

MEMORANDUM



1809 7th Avenue, Suite 900
Seattle, Washington 98101 U.S.A.

p 206-387-4200
f 206-387-4201

www.globalenergyconcepts.com
www.dnv.com

Date: December 10, 2009

To: Robi Robichaud

From: Hugh Turnbaugh

Subject: Hub-Height Wind Flow Model Results at the Guam Naval Ordnance Annex

DNV Global Energy Concepts Inc. (DNV-GEC) estimated average hub-height wind speeds over the Guam Naval Ordnance Annex based on the MS-Micro/3 software package wind flow model results, elevation and exposure, and DNV-GEC's judgment about wind flow across the terrain. The wind flow model was seeded with a wind speed frequency distribution derived from data collected from September 2008 through September 2009 at Site 8201. Table 1 summarizes the results at the requested hub heights of 65 m and 80 m and the Course of Action (COA) locations #2 and #3.

Table 1. Site Information and Estimated Wind Speeds

Location Name	Latitude	Longitude	Elevation (m)	65-m Estimated Average Wind Speeds (m/s)	80-m Estimated Average Wind Speeds (m/s)
Site 8201	13° 22' 40.02" N	144° 40' 15.60" E	237	8.1	8.4
COA2	13° 19' 22.80" N	144° 40' 43.99" E	312	6.8 – 8.3	7.0 – 8.6
COA3	13° 23' 14.05" N	144° 43' 18.05" E	156	6.0 – 7.4	6.4 – 7.8

Figure 1 and Figure 2 show wind maps at the requested heights of 65 m and 80 m, respectively, which have been generated using the MS-Micro/3 software package. The MS-Micro/3 wind flow solver is included as part of the WindFarm software package by ReSoft.

Based on DNV-GEC's experience, the wind flow model wind speed estimates can be biased high or low depending on the location and exposure of the input data. To help estimate the potential bias, DNV-GEC estimated the difference in wind speed measurements between Site 8201 and the nearby Guam Power Authority (GPA) 60-m met tower for the period October 2008 through March 2009. We then compared the difference in measured wind speeds to the predicted difference using the wind flow model, considering the exposure and elevation difference (230 m) between the sites. This resulted in a 20% difference between modeled and measured wind speeds at the GPA met tower location. Considering the similar exposure characteristics, and lesser difference in elevation between Site 8201 and the COA2 and COA3 locations than between Site 8201 and the GPA met tower, DNV-GEC estimated the uncertainty in the modeled wind speed estimates to be 10% at the COA2 and COA3 locations. In general, DNV-GEC estimates a 2% change in energy production for every 1% change in wind speed. Thus, the 10% uncertainty on



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wind speed corresponds to approximately 20% uncertainty in energy production at these locations.

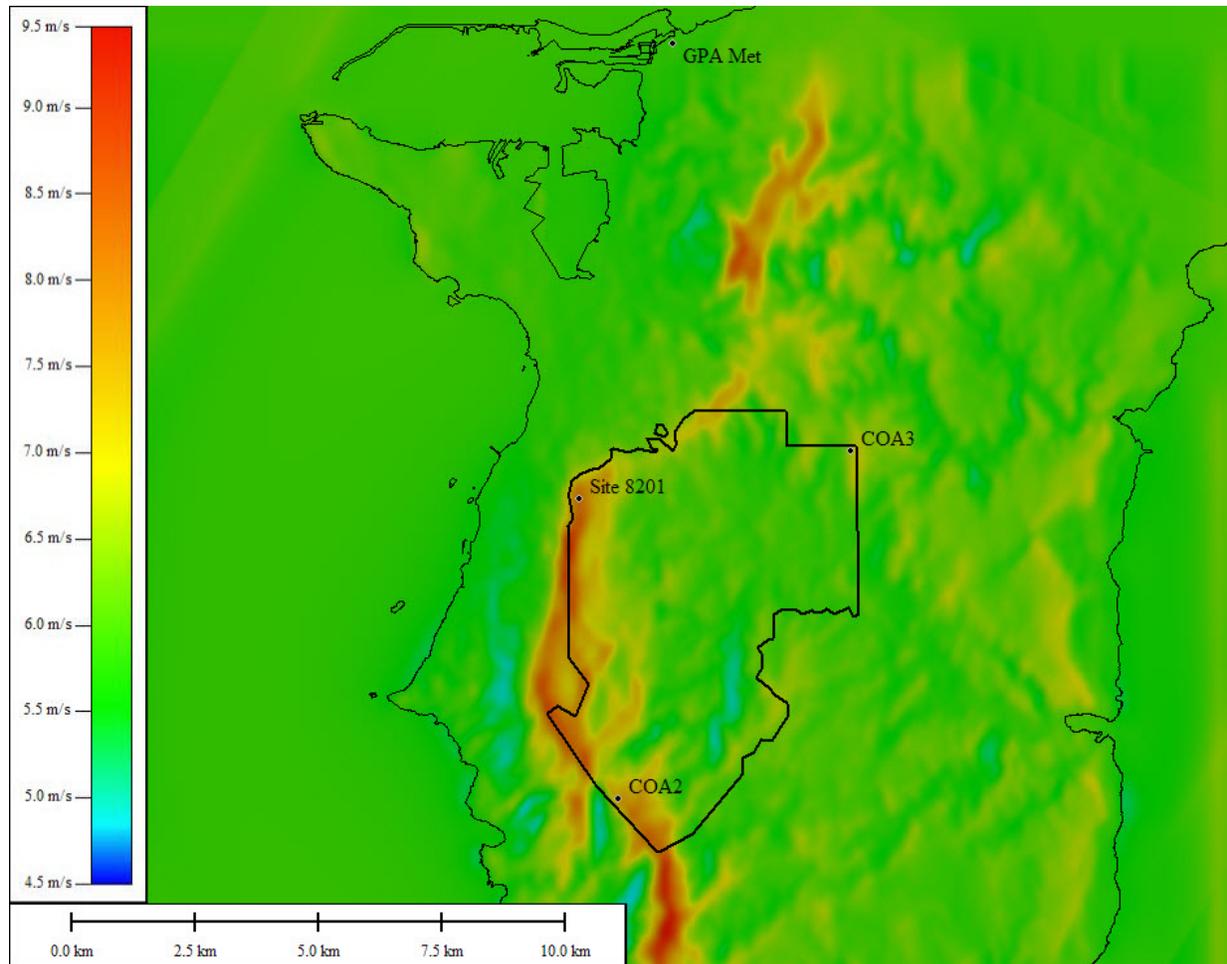


Figure 1. Wind-Flow Estimated 65-m Wind Speed Map

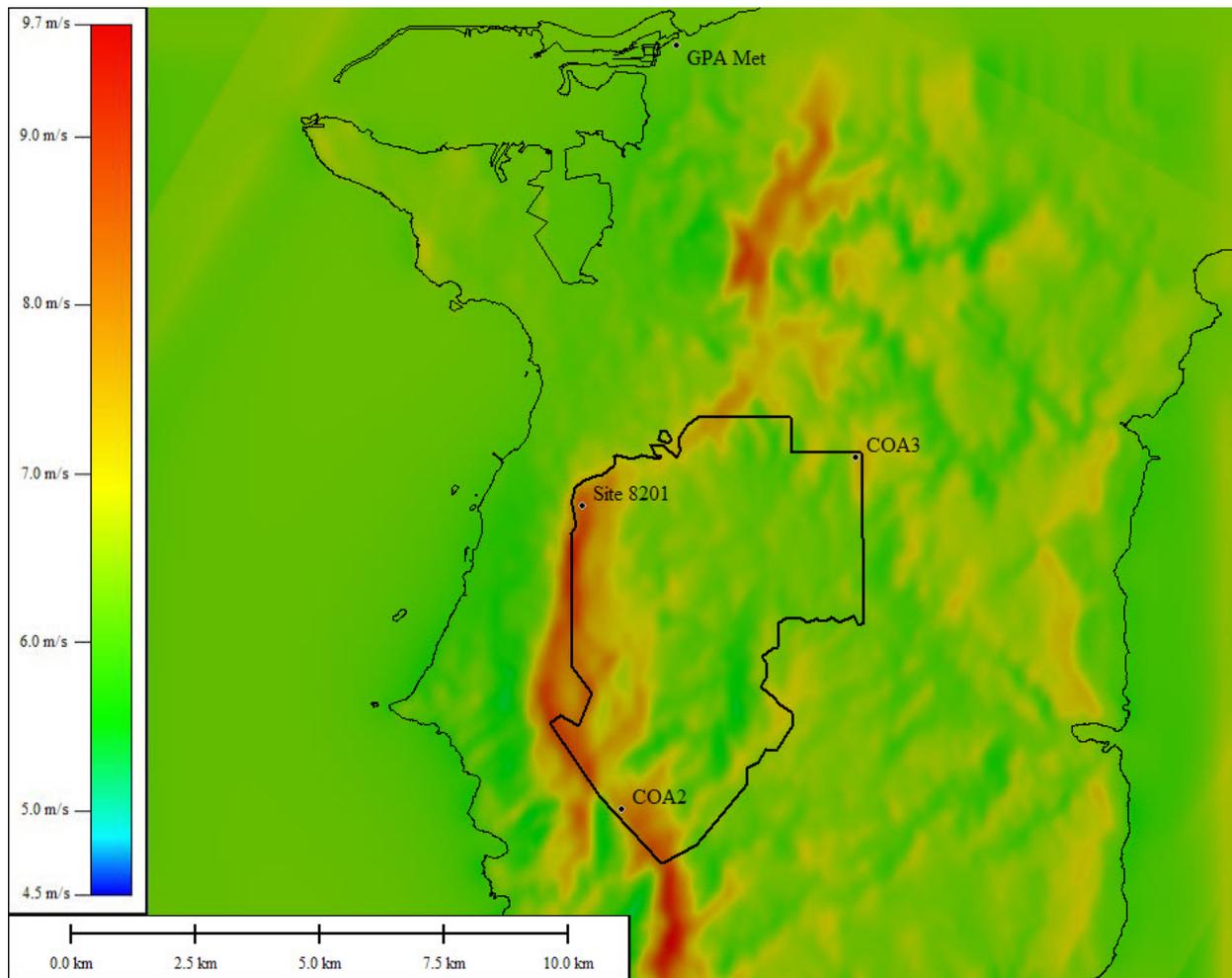


Figure 2. Wind-Flow Estimated 80-m Wind Speed Map