

GEORGIA MOUNTAIN COMMUNITY WIND TECHNICAL REVIEW OF PETITIONER'S SIMULATIONS AND SUPPLEMENTAL SIMULATIONS

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Georgia Mountain Community Wind Project Review – Technical Memorandum

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1.0 INTRODUCTION

Georgia Mountain Community Wind (referred to as “Petitioner”) is proposing a 7.5 to 12 MW wind farm located in the Towns of Georgia and Milton, Vermont. For the purpose of this memorandum, the project being proposed consists of five (5) 1.5 MW turbines along the Georgia Mountain ridgeline.

Jean Vissering Landscape Architecture (JVLA) retained Saratoga Associates, Landscape Architects, Architects, Engineers, and Planners, P.C. (Saratoga) to review select simulations provided by the Petitioner as well as create additional simulations in support of the visual analysis. The Petitioner's simulations were presented in a petition filed on March 26, 2009 to the State of Vermont Public Service Board.

2.0 VERIFICATION OF PETITIONERS SIMULATIONS

2.1 PETITIONERS SIMULATIONS

The Petitioner's consultant, Vera Wind Energy Consulting (VERA), created simulations (dated March 2009) from the following nine (9) locations:

- > I-89 Bridge over Lamoille River, Milton;
- > State Route 104A at Georgia-Fairfax Town Line;
- > Georgia Public Library US Route 7, Georgia;
- > US Route 7 at Arrowhead Reservoir, Southwestern Shore;
- > US Route 7 Intersection with Bartlett Road, Milton;
- > Intersection of Westford Road and Hunting Ridge Road, Milton;
- > State Route 2 Causeway to South Hero;
- > Panorama from State Route 2 Causeway; and
- > BFA High School, Fairfax.

As a response to an interrogatory request, VERA supplied the following information for use by Saratoga:

- > Turbine coordinates;
- > Original and edited photographs;
- > Photo simulation coordinates;
- > Coordinates of the Georgia Mountain met tower and cell tower;
- > Contour data in intervals of 10 and 20 feet within 10 miles of the project; and
- > Photo simulation methodology.

The photographs used during the simulation process were collected by VERA, using a Nikon D60 10.2-megapixel digital SLR camera with each location documented using a handheld global positioning system (GPS) unit. The Petitioner's simulations were created using WindPRO 2.5 Software. WindPRO, although a generally accepted application used in the creation of visual

simulations, does pose limitations when considering tree clearing, transmission lines, and other associated structures that might need to be incorporated into the model.

Utilizing the information supplied by the Petitioner, along with additional publicly available data (i.e. LIDAR topography), Saratoga recreated two (2) simulations using the methodology outlined in Section 3.1.2. Specifically, Saratoga was requested to review the US Route 7 at Arrowhead Mountain Lake Southwestern Shore and the Route 2 Causeway to South Hero locations for technical accuracy (see Appendix A). Once complete, the new simulations were overlaid on the Petitioners simulations to identify any inconsistencies.

2.2 CONCLUSION

The equipment used in data collection meets the minimum criteria for generally accepted industry standards. Generally, 10-megapixels is of sufficient resolution for the production of photo simulations. However, simulations produced from viewpoints more than 5 miles from the proposed project should be rendered at a higher resolution to reveal greater detail in the project turbines. Saratoga increased the pixel dimensions of the base photograph and the turbine rendering for Viewpoint 7A (Figure A2-B) to 24-megapixels. This ensures that, at 9-miles, the individual components of the wind turbines and their resulting shadows will be discernable in the final simulation. This contributes to a more accurate portrayal of the proposed project (see Figure 1).



Figure 1 Rendering Resolution Example

Based on the two (2) viewpoint locations reviewed by Saratoga, the simulations prepared by the Petitioner appear to be sufficiently accurate for use in the visual impact assessment conducted for the Georgia Mountain Community Wind Project. Minor color differences between the simulations do exist. Color shifts on the turbines may be attributed to subtle differences in the lighting engine used by the simulation software. It was noted during the review that the Petitioner had altered the base photographs provided to Saratoga. The practice of altering base photographs is acceptable if the digital camera used misinterpreted the actual field conditions. Saratoga did not attempt to alter the color of the photographs, as actual field conditions were unknown.

Although tree clearing was not considered in the simulations, it is anticipated that clearing around the turbines will have very little influence in the overall visibility of the project. In addition, visibility of

the proposed transmission structures, operation and maintenance building, nighttime conditions and the access road(s) was not addressed in the simulations. Transmission lines and access roads may be visible to the local community and should be evaluated. Data for access road clearing or transmission structures was not provided to Saratoga, so a supplemental analysis was not possible.

3.0 SUPPLEMENTAL SIMULATIONS

3.1 PHOTO SIMULATIONS

In addition to reviewing two (2) of the Petitioners simulations, it was requested that Saratoga complete additional simulations. The process used to complete these simulations is outlined below.

3.1.1 Photography

On several occasions between June 1, 2009 and July 10, 2009, a representative (trained field observer) from JVLA drove public roads and visited several predetermined locations of aesthetic interest that were assumed to have potential project visibility.

To document existing visibility in the direction of proposed Project, JVLA took photographs using a 10-megapixel Nikon D200 digital camera with a lens setting of approximately 50mm¹ to simulate normal human eyesight relative to scale.

The precise coordinates of each photo location were recorded in the field using a Garmin 60CSx handheld global positioning system (GPS) unit.

3.1.2 Photo Simulation Preparation

Selection of Key Receptors for Photo Simulation – To demonstrate how the proposed turbines will appear from additional select locations, simulations were created from two (2) of the locations visited by JVLA.

Table 1 Locations Selected for Photo Simulation

Map ID	Receptor Name
1	State Route 104A, Town of Georgia
2	Georgia Mountain Road, Town of Georgia

The location of simulated views and all photo simulations are presented in Appendix A.

Photo Simulation Methodology – A photo simulation of the proposed Project was prepared from each location identified in Table 1. Photo simulations are developed by superimposing a rendering of a three-dimensional computer model of the proposed Project into the base photograph taken from each corresponding resource. The three-dimensional computer model was developed using *AutoDesk Civil 3D 2009®* and *3D Studio Max Design 2009®* software (3D Studio Max).

¹ A Nikon D200 digital SLR was used for all Project photography. This digital camera, similar to most digital SLR cameras, has a sensor that is approximately 1.5 times smaller than a comparable full frame 35mm film camera. Recognizing this differential, the zoom lens used was set to approximately 34mm to achieve a field-of-view comparable to a 50mm lens on a full frame 35mm camera (34mm x 1.5 = 51mm).

Simulated perspectives (camera views) were then matched to the corresponding base photograph for each simulated view by replicating the precise coordinates of the field camera position (as recorded by GPS and verified with aerial photography) and the focal length of the camera lens used (e.g. 50mm). Precisely matching these parameters assures scale accuracy between the base photograph and the subsequent simulated view. The cameras elevation (Z) value is derived from 2-foot interval LIDAR data or Digital Elevation Model (DEM) data (in locations where LIDAR data was unavailable) plus the cameras approximate height above ground level. The camera's target position was set to match the bearing of the corresponding existing condition photograph as recorded in the field. With the existing conditions photograph displayed as a "viewport background," and the viewport properties set to match the photograph pixel dimensions, minor camera adjustments were made (horizontal and vertical positioning, and camera roll) to align the horizon in the background photograph with the corresponding features of the 3D model.

To verify the camera alignment, visible elements (e.g. structures, towers, roads) within the photograph are identified and digitized from digital orthophotos. Each element is assigned a Z value based on LIDAR data and then imported to 3D Studio Max. A 3D terrain model is also created (using available 2-foot interval LIDAR data) to replicate the existing site topography. The digitized elements are then aligned with corresponding elements in the photograph by adjusting the camera target.

Once the camera alignment is verified, a to-scale 3D model of the proposed Project is merged into the model space. The 3D model of the proposed Project is intended to accurately convey the current design intent. To the extent practicable, and to the extent necessary to reveal impacts design details of the proposed Project were built into the 3D model and incorporated into the photo simulation.² Consequently, the scale, alignment, elevations and location of the turbines are true to the proposed layout and turbine model.

With the model in place, a daylight system was created based on the exact date and time of the photograph. Regional inputs such as time zone and location are also applied to the daylight system. To accurately depict "reflected light" a ground plane utilizing the previously created mesh (based on DEM data) is placed in the scene. This ground plane also identifies any additional shadows cast by the proposed Project. The camera view is then rendered and saved.

The rendered view was then opened using *Adobe Photoshop CS2* software for post-production editing (i.e. airbrush out portion of the proposed towers that fall below foreground topography, vegetation, or existing structures).

Arms Length Rule – The photo simulations have been designed to be printed using an 11"x17" page format. At this image size, the page should be held at approximately arms length³ so that the scene will appear at the correct scale. Viewing the image closer would make the scene appear too large and

² Dimensions of proposed turbines included in the 3D model were taken from data supplied by VERA and verified through the GE technical turbine data found at: <http://www.gepower.com>

³ Viewing distance is calculated based a 39.6-degree field-of-view for the 50mm camera lens used, and the 15.5" wide image presented in Appendix A. "Arm's length" is assumed to be approximately 22.5 inches from the eye. Arm's length varies for individual viewers.

viewing the image from greater distance would make the scene appear too small compared to what an observer would actually see in the field.

For viewing photo simulations at other page sizes (i.e., computer monitor, projected image or other hard copy output) the viewing distance/page width ratio is approximately 1.5/1. For example, if the simulation were viewed on a 42-inch wide poster size enlargement, the correct viewing distance would be approximately 63 inches, or 5 ¼ feet.

Field Viewing – The photo simulations present an accurate depiction of the appearance of proposed Project suitable for general understanding of the degree and character of Project visibility. However, these images are a two-dimensional representation of a three-dimensional landscape. The human eye is capable of recognizing a greater level of detail than can be illustrated in a two-dimensional image. Agency decision-makers and interested parties may benefit from viewing the photo simulations in the field from any or all of the simulated locations. In this manner, observers can directly compare the level of detail visible in the base photograph with actual field observed conditions.

Appendix A
Petitioners Simulation Verification



Image Provided by VERA

Petitioners Simulation

Figure A1-A

**Location: US Route 7 - Arrowhead Lake
Town of Milton
2.5 Miles From Nearest Turbine**



Saratoga Associates Simulation (Utilizing Petitioners Field Data)
Approximate Viewing Distance: 23 Inches

Figure A1-B

**Location: US Route 7 - Arrowhead Lake
Town of Milton
2.5 Miles From Nearest Turbine**



Image Provided by VERA

Petitioners Simulation

Figure A2-A

Location: US Route 2 - Causeway At Lake Champlain
Town of Milton
8.98 Miles From Nearest Turbine



Saratoga Associates Simulation (Utilizing Petitioners Field Data)
Approximate Viewing Distance: 23 Inches

Figure A2-B

**Location: US Route 2 - Causeway At Lake Champlain
Town of Milton
8.98 Miles From Nearest Turbine**

Appendix B
Supplemental Simulations



Existing
(Photograph by JVLA)

Figure B1-A

Location: State Route 104A
Town of Georgia



Simulation

Camera	Nikon D200	Number of Turbines Visible	5
Focal Length	35mm (52.5 mm)	Height to Turbine Hub	80 Meters (262 Feet)
Viewpoint Location	44.68195000° N, 73.06395000° W	Turbine Rotor Diameter	77 Meters (253 Feet)
Direction of View	Southwest	Distance to Nearest Visible Turbine	1.24 Miles
Date and Time	6/4/2009 12:20	Approximate Viewing Distance	23 Inches

Figure B1-B

Location: State Route 104A
Town of Georgia



Existing View

Note: Panorama images are provided to show the wind project in context with the landscape surroundings. The 50 mm images shown in preceding figures will provide the proper scale and perspective.

Figure B1-C

Location: State Route 104A
Town of Georgia



Panorama Simulation

Note: Panorama images are provided to show the wind project in context with the landscape surroundings. The 50 mm images shown in preceding figures will provide the proper scale and perspective.

Figure B1-D

Location: State Route 104A
Town of Georgia



Existing
(Photograph by JVLA)

Figure B2-A

Location: Georgia Mountain Road
Town of Georgia



Simulation

Camera	Nikon D200	Number of Turbines Visible	4
Focal Length	35mm (52.5 mm)	Height to Turbine Hub	80 Meters (262 Feet)
Viewpoint Location	44.67035000° N, 73.05816667° W	Turbine Rotor Diameter	77 Meters (253 Feet)
Direction of View	Southwest	Distance to Nearest Visible Turbine	0.74 Miles
Date and Time	7/10/2009 12:20	Approximate Viewing Distance	23 Inches

Figure B2-B

Location: Georgia Mountain Road
Town of Georgia



Existing
(Photograph by JVLA)

Figure B2-C

**Location: Georgia Mountain Road
Town of Georgia**



Simulation

Camera	Nikon D200	Number of Turbines Visible	3
Focal Length	35mm (52.5 mm)	Height to Turbine Hub	80 Meters (262 Feet)
Viewpoint Location	44.67035000° N, 73.05816667° W	Turbine Rotor Diameter	77 Meters (253 Feet)
Direction of View	Southwest	Distance to Nearest Visible Turbine	0.74 Miles
Date and Time	7/10/2009 12:20	Approximate Viewing Distance	23 Inches

Figure B2-D

Location: Georgia Mountain Road
Town of Georgia



Existing View

Note: Panorama images are provided to show the wind project in context with the landscape surroundings. The 50 mm images shown in preceding figures will provide the proper scale and perspective.

Figure B2-E

Location: Georgia Mountain Road
Town of Georgia



Panorama Simulation

Note: Panorama images are provided to show the wind project in context with the landscape surroundings. The 50 mm images shown in preceding figures will provide the proper scale and perspective.

Figure B2-F

Location: Georgia Mountain Road
Town of Georgia