NANA Regional Corporation

Wind Resource Assessment Project (WRAP): 2008-2010

US Department of Energy Tribal Energy Program,

awarded grant #DE-FG360-07G017076

Final Report

Installation of AEA met tower in Deering, August 2008 (photo by Brian Yanity)

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PROJECT SUMMARY

NANA Regional Corporation (NRC) of northwest Alaska is located in an area with abundant wind energy resources. In 2007, NRC was awarded grant #DE-FG36-07GO17076 by the US Department of Energy's Tribal Energy Program for funding a Wind Resource Assessment Project (WRAP) for the NANA region. The NANA region, including Kotzebue Electric Association (KEA) and Alaska Village Electric Cooperative (AVEC) have been national leaders at developing, designing, building, and operating wind-diesel hybrid systems in Kotzebue (starting in 1996) and Selawik (2002).

Promising sites for the development of new wind energy projects in the region have been identified by the WRAP, including Buckland, Deering, and the Kivalina/Red Dog Mine Port Area. Ambler, Shungnak, Kobuk, Kiana, Noorvik & Noatak were determined to have poor wind resources at sites in or very near each community. However, all five of these communities may have better wind resources atop hills or at sites with slightly higher elevations several miles away.

The wind energy resource in the NANA region are being quantified by anemometers installed on meteorological (met) towers at community sites identified by the WRAP study team. Wind data has been collected for more than a year at three locations. Met towers equipped with anemometers were secured from the Alaska Energy Authority (AEA) Anemometer Loan Program and project participants, and installed during summer 2008 at identified sites in Deering and Noorvik, and an AEA-owned met tower was moved to a new site in Buckland.

In September 2008, members of the NANA WRAP technical team went on a reconnaissance trip to identify potential wind energy sites near the Red Dog Mine and Port areas. The Red Dog Port area was one of the sites originally proposed in the early stages of the NANA WRAP. Although not included in this Department of Energy (DOE)-funded project, members of the NANA WRAP technical team in October 2008 installed one met tower at the Red Dog Mine area, and an anemometer (utilizing an existing radio tower) at the Red Dog Port area. Large-scale wind energy development at the Red Dog Mine and Port areas could be connected by transmission lines to the communities of Kivalina and Noatak. The wind resource assessment work underway at the Red Dog Mine can be directly linked to the awareness-raising efforts of the DOE-sponsored energy initiatives in the NANA region. Also, WRAP funding was used for wind data analysis for the Red Dog Port site, as well as preliminary economic analysis for wind generation at the port site, using the HOMER energy-economic modeling software. During summer 2009, further discussions with Teck were held regarding the wind energy resources at the port site, including preparation of a report summarizing the results of the HOMER modelling of wind-diesel economic feasibility.

In 2009, AEA (with approval from the state legislature) awarded a $10,750,000 Renewable Energy Fund grant to the Northwest Arctic Borough (NWAB) for design and construction of wind-diesel projects in Deering, Buckland, and Noorvik. The feasibility study/conceptual design phase of this grant began in September 2010.

COLLECTION AND ANALYSIS OF DATA

In August 2008, two met towers manufactured by NRG and borrowed through the AEA's Anemometer Loan Program were installed in Noorvik and Deering. An existing AEA-owned met tower in Buckland was moved (or an anemometer "reinstallation") during June 2008 to a new location on a hilltop west of the community. These met towers record data from three anemometers (two at 30 m height above ground level, and one at 20 m), a wind vane and a temperature sensor. Ruth Moto-Hingsbergen of Ipnatchiaq Electric Company oversaw data collection from the Deering met tower, and Tim Gavin, Jr. oversaw data collection from the Buckland met tower.

In October 2009, Noorvik's met tower was taken down in order to be moved to a new location about 4 miles east of the community. Also in October 2009, a micro-weather station was installed in Ambler on an existing 30 m tilt-up tower to collect wind data. In June 2010, an anemometer and datalogger were installed on an existing communications tower at the clinic in Noatak.

The locations of the AEA met towers, and other WRAP data collection sites, are shown in Figure 1. The predicted Wind Power Class shown on the map for each site, ranging from Class 1 (poor) to Class 7 (superb), is based on data collected from the the WRAP studies, Teck's anemometer at the Red Dog Port, and Alaska Energy Authority's wind resource reports for Koztebue and Selawik. No collected data is yet available from the anemometer installed in Noatak.

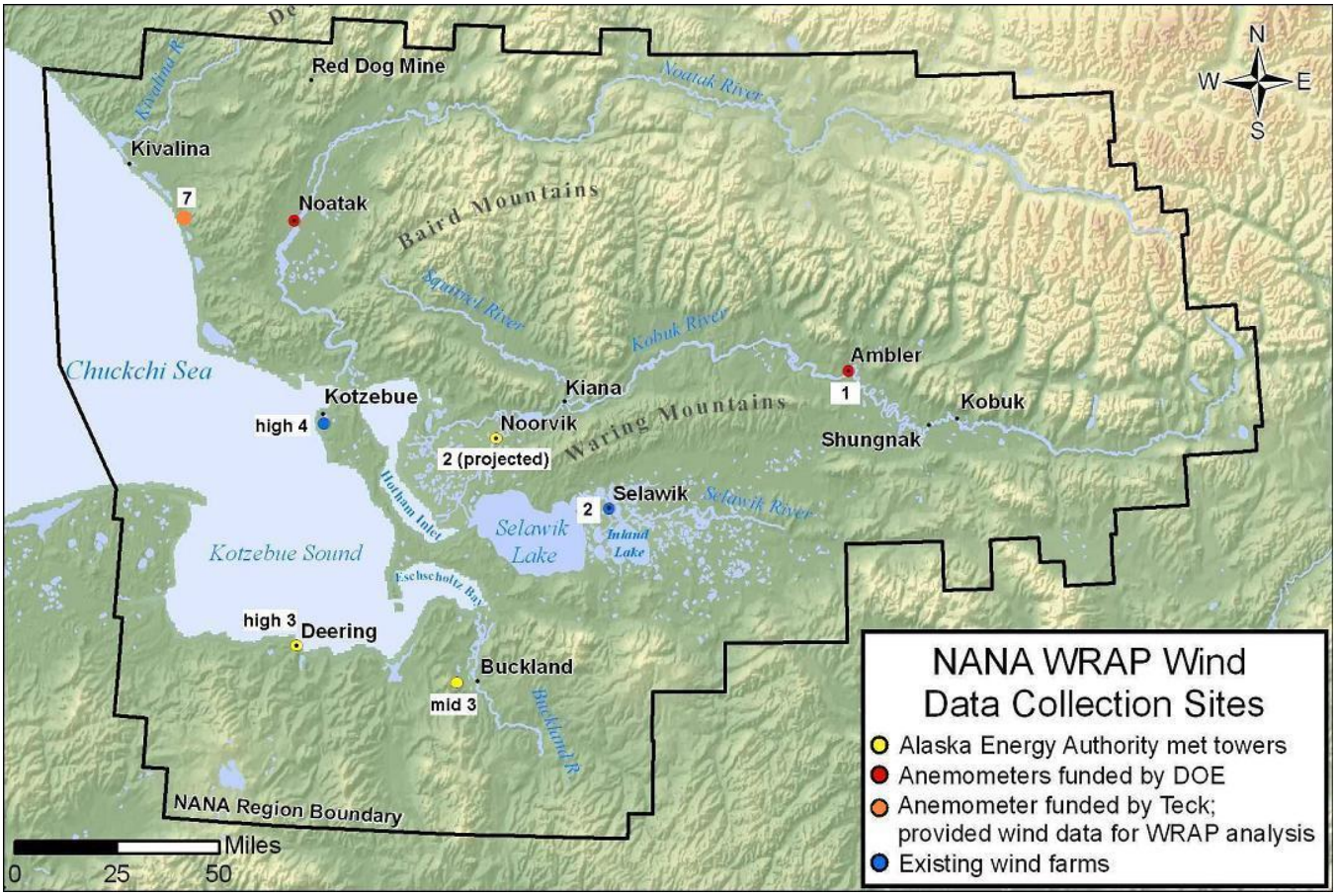

Figure 1: NANA WRAP data collection sites, with Wind Power Class predicted from collected data shown (map by Paula Hansen)

IDENTIFYING WIND SITES

Wind site identification for the NANA region was conducted between February and July 2008; several sites in or near Buckland, Deering, Noorvik, and the Red Dog Mine's Port area were prioritized. Preliminary wind energy resource reports for the NANA region were completed in January and June 2008 by V3 Energy, LLC (see Appendix II-A and Appendix II-C, respectively). The resource reports included high resolution wind resource assessment maps developed for the NANA regional communities by AEA. Kivalina was judged to have insufficient land area available for wind turbines, and possible sites on hills or ridges near Kiana, Ambler, Shungnak and Kobuk were

discussed, although the resources within 1 mile of these four communities were predicted to be Class 2 (marginal) or Class 1 (poor).

An environmental and cultural resource analysis was conducted for several possible wind energy sites in the NANA Region, and DOE-required "environmental checklists" were submitted for the three met tower installations. Preliminary environmental permitting discussions were conducted with the US Fish and Wildlife Service, which has stated no objection to the met towers at the Deering, Buckland, Noorvik, the Port of Red Dog Mine, and Noatak sites.

This AEA tower loan program requires a representative from a local entity in each community to sign a Memorandum of Agreement (MOA) with the AEA. This representative or local entity will take responsibility for the met tower and collecting its data. The AEA also requires consultation with the U.S. Fish and Wildlife Service and the Federal Aviation Administration. Tribal resolutions for Deering, Buckland, and Noorvik were secured before the met towers were installed in each community.

FINANCIAL AND ECONOMIC ANALYSIS OF WIND-DIESEL SYSTEMS

In March 2008, a preliminary financial feasibility analysis was conducted for conceptual wind-diesel systems in Deering, Buckland and Noorvik using the software program RETScreen. The results of this financial analysis are attached as Appendix II-B. RETScreen results predict benefit/cost (B/C) ratios for Deering (1.54), Buckland (1.20) and Noorvik (1.17). It should be noted a that these B/C ratios were calculated without any wind data yet collected, so a new financial analysis with updated cost estimates will be performed with the wind data collected by the WRAP, as part of the feasibility studies funded by the Northwest Arctic Borough's grant from AEA. A preliminary HOMER economic analysis was also done for a proposed wind-diesel system at the Red Dog Port site, to serve both the port facilities and the community of Kivalina with a new power line (see Appendix II-E).

PUBLICATIONS / PRESENTATIONS

A presentation on the NANA regional energy plans, including the WRAP, was given at the NANA Regional Energy Summit in Kotzebue in July 2008 and at the DOE Tribal Energy Program conference in Denver in mid-November 2008.

NANA Pacific and NANA Development Corp. WRAP participants contributed wind energy resource information to the NANA Region Strategic Energy Plan, which was completed at the end of December 2008.

DATA RESULTS AND CONCLUSIONS

The most promising communities for wind energy development in the NANA region are those nearest the coast: Kotzebue, Buckland, Deering and Kivalina. Because Kotzebue and Selawik already have wind turbines installed, and are planning to add additional turbines, the NANA WRAP team decided to focus on the most promising communities with undeveloped wind resources.

BUCKLAND

In June 2008, an AEA met tower was installed on a hilltop about 4.5 miles west of Buckland. The main conclusions of the V3 Energy wind resource report (Appendix I-A), based on the data collected from the met tower at the Buckland hilltop site, are listed below:

Measurement period	June 11, 2008 to March 13, 2010
Wind Power Class	Mid 3 (fair)
Wind speed mean (at 30 m)	5.58 m/s
Power density mean (at 30 m)	302 W/m^2

In addition to the analysis of the collected met tower data, New Roots Energy prepared a report for the hilltop site west of Buckland (also in Appendix I-A), based on a computer model and not from data collected on site. This report predicted a Class 2 (marginal) wind resource, with an average wind speed (at 35 m) of 5.3 m/s (11.9 mph). The wind resource at this site warrants a conceptual design/feasibility study for a new wind energy project. However, the 21 months of data collected at the site shows that the New Roots Energy computer model prediction to be too low.

DEERING

In August 2008, an AEA met tower was installed on a hilltop slightly less than 1 mile northwest of Deering, near Cape Deceit. This site is thought to have the best developable wind near Deering, as it is near an existing road on a broadly sloping hill overlooking Kotzebue Sound with good exposure to winds from all directions. The main conclusions of the V3 Energy wind resource report (Appendix I-B), based on the data collected from the met tower at the Deering hilltop site, are listed below:

Measurement period	August 9, 2008 to August 6, 2010
Wind Power Class	High 3 (fair)
Wind speed mean (at 30 m)	6.00 m/s
Power density mean (at 30 m)	316 W/m^2

The wind resource at this site warrants a conceptual design/feasibility study for a new wind energy project.

NOORVIK

In August 2008, an AEA met tower was installed at the old airport site about 1/2 mile east of Noorvik. In October 2009, the AEA met tower in Noorvik was taken down from the old airport location. The met tower is presently in storage but is planned to be relocated to a site about 4 miles east of the community. The site chosen has existing

met tower anchors used in 2002, for a previous wind energy study commissioned by Maniilaq Association. Unfortunately, only several months of data was collected from the previous met tower installation.

The main conclusions of the V3 Energy wind resource report (Appendix I-C), based on the data collected from the met tower at the Noorvik old airport site are listed below:

Measurement period	August 2, 2008 to May 6, 2009 (6.5 months data recovered)
Wind Power Class	2 (marginal), projected from 6.5 months data
Wind speed mean (at 30 m)	4.5 m/s, projected from 6.5 months data
Power density mean (at 30 m)	170 W/m^2, projected from 6.5 months data

In addition to the analysis of the 6.5 months of collected met tower data, New Roots Energy prepared a report for the site several miles east of Noorvik (also in Appendix I-C), based on a computer model and not from data collected on site. This report predicted a Class 1 (poor) wind resource, with an average wind speed (at 35 m) of 4.6 m/s (10.3 mph).

At this point, it is uncertain if the wind resource at Noorvik's old airport site would warrant a conceptual design/feasibility study for a new wind energy project at this location, so it is recommended that more data be collected at this site. Ideally, the met tower should re-erected at the same site to collect several additional months of data for a more complete resource assessment. It is also recommended that wind data collected at the new site east of the community for at least one year to determine if it is viable for wind energy development. It would much less expensive to develop a wind project at the old airport site than the site several miles east of the community, due to costs of building a power line.

KIVALINA/RED DOG PORT AREA

AEA's wind map predicts Class 4 winds for Kivalina (see Appendix II-A), but the present town site does not have an adequate site for wind turbines due to the location of the airport runway on the narrow spit of land on which the village is located. The community of Kivalina is also discussing moving to a new town site, the location of which has not yet been decided.

Alaska Village Electric Cooperative (AVEC), the electric utility which serves Kivalina, and NANA proposed the concept of constructing a new power line from Red Dog Port's existing power plant to Kivalina, either the existing town site (a distance of about 16 miles) or to the new town site.

In September 2008, an anemometer was installed on an existing communications tower on a hilltop about 2.5 miles from the port site, as part of a wind resource assessment for Teck, the operator of the Red Dog Mine. The main conclusions of the V3 Energy wind resource report (see Appendix II-E), based on the first 5.4 months of data collected from the met tower at the Red Dog Port hilltop site, are listed below:

Measurement period	October 10, 2008 to March 22, 2009
Wind Power Class	7 (superb)
Wind speed mean (at 33 m)	7.76 m/s
Power density mean (at 33 m)	1,247 W/m^2

Teck provided its wind resource and power generation data from its existing diesel power plant at the port to the NANA WRAP team, and AVEC provided power generation statistics for Kivalina. Using an assumed average wind

speed of 7 m/s, HOMER analysis was performed for modeling one or more 1.65 MW Vestas V82 turbines, with an interconnection to Kivalina (see Appendix II-E). The analysis confirmed that wind and diesel power generated at the port would likely be an economical source of electricity for Kivalina; it is recommended that a feasibility study of the power line and a Red Dog Port wind farm be conducted.

NOATAK

In June 2010, an anemometer and new datalogger was installed on a 15 m (50') communications tower at the Noatak clinic. No data collected from this anemometer was yet available during the writing of this report.

Noatak is not expected to have a viable wind energy resource, sites in or near the community predicted to be Class 1 (poor) by the January 2008 regional wind resource assessment by V3 Energy (see Appendix II-A). The AEA wind map predicts that the nearest Class 3 (fair) wind resources are located at least 7 miles away, atop the hills to the west.

AMBLER

In October 2009, a micro-weather station was installed in central Ambler by Ingemar Mathiasson, which includes an anemometer atop a tower belonging to Ambler ITC, about 32 m (105') above ground level. For the measurement period between October 30, 2009 and July 26, 2010 (with a gap in data between December 29, 2009 and February 22, 2010), the average wind speed listed for the 8.8 months was 3.48 m/s at 30 m, which is estimated to be 3.74 m/s at 50 m. This is well under the threshold of 5.6 m/s or less for wind Class- 1 (poor). The Windographer report on this Ambler anemometer data is attached in Appendix I-D.

The June 2008 letter report by V3 Energy discusses a possible hilltop wind site about 3.5 miles NNW of Ambler (see Appendix II-C). The existing micro-weather station and tower could be moved to this location to assess the wind resource, if Ambler stakeholders felt this was justified given local knowledge of wind conditions on the hills north of the community.

KIANA

Kiana is not expected to have a viable wind energy resource, and sites in or near the community are predicted to be Class 2 (marginal) by the January 2008 regional wind resource assessment by V3 Energy (see Appendix II-A).

The June 2008 letter report by V3 Energy discusses two possible hilltop wind sites, located more about 1.5 and 3 miles north of Kiana (see Appendix II-C). These sites could warrant further investigation, if Kiana stakeholders felt this was justified given local knowledge of wind conditions on the hills north of the community.

SHUNGNAK AND KOBUK

The Shungnak-Kobuk area is not expected to have a viable wind energy resource, and sites in or near these two communities are predicted to be Class 1 (poor) by the January 2008 regional wind resource assessment by V3 Energy (see Appendix II-A). The June 2008 letter report by V3 Energy concludes that the terrain of possible hilltop wind sites located several miles north of Shungnak and Kobuk is too steep for the practical installation of village-scale wind turbines (see Appendix II-C).

PLANS FOR 2011 AND BEYOND

In 2009, NWAB was awarded $10,750,000 from AEA for the feasibility analysis, design and construction of wind power projects in Deering, Buckland and Noorvik. The feasibility and design studies under the AEA grant began in September 2010. Given that the wind energy resources in Deering and Buckland appear strong enough for economically viable wind projects, funding will likely be secured for continuing design and construction activities. Noorvik will be funded only if additional data collection proves that the community has a viable wind energy resource, and the cost of a power line connecting the wind turbines to the community is not too high.

BUCKLAND

If AEA is satisfied with the present amount of data collected from the hilltop site, the met tower will be taken down from its present location, and moved to a new location closer to Buckland, a relatively flat area reported to be windy (about mid-way between the present met tower site and the airport). Another possibility is that the AEA met tower scheduled to be taken down in Deering could be moved to the new site in Buckland. NWAB's grant would fund this work, and the collected data will be used for the Buckland wind-diesel feasibility study. The NWAB will work with the City of Buckland during the feasibility study process.

DEERING

AEA has stated that the Deering met tower can now be taken down, because enough data has been collected at the site. NWAB's grant would fund this work, and the collected data will be used for the Deering wind-diesel feasibility study. The NWAB will work with Ipnatchiaq Electric Company (the Deering utility) during the feasibility study process.

NOORVIK

At this point, it is uncertain if the wind resource at Noorvik's old airport site would warrant a conceptual design/feasibility study for a new wind energy project at this location, so it is recommended that more data be collected at this site. It is also recommended that wind data collected at the new site east of the community for at least one year to determine if it is viable for wind energy development. It would much less expensive to develop a wind project at the old airport site than the site several miles east of the community, due to costs of building a power line. The met tower is expected to be moved to the new site in late September/early October 2010. The NWAB will work with AVEC (the Noorivk utilty) during the wind resource assessment study process.

RED DOG PORT/KIVALINA WIND ENERGY AND POWER LINE PROJECT

AVEC has hired WHPacific for the feasibility study of a wind-diesel system at the Red Dog Port, with a connecting power line to Kivalina. The feasibility study activities will begin in October 2010, with assistance from Teck.