Renewable Energy Resource Assessment

for the Communities of

Cold Bay,

False Pass,

and

Nelson Lagoon

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OVERVIEW

As a result of rising energy prices, the Aleutians East Borough (AEB) is motivated to lower energy costs for its community residents and facilities. Your Clean Energy, LLC (YCE) of Anchorage was retained to perform an assessment of renewable energy resources (hydro, wind, tidal, solar, waste heat recovery) for the small, isolated communities of Cold Bay, False Pass, and Nelson Lagoon, Alaska. This assessment was funded by a grant from the Alaska Energy Authority. This report includes an assessment of existing energy generation and usage in these three AEB communities, and an evaluation of available renewable energy resources for each community. The AEB will use this report to appropriate its own funds and/or to seek grant funds for the design and construction of appropriate renewable energy facilities.

This report was completed in three phases. Phase I was the research component. Background research was completed on each community and the findings include existing reports and studies, existing fuel facilities and prices, existing power generation facilities, community fuel and electricity usage, and current energy projects.

Phase II of the project involved in-person site visits to the communities. The site visits for each community were completed in January, 2010, to assess viability and potential locations for renewable energy systems.

Phase III incorporates economic evaluations of appropriate renewable energy projects for each community and a ranking of the cost effectiveness of the proposed projects.

EXECUTIVE SUMMARY OF RECOMMENDATIONS

The following list is an executive summary of all recommendations found in this report. The recommendations are prioritized with the preferred course of action listed first. These recommendations can serve as a guide in bringing more renewable energy projects to the communities of Cold Bay, False Pass and Nelson Lagoon.

COLD BAY

1. Obtain funding for the design and construction of one Northwind 100 Arctic B-Model wind turbine with tubular tower. It is recommended that the power utility G&K own and operate the wind turbine so that the 30% Federal Tax Credit can be utilized. Actual wind turbine locations will be determined with input from FAA, USFWS, G&K, land owners and the community. It is recommended that one wind turbine be installed initially to produce a low penetration wind system that the power utility can easily manage. This system can be integrated without complicated controls or major upgrades and allow a determination of the wind turbine's potential effects on bird populations in the area. In the future, once the wind turbine's environmental impacts are better known, and the power utility is ready for additional wind penetration, additional wind turbines can be installed.
2. Obtain funding for the design and construction of a district waste heat recovery system. Scenario 1 is recommended, which would supply waste heat to the FAA shop, DOT/PF shop, DOT/PF warm storage, and DOT/PF warm sand storage. This is the lowest cost option with the fastest payback. The system should be constructed with appropriate piping sizes to allow for additional district loops to be constructed in the future. This would allow Scenarios 2 and 3 to be constructed cost effectively when additional grant funding is available.
3. Obtain funding for a stream flow study of the four hydropower sites near Cold Bay in the 1980 US Army Corps of Engineers (USACE) Report, for a minimum of one year. The study will determine the stream flow of each site throughout the course of the year and identify potential stream sediment and environmental issues. The study will also identify potential stream intake and power house locations. All potential hydropower sites near Cold Bay are located on National Wildlife Refuge lands. It is recommended that the US Fish and Wildlife Service be engaged in all hydropower planning, including the stream flow study. This study should include stream flow of potential hydropower sites in False Pass to minimize the cost of the overall study.

FALSE PASS

1. It is recommended that a study be completed to ensure that a potential waste heat recovery system from the False Pass Power Plant to the False Pass School will provide sufficient heat to the school throughout the year. This study would monitor the school's daily heating oil use and the power plant's daily diesel consumption through the heating season.
2. Obtain funding for the design and construction of a waste heat recovery system that would use waste heat from the False Pass Power Plant to heat the False Pass School.
3. Obtain funding for the design and construction of two Bergey 10 kW wind turbines on 30m tilt up towers. This will provide a low wind penetration system which the power utility can easily manage. In the future, additional wind turbines could be installed. It is recommended that this project happen in conjunction with the Nelson Lagoon wind project to minimize mobilization costs, and future costs of maintenance, repairs, and spare parts.
4. Obtain funding for a stream flow study of Unga Man's Creek and Water Fall Creek. This study would have the same scope as the Cold Bay stream flow study and should be included with the Cold Bay stream flow study to minimize costs.

NELSON LAGOON

1. Obtain funding for the design and construction of two Bergey 10 kW wind turbines on 30m tilt up towers. This will provide a low wind penetration system which the power utility can integrate and manage. In the future, additional wind turbines could be installed. It is recommended that this project happen in conjunction with the False Pass wind project to minimize mobilization costs, as well as future costs of maintenance, repairs, and spare parts.
2. Obtain funding for the design and construction of a waste heat recovery system between the Nelson Lagoon Power Plant and the Nelson Lagoon Storage Building. Waste heat would be used to heat the Nelson Lagoon Storage Building, including the currently unheated warehouse space. During cold winter days, heating of the warehouse space would have a lower priority compared to the heating the occupied portion of the building. Because the existing Nelson Lagoon power plant does not utilize any waste heat recovery and the Nelson Lagoon Storage Building is very close to the power plant, it is not anticipated that daily fuel consumption monitoring of the building and the power plant is needed prior to obtaining funds for this project. This is due to the fact that there is significant waste heat available for the building to use. However, this data would be helpful in the design of the waste heat system.

COLD BAY

Existing Research and Studies

There are four existing reports addressing renewable energy production Cold Bay, most of which were funded by the Alaska Energy Authority.

- 1980 - The earliest report found was a reconnaissance study for small hydropower projects in Alaska prepared by the U.S. Army Corps of Engineers.
  - **Regional inventory and reconnaissance study for small hydropower projects. Aleutian Islands, Alaska Peninsula, Kodiak Island, Alaska. Volume II: Community Hydropower Reports.** Department of the Army, Alaska District, Corps of Engineers. October 1980.
- 1982 - The second is a reconnaissance study of energy requirements and alternatives for 20 rural Alaskan communities, including Cold Bay.
  - **Reconnaissance Study of Energy Requirements and Alternatives for the Villages of Aniak, Atka, Chefornak, Chignik Lake, Cold Bay, False Pass, Hooper Bay, Ivanof Bay, Kotlik, Lower and Upper Kalskag, Mekoryuk, Newtok, Nightmute, Nikolski, St. George, St. Mary's, St. Paul, Toksook Bay and Tununak.** Northern Technical Services & Van Gulik and Associates. Alaska Power Authority Publication (now Alaska Energy Authority). July, 1982. Accessed from Alaska Housing Finance Corporation RIC Library.
- 1991 - The next report was initiated by the Cold Bay utility, G&K, through Alaska Energy Authority and is an in-depth economic and engineering study of using waste heat from the utility's generators to heat buildings in the community.
  - **Report and Concept Design, Cold Bay Waste Heat Recovery**. February 12, 1991. Frank Moolin & Associates, Inc. Sponsored by Alaska Energy Authority.
- 2005 - The final report is a wind resource summary that can be used to assess wind power production in Cold Bay.
  - **Weather Station Wind Resource Summary for Cold Bay Airport, AK**. August, 2005. Alaska Energy Authority.

GENERAL COMMUNITY INFORMATION

Cold Bay is located near the Izembek National Wildlife Refuge at the western end of the Alaska Peninsula. It lies 634 miles southwest of Anchorage, and 180 miles northeast of Unalaska. The population of Cold Bay is approximately 90 people. The local economy is mostly based on government services relating to the airport.

EXISTING FUEL FACILITIES

Like most rural Alaskan communities, Cold Bay uses diesel #2 and heating oil to produce both power and heat for the buildings in their community, respectively. Frosty Fuels, a subsidiary of Aleut Enterprises LLC, is the fuel distributer to Cold Bay.

Frosty Fuels buys diesel #2 and Jet A fuels from either Crowley or Delta Western depending on the best price and delivery times. Crowley and Delta Western are the only two fuel barge companies that serve Cold Bay and have the ability to regularly access Cold Bay throughout the year. There are 3 to 4 fuel delivery barges to Cold Bay annually.

Diesel #2 is used exclusively for power generation by the electric utility, G&K. Diesel #2 is either Ultra Low Sulfur or High Sulfur and depends on the fuel being delivered by the fuel barge companies. G&K usually receives Ultra Low Sulfur Diesel #2. Frosty Fuels has a 110,000 gallon Diesel #2 tank that is connected via buried pipeline to G&K's 12,500-gallon double wall tank at their site for storage. The utility also has an automated transfer system that brings fuel from the outdoor storage tank to a 950-gallon powerhouse day tank. This results in a combined total storage capacity of 123,450 gallons for the Cold Bay community.

Jet A fuel is stored in two 150,000 gallon tanks owned by Frosty Fuels, with a combined capacity of 300,000 gallons. The majority of the Jet A fuel is used at the airport for refueling airplanes. Some of the Jet A is sold as heating oil which is used for heating buildings in Cold Bay. In Cold Bay, heating oil and Jet A are equivalent fuels. As a side note, Jet A fuel can be sold as Heating Oil #1, however, Heating Oil #1 cannot be sold as Jet A fuel.

Fuel	Storage Capacity	Type	Uses
Diesel #2	123,450 gal	Typically Ultra Low Sulfur #2	G&K Power Plant
Jet A (or Heating Oil)	300,000 gal	Jet A (High Sulfur #1)	Heating Oil and Jet Fuel

Cold Bay Fuel Storage Capacity

Fuel prices

Cold Bay experiences swings in the price of fuel every 3 to 4 months, when a new barge shipment of fuel is received. The following table shows the current 2009 fuel prices for Diesel #2, Heating Oil #1, and Jet A. In Cold Bay, although Heating Oil #1 and Jet A Fuel are essentially the same fuel, they are sold at different rates. In the winter of 2008, heating oil #1 reached a high price of $5.15/gal.

Fuel	2009 Price	Uses
Diesel #2	$3.39/gal (G&K Yearly Average)	G&K Power Plant
Heating Oil #1	$3.59/gal	Heating Oil
Jet A	$3.99/gal	Airplanes

2009 Cold Bay Fuel Prices

In June 2010, the State will require all diesel internal combustion engines to use only Ultra Low Sulfur Diesel. In 2007, Tesoro became the only manufacturer of Ultra Low Sulfur Diesel in Alaska. Tesoro had to make a large investment to be able to produce this fuel which raises the price of the product compared to other fuels. Petrostar is in the process of making this investment and will be producing ultra low sulfur products soon. Flint Hills did not make this investment. Because of this market, switching to Ultra Low Sulfur Diesel will for some consumers mean that the price they pay for fuel will increase.

Community Heating Oil Usage

Over the last four years, an average of 192,400 gallons of heating oil #1 per year is used for heating buildings in Cold Bay. The annual gallons of heating oil #1 sold in Cold Bay by Frosty Fuels are shown below for 2006 to 2009.

Year	Gallons of Heating Oil Sold
2006	189,000
2007	178,300
2008	169,300
2009	232,900
4 year Average	**192,400**

2009 Cold Bay Fuel Prices

EXISTING POWER GENERATION

G&K is the electric utility in Cold Bay and was started by owner Gary Ferguson, who was hired by the Department of Military Affairs in 1984 to build a power plant to supply emergency power to the U.S. Air Force Base in Cold Bay. During this process Mr. Ferguson was asked by the State to rebuild the electric utility for the community of Cold Bay. Over the next three years the electric utility was completely rebuilt and G&K began operation in 1987. To meet the U.S. Air Force's power requirements, G&K had to produce guaranteed uninterrupted power by maintaining a spinning reserve of 100 kW, maintaining voltage within 5% and frequency within 1%, and be able to start up dead generators to running capacity in five seconds or less. Because of these requirements, G&K's power utility has never experienced an unexpected power outage. A drop in power only occurs during scheduled maintenance. G&K continues to supply firm power to the critical loads of the Air Force's Long Range Radar Site and the FAA's navigational equipment. G&K operates the Cold Bay generation facility under RCC certificate #88 through the Regulatory Commission of Alaska (RCA).

Electricity Price

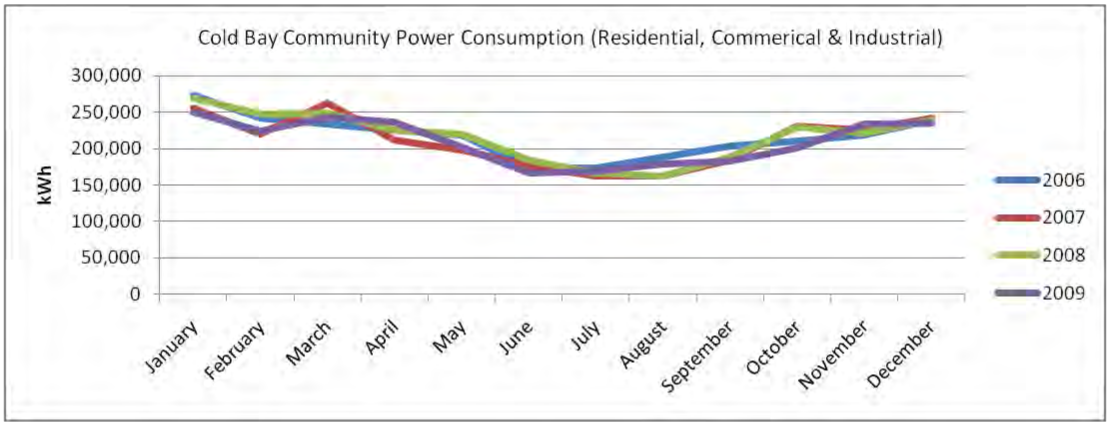
The G&K electricity costs for 2009 are shown below. Prices depend on if the client is residential or commercial and on whether the client is eligible for the Power Cost Equalization (PCE) program administered by AEA. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities.

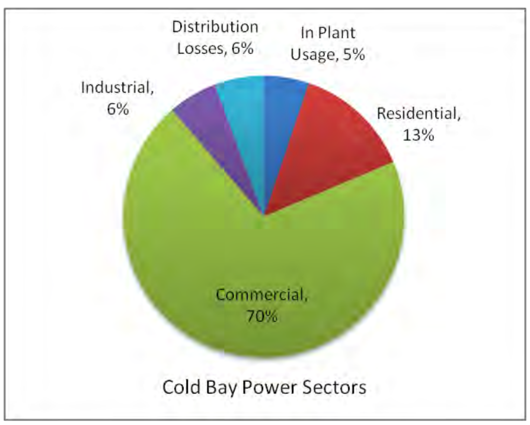
Residential price with PCE	59.12 cents/kWh
Residential price without PCE	67.61 cents/kWh
Commercial price with PCE	67.19 cents/kWh
Commercial price without PCE	68.57 cents/kWh

2009 Cold Bay Electricity Prices

Community Power Load

G&K provides power to approximately 61 residential, 53 commercial and 1 industrial customer (FAA) in Cold Bay. Governmental customers are categorized as commercial customers. The annual community power consumption (4-year Average) is approximately 2,600,000 kWh per year, which includes only power sold to customers and does not include power that is used to operate the power plant or power lost in distribution. In the past, when the military had a large presence at the airport, the power consumption of Cold Bay was much higher than it is today, with peak loads of 800 kW. In recent years the community power load has decreased because of decreased military operations and a decrease in population. The four year average peak load is now 328 kW.





	2006	2007	2008	2009	Average	
Gross Generation	2,907,168	2,812,096	2,922,604	2,876,502	**2,879,593**	*kWh*
In Plant Usage	149,728	152,896	147,788	150,102	**150,129**	*kWh*
Residential	394,967	389,808	388,478	376,484	**387,434**	*kWh*
Commercial	2,049,941	1,990,110	2,043,726	1,978,707	**2,015,621**	*kWh*
Industrial	154,800	154,080	172,560	168,360	**162,450**	*kWh*
Distribution Losses	157,732	125,202	170,052	202,849	**163,959**	*kWh*
Peak Load	600	600	600	600	**600**	*kW*
Average Load	332	321	333	328	**328**	*kW*
Diesel Usage	215,198	211,235	216,431	212,374	**213,810**	*gallons/year*
kWh/gal Generated	13.51	13.31	13.50	13.54	**13.47**	*kWh/gal*
kWh/gal Sold	12.08	12.00	12.04	11.88	**12.00**	*kWh/gal*

Cold Bay Power Consumption Statistics

Diesel Usage for Power Generation

The Utility purchases about 220,000-gallons of Diesel #2 per year from Frosty Fuel. The diesel used for power generation is shown for 2006 through 2009 in the table above. The usage is shown in more detail in the table below. According to G&K, there was one time in 25 years that the fuel barge did not arrive on its scheduled date and the utility's diesel fuel reserve reduced to only 1,000 gallons.

Diesel used for generation per year	220,000	*gal/year*
Diesel used for generation per week	4,000 to 5,000	*gal/week*
Diesel used for generation on average	25	*gal/hr*
Diesel used for generation at Peak	30	*gal/hr*

Cold Bay Diesel Usage for Power Generation

Projected Power Loads

According to G&K, electric loads are anticipated to increase due to a new facility that the Coast Guard is planning to build. This new facility would draw power in the 50 to 100 kW range.

Power Transmission system

The Utility's distribution system is all underground, using 15 kV Pirelli cable and operates at 12,470 volts grounded Y. The underground cable is all in conduit, buried with engineered backfill. Most cable is three-phase with the exception of some single-phase runs and covers a distance of approximately 12 miles. All customers are individually metered, with all commercial customers also being demand metered.

Generator Status

The G&K generation system includes two Caterpillar 3512 diesel engines, 1200 RPM units, directly coupled to Kato 2400 V , 0.8 PF 3-phase generators rated at 650 kW each; and one Caterpillar 3512 diesel engine, 1200 RPM directly coupled to a Kato 2400 V, 0.8 PF generator rated at 850 kW. All generators feed into a Brown Bovari Switch gear rated at 1,200-amps. The Switch gear is computer controlled and is fully automatic on demand.

Typically the utility runs one generator at a time and cycles through each generator every 720 hours. The average operating efficiency of the generators over the last 12 months, from Dec 2008 to Nov 2009, is 13.53 kWh/gallon. The utility has reached an efficiency of up to 14 kWh/gallon, at times throughout the year.

The generators were installed in 1987 and now have between 67,000 and 79,000 hours of operation on them. The generators are well maintained and each one has been rebuilt at least twice. G&K expects them to have a usable life of 150,000 hours. Replacement cost for a single generator is over $300,000. Below is a summary of the generators and their status.

Generator	Rated Capacity	Type
Generator 1	650 kW	3512 Caterpillar Diesel Electric Generator
Generator 2	850 kW	3513 Caterpillar Diesel Electric Generator
Generator 3	650 kW	3514 Caterpillar Diesel Electric Generator
Total Generating Capacity	2,150 kW	

Generator Power Factor	0.8
Current Operating Hours of Generators	67,000 to 79,000 hours
Expected Life Time of Generators	150,000 hours
Replacement Costs	$300,000/generator
Condition and Age	Generators were installed in 1987 and have been well maintained

Cold Bay Generator Summary

Existing Waste Heat Recovery

G&K installed a heat recovery system designed to sell waste heat to the community when the power plant was built in 1987. It consists of a manifold cooling system with a tube and shell heat exchanger. A small fraction of the waste heat is used to heat all of G&K's buildings; these buildings have a combined size of approximately 10,000 square feet. Currently, no waste heat is used by the rest of the community.

In the 1990's, G&K applied for an AEA grant to evaluate the potential for a community scale waste heat recovery system. They received the grant and AEA contracted Frank Moolin & Associates, Inc., to complete the "Report and Concept Design, Cold Bay Waste Heat Recovery", an in-depth economic study on using waste heat from G&K to heat community buildings. The report was completed on February 12, 1991.

The report concluded that "a waste heat recovery system could provide enough heat to heat virtually all of the publicly owned buildings in the general vicinity of the power house and several publicly owned and private commercial buildings further from the power house as well. However, these buildings are spread out and cannot be served on an equal cost basis. Also, varying ownership and planned future use of the buildings makes some buildings more attractive for providing waste heat to. Therefore, policy makers will have to choose between alternatives."

The study identified six different scenarios for waste heat recovery, four of which were evaluated based on estimated project costs, total fuel oil savings, and operations & maintenance. The scenarios are presented below as they were presented in the study, in 1990 dollars (USD). To bring the costs up to date, the total annual fuel cost savings are also given based on Cold Bay's 2009 heating oil cost of $3.59/gallon.

- Scenario #1 provides waste heat to four public buildings nearest the power house. This includes the FAA shop, the State Department of Transportation / Public Facilities (DOT/PF) shop, State DOT/PF warm storage, and the state DOT/PF warm sand storage.

Estimated Project Cost	$429,839	(1990 USD)*
Total Annual Fuel Oil Savings	25,900 Gallons	

Total Annual Fuel Cost Savings	$28,500	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$92,981	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$7,600)	(1990 USD)

* The Estimated Project Cost is a correction from the Moolin report

- Scenario #2 includes the buildings in scenario #1 and extends a heating loop to the north to serve the City Office building and the U.S. Fish & Wildlife (USFWS) Complex. This complex includes the main office building, the bunkhouse, and four separate housing buildings. This scenario is an expansion of scenario #1 and includes the scenario #1 values.

Estimated Project Cost	$1,271,053	(1990 USD)
Total Annual Fuel Oil Savings	35,900 Gallons	
Total Annual Fuel Cost Savings	$39,500	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$128,881	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$13,700)	(1990 USD)

- Scenario #3 includes the buildings in scenario #1 and extends a heating loop to the south to serve the Cold Bay school. This scenario is an expansion of scenario #1 and includes the scenario #1 values.

Estimated Project Cost	$777,021	(1990 USD)
Total Annual Fuel Oil Savings	31,700 Gallons	
Total Annual Fuel Cost Savings	$34,900	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$113,803	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$11,700)	(1990 USD)

- Scenario #4 includes all of the buildings listed above (essentially it is scenario #1 expanded to the north to include the additional scenario #2 buildings and to the south to include the additional scenario #3 building).

Estimated Project Cost	$1,614,728	(1990 USD)
Total Annual Fuel Oil Savings	41,400 Gallons	
Total Annual Fuel Cost Savings	$45,500	(1990 Heating Oil Cost)
Total Annual Fuel Cost Savings	$148,626	(2009 Heating Oil Cost @ $3.59/gal)
(O&M Cost	$16,800)	(1990 USD)

- Scenario #4a is identical to scenario #4 with distribution pipe sizes increased to allow for future expansion to the south. Annual fuel and dollar savings are identical.

Estimated Project Cost	$1,788,642	(1990 USD)

- Scenario #5 and scenario #6 expand the system further by extending a heating loop south past the school to serve the clinic, the airport buildings and buildings in between. There is not enough waste heat to serve these two scenarios. Both scenario #5 and #6 are considered a low probability for waste heat recovery due to high construction costs, piping heat losses, and uncertain future of some of the users.

Although the waste heat recovery study was completed in 1991, no waste heat recovery system has been implemented since that time. According to Gary Ferguson of G&K, community interest has been low, most likely due to the capital costs of the project. Ferguson says that the main hurdle is financing the project and recommends that grant funds should be used to construct a waste heat recovery system. Since 1990, the average community electrical load has decreased from 416 kW to 328 kW, resulting in a 20% decrease in waste heat production since the AEA report was written. Even with this reduction, a waste heat recovery system still has the potential for significantly reducing heating oil consumption in the community.

OTHER EXISTING ENERGY SYSTEMS

In February 2009, the U.S. Fish and Wildlife Service received money from the American Recovery and Reinvestment Act (ARRA) to construct wind projects at their stations in Cold Bay and King Salmon. The ARRA money must be obligated by October 2010, requiring that the wind projects in both locations be constructed before this date. The project is on a fast track so that it can be built and paid for by the ARRA funds. The Environmental Assessment (EA) for the project is currently underway and a draft EA was completed at the end of January, 2010. The USFWS hired Marsh Creek to engineer the wind projects. A contractor to build the projects has not been secured.

At the moment, the details of the USFWS wind project in Cold Bay have not been completely decided upon. The USFWS has decided to use GALE Vertical Axis Wind Turbines, manufactured by Tangarie. There will be 3 to 4 turbines installed at the station and each turbine will be 5 kW or 10 kW in size. The turbines will be mounted on top of 25 ft, tilt up, monopole towers. There are two potential locations for the wind turbines; one next to the bunkhouse and the other in the center field.

The use of the power produced by the wind turbines has not yet been decided by USFWS. The two options are to (1) connect the turbines to the G&K electrical grid, or (2) use electrical resistance heaters to heat water for space heating and domestic hot water for the buildings in the USFWS complex. G&K is cautious about USFWS connecting the wind turbines to the grid because they are concerned that they may not be able to control the voltages and frequencies to the standards required by the US Air Force. Additionally, recent high fuel costs have placed financial strain on the utility and they are concerned about a drop in sales that may occur if individual customers install and operate their own wind turbines.

APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES IN COLD BAY

From background research and the January, 2010 site visit, it was determined that Cold Bay has three feasible sources for energy recovery or renewable energy production. Upon completing an economic evaluation for each, the following ranking is as follows:

1. Wind Power
2. Waste Heat Recovery
3. Hydroelectric Power

It was determined that the following other renewable energy sources were not feasible at this time: solar, geothermal, biomass, and tidal. Adequate sun exposure is not available for solar power. No geothermal hot springs were located in proximity to Cold Bay to be feasible for assessment. There is no wood source for biomass heating. Tidal currents occur in Cold Bay, however they are not strong enough at the city dock for any practical power production at this time and there is floating ice in the winter.

Economic Evaluations

For all economic evaluations completed for Cold Bay the following energy prices and associated escalation rates were used. The current price of energy as of January 2010 was used. Escalation rates were based on historic and recent trends in energy prices. A discount rate of 3% was used for the time-value of money in the net present worth evaluations.

Cold Bay		
Diesel #2 Price	$3.39	/gal
Escalation Used	8%	
Heating Oil Price	$3.59	/gal
Escalation	8%	
Residential Electricity Rate with PCE	$0.60	/kWh
Escalation	6%	
Discount Rate	3%	

Wind Power

Producing electrical power from the wind in Cold Bay is feasible and cost effective compared to power from diesel generation. The wind resource in Cold Bay is outstanding with average annual wind speeds of approximately 16.75 mph (7.5 m/s), as measured at a height of 10m from the Cold Bay Airport. This high wind speed, at this height above ground, give Cold Bay a wind power class of 7, which is the highest wind power class rating obtainable. In general, sites with a wind power class rating of 4 or higher are suitable for large scale wind plants. Wind resource data was analyzed by AEA and is shown on the following page along with details of the data collection site at the Cold Bay Airport.

The economics for wind power in Cold Bay was based on installing one Northwind 100 Arctic B-model wind turbine. This turbine has one of the best track records in Alaska with about 37 turbines installed statewide. The tower is a 37m monopole tubular tower that allows maintenance personnel to access the wind turbine from inside the tower, reducing maintenance costs. Current Cold Bay energy prices, escalations and 3% discount rate were used for the net present worth evaluation. Additionally, a 30% tax credit is available on the total installed cost of the wind project, if the project is financed by a private entity that pays taxes. The borough may not be eligible to directly receive the tax credit because they are a tax exempt entity. However, the 30% tax credit can be internalized by a private local utility company. This tax credit was included in the evaluation. O&M costs were estimated at $0.021/kWh produced and the turbine's reliability factor (RF) was estimated at 98% (i.e. the annual percentage of wind turbine operation). Both of these values come from Alaska Village Electric Cooperative's (AVEC) experience with the Northwind 100.

Cold Bay Wind Power	
Wind Turbine	Northwind 100kW Arctic B-model
Rotor Diameter	69ft (21m)
Design Life	20 yrs
Number of Turbines	1
Tower	120ft (37m) Tubular Tower
Estimated Project Cost	$1,100,000
Annual Electricity Savings (kWh) @ 98% RF	327,320
Annual Electricity Savings @ $0.60/kWh	$196,392
Average Energy Penetration	13%
Annual O&M Costs	$6,874
20 yr Net Present Worth	$4,170,654
Payback (yrs)	5

The use of wind power was discussed with Gary Ferguson of the Cold Bay power utility (G&K) to better understand their system needs. Currently, G&K is not certain how much wind penetration they can effectively manage. However, they would like an engineering study to determine the level of wind penetration that is appropriate for their system. The utility is also interested in the 50 kW vertical axis turbine because the generator for these units is on the ground, making it easier to maintain. G&K would be in favor of a wind project if there was grant money available to purchase and construct the system. However, G&K is not prepared to pay for the wind project on their own due to large capital costs of the system. If G&K were to pay for the project, they might not be able to lower power costs to consumers.

A low penetration system is a viable option for Cold Bay. Installing a single Northwind 100 Arctic wind turbine would provide a cost effective low penetration (13%) system for Cold Bay. Low penetration systems require fewer controls and are generally less expensive. As wind penetration increases to medium and high levels, the controls become more complex and the project increases in cost.

PENETRATION CLASS	OPERATING CHARACTERISTICS	PENETRATION	
		PEAK INSTANTANEOUS	ANNUAL AVERAGE
LOW	• Diesel runs full time • Wind power reduces net load on diesel • All wind energy goes to primary load • No supervisory control system	< 50%	< 20%
MEDIUM	• Diesel runs full time • At high wind power levels, secondary loads dispatched to ensure sufficient diesel loading • Alternatively, wind turbines are curtailed during high winds and low loads • Requires relatively simple control system	50 – 100%	20 – 50%
HIGH	• Diesels may be shut down during high wind availability • Auxiliary components required to regulate voltage and frequency • Requires sophisticated control system	100 - 400%	50 – 150%

Figure from the 'Wind-Diesel Hybrid System Options for Alaska' presentation by Steve Drouilhet, NREL

Regardless of the system penetration, the wind-diesel system must be designed as a whole system to ensure that the diesel generators run at optimum efficiencies and that excess wind power can be dumped to heat. This is important because G&K must maintain an efficiency of 11 kWh sold per gallon to qualify for PCE from AEA. If the utility drops below 11 kWh sold per gallon they may lose their PCE eligibility. G&K has space ready for another generator in their Generator Building and installing a smaller 400 kW diesel generator in this location in conjunction with wind generators may provide higher efficiencies.

The availability of a local crane for wind projects was researched. The electric utility, G&K, has a truck-mounted 60' boom crane made by National Crane. The truck is at its end of life and G&K is undecided whether or not to replace the crane due to large replacement costs.

MET Tower

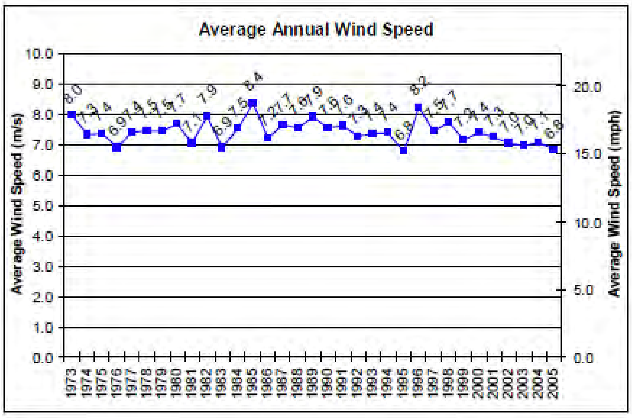
A 30-meter meteorological tower (or MET tower) used to collect wind speed and direction measurements at heights of 30 m and 20 m is the AEA standard for assessing wind power projects in Alaska. Although the wind resource measured at the Cold Bay Airport is known, installing a MET tower at the location of the actual wind turbine site and collecting data for an entire year will produce more accurate data for assessing wind power at that specific site. In Cold Bay where the wind resource has already determined to be outstanding, waiting over a year for MET tower installation and data collection to assess a specific wind site may not be the best use of time and resources.

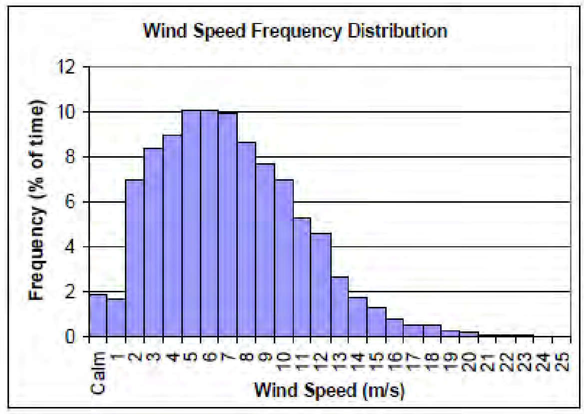
However, the Anemometer Loan Program through AEA will supply MET towers to qualified communities, at a low cost. The program is currently not funded and not operational, but is expected to be running again in July, 2010, according to the program manager James Jenson of AEA. In June of 2008, Gary Ferguson of G&K submitted an application to this program to bring an unused AEA MET tower from King Cove to Cold Bay. Because the loan program was not funded, there was no response to G&K and the tower is still awaiting use in King Cove. It is recommended that AEA be contacted to secure the King Cove MET tower once the loan program is once again funded and running.

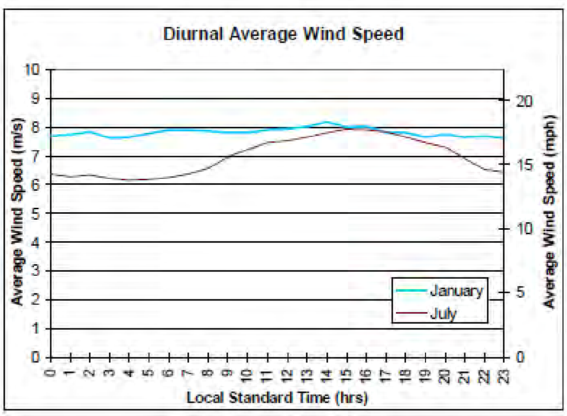
Cold Bay Wind Resource

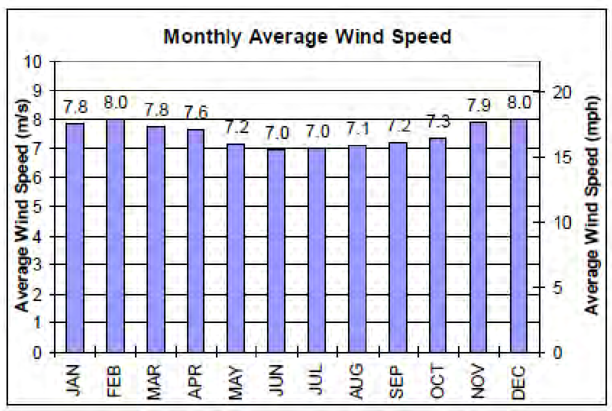
In August, 1995, AEA produced the "Weather Station Wind Resource Summary for Cold Bay Airport, AK". This report uses data collected by the Automated Surface Observing System (ASOS) at the Cold Bay airport from January 1973 to May 1995. The station is at an elevation of 29.9 meters and records wind speed and direction at 10 meters above the ground surface. The wind resource was determined to be outstanding at this location (16.75 mph, 7.5 m/s) at 10 m elevation, with a wind power class rating of 7.

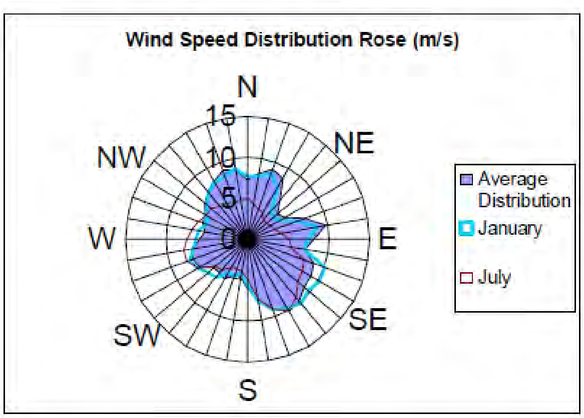
AVERAGE POWER DENSITY	502
WIND POWER CLASS	7
POWER RATING	OUTSTANDING

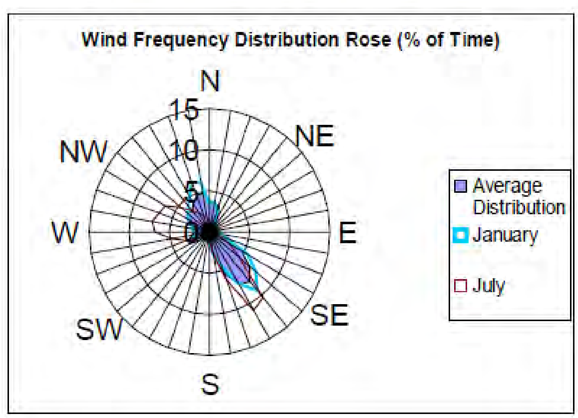










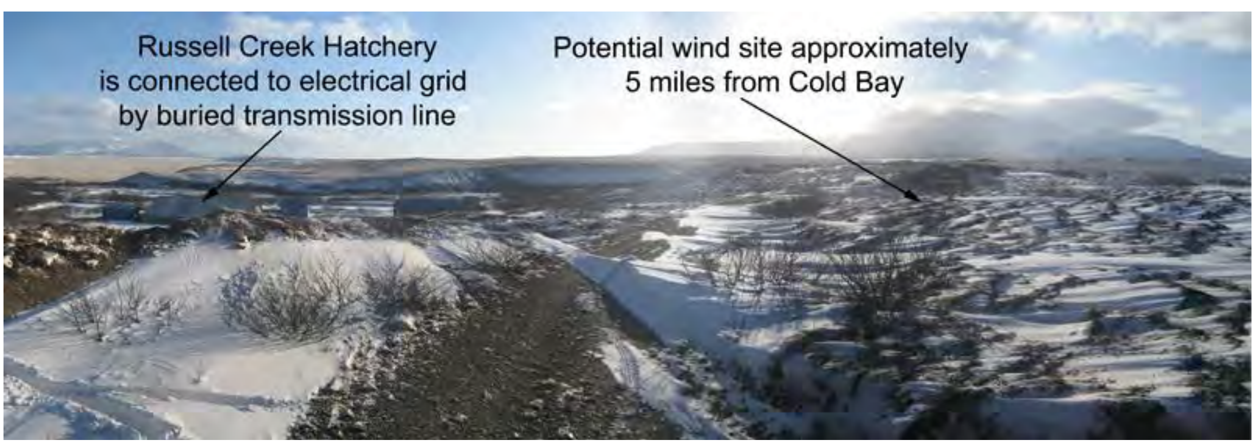


Potential Wind Turbine Sites in Cold Bay

During the site visit, three separate locations for wind turbine sites in Cold Bay were determined, as shown below. The ownership of the land is noted in each case below. All sites have a flat ground profile with limited turbulence from surrounding structures.

G&K Power Plant Wind Site - Located to the side of the Quonset hut near the G&K Power Plant.

G&K Storage Lot Wind Site - Located next to the G&K Storage Lot, across the street from Cold Bay Lodge.



Russell Creek Hatchery Wind Site - Located on the hills above the Russell Creek Hatchery and owned by the King Cove Corporation

Waste Heat Recovery

Although not a renewable energy source, waste heat recovery holds a substantial opportunity for the community to reduce their heating oil consumption. As explained in the Existing Waste Heat Recovery section above, G&K already has a waste heat manifold system installed that was designed to send waste heat to the surrounding buildings in the community.

The economic case for waste heat recovery in Cold Bay was based largely on the 1991 Frank Moolin & Associates report. The estimated project costs and O&M costs for the 4 different scenarios in the Moolin report were updated to 2010 dollars. The heating loads of the buildings in the scenarios were assumed to be the same as the recorded values in the Moolin report. Current energy prices with associated escalation rates and a 3% discount rate were used to complete the 30 year net present worth evaluation.

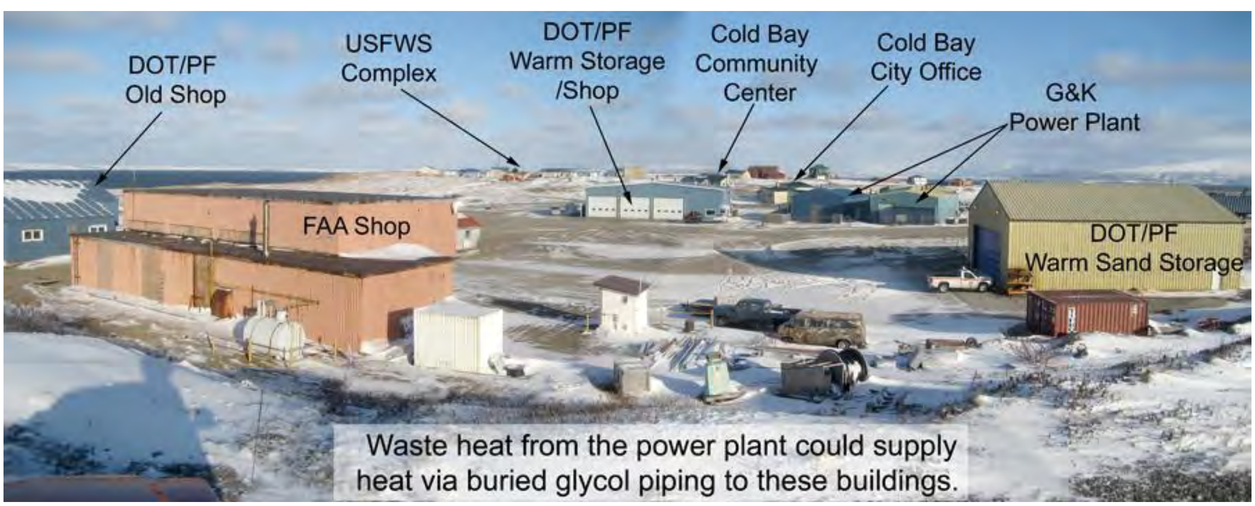
Cold Bay Waste Heat Recovery	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Estimated Project Cost	$684,022	$2,022,682	$1,236,507	$2,569,587
Annual Fuel Oil Savings (gal)	25,900	35,900	31,700	41,400
Annual Fuel Oil Savings @ $3.59/gal	$92,981	$128,881	$113,803	$148,626
Annual O&M Costs	$12,094	$21,801	$18,619	$26,735
30 yr Net Present Worth	$4,802,924	$5,431,647	$5,364,691	$5,978,977
Payback (yrs)	8	14	11	15

Scenario 1 - FAA shop, DOT/PF shop, DOT/PF warm storage, and DOT/PF warm sand storage.

Scenario 2 - City Office, USFWS Complex (the USFWS complex includes main office building, bunkhouse, and four separate housing buildings) and Scenario 1 buildings.

Scenario 3 - Cold Bay school and Scenario 1 buildings.

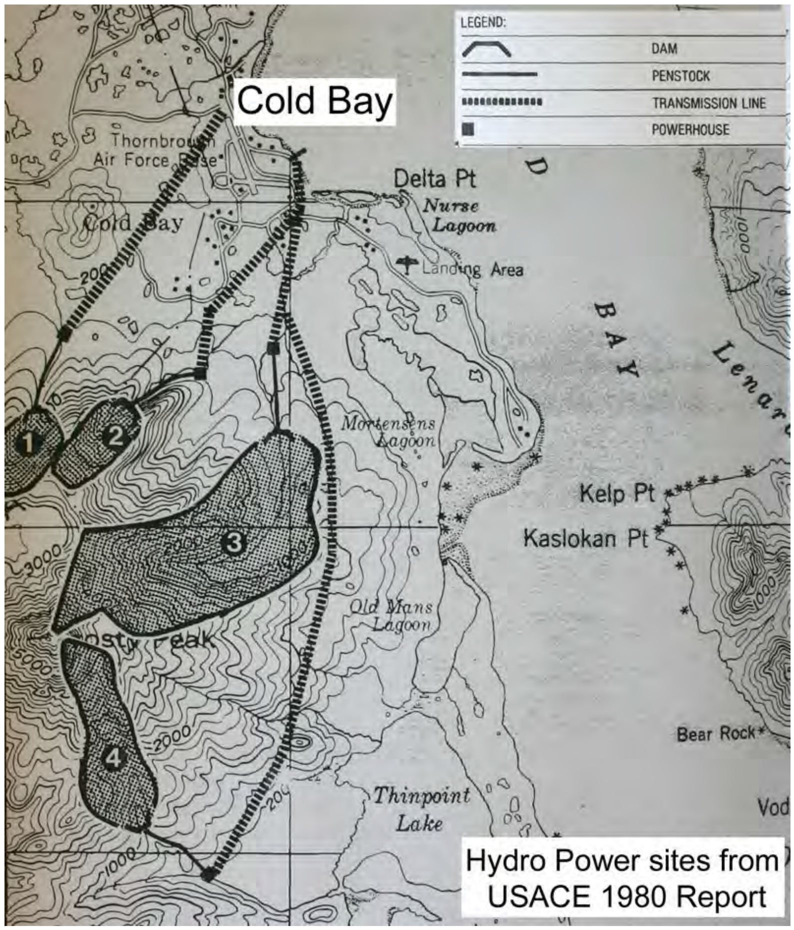
Scenario 4 - Includes all buildings in Scenarios 1, 2 and 3.



The buildings in each scenario will receive heat from an insulated, buried district heating loop that delivers waste heat from G&K's diesel generators. Piping lengths vary depending on the scenario. Please refer to the Moolin report for piping lengths, building heating loads, waste heat production and system layout.

Hydropower

The "Regional inventory and reconnaissance study for small hydropower projects" conducted by the U.S. Army Corps of Engineers (USACE), in October 1980, established four potential “run of the river” hydropower sites on the flanks of Frosty Peak, as shown in the map below. For each site a 50 year economic analysis was completed.



The USACE report was revisited by the "Reconnaissance Study of Energy Requirements and Alternatives" completed by Northern Technical Services & Van Gulik and Associates in July 1982. In the study, Northern Technical Services determined that the "hydropower potential for Cold Bay referenced from the USACE’s 1980 reconnaissance study was found to be overly optimistic and therefore, the data was not used in the evaluation".

Due to the fact that the yearly flow regime of each site is unknown, power production could not be determined and an economic evaluation could not be completed. However, these sites still hold an opportunity for producing cost effective renewable energy. **It is recommended that the stream flows for the four sites be monitored for a minimum of one year to establish the annual power production of each site.**

Potential hurdles to these four hydro projects are anticipated to be land ownership and environmental issues. Site 1 (Frosty Creek) is located in the Izembek National Wildlife Refuge. Site 2 (North Fork of Russell Creek), Site 2 (South Fork of Russell Creek), and Site 4 (Thin Point Creek) are located in the Alaska Peninsula National Wildlife Refuge. There is annual salmon migration in all streams according to the USACE report.

FALSE PASS

EXISTING RESEARCH AND STUDIES

There are three existing reports concerning renewable energy in False Pass, all of which sponsored by the Alaska Energy Authority. The earliest report was a reconnaissance study for small hydropower projects in Alaska by the U.S. Army Corps of Engineers in 1980. The second was a reconnaissance study of energy requirements and alternatives for 20 rural Alaskan communities, including False Pass, completed in 1982. The final report, completed in 2010, was a draft wind resource summary which can be used to assess wind power production in False Pass.

- **Regional inventory and reconnaissance study for small hydropower projects. Aleutian Islands, Alaska Peninsula, Kodiak Island, Alaska. Volume II: Community Hydropower Reports**. Department of the Army, Alaska District, Corps of Engineers. October 1980.
- **Reconnaissance Study of Energy Requirements and Alternatives for the Villages of Aniak, Atka, Chefornak, Chignik Lake, Cold Bay, False Pass, Hooper Bay, Ivanof Bay, Kotlik, Lower and Upper Kalskag, Mekoryuk, Newtok, Nightmute, Nikolski, St. George, St. Mary's, St. Paul, Toksook Bay and Tununak.** Northern Technical Services & Van Gulik and Associates. Alaska Power Authority Publication (now Alaska Energy Authority). July, 1982. Accessed from Alaska Housing Finance Corporation RIC Library.
- **Draft Wind Resource Report of False Pass, AK**. Correspondence with James Jenson, AEA. January 21, 2010

GENERAL COMMUNITY INFORMATION

False Pass is located on the eastern shore of Unimak Island on a strait connecting the Pacific Gulf of Alaska to the Bering Sea. It is 646 air miles southwest of Anchorage. The local economy is based on commercial salmon fishing and fishing services. Bering Pacific has the only operational processing plant in False Pass. Peter Pan Seafoods owns a processing plant in False Pass that is currently not operating. The population of False Pass, according to the Alaska Department of Community and Economic Development, is 46 residents.

EXISTING FUEL FACILITIES

The City of False Pass owns and operates a 60,000 gallon diesel #2 tank farm, used exclusively for power production by the City-owned power utility. At the power plant the City owns a 5,000 gallon tank; fuel is delivered to this tank from the tank farm with an 850 gallon fuel truck about once every week. A year's worth of diesel #2 is purchased once a year in the spring and barged to False Pass.

Peter Pan Sea Foods owns and operates another tank farm in False Pass which sells heating oil, gasoline, and diesel #2 and collects waste oil from fishing boats. All heating oil used in False Pass is purchased from Peter Pan Seafoods.

Fuel	Storage Capacity	Uses
Diesel #2	65,000 gal	Power Generation
Heating Oil #1	27,000 gal	Heating Oil

False Pass Fuel Storage Capacity

Fuel Prices

Fuel prices vary from year to year depending on bulk fuel prices. In April 2008 the city purchased 40,000 gallons of Diesel #2 at $4.10/gal. In May 2009, the city purchased the same amount of Diesel #2 for $2.29/gal. Although Diesel #2 is purchased once a year through Crowley, this fuel can also be bought through Peter Pan Seafoods in False Pass. The current Peter Pan Seafoods price for Diesel #2 is $2.70/gal. The current price for heating oil #1 is $3.45/gal.

Fuel	2009 Price	Uses
Diesel #2	$2.29/gal	Power Generation
Heating Oil #1	$3.45/gal	Heating Oil

Current False Pass Fuel Prices (May 2009)

Community Heating Oil Usage

The table below shows the gallons of heating oil sold annually by Peter Pan Sea Foods to the community of False Pass. The past prices of heating oil could not be obtained from Peter Pan Sea Foods; however, prices were estimated from False Pass School's heating oil records. The prices shown are the average annual prices of heating oil.

Heating Fuel	2006	2007	2008	2009	Average	
Gross Heating Fuel Sales	18,000	21,000	20,000	17,000	19,000	gal/year
Average annual Heating Fuel Price	$2.83	$2.87	$3.78	$3.81	$3.32	/gal

EXISTING POWER GENERATION

The City of False Pass operates the community's power utility and serves 21 residential, 11 commercial, 1 Federal/State facility, and 9 community facilities customers. Residents pay for electricity with prepaid cards.

Electricity Price

The price of electricity in False Pass depends on a monthly base rate and surcharge and whether or not the customer gets PCE. The surcharge varies monthly, usually around 11 cents per kWh, and is the combination of a fuel surcharge and a repair & refurbish surcharge. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities. In False Pass, commercial customers do not qualify for PCE.

Residential price with PCE	28 cents per kWh
Residential price without PCE	53 cents per kWh
Commercial price	47 cents per kWh

2009 False Pass Electricity Prices

Community Power Load

All available utility data concerning the community power load in False Pass has been collected, however the data set is incomplete with missing data for some months. 2008 was the only year that all of the PCE reports were valid, and was used to estimate the community power load. Upon review it appears that the utility data may be unreliable. This is due to the fact that distribution losses are 25% of gross power generation, much higher than should be expected. Due to this fact, the actual gross generation of False Pass is most likely lower than shown. In order for a more accurate evaluation of utility data to be performed, it will be necessary for the community to record data more consistently.

During the site visit in January, 2010, the average community demand load was recorded at 65 kW.

False Pass	kWh	% of Gross
Gross Generation	560,550	100%
Total Sales	384,699	69%
In-Plant Usage	36,358	6%
Distribution Losses	139,493	25%
Residential	88,462	16%
Commercial	206,447	37%
Community Facilities	79,598	14%
Fed/State Facilities	10,192	2%

2008 False Pass Community Power Load

Diesel Usage for Power Generation

In 2007 and 2008, False Pass used 50,662 gallons and 43,412 gallons of Diesel #2 for power production, respectively. This results in an average of 47,000 gallons of fuel used per year to produce power in the False Pass.

Projected Power Loads

The community population of False Pass has been decreasing in recent years. In 2005, the population was 62, and in 2008 the population dropped to 46 residents. However, according to the city maintenance personnel, the demand for power for some customers is increasing due to more shops being built. Two years ago Bering Pacific Seafoods (BPS) built a new fish processing plant near the False Pass harbor and installed their own diesel generators to power the facility during processing. As a result, BPS has not substantially increased the City's load. At times of high volume processing, BPS can draw power from the grid as needed to supplement their onsite generator power production.

It is possible that BPS would buy more electricity from the City during peak processing times if a renewable energy system was installed that produced power at a lower cost per kWh than BPS's diesel generators. From this information it can be conservatively estimated that in the near future the community power load for False Pass will most likely stay constant.

Generator Status

False Pass has three generators, which are listed below with their capacities. The size of Generator 3 was not confirmed by the utility during the time of the site visit, but was estimated to be 150 kW. The utility has a spare 125 kW generator, stored in the City Shop, to replace Generator 2.

Generator	Rated Capacity	Type
Generator 1	90 kW	John Deere Generator
Generator 2	125 kW	John Deere Generator
Generator 3	150 kW	John Deere Generator
Total Generating Capacity	365 kW	

Current Operating Hours of Generators	8,373 hrs for Gen 2, 10,860 hrs for Gen 3
Expected Life Time of Generators	20,000 hrs
Condition and Age	Well maintained

False Pass Generator Summary

Power Transmission

The utility's power distribution system is all underground 3-phase wire operating at 12,470 volts grounded Y. The northern extent of the community distribution system is located at Bering Pacific Sea Foods.

Existing Waste Heat Recovery

The False Pass utility has been using a waste heat recovery system to heat part of the city shop from the diesel generators. A tube and shell heat exchanger in the generator building transfers heat from the generators through a buried glycol piping loop to two Modine unit heaters in the City Shop. Two air cooling fans in the generator building dump excess heat that cannot be utilized by the City Shop.

During the site visit an old waste heat recovery system was found at the Old Generator Building that includes a 3" HPDE piping loop to the school approximately 200 yards away. The pipe was insulated with spray foam only on the top side of the piping, with no other protection from the environment.

The insulation is now dilapidated with vegetation growing on it, and the piping is exposed in various places. The pipe runs to the crawlspace of the school in a 2' deep trench, which is covered by the school playground field. In the school crawlspace the piping is attached to copper fittings and is disconnected from the school's heating system. According to locals the system did not send adequate amounts of heat to the school because of a combination of poor piping insulation and the distance of the piping run.

OTHER EXISTING ENERGY SYSTEMS

In late 2008, the Aleutian Pribilof Island Community Development Association (APICDA) installed one small wind system each in the communities of False Pass, Nelson Lagoon, and Akutan. The projects were privately funded by APICDA, whose goal was to create pilot renewable energy projects to lower the cost of power in these communities. All three projects utilize a Sky Stream 1.8kW wind turbine with a 33 ft monopole tower and are equipped with data-loggers to measure wind speed, wind direction and power output, along with other data. Since installation, all wind turbines have had new inverters installed, giving them an upgraded capacity of 2.4 kW. All three of the systems are grid tied and the tower locations were chosen by the communities.

The False Pass wind system is located next to the City Office.

According to Everette Anderson, the project manager from APICDA, the systems in both False Pass and Nelson Lagoon have had data-logger issues and stopped operating correctly in December, 2009. In January, 2010, a technician from H&K Energy was sent to False Pass to troubleshoot the wind system. Since the visit the wind turbine has been operating properly.

APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES IN FALSE PASS

From background research and the January, 2010 site visit, it was determined that False Pass has three feasible sources for energy and renewable energy production. Upon completing an economic evaluation for each, the ranking of these technologies is as follows:

1. Waste Heat Recovery
2. Wind Power
3. Hydroelectric Power

Hydroelectric power may prove to rank higher, however annual stream flow data must be collected from both Unga Man's creek and Waterfall creek to properly evaluate the power potential and cost savings.

Tidal Power in Isanotski Straight is potentially viable, but requires more research to determine its feasibility.

It was determined that the following other renewable energy sources were not feasible at this time: solar, geothermal, and biomass. Adequate sun exposure is not available for solar power. No geothermal hot springs were located in proximity to False Pass to be feasible for assessment. There is no considerable wood resource for biomass heating.

Economic Evaluations

For economic evaluations completed for False Pass in this report the following energy prices and associated escalation rates were used. The current price of energy as of January 2010 was used. Escalation rates were based on historic and recent trends in energy prices. A discount rate of 3% was used for the time-value of money in the net present worth evaluations.

False Pass		
Diesel #2 Price	$2.29	/gal
Escalation	8%	
Heating Oil Price	$3.45	/gal
Escalation	8%	
Residential Electricity Rate with PCE	$0.28	/kWh
Escalation	6%	
Discount Rate	3%	

Waste Heat Recovery

Although not a renewable energy source, waste heat recovery holds an opportunity for the community to reduce their heating oil consumption. The city already uses waste heat from the power plant to heat a section of the city shop. It was determined from the January, 2010, site visit by YCE that the next closest public building to the power plant is the False Pass School, approximately 600 ft away.

It appears that the amount of waste heat from the power plant is sufficient to heat a large percentage, if not all, of the school throughout the year. **To confirm this, it is recommended that daily heating oil use for the school and daily diesel consumption of the power plant be monitored through the heating season.** This data can ensure that the waste heat system will provide sufficient heat to the school for each day of the heating season. To complete the economic evaluation it was assumed that the waste heat system would displace all of the heating oil consumed by the school, approximately 5,162 gallons annually.

False Pass Waste Heat Recovery	
Building receiving heat	False Pass School
Distance from Power Plant	600 ft
Estimated Project Cost	$300,190
Annual Heating Oil Savings (gal)	5,162
Annual Heating Oil Savings @ $3.45/gal	$17,809
Annual O&M Costs	$1,500
30 yr Net Present Worth	$775,233
Payback (yrs)	14

Due to the 600 ft piping run from the power plant to the school, it is required that sufficient piping insulation is installed to limit heat loss. In the past, a similar waste heat project that brought waste heat from the old power plant to the school failed due to the inadequate insulation of the piping run. Proper insulation and jacketing of the heat distribution pipe is critical for the project to operate properly.

Wind Power

Producing power from the wind in False Pass is feasible and cost effective compared to power from diesel generation. The wind resource in False Pass is excellent with average annual wind speeds of 13.4 mph (6.0 m/s), occurring at a height of 30m. This wind speed, at this height above ground, gives False Pass a wind power class of 5. In general, sites with a wind power class rating of 4 or higher are suitable for large scale wind plants. Wind resource data was collected and analyzed by AEA using a MET tower and is shown on the following page along with details of the data collection.

False Pass has turbulent winds, confirmed by both local residents and the AEA wind data, caused by the city's proximity to mountains. Prevailing winds come from the north and south; however, large gusts of wind come from the west off of the mountains. Because of the high levels of turbulence in False Pass, it is important that any installed wind turbine be able to resist fatigue caused by the regular presence of turbulent winds.

The wind economic evaluation for False Pass was based on using two Bergey Excel 10kW wind turbines. The Bergey Excel is a heavy duty wind turbine suitable for rural Alaska. Currently, Port Heiden utilizes two grid tied Bergey Excels. The 30m tilt-up lattice tower can be tilted up and down without the need of a crane, reducing O&M costs.

False Pass Wind Power	
Wind Turbine	Bergey Excel 10kW
Rotor Diameter	22 ft (7 m)
Number of Turbines	2
Tower	30m Tilt-up Lattice Tower
Estimated Project Cost	$170,000
Annual Electricity Savings (kWh)	27,120
Annual Electricity Savings @ $0.28/kWh	$7,594
Annual Energy Penetration	7%
Annual O&M Costs	$570
20 yr Net Present Worth	$65,958
Payback (yrs)	15

This proposed wind system is low penetration, with an annual energy penetration of 7%. Connection of the two wind turbines to the grid will allow the existing diesel generators to operate without the need for advanced controls. In the future, additional wind turbines could be installed to increase penetration.

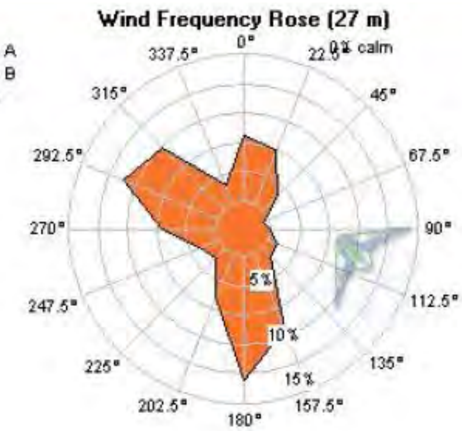
False Pass MET Tower

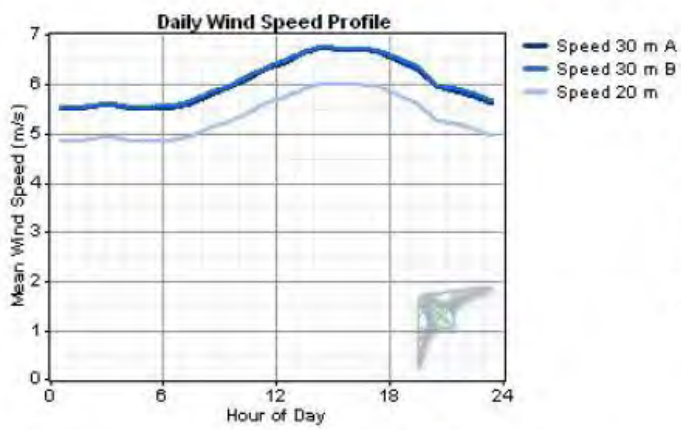
A 30-meter MET tower was installed in May, 2005, by AEA to measure wind speeds and directions in False Pass. The tower was installed at the north end of town near the new landfill. The data is not finalized and only a draft wind resource report has been created thus far.

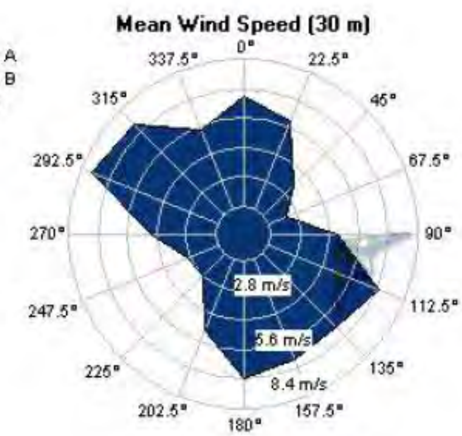
False Pass Wind Resource

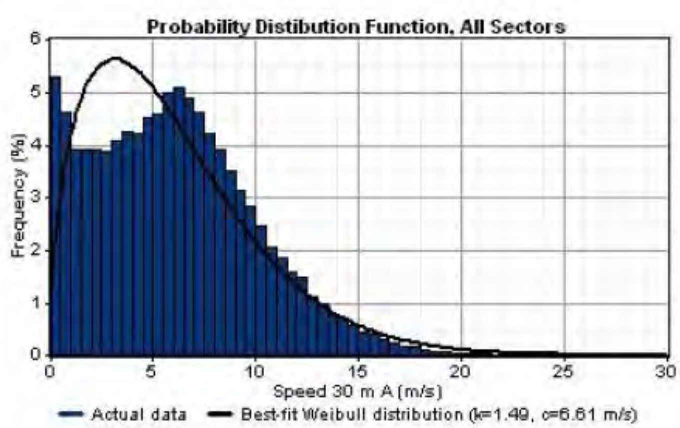
Below is the draft wind resource report from AEA. The MET tower has anemometers at 20 m and 30 m. The average annual wind speed at 30 m is 13.4 mph (6.0 m/s).

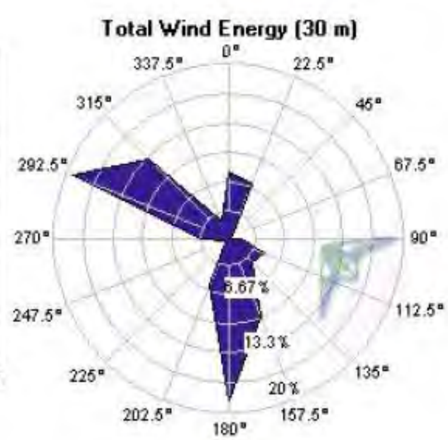
Power density at 50m	555 W/m²
Wind power class	5 (Excellent)







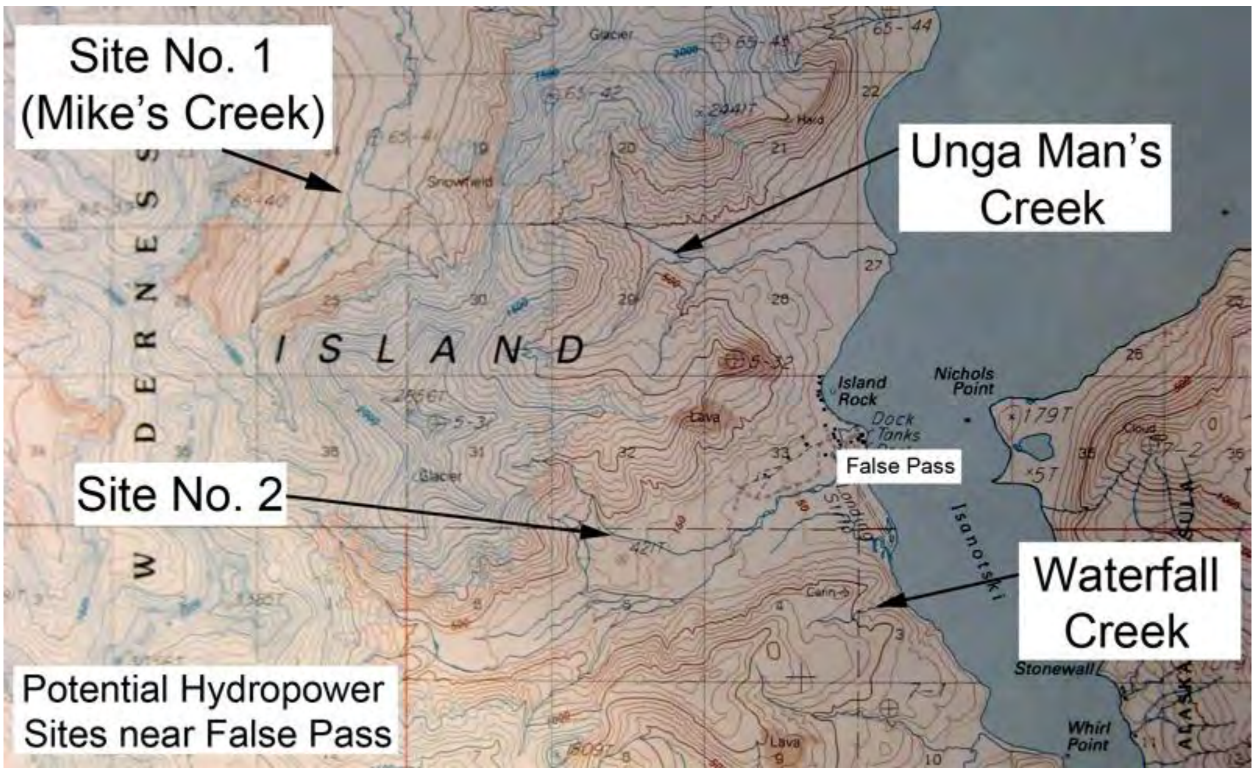




Hydropower

The "Regional inventory and reconnaissance study for small hydropower projects" conducted by the U.S. Army Corps of Engineers (USACE) in October 1980, established two potential run of the river hydropower sites near False Pass. For each site a 50 year economic analysis was completed. Site No. 1 is Mike's Creek, whose headwaters are located northwest over the mountains from False Pass and flows north to the Bering Sea. Site No. 2 is located three miles to the west of False Pass at the base of Round Top Mountain.

The USACE report was revisited by the "Reconnaissance Study of Energy Requirements and Alternatives" completed by Northern Technical Services & Van Gulik and Associates in July 1982. In the study, Northern Technical Services reviewed Site No. 2 and determined that "hydroelectric power generation was considered but was found to be economically unattractive" at this site. Although, the economics for Site No. 1 and Site No. 2 have most likely become more attractive due to the rise in energy costs, both sites are located in the Aleutians Peninsula National Wildlife Refuge, which may prohibit development of these hydro resources due to environmental impacts.



Following the January, 2010, site visit by YCE it was determined that Unga Man's Creek, located to the west of False Pass's new landfill, and Waterfall Creek, located to the southwest of the runway, may be viable sources of hydropower. Both creeks are located on land owned by the Isanotski Corporation, False Pass's Native Corporation, who is interested in developing hydropower on their land. According to locals both creeks are non-anadromous. In addition, Unga Man's Creek and Waterfall Creek are not listed in the Alaska Department of Fish and Game's Anadromous Waters Catalog.

Due to land ownership, absence of anadromous fish and proximity to False Pass, Unga Man's Creek and Waterfall Creek hold an opportunity for cost effective renewable energy production. However, the annual flow characteristics of both creeks are unknown, prohibiting an evaluation of the creeks' power potential throughout the year, and prohibiting a hydropower economic evaluation. **It is recommended that the stream flows of Unga Man's Creek and Waterfall Creek be monitored for a minimum of one year to obtain the power potential of each site.**

During the site visit by YCE, in January 2010, the flow of Unga Man's Creek was estimated at 10 cfs, using the drogue method. In February, Chuck Martinson of the Isanotski Corporation estimated the flow of Waterfall Creek at 300 gpm (0.67 cfs), using the bucket method. These measurements are insufficient to determine the power production of the sites due to the fact that stream flows can change drastically throughout the year.

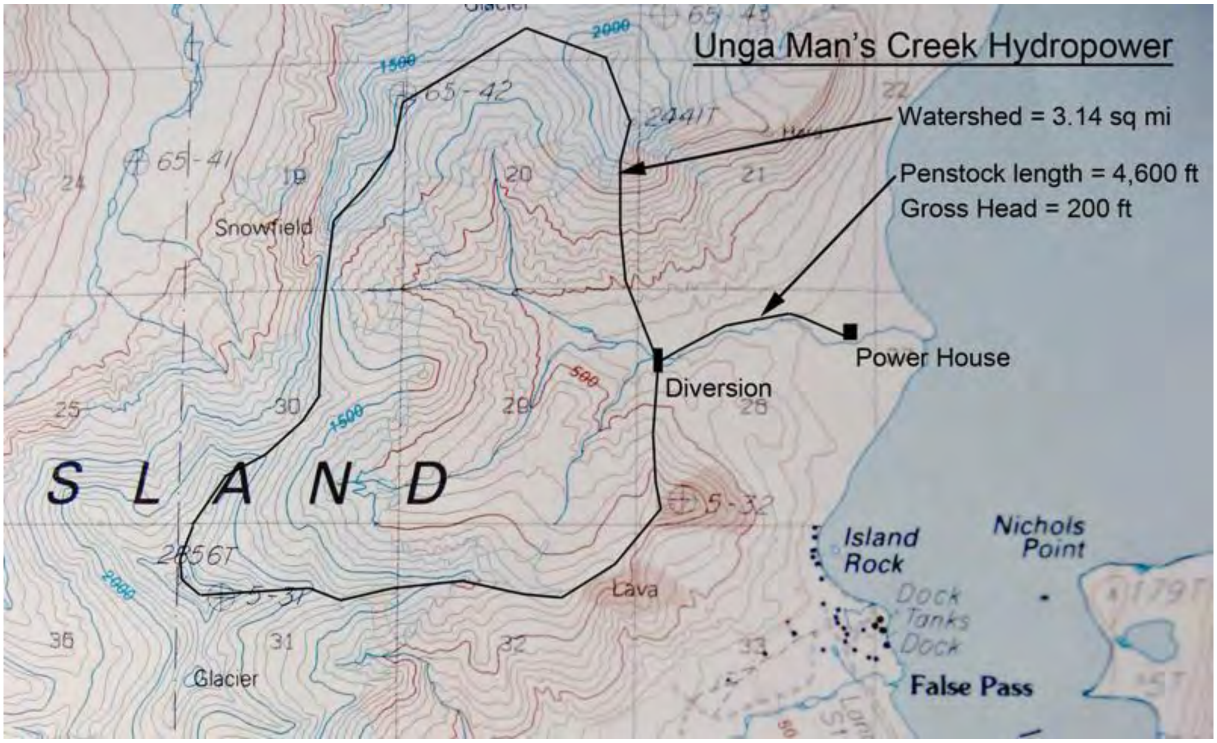
To illustrate the benefits that these two hydro projects could produce, the power potential and associated electricity savings were graphed as a function of stream flow, shown on the following pages. For these calculations it was assumed that 50% of the annual average stream flow was diverted to the penstock. A total system efficiency of 51% was used, which includes head losses in the penstock, manifold, turbine, drive, and generator.

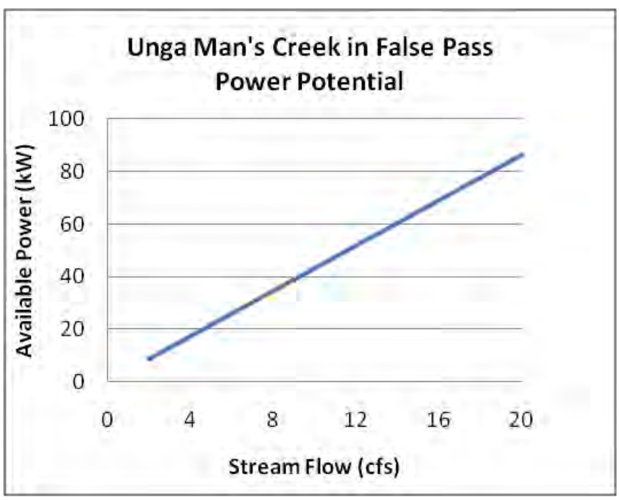
False Pass Hydro Power	**Unga Man's Creek**	**Waterfall Creek**
Average Annual Flow	Unknown	Unknown
Estimated Flow in Jan-Feb	10 cfs	0.67 cfs
Gross Head	200 ft	400 ft
Penstock Length	4,600 ft	1,400 ft
Transmission Line Length	3,000 ft	2,200 ft
Access Road Length	4,600 ft	3,600 ft

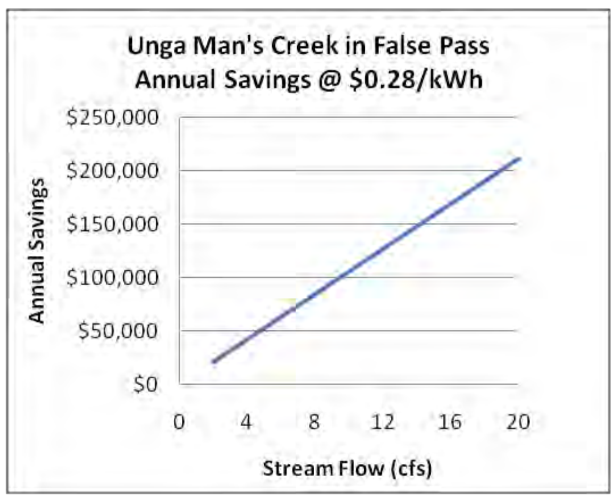
It appears that Unga Man's Creek hydro could provide significant energy savings to False Pass. If the average flow is determined to be 16 cfs, this would result in an average power production of 69 kW, which would cover the average load of False Pass of 65 kW. Waterfall Creek would provide smaller savings, most likely around 4 kW to 8 kW. However, all of these numbers depend on actual stream flows**. It is recommended that the flows of these creeks be monitored for a minimum of one year so that an accurate evaluation can be obtained.**

The power house for Unga Man's Creek Hydro would be best situated near the Unga Man's Creek Bridge on the road that travels from Bering Pacific Seafoods to the False Pass Landfill. Approximately 3,000 ft of underground transmission line would be required to deliver power from the power house to the False Pass electric grid located at Bering Pacific Seafoods. A 4,600 ft penstock with a gross head of 200 ft elevation will carry water from the diversion dam to the power house, located on the north side of Unga Man's Creek. An access road of the same length will be needed to access the diversion dam.

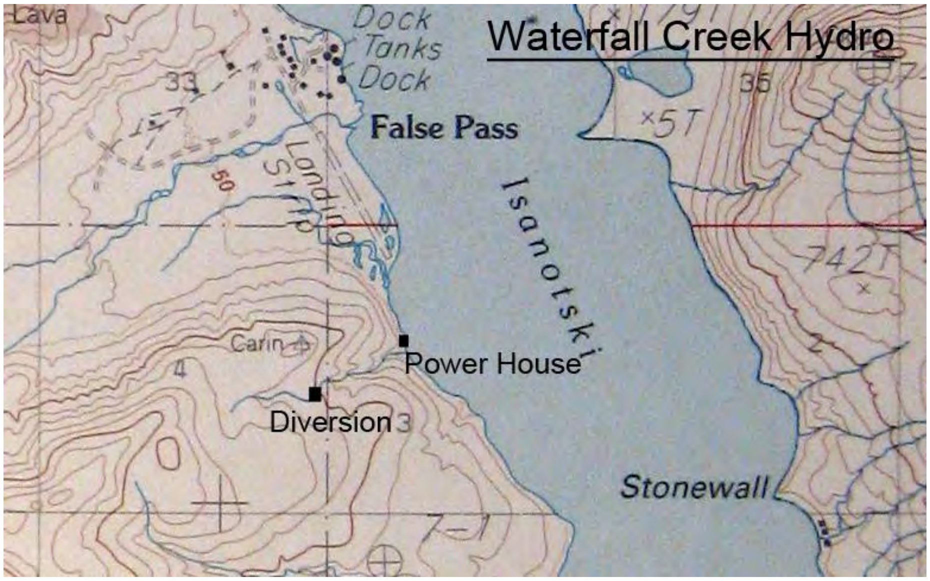
The power house for Waterfall Creek Hydro would be situated out of tidal zone of Isanotski Straight and easily assessable. Approximately 2,200 ft of buried transmission line would be required to deliver power to the electric grid located at the False Pass runway. A 1,400 ft penstock with a gross head of 400 ft would carry water from the diversion dam to the power house. An access road will be needed from the airport to the power house and from the power house to the diversion dam.

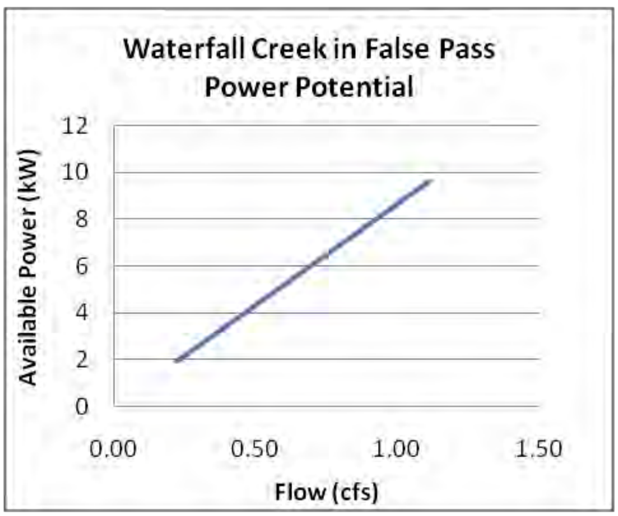

Unga Man's Creek Hydropower
Watershed = 3.14 sq mi
Penstock length = 4,600 ft
Gross Head = 200 ft
Power House
Diversion
Snowfield
Glacier
Lava
Island Rock
Nichols Point
Dock
Tanks
Dock
False Pass

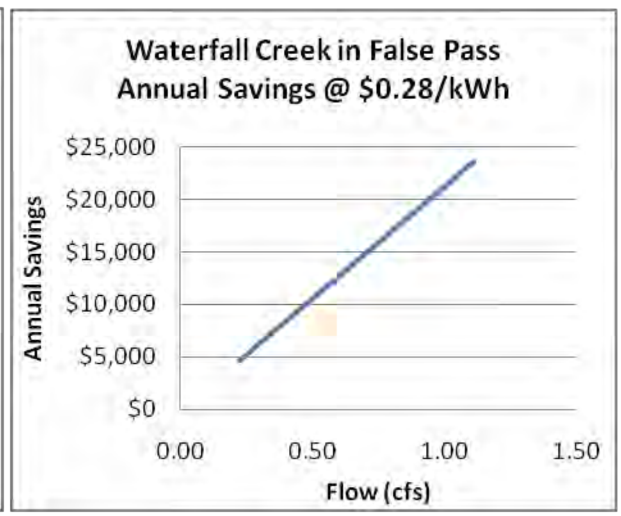

Unga Man's Creek in False Pass
Power Potential
Available Power (kW)
100
80
60
40
20
0
0 4 8 12 16 20
Stream Flow (cfs)

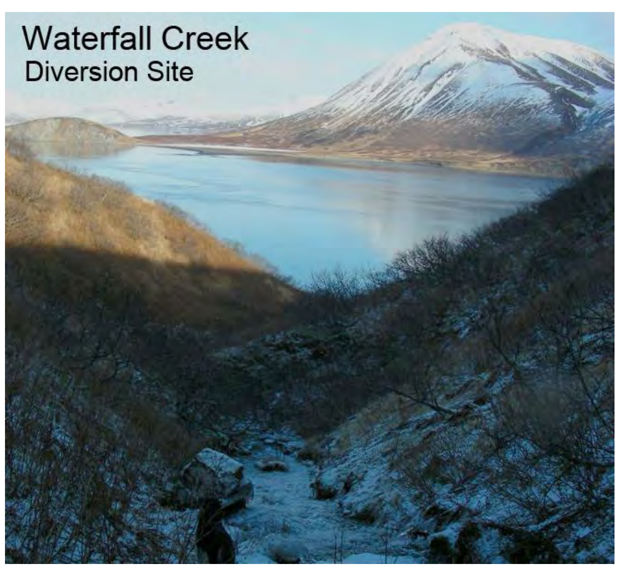

Unga Man's Creek in False Pass
Annual Savings @ $0.28/kWh
Annual Savings
$250,000
$200,000
$150,000
$100,000
$50,000
$0
0 4 8 12 16 20
Stream Flow (cfs)


Unga Man's Creek watershed
to the northwest of
False Pass


Waterfall Creek Hydro
Lava
Dock
Tanks
Dock
33
35
False Pass
Landing Strip
50
Isanotski
742
Carin
4
Power House
Diversion
3
Stonewall


Waterfall Creek in False Pass
Power Potential
Available Power (kW)
12
10
8
6
4
2
0
0.00
0.50
1.00
1.50
Flow (cfs)


Waterfall Creek in False Pass
Annual Savings @ $0.28/kWh
Annual Savings
$25,000
$20,000
$15,000
$10,000
$5,000
$0
0.00
0.50
1.00
1.50
Flow (cfs)


Waterfall Creek
Diversion Site

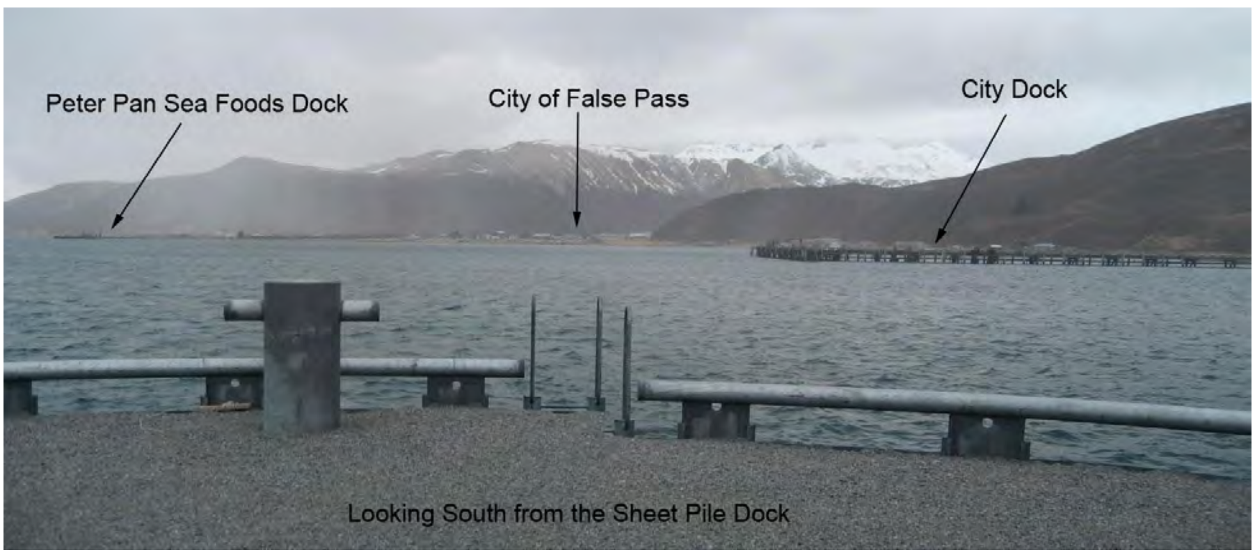
Tidal Power

Tidal power may be a potentially viable renewable energy resource in False Pass. Tidal currents for Isanotski Straight are calculated by NOAA Tides & Currents. Isanotski Straight is normally ice free from April through January.

Currently, tidal power technologies are in their infancy compared to the commercially viable technologies of wind power and hydropower. Maintenance costs for tidal power generators are unknown but are expected to require significantly more maintenance than a wind turbine due to the presence of moving parts in tidal sea water. Additionally, in False Pass, tidal power would be seasonal and would not operate when sea ice is present in Isanotski Straight.

Due to these challenges, it is recommended that wind power and hydropower be developed first before tidal power is explored further. Wind turbines and hydropower Pelton turbines can be maintained on land and will be simpler to maintain than a tidal generator. Furthermore, the wind resources in False Pass are excellent and wind turbines can produce energy year-round.

The current velocities and direction and water level have not been measured and documented at the False Pass docks, prohibiting a proper evaluation of the tidal power potential at the site. If at some time in the future tidal power becomes more commercially tested and viable, it is recommended that data loggers be mounted on both sides of the City dock and Sheet Pile dock to record this data for the ice free months of the year. With this data a proper evaluation of tidal power in False Pass can be completed.



NELSON LAGOON

EXISTING RESEARCH AND STUDIES

One existing study was found for Nelson Lagoon concerning energy in the community. Completed in 1983, the study is a report on a diesel intertie wind generator system.

- **Nelson Lagoon Diesel Intertie Wind Generator Data Monitoring Project - Final Report.** S&S Electric Inc. Sponsored by the State of Alaska Dept. of Commerce & Economic Development. Completed February 1983.

GENERAL COMMUNITY INFORMATION

Nelson Lagoon is located 580 miles southwest of Anchorage, on the northern coast of the Alaska Peninsula, on a narrow sand spit that separates the lagoon from the Bering Sea. The community economy is largely based on commercial fishing. Nelson Lagoon has a population of approximately 69 residents according to the Alaska Department of Community and Economic Development.

EXISTING FUEL FACILITIES

Nelson Lagoon Enterprises, Inc. owns and operates the Nelson Lagoon Electrical Cooperative and the Nelson Lagoon Fuel Company. Across the road from the community dock, Nelson Lagoon Enterprises owns a tank farm consisting of nine fuel tanks, each with a capacity of 27,000 gallons. The tanks contain a variety of fuels: AV gas, Unleaded, Heating Fuel #1, and Diesel #2. The table below shows the storage facilities and capacities. Diesel #2 is used exclusively for power generation. Heating Oil #1 is used for heating buildings in both Nelson Lagoon and surrounding cabins accessed by bush plane.

Fuel	Storage Capacity	Uses
Diesel #2	54,000 gal	Power Generation
Heating Oil #1	81,000 gal	Heating Oil
AV Gas	54,000 gal	Airplanes
Unleaded	54,000 gal	Ground Transportation

Nelson Lagoon Fuel Storage Capacity

Crowley is the only fuel supplier to Nelson Lagoon. A bulk delivery of fuel is barged in once a year, usually in June or July before the fishing season begins.

Fuel prices

Fuel prices in Nelson Lagoon fluctuate on a yearly basis depending on Crowley's fuel prices at the time fuels are purchased once a year. The current 2009 prices of fuels in Nelson Lagoon are shown below.

Fuel	2009 Price	Uses
Diesel #2	$4.10/gal	Power Generation
Heating Oil #1	$4.22/gal	Heating Oil
AV Gas	$5.95/gal	Airplanes
Unleaded	$4.58/gal	Ground Transportation

2009 Nelson Lagoon Fuel Prices

Community Heating Oil Usage

The table below is the estimate of Nelson Lagoon's heating oil consumption.

Heating Fuel	2006	2007	2008	2009	Average	
Nelson Lagoon Community Usage	34,334	30,388	32,221	32,725	32,417	*gal/year*
Average annual Heating Fuel Price	$3.71	$4.04	$5.12	$4.99	$4.46	*/gal*

EXISTING POWER GENERATION

Nelson Lagoon Electrical Cooperative operates the power utility and serves 47 residential, 11 commercial, 2 Federal/State Facilities, and 9 community facilities customers. Residents pay for electricity with prepaid cards.

The new Generator Building was built in 1998 by Alaska Power Systems and is located near the community dock, tank farm and Nelson Lagoon Storage Building.

Electricity Price

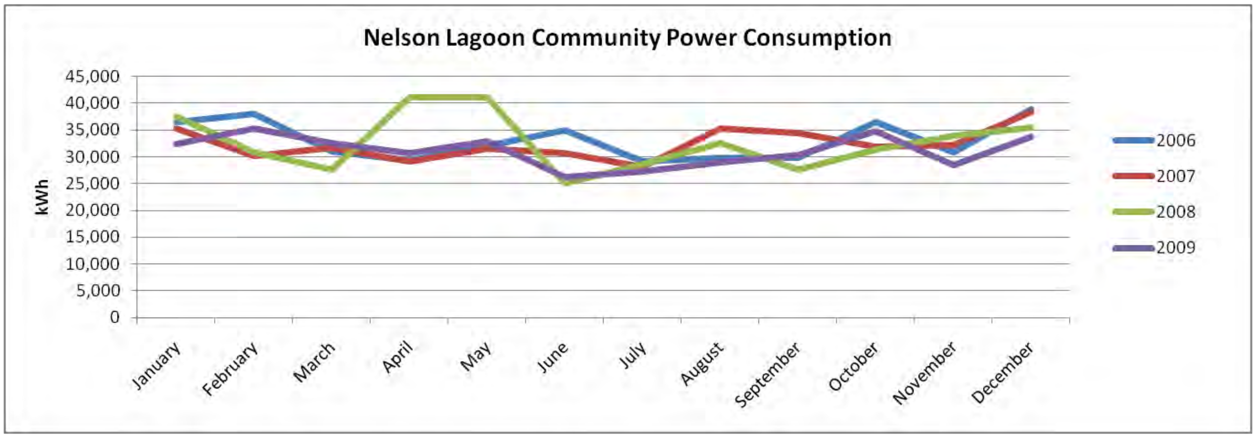
The Utility has two rates: an electric rate with the PCE credit and an electric rate without the PCE credit. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities.

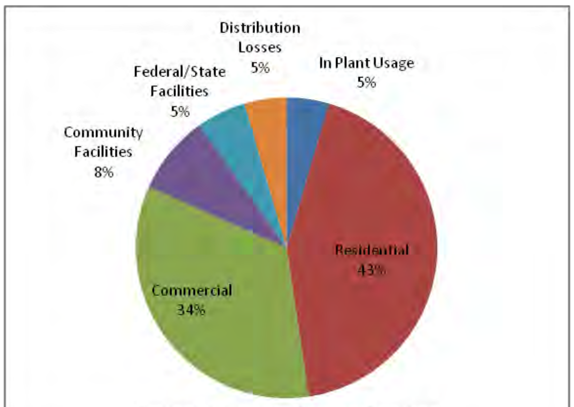
	2006	2007	2008	2009	Jan '10	Average
Electric Rate - Non-PCE*	$0.46	$0.52	$0.52	$0.67	$0.74	$0.54 /kWh
PCE Credit*	$0.27	$0.31	$0.38	$0.39	$0.38	$0.34 /kWh
Electric Rate - with PCE*	$0.19	$0.21	$0.14	$0.28	$0.36	$0.20 /kWh
*All numbers are yearly averages except for January 2010						

Nelson Lagoon Electricity Prices

Community Power Load

The annual community power consumption (4-year average) of Nelson Lagoon is approximately 388,000 kWh per year, which includes power sold to customers and does not include power that is used to operate the power plant, or power lost in distribution. The following graphs and table are based on Nelson Lagoon's PCE reports. The kWh numbers provided by the Nelson Lagoon Electrical Coop for gross generation and in-plant usage were inconsistent and therefore not included in the table below. It is estimated that in-plant usage and distribution losses are each approximately 5% of the total power sales.





Nelson Lagoon Power Sectors

	2006	2007	2008	2009	Average	
Gross Generation	na	na	na	na	**426,803**	kWh (YCE estimate)
In Plant Usage	na	na	na	na	**19,400**	kWh (YCE estimate)
Residential	190,940	188,810	184,310	171,723	**183,946**	kWh (from Coop)
Commercial	132,853	143,849	153,754	149,888	**145,086**	kWh (from Coop)
Community Facilities	52,431	29,797	32,540	30,553	**36,330**	kWh (from Coop)
Federal/State Facilities	20,740	26,347	22,011	21,464	**22,641**	kWh (from Coop)
Distribution Losses	na	na	na	na	**19,400**	kWh (YCE estimate)
Peak Load	na	na	na	na	**75**	kW (YCE estimate)
Average Load	na	na	na	na	**49**	kW (YCE estimate)
Diesel Usage	30,826	36,622	32,523	33,036	**33,252**	*gallons/year (from Coop)*
kWh/gal Generated	na	na	na	na	**12.84**	*kWh/gal (YCE estimate)*
kWh/gal Sold	12.88	10.62	12.07	11.31	**11.72**	*kWh/gal (from Coop)*

Nelson Lagoon Power Consumption Statistics

Diesel Usage for Power Generation

Nelson Lagoon has used an average of 33,252 gallons per year of diesel #2 for electrical generation, for the last four years. The diesel used for power generation is shown for 2006 through 2009 in the table above.

Projected Power Loads

The population of Nelson Lagoon has stayed constant over the last four years. The power load has also stayed fairly constant. According to the community, Bering Pacific Sea Foods is planning on building a new fish processing facility near the dock, which would increase the power load of the community.

Generator Status

Nelson Lagoon has three diesel generators for power generation, all of which are manufactured by John Deere. The 90 kW generator is currently out of service.

Generator	Rated Capacity	Type	Status
Generator 1	125 kW	John Deere Generator	Operational
Generator 2	100 kW	John Deere Generator	Operational
Generator 3	90 kW	John Deere Generator	Currently Out of Service
Total Generating Capacity	315 kW		

Nelson Lagoon Generator Capacities and Type

Power Transmission system

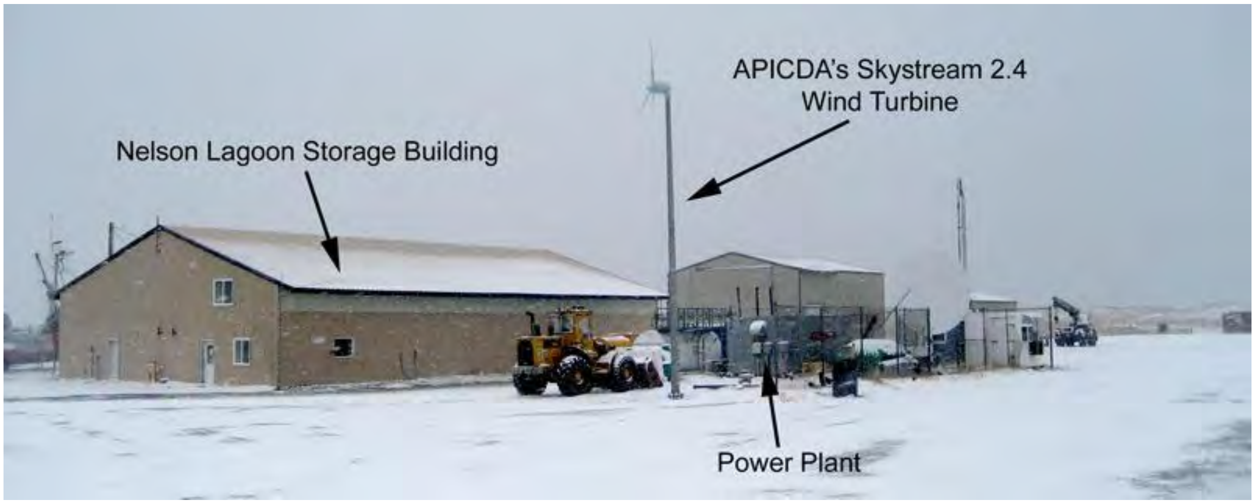
The utility's power distribution system is all underground 3-phase wire operating at 12,470 volts grounded Y.

Waste Heat Recovery

There is no waste heat recovery system installed on diesel generators at the Nelson Lagoon power plant. Waste heat is currently being dumped to outside air with two air coolers. The Nelson Lagoon Storage Building is the most proximal building to the power plant and could utilize waste heat from the generators for space heating. This potential project is discussed in the following pages.

OTHER EXISTING ENERGY SYSTEMS

In late 2008, the Aleutian Pribilof Island Community Development Association (APICDA) installed one small wind system each in the communities of False Pass, Nelson Lagoon, and Akutan. The projects were privately funded by APICDA, whose goal was to create pilot renewable energy projects to lower the cost of power in these communities. All three projects utilize a Sky Stream 1.8kW wind turbine with a 33 ft monopole tower and are equipped with data-loggers to measure wind speed, wind direction and power output, along with other data. Since installation, all wind turbines have had new inverters installed, giving them an upgraded capacity of 2.4 kW. All three of the systems are grid tied and the tower locations were chosen by the communities.



The Nelson Lagoon wind system is located next to the Nelson Lagoon Storage Building and the power plant, near the city dock.

According to Everette Anderson, the project manager from APICDA, the systems in both False Pass and Nelson Lagoon have had data-logger issues and stopped operating correctly in December, 2009. In January, 2010, a technician from H&K Energy was sent to Nelson Lagoon to troubleshoot the wind system. Since this visit the wind turbine in Nelson Lagoon has been operating properly.

APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES IN NELSON LAGOON

From background research and the January, 2010 site visit by YCE it was determined that Nelson Lagoon has two feasible sources for energy and renewable energy production. Upon completing an economic evaluation for each, the ranking of energy technologies is as follows:

1. Wind Power
2. Waste Heat Recovery

Tidal Power in the lagoon off of the community dock is potentially viable, but requires more research to determine its feasibility.

It was determined that other renewable energy sources were not feasible at this time: solar, geothermal, and biomass. Adequate sun exposure is not available for solar power. No geothermal hot springs were located in proximity to Nelson Lagoon to be feasible for assessment. There is no considerable wood resource for large scale biomass heating.

Economic Evaluations

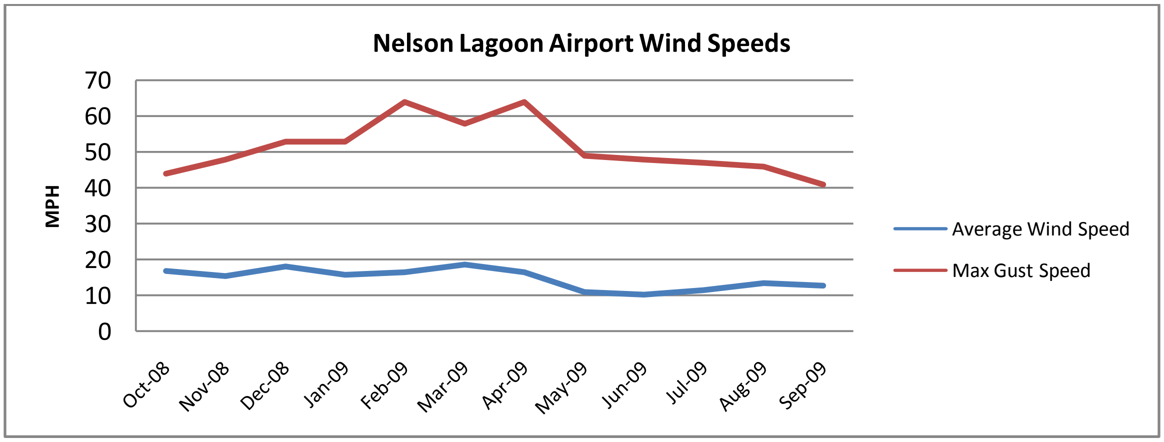
For all economic evaluations completed for Nelson Lagoon the following energy prices and associated escalation rates were used. The current price of energy as of January 2010 was used. Escalation rates were based on historic and recent trends in energy prices. A discount rate of 3% was used for the time-value of money in the net present worth evaluations.

Nelson Lagoon		
Diesel #2 Price	$4.10	/gal
Escalation	8%	
Heating Oil Price	$4.22	/gal
Escalation	8%	
Residential Electricity Rate with PCE	$0.36	/kWh
Escalation	6%	
Discount Rate	3%	

Wind Power

Producing power from the wind in Nelson Lagoon is feasible and cost effective compared to power from diesel generation. An interesting historical note is that in 1976, the Division of Energy and Power installed the first community-scale wind project in the State of Alaska in Nelson Lagoon. However, the 20 kW Grumman Windstream turbine had a design flaw and was dismantled. Today, wind technology has matured from its infancy in the 1970's. Modern heavy duty wind turbines, such as the Bergey Excel 10kw, hold promise for energy and cost savings for the community of Nelson Lagoon.

Nelson Lagoon's wind resource has not been properly characterized with an AEA Met Tower for wind power production. However, wind data from the Nelson Lagoon Airport (Station ID. PAOU) automated weather station was used to assess wind power in Nelson Lagoon. The average annual wind speed was determined to be 14.7 mph, with a max wind gust speed of 64 mph. During the operation of the 1976 wind turbine, an annual average wind speed of 14 mph was recorded. This high wind speed makes Nelson Lagoon an excellent location for wind power production. The figure below shows the average monthly wind speeds and maximum wind gust speeds collected at the airport from October 2008 to September 2009. Prevailing winds come from both the southeast and the northwest.



The wind economic evaluation for False Pass was based on using two Bergey Excel 10kW wind turbines. The Bergey Excel is a proven heavy duty wind turbine. Currently, Port Heiden utilizes two grid tied Bergey Excels. The 30m tilt-up lattice tower can be tilted up and down without the need of a crane, reducing O&M costs.

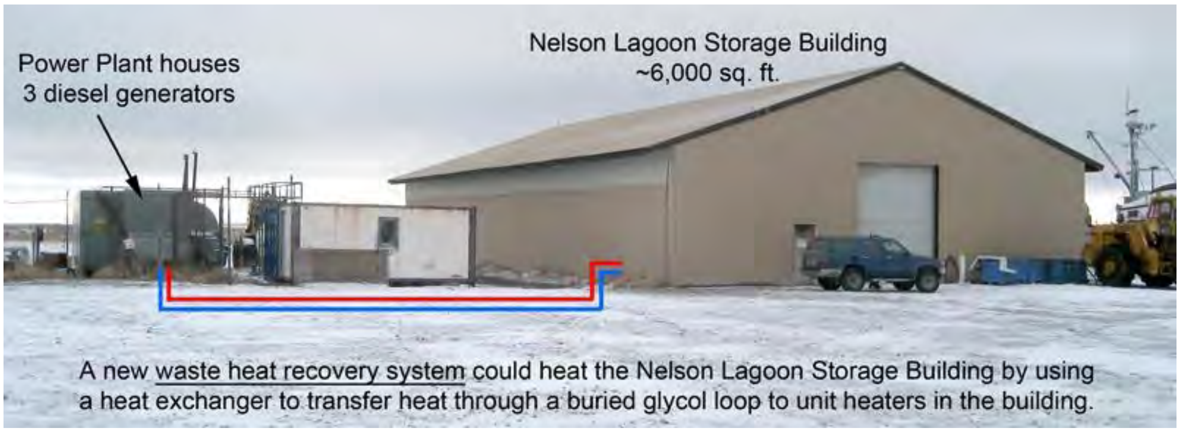
Nelson Lagoon Wind Power	
Wind Turbine	Bergey Excel 10kW
Rotor Diameter	22 ft (7 m)
Number of Turbines	2
Tower	30m Tilt-up Lattice Tower
Estimated Project Cost	$170,000
Annual Electricity Savings (kWh)	32,880
Annual Electricity Savings @ $0.36/kWh	$11,837
Annual Energy Penetration	8%
Annual O&M Costs	$690
20 yr Net Present Worth	$241,389
Payback (yrs)	9

This wind system is low penetration, with an annual energy penetration of 8%. Connection of the two wind turbines to the grid will allow the existing diesel generators to operate without the need for advanced controls. In the future, additional wind turbines could be installed to increase penetration.

Land located next to the boat storage yard is the recommended area for installation of wind turbines. The location is near the power plant and there are no buildings to obstruct wind flow at the site. The land is owned by APICDA.

Waste Heat Recovery

Although not a renewable energy source, waste heat recovery holds an opportunity for the community to reduce their heating oil consumption. It was determined from the January, 2010 site visit by YCE that the closest building to the power plant is the Nelson Lagoon Storage Building, owned by APICDA. The storage building would be the most practical user of waste heat because the remainder of community buildings are located approximately one mile away from the power plant, making a waste heat loop to those community buildings expensive and potentially unusable because of heat loss. The Nelson Lagoon Storage Building is approximately 60ft from the Power Plant.



The Nelson Lagoon Storage Building is approximately 6,000 sq. ft. and is used for fishing net and gear storage and houses the harbor masters office, including bathrooms with showers and a common room. The fishing net and gear storage uses three quarters of the building and is currently unheated warehouse space, with no roof or wall insulation. The other quarter of the building is heated with a forced air furnace burning heating oil. There is a community need for the fishing net and gear storage to be heated so that nets can be worked on in the winter more effectively.

It appears that the power plant produces enough waste heat to cover the existing heating load of the storage building with extra heat available. **To confirm this, it is recommended that daily heating oil use for the building and daily diesel consumption of the power plant be monitored through the heating season to ensure that the waste heat system can provide sufficient heat to the building for each day of the heating season.**

The waste heat economic evaluation was based on two scenarios. Scenario 1 uses waste heat from the power plant to offset the existing heating oil consumption of the storage building, estimated at 1,200 gallons annually. Scenario 2 evaluates the potential savings if the entire storage building was heated, including fishing net and gear storage areas, with heating oil savings estimated at 3,000 gallons annually. An insulated and buried 60ft pipe is proposed to carry waste heat from the power plant to the storage building.

Nelson Lagoon Waste Heat Recovery	Scenario 1	Scenario 2
Building receiving heat	Nelson Lagoon Storage Building (existing heating load)	Nelson Lagoon Storage Building (if whole building is heated)
Distance from Power Plant	60 ft	60 ft
Estimated Project Cost	$66,019	$71,019
Estimated Annual Heating Oil Savings (gal)	1,200	3,000
Annual Heating Oil Savings @ $4.22/gal	$5,064	$12,660
Estimated Annual O&M Costs	$1,000	$1,000
30 yr Net Present Worth	$222,576	$695,468
Payback (yrs)	13	6

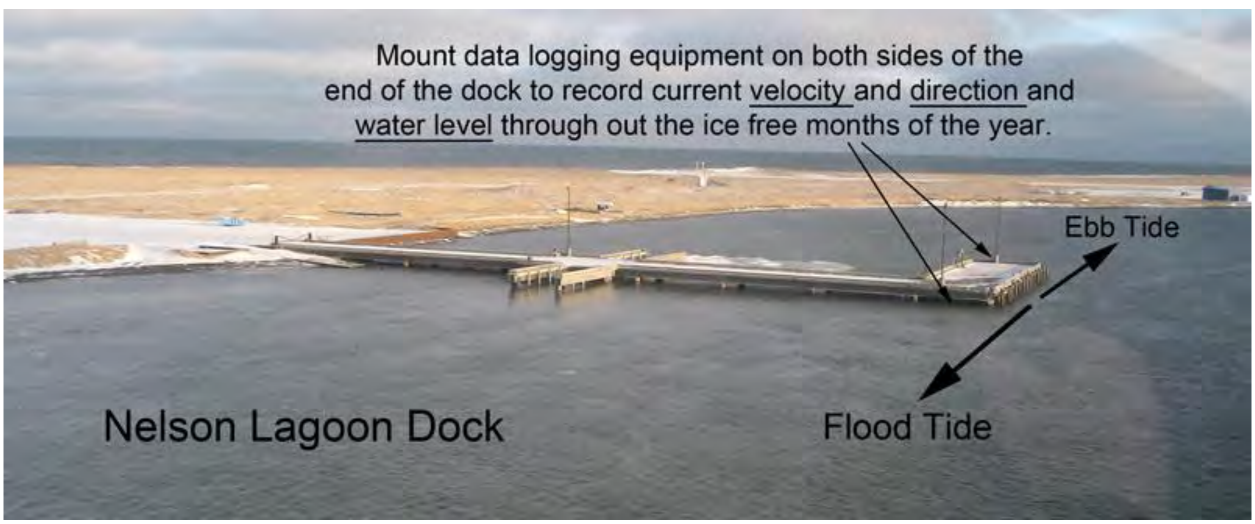
Tidal Power

There are strong tidal currents at the Nelson Lagoon dock that may be appropriate for power production. The tides flow into and out of Nelson Lagoon at an estimated speed of 7 to 8 knots in each direction. The speed of the tides out of Nelson Lagoon (ebb tides) are faster due to the added velocity of the out flowing Nelson River, due to the fact that the lagoon is situated at the outfall of the Nelson River. The dock could potentially be a good site because it is close to existing power lines and power plant. The lagoon is ice free from early June to late October. The dock is positioned close to the deeper part of the river channel and experiences higher flow velocities. Hydrokinetic units could potentially be installed to the east and west side of the dock to produce power. The system must be protected from alders and mud lumps floating down river and in from the lagoon.

However, at this time, tidal power technologies are in their infancy compared to the commercially viable technologies of wind power. Maintenance costs for tidal power generators are unknown but are expected to require significantly more maintenance than a wind turbine due to moving parts in sea water. Additionally, in Nelson Lagoon, tidal power would be seasonal and would not operate when sea ice is present. Although the Nelson Lagoon dock does have a potentially good site to use tidal power, using Nelson Lagoon as a place to field test emerging tidal technology will be very expensive due to high transportation and construction costs.

Due to these challenges, it is recommended that wind power be developed first before tidal power is explored further. Wind turbines can be maintained on land and will be simpler to maintain than a tidal generator. Furthermore, the wind resources in Nelson Lagoon are excellent and wind turbines can produce energy year-round.

The current velocities and direction and water level have not been measured in Nelson Lagoon, prohibiting a proper evaluation of the tidal power potential at the site. If at some time in the future small scale tidal power becomes more commercially tested and viable, it is recommended that data loggers be mounted on both sides of the dock to record this data for the ice free months of the year. With this data a proper evaluation of tidal power in Nelson Lagoon could be completed.



ENVIRONMENTAL PERMITTING FOR RENEWABLE ENERGY PROJECTS

All of the renewable energy options in the report may be subject to State and or permitting requirements. Each project will require specific permits based on its location and potential impacts and will be dictated by the agencies relevant to those impacts. For the purpose of this report, a comprehensive list of possible permits will be presented and in the planning phase of an actual project, specific permit applications should be identified. As a result of an actual permit application, a renewable energy project could be restricted or prohibited. However, such a conclusion will only be known upon review of the appropriate agency.

WIND POWER PERMITTING

The major permitting challenges for wind power in Cold Bay, False Pass and Nelson Lagoon include:

- Threatened Species - The Steller's Eider is currently federally listed as threatened and regularly occurs on Izembek NWR, near Cold Bay. Steller's eider also occurs in Nelson Lagoon, currently listed as critical habitat for the species.
- Telecommunications Interference - Wind turbines may interfere with communications signals by generating electromagnetic noise and/or creating physical obstructions that distort communications signals. The Cold Bay airport contains many government radar facilities.
- Aviation Considerations - All wind tower locations must be approved by the Federal Aviation Administration (FAA).

The potential impacts of wind turbines on threatened and migratory birds were discussed with Nancy Hoffman, the USFWS Izembek Refuge Manager, during the site visit. The USFWS is concerned about bird kills caused by birds flying into wind turbines, towers and guy wires. They have not adopted a formal position against installing wind turbines. In fact, the USFWS is in the process of installing vertical axis wind turbines at their complex in Cold Bay. The USFWS staff in Cold Bay has expressed the position that at potential wind turbine sites the flight patterns of birds should be assessed before turbine installation so that bird kills can be minimized.

The USFWS has not prohibited horizontal axis wind turbines in Cold Bay, however at this present time they prefer vertical axis wind turbines because they have reduced blade area and tip speed, both of which to mitigate bird collisions. Nancy Hoffman said that she would be more interested in horizontal axis wind turbines if the turbines were used in a research project to determine how horizontal axis and vertical axis wind turbines compare with respect to bird collisions. If Cold Bay USFWS staff is sufficient at the time of the project, USFWS resources could be used to conduct baseline preconstruction surveys along with creating and implementing a wind turbine monitoring plan.

During the site visit USFWS and YCE discussed the following mitigation measures:

- Coloring or striping wind turbine blades and towers to make them more visible to birds
- Keeping tower heights less than 40 ft, because birds at the site typically fly at elevations greater than 40 ft.
- If structurally and economically feasible, using monopole towers that do not use guy wires
- If guy wires are necessary, using streamers to make guy wires visible to birds
- Using vertical axis wind turbines that reduce the potential contact area and blade speed for bird collisions

Below is a comprehensive list of agencies and possible permits required for wind power projects.

Agency	Permits/General Concerns
Federal Aviation Administration (FAA)	Notice of Proposed Construction, Hazard Determination, Telecommunication impacts
National Telecommunications Information Administration, and National Weather Service	Telecommunications impacts
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Fish and Wildlife Service-Fisheries and Ecological Services	Migratory Birds
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration-Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

Waste Heat Recovery Permitting

Waste heat recovery projects typically have limited potential environmental impacts due to urbanized nature of the project. Due to this fact, there are no major environmental challenges, as yet determined, that would restrict a waste heat recovery project. Below is a comprehensive list of agencies and possible permits required for a waste heat recovery project.

Agency	**Permits/General Concerns**
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration-Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

HYDRO POWER PERMITTING

Cold Bay is the only community with anticipated environmental permitting challenges for the development of hydro power projects. Potential hurdles for the four hydro projects identified in this report are land ownership and environmental issues. Site 1 (Frosty Creek) is located in the Izembek National Wildlife Refuge. Site 2 (North Fork of Russell Creek), Site 2 (South Fork of Russell Creek), and Site 4 (Thin Point Creek) are located in the Alaska Peninsula National Wildlife Refuge. Furthermore, there is salmon migration in all streams according to the USACE report.

False Pass is anticipated to have less environmental permitting challenges due to the fact that both Man's Creek and Waterfall Creek are non-anadromous according locals and are located on land owned by the Isanotski Corporation. Both creeks are not listed in the Alaska Department of Fish and Game's Anadromous Waters Catalog.

Below is a comprehensive list of agencies and possible permits required for hydro power projects.

Agency	Permits/General Concerns
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Fish and Wildlife Service-Fisheries and Ecological Services	Migratory Birds, Fisheries
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Fish and Game-Habitat Division	Fish Habitat Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration-Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
National Oceanic and Atmospheric Administration-Habitat Conservation	Anadromous Fisheries
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding

TIDAL POWER PERMITTING

Currently, tidal power is in its infancy compared to the technologies of wind power, hydro power, and waste heat recovery. As a result, anticipated environmental permitting challenges are not well known. Below is a comprehensive list of agencies and possible permits required for tidal power projects.

Agency	Permits/General Concerns
U.S. Fish and Wildlife Service-Endangered Species	Threatened & Endangered Species
U.S. Fish and Wildlife Service-Fisheries and Ecological Services	Migratory Birds, Fisheries
U.S. Army Corps of Engineers-Regulatory Branch	Wetland Impacts
Alaska Department of Environmental Conservation-Water	Section 401 Water Quality Certification, NPDES General Construction Permit
Alaska Department of Fish and Game-Habitat Division	Fish Habitat Permit
Alaska Department of Natural Resources-Division of Coastal and Oceans Management	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
Alaska Department of Natural Resources-State Historic Preservation Officer	Historical Sites
Alaska Department of Natural Resources-Mining Land and Water	State Land issues, Water rights, Temporary water use authorization
National Oceanic and Atmospheric Administration- Protected Species	Threatened & Endangered Species under NOAA's jurisdiction
National Oceanic and Atmospheric Administration-Habitat Conservation	Anadromous Fisheries
City-Coastal Zone	Coastal Project Questionnaire, Enforceable Policies Determination, Consistency Determination
City-Floodplains	Project location and flooding