 Hp backwash pumps, and operates at a constant 400 gallon per minute (gpm) capacity.

2.1.3. *Plant Capacity*

The water treatment capacity of the existing CSWTP is 400 GPM with a water storage capacity of 505,000 gallons. According to the 2005 Master Plan prepared by CRW (CRW, 2005), the plant is currently operating at approximately 69 GPM average daily flow to serve the existing piped system and truck-haul operations. There is ample treatment capacity at the

CSWTP to serve additional expansion; however, the water storage tank capacity is limited to the existing piped system (City Subdivision and City Center).

Further expansion of the water distribution system from the CSWTP would require additional water storage to account for fluctuations in flow, to provide additional dedicated reserves against possible interruption in supply and to accommodate fire-fighting requirements. Water distribution modeling completed for the 2005 Master Plan(CRW, 2005) shows that the CSWTP can support a piped water distribution system to serve development east of Ridgecrest Drive (Mission Lake area, the "Avenue" area, Harbor areas, and the development around the new YKHC offices) as well as development around the Hospital. However, additional water storage tanks, booster pump stations, circulation pumps, and water heating systems would be needed to serve these areas and will be discussed in Section 4.0.

2.1.4. *Water Storage*

Currently, there is a 60 foot diameter by 24 feet high, 505,000 gallon steel storage tank located adjacent to the treatment plant. Thermal siphons and air duct vents were installed in the soils below the tank in order to freeze the underlying soils for the foundation. Tank storage capacity is sufficient for the needs of the existing system only and can store several days' worth of the existing average daily flow of approximately 100,000 gallons per day, as well as meet peaking demands and fire flow requirements.

2.1.5. *Electrical Systems*

The electrical requirements for the proposed additions to the existing Bethel water treatment plant consist of providing power to (2) new 5 HP circulation pumps for freeze protection of the new proposed water line. Based on as-builts dated February 1999 the existing facility has 115 amps (A) of spare capacity at 480 volts (V) 3-phase. With the water circulation pumps operating as lead/lag, where only one pump can operate at any time, there is space in the existing motor control center MCC-A for (1) breaker to feed the controller for these pumps. There is also adequate space and capacity on the existing Panel 'B' at 208V if the pumps are unavailable at 480V. We assume that this will not require any upgrades to the service at this time.

2.1.6. *Boiler Equipment*

Water in the existing tank is heated by circulating water through a heat exchanger located inside the CSWTP building. Once initially heated by the treatment process, the water inside an insulated storage tank requires relatively little additional energy to maintain a constant temperature due to its heat capacity.

The existing water treatment boiler plant will be used to heat the water line between the existing water treatment plant and the new booster station. The existing boiler plant heating mains will be connected to a new double wall heat exchanger. Water transferred to the booster station will be heated via the heat exchanger prior to being pumped to the new booster station. A domestic water circulation pump will also be provided to continuously circulate the water between the booster station and water treatment facility when the tank is not being filled.

2.2. Truck Haul Facilities

One exterior water truck filling station with 5 HP pumps is located at the CSWTP. With the City's water truck fleet, this truck fill facility, along with the two at the Bethel Heights WTP, provide water distribution for most consumers in Bethel. A fleet of water trucks are employed to distribute water. Trucks and equipment specifications are designed by the City and are typically Ford Sterling L TS500's with an estimated design life of 5 to 10 years. Truck components include a 3,500 to 4,000 gallon capacity tank, chassis, motor, cab, heavy duty suspension, pumps, hoses, valves, and monitoring equipment.

2.3. Existing Distribution

Water lines served by the City Subdivision WTP consist of water mains and service lines. Currently there are three water main loops; Loop A, Loop B and Loop C, which serve buildings in the City Subdivision. The water mains are aboveground 6-inch diameter HDPE pipe, featuring insulated arctic pipe construction. Certain sections of the water main have a 1/2-inch diameter HDPE circulating glycol line located below the 6-inch diameter water line, which are used for heating the circulating water line. Each lot is served by the water main via a service line, which stubs off the main lines through a service box. Both water and sewer service lines are usually contained in one arctic pipe. The water service has a 1-inch diameter HDPE supply and return line, contained inside of a carrier pipe. The water from the service line runs through a water service box that feeds the house or is circulated back into the water main. Leveling sleepers (4x12 pressure-treated timbers) provide the primary support for the aboveground water mains. The timbers are typically secured to the ground with a "Duckbill" style earth anchor while the arctic pipe is secured in place by a steel strap that wraps around the CMP and attaches to the leveling sleeper.

3.0 INSTITUTIONAL CORRIDOR

For purposes of this study, the Institutional Corridor can be defined as the area along Chief Eddie Hoffman Highway, beginning near the Alaska State Fish and Wildlife facility and ending up at the Public Health Service building, including many of the City of Bethel's major support institutions and covering approximately 0.8 mile.

3.1. COMMERCIAL INSTITUTIONS

There are currently seventeen facilities associated with the Institutional Corridor. Each facility has unique functions, existing water systems and future demand requirements. This list includes several potential facilities along the corridor that are being addressed for future water demands. Details of each institution are as follows:

- ***YKHC – 40 housing units.*** This facility has been slated for demolition and is to be replaced by an 18-bed long-term care facility.
- ***YKHC – Hospital.*** This facility has its own well and a 100,000 gallon water storage tank on site. 50,000 gallons of this is dedicated fire water storage. The well equipment and storage tanks are old, however, and are in need of replacement.
- ***YKHC – Annex.*** This facility is served by the Hospital Well.
- ***YKHC – Outpatient Hostel.*** This facility is served by the Hospital Well.
- ***YKHC – Keys Receiving Home.*** This facility is served by the DHHS Well.
- ***Alaska DHHS – Youth Detention Facility.*** This facility is served by the DHHS Well.
- ***Alaska DHHS – Corrections Facility.*** This Facility has its own well and three ten-thousand gallon fire water storage tanks. The well equipment and storage tanks are old, however, and are in need of replacement.
- ***YKHC – Housing.*** This facility has been slated for demolition and is to be replaced by a 32-bed pre-maternal facility.
- ***AVCP Pacifica House.*** This facility has its own well.
- ***YKHC Sobering Center.*** This future facility will have hauled water.
- ***US Post Office.*** This facility has hauled water.
- ***Alaska Public Health Service.*** This facility has hauled water.

- ***YKHC – Main Administration Office.*** This facility is served by the Hospital Well.
- ***Alaska State Fish and Wildlife.*** This facility has hauled water.
- ***YKHC Special Needs Housing.*** This facility has hauled water.
- ***YKHC Warehouse.*** Currently, there is no water at this building but it will eventually need a sprinkler system only.
- ***Crowley Warehouse.*** Currently, there is no water at this building but it will eventually need a sprinkler system and domestic water.

3.2. WATER USAGE

Each of the identified institutions have unique water demands based on functionality and history of water usage. Table 3.1 outlines the average water usage of the various facilities along with the anticipated future improvements. Appendix C contains spreadsheets detailing the water usage for most of the identified properties for the period of September 1, 2008 through August 31, 2009.

Table 3.1 – Current and Future Water Usage		
Water Service	**Annual Water Usage (gallons per year)**	**Notes**
YKHC – 18-Bed Long Term Care Facility	173,500	Based on 18 beds times 26.4 gallons per bed per day
YKHC – Hospital	12,776,440	Well with Fire Protection Storage Tank
YKHC – Annex		Served by Hospital Well
YKHC – Outpatient Hostel		Served by Hospital Well
YKHC – Keys Receiving Home		Served by DHHS Well
Alaska DHHS – Youth Detention Facility		Served by DHHS Well
Alaska DHHS – Corrections Facility	2,507,800	Well with Fire Protection Storage Tanks
YKHC Housing – 32-Bed Pre-Maternal Facility	308,500	Based on 32 beds times 26.4 gallons per bed per day
AVCP Pacifica House	995,040	Well
YKHC – Sobering Center	52,000	Future Development - Hauled Water
US Post Office	78,000	Hauled Water
Alaska Public Health Service	65,000	Hauled Water
YKHC – Main Administrative Office		Served by Hospital Well
Alaska State Fish and Wildlife	268,200	Hauled Water
YKHC – Special Needs Housing	240,900	Hauled Water
YKHC – Warehouse		Sprinkler system only in future
Crowley Warehouse	71,175	Sprinkler and domestic water in future
Totals	**17,536,555 gals/year**	
With 10% estimated growth in area	**19,290,210.5 gals/year**	
	52,850 gals/day	
	36.70 gals/min	

3.3. Summary of Existing Easements and ROWS Along the Corridor

Plats for the Institutional Corridor area were researched for this project to determine the locations and dimensions of recorded utility easements and existing right of ways. Currently there are several existing plats and recorded documents that control the property along the Institutional Corridor, but there are areas where there are no recorded easements. Additional research, such as Title Searches and Reports should be commissioned prior to design implementation to verify whether or not easements are available along the full alignment.

Appendix B contains the existing ROW documents along Chief Eddie Hoffman Highway, along with other applicable plats.

In addition, the land identified as a potential site for a new water storage tank and booster pump station, Lot 2 of the Wave Center Subdivision, is currently owned by Tunista Properties, Inc. and is managed by Calista Corporation. A lease or purchase agreement with them would have to be entered into by the City in order to move forward with this proposed expansion. A copy of the Plat and legal documents can be found in Appendix B.

4.0 CONCEPTUAL ALTERNATIVES

It has been determined through various studies and planning efforts that progressive, phased elimination of the truck haul delivery system is a primary City objective. The 2005 Master Plan (CRW, 2005) identified two options for meeting this goal: ten Water Treatment Plants spread around the City versus three Water Treatment Plants with ten booster pump stations. Evaluations showed that the second option was recommended due to significantly lower capital costs as well as operations and maintenance costs.

The booster pump stations would eventually provide interim truck haul operations along with up to three circulating water loops to serve the surrounding areas. Water storage tanks for peak water demand, dedicated reserves for potential supply interruption and fire flow would be located near these booster stations. This report will make recommendations that will fit in to this "Backbone" type of piped water system layout that was identified in the 2005 master planning effort.

This report has identified two alternatives: sizing the water storage tank and booster pump station for the initial Institutional Corridor facilities versus installing the infrastructure needed to support the long term expansion into this part of the City. Key design issues considered in this Conceptual Report are: CSWTP capacity, water main alignment, and booster pump station and water storage design.

Designs of key elements include the following parameters:

4.1. WATER MAIN LOOP

Evaluation of velocity and headloss for a variety of flow rates for both the line going from the CSWTP to the water storage tank as well as the proposed circulating loop around the corridor can be found in Appendix D.

According to these calculations, for the line running between the CSWTP and the proposed water storage tank, a 6-inch diameter pipeline running approximately 5,400 lineal feet will be sufficient to convey the required flows while maintaining headloss at acceptable levels. It is recommended that this line be heat traced for freeze protection, since it is not a looped system.

At this conceptual level, it appears that 3Hp circulation pumps installed in the CSWTP will be required to transfer this flow to the proposed storage tank. More detailed design in the future will be needed to confirm the pump selection.

For the approximately 8,600 lineal foot of looped water main along Chief Eddie Hoffman Highway, preliminary hydraulic analysis shows that an 8-inch diameter pipeline will require flows of 300 and 395 gallons per minute for average and peak flows, respectively, through the system in order to maintain a desired velocity of two feet per second while maintaining headloss at acceptable levels. In addition, an 8-inch line will allow for expansion of the loop in subsequent projects and will be sufficient for fire flow requirements. Consequently, it is recommended that a water loop in the institutional corridor be constructed of 8-inch HDPE arctic insulated pipe.

It appears that 5 Hp circulation pumps installed in the proposed booster pump station will be required to transfer this flow around the new loop. In addition, booster pum ps for fire flow will be required to meet the 1,500 gallons per minute proposed flow, which will be achieved by delivering 750 gallons per minute through the system from both the supply and return piping under such an event. More detailed system analysis and design in the future will be needed to fine-tune the pump selection. Other design parameters, such as the required pressures for the existing sprinkler systems currently installed in some of the buildings and existing fire storage tanks, will need to be taken into careful consideration during the design process.

It is recommended that all water main piping meet VSW/ANTHC specifications for pre-insulated pressure water mains using SDR 11 HDPE carrier pipe and aluminum jacket casing material. The installation of isolation, drain and air release valves in this mainline, as required, is also recommended.

Drawings 2-4 in Appendix A show conceptual level alignments. This route will transfer treated water from the SCWTP to the proposed water storage tank approximately 5,350 feet away. From there it will flow through the booster pump station circulation pumps and out along the Chief Eddie Hoffman Highway Right of Way until just past the Alaska State Fish and Wildlife building, where it will loop back to the Booster pump station along the opposite side of the road. This loop will entail approximately 8,600 lineal feet of water pipe, with approximately 25 road crossings and 600 pile foundations.

This alignment will not only pick up the currently identified Institutions, but will also allow for expansion into adjacent residential areas in future infrastructure development projects.

4.2. WATER SERVICES

New water services sizes will vary, depending on the water requirements of the facility. Variations include 1" HDPE circulating supply and return lines housed inside 4" x 12" arctic insulated carrier pipes, 2" HDPE circulating supply and return lines housed inside 6" x 15" arctic

insulated carrier pipes, 4" HDPE supply with 1" return lines or 6" HDPE supply with 1" return lines. Larger facilities with existing sprinkler systems will require 6-inch services. Table 4.1 outlines a preliminary estimate of the water service types and approximate length of service for each of the identified facilities.

Table 4.1 - Water Service Connections

Potential Client	1" Supply & Return	2" Supply & Return	4" Supply & 1" Return	6" Supply & 1" Return
YKHC – 18-Bed Long Term Care Facility			100'	309'
YKHC – Hospital				311'
YKHC – Annex				
YKHC – Outpatient Hostel				
YKHC – Keys Receiving Home			340'	
Alaska DHHS – Youth Detention Facility				248'
Alaska DHHS – Corrections Facility				85'
YKHC Housing – 32-Bed Pre-Maternal Facility				238'
AVCP Pacifica House			206'	166' 92'
YKHC – Sobering Center		50'		
US Post Office				10
Alaska Public Health Service	121'			
YKHC – Main Administrative Office			280'	
Alaska State Fish and Wildlife	102'			
YKHC Warehouse				38'
Crowley Warehouse				60'
Totals	**223'**	**50'**	**926'**	**1,557'**

Pitoriface type of connections should be installed at the mainline for all 1" and 2" diameter service lines. It is recommended that circulation pumps be installed inside all of the facilities

receiving water service to ensure suitable freeze protection through adequate flow velocities. The various institutions would be responsible for operating and maintaining these circulation pumps, which will lower the velocities required in the mainline. This in turn will reduce the pumping horse power requirements, which will decrease capital output, annual electrical consumption costs, and overall operation and m aintenance costs for the City.

4.3. PILE FOUNDATIONS

Warm, ice-rich permafrost (just slightly below 32 degrees F), as found in Bethel, is particularly susceptible to thawing and even small changes to the thermal regime of an area containing warm permafrost can result in significant thawing and subsequent loss of soil strength; often resulting in significant ground settlements.

As such, water and sewer utilities in the Bethel area are typically supported by foundations which are designed to reduce the potential for utility damage as a result of permafrost thawing and subsequent settlement. These foundations typically consist of steel H- piles driven into the permafrost or thawed soils. Driven H-piles, installed during specific times of the year to minimize impact to the warm permafrost, are the recommended alternative.

4.4. WATER STORAGE

Mathematical modeling and a cost benefit analysis were performed as part of the preparation of previous studies in order to determine the most efficient and effective option for expanding the City of Bethel's water system (CRW, 2008). It was determined that a "Backbone" System, consisting primarily of three water treatment plants and ten booster pump stations is the most efficient and cost-effective configuration for expanding piped water to the citizens of Bethel and the requirements for water storage will proceed along these lines.

Two alternatives have been identified for water storage associated with this approach. Alternative #1, which is designed to serve only the facilities along the Institutional Corridor, would construct a 355,000 gallon welded or bolted steel water storage tank. This insulated tank would have the capacity to meet peak water demand, would provide dedicated reserves for potential supply interruption and provide enough capacity for fire flow requirements for these facilities.

Alternative #2 would construct a 655,00 gallon bolted or welded steel water storage tank on the same lot. This storage tank has been sized with the same parameters as Alternative #1, except

that it also adds the additional capacity for future expansion into the subdivisions to the south and northwest of the corridor site, where an additional 485 developable lots have been identified. Drawing 5 in Appendix A shows a conceptual layout of the water storage tank and booster pump station, while Drawing 1 identifies the expansion areas associated with Alternative #2.

Previous studies (CRW, 2005) had suggested using a fire flow requirement of 500 gallons per minute for two hours as a minimum flow. For the purposes of this study, we are utilizing a minimum fire flow of 1,500 gallons per minute for two hours, as recommended by Appendix B of the 2006 International Fire Code (IFC, 2006), for minimum fire flow for buildings in urban areas. Additionally, the Alaska State Fire Marshall and the City of Bethel Fire Department have requested this flow rate for fire-fighting capacity and reserves. While we understand that rural Alaska has unique socio-economic, geographic and climatic constraints that many times require a relaxing of urban standards with regards to fire flow and domestic water use, we recommend planning for these standard fire flows in this part of Bethel. The corridor area houses some of the essential social and health institutions in the City, including the Corrections Facility and the Hospital, with associated support buildings, which must be adequately protected from fire hazards.

Table 4.2, below, outlines the water storage requirements for each Alternative.

Table 4.2 - Water Storage	
ALT #1	Peaking Volume + Fire Flow + Outage Requirements
	2(52,850) + 180,000 + 1(52,850) = 338,550 gal
	54'ϕ by 20' high Bolted Tank = 354,981 gal
ALT #2	Peaking Volume + Fire Flow + Outage Requirements
	2(147,425) + 180,000 + 1(147,425) = 622,275 gal
	65'ϕ by 26' high Bolted Tank = 655,612 gal

It has been suggested to purchase the lot located west of the existing SCWTP for a new water storage tank to support the peak demands and fire flow of the new Institutional Corridor water main. However, in moving more in concert with the Master Planning efforts of creating a "Backbone" system, we have identified a lot along Chief Eddie Hoffman that could house both a new water storage tank along with a booster pump station. The 2005 Master Plan identifies this location as the Nunvak Booster Station and Water Storage Tank. This property, Lot 2 of Wave

Center Subdivision, is currently owned by Tunista, Inc. and a purchase or lease agreement would need to be entered into by Tunista and the City of Bethel. Other lots in this vicinity could be analyzed for suitability should this lot not be available, or if a suitable agreement cannot be worked out between the parties.

Either alternative would require the installation of either thermal siphons and air duct vents installed in the soils below the tank in order to freeze the underlying soils for the foundation or the installation of thermo-piles. Detailed design will need to analyze these options and recommend a preferred alternative.

4.5. Water Treatment Plant Renovations

New circulations pumps with associated equipment such as flow meters, temperature and pressure gauges, etc. will need to be installed in the CSWTP to circulate water approximately 5,350 feet to the proposed water storage tank on Chief Eddie Hoffman Highway. Initial calculations indicate a 5 Hp pump would be sufficient to transfer the flow over this distance while maintaining adequate flow to prevent freezing.

The required average flow for the institutions along the corridor is approximately 36.70 gallons per minute, as shown in Table 3.1. Since the plant is currently operating at approximately 69 gallons per minute average daily flow and has a water treatment capacity of 400 gallons per minute, there is sufficient capacity at the plant and modifications to the treatment system will not be required. In addition, there is sufficient flow to accommodate the potential expansion into the future development areas, as shown on Drawing 1 in Appendix A. These areas will require additional flows of approximately 66 gallons per minute, which will still leave the plant at close to 43% of its design capacity. Peaking flow requirements for both Alternatives will be handled by the water storage tank reserves.

Due to the fact that the proposed expansion covers many of Bethel's most sensitive institutions, it is recommended that a back-up water source be provided for the CSWTP. The new well will most likely be comprised of a 10-inch diameter steel casing, drilled approximately 500 feet and equipped with a 6-inch diameter 40 -50 HP submersible turbine pump.

4.6. BOOSTER PUMP STATION

As mentioned previously, the 2005 Master Plan (CRW, 2005) identifies a Backbone type of development as the preferred option for water service expansion. Two alternatives have been identified for booster pump station construction in line with this approach.

Alternative #1 would construct a 1,200 square foot booster pump station that would serve as a heated facility to house only the circulation and booster pumps and mechanical and electrical equipment for just the 17 identified facilities associated with the Institutional Corridor.

Alternative #2 would construct an approximately 3,000 square foot booster pump station. Initially, this building would house the equipment identified in Alternative #1 associated with the Institutional Corridor. Eventually, this building could be utilized to house circulation and booster pumps for several water main loops in this area. Buildings to be served would include those in the subdivisions to the south and northwest of the site, where approximately 485 additional lots have been identified. In addition, truck haul facilities could eventually be located here to serve other outlying areas until piped expansion reaches them as well. The portion not utilized initially would be only roughed in and sealed off from the 1,200 ft2 required for the initial corridor phase. The cost estimates for this alternative only include the equipment for servicing just the Institutional corridor facilities.

The square footages identified for these booster stations are approximate. More detailed design will fine-tune the required area for a more cost-effective solution. Construction can be either stick built wood--framed construction or a pre-manufactured metal building. Foundation system alternatives include thermo-syphons installed in the pad for refrigeration or a thermo-pile type of foundation. Both options will need to be analyzed and detailed during the design process and a preferred alternative recommended.

4.7. MECHANICAL CONSIDERATIONS

The building mechanical and plumbing design will conform to the following guidelines:

- 2006 International Building Code
- 2006 International Mechanical Code
- 2006 International Fire Code
- 2006 Uniform Plumbing Code

Design conditions for determining building loads and equipment sizing will be in accordance with climatic conditions as outlined by ASHRAE and local experience. Specific conditions to be used are:

- Winter Design, Outside: -40 F
- Winter Design, Inside: +60 F
- Summer Design, Outside: +74 F

4.7.1. *Plumbing*

Domestic hot water and cold water piping mains will be Type 'L' copper with lead free solder fittings for sizes 3" and smaller; and schedule 40 steel for larger sizes. Piping will be specified to be insulated with preformed fiberglass semi-rigid insulation. Waste and vent piping will be no-hub cast iron pipe. The waste system vent will be routed through the roof.

Domestic hot water will be generated using a 10 gallon, 120 volt, 2000 watt electric heater. Plumbing fixtures will consist of a service sink and emergency eye/face wash. The service sink will be a wall mounted cast iron sink with a service sink type faucet. The eye/face wash will be a wall mounted unit with a tempering valve.

Floor drains will be provided as necessary in the booster station. All floor drains will be provided with trap primers. A reduced pressure principle backflow preventer will be provided on the water service for the pump station.

A 1000-gallon fuel oil tank storage will be provided to supply fuel for the heating boilers. Fuel from the storage tank will be pumped to a 50-gallon day tank located inside of the booster station. The boilers will be connected to the day-tank. Schedule 40 steel pipe with threaded joints will be used for fuel oil piping.

4.7.2. *Heating*

The heating plant will consist of fuel oil fired cast iron boilers. Boilers will be selected to include two boilers each sized at 100% of the total heating and ventilation load. The boilers will operate in a lead / lag configuration such that if one boiler fails the other will operate to provide heat for the water booster station. Each boiler will have its own circulator pump for primary/secondary pumping into the main building heating loop. The boilers will be vented to the exterior via a vent routed through th e roof.

The main heating system pumps will circulate hydronic fluid to the unit heaters used to the heat the facility; and to the heat exchangers used to heat the water storage tanks and water service mains. The pumping system will consist of two heating pumps, an expansion tank, air separator, and glycol fill pump. There will be two heating glycol pumps for redundancy; if one pump fails, the second pump will automatically start.

Hydronic piping will be type 'L' copper with soldered fittings. The piping will be insulated with preformed fiberglass semi-rigid insulation.

A glycol fill tank will be provided. The hydronic heating solution will consist of inhibited propylene glycol and water mixed 50-50. The solution will be pre-mixed by the manufacturer and shipped to the site in sealed barr els.

The exterior domestic water storage tank, under both Alternative #1 and #2, will be heated via a double walled heat exchanger and circulating pumps. Water from the tank will be continuously pumped through the cold side of the heat exchanger and back to the tank. Heated glycol from the boiler system will be circulated through the hot side of the heat exchanger. There will be two tank water circulating pumps for redundancy; if one pump fails, the second pump will automatically start.

The domestic water mains being routed out of the booster station will also be heated by the boiler system. Domestic water will be pulled out of the domestic water mains heated up and then injected back into the piping system. A double walled heat exchanger will be utilized with domestic water on the cold side and heated glycol on the hot side.

Hydronic unit heaters will be provided to heat the pump station interior spaces.

4.7.3. *Ventilation*

Ventilation for the pump station will be provided by a ventilation fan and an undampered relief opening. Combustion air for the boilers will be via the relief opening. Arctic hoods will be utilized for all ventilation intakes and relief air openings.

4.7.4. *Controls*

A direct digital control system will be provided for the facility. All mechanical systems will be controlled by the DDC system. Internal alarms generated by the DDC system will be transmitted to the owner's office in Bethel via the phone lines.

4.7.5. *Testing and Balancing*

A contractor specializing in the balancing and testing of mechanical systems will accomplish the testing and balancing. The contractor will verify system operation, control integration and adjust the systems to the design flow rates. The balancing contractor will be proficient in the use of the latest computer technology for integrating with the direct digital control systems. All balance points will be marked in the field on the balance valves and dampers as well as included in the balancing report that will become part of the operation and maintenance manual.

4.7.6. *Equipment*

Required mechanical equipment under each Alternative are detailed below:

Mechanical Equipment – Alternative #1

Boiler B-1 and B-2: Oil Fired, 212,000 Btuh Output, Weil-McLain WGO-6.
Boiler Pumps CP-1 and CP-2: 20 Gpm, 8 Ft Head, 1/25 h.p., Taco 0014.
System Circulation Pumps CP-3 and CP-4: 20 Gpm, 25 Ft Head, 1/3 h.p. Taco 1400-45.
Unit Heater UH-1,2,3,4: 8400 Btuh, 400 Cfm, 1/30 h.p., Rittling RH-18.
WTP to Storage Heat Exchanger HX-1: 110,000 btu transferred, 180 EGT, 140 LGT, 40 EWT, 80 LWT, Double Wall Brazed Plate and Frame. (Located in existing WTP.)
Tank Heat Exchanger HX-2: 6,600 btu transferred, 180 EGT, 140 LGT, 40 EWT, 80 LWT, Double Wall Brazed Plate and Frame.
Domestic Service Loop Heat Exchanger HX-3: 160,000 btu transferred, 180 EGT, 140 LGT, 40 EWT, 80 LWT, Double Wall Brazed Plate and Frame.
Ventilation Fan VF-1: 1200 Cfm, 1.20 in static, explosion proof motor, spark resistant fan construction, 3/4 h.p., Cook 150SQN-HP.
Water Heater WH-1: 10 Gallon tank, 9 gph at 90 F Rise, 120 Volt, 2000 watt element, Bradford White M-1-6U6SS.
Service Sink, P-1: Cast iron service sink, Kohler Bannon.
Eye/face Wash, EW-1: Wall-mounted eye/face wash, tempering valve, Haws 7360BT.
Fuel Oil Storage Tank, FST-1: 1000 gallon, double wall, above-grade, skid mounted.
Fuel Oil Day Tank, DT-1: 50 gallon, rupture basin, duplex pumps.

Mechanical Equipment – Alternative #2

Boiler B-1 and B-2: Oil Fired, 242,000 Btuh Output, Weil-McLain WGO-6.
Boiler Pumps CP-1 and CP-2: 23 Gpm, 8 Ft Head, 1/25 h.p., Taco 0014.
System Circulation Pumps CP-3 and CP-4: 23 Gpm, 25 Ft Head, 1/3 h.p. Taco 1400-45.
Unit Heater UH-1,2,3,4: 17,600 Btuh, 630 Cfm, 1/15 h.p., Rittling RH-33.
WTP to Storage Heat Exchanger HX-1: 110,00 btu transferred, 180 EGT, 140 LGT, 40 EWT, 80 LWT, Double Wall Brazed Plate and Frame. (Located in existing WTP.)
Tank Heat Exchanger HX-2: 13,500 btu transferred, 180 EGT, 140 LGT, 40 EWT, 80 LWT, Double Wall Brazed Plate and Frame.
Domestic Service Loop Heat Exchanger HX-3: 160,000 btu transferred, 180 EGT, 140 LGT, 40 EWT, 80 LWT, Double Wall Brazed Plate and Frame.

Ventilation Fan VF-1: 3000 Cfm, 1.20 in static, In-line fan, 2.0 h.p., Cook 165SQN-B.
Water Heater WH-1: 10-Gallon tank, 9 gph at 90 F Rise, 120 Volt, 2000-watt element, Bradford White M-1-6U6SS.
Service Sink, P-1: Cast iron service sink, Kohler Bannon.
Eye/face Wash, EW-1: Wall-mounted eye/face wash, tempering valve, Haws 7360BT.
Fuel Oil Storage Tank, FST-1: 1000 gallon, double wall, above-grade, skid mounted.
Fuel Oil Day Tank, DT-1: 50 gallon, rupture basin, duplex pumps.

Table 4.3 outlines the heating requirements for the various components associated with each Alternative.

Table 4.3 - Heating Requirements		
Length of Main		
Component	**Length**	
WTP to Storage Tank	5,334 ft	
Chief Eddie Hoffman Highway Loop	8,567 ft	
Assumed Heat Loss		
Water Mains	50 BTU/day/ft	
Building	10 BTU/hr	
Storage Tank	0.3 BTU/gal/day	
Water Main Calculations		
Component	**Results**	
WTP to Storage Tank	(5,344') (50 BTU/day/ft) = 267,200 BTU/day	
Chief Eddie Hoffman Highway Loop	(8,567') (50 BTU/day/ft) = 428,350 BTU/day	
Water Storage Tank Calculations		
Alternatives	**Results**	
Alt #1	(354,981 gal) (0.3 BTU/gal/day) = 106,494 BTU/day	
Alt #2	(655,612 gal) (0.3 BTU/gal/day) = 196,684 BTU/day	
Booster Pump Station Calculations		
Alternatives	**Results**	
Alt #1	(3,000 sf) (10 BTU/hr/sf) = 30,000 BTU/hr	
Alt #2	(1,200 sf) (10 BTU/hr/sf) = 12,000 BTU/hr	
Total Requirements		
	Alt #1	**Alt #2**
Water Mains	267,200 / 24 = 11,133 BTU/hr 428,350 / 24 = 17,848 BTU/hr	267,200 / 24 = 11,133 BTU/hr 428,350 / 24 = 17,848 BTU/hr
WST	106,494 / 24 = 4,437 BTU/hr	196,684 / 24 = 8,195 BTU/hr
Booster Station	12,000 BTU/hr	30,000 BTU/hr
TOTAL	**45,418 BTU/hr**	**67,176 BTU/hr**

4.8. ELECTRICAL CONSIDERATIONS

The electrical design will conform to the following codes and guidelines:

- 2006 International Building Code
- 2006 International Fire Code
- 2008 National Electrical Code
- The Illuminating Engineers Society (IES) of North America Lighting Handbook 9th Ed.

4.8.1. *Power Distribution*

The proposed booster station will require a new electrical service and systems for operation. Assuming a 50HP booster pump is required for service, Alternative #1 will require a minimum 400A service at 208V, 4-wire, 3-phase. For Alternative #2, the minimum service size will be 600A at the same voltage. These services will both require current transformer cabinets for metering the building. Primary line extensions will have to be coordinated with local utility as required.

4.8.2. *Lighting*

The lighting for the booster station will utilize fluorescent sources with T8 lamps where ever possible. Exterior fixtures will utilize pulse width metal halide building fixtures. IES recommended lighting levels for a maintenance work station should be provided.

4.8.3. *Telecommunication*

The telecommunication will consist of a single telephone line for building maintenance to use for convenience purposes. It does not appear that any security systems are required at this time.

5.0 DESIGN CONSIDERATIONS

5.1. GEOTECHNICAL INVESTIGATIONS

The City of Bethel is located in a western region of Alaska known as the Yukon-Kuskokwim Delta, and is situated adjacent to the Kuskokwim River. The soils in the area are typically characterized by thick, fluvial deposits of interbedded fine sand and silt. Discontinuous permafrost conditions persist throughout the area, and shallow permafrost conditions have been repeatedly documented throughout the City of Bethel, including along the Chief Eddie Hoffman Highway corridor. Shallow permafrost (as it pertains to this evaluation) can be defined as any permafrost which occurs at depths less than five feet below the existing ground surface. Shallow permafrost is usually observed in undisturbed areas, where the organic tundra mat has insulated the permafrost surface from additional thermal inputs. Once an area is disturbed, permafrost surface depths can increase significantly as thawing occurs. Permafrost in the Bethel area can be classified as "warm permafrost" which refers to permafrost with temperatures ranging between approximately 30-32 degrees F. Warm permafrost is particularly susceptible to thawing, and even small changes to the thermal regime of an area containing warm permafrost can result in significant thawing and subsequent loss of soil strength; often resulting in significant ground settlements.

A full geotechnical investigation will be essential for this project prior to full design. Such investigations are necessary to determine cost-effective design parameters for the water tank and booster pump station foundations as well as for the piling and other support systems. It will also provide confirmation to the funding and regulatory agencies that competent study of the site has been performed in concert with the design and will provide soils information for construction bids so that potential contractors will know what the subsurface conditions are prior to bidding the project.

A preliminary geotechnical report was prepared for this project by Northern Geotechnical Engineering and is attached in Appendix G. Results of this initial evaluation indicate that both shallow and warm permafrost conditions likely exist within the proposed project alignment, and that further subsurface explorations will need to be conducted along the proposed alignment and at the tank site in order to better characterize the nature and extent of the existing soils.

5.2. SURVEYING

Surveying must be performed to provide topographic and horizontal location of the existing lines and right of way. Detailed information will be required at road crossings so that elevations can be established for design. Additionally, suitable easements and rights-of-way must be confirmed or established, as necessary.

Establishment of right-of-way and platting can be a time consuming project component and should be started as soon as possible. The surveying can be done at any time of the year but will be most efficient when the weather, ground surface, and snow conditions are ideal. Cold weather and darkness slow productivity and deep snow requires digging to make measurements.

5.3. PERMITTING REQUIREMENTS

Various Agency permits will be required to be obtained during the design process and prior to construction activities, as follows:

5.3.1. *OPMP Coastal Project Questionnaire*

A Coastal Project Questionnaire (CPQ) is required for all proposed projects located in or potentially affecting coastal areas in Alaska. Bethel lies in a coastal area and therefore completion of a CPQ will be required and the completed documentation sent to the Office of Project Management and Permitting (OPMP). OPMP would then forward the questionnaire to the following:

- Alaska Department of Environmental Conservation (ADEC)
- Alaska Department of Fish and Game
- Alaska Department of Natural Resources (ADNR)
- Affected local coastal communities
- Other interested members of the public

Required permits will be identified based on responses to questions posed in the CPQ for permitting agencies at both state and district levels.

5.3.2. *ADEC Approval to Construct and Operate*

Projects that modify an existing Class A or Class B Public Water System must apply for an Approval to Construct from the Alaska Department of Environmental Conservation (ADEC). Because of the mutual proximity of water and sewer mains, a separation distance waiver will also be required for these facilities. After construction, an Approval to Operate permit will need to be requested from ADEC by the City with a submittal of record drawings.

5.3.3. *ADOT/PF Utility permit*

For the crossing located within Ridgecrest Drive and any other State property, a utility permit will need to be issued by ADOT/PF. A utility permit is essentially a legal agreement made between the State and the local municipality to defile the rights and responsibilities of each party with regard to operating a facility within State rights of way.

5.4. DESIGN CRITERIA

Design Parameters	
Component	**Parameters**
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 gusts)	120 miles per hour
Seismic Load	Per current edition of IBC
Ground Snow Load	40 PSF
Active Layer Depth	2 – 7 feet
Presence of Permafrost	Generally continuous

Design Criteria	
Component	**Criteria**
Design Period	20 Years (2030)
Piped Water	65 gallons/capita/day (GCPD)
Fire Flow	1500 GPM (minimum – 750 gpm both ways)
Residual Pressure	20 PSIG (minimum)
Hydrant Spacing	500 feet (minimum)
Water Storage	
Reserve Volume	3-day supply of Average Daily Demand (ADD)
Fire Supply	2-hour duration at 1500 GPM (minimum)
Equalization Volume	Max Daily Demand (MDD) less 8 hours of well pump output
Water Distribution (for local systems)	
Water Demand Peaking Factors	
Maximum Day Demand (MDD)	PHD ÷ 1.75
Peak Hour Demand (PHD)	125 + (1.2 x (N-50)), where N is the number of dwellings served (per ADEC design criteria.)
Minimum Pressure	20 PSIG
Maximum Pressure	100 PSIG
Minimum Pipe Diameter	6 inches
Pressure Pumps	Design based on peak hourly demand (PHD) with step-up pressure and hydro pneumatic system to efficiently accommodate fluctuations in water distribution demand.
Water Heating System	Maintain temperature of return water from distribution system @ 45 to 55 °F.
Water Storage Tank	Bolted or welded steel tank with vertical side shells. Minimum 5 inches of insulation on exposed tank surfaces. Tank inlet and outlet shall be located to minimize short-circuiting. Tank inlet shall provide pinch valve diffusers at pipe end to improve circulation of stored water.
Circulation Systems	Size system to meet peak hourly demands. Locate circulation pumps on return ends of loops.
Emergency Standby Generator	Required as back up for power outages.
General	Provide floor-mounted, powered, alternating backup for major equipment components
Circulation Loops	Provide between 1 – 2 ft/sec flow rate for water distribution loop circulation.

6.0 ENGINEER'S COST ESTIMATE

The two alternatives evaluated for cost considerations both deliver potable water to the Institutions along the Chief Eddie Hoffman Highway. Alternative #1 would size the water storage tank and booster pump station for the initial Institutional Corridor facilities. Alternative #2 would install the infrastructure needed to support the long term expansion into this part of the City, as suggested in previous planning efforts.

New funding is required for survey, geotechnical investigations, design and bidding services, project construction and site inspection and administration services.

A cost breakdown for each Alternative is included in Appendix F. These cost estimates are based on previous estimates performed for the Bethel area, with expected escalations of future construction and materials costs. The cost evaluation includes project administration, engineering design, construction management and a 15% contingency on construction cost. The contingency takes into account design and construction details not foreseen at this conceptual feasibility study level. The total estimated project cost in Year 2010 dollars for the recommended alternatives are as follows:

- Alternative #1: 355,000 gallon water tank and 1,200 ft2 booster station = $11,708,450
- Alternative #2: 655,000 gallon water tank and 3,000 ft2 booster station = $14,417,880

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1. GENERAL

The primary goal of this design study report was to evaluate the feasibility of extending piped water service to the Institutions along the Chief Eddie Hoffman Highway corridor.

This will be an important and strategic project that can be accomplished cost-effectively with minimal disturbance to the terrain and without disruption to Bethel's existing water treatment and distribution systems.

7.2. MASTER PLAN COMPATIBILITY

The *2005 Water and Sewer Master Plan Update (CRW, 2005)* reflects a preferred general distribution expansion plan that features circulating transmission lines which extend from three regional water treatment plants to remote storage and distribution facilities, or booster pump stations. The transmission lines would fill water storage tanks at these facilities and the booster stations would provide pressure and circulation pumps to distribute the water into separate circulating water loops as well as serve as local truck fill facilities. Development of this Institutional Corridor study has been conducted with this planning strategy.

7.3. RECOMMENDED ALTERNATIVE

Because treated water storage reservoirs or tanks tend to be quite large and expensive, a fairly distant planning horizon is recommended to avoid the premature need for expansion. In addition, much of the capital construction costs of buildings can be attributed to mobilization, labor force and shipping costs. Thus, the costs of building a larger structure and only finishing out and utilizing a portion of it initially is more cost-effective than building a smaller building and adding on in future projects.

Therefore, based on anticipated population growth in Bethel, preliminary cost estimates and the desire to expand the City's infrastructure in a manner consistent with the overall plan for development, this study recommends moving forward with Alternative #2: a 655,000 gallon storage tank and a 3,000 ft2 building.

A preliminary economic analysis was performed, included in Appendix E, to look at the operation and maintenance costs of the two Alternatives as well as to estimate the potential

annual income to the City. Table 7.1 outlines the two alternatives with respect to capital costs, annual operation and maintenance costs and the present worth of each option. It also looks at the potential income for the City from both the Institutional Corridor properties as well as from residences located in future development areas within this area.

This analysis substantiates the benefits of Alternative #2 in that while the present worth of this Alternative is slightly higher than Alternative #1, the potential payback to the City in increased revenue from water service sales is considerably higher and can substantially contribute to the City's ability to continue its expansion of the piped water system into more areas of the City through increased revenues.

Table 7.1 – Alternatives Matrix

Alternative	Capital Cost	Annual O&M Costs	Present Worth (2030)	Services Revenue	Future Services Revenue	Advantages/ Disadvantages
ALT #1	$8,937,742	$ 159,261	$ 18,331,451	$ 40,188	$ 40,188	Lower Capital costs. No room for expansion into future development areas.
ALT #2	$11,006,017	$ 163,701	$ 21,971,055	$ 40,188	$ 768,154	Provides capacity for expansion into future development. Higher initial capital costs. Significant potential revenue.

8.0 APPENDICES

A. PROPOSED UTILITY LAYOUT AND DETAILS

B. PLATS AND EASEMENTS

C. EXISTING WATER USAGE

D. HYDRAULIC MODELING

E. ENGINEERING CALCULATIONS

F. ENGINEER'S COST ESTIMATE

G. GEOTECHNICAL REPORT

H. EQUIPMENT DATA/CUT SHEETS

I. BIBLIOGRAPHY

APPENDIX A – PROPOSED UTILITY LAYOUT AND DETAILS

APPENDIX B – PLATS AND EASEMENTS

Alaska Corporations, Business and Professional Licensing

Search
- By Entity Name
- By AK Entity #
- By Officer Name
- By Registered Agent
- Verify Certification
- Biennial Report
- File Online
- Initial Biennial Report
- LLC
- File Online
- Business Corporation
- File Online
- Online Orders
- Register for Online Orders
- Order Good Standing
- Name Registration
- Register a Business Name Online
- Renew a Business Name

Date: 12/30/2009

Filed Documents

(Click above to view filed documents that are available.)

Entity Name History

Name	Name Type
TUNISTA, INC.	Legal
Tunista Properties, Inc.	Prev Legal

Business Corporation Information

AK Entity #:	28207D
Status:	Active - Good Standing
Entity Effective Date:	10/22/1982
Primary NAICS Code:	531390: Other Activities Related to Real Estate
Home State:	AK
Principal Office Address:	301 Calista Ct #A Anchorage AK 99518
Expiration Date:	Perpetual
Last Biennial Report Filed Date:	1/26/2009
Last Biennial Report Filed:	2010

Registered Agent

Agent Name:	CALISTA CORPORATION
Office Address:	301 Calista Ct #A Anchorage AK 99518
Mailing Address:	
Principal Office Address:	301 Calista Ct #A Anchorage AK 99518

Officers, Directors, 5% or more Shareholders, Members or Managers

Name:	**Dixie Retherford**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	President
Owner Pct:	0
Name:	**Dixie Retherford**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	Director
Owner Pct:	0

Name:	**Felix P Hess**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	Vice President
Owner Pct:	0

Name:	**Felix P Hess**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	Director
Owner Pct:	0

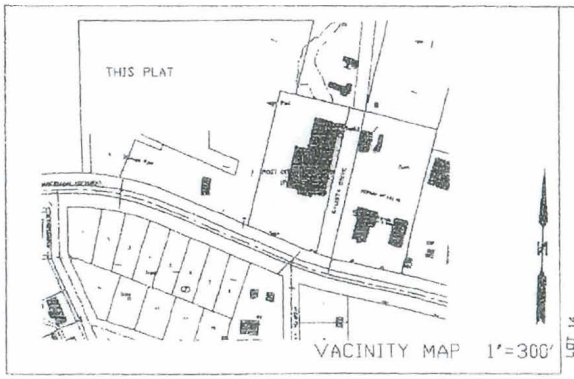
Name:	**Joann Werning**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	Secretary
Owner Pct:	0

Name:	**Joann Werning**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	Treasurer
Owner Pct:	0

Name:	**Joann Werning**
Address:	301 Calista Ct #a Anchorage AK 99518
Title:	Director
Owner Pct:	0

Officers & Directors

E-mail the Corporations Staff (907) 465-2550



CERTIFICATE OF OWNERSHIP

I, DIXIE RETHERFORD , PRESIDENT OF TUNISTA PROPERTIES, INC., CERTIFY THAT TUNISTA PROPERTIES, INC., IS THE OWNER OF THE PROPERTY DESCRIBED IN THIS PLAT AND AS PRESIDENT I ADOPT THIS PLAN OF RESUBDIVISION BY MY FREE CONSENT.

DIXIE RETHERFORD, PRESIDENT

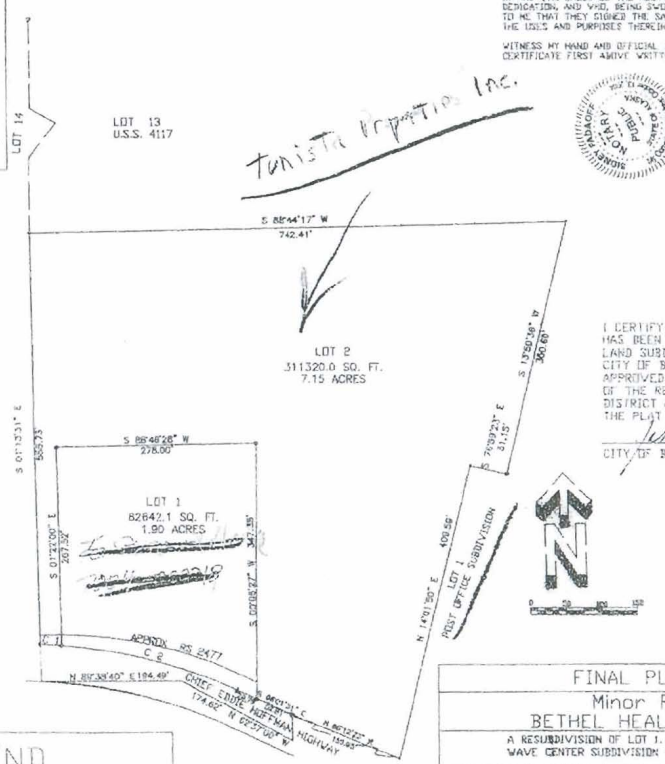
NOTARY'S ACKNOWLEDGMENT

THIS IS TO CERTIFY THAT ON THE 20 DAY OF March, 2003, BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC IN AND FOR THE STATE OF ALASKA, DULY COMMISSIONED AND SWORN, PERSONALLY APPEARED DIXIE RETHERFORD, TO ME KNOWN TO BE THE PERSON DESCRIBED IN AND WHO EXECUTED THE ABOVE CERTIFICATE OF OWNERSHIP AND DEDICATION, AND WHO, BEING SWORN OR UNDER OATH, ACKNOWLEDGE TO ME THAT THEY SIGNED THE SAME FREELY AND VOLUNTARILY FOR THE USES AND PURPOSES THEREIN MENTIONED

WITNESS MY HAND AND OFFICIAL SEAL THE DAY AND YEAR IN THIS CERTIFICATE FIRST ABOVE WRITTEN.

Sidney Padaroff
NOTARY FOR THE STATE OF ALASKA

10/13/04
MY COMMISSION EXPIRES



NOTES:

1. BASIS OF BEARING WAS OBTAINED FROM POST OFFICE SUBDIVISION, PLAT #2000-R BETHEL RECORDING DISTRICT.
2. NO PRIVATE ACCESS TO STATE MAINTAINED ROW'S UNLESS APPROVED BY THE STATE OF ALASKA DEPARTMENT OF TRANSPORATION.

CURVE	RADIUS	ARC LENGTH	CHORD LENGTH	CHORD BEARING	DELTA ANGLE
C1	766.02'	30.09'	30.09'	S 88°48'40" E	02°15'03"
C2	766.03'	249.58'	248.45'	S 70°21'11" E	18°39'56"

I CERTIFY THAT THIS SUBDIVISION PLAT HAS BEEN FOUND TO COMPLY WITH THE LAND SUBDIVISION REGULATIONS OF THE CITY OF BETHEL. THIS PLAT HAS BEEN APPROVED FOR RECORDING IN THE OFFICE OF THE RECORDER IN THE FOURTH JUDICIAL DISTRICT AT BETHEL, ALASKA IN WHICH THE PLAT IS LOCATED.

Mar 27 '03
CITY OF BETHEL PLANNING OFFICER.

Surveyor's Certificate

I, Albert Bianchi 3141 LS, on this 2 day of March, 2003, hereby certify that I am a registered professional land surveyor in the state of Alaska and that this plat represents a survey made by me or under my direct supervision, that the monuments shown on the plat actually exist as described, that all monuments set as a part of this subdivision were set by me or under my direct supervision, and that all dimensional and other details are true and correct to the best of my knowledge.

Albert Bianchi

LEGEND

These standard symbols will be found in the drawing.

- 1" IRON PIPE RECOVERED
- 2-1/2" ALUM CAP 1986
- RED PLASTIC CAP
- 6" X 6"CONCRETE HIGHWAY MARKER
- 5/8" REBAR W/1-1/2"ALUM CAP
- 5/8" X 30" REBAR SET
- 5/8 " rebar (Found)

2003-9
BETHEL RECORDER
DATE MAR. 28 03
TIME 2:09 P.M.
Recorded By City of Bethel
Address

FINAL PLAT OF
Minor Replat
BETHEL HEALTH CLINIC

A RESUBDIVISION OF LOT 1, 2 , AND 3 of the WAVE CENTER SUBDIVISION (2000-20)

LOCATED WITHIN SECTION 17 AND 18, T6N,R71W, SM
CITY OF BETHEL, BETHEL RECORDING DISTRICT ALASKA
CONTAINING 9.869 ACRES.

CREATING		
1. LOT 1	CONTAINING	1.90 acres.
2. LOT 2	CONTAINING	7.15 acres

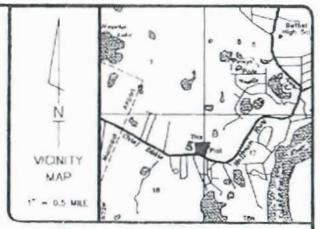
DELTA SURVEYS PLUS
P.O. BOX 49
BETHEL, ALASKA 99559
907-543-3268
SCALE 1"=100'

TUNISTA PROPERTIES, INC.
301 CALISTA COURT
ANCHORAGE, ALASKA 99518

THIS PLAT NOT SUBJECT TO TAXATION AT THE TIME OF FILING.

NOTES:

1) Basis of Bearing was obtained from Post Office Subdivision, Plat # 2000-8 Bethel Recording District.
2) Building Setback – A setback of 15 feet is required from all street rights-of-way, 10 ft. from the side and rear lot lines unless lesser standards are approved by resolution of the appropriate Planning Commission.
3) No private access to State maintained ROW's permitted unless approved by the State of Alaska Department of Transportation.
4) No permanent structure shall be constructed or placed within a utility easement which would interfere with the ability of a Utility to use the easement.



CERTIFICATE of OWNERSHIP and DEDICATION

I HEREBY CERTIFY THAT WE ARE THE OWNER(S) OF THE REAL PROPERTY SHOWN AND DESCRIBED HEREON AND THAT WE HEREBY ADOPT THIS PLAN OF SUBDIVISION AND BY OUR FREE CONSENT DEDICATE ALL RIGHTS-OF-WAY AND PUBLIC AREAS TO PUBLIC USE AND GRANT ALL EASEMENTS TO THE USE SHOWN.

Jim Clark, General Manager
WAVE Wholesale Company, LLC
321 Collate Ct.
Anchorage, AK 99518

NOTARY'S ACKNOWLEDGMENT

SUBSCRIBED AND SWORN BEFORE ME THIS 17th DAY OF July 2000 FOR Alaska Bible Th. Jim Clark, General Mangr.

NOTARY PUBLIC FOR ALASKA
MY COMMISSION EXPIRES 3-16-03

BEVERLY E. ROE NOTARY PUBLIC STATE OF ALASKA

PLAT APPROVAL

THIS PLAT WAS APPROVED BY THE CITY OF BETHEL PLANNING COMMISSION AT THE MEETING OF _____

FOR THE CITY OF BETHEL

Name: _____

Title: _____

LEGEND

- 3-1/4" BLM Brass Cap Monument – 1964 (found)
- 1" Iron Pipe (found)
- 2-1/2" Alum. Cap – 1986, LS 5460 (found)
- 6"x6" Concrete Highway Monument
- Red Plastic Cap, McClintock
- 5/8" Rebar w/ 1-1/2" Alum. Cap (found)
- 5/8"x30" Rebar w/ 1-1/2" Alum. Cap (set)
- [ ] Record Datum – Post Office Subdivision Plat No. 2000-8
- [ ] Record Datum – U. S. Survey No. 4117 Dated May 9, 1966
- ( ) Record Datum – Dept. of Transportation Right-of-Way Map for Bethel Airport to Brown's Slough
- R&M Record and Measured
- NT Non-Tangent
- Former Lot Line
- Utility Pole
- Overhead Utility Line

2000 - 2.0

Bethel REC DIST.
DATE July 26 2000
TIME 2:22 P.M.
Prepared by City of Bethel
#Pages

RECORDED
_____ REC. DIST.
DATE _____ 20__
TIME _____ M
REQUESTED BY
INTEGRITY SURVEYS
605 SWIRES DRIVE
KENAI, ALASKA 99611

LINE TABLE		
Line	Bearing	Length
L1	S33°05'42"W	20.01'
L2	N00°09'59"W	(34.78')
L3	S66°00'00"E	23.05'

CURVE TABLE					
Curve	Delta	Radius	Length	Chord	Chord Direction
C1	21°11'00"	766.20'	283.28'	281.67'	N78°03'33"W
C2	01°52'27"	766.20'	25.04'	25.04'	N87°42'32"W
C3	06°34'45"	766.20'	87.97'	87.93'	N83°29'20"W
C4	12°43'55"	766.20'	170.26'	169.91'	N73°50'01"W

TAX CERTIFICATE

Lands within this subdivision are not subject to property taxes at time of filing.

STATE OF ALASKA 4931 CLIFFORD L. BAKER No. LS-5033

SURVEYOR'S CERTIFICATE

I hereby certify that, I am properly registered and licensed to practice land surveying in the State of Alaska, this plat represents a survey made by me or under my direct supervision, the monuments shown hereon actually exist as described, and all dimensions and other details are correct to the normal standards of practice of land surveyors in the State of Alaska.

Date 02 Nov 2000

Wave Center Subdivision

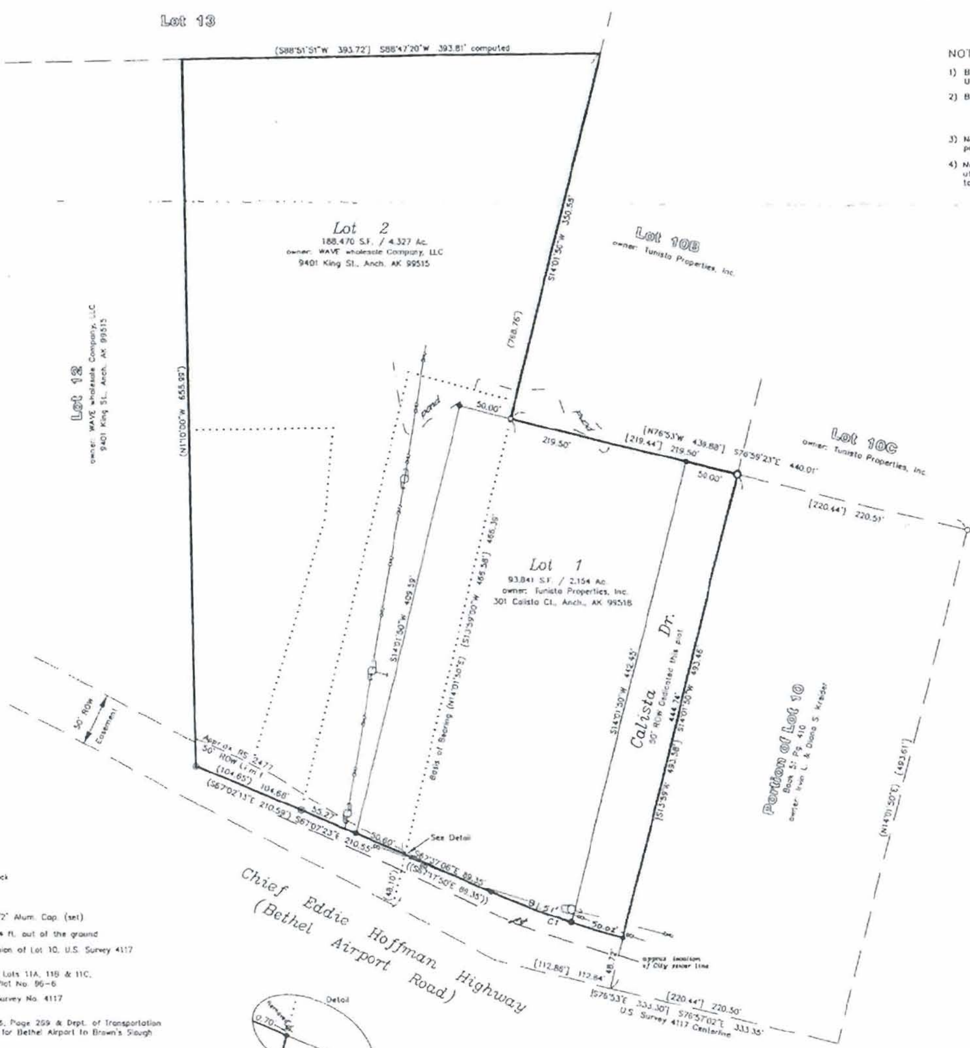
A subdivision of Lot 12 U.S. Survey No. 4117 and Lot 2 Post Office Subdivision. A Subdivision creating Lots 1 through 3.

Located within the Section 17 & 18, T8N, R71W, S.M., City of Bethel, Bethel Recording District, Alaska. Containing 2.642 Acres

Containing 9.337 Acres

Integrity Surveys
605 Swires Drive Kenai, Alaska 99611-8363
SURVEYORS PHONE – (907) 283-9047 FAX – (907) 283-9271 PLANNERS

JOB NO.	20037	DRAWN:	15 July, 2000 CB
SURVEYED:	12-14 July, 2000	SCALE:	1" = 50'
FIELD BK.	99-7, Pg. 134-141	DISK.	US 4117



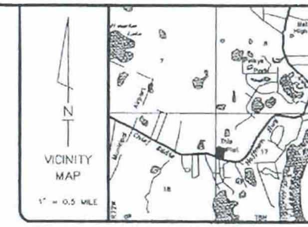
NOTES:

1) Basis of Bearing was obtained from plat of Lots 11A, 11B & 11C U. S. Survey No. 4117.

2) Building Setback – A setback of 15 feet is required from all street rights-of-way, 10 ft. from the side and rear lot lines unless lesser standards are approved by resolution of the appropriate Planning Commission.

3) No private access to State maintained ROW's permitted unless approved by the State of Alaska Department of Transportation.

4) No permanent structure shall be constructed or placed within a utility easement which would interfere with the ability of a Utility to use the easement.



CERTIFICATE of OWNERSHIP and DEDICATION

WE HEREBY CERTIFY THAT WE ARE THE OWNER(S) OF THE REAL PROPERTY SHOWN AND DESCRIBED HEREON AND THAT WE HEREBY ADOPT THIS PLAN OF SUBDIVISION AND BY OUR FREE CONSENT DEDICATE ALL RIGHTS-OF-WAY AND PUBLIC AREAS TO PUBLIC USE AND GRANT ALL EASEMENTS TO THE USE SHOWN.

Dixie Retherford, President
Tunista Properties, Inc.
301 Calista Ct.
Anchorage, AK 99518

Jim Clark, General Manager
WAVE Wholesale Company, LLC
301 Calista Ct.
Anchorage, AK 99518

NOTARY'S ACKNOWLEDGMENT

SUBSCRIBED AND SWORN BEFORE ME THIS ___ DAY OF April 2000 FOR Dixie Retherford and Jim Clark

NOTARY PUBLIC FOR ALASKA
MY COMMISSION EXPIRES May 12, 2003

PLAT APPROVAL

THIS PLAT WAS APPROVED BY THE CITY OF BETHEL PLANNING COMMISSION AT THE MEETING OF April 13, 2000

FOR THE CITY OF BETHEL

Name: Scott P. Gown
Title: Chairman - Planning Commission

2000-8
RECORDED 20
Bethel REC. DIST.
DATE: 5/23 2000
TIME: 10:30 A.M.
REQUESTED BY:
INTEGRITY SURVEYS
605 SWIRES DRIVE
KENAI, ALASKA 99611

STATE OF ALASKA
49th
Cliff Baker
CLIFFORD E. BAKER
No. LS-5152
REGISTERED PROFESSIONAL LAND SURVEYOR

LEGEND:

- ◉ Red Plastic Cap, McClintock
- o 5/8" Rebar (found)
- • 5/8"x30" Rebar w/ 1-1/2" Alum. Cap (set)
- O 4" Steel Post projecting 4 ft. out of the ground
- [ ] Record Datum – Subdivision of Lot 10, U.S. Survey 4117 Plat No. 82-17
- ( ) Record Datum – Plat of Lots 11A, 11B & 11C, U.S. Survey 417, Plat No. 96-6
- } { Record Datum – U. S. Survey No. 4117 Dated May 9, 1966
- (( )) Record Datum – Book 16, Page 259 & Dept. of Transportation Right-of-Way Map for Bethel Airport to Brown's Slough
- ..... Former Lot Line
- Right of Way Easement Being Vacated this Plat
- Utility Pole
- GCI Underground Cable
- Overhead Utility Line
- Spot Elevation

TAX CERTIFICATE

Lands within this subdivision are not subject to property taxes at time of filing.

CURVE TABLE					
Curve	Delta	Radius	Length	Chord	Chord Bearing
C1	08°19'41"	904.93'	131.53'	131.42'	S71°46'56"E

SURVEYOR'S CERTIFICATE

I hereby certify that; I am properly registered and licensed to practice land surveying in the State of Alaska, this plat represents a survey made by me or under my direct supervision, the monuments shown hereon actually exist as described, and all dimensions and other details are correct to the normal standards of practice of land surveyors in the State of Alaska.

Date 24 APRIL 2000

Post Office Subdivision

A subdivision of Lot 10A U.S. Survey No. 4117, Plat No. 82-17 and Lots 11 A-C U.S. Survey No. 4117, Plat No. 96-6. A Subdivision creating Lots 1 & 2, and a public right-of-way designated as Calista Drive.

Located within the Section 17, T8N, R71W, S.M., City of Bethel, Bethel Recording District, Alaska.

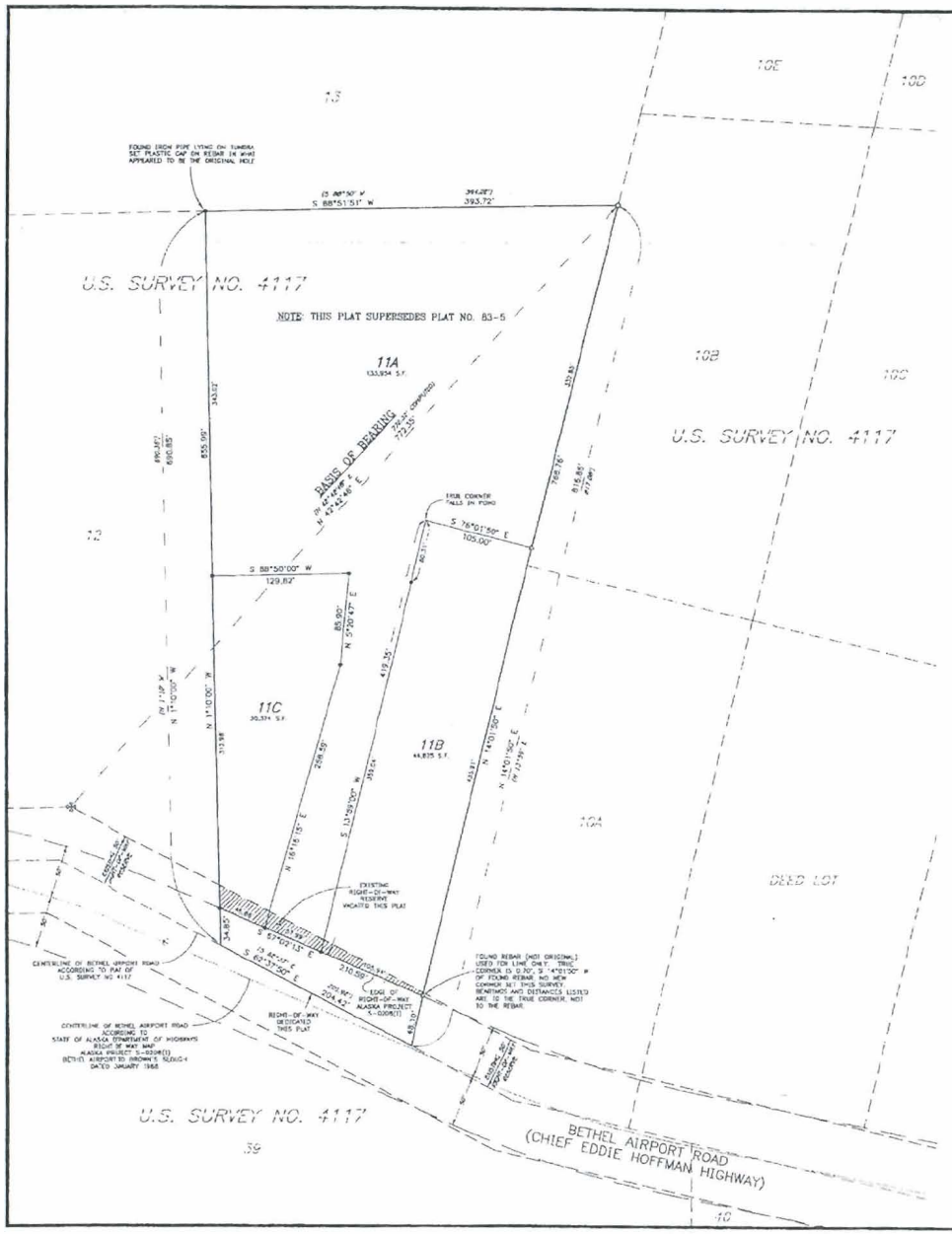
Containing 6.991 Acres

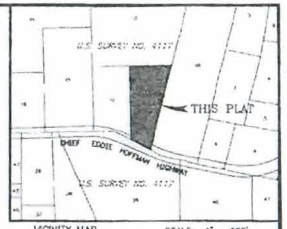
Integrity Surveys

605 Swires Drive — Kenai, Alaska 99611-8363
SURVEYORS — PHONE – (907) 283-9047 FAX --- (907) 283-9071 — PLANNERS

JOB NO.	99154	DRAWN	14 April, 2000 CB
SURVEYED:	Oct. 99 – May 2000	SCALE	1" = 50'
FIELD BK:	99-7, Pg. 54-63	DISK	US 4117

Bethel 2000-8





VICINITY MAP SCALE: 1" = 500'

CERTIFICATE OF OWNERSHIP AND DEDICATION

I HEREBY CERTIFY THAT I AM THE OWNER OF THE PROPERTY DESCRIBED HEREON AND HEREBY APPROVE THIS SUBDIVISION PLAT.

DONALD E. ELLIOT
P.O. BOX 84
BETHEL, ALASKA 99559

DATE

NOTARY'S ACKNOWLEDGEMENT

SUBSCRIBED AND SWORN TO BEFORE ME THIS DAY OF 19__, FOR

NOTARY FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES:

My Commission Expires April 20, 1999

NOTARY PUBLIC

CITY APPROVAL CERTIFICATE

THE CITY OF BETHEL HEREBY APPROVES THE SUBDIVISION AND RIGHT-OF-WAY VACATION SHOWN ON THIS PLAT

NAME:
TITLE: Citizen
FOR THE CITY OF BETHEL

DATE

CERTIFICATE OF APPROVAL BY ALASKA D.E.C.

WASTEWATER DISPOSAL: APPROVAL OF THIS SUBDIVISION IS BASED ON THE REPRESENTATION THAT NO WASTEWATER WILL BE DISPOSED OF ON ANY LOT. CONDITIONS ARE NOT SUITABLE FOR ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEMS. APPROVAL OF ENGINEERING PLANS FOR THE ONSITE COLLECTION SYSTEM MUST BE ISSUED BY THIS DEPARTMENT OR AUTHORIZED AGENT. THIS APPROVAL WILL NEED TO BE OBTAINED BY THE OWNER OF LOT WHEN IT IS DEVELOPED.
SUBJECT TO ANY NOTED RESTRICTIONS, THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION APPROVES THIS SUBDIVISION FOR PLATTING

SIGNATURE DATE 6/3/96
Environmental Engineer
TITLE

CERTIFICATE OF APPROVAL BY ALASKA D.E.C.

~~WASTEWATER DISPOSAL: THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION HAS REVIEWED PLANS FOR THIS SUBDIVISION WASTEWATER DISPOSAL AND APPROVES THIS SUBDIVISION FOR PLATTING~~

SIGNATURE DATE
TITLE

LEGEND

- △ FOUND 5/8" REBAR
- ✱ FOUND 3 1/4" BLM BRASS CAP MONUMENT
- ○ FOUND IRON PIPE
- ● SET 1 1/4" PLASTIC CAP ON 5/8" X 30" REBAR
- X.XX XX MEASURED DATA
- (X.XX XX) RECORD DATA PER U.S. SURVEY NO. 4117
- (COMPUTED) COMPUTED FROM THE RECORD OF U.S. SURVEY NO. 4117

LOT CORNER MCCLINTOCK

TYPICAL PLASTIC CAP MARKING

NOTE: THIS PLAT SUPERSEDES PLAT NO. 83-5

96-6
RECORDED - FILED
BETHEL REC. DIST.
6-20 96
1:04 P.M.
McCLINTOCK LAND ASSOC.

STATE OF ALASKA 49TH
WILLIAM McCLINTOCK
LS-3480
REGISTERED LAND SURVEYOR

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT I AM PROPERLY REGISTERED AND LICENSED TO PRACTICE LAND SURVEYING IN THE STATE OF ALASKA AND THAT THIS PLAT REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION

WILLIAM McCLINTOCK
REGISTERED LAND SURVEYOR
LS-3480

5-31-95
DATE

50 0 50 100 150
SCALE IN FEET

THIS PLAT NOT SUBJECT TO TAXATION AT THE TIME OF FILING

PLAT OF
LOTS 11A, 11B AND 11C
U.S. SURVEY NO. 4117

A SUBDIVISION OF
LOT 11, U.S. SURVEY NO. 4117
CONTAINING 217,235 SQ. FT.
BETHEL RECORDING DISTRICT

PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
11940 BUSINESS BOULEVARD, SUITE 205
EAGLE RIVER, ALASKA 99577
(907) 694-4495

JOB: 95-172	DWN: BM	DWG: PL95-172	PRK: GW-P66-C	SCL: 1"=50'			
CKD: BETHEL	DWN: JM	FB NO. 95-34	SURVEY: B S-95	SHEET 1 OF 1			

STATE OF ALASKA

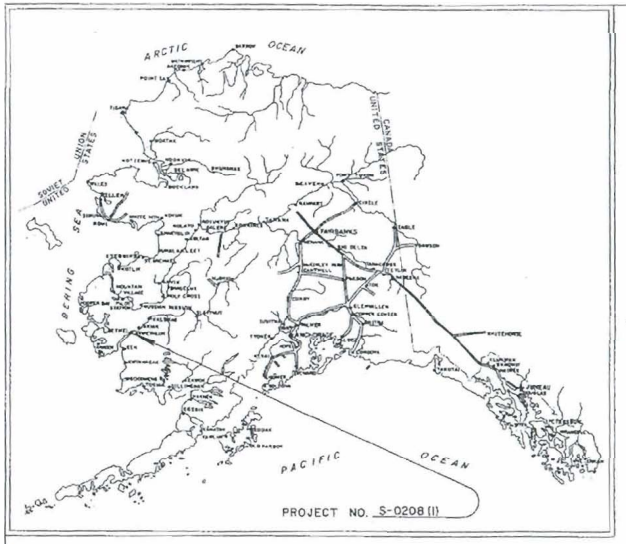
DEPARTMENT OF HIGHWAYS

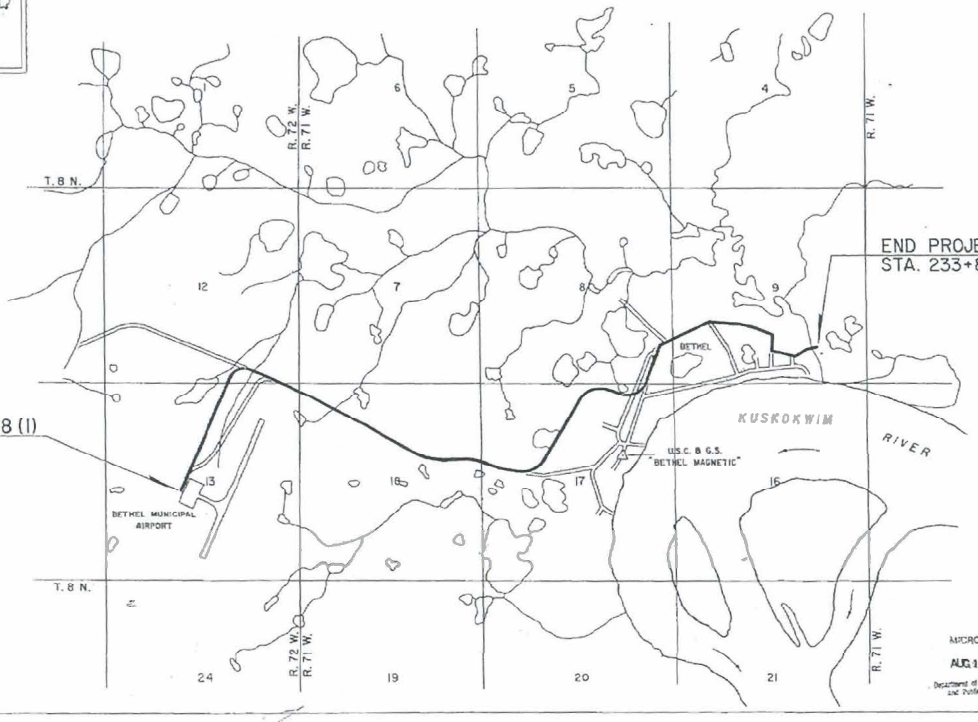
RIGHT OF WAY MAP

ALASKA PROJECT

S-0208 (1)

BETHEL AIRPORT TO BROWN'S SLOUGH





PROJECT LENGTH 4.287 MI.

SCALE

1500 0 1500 3000 4500 6000

FEET

DEPARTMENT OF HIGHWAYS

APPROVED May 16, 1968

Date

C. E. Stem

COMMISSIONER

DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

APPROVED _____, 19

Date

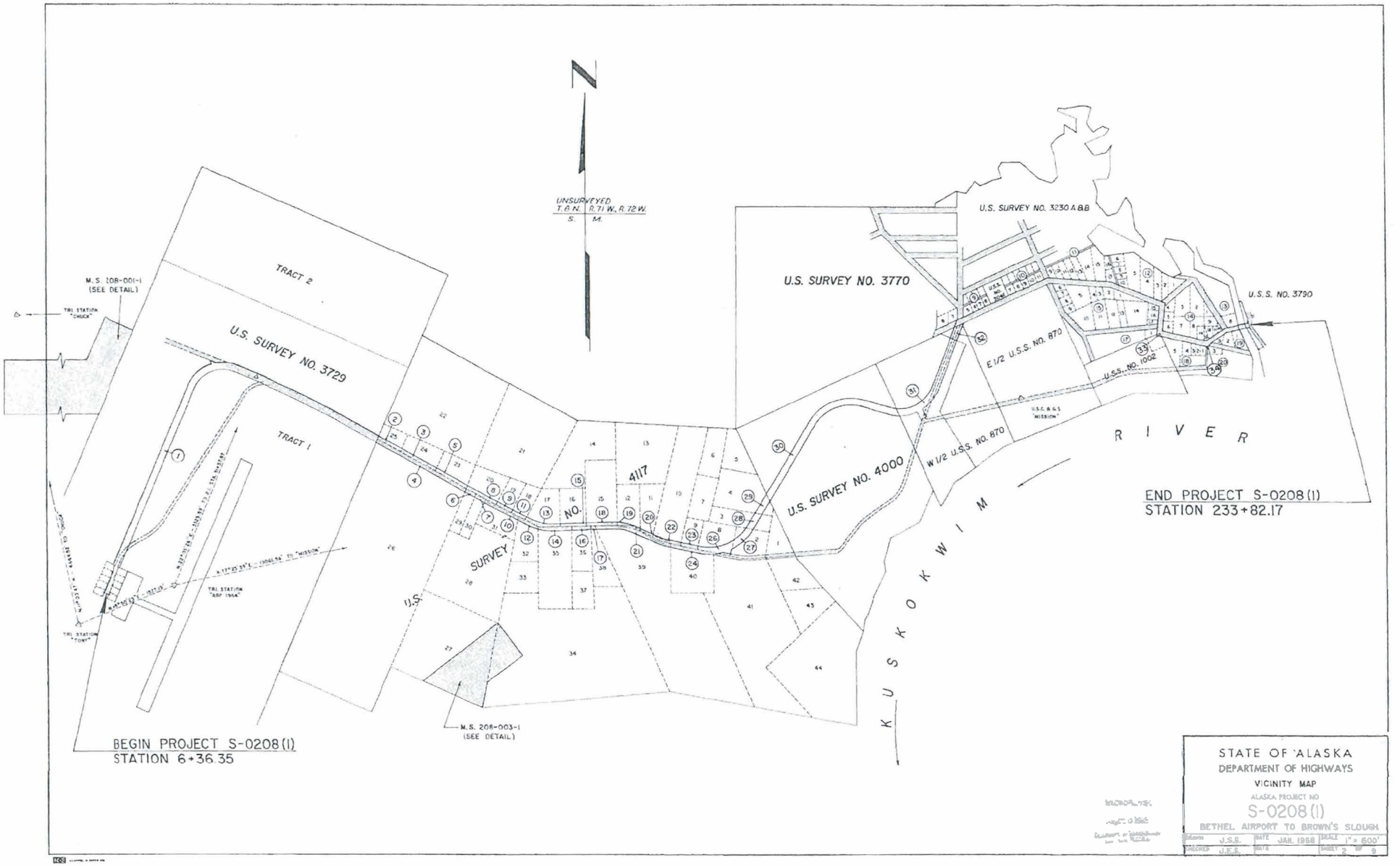
DIVISION ENGINEER

MICROFILMED

AUG 10 1983

Department of Transportation and Public Facilities

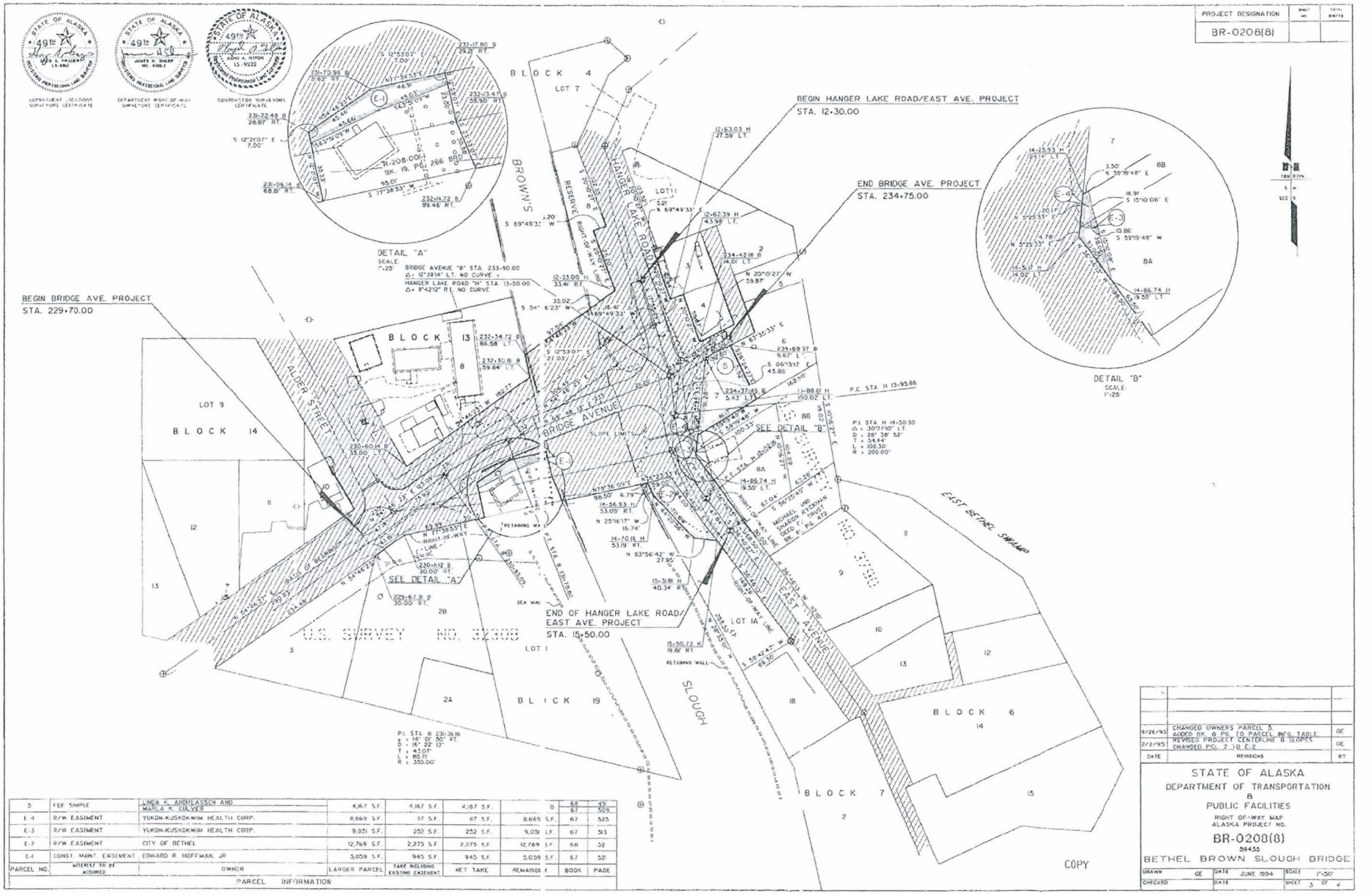
SHEET NO. 30



STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
VICINITY MAP
ALASKA PROJECT NO
S-0208(1)
BETHEL AIRPORT TO BROWN'S SLOUGH

DRAWN	J.S.S.	DATE	JAN. 1968	SCALE	1" = 600'
CHECKED	J.E.S.	DATE		SHEET	2 OF 9

PROJECT DESIGNATION	SHEET NO.	TOTAL SHEETS
BR-0208(8)		



PARCEL NO.	INTEREST TO BE ACQUIRED	OWNER	LARGER PARCEL	TAKE INCLUDING EXISTING EASEMENT	NET TAKE	REMAINDER	BOOK	PAGE
5	FEE SIMPLE	LINDA K. ANDRIEASSEN AND MARLA K. CULVER	4,167 S.F.	4,167 S.F.	4,167 S.F.	0	68 67	49 509
E-4	R/W EASEMENT	YUKON-KUSKOKWIM HEALTH CORP.	8,869 S.F.	87 S.F.	87 S.F.	8,869 S.F.	67	525
E-3	R/W EASEMENT	YUKON-KUSKOKWIM HEALTH CORP.	9,051 S.F.	252 S.F.	252 S.F.	9,051 S.F.	67	513
E-2	R/W EASEMENT	CITY OF BETHEL	12,769 S.F.	2,275 S.F.	2,275 S.F.	12,769 S.F.	68	52
E-1	CONST. MAINT. EASEMENT	EDWARD R. HOFFMAN, JR.	5,059 S.F.	945 S.F.	945 S.F.	5,059 S.F.	67	521

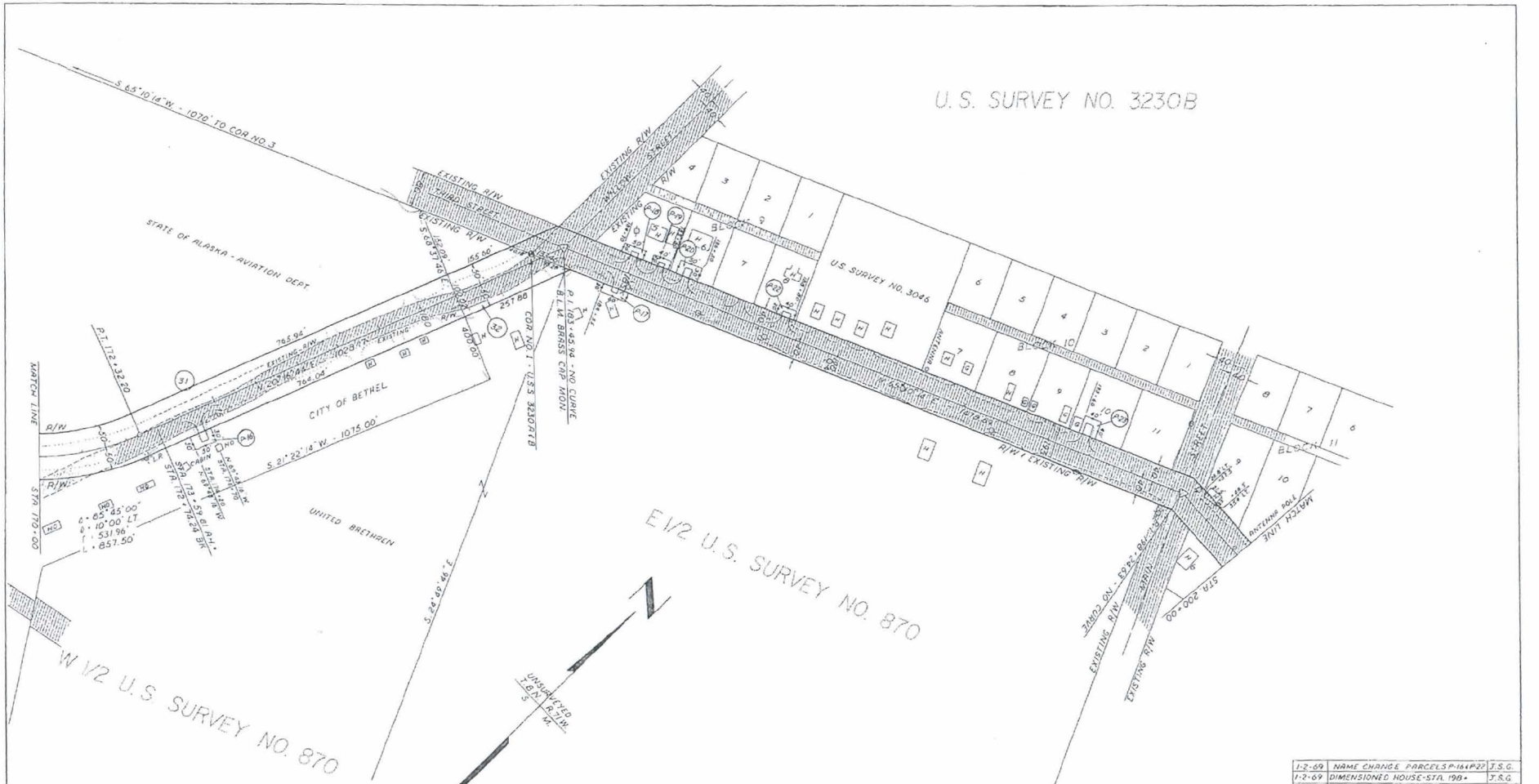
PARCEL INFORMATION

DATE	REVISIONS	BY
9/28/95	CHANGED OWNERS PARCEL 5. ADDED BK. & PG. TO PARCEL INFO. TABLE	GE
2/2/95	REVISED PROJECT CENTERLINE & SLOPES CHANGED PGL 2 TO E-2	GE

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
&
PUBLIC FACILITIES
RIGHT OF WAY MAP
ALASKA PROJECT NO.
BR-0208(8)
59455
BETHEL BROWN SLOUGH BRIDGE

DRAWN	GE	DATE	JUNE 1994	SCALE	1"=50'
CHECKED		DATE		SHEET	3 OF 4

BETHEL 95-9



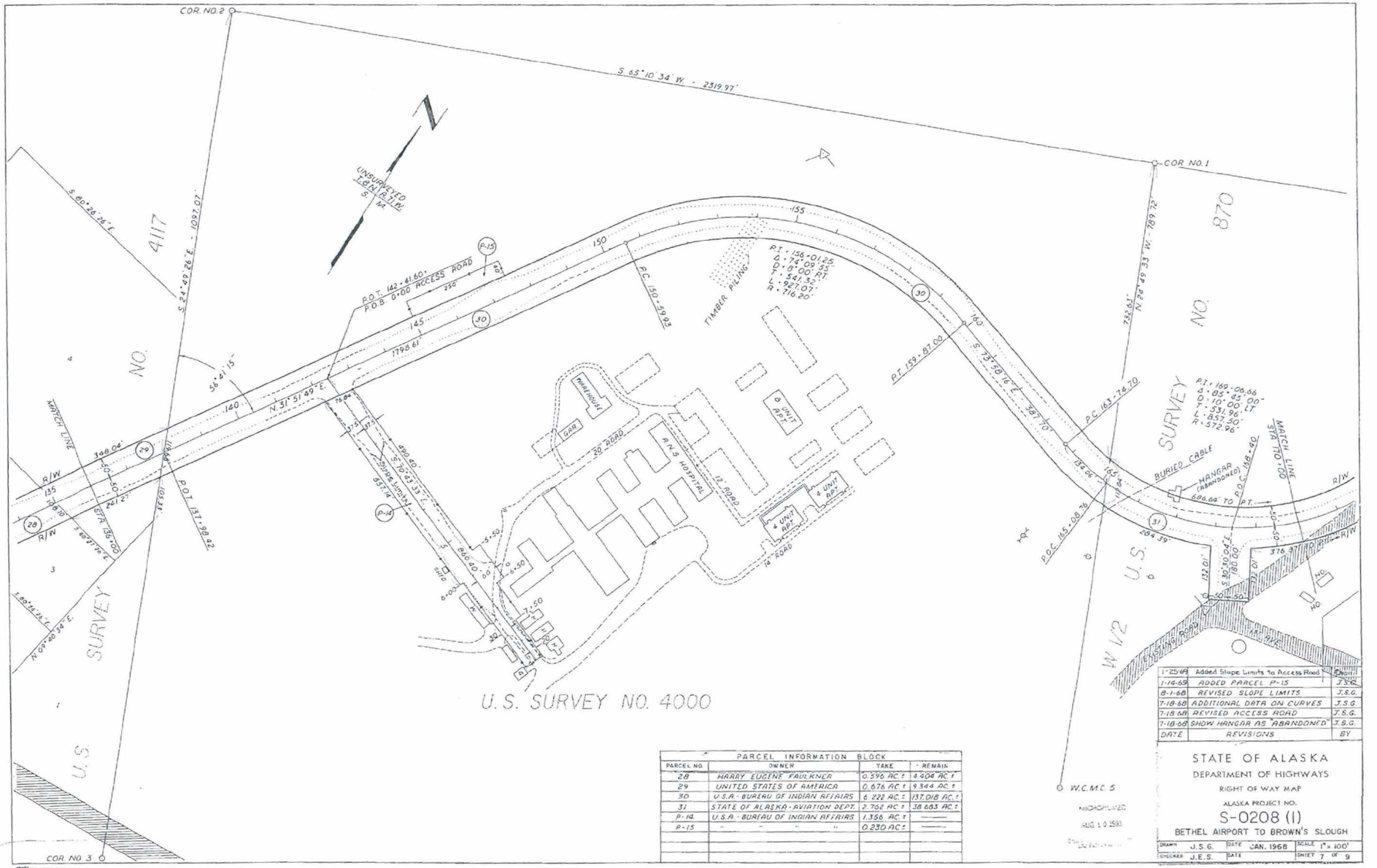
PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
P-16	CITY OF BETHEL	1500 SQ FT	—
P-17	UNITED BRETHREN	1200 " "	—
P-18	V. R. MULCAHY	1000 " "	—
P-19	V. R. MULCAHY	800 " "	—
P-20	JOE N. PIKE	1500 " "	—
P-21	DELETED	—	—
P-22	BERNARD BLUMENSTEIN	800 " "	—
P-23	UNITED TRANSPORTATION, INC	1600 " "	—

PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
31	STATE OF ALASKA-AVIATION DEPT	2.762 AC ±	38.683 AC ±
32	UNITED BRETHREN	0.276 AC ±	19.724 AC ±

DATE	REVISIONS	BY
1-2-69	NAME CHANGE PARCELS P-16 & P-22	J.S.G.
1-2-69	DIMENSIONED HOUSE-STA. 198+	J.S.G.
8-2-68	REVISED PARCEL P-17	J.S.G.
8-2-68	DELETED PARCEL P-21	J.S.G.
8-2-68	REVISED SLOPE LIMITS	J.S.G.

STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
RIGHT OF WAY MAP
ALASKA PROJECT NO.
S-0208 (1)
BETHEL AIRPORT TO BROWN'S SLOUGH

DRAWN J.S.G.	DATE JAN. 1968	SCALE 1" = 100'	
CHECKED J.E.S.	DATE	SHEET 8 OF 9	

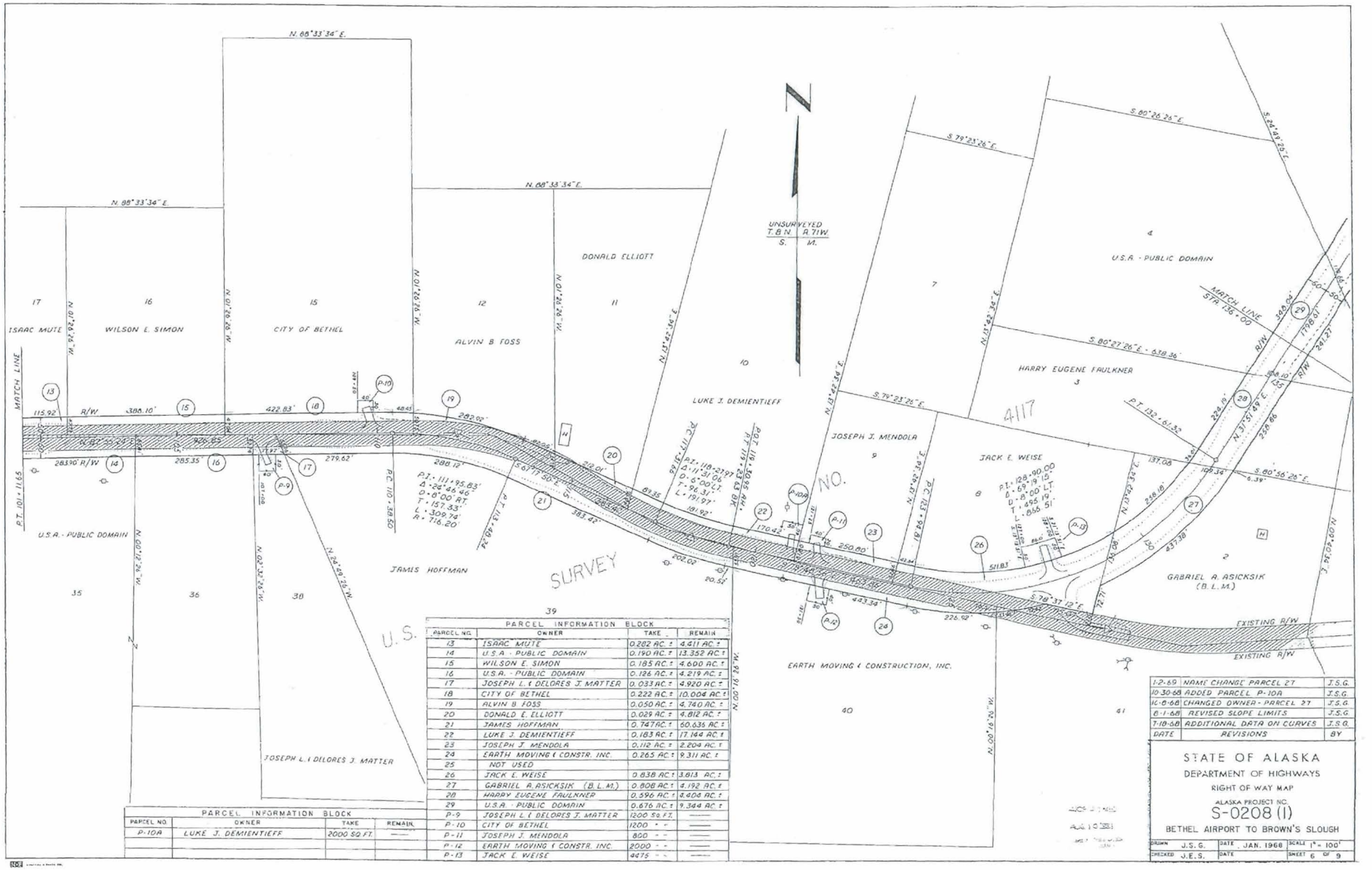


PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
28	HARRY EUGENE FAULKNER	0.596 AC.±	4.404 AC.±
29	UNITED STATES OF AMERICA	0.676 AC.±	9.344 AC.±
30	U.S.A. - BUREAU OF INDIAN AFFAIRS	6.222 AC.±	137.018 AC.±
31	STATE OF ALASKA - AVIATION DEPT.	2.762 AC.±	38.683 AC.±
P-14	U.S.A. - BUREAU OF INDIAN AFFAIRS	1.356 AC.±	——
P-15	" " " "	0.230 AC.±	——

DATE	REVISIONS	BY
1-25-69	Added Slope Limits to Access Road	J.S.G.
1-14-69	ADDED PARCEL P-15	J.S.G.
8-1-68	REVISED SLOPE LIMITS	J.S.G.
7-18-68	ADDITIONAL DATA ON CURVES	J.S.G.
7-18-68	REVISED ACCESS ROAD	J.S.G.
7-18-68	SHOW HANGAR AS "ABANDONED"	J.S.G.

STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
RIGHT OF WAY MAP
ALASKA PROJECT NO.
S-0208 (1)
BETHEL AIRPORT TO BROWN'S SLOUGH

DRAWN	J.S.G.	DATE	JAN. 1968	SCALE	1" = 100'
CHECKED	J.E.S.	DATE		SHEET	7 OF 9



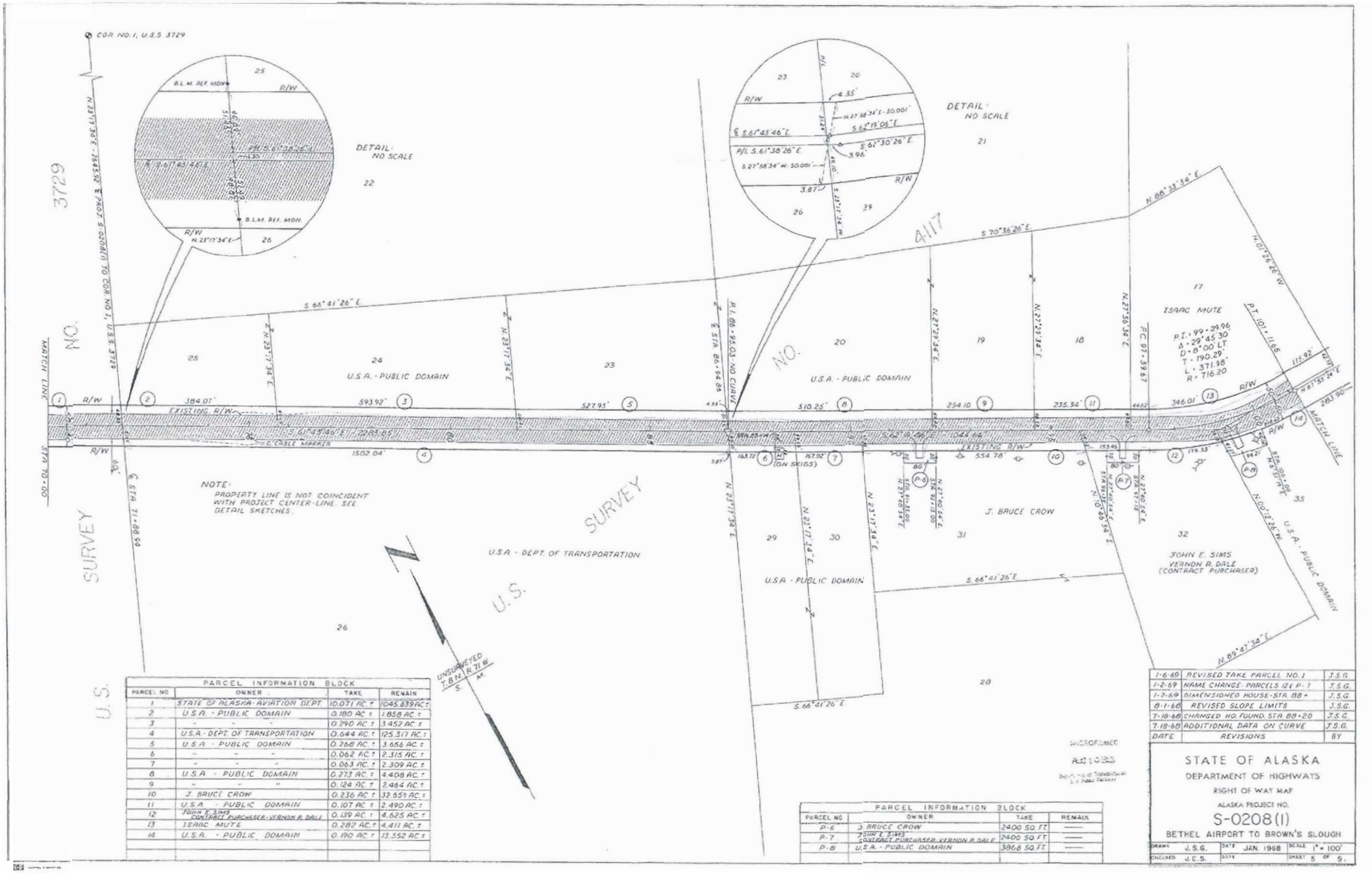
PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
13	ISAAC MUTE	0.282 AC. ±	4.411 AC. ±
14	U.S.A. - PUBLIC DOMAIN	0.190 AC. ±	13.352 AC. ±
15	WILSON E. SIMON	0.185 AC. ±	4.600 AC. ±
16	U.S.A. - PUBLIC DOMAIN	0.126 AC. ±	4.219 AC. ±
17	JOSEPH L. & DELORES J. MATTER	0.033 AC. ±	4.920 AC. ±
18	CITY OF BETHEL	0.222 AC. ±	10.004 AC. ±
19	ALVIN B. FOSS	0.050 AC. ±	4.740 AC. ±
20	DONALD E. ELLIOTT	0.029 AC. ±	4.812 AC. ±
21	JAMES HOFFMAN	0.747 AC. ±	60.636 AC. ±
22	LUKE J. DEMIENTIEFF	0.183 AC. ±	17.144 AC. ±
23	JOSEPH J. MENDOLA	0.112 AC. ±	2.204 AC. ±
24	EARTH MOVING & CONSTR. INC.	0.265 AC. ±	9.311 AC. ±
25	NOT USED		
26	JACK E. WEISE	0.838 AC. ±	3.813 AC. ±
27	GABRIEL A. ASICKSIK (B.L.M.)	0.808 AC. ±	4.192 AC. ±
28	HARRY EUGENE FAULKNER	0.596 AC. ±	4.404 AC. ±
29	U.S.A. - PUBLIC DOMAIN	0.676 AC. ±	9.344 AC. ±
P-9	JOSEPH L. & DELORES J. MATTER	1200 SQ. FT.	——
P-10	CITY OF BETHEL	1200 " "	——
P-11	JOSEPH J. MENDOLA	800 " "	——
P-12	EARTH MOVING & CONSTR. INC.	2000 " "	——
P-13	JACK E. WEISE	4475 " "	——

PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
P-10A	LUKE J. DEMIENTIEFF	2000 SQ. FT.	——

DATE	REVISIONS	BY
1-2-69	NAME CHANGE PARCEL 27	J.S.G.
10-30-68	ADDED PARCEL P-10A	J.S.G.
10-8-68	CHANGED OWNER - PARCEL 27	J.S.G.
8-1-68	REVISED SLOPE LIMITS	J.S.G.
7-18-68	ADDITIONAL DATA ON CURVES	J.S.G.

STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
RIGHT OF WAY MAP
ALASKA PROJECT NO.
S-0208 (1)
BETHEL AIRPORT TO BROWN'S SLOUGH

DRAWN J.S.G.	DATE JAN. 1968	SCALE 1" = 100'	
CHECKED J.E.S.	DATE	SHEET 6 OF 9	



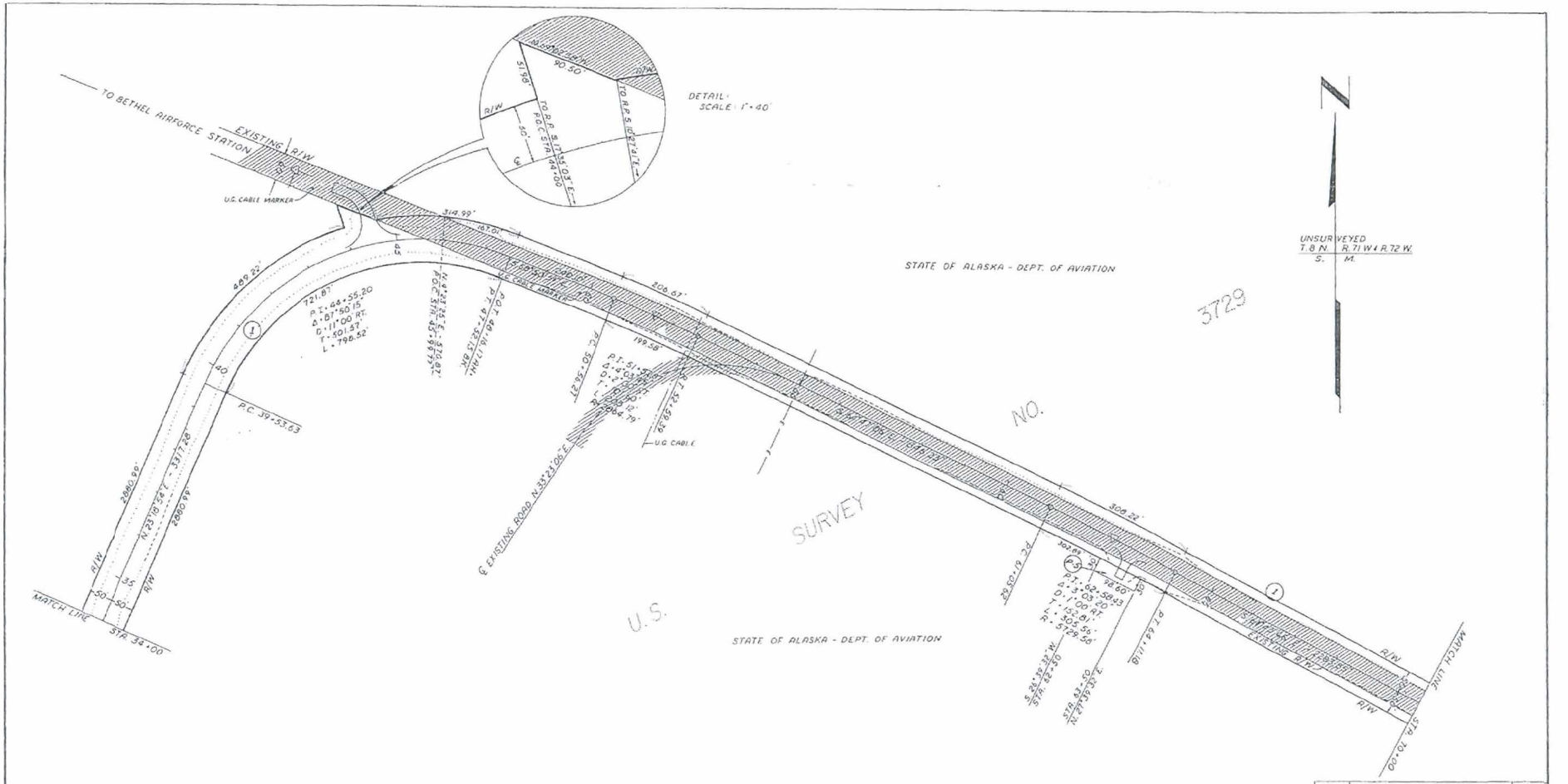
PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
1	STATE OF ALASKA-AVIATION DEPT	10.071 AC. ±	1045.839 AC. ±
2	U.S.A. - PUBLIC DOMAIN	0.180 AC. ±	1.858 AC. ±
3	" " "	0.290 AC. ±	3.452 AC. ±
4	U.S.A. - DEPT. OF TRANSPORTATION	0.644 AC. ±	125.317 AC. ±
5	U.S.A. - PUBLIC DOMAIN	0.268 AC. ±	3.656 AC. ±
6	" " "	0.062 AC. ±	2.315 AC. ±
7	" " "	0.063 AC. ±	2.309 AC. ±
8	U.S.A. - PUBLIC DOMAIN	0.273 AC. ±	4.408 AC. ±
9	" " "	0.124 AC. ±	2.464 AC. ±
10	J. BRUCE CROW	0.236 AC. ±	32.659 AC. ±
11	U.S.A. - PUBLIC DOMAIN	0.107 AC. ±	2.490 AC. ±
12	JOHN E. SIMS CONTRACT PURCHASER-VERNON R. DALE	0.139 AC. ±	4.625 AC. ±
13	ISAAC MUTE	0.282 AC. ±	4.411 AC. ±
14	U.S.A. - PUBLIC DOMAIN	0.190 AC. ±	13.352 AC. ±

PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
P-6	J. BRUCE CROW	2400 SQ. FT.	—
P-7	JOHN E. SIMS CONTRACT PURCHASER: VERNON R. DALE	2400 SQ. FT.	—
P-8	U.S.A. - PUBLIC DOMAIN	3868 SQ. FT.	—

DATE	REVISIONS	BY
1-6-69	REVISED TAKE PARCEL NO. 1	J.S.G.
1-2-69	NAME CHANGE: PARCELS 12 & P-7	J.S.G.
1-2-69	DIMENSIONED HOUSE-STA. 88+	J.S.G.
8-1-68	REVISED SLOPE LIMITS	J.S.G.
7-18-68	CHANGED HO. FOUND. STA 88+20	J.S.G.
7-18-68	ADDITIONAL DATA ON CURVE	J.S.G.

STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
RIGHT OF WAY MAP
ALASKA PROJECT NO.
S-0208(1)
BETHEL AIRPORT TO BROWN'S SLOUGH

DRAWN	J.S.G.	DATE	JAN. 1968	SCALE	1" = 100'
CHECKED	J.C.S.	DATE		SHEET	5 OF 9

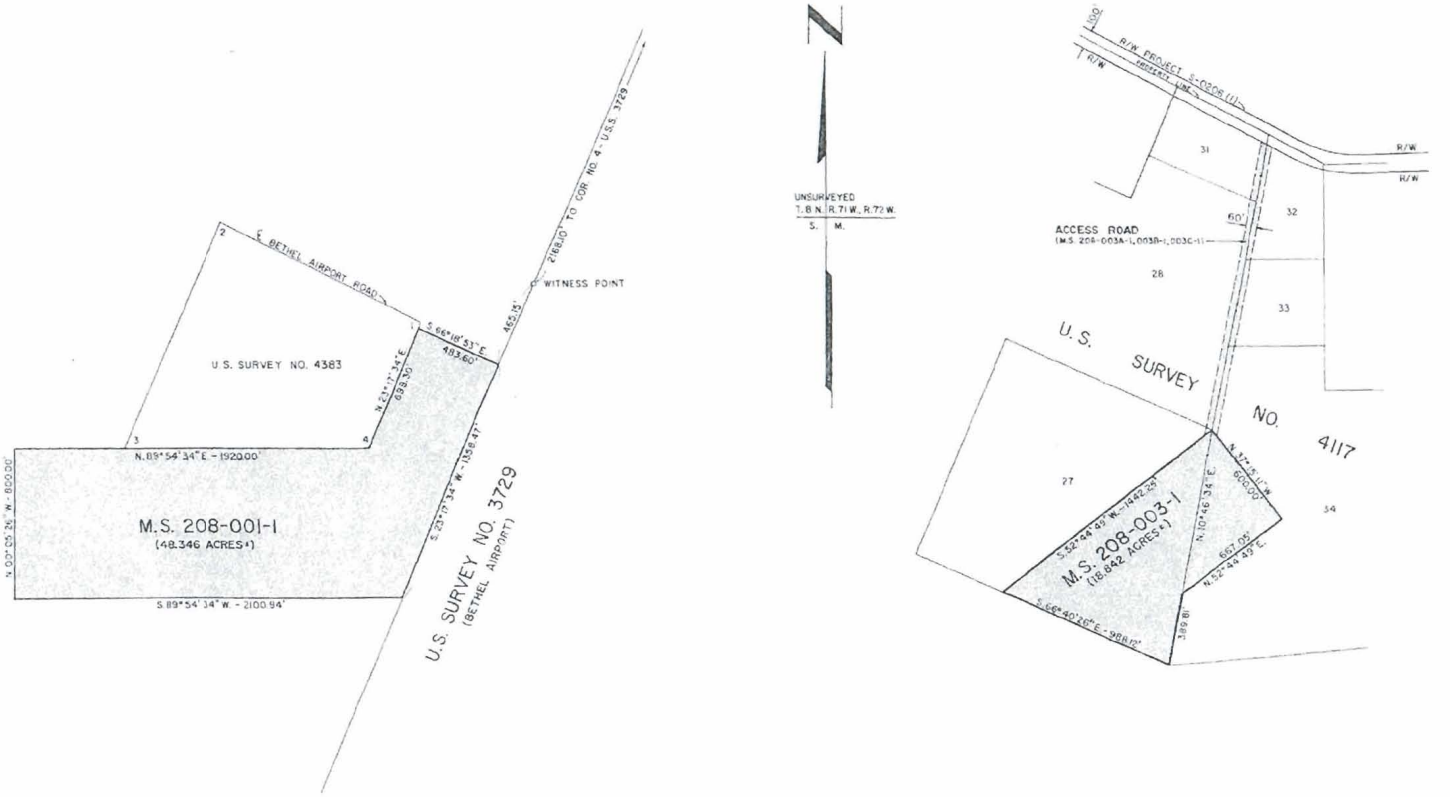


PARCEL INFORMATION BLOCK			
PARCEL NO.	OWNER	TAKE	REMAIN
1	STATE OF ALASKA - AVIATION DEPT.	1007 AC ±	1045.839 AC ±
P-5	" " "	2966 SQ. FT.	——

DATE	REVISIONS	BY
1-6-69	REVISED TAKE PARCEL 1	J.S.G.
1-2-69	REVISED CURVE - P.I. 44+55.20	J.S.G.
8-1-68	REVISED SLOPE LIMITS	J.S.G.
8-1-68	ADDED R/W MONUMENT TIE	J.S.G.
7-17-68	ADDITIONAL DATA ON CURVES	J.S.G.

STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
RIGHT OF WAY MAP
ALASKA PROJECT NO.
S-0208 (1)
BETHEL AIRPORT TO BROWN'S SLOUGH

DRAWN	J.S.G.	DATE	JAN. 1968	SCALE	1" = 100'
CHECKED	J.E.S.	DATE		SHEET	4 OF 9



BETHEL AIRPORT TO BROWN'S SLOUGH

STATE OF ALASKA
DEPARTMENT OF HIGHWAYS
MATERIAL SOURCES PLAT
ALASKA PROJECT NO.
S-0208(1)

DRAWN J.S.G.	DATE JAN. 1968	SCALE 1" = 300'	
CHECKED J.E.S.	DATE	SHEET 2A OF 9	

PROJECT DESIGNATION	SHEET NO.	TOTAL SHEETS
BR-0208(8)		

MONUMENT SUMMARY SHEET

RECOVERED CORNERS - BRIDGE AVENUE

LOCATION	MONUMENT TYPE	NORTHING	EASTING	STATION	OFFSET	WORK ITEM
NC PI-8	3" Brass Cap Mon in Case	11972.657	24713.648	230+17.19	0.01 RT	1, 2, 6 (SEE NOTE 2)
L1 Blk 20 WD 10 USS 3230	Rebar with Al Cap	11625.839	25011.235	230+80.12	455.13 RT	
WC2 MC4 TR B ATS 1348	Rebar with Al Cap	11917.437	24817.181	230+98.91	104.83 RT	
L1 Blk A ROW WD 10 USS 3230	Rebar with Al Cap	11566.823	25010.038	230+82.89	420.80 RT	
WC1 MC4 TR B ATS 1348	Rebar with Al Cap	11922.912	24853.122	231 08.19	120.06 RT	
NE L 7 Blk 13 USS #3220 A&B	Rebar	12358.586	24804.426	232 44.49	298.16 LT	
PI-1 HANGER LAKE ROAD	PK Nail	12151.470	25080.431	234 10.58	8.17 LT	1, 3 (SEE NOTE 3)
NW L7 BLK 6 USS #3790	Rebar	12155.282	25090.455	234 37.84	5.39 RT	1, 3 (SEE NOTE 3)
NE L 8 Blk 4 USS #3790	Rebar	12407.626	24932.063	234 45.67	292.40 LT	
W L 3 Blk 8 USS #3790	Rebar	12284.483	25029.001	234 56.57	136.15 LT	
SW Cemetery 6 USS #3790	Iron Pipe	11977.969	25259.747	234 79.48	246.94 RT	

RECOVERED CORNERS - HANGER LAKE ROAD / EAST AVENUE

LOCATION	MONUMENT TYPE	NORTHING	EASTING	STATION	OFFSET	WORK ITEM
E L 2 Blk 8 USS #3790	Angle Iron	12282.065	25207.466	12+57.49	197.53 LT	
	2 1/2" Brass Cap Mon in Case	12193.232	25026.008	12 88.17	2.36 RT	4
OLD BRIDGE AVE. / HANGER LAKE RD. / EAST AVE.	Rebar with Al Cap	12045.573	25049.782	14 35.30	11.72 RT	1, 3 (SEE NOTES 3 AND 4)
NC R-7	3" Brass Cap Mon in Case	11777.686	24437.525	14 51.50	679.11 RT	

INSTALL PROJECT CENTERLINE MONUMENTS

LOCATION	MONUMENT TYPE	NORTHING	EASTING	STATION	WORK ITEM
PC BRIDGE AVE	Primary in Case	12016.443	24775.845	230+93.9 B	5, 6
PT BRIDGE AVE	Primary in Case	12056.856	24850.953	231+78.0 B	5, 6
BRIDGE AVE / HANGER LAKE RD INTERSECTION	Primary in Case	12133.222	25047.895	233+90.0 B	5, 6
END OF PROJECT, BRIDGE AVE	Primary in Case	12180.589	25118.487	234+75.0 B	5, 6
BEGINNING OF PROJECT, HANGER LAKE RD	Primary in Case	12247.397	25012.983	12+30.0 H	5, 6
PC HANGER LAKE RD	Primary in Case	12087.632	25052.664	13+95.6 H	5, 6
PT HANGER LAKE RD	Primary in Case	11989.853	25091.278	15+02.6 H	5, 6
END OF PROJECT, HANGER LAKE RD	Primary in Case	11951.483	25119.851	15+50.0 H	5, 6

WORK ITEM	WORK REQUIRED	PAY ITEM NO.
1	REFERENCE MONUMENT	642(8)
2	REPLACE PRIMARY MONUMENT	642(7A)
3	REPLACE SECONDARY MONUMENT	642(7B)
4	REMOVE, DO NOT REPLACE	
5	INSTALL SURVEY MONUMENT	614(1)
6	INSTALL MONUMENT CASE	614(2)

HORIZONTAL CONTROL:

A LOCAL GROUND COORDINATE SYSTEM BASED UPON A COMPASS ADJUSTED TRAVERSE PERFORMED BY AKDOT FOR OTHER PROJECTS IN THE AREA. AN ENCASED BRASS CAP MONUMENT, LOCATED 0.01 FEET RIGHT OF STATION 230+17.19 AT THE INTERSECTION OF BRIDGE AVE. AND ALDER ST., HAS COORDINATES OF N 8972.6371 E 24713.6477 FROM SAID MONUMENT AN ENCASED BRASS CAP MONUMENT LOCATED AT THE INTERSECTION OF BRIDGE AVE. AND SECOND AVE., BEARS S 54° 46' 26.6" W 338.02 FEET (S 54° 50' 30" W 338.04 FEET BLM RECORD PER USS 3230 A & B), AND HAS COORDINATES OF N 8777.6864 E 24437.5247. SAID LINE IS THE BASIS OF BEARINGS.

NOTES:

1. WHETHER LISTED OR NOT, ALL MONUMENTS OR PROPERTY MARKERS/CORNERS OR ACCESSORIES WHICH WILL BE DISTURBED OR BURIED SHALL BE REFERENCED AND RE-ESTABLISHED IN THEIR ORIGINAL POSITION (A.S. 19.10.260) AND RECORDED (A.S. 34.65.040).
2. THIS POINT WAS REPLACED WITH A 3 1/4" ALUMINUM MONUMENT.
3. THIS POINT WAS REPLACED WITH A 5/8" REBAR WITH A 2" AL CAP.
4. THIS POINT IS SET BELOW FINISH GRADE.

COPY

97-9

RECORDED FILED NC
BETHEL
on 5-13 97
Book 10-31 A
Page AS/OUT

DATE	REVISIONS	BY
3/7/96	ADDED PROJECT CENTERLINE MONUMENTS.	GC
2/28/95	REVISED STATION OFFSETS.	GC

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
&
PUBLIC FACILITIES

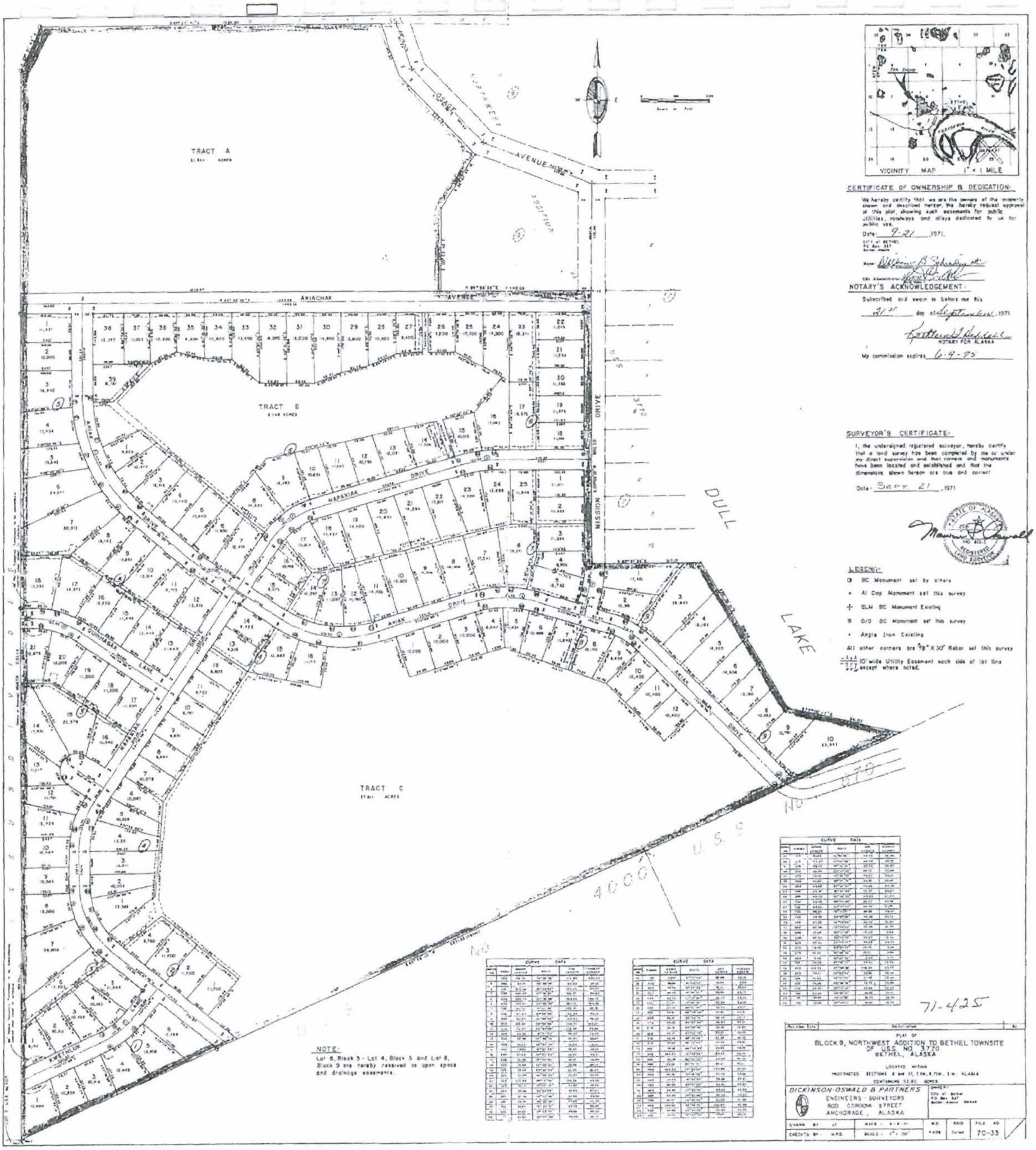
RIGHT OF WAY MAP
ALASKA PROJECT NO.

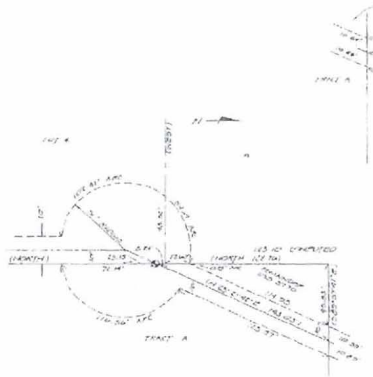
BR-0208(8)
51455

BETHEL BROWN SLOUGH BRIDGE

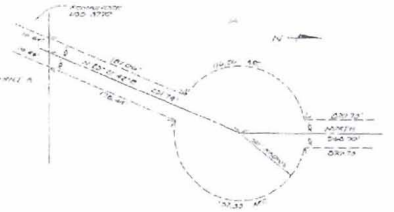
DRAWN	JB	DATE	Aug. 1994	SCALE	No Scale
CHECKED		DATE		SHEET	4 OF 4

RETUFI 97-9

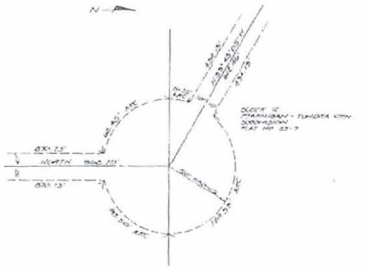

VICINITY MAP 1" = 1 MILE
CERTIFICATE OF OWNERSHIP & DEDICATION.
We hereby certify that we are the owners of the property shown and described hereon. We hereby request approval of this plat, showing such easements for public utilities, roadways and alleys dedicated by us for public use.
Date: 9-21, 1971.
NOTARY'S ACKNOWLEDGEMENT.
Subscribed and sworn to before me this 21st day of September, 1971.
NOTARY FOR ALASKA
My commission expires 6-9-75
SURVEYOR'S CERTIFICATE.
I, the undersigned registered surveyor, hereby certify that a land survey has been completed by me or under my direct supervision and that corners and monuments have been located and established and that the dimensions shown hereon are true and correct.
Date: Sept. 21, 1971
STATE OF ALASKA
REGISTERED LAND SURVEYOR
LEGEND.
BC Monument set by others
Al Cap Monument set this survey
BLM BC Monument Existing
O/O BC Monument set this survey
Angle Iron Existing
All other corners are 5/8" X 30" Rebar set this survey
10' wide Utility Easement each side of lot line except where noted.
NOTE.
Lot 6, Block 3 - Lot 4, Block 5 and Lot 8, Block 9 are hereby reserved as open space and drainage easements.
TRACT A
TRACT B
TRACT C
AKIACHAK AVENUE
MISSION DRIVE
NAPAKIAK DRIVE
AKIAK DRIVE
KWETHLUK
DULL LAKE
U.S.S. NO. 4000
U.S.S. NO. 3770
CURVE DATA
71-425
PLAT OF
BLOCK 9, NORTHWEST ADDITION TO BETHEL TOWNSITE OF U.S.S. NO. 3770
BETHEL, ALASKA
DICKINSON-OSWALD & PARTNERS
ENGINEERS - SURVEYORS
800 CORDOVA STREET
ANCHORAGE, ALASKA
FILE NO.
70-33



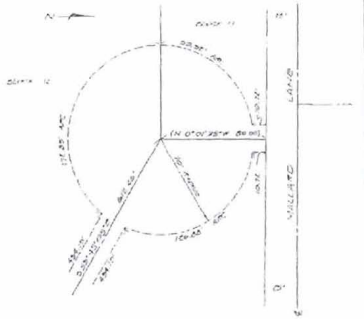
DETAIL A
SCALE 1" = 40'



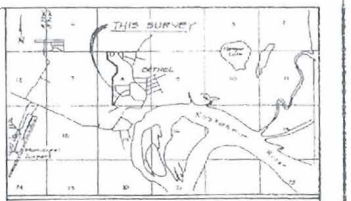
DETAIL B
SCALE 1" = 40'



DETAIL C
SCALE 1" = 40'



DETAIL D
SCALE 1" = 40'



VICINITY MAP SCALE 1" = 1 1/2 MILE

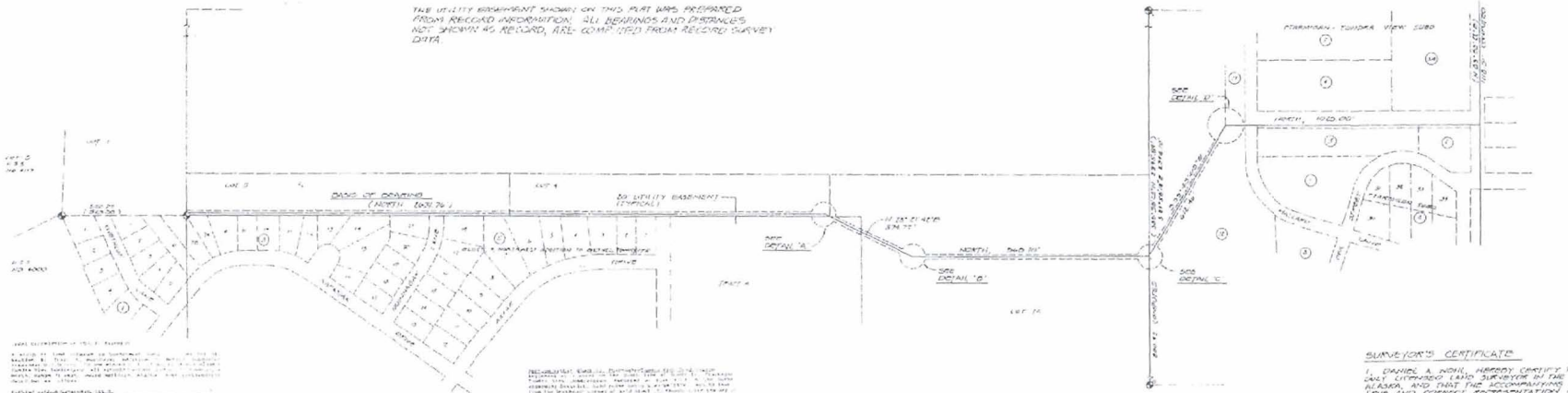
LEGEND

- FOUND BRASS CAP MONUMENT
- ( ) RECORD INFORMATION

MAGNETIC DECLINATION 19°37'E
FROM RECORD TOWNSHIP SURVEY OF T.8N., R.71W., S.M., AK

NOTE

THE UTILITY EASEMENT SHOWN ON THIS PLAT WAS PREPARED FROM RECORD INFORMATION. ALL BEARINGS AND DISTANCES NOT SHOWN AS RECORD, ARE COMPUTED FROM RECORD SURVEY DATA



90-8RS

RECORDED 9:45 20
BETHEL
DATE JULY 25 1990
TIME 11:33 A.M.
BY J. SUHR
REC. 101.50
BETHEL, AK 99559

NOT FOR HOME BUILDING

This Survey Does Not Constitute A Subdivision As Defined By AS 40.15.190(12).

CERTIFICATE OF OWNERSHIP

I, MARK EARNEST, A DULY APPOINTED REPRESENTATIVE OF THE CITY OF BETHEL HEREBY CERTIFY THE CITY OF BETHEL IS THE BENEFICIAL OWNER OF THE PROPERTY SHOWN HEREON, AND HEREBY APPROVE THIS PLAT SUBJECT TO ANY EASEMENTS AND RIGHTS OF WAY SHOWN HEREON.

BY Mark Earnest
TITLE City Manager
DATE 6/19/90

NOTARY'S ACKNOWLEDGEMENT

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 19 DAY OF JUNE, 1990
BY Mark Earnest AT Bethel, Alaska
Kathy L. Lee
NOTARY PUBLIC IN AND FOR THE STATE OF ALASKA
04/10/93
MY COMMISSION EXPIRES

APPROVAL OF PLANNING COMMISSION

THIS PLAT IS HEREBY APPROVED BY THE PLANNING COMMISSION OF THE CITY OF BETHEL THIS 14 DAY OF June, 1990
BY [signature]
TITLE Acting Chair

SURVEYOR'S CERTIFICATE

I, DANIEL A. NOHL, HEREBY CERTIFY THAT I AM A DULY LICENSED LAND SURVEYOR IN THE STATE OF ALASKA, AND THAT THE ACCOMPANYING PLAT IS A TRUE AND CORRECT REPRESENTATION OF A SURVEY PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT SAID SURVEY WAS DONE FROM MONUMENTS AND LANDMARKS FOUND AS SHOWN.

Daniel A. Nohl
DANIEL A. NOHL LS 6716
5-31-90
DATE

STATE OF ALASKA 4915 DANIEL A. NOHL LS-6716

TAX STATEMENT

THE LANDS CONTAINED AND DESCRIBED HEREON ARE NOT SUBJECT TO TAXATION AT THE TIME OF RECORDING

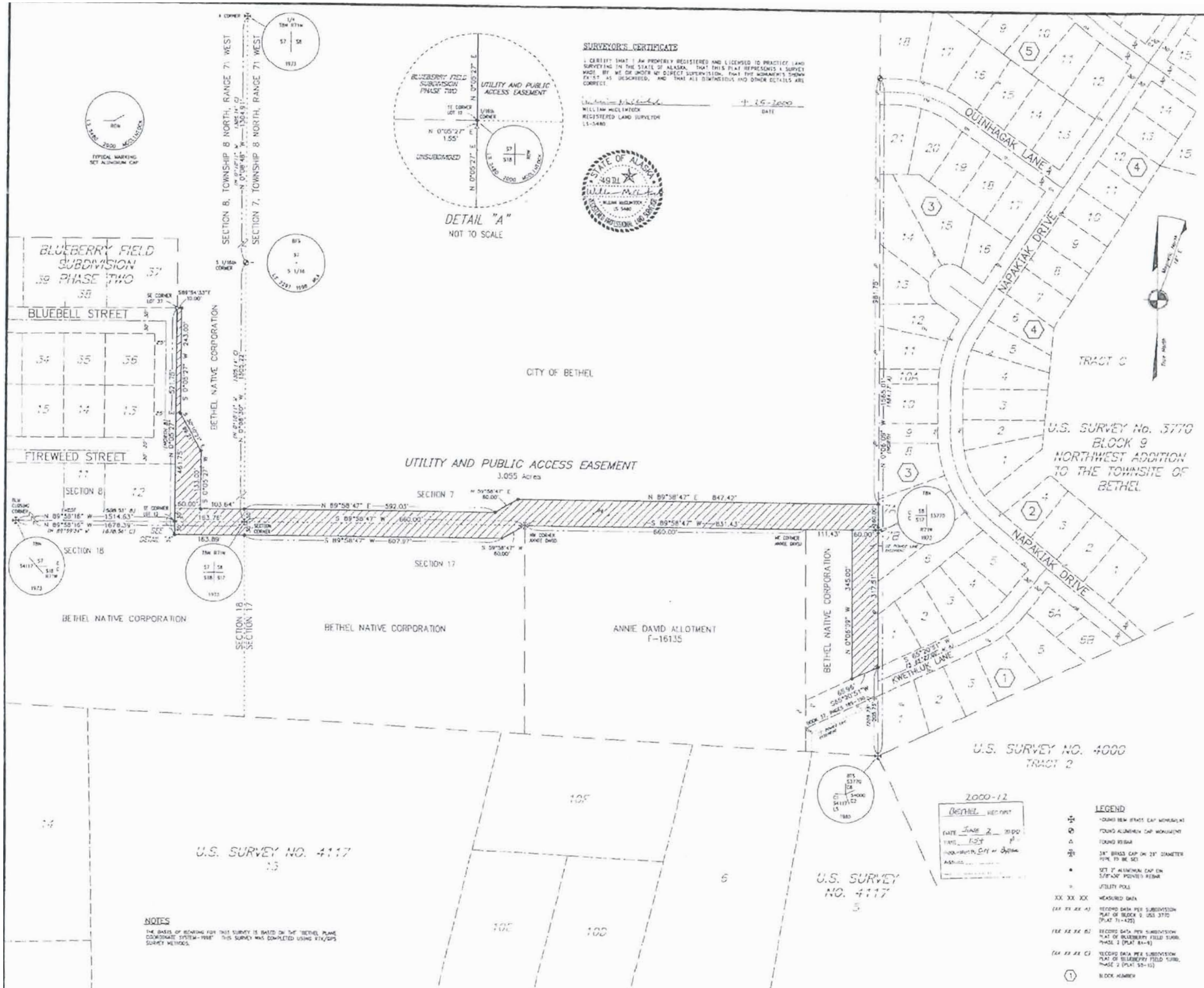
DATE OF SURVEY: BEGUN APRIL 3, 1990 END APRIL 10, 1990

RECORD OF SURVEY

LOCATION SURVEY OF ELECTRICAL TRANSMISSION LINE EASEMENT SITUATED IN SECTION 8, TOWNSHIP 8 NORTH, RANGE 71 WEST, SEWARD MERIDIAN, ALASKA

BETHEL RECORDING DISTRICT

JORDAN SUHR, PE PO BOX 511 BETHEL, ALASKA	PREPARED BY ALASKAN CONSULTING SURVEYORS, INC AND 5841 ARTIC BLVD, SUITE 201 ANCHORAGE, ALASKA	
GRID: N/A	SCALE 1" = 100'	DATE 5-11-90	SHEET 1 OF 1
DRAWN: DAM	FILE NO 90-12	CHK'D NOHL	FLD BK 589-06

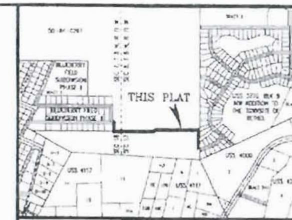


SURVEYOR'S CERTIFICATE

I CERTIFY THAT I AM PROPERLY REGISTERED AND LICENSED TO PRACTICE LAND SURVEYING IN THE STATE OF ALASKA, THAT THIS PLAT REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION, THAT THE MONUMENTS SHOWN EXIST AS DESCRIBED, AND THAT ALL DIMENSIONS AND OTHER DETAILS ARE CORRECT.

WILLIAM McCLINTOCK
REGISTERED LAND SURVEYOR
LS-5480

4-25-2000
DATE



VICINITY MAP SCALE: 1" = 1000'
USGS QUAD MAP BETHEL (D-8), 1954

CERTIFICATE OF OWNERSHIP AND DEDICATION

WE, THE UNDERSIGNED, CERTIFY THAT WE ARE THE OWNERS OF THE PROPERTY SHOWN ON THIS PLAT, ON BEHALF OF THE CITY OF BETHEL AND BETHEL NATIVE CORPORATION. WE APPROVE THIS SURVEY AND PLAT AND DEDICATE OR RESERVE FOR PUBLIC OR PRIVATE USE, AS NOTED, ALL EASEMENTS, PUBLIC UTILITY AREAS, AND RIGHTS-OF-WAY AS SHOWN AND DESCRIBED ON THIS PLAT.

OWNER

05-15-00
DATE

PRINTED NAME: ROBERT E. HERRON
TITLE: CITY MANAGER
CITY OF BETHEL
P.O. BOX 388
BETHEL, ALASKA 99559

NOTARY'S ACKNOWLEDGEMENT

SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF May, 20 00.

FOR Bob Herron, Bethel City Manager

NOTARY FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES: 02/04/02

OWNER

05-02-00
DATE

PRINTED NAME: MARC D. STEMP
TITLE: PRESIDENT / CEO
BETHEL NATIVE CORPORATION
P.O. BOX 719
BETHEL, ALASKA 99559

NOTARY'S ACKNOWLEDGEMENT

SUBSCRIBED AND SWORN TO BEFORE ME THIS 2nd DAY OF May, 20 00.

FOR Marc D. Stemp Pres/CEO Bethel Native Corp.

NOTARY FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES: 3/13/04

ALBERT D. NEWMAN
NOTARY PUBLIC
STATE OF ALASKA

CITY APPROVAL CERTIFICATE

THE CITY OF BETHEL HEREBY APPROVES THE SUBDIVISION SHOWN ON THIS PLAT.

5/12/00
DATE

PRINTED NAME: John P. Guinan
TITLE: Chairman - Planning Commission
FOR THE CITY OF BETHEL

SCALE IN FEET

THIS PLAT NOT SUBJECT TO TAXATION AT THE TIME OF FILING

PLAT OF

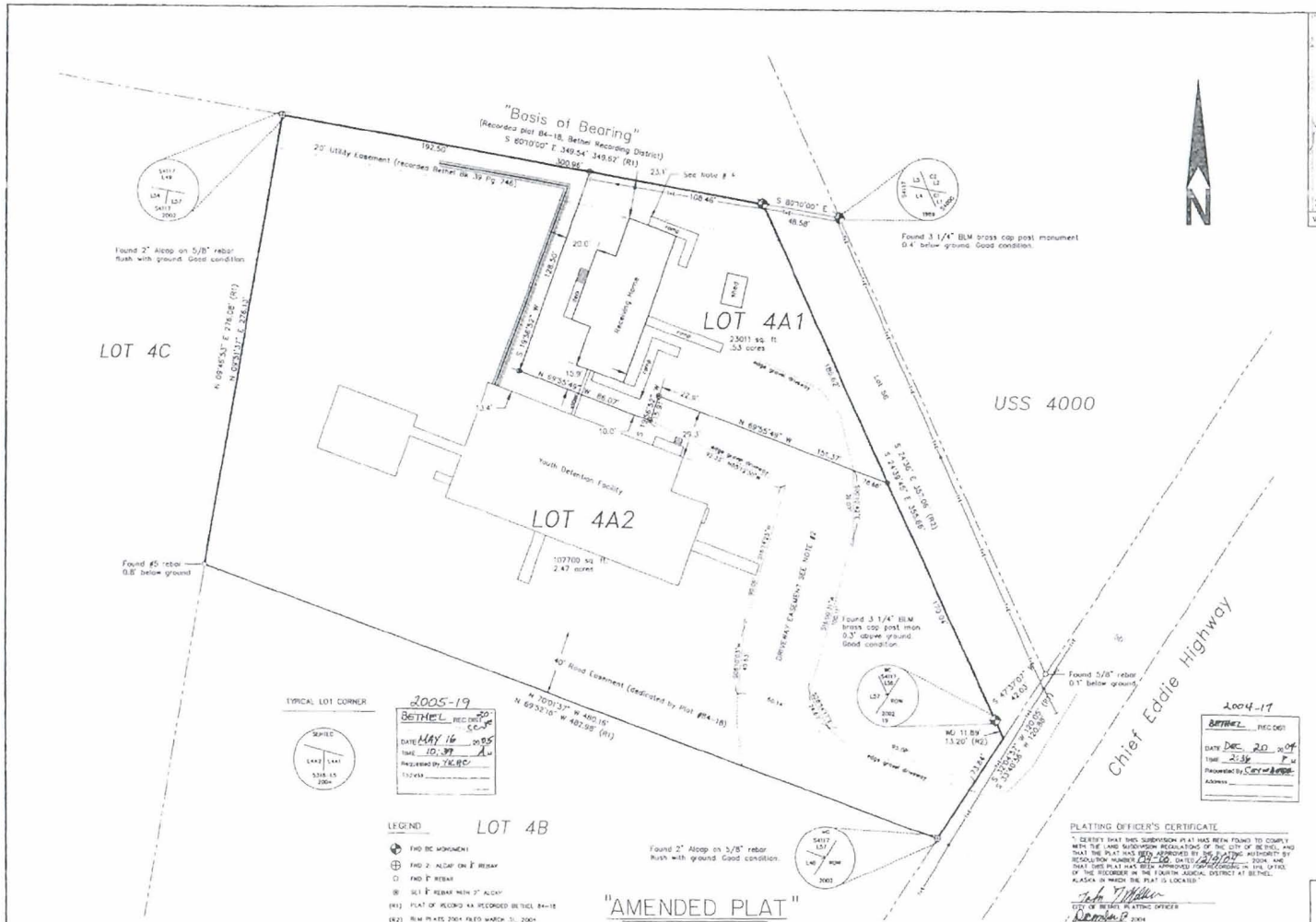
UTILITY AND PUBLIC ACCESS EASEMENT

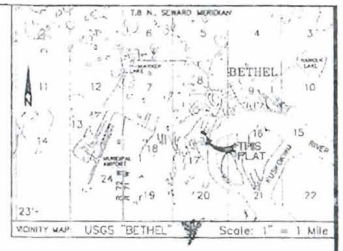
SITUATED WITHIN
SECTIONS 7, 8, 17 & 18,
TOWNSHIP 8 NORTH, RANGE 71 WEST,
SEWARD MERIDIAN, ALASKA

CONTAINING 3.055 ACRES MORE OR LESS
BETHEL RECORDING DISTRICT

PREPARED BY
McCLINTOCK LAND ASSOCIATES, INC.
11940 BUSINESS BOULEVARD, SUITE 200
EAGLE RIVER, ALASKA 99577
(907) 694-4489

PLOT: 1"=100'	CHK: BM	JOB: 98-272	DWG: PL98-272	FB NO. 99-14-56
GRID: BETHEL	DWN: JC	DATE: 3-10-00	DISK: MACRON-C	SHEET 1 OF 1





LEGEND

- FND BC MONUMENT
- FND 2" ALCAP ON 5/8" REBAR
- FND 5/8" REBAR
- SET 5/8" REBAR WITH 2" ALCAP
- (R1) PLAT OF RECORD AS RECORDED BETHEL 84-18
- (R2) BLM PLATS 2004 FILED MARCH 31, 2004

SURVEYOR'S CERTIFICATE

I, MICHAEL J. HORNE, REGISTERED PROFESSIONAL LAND SURVEYOR NO. LS-5318, ON THIS 9th DAY OF December 2004 HEREBY CERTIFY THAT I AM A REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF ALASKA AND THAT THIS PLAT REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECT SUPERVISION, THAT THE MONUMENTS SHOWN ON THE PLAT ACTUALLY EXIST AS DESCRIBED, THAT ALL MONUMENTS SET AS A PART OF THIS SUBDIVISION WERE SET BY ME OR UNDER MY DIRECT SUPERVISION AND THAT ALL DIMENSIONAL AND OTHER DETAILS ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

STATE OF ALASKA 5318 LS MICHAEL J. HORNE 12/9/04

REFERENCE TO RESTRICTIVE CONDITIONS

SAID DEVELOPMENT AND USE OF LAND IN THIS SUBDIVISION WILL BE GOVERNED BY A DECLARATION OF RESTRICTIVE CONDITIONS WHICH IS RECORDED IN BOOK 0001 PAGE 0411 IN THE RECORDING DISTRICT, FOURTH JUDICIAL DISTRICT, STATE OF ALASKA.

CITY MANAGER (BETHEL) BOB HERRON
December 13 2004

NOTES:

1. NO INDIVIDUAL ON-LOT WASTEWATER DISPOSAL AND / OR WATER SUPPLY SYSTEMS WILL BE ALLOWED UNLESS PRIOR APPROVAL IS OBTAINED FROM THE CITY OF BETHEL AND THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION AND / OR ITS SUCCESSORS.
2. A PUBLIC DRIVEWAY ACCESS EASEMENT IS GRANTED BY THIS PLAT TO LOT 4A1 FROM THE CHIEF EDDIE HIGHWAY ACROSS LOT 4A2 USING THE EXISTING DRIVEWAY WITH DIMENSIONS AS SHOWN. Easement to be determined once alternative access provided
3. THIS SUBDIVISION IS WITHIN THE FEMA FLOOD ZONE C AREA
4. LETTERS OF NON-OBJECTION CONCERNING THE RAMP ENCROACHMENT INTO THE 20' UTILITY EASEMENT FROM BETHEL NATIVE CORPORATION AND BETHEL UTILITIES CORPORATION HAVE BEEN RECORDED IN THE BETHEL RECORDING DISTRICT, SERIAL NUMBER 2004-001548-0 ON 5/24/2003, PAGES 1 THRU 3.

CERTIFICATE OF OWNERSHIP AND DEDICATION

I, THE UNDERSIGNED HEREBY CERTIFY THAT I AM THE ACTING CHIEF OF RIGHT OF WAY, DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES, THAT THE STATE OF ALASKA IS THE OWNER OF THE PROPERTY SHOWN AND DESCRIBED ON THIS PLAT, AND THAT THE STATE ADOPTS THIS PLAN OF SUBDIVISION BY IT'S FIRST CONSENT AND DEDICATES ALL RIGHTS-OF-WAY, STREETS, ALLEYS, AND PUBLIC AREAS TO THE CITY OF BETHEL, AND GRANTS TO THE CITY OF BETHEL FOR THE USES SHOWN ALL EASEMENTS NOT SHOWN AS PRIVATE ON THIS PLAT, AND ALL EASEMENTS AND RIGHTS-OF-WAY DEDICATED FOR PUBLIC USE AS SHOWN AND DESCRIBED HEREON, HAS BEEN REVIEWED BY THE CENTRAL REGION OFFICE AND IS HEREBY RECOMMENDED FOR APPROVAL BY THE COMMISSIONER.

WILLIAM R. SIMCOSKE, P.E.
ACTING CHIEF OF RIGHT OF WAY
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
P.O. BOX 196900
ANCHORAGE, AK 99519-6900

12-08-04
DATE

NOTARY ACKNOWLEDGMENT

THIS IS TO CERTIFY THAT ON THE 8th DAY OF DECEMBER 2004, BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC IN AND FOR THE STATE OF ALASKA, DULY COMMISSIONED AND SWORN, PERSONALLY APPEARED WILLIAM R. SIMCOSKE TO ME KNOWN TO BE THE PERSON(S) DESCRIBED IN AND WHO EXECUTED THE ABOVE CERTIFICATE OF OWNERSHIP AND DEDICATION, AND WHO, BEING SWORN OR UNDER OATH, ACKNOWLEDGED TO ME THAT THEY SIGNED THE SAME FREELY AND VOLUNTARILY FOR THE USES AND PURPOSES THEREIN MENTIONED (AND THAT THEY DID SO ON BEHALF OF AND WITH THE FULL AUTHORITY OF STATE OF ALASKA).

WITNESS MY HAND AND OFFICIAL SEAL THE DAY AND YEAR IN THIS CERTIFICATE FIRST ABOVE WRITTEN.

NOTARY FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES 2-28-05

State of Alaska
NOTARY PUBLIC
MIKE HARTMAN
My Commission expires 2-28-05

APPROVED BY:

COMMISSIONER
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

12/8/04
DATE

NOTARY ACKNOWLEDGMENT

THIS IS TO CERTIFY THAT ON THE 8th DAY OF December 2004, BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC IN AND FOR THE STATE OF ALASKA, DULY COMMISSIONED AND SWORN, PERSONALLY APPEARED GORDON L. KEITH TO ME KNOWN TO BE THE PERSON(S) DESCRIBED IN AND WHO EXECUTED THE ABOVE CERTIFICATE OF OWNERSHIP AND DEDICATION, AND WHO, BEING SWORN OR UNDER OATH, ACKNOWLEDGED TO ME THAT THEY SIGNED THE SAME FREELY AND VOLUNTARILY FOR THE USES AND PURPOSES THEREIN MENTIONED (AND THAT SHE DID SO ON BEHALF OF AND WITH THE FULL AUTHORITY OF SE OF AK).

WITNESS MY HAND AND OFFICIAL SEAL THE DAY AND YEAR IN THIS CERTIFICATE FIRST ABOVE WRITTEN.

NOTARY FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES 4/24/06

NOTARY PUBLIC

TAX CERTIFICATE

THE LANDS CONTAINED AND DESCRIBED HEREON ARE NOT SUBJECT TO TAXATION AT THE TIME OF RECORDING.

PLATTING OFFICER'S CERTIFICATE

I, CERTIFY THAT THIS SUBDIVISION PLAT HAS BEEN FOUND TO COMPLY WITH THE LAND SUBDIVISION REGULATIONS OF THE CITY OF BETHEL, AND THAT THE PLAT HAS BEEN APPROVED BY THE PLATTING AUTHORITY BY RESOLUTION NUMBER 12-10 DATED 12/8/04 2004, AND THAT THIS PLAT HAS BEEN APPROVED FOR RECORDING IN THE OFFICE OF THE RECORDER IN THE FOURTH JUDICIAL DISTRICT AT BETHEL, ALASKA IN WHICH THE PLAT IS LOCATED.

CITY OF BETHEL PLATTING OFFICER
December 8 2004

2005-19
BETHEL REC DIST
DATE MAY 16 2005
TIME 10:39 AM
Requested by YKHC
Address

2004-17
BETHEL REC DIST
DATE DEC 20 2004
TIME 2:36 PM
Requested by City of Bethel
Address

FINAL PLAT OF
LOTS 4A1 & 4A2
YKHC Receiving Home Subdivision
a subdivision of
Lot 57, U. S. Survey No. 4117
BLM plat 2004 (filed March 31, 2004)
Bethel Recording District, State of Alaska
situated within
Section 17, T. 8 N., R. 71 W., Seward Meridian, Alaska
Containing 3.00 Acres more or less.

SENTEC, Inc.
Surveying Mapping Land Planning
2302 Gambell Avenue Anchorage, Alaska 99517

08/12/05	Change Plat note 2. to a temporary easement	MJH		

DATE: 10/20/04	DRAWN: GJR	CHECKED: MJH	SHEET 1 of 1
SCALE: 1" = 50'	F. BOOK: 523	W.O.: 41665	

LEGEND

FOUND BRASS CAP MONUMENT

LEGAL DESCRIPTION OF UTILITY EASEMENT

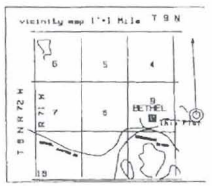
GENERAL: A 20 FOOT WIDE STRIP, 10' ON EACH SIDE OF A CENTERLINED TO BE DESCRIBED. THE LINE PROVIDES WASTE HEAT LINES FROM A MAJOR LINE INTO THE CALISTA APARTMENTS COMPLEX: MORE PROPERLY DESCRIBED THUSLY:

BEGINNING FOR REFERENCE AT THE BLM BRASS CAP MONUMENT FOR CORNER NUMBER 1 OF USS 4117; WHICH IS COINCIDENT WITH CORNER NUMBER 2 OF USS 4000
THENCE S 36-24-55 W: 357.02 FEET DISTANCE TO THE INTERSECTION OF A 10" PRE-INSULATED STEEL SUPPLY LINE (WASTE HEAT) WITH THE LINE CONNECTING INTO BUILDING #800. THIS INTERSECT BEING THE TRUE POINT OF BEGINNING FOR THIS DESCRIPTION.

THENCE S 73-31-58 E: 64.01 FEET DISTANCE INTO THE ENTRY INTO BUILDING NUMBER 800. THIS STRIP IS 10' WIDE ON BOTH SIDES OF THE CENTERLINE THUS DESCRIBED. AREA IS 1,280 SQ. FT. , MORE OR LESS.

DESCRIBED IN BETHEL ALASKA THIS 1ST DAY OF APRIL 1993 BY ALBERT BIANCHI OF DELTA SURVEYING COMPANY.

SCALE
1" = 100'



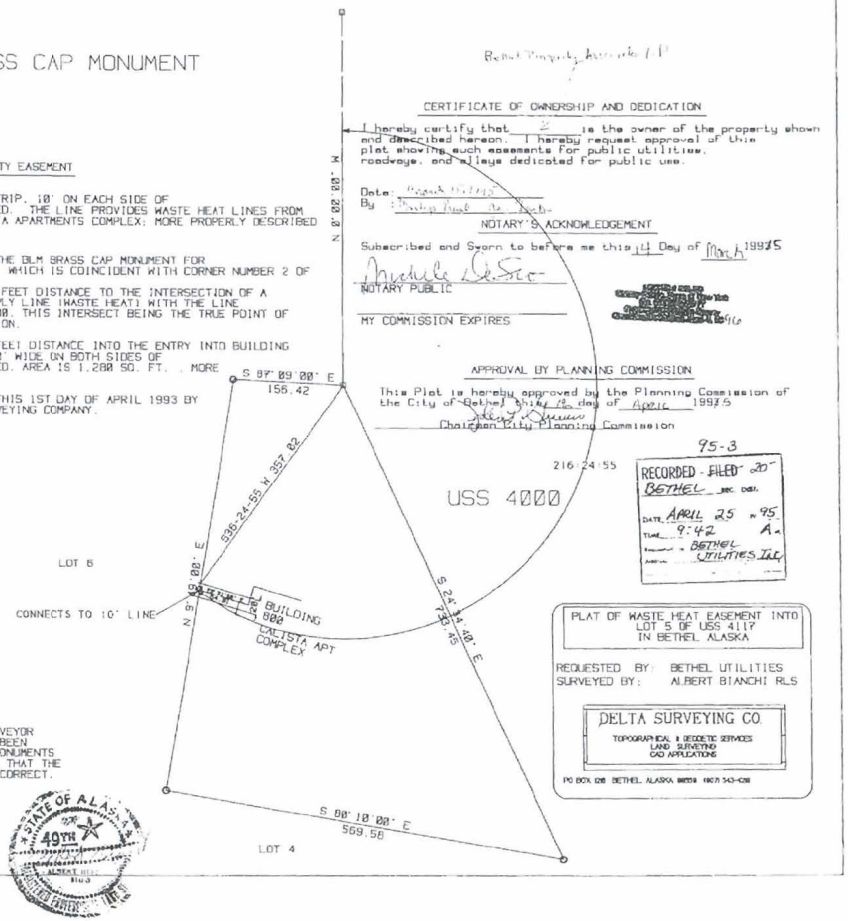
SURVEYOR'S CERTIFICATE

I, THE UNDERSIGNED REGISTERED LAND SURVEYOR HEREBY CERTIFY THAT A LAND SURVEY HAS BEEN COMPLETED BY ME AND THAT CORNERS AND MONUMENTS HAVE BEEN LOCATED AND ESTABLISHED, AND THAT THE DIMENSIONS SHOWN THEREON ARE TRUE AND CORRECT.

DATE: _____

BY: _____

STATE OF ALASKA 49TH ALBERT BIANCHI



CERTIFICATE OF OWNERSHIP AND DEDICATION

I hereby certify that _____ is the owner of the property shown and described hereon. I hereby request approval of this plat showing such easements for public utilities, roadways, and alleys dedicated for public use.

Date: _____
By: _____

NOTARY'S ACKNOWLEDGEMENT

Subscribed and Sworn to before me this 14 Day of March 1995

NOTARY PUBLIC

MY COMMISSION EXPIRES

APPROVAL BY PLANNING COMMISSION

This Plat is hereby approved by the Planning Commission of the City of Bethel this 18 day of April 1995

Chairman City Planning Commission

95-3

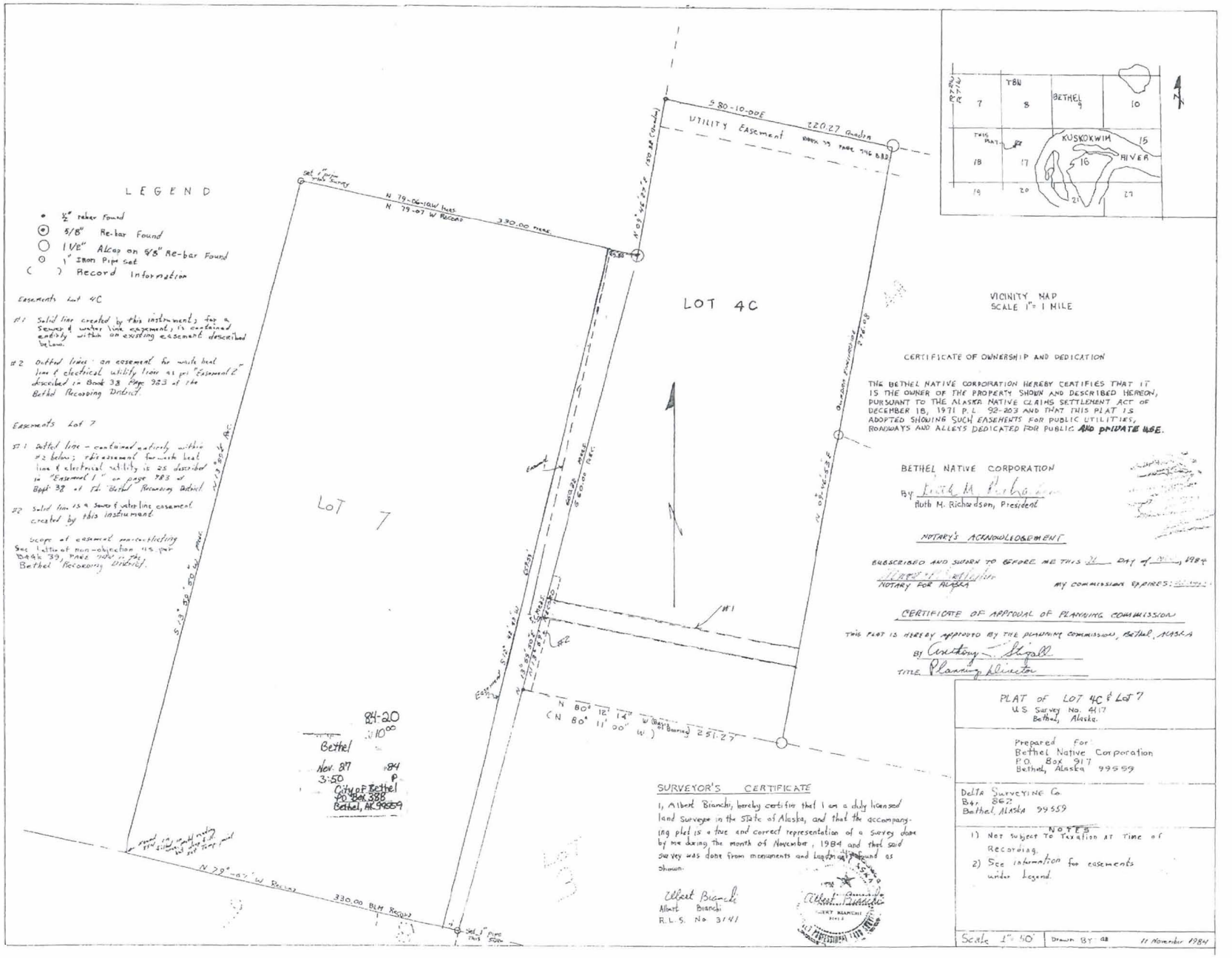
RECORDED - FILED 20
BETHEL REC. DIST.
DATE APRIL 25 19 95
TIME 9:42 A.M.
BETHEL UTILITIES INC

PLAT OF WASTE HEAT EASEMENT INTO LOT 5 OF USS 4117 IN BETHEL ALASKA

REQUESTED BY: BETHEL UTILITIES
SURVEYED BY: ALBERT BIANCHI RLS

DELTA SURVEYING CO.
TOPOGRAPHICAL & GEODETIC SERVICES
LAND SURVEYING
CAD APPLICATIONS

PO BOX 128 BETHEL ALASKA 99559 (907) 543-128



CERTIFICATE OF OWNERSHIP AND DEDICATION

THE BETHEL NATIVE CORPORATION HEREBY CERTIFIES THAT IT IS THE OWNER OF THE PROPERTY SHOWN AND DESCRIBED HEREON, PURSUANT TO THE ALASKA NATIVE CLAIMS SETTLEMENT ACT OF DECEMBER 18, 1971 P.L. 92-203 AND THAT THIS PLAT IS ADOPTED SHOWING SUCH EASEMENTS FOR PUBLIC UTILITIES, ROADWAYS AND ALLEYS DEDICATED FOR PUBLIC AND PRIVATE USE.

BETHEL NATIVE CORPORATION

By Ruth M. Richardson

Ruth M. Richardson, President

NOTARY'S ACKNOWLEDGEMENT

SUBSCRIBED AND SWORN TO BEFORE ME THIS 21 DAY OF [illegible], 1984

[illegible]

NOTARY FOR ALASKA

MY COMMISSION EXPIRES: [illegible]

CERTIFICATE OF APPROVAL OF PLANNING COMMISSION

THIS PLAT IS HEREBY APPROVED BY THE PLANNING COMMISSION, BETHEL, ALASKA

BY Anthony Shiffall

TITLE Planning Director

PLAT OF LOT 4C & Lot 7
U.S. Survey No. 417
Bethel, Alaska.

Prepared For:
Bethel Native Corporation
P.O. Box 917
Bethel, Alaska 99559

Delta Surveyine Co.
Box 862
Bethel, Alaska 99559

NOTES

1) Not Subject To Taxation At Time of Recording.
2) See information for easements under Legend.

Scale 1" = 40' | Drawn By: GB | 11 November 1984

SURVEYOR'S CERTIFICATE

I, Albert Bianchi, hereby certify that I am a duly licensed land Surveyor in the State of Alaska, and that the accompanying plat is a true and correct representation of a survey done by me during the month of November, 1984 and that said survey was done from monuments and Legal [illegible] found as shown.

Albert Bianchi

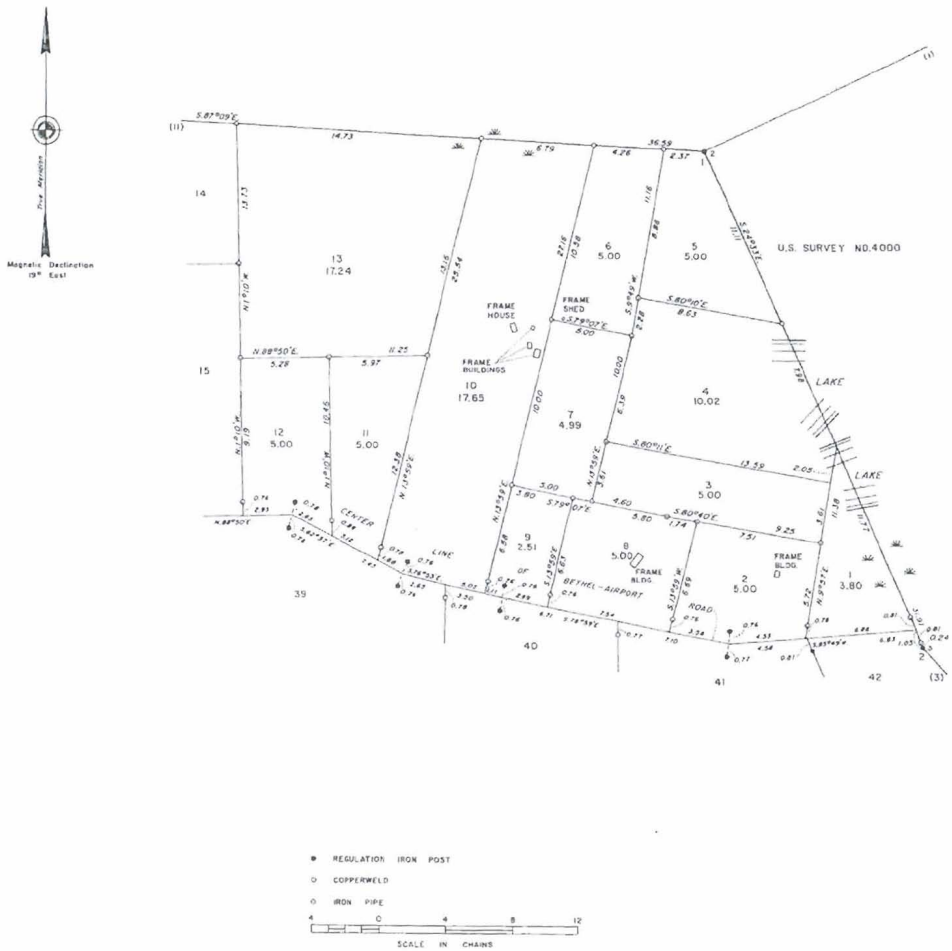
Albert Bianchi
R.L.S. No 3141

THE STATE OF ALASKA
ALBERT BIANCHI
3141
REGISTERED PROFESSIONAL LAND SURVEYOR

Trail
Tank
Pipeline (2)
Paved Parking
Sign
Ball Court
Stairs
Ball Court
Pipeline (3)
Flag Pole
= 47.06
Storage Pad
Deck
Tanks
Stairs
Ruin
Tank
Pipeline (1)
Borrow Pit
WS = 15.30
Sign
Sign

ORIGINAL

Sheet 1 of 5 sheets



B.M.S.

U.S. SURVEY NO. 4117, ALASKA

EMBRACING

LOTS 1 THROUGH 44

LOCATED

APPROXIMATELY ONE MILE WEST

OF BETHEL, ALASKA

ON BOTH SIDES

OF THE BETHEL-AIRPORT ROAD

APPROXIMATE GEOGRAPHIC POSITION

LATITUDE 60° 47' N., LONGITUDE 161° 47' W.

AREA: 715.00 ACRES

SURVEYED BY:

EDWARD A. TAYLOR, SUPERVISORY CADASTRAL SURVEYOR

JULY 18, 1963 TO JULY 14, 1964

Under Special Instructions
Dated July 2, 1963, and
Approved July 17, 1963.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Washington, D. C. May 9, 1966

This plat is strictly conformable to the approved field notes, and the survey, having been correctly executed in accordance with the requirements of law and the regulations of this Bureau, is hereby accepted.

For the Director

R.E. Brown

Acting Chief, Division of Engineering

Vol 1102 p177

APPENDIX C – EXISTING WATER USAGE

Report Criteria:
Customer.Cust No = 163201, 243101, 199302, 163101

1993.02 AVCP PACIFICA HOUSE — 1220 STATE WELL SWMTR

Metered Services:

WAMTR Current Rate Table: 1999 Water - Metered Non-Bill

Period	Read Date	Meter Id	Beg Read	End Read	Usage	Demand	Muliplier	Amount	Status
09/30/2008	09/26/2008	DH1220	317,780	395,900	78,120	.0000	1.0000	.00	
10/31/2008	10/27/2008	DH1220	395,900	500,930	105,030	.0000	1.0000	.00	
11/30/2008	11/25/2008	DH1220	500,930	586,220	85,290	.0000	1.0000	.00	
12/31/2008	12/24/2008	DH1220	586,220	655,290	69,070	.0000	1.0000	.00	
01/31/2009	01/27/2009	DH1220	655,290	725,620	70,330	.0000	1.0000	.00	
02/28/2009	02/24/2009	DH1220	725,620	792,630	67,010	.0000	1.0000	.00	
03/31/2009	03/25/2009	DH1220	792,630	858,920	66,290	.0000	1.0000	.00	
04/30/2009	04/28/2009	DH1220	858,920	938,760	79,840	.0000	1.0000	.00	
05/31/2009	05/22/2009	DH1220	938,760	1,001,260	62,500	.0000	1.0000	.00	
06/30/2009	06/24/2009	DH1220	1,001,260	1,095,410	94,150	.0000	1.0000	.00	
07/31/2009	07/27/2009	DH1220	1,095,410	1,199,280	103,870	.0000	1.0000	.00	
08/31/2009	08/26/2009	DH1220	1,199,280	1,312,820	113,540	.0000	1.0000	.00	
					995,040			.00	

1631.01 US FISH & WILDLIFE HEADGTRS — 807 STATE METERED

Metered Services:

WAMTR Current Rate Table: 1999 Water - Metered Non-Bill

Period	Read Date	Meter Id	Beg Read	End Read	Usage	Demand	Muliplier	Amount	Status
09/30/2008	09/26/2008	DH807	15,688,300	15,706,300	18,000	.0000	1.0000	.00	
10/31/2008	10/27/2008	DH807	15,706,300	15,723,400	17,100	.0000	1.0000	.00	
11/30/2008	11/25/2008	DH807	15,723,400	15,738,400	15,000	.0000	1.0000	.00	
12/31/2008	12/24/2008	DH807	15,738,400	15,752,700	14,300	.0000	1.0000	.00	
01/31/2009	01/27/2009	DH807	15,752,700	15,770,000	17,300	.0000	1.0000	.00	
02/28/2009	02/24/2009	DH807	15,770,000	15,785,000	15,000	.0000	1.0000	.00	
03/31/2009	03/25/2009	DH807	15,785,000	15,804,000	19,000	.0000	1.0000	.00	
04/30/2009	04/28/2009	DH807	15,804,000	15,825,000	21,000	.0000	1.0000	.00	
05/31/2009	05/22/2009	DH807	15,825,000	15,847,200	22,200	.0000	1.0000	.00	
06/30/2009	06/24/2009	DH807	15,847,200	15,891,200	44,000	.0000	1.0000	.00	
07/31/2009	07/27/2009	DH807	15,891,200	15,926,300	35,100	.0000	1.0000	.00	
08/31/2009	08/26/2009	DH807	15,926,300	15,956,500	30,200	.0000	1.0000	.00	
					268,200			.00	

1632.01 YKHC MAIN HOSPITAL 900 STATE METERED

Metered Services:

WAMTR Current Rate Table: 1999 Water - Metered Non-Bill

Period	Read Date	Meter Id	Beg Read	End Read	Usage	Demand	Multiplier	Amount	Status
09/30/2008	09/26/2008	DH900	123,718,000	124,736,000	1,018,000	.0000	1.0000	.00	
10/31/2008	10/27/2008	DH900	124,736,000	125,824,000	1,088,000	.0000	1.0000	.00	
11/30/2008	11/25/2008	DH900	125,824,000	126,829,000	1,005,000	.0000	1.0000	.00	
12/31/2008	12/24/2008	DH900	126,829,000	127,921,000	1,092,000	.0000	1.0000	.00	
01/31/2009	01/27/2009	DH900	127,921,000	128,520,000	599,000	.0000	1.0000	.00	
02/28/2009	02/24/2009	DH900	128,520,000	129,706,000	1,186,000	.0000	1.0000	.00	
03/31/2009	03/25/2009	DH900	129,706,000	130,985,000	1,279,000	.0000	1.0000	.00	
04/30/2009	04/28/2009	DH900	130,985,000	132,318,000	1,333,000	.0000	1.0000	.00	
05/31/2009	05/22/2009	DH900	132,318,000	133,208,000	890,000	.0000	1.0000	.00	
06/30/2009	06/24/2009	DH900	133,208,000	134,311,000	1,103,000	.0000	1.0000	.00	
07/31/2009	07/27/2009	DH900	134,311,000	135,408,000	1,097,000	.0000	1.0000	.00	
08/31/2009	08/26/2009	DH900	135,408,000	136,494,440	1,086,440	.0000	1.0000	.00	
					12,776,440			.00	

2431.01 YUKON KUSKOKWIM CORRECTIONAL 1000A STATE METERED

Metered Services:

WAMTR Current Rate Table: 1999 Water - Metered Non-Bill

Period	Read Date	Meter Id	Beg Read	End Read	Usage	Demand	Multiplier	Amount	Status
09/30/2008	09/26/2008	DH1000A	58,038,200	58,241,700	203,500	.0000	1.0000	.00	
10/31/2008	10/27/2008	DH1000A	58,241,700	58,462,100	220,400	.0000	1.0000	.00	
11/30/2008	11/25/2008	DH1000A	58,462,100	58,659,500	197,400	.0000	1.0000	.00	
12/31/2008	12/24/2008	DH1000A	58,659,500	58,853,100	193,600	.0000	1.0000	.00	
01/31/2009	01/27/2009	DH1000A	58,853,100	59,091,300	238,200	.0000	1.0000	.00	
02/28/2009	02/24/2009	DH1000A	59,091,300	59,285,400	194,100	.0000	1.0000	.00	
03/31/2009	03/25/2009	DH1000A	59,285,400	59,488,400	203,000	.0000	1.0000	.00	
04/30/2009	04/28/2009	DH1000A	59,488,400	59,698,100	209,700	.0000	1.0000	.00	
05/31/2009	05/22/2009	DH1000A	59,698,100	59,864,400	166,300	.0000	1.0000	.00	
06/30/2009	06/24/2009	DH1000A	59,864,400	60,091,400	227,000	.0000	1.0000	.00	
07/31/2009	07/27/2009	DH1000A	60,091,400	60,331,500	240,100	.0000	1.0000	.00	
08/31/2009	08/26/2009	DH1000A	60,331,500	60,546,000	214,500	.0000	1.0000	.00	
					2,507,800			.00	

Grand Totals:	Usage	Amount
Water - Metered	16,547,480	.00
Water Hauled	0	.00
Water-Piped Unmtr	0	.00
Sewer - Metered	0	.00
Sewer Hauled	0	.00
Contract Water	0	.00
Garbage	0	.00
Pumphouse Water	0	.00
Landfill	0	.00
Sewer Piped Unmtr	0	.00
SC Discount	0	.00
Contract Sewer	0	.00
Reconnect Fee	0	.00
NSF Fees	0	.00
Water XCall	0	.00
Sewer XEvac	0	.00
Sales Tax	0	.00
Penalty	0	.00
Util Inspection Fees	0	.00

Report Criteria:
Customer.Cust No = 163201, 243101, 199302, 163101

APPENDIX D – HYDRAULIC MODELING

830.01 City of Bethel
Calculation of Velocity and Headloss

BETHEL INSTITUTIONAL CORRIDOR STUDY

1/11/2010

CSWTP TO WATER STORAGE TANK

Loop CSWTP TO WST	ID inches	D, feet	Length ft	Area, ft^2	C value	Flow gpm	Flow, cfs	V ft/s	h_L ft	psi	$V^2/2g$ ft	$V^2/2g$ psi	Total Loss feet	Total Loss psi
AVERAGE DEMAND MINIMUM VELOCITY OF 1 ft/s														
CSWTP	4	0.33	100	0.08726639	135	100	0.22	2.55	0.71	0.32	0.10	0.05	0.81	0.36
6 inch Pipes	5.4	0.45	1700	0.15904299	135	100	0.22	1.40	2.79	1.26	0.03	0.01	2.82	1.27
Min.Velocity 1 ft/s	5.4	0.45	1800	0.15904299	135	100	0.22	1.40	2.95	1.33	0.03	0.01	2.98	1.34
	5.4	0.45	1700	0.15904299	135	100	0.22	1.40	2.79	1.26	0.03	0.01	2.82	1.27
WST	4	0.33	100	0.08726639	135	100	0.22	2.55	0.71	0.32	0.10	0.05	0.81	0.36
Totals			5400						9.94	4.48	0.29	0.13	10.24	4.61
												Static	37.00	16.66
												Totals	47.24	21.27
CSWTP	4	0.33	100	0.08726639	135	160	0.36	4.08	1.69	0.76	0.26	0.12	1.95	0.88
8 inch Pipes	7	0.58	1700	0.26725332	135	160	0.36	1.33	1.88	0.85	0.03	0.01	1.91	0.86
Min.Velocity 1 ft/s	7	0.58	1800	0.26725332	135	160	0.36	1.33	1.99	0.90	0.03	0.01	2.02	0.91
	7	0.58	1700	0.26725332	135	160	0.36	1.33	1.88	0.85	0.03	0.01	1.91	0.86
WST	4	0.33	100	0.08726639	135	160	0.36	4.08	1.69	0.76	0.26	0.12	1.95	0.88
Totals			5400						9.13	4.11	0.60	0.27	9.73	4.38
												Static	37.00	16.66
												Totals	46.73	21.04
AVERAGE DEMAND MINIMUM VELOCITY OF 2 ft/s														
CSWTP	4	0.33	100	0.08726639	135	160	0.36	4.08	1.69	0.76	0.26	0.12	1.95	0.88
6 inch Pipes	5.4	0.45	1700	0.15904299	135	160	0.36	2.24	6.65	3.00	0.08	0.04	6.73	3.03
Min.Velocity 1 ft/s	5.4	0.45	1800	0.15904299	135	160	0.36	2.24	7.04	3.17	0.08	0.04	7.12	3.21
	5.4	0.45	1700	0.15904299	135	160	0.36	2.24	6.65	3.00	0.08	0.04	6.73	3.03
WST	4	0.33	100	0.08726639	135	160	0.36	4.08	1.69	0.76	0.26	0.12	1.95	0.88
Totals			5400						23.73	10.68	0.75	0.34	24.48	11.02
												Static	37.00	16.66
												Totals	61.48	27.68
CSWTP	4	0.33	100	0.08726639	135	270	0.60	6.88	4.44	2.00	0.74	0.33	5.18	2.33
8 inch Pipes	7	0.58	1700	0.26725332	135	270	0.60	2.25	4.95	2.23	0.08	0.04	5.03	2.26
Min.Velocity 1 ft/s	7	0.58	1800	0.26725332	135	270	0.60	2.25	5.24	2.36	0.08	0.04	5.32	2.40
	7	0.58	1700	0.26725332	135	270	0.60	2.25	4.95	2.23	0.08	0.04	5.03	2.26
WST	4	0.33	100	0.08726639	135	270	0.60	6.88	4.44	2.00	0.74	0.33	5.18	2.33
Totals			5400						24.03	10.82	1.71	0.77	25.73	11.59
												Static	37.00	16.66
												Totals	62.73	28.25

NEW LOOP ALONG CORRIDOR

Loop Instit. Corr.	ID inches	D, feet	Length ft	Area, ft²	C value	Flow gpm	Flow, cfs	V ft/s	h_L ft	h_L psi	$V^2/2g$ ft	$V^2/2g$ psi	Total Loss feet	Total Loss psi
						AVERAGE DEMAND MINIMUM VELOCITY OF 1 ft/s								
BSTA	4	0.33	100	0.08726639	135	140	0.31	3.57	1.32	0.59	0.20	0.09	1.52	0.68
6 inch Pipes	5.4	0.45	2800	0.15904299	135	130	0.29	1.82	7.46	3.36	0.05	0.02	7.51	3.38
Min.Velocity 1 ft/s	5.4	0.45	2800	0.15904299	135	120	0.27	1.68	6.44	2.90	0.04	0.02	6.48	2.92
	5.4	0.45	2800	0.15904299	135	110	0.24	1.54	5.48	2.47	0.04	0.02	5.52	2.48
BSTA	4	0.33	100	0.08726639	135	100	0.22	2.55	0.71	0.32	0.10	0.05	0.81	0.36
Totals			8600						21.40	9.64	0.43	0.19	21.83	9.83
BSTA	4	0.33	100	0.08726639	135	200	0.45	5.10	2.55	1.15	0.40	0.18	2.95	1.33
8 inch Pipes	7	0.58	2800	0.26725332	135	190	0.42	1.58	4.26	1.92	0.04	0.02	4.29	1.93
Min.Velocity 1 ft/s	7	0.58	2800	0.26725332	135	180	0.40	1.50	3.85	1.73	0.03	0.02	3.89	1.75
	7	0.58	2800	0.26725332	135	170	0.38	1.42	3.46	1.56	0.03	0.01	3.50	1.57
BSTA	4	0.33	100	0.08726639	135	160	0.36	4.08	1.69	0.76	0.26	0.12	1.95	0.88
Totals			8600						15.81	7.12	0.77	0.35	16.57	7.46
						PEAK HOUR MINIMUM VELOCITY OF 1 ft/s								
BSTA	4	0.33	100	0.08726639	135	240	0.53	6.12	3.57	1.61	0.58	0.26	4.15	1.87
6 inch Pipes	5.4	0.45	2800	0.15904299	135	195	0.43	2.73	15.80	7.12	0.12	0.05	15.92	7.17
Min.Velocity 1 ft/s	5.4	0.45	2800	0.15904299	135	150	0.33	2.10	9.72	4.38	0.07	0.03	9.79	4.41
	5.4	0.45	2800	0.15904299	135	105	0.23	1.47	5.03	2.26	0.03	0.02	5.06	2.28
BSTA	4	0.33	100	0.08726639	135	60	0.13	1.53	0.27	0.12	0.04	0.02	0.31	0.14
Totals			8600						34.40	15.49	0.84	0.38	35.24	15.87
BSTA	4	0.33	100	0.08726639	135	395	0.88	10.07	8.98	4.04	1.58	0.71	10.56	4.75
8 inch Pipes	7	0.58	2800	0.26725332	135	350	0.78	2.91	13.18	5.93	0.13	0.06	13.31	5.99
Min.Velocity 1 ft/s	7	0.58	2800	0.26725332	135	305	0.68	2.54	10.21	4.60	0.10	0.05	10.31	4.64
	7	0.58	2800	0.26725332	135	260	0.58	2.16	7.60	3.42	0.07	0.03	7.67	3.46
BSTA	4	0.33	100	0.08726639	135	215	0.48	5.48	2.92	1.31	0.47	0.21	3.38	1.52
Totals			8600						42.89	19.31	2.35	1.06	45.24	20.37
						AVERAGE DEMAND MINIMUM VELOCITY OF 2 ft/s								
BSTA	4	0.33	100	0.08726639	135	130	0.29	3.31	1.15	0.52	0.17	0.08	1.32	0.59
6 inch Pipes	5.4	0.45	2800	0.15904299	135	120	0.27	1.68	6.44	2.90	0.04	0.02	6.48	2.92
Min.Velocity 1 ft/s	5.4	0.45	2800	0.15904299	135	110	0.24	1.54	5.48	2.47	0.04	0.02	5.52	2.48
	5.4	0.45	2800	0.15904299	135	100	0.22	1.40	4.59	2.07	0.03	0.01	4.62	2.08
BSTA	4	0.33	100	0.08726639	135	90	0.20	2.29	0.58	0.26	0.08	0.04	0.66	0.30
Totals			8600						18.24	8.21	0.36	0.16	18.60	8.38
BSTA	4	0.33	100	0.08726639	135	300	0.67	7.65	5.40	2.43	0.91	0.41	6.31	2.84
8 inch Pipes	7	0.58	2800	0.26725332	135	290	0.65	2.41	9.30	4.19	0.09	0.04	9.39	4.23
Min.Velocity 1 ft/s	7	0.58	2800	0.26725332	135	280	0.62	2.33	8.72	3.93	0.08	0.04	8.80	3.96
	7	0.58	2800	0.26725332	135	270	0.60	2.25	8.15	3.67	0.08	0.04	8.23	3.71
BSTA	4	0.33	100	0.08726639	135	260	0.58	6.63	4.14	1.87	0.68	0.31	4.83	2.17
Totals			8600						35.72	16.08	1.84	0.83	37.56	16.92
						PEAK HOUR MINIMUM VELOCITY OF 2 ft/s								
BSTA	4	0.33	100	0.08726639	135	305	0.68	7.78	5.57	2.51	0.94	0.42	6.51	2.93
6 inch Pipes	5.4	0.45	2800	0.15904299	135	260	0.58	3.64	26.90	12.11	0.21	0.09	27.11	12.21
Min.Velocity 1 ft/s	5.4	0.45	2800	0.15904299	135	215	0.48	3.01	18.93	8.52	0.14	0.06	19.07	8.59
	5.4	0.45	2800	0.15904299	135	170	0.38	2.38	12.26	5.52	0.09	0.04	12.35	5.56
BSTA	4	0.33	100	0.08726639	135	125	0.28	3.19	1.07	0.48	0.16	0.07	1.23	0.55
Totals			8600						64.73	29.15	1.53	0.69	66.26	29.84
BSTA	4	0.33	100	0.08726639	135	395	0.88	10.07	8.98	4.04	1.58	0.71	10.56	4.75
8 inch Pipes	7	0.58	2800	0.26725332	135	350	0.78	2.91	13.18	5.93	0.13	0.06	13.31	5.99
Min.Velocity 1 ft/s	7	0.58	2800	0.26725332	135	305	0.68	2.54	10.21	4.60	0.10	0.05	10.31	4.64
	7	0.58	2800	0.26725332	135	260	0.58	2.16	7.60	3.42	0.07	0.03	7.67	3.46
BSTA	4	0.33	100	0.08726639	135	215	0.48	5.48	2.92	1.31	0.47	0.21	3.38	1.52
Totals			8600						42.89	19.31	2.35	1.06	45.24	20.37

NEW LOOP ALONG CORRIDOR

Loop Instit. Corr.	ID inches	D, feet	Length ft	Area, ft^2	C value	Flow gpm	Flow, cfs	V ft/s	h_L ft	psi	$V^2/2g$ ft	$V^2/2g$ psi	Total Loss feet	Total Loss psi
						FIRE FLOW								
BSTA	4	0.33	100	0.08726639	135	750	1.67	19.12	29.41	13.25	5.68	2.56	35.09	15.80
6 inch Pipes	5.4	0.45	2800	0.15904299	135	750	1.67	10.49	190.97	86.00	1.71	0.77	192.68	86.77
Feed Both Ends	5.4	0.45	2800	0.15904299	135	740	1.65	10.35	186.29	83.89	1.66	0.75	187.95	84.64
2 x 750 gpm	5.4	0.45	2800	0.15904299	135	730	1.62	10.21	181.66	81.80	1.62	0.73	183.28	82.53
BSTA	4	0.33	100	0.08726639	135	730	1.62	18.61	27.98	12.60	5.38	2.42	33.36	15.02
Totals			8600						616.31	277.53	16.05	7.23	632.37	284.76
BSTA	4	0.33	100	0.08726639	135	750	1.67	19.12	29.41	13.25	5.68	2.56	35.09	15.80
8 inch Pipes	7	0.58	2800	0.26725332	135	750	1.67	6.24	53.96	24.30	0.61	0.27	54.57	24.57
Feed Both Ends	7	0.58	2800	0.26725332	135	740	1.65	6.16	52.64	23.70	0.59	0.27	53.23	23.97
2 x 750 gpm	7	0.58	2800	0.26725332	135	730	1.62	6.08	51.33	23.12	0.57	0.26	51.91	23.37
BSTA	4	0.33	100	0.08726639	135	730	1.62	18.61	27.98	12.60	5.38	2.42	33.36	15.02
Totals			8600						215.33	96.96	12.83	5.78	228.16	102.74
BSTA	4	0.33	100	0.08726639	135	500	1.11	12.75	13.89	6.26	2.52	1.14	16.42	7.39
6 inch Pipes	5.4	0.45	2800	0.15904299	135	500	1.11	7.00	90.20	40.62	0.76	0.34	90.96	40.96
Feed Both Ends	5.4	0.45	2800	0.15904299	135	490	1.09	6.86	86.89	39.13	0.73	0.33	87.62	39.46
2 x 500 gpm	5.4	0.45	2800	0.15904299	135	480	1.07	6.72	83.64	37.66	0.70	0.32	84.34	37.98
BSTA	4	0.33	100	0.08726639	135	480	1.07	12.24	12.88	5.80	2.33	1.05	15.21	6.85
Totals			8600						287.50	129.47	7.04	3.17	294.54	132.64
BSTA	4	0.33	100	0.08726639	135	500	1.11	12.75	13.89	6.26	2.52	1.14	16.42	7.39
8 inch Pipes	7	0.58	2800	0.26725332	135	500	1.11	4.16	25.49	11.48	0.27	0.12	25.76	11.60
Feed Both Ends	7	0.58	2800	0.26725332	135	490	1.09	4.08	24.55	11.06	0.26	0.12	24.81	11.17
2 x 500 gpm	7	0.58	2800	0.26725332	135	480	1.07	4.00	23.63	10.64	0.25	0.11	23.88	10.75
BSTA	4	0.33	100	0.08726639	135	480	1.07	12.24	12.88	5.80	2.33	1.05	15.21	6.85
Totals			8600						100.45	45.23	5.63	2.53	106.07	47.77

APPENDIX E – ENGINEERING CALCULATIONS

CITY OF BETHEL

Institutional Corridor Study Operations and Maintenance Costs

Design Assumptions

SYSTEM DATA - BOOSTER PUMP STATION FACILITY

Booster Pump Station Building					
Alt #1				1,200	sf
Alt #2				3,000	sf
Electrical Equipment					
Water Main Circulation Pumps					
Loop 1				5	hp
Water Main Pressure Pumps					
Loop 1				10	hp
Water Storage Tank Circulation Loop Pump				5	hp
Glycol Circulation Pump					
Loop 1				1.5	hp
Glycol Plant Pump				1.5	hp
Glycol Process Pump				1	hp
Booster Pumps				50	hp
Building Air Handler				15	hp
Building Lights				0.5	watt/hr/sf
Heating Fuel Demand					
Circulating Water Mains			Quantity	Heat Loss	
Water Mains (avg for each subdv)			15,510 ft	50	BTU/day ft
Buillding Heat (maintained @ 70 °F)					
Alt #1			1,200 sf	10	BTU/hr sf
Alt #2			1,200 sf	10	BTU/hr sf
Water Storage Tank					
Alt #1			355,000 gal	0.3	BTU/gal/day
Alt #2			655,000 gal	0.3	BTU/gal/day
OPERATIONAL COST DATA	3-phase/mo	price/kwh	PCA/kwh	RCC/kwh	
Cost per kwH	$ 41	$ 0.2823	$ 0.0061	$ 0.0004	$ 0.2888 /kwh
Cost per gallon of heating fuel					$ 4.96 /gal
Administrative cost per service					$ 15.00 /month
Burdened labor rate for a laborer (includes taxes & benefits)					$ 30.00 /hr
Burdened labor rate for an operator (includes taxes & benefits)					$ 36.00 /hr
OTHER ASSUMPTIONS		No. of Employees	No. of Facilities	Estimated hr/wk	
Labor					
Booster pump station/W&S mains - laborer		1	1	20	20 hr/wk
Minor Parts and Supplies					30 % of labor
Expected Equipment Life					
Pumps					10 yr
Heat exchangers					15 yr
Boilers					15 yr
System controls					15 yr
Inflation Rate					3 %
Available Energy per Gallon of Heating Fuel					100,000 BTU/gal
Insurance					$ 15,000 yr
USER DATA					
Residential Services					
Alt #1			- services		
			- services		
(future)			485		
Commercial Services					
			17 services	19,290,211	gal/year
			17 services	19,290,211	gal/year

Estimated Electrical Demand

BOOSTER PUMP STATION FACILITY	Size (hp)[1]	Usage (hr/day)	Annual Demand (kwh)
Water Main Circulation Pumps			
Loop 1	5	24	32,662
Water Main Pressure Pumps			
Loop 1	10	6	16,331
Water Treatment Pumps			
Water Storage Tank Circulation Loop Pumps	5	24	32,662
Glycol Circulation Pumps			
Loop 1	1.5	24	9,798
Glycol Plant Pump	1.5	24	9,798
Glycol Process Pump	1	24	6,532
Booster Pumps	50	1	13,609
Building Air Handler	15	10	40,827
Building Lights			
Alt #1		10	6,000
Alt #2		10	15,000
Alt #1	**Total for One Booster Pump Station**		168,220
Alt #2	**Total for One Booster Pump Station**		177,220

1. (1 hp=.7457 kw)

Estimated Heating Demand

BOOSTER PUMP STATION FACILITY	Heat Loss/unit	Quantity	Annual Demand (1000 BTU)
Piped Mains			
Water Loops	50	15,510 ft	283,058
Building Heat			
	10	1,200 sf	105,120
	10	1,200 sf	105,120
Water Storage Tank Heat			
	0.3	355,000 gal	38,873
Alt #2	0.3	655,000 gal	71,723
Alt #1	**Total for One Booster Pump Station**		427,050
Alt #2	**Total for One Booster Pump Station**		459,900

Replacement Costs

BOOSTER PUMP STATION	Quantity	Size	Unit Cost	Cost
Water Main Circulation Pumps				
Loop 1	1	5 hp	$ 3,000	$ 3,000
Water Main Pressure Pumps				
Loop 1	1	10 hp	$ 7,500	$ 7,500
Glycol Circulation Pumps				
Loop 1	1	1.5 hp	$ 1,200	$ 1,200
Glycol Plant Pump	1	1.5 hp	$ 1,200	$ 1,200
Glycol Process Pump	1	1 hp	$ 1,000	$ 1,000
Booster Pumps	1	50 hp	$ 60,000	$ 60,000
Heat Exchanger	2	BTU	$ 12,000	$ 24,000
Boilers	2	BTU	$ 90,000	$ 180,000
System Controls	1	1 ea	$ 25,000	$ 25,000

PUMP COSTS	$	73,900
HEAT EXCHANGER COSTS	$	24,000
BOILER COSTS	$	180,000
SYSTEM CONTROL COSTS	$	25,000

Estimated Annual Operations and Maintence Cost

BOOSTER PUMP STATION FACILITY			Annual Cost
Administration			
	x 17	services	$ 255
	x 17	services	$ 255
(future)	x 502		$ 7,530
Labor			$ 33,600
Minor Parts and Supplies			$ 10,080
Electricity			
			$ 49,081
Alt #2			$ 51,680
Heating Fuel			
			$ 21,182
			$ 22,811
Insurance			$ 15,000
		Alt #1 Total Annual O&M Costs	$ 129,452
		Alt #2 Total Annual O&M Costs	$ 133,681

REPAIR AND REPLACEMENT COSTS	Life (yr)	Capital Cost	Inflation Rate	Annual Cost
Pumps	10	$ 73,900	3%	$ 7,612
Heat Exchangers	15	$ 24,000	3%	$ 1,648
Boilers	15	$ 180,000	3%	$ 12,360
System Controls	15	$ 25,000	3%	$ 1,717
			Total Annual R&R Costs	$ 23,336

RESERVE		
5% of Annual O&M Costs		
Alt #1	Total Annual Reserve	$ 6,473
Alt #2	Total Annual Reserve	$ 6,684

Alt #1	Total Annual Operating Cashflow	$ 159,261
Alt #2	Total Annual Operating Cashflow	$ 163,701

Estimated Annual Services Income

DATA - SERVICES INCOME	Monthly Rate
Residential Water Servies	$ 125.08
Residential Sewer Servies	$ 33.92
Commercial Water Services per 1000 gal	$ 25.00
Commercial Sewer Services per 1000 gal	$ 17.49

SERVICES INCOME - WATER			Annual Income
Residential			
Alt #1	-	services	$ -
Alt #2	-	services	$ -
(future)	485	services	$ 727,966
Comercial			
Alt #1	19,290,211	gal/year	$ 40,188
Alt #2	19,290,211	gal/year	$ 40,188
		Alt #1 Total Annual Income	$ 40,188
		Alt #2 Total Annual Income	$ 40,188

Alt #1 Net Annual Cost	$ 119,073
Alt #2 Net Annual Cost	$ 123,514

Economic Analysis Worksheet

Bethel Instututioal Corridor ALT #1

Prepared by Dale McCoy
LCG

Given		Input	
Annual Interest Rate, *i*	2.7%	2.7	**from 'OMB Table'**
Periods, n	20	20	**years**
Present Value, P	$ 8,937,742	$ 8,937,742	**Present Value 2010 Dollars**
Future Value, F	$ -	$ -	**Future Value 2010 Dollars**
Annuity, A	$ 119,073	$ 119,073	**Annual Net Value 2010 Dollars**

		Excel Formulas	
Future Value given Present Value	(F/P,i%,n)	FV(rate,nper,pmt,**pv**,type)	$ 15,227,783
Present Value given Future Value	(P/F,i%,n)	PV(rate,nper,pmt,**fv**,type)	$ -
Annual Value given Future Value	(A/F,i%,n)	PMT(rate,nper,pv,**fv**,type)	$ -
Annual Value given Present Value	(A/P,i%,n)	PMT(rate,nper,**pv**,fv,type)	$ 584,218
Future Value given Annual Value	(F/A,i%,n)	FV(rate,nper,**pmt**,pv,type)	$ 3,103,668
Present Value given Annual Value	(P/A,i%,n)	PV(rate,nper,**pmt**,fv,type)	$ 1,821,656

Total Cost in Dollars for 2030	**$ 18,331,451**
Total Cost in Dollars for 2010	$ 10,759,398
Total Annual Cost in Dollars	$ 703,291

OMB 'Real' Federal Treasury Intrest Rates (Dec. 2009)	
3-year	0.9
5-year	1.6
7-year	1.9
10-year	2.2
20-year	2.7
30-year	2.7

Source: www.whitehouse.gov/omb/circulars_a094_a94_appx-c/

Year	CPI	Inflation Rate
2006	201.6	
2007	207.3	2.750%
2008	215.3	3.716%
2009 (Aug)	216.33	0.476%

Source: ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

Economic Analysis Worksheet

Bethel Instututioal Corridor ALT #2

Prepared by Dale McCoy
LCG

Given		Input	
Annual Interest Rate, *i*	2.7%	2.7	from 'OMB Table'
Periods, n	20	20	years
Present Value, P	$11,006,017	$ 11,006,017	Present Value 2010 Dollars
Future Value, F	$ -	$ -	Future Value 2010 Dollars
Annuity, A	$ 123,514	$ 123,514	Annual Net Value 2010 Dollars

		Excel Formulas	
Future Value given Present Value	(F/P,i%,n)	FV(rate,nper,pmt,**pv**,type)	$ 18,751,631
Present Value given Future Value	(P/F,i%,n)	PV(rate,nper,pmt,**fv**,type)	$ -
Annual Value given Future Value	(A/F,i%,n)	PMT(rate,nper,pv,**fv**,type)	$ -
Annual Value given Present Value	(A/P,i%,n)	PMT(rate,nper,**pv**,fv,type)	$ 719,411
Future Value given Annual Value	(F/A,i%,n)	FV(rate,nper,**pmt**,pv,type)	$ 3,219,423
Present Value given Annual Value	(P/A,i%,n)	PV(rate,nper,**pmt**,fv,type)	$ 1,889,597

Total Cost in Dollars for 2030	**$ 21,971,055**
Total Cost in Dollars for 2010	$ 12,895,614
Total Annual Cost in Dollars	$ 842,925

OMB 'Real' Federal Treasury Intrest Rates (Dec. 2009)	
3-year	0.9
5-year	1.6
7-year	1.9
10-year	2.2
20-year	2.7
30-year	2.7

Source: www.whitehouse.gov/omb/circulars_a094_a94_appx-c/

Year	CPI	Inflation Rate
2006	201.6	
2007	207.3	2.750%
2008	215.3	3.716%
2009 (Aug)	216.33	0.476%

Source: ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

APPENDIX F – ENGINEER'S COST ESTIMATE

Cost Estimate

Prepared By: LCG
Date:03/08/10

INSTITUTIONAL CORRIDOR WATER SYSTEM
CITY OF BETHEL

ALTERNATIVE #1 - INSTITUTIONAL CORRIDOR

ITEM NO.	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	MOBILIZATION & DEMOBILIZATION	LS	1	10%	$697,450.00
2	TRAFFIC CONTROL & PUBLIC RELATIONS	LS	1	$40,000.00	$40,000.00
3	CONSTRUCTION SURVEYING	LS	1	$35,000.00	$35,000.00
4	PREPARATION OF SWPPP	LS	1	$15,000.00	$15,000.00
	MAINTENANCE OF WATER SERVICE/TEMPORARY SERVICE	LS	1	$150,000.00	$150,000.00
6	6" x 15" PIPE, HDPE ARCTIC INSULATED WATER MAIN	LF	5,400	$190.00	$1,026,000.00
	HEAT TRACE FOR 6" x 15" PIPE, HDPE ARCTIC INSULATED WATER MAIN	LF	5,400	$50.00	$270,000.00
8	8" x 18" PIPE, HDPE ARCTIC INSULATED WATER MAIN	LF	8,600	$225.00	$1,935,000.00
9	AIR RELEASE VALVE IN MAIN LINE	EACH	10	$4,000.00	$40,000.00
10	ISOLATION VALVE IN MAIN LINE	EACH	10	$5,000.00	$50,000.00
11	ROAD CROSSING	EACH	25	$25,000.00	$625,000.00
12	FIRE HYDRANT	EACH	20	$5,675.00	$113,500.00
13	PIPE SUPPORTS	EACH	1,000	$800.00	$800,000.00
14	INSTALL WATER SERVICES WITH MAINLINE AND BUILDING CONNECTIONS	EACH	17	$15,000.00	$255,000.00
15	CIRCULATION PUMP SYSTEM (2 PUMPS)	EACH	1	$38,000.00	$38,000.00
16	REVISE CSWTP PIPING AND CONTROLS	EACH		$25,000.00	$25,000.00
17	BOOSTER PUMP SYSTEM (4 PUMPS)	EACH		$57,000.00	$57,000.00
18	HEATING SYSTEM FOR LOOP HEAT, WATER STORAGE TANK AND BOOSTER STATION	EACH	1	$100,000.00	$100,000.00
19	355,000 STEEL WATER STORAGE TANK	GAL	355,000	$2.00	$710,000.00
20	1,200 FT2 BOOSTER PUMP STATION	FT2	1,200	$575.00	$690,000.00
21	WELL AT CSWTP	EACH	1	$100,000.00	$100,000.00
				TOTAL ALT #1	$7,771,950.00
				CONTINGENCY AT 15%	$1,165,792.50
				TOTAL ALT #1 PLUS CONTINGENCY	$8,937,742.50

ENGINEERING, SURVEY AND CONSTR. ADMIN - ALT #1	
BETHEL/USDA ADMINISTRATION (10%)	$893,774.25
ENGINEERING (6%)	$536,264.55
CONSTRUCTION MANAGEMENT (15%)	$1,340,661.38
	$2,770,700.18
TOTAL ALT #1	$11,708,442.68

Cost Estimate

Prepared By: LCG
Date:03/08/10

ALTERNATIVE #2 - FUTURE TANK CAPACITY

ITEM NO.	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	MOBILIZATION & DEMOBILIZATION	LS	1	10%	$860,950.00
2	TRAFFIC CONTROL & PUBLIC RELATIONS	LS	1	$40,000.00	$40,000.00
	CONSTRUCTION SURVEYING	LS		$35,000.00	$35,000.00
4	PREPARATION OF SWPPP	LS		$15,000.00	$15,000.00
5	MAINTENANCE OF WATER SERVICE/TEMPORAI	LS	1	$150,000.00	$150,000.00
6	6" x 15" PIPE, HDPE ARCTIC INSULATED WATER MAIN	LF	5,400	$190.00	$1,026,000.00
	HEAT TRACE FOR 6" x 15" PIPE, HDPE ARCTIC INSULATED WATER MAIN	LF	5,400	$50.00	$270,000.00
8	8" x 18" PIPE, HDPE ARCTIC INSULATED WATER MAIN	LF	8,600	$225.00	$1,935,000.00
9	AIR RELEASE VALVE IN MAIN LINE	EACH	10	$4,000.00	$40,000.00
10	ISOLATION VALVE IN MAIN LINE	EACH	10	$5,000.00	$50,000.00
11	ROAD CROSSING	EACH	25	$25,000.00	$625,000.00
12	FIRE HYDRANT	EACH	20	$5,675.00	$113,500.00
13	PIPE SUPPORTS	EACH	1,000	$800.00	$800,000.00
14	INSTALL WATER SERVICES WITH MAINLINE AND BUILDING CONNECTIONS	EACH	17	$15,000.00	$255,000.00
15	CIRCULATION PUMP SYSTEM (2 PUMPS)	EACH	1	$38,000.00	$38,000.00
16	REVISE CSWTP PIPING AND CONTROLS	EACH	1	$25,000.00	$25,000.00
17	BOOSTER PUMP SYSTEM (4 PUMPS)	EACH	1	$57,000.00	$57,000.00
18	HEATING SYSTEM FOR LOOP HEAT, WATER STORAGE TANK AND BOOSTER STATION	EACH		$100,000.00	$100,000.00
19	655,000 STEEL WATER STORAGE TANK	GAL	655,000	$2.00	$1,310,000.00
20	3,000 FT2 BOOSTER PUMP STATION	FT2	3,000	$575.00	$1,725,000.00
21	WELL AT CSWTP	EACH	1	$100,000.00	$100,000.00
				TOTAL ALT #2	$9,570,450.00
				CONTINGENCY AT 15%	$1,435,567.50
				TOTAL ALT #2 PLUS CONTINGENCY	$11,006,017.50

ENGINEERING, SURVEY AND CONSTR. ADMIN - ALT #2	
BETHEL/USDA ADMINISTRATION (10%)	$1,100,601.75
ENGINEERING (6%)	$660,361.05
CONSTRUCTION MANAGEMENT (15%)	$1,650,902.63
	$3,411,865.43
TOTAL ALT #2	$14,417,882.93

APPENDIX G – GEOTECHNICAL REPORTS

PRELIMINARY GEOTECHNICAL REPORT

for the

CITY OF BETHEL INSTITUTIONAL CORRIDOR FEASIBILITY STUDY BETHEL, ALASKA

Prepared for:

Larsen Consulting Group, Inc.
3710 Woodland Drive
Suite 2100
Anchorage, AK 99517

Prepared by:

Andy Smith – Project Geologist
Northern Geotechnical Engineering, Inc.

DECEMBER 2009

2329-09

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

December 11, 2009 2329-09

Larsen Consulting Group, Inc.
3710 Woodland Drive
Suite 2100
Anchorage, Alaska 99517

Attn: Andrea Stancliff, P.E.

RE: PRELIMINARY GEOTECHNICAL REPORT FOR THE INSTITUTIONAL CORRIDOR FEASIBILITY STUDY, BETHEL, ALASKA.

Andrea,

Attached herewith is our preliminary geotechnical report for the project cited above. Our evaluation of the proposed project is based entirely on: 1) available geotechnical information for sites adjacent to the proposed project alignment; and 2) our own experience dealing with permafrost soils in the Bethel area. Therefore, only general conclusions and recommendations can be made at this time.

We greatly appreciate the opportunity to be of service to you. If you have any questions regarding the material presented in this report, please contact our office at (907) 344-5934.

Sincerely,

NORTHERN GEOTECHNICAL ENGINEERING, INC.

Andy Smith
Project Geologist

Keith F. Mobley P.E.
President

STATE OF ALASKA
49TH
11 Dec 2009
KEITH F. MOBLEY
CE - 5066
Registered Engineer

Table of Contents

1.0 INTRODUCTION 1
2.0 PROJECT DESCRIPTION 1
3.0 RELEVANT GEOTECNICAL INFORMATION 2
4.0 SUBSURFCE CONDITIONS 3
5.0 CONCLUSIONS 3
6.0 RECOMMENDATIONS 5
7.0 CLOSURE 6

FIGURES

Figure 1 Project Location Map
Figure 2 Project Area Detail
Figure 3 Available Subsurface Data Locations

TABLES

Table 1 Available Subsurface Data Summary

APPENDICIES

Appendix A References Cited

1.0 INTRODUCTION

This report presents the findings of a preliminary geotechnical evaluation performed as part of feasibility study being conducted by Larsen Consulting group, Inc. (LCG) for the City of Bethel at the Institutional Corridor Feasibility Study (ICFS) project located in Bethel, Alaska. Northern Geotechnical Engineering, Inc. (NGE) obtained and evaluated existing geotechnical data for several locations adjacent to the proposed project in order to ascertain the general subsurface conditions adjacent to the proposed project in an effort to develop recommendations for future geotechnical explorations; and ultimately develop foundation recommendations for the proposed project.

Results of our evaluation indicate that both shallow and warm permafrost conditions likely exist within the proposed project alignment, and that further subsurface explorations may need to be conducted along the proposed alignment in order to better characterize the nature and extent of the existing soils.

2.0 PROJECT DESCRIPTION

The ICFS project is a civil improvement project proposed to be conducted within the City of Bethel, Alaska (Figure 1). A goal of the project is to supply select buildings located along the Chief Eddie Hoffman Highway corridor with new potable water services. The water main is proposed to run from the City Subdivision Water Treatment Plant (WTP) located on Akiak Drive to selected buildings located on Chief Eddie Hoffman Highway (Figure 2). The route of the proposed water line is currently unknown, but it will likely run south from the WTP across an undeveloped portion of the city to Chief Eddie Hoffman Highway, where it will then continue south along Chief Eddie Hoffman Highway with services to the selected buildings.

The City of Bethel is located in a western region of Alaska known as the Yukon-Kuskokwim Delta, and is situated adjacent to the Kuskokwim River. The soils in the area are typically characterized by thick, fluvial deposits of interbedded fine sand and silt. Discontinuous permafrost conditions persist throughout the area, and shallow permafrost conditions have been repeatedly documented throughout the City of Bethel, including along the Chief Eddie Hoffman Highway corridor. Shallow permafrost (as it pertains to this evaluation) can be defined as any permafrost which occurs at depths less than five

feet below the existing ground surface (bgs). Shallow permafrost is usually observed in undisturbed areas, where the organic tundra mat has insulated the permafrost surface from additional thermal inputs. Once an area is disturbed, permafrost surface depths can increase significantly as thawing occurs. Permafrost in the Bethel area can be classified as "warm permafrost" which refers to permafrost with temperatures ranging between approximately 30-32°F. Warm permafrost is particularly susceptible to thawing, and even small changes to the thermal regime of an area containing warm permafrost can result in significant thawing and subsequent loss of soil strength; often resulting in significant ground settlements.

As such, water and sewer utilities in the Bethel area are typically supported by foundations which are designed to reduce the potential for utility damage as a result of permafrost thawing and subsequent settlement. These foundations typically consist of steel piles driven into the permafrost or thawed soils.

The objective of this geotechnical evaluation is to review existing subsurface data which is relevant to the project and use the information to develop recommendations for future geotechnical explorations, with the ultimate goal of developing foundation recommendations and evaluating potential risk for the proposed project.

3.0 RELEVANT GEOTECNICAL INFORMATION

NGE obtained and reviewed available, relevant geotechnical information for areas adjacent to the proposed project alignment in order to obtain some indications as to the subsurface conditions which likely exist within the proposed project alignment. The geotechnical information obtained by NGE consists of various forms of subsurface data, including: existing borehole and test pit logs; penetrometer data; soil temperature data; and laboratory testing results. The geotechnical information was obtained from NGE archives, as well as from other sources (both public and private) including the State of Alaska Department of Transportation & Public Facilities (AK DOT&PF) and other local geotechnical engineering firms who have conducted subsurface explorations in the area of the proposed project. A total of eight individual geotechnical investigations were identified by NGE which contained information relevant to the proposed project (Figure 3).

4.0 SUBSURFCE CONDITIONS

Based on the existing subsurface information reviewed by NGE, the project area is likely underlain by a sequence of interbedded silty sand and silt of unknown thickness, but extending to depths of at least 60 feet bgs. In previously undisturbed areas, the sand/silt material may be overlain by several feet or peat/organics, especially in low-lying areas, such as bogs, sloughs, and shallow ponds. Permafrost conditions likely exist in any previously undisturbed areas at depths as shallow as 1-2 feet bgs. The permafrost likely contains some visible ice (ice lenses); especially in organic soils and soils with high silt contents, and/or in areas with readily available surface water (such as a pond or low-lying area).

Temperature data collected at sites adjacent to the proposed project alignment indicate that warm permafrost conditions likely exist, and any areas which have been previously disturbed have likely experienced varying degrees of thawing. Previous explorations in the area indicate that sites which have been previously disturbed are thawed to depths of up to at least 50-60 feet bgs. However, it is uncertain as to: 1) when the sites were initially disturbed; and 2) what the thermal state of the soils were prior to the disturbance.

Groundwater depths in the area are reported to range from the ground surface to depths of up to at least 28 feet bgs. In areas of shallow permafrost, the groundwater is generally perched above the top of the permafrost. In thawed areas the groundwater can be locally perched on less permeable silt layers (or deeper permafrost), and average groundwater depths in the thawed areas range between 15 and 20 feet bgs.

5.0 CONCLUSIONS

Currently, the project is in the initial research and design phase, and the alignment of the proposed utility remains uncertain. However, it can be assumed that a portion of the proposed utility alignment will likely be located within (or parallel to) the Chief Eddie Hoffman Highway corridor/right-of way (ROW). The soils within and directly adjacent to Chief Eddie Hoffman Highway have likely undergone varying degrees of thawing, as evidenced by:

- The undulating surface of Chief Eddie Hoffman Highway (prior to recent road upgrades) which is an indication of significant differential settlement as a result of permafrost thawing;
- Previous subsurface explorations conducted directly adjacent to Chief Eddie Hoffman Highway which encountered thawed soils;
- Existing subsurface data from other previously disturbed areas near Chief Eddie Hoffman Highway which indicate that presence of thawed soils.

The thaw bulb associated with Chief Eddie Hoffman Highway appears to have a limited lateral extent, and shallow permafrost conditions have been encountered just outside of the Chief Eddie Hoffman Highway ROW, where areas of undisturbed soils persist.

It can also be assumed that portions of the developed sites proposed to receive utility service as part for this project have also undergone varying degrees of thawing, as a result of site development. Thus (depending on the proposed alignment), portions of the proposed utility services may be constructed on either: 1) thawed ground; 2) partially thawed ground; or 3) shallow permafrost.

Based on the available subsurface information reviewed for this report, it can be assumed that any portion of the proposed utility alignment which crosses previously undisturbed ground will encounter shallow permafrost conditions, and the permafrost surface will likely be at or immediately beneath the bottom of the surficial tundra mat.

Any disturbance to areas containing shallow permafrost (during utility installation) will likely result in some level of thawing. The impact of utility installation on any existing shallow permafrost can be reduced by conducting construction activities during winter months.

It is assumed that the proposed utility will be located above ground and be supported by pile foundations bearing on either: 1) deep permafrost; or 2) thawed ground. Piles founded in either soils condition will need to be designed to resist uplift forces generated by seasonal frost jacking, wind, and seismic loads. Piles founded in permafrost will need to be embedded to adequate depths so as to reduce the potential for future thawing beneath the pile (as a result of ground disturbance, utility operation, climate change, etc.).

The type and method of pile installation should be selected to minimize disturbance to the existing permafrost.

Recent climate trends indicate a general increase of average annual temperatures over the past 50 years. The warming climate trend is predicted to continue, and it remains uncertain as to what impact the climate changes will have on permafrost soils. Some permafrost in the area of the proposed project occurs at relatively shallow depth and is considered "warm permafrost", and is therefore sensitive to relatively small changes in the thermal regime in which it exists. Removal of insulating cover (tundra) and increases in average temperatures will almost certainly result in more rapid thawing of the permafrost. Furthermore, climate change also influences the effectiveness of passive permafrost protection measures such as thermopiles, thermosyphons, and insulation. Therefore, potential climate change should always be considered when designing foundation systems for permafrost soils.

6.0 RECOMMENDATIONS

Our evaluation of the proposed project is based entirely on: 1) available geotechnical information for sites adjacent to the proposed project alignment; and 2) our own experience dealing with permafrost soils in the Bethel area. Therefore, only general conclusions and recommendations can be made at this time. Based on the information available to us at this time, it is apparent that both: 1) shallow, warm permafrost; and 2) thawed conditions, likely underlie the proposed alignment. However, additional subsurface information will need to be collected in order to develop a more thorough understanding of the soil conditions along the proposed utility alignment.

We recommend that a comprehensive geotechnical exploration program be developed which focuses exclusively on the proposed utility alignment. Several borings should be advanced along the proposed utility alignment with the goal of characterizing the soils and soil conditions. The presence (or lack thereof) of permafrost will ultimately guide the final foundation design, and it will be important to have representative subsurface information along the entire length of the proposed utility alignment. Representative samples should be collected during the exploration program and returned to an accredited soils laboratory for further identification and analysis. Subsurface temperature data

should also be collected at select sites along the proposed alignment to monitor permafrost conditions and provide site specific temperature data for any thermal modeling which may be conducted in conjunction with the geotechnical investigation. Engineering recommendations for potential foundation systems can then be made based off of the results of the field and laboratory effort.

The impact of a changing climate on permafrost is problematic and difficult to predict. However, the impact of potential climate change on permafrost can be estimated using a technique known as thermal modeling. Thermal modeling is a relatively inexpensive and non-invasive way of predicting how a project and/or climate change may impact permafrost soils. Thermal modeling allows the user to create a two-dimensional profile model of the project using real-world site data including soil properties and historical climatic data. The software uses a process known as finite-element analysis to predict what the impact changing climate conditions may have on the permafrost at a given location. Thermal modeling is a proactive method of predicting the impact that: 1) climate change may have on permafrost; 2) a project may have on the permafrost; and 3) proposed refrigeration/insulation systems may have on the permafrost.

Given the recent warming climate trend and the relatively high susceptibility of the permafrost in the Bethel area to thawing; it may be beneficial to conduct some thermal modeling as part of the geotechnical investigations to take a look at the potential impact that the proposed project and/or climate change may have on the existing permafrost.

7.0 CLOSURE

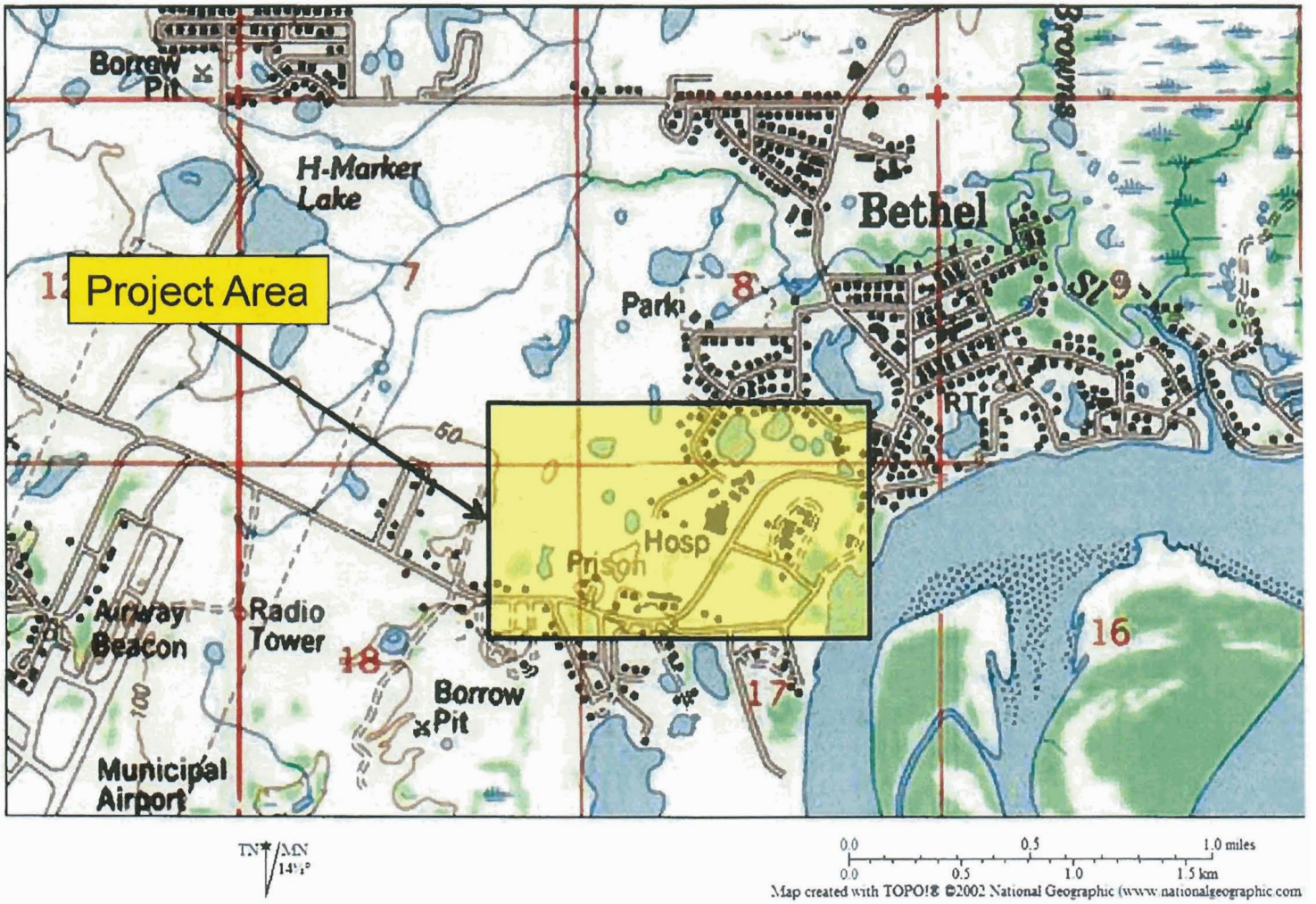
Northern Geotechnical Engineering Inc. prepared this report exclusively for the use of *Larsen Consulting Group, Inc* and their consultants for use in determination of the feasibility of the proposed project. *Northern Geotechnical Engineering, Inc.* should be notified if significant changes are to occur in the nature or design of the proposed project in order that the conclusions and recommendations presented in this report may be reviewed and, if necessary, modified to satisfy the proposed changes.

Due to the natural variability of earth materials, variations in subsurface conditions may exist other than those identified during the course of the evaluation. The recommended additional explorations will reduce, but not eliminate, the uncertainty of the subsurface

conditions along the proposed project alignment. Therefore, it is recommended that a qualified geotechnical engineer be on-site during construction activities to provide corrective recommendations for any unexpected conditions revealed during construction. Furthermore, the construction budget should allow for any unanticipated conditions that may be encountered during construction activities.

Northern Geotechnical Engineering Inc. conducted this evaluation following the standard of care expected of professionals undertaking similar work in the State of Alaska under similar conditions. No warranty expressed or implied is made.

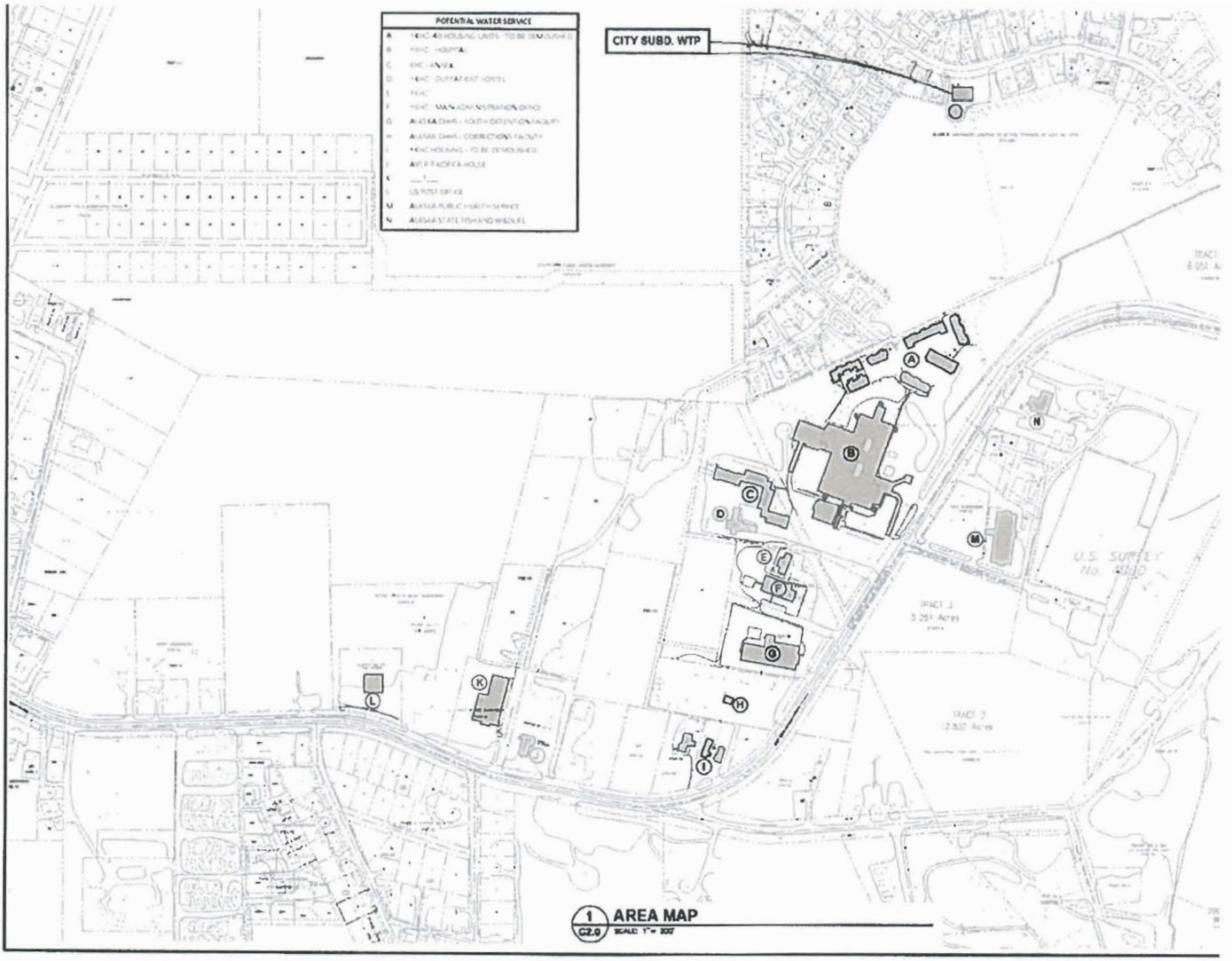
FIGURES



SITE LOCA

Institutional Corridor Feasibility
Bethel, AK

2329-09

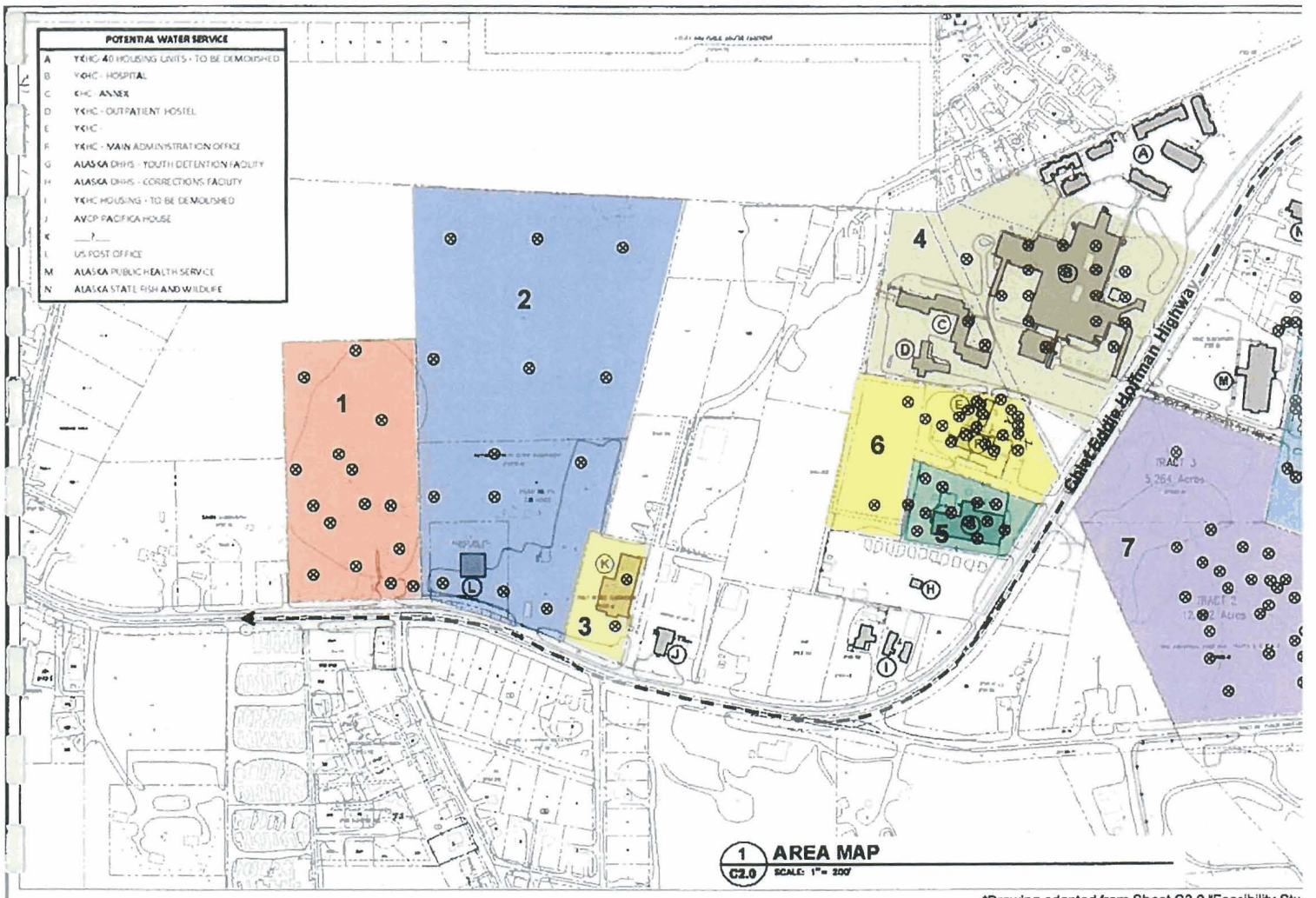


PROJECT AF

Institutional Corridor Feasibility S
Bethel, AK

2329-09

Drawing adapted from Sheet C2.0 "Feasibility Study Area Map" prepared by Larsen Consulting Group, 11/10/09



*Drawing adapted from Sheet C2.0 "Feasibility Stu

1 = Geotechnical Report for the Proposed Bethel Readiness Center – NGE, Inc. - 2004

2 = Geotechnical Study, New Wave Center – Shannon & Wilson, Inc. - 1999

3 = Geotechnical Explorations, Lot 10A, USS4117 – Shannon & Wilson, Inc. - 1997

4 = Soil Borings Conducted for the Bethel Hospital - Shannon & Wilson, Inc. - 1974

⊗ = Approximate location of past subsurface exploration

5 = Foundation Report for Bethel Regional Jail - AK DOT & PF - 1982

6 = Geotechnical Report for Bethel Youth Facility - AK DOT & PF - 1984

7 = Crowley Tank Farm – Duane Miller & Associates - 2001

8 = Old PHS Hospital – US Army Corps of Engineers - 1994

TABLES

Table 1 - Available Subsurface Data Summary

Institutional Corridor Feasibility Study
Bethel, AK
Project 2329-09

Site ID	Exploration ID	Engineer	Type of Exploration	Total Exploration Depth (ft bgs)	Date of Exploration Completion	Permafrost depth (ft bgs)		Avg. Permafrost Temp (° F)	Permafrost Temp Range (° F)		Visible Ice	Groundwater Depth (ft bgs)
						Top	Bottom		Low	High		
1	TB-1	Dowl	Boring	52.5	4/17/2002	–	–	–	–	–	–	10.0
1	TB-2	Dowl	Boring	52.5	4/16/2002	–	–	–	–	–	–	9.0
1	TB-3	Dowl	Boring	52.5	4/17/2002	–	–	–	–	–	–	14.0
1	TB-4	Dowl	Boring	31.5	4/16/2002	2.0	?	31.6	30.7	31.6	No	Not Encountered
1	B-1	NGE	Boring	40.5	9/6/2003	19.0	?	31.9	31.8	31.9	No	14.0
1	B-2	NGE	Boring	40.0	9/6/2003	–	–	–	–	–	–	14.0
1	B-3	NGE	Boring	50.0	9/6/2003	–	–	–	–	–	–	20.0
1	B-4	NGE	Boring	25.5	9/7/2003	9.0	?	–	–	–	No	Not Encountered
1	B-5	NGE	Boring	40.0	9/7/2003	3.0	?	31.9	31.7	32.0	No	Not Encountered
1	B-6	NGE	Boring	45.5	9/7/2003	37.0	?	31.9	31.9	31.9	No	15.0
1	B-7	NGE	Boring	51.0	9/8/2003	–	–	–	–	–	–	15.0
1	B-8	NGE	Boring	50.0	9/8/2003	–	–	–	–	–	–	24.0
1	B-9	NGE	Boring	25.5	9/8/2003	9.0	?	31.9	31.9	32.0	No	Not Encountered
1	B-10	NGE	Boring	50.5	9/9/2003	–	–	–	–	–	–	23.0
1	B-11	NGE	Boring	50.5	9/9/2003	–	–	–	–	–	–	16.0
2	B-1	S & W	Boring	18.5	10/27/1998	2.0	?	–	–	–	No	Not Encountered
2	B-2	S & W	Boring	20.9	10/27/1998	2.0	?	31.3	30.1	31.9	No	Not Encountered
2	B-3	S & W	Boring	20.5	10/27/1998	3.5	?	31.7	31.4	31.9	No	Not Encountered
2	B-4	S & W	Boring	18.5	10/27/1998	5.0	?	–	–	–	No	0.7
2	B-5	S & W	Boring	19.5	10/28/1998	2.5	?	31.8	31.7	31.9	Yes	Not Encountered
2	B-6	S & W	Boring	19.5	10/28/1998	2.5	?	–	–	–	Yes	4.0
2	B-7	S & W	Boring	19.5	10/29/1998	2.5	?	–	–	–	Yes	Not Encountered
2	B-8	S & W	Boring	19.5	10/29/1998	2.0	?	–	–	–	Yes	0.0
2	B-9	S & W	Boring	20.0	10/30/1998	2.5	?	–	–	–	Yes	Not Encountered
2	B-10	S & W	Boring	20.0	10/30/1998	1.5	?	31.4	30.7	31.8	Yes	Not Encountered
2	B-11	S & W	Boring	20.5	10/30/1998	2.5	?	–	–	–	Yes	Not Encountered
2	B-12	S & W	Boring	19.5	10/30/1998	2.5	?	31.4	30.4	31.7	Yes	Not Encountered
2	B-13	S & W	Boring	39.0	10/30/1998	2.5	?	31.7	31.6	32.0	Yes	Not Encountered
3	TP-1	NGE	Test Pit	1.7	1997	1.7	?	32.0	1.7	?	?	Not Encountered
3	TP-2	NGE	Test Pit	2.2	1997	2.2	?	32.0	2.2	?	?	Not Encountered
4	B-1	S & W	Boring	24.6	9/27/1974	2.0	?	–	–	–	No	0.5
4	B-2	S & W	Boring	26.0	9/28/1974	2.0	?	–	–	–	Yes	1.0
4	B-3	S & W	Boring	25.0	9/28/1974	2.5	?	–	–	–	No	1.0
4	B-4	S & W	Boring	25.0	9/30/1974	2.0	?	–	–	–	No	2.0
4	B-5	S & W	Boring	25.0	9/30/1974	5.0	?	–	–	–	No	5.0
4	B-6	S & W	Boring	25.0	10/1/1974	1.0	?	–	–	–	No	1.0
4	B-7	S & W	Boring	25.0	10/1/1974	0.7	?	–	–	–	Yes	2.0
4	B-8	S & W	Boring	25.0	10/1/1974	0.5	?	–	–	–	Yes	0.5
4	B-9	S & W	Boring	30.0	10/2/1974	2.0	?	–	–	–	No	2.0
4	B-10	S & W	Boring	50.0	10/2/1974	2.5	?	30.6	30.0	32.0	No	Not Encountered
4	B-11	S & W	Boring	25.0	10/2/1974	3.0	?	–	–	–	No	0.6
4	B-12	S & W	Boring	30.0	10/3/1974	3.0	?	–	–	–	No	3.0
4	B-13	S & W	Boring	30.0	10/3/1974	2.9	?	–	–	–	b	3.3
4	B-14	S & W	Boring	27.0	10/3/1974	2.5	?	–	–	–	No	1.5
4	B-15	S & W	Boring	31.5	10/4/1974	–	–	–	–	–	–	Not Encountered
4	B-16	S & W	Boring	30.0	10/5/1974	2.0	?	31.8	30.0	33.0	No	2.0
4	B-17	S & W	Boring	30.0	10/6/1974	2.5	?	–	–	–	Yes	2.5
4	B-18	S & W	Boring	30.0	10/6/1974	0.8	?	–	–	–	Yes	0.8
5	Boring 1	AK DOT&PF	Boring	35.5	2/7/1982	–	–	–	–	–	–	17.2
5	Boring 2	AK DOT&PF	Boring	32.0	2/7/1982	0.0	?	–	–	–	No	Not Encountered
5	Boring 3	AK DOT&PF	Boring	30.0	2/7/1982	–	–	–	–	–	–	Unknown
5	Boring 4	AK DOT&PF	Boring	30.0	2/8/1982	–	–	–	–	–	–	Unknown
5	Boring 5	AK DOT&PF	Boring	30.0	2/8/1982	–	–	–	–	–	–	Unknown
5	Boring 6	AK DOT&PF	Boring	30.0	2/8/1982	–	–	–	–	–	–	Unknown
5	Boring 7	AK DOT&PF	Boring	30.0	2/8/1982	–	–	–	–	–	–	Unknown
5	Boring 8	AK DOT&PF	Boring	57.0	2/8/1982	–	–	–	–	–	–	17.7
5	Boring 9	AK DOT&PF	Boring	9.8	2/18/1982	–	–	–	–	–	–	Not Encountered
5	Boring 10	AK DOT&PF	Boring	30.0	2/19/1982	–	–	–	–	–	–	12.5
5	Penetrometer 1	AK DOT&PF	Penetrometer	55.0	2/9/1982	–	–	–	–	–	–	Unknown
5	Penetrometer 2	AK DOT&PF	Penetrometer	41.0	2/18/1982	–	–	–	–	–	–	Unknown
6	Boring 1	AK DOT&PF	Boring	32.0	7/10/1984	13.2	?	–	–	–	No	Not Encountered

Table 1 - Available Subsurface Data Summary

Institutional Corridor Feasibility Study
Bethel, AK
Project 2329-09

Site ID	Exploration ID	Engineer	Type of Exploration	Total Exploration Depth (ft bgs)	Date of Exploration Completion	Permafrost depth (ft bgs)		Avg. Permafrost Temp (°F)	Permafrost Temp Range (°F)		Visible Ice	Groundwater Depth (ft bgs)
						Top	Bottom		Low	High		
6	Boring 2	AK DOT&PF	Boring	25.0	7/10/1984	–	–	–	–	–	–	10.5
6	Boring 3	AK DOT&PF	Boring	29.5	7/10/1984	–	–	–	–	–	–	12.5
6	Boring 4	AK DOT&PF	Boring	29.0	7/11/1984	–	–	–	–	–	–	14.1
6	Boring 5	AK DOT&PF	Boring	32.0	7/11/1984	9.0	?	–	–	–	No	Not Encountered
6	Boring 6	AK DOT&PF	Boring	32.0	7/11/1984	2.0	?	–	–	–	Yes	Unknown
6	Boring 7	AK DOT&PF	Boring	30.5	7/12/1984	–	–	–	–	–	–	14.5
6	Boring 8	AK DOT&PF	Boring	31.0	7/12/1984	–	–	–	–	–	–	11.4
6	Boring 9	AK DOT&PF	Boring	29.0	7/12/1984	–	–	–	–	–	–	14.5
6	Boring 10	AK DOT&PF	Boring	30.0	7/12/1984	–	–	–	–	–	–	11.4
6	Boring 11	AK DOT&PF	Boring	30.0	7/13/1984	–	–	–	–	–	–	11.4
6	Boring 12	AK DOT&PF	Boring	29.5	7/13/1984	–	–	–	–	–	–	11.4
6	Boring 13	AK DOT&PF	Boring	32.0	7/13/1984	9.0	?	–	–	–	–	Not Encountered
6	Boring 14	AK DOT&PF	Boring	32.0	7/13/1984	–	–	–	–	–	–	14.8
6	Boring 15	AK DOT&PF	Boring	31.0	7/14/1984	–	–	–	–	–	–	11.4
6	Boring 16	AK DOT&PF	Boring	27.0	7/14/1984	–	–	–	–	–	–	14.5
6	Boring 17	AK DOT&PF	Boring	31.0	7/14/1984	–	–	–	–	–	–	11.7
6	Boring 18	AK DOT&PF	Boring	31.5	7/14/1984	–	–	–	–	–	–	18.5
6	Boring 19	AK DOT&PF	Boring	31.0	7/15/1984	–	–	–	–	–	–	19.0
6	Penetrometer 20	AK DOT&PF	Penetrometer	40.0	7/15/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 21	AK DOT&PF	Penetrometer	40.0	7/15/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 22	AK DOT&PF	Penetrometer	40.0	7/15/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 23	AK DOT&PF	Penetrometer	10.0	7/15/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 24	AK DOT&PF	Penetrometer	10.0	7/16/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 25	AK DOT&PF	Penetrometer	10.0	7/16/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 26	AK DOT&PF	Penetrometer	10.0	7/16/1984	–	–	–	–	–	–	Unknown
6	Penetrometer 27	AK DOT&PF	Penetrometer	7.0	7/16/1984	2.0	?	–	–	–	–	Unknown
6	Boring 28	AK DOT&PF	Boring	30.0	7/16/1984	–	–	–	–	–	–	18.0
7	B-1	Duane Miller	Boring	30.0	1/3/2001	2.0	?	–	–	–	Yes	Not Encountered
7	B-2	Duane Miller	Boring	10.0	1/3/2001	–	–	–	–	–	–	1.0
7	B-3	Duane Miller	Boring	11.0	1/3/2001	–	–	–	–	–	–	Not Encountered
7	B-4	Duane Miller	Boring	11.0	1/3/2001	–	–	–	–	–	–	Not Encountered
7	B-5	Duane Miller	Boring	30.0	1/3/2001	2.0	?	–	–	–	Yes	Not Encountered
7	B-6	Duane Miller	Boring	30.0	1/3/2001	1.5	?	–	–	–	Yes	Not Encountered
7	B-7	Duane Miller	Boring	30.0	1/4/2001	2.0	?	–	–	–	Yes	Not Encountered
7	B-8	Duane Miller	Boring	15.0	1/4/2001	2.0	?	–	–	–	Yes	Not Encountered
7	B-9	Duane Miller	Boring	10.0	1/4/2001	–	–	–	–	–	–	4.0
7	B-10	Duane Miller	Boring	10.0	1/4/2001	–	–	–	–	–	–	Not Encountered
7	B-11	Duane Miller	Boring	20.5	1/4/2001	–	–	–	–	–	–	14.0
7	B-12	Duane Miller	Boring	30.5	1/5/2001	–	–	–	–	–	–	14.0
7	B-13	Duane Miller	Boring	25.5	1/5/2001	–	–	–	–	–	–	14.0
7	B-14	Duane Miller	Boring	30.5	1/5/2001	–	–	–	–	–	–	21.0
7	B-15	Duane Miller	Boring	11.0	1/5/2001	6.5	?	–	–	–	No	Not Encountered
7	B-16	Duane Miller	Boring	9.5	1/6/2001	–	–	–	–	–	–	Not Encountered
7	B-17	Duane Miller	Boring	15.0	1/6/2001	5.5	?	–	–	–	No	Not Encountered
7	B-18	Duane Miller	Boring	50.5	9/25/2001	–	–	–	–	–	–	14.0
7	B-19	Duane Miller	Boring	49.0	9/26/2001	–	–	–	–	–	–	19.0
7	B-20	Duane Miller	Boring	64.0	9/27/2001	–	–	–	–	–	–	14.0
7	B-21	Duane Miller	Boring	49.0	9/28/2001	–	–	–	–	–	–	14.0
7	B-22	Duane Miller	Boring	49.0	9/29/2001	–	–	–	–	–	–	14.0
7	B-23	Duane Miller	Boring	40.5	9/29/2001	–	–	–	–	–	–	14.0
7	BH-1	Golder	Boring	13.0	8/20/2001	–	–	–	–	–	–	Not Encountered
7	BH-2	Golder	Boring	16.5	8/20/2001	–	–	–	–	–	–	13.5
7	BH-3	Golder	Boring	24.0	8/20/2001	–	–	–	–	–	–	23.0
7	BH-4	Golder	Boring	29.0	8/21/2001	–	–	–	–	–	–	26.0
7	MW-1	Golder	Boring	31.5	8/20/2001	–	–	–	–	–	–	28.0
7	MW-2	Golder	Boring	26.5	8/21/2001	–	–	–	–	–	–	22.0
7	MW-3	Golder	Boring	25.5	8/21/2001	–	–	–	–	–	–	21.0
7	MW-4	Golder	Boring	20.0	8/21/2001	–	–	–	–	–	–	14.0
7	MW-5	Golder	Boring	15.0	8/22/2001	–	–	–	–	–	–	12.0
8	MW-1	US ACOE	Boring	30.0	11/3/1993	28.5	?	–	–	–	–	26.0
8	MW-2	US ACOE	Boring	30.5	11/5/1993	29.0	?	–	–	–	–	27.5
8	MW-3	US ACOE	Boring	30.5	11/5/1993	–	–	–	–	–	–	24.5
8	MW-4	US ACOE	Boring	25.0	11/7/1993	–	–	–	–	–	–	20.5
8	MW-5	US ACOE	Boring	28.5	11/9/1993	–	–	–	–	–	–	24.5

Table 1 - Available Subsurface Data Summary

Institutional Corridor Feasibility Study
Bethel, AK
Project 2329-09

Site ID	Exploration ID	Engineer	Type of Exploration	Total Exploration Depth (ft bgs)	Date of Exploration Completion	Permafrost depth (ft bgs)		Avg. Permafrost Temp (° F)	Permafrost Temp Range (° F)		Visible Ice	Groundwater Depth (ft bgs)
						Top	Bottom		Low	High		
8	MW-6	US ACOE	Boring	25.5	11/10/1993	–	–	–	–	–	–	20.0
8	MW-7	US ACOE	Boring	13.5	11/11/1993	–	–	–	–	–	–	10.0
8	MW-8	US ACOE	Boring	14.5	11/12/1993	–	–	–	–	–	–	9.8
8	MW-9	US ACOE	Boring	27.0	11/14/1993	–	–	–	–	–	–	25.0
8	MW-10	US ACOE	Boring	17.5	11/14/1993	17.0	?	–	–	–	–	13.5
8	MW-11	US ACOE	Boring	27.0	11/15/1993	26.5	?	–	–	–	–	24.3
8	MW-12	US ACOE	Boring	26.5	11/18/1993	–	–	–	–	–	–	24.5
8	MW-13	US ACOE	Boring	25.5	11/19/1993	23.5	?	–	–	–	–	Not Encountered
8	MW-14	US ACOE	Boring	20.5	11/21/1993	17.5	?	–	–	–	–	Not Encountered
8	MW-15	US ACOE	Boring	16.5	11/21/1993	14.5	?	–	–	–	–	12.0
8	MW-16	US ACOE	Boring	18.0	11/21/1993	–	–	–	–	–	–	14.0
8	PHS 2	US ACOE	Boring	25.5	11/4/1993	–	–	–	–	–	–	24.0
8	PHS 3	US ACOE	Boring	30.5	11/4/1993	–	–	–	–	–	–	28.0
8	PHS 6	US ACOE	Boring	25.5	11/7/1993	–	–	–	–	–	–	25.5
8	PHS 7	US ACOE	Boring	25.5	11/7/1993	24.5	?	–	–	–	–	19.0
8	PHS 9	US ACOE	Boring	20.5	11/8/1993	–	–	–	–	–	–	18.5
8	PHS 10	US ACOE	Boring	25.5	11/8/1993	–	–	–	–	–	–	24.0
8	PHS 12	US ACOE	Boring	25.5	11/9/1993	–	–	–	–	–	–	23.5
8	PHS 14	US ACOE	Boring	25.5	11/10/1993	–	–	–	–	–	–	24.0
8	PHS 15	US ACOE	Boring	15.5	11/11/1993	15.0	?	–	–	–	–	10.0
8	PHS 17	US ACOE	Boring	8.5	11/11/1993	–	–	–	–	–	–	8.0
8	PHS 18	US ACOE	Boring	10.5	11/11/1993	–	–	–	–	–	–	10.3
8	PHS 19	US ACOE	Boring	10.5	11/11/1993	–	–	–	–	–	–	8.0
8	PHS 21	US ACOE	Boring	25.5	11/12/1993	–	–	–	–	–	–	24.0
8	PHS 24	US ACOE	Boring	10.5	11/14/1993	10.0	?	–	–	–	–	Not Encountered
8	PHS 26	US ACOE	Boring	20.5	11/15/1993	–	–	–	–	–	–	18.0
8	PHS 27	US ACOE	Boring	10.2	11/16/1993	–	–	–	–	–	–	8.3
8	PHS 28	US ACOE	Boring	25.5	11/16/1993	–	–	–	–	–	–	24.0
8	PHS 29	US ACOE	Boring	15.5	11/16/1993	–	–	–	–	–	–	Not Encountered
8	PHS 30	US ACOE	Boring	5.5	11/16/1993	–	–	–	–	–	–	Not Encountered
8	PHS 31	US ACOE	Boring	5.5	11/16/1993	–	–	–	–	–	–	Not Encountered
8	PHS 33	US ACOE	Boring	20.5	11/17/1993	–	–	–	–	–	–	Not Encountered
8	PHS 36	US ACOE	Boring	25.5	11/19/1993	–	–	–	–	–	–	25.0
8	PHS 37	US ACOE	Boring	10.5	11/19/1993	9.8	?	–	–	–	–	Not Encountered
8	PHS 42	US ACOE	Boring	15.5	11/22/1993	–	–	–	–	–	–	14.0
8	PHS 43	US ACOE	Boring	18.5	11/21/1993	–	–	–	–	–	–	Not Encountered
8	PHS 44	US ACOE	Boring	5.5	11/21/1993	–	–	–	–	–	–	Not Encountered
8	PHS 45	US ACOE	Boring	5.5	11/21/1993	–	–	–	–	–	–	Not Encountered
8	PHS 46	US ACOE	Boring	5.5	11/21/1993	–	–	–	–	–	–	Not Encountered
8	PHS 47	US ACOE	Boring	5.5	11/21/1993	–	–	–	–	–	–	Not Encountered

APPENDIX A

REFERENCES CITED

REFERENCES CITED

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APPENDIX H – EQUIPMENT DATA / CUT SHEETS

New Item | Preferences | Help | Return to Products

Paco Express 7.0.1.33

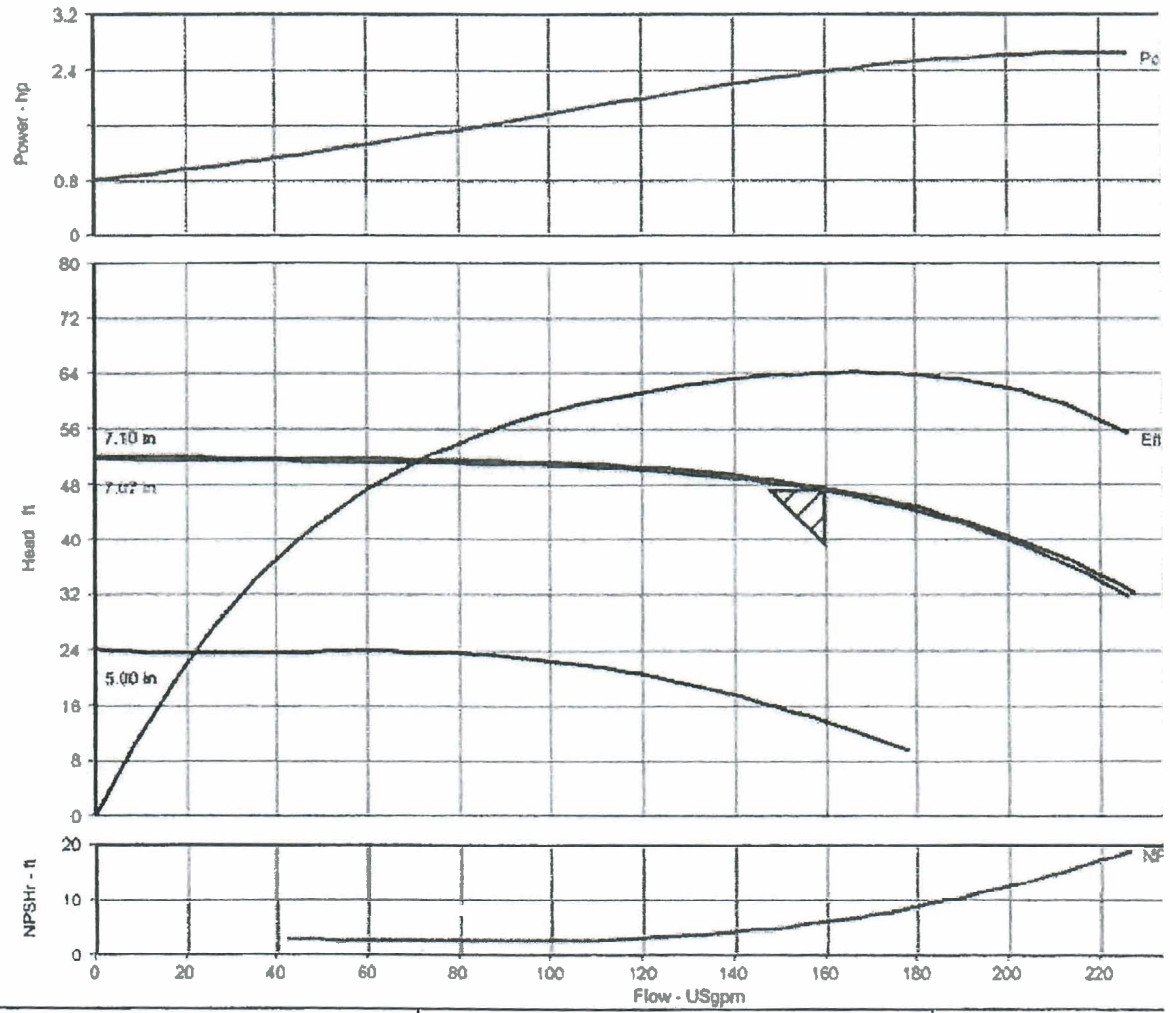
Selection Criteria
- Conditions of Service
- Product Lines
- Pump Size List

Selection Results
- Search Results
- Performance Curve
- Performance Datasheet
- Life Cycle Cost

Units | Save and return | Curve Preferences | Print

Instructions: To navigate to other pages, click o

Performance Curve | Multi-Speed Curves



Customer		**Pump size**	**: 20709 LC**	Flow, rated
Customer reference		Stages	: 1	Head, rated
Item number		Pump speed, rated	: 1,750 rpm	Fluid density, rated / ma
Service		Based on curve number	: RC9912-1 Rev 0	Viscosity
Quantity of pumps	1	Efficiency	: 79.91 %	Cq/Ch/Ce [ANSI/HI 9.6.
Quote number	:	Power, rated	: 2.4 hp	
Date last saved	: 11 Jan 2010 5:37 PM	NPSH required	: 6.06 ft	

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New Item | Preferences | Help | Return to Products

Paco Express 7.0.1.33

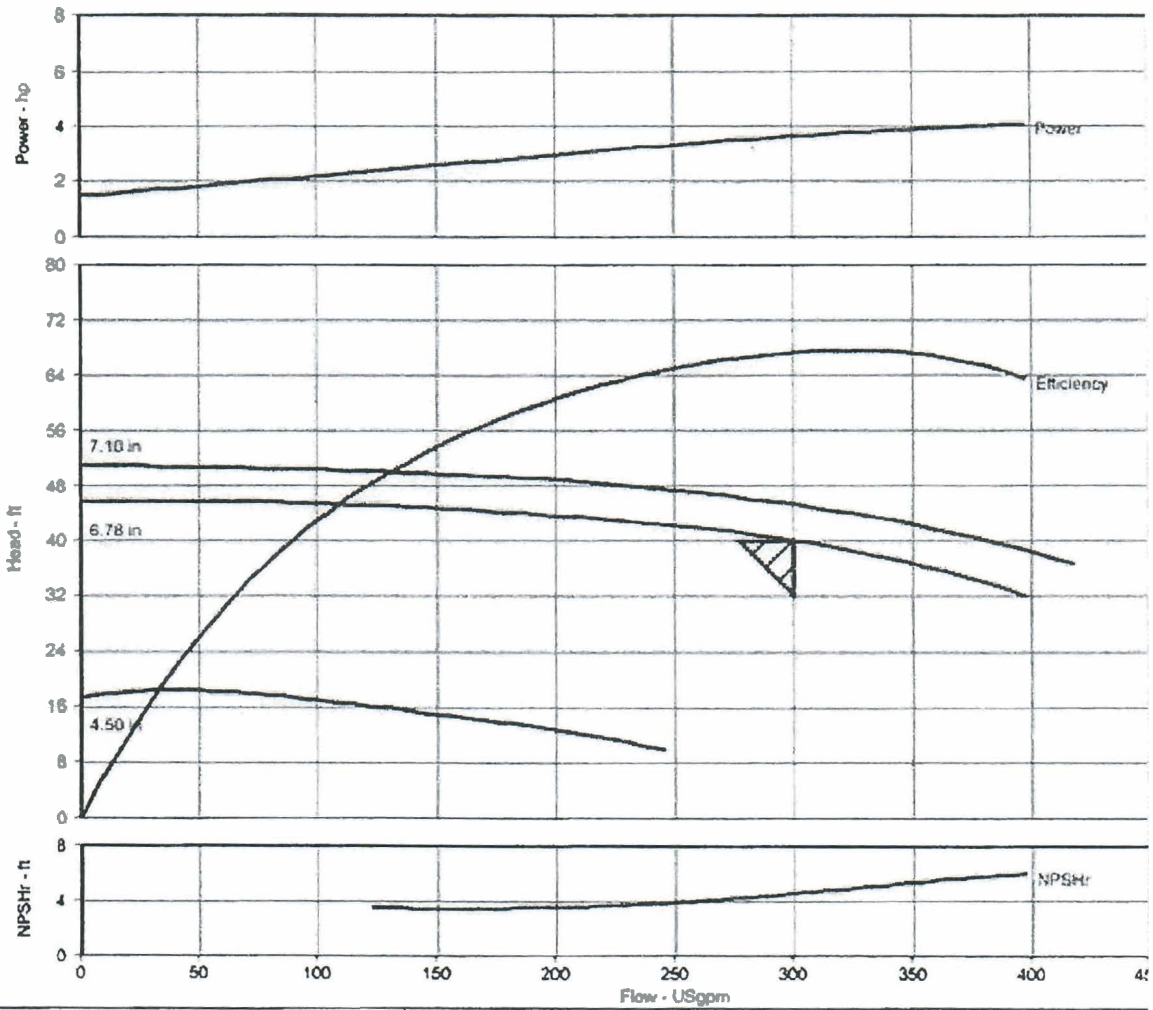
Selection Criteria
- Conditions of Service
- Product Lines
- Pump Size List

Selection Results
- Search Results
- Performance Curve
- Performance Datasheet
- Life Cycle Cost

Units | Save and return | Curve Preferences | Print

Instructions: To navigate to other pages, click o

Performance Curve | Multi-Speed Curves



Customer		**Pump size**	**: 30707 LC**	Flow, rated
Customer reference		Stages	1	Head, rated
Item number		Pump speed, rated	: 1,750 rpm	Fluid density, rated / ma
Service		Based on curve number	: RC1957 Rev 0	Viscosity
Quantity of pumps	1	Efficiency	: 84.06 %	Cq/Ch/Ce [ANSI/HI 9.6.
Quote number		Power, rated	: 3.6 hp	
Date last saved	: 11 Jan 2010 5:28 PM	NPSH required	: 4.53 ft	

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New Item | Preferences | Help | Return to Products

Paco Express 7.0.1.33

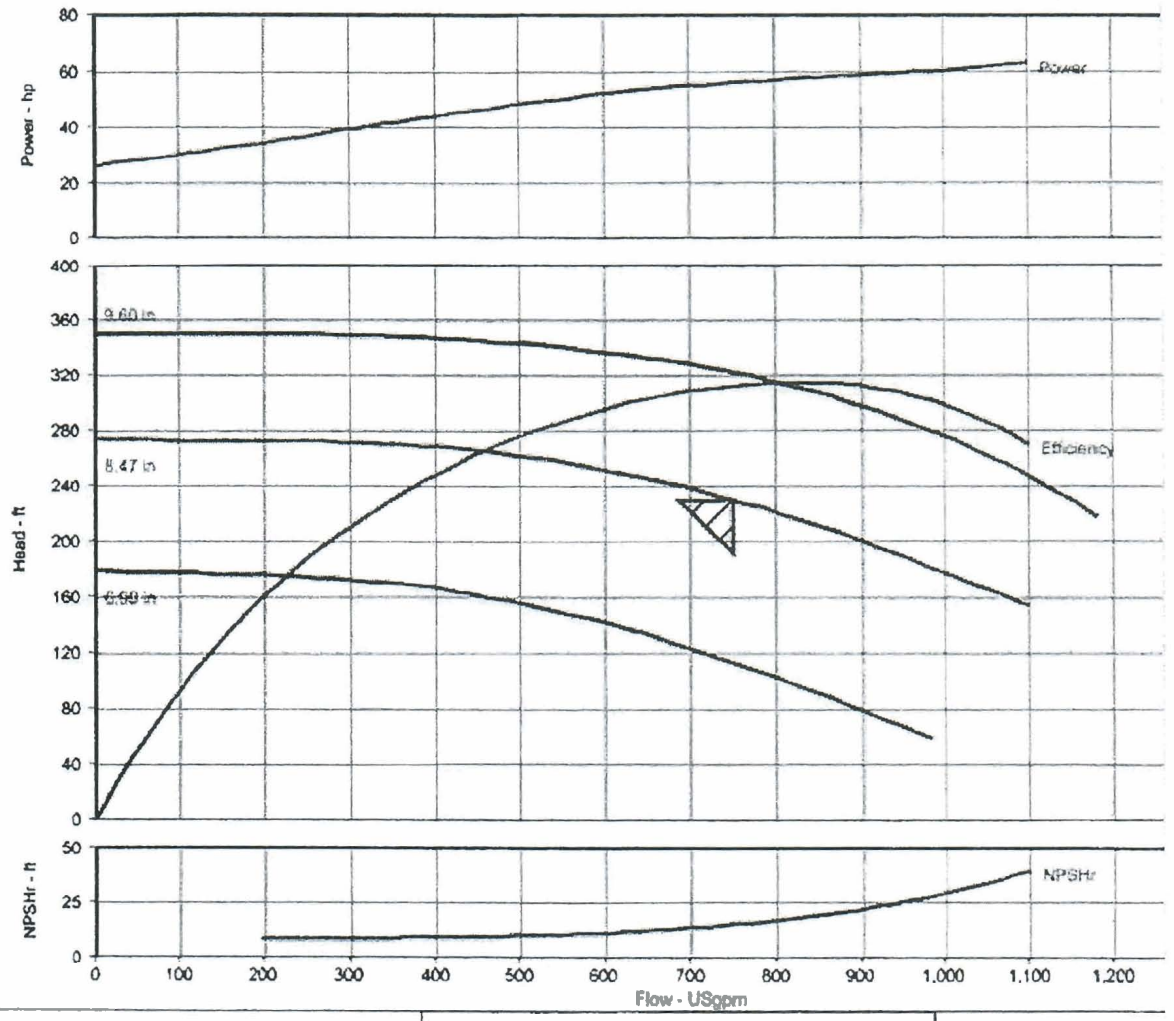
Selection Criteria
- Conditions of Service
- Product Lines
- Pump Size List

Selection Results
- Search Results
- Performance Curve
- Performance Datasheet
- Life Cycle Cost

Units | Save and return | Curve Preferences | Print

Instructions: To navigate to other pages, click o

Performance Curve | Multi-Speed Curves



Customer		**Pump size**	**: 30957 LC**	Flow, rated
Customer reference		Stages	: 1	Head, rated
Item number		Pump speed, rated	: 3,500 rpm	Fluid density, rated / ma
Service		Based on curve number	: RC9908-1 Rev 0	Viscosity
Quantity of pumps	1	Efficiency	: 77.99 %	Cq/Ch/Ce [ANSI/HI 9.6.
Quote number	:	Power, rated	: 56 hp	
Date last saved	: 11 Jan 2010 5:33 PM	NPSH required	: 14.68 ft	

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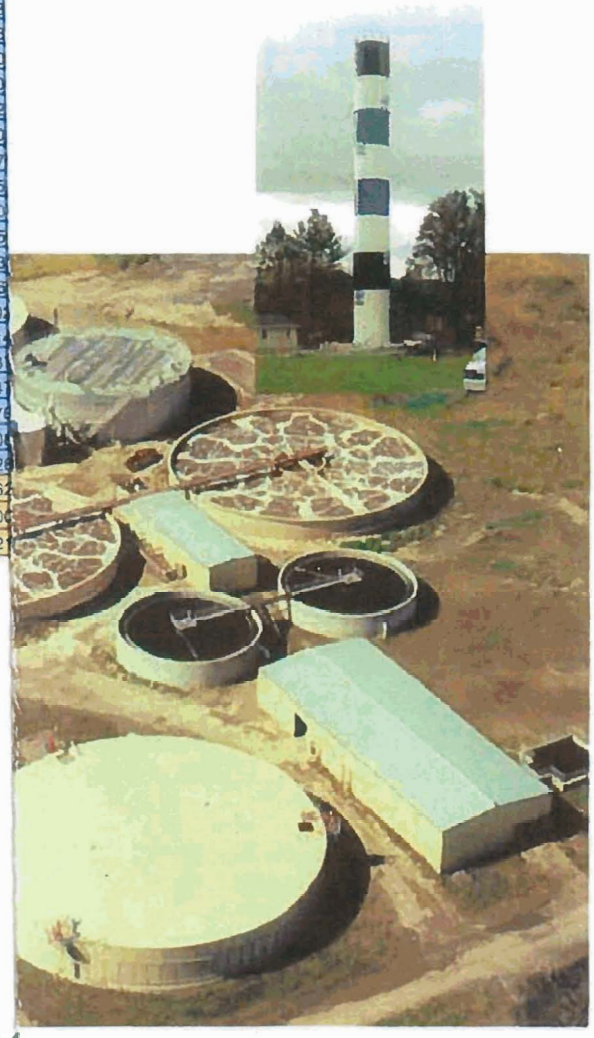
Columbian TecTank Liquid (Bolted)

Freeboard	0	inches	Units =								
		Model Ht	8	10		0	88	96	104	112	120
		Actual Ht (ft)	8.05	10.00	1	60	88.66	96.72	104.78	112.84	120.90
Model Diam	Actual Inside Diam (ft)	Capacity per 12" Ht									
9	9.231	501	4,035	5,007	5	854	44,389	48,424	52,460	56,495	60,530
12	12.308	890	7,174	8,901	1	740	78,914	86,088	93,262	100,436	107,610
15	15.385	1,391	11,209	13,907	2	093	123,303	134,512	145,721	156,931	168,140
18	18.462	2,003	16,141	20,027	3	414	177,556	193,697	209,839	225,980	242,121
21	21.539	2,726	21,970	27,258	4	703	241,673	263,643	285,614	307,584	329,554
24	24.616	3,560	28,696	35,603	5	959	315,655	344,351	373,046	401,742	430,438
28	26.154	4,019	32,394	40,191	6	937	356,331	388,725	421,118	453,512	485,906
29	29.709	5,186	41,798	51,859	8	985	459,783	501,582	543,380	585,179	626,977
32	32.680	6,275	50,576	62,750	10	785	556,341	606,918	657,494		
38	38.662	8,783	70,787	87,825	14	870	778,668				
41	41.592	10,164	81,923	101,641	16	227					
47	47.534	13,276	107,002	132,757	21						
54	54.962	17,749	143,057	177,490	28						
59	59.418	20,744	167,194	207,437	33						
65	65.360	25,100	202,306	251,000	40						
72	72.787	31,128	250,895	311,284	50						
74	74.272	32,412	261,237	324,115	52						
80	80.214	37,805	304,709	378,051	60						
84	84.670	42,122	339,503	421,220	67						
89	89.127	46,673	376,186	466,733	75						
92	92.098	49,837	401,684	498,368	80						
95	95.068	53,103	428,009	531,029	85						
99	99.525	58,199	469,082	581,988	93						
101	101.010	59,948	483,185	599,485	96						
104	103.981	63,527	512,027	635,269	1,0						
110	109.922	70,994	572,208	709,935	1,1						
120	120.321	85,061	685,595	850,614	1,3						
124	124.776	91,477	737,305	914,770	1,4						
136	136.651	109,733	884,451	1,097,334	1,7						
148	148.544	129,646	1,044,948	1,296,462	2,0						
154	154.486	140,226	1,130,220	1,402,258	2,2						
166	166.370	162,630	1,310,795	1,626,296	2,6						
178	178.253	186,691	1,504,729	1,866,909	3,0						
184	184.195	199,345	1,606,720	1,993,449	3,2						

	AWWA Specifications
	CTT Specifications
Seismic Zone 0, Freeboard = 0	
Other sizes available upon request	



Conversion Factors

	per US Gallon
to Cubic Meters	0.00378
Imperial Gallons	0.83267
Liters	3.78541

Columbian TecTank Liquid (Welded)

Freeboard	0	inches	Units =		US						
	Model Ht	6	12	18	24	7	113	119	125	131	137
	Actual Ht	5.92	11.84	17.76	23.68	54	112.48	118.40	124.32	130.24	136.16
Model (diam)	Actual diam (ft)										
8	8	2,226	4,452	6,678	8,905	063	42,297	44,523	46,749	48,975	51,201
9	9	2,817	5,635	8,452	11,270	705	53,532	56,349	59,166	61,984	64,801
10	10	3,478	6,957	10,435	13,913	598	66,088	69,567	73,045	76,523	80,002
11	11	4,209	8,418	12,626	16,835	744	79,967	84,176	88,384	92,593	96,802
12	11.92	4,942	9,884	14,827	19,769	944	93,903	98,845	103,787	108,729	113,671
13	12.92	5,806	11,613	17,419	23,225	493	110,319	116,125	121,931	127,738	133,544
14	13.92	6,740	13,480	20,220	26,959	294	128,057	134,797	141,537	148,277	155,016
15	14.92	7,743	15,486	23,229	30,972	348	147,117	154,860	162,603	170,346	178,089

APPENDIX I – BIBILOGRAPHY

BIBLIOGRAPHY

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