

Memorandum

To: Sonny Adams

From: Douglas Vaught, P.E.

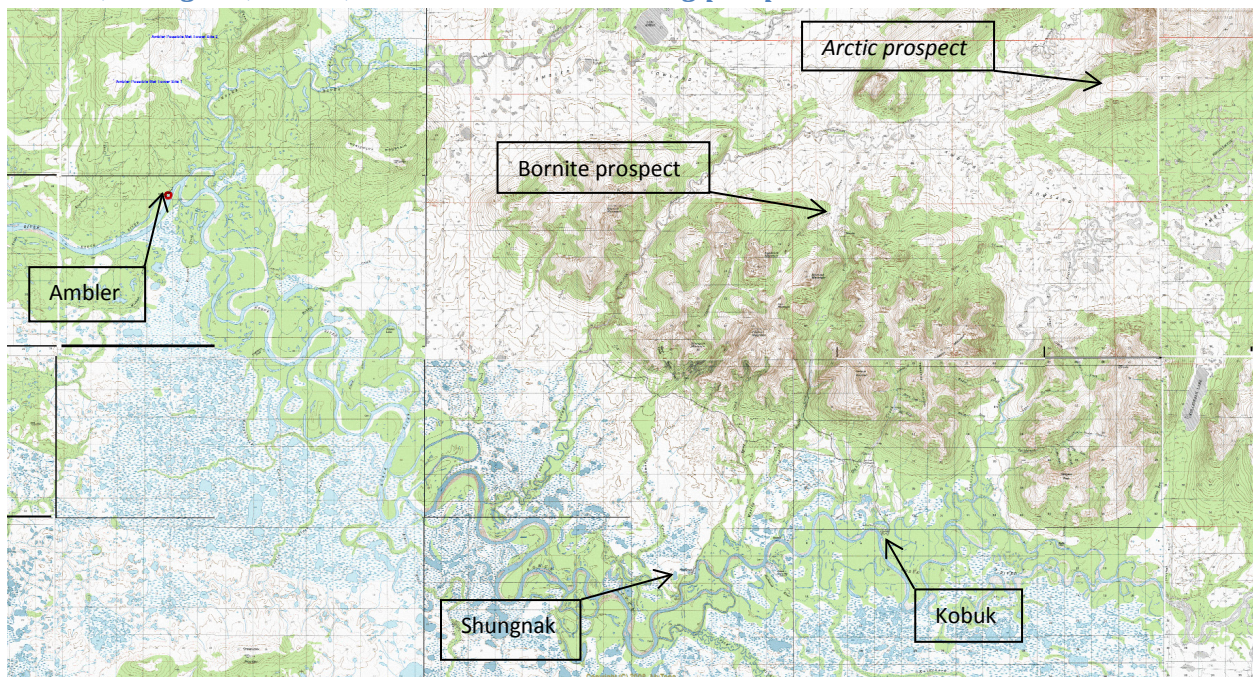
Date: April 12, 2013

Re.: Shungnak and Kobuk Area Met Tower Site Options

NANA Regional Corporation (NRC), working with WHPacific, purchased a 34 meter NRG met tower in early autumn, which is presently stored at the Dall Creek airstrip near Kobuk. WHPacific contracted V3 Energy, LLC to assist with site selection.

In September and October V3 Energy was asked to review site options near Kobuk, Shungnak, the Arctic mine prospect, the Bornite mine prospect, and Ambler. Subsequent discussions narrowed the choice to the Shungnak and Ambler areas, both with the consideration that wind turbines could be installed near a possible electrical distribution intertie route connecting Ambler to Shungnak and Kobuk.

Ambler, Shungnak, Kobuk, Bornite and Arctic mining prospects



Scale: Ambler to Kobuk - 29 straight line miles

WASP analysis of Shungnak

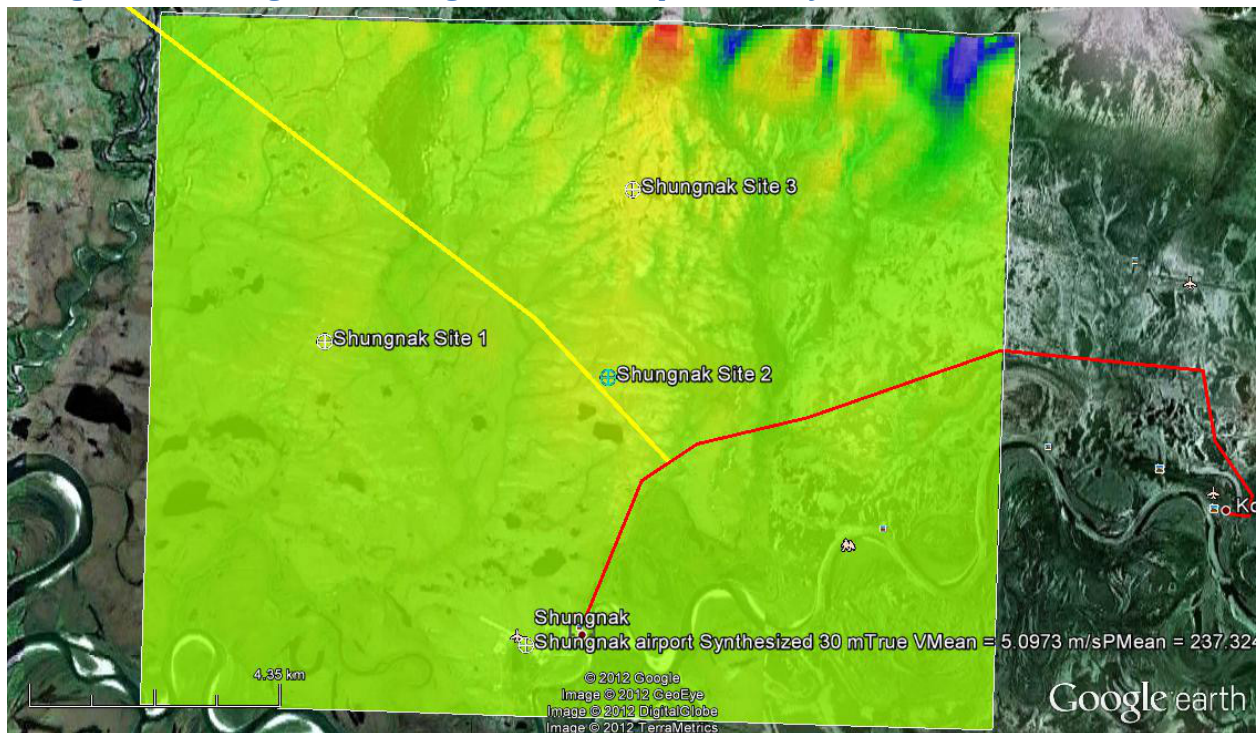
An analysis of the wind resource in the vicinity of Shungnak was accomplished with use of WASP software with the Shungnak airport data as the wind data reference point. The Shungnak airport has been equipped an automated weather observation station (AWOS) since December 2009. Shungnak AWOS data was obtained via the National Climatic Data Center for the time period of December 10,

2009 to November 1, 2012. The wind data was converted from units of miles per hour to meters per second, scaled from 10 to 30 meters, and processed to eliminate non-hourly data before import to WAsP. It is important to understand that hourly AWOS data does not represent the average wind speed over an hourly reporting period, rather just a short interval of time immediately prior to the hour. As such, it must be used with caution for purposes such as predicting actual wind turbine performance. But, as a means to compare prospective sites against each other, airport wind data is fine.

The image below includes the Shungnak airport bottom center and three possible turbine sites. Shungnak Site 1 is a high point about four miles from Shungnak in the area recommended by Alaska Energy Authority based on its AWS Truewind model. Shungnak Site 2 is very near the proposed Ambler to Shungnak intertie route and relatively near Shungnak. WAsP modeling predicts higher wind speeds at Site 2 than Site 1. Shungnak Site 3 is higher elevation than the other two sites and about the same distance from the proposed intertie route as is Site 1. Of the three sites, WAsP modeling predicts that Site 3 has the highest wind speeds (shown by yellow overlay compared to the lower wind speed green and blue).

The second image below shows the same WAsP overlay, but with an additional overlay of AEA's AWS Truewind wind class prediction. As one can see, AWS Truewind predicts a broad swath of Class 2 winds surrounding Site 1 but only sporadic prediction of Class 2 winds in the vicinity of Sites 2 and 3. WAsP modeling on the other hand predicts a better wind resource at Sites 2 and 3 than Site 1.

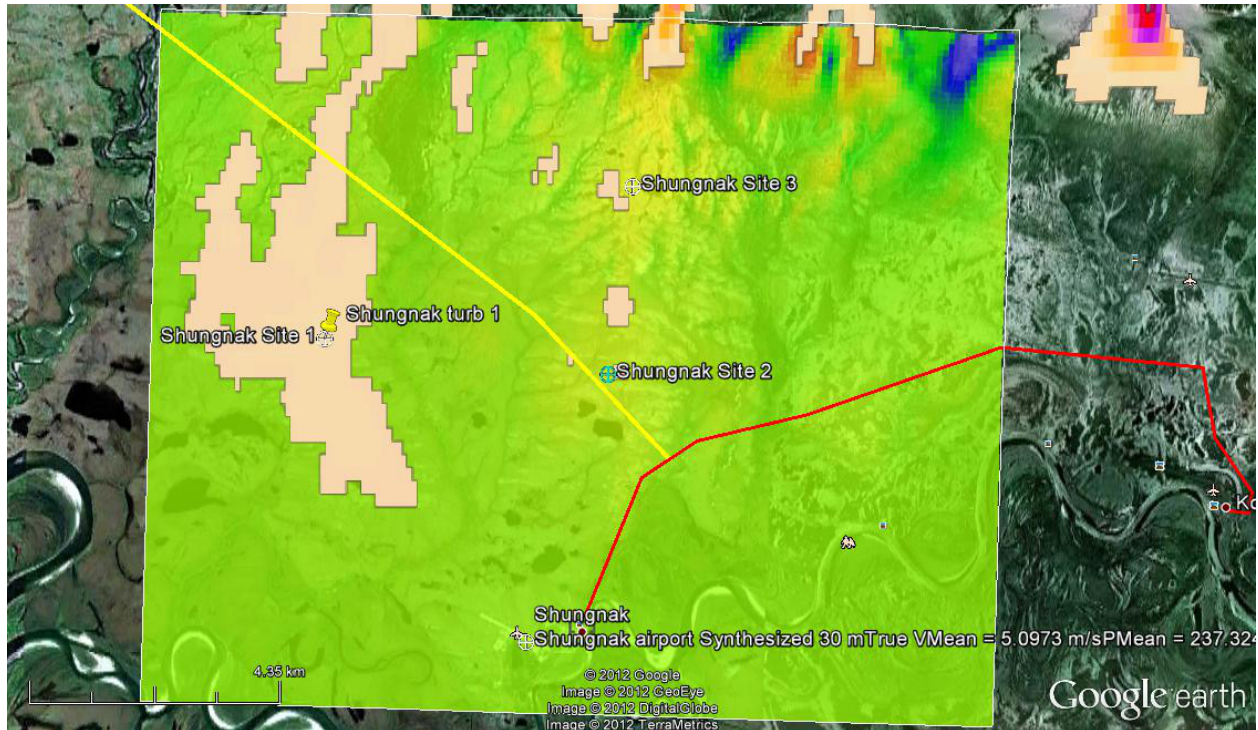
Shungnak area, Google Earth image, WAsP wind speed overlay



Note: Red line – existing Shungnak-Kobuk intertie; yellow line – proposed Ambler-Shungnak intertie

Shungnak airport and site comparison table

Location/Site	UTM	Elev. (m)	Speed (m/s)	Speed compared to airport
Shungnak Airport	4W 580656 E, 7419919 N	50.0	5.09	1.00
Shungnak Site 1	4W 577014 E, 7425064 N	55.8	5.22	1.03
Shungnak Site 2	4W 581940 E, 7424594 N	72.4	5.34	1.05
Shungnak Site 3	4W 582269 E, 7427844 N	124.3	5.48	1.08

Shungnak area, WASP wind speed overlay and AWS Truwind wind class overlay

Note: Red line – existing Shungnak-Kobuk intertie; yellow line – proposed Ambler-Shungnak intertie

WASP analysis of Ambler

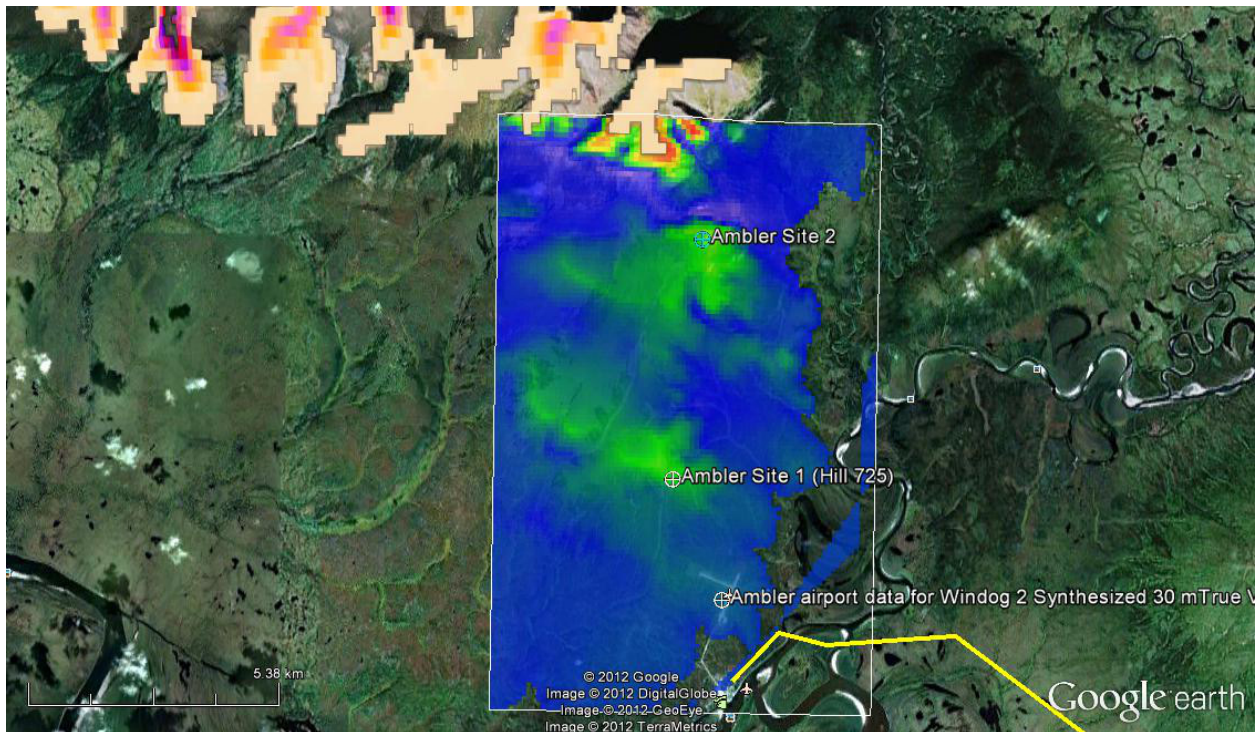
An analysis of the wind resource in the vicinity of Ambler was accomplished in October with use of WASP software with the Ambler airport data as the wind data reference point. The Ambler airport has been equipped an automated weather observation station (AWOS) since the late 1980's, but only January 1, 2010 through November 28, 2011 AWOS data was obtained via the National Climatic Data Center for this analysis. The wind data was converted from units of miles per hour to meters per second, scaled from seven to 30 meters, and processed to average hourly data before import to WASP. It is important to understand that AWOS data does not represent the average wind speed over a reporting period, rather just a short interval of time immediately prior to the report. As such, it must be used with caution for purposes such as predicting actual wind turbine performance. But, as a means to compare prospective sites against each other, airport wind data is fine.

The image below includes the Ambler airport bottom center and two possible turbine sites, as previously discussed. Ambler Site 1 (Hill 725), 1.5 miles from Ambler, is the nearest reasonable location

for wind turbines near Ambler. It is located on a hill marked by its elevation on the USGS topographic map, hence the reference to Hill 725. This site is complicated however by the presence of two native allotments that cover the top of the hill; hence a met tower must be located on the periphery of the allotment boundary. Ambler Site 2, at nearly five miles distance from the village center, would be much more expensive to develop but is not hampered by native allotment issues. WAsP modeling predicts that Ambler Site 1 (Hill 725) and Ambler 2 have similar wind regimes.

The second image below shows the same WAsP overlay, but with an additional overlay of AEA's AWS Truewind wind class prediction. As one can see, AWS Truewind predicts low productivity Class 1 winds at Ambler and also at Ambler Sites 1 and 2. The predicted wind classification only improves in the higher hills/mountains north of Ambler Site 2, but these locations would be very difficult and expensive to develop for wind power.

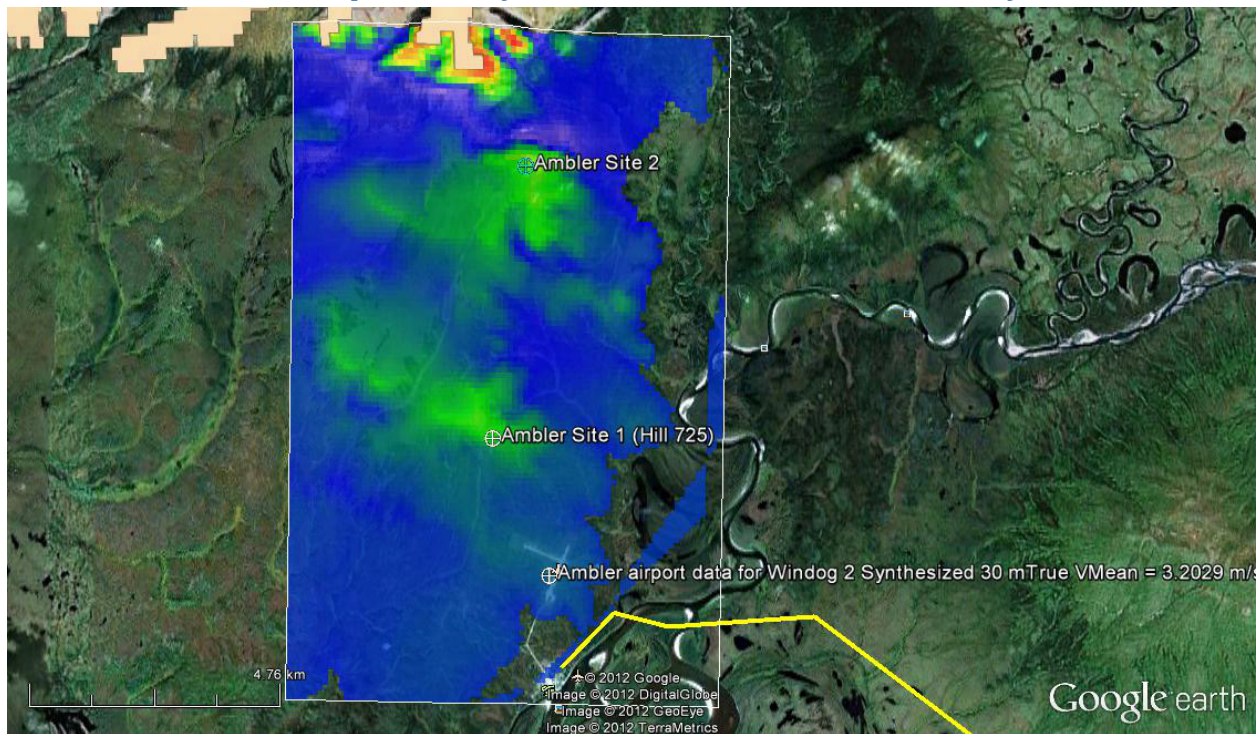
Ambler area, Google Earth image, WAsP wind speed overlay



Note: Yellow line – proposed Ambler-Shungnak intertie

Ambler airport and site comparison table

Location/Site	UTM	Elev. (m)	Spd (m/s)	Spd comp. to airport
Ambler Airport	4W 549571 E, 7443494 N	66.2	3.28	1.00
Ambler Site 1 (Hill 725)	4W 548465 E, 7446074 N	159.8	3.63	1.11
Ambler site 2	4W 549001 E, 7451188 N	250.0	3.74	1.14

Ambler area, WAsP wind speed overlay and AWS Truewind wind class overlay

Note: Yellow line – proposed Ambler-Shungnak intertie

Recommendations

Ambler and Shungnak airport AWOS data are not exactly comparable, but nevertheless, in a broad sense it is apparent that the Shungnak airport data has recorded higher mean annual wind speeds than has the Ambler airport. With WAsP software modeling, this translates to predictions of a stronger wind resources at the three potential Shungnak wind sites than at the two Ambler wind sites, noting of course that the Shungnak wind classification prediction is only Class 2. But, the renewable energy resource options in the upper Kobuk River valley are limited and Class 2 winds with an appropriate wind turbine may prove economical to offset the very high cost of diesel fuel in the region.

The extreme cold and long darkness of mid-winter in the Ambler and Shungnak region have delayed installation of the met tower until early spring at the earliest. Recognizing that the NRC met tower is presently stored at Dall Creek near Kobuk and moving it to Ambler would be time consuming and potentially expensive, it is important to decide which site most warrants investigation with a wind resource effort. Based on a comparative analysis of measured and predicted wind speeds in Shungnak and Ambler, it appears that Shungnak should be monitored first. Looking at the Shungnak area, WAsP modeling suggests that Shungnak Sites 2 or 3 are superior to Shungnak Site 1. Of the two, Shungnak Site 2 has the advantage of proximity to both the village of Shungnak and the proposed Ambler-Shungnak intertie route, although Shungnak Site 3 is predicted to have wind speeds a few percent higher than at Shungnak Site 2.