CONCEPT DESIGN REPORT AND

CONSTRUCTION COST ESTIMATE

FOR ENERGY INFRASTRUCTURE PROJECTS

IN THE COMMUNITY OF:

ST. GEORGE

PREPARED FOR:

STATE OF ALASKA

ALASKA ENERGY AUTHORITY/ RURAL ENERGY GROUP

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EXECUTIVE SUMMARY

This report has been prepared by Alaska Energy and Engineering, Inc. (AE&E) for the Alaska Energy Authority / Rural Energy Group (AEA/REG). The purpose of this study is to provide a concept design and construction cost estimate for the following potential local energy projects for the community of St. George:

- Diesel Power Plant Replacement.
- Diesel Generation Heat Recovery System.
- Distribution System Repair/Replacement.
- Wind Generation.

Participants in the project include the City of St. George and the Pribilof Islands School District.

A site investigation was performed by Tim Sandstrom, Josh Craft, Devany Plentovich, Deborah Vo and Rebecca Garrett of the Alaska Energy Authority/Rural Energy Group (AEA/REG) along with John Dickerson of Alaska Energy & Engineering (AE&E) and Don Henry of Alaska Power and Communications on May 22-23, 2012. The purpose of the site visit was to meet with local residents to discuss the scope of potential energy projects as well as to gather field data on existing energy infrastructure. An unusually late spring and inclement weather conditions delayed the site investigation by several weeks. Even with the delay, snow cover prevented the inspection of a portion of the power distribution equipment in the community.

The existing St. George power plant was constructed prior to 1970. It contains a total of 4 diesel generators. At this time only 2 of the generators are functional. Previous reports indicate that the building, generators, and all associated mechanical and electrical systems are in poor condition and past their useable lives and probably not suitable for reuse. The existing power plant site was deemed to be contaminated with petroleum products and was subject to a site environmental cleanup as required by the Alaska Department of Conservation. The site continues to have residual petroleum contamination and is currently subject to ongoing environmental monitoring. Therefore this site is deemed not suitable for a new power plant.

The proposed new power plant site is directly across Advance Avenue to the east of the old power plant building. The new plant will consist of pre-fabricated steel module with a field installed roof system. The module will have a generation room which will contain four generators and associated mechanical equipment and a control room which will contain programmable automatic paralleling switchgear and SCADA equipment. Other features of the new plant include a fire suppression system, critical grade exhaust silencers, heat recovery, used oil blending, heat recovery, and wind power integration controls. All systems will be operationally complete and shop-tested in Anchorage prior to shipment.

The proposed heat recovery system will capture jacket water heat from the diesel generators using a heat exchanger plus heat generated from excess wind power using an electric boiler. It will then deliver heat to the school, public safety building, City power plant building, City public works building and future Tanaq Corporation Shop. These five public facilities are estimated to use approximately 15,000 gallons of diesel annually for space and water heating. Based on calculations, it appears that the proposed heat recovery system can displace virtually all of the diesel fuel for heating the connected buildings.

Power is currently generated at 480 volt, 3-phase, 4-wire and distributed at 12.47/7.2 kV 3-phase. There are two separate community feeders with a 150kVA transformer feeding the village loop and another 150kVA transformer feeding the cross-island industrial loop to the airport/harbor. The distribution system is underground and consists of URD, #2 AWG, aluminum, jacketed concentric neutral conductors with cross-inked polyethylene insulation at either 100% or 133% level. The transformer enclosures are carbon steel and are near the end of their useful life in the harsh marine environment. There are reports of faults and other problems and according to PCE records the line loss for the system is very high. The entire distribution system should be replaced.

Due to limited funding, the proposed distribution replacement has been split into 3 phases. Phase 1 is the cross island feeder from the townsite to the proposed wind farm. Phase 2 is replacement of the residential distribution within the town site area. Phase 3 is the cross island feeder from the proposed wind farm to Zapadni Bay. All new distribution conductors will be installed underground in HDPE ducts. All new transformers will be stainless steel construction.

Prior studies have identified excellent potential for wind generation in St. George with a Class 7 wind regime. A single Windmatic model 17s turbine with a capacity of 95kW is proposed to be installed on a monopole tower. The wind turbine will be located on the north side of Zapadni Bay Road, approximately 1.5 miles from the townsite of St. George in an area locally known as Cross Hill. An electric boiler will be installed in the diesel power plant to provide frequency control and also to utilize excess power when the wind output exceeds the electrical demand. The diesel power plant switchgear will communicate with the wind turbine controller via a buried fiber optic cable and will act as the master controller to coordinate the system for optimum efficiency.

The proposed energy projects schedule calls for design, permitting, and procurement of long lead items to occur in the summer and fall of 2012. Fabrication and testing of the diesel power plant module will be done in the winter of 2012-2013. Mobilization will occur in the summer of 2013 with all currently funded projects completed by the end of 2013.

A summary of the estimated total costs, including all design, supervision, inspection, permitting, and a 15% contingency, are:

- $2,046,000 Diesel Power Plant
- $387,000 Heat Recovery Project
- $1,362,000 Wind Generation
- $1,830,000 Power Distribution Upgrades – Phases 1 & 2
- **$5,625,000 Total Cost Proposed 2013 Energy Projects**
- $795,000 Power Distribution Upgrades – Phase 3
- **$6,420,000 Grand Total Cost All Proposed Energy Projects**

Note that the total cost of the proposed 2013 energy projects exceeds the available funding. It is proposed that all materials be purchased and shipped in on the chartered barges. There should be adequate funds to complete the installation of all of Phase 1 distribution and a significant portion of Phase 2. Additional funding may be required for completion of Phase 2 and will definitely be required for Phase 3.

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1.0 INTRODUCTION

This report has been prepared by Alaska Energy and Engineering, Inc. (AE&E) for the Alaska Energy Authority / Rural Energy Group (AEA/REG). The purpose of this study is to provide a concept design and construction cost estimate for the following potential local energy projects for the community of St. George:

- Diesel power plant replacement
- Heat recovery system
- Power Distribution Upgrades
- Wind generation system

Participants in the project include the City of St. George and the Pribilof Islands School District.

1.1 Program Overview

The Alaska Energy Authority (AEA), Rural Energy Group is pursuing grant funds to upgrade rural bulk fuel tank farms and electric power systems. All project components are dependent on available funding. Following is a brief outline of the program:

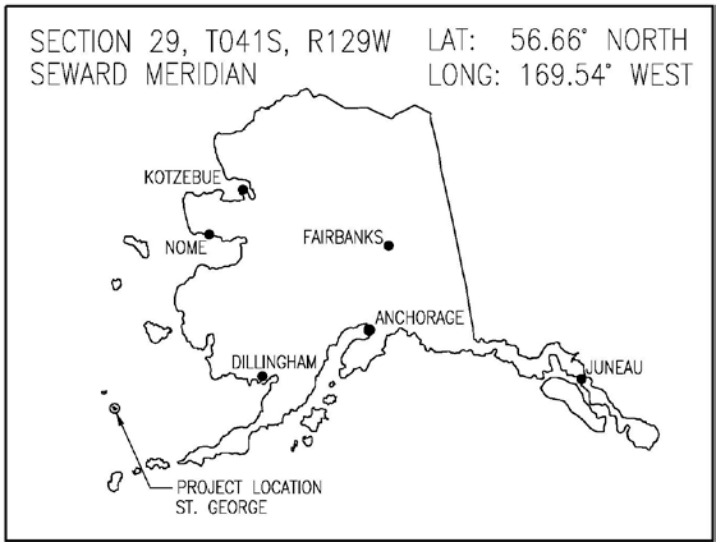
- The funding for the project is a combination of State and Federal grants. In order to receive grant funds, each community must demonstrate that the proposed facility will be sustainable by accepting a business plan. The business plan shall describe who will own the facility, and how it will be operated, maintained and replaced.
- New energy projects are funded, designed, and constructed in three phases: Phase 1, Conceptual Design; Phase 2, Design Completion; and Phase 3, Construction.
- During Phase 1, Conceptual Design, staff from AEA will visit a community, discuss the program, and work with residents and the local government to select sites for the new facilities.
- At the completion of Phase 1 Conceptual Design, the community will be requested to review and approve the location, capacity, and basic configuration of the facilities as well as a business plan.
- During Phase 2, Design Completion, the design for the new energy projects will be completed. An environmental assessment will be prepared and site control documented.
- Each community will be requested to provide “in kind” contributions as available.
- Training Available: AEA has several training programs available for communities.

1.2 Community Description

St. George is located on the northeast shore of St. George Island, the southern-most of the four Pribilof Islands. It lies 47 miles south of St. Paul Island, 750 air miles west of Anchorage, and 250 miles northwest of Unalaska. It lies at approximately 56.60° North Latitude and -169.54° West Longitude. (Sec. 29,

T041S, R129W, Seward Meridian.) The area encompasses 34.8 sq. miles of land and 147.6 sq. miles of water. The climate of St. George is controlled by the cold waters of the Bering Sea. The maritime location results in cool weather year-round and a narrow range of mean temperatures varying from 24 to 52 °F. Average annual precipitation is 23 inches, with 57 inches of snowfall. Cloudy, foggy weather is common during summer months. The population was estimated at 97 residents in 2011. St. George is a second class city located in the Aleutian Islands Recording District, the Pribilof Islands School District and the Aleut Native Corporation. It is not within an organized borough.

LOCATION MAP



1.3 Site Investigation

A site investigation was performed by Tim Sandstrom, Josh Craft, Devany Plentovich, Deborah Vo and Rebecca Garrett of the Alaska Energy Authority/Rural Energy Group (AEA/REG) along with John Dickerson of Alaska Energy & Engineering (AE&E) and Don Henry of Alaska Power and Communications on May 22-23, 2012. The purpose of the site visit was to meet with local residents to discuss the scope of potential energy projects as well as to gather field data on existing energy infrastructure. An unusually late spring and inclement weather conditions delayed the site investigation by several weeks. Even with the delay, snow cover prevented the inspection of a portion of the power distribution equipment in the community. In addition to the data gathered during the site visit, all available information was obtained and analyzed from the following sources:

- St. George Wind Farm Construction 65% Design, Marsh Creek, 2011
- St. George Power Cost Equalization (PCE) Data, 2011
- St. George Airport Electric Power Upgrade Design, Polarconsult, 1996
- Zapadni Bay Road Electrical Relocation Design, Polarconsult, 1996
- State of Alaska, Dept. of Community & Regional Affairs (DCRA)Community Profile & Map
- St. George, various survey plats
- Corps of Engineers wetlands and flood information
- Alaska Dept. of Environmental Conservation Contaminated Site Data Base
- Other relevant data.

Additional information and input was obtained from the following individuals:

- Patrick Pletinkoff, Mayor, City of St. George, 859-2263
- Dennis Lekanof, Public Works Director, City of St. George, 859-2263
- Rodney Lekanof, St. George Tanaq Corporation, 859-2224
- Chris Merculief, St. George Traditional Council, 859-2205
- Sally Merculief, St. George Traditional Council, 859-2205
- Gil Kasheverof, Power Plant Operator
- Crystal Lekanof, City Clerk, 859-2263
- Earl Trumble, Business Manager, Pribilof Islands School District
- Don Henry, Alaska Power & Communication, Lineman
- Rick Elliot, Land Consultant

1.4 Code Analysis & Deficiencies

The following is a summary of existing power plant code analysis and deficiencies observed during the site investigations.

- Poor site drainage at existing power plant building causing seasonal flooding.
- Antiquated / inefficient diesel genset #1 – expensive to maintain and operate.
- Extremely high hours on gensets #2 & #3 – due for replacement soon.
- Manual paralleling switchgear only.
- Exposed interior vinyl-encased fiberglass batt insulation absorbs oil vapors, is difficult to clean and is a potential fire hazard.
- No operational fire suppression system
- Power plant building previously incurred severe fire damage
- Power plant site experienced a fuel spill and is contaminated

The concept design for all energy projects have been prepared to meet current code and regulatory requirements, which include:

- The 2006 Edition of the International Building Code (IBC).
- The 2006 Edition of the International Fire Code (IFC) and currently adopted Alaska State Fire Marshal Fire and Safety Regulations.
- The 2011 Edition of the National Electrical Code (NEC).
- The 2012 Edition of the National Electrical Safety Code (NESC).
- 40 CFR, Part 112.1-12, U.S. Environmental Protection Agency Spill Prevention Requirements

2.0 EXISTING FACILITIES

The existing power plant and electrical distribution system were visually examined to determine suitability for re-use. The following paragraphs summarize findings for the community.

2.1 Power Plant

The St. George power plant was constructed prior to 1970. It is located on the northern edge of town at the intersection of Advance Avenue and Waterfront Street. Previous reports indicate that the power plant and all associated mechanical and electrical systems are in poor condition and past their useable lives.

The existing power plant is located on Lot 4, Tract 43 of the Qawax Subdivision. This site was deemed to be contaminated with petroleum products and was subject to a site environmental cleanup as required by the Alaska Department of Conservation. The site continues to have residual petroleum contamination and

is currently subject to ongoing environmental monitoring. Therefore this site is deemed not suitable for locating a power system upgrade project.

There are two Caterpillar and two Detroit generators currently installed in the power plant. Unit #1 is a Detroit Series 60 with a capacity of 340kW at 1,800RPM. Units #2 and #3 are Caterpillar Model 3406 units with a prime capacity of 175kW at 1,200RPM. Unit #4 is a Detroit Series 60 with a prime capacity of 280kW at 1,200RPM. Total engine hours for each of these units is unknown but all units are over 10 years old. They are all likely beyond their usable lives and probably not suitable for reuse.

2.2 Power Distribution

The electrical distribution system consists of buried primary cable, primary cable sectionalizing cabinets, transformers, and fusible cabinets. All primary distribution cable throughout the community is direct-buried without duct or conduit. Primary conductors are URD, #2 AWG, aluminum, jacketed concentric neutral with cross-linked polyethylene insulation, at 100% or 133% level depending on the age of the cable. This type of cable insulation in a direct-bury application is known to result in a reduced life expectancy for the cable.

For the purposes of this report the distribution system has been broken into three distinct sections: 1) The cross island feeder, town site to wind farm section; 2) The town site residential section and; 3) The cross island feeder, wind farm to Zapadni Bay section. Observations on the system are as follows:

1) *Cross Island Feeder, Town Site to Wind Farm.* This section includes the town site "commercial" district as well as the cross island feeder up to the proposed wind farm site. It is powered by 150kVA step-up transformer PM-26. Service transformers for this section include 480/277 3-phase transformers, 208/120V 3-phase transformers, and single-phase transformers. In addition there are several old abandoned transformers that are no longer in service. There are currently a total of 12 each 3-phase services and two single phase services in this section. The original fused sectionalizing cabinet located at the connection of the cross island feeder to the town site commercial loop is severely rusted and has been disconnected and abandoned. Sectionalizing cabinet SC3, which is also severely rusted, now serves as the connection point for the tie line, as well as a normally open back-up connection for the town site residential loop. Approximately 15,300 feet of direct-buried three-phase cable was installed along Zapadni Bay Road between sectionalizing cabinet SC3 and the wind farm site, located near sectionalizing cabinet SC6. The buried cable lengths in this section range from 4,725 feet to 5,440 feet. Due to limitations on cable reel size, multiple buried splices would have been required to install the cables. Approximately four years ago one phase of the tie-line failed between SC5 and SC6, which are approximately 4,725 feet apart. Since the time of the original cable installation the road has been raised to limit accumulations of windblown snow. As a result, the existing cable is now buried up to 20 feet below road grade, which has ruled out the repair of the cable without major damage to the road. A primary cable was laid on the ground between the sectionalizing

cabinets, with the intent of repairing the faulted line, but it was never connected. Sectionalizing cabinet SC6 was buried in snow at the time of the site visit and could not be inspected. Sectionalizing cabinets SC4 and SC5 are of fiberglass construction and are in serviceable condition.

2) *Town Site Residential.* The town site residential section is powered from 150kVA step-up transformer PM-1. There are twelve each 25 kVA and eight each 15 kVA single-phase transformers with a total of 64 services and 24 street lights. The transformers have carbon steel tanks and enclosures, appear old, and are extremely rusty. There are a total of three primary cable sectionalizing cabinets in this distribution section. Two of the sectionalizing cabinets are of fiberglass construction and are in serviceable condition. The third enclosure is of carbon steel construction and is severely rusted. A vast majority of the service meter bases were in poor condition with moderate to severe rust. Most of the street lights are connected with direct buried romex conductor that is in very poor condition.

3) *Cross Island Feeder, Wind Farm to Zapadni Bay.* This section runs from sectionalizing cabinet SC6 at the proposed wind farm site to the extent of the distribution system at Zapadni Bay. The buried primary cable observed throughout this section appears to be newer and in better condition than that observed within the town site. However, it also consists of cross-linked poly insulation in a direct-buried application, which will yield a reduced life expectancy for the cable. Two buried primary cable lengths, between SC6 & SC7 and between SC7 & SC8, are approximately 5,000 feet and 4,700 feet long respectively, again requiring multiple buried cable splices. A 2005 electrical service upgrade project at the St. George airport included installation of new pad-mount service transformers, new sectionalizing cabinets and new cable-in-conduit service conductors to all existing airport buildings and facility services. These upgrades did not include the replacement of any existing buried 3-phase primary conductors or equipment. At the time of the site visit much of the area between the airport and the harbor was still covered in deep snow, making it impossible to get field data from many of the remaining transformers, sectionalizing cabinets and building services in this area. This distribution section serves the airport, FAA complex, water well area, new fish plant and boat harbor. It includes a total of approximately 17 transformers and 9 sectionalizing cabinets. At least two of the transformers are 3-phase units, including one 75kVA 3-phase transformer at the airport and one 112.5kVA three-phase transformer at the fish plant, both in like new condition. The remaining transformers are likely all single phase pad-mount units in the 15 to 25kVA range and varying from like new to poor condition. An additional site survey after snow melt will be required to verify condition and name plate data on all distribution equipment as well as to verify total feet of installed buried distribution cable in this area. In general, the airport/harbor distribution section appears to be newer and in better overall condition than the other two sections.

2.3 Heat Recovery System

According to previous reports, a rudimentary Heat Recovery system with buried steel arctic pipe heat loops to the City shop and Publics Works building was installed over 10 years ago. It appears that the system was never fully operational. None of this equipment or piping was observed during the site visit.

3.0 COMMUNITY POWER DEMAND

Power consumption data for eight months of 2011 was obtained from power recorders installed and operated by Marsh Creek Energy Systems. The missing four months were estimated by comparing the St. George load profile for known months with other similar communities and interpolating the missing data. Graphs showing actual and estimated data are included in Appendix D. Based on this data it is estimated that annual power generation in 2011 was approximately 886,000kWH. No data is available for annual power generation fuel consumption but it is estimated to be approximately 64,000 gallons assuming a power generation efficiency of around 14 kWh/gal (Detroit Diesel Series 60 engine). According to the available power recorder load data the peak demand in 2011 was 160 kW on January 24. The recorded minimum load was 43 kW on August 15.

3.1 Estimated Future Load Growth

It is important to evaluate the impact of planned infrastructure improvement projects on an existing power generation system. New construction and other community improvements can adversely impact the adequacy of existing facilities.

Due to a lack of long-term load data, it is difficult to address the current power use trends in St. George. The population has declined from 152 in 2000 to approximately 97 in 2011 so it is likely that annual residential power consumption is also trending down. A new fish processing plant was recently completed but is not currently in use. The plant has the potential to increase peak demand by as much as 100 kW if utilized in the future. A new deep-water harbor is currently being designed. If constructed, it would allow larger fishing vessels to deliver product and possibly home port in St. George. This also has the potential to increase peak demand by an additional estimated 100kW. If both projects are developed the community could reach peak loads of 350 kW to 400 kW. Without these projects the loads are not expected to exceed 200 kW.

3.2 Alternative Energy – Heat Recovery

St. George is considered a good candidate for a Heat Recovery project due to the near proximity of several suitable public buildings to the proposed new power plant site. There is also potential to include a dispatchable electric boiler with wind turbine frequency control capability in the district heating loop. This boiler will allow excess wind power generation (above community demand) to displace diesel fuel for building space heat. Analysis of a potential energy recovery/district heating project is included in Appendix E. The proposed system is described Section 4.2.

3.3 Alternative Energy – Wind Generation

The Alaska Energy Authority/Alaska Industrial Development and Export Authority published a draft Rural Alaska Energy Plan dated December 31, 2002 as a follow-up report to the previously released Screening Report of Alaska Rural Energy Plan dated April 2001. The Screening Report evaluated a dozen alternative energy technologies other than diesel engine heat recovery. Only wind energy was identified as alternative energy technology warranting further evaluation in the draft Rural Alaska Energy Plan. Previous U.S. Department of Energy (USDOE) funded wind studies have determined that St. George lies within an excellent Class 7 wind regime, having an annual average long term wind speed of approximately 20 mph. In 2011 Marsh Creek Energy Service prepared a 65% design for the St. George Wind Farm. This design verified the potential resource and identified a site. Due to the proven wind potential and active community involvement, the community of St. George appears to be a good candidate for wind generation development. The Alaska Energy Authority has prepared a model and made recommendations for a system configuration which is included in Appendix F. The proposed system is described Section 4.4.

3.4 Alternative Energy - Efficiency Improvements

Careful sizing and selection of new generators with advanced technology in conjunction with the installation of new fully automatic paralleling switchgear and a continuous off-line engine preheat system will maximize the fuel efficiency of the new diesel power plant.

With the exception of the previously mentioned systems, there are no other known practical alternative energy sources currently available at St. George. At this time it appears that supplemental wind generation, heat recovery, and possibly additional end-use conservation are the only viable fuel-saving technologies available for St. George.

4.0 PROPOSED ENERGY INFRASTRUCTURE PROJECT DESCRIPTIONS

The following proposed facility descriptions are separated into four sections:

- Section 4.1, "Diesel Power Plant Replacement" describes the proposed construction of a new modular diesel power plant including new generation equipment, switchgear, controls, and fuel storage.
- Section 4.2, "Diesel Generation Heat Recovery System", describes a potential Heat Recovery project serving the school and other community buildings in the vicinity of the new diesel power plant.
- Section 4.3, "Distribution System Repair/Replacement", describes proposed upgrades and repairs to the existing power distribution system.
- Section 4.4, "Wind Generation", describes the proposed installation of a 95 kW wind turbine generator and grid integration system. It also describes a potential excess wind energy recovery system.

4.1 Diesel Power Plant Replacement

The City of St. George diesel power plant is the sole source of power generation for the community and it will continue to provide prime power even if wind or

other alternative energy projects are developed. Due to the age and condition of the existing facility, including building, generators and equipment, the power plant is in need of complete replacement. Keeping the existing plant on-line during installation of the new power plant will provide power to the community during construction and will eliminate the project cost of providing temporary power. Locating the new power plant in the same general vicinity as the old plant will simplify the new distribution feeder connections and maintain close proximity to the public buildings deemed suitable for heat recovery.

The proposed location for the new modular power plant is directly across Advance Avenue to the east of the old power plant building as shown on drawing M1.2 in Appendix A. The structure will be a prefabricated 15'-6" by 46' insulated steel module with a field installed roof system. The module will have a generation room which will contain four generators and associated mechanical equipment and a control room which will contain programmable automatic paralleling switchgear and SCADA equipment. Other features of the new plant include a fire suppression system, critical grade exhaust silencers, heat recovery, used oil blending, heat recovery, and wind power integration controls. All systems will be operationally complete and shop-tested in Anchorage prior to shipment. The modular power plant layout is shown on drawings M3.1 and M3.2 in Appendix A.

4.1.1 Generator Selection

Proper sizing and selection of the diesel generators is critical to meet the community electric loads while minimizing fuel consumption. However, the proposed large vessel harbor and fish processing plant projects could effectively double the current community peak loads from under 200kW to approximately 400kW if both projects are fully developed. In order to efficiently meet the existing electric demands and to optimize the integration of wind power, the new diesel power plant will be initially equipped with four identical John Deere model 6090AFM70 Tier 2 marine diesel generators. The engines are rated 210kW prime power electrical and have the highest fuel efficiency of any model in their class. In addition, the marine configuration provides approximately twice the potential jacket water heat available for recovery over conventional engines. If the future demand increases due to previously mentioned projects, the module has been designed to allow for replacement of two original 210kW generators with two new Scania model DI13075M Tier 2 marine diesel generators rated 400kW prime power electrical.

4.1.2 Switchgear & SCADA

The new switchgear will have a total of 7 sections - one for each diesel generator; one for master control and metering; and one for each of the two distribution feeder breakers, which will also house the radiator variable frequency drive controllers, the station service breaker, and the electric boiler breaker. The switchgear will be fully automatic with paralleling capability and will utilize a programmable logic controller (PLC) to automatically match the running generator(s) to the community load, including monitoring the wind generation.

The new switchgear will include a SCADA system for remote generation and distribution monitoring. A desktop PC will be provided in the new plant control room to allow operator access and control of the different systems. A fiber optic data communication cable from the remote wind turbine will allow monitoring and control of the remote wind turbine.

The new switchgear will provide automatic paralleling and load control of the four generating units. The load control system will monitor the electrical demand on the generators along with wind generation output and automatically select the number of generating units required to meet the demand. The switchgear will automatically start the most suitable engine, bring it up to speed, automatically synchronize the unit, and close the engine circuit breaker. When a unit is taken off line, either for maintenance or due to a reduction in electric load, the switchgear will automatically remove the unit from the bus and allow the engine to cool down before shutdown. Generator controls and relaying will provide complete protection and monitoring of each engine- generator and the feeders.

4.1.3 Power Plant Fuel System

ESTIMATED ST. GEORGE POWER MONTHLY FUEL CONSUMPTION

Average Daily Use for Peak Month in Gallons (1)	200
Peak Monthly Use in Gallons	6,200

(1) Average 116kW load for January 2011 at 14kWhr/gallon assumed efficiency.

A 6,000 gallon double wall intermediate tank will be located adjacent to the module. The tank will be in compliance with EPA requirements for redundant overfill protection for alternative secondary containment systems. It will also be equipped with a fill limiter, clock gauge, gauge hatch, pressure/vacuum whistle vent, and emergency venting. A welded steel day tank supply pipeline will include a flanged 1" actuated ball valve located at the tank connection for automatic isolation of the tank and pipeline between day tank fill cycles. The intermediate tank will be top filled and equipped with a ground-level quick connect and spill catch basin. The tank will be truck filled from the tank farm, typically once per week. The EPA requires surface flow containment around a fuel truck during fuel transfers to a regulated facility in order to prevent fuel spills from entering navigable waters. Surface flow containment requirements for the power plant tank will be met by appropriate grading of the truck staging area. The power plant site is shown on drawing M1.2 in Appendix A.

A new automatic fill 160 gallon fuel oil day tank will be installed inside the module. It will be equipped with a gear pump, redundant overfill protection and alarm systems, a hand priming pump, and a totalizing meter. The plant will also be equipped with a used oil blending system. Used engine oil will be pumped into a hopper during oil changes. Each time the day tank fills the system will filter and blend used oil with diesel fuel a ratio of 0.5% of used oil to diesel fuel.

All fuel and oil piping will be schedule 80 steel with welded or threaded joints. Each isolated section of piping will be provided with pressure relieving devices to account for thermal expansion of product caused by temperature fluctuations.

Provisions for movement of the piping caused by thermal expansion and contraction will be included. All valves will be steel body industrial grade valves intended for use with fuels.

4.2 Diesel Generation Heat Recovery

An analysis of available diesel heat recovery was conducted. The results are included in Appendix E. The proposed diesel heat recovery project consists of the following components:

- Heat recovery supply and return buried steel arctic pipe (approximately 1000 feet of 2-1/2" diameter piping and 800 feet of 2" diameter piping) between the module and connected buildings.
- Heating connections at the school, public safety building, old power plant, public works building, and the new Tanaq Corporation shop building. These four existing and one future facilities are estimated to use 15,000 gallons of diesel annually for space and water heating.
- Heat exchanger, pumps and associated equipment in module.
- Recovered heat BTU meter in module and at the school.
- Individual heat exchangers or unit heaters with associated equipment in each of the four identified facilities.
- Alarms for loss of flow, loss of pressure, and no load/backfeed condition with annunciation in the module switchgear.

An overall area site plan showing the proposed heat recovery pipeline routing is shown on drawing M1.2 in Appendix A.

Based on the analysis in Appendix E, it appears that the proposed heat recovery system can displace virtually all of the diesel fuel for heating the connected buildings.

4.3 Distribution System Repair/Replacement

Some new service equipment has recently been installed in the Zapadni Bay area, including at the airport, fish processing plant and well field. With the exception of these new services, the entire electrical distribution system on St. George Island will be replaced. Following are major features of the proposed distribution system upgrades:

- The new distribution system will be constructed in accordance with Rural Utility Service Bulletin 1728F-806, Specifications and Drawings for Underground Electric Distribution.
- The power plant step-up transformers and the distribution step down transformers will be replaced. All new equipment will be dead front.
- All new transformers will be provided with stainless steel enclosures and all new junction boxes will be of fiberglass construction. Any existing sectionalizing cabinets in the system that have carbon steel enclosures will be removed and replaced with a fiberglass enclosure. In a marine environment, standard metal enclosures for pad-mounted transformers and

sectionalizing cabinets cannot stand up to the salt laden air. The stainless steel and fiberglass enclosures will provide long term maintenance free service.

- All transformers and sectionalizing cabinets will be provided with a fiberglass ground sleeve for support of the equipment.
- All new primary and secondary cable will be installed in 2" HDPE conduit. This will better protect the conductors from damage and allow easy future replacement of the cable in the case of a failure.
- All new primary cable will be Polyethylene jacketed concentric neutral with ethylene propylene (EPR) insulation, 133% MV105, and all primary terminations will be through load break elbows. All connections will be above grade in sectionalizing cabinets. No buried or below grade connections will be made. No in-line splices will be made in the cables.
- All cable connections will be located above grade in sectionalizing cabinets which will be located no farther than 2500 feet apart to prevent underground splices. This will provide access to the distribution cable for future load connections and increase the reliability of the distribution system. All primary cable connections will be made using 200 amp load break elbows.
- All load break elbows and other connectors will be provided with seals and covers to provide a long lasting and reliable distribution system.
- All secondary connections will be provided with compression connectors with boots at the transformer.

Due to budget limitations the distribution upgrades have been split into 3 distinct phases based on priority. Following is a description of the phases:

- **Phase 1 – Cross Island Feeder, Town Site to Wind Farm.** This phase will include replacement of the feeder from the new diesel power plant to the proposed wind farm site. It is required to be completed first in order to repair the existing buried cable fault between existing sectionalizing cabinets SC5 and SC6. It will provide a reliable connection for the wind generator and allow installation of a fiber optic communication line between the diesel plant and the wind turbine. This will also include replacement of all primary and secondary conductors, transformers, sectionalizing cabinets, and meter bases in the "commercial" section of the town site area distribution.
- **Phase 2 – Town Site Area Residential Replacement.** This will include replacement of all primary and secondary conductors, transformers, sectionalizing cabinets, street light connections and meter bases in the town site residential section.
- **Phase 3 – Cross Island Feeder, Wind Farm to Zapadni Bay.** This will include replacement of the remainder of the cross island tie line from the proposed wind farm site to the extent of the distribution system at Zapadni

Bay. This work will also include replacement of all secondary conductors, transformers, sectionalizing cabinets, and meter bases within this section, with the exception of the recently updated secondary services at the airport, well field and fish plant.

4.4 Wind Generation

The Alaska Energy Authority Alternative Energy staff performed modeling for the wind system, reviewed prior studies, and compared options. The results of their investigation are included in Appendix F. Following is a summary description of the wind generation project:

- St. George has a Class 7 (excellent) wind regime and is a good candidate for a wind generation project.

- A single Windmatic model 17s turbine with a capacity of 95kW is recommended. The modeling indicates that this turbine could have a capacity factor as high as 38%.

- The turbine will be installed on a monopole tower. Prior geotechnical investigations indicate the presence of relatively shallow bedrock at the wind generation site making pile type foundations difficult; therefore, a reinforced concrete gravity mat foundation will be used.

- An electric boiler will be installed in the diesel power plant. The boiler will be used to provide frequency control and also as a secondary dump load when the wind output exceeds the electrical demand. The boiler will be connected to the diesel heat recovery system so that excess electric power can be used to heat buildings.

- The diesel power plant switchgear will communicate with the wind turbine controller via a buried fiber optic cable. The diesel switchgear will act as the master controller to coordinate the system for optimum efficiency. The proposed system will always require diesel generation to maintain frequency. The controls will be designed to make use of the maximum wind power available to offset diesel generation. Excess wind power will be used for heat.

- Based on the modeling, the proposed wind turbine is estimated to have a gross production of 300,000 kWh per year. It is estimated that 240,000 kWh per year will go directly to offset diesel power generation which will reduce diesel fuel consumption at the power plant by approximately 18,000 gallons per year. In addition, the wind turbine is estimated to produce excess power that can be used for building heat equivalent to approximately 1,400 gallons per year.

5.0 SITE SELECTION & CONTROL

Work for this project will be performed in four general areas as described in the following sections: (5.1) the “Power Plant Site”; (5.2) the “Heat Recovery System Areas”; (5.3) the “Power Distribution System Upgrade Areas”; and (5.4) the "Wind Farm Site". There are no known flood hazards at any of these locations.

5.1 Power Plant Site

The proposed new power plant site was selected by the community and is within a portion of Lots 12 and 13, Tract 43 Qawax Subdivision. The new power plant will be located on an existing gravel pad south of the existing City public safety building.

5.2 Heat Recovery System Areas

The proposed Heat Recovery pipeline mains are routed across Lots 12 & 13, Tract 43 of Qawax Subdivision, Lots 1 & 2, Tract 41 of Qawax Subdivision, an unsubdivided portion of Tract 41 and the Advance Avenue ROW. Work will also be performed inside City and School District buildings located on these lots.

5.3 Power Distribution System Upgrade Areas

All power distribution upgrades will occur along existing easements and road ROW’s.

5.4 Wind Farm Site

The proposed wind farm site is located on the north side of Zapadni Bay Road, approximately 1.5 miles from the townsite of St. George in an area locally known as Cross Hill. The location is shown on drawing M1.1 in Appendix A. The site was identified as part of the 65% design for the wind farm.

5.5 Site Control

A sight control opinion letter was written on February 27, 2012. A copy of the letter is included in Appendix C.

The proposed new power plant site is vested in the City of St. George.

The proposed heat recovery system areas are vested in the City of St. George and the Pribilof Islands School District.

The proposed power distribution system upgrade areas are vested predominantly in the City of St. George, the Alaska Department of Transportation and the St. George Tanaq Corporation.

The proposed wind farm site is vested in the St. George Tanaq Corporation. A lease agreement between the St. George Tanaq Corporation and the City of St. George has been drafted for a two acre plot at this site. To date the lease has not been implemented.

6.0 PERMITTING

The proposed projects are subject to regulations of State and Federal agencies including the Alaska Department of Environmental Conservation (ADEC), the Division of Fire Prevention, Federal Aviation Administration, U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency.

6.1 Environmental Assessment

An Environmental Assessment (EA) will be completed prior to construction of the proposed projects. An EA is required for all projects that are federally funded or require a federal permit (such as a Corps of Engineers Wetlands Permit). The EA determines whether there is a significant impact to the environment caused by the project. As part of the EA, a Coastal Project Questionnaire will be completed to identify state or federal permits that may be required.

6.2 Fire Code

A Plan Review permit from the State Fire Marshal is required for the proposed diesel generation project. Final stamped design drawings will be submitted to the Fire Marshal for review prior to construction. Plans will be reviewed for conformance with the International Fire Code and related codes including the International Building Code and the National Electrical Code. The review process typically takes 3 to 6 weeks.

6.3 Spill Response

The power plant will have oil storage tanks in excess of 1,320 gallons and will be subject to U.S. Environmental Protection Agency regulations. A Spill Prevention Control and Countermeasures (SPCC) plan will be prepared as part of this project.

6.4 Air Quality Permit

The existing St. George power plant consumes less than 100,000-gallons of diesel fuel annually; therefore, it can be permitted under the DEC General Permitting (GPA) regulations.

6.5 Wind Farm Project Permitting

The wind farm portion of this project requires approval by the Federal Aviation Administration (FAA) and review by the U.S. Fish and Wildlife Service (USFW). An FAA Aeronautical Study (No. 2008-WTW-5725-OE) was completed that authorizes construction of a single wind turbine up to 150 feet above ground level. The Aeronautical Study approval expires on January 10, 2013. A request for extension and an Actual Construction Notice, Form 7460-2, will be submitted to the FAA prior to expiration. The Alaska State Historic Preservation Officer (SHPO) and the USFW were consulted on the wind farm project. The SHPO issued a finding of No Historic Properties Affected for the project. The USFW concurred that the project is Not Likely to Adversely Affect listed Steller's and spectacled eiders. Further consultation with the agencies will be conducted to ensure the project complies with state and federal requirements.

7.0 CONSTRUCTION PLAN

The AEA/REG has a history of administering similar projects on a "modified" force-account basis. Force-account construction involves the owner or grantee acting as the employer and utilizing primarily local labor. This method tends to achieve a higher percentage of local hire and is strongly supported by many communities and funding agencies. The highly technical nature of power generation and distribution projects requires a limited number of workers with specific experience and expertise to be brought in for the project when not available locally. All work must be supervised and managed by a superintendent with extensive experience in the construction of rural power generation and distribution systems. All specialty work, such as pipe welding and electrical installation must be performed by skilled craftsmen with appropriate certifications.

Shipping project construction materials and equipment into St. George will need to be by shallow draft landing craft due to the lack of draft in the existing small boat harbor. The most likely scenario will be to stage materials in Anchorage, Homer, or Seward and charter a suitable vessel to haul directly to St. George.

7.1 Local Job Skills

An inquiry was made to the City for information regarding the availability of specialty skilled labor in St. George. The following table summarizes the results:

Skilled Trades	Number Available
Certified Welder	0
Welder Helper	1
Journeyman Electrician	0
Heavy Equipment Operator	10
Mechanic/Helper	0
Certified Truck Drivers	12

In addition to the specialty trades listed, there are a number of local residents with general labor experience in various types of construction. It appears that at a minimum a project superintendent, a pipe welder/mechanical foreman, a journeyman electrician and a journeyman lineman will need to be brought into St. George for this project. A crew with specialty experience will be required for installation of the wind turbine.

7.2 Local Equipment

The City provided the following inventory of locally available heavy equipment:

Unit / Owner	Make / Model #	Year / Condition
14 Yard Dump Truck #1/City	Mac	Unknown
14 Yard Dump Truck #2/City	Mac	Unknown
D-5 Dozer/City	Caterpillar	Unknown

Loader #1/City	John Deere 624	Unknown
Loader #2/City	Volvo	Unknown
Excavator/City	Hitachi UH-07-LC	Unknown

The equipment is in unknown condition. If any of the local equipment is to be used for the project, an experienced fleet service mechanic should be sent to St. George to inspect the equipment and ensure that it is in proper operating condition prior to beginning construction. A smaller excavator will be required for the distribution upgrade work. Due to the high cost of barging equipment in and out of St. George, a used excavator should be purchased, shipped in with the project materials, and left in St. George.

7.3 Material Sources

Gravel will be required for pad development and finish grading at the proposed diesel power plant and wind farm sites. Screened gravel or sand will be required for bedding heat recovery arctic pipe and electric distribution conduit. The City has a beach source for both sand and gravel that should be adequate for all grading work as well as bedding but is too soft to be used for concrete. The City also has a rock quarry/borrow site that has been used to produce crushed rock in the past. There is no crusher on site and all previously crushed material has been used up. It appears that aggregate for concrete will need to be imported.

8.0 SCHEDULE

The following schedule has been developed on the basis of performing the majority of the field work in 2013. This schedule is contingent on approval of the plan by the project participants as well as on funding availability.

- Jul - Nov 2012: Design, permitting, and site control.
- Aug - Nov 2012: Fabrication of module structure and procure materials.
- Oct - Nov 2012: Procure wind generation and distribution materials.
- Dec 2012 - Apr 2013: Module equipment installation.
- Apr 2012: Package and stage wind generation and distribution materials.
- May 2013: Test module, package, and stage for shipment.
- May 2013: Mobilize distribution materials, concrete, and wind turbine.
- Jun - Jul 2013: Install foundations and wind turbine, start distribution.
- Jul 2013: Mobilize module, fuel tank, and arctic pipe; demobilize crane.
- Aug - Sep 2013: Install power plant and heat recovery.
- Oct 2013: Power plant commissioning & operator training.
- Aug - Nov 2013: Complete distribution (depending upon scope of work).
- Dec 2013: O&M manuals and project close out.

9.0 COST ESTIMATE

The construction cost estimates have been developed based on a "modified" force-account approach utilizing a combination of local labor, certified craftsmen, and specialty sub-contractors under the direction of an experienced construction manager. Labor rates are based on Title 36 equivalent wages for certified specialty labor and prevailing local force-account wage rates for general labor and equipment operation.

Detailed cost estimates are included in Appendix B. Separate estimates have been prepared for the Diesel Power Plant, Heat Recovery System, Distribution Upgrades (3 separate phases), and Wind Generation. A summary of the estimated total costs, including all design, supervision, inspection, permitting, and a 15% contingency, are:

- $2,046,000 Diesel Power Plant
- $387,000 Heat Recovery Project
- $1,362,000 Wind Generation
- $1,830,000 Power Distribution Upgrades – Phases 1 & 2
- **$5,625,000 Total Cost Proposed 2013 Energy Projects**
- $795,000 Power Distribution Upgrades – Phase 3
- **$6,420,000 Grand Total Cost All Proposed Energy Projects**

Note that the total cost of the proposed 2013 energy projects exceeds the available funding. It is proposed that all materials be purchased and shipped in on the chartered barges. There should be adequate funds to complete the installation of all of Phase 1 distribution and a significant portion of Phase 2. Additional funding may be required for completion of Phase 2 and will definitely be required for Phase 3.

APPENDIX A

CONCEPT DESIGN DRAWINGS

1 M1.1 ST. GEORGE ISLAND PLAN
SCALE AS INDICATED

LEGEND

- BUTTERFLY VALVE
- GATE VALVE
- BALL VALVE
- CHECK VALVE
- HOSE END DRAIN VALVE
- GAUGE COCK
- AUTOMATIC AIR VENT
- THERMOMETER
- PRESSURE GAUGE
- TEMPERATURE SENSOR
- PRESSURE SENSOR
- FLEXIBLE CONNECTOR
- FLANGED JOINT
- UNION
- ELBOW TURNED UP
- ELBOW TURNED DOWN
- PIPING CONNECTION (TEE)
- CHANGE OF PIPE SIZE
- DIRECTION OF FLOW

ABBREVIATIONS

ø	DIAMETER (PHASE)
A	AMPS
AFF	ABOVE FINISHED FLOOR
BTU	BRITISH THERMAL UNIT
DFR	DIESEL FUEL RETURN
DFS	DIESEL FUEL SUPPLY
EWT	ENTERING WATER TEMPERATURE
EXIST	EXISTING
ECR	ENGINE COOLANT RETURN
ECS	ENGINE COOLANT SUPPLY
FPT	FEMALE PIPE THREAD
GA	GAUGE
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
GRC	GALVANIZED RIGID CONDUIT
HP	HORSEPOWER
HRR	HEAT RECOVERY RETURN
HRS	HEAT RECOVERY SUPPLY
ID	INSIDE DIAMETER
KW	KILOWATT
LT	LIQUID TIGHT
LWT	LEAVING WATER TEMPERATURE
MAX	MAXIMUM
MBH	THOUSAND BTU PER HOUR
MIN	MINIMUM
MPT	MALE PIPE THREAD
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OC	ON CENTER
OD	OUTSIDE DIAMETER
PRV	PRESSURE RELIEF VALVE
PSI	POUNDS/PER SQUARE INCH
PSIG	POUNDS/PER SQ INCH GAUGE
SCH	SCHEDULE
TDH	TOTAL DEVELOPED HEAD
TYP	TYPICAL
UOR	USED OIL RETURN
V	VOLTS
W	WATTS
WG	WATER GAUGE
WPD	WATER PRESSURE DROP

SCHEDULE OF DRAWINGS:

M1.1 ST. GEORGE ISLAND PLAN, LEGEND, & SCHEDULE OF DRAWINGS

M1.2 POWER PLANT & HEAT RECOVERY SITE PLAN & DETAILS

M3.1 EQUIPMENT LAYOUT PLAN, SECTION, & DETAILS

M3.2 WALL ELEVATIONS & DETAILS

CONCEPT
DESIGN
NOT FOR
CONSTRUCTION

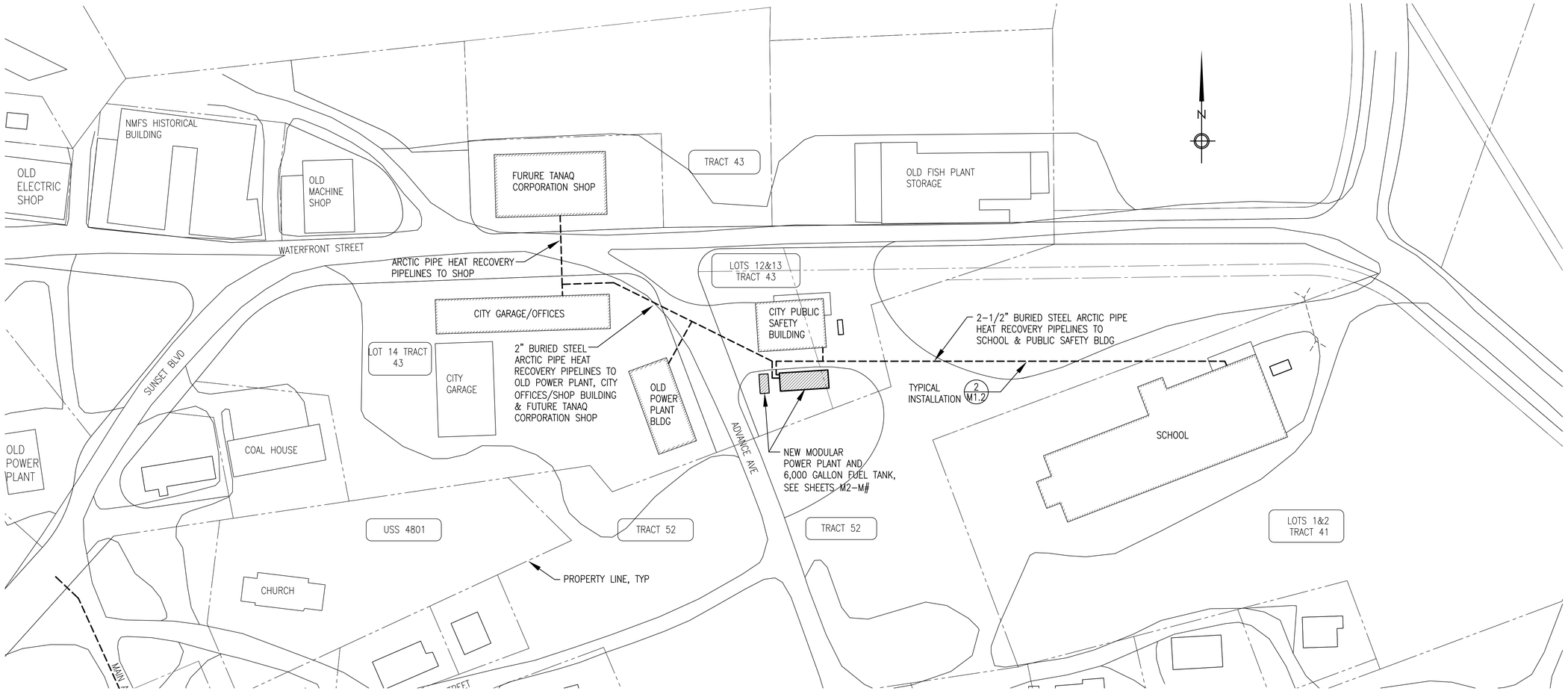
State of Alaska
Department of Community and Economic Development
AIDEA/AEA
Rural Energy Group
813 West Northern Lights Blvd.
Anchorage, Alaska 99503
ALASKA ENERGY AUTHORITY

PROJECT: ST. GEORGE POWER SYSTEM UPGRADE

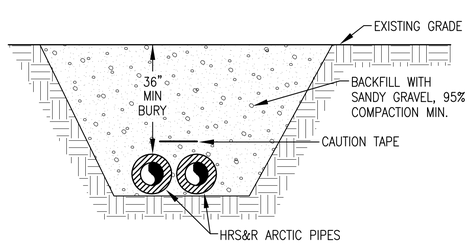
TITLE: ST. GEORGE ISLAND PLAN, LEGEND, & SCHEDULE OF DRAWINGS

ALASKA ENERGY AND ENGINEERING, INC
P.O. BOX 111405 ANCHORAGE, ALASKA 99511-1405 PHONE (907) 349-0100

DRAWN BY: BCG	SCALE: AS NOTED	FILE NAME: STGEORGE M1	SHEET: M1.1 OF 4
DESIGNED BY: BCG	DATE: 6/18/12	PROJECT NUMBER:	



1 M1.2 POWER PLANT & HEAT RECOVERY SITE PLAN
1"=60'



2 M1.2 TYPICAL BURIED ARCTIC PIPE INSTALLATION
NO SCALE

CONCEPT DESIGN NOT FOR CONSTRUCTION

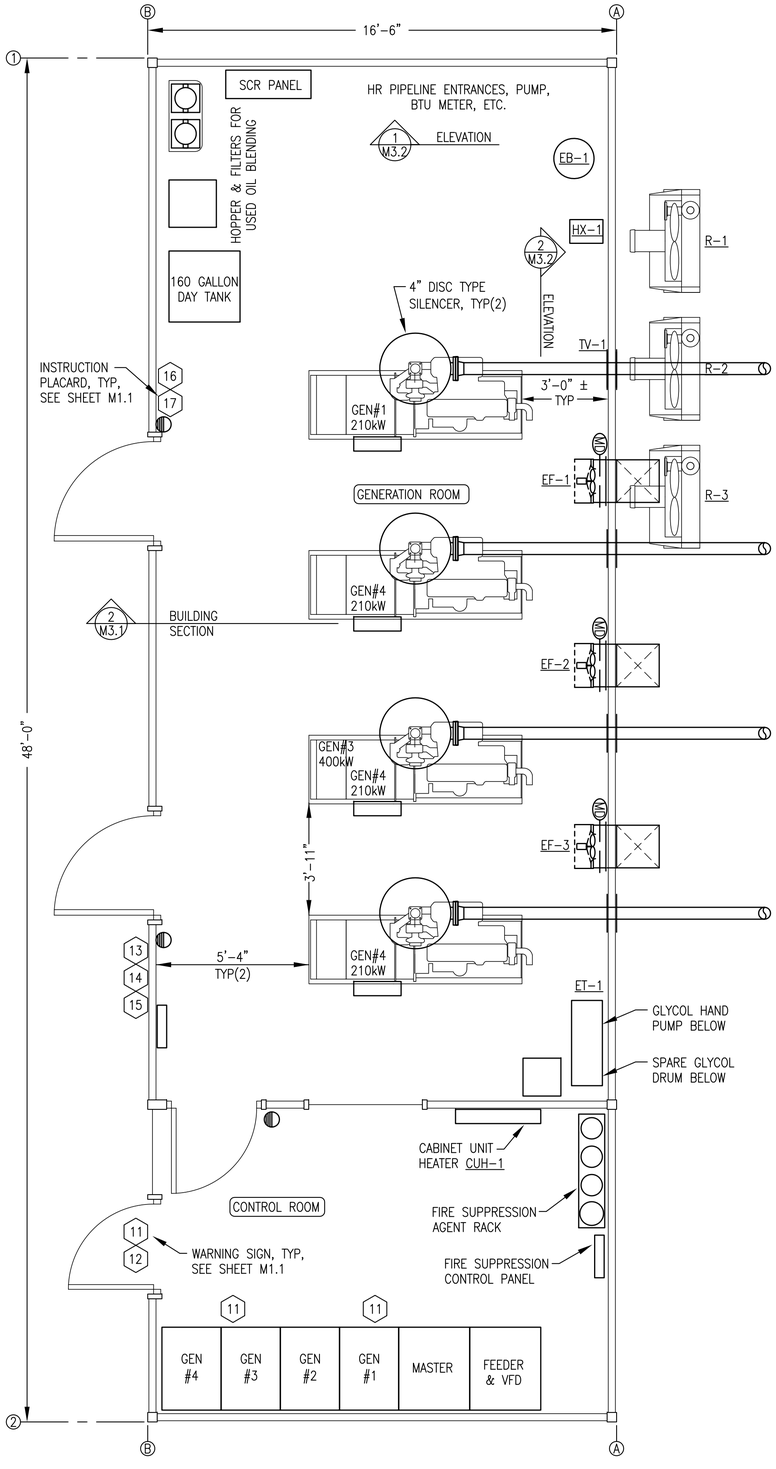
State of Alaska
Department of Community and Economic Development
AIDEA/AEA
Rural Energy Group
813 West Northern Lights Blvd.
Anchorage, Alaska 99503
ALASKA ENERGY AUTHORITY

PROJECT: ST. GEORGE POWER SYSTEM UPGRADE

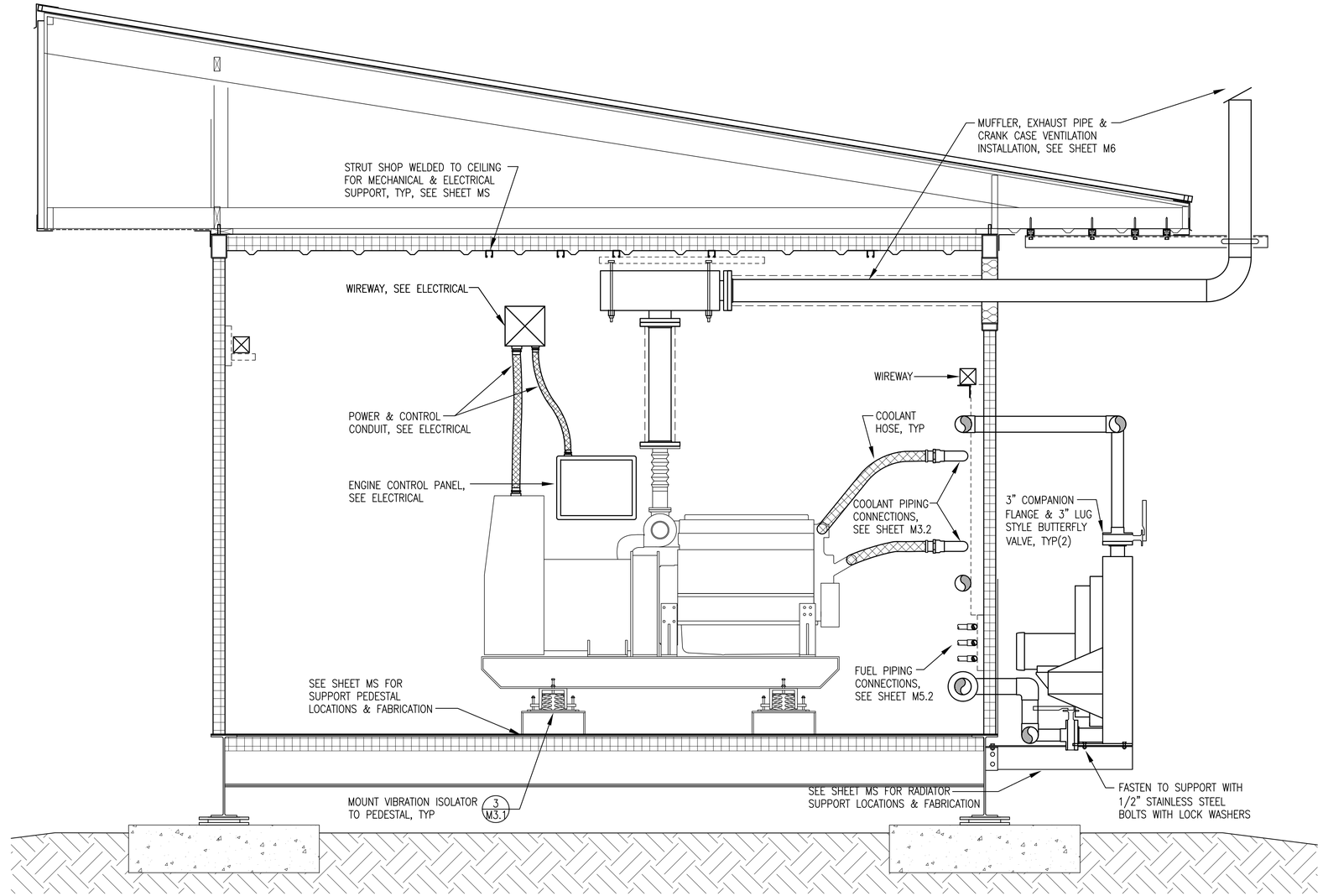
TITLE: POWER PLANT & HEAT RECOVERY SITE PLAN & DETAILS

ALASKA ENERGY AND ENGINEERING, INC
P.O. BOX 111405 ANCHORAGE, ALASKA 99511-1405 PHONE (907) 349-0100

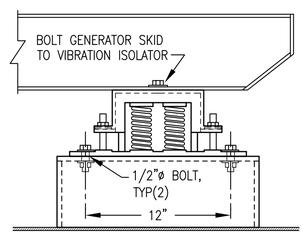
DRAWN BY: BCG	SCALE: AS NOTED	FILE NAME: STGEORGE M1	SHEET: M1.2 OF 4
DESIGNED BY: BCG	DATE: 6/18/12	PROJECT NUMBER:	



1 M3.1 EQUIPMENT LAYOUT PLAN
3/8"=1'-0"



2 M3.1 BUILDING SECTION/GENERATOR INSTALLATION
3/4"=1'-0"



NOTE: VIBRATION ISOLATORS FURNISHED WITH GENERATORS. VERIFY GENERATOR SKID & VIBRATION ISOLATOR BOLTING DIMENSIONS PRIOR TO DRILLING PEDESTALS.

3 M3.1 VIBRATION ISOLATOR INSTALLATION
1"=6"

CONCEPT DESIGN NOT FOR CONSTRUCTION

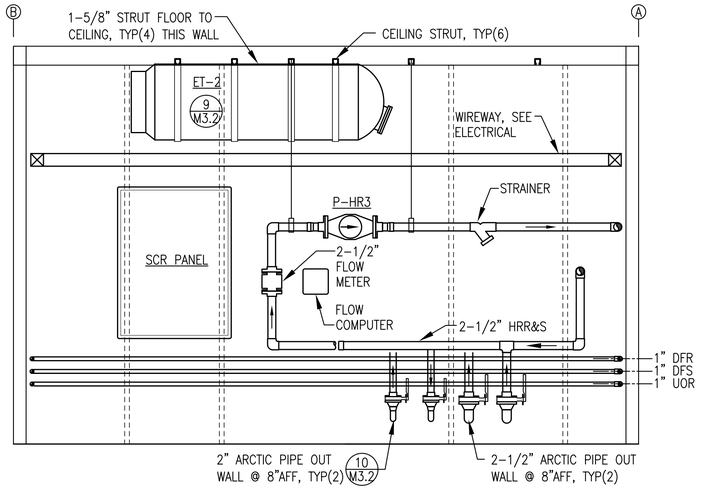
State of Alaska
Department of Community and Economic Development
AIDEA/AEA
Rural Energy Group
813 West Northern Lights Blvd.
Anchorage, Alaska 99503
ALASKA ENERGY AUTHORITY

PROJECT: ST. GEORGE POWER SYSTEM UPGRADE

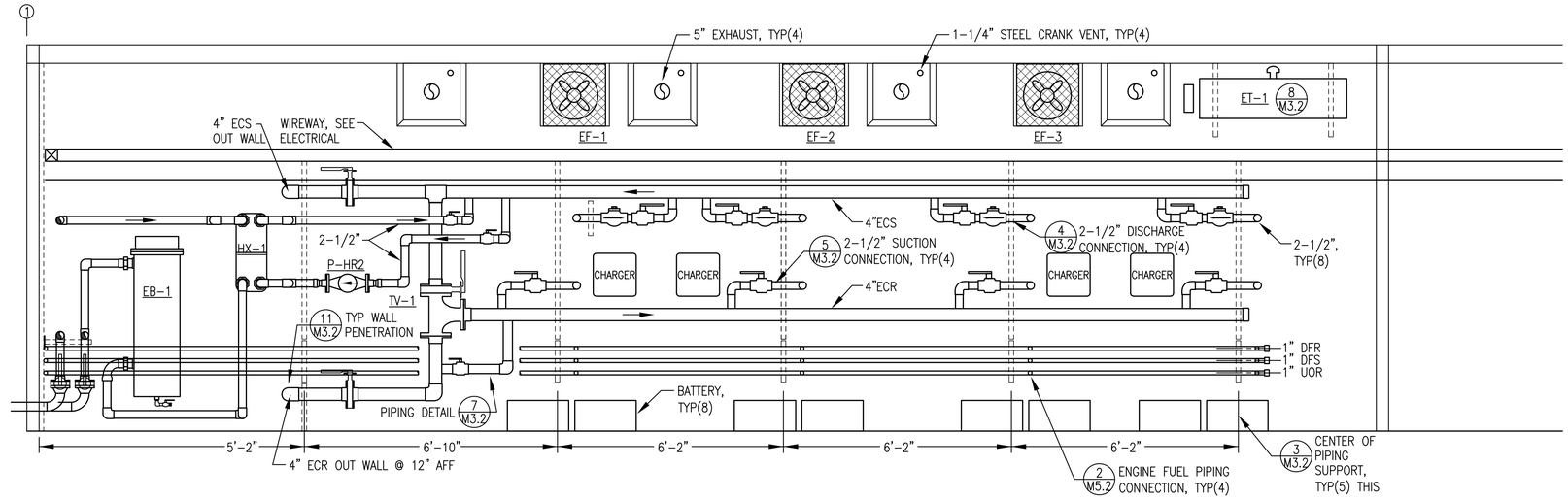
TITLE: EQUIPMENT LAYOUT PLAN, SECTION, & DETAILS

ALASKA ENERGY AND ENGINEERING, INC
P.O. BOX 111405 ANCHORAGE, ALASKA 99511-1405 PHONE (907) 349-0100

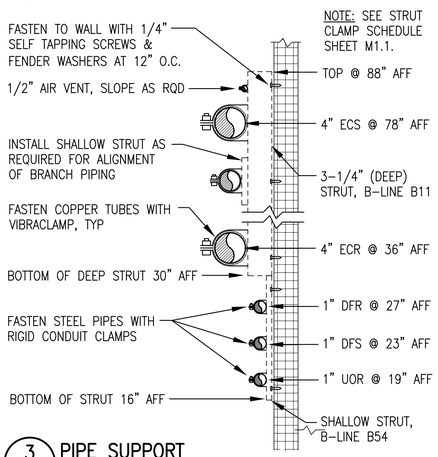
DRAWN BY: JTD/BCG	SCALE: AS NOTED	FILE NAME: STGEORG M2-M7	SHEET: M3.1 OF 4
DESIGNED BY: BCG	DATE: 6/18/12	PROJECT NUMBER:	



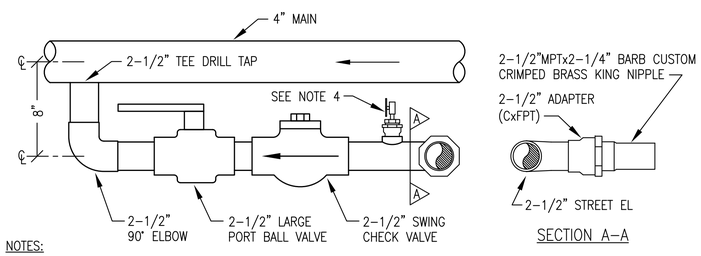
1 M3.2 END WALL ELEVATION
1/2"=1'-0"



2 M3.2 BACK WALL ELEVATION
1/2"=1'-0"



3 M3.2 PIPE SUPPORT
NO SCALE



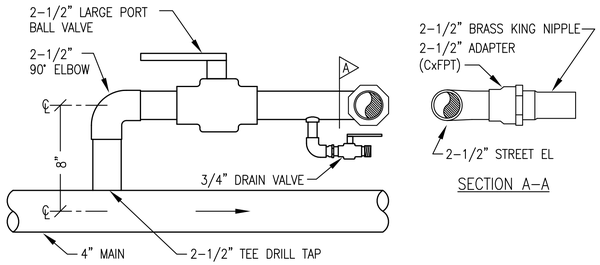
NOTES:

1) MAIN PIPING 4" WITH 1" INSULATION. ALL BRANCH PIPING NOT INSULATED.

2) ALL PIPING TYPE L COPPER TUBE. ALL LINE SIZE VALVES SOLDER END.

3) 3/4" FITTING ADAPTER (FTGxFPT) IN 3/4" T-DRILL TAP WITH BUSHING, 1/4" GAUGE COCK, & THREADED PLUG.

4 M3.2 TYPICAL GENERATOR DISCHARGE CONNECTION
NO SCALE

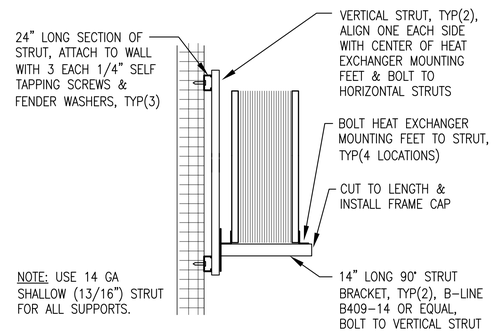


NOTES:

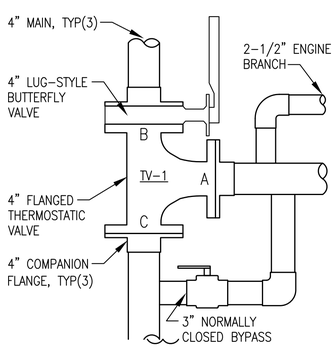
1) MAIN PIPING 4" WITH 1" INSULATION. ALL BRANCH PIPING NOT INSULATED.

2) ALL PIPING TYPE L COPPER TUBE. ALL LINE SIZE VALVES SOLDER END.

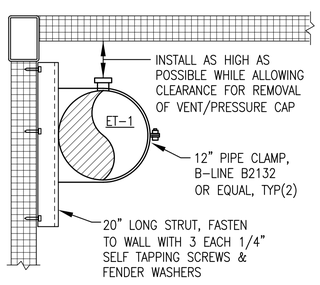
5 M3.2 TYPICAL GENERATOR SUCTION CONNECTION
NO SCALE



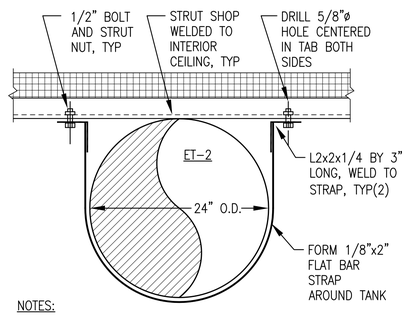
7 M3.2 HEAT EXCHANGER SUPPORT FROM WALL
NO SCALE



6 M3.2 TV-1 INSTALLATION
NO SCALE



8 M3.2 EXP TANK ET-1 SUPPORT
NO SCALE

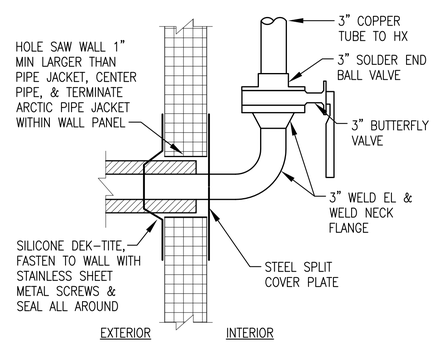


NOTES:

1) SMOOTH EDGES AFTER FABRICATION AND PAINT STRAPS PER SPECIFICATIONS.

2) ONE STRAP SHOWN. INSTALL FOUR IDENTICAL STRAPS.

9 M3.2 EXP TANK ET-2 SUPPORT
NO SCALE



10 M3.2 ARCTIC PIPE WALL PENETRATION
NO SCALE

CONCEPT DESIGN NOT FOR CONSTRUCTION

State of Alaska
Department of Community and Economic Development
AIDEA/AEA
Rural Energy Group
813 West Northern Lights Blvd.
Anchorage, Alaska 99503
ALASKA ENERGY AUTHORITY

PROJECT: ST. GEORGE POWER SYSTEM UPGRADE

TITLE: WALL ELEVATIONS & PIPING DETAILS

ALASKA ENERGY AND ENGINEERING, INC
P.O. BOX 111405 ANCHORAGE, ALASKA 99511-1405 PHONE (907) 349-0100

DRAWN BY: JTD/BCG	SCALE: AS NOTED	FILE NAME: STGEOR M2-M7	SHEET: M3.2 OF 4
DESIGNED BY: BCG	DATE: 6/18/12	PROJECT NUMBER:	

APPENDIX B

CONSTRUCTION COST ESTIMATE

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Module Fabrication Work in Anchorage										
Module Structure	1	ea.	$160,000	$160,000	0	0	$95	$0		$160,000
Move/Setup Module	1	lump	$3,000	$3,000	40	40	$95	$3,800		$6,800
210 kW Genset (JD 6090AFM)	4	ea.	$80,000	$320,000	30	120	$95	$11,400		$331,400
Switchgear	1	ea.	$220,000	$220,000	100	100	$95	$9,500		$229,500
Fire Supression	1	lump	$0	$0	80	80	$95	$7,600	$40,000	$47,600
Sheet Metal Fabrications	1	lump	$10,000	$10,000	60	60	$95	$5,700		$15,700
Radiators	3	ea.	$8,000	$24,000	20	60	$95	$5,700		$29,700
Coolant Piping & Equipment	1	lump	$25,000	$25,000	200	200	$95	$19,000		$44,000
Day Tank, Hopper, Blender	1	lump	$5,000	$5,000	60	60	$95	$5,700		$10,700
Day Tank Appurtenances	1	lump	$5,000	$5,000	30	30	$95	$2,850		$7,850
Fuel & Oil Pumps	1	lump	$5,000	$5,000	30	30	$95	$2,850		$7,850
Fuel, Oil, & Exhaust Piping	1	lump	$10,000	$10,000	80	80	$95	$7,600		$17,600
Hoses & Fittings	1	lump	$3,000	$3,000	20	20	$95	$1,900		$4,900
Pipe Insulation	1	lump	$3,000	$3,000	40	40	$95	$3,800		$6,800
Fuel System Control Panel	1	lump	$8,000	$8,000	40	40	$95	$3,800		$11,800
Instrumentation	1	lump	$5,000	$5,000	20	20	$95	$1,900		$6,900
Conduit, Cable & Elec Equipment	1	lump	$20,000	$20,000	300	300	$95	$28,500		$48,500
Feeder & Shielded Cable	1	lump	$20,000	$20,000	40	40	$95	$3,800		$23,800
Misc Strut, Hangers, Fasteners, E	1	lump	$6,000	$6,000	60	60	$95	$5,700		$11,700
Insulate Piping	1	lump	$0	$0	0	0	$95	$0	$3,000	$3,000
Signs & Valve Tags	1	lump	$1,000	$1,000	30	30	$95	$2,850		$3,850
Misc Hardware	1	lump	$2,000	$2,000	0	0	$95	$0		$2,000
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Welding Rod, Gases, Etc.	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Fill Coolant, Fuel, & Lube	1	lump	$5,000	$5,000	20	20	$95	$1,900		$6,900
Shop Load Test	1	lump	$0	$0	80	80	$95	$7,600		$7,600
Package for Shipping	1	lump	$1,000	$1,000	80	80	$95	$7,600		$8,600
Module Fabrication Sub-Total				$871,000		1,590		$151,050	$43,000	$1,065,050
Power Plant Installation in St. George										
Clear & Prep Site	1	lump		$0	100	100	$95	$9,500		$9,500
Gravel	500	cu.yd.	$15	$7,500	0.10	50	$95	$4,750		$12,250
Form Lumber, Etc	1	lump	$500	$500	0	0	$95	$0		$500

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Concrete Footings	20	cu.yd.	$100	$2,000	8	160	$95	$15,200		$17,200
Place Module on Footings	1	lump	$0	$0	80	80	$95	$7,600		$7,600
Roof System	1	lump	$30,000	$30,000	200	200	$95	$19,000		$49,000
Stairs & Landing	1	lump	$4,000	$4,000	40	40	$95	$3,800		$7,800
Install Hoods & Exhaust	1	lump	$0	$0	60	60	$95	$5,700		$5,700
Intermediate Fuel Tank & Piping	1	ea.	$40,000	$40,000	100	100	$95	$9,500		$49,500
Step Up Transformers	2	ea.	$20,000	$40,000	80	160	$95	$15,200		$55,200
Reactors (25 kVAR 1-phase)	3	ea.	$20,000	$60,000	20	60	$95	$5,700		$65,700
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Welding Rod, Gases, Etc.	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Rent/Repair Heavy Equip	1	lump							$20,000	$20,000
Pickup Rent	2	mo.							$1,200	$1,200
Welder/Compr/Misc Tool Rent	1	lump							$10,000	$10,000
Project Diesel Fuel/Gasoline	1	lump							$5,000	$5,000
Commission/Train Operators	40	hr			1	40	$95	$3,800		$3,800
Superintendent Overhd Off-Site	40	hr			1	40	$95	$3,800		$3,800
Superintendent Overhd On-Site	40	hr			1	40	$95	$3,800		$3,800
Crew Travel Time	100	hr			1	100	$95	$9,500		$9,500
Crew Airfares	5	trips							$5,000	$5,000
Crew Per Diem	100	mn.dy							$6,000	$6,000
Housing Rent	3	mo.							$6,000	$6,000
Barge Charter Mobilization	1	trip							$180,000	$180,000
Miscellaneous Air Freight	1	lump							$10,000	$10,000
Power Plant Installation Sub-Total				$194,000		1,230		$116,850	$243,200	$554,050
Construction Sub-Total				$1,065,000		2,820		$267,900	$286,200	$1,619,100
Engineering Design & Permitting	1	lump							$80,000	
Construction Administration	1	lump							$80,000	
Project Sub-Total				$1,065,000				$267,900	$446,200	$1,779,100
Contingency	15	%								$266,865
									Total Project Cost	**$2,045,965**

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
2-1/2" Arctic Pipe	1,000	ft.	$40	$40,000	0.25	250	$95	$23,750		$63,750
2" Arctic Pipe	800	ft.	$37.50	$30,000	0.25	200	$95	$19,000		$49,000
Heat Exchangers	1	lump	$10,000	$10,000	60	60	$95	$5,700		$15,700
Unit Heaters, Etc.	1	lump	$15,000	$15,000	100	100	$95	$9,500		$24,500
Interior Piping & Equipment	1	lump	$20,000	$20,000	200	200	$95	$19,000		$39,000
Instrumentation	1	lump	$10,000	$10,000	20	20	$95	$1,900		$11,900
Strut, Hangers, Fasteners, Etc.	1	lump	$3,000	$3,000	30	30	$95	$2,850		$5,850
Signs & Valve Tags	1	lump	$500	$500	10	10	$95	$950		$1,450
Misc Hardware	1	lump	$1,000	$1,000	0	0	$95	$0		$1,000
Misc Tools & Safety Gear	1	lump	$2,000	$2,000	0	0	$95	$0		$2,000
Welding Rod, Gases, Etc.	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Misc. Building Modifications	1	lump	$5,000	$5,000	40	40	$95	$3,800		$8,800
Rent/Repair Heavy Equip	1	lump							$10,000	$10,000
Pickup Rent	1	mo.							$600	$600
Welder/Compr/Misc Tool Rent	1	lump							$5,000	$5,000
Project Diesel Fuel/Gasoline	1	lump							$2,000	$2,000
Commission System	20	hr			1	20	$95	$1,900		$1,900
Superintendent Overhd Off-Site	20	hr			1	20	$95	$1,900		$1,900
Superintendent Overhd On-Site	20	hr			1	20	$95	$1,900		$1,900
Crew Travel Time	60	hr			1	60	$95	$5,700		$5,700
Crew Airfares	3	trips							$3,000	$3,000
Crew Per Diem	45	mn.dy							$2,700	$2,700
Housing Rent	2	mo.							$4,000	$4,000
Miscellaneous Air Freight	1	lump							$10,000	$10,000
Construction Sub-Total				$141,500		1,030		$97,850	$37,300	$276,650
Engineering Design & Permitting	1	lump							$30,000	
Construction Administration	1	lump							$30,000	
Project Sub-Total				$141,500				$97,850	$97,300	$336,650
Contingency	15	%								$50,498
									Total Project Cost	**$387,148**

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Phase #1 - Cross Island Feeder Townsite to Wind Farm Replacement										
3 Ph Primary Feeder to Townsite	17,200	ft.	$13.20	$227,040	0.10	1720	$95	$163,400		$390,440
3-Phase Tap Boxes	13	ea.	$2,250	$29,250	20	260	$95	$24,700		$53,950
45 kVA 3 Ph Padmount XFMR	4	ea.	$10,000	$40,000	40	160	$95	$15,200		$55,200
25 kVA 1 Ph Padmount XFMR	2	ea.	$5,000	$10,000	20	40	$95	$3,800		$13,800
Secondary Conductor	1,000	ft.	$4.50	$4,500	0.40	400	$95	$38,000		$42,500
3 Phase Meter Bases	10	ea.	$1,200	$12,000	5	50	$95	$4,750		$16,750
3 Phase Meters	10	ea.	$400	$4,000	1	10	$95	$950		$4,950
Single Phase Meter Bases	3	ea.	$350	$1,050	4	12	$95	$1,140		$2,190
Single Phase Meters	3	ea.	$50	$150	1	3	$95	$285		$435
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Used Mini Excavator Purchase	1	ea.	$40,000	$40,000	0	0	$95	$0		$40,000
Rent/Repair Heavy Equip	1	lump							$10,000	$10,000
Pickup Rent	3	mo.							$1,800	$1,800
Lineman Overhead Off-Site	20	hr			1	20	$95	$1,900		$1,900
Lineman Overhead On-Site	20	hr			1	20	$95	$1,900		$1,900
Crew Travel Time	40	hr			1	40	$95	$3,800		$3,800
Crew Airfares	2	trips							$4,000	$4,000
Crew Per Diem	100	mn.dy							$6,000	$6,000
Housing Rent	3	mo.							$6,000	$6,000
Miscellaneous Air Freight	1	lump							$15,000	$15,000
Phase #1 Construction Sub-Total				$372,990		2,735		$259,825	$42,800	$675,615
Phase #2 - Townsite Area Residential Feeder Replacement										
3 Ph Primary Conductor	3,500	ft.	$13.20	$46,200	0.20	700	$95	$66,500		$112,700
3-Phase Tap Boxes	17	ea.	$2,250	$38,250	20	340	$95	$32,300		$70,550
1 Ph Primary Conductor	6,000	ft.	$4.40	$26,400	0.18	1080	$95	$102,600		$129,000
1-Phase Tap Boxes	12	ea.	$1,000	$12,000	15	180	$95	$17,100		$29,100
25 kVA 1 Ph Padmount XFMR	12	ea.	$5,000	$60,000	20	240	$95	$22,800		$82,800
Secondary Conductor	5,000	ft.	$4.50	$22,500	0.40	2000	$95	$190,000		$212,500
3 Phase Meter Bases	1	ea.	$1,200	$1,200	5	5	$95	$475		$1,675
3 Phase Meters	1	ea.	$400	$400	1	1	$95	$95		$495
Single Phase Meter Bases	70	ea.	$350	$24,500	4	280	$95	$26,600		$51,100
Single Phase Meters	70	ea.	$50	$3,500	1	70	$95	$6,650		$10,150
Strut, Hangers, Fasteners, Etc.	1	lump	$6,000	$6,000	0	0	$95	$0		$6,000
Misc Hardware	1	lump	$2,000	$2,000	0	0	$95	$0		$2,000
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Rent/Repair Heavy Equip	1	lump							$10,000	$10,000

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Pickup Rent	10	mo.							$6,000	$6,000
Lineman Overhead On-Site	40	hr			1	40	$95	$3,800		$3,800
Crew Travel Time	100	hr			1	100	$95	$9,500		$9,500
Crew Airfares	5	trips							$5,000	$5,000
Crew Per Diem	300	mn.dy							$18,000	$18,000
Housing Rent	10	mo.							$20,000	$20,000
Miscellaneous Air Freight	1	lump							$10,000	$10,000
Phase #2 Construction Sub-Total				$247,950		5,036		$478,420	$69,000	$795,370
Phase #1 & #2 Construction Sub-Total				$620,940		7,771		$738,245	$111,800	$1,470,985
Engineering (All Phases)	1	lump							$80,000	
Const. Admin. (Phases 1 & 2)	1	lump							$40,000	
Phase 1 & 2 Project Sub-Total				$620,940				$738,245	$231,800	$1,590,985
Contingency	15	%								$238,648
									Phase #1 & #2 Total Project Cost	**$1,829,633**
Phase #3 - Cross Island Feeder Wind Farm to Zapadni Bay Replacement										
3 Ph Primary Conductor	16,000	ft.	$13.20	$211,200	0.10	1600	$95	$152,000		$363,200
3-Phase Tap Boxes	10	ea.	$2,250	$22,500	20	200	$95	$19,000		$41,500
1-Phase Tap Boxes	4	ea.	$1,000	$4,000	15	60	$95	$5,700		$9,700
45 kVA 3 Ph Padmount XFMR	2	ea.	$10,000	$20,000	40	80	$95	$7,600		$27,600
25 kVA 1 Ph Padmount XFMR	6	ea.	$5,000	$30,000	20	120	$95	$11,400		$41,400
Secondary Conductor	2,000	ft.	$4.50	$9,000	0.40	800	$95	$76,000		$85,000
3 Phase Meter Bases	4	ea.	$1,200	$4,800	5	20	$95	$1,900		$6,700
3 Phase Meters	4	ea.	$400	$1,600	1	4	$95	$380		$1,980
Single Phase Meter Bases	6	ea.	$350	$2,100	4	24	$95	$2,280		$4,380
Single Phase Meters	6	ea.	$50	$300	1	6	$95	$570		$870
Misc Strut, Hangers, Fasteners,	1	lump	$2,000	$2,000	60	60	$95	$5,700		$7,700
Misc Hardware	1	lump	$2,000	$2,000	0	0	$95	$0		$2,000
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Rent/Repair Heavy Equip	1	lump							$10,000	$10,000
Pickup Rent	3	mo.							$1,800	$1,800
Lineman Overhead Off-Site	20	hr			1	40	$95	$3,800		$3,800
Lineman Overhead On-Site	20	hr			1	40	$95	$3,800		$3,800
Crew Travel Time	40	hr			1	60	$95	$5,700		$5,700
Crew Airfares	3	trips							$3,000	$3,000
Crew Per Diem	130	mn.dy							$7,800	$7,800
Housing Rent	4	mo.							$8,000	$8,000

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Miscellaneous Air Freight	1	lump							$10,000	$10,000
Phase #3 Construction Sub-Total				$314,500		3,114		$295,830	$40,600	$650,930
Const. Admin. (Phase 3 Only)	1	lump							$40,000	
Phase #3 Project Sub-Total				$314,500				$295,830	$80,600	$690,930
									Phase #3 Total Project Cost	**$794,570**

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Windmatic 17s Remanufactured	1	ea.	$150,000	$150,000	0	0	$95	$0		$150,000
75' Monopole Tower	1	ea.	$90,000	$90,000	0	0	$95	$0		$90,000
Windwatchers 2.0 Controller	1	ea.	$80,000	$80,000	0	0	$95	$0		$80,000
Clear & Prep Site	1	lump		$0	100	100	$95	$9,500		$9,500
Access Road	1	lump	$15,000	$15,000	150	150	$95	$14,250		$29,250
Form Lumber, Etc	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Concrete Footings	110	cu.yd.	$200	$22,000	6	660	$95	$62,700		$84,700
Tower Erection	1	lump	$0	$0	0	0	$95	$0	$50,000	$50,000
Heated Control Module	1	ea.	$20,000	$20,000	200	200	$95	$19,000		$39,000
Step Up Transformer	1	ea.	$20,000	$20,000	80	80	$95	$7,600		$27,600
Ground Grid	1	lump	$2,000	$2,000	60	60	$95	$5,700		$7,700
Fiber Optic to Diesel Plant	17,000	ft.	$0.60	$10,200	0.010	170	$95	$16,150		$26,350
Electric Boiler at Diesel Plant	1	ea.	$15,000	$15,000	60	60	$95	$5,700		$20,700
Electric Boiler Control Panel	1	ea.	$20,000	$20,000	60	60	$95	$5,700		$25,700
Switchgear Modifications	1	lump	$5,000	$5,000	40	40	$95	$3,800		$8,800
Misc Tools & Safety Gear	1	lump	$5,000	$5,000	0	0	$95	$0		$5,000
Crane Rental	1	lump	$0	$0	0	0	$95	$0	$75,000	$75,000
Rent/Repair Heavy Equip	1	lump							$10,000	$10,000
Pickup Rent	2	mo.							$1,200	$1,200
Misc Tool Rent	1	lump							$5,000	$5,000
Project Diesel Fuel/Gasoline	1	lump							$5,000	$5,000
Commission/Train Operators	40	hr			1	40	$95	$3,800		$3,800
Superintendent Overhd Off-Site	40	hr			1	40	$95	$3,800		$3,800
Superintendent Overhd On-Site	40	hr			1	40	$95	$3,800		$3,800
Crew Travel Time	100	hr			1	100	$95	$9,500		$9,500
Crew Airfares	5	trips							$5,000	$5,000
Crew Per Diem	200	mn.dy							$12,000	$12,000
Housing Rent	3	mo.							$6,000	$6,000
Ship Wind Turbine & Tower to Anch	1	lump							$20,000	$20,000
Barge Charter Mobilization	1	trip							$180,000	$180,000
Miscellaneous Air Freight	1	lump							$5,000	$5,000

ITEM	QUAN	UNIT	UNIT COST	MATL COST	UNIT HRS	LAB HRS	LAB RATE	LABOR COST	CONTR COST	TOTAL COST
Construction Sub-Total				$459,200		1,800		$171,000	$374,200	$1,004,400
Engineering Design & Permitting	1	lump							$100,000	
Construction Administration	1	lump							$80,000	
Project Sub-Total				$459,200				$171,000	$554,200	$1,184,400
Contingency	15	%								$177,660
									Total Project Cost	**$1,362,060**

APPENDIX C

SITE CONTROL DOCUMENTS

Rick Elliott
Land Consultant
5452 Cape Seville Drive
Anchorage, Alaska 99516
Phone/Fax: (907)868-4043
e-mail: rickelliott@gci.net

February 17, 2012 Sent Via email to: thurley@alaska.com

Mr. Tim Hurley
Western Alaska Land Title Co.
506 W Marine Way STE 3
Kodiak, AK 99615

Re: St. George Power System Upgrade
Request for Certificate to Plat

Dear Mr. Hurley:

Please find enclosed portions of the Saint George DCRA community profile map that identify parcels that need a Certificate to Plat. Please prepare a Certificate to Plat for the following parcels:

1. Qawax Subdivision, Tract 43, Plat 85-34, Lot 12, 13&14 Aleutian Islands Recording District.
2. East Landing Subdivision Addition No. 2, Tract 41, Plat 86-1, Lots 1&2, Aleutian Islands Recording District.
3. Un-subdivided portion of Tract 52, within Section 29, Township 41S, Range 129W., Seward Meridian, Aleutian Islands Recording District, as shown on the map. (The community profile shows a reference to "Tract 41" but I believe this is incorrect.)

Attached are the two subdivision plats noted above and a copy of the BLM survey. It looks like some of Tracts may be shown incorrectly on the DCRA community profile map, but with the subdivision plats and the BLM survey I think the area of interest can be clearly identified.

We request the Certificate to Plat be completed by March 1, 2012. **You are authorized to bill up to $1,500.00 for this effort. If you are unable to meet the desired due date and anticipate exceeding this amount, please call prior to proceeding.**

If you have any questions please call (907) 868-4043.

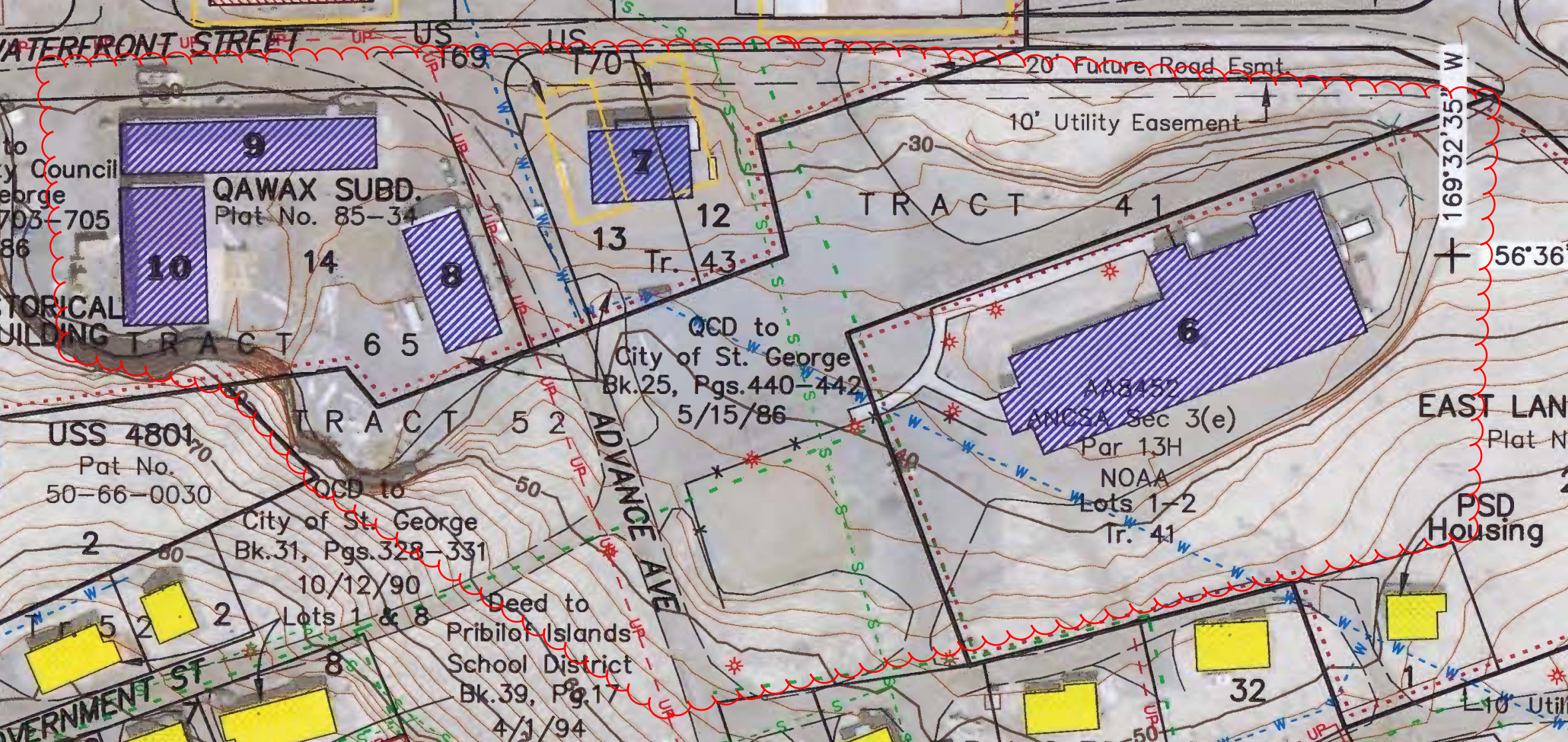
Sincerely,

Rick Elliott

Rick Elliott

Land Consultant for Alaska Energy and Engineering

Attachments: as noted

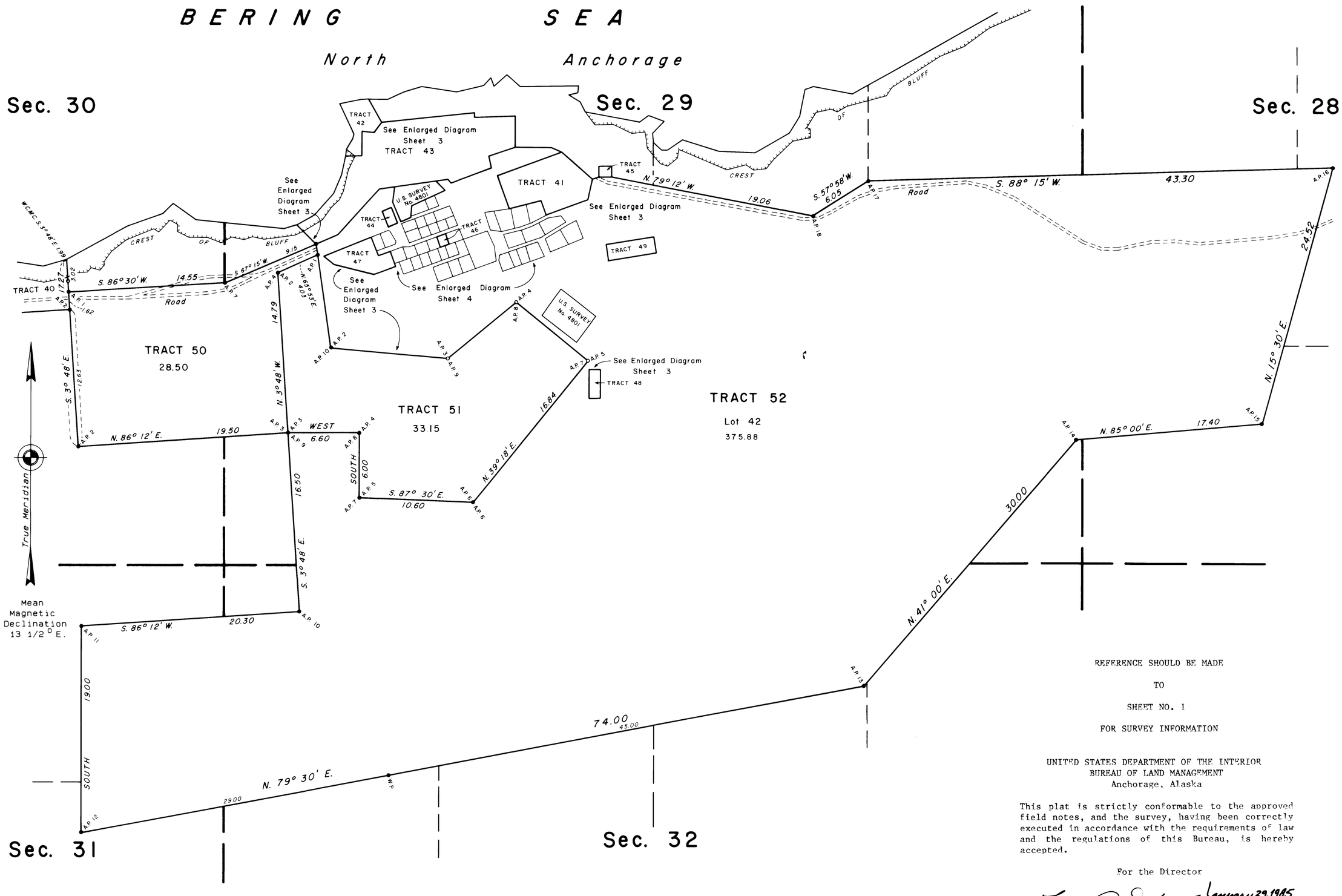

WATERFRONT STREET
US 169
US 170
20' Future Road Esmt.
10' Utility Easement
169°32'35" W
56°36'
9
7
10
8
6
QAWAX SUBD.
Plat No. 85-34
14
13
12
Tr. 43
TRACT 41
TRACT 65
TRACT 52
QCD to
City of St. George
Bk.25, Pgs.440-442
5/15/86
ADVANCE AVE
AA8452
ANCSA Sec 3(e)
Par 13H
NOAA
Lots 1-2
Tr. 41
EAST LAN
Plat N
PSD
Housing
USS 4801
Pat No.
50-66-0030
QCD to
City of St. George
Bk.31, Pgs.328-331
10/12/90
Lots 1 & 8
Deed to
Pribilof Islands
School District
Bk.39, Pg.17
4/1/94
GOVERNMENT ST
2
8
7
32
1
L10' Util

Officially Filed
DATE FEBRUARY 15, 1985

ORIGINAL

Sheet 2 of 4 Sheets

TOWNSHIP 41 SOUTH, RANGE 129 WEST, OF THE SEWARD MERIDIAN, ALASKA



REFERENCE SHOULD BE MADE

TO

SHEET NO. 1

FOR SURVEY INFORMATION

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Anchorage, Alaska

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

January 29, 1985
Date

Deputy State Director for Cadastral Survey, Alaska

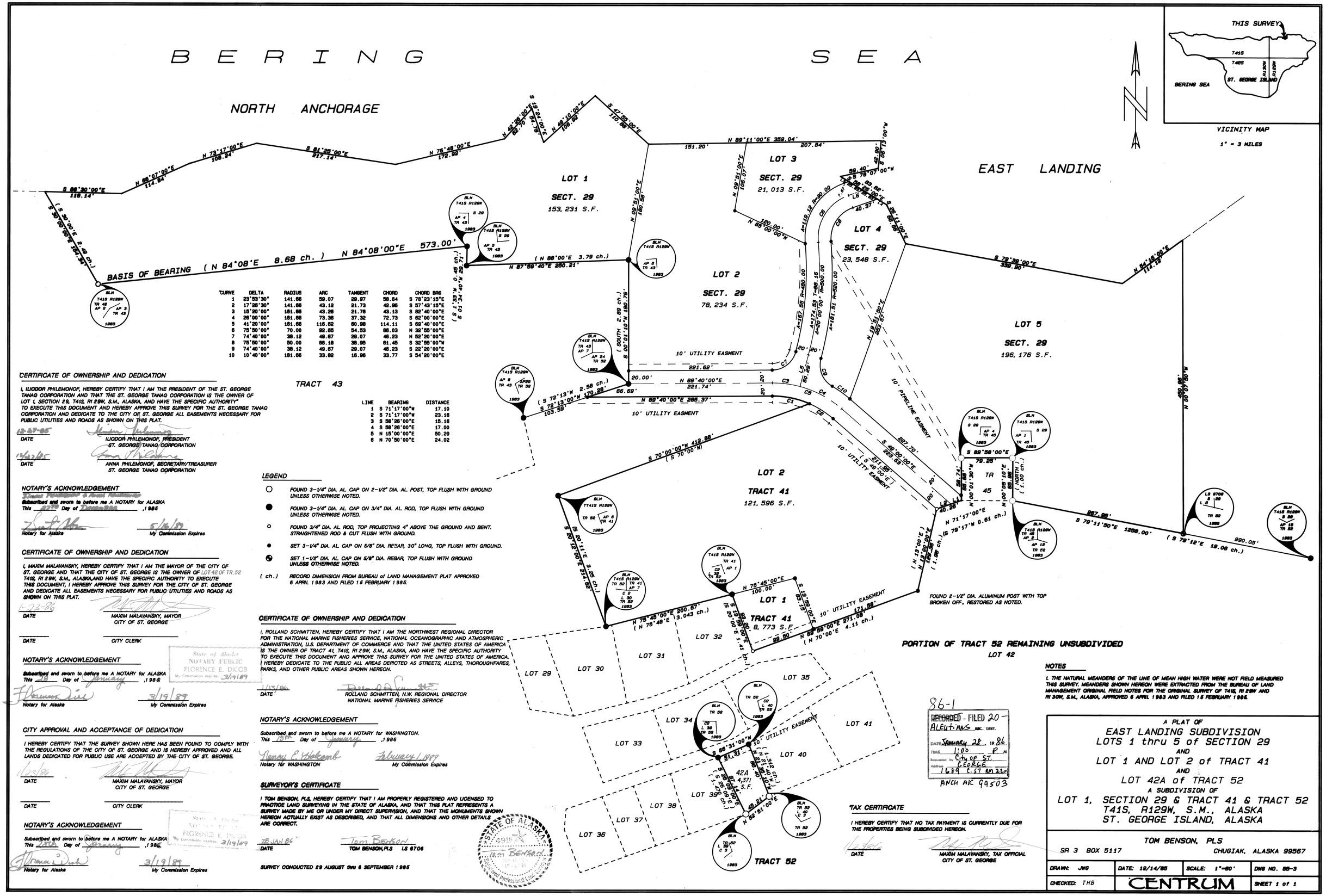
● ALUMINUM ROD, 3/4 IN. DIAM., WITH ALUMINUM CAP.

○ ALUMINUM POST, 30 INS. LONG, 2 1/2 INS. DIAM., WITH ALUMINUM CAP.

1 0 1 2 3 4 5 6 7 8 9 10 20 40
Chains

ENLARGED DIAGRAM

S.R.P.



CURVE	DELTA	RADIUS	ARC	TANGENT	CHORD	CHORD BRG
1	23°53'30"	141.66	59.07	29.97	58.64	S 78°23'15"E
2	17°26'30"	141.66	43.12	21.73	42.96	S 57°43'15"E
3	15°20'00"	161.66	43.26	21.76	43.13	S 62°40'00"E
4	26°00'00"	161.66	73.36	37.32	72.73	S 62°00'00"E
5	41°20'00"	161.66	116.62	60.98	114.11	S 69°40'00"E
6	75°50'00"	70.00	92.66	54.53	86.03	N 32°55'00"E
7	74°40'00"	36.12	49.67	29.07	46.23	N 52°20'00"E
8	75°50'00"	50.00	66.18	38.95	61.45	S 32°55'00"N
9	74°40'00"	36.12	49.67	29.07	46.23	S 22°20'00"E
10	10°40'00"	181.66	33.82	16.96	33.77	S 54°20'00"E

LINE	BEARING	DISTANCE
1	S 71°17'00"W	17.10
2	S 71°17'00"W	23.16
3	S 58°26'00"E	15.16
4	S 58°26'00"E	17.00
5	N 15°00'00"E	50.29
6	N 70°50'00"E	24.02

CERTIFICATE OF OWNERSHIP AND DEDICATION

I, ILIODOR PHILEMONOF, HEREBY CERTIFY THAT I AM THE PRESIDENT OF THE ST. GEORGE TANAQ CORPORATION AND THAT THE ST. GEORGE TANAQ CORPORATION IS THE OWNER OF LOT 1, SECTION 29, T41S, R129W, S.M., ALASKA, AND HAVE THE SPECIFIC AUTHORITY TO EXECUTE THIS DOCUMENT AND HEREBY APPROVE THIS SURVEY FOR THE ST. GEORGE TANAQ CORPORATION AND DEDICATE TO THE CITY OF ST. GEORGE ALL EASEMENTS NECESSARY FOR PUBLIC UTILITIES AND ROADS AS SHOWN ON THIS PLAT.

12-27-85 — DATE
ILIODOR PHILEMONOF, PRESIDENT
ST. GEORGE TANAQ CORPORATION

12/27/85 — DATE
ANNA PHILEMONOF, SECRETARY/TREASURER
ST. GEORGE TANAQ CORPORATION

NOTARY'S ACKNOWLEDGEMENT

Subscribed and sworn to before me A NOTARY for ALASKA
This 27th Day of December, 1985

Notary for Alaska — 5/16/89 My Commission Expires

CERTIFICATE OF OWNERSHIP AND DEDICATION

I, MAXIM MALAVANSKY, HEREBY CERTIFY THAT I AM THE MAYOR OF THE CITY OF ST. GEORGE AND THAT THE CITY OF ST. GEORGE IS THE OWNER OF LOT 42 OF TR. 52 T41S, R129W, S.M., ALASKA, AND HAVE THE SPECIFIC AUTHORITY TO EXECUTE THIS DOCUMENT, I HEREBY APPROVE THIS SURVEY FOR THE CITY OF ST. GEORGE AND DEDICATE ALL EASEMENTS NECESSARY FOR PUBLIC UTILITIES AND ROADS AS SHOWN ON THIS PLAT.

1-22-86 — DATE
MAXIM MALAVANSKY, MAYOR
CITY OF ST. GEORGE

DATE — CITY CLERK

NOTARY'S ACKNOWLEDGEMENT

Subscribed and sworn to before me A NOTARY for ALASKA
This 28 Day of January, 1986

State of Alaska NOTARY PUBLIC FLORENCE E. DICOB My Commission expires: 3/19/89

Notary for Alaska — 3/19/89 My Commission Expires

CITY APPROVAL AND ACCEPTANCE OF DEDICATION

I HEREBY CERTIFY THAT THE SURVEY SHOWN HERE HAS BEEN FOUND TO COMPLY WITH THE REGULATIONS OF THE CITY OF ST. GEORGE AND IS HEREBY APPROVED AND ALL LANDS DEDICATED FOR PUBLIC USE ARE ACCEPTED BY THE CITY OF ST. GEORGE.

1/23/86 — DATE
MAXIM MALAVANSKY, MAYOR
CITY OF ST. GEORGE

DATE — CITY CLERK

NOTARY'S ACKNOWLEDGEMENT

Subscribed and sworn to before me A NOTARY for ALASKA
This 28th Day of January, 1986

State of Alaska NOTARY PUBLIC FLORENCE E. DICOB My Commission expires: 3/19/89

Notary for Alaska — 3/19/89 My Commission Expires

LEGEND

- ○ FOUND 3-1/4" DIA. AL. CAP ON 2-1/2" DIA. AL. POST, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
- ● FOUND 3-1/4" DIA. AL. CAP ON 3/4" DIA. AL. ROD, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
- ○ FOUND 3/4" DIA. AL. ROD, TOP PROJECTING 4" ABOVE THE GROUND AND BENT. STRAIGHTENED ROD & CUT FLUSH WITH GROUND.
- ● SET 3-1/4" DIA. AL. CAP ON 5/8" DIA. REBAR, 30" LONG, TOP FLUSH WITH GROUND.
- SET 1-1/2" DIA. AL. CAP ON 5/8" DIA. REBAR, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
- (ch.) RECORD DIMENSION FROM BUREAU of LAND MANAGEMENT PLAT APPROVED 6 APRIL 1983 AND FILED 15 FEBRUARY 1985.

CERTIFICATE OF OWNERSHIP AND DEDICATION

I, ROLLAND SCHMITTEN, HEREBY CERTIFY THAT I AM THE NORTHWEST REGIONAL DIRECTOR FOR THE NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE AND THAT THE UNITED STATES OF AMERICA IS THE OWNER OF TRACT 41, T41S, R129W, S.M., ALASKA, AND HAVE THE SPECIFIC AUTHORITY TO EXECUTE THIS DOCUMENT AND APPROVE THIS SURVEY FOR THE UNITED STATES OF AMERICA. I HEREBY DEDICATE TO THE PUBLIC ALL AREAS DEPICTED AS STREETS, ALLEYS, THOROUGHFARES, PARKS, AND OTHER PUBLIC AREAS SHOWN HEREON.

1/13/86 — DATE
ROLLAND SCHMITTEN, N.W. REGIONAL DIRECTOR
NATIONAL MARINE FISHERIES SERVICE

NOTARY'S ACKNOWLEDGEMENT

Subscribed and sworn to before me A NOTARY for WASHINGTON.
This 15th Day of January, 1986

Nancy C. Holkcomb — February 1, 1989
Notary for WASHINGTON — My Commission Expires

SURVEYOR'S CERTIFICATE

I TOM BENSON, PLS, 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, AND THAT THE MONUMENTS SHOWN HEREON ACTUALLY EXIST AS DESCRIBED, AND THAT ALL DIMENSIONS AND OTHER DETAILS ARE CORRECT.

28 JAN 86 — DATE
TOM BENSON, PLS LS 6706

SURVEY CONDUCTED 29 AUGUST thru 6 SEPTEMBER 1985

STATE OF ALASKA 49TH Tom Benson Registered Professional Land Surveyor

86-1
RECORDED - FILED 20
ALEUTIANS REC. DIST.
DATE JANUARY 28 1986
TIME 1:00 P.M.
Recorded by City of St. George
Address 1689 C ST RM 210
ANCH AK 99503

TAX CERTIFICATE

I HEREBY CERTIFY THAT NO TAX PAYMENT IS CURRENTLY DUE FOR THE PROPERTIES BEING SUBDIVIDED HEREON.

DATE — MAXIM MALAVANSKY, TAX OFFICIAL
CITY OF ST. GEORGE

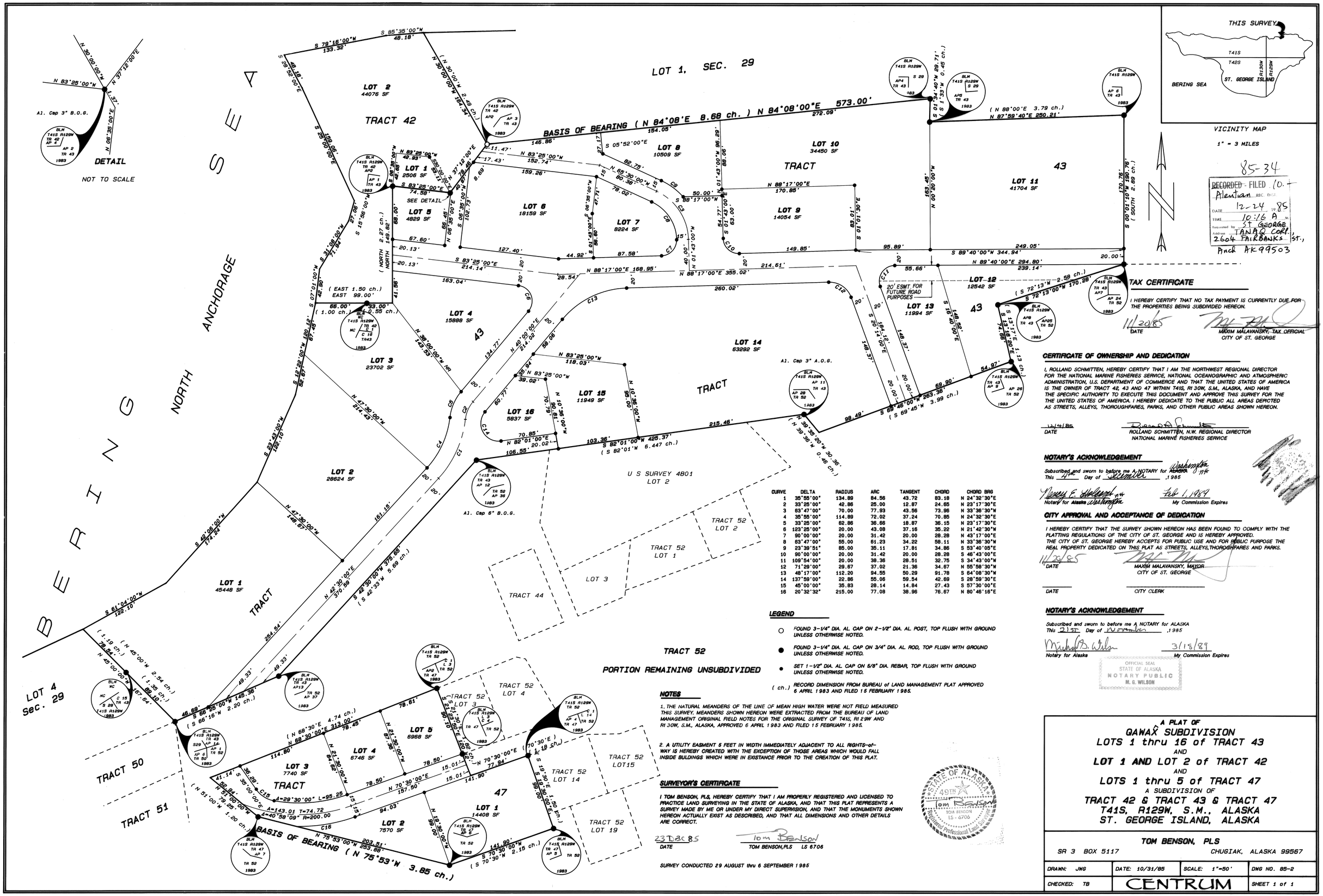
NOTES

1. THE NATURAL MEANDERS OF THE LINE OF MEAN HIGH WATER WERE NOT FIELD MEASURED THIS SURVEY, MEANDERS SHOWN HEREON WERE EXTRACTED FROM THE BUREAU OF LAND MANAGEMENT ORIGINAL FIELD NOTES FOR THE ORIGINAL SURVEY OF T41S, R129W AND R130W, S.M., ALASKA, APPROVED 6 APRIL 1983 AND FILED 15 FEBRUARY 1985.

A PLAT OF
EAST LANDING SUBDIVISION
LOTS 1 thru 5 of SECTION 29
AND
LOT 1 AND LOT 2 of TRACT 41
AND
LOT 42A of TRACT 52
A SUBDIVISION OF
LOT 1, SECTION 29 & TRACT 41 & TRACT 52
T41S, R129W, S.M., ALASKA
ST. GEORGE ISLAND, ALASKA

TOM BENSON, PLS
SR 3 BOX 5117 CHUGIAK, ALASKA 99567

DRAWN: JWG	DATE: 12/14/85	SCALE: 1"=60'	DWG NO. 85-3
CHECKED: THB	CENTRUM		SHEET 1 of 1



85-34

RECORDED - FILED
Aleutian REC. DIST.
DATE 12-24 1985
TIME 10:16 A M
Requested by ST GEORGE
Address TANAQ CORP., 2604 FAIRBANKS ST., Anch AK99503

TAX CERTIFICATE

I HEREBY CERTIFY THAT NO TAX PAYMENT IS CURRENTLY DUE FOR THE PROPERTIES BEING SUBDIVIDED HEREON.

11/20/85
DATE

MAXIM MALAVANSKY, TAX OFFICIAL
CITY OF ST. GEORGE

CERTIFICATE OF OWNERSHIP AND DEDICATION

I, ROLLAND SCHMITTEN, HEREBY CERTIFY THAT I AM THE NORTHWEST REGIONAL DIRECTOR FOR THE NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE AND THAT THE UNITED STATES OF AMERICA IS THE OWNER OF TRACT 42, 43 AND 47 WITHIN T41S, R130W, S.M., ALASKA, AND HAVE THE SPECIFIC AUTHORITY TO EXECUTE THIS DOCUMENT AND APPROVE THIS SURVEY FOR THE THE UNITED STATES OF AMERICA. I HEREBY DEDICATE TO THE PUBLIC ALL AREAS DEPICTED AS STREETS, ALLEYS, THOROUGHFARES, PARKS, AND OTHER PUBLIC AREAS SHOWN HEREON.

12/4/85
DATE

ROLLAND SCHMITTEN, N.W. REGIONAL DIRECTOR
NATIONAL MARINE FISHERIES SERVICE

NOTARY'S ACKNOWLEDGEMENT

Subscribed and sworn to before me A NOTARY for Washington
This 4th Day of December, 1985

Notary for Alaska Washington
Feb 1, 1989
My Commission Expires

CITY APPROVAL AND ACCEPTANCE OF DEDICATION

I HEREBY CERTIFY THAT THE SURVEY SHOWN HEREON HAS BEEN FOUND TO COMPLY WITH THE PLATTING REGULATIONS OF THE CITY OF ST. GEORGE AND IS HEREBY APPROVED.
THE CITY OF ST. GEORGE HEREBY ACCEPTS FOR PUBLIC USE AND FOR PUBLIC PURPOSE THE REAL PROPERTY DEDICATED ON THIS PLAT AS STREETS, ALLEYS, THOROUGHFARES AND PARKS.

11/20/85
DATE

MAXIM MALAVANSKY, MAYOR
CITY OF ST. GEORGE

DATE

CITY CLERK

NOTARY'S ACKNOWLEDGEMENT

Subscribed and sworn to before me A NOTARY for ALASKA
This 21st Day of November, 1985

Notary for Alaska

3/18/89
My Commission Expires

OFFICIAL SEAL
STATE OF ALASKA
NOTARY PUBLIC
M. G. WILSON

CURVE	DELTA	RADIUS	ARC	TANGENT	CHORD	CHORD BRG
1	35°55'00"	134.89	84.56	43.72	83.18	N 24°32'30"E
2	33°25'00"	42.86	25.00	12.87	24.65	N 23°17'30"E
3	63°47'00"	70.00	77.93	43.56	73.96	N 33°36'30"W
4	35°55'00"	114.89	72.02	37.24	70.85	N 24°32'30"E
5	33°25'00"	62.86	36.66	18.87	36.15	N 23°17'30"E
6	123°25'00"	20.00	43.08	37.16	35.22	N 21°42'30"W
7	90°00'00"	20.00	31.42	20.00	28.28	N 43°17'00"E
8	63°47'00"	55.00	61.23	34.22	58.11	N 33°36'30"W
9	23°39'51"	85.00	35.11	17.81	34.86	S 53°40'05"E
10	90°00'00"	20.00	31.42	20.00	28.28	S 46°43'00"E
11	109°54'00"	20.00	38.36	28.51	32.75	S 34°43'00"W
12	71°29'00"	29.67	37.02	21.36	34.67	N 55°58'30"W
13	46°17'00"	112.20	94.55	50.29	91.78	S 64°08'30"W
14	137°59'00"	22.86	55.06	59.54	42.69	S 28°59'30"E
15	45°00'00"	35.83	28.14	14.84	27.43	S 57°30'00"E
16	20°32'32"	215.00	77.08	38.96	76.67	N 80°46'16"E

LEGEND

- ○ FOUND 3-1/4" DIA. AL. CAP ON 2-1/2" DIA. AL. POST, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
- ● FOUND 3-1/4" DIA. AL. CAP ON 3/4" DIA. AL. ROD, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
- • SET 1-1/2" DIA. AL. CAP ON 5/8" DIA. REBAR, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
- (ch.) RECORD DIMENSION FROM BUREAU of LAND MANAGEMENT PLAT APPROVED 6 APRIL 1983 AND FILED 15 FEBRUARY 1985.

TRACT 52

PORTION REMAINING UNSUBDIVIDED

NOTES

1. THE NATURAL MEANDERS OF THE LINE OF MEAN HIGH WATER WERE NOT FIELD MEASURED THIS SURVEY. MEANDERS SHOWN HEREON WERE EXTRACTED FROM THE BUREAU OF LAND MANAGEMENT ORIGINAL FIELD NOTES FOR THE ORIGINAL SURVEY OF T41S, R129W AND R130W, S.M., ALASKA, APPROVED 6 APRIL 1983 AND FILED 15 FEBRUARY 1985.

2. A UTILITY EASMENT 5 FEET IN WIDTH IMMEDIATELY ADJACENT TO ALL RIGHTS-of-WAY IS HEREBY CREATED WITH THE EXCEPTION OF THOSE AREAS WHICH WOULD FALL INSIDE BULDINGS WHICH WERE IN EXISTANCE PRIOR TO THE CREATION OF THIS PLAT.

SURVEYOR'S CERTIFICATE

I TOM BENSON, PLS, 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, AND THAT THE MONUMENTS SHOWN HEREON ACTUALLY EXIST AS DESCRIBED, AND THAT ALL DIMENSIONS AND OTHER DETAILS ARE CORRECT.

23 Dec 85
DATE

Tom Benson
TOM BENSON, PLS LS 6706

SURVEY CONDUCTED 29 AUGUST thru 6 SEPTEMBER 1985

STATE OF ALASKA
49TH
TOM BENSON
TOM BENSON
LS - 6706
Registered Professional Land Surveyor

A PLAT OF
QAWAX̂ SUBDIVISION
LOTS 1 thru 16 of TRACT 43
AND
LOT 1 AND LOT 2 of TRACT 42
AND
LOTS 1 thru 5 of TRACT 47
A SUBDIVISION OF
TRACT 42 & TRACT 43 & TRACT 47
T41S, R129W, S.M., ALASKA
ST. GEORGE ISLAND, ALASKA

TOM BENSON, PLS
SR 3 BOX 5117 CHUGIAK, ALASKA 99567

DRAWN: JNG	DATE: 10/31/85	SCALE: 1"=50'	DWG NO. 85-2
CHECKED: TB	CENTRUM		SHEET 1 of 1

WESTERN ALASKA LAND TITLE CO.

314 Center Avenue • P.O. Box 864 • Kodiak, Alaska 99615
(907) 486-4433 • Fax (907) 486-5109
Email: waltco@alaska.com

CERTIFICATE TO PLAT

ALASKA ENERGY AND ENGINEERING
5452 CAPE SEVILLE DRIVE
ANCHORAGE, AK 99516

Our Order Number: 7138

Date: February 27, 2012 at 8:00 a.m.

Amount Due $1,200.00

That title to the property described herein is vested on the date shown above in

As to Parcel 1
CITY OF ST. GEORGE

As to Parcel 2
UNITED STATES OF AMERICA

As to Parcel 3
CITY OF ST. GEORGE, an estate in fee simple, subject only to the exceptions shown herein.

This report shall have no force or effect except as a basis for the coverage specified herein.

By_____
Timothy J. Hurley, President Validating Signatory

LEGAL DESCRIPTION:

PARCEL NO. 1:
LOTS 12, 13, AND 14, OF TRACT 43, QAWAX SUBDIVISION, according to Plat No. 85-34, located in the Aleutian Islands Recording District, Third Judicial District, State of Alaska, EXCEPTING THEREFROM the subsurface estate, and all rights, privileges, immunities and appurtenances, of whatsoever nature, accruing unto said estate pursuant to the Alaska Native Claims Settlement Act of December 18, 1971 (85 Stat. 688, 794; 43 U.S.C. 1601, 1613 (f) (1976)).

PARCEL NO. 2:
LOT 1, AND LOT 2, OF TRACT 41, EAST LANDING SUBDIVISION, according to Plat No. 86-1, located in the Aleutian Islands Recording District, Third Judicial District, State of Alaska.

NOTE: Investigation should be made to determine if there are any service, installation, maintenance or construction charges for sewer, water or electricity.

WESTERN ALASKA LAND TITLE CO.

314 Center Avenue • P.O. Box 864 • Kodiak, Alaska 99615
(907) 486-4433 • Fax (907) 486-5109
Email: waltco@alaska.com

CERTIFICATE TO PLAT

Order Number: 7138

PARCEL NO. 3:
THAT PORTION OF LOT 42B, TRACT 52, TANANG SUBDIVISION, according to Plat No. 90-14, located in the Aleutian Islands Recording District, Third Judicial District, State of Alaska, Which lies Northerly of Lot 28, Tract 52 and Easterly of Lot 8, Tract 52, EXCEPTING THEREFROM the subsurface estate, and all rights, privileges, immunities and appurtenances, of whatsoever nature, accruing unto said estate pursuant to the Alaska Native Claims Settlement Act of December 18, 1971 (85 Stat. 688, 794; 43 U.S.C. 1601, 1613 (f) (1976)).

- continued -

NOTE: Investigation should be made to determine if there are any service, installation, maintenance or construction charges for sewer, water or electricity.

SUBJECT TO:

As to Parcel 1

1. The rights, provisions, restrictions, reservations, limitations and encumbrances contained in Quitclaim Deeds from the United States of America recorded May 9, 1986 in Book 25 at Page 405 and recorded May 15, 1886 in Book 25 at Page 440:

2. Matters disclosed by Plat No. 85-34.

3. Matters disclosed in:
"Notice of environmental cleanup and residual soil contamination at two party agreement site 8, St. George Island, Alaska", recorded August 11, 2008 under Serial Number 2008-000390-0.
(Affects Lot 14)

4. This report is restricted to the use of the addressee, and is not to be used as a basis for closing any transaction affecting title to said premises. Liability of the company for the information provided herein and any claim of negligence resulting therefrom shall be limited to the compensation received therefore.

As to Parcel 2

5. Matters disclosed by Plat No. 86-1.

6. Right, title and interest, if any, of the Prihilof School District, grantee in Deed from the State of Alaska Department of Transportation and Public Facilities, recorded April 25, 1986 in Book 25 at page 384.

7. This report is restricted to the use of the addressee, and is not to be used as a basis for closing any transaction affecting title to said premises. Liability of the company for the information provided herein and any claim of negligence resulting therefrom shall be limited to the compensation received therefore.

As to Parcel 3

8. The rights, provisions, easements, restrictions, reservations, limitations and encumbrances contained in Patent from United States of America recorded December 31, 1985 in Book 25 at Page 18, including but not limited to the following:

   a. Valid existing rights therein, if any, including but not limited to those created by any lease (including a lease issued under Sec. 6 (g) of Alaska Statehood Act of July 7, 1958 (72 Stat. 339; 48 U.S.C. Ch. 2, Sec. 6 (g) (1976)), contract, permit, right-of-way or easement, and the right of lessee, contractee, permittee or grantee to the complete enjoyment of all rights, privileges and benefits thereby granted to him. Further pursuant to Section 17 (b) (2) of the Alaska Native claims Settlement Act (ANCSA), any valid existing right recognized by ANCSA shall continue to have whatever right of access as is now provided by law.

   b. Requirements of Section 14 (c) of the Alaska Native Claims Settlement Act of December 18,1971.

9. The exception and reservations contained in the Patent referenced herein, including without limitations, as follows:

   "The subsurface estate therein, and all right, privileges, immunities and appurtenances, of whatsoever nature, accruing unto said estate pursuant to the Alaska Native Claims Settlement Act of December 18, 1971 (85 Stat. 688, 707; 43 U.S.C. 1601, 1613 (h) (3) (1976))."

   NOTE: Section 14 of said Act provides as follows:

   "that the right to explore, develop or remove minerals from the subsurface estate in the lands within the boundaries of any native village shall be subject to the consent of the Village Corporation."

10. Easements, restrictions, reservations, limitations, encumbrances, requirements, terms and conditions imposed by the Alaska Native Claims Settlement Act or the Alaska National Interest Lands Conservation Act.

11. St. George Tanaq Corporation, City of St. George, ANCSA 14 (C) 3 Agreement, including the terms and provisions thereof, recorded October 12, 1990 in Book 31 at page 228.
    (Includes other property.)

12. Matters disclosed by Plat No. 90-14.

13. Provisions contained in Deed to City of St. George Tanaq Corporation recorded October 12, 1990 in Book 31 at Page 315.
    (Includes other property.)

14. This report is restricted to the use of the addressee, and is not to be used as a basis for closing any transaction affecting title to said premises. Liability of the company for the information provided herein and any claim of negligence resulting therefrom shall be limited to the compensation received therefore.

END OF EXCEPTIONS

Privacy Policy Notice

PURPOSE OF THIS NOTICE

Title V of the Gramm-Leach-Bliley Act (GLBA) generally prohibits any financial institution, directly or through its affiliates, from sharing nonpublic personal information about you with a nonaffiliated third party unless the institution provides you with a notice of its privacy policies and practices, such as the type of information that it collects about you and the categories of persons or entities to whom it may be disclosed. In compliance with the GLBA, we are providing you with this document, which notifies you of the privacy policies and practices of **Stewart Title Guaranty Company and Western Alaska Land Title Company.**

We may collect nonpublic personal information about you from the following sources:

- Information we receive from you, such as on applications or other forms.
- Information about your transactions we secure from our files, or from our affiliates or others.
- Information we receive from a consumer reporting agency.
- Information that we receive from others involved in your transaction, such as the real estate agent or lender.

Unless it is specifically stated otherwise in an amended Privacy Policy Notice, no additional nonpublic personal information will be collected about you.

We may disclose any of the above information that we collect about our customers or former customers to our affiliates or to nonaffiliated third parties as permitted by law.

We also may disclose this information about our customers or former customers to the following types of nonaffiliated companies that perform marketing services on our behalf or with whom we have joint marketing agreements:

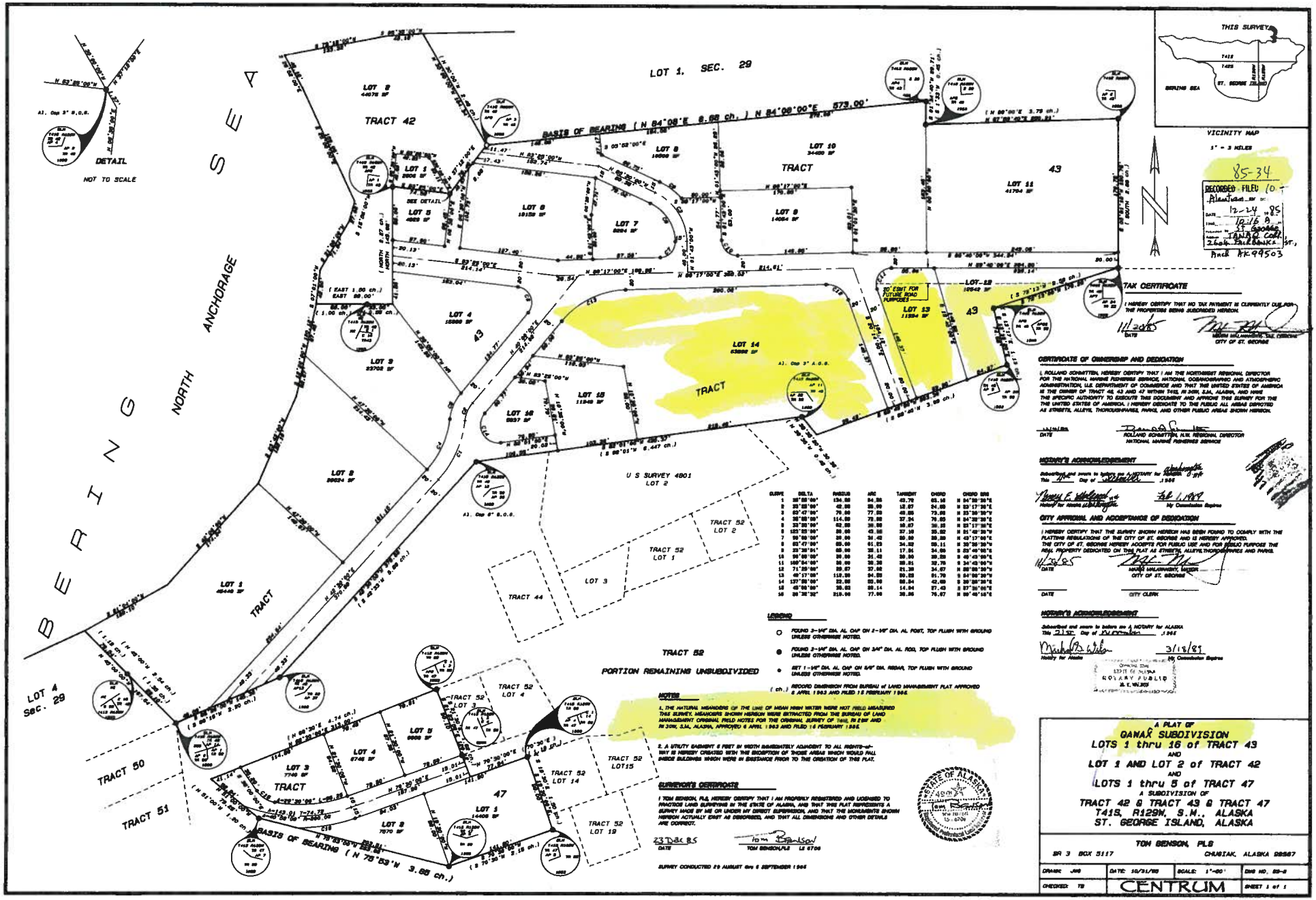
- Financial service providers such as companies engaged in banking, consumer finance, securities and insurance.
- Non-financial companies such as envelope stuffers and other fulfillment service providers.

WE DO NOT DISCLOSE ANY NONPUBLIC PERSONAL INFORMATION ABOUT YOU WITH ANYONE FOR ANY PURPOSE THAT IS NOT SPECIFICALLY PERMITTED BY LAW.

We restrict access to nonpublic personal information about you to those employees who need to know that information in order to provide products or services to you. We maintain physical, electronic, and procedural safeguards that comply with federal regulations to guard your nonpublic personal information. (6/2007)

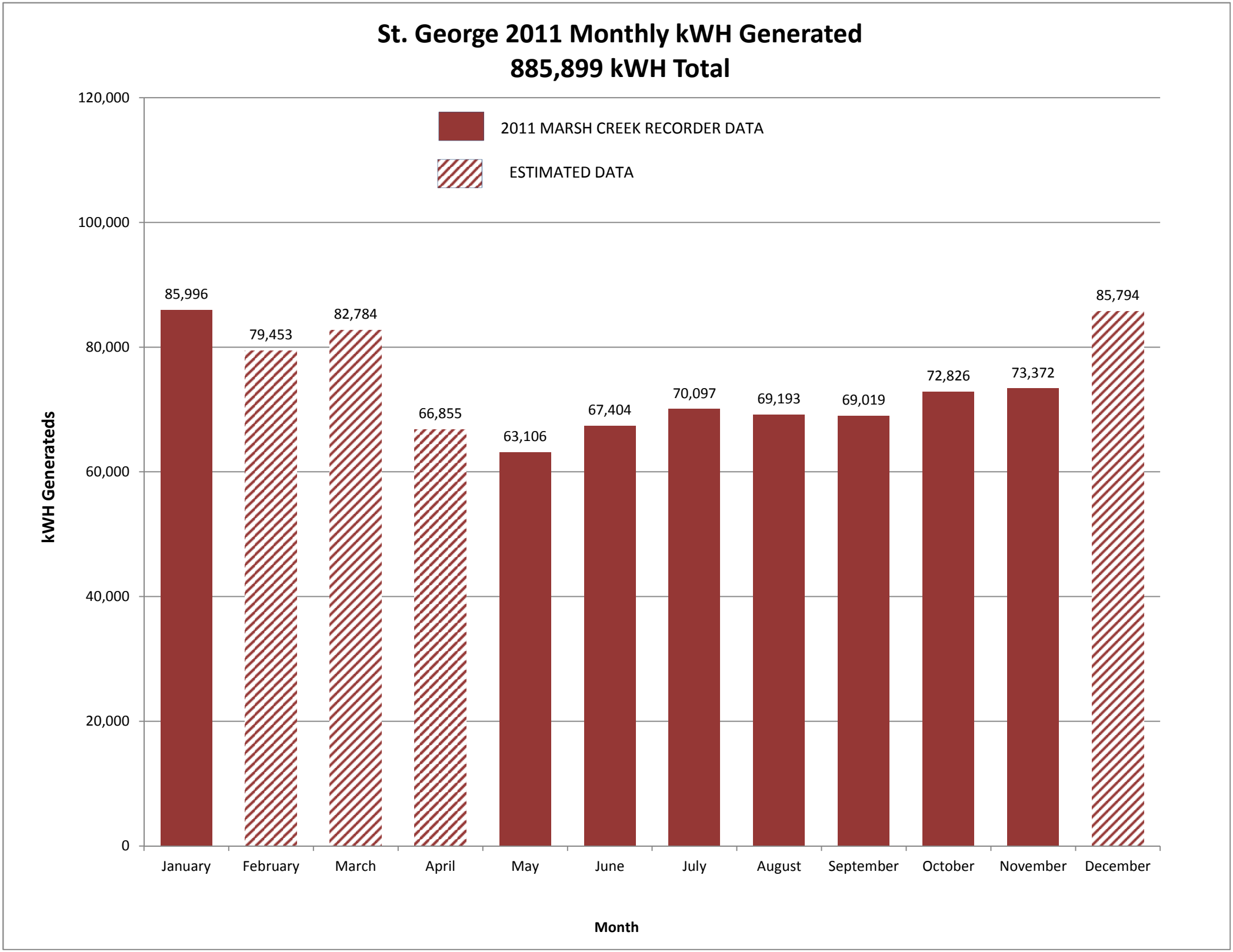
TJH/jlc
2/28/12

85-34


BERING SEA
NORTH ANCHORAGE
LOT 1, SEC. 29
TRACT 42
TRACT
LOT 43
LOT 11
LOT 14
LOT 15
LOT 16
LOT 13
LOT 12
LOT 10
LOT 9
LOT 8
LOT 7
LOT 6
LOT 5
LOT 4
LOT 3
LOT 2
LOT 1
U S SURVEY 4901 LOT 2
TRACT 52 LOT 1
TRACT 52 LOT 2
TRACT 52 LOT 3
TRACT 52 LOT 4
TRACT 52 LOT 14
TRACT 52 LOT 15
TRACT 52 LOT 19
TRACT 44
TRACT 50
TRACT 51
LOT 4 Sec. 29
47
BASIS OF BEARING (N 84°09'E 8.68 ch.) N 84°09'00"E 573.00'
BASIS OF BEARING (N 78°53'W 3.66 ch.)
DETAIL
NOT TO SCALE
THIS SURVEY
BERING SEA
ST. GEORGE ISLAND
VICINITY MAP
1" = 3 MILES
85-34
RECORDED FILED
12-24-85
TANAQ COLL
260 Fairbanks St.
Anch AK 99503
TAX CERTIFICATE
I HEREBY CERTIFY THAT NO TAX PAYMENT IS CURRENTLY DUE FOR THE PROPERTIES BEING SUBDIVIDED HEREON.
DATE
MARIA MALAMAMAN, TAX CLERK
CITY OF ST. GEORGE
CERTIFICATE OF OWNERSHIP AND DEDICATION
I, ROLLAND SCHMITTEN, HEREBY CERTIFY THAT I AM THE NORTHWEST REGIONAL DIRECTOR FOR THE NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE AND THAT THE UNITED STATES OF AMERICA IS THE OWNER OF TRACT 42, 43 AND 47 WITHIN T41S, R129W, S.M., ALASKA, AND HAVE THE SPECIFIC AUTHORITY TO EXECUTE THIS DOCUMENT AND APPROVE THIS SURVEY FOR THE THE UNITED STATES OF AMERICA. I HEREBY DEDICATE TO THE PUBLIC ALL AREAS DEPICTED AS STREETS, ALLEYS, THOROUGHFARES, PARKS, AND OTHER PUBLIC AREAS SHOWN HEREON.
DATE
ROLLAND SCHMITTEN, N.W. REGIONAL DIRECTOR
NATIONAL MARINE FISHERIES SERVICE
NOTARY'S ACKNOWLEDGEMENT
Subscribed and sworn to before me A NOTARY for ALASKA
Title Day of 1985
Notary for Alaska
My Commission Expires
CITY APPROVAL AND ACCEPTANCE OF DEDICATION
I HEREBY CERTIFY THAT THE SURVEY SHOWN HEREON HAS BEEN FOUND TO COMPLY WITH THE PLATTING REGULATIONS OF THE CITY OF ST. GEORGE AND IS HEREBY APPROVED. THE CITY OF ST. GEORGE HEREBY ACCEPTS FOR PUBLIC USE AND FOR PUBLIC PURPOSE THE REAL PROPERTY DEDICATED ON THIS PLAT AS STREETS, ALLEYS, THOROUGHFARES AND PARKS.
DATE
MARIA MALAMAMAN, MAYOR
CITY OF ST. GEORGE
DATE
CITY CLERK
NOTARY'S ACKNOWLEDGEMENT
Subscribed and sworn to before me A NOTARY for ALASKA
Title Day of 1985
Notary for Alaska
3/18/89
My Commission Expires
OFFICIAL SEAL
STATE OF ALASKA
NOTARY PUBLIC
M. E. WILSON
LEGEND
FOUND 3-1/4" DIA. AL. CAP ON 2-1/2" DIA. AL. POST, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
FOUND 3-1/4" DIA. AL. CAP ON 3/4" DIA. AL. ROD, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
SET 1-1/2" DIA. AL. CAP ON 5/8" DIA. REBAR, TOP FLUSH WITH GROUND UNLESS OTHERWISE NOTED.
(ch.) RECORD DIMENSION FROM BUREAU of LAND MANAGEMENT PLAT APPROVED 6 APRIL 1963 AND FILED 15 FEBRUARY 1966.
NOTES
1. THE NATURAL MEANDERS OF THE LINE OF MEAN HIGH WATER WERE NOT FIELD MEASURED THIS SURVEY. MEANDERS SHOWN HEREON WERE EXTRACTED FROM THE BUREAU OF LAND MANAGEMENT ORIGINAL FIELD NOTES FOR THE ORIGINAL SURVEY OF T41S, R129W AND R130W, S.M., ALASKA, APPROVED 6 APRIL 1963 AND FILED 15 FEBRUARY 1966.
2. A UTILITY EASEMENT 6 FEET IN WIDTH IMMEDIATELY ADJACENT TO ALL RIGHTS-of-WAY IS HEREBY CREATED WITH THE EXCEPTION OF THOSE AREAS WHICH WOULD FALL INSIDE BUILDINGS WHICH WERE IN EXISTANCE PRIOR TO THE CREATION OF THIS PLAT.
SURVEYOR'S CERTIFICATE
I TOM BENSON, PLS, 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, AND THAT THE MONUMENTS SHOWN HEREON ACTUALLY EXIST AS DESCRIBED, AND THAT ALL DIMENSIONS AND OTHER DETAILS ARE CORRECT.
23 DEC 85
DATE
TOM BENSON, PLS LS 6706
SURVEY CONDUCTED 29 AUGUST thru 6 SEPTEMBER 1984
STATE OF ALASKA
TOM BENSON
LS 6706
A PLAT OF
GANAK SUBDIVISION
LOTS 1 thru 16 of TRACT 43
AND
LOT 1 AND LOT 2 of TRACT 42
AND
LOTS 1 thru 5 of TRACT 47
A SUBDIVISION OF
TRACT 42 & TRACT 43 & TRACT 47
T41S, R129W, S.M., ALASKA
ST. GEORGE ISLAND, ALASKA
TOM BENSON, PLS
BR 3 BOX 5117
CHUGIAK, ALASKA 99567
DRAWN: JAG
DATE: 10/31/85
SCALE: 1"=60'
DWG NO. 85-8
CHECKED: TB
CENTRUM
SHEET 1 of 1

APPENDIX D

ELECTRICAL LOAD DATA


St. George 2011 Monthly kWH Generated
885,899 kWH Total
2011 MARSH CREEK RECORDER DATA
ESTIMATED DATA
120,000
100,000
80,000
60,000
40,000
20,000
0
kWH Generateds
85,996
79,453
82,784
66,855
63,106
67,404
70,097
69,193
69,019
72,826
73,372
85,794
January
February
March
April
May
June
July
August
September
October
November
December
Month

APPENDIX E

HEAT RECOVERY WORKSHEET AND GRAPHS

ST. GEORGE RECOVERED HEAT UTILIZATION SIMULATION WORK SHEET

			PROGRAM RESULTS:	
Annual O&M cost:	0	$/year.	Savings, year 0, gallons	**14522**
Cost Estimate		$		
Fuel heat value	138000	Btu/gall.		
Fuel cost	0.00	$/gallon		
Fuel cost escal.	0	/year		
Power increase	0	/year		
Discount rate	0	/year		

GEN DATA: Jacket Water Only

Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh
Heat rate at kw-load above	0	3200	Btu/kwh

SYSTEM LOSS DATA:

Constant losses:			
Plant piping:	5000	Btu/hr.	Piping main insulated, branch piping & flexes bar
Buried Arctic piping:	24000	Btu/hr.	(800' of 3" @ 0.155 & 500' of 1-1/2" at 0.124)*(170F-40F)
Genset Eng. Preheat	15000	Btu/hr.	Pre-heat 3 offline engines
Total constant:	**44000**	Btu/hr.	
Variable losses:			
Radiators/Exter Pipe	0	Btu/hr.xF	Amot normally closed
Plant Heating	50	Btu/hr.xF	Control room only, genr rm heated by running engin
	0	Btu/hr.xF	

GENERATION DATA: See Note

Kwh/month:	
January	85,996
February	79,453
March	82,784
April	66,855
May	63,106
June	67,404
July	70,097
August	69,193
September	69,019
October	72,826
November	73,372
December	85,794
	885899

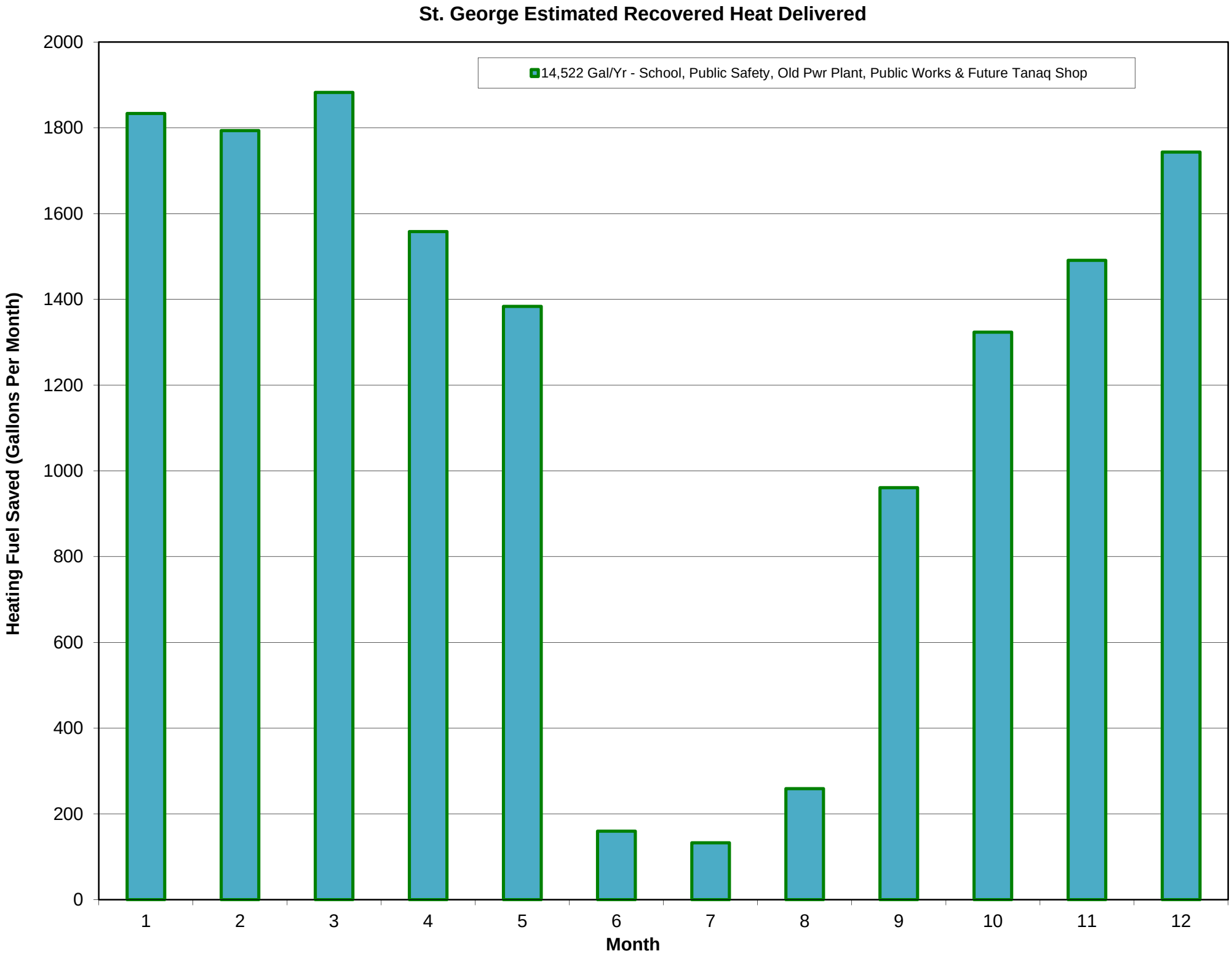
WEATHER DATA

HDD/Month:	**St. Paul**
	1190
	1193
	1265
	1101
	924
	705
	586
	536
	612
	843
	960
	1116
	11031

NOTE: Missing 4 months of generation data. Used Old Harbor and Atka for comparison because they are similar ice-free maritime communities with diesel only generation. Available 2011 PCE data used to compare with known 2011 St. George monthly data (red) and extrapolate unknown 2011 St. George monthly data (blue).

BUILDING DATA

Fuel use, gallons	Seasona	Non-Seasona	Boiler Efficiency	Building in use, 1=yes, 0=no											
School	6500	0	75%	1	1	1	1	1	0	0	0	1	1	1	1
Pub Safety	2500	0	75%	1	1	1	1	1	0	0	1	1	1	1	1
Pub Works	2500	0	75%	1	1	1	1	1	1	1	1	1	1	1	1


St. George Estimated Recovered Heat Delivered
14,522 Gal/Yr - School, Public Safety, Old Pwr Plant, Public Works & Future Tanaq Shop
Heating Fuel Saved (Gallons Per Month)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
11
12
Month

APPENDIX F

WIND POWER MODELING REPORT BY AEA

Introduction

In September 2004, the Alaska Energy Authority (the Authority), the Aleutian/Pribilof Islands Association, TDX Power, and members of the community installed a 30 meter meteorological tower on St. George Island to evaluate the feasibility of wind power in St. George. A Wind Resource Assessment was performed by the Authority and the wind regime in St. George was found to be Class 7 (superb). A Denali Commission and Renewable Energy Fund Round One grant was awarded to the City of St. George for the design and construction of a wind farm. A Rural Power System Upgrade (RPSU) is being funded in St. George by the Rural Power System Upgrade Program (RPSU) and the Denali Commission. The RPSU and Wind Project have been combined and will be managed by the Authority. This document is an appendix to the RPSU Conceptual Design Report (CDR) and will provide a narrative for the analysis performed by the Authority in regards to the St. George Wind Farm.

Background

Originally, the St. George Wind Project included funding from three sources totaling $3,000,000. The Denali Commission provided $1,000,000, round one of the RE Fund provided $1,500,000 and the Grantee was to provide a $500,000 match which was expected to come from the Authority's Power Project Loan Fund. The Denali Commission subsequently rescinded their funding of the wind project. The grantee has also been reimbursed $236,638 from the Renewable Energy Fund for contractual services in the production of a 65% design. The RE Fund balance for this project is $1,263,362.

The Denali Commission and Rural Power Systems Upgrade (RPSU) Program are providing funds to perform RPSU work in St. George. At the suggestion of the Authority and with the agreement of the Grantee, the RPSU grant and REF round 1 grant will be combined and managed by the Authority under a comprehensive St. George Energy project. At the recommendation of the Authority, $500,000 of the RPSU funds will be used as the match for the REF grant releasing the City of St. George from their obligation to provide funds to the project. The St. George Energy project has funding from Round 1 of the RE Fund in the amount of $ $1,263,362 plus $2,100,000 from the Denali Commission and $1,804,000 from the RPSU Program for a total of $5,167,362.

A 65% Design Report was written by Marsh Creek, LLC based on the original $3,000,000 budget. This design called for the installation of a high penetration wind-diesel-battery system. The system would consist of two remanufactured Vestas V-17 wind turbines, a 336 kWh battery, a grid forming inverter, a synchronous condenser, an electric boiler, Electric Thermal Storage (ETS), secondary load controls and upgrades to the power plant. Ultimately, the reduction in budget for the wind farm has necessitated a reduction in the complexity of the system, resulting in the current recommendations.

Wind Regime

The full Wind Resource Analysis performed by Mia Divine of the Authority is attached. A summary of the findings is provided in this section. As stated above, a met tower was erected in St. George in September of 2004 and data was collected for 13 months. Data recovery was near 100%. The met tower recorded no significant icing or other events which would cause turbine down time.

The wind resource in St. George is superb. The average wind speed at 30 meters is 9.6 m/s (21.1 mph) and the average power density is 968 W/m². The turbulence intensity is .098 with the wind at 15 m/s. These averages label the wind regime as Class 7 and category C. (Wind Classes range from 1 (poor) to 7 (superb) and turbulence categories range from A (high turbulence) to C (low turbulence).) St. George has high wind speeds with low turbulence. The wind shear of .111 is lower than the typical of .14. Wind shear is a measure of how wind speed increases with elevation. Since St. George experiences Class 7 winds at 30 meters the low wind shear will have no negative impact on the project. The primary wind directions are West-Southwest and East-Northeast.

Most turbines are built to survive in environments with temperatures higher than -20 C (-4° F). During the met tower study the temperature in St. George never dropped below -15 C (5° F). However, the record low temperature in St. George is -20.5 C (-5° F). Any turbine constructed in St. George will need to be Arctic rated as they will need to operate at these temperatures, not just survive. Parasitic loads, such as heaters, and changes in lubricants may be necessary. All metal should be checked to ensure that they do not lose their strength at these low temperatures.

St. George is an excellent candidate for wind power from a wind resource perspective. The community experiences wind speeds above most turbine's cut-in speeds 91% of the year. The community will not need to install an especially tall tower. This will save in both tower and foundation costs. The low turbulence does not call for the installation of a specialty wind turbine. Special considerations need to be made due to the sub-arctic environment and the community's location on an island in the Bering Sea. While the met tower did not record any icing it has been reported that such events do occur in St. George. In some cases an inch or more can accumulate on structures in the community. Any turbine chosen should be Arctic rated and the effects of icing should be carefully considered for both turbine and tower.

Community Load Profile

Currently, the most accurate electrical load data for St. George is Monthly Power Generated. Within this dataset the months of February, March, April and June are estimated. Primarily this data has been used to determine the average load on the power system. The average load in St. George has been estimated to range from 90 – 100 kW. The table below provides the numbers used to generate these estimates. The first column, labeled AEA Analysis, was built during the Authorities first cursory data analysis. These numbers are pulled from the Power Cost Equalization (PCE) Program, from meter readings at the power plant and from estimates made by Marsh Creek in the 2011 65% Design Report. The second column, labeled PCE Data, uses FY 2011 and FY 2012 data from PCE reporting and estimates made by Marsh Creek in the 2011 65% Design Report. The third column, labeled Marsh Creek, is data received by Marsh Creek in April 2012. Both the high and low estimates have been used as parameters for modeling and economic feasibility projections.

	St. George kWh generated		
	AEA Analysis	PCE Data	Marsh Creek
January	85,996	73,564	79,949
February	73,501	79,453	68,288
March	88,731	82,784	70,155
April	87,488	66,855	64,963
May	63,106	63,106	63,106
June	77,043	67,404	60,957
July	64,048	64,048	64,048
August	62,566	62,566	62,566
September	63,230	63,230	63,230
October	66,941	66,941	66,941
November	63,613	63,613	63,605
December	79,442	67,301	67,301
Total	875,705	820,865	795,109
Avg. Load (kW)	**100**	**94**	**91**

This data is adequate to provide average load estimates, but for system modeling hourly load data is required. Two different methods were used to estimate hourly load data for St. George. The first method used hourly load data from another community with equivalent commercial loads. This data demonstrates a general trend in the variability and amount of electricity being used at a given hour of the day. In this case Shaktoolik hourly load data was used. The hourly load data from Shaktoolik was entered into HOMER and was scaled for use in the St. George model. The second method used the AEA Alaska Village Electric Load Calculator and built data directly from community information. The hourly load data built by the Load Calculator was entered into HOMER and again scaled for use in the model. This Load Calculator estimated the average load in the community at 98 kW. In both cases, after the hourly load data was imported into HOMER, projections were made by scaling the data to both 90 kW and 100 kW average loads. Projections varied by less than 10% using the different techniques. For the production and economic estimates, the Alaska Village Electric Load Calculator version was used and scaled to 90kW averaged load.

Turbine and Tower Selection

From the average load data and wind resource analysis an approximate size for a properly sized wind farm can be determined. Another factor in this determination, especially in this case, is the budget. In a Class 7 wind regime most turbines are projected to operate at roughly a 36% capacity factor (CF). The AEA Wind Program will only approve low and medium penetration projects. Based on this guideline and the approximate 100 kW average load in St. George a maximum 167 kW nameplate capacity could be installed. Turbines near that size include the: Vestas V-27 (225 kW), V-17 (90 kW) and V-15 (65 kW); Windmatic 17s (95 kW) and 15s (65 kW); Northern Power NW100b (100 kW).

The 225kW Vestas V-27 exceeds the allowable nameplate capacity and at $485,000, does not fit within the budget. The expense for multiple foundations along with capacity limitations eliminates two turbine scenarios. The NW100b is the next logical turbine but costs approximately $220,000 more and is a more complicated machine than the Vestas or Windmatic turbines. The best options appear to be either a remanufactured Vestas V-17 or a remanufactured Windmatic 17s. Both machines are very similar in design and make-up, although the Windmatic does have a slightly higher nameplate capacity. According to Windographer the Windmatic 17s will have a 37% capacity factor while the Vestas V-17 will be slightly lower at 35%. However, the AEA Wind Program uses a ceiling of 36.2% for wind turbines in a class 7 wind regime and this is the value which is used for analysis. The ceiling is based on actual production by turbines in Alaska. The Vestas V-17 is approximately $60,000 more expensive than the Windmatic 17s. The Windmatic 17s provides more power production at a lower cost and is therefore the best selection.

Windwatchers Systems has designed a custom controller for use with the Windmatic 17s. The controller takes power from the wind turbine and runs it through a variable speed inverter creating a stable output voltage and frequency at very close to unity power factor. This eliminates the need for a synchronous condenser and other complex control systems. It also has the ability to limit the speed of the turbine by electrically "braking" the generator. This can be used to limit power output during times of high wind speed and low electric load. It also reduces wear on the mechanical brakes when stopping the turbine.

There are both lattice and monopole towers available for Windmatic turbines. Based on reports of icing events occurring in St. George, ice effects need to be considered in tower selection. Tubular monopole towers are not affected by ice to the same degree as lattice towers. There are fewer surfaces to which the ice can attach. Another benefit of a monopole tower is the ability to climb inside the tower and out of the elements. This can be especially beneficial in icing scenarios where a lattice tower may be too slick to climb for weeks. Monopole towers are more expensive but the additional cost appears to be justified by increased safety and greater accessibility for maintenance during icing conditions.

Production and Economic Estimates

A conservative approach was used in the following production and economic estimates. The lowest predicted average load was used along with the AEA Load Calculator dataset in the HOMER model. This combination estimated the highest amount of "excess" energy. Excess energy is energy produced by the system which exceeds the electrical demand on the system. This usually occurs during times of high wind and/or low load.

Gross production for a remanufactured Windmatic 17s in St. George is estimated at 300,000 kWh. An estimated 5% (15,000 kWh) will be lost to parasitic loads and transmission losses. There is also expected to be 48,000 kWh of "excess" electrical energy. This will be used in the secondary loads and converted to heat for use in the heat recovery loop. The net wind production used for electricity is predicted to be 240,000 kWh. This corresponds to a reduction in diesel used for electricity of nearly 18,000 gallons and a reduction in diesel used for heat of 1,400 gallons. These numbers assume a generator efficiency of 13 kWh/gal and a diesel boiler efficiency of 85%.

The FY 2011 PCE report shows the price of diesel for electricity at $5.85/gal. AEA uses the PCE price for diesel plus fifty cents as a baseline for the price of diesel for heat. In this case a price of $6.35/gal is assumed. AEA also uses the industry standard of $.04/kWh for an estimate on Operations and Maintenance costs. Using these prices, the proposed system will save the community an average of $134,000/year over the 20 year lifetime of the project. Lifetime savings of the project are estimate at $2.6M with a net present value of the project at $1.9M.

Recommendations

The wind resource in St. George is excellent and a wind project in St. George is viable. The Authority recommends that St. George install a single Windmatic 17s wind turbine. The average penetration of wind on the system could be as high as 38% in this scenario. This turbine should be installed on a monopole tower. The turbine should be used along with the Windwatchers Systems variable speed controller.

A 75kW electric boiler should be installed at the power plant to serve as a secondary “dump” load. The boiler should be connected into the diesel waste heat recovery loop so that excess wind energy can be used for heating buildings. The boiler should be equipped with a high speed variable load control to provide frequency control on the system. The wind control should be integrated with the diesel power plant switchgear and should be accessible through a common Supervisory Control and Data Acquisition (SCADA) system.

The City of St. George has plans to expand their electricity usage through the construction of a port and other fishing related industry. With an increase in the average load, installation of a second wind turbine may become viable. The upgrades to the generation and distribution system should be designed and built with the expansion of the wind farm in mind.

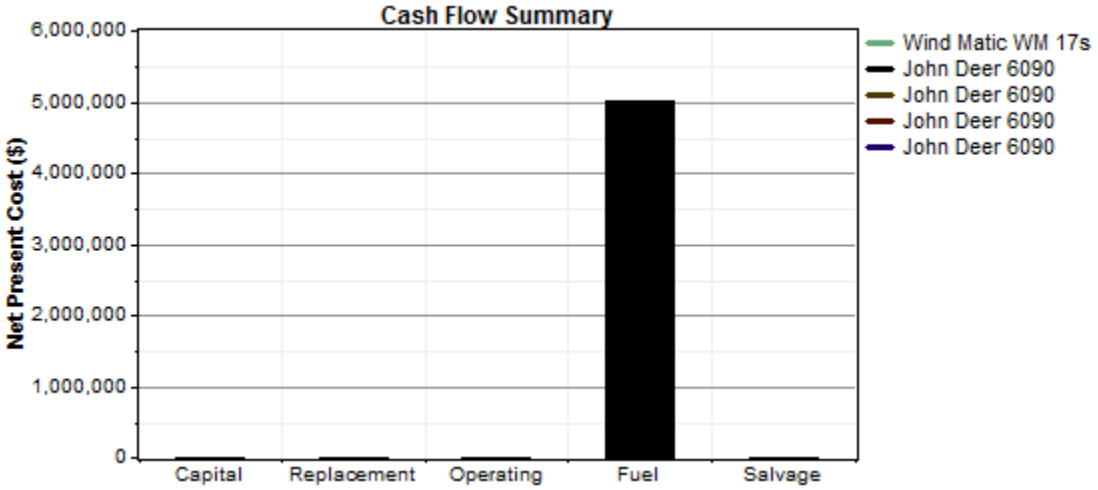
System Report - St George w AEA Calculated load data (4 JD6090) (1 W17s).hmr

System architecture

Wind turbine	1 Wind Matic WM 17s
John Deer 6090	190 kW
John Deer 6090	190 kW
John Deer 6090	190 kW
John Deer 6090	190 kW

Cost summary

Total net present cost	$ 5,005,432
Levelized cost of energy	$ 0.422/kWh
Operating cost	$ 336,444/yr

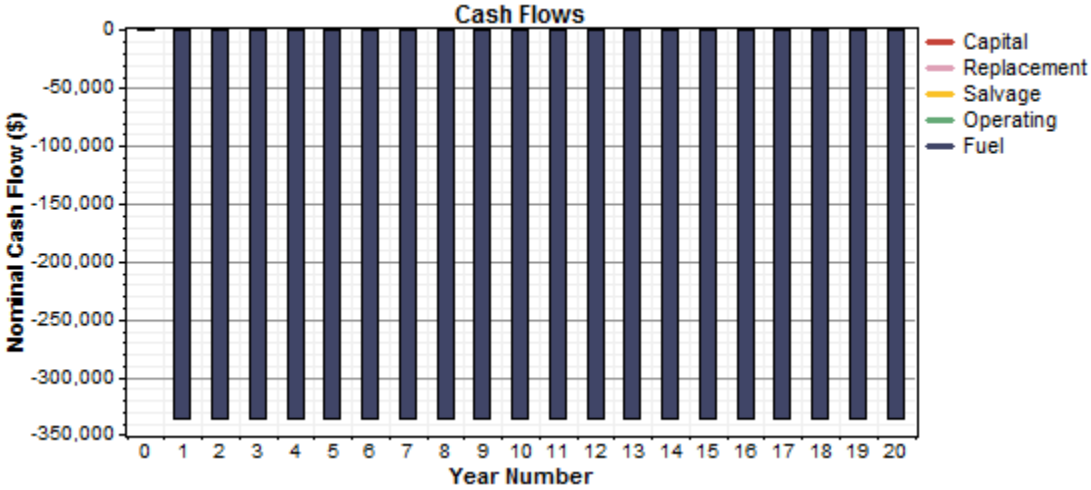


Net Present Costs

Component	Capital	Replacement	O&M	Fuel	Salvage	Total
	($)	($)	($)	($)	($)	($)
Wind Matic WM 17s	0	0	0	0	0	0
John Deer 6090	0	0	0	5,005,434	0	5,005,434
John Deer 6090	0	0	0	0	0	0
John Deer 6090	0	0	0	0	0	0
John Deer 6090	0	0	0	0	0	0
System	0	0	0	5,005,434	0	5,005,434

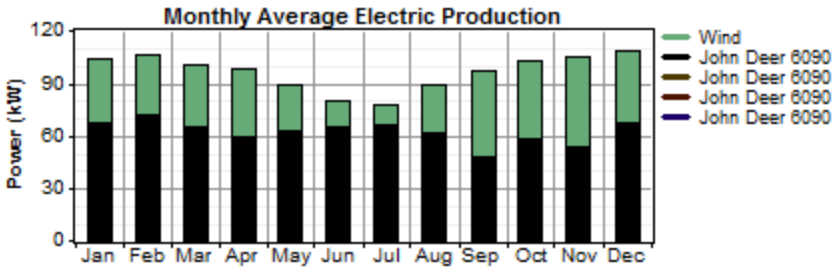
Annualized Costs

Component	Capital	Replacement	O&M	Fuel	Salvage	Total
	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)
Wind Matic WM 17s	0	0	0	0	0	0
John Deer 6090	0	0	0	336,444	0	336,444
John Deer 6090	0	0	0	0	0	0
John Deer 6090	0	0	0	0	0	0
John Deer 6090	0	0	0	0	0	0
System	0	0	0	336,444	0	336,444



Electrical

Component	Production	Fraction
	(kWh/yr)	
Wind turbine	300,516	36%
John Deer 6090	545,024	64%
John Deer 6090	0	0%
John Deer 6090	0	0%
John Deer 6090	0	0%
Total	845,540	100%

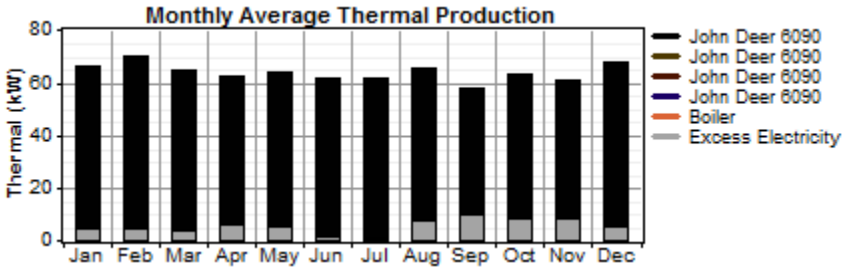


Load	Consumption	Fraction
	(kWh/yr)	
AC primary load	797,527	100%
Total	797,527	100%

Quantity	Value	Units
Excess electricity	48,013	kWh/yr
Unmet load	0.00581	kWh/yr
Capacity shortage	0.00	kWh/yr
Renewable fraction	0.000	

Thermal

Component	Production	Fraction
	(kWh/yr)	
John Deer 6090	511,999	91%
Boiler	0	0%
Excess electricity	48,013	9%
Total	560,012	100%



Load	Consumption	Fraction
	(kWh/yr)	
Thermal load	0	

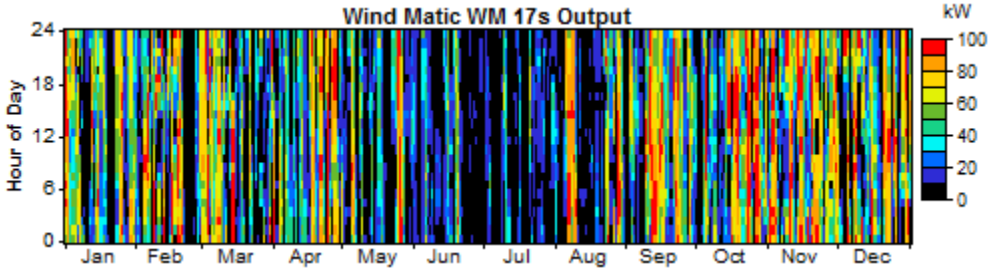
Total	0	

Quantity	Value	Units
Excess thermal energy	560,012	kWh/yr

AC Wind Turbine: Wind Matic WM 17s

Variable	Value	Units
Total rated capacity	95.0	kW
Mean output	34.3	kW
Capacity factor	36.1	%
Total production	300,516	kWh/yr

Variable	Value	Units
Minimum output	0.00	kW
Maximum output	95.0	kW
Wind penetration	37.7	%
Hours of operation	8,162	hr/yr
Levelized cost	0.00	$/kWh



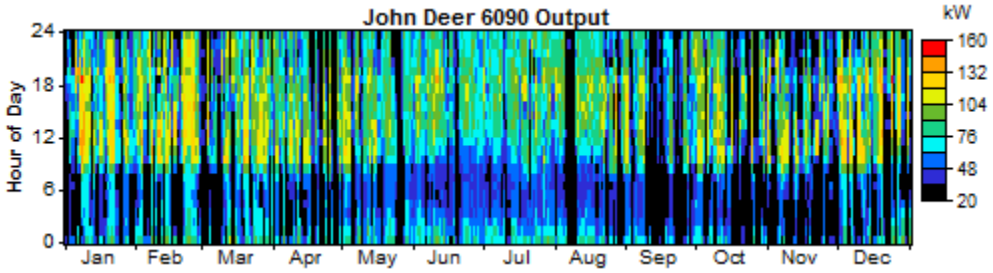
John Deer 6090

Quantity	Value	Units
Hours of operation	8,760	hr/yr
Number of starts	1	starts/yr
Operational life	1.71	yr
Capacity factor	32.7	%
Fixed generation cost	5.40	$/hr
Marginal generation cost	0.530	$/kWhyr

Quantity	Value	Units

Electrical production	545,024	kWh/yr
Mean electrical output	62.2	kW
Min. electrical output	28.5	kW
Max. electrical output	151	kW
Thermal production	511,999	kWh/yr
Mean thermal output	58.4	kW
Min. thermal output	33.6	kW
Max. thermal output	124	kW

Quantity	Value	Units
Fuel consumption	159,452	L/yr
Specific fuel consumption	0.293	L/kWh
Fuel energy input	1,569,008	kWh/yr
Mean electrical efficiency	34.7	%
Mean total efficiency	67.4	%



John Deer 6090

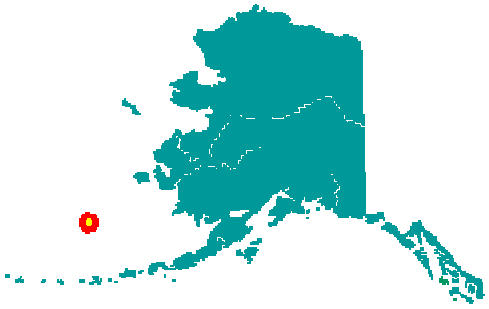
Quantity	Value	Units
Hours of operation	0	hr/yr
Number of starts	0	starts/yr
Operational life	1,000	yr
Capacity factor	0.00	%
Fixed generation cost	5.40	$/hr
Marginal generation cost	0.530	$/kWhyr

Quantity	Value	Units
Electrical production	0.00	kWh/yr

813 W. Northern Lights Blvd.
Anchorage, AK 99503
Phone: 907-269-3000
Fax: 907-269-3044
www.aidea.org/wind.htm

Wind Resource Assessment for ST GEORGE, ALASKA Site # 2401

Date last modified: 11/22/2005
Prepared by: Mia Devine



St.George Met Tower (right) and unidentified tower (left)

Latitude: (NAD27)	56˚ 35' 11.6" N 56˚ 35.193
Longitude: (NAD27)	169˚ 36' 52.7" W -169˚ 36.878

Elevation:	130 ft
Tower Type:	30-meter NRG Tall Tower
Monitor Start: Monitor End:	9/14/2004 In operation

INTRODUCTION

In September 2004 the Alaska Energy Authority, Aleutian/Pribilof Islands Association, TDX Power, and members of the community installed a 30-meter tall meteorological tower on Saint George Island. The purpose of this monitoring effort is to evaluate the feasibility of utilizing utility-scale wind energy in the community. This report summarizes the wind resource data collected to date and the long-term energy production potential of the site.

SITE DESCRIPTION

The community of Saint George is located on the northeast shore of Saint George Island. Saint George Island is located about 750 miles west of Anchorage and 250 miles northwest of Unalaska. Figure 1 shows the location of the met tower.

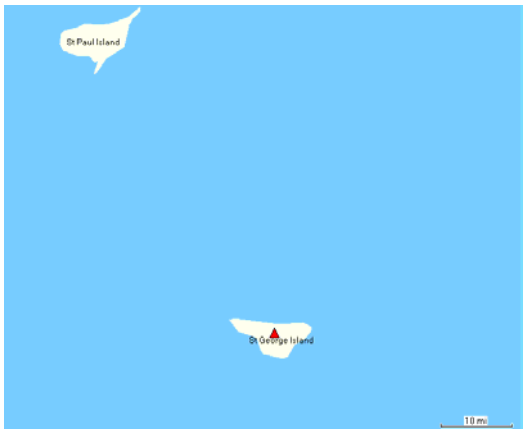


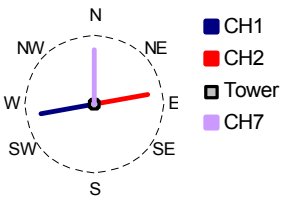
Figure 1. Map of Met Tower Site and Surrounding Area

Table 1 lists the types of sensors that were mounted on the met tower, the channel of the data logger that each sensor was wired into, and where each sensor was mounted on the tower.

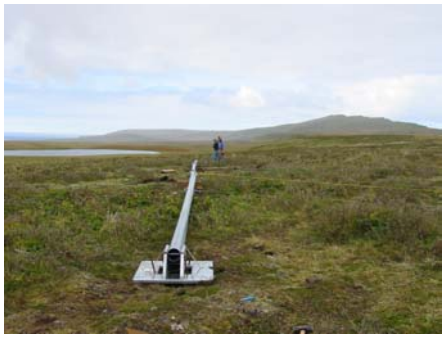
Table 1. Summary of Sensors Installed on the Met Tower

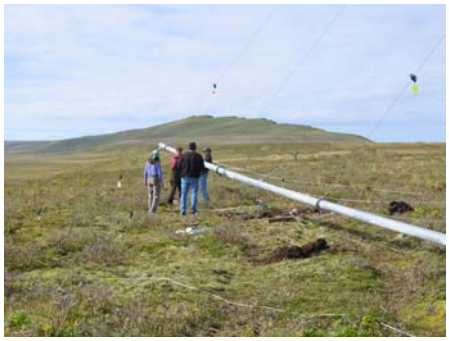
Ch #	Sensor Type	Height	Offset	Boom Orientation
1	#40 Anemometer	30 m	NRG Standard	260˚ True
2	#40 Anemometer	20 m	NRG Standard	80˚ True
7	#200P Wind Vane	30 m	True North	True North
9	#110S Temperature	5 m	0	-

Arial view of equipment on tower



The photos below illustrate the surrounding ground cover and any major obstructions, which could have an affect on how the wind flows over the terrain from a particular direction.





DATA PROCESSING PROCEDURES AND DEFINITIONS

The following information summarizes the data processing procedures that were performed on the raw measured data in order to create an annual dataset of "typical" wind speeds, which could then be used to calculate potential power production from wind turbines. There are various methods and reasons for adjusting the raw data, so the purpose of these notes is to document what was done in this situation. The raw data set is available on the Alaska Energy Authority website (www.akenergyauthority.org) so one could perform their own data processing procedures.

Units – Since most wind turbine manufacturer data is provided in metric units, those units are used here.

1 meter/second = 2.24 mph = 1.95 knots
1 meter = 3.28 feet
1 ˚C = 5/9 (˚F – 32)

Max/Min Test – All of the 10-minute data values were evaluated to ensure that none of them fell outside of the normal range for which the equipment is rated.

Tower Shadow – The tower itself can affect readings from the anemometer at times when the anemometer is located downwind of the tower. In this case, the 30-meter anemometer may record slightly lower values than the free stream velocity when the wind is coming from the east.

Icing – Anomalies in the data can suggest when the sensors were not recording accurately due to icing events. Since wind vanes tend to freeze before the anemometers, icing events are typically identified whenever the 10-minute standard deviation of the wind vane is zero (the wind vane is not moving) and the temperature is at or below freezing. Some additional time before and after the icing event are filtered out to account for the slow build up and shedding of ice.

Filling Gaps – Whenever measured met tower data is available, it is used. Two different methods are used to fill in the remaining portion of the year. First, nearby airport data is used if available. A linear correlation equation is defined between the airport and met tower site, which is used to adjust the hourly airport data recorded at the time of the gap. If neither met tower nor airport data is available for a given timestep, the software program Windographer (www.mistaya.ca) is used. Windographer uses statistical methods based on patterns in the data surrounding the gap, and is good for filling short gaps in data.

Long-term Estimates – The year of data collected at the met tower site can be adjusted to account for inter-annual fluctuations in the wind resource. To do this, a nearby weather station with a consistent historical record of wind data and with a strong correlation to the met tower location is needed. If a suitable station is not available, there is a higher level of uncertainty in the wind speed that is measured being representative of a typical year.

Turbulence Intensity – Turbulence intensity is the most basic measure of the turbulence of the wind. Turbulence intensity is calculated at each 10-minute timestep by dividing the standard deviation of the wind speed during that timestep by the average wind speed over that timestep. It is calculated only when the mean wind speed is at least 4 m/s. Typically, a turbulence intensity of 0.10 or less is desired for minimal wear on wind turbine components.

Wind Shear – Typically, wind speeds increase with height above ground level. This vertical variation in wind speed is called wind shear and is influenced by surface roughness, surrounding terrain, and atmospheric stability. The met tower is equipped with anemometers at different heights so that the wind shear exponent, α, can be calculated according to the power law formula:

$$\left(\frac{H_1}{H_2}\right)^{\alpha} = \left(\frac{v_1}{v_2}\right)$$ where H_1 and H_2 are the measurement heights and v_1 and v_2 are the measured wind speeds.

Wind shear is calculated only with wind speed data above 4 m/s. Values can range from 0.05 to 0.25, with a typical value of 0.14.

Scaling to Hub Height – If the wind turbine hub height is different from the height at which the wind resource is measured, the wind resource can be adjusted using the power law formula described above and using the wind shear data calculated at the site.

Air Density Adjustment – The power that can be extracted from the wind is directly related to the density of the air. Air density, ρ, is a function of temperature and pressure and is calculated for each 10-minute timestep according to the following equation (units for air density are kg/m^3):

$\rho = \frac{P}{R \times T}$, where P is pressure (kPa), R is the gas constant for air (287.1 J/kgK), and T is temperature in Kelvin.

Since air pressure is not measured at the met tower site, the site elevation is used to calculate an annual average air pressure value according to the following equation:

P = 1.225 – (1.194 x 10^{-4}) x elevation

Since wind turbine power curves are based on a standard air density of 1.225 kg/m3, the wind speeds measured at the met tower site are adjusted to create standard wind speed values that can be compared to the standard power curves. The adjustment is made according to the following formula:

$$V_{standard} = V_{measured} \times \left(\frac{\rho_{measured}}{\rho_{standard}} \right)^{\frac{1}{3}}$$

Wind Power Density – Wind power density provides a more accurate representation of a site's wind energy potential than the annual average wind speed because it includes how wind speeds are distributed around the average as well as the local air density. The units of wind power density are watts per square meter and represent the power produced per square meter of area that the blades sweep as they rotate around the rotor.

Wind Power Class – A seven level classification system based on wind power density is used to simplify the comparison of potential wind sites. Areas of Class 4 and higher are considered suitable for utility-scale wind power development.

Weibull Distribution – The Weibull distribution is commonly used to approximate the wind speed frequency distribution in many areas when measured data is not available. In this case, the Weibull distribution is used to compare with our measured data. The Weibull is defined as follows:

$$P(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} \exp\left(\frac{-v}{c}\right)^{k}$$

Where P(v) is the probability of wind speed v occurring, c is the scale factor which is related to the average wind speed, and k is the shape factor which describes the distribution of the wind speeds. Typical k values range from 1.5 to 3.0, with lower k values resulting in higher average wind power densities.

WIND DATA RESULTS FOR ST GEORGE MET TOWER SITE

Table 2 summarizes the amount of data that was successfully retrieved from the anemometers at the met tower site. There was minimal data loss due to icing or equipment failure.

Table 2. Data Recovery Rates for St George Met Tower Data

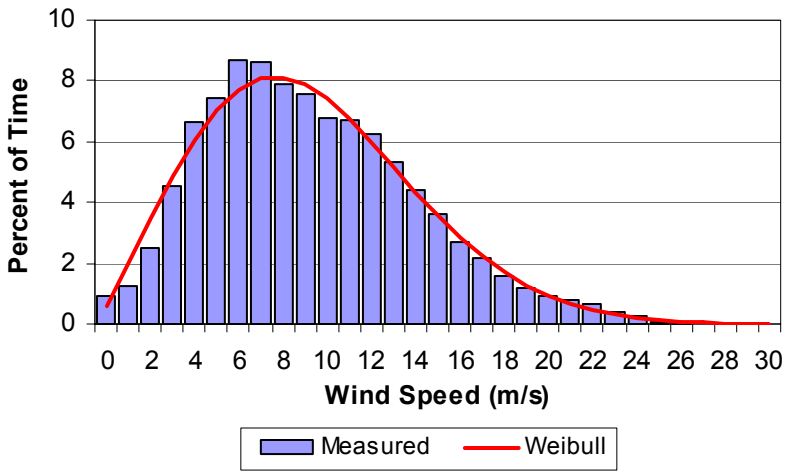
Month	% Data Recovered
January	100.0%
February	99.9%
March	99.7%
April	99.9%
May	100.0%
June	100.0%
July	100.0%
August	100.0%
September	100.0%
October	100.0%
November	100.0%
December	99.9%
Annual Avg	**100%**

Table 3 summarizes the wind resource data measured at the met tower site. As shown, the highest wind month is November and the lowest wind month is July. The annual average wind speed is 9.6 m/s (21.5 mph).

Table 3. Measured Wind Speeds at St. George Met Tower Location, 30-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0	10.4	9.1	9.8	10.8	8.3	7.0	5.9	8.3	10.1	11.4	13.2	11.3	9.6
1	10.2	9.6	9.7	10.5	8.4	6.9	6.0	8.4	10.2	11.5	13.2	11.3	9.7
2	10.1	9.6	9.5	10.5	8.4	6.9	6.1	8.2	10.3	12.1	13.4	11.2	9.7
3	9.8	9.0	9.4	10.4	8.5	6.9	6.0	8.6	10.2	12.3	13.2	10.8	9.6
4	9.8	9.2	9.3	10.4	8.4	6.9	5.7	8.6	10.3	12.0	12.5	11.0	9.5
5	9.7	9.4	9.2	10.3	8.2	7.2	5.5	8.7	10.5	12.0	11.7	11.0	9.4
6	9.5	9.7	9.2	10.3	8.1	6.9	5.7	8.6	10.8	11.8	11.6	11.1	9.4
7	9.6	9.5	9.5	10.3	8.2	6.7	5.8	8.5	10.9	11.6	11.7	11.0	9.4
8	9.5	9.4	9.5	10.1	8.3	6.7	6.1	8.3	10.8	11.4	11.8	10.9	9.4
9	9.6	9.1	9.1	10.2	8.4	6.6	6.2	8.4	10.8	11.2	12.0	10.4	9.3
10	9.5	9.0	9.2	10.3	8.2	6.7	6.3	8.5	10.8	11.1	12.4	10.5	9.4
11	9.4	8.7	9.2	10.2	8.6	6.8	6.6	8.7	11.1	11.4	12.6	10.5	9.5
12	9.6	8.5	9.3	10.1	8.7	6.9	6.8	8.8	11.4	11.2	12.5	10.5	9.5
13	10.0	8.9	9.4	10.1	8.7	7.1	6.9	8.7	11.4	11.6	12.4	10.4	9.6
14	9.8	9.2	9.7	10.4	9.1	7.1	6.9	8.6	11.4	11.8	12.3	10.4	9.7
15	9.8	9.5	9.8	10.4	9.1	7.2	7.1	8.4	11.4	12.0	12.3	10.4	9.8
16	9.6	9.6	10.0	10.4	8.9	7.0	7.0	8.5	11.2	12.1	12.1	10.3	9.7
17	9.4	9.8	9.9	10.2	8.8	6.9	7.0	8.4	11.1	12.1	12.1	10.4	9.7
18	9.4	9.7	9.6	10.2	8.6	6.9	7.0	8.3	11.0	12.0	12.4	10.6	9.6
19	9.3	9.4	9.4	10.2	8.6	6.8	6.9	8.5	11.0	11.8	12.5	11.0	9.6
20	9.7	9.6	9.4	10.1	8.5	6.6	6.6	8.9	10.7	11.6	12.5	10.9	9.6
21	10.1	9.5	9.7	9.9	8.4	6.7	6.4	8.8	10.6	11.7	12.2	11.1	9.6
22	10.1	9.2	9.9	9.8	8.3	6.7	6.4	8.4	10.4	11.7	12.5	11.2	9.6
23	10.4	9.1	10.3	10.0	8.3	6.7	6.0	8.3	10.3	11.7	12.4	11.3	9.6
Avg	9.8	9.3	9.5	10.3	8.5	6.9	6.4	8.5	10.8	11.7	12.4	10.8	9.6

A common method of displaying a year of wind data is a wind frequency distribution, which shows the percent of the year that each wind speed occurs. Figure 2 shows the measured wind frequency distribution as well as the best matched Weibull distribution (c = 11, k= 2.13).



Bin m/s	Measured Hours
0	83
1	112
2	221
3	400
4	580
5	651
6	760
7	757
8	691
9	661
10	594
11	586
12	546
13	465
14	387
15	317
16	239
17	189

Bin m/s	Measured Hours
18	140
19	106
20	79
21	68
22	55
23	37
24	22
25	9
26	4
27	1
28	0
29	1
30	1
31	1
32	0
33	0
34	0
Total:	8,760

Figure 2. Wind Speed Frequency Distribution of St George Met Tower Data, Sept 2004 – Oct 2005

The cut-in wind speed of many wind turbines is 4 m/s and the cut-out wind speed is around 25 m/s. The frequency distribution shows that a large percentage of the wind in Saint George occurs within this operational zone.

TEMPERATURE

The air temperature can affect wind power production in two primary ways: 1) colder temperatures lead to higher air densities and therefore more power production, and 2) some wind turbines shut down in very cold situations (usually around –25°C). The monthly average temperatures measured at the met tower are shown in Figure 3. The temperature never dropped below -15°C from mid September 2004 through the end of October 2005.

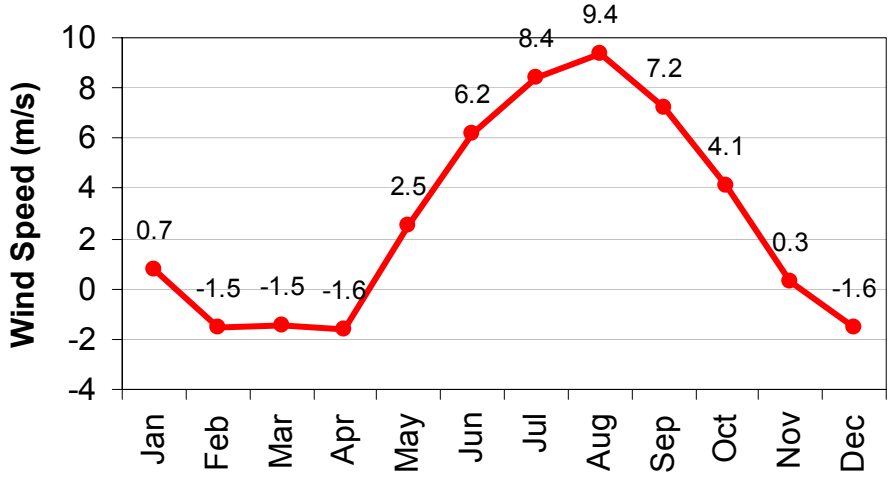


Figure 3. Monthly Average Air Temperatures at St George Met Tower Site

Table 4 shows the monthly wind roses for the year of data measured at the Saint George met tower.

Table 4. Monthly Wind Roses for Saint George Met Tower Site

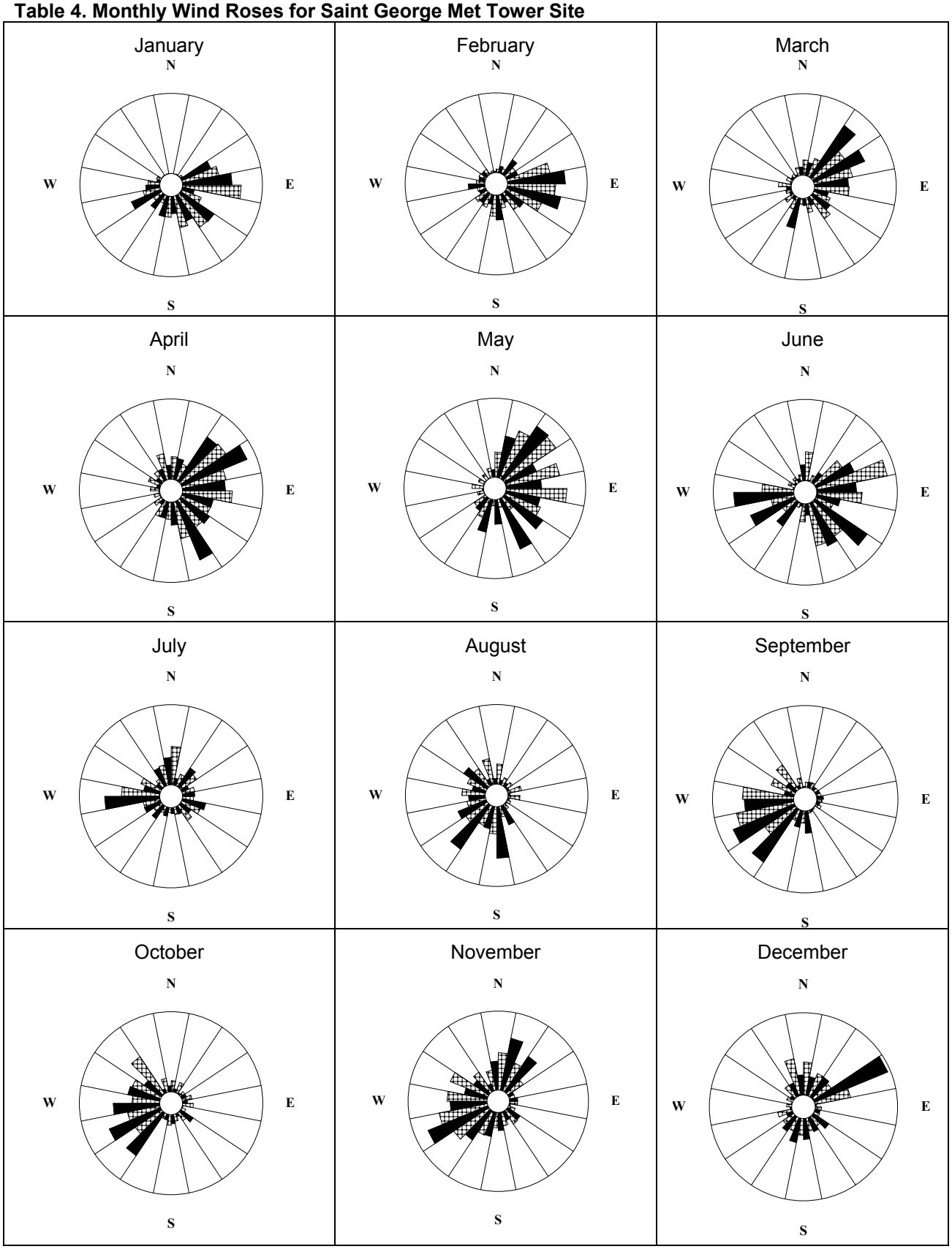


Table 5. Annual Wind Rose for Saint George Met Tower Site (Sept 2004 – Oct 2005)

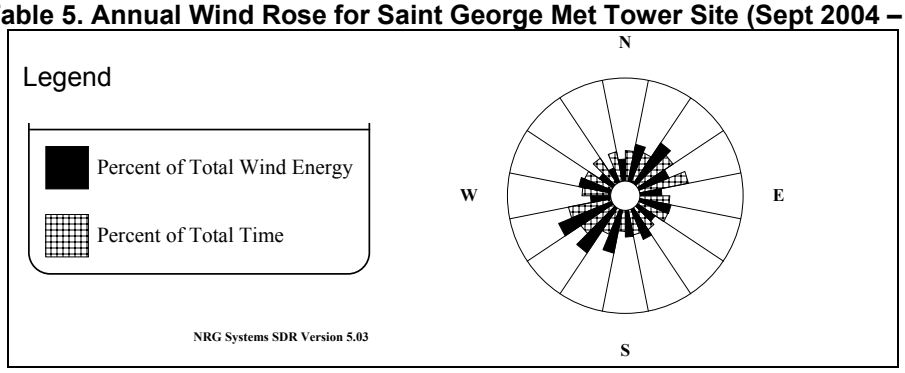


Table 6 summarizes the monthly turbulence intensity and wind shear at the met tower site. A turbulence intensity value of less than 0.10 is considered low and unlikely to contribute to excessive wear of wind turbines. Turbulence intensity is based on recordings of the 30-meter level anemometer. Wind shear is calculated between the 30-meter anemometer and the 20-meter anemometer. Due to the different directions those booms are facing, shear can only be calculated from certain directions when both anemometers are exposed to free stream wind speeds. Both turbulence intensity and wind shear are only calculated for wind speeds greater than 4 m/s. Figure 4 shows the turbulence intensity and wind shear by direction.

Table 6. Monthly Turbulence Intensity and Wind Shear at St George Met Tower Site

Month	Turbulence Intensity	20m to 30m Wind Shear
Jan	0.11	0.20
Feb	0.11	0.06
Mar	0.11	0.07
Apr	0.11	0.06
May	0.11	0.09
Jun	0.11	0.06
Jul	0.10	0.15
Aug	0.10	0.12
Sep	0.10	0.11
Oct	0.11	0.13
Nov	0.10	0.09
Dec	0.11	0.10
Annual Avg	**0.11**	**0.10**

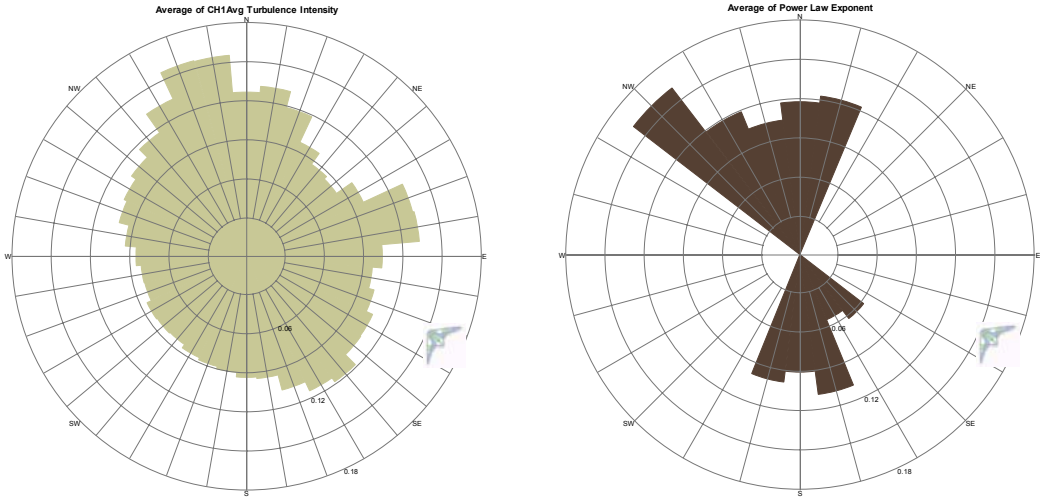


Figure 4. Turbulence Intensity and Wind Shear by Direction at St George Met Tower Site

LONG-TERM REFERENCE STATION

Wind data from the Saint George Airport weather station (shown in Figure 5), located about 15 miles southeast of the met tower site, serves as a long-term reference for the wind resource in the area. The Automated Surface Observing System (ASOS) was installed in September of 1996. The wind data is measured at a height of 10 meters above ground level and at an elevation of 38.1 meters.

Figure 5. ASOS Equipment in Saint George (source: Ed Doerr, NOAA)

Seven years of wind speed data from the Saint George ASOS are summarized in Table 7 and Figure 6. The average wind speed over the 7-year period is 7.5 m/s. The annual wind speed rarely deviates more than 3% above or below this long-term average.

Table 7. Monthly Wind Speeds at Saint George Airport, 10-m Height (m/s)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVE	% of long-term average
1998		7.2	7.1	8.6	6.9	6.0	4.6	6.0	7.7	7.1	8.2	9.7	7.2	96%
1999	9.0	10.2	9.5	7.8	6.5	6.6	6.1	5.6	5.8	7.5	9.1	8.2	7.6	102%
2000	9.2	10.1	8.1	7.1	5.2	6.4	5.0	5.0	7.2	7.8	8.9	7.1	7.3	97%
2001	9.4	9.9	7.2	8.1	6.3	5.9	5.5	5.3	6.5	8.0	9.1	10.9	7.7	102%
2002	9.6	7.4	8.7	8.6	7.5	5.9	4.9	6.1	7.7	8.5	7.3	6.1	7.4	98%
2003	9.6	7.9	8.2	7.7	6.9	5.4	5.9	6.0	6.4	8.7	9.6	10.0	7.7	102%
2004	9.4	9.4	6.5	7.8	7.4	5.5	4.5	5.4	6.2	10.0	10.0	9.2	7.6	101%
AVE	9.4	8.9	7.9	7.9	6.7	6.0	5.2	5.6	6.8	8.2	8.9	8.8	7.5	100%

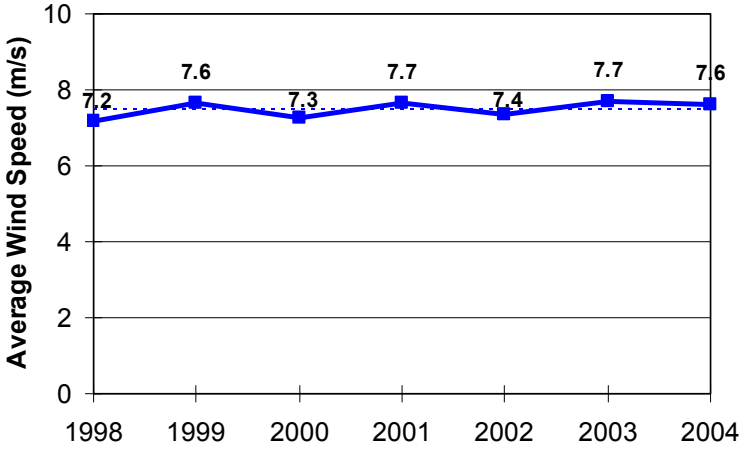


Figure 6. Annual Average Wind Speeds at Saint George Airport Weather Station, 10-m Height

Hourly wind speed measurements from the Saint George Airport weather station that are concurrent with recordings from the met tower site were purchased from the National Climatic Data Center. Data between these two sites was compared and a correlation coefficient of 0.87 was calculated (a value of 1 is perfect). This suggests that, although the actual wind speed values at the two sites are different, the pattern of wind speed fluctuations is similar between the sites. Figure 7 compares the met tower data with the ASOS data. Wind data from the Saint Paul Island ASOS, located about 45 miles to the northwest, is also included for comparison.

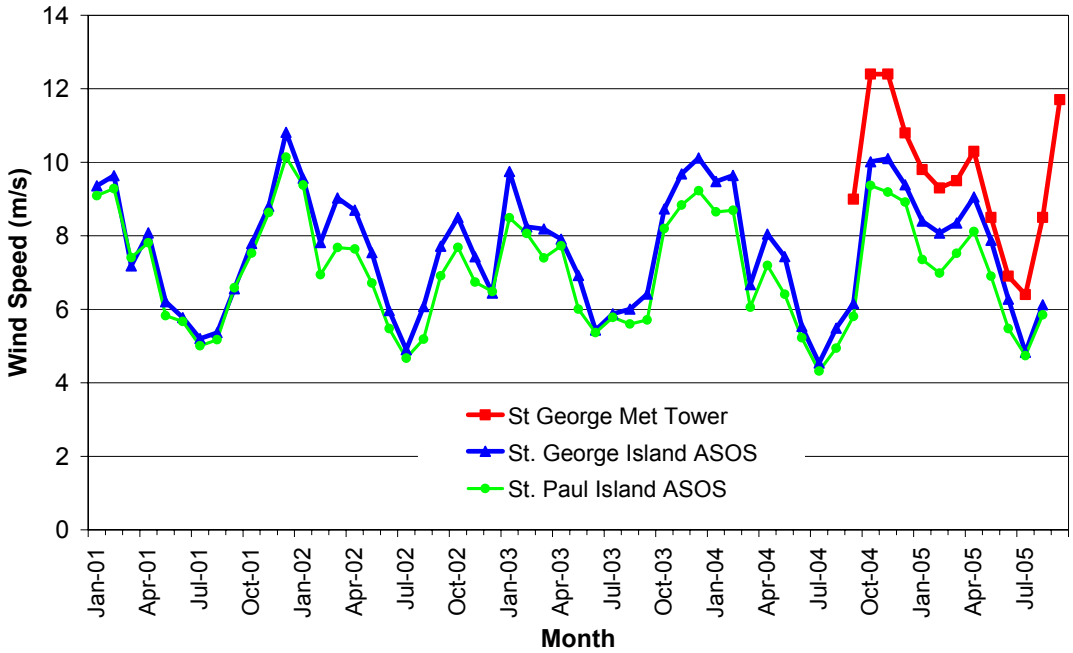


Figure 7. Comparison of Average Monthly Wind Speeds Between Met Tower and ASOS Measurements

A ratio of the short-term ASOS data to the long-term ASOS average was calculated for each month of the year. This ratio was then applied to adjust the met tower data to what could be expected at the site over the long term. Overall, the period of measured data was 3% windier than the estimated long-term average. Figure 8 and Figure 9 compare the measured data set to the long-term estimates. Table 8 presents the calculated long-term data set.

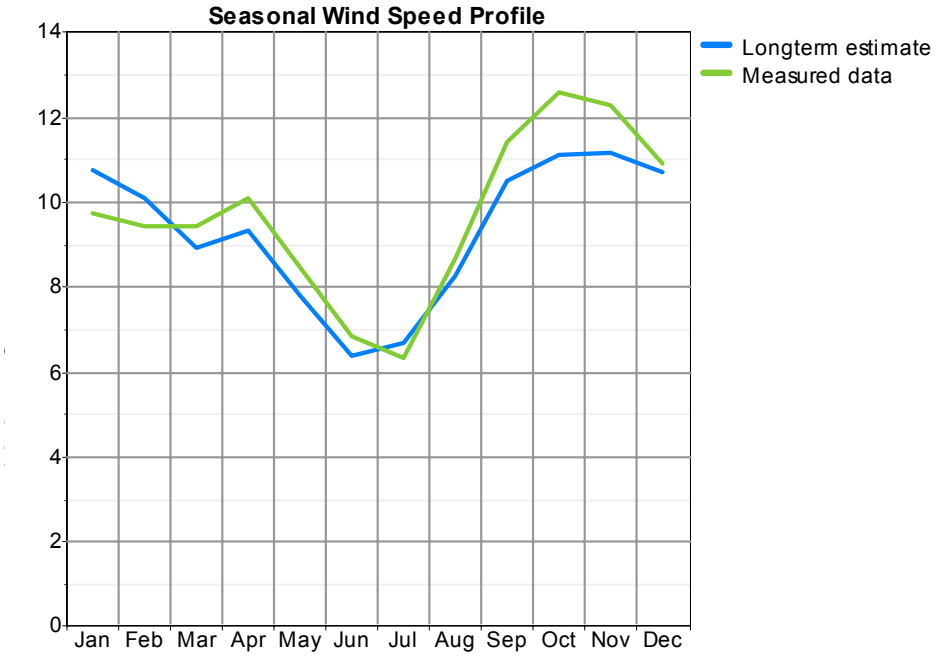


Figure 8. Monthly Average Wind Speeds at St George Met Tower Site, 30m Height

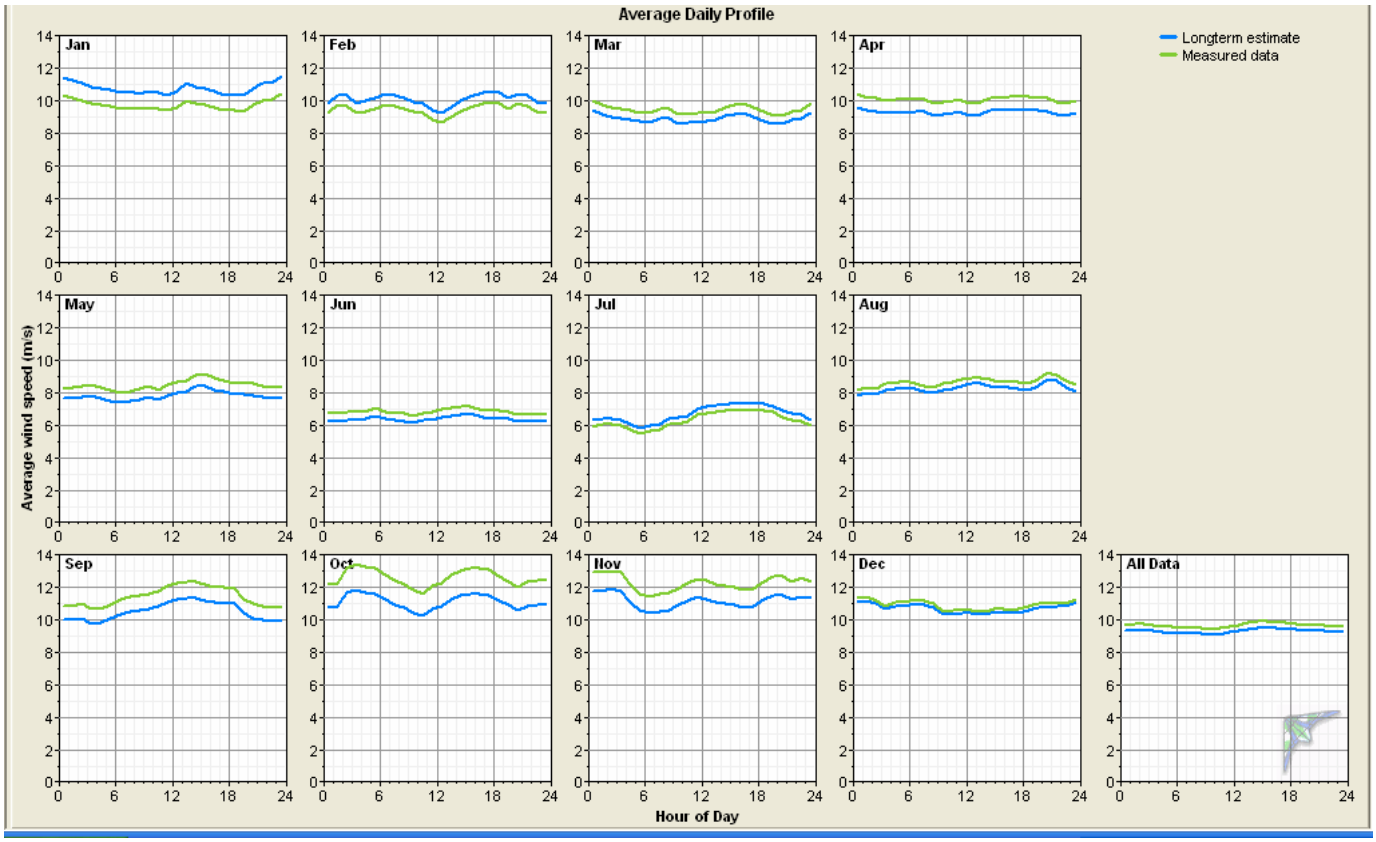


Figure 9. Diurnal Profiles of Wind Speeds at St George Met Tower Site, 30m Height

Table 8. Estimated Long-term Wind Speeds at St. George Met Tower Location, 30-m Height (m/s)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0	11.5	9.7	9.2	10.0	7.6	6.5	6.2	8.0	10.0	10.4	12.0	11.2	9.3
1	11.3	10.2	9.1	9.8	7.7	6.5	6.3	8.0	10.0	10.4	12.0	11.1	9.4
2	11.1	10.3	9.0	9.7	7.7	6.4	6.5	7.9	10.1	11.1	12.2	11.0	9.4
3	10.9	9.8	8.8	9.6	7.8	6.4	6.4	8.2	9.8	11.5	12.1	10.6	9.3
4	10.8	9.9	8.8	9.6	7.7	6.4	6.2	8.2	9.9	11.3	11.5	10.7	9.3
5	10.7	10.1	8.7	9.5	7.6	6.6	5.8	8.3	10.2	11.4	10.8	10.8	9.2
6	10.5	10.3	8.6	9.6	7.5	6.5	6.0	8.2	10.4	11.1	10.5	10.8	9.2
7	10.6	10.3	8.9	9.5	7.5	6.3	6.1	8.1	10.6	10.7	10.6	10.8	9.2
8	10.5	10.1	9.0	9.4	7.6	6.2	6.4	7.9	10.9	10.6	10.7	10.7	9.2
9	10.6	9.8	8.7	9.3	7.8	6.1	6.6	8.1	10.9	10.2	10.9	10.3	9.1
10	10.5	9.7	8.6	9.5	7.5	6.3	6.6	8.1	11.2	10.0	11.2	10.3	9.1
11	10.4	9.4	8.7	9.5	7.9	6.3	7.0	8.3	11.3	10.5	11.4	10.2	9.2
12	10.6	9.1	8.7	9.3	8.0	6.4	7.2	8.5	11.5	10.7	11.4	10.4	9.3
13	11.0	9.4	8.8	9.3	8.0	6.6	7.3	8.4	11.6	11.0	11.3	10.1	9.4
14	10.9	9.8	9.1	9.6	8.3	6.6	7.3	8.2	11.6	11.4	11.2	10.2	9.5
15	10.8	10.1	9.3	9.6	8.4	6.7	7.5	8.1	11.5	11.5	11.2	10.2	9.6
16	10.6	10.3	9.3	9.6	8.2	6.6	7.4	8.2	11.4	11.5	11.1	10.1	9.5
17	10.4	10.5	9.3	9.5	8.1	6.4	7.4	8.0	11.3	11.5	11.1	10.2	9.5
18	10.4	10.6	9.0	9.4	8.0	6.4	7.4	7.9	11.2	11.3	11.2	10.4	9.4
19	10.2	10.0	8.9	9.4	7.9	6.4	7.3	8.1	10.8	11.1	11.4	10.6	9.3
20	10.8	10.3	8.8	9.3	7.9	6.2	7.1	8.5	10.5	10.7	11.4	10.7	9.4
21	11.0	10.3	9.0	9.2	7.8	6.2	6.8	8.5	10.3	10.8	11.2	10.8	9.3
22	11.2	9.9	9.2	9.1	7.7	6.2	6.8	8.1	10.2	10.8	11.3	10.9	9.3
23	11.5	9.7	9.5	9.2	7.6	6.2	6.4	8.0	10.1	10.8	11.3	10.9	9.3
Avg	10.8	10.0	9.0	9.5	7.8	6.4	6.8	8.2	10.7	10.9	11.3	10.6	9.3

POTENTIAL POWER PRODUCTION FROM WIND TURBINES IN SAINT GEORGE

Table 9 lists a number of parameters that are typically used to characterize the power production potential of a particular site.

Table 9. Summary of Power Production Potential of Saint George Met Tower Site

Average Wind Power Density (30m height)	921 W/m^2
Wind Power Class	7+
Rating	Superior

Various wind turbines, listed in Table 12, were used to calculate the energy production at the met tower site based on the long-term wind resource data set. Although different wind turbines are offered with different tower heights, to be consistent it is assumed that any wind turbine rated at 100 kW or less would be mounted on a 30-meter tall tower, while anything larger would be mounted on a 50-meter tower. The wind resource was adjusted to these heights based on the measured wind shear at the site. Table 10 summarizes the estimated energy production from various wind turbines at the Saint George met tower site.

Table 10. Gross Annual Energy Production from Various Wind Turbines at St. George Met Tower Site (kWh)

Month	Proven 2.5kW	Proven 6kW	Bergey 10 kW	FL30	Entegrity	FL100	NW100	FL250	V27	V47
Jan	1,319	3,206	3,473	15,923	29,141	55,817	45,440	126,120	112,818	357,880
Feb	1,055	2,584	2,639	12,956	23,016	43,635	35,293	96,754	86,423	281,692
Mar	1,069	2,712	3,073	13,660	23,094	45,184	37,189	96,855	88,991	296,701
Apr	1,109	2,815	3,182	14,160	24,006	46,817	38,513	100,224	92,233	308,637
May	806	2,089	2,207	10,495	16,559	32,397	26,431	73,607	66,697	230,586
Jun	527	1,416	1,478	7,030	9,749	19,772	16,100	43,980	40,205	146,474
Jul	613	1,653	1,761	8,365	11,894	23,835	19,505	59,198	54,393	196,870
Aug	857	2,123	2,324	10,621	17,563	34,711	27,917	78,119	70,400	233,802
Sep	1,286	3,239	3,530	16,187	28,389	54,360	44,766	121,431	110,653	363,452
Oct	1,323	3,230	3,283	16,284	29,347	55,354	44,762	127,676	112,981	364,483
Nov	1,318	3,249	3,408	16,229	29,252	55,325	45,208	122,446	111,023	361,566
Dec	1,190	2,915	2,874	14,142	26,094	48,609	39,691	108,336	99,077	321,405
Annual	12,473	31,230	33,233	156,052	268,103	515,815	420,815	1,154,747	1,045,895	3,463,546
Annual kWh/m^2	1,299	1,312	863	1,173	1,515	1,482	1,482	1,688	1,825	1,996

Table 10 also lists the annual energy production per square meter of swept area (kWh/m^2). This allows one to directly compare the efficiency of one wind turbine against another, as shown in Figure 10.

Figure 10. Comparison of Power Production per Square Meter of Swept Area from Various Wind Turbines

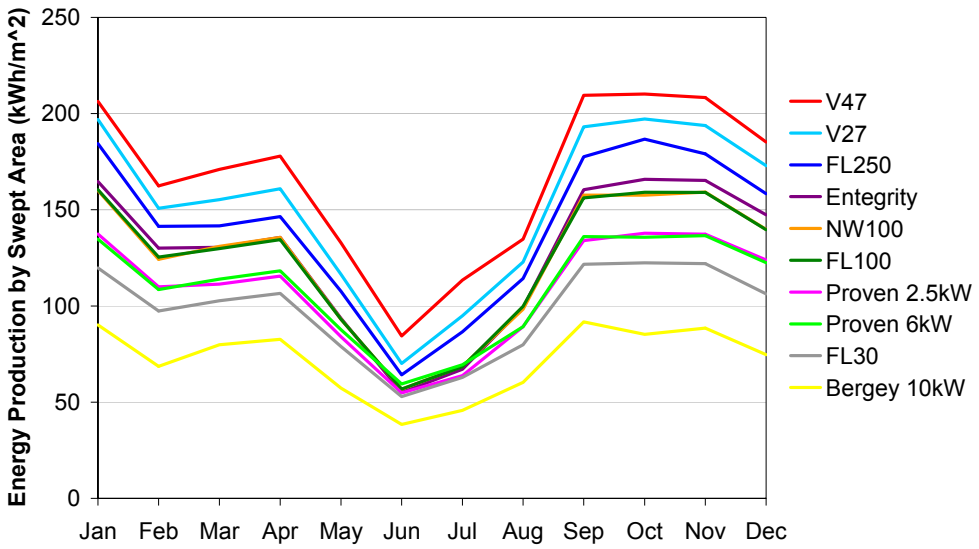


Table 11 summarizes the gross capacity factor of the different wind turbines per month. Gross capacity factor is the amount of energy produced based on the given wind resource divided by the maximum amount of energy that could be produced if the wind turbine were to operate at rated power during that entire period. The gross capacity factor could be further reduced by up to 10% to account for transformer/line losses, turbine downtime, soiling of the blades, icing of the blades, yaw losses, and extreme weather conditions.

Table 11. Gross Capacity Factor of Different Wind Turbines at Met Tower Site

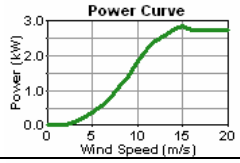
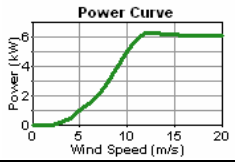
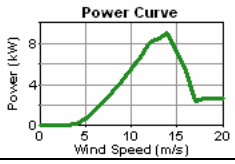
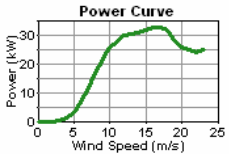
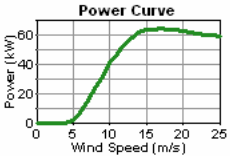
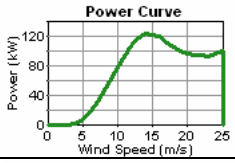
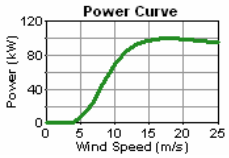
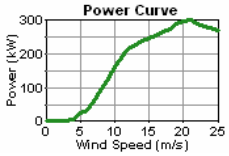
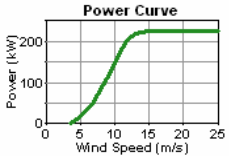
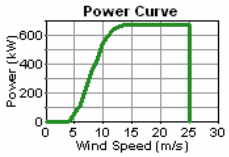
Month	Proven 2.5kW	Proven 6kW	Bergey 10 kW	FL30	Entegrity	FL100	NW100	FL250	V27	V47
Jan	71%	72%	47%	71%	59%	75%	61%	68%	67%	73%
Feb	63%	64%	39%	64%	52%	65%	53%	58%	57%	64%
Mar	57%	61%	41%	61%	47%	61%	50%	52%	53%	60%
Apr	62%	65%	44%	66%	51%	65%	53%	56%	57%	65%
May	43%	47%	30%	47%	34%	44%	36%	40%	40%	47%
Jun	29%	33%	21%	33%	21%	27%	22%	24%	25%	31%
Jul	33%	37%	24%	37%	24%	32%	26%	32%	32%	40%
Aug	46%	48%	31%	48%	36%	47%	38%	42%	42%	48%
Sep	71%	75%	49%	75%	60%	76%	62%	67%	68%	76%
Oct	71%	72%	44%	73%	60%	74%	60%	69%	67%	74%
Nov	73%	75%	47%	75%	62%	77%	63%	68%	69%	76%
Dec	64%	65%	39%	63%	53%	65%	53%	58%	59%	65%
Annual	57%	59%	38%	59%	46%	59%	48%	53%	53%	60%

CONCLUSION

This report provides a summary of wind resource data collected from mid September 2004 through October 2005 on Saint George Island, Alaska. The data was compared to long-term trends in the area. Based on correlations with the Saint George ASOS weather data, estimates were made to create a long-term dataset for the Saint George met tower site. This information was used to make predictions as to the potential energy production from various wind turbines at the site.

It is estimated that the long-term annual average wind speed at the site is 9.3 m/s at a height of 30 meters above ground level. Taking the local air density into account, the average wind power density for the site is 921 W/m^2. This information means that Saint George Island has at least a Class 7 wind resource, which is superior for wind power development.

Table 12. Wind Turbine Models Used in Power Production Analysis

Proven 2.5 kW http://www.provenenergy.com			Tower Height: 30 meters Swept Area: 9.6 m^2 Turbine Weight: 190 kg
Proven 6 kW http://www.provenenergy.com			Tower Height: 30 meters Swept Area: 23.8 m^2 Turbine Weight: 500 kg
Bergey 10 kW www.bergey.com			Tower Height: 30 meters Swept Area: 38.5 m^2 Weight: not available
Fuhrlander FL30 30 kW www.lorax-energy.com			Tower Height: 30 meters Swept Area: 133 m^2 Weight (nacelle & rotor): 410 kg
Entegrity 66 kW www.entegritywind.com			Tower Height: 30 meters Swept Area: 177 m^2 Weight (drivetrain & rotor): 2,420 kg
Fuhrlander FL100 100 kW www.lorax-energy.com			Tower Height: 30 meters Swept Area: 348 m^2 Weight (nacelle & rotor): 2,380 kg
Northern Power NW100/19 100 kW www.northernpower.com			Tower Height: 30 meters Swept Area: 284 m^2 Weight (nacelle & rotor): 7,086 kg
Fuhrlander FL250 250 kW www.lorax-energy.com			Tower Height: 50 meters Swept Area: 684 m^2 Weight (nacelle & rotor): 4,050 kg
Vestas V27 225 kW (refurbished, various suppliers)			Tower Height: 50 meters Swept Area: 573 m^2 Weight: not available
Vestas V47 660 kW www.vestas.com			Tower Height: 50 meters Swept Area: 1,735 m^2 Weight: not available

APPENDIX G

COMMUNITY CORRESPONDENCE

St. George Office:

P.O. Box 929
St. George, Alaska 99591-0929
Tel: (907) 859-2263
Fax: (907) 859-2212

CITY OF ST. GEORGE
ALL-AMERICA CITY - 1988

FAX

To: John Dickerson **From:** Crystal

Fax: _____ **Date:** 04.25.12

Phone: _____ **Pages:** 3 **(Including Cover Sheet)**

Re: Laborers - Equipe List **Phone:** _____ **Fax:** _____

***Comments:** **IF YOU DO NOT RECEIVE ALL PAGES, PLEASE CALL BACK**

PHONE: (907)859.2263 ext. 0 or 3 FAX: (907)859.2212

SIGNED: _____

ST. GEORGE ENERGY PROJECTS
LOCAL LABOR POOL

Name	Laborer	Truck Driver	Heavy Equip Operator	Heavy Equip Mechanic	Welders Helper	Certified Welder (1)	Apprentice Electrician	Journeyman Electrician (2)
Antony Merculieff	X	X	X					
Joachim Meredith	X	X	X					
Justin Pletnikoff	X	X	X					
Laurence Protopopoff	X	X	X					
Carl Lestenkof	X	X	X					
William J. Merculieff	X	X	X					
Randy Philemonof	X	X	X					
Sharon Merculieff	X							
Curtis Lestenkof	X							
Gary Merculieff	X	X	X					
Constantine Lestenkof		X	X					
Corrine Lekanof	X							
Dennis Lekanof	X	X	X		X			
Mark Merculieff JR	X							
Naomi Philemonof	X							
Theodore Lekanof	X	X						
Todd Lestenkof	X	X						
Nathaniel Lekanof	X							
Serge Lekanof	X							
Tracy Lekanof	X							

1) With Current API Welding Certificate
2) With Current Certificate of Fitness

3/27/2012

ST. GEORGE ENERGY PROJECTS
LOCALLY AVAILABLE EQUIPMENT LIST

OWNER	MAKE	MODEL	YEAR	CAPACITY (YDS, TONS)	ATTACHMENTS - (BACK-HOE, FORKS, AUGER, ETC..)	CONDITION, COMMENTS
DUMP TRUCKS						
2 MAC Trucks					14 yards	$101.48 hourly $712.08 Daily
DOZERS						
D-5						$225.63 hourly $1,558.71 daily
LOADERS						
John Deere	624					$219.42 hourly $1,515.24 daily
Volvo						$219.42 hourly $1,515.24 daily
TRACK HOES (EXCAVATORS)						
Hitachi	UH-07-LC					$242.19 hourly $1664.28 daily
SKID-STEERS (BOBCATS)						
CRANES						

Alaska Energy and Engineering, Inc.
Mailing Address - P.O. Box 111405
Anchorage, AK 99511-1405
Office (907) 349-0100
(907) 349-8001 FAX

March 28, 2012

The Honorable Pat Pletnikoff, Mayor
Attention: Crystal
City of St. George
St. George, Alaska

Sent Via Fax to: (907) 859-2212 (3 Pages Total)

Dear Mr. Pletnikoff:

Alaska Energy and Engineering, Inc. (under authorization of the AEA/Rural Energy Programs), is working on a concept design report (CDR) for the community of St. George. The CDR will address a variety of proposed projects for your community, including a modular diesel power plant, a diesel generation heat recovery system, power distribution upgrades and wind generation.

If funded for construction, the AEA/REG has a history of administering similar projects on a "modified" force-account basis. Force-account construction involves the owner or grantee, in this case likely the City of St. George, acting as the employer and utilizing local labor to the maximum extent practicle. The attached form titled "Local Labor Pool" is for listing the availability of specialty skilled labor in St. George for inclusion in the CDR.

Also attached is a form titled "Locally Available Equipment List" requesting information on equipment that could be used on the proposed energy projects. This is also information we need in order to complete the CDR.

I would appreciate your assistance in getting these forms completed and returned to me by fax at (907) 349-8001. If you have any questions please call me on my direct line at (907) 336-8031 or e-mail me at jdickerson@ak.net.

Sincerely,

Alaska Energy and Engineering, Inc.

John Dickerson, Project Engineer

cc: Tim Sandstrom, Project Manager, AEA/Rural Energy Group

ST. GEORGE ENERGY PROJECTS
LOCAL LABOR POOL

Name	Laborer	Truck Driver	Heavy Equip Operator	Heavy Equip Mechanic	Welders Helper	Certified Welder (1)	Apprentice Electrician	Journeyman Electrician (2)

1) With Current API Welding Certificate
2) With Current Certificate of Fitness

3/27/2012

ST. GEORGE ENERGY PROJECTS
LOCALLY AVAILABLE EQUIPMENT LIST

OWNER	MAKE	MODEL	YEAR	CAPACITY (YDS, TONS)	ATTACHMENTS - (BACK-HOE, FORKS, AUGER, ETC..)	CONDITION, COMMENTS
DUMP TRUCKS						
DOZERS						
LOADERS						
TRACK HOES (EXCAVATORS)						
SKID-STEERS (BOBCATS)						
CRANES						

Transmission Report

Date/Time	03-28-2012	08:40:19 a.m.	Transmit Header Text	
Local ID 1	907 349 8001		Local Name 1	ALASKA ENERGY & ENGINEERING
Local ID 2			Local Name 2	

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Alaska Energy and Engineering, Inc.
Mailing Address - P.O. Box 111405
Anchorage, AK 99511-1405
Office (907) 349-0100
(907) 349-8001 FAX

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Sincerely,

Alaska Energy and Engineering, Inc.

John Dickerson, Project Engineer

cc: Tim Sandstrom, Project Manager, AEA/Rural Energy Group

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Abbreviations:

HS: Host send	PL: Polled local	MP: Mailbox print	TU: Terminated by user	
HR: Host receive	PR: Polled remote	CP: Completed	TS: Terminated by system	G3: Group 3
WS: Waiting send	MS: Mailbox save	FA: Fail	RP: Report	EC: Error Correct