APPENDIX B:

VISUALIZATION, PHOTO ANALYSIS & SHADOW FLICKER ANALYSIS

THE RENAISSANCE GROUP

A Conserve First Company

Kenston Local Schools
Wind Turbine Project
Turbine Visualization and Photo Analysis

Prepared for:
Kenston Local Schools

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Thank You for Choosing The Renaissance Group, a Conserve First LLC Company

Introduction

Although the visual impact of wind turbine installations is highly subjective, some people consider them a tremendous asset to their landscape and community and others say "not in my backyard". This said, it is often beneficial to get a sense of what an installation will look like before it is installed. The actual visibility of a turbine installation is affected by many factors: the size of the machine, the number of machines, tower and blade tip heights, turbine color, distance to the viewer, obstructions such as trees, hills and buildings, atmospheric conditions, Sun angle and even the curvature of the Earth. All things considered, the overall height of a turbine, obstructions in the sightline between the viewer and the turbine and the distance between the machine and the viewer has the greatest impact. Even in open unobstructed ground very tall towers become very small in the distance and even the largest of machines can be blocked by relatively short obstructions close to the viewer. All this said, when in an open sightline in close proximity, a modern wind turbine can be an imposing or an awe inspiring presence in the view-shed pending ones point of view. In all such cases, few would argue that the turbine was not a significant element of the said view-shed. (Further understanding concerning the relative view-shed size of turbines at distance and their visibility in relation to obstructions can be viewed on the following addendums at the end of this report: Horizon View Impact Calculator, Example Turbine View Calculator, Wind Turbine Visibility Over Obstruction Tables and Sample Wind Turbine View Calculator.)

Methods

Using field surveys, mathematical modeling and stake holder interests, the study team identified representative sightline locations for actual turbine visualization studies. At these sites, precise location logs were taken with accompanying photographs toward the turbine site. Camera bearings were confirmed using detailed maps and compass bearings. The camera height above ground was approximately 68" and the tilt was maintained at zero degrees/level. The camera's focal length was maintained at 28 mm which was entered into the rendering software and which approximates a typical person's field of view for the camera used, or approximately 65%. WindPro 2.7, an internationally accepted wind project modeling software, was used to create the visualizations. The software uses the input data such as turbine location, viewer location, topographical baselines maps, turbine model and height, camera bearing, camera tilt and camera focal length to calculate the distance of the turbine, its perspective height, differential ground levels and Sun angles to correctly locate, scale and shade the turbine onto the base sightline photograph. The technician then verifies for scale and location using secondary plots. The technician also manually removes the portions of the turbine overlay that would be blocked by the obstruction shown in the photo that would between the viewer and the turbine.

Special consideration was given to identifying potentially historically or culturally significant view-sheds for historic buildings, sites and landscapes. This review was done in conjunction with the local Historical Society and utilizing the Ohio Historic Preservation Office database.

Panoramic photos were also taken at sample locations including the turbine installation site.

A Sony DSC-HX1 camera was used for all source imagery.

Results

See the following pages for representative turbine visualizations. Due to local obstruction proximities and densities to typical sightlines such as trees and buildings, much of the community will not be able to see the turbine. Due to local topography, the turbine will be most visible for sites to the South. This said, due to

perspective, the turbine will appear as a very small element of the skyline for most locations where it is visible similar to the regions existing communication towers and granaries.

No historical or cultural site view-sheds were found that would be significantly impacted by the turbines installation.

For sites not modeled, the Report's included "Visualization Tables" can be used to determine approximate turbine visibility in relationship to viewer obstructions. A "Sample Wind Turbine View Calculator" has also been developed to mathematically model locations of concern upon community request, a sample of which is included in this report.

Kenston Visualizations Log

Set Number	Picture Number	Distance from Turbine (miles)	Site Description	Latitude	Longitude	Direction
1	1269	0.15	Entrance near Radio Station/Tennis Courts	41° 23' 40.48" N	81° 18' 28.79" W	90°
2	1291	0.16	17446 Snyder	41° 23' 46.59" N	81° 18' 28.10" W	136°
3	1298	0.26	9490 Washington	41° 23' 53.66" N	81° 18' 14.09" W	194°
4	1302	0.43	17485 Indian Hills Drive	41° 23' 34.87" N	81° 17' 49.08" W	285°
5	1310	0.44	South Entrance of School	41° 23' 17.50" N	81° 18' 13.88" W	352°
6	1332	0.80	From 422	41° 23' 01.71" N	81° 18' 37.69" W	21°

Proposed Site Panoramic Photos Looking Out

Looking East

Looking South

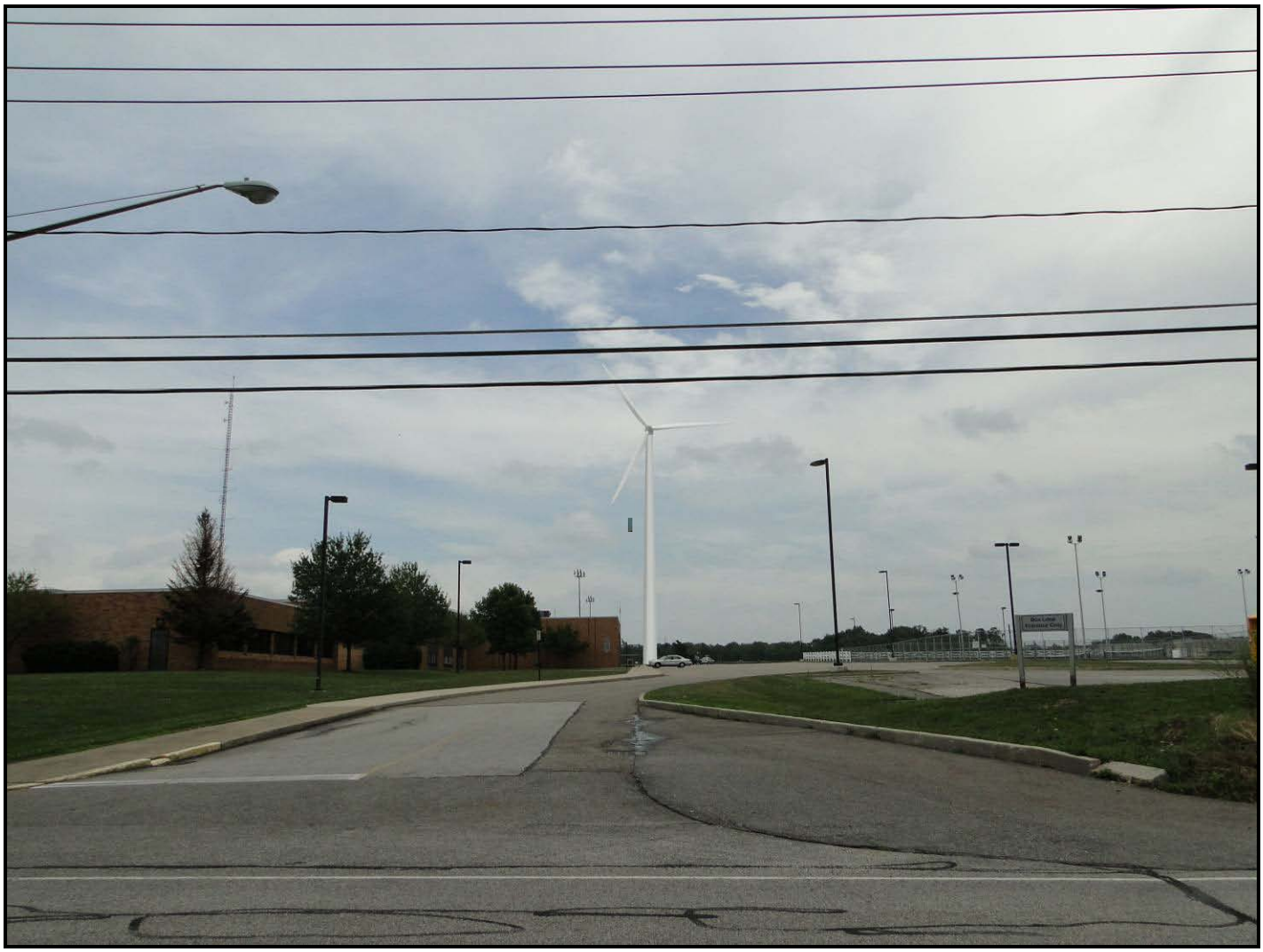
Looking West

Looking North

Turbine View Visualizations

K-V-1

Entrance near Radio Station/Tennis Courts



K-V-2

17446 Snyder

K-V-3

9490 Washington

K-V-4

17485 Indian Hills Drive
Not Visible Behind Trees

K-V-5

South Entrance of School

K-V-6

From 422
Barely Visible Behind Trees

Example Images of Other Regional Tall Structures

Radio Tower on Kenston Middle School (155')

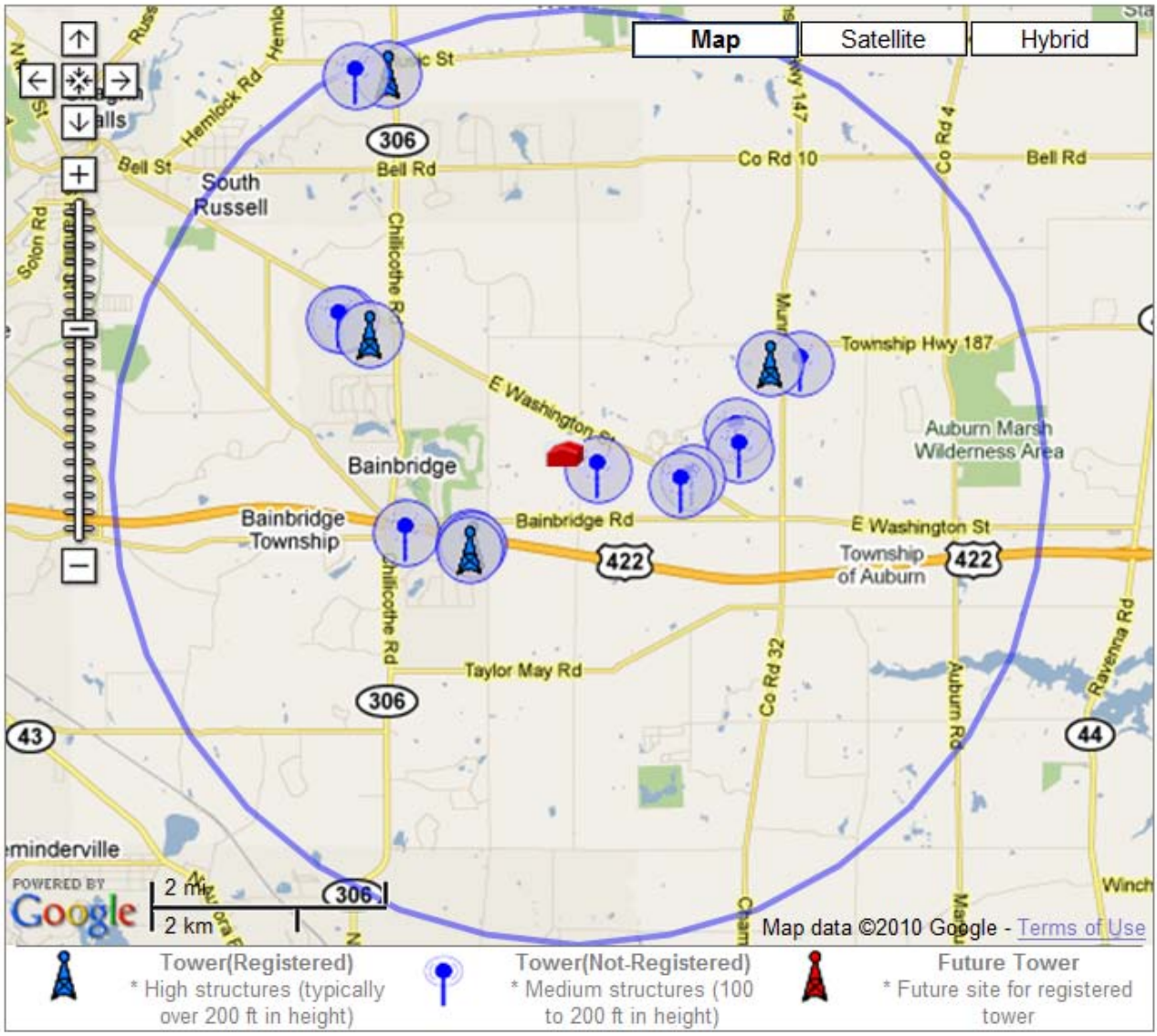
Cell Tower Behind Indian Hills Drive

Cell Tower Off of Washington Street

(Also See Tall Tower Map and Tables Below)

Existing Tall Towers Within 4 Miles of The Proposed Turbine Site

- **Tower Structures - (17419 Snyder Rd, Chagrin Falls, OH 44023)**



Registered Towers			
1	American Towers, Inc.	294 feet	1.21 miles
2	Towerco Assets Llc	264 feet	2.12 miles
2	New Cingular Wireless Pcs, Llc	199 feet	2.43 miles
4	Alltel Ohio Limited Partnership	269 feet	3.69 miles

Non-Registered Towers			
1	Kenston Local School District	275 feet	.20 miles
2	At&t Wireless Pcs Inc	199 feet	1.05 miles
3	Nextel West Corp	199 feet	1.16 miles
4	American Tower	294 feet	1.26 miles
5	Verizon Wireless	190 feet	1.65 miles
6	Com Net Construction Services	295 feet	1.66 miles
7	Com Net Construction Services Inc	300 feet	1.83 miles
8	Sprintcom Inc	265 feet	2.42 miles
9	At&t Wireless Services	184 feet	2.70 miles
10	Sprintcom Inc	190 feet	2.75 miles
11	Nextel West Corp	187 feet	3.85 miles

Future Towers			
1	Geauga,county Of	259 feet	1.28 miles

Multiple Antennas on Listed Towers

1	Nextel License Holdings 4, Inc.	187 feet	3.86 miles
	Nextel License Holdings 4, Inc	187 feet	3.86 miles
	Nextel License Holdings 4, Inc.	187 feet	3.86 miles
2	Bainbridge Fire Dept	259 feet	1.28 miles
	Geauga, County Of	259 feet	1.28 miles
	Bainbridge, Township Of	NA	1.27 miles
	Bainbridge, Township Of	NA	1.27 miles
3	Geauga, County Of	259 feet	1.30 miles
	Geauga, County Of	NA	1.30 miles
4	Bainbridge, Township Of	36 feet	2.06 miles
	Ohio, State Of, Highway Patrol	46 feet	2.06 miles
	Bainbridge, Township Of	49 feet	2.06 miles
5	Chargin Valley Citizens Radio Group	NA	3.94 miles
	Chargin Valley Citizens Radio Group	51 feet	3.94 miles
6	Alltel Ohio Limited Partnership	295 feet	1.26 miles
	Fibertower Network Services Corp.	280 feet	1.25 miles

See the Website below for full details on these sites including precise locations, heights and frequencies.

http://www.antennasearch.com/

Single Antennas on Area Towers

7	Nextel License Holdings 4, Inc.	199 feet	1.16 miles
8	Kenston School District	16 feet	.26 miles
9	Kenston Local Schools	NA	.40 miles
10	Bainbridge, Township Of	49 feet	1.11 miles
11	Tanglewood Country Club	NA	1.32 miles
12	Resource America Inc	NA	1.46 miles
13	Wegener, Dave	NA	1.92 miles
14	Cathan Farms	NA	1.96 miles
15	Margan Ent Inc	NA	2.02 miles
16	Bainbridge, Township Of	39 feet	2.28 miles
17	Solon Excavators Sand & Gravel Inc	NA	2.56 miles
18	South Russell, Village Of	NA	2.99 miles
19	Chagrin Falls Exempted Schools	16 feet	3.27 miles
20	Russell, Township Of	NA	3.58 miles
21	Auburn Volunteer Fire Dept Inc	135 feet	3.75 miles
22	Kenston Local School District	151 feet	.11 miles
23	Metropolitan Area Networks, Inc.	294 feet	1.23 miles
24	New Par	190 feet	1.66 miles
25	Mci Worldcom Network Services Inc	170 feet	1.67 miles
26	Fibertower Network Services Corp.	199 feet	2.45 miles
27	Fibertower Network Services Corp.	185 feet	3.71 miles

See the Website below for full details on these sites including but not limited to: precise locations, heights, frequencies and owners.

http://www.antennasearch.com/

Horizon View Impact Calculator

Rotor Diameter	144.3	Feet

Viewer Distance From Turbine		Percent of Total Horizon View-shed Affected	Percent of Total Average Persons Field of View Affected
Feet	Miles		
100	0.02	22.97%	100.00%
200	0.04	11.48%	68.90%
400	0.08	5.74%	34.45%
800	0.15	2.87%	17.22%
1,600	0.30	1.44%	8.61%
3,200	0.61	0.72%	4.31%
5,280	1.00	0.43%	2.61%
10,560	2.00	0.22%	1.30%
15,840	3.00	0.14%	0.87%
21,120	4.00	0.11%	0.65%
26,400	5.00	0.09%	0.52%
52,800	10.00	0.04%	0.26%

Assumptions:

Model assumes absolute worst case for all variables.

Viewer is stationary, focused and looking directly at and centered on the turbine.

Viewer's field of view is 60 degrees.

Model assumes no sightline obstructions, crystal clear atmospheric visibility and 100% of the turbine is visible.

Model assumes the largest rotor diameter under consideration for the site.

Model assumes the turbine rotor is perpendicular to and fully visible to the viewer.

Model assumes worst case as if the turbine rotor diameter influences the entire column of the horizon as if the turbine was a solid plane covering the entire portion of the horizon at a width of the turbine's rotor.

Sample Turbine View Calculations

Baselines For Calculations

Turbine Height to Blade Tip	273	Feet
Turbine Height to Hub	196.8	Feet
Persons Eye Height Based on Level Ground.	5.5	Feet

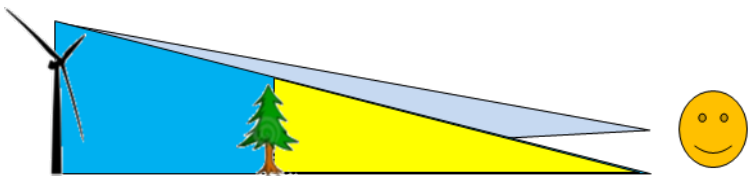
Listed Obstruction Height (Feet)
Will Block Turbine View
Within Listed Distance of Viewer (Feet)

		Typical One Story House or Short Tree		Typical Two Story House or Tree		Typical Tall Tree or Tall Building		Apparent Height of Turbine at 3' Arm's Length (Inches Tall) (If You Could See the Entire Turbine)
Obstruction Height (Feet)		17.5		35		70		
Minimum Visible Target to be Blocked		Hub Up	Blade Tip	Hub Up	Blade Tip	Hub Up	Blade Tip	
Viewer Distance From Turbine (Feet)	500	23	18	57	44	126	97	23.9
	1000	47	36	115	88	251	193	11.9
	1500	70	54	172	133	377	290	8.0
	2000	93	72	230	177	502	387	6.0
	2500	117	90	287	221	628	483	4.8
	3000	140	108	344	265	753	580	4.0
	3500	163	126	402	310	879	677	3.4
	4000	187	144	459	354	1004	774	3.0
	4500	210	162	517	398	1130	870	2.7
	5000	234	180	574	442	1255	967	2.4

Example: At a distance of 2,500 feet from the turbine your view of the turbine would be blocked by any 17.5 foot structure or tree if it was less than 90 feet from you. The apparent height of an unobstructed turbine view at this distance would 4.8 inches tall at a 3 foot arms length from your eye.

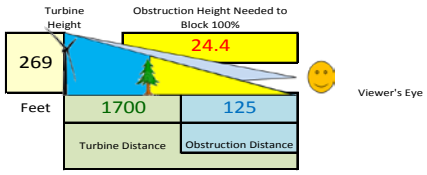
Typical community and natural obstructions will block the view of the turbine for many residences and businesses, even some in close proximity to the site.

Values are approximate.



Sample Wind Turbine Visibility Over Obstructions Tables

Turbine Information:	Feet	Meters
Tower Height	196.9	60.0
Rotor Diameter	144.4	44.0
Tip Height	269.0	82.0
Eye Height	5.0	1.5



Example: Using the tables below, a wind turbine 1700 feet away from you would be blocked by any obstruction over 24.8 feet tall 125 feet or less away from you. Based on flat ground and provided eye height. As can be seen, relatively low obstructions close to the viewer typical of many residential, urban or wooded areas will completely obstruct your view of a wind turbine.

Obstruction Height \ Turbine Distance	100	125	150	175	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
10	31.4	26.1	22.6	20.1	18.2	13.8	11.6	10.3	9.4	8.8	8.3	7.9	7.6	7.4	7.2	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3
20	57.8	47.2	40.2	35.2	31.4	22.6	18.2	15.6	13.8	12.5	11.6	10.9	10.3	9.8	9.4	9.1	8.8	8.5	8.3	8.1	7.9	7.8	7.6
30	84.2	68.4	57.8	50.3	44.6	31.4	24.8	20.8	18.2	16.3	14.9	13.8	12.9	12.2	11.6	11.1	10.7	10.3	10.0	9.7	9.4	9.2	9.0
40	110.6	89.5	75.4	65.3	57.8	40.2	31.4	26.1	22.6	20.1	18.2	16.7	15.6	14.6	13.8	13.1	12.5	12.0	11.6	11.2	10.9	10.6	10.3
50	137.0	110.6	93.0	80.4	71.0	49.0	38.0	31.4	27.0	23.9	21.5	19.7	18.2	17.0	16.0	15.2	14.4	13.8	13.3	12.8	12.3	11.9	11.6
60	163.4	131.7	110.6	95.5	84.2	57.8	44.6	36.7	31.4	27.6	24.8	22.6	20.8	19.4	18.2	17.2	16.3	15.6	14.9	14.3	13.8	13.3	12.9
70	189.8	152.9	128.2	110.6	97.4	66.6	51.2	42.0	35.8	31.4	28.1	25.5	23.5	21.8	20.4	19.2	18.2	17.3	16.6	15.9	15.3	14.7	14.2
80	216.2	174.0	145.8	125.7	110.6	75.4	57.8	47.2	40.2	35.2	31.4	28.5	26.1	24.2	22.6	21.2	20.1	19.1	18.2	17.4	16.7	16.1	15.6
90	242.6	195.1	163.4	140.8	123.8	84.2	64.4	52.5	44.6	38.9	34.7	31.4	28.8	26.6	24.8	23.3	22.0	20.8	19.9	19.0	18.2	17.5	16.9
100	269.0	216.2	181.0	155.9	137.0	93.0	71.0	57.8	49.0	42.7	38.0	34.3	31.4	29.0	27.0	25.3	23.9	22.6	21.5	20.5	19.7	18.9	18.2
125	NA	269.0	225.0	193.6	170.0	115.0	87.5	71.0	60.0	52.1	46.3	41.7	38.0	35.0	32.5	30.4	28.6	27.0	25.6	24.4	23.3	22.4	21.5
150	NA	NA	269.0	231.3	203.0	137.0	104.0	84.2	71.0	61.6	54.5	49.0	44.6	41.0	38.0	35.5	33.3	31.4	29.8	28.3	27.0	25.8	24.8
175	NA	NA	NA	269.0	236.0	159.0	120.5	97.4	82.0	71.0	62.8	56.3	51.2	47.0	43.5	40.5	38.0	35.8	33.9	32.2	30.7	29.3	28.1
200	NA	NA	NA	NA	269.0	181.0	137.0	110.6	93.0	80.4	71.0	63.7	57.8	53.0	49.0	45.6	42.7	40.2	38.0	36.1	34.3	32.8	31.4
225	NA	NA	NA	NA	NA	203.0	153.5	123.8	104.0	89.9	79.3	71.0	64.4	59.0	54.5	50.7	47.4	44.6	42.1	39.9	38.0	36.3	34.7
250	NA	NA	NA	NA	NA	225.0	170.0	137.0	115.0	99.3	87.5	78.3	71.0	65.0	60.0	55.8	52.1	49.0	46.3	43.8	41.7	39.7	38.0
500	NA	NA	NA	NA	NA	NA	NA	269.0	225.0	193.6	170.0	151.7	137.0	125.0	115.0	106.5	99.3	93.0	87.5	82.7	78.3	74.5	71.0
1000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	269.0	245.0	225.0	208.1	193.6	181.0	170.0	160.3	151.7	144.0	137.0

Obstruction Height \ Turbine Distance	2100	2200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300
10	6.3	6.2	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.3	6.2	6.1	6.1	6.1	6.0	6.0	5.9	5.9	5.9	5.9	5.8	5.8
20	7.5	7.4	9.1	8.8	8.5	8.3	8.1	7.9	7.8	7.6	7.5	7.4	7.3	7.2	7.1	7.0	7.0	6.9	6.8	6.8	6.7	6.7	6.6
30	8.8	8.6	11.1	10.7	10.3	10.0	9.7	9.4	9.2	9.0	8.8	8.6	8.4	8.3	8.2	8.0	7.9	7.8	7.7	7.6	7.6	7.5	7.4
40	10.0	9.8	13.1	12.5	12.0	11.6	11.2	10.9	10.6	10.3	10.0	9.8	9.6	9.4	9.2	9.1	8.9	8.8	8.6	8.5	8.4	8.3	8.2
50	11.3	11.0	15.2	14.4	13.8	13.3	12.8	12.3	11.9	11.6	11.3	11.0	10.7	10.5	10.3	10.1	9.9	9.7	9.6	9.4	9.3	9.1	9.0
60	12.5	12.2	17.2	16.3	15.6	14.9	14.3	13.8	13.3	12.9	12.5	12.2	11.9	11.6	11.3	11.1	10.9	10.7	10.5	10.3	10.1	10.0	9.8
70	13.8	13.4	19.2	18.2	17.3	16.6	15.9	15.3	14.7	14.2	13.8	13.4	13.0	12.7	12.4	12.1	11.8	11.6	11.4	11.2	11.0	10.8	10.6
80	15.1	14.6	21.2	20.1	19.1	18.2	17.4	16.7	16.1	15.6	15.1	14.6	14.2	13.8	13.4	13.1	12.8	12.5	12.3	12.0	11.8	11.6	11.4
90	16.3	15.8	23.3	22.0	20.8	19.9	19.0	18.2	17.5	16.9	16.3	15.8	15.3	14.9	14.5	14.1	13.8	13.5	13.2	12.9	12.7	12.4	12.2
100	17.6	17.0	25.3	23.9	22.6	21.5	20.5	19.7	18.9	18.2	17.6	17.0	16.5	16.0	15.6	15.2	14.8	14.4	14.1	13.8	13.5	13.3	13.0
125	20.7	20.0	30.4	28.6	27.0	25.6	24.4	23.3	22.4	21.5	20.7	20.0	19.3	18.8	18.2	17.7	17.2	16.8	16.4	16.0	15.6	15.3	15.0
150	23.9	23.0	35.5	33.3	31.4	29.8	28.3	27.0	25.8	24.8	23.9	23.0	22.2	21.5	20.8	20.2	19.7	19.1	18.7	18.2	17.8	17.4	17.0
175	27.0	26.0	40.5	38.0	35.8	33.9	32.2	30.7	29.3	28.1	27.0	26.0	25.1	24.3	23.5	22.8	22.1	21.5	20.9	20.4	19.9	19.4	19.0
200	30.1	29.0	45.6	42.7	40.2	38.0	36.1	34.3	32.8	31.4	30.1	29.0	28.0	27.0	26.1	25.3	24.6	23.9	23.2	22.6	22.0	21.5	21.0
225	33.3	32.0	50.7	47.4	44.6	42.1	39.9	38.0	36.3	34.7	33.3	32.0	30.8	29.8	28.8	27.8	27.0	26.2	25.5	24.8	24.2	23.6	23.0
250	36.4	35.0	55.8	52.1	49.0	46.3	43.8	41.7	39.7	38.0	36.4	35.0	33.7	32.5	31.4	30.4	29.4	28.6	27.8	27.0	26.3	25.6	25.0
500	67.9	65.0	106.5	99.3	93.0	87.5	82.7	78.3	74.5	71.0	67.9	65.0	62.4	60.0	57.8	55.8	53.9	52.1	50.5	49.0	47.6	46.3	45.0
1000	130.7	125.0	208.1	193.6	181.0	170.0	160.3	151.7	144.0	137.0	130.7	125.0	119.8	115.0	110.6	106.5	102.8	99.3	96.0	93.0	90.2	87.5	85.0

Obstruction Height \ Turbine Distance	3400	3500	3600	3700	3800	3900	4000	4100	4200	4300	4400	4500	4600	4700	4800	4900	5000	5100	5200	5300	5400	5500	5600
10	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
20	6.6	6.5	6.5	6.4	6.4	6.4	6.3	6.3	6.3	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	5.9
30	7.3	7.3	7.2	7.1	7.1	7.0	7.0	6.9	6.9	6.8	6.8	6.8	6.7	6.7	6.7	6.6	6.6	6.6	6.5	6.5	6.5	6.4	6.4
40	8.1	8.0	7.9	7.9	7.8	7.7	7.6	7.6	7.5	7.5	7.4	7.3	7.3	7.2	7.2	7.2	7.1	7.1	7.0	7.0	7.0	6.9	6.9
50	8.9	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.1	8.1	8.0	7.9	7.9	7.8	7.8	7.7	7.6	7.6	7.5	7.5	7.4	7.4	7.4
60	9.7	9.5	9.4	9.3	9.2	9.1	9.0	8.9	8.8	8.7	8.6	8.5	8.4	8.4	8.3	8.2	8.2	8.1	8.0	8.0	7.9	7.9	7.8
70	10.4	10.3	10.1	10.0	9.9	9.7	9.6	9.5	9.4	9.3	9.2	9.1	9.0	8.9	8.9	8.8	8.7	8.6	8.6	8.5	8.4	8.4	8.3
80	11.2	11.0	10.9	10.7	10.6	10.4	10.3	10.2	10.0	9.9	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.1	9.1	9.0	8.9	8.8	8.8
90	12.0	11.8	11.6	11.4	11.3	11.1	10.9	10.8	10.7	10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.8	9.7	9.6	9.5	9.4	9.3	9.2
100	12.8	12.5	12.3	12.1	11.9	11.8	11.6	11.4	11.3	11.1	11.0	10.9	10.7	10.6	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.8	9.7
125	14.7	14.4	14.2	13.9	13.7	13.5	13.3	13.0	12.9	12.7	12.5	12.3	12.2	12.0	11.9	11.7	11.6	11.5	11.3	11.2	11.1	11.0	10.9
150	16.6	16.3	16.0	15.7	15.4	15.2	14.9	14.7	14.4	14.2	14.0	13.8	13.6	13.4	13.3	13.1	12.9	12.8	12.6	12.5	12.3	12.2	12.1
175	18.6	18.2	17.8	17.5	17.2	16.8	16.6	16.3	16.0	15.7	15.5	15.3	15.0	14.8	14.6	14.4	14.2	14.1	13.9	13.7	13.6	13.4	13.3
200	20.5	20.1	19.7	19.3	18.9	18.5	18.2	17.9	17.6	17.3	17.0	16.7	16.5	16.2	16.0	15.8	15.6	15.4	15.2	15.0	14.8	14.6	14.4
225	22.5	22.0	21.5	21.1	20.6	20.2	19.9	19.5	19.1	18.8	18.5	18.2	17.9	17.6	17.4	17.1	16.9	16.6	16.4	16.2	16.0	15.8	15.6
250	24.4	23.9	23.3	22.8	22.4	21.9	21.5	21.1	20.7	20.4	20.0	19.7	19.3	19.0	18.8	18.5	18.2	17.9	17.7	17.5	17.2	17.0	16.8
500	43.8	42.7	41.7	40.7	39.7	38.8	38.0	37.2	36.4	35.7	35.0	34.3	33.7	33.1	32.5	31.9	31.4	30.9	30.4	29.9	29.4	29.0	28.6
1000	82.7	80.4	78.3	76.4	74.5	72.7	71.0	69.4	67.9	66.4	65.0	63.7	62.4	61.2	60.0	58.9	57.8	56.8	55.8	54.8	53.9	53.0	52.1

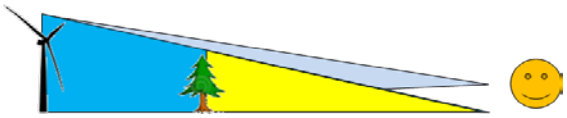
Obstruction Height \ Turbine Distance	5700	5800	5900	6000	6100	6200	6300	6400	6500	6600	6700	6800	6900	7000	7100	7200	7300	7400	7500	7600	7700	7800	7900
10	5.5	5.5	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.3	5.3	5.3	5.3
20	5.9	5.9	5.9	5.9	5.9	5.9	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
30	6.4	6.4	6.3	6.3	6.3	6.3	6.3	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.0	6.0	6.0	6.0
40	6.9	6.8	6.8	6.8	6.7	6.7	6.7	6.7	6.6	6.6	6.6	6.6	6.5	6.5	6.5	6.5	6.4	6.4	6.4	6.4	6.4	6.4	6.3
50	7.3	7.3	7.2	7.2	7.2	7.1	7.1	7.1	7.0	7.0	7.0	6.9	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.7	6.7	6.7	6.7
60	7.8	7.7	7.7	7.6	7.6	7.6	7.5	7.5	7.4	7.4	7.4	7.3	7.3	7.3	7.2	7.2	7.2	7.1	7.1	7.1	7.1	7.0	7.0
70	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.8	7.7	7.7	7.6	7.6	7.6	7.5	7.5	7.5	7.4	7.4	7.4	7.3
80	8.7	8.6	8.6	8.5	8.5	8.4	8.4	8.3	8.2	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.9	7.8	7.8	7.7	7.7	7.7
90	9.2	9.1	9.0	9.0	8.9	8.8	8.8	8.7	8.7	8.6	8.5	8.5	8.4	8.4	8.3	8.3	8.3	8.2	8.2	8.1	8.1	8.0	8.0
100	9.6	9.6	9.5	9.4	9.3	9.3	9.2	9.1	9.1	9.0	8.9	8.9	8.8	8.8	8.7	8.7	8.6	8.6	8.5	8.5	8.4	8.4	8.3
125	10.8	10.7	10.6	10.5	10.4	10.3	10.2	10.2	10.1	10.0	9.9	9.9	9.8	9.7	9.6	9.6	9.5	9.5	9.4	9.3	9.3	9.2	9.2
150	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.2	11.1	11.0	10.9	10.8	10.7	10.7	10.6	10.5	10.4	10.4	10.3	10.2	10.1	10.1	10.0
175	13.1	13.0	12.8	12.7	12.6	12.5	12.3	12.2	12.1	12.0	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.2	11.2	11.1	11.0	10.9	10.8
200	14.3	14.1	14.0	13.8	13.7	13.5	13.4	13.3	13.1	13.0	12.9	12.8	12.7	12.5	12.4	12.3	12.2	12.1	12.0	11.9	11.9	11.8	11.7
225	15.4	15.2	15.1	14.9	14.7	14.6	14.4	14.3	14.1	14.0	13.9	13.7	13.6	13.5	13.4	13.3	13.1	13.0	12.9	12.8	12.7	12.6	12.5
250	16.6	16.4	16.2	16.0	15.8	15.6	15.5	15.3	15.2	15.0	14.9	14.7	14.6	14.4	14.3	14.2	14.0	13.9	13.8	13.7	13.6	13.5	13.4
500	28.2	27.8	27.4	27.0	26.6	26.3	26.0	25.6	25.3	25.0	24.7	24.4	24.1	23.9	23.6	23.3	23.1	22.8	22.6	22.4	22.1	21.9	21.7
1000	51.3	50.5	49.8	49.0	48.3	47.6	46.9	46.3	45.6	45.0	44.4	43.8	43.3	42.7	42.2	41.7	41.2	40.7	40.2	39.7	39.3	38.8	38.4

Sample Wind Turbine View Calculator

		Address	Longitude	Latitutude
Project Turbine	Kenston Local Schools	17419 Snyder Road Chagrin Falls Ohio	81° 18' 17.99" W	41° 23' 39.61" W

Suject Viewpoint Property

Point of View Sample



	User Inputs	Calculations

Turbine Information:	Feet	Meters	Notes:
Tower Height	196.9	60.0	
Rotor Diameter	144.4	44.0	
Tip Height	269.0	82.0	
Turbine Location Elevation Above Sea-level	1252.0	381.6	

Viewpoint Information:	Feet	Meters	Notes:
Viewpoint Distance From Turbine	500.0	152.4	
Viewpoint Eye Height Above Ground	5.5	1.7	
Viewpoint Ground Elevation Above Sea-level	1260.0	384.0	
Net Viewpoint Ground Elevation Above Sea-level	1265.5	385.7	Eye height + ground elevation above sea-level (Level Line For Calculations)

Obstruction Information:	Feet	Meters	Notes:
Obstruction Distance From Viewpoint	125.0	38.1	
Obstruction Height Above Ground	35.0	10.7	
Obstruction Ground Elevation Above Sea-level	1265.0	385.6	
Net Obstruction Height Above Sea-Level	1300.0	396.2	

Results:			Notes:	
Will The Turbine Be Visible?	Yes	48.7%	Percent of Total Turbine and Tower	
Relative Visible Turbine Height at Obstruction Distance	32.8	10.0	Feet / Meters	Usefull for landscape scale
Actual Portion of Turbine Showing	131.0	39.9	Feet / Meters	
Will Blades Be Visible?	Yes	91%	Percent Rotor Diameter	
Will Hub Be Visible?	Yes			
Apparent Height of Visible Portion of Turbine, at Distance From Eye Below	0.524	0.2	Feet / Meters	
	6.3	16.0	Inches / Centimeters	
Distance From Eye	2	0.61	Feet / Meters	

Although this calculator does take into account relative topography, it does not take into account the width of obstructions or their shape. It calculates on a single vertical plane at a time. Although a good guide, it should only be used as a rough indicator of the magnitude of potential turbine visibility from a particular viewpoint.

THE RENAISSANCE GROUP

A Conserve First Company

Kenston Local Schools
Wind Turbine Project
Shadow Flicker Analysis

Prepared for:
Kenston Local Schools

Prepared by:
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Submitted September 2, 2010

Thank You for Choosing The Renaissance Group, a Conserve First LLC Company

Introduction

Proposed Turbine Location:

Kenston Local Schools
17419 Snyder Road
Chagrin Falls, Ohio 44023

Latitude: 41° 23' 39.61" N
Longitude: 81° 18' 17.99" W

While all tall objects cast shadows, wind turbines, due to their spinning blades, can cause moving/flickering shadows which can become an annoyance, especially in residential areas when they pass over windows. Fortunately, while the adverse effects of shadows can be subjective, the shadows themselves can be precisely modeled for location and duration. While modeling shadows for location knowing the latitude of site, the topography and the height and rotor diameter of a wind turbine is a precise science, quantifying the frequency of the shadow's actual occurrence is more difficult due to changing weather patterns affecting the actual Sun's intensity and presence. Further, weather patterns affect the orientation of the wind turbines blades as they follow the wind and hence their orientation to the Sun and the site. In short, on a cloudy day, there will be no shadows, and similarly, when the blades are parallel or close to parallel to the observer, none to limited moving shadow will be visible, and of course, if the wind is not sufficiently blowing to rotate the blades of the turbine, you will not have any moving shadow. Further, it is important to note the higher the angle of the Sun, the shorter the reach of the shadow and the smaller the area of potential impact. Further yet, it also important to note, due to the diffusion of light over distance, shadow intensity drops off significantly with distance. The thickness of the obstruction to the Sun, in this case the blades, also plays significantly into the actual apparent intensity and realized length of shadows. It is for these reasons that shadow distances over ten rotor diameters away from the turbine are considered insignificant. For shadow receptor sites within a turbine's shadow's reach, not all will receive shadow due to existing obstructions that block the shadows path such as other buildings, hills or trees. While evergreen trees will fairly consistently block shadows year-round, deciduous trees will have a lesser impact in the winter months when they have no leaves. Pending the density of the tree stand, single tree to an entire wooded area, winter shadows in these situations can go from being just slightly diffused to still totally obstructed. To properly model the true impacts of shadow flicker, all these considerations must be taken into account. Unobstructed shadows in latitudes similar to this study site will typically have a bow tie or flatten cross shape. In the winter, the sun rises lower on the horizon in the Southeast and sets in the Southwest and in the Summer, the Sun rises in the Northeast and sets in the Northwest all creating a path or area of potential shadow. The southern portion of the bowtie typically is larger due to there being more sunny days in the Summer although Winter shadows will be longer overall and tend to last for longer periods due to the lower angle of the Sun's rays. You will typically see more impacts in alignment with the site's predominate wind direction due to the corresponding predominate turbine blade orientation perpendicular to this direction and thus more visible moving shadows in this direction.

Although no official US policy has been adopted, international standards appear to be in consensus that flickering shadows in excess of thirty hours per year impacting a particular location are considered a potential nuisance.[i] This said, the qualitative impacts of the shadows are subjective.

When considering potential health impacts from wind turbine shadows/flicker, photosensitivity triggered epilepsy is the only issue that is discussed and has been dismissed for mid to large scale modern wind turbines such as the one being considered by the site due to turbine operating frequencies being too low to trigger seizures. According to the British Epilepsy Association, approximately five percent of individuals with epilepsy have sensitivity to light, and most people with photosensitive epilepsy are sensitive to flickering around 16-25Hz (Hertz or Hz = 1 flash per second), although some people may be sensitive to rates as low as 3Hz and as high as 60Hz (British Epilepsy Association, 2007). Specific to wind power projects, the British Epilepsy Association (2007) states that there is no evidence that wind turbines can trigger seizures, and newer wind commercial scale turbines are built to operate at a frequency of 1Hz or less. This conclusion is also supported by the epilepsy thresholds published by the American Epilepsy Foundation.[ii] Therefore, health effects due to projected shadow flicker are not anticipated or further evaluated. The primary concern with shadow flicker is the annoyance it could cause for adjacent home and business owners.

Methods

WindPro 2.7, an internationally accepted software modeling tool, was used to generate the areas of potential shadow flicker impact around the proposed turbine installation site. The software imports historic weather variable averages from the nearest national weather station to obtain average numbers of days with sunshine and the average wind direction distributions. Local Latitude drives the solar path models. Local topographical information is input to determine if there are any natural geographic influences such as hills or valleys. The turbine information including tower height and rotor diameter are input as variables to the location's shadow source models. Rotor diameter is also used to determine the study area of influence, a ten rotor diameters radius around the turbine or 1,443 feet for the largest rotor diameter being considered for this site, based on internationally accepted standards.[iii] Wind turbine operational variables for the site are also input which correspond to the turbine's overall percentage of operational time such as percentage of time when the wind speed is too low to rotate the blades and industry norms for availability driven from scheduled and unscheduled maintenance downtime. Wind speed Weibull distributions are from The Renaissance Group and State of Ohio wind data sets and models. Trees and other local obstructions are not considered in the base model (although can be added if desired) and thus the model can be considered a worst case, as if no obstructions existed. If a particular shadow receptor is found to be of potential concern, a receptor specific analysis of potential shadow flicker hours and occurrence periods/times is conducted, otherwise, the results are plotted for the area as a whole as average not-to-exceed threshold iso-lines on the map. Models were run at a two thousand meter hyper-conservative distance well beyond the likely observable shadows for this location and the turbines under consideration. For the playing field locations, extra-wide

and tall receptor windows were used of 100' x 100' to better insure potential impact recording. With this in mind, it is important to note that the model records all potential impacts as if they impacted the entire receptor, while in reality, they will only impact a relatively small portion of these large receptors at a given time.

Results

See "Kenston WTG Shadow Flicker Analysis" map for a visualization of the results. No homes or occupied business structures outside the owner's property within the turbines shadow influence will receive significant flickering shadows of over 30 hours per year. Two to three houses to the Southwest of the site could receive less than ten hours of moving shadows per year, but the shadows would likely be highly diffused to completely blocked due to existing trees. While portions of the Middle School to the Northwest of the site will receive significant shadowing of over 30 hours per year, the structure has no windows facing the turbine. It is also worth noting that the portion of the building closest to the turbine is the maintenance garage. The tennis courts to the Southwest will receive moving morning shadows up to almost fifty hours per year during sunny late fall to early spring mornings. The stadium to the Northeast of the site will receive significant moving shadows throughout much of the year from late afternoon into the evenings. To a lesser extent, the playing fields further to the East and Northeast will also receive moving shadows for 10 to 20 hours per year. For the periods when shadowing events will overlap scheduled sporting or other use events for any of these locations, the school has adopted a policy that will temporarily shut down the turbine during the shadows impact on the playing fields. The financial loss to the school district from this policy will be minimal due to the short duration of the shadow events and the fact the sporting events typically last only a few hours, and further, that shutdowns will only need to occur during sunny weather. (See below for further information and recommendations for the potentially impacted receptor sites.) (Also see "Turbine Use, Safety Policies and General Background" document for information on the Schools Turbine policies relating to shadow flicker.)

Models were run using a hyper-conservative two thousand meters, a distance well beyond the industry norm of ten rotor diameters, to insure full reporting of potential impacts. The models show the same iso-lines contour results for general shadow hour thresholds based on the actual average site conditions, but the tabular information shows worse case shadow hours and the potential hours of impact for particular receptor locations, as if it was always sunny. Also, note the further away from the turbine a receptor is the less intense the shadow will be. Beyond ten rotor diameters, shadows will be diffuse and difficult to see.

Overview of Tabular Results for Particular Sample Receptors:

- Receptor A: 990 Feet Away: Elementary School to East: Shadows will be rare, but possible in mid-April to early-May and from mid-August to late-August evenings with a total average of less than 7 hours of moving shadow per year possible.
- Receptor B: 930 Feet Away: 17430 Snyder Road: Shadows will not impact this receptor.
- Receptor C: 1830 Feet Away: 17360 Wood Acre Trail Shadows will not impact this receptor

- Receptor D: 1,085 Feet Away: 17405 Snyder Road: Shadows will be highly diffuse, to completely blocked, as the receptor is substantially blocked by multiple trees, but possible during portions of mid to late May and the first couple of days in August with a total average of less than 11 hours of moving morning shadow per year.

- Receptor E: 1,030 Feet Away: 17406 Snyder Road: Shadows will be highly diffuse, to completely blocked, as the receptor is substantially blocked by multiple trees including evergreens, but possible during portions of very late-January to late-February and mid-October to mid-November mornings with a total average of less than 5 hours of moving shadow per year.

- Receptor F: 920 Feet Away: 17446 Snyder Road: Shadows will be highly diffuse, to completely blocked, as the receptor is substantially blocked by multiple trees, but possible during portions of mid-March to mid-April and middle September mornings with a total average of less than 6 hours of moving morning shadow per year.

- Receptor G: 950 Feet Away: 17476 Snyder Road: Shadows will be highly diffuse, to completely blocked, as the receptor is substantially blocked by multiple trees, but possible during portions of mid to late May and early-August mornings with a total average of less than 17 hours of moving morning shadow per year.

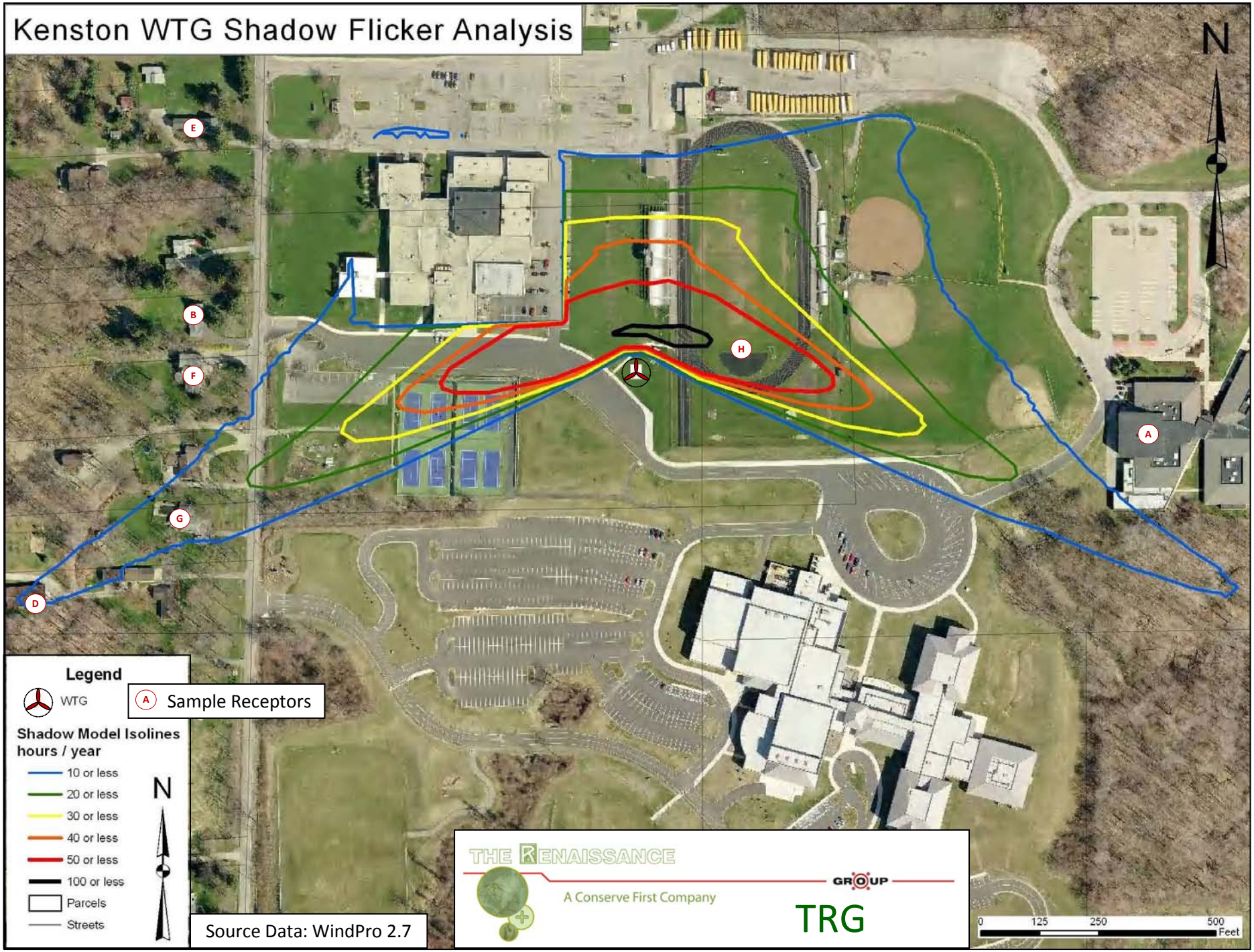
- Receptor H: 150 Feet Away: Stadium: Shadows will be distinct during most evenings of the year on some portion of the stadium field except late-May to mid-August with a total average of less than 147 hours of moving shadow per year.

The duration of particular shadow events can vary from a minute to hours pending the receptor. See the following tables at the end of this report for precise dates and times where shadows could occur for each listed sample receptor.

Note the iso-line diagram on the following page shows hour thresholds of shadow impact based on average site conditions with results being referenced to one meter squares of potential impact, i.e. a meter square area within an iso-line area will receive up to the threshold of shadow hours per year. As the tabular information represents larger areas and adds up the entire receptor as if it was one location, its cumulative hour results may be higher. This equates to watching if a shadow will enter a window to watching if it will enter any portion of an entire ball field or yard. Although impacts can be subjective, shadows impacting a specific receptor window are considered significantly more severe than those that impact a yard.

Recommendations

Based on the study findings, no occupied structure will receive over 30 hours of moving shadow per year, the currently accepted consensus on nuisance thresholds for moving shadows/flickering. No local, State or Federal policy or regulation exists to govern shadow flicker thresholds. This said, some receptors will receive some shadow which the affect of will be subjective to the receptor owners' views on the project and their sensitivity. With this in mind, the study authors would recommend that the project site owner follow the guidelines and mediation strategies outlined in "Turbine Use, Safety Policies and General Background".



Project:
Kenston Shadow Receptor Potential Impacts Analysis, 2000 Meters

THE RENAISSANCE GROUP — A Conserve First Company

Printed/Page
8/28/2010 7:34 PM / 1
Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com
Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Main Result

Calculation: Shadow081410

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
380	329	251	247	262	379	436	377	417	706	782	866

W	WNW	NW	NNW	Sum
679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: 2ftAubBain.wpo (2)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m

Scale 1:12,500
New WTG
Shadow receptor

WTGs

	UTM WGS84 Zone: 17				WTG type						Shadow data	
	East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Calculation distance	RPM
	UTM WGS84 Zone: 17		[m]					[kW]	[m]	[m]	[m]	[RPM]
1	474,503	4,582,579	381.7	Kenston WTG	No	BONUS	MK IV-600/120	600	44.0	60.0	2,000	27.0

Shadow receptor-Input

No.	UTM WGS84 Zone: 17 East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
A	474,833	4,582,536	378.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	474,220	4,582,661	376.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C	474,978	4,582,902	377.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D	474,106	4,582,446	362.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	474,219	4,582,743	376.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F	474,217	4,582,614	374.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G	474,207	4,582,496	368.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H	474,561	4,582,638	383.4	30.0	30.0	0.2	-180.0	90.0	"Green house mode"

Project:
Kenston

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8/28/2010 7:34 PM / 2
Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com
Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Main Result

Calculation: Shadow081410

Calculation Results

Shadow receptor

No.	Shadow, expected values: Shadow hours per year [h/year]
A	6:27
B	0:00
C	0:00
D	10:27
E	4:19
F	5:52
G	16:32
H	146:50

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	Kenston WTG	762:49	185:38

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

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8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** A - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (1)

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
Minimum sun height over horizon for influence	3	°
Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April		May		June	July	August		September	October	November	December
1	07:52	07:38	07:01	07:10		06:24	18:58 (1)	05:55	05:56	06:20		06:51	07:22	06:56	07:32
	17:06	17:41	18:16	19:50		20:21	22 19:20 (1)	20:52	21:03	20:45		20:02	19:09	17:22	16:57
2	07:52	07:37	07:00	07:08		06:23	18:59 (1)	05:54	05:56	06:21		06:52	07:23	06:58	07:33
	17:07	17:42	18:17	19:51		20:23	19 19:18 (1)	20:52	21:03	20:44		20:00	19:07	17:21	16:57
3	07:52	07:36	06:58	07:07		06:21	19:01 (1)	05:54	05:57	06:22		06:53	07:24	06:59	07:34
	17:08	17:44	18:18	19:52		20:24	15 19:16 (1)	20:53	21:03	20:42		19:57	19:05	17:19	16:57
4	07:52	07:35	06:57	07:05		06:20	19:03 (1)	05:54	05:57	06:23		06:54	07:25	07:00	07:35
	17:09	17:45	18:19	19:53		20:25	11 19:14 (1)	20:54	21:03	20:41		19:55	19:04	17:18	16:57
5	07:52	07:34	06:55	07:03		06:19		05:53	05:58	06:24		06:55	07:26	07:01	07:36
	17:10	17:46	18:20	19:55		20:26		20:55	21:03	20:40		19:53	19:02	17:17	16:56
6	07:52	07:33	06:54	07:02		06:18		05:53	05:58	06:25		06:56	07:27	07:02	07:37
	17:11	17:47	18:21	19:56		20:27		20:55	21:02	20:39		19:52	19:00	17:16	16:56
7	07:52	07:32	06:52	07:00		06:16		05:53	05:59	06:26		06:57	07:28	07:04	07:38
	17:12	17:49	18:23	19:57		20:28		20:56	21:02	20:38		19:50	18:59	17:15	16:56
8	07:52	07:30	07:50	06:59		06:15		05:52	06:00	06:27	19:16 (1)	06:58	07:29	07:05	07:39
	17:13	17:50	19:24	19:58		20:29		20:57	21:02	20:37	4 19:20 (1)	19:48	18:57	17:14	16:56
9	07:52	07:29	07:49	06:57		06:14		05:52	06:00	06:28	19:12 (1)	06:59	07:30	07:06	07:39
	17:14	17:51	19:25	19:59		20:30		20:57	21:01	20:35	12 19:24 (1)	19:47	18:55	17:13	16:56
10	07:52	07:28	07:47	06:55		06:13		05:52	06:01	06:29	19:10 (1)	07:00	07:31	07:07	07:40
	17:15	17:53	19:26	20:00		20:31		20:58	21:01	20:34	16 19:26 (1)	19:45	18:54	17:11	16:56
11	07:51	07:27	07:45	06:54		06:12		05:52	06:02	06:30	19:07 (1)	07:01	07:32	07:09	07:41
	17:16	17:54	19:27	20:00		20:32		20:58	21:01	20:33	20 19:27 (1)	19:43	18:52	17:10	16:56
12	07:51	07:26	07:44	06:52	19:08 (1)	06:11		05:52	06:02	06:31	19:06 (1)	07:02	07:33	07:10	07:42
	17:17	17:55	19:28	20:01	8 19:16 (1)	20:33		20:59	21:00	20:31	22 19:28 (1)	19:41	18:51	17:09	16:56
13	07:51	07:24	07:42	06:50	19:05 (1)	06:10		05:52	06:03	06:32	19:04 (1)	07:03	07:35	07:11	07:43
	17:18	17:56	19:29	20:02	15 19:20 (1)	20:34		20:59	21:00	20:30	25 19:29 (1)	19:40	18:49	17:09	16:56
14	07:50	07:23	07:40	06:49	19:02 (1)	06:09		05:52	06:04	06:33	19:03 (1)	07:04	07:36	07:12	07:44
	17:19	17:58	19:31	20:03	20 19:22 (1)	20:35		21:00	20:59	20:29	27 19:30 (1)	19:38	18:47	17:08	16:57
15	07:50	07:22	07:39	06:47	19:00 (1)	06:08		05:52	06:05	06:34	19:02 (1)	07:05	07:37	07:13	07:44
	17:20	17:59	19:32	20:04	23 19:23 (1)	20:36		21:00	20:59	20:27	28 19:30 (1)	19:36	18:46	17:07	16:57
16	07:50	07:20	07:37	06:46	18:59 (1)	06:07		05:52	06:05	06:35	19:02 (1)	07:06	07:38	07:15	07:45
	17:22	18:00	19:33	20:05	25 19:24 (1)	20:37		21:01	20:58	20:26	29 19:31 (1)	19:35	18:44	17:06	16:57
17	07:49	07:19	07:35	06:44	18:57 (1)	06:06		05:52	06:06	06:36	19:01 (1)	07:07	07:39	07:16	07:46
	17:23	18:01	19:34	20:06	27 19:24 (1)	20:38		21:01	20:58	20:25	30 19:31 (1)	19:33	18:43	17:05	16:57
18	07:49	07:18	07:34	06:43	18:57 (1)	06:05		05:52	06:07	06:37	19:00 (1)	07:08	07:40	07:17	07:46
	17:24	18:02	19:35	20:07	28 19:25 (1)	20:39		21:01	20:57	20:23	31 19:31 (1)	19:31	18:41	17:04	16:58
19	07:48	07:16	07:32	06:41	18:56 (1)	06:04		05:52	06:08	06:38	19:00 (1)	07:09	07:41	07:18	07:47
	17:25	18:04	19:36	20:09	29 19:25 (1)	20:40		21:02	20:56	20:22	31 19:31 (1)	19:29	18:40	17:04	16:58
20	07:47	07:15	07:30	06:40	18:55 (1)	06:03		05:52	06:09	06:39	19:00 (1)	07:10	07:42	07:19	07:48
	17:26	18:05	19:37	20:10	31 19:26 (1)	20:41		21:02	20:56	20:20	31 19:31 (1)	19:28	18:38	17:03	16:59
21	07:47	07:13	07:29	06:38	18:54 (1)	06:02		05:52	06:10	06:40	18:59 (1)	07:11	07:44	07:20	07:48
	17:27	18:06	19:38	20:11	31 19:25 (1)	20:42		21:02	20:55	20:19	32 19:31 (1)	19:26	18:37	17:02	16:59
22	07:46	07:12	07:27	06:37	18:55 (1)	06:01		05:52	06:11	06:41	18:59 (1)	07:12	07:45	07:22	07:49
	17:29	18:07	19:39	20:12	31 19:26 (1)	20:43		21:03	20:54	20:17	31 19:30 (1)	19:24	18:35	17:01	16:59
23	07:46	07:11	07:25	06:35	18:55 (1)	06:01		05:53	06:11	06:42	18:59 (1)	07:13	07:46	07:23	07:49
	17:30	18:09	19:40	20:13	31 19:26 (1)	20:44		21:03	20:53	20:16	31 19:30 (1)	19:22	18:34	17:01	17:00
24	07:45	07:09	07:24	06:34	18:54 (1)	06:00		05:53	06:12	06:43	19:00 (1)	07:14	07:47	07:24	07:50
	17:31	18:10	19:42	20:14	31 19:25 (1)	20:45		21:03	20:52	20:14	29 19:29 (1)	19:21	18:32	17:00	17:01
25	07:44	07:08	07:22	06:32	18:55 (1)	05:59		05:53	06:13	06:44	19:00 (1)	07:15	07:48	07:25	07:50
	17:32	18:11	19:43	20:15	30 19:25 (1)	20:46		21:03	20:52	20:13	28 19:28 (1)	19:19	18:31	17:00	17:01
26	07:43	07:06	07:20	06:31	18:54 (1)	05:58		05:53	06:14	06:45	19:00 (1)	07:16	07:49	07:26	07:50
	17:34	18:12	19:44	20:16	30 19:24 (1)	20:47		21:03	20:51	20:11	27 19:27 (1)	19:17	18:30	16:59	17:02
27	07:42	07:05	07:19	06:29	18:55 (1)	05:58		05:54	06:15	06:46	19:01 (1)	07:18	07:50	07:27	07:51
	17:35	18:13	19:45	20:17	29 19:24 (1)	20:47		21:03	20:50	20:10	25 19:26 (1)	19:16	18:28	16:59	17:02
28	07:42	07:03	07:17	06:28	18:56 (1)	05:57		05:54	06:16	06:47	19:02 (1)	07:19	07:52	07:28	07:51
	17:36	18:14	19:46	20:18	27 19:23 (1)	20:48		21:03	20:49	20:08	22 19:24 (1)	19:14	18:27	16:58	17:03
29	07:41		07:15	06:27	18:56 (1)	05:57		05:55	06:17	06:48	19:03 (1)	07:20	07:53	07:30	07:51
	17:37		19:47	20:19	26 19:22 (1)	20:49		21:03	20:48	20:06	19 19:22 (1)	19:12	18:26	16:58	17:04
30	07:40		07:13	06:25	18:57 (1)	05:56		05:55	06:18	06:49	19:05 (1)	07:21	07:54	07:31	07:52
	17:39		19:48	20:20	24 19:21 (1)	20:50		21:03	20:47	20:05	15 19:20 (1)	19:11	18:24	16:58	17:05
31	07:39		07:12			05:55			06:19	06:50	19:09 (1)		07:55		07:52
	17:40		19:49			20:51			20:46	20:03	7 19:16 (1)		18:23		17:05
Potential sun hours	297	297	370	399		449		453	460	429		375	345	297	287
Total, worst case					96		4 7		6		72	5			
Sun reduction					0.57		0.62				0.65				
Oper. time red.					0.87		0.87				0.87				
Wind dir. red.					0.64		0.64				0.64				
Total reduction					0.32		0.34				0.36				
Total, real					57		1 3		2		07	2			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** B - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:52	07:38	07:01	07:10	06:24	05:55	05:56	06:20	06:51	07:22	06:56	07:32
	17:07	17:41	18:16	19:50	20:21	20:52	21:03	20:45	20:02	19:09	17:22	16:57
2	07:52	07:37	07:00	07:08	06:23	05:55	05:56	06:21	06:52	07:23	06:58	07:33
	17:07	17:42	18:17	19:51	20:23	20:52	21:03	20:44	20:00	19:07	17:21	16:57
3	07:52	07:36	06:58	07:07	06:21	05:54	05:57	06:22	06:53	07:24	06:59	07:34
	17:08	17:44	18:18	19:52	20:24	20:53	21:03	20:43	19:57	19:05	17:19	16:57
4	07:52	07:35	06:57	07:05	06:20	05:54	05:57	06:23	06:54	07:25	07:00	07:35
	17:09	17:45	18:19	19:53	20:25	20:54	21:03	20:41	19:55	19:04	17:18	16:57
5	07:52	07:34	06:55	07:04	06:19	05:53	05:58	06:24	06:55	07:26	07:01	07:36
	17:10	17:46	18:20	19:55	20:26	20:55	21:03	20:40	19:53	19:02	17:17	16:56
6	07:52	07:33	06:54	07:02	06:18	05:53	05:58	06:25	06:56	07:27	07:02	07:37
	17:11	17:48	18:21	19:56	20:27	20:55	21:02	20:39	19:52	19:00	17:16	16:56
7	07:52	07:32	06:52	07:00	06:16	05:53	05:59	06:26	06:57	07:28	07:04	07:38
	17:12	17:49	18:23	19:57	20:28	20:56	21:02	20:38	19:50	18:59	17:15	16:56
8	07:52	07:30	07:50	06:59	06:15	05:52	06:00	06:27	06:58	07:29	07:05	07:39
	17:13	17:50	19:24	19:58	20:29	20:57	21:02	20:37	19:48	18:57	17:14	16:56
9	07:52	07:29	07:49	06:57	06:14	05:52	06:00	06:28	06:59	07:30	07:06	07:39
	17:14	17:51	19:25	19:59	20:30	20:57	21:02	20:35	19:47	18:56	17:13	16:56
10	07:52	07:28	07:47	06:55	06:13	05:52	06:01	06:29	07:00	07:31	07:07	07:40
	17:15	17:53	19:26	20:00	20:31	20:58	21:01	20:34	19:45	18:54	17:12	16:56
11	07:51	07:27	07:45	06:54	06:12	05:52	06:02	06:30	07:01	07:32	07:09	07:41
	17:16	17:54	19:27	20:00	20:32	20:58	21:01	20:33	19:43	18:52	17:11	16:56
12	07:51	07:26	07:44	06:52	06:11	05:52	06:02	06:31	07:02	07:33	07:10	07:42
	17:17	17:55	19:28	20:01	20:33	20:59	21:00	20:31	19:41	18:51	17:10	16:56
13	07:51	07:24	07:42	06:50	06:10	05:52	06:03	06:32	07:03	07:35	07:11	07:43
	17:18	17:56	19:29	20:02	20:34	20:59	21:00	20:30	19:40	18:49	17:09	16:56
14	07:50	07:23	07:40	06:49	06:09	05:52	06:04	06:33	07:04	07:36	07:12	07:44
	17:19	17:58	19:31	20:03	20:35	21:00	20:59	20:29	19:38	18:48	17:08	16:57
15	07:50	07:22	07:39	06:47	06:08	05:52	06:05	06:34	07:05	07:37	07:13	07:44
	17:21	17:59	19:32	20:04	20:36	21:00	20:59	20:27	19:36	18:46	17:07	16:57
16	07:50	07:20	07:37	06:46	06:07	05:52	06:05	06:35	07:06	07:38	07:15	07:45
	17:22	18:00	19:33	20:05	20:37	21:01	20:58	20:26	19:35	18:44	17:06	16:57
17	07:49	07:19	07:35	06:44	06:06	05:52	06:06	06:36	07:07	07:39	07:16	07:46
	17:23	18:01	19:34	20:06	20:38	21:01	20:58	20:25	19:33	18:43	17:05	16:57
18	07:49	07:18	07:34	06:43	06:05	05:52	06:07	06:37	07:08	07:40	07:17	07:46
	17:24	18:02	19:35	20:07	20:39	21:01	20:57	20:23	19:31	18:41	17:04	16:58
19	07:48	07:16	07:32	06:41	06:04	05:52	06:08	06:38	07:09	07:41	07:18	07:47
	17:25	18:04	19:36	20:09	20:40	21:02	20:56	20:22	19:29	18:40	17:04	16:58
20	07:47	07:15	07:30	06:40	06:03	05:52	06:09	06:39	07:10	07:42	07:19	07:48
	17:26	18:05	19:37	20:10	20:41	21:02	20:56	20:20	19:28	18:38	17:03	16:59
21	07:47	07:13	07:29	06:38	06:02	05:52	06:10	06:40	07:11	07:44	07:20	07:48
	17:28	18:06	19:38	20:11	20:42	21:02	20:55	20:19	19:26	18:37	17:02	16:59
22	07:46	07:12	07:27	06:37	06:01	05:52	06:11	06:41	07:12	07:45	07:22	07:49
	17:29	18:07	19:39	20:12	20:43	21:03	20:54	20:17	19:24	18:35	17:01	17:00
23	07:46	07:11	07:25	06:35	06:01	05:53	06:11	06:42	07:13	07:46	07:23	07:49
	17:30	18:09	19:40	20:13	20:44	21:03	20:53	20:16	19:23	18:34	17:01	17:00
24	07:45	07:09	07:24	06:34	06:00	05:53	06:12	06:43	07:14	07:47	07:24	07:50
	17:31	18:10	19:42	20:14	20:45	21:03	20:52	20:14	19:21	18:32	17:00	17:01
25	07:44	07:08	07:22	06:32	05:59	05:53	06:13	06:44	07:15	07:48	07:25	07:50
	17:32	18:11	19:43	20:15	20:46	21:03	20:52	20:13	19:19	18:31	17:00	17:01
26	07:43	07:06	07:20	06:31	05:58	05:54	06:14	06:45	07:17	07:49	07:26	07:50
	17:34	18:12	19:44	20:16	20:47	21:03	20:51	20:11	19:17	18:30	16:59	17:02
27	07:43	07:05	07:19	06:29	05:58	05:54	06:15	06:46	07:18	07:51	07:27	07:51
	17:35	18:13	19:45	20:17	20:47	21:03	20:50	20:10	19:16	18:28	16:59	17:02
28	07:42	07:03	07:17	06:28	05:57	05:54	06:16	06:47	07:19	07:52	07:28	07:51
	17:36	18:15	19:46	20:18	20:48	21:03	20:49	20:08	19:14	18:27	16:58	17:03
29	07:41		07:15	06:27	05:57	05:55	06:17	06:48	07:20	07:53	07:30	07:51
	17:37		19:47	20:19	20:49	21:03	20:48	20:06	19:12	18:26	16:58	17:04
30	07:40		07:14	06:25	05:56	05:55	06:18	06:49	07:21	07:54	07:31	07:52
	17:39		19:48	20:20	20:50	21:03	20:47	20:05	19:11	18:24	16:58	17:05
31	07:39		07:12		05:55		06:19	06:50		07:55		07:52
	17:40		19:49		20:51		20:46	20:03		18:23		17:05
Potential sun hours	297	297	370	399	449	453	460	429	375	345	297	287
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

Printed/Page
8/28/2010 7:34 PM / 5
Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com
Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** C - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:52	07:38	07:01	07:10	06:24	05:55	05:56	06:20	06:51	07:22	06:56	07:32
	17:06	17:41	18:16	19:50	20:21	20:52	21:03	20:45	20:02	19:09	17:22	16:57
2	07:52	07:37	07:00	07:08	06:23	05:54	05:56	06:21	06:52	07:23	06:58	07:33
	17:07	17:42	18:17	19:51	20:23	20:52	21:03	20:44	20:00	19:07	17:20	16:57
3	07:52	07:36	06:58	07:07	06:21	05:54	05:57	06:22	06:53	07:24	06:59	07:34
	17:08	17:44	18:18	19:52	20:24	20:53	21:03	20:42	19:57	19:05	17:19	16:57
4	07:52	07:35	06:57	07:05	06:20	05:54	05:57	06:23	06:54	07:25	07:00	07:35
	17:09	17:45	18:19	19:53	20:25	20:54	21:03	20:41	19:55	19:04	17:18	16:57
5	07:52	07:34	06:55	07:03	06:19	05:53	05:58	06:24	06:55	07:26	07:01	07:36
	17:10	17:46	18:20	19:55	20:26	20:55	21:03	20:40	19:53	19:02	17:17	16:56
6	07:52	07:33	06:54	07:02	06:18	05:53	05:58	06:25	06:56	07:27	07:02	07:37
	17:11	17:47	18:21	19:56	20:27	20:55	21:02	20:39	19:52	19:00	17:16	16:56
7	07:52	07:32	06:52	07:00	06:16	05:53	05:59	06:26	06:57	07:28	07:04	07:38
	17:12	17:49	18:23	19:57	20:28	20:56	21:02	20:38	19:50	18:59	17:15	16:56
8	07:52	07:30	07:50	06:59	06:15	05:52	06:00	06:27	06:58	07:29	07:05	07:39
	17:13	17:50	19:24	19:58	20:29	20:57	21:02	20:37	19:48	18:57	17:14	16:56
9	07:52	07:29	07:49	06:57	06:14	05:52	06:00	06:28	06:59	07:30	07:06	07:39
	17:14	17:51	19:25	19:59	20:30	20:57	21:01	20:35	19:47	18:55	17:13	16:56
10	07:52	07:28	07:47	06:55	06:13	05:52	06:01	06:29	07:00	07:31	07:07	07:40
	17:15	17:53	19:26	20:00	20:31	20:58	21:01	20:34	19:45	18:54	17:11	16:56
11	07:51	07:27	07:45	06:54	06:12	05:52	06:02	06:30	07:01	07:32	07:09	07:41
	17:16	17:54	19:27	20:00	20:32	20:58	21:01	20:33	19:43	18:52	17:10	16:56
12	07:51	07:26	07:44	06:52	06:11	05:52	06:02	06:31	07:02	07:33	07:10	07:42
	17:17	17:55	19:28	20:01	20:33	20:59	21:00	20:31	19:41	18:51	17:09	16:56
13	07:51	07:24	07:42	06:50	06:10	05:52	06:03	06:32	07:03	07:35	07:11	07:43
	17:18	17:56	19:29	20:02	20:34	20:59	21:00	20:30	19:40	18:49	17:09	16:56
14	07:50	07:23	07:40	06:49	06:09	05:52	06:04	06:33	07:04	07:36	07:12	07:44
	17:19	17:58	19:31	20:03	20:35	21:00	20:59	20:29	19:38	18:47	17:08	16:57
15	07:50	07:22	07:39	06:47	06:08	05:52	06:05	06:34	07:05	07:37	07:13	07:44
	17:20	17:59	19:32	20:04	20:36	21:00	20:59	20:27	19:36	18:46	17:07	16:57
16	07:50	07:20	07:37	06:46	06:07	05:52	06:05	06:35	07:06	07:38	07:15	07:45
	17:22	18:00	19:33	20:05	20:37	21:01	20:58	20:26	19:35	18:44	17:06	16:57
17	07:49	07:19	07:35	06:44	06:06	05:52	06:06	06:36	07:07	07:39	07:16	07:46
	17:23	18:01	19:34	20:06	20:38	21:01	20:58	20:25	19:33	18:43	17:05	16:57
18	07:49	07:18	07:34	06:43	06:05	05:52	06:07	06:37	07:08	07:40	07:17	07:46
	17:24	18:02	19:35	20:07	20:39	21:01	20:57	20:23	19:31	18:41	17:04	16:58
19	07:48	07:16	07:32	06:41	06:04	05:52	06:08	06:38	07:09	07:41	07:18	07:47
	17:25	18:04	19:36	20:09	20:40	21:02	20:56	20:22	19:29	18:40	17:04	16:58
20	07:47	07:15	07:30	06:40	06:03	05:52	06:09	06:39	07:10	07:42	07:19	07:48
	17:26	18:05	19:37	20:10	20:41	21:02	20:56	20:20	19:28	18:38	17:03	16:59
21	07:47	07:13	07:29	06:38	06:02	05:52	06:10	06:40	07:11	07:44	07:20	07:48
	17:27	18:06	19:38	20:11	20:42	21:02	20:55	20:19	19:26	18:37	17:02	16:59
22	07:46	07:12	07:27	06:37	06:01	05:52	06:11	06:41	07:12	07:45	07:22	07:49
	17:29	18:07	19:39	20:12	20:43	21:03	20:54	20:17	19:24	18:35	17:01	16:59
23	07:46	07:11	07:25	06:35	06:01	05:53	06:11	06:42	07:13	07:46	07:23	07:49
	17:30	18:09	19:40	20:13	20:44	21:03	20:53	20:16	19:22	18:34	17:01	17:00
24	07:45	07:09	07:24	06:34	06:00	05:53	06:12	06:43	07:14	07:47	07:24	07:50
	17:31	18:10	19:42	20:14	20:45	21:03	20:52	20:14	19:21	18:32	17:00	17:01
25	07:44	07:08	07:22	06:32	05:59	05:53	06:13	06:44	07:15	07:48	07:25	07:50
	17:32	18:11	19:43	20:15	20:46	21:03	20:52	20:13	19:19	18:31	17:00	17:01
26	07:43	07:06	07:20	06:31	05:58	05:53	06:14	06:45	07:16	07:49	07:26	07:50
	17:34	18:12	19:44	20:16	20:47	21:03	20:51	20:11	19:17	18:30	16:59	17:02
27	07:42	07:05	07:19	06:29	05:58	05:54	06:15	06:46	07:18	07:50	07:27	07:51
	17:35	18:13	19:45	20:17	20:47	21:03	20:50	20:10	19:16	18:28	16:59	17:02
28	07:42	07:03	07:17	06:28	05:57	05:54	06:16	06:47	07:19	07:52	07:28	07:51
	17:36	18:14	19:46	20:18	20:48	21:03	20:49	20:08	19:14	18:27	16:58	17:03
29	07:41		07:15	06:27	05:56	05:55	06:17	06:48	07:20	07:53	07:30	07:51
	17:37		19:47	20:19	20:49	21:03	20:48	20:06	19:12	18:26	16:58	17:04
30	07:40		07:13	06:25	05:56	05:55	06:18	06:49	07:21	07:54	07:31	07:52
	17:39		19:48	20:20	20:50	21:03	20:47	20:05	19:10	18:24	16:58	17:05
31	07:39		07:12		05:55		06:19	06:50		07:55		07:52
	17:40		19:49		20:51		20:46	20:03		18:23		17:05
Potential sun hours	297	297	370	399	449	453	460	429	375	345	297	287
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

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8/28/2010 7:34 PM / 6

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** D - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:52	07:38	07:01	07:10	06:24	05:55	06:53 (1) 05:56	07:02 (1) 06:20	07:10 (1) 06:51	07:22	06:56	07:32
	17:07	17:41	18:16	19:50	20:21	20:52 24	07:17 (1) 21:03 17	07:19 (1) 20:45 8	07:18 (1) 20:02	19:09	17:22	16:57
2	07:52	07:37	07:00	07:08	06:23	05:55	06:53 (1) 05:56	07:02 (1) 06:21	06:52	07:23	06:58	07:33
	17:07	17:42	18:17	19:51	20:23	20:52 23	07:16 (1) 21:03 18	07:20 (1) 20:44	20:00	19:07	17:21	16:57
3	07:52	07:36	06:58	07:07	06:21	05:54	06:54 (1) 05:57	07:01 (1) 06:22	06:53	07:24	06:59	07:34
	17:08	17:44	18:18	19:52	20:24	20:53 22	07:16 (1) 21:03 19	07:20 (1) 20:43	19:57	19:05	17:19	16:57
4	07:52	07:35	06:57	07:05	06:20	05:54	06:54 (1) 05:57	07:02 (1) 06:23	06:54	07:25	07:00	07:35
	17:09	17:45	18:19	19:53	20:25	20:54 23	07:17 (1) 21:03 19	07:21 (1) 20:41	19:55	19:04	17:18	16:57
5	07:52	07:34	06:55	07:04	06:19	05:53	06:54 (1) 05:58	07:01 (1) 06:24	06:55	07:26	07:01	07:36
	17:10	17:46	18:20	19:55	20:26	20:55 22	07:16 (1) 21:03 20	07:21 (1) 20:40	19:53	19:02	17:17	16:56
6	07:52	07:33	06:54	07:02	06:18	05:53	06:55 (1) 05:58	07:01 (1) 06:25	06:56	07:27	07:02	07:37
	17:11	17:48	18:21	19:56	20:27	20:55 21	07:16 (1) 21:02 21	07:22 (1) 20:39	19:52	19:00	17:16	16:56
7	07:52	07:32	06:52	07:00	06:16	05:53	06:56 (1) 05:59	07:01 (1) 06:26	06:57	07:28	07:04	07:38
	17:12	17:49	18:23	19:57	20:28	20:56 20	07:16 (1) 21:02 22	07:23 (1) 20:38	19:50	18:59	17:15	16:56
8	07:52	07:30	07:50	06:59	06:15	05:52	06:56 (1) 06:00	07:01 (1) 06:27	06:58	07:29	07:05	07:39
	17:13	17:50	19:24	19:58	20:29	20:57 20	07:16 (1) 21:02 22	07:23 (1) 20:37	19:48	18:57	17:14	16:56
9	07:52	07:29	07:49	06:57	06:14	05:52	06:56 (1) 06:00	07:01 (1) 06:28	06:59	07:30	07:06	07:39
	17:14	17:51	19:25	19:59	20:30	20:57 19	07:15 (1) 21:02 22	07:23 (1) 20:35	19:47	18:56	17:13	16:56
10	07:52	07:28	07:47	06:55	06:13	05:52	06:57 (1) 06:01	07:01 (1) 06:29	07:00	07:31	07:07	07:40
	17:15	17:53	19:26	20:00	20:31	20:58 18	07:15 (1) 21:01 23	07:24 (1) 20:34	19:45	18:54	17:12	16:56
11	07:51	07:27	07:45	06:54	06:12	07:02 (1) 05:52	06:57 (1) 06:02	07:00 (1) 06:30	07:01	07:32	07:09	07:41
	17:16	17:54	19:27	20:00	20:32 3	07:05 (1) 20:58 18	07:15 (1) 21:01 24	07:24 (1) 20:33	19:43	18:52	17:11	16:56
12	07:51	07:26	07:44	06:52	06:11	06:58 (1) 05:52	06:58 (1) 06:02	07:01 (1) 06:31	07:02	07:33	07:10	07:42
	17:17	17:55	19:28	20:01	20:33 11	07:09 (1) 20:59 17	07:15 (1) 21:00 24	07:25 (1) 20:31	19:41	18:51	17:10	16:56
13	07:51	07:24	07:42	06:50	06:10	06:56 (1) 05:52	06:59 (1) 06:03	07:01 (1) 06:32	07:03	07:35	07:11	07:43
	17:18	17:56	19:29	20:02	20:34 14	07:10 (1) 20:59 16	07:15 (1) 21:00 24	07:25 (1) 20:30	19:40	18:49	17:09	16:56
14	07:50	07:23	07:40	06:49	06:09	06:55 (1) 05:52	06:59 (1) 06:04	07:00 (1) 06:33	07:04	07:36	07:12	07:44
	17:19	17:58	19:31	20:03	20:35 17	07:12 (1) 21:00 16	07:15 (1) 20:59 25	07:25 (1) 20:29	19:38	18:48	17:08	16:57
15	07:50	07:22	07:39	06:47	06:08	06:54 (1) 05:52	06:59 (1) 06:05	07:00 (1) 06:34	07:05	07:37	07:13	07:44
	17:21	17:59	19:32	20:04	20:36 19	07:13 (1) 21:00 16	07:15 (1) 20:59 25	07:25 (1) 20:27	19:36	18:46	17:07	16:57
16	07:50	07:20	07:37	06:46	06:07	06:53 (1) 05:52	07:00 (1) 06:05	07:00 (1) 06:35	07:06	07:38	07:15	07:45
	17:22	18:00	19:33	20:05	20:37 21	07:14 (1) 21:01 15	07:15 (1) 20:58 26	07:26 (1) 20:26	19:35	18:44	17:06	16:57
17	07:49	07:19	07:35	06:44	06:06	06:52 (1) 05:52	07:00 (1) 06:06	07:01 (1) 06:36	07:07	07:39	07:16	07:46
	17:23	18:01	19:34	20:06	20:38 22	07:14 (1) 21:01 15	07:15 (1) 20:58 25	07:26 (1) 20:25	19:33	18:43	17:05	16:57
18	07:49	07:18	07:34	06:43	06:05	06:52 (1) 05:52	07:00 (1) 06:07	07:01 (1) 06:37	07:08	07:40	07:17	07:46
	17:24	18:02	19:35	20:07	20:39 24	07:16 (1) 21:01 15	07:15 (1) 20:57 26	07:27 (1) 20:23	19:31	18:41	17:04	16:58
19	07:48	07:16	07:32	06:41	06:04	06:52 (1) 05:52	07:01 (1) 06:08	07:00 (1) 06:38	07:09	07:41	07:18	07:47
	17:25	18:04	19:36	20:09	20:40 24	07:16 (1) 21:02 14	07:15 (1) 20:56 26	07:26 (1) 20:22	19:29	18:40	17:04	16:58
20	07:47	07:15	07:30	06:40	06:03	06:51 (1) 05:52	07:02 (1) 06:09	07:01 (1) 06:39	07:10	07:42	07:19	07:48
	17:26	18:05	19:37	20:10	20:41 25	07:16 (1) 21:02 14	07:16 (1) 20:56 25	07:26 (1) 20:20	19:28	18:38	17:03	16:59
21	07:47	07:13	07:29	06:38	06:02	06:51 (1) 05:52	07:02 (1) 06:10	07:01 (1) 06:40	07:11	07:44	07:20	07:48
	17:28	18:06	19:38	20:11	20:42 25	07:16 (1) 21:02 14	07:16 (1) 20:55 25	07:26 (1) 20:19	19:26	18:37	17:02	16:59
22	07:46	07:12	07:27	06:37	06:01	06:51 (1) 05:52	07:02 (1) 06:11	07:01 (1) 06:41	07:12	07:45	07:22	07:49
	17:29	18:07	19:39	20:12	20:43 25	07:16 (1) 21:03 14	07:16 (1) 20:54 26	07:27 (1) 20:17	19:24	18:35	17:02	17:00
23	07:46	07:11	07:25	06:35	06:01	06:51 (1) 05:53	07:02 (1) 06:11	07:02 (1) 06:42	07:13	07:46	07:23	07:49
	17:30	18:09	19:40	20:13	20:44 26	07:17 (1) 21:03 14	07:16 (1) 20:53 25	07:27 (1) 20:16	19:23	18:34	17:01	17:00
24	07:45	07:09	07:24	06:34	06:00	06:51 (1) 05:53	07:03 (1) 06:12	07:02 (1) 06:43	07:14	07:47	07:24	07:50
	17:31	18:10	19:42	20:14	20:45 26	07:17 (1) 21:03 14	07:17 (1) 20:52 24	07:26 (1) 20:14	19:21	18:32	17:00	17:01
25	07:44	07:08	07:22	06:32	05:59	06:51 (1) 05:53	07:02 (1) 06:13	07:03 (1) 06:44	07:15	07:48	07:25	07:50
	17:32	18:11	19:43	20:15	20:46 25	07:16 (1) 21:03 15	07:17 (1) 20:52 23	07:26 (1) 20:13	19:19	18:31	17:00	17:01
26	07:43	07:06	07:20	06:31	05:58	06:51 (1) 05:54	07:02 (1) 06:14	07:02 (1) 06:45	07:17	07:49	07:26	07:50
	17:34	18:12	19:44	20:16	20:47 26	07:17 (1) 21:03 15	07:17 (1) 20:51 23	07:25 (1) 20:11	19:17	18:30	16:59	17:02
27	07:43	07:05	07:19	06:29	05:58	06:51 (1) 05:54	07:03 (1) 06:15	07:03 (1) 06:46	07:18	07:51	07:27	07:51
	17:35	18:13	19:45	20:17	20:47 26	07:17 (1) 21:03 15	07:18 (1) 20:50 21	07:24 (1) 20:10	19:16	18:28	16:59	17:02
28	07:42	07:03	07:17	06:28	05:57	06:52 (1) 05:54	07:02 (1) 06:16	07:04 (1) 06:47	07:19	07:52	07:28	07:51
	17:36	18:15	19:46	20:18	20:48 25	07:17 (1) 21:03 16	07:18 (1) 20:49 20	07:24 (1) 20:08	19:14	18:27	16:58	17:03
29	07:41		07:15	06:27	05:57	06:52 (1) 05:55	07:02 (1) 06:17	07:05 (1) 06:48	07:20	07:53	07:30	07:51
	17:37		19:47	20:19	20:49 25	07:17 (1) 21:03 16	07:18 (1) 20:48 18	07:23 (1) 20:06	19:12	18:26	16:58	17:04
30	07:40		07:14	06:25	05:56	06:52 (1) 05:55	07:02 (1) 06:18	07:06 (1) 06:49	07:21	07:54	07:31	07:52
	17:39		19:48	20:20	20:50 25	07:17 (1) 21:03 17	07:19 (1) 20:47 16	07:22 (1) 20:05	19:11	18:24	16:58	17:05
31	07:39		07:12		05:55	06:52 (1)	06:19	07:08 (1) 06:50		07:55		07:52
	17:40		19:49		20:51 25	07:17 (1)	20:46 12	07:20 (1) 20:03		18:23		17:05
Potential sun hours	297	297	370	399	449	453	460	429	375	345	297	287
Total, worst case					59	4 18	5 86	6			8	
Sun reduction					0.62	0.62	0.69	0.65				
Oper. time red.					0.87	0.87	0.87	0.87				
Wind dir. red.					0.67	0.67	0.67	0.67				
Total reduction					0.36	0.36	0.40	0.38				
Total, real					64	1 86	1 74	2			3	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

Printed/Page
8/28/2010 7:34 PM / 7

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** E - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
Minimum sun height over horizon for influence	3	°
Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January		February		March	April	May	June	July	August	September	October		November		December
1	07:52		07:38		08:23 (1)	07:01	07:10	06:24	05:55	05:56	06:20	06:51	07:22		06:56		07:47 (1)	07:32
	17:07		17:41	18	08:41 (1)	18:16	19:50	20:21	20:52	21:03	20:45	20:02	19:09		17:22	32	08:19 (1)	16:57
2	07:52		07:37		08:22 (1)	07:00	07:08	06:23	05:55	05:56	06:21	06:52	07:23		06:58		07:47 (1)	07:33
	17:07		17:42	21	08:43 (1)	18:17	19:51	20:23	20:52	21:03	20:44	20:00	19:07		17:21	32	08:19 (1)	16:57
3	07:52		07:36		08:21 (1)	06:58	07:07	06:21	05:54	05:57	06:22	06:53	07:24		06:59		07:47 (1)	07:34
	17:08		17:44	23	08:44 (1)	18:18	19:52	20:24	20:53	21:03	20:43	19:57	19:05		17:19	31	08:18 (1)	16:57
4	07:52		07:35		08:20 (1)	06:57	07:05	06:20	05:54	05:57	06:23	06:54	07:25		07:00		07:49 (1)	07:35
	17:09		17:45	26	08:46 (1)	18:19	19:53	20:25	20:54	21:03	20:41	19:55	19:04		17:18	29	08:18 (1)	16:57
5	07:52		07:34		08:20 (1)	06:55	07:04	06:19	05:53	05:58	06:24	06:55	07:26		07:01		07:49 (1)	07:36
	17:10		17:46	27	08:47 (1)	18:20	19:55	20:26	20:55	21:03	20:40	19:53	19:02		17:17	29	08:18 (1)	16:56
6	07:52		07:33		08:19 (1)	06:54	07:02	06:18	05:53	05:58	06:25	06:56	07:27		07:02		07:50 (1)	07:37
	17:11		17:47	29	08:48 (1)	18:21	19:56	20:27	20:55	21:02	20:39	19:52	19:00		17:16	27	08:17 (1)	16:56
7	07:52		07:32		08:19 (1)	06:52	07:00	06:16	05:53	05:59	06:26	06:57	07:28		07:04		07:51 (1)	07:38
	17:12		17:49	30	08:49 (1)	18:23	19:57	20:28	20:56	21:02	20:38	19:50	18:59		17:15	25	08:16 (1)	16:56
8	07:52		07:30		08:19 (1)	07:50	06:59	06:15	05:52	06:00	06:27	06:58	07:29		07:05		07:52 (1)	07:39
	17:13		17:50	30	08:49 (1)	19:24	19:58	20:29	20:57	21:02	20:37	19:48	18:57		17:14	23	08:15 (1)	16:56
9	07:52		07:29		08:18 (1)	07:49	06:57	06:14	05:52	06:00	06:28	06:59	07:30		07:06		07:53 (1)	07:39
	17:14		17:51	31	08:49 (1)	19:25	19:59	20:30	20:57	21:02	20:35	19:47	18:56		17:13	21	08:14 (1)	16:56
10	07:52		07:28		08:18 (1)	07:47	06:55	06:13	05:52	06:01	06:29	07:00	07:31		07:07		07:54 (1)	07:40
	17:15		17:53	31	08:49 (1)	19:26	20:00	20:31	20:58	21:01	20:34	19:45	18:54		17:12	18	08:12 (1)	16:56
11	07:51		07:27		08:18 (1)	07:45	06:54	06:12	05:52	06:02	06:30	07:01	07:32		07:09		07:57 (1)	07:41
	17:16		17:54	32	08:50 (1)	19:27	20:00	20:32	20:58	21:01	20:33	19:43	18:52		17:11	14	08:11 (1)	16:56
12	07:51		07:26		08:18 (1)	07:44	06:52	06:11	05:52	06:02	06:31	07:02	07:33		07:10		08:00 (1)	07:42
	17:17		17:55	32	08:50 (1)	19:28	20:01	20:33	20:59	21:00	20:31	19:41	18:51		17:10	8	08:08 (1)	16:56
13	07:51		07:24		08:18 (1)	07:42	06:50	06:10	05:52	06:03	06:32	07:03	07:35		07:11			07:43
	17:18		17:56	31	08:49 (1)	19:29	20:02	20:34	20:59	21:00	20:30	19:40	18:49		17:09			16:56
14	07:50		07:23		08:18 (1)	07:40	06:49	06:09	05:52	06:04	06:33	07:04	07:36		07:12			07:44
	17:19		17:58	31	08:49 (1)	19:31	20:03	20:35	21:00	20:59	20:29	19:38	18:48		17:08			16:57
15	07:50		07:22		08:19 (1)	07:39	06:47	06:08	05:52	06:05	06:34	07:05	07:37		07:13			07:44
	17:21		17:59	30	08:49 (1)	19:32	20:04	20:36	21:00	20:59	20:27	19:36	18:46		17:07			16:57
16	07:50		07:20		08:19 (1)	07:37	06:46	06:07	05:52	06:05	06:35	07:06	07:38		07:15			07:45
	17:22		18:00	29	08:48 (1)	19:33	20:05	20:37	21:01	20:58	20:26	19:35	18:44		17:06			16:57
17	07:49		07:19		08:20 (1)	07:35	06:44	06:06	05:52	06:06	06:36	07:07	07:39		07:16			07:46
	17:23		18:01	27	08:47 (1)	19:34	20:06	20:38	21:01	20:58	20:25	19:33	18:43		17:05			16:57
18	07:49		07:18		08:20 (1)	07:34	06:43	06:05	05:52	06:07	06:37	07:08	07:40		07:17			07:46
	17:24		18:02	26	08:46 (1)	19:35	20:07	20:39	21:01	20:57	20:23	19:31	18:41		17:04			16:58
19	07:48		07:16		08:22 (1)	07:32	06:41	06:04	05:52	06:08	06:38	07:09	07:41		07:18			07:47
	17:25		18:04	23	08:45 (1)	19:36	20:09	20:40	21:02	20:56	20:22	19:29	18:40		17:04			16:58
20	07:47		07:15		08:24 (1)	07:30	06:40	06:03	05:52	06:09	06:39	07:10	07:42		08:58 (1)		07:19	07:48
	17:26		18:05	19	08:43 (1)	19:37	20:10	20:41	21:02	20:56	20:20	19:28	18:38	11	09:09 (1)		17:03	16:59
21	07:47		07:13		08:25 (1)	07:29	06:38	06:02	05:52	06:10	06:40	07:11	07:44		08:55 (1)		07:20	07:48
	17:28		18:06	15	08:40 (1)	19:38	20:11	20:42	21:02	20:55	20:19	19:26	18:37	17	09:12 (1)		17:02	16:59
22	07:46		07:12		08:29 (1)	07:27	06:37	06:01	05:52	06:11	06:41	07:12	07:45		08:53 (1)		07:22	07:49
	17:29		18:07	8	08:37 (1)	19:39	20:12	20:43	21:03	20:54	20:17	19:24	18:35	20	09:13 (1)		17:01	17:00
23	07:46		07:11			07:25	06:35	06:01	05:53	06:11	06:42	07:13	07:46		08:52 (1)		07:23	07:49
	17:30		18:09			19:40	20:13	20:44	21:03	20:53	20:16	19:23	18:34	24	09:16 (1)		17:01	17:00
24	07:45		07:09			07:24	06:34	06:00	05:53	06:12	06:43	07:14	07:47		08:51 (1)		07:24	07:50
	17:31		18:10			19:42	20:14	20:45	21:03	20:52	20:14	19:21	18:32	25	09:16 (1)		17:00	17:01
25	07:44		07:08			07:22	06:32	05:59	05:53	06:13	06:44	07:15	07:48		08:49 (1)		07:25	07:50
	17:32		18:11			19:43	20:15	20:46	21:03	20:52	20:13	19:19	18:31	28	09:17 (1)		17:00	17:01
26	07:43		07:06			07:20	06:31	05:58	05:54	06:14	06:45	07:17	07:49		08:48 (1)		07:26	07:50
	17:34		18:12			19:44	20:16	20:47	21:03	20:51	20:11	19:17	18:30	30	09:18 (1)		16:59	17:02
27	07:43		07:05			07:19	06:29	05:58	05:54	06:15	06:46	07:18	07:51		08:49 (1)		07:27	07:51
	17:35		18:13			19:45	20:17	20:47	21:03	20:50	20:10	19:16	18:28	30	09:19 (1)		16:59	17:02
28	07:42		07:03			07:17	06:28	05:57	05:54	06:16	06:47	07:19	07:52		08:48 (1)		07:28	07:51
	17:36		18:15			19:46	20:18	20:48	21:03	20:49	20:08	19:14	18:27	31	09:19 (1)		16:58	17:03
29	07:41					07:15	06:27	05:57	05:55	06:17	06:48	07:20	07:53		08:47 (1)		07:30	07:51
	17:37					19:47	20:19	20:49	21:03	20:48	20:06	19:12	18:26	32	09:19 (1)		16:58	17:04
30	07:40	08:28 (1)				07:14	06:25	05:56	05:55	06:18	06:49	07:21	07:54		08:47 (1)		07:31	07:52
	17:39	8 08:36 (1)				19:48	20:20	20:50	21:03	20:47	20:05	19:11	18:24	32	09:19 (1)		16:58	17:05
31	07:39	08:25 (1)				07:12		05:55		06:19	06:50		07:55		08:48 (1)			07:52
	17:40	14 08:39 (1)				19:49		20:51		20:46	20:03		18:23	32	09:20 (1)			17:05
Potential sun hours	297		297			370	399	449	453	460	429	375	345			297		287
Total, worst case		22		569										312			289	
Sun reduction		0.36		0.41										0.51			0.27	
Oper. time red.		0.87		0.87										0.87			0.87	
Wind dir. red.		0.62		0.62										0.62			0.62	
Total reduction		0.20		0.22										0.28			0.15	
Total, real		4		126										86			43	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

Printed/Page
8/28/2010 7:34 PM / 8

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** F - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
Minimum sun height over horizon for influence	3	°
Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January	February	March		April		May	June	July	August	September		October	November	December
1	07:52	07:38	07:01		07:10	08:08 (1)	06:24	05:55	05:56	06:20	06:51		07:22	06:56	07:32
	17:07	17:41	18:16		19:50	34 08:42 (1)	20:21	20:52	21:03	20:45	20:02		19:09	17:22	16:57
2	07:52	07:37	07:00		07:08	08:08 (1)	06:23	05:55	05:56	06:21	06:52		07:23	06:58	07:33
	17:07	17:42	18:17		19:51	33 08:41 (1)	20:23	20:52	21:03	20:44	20:00		19:07	17:21	16:57
3	07:52	07:36	06:58		07:07	08:09 (1)	06:21	05:54	05:57	06:22	06:53	08:15 (1)	07:24	06:59	07:34
	17:08	17:44	18:18		19:52	31 08:40 (1)	20:24	20:53	21:03	20:43	19:57	11 08:26 (1)	19:05	17:19	16:57
4	07:52	07:35	06:57		07:05	08:09 (1)	06:20	05:54	05:57	06:23	06:54	08:12 (1)	07:25	07:00	07:35
	17:09	17:45	18:19		19:53	30 08:39 (1)	20:25	20:54	21:03	20:41	19:55	17 08:29 (1)	19:04	17:18	16:57
5	07:52	07:34	06:55		07:04	08:11 (1)	06:19	05:53	05:58	06:24	06:55	08:09 (1)	07:26	07:01	07:36
	17:10	17:46	18:20		19:55	27 08:38 (1)	20:26	20:55	21:03	20:40	19:53	21 08:30 (1)	19:02	17:17	16:56
6	07:52	07:33	06:54		07:02	08:11 (1)	06:18	05:53	05:58	06:25	06:56	08:07 (1)	07:27	07:02	07:37
	17:11	17:48	18:21		19:56	25 08:36 (1)	20:27	20:55	21:02	20:39	19:52	25 08:32 (1)	19:00	17:16	16:56
7	07:52	07:32	06:52		07:00	08:12 (1)	06:16	05:53	05:59	06:26	06:57	08:06 (1)	07:28	07:04	07:38
	17:12	17:49	18:23		19:57	21 08:33 (1)	20:28	20:56	21:02	20:38	19:50	27 08:33 (1)	18:59	17:15	16:56
8	07:52	07:30	07:50		06:59	08:15 (1)	06:15	05:52	06:00	06:27	06:58	08:04 (1)	07:29	07:05	07:39
	17:13	17:50	19:24		19:58	17 08:32 (1)	20:29	20:57	21:02	20:37	19:48	30 08:34 (1)	18:57	17:14	16:56
9	07:52	07:29	07:49		06:57	08:17 (1)	06:14	05:52	06:00	06:28	06:59	08:03 (1)	07:30	07:06	07:39
	17:14	17:51	19:25		19:59	11 08:28 (1)	20:30	20:57	21:02	20:35	19:47	31 08:34 (1)	18:56	17:13	16:56
10	07:52	07:28	07:47		06:55		06:13	05:52	06:01	06:29	07:00	08:02 (1)	07:31	07:07	07:40
	17:15	17:53	19:26		20:00		20:31	20:58	21:01	20:34	19:45	33 08:35 (1)	18:54	17:12	16:56
11	07:51	07:27	07:45		06:54		06:12	05:52	06:02	06:30	07:01	08:01 (1)	07:32	07:09	07:41
	17:16	17:54	19:27		20:00		20:32	20:58	21:01	20:33	19:43	34 08:35 (1)	18:52	17:11	16:56
12	07:51	07:26	07:44		06:52		06:11	05:52	06:02	06:31	07:02	08:00 (1)	07:33	07:10	07:42
	17:17	17:55	19:28		20:01		20:33	20:59	21:00	20:31	19:41	34 08:34 (1)	18:51	17:10	16:56
13	07:51	07:24	07:42		06:50		06:10	05:52	06:03	06:32	07:03	07:59 (1)	07:35	07:11	07:43
	17:18	17:56	19:29		20:02		20:34	20:59	21:00	20:30	19:40	35 08:34 (1)	18:49	17:09	16:56
14	07:50	07:23	07:40		06:49		06:09	05:52	06:04	06:33	07:04	07:59 (1)	07:36	07:12	07:44
	17:19	17:58	19:31		20:03		20:35	21:00	20:59	20:29	19:38	35 08:34 (1)	18:48	17:08	16:57
15	07:50	07:22	07:39		06:47		06:08	05:52	06:05	06:34	07:05	07:59 (1)	07:37	07:13	07:44
	17:21	17:59	19:32		20:04		20:36	21:00	20:59	20:27	19:36	34 08:33 (1)	18:46	17:07	16:57
16	07:50	07:20	07:37		06:46		06:07	05:52	06:05	06:35	07:06	07:58 (1)	07:38	07:15	07:45
	17:22	18:00	19:33		20:05		20:37	21:01	20:58	20:26	19:35	35 08:33 (1)	18:44	17:06	16:57
17	07:49	07:19	07:35		06:44		06:06	05:52	06:06	06:36	07:07	07:58 (1)	07:39	07:16	07:46
	17:23	18:01	19:34		20:06		20:38	21:01	20:58	20:25	19:33	34 08:32 (1)	18:43	17:05	16:57
18	07:49	07:18	07:34		06:43		06:05	05:52	06:07	06:37	07:08	07:59 (1)	07:40	07:17	07:46
	17:24	18:02	19:35		20:07		20:39	21:01	20:57	20:23	19:31	32 08:31 (1)	18:41	17:04	16:58
19	07:48	07:16	07:32		08:22 (1)	06:41	06:04	05:52	06:08	06:38	07:09	07:59 (1)	07:41	07:18	07:47
	17:25	18:04	19:36	14	08:36 (1)	20:09	20:40	21:02	20:56	20:22	19:29	31 08:30 (1)	18:40	17:04	16:58
20	07:47	07:15	07:30		08:20 (1)	06:40	06:03	05:52	06:09	06:39	07:10	08:00 (1)	07:42	07:19	07:48
	17:26	18:05	19:37	20	08:40 (1)	20:10	20:41	21:02	20:56	20:20	19:28	29 08:29 (1)	18:38	17:03	16:59
21	07:47	07:13	07:29		08:17 (1)	06:38	06:02	05:52	06:10	06:40	07:11	08:00 (1)	07:44	07:20	07:48
	17:28	18:06	19:38	24	08:41 (1)	20:11	20:42	21:02	20:55	20:19	19:26	28 08:28 (1)	18:37	17:02	16:59
22	07:46	07:12	07:27		08:15 (1)	06:37	06:01	05:52	06:11	06:41	07:12	08:01 (1)	07:45	07:22	07:49
	17:29	18:07	19:39	27	08:42 (1)	20:12	20:43	21:03	20:54	20:17	19:24	25 08:26 (1)	18:35	17:02	17:00
23	07:46	07:11	07:25		08:13 (1)	06:35	06:01	05:53	06:11	06:42	07:13	08:03 (1)	07:46	07:23	07:49
	17:30	18:09	19:40	29	08:42 (1)	20:13	20:44	21:03	20:53	20:16	19:23	21 08:24 (1)	18:34	17:01	17:00
24	07:45	07:09	07:24		08:13 (1)	06:34	06:00	05:53	06:12	06:43	07:14	08:05 (1)	07:47	07:24	07:50
	17:31	18:10	19:42	31	08:44 (1)	20:14	20:45	21:03	20:52	20:14	19:21	16 08:21 (1)	18:32	17:00	17:01
25	07:44	07:08	07:22		08:11 (1)	06:32	05:59	05:53	06:13	06:44	07:15	08:09 (1)	07:48	07:25	07:50
	17:32	18:11	19:43	33	08:44 (1)	20:15	20:46	21:03	20:52	20:13	19:19	7 08:16 (1)	18:31	17:00	17:01
26	07:43	07:06	07:20		08:10 (1)	06:31	05:58	05:54	06:14	06:45	07:17		07:49	07:26	07:50
	17:34	18:12	19:44	34	08:44 (1)	20:16	20:47	21:03	20:51	20:11	19:17		18:30	16:59	17:02
27	07:43	07:05	07:19		08:10 (1)	06:29	05:58	05:54	06:15	06:46	07:18		07:51	07:27	07:51
	17:35	18:13	19:45	34	08:44 (1)	20:17	20:47	21:03	20:50	20:10	19:16		18:28	16:59	17:02
28	07:42	07:03	07:17		08:09 (1)	06:28	05:57	05:54	06:16	06:47	07:19		07:52	07:28	07:51
	17:36	18:15	19:46	35	08:44 (1)	20:18	20:48	21:03	20:49	20:08	19:14		18:27	16:58	17:03
29	07:41		07:15		08:09 (1)	06:27	05:57	05:55	06:17	06:48	07:20		07:53	07:30	07:51
	17:37		19:47	34	08:43 (1)	20:19	20:49	21:03	20:48	20:06	19:12		18:26	16:58	17:04
30	07:40		07:14		08:09 (1)	06:25	05:56	05:55	06:18	06:49	07:21		07:54	07:31	07:52
	17:39		19:48	35	08:44 (1)	20:20	20:50	21:03	20:47	20:05	19:11		18:24	16:58	17:05
31	07:39		07:12		08:09 (1)		05:55		06:19	06:50			07:55		07:52
	17:40		19:49	34	08:43 (1)		20:51		20:46	20:03			18:23		17:05
Potential sun hours	297	297	370			399	449	453	460	429	375		345	297	287
Total, worst case				384		229						625			
Sun reduction				0.41		0.57						0.55			
Oper. time red.				0.87		0.87						0.87			
Wind dir. red.				0.64		0.64						0.64			
Total reduction				0.23		0.32						0.31			
Total, real				88		73						192			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

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8/28/2010 7:34 PM / 9

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** G - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:52	07:38	07:01	07:10	06:24	05:55	07:05 (1)	05:56	07:13 (1)	06:20	07:16 (1)	06:51	07:22	06:56	07:32
	17:07	17:41	18:16	19:50	20:21	20:52 31	07:36 (1)	21:03 26	07:39 (1)	20:45 28	07:44 (1)	20:02	19:09	17:22	16:57
2	07:52	07:37	07:00	07:08	06:23	05:55	07:04 (1)	05:56	07:13 (1)	06:21	07:17 (1)	06:52	07:23	06:58	07:33
	17:07	17:42	18:17	19:51	20:23	20:52 31	07:35 (1)	21:03 26	07:39 (1)	20:44 26	07:43 (1)	20:00	19:07	17:21	16:57
3	07:52	07:36	06:58	07:07	06:21	05:54	07:05 (1)	05:57	07:13 (1)	06:22	07:18 (1)	06:53	07:24	06:59	07:34
	17:08	17:44	18:18	19:52	20:24	20:53 31	07:36 (1)	21:03 26	07:39 (1)	20:43 24	07:42 (1)	19:57	19:05	17:19	16:57
4	07:52	07:35	06:57	07:05	06:20	05:54	07:06 (1)	05:57	07:13 (1)	06:23	07:19 (1)	06:54	07:25	07:00	07:35
	17:09	17:45	18:19	19:53	20:25	20:54 30	07:36 (1)	21:03 27	07:40 (1)	20:41 22	07:41 (1)	19:55	19:04	17:18	16:57
5	07:52	07:34	06:55	07:04	06:19	05:53	07:06 (1)	05:58	07:13 (1)	06:24	07:21 (1)	06:55	07:26	07:01	07:36
	17:10	17:46	18:20	19:55	20:26	20:55 29	07:35 (1)	21:03 27	07:40 (1)	20:40 18	07:39 (1)	19:53	19:02	17:17	16:56
6	07:52	07:33	06:54	07:02	06:18	07:15 (1) 05:53	07:07 (1)	05:58	07:13 (1)	06:25	07:23 (1)	06:56	07:27	07:02	07:37
	17:11	17:48	18:21	19:56	20:27 10	07:25 (1) 20:55 28	07:35 (1)	21:02 28	07:41 (1)	20:39 14	07:37 (1)	19:52	19:00	17:16	16:56
7	07:52	07:32	06:52	07:00	06:16	07:12 (1) 05:53	07:07 (1)	05:59	07:13 (1)	06:26	07:26 (1)	06:57	07:28	07:04	07:38
	17:12	17:49	18:23	19:57	20:28 16	07:28 (1) 20:56 28	07:35 (1)	21:02 29	07:42 (1)	20:38 7	07:33 (1)	19:50	18:59	17:15	16:56
8	07:52	07:30	07:50	06:59	06:15	07:09 (1) 05:52	07:08 (1)	06:00	07:12 (1)	06:27		06:58	07:29	07:05	07:39
	17:13	17:50	19:24	19:58	20:29 20	07:29 (1) 20:57 27	07:35 (1)	21:02 30	07:42 (1)	20:37		19:48	18:57	17:14	16:56
9	07:52	07:29	07:49	06:57	06:14	07:08 (1) 05:52	07:08 (1)	06:00	07:13 (1)	06:28		06:59	07:30	07:06	07:39
	17:14	17:51	19:25	19:59	20:30 22	07:30 (1) 20:57 26	07:34 (1)	21:02 30	07:43 (1)	20:35		19:47	18:56	17:13	16:56
10	07:52	07:28	07:47	06:55	06:13	07:07 (1) 05:52	07:08 (1)	06:01	07:13 (1)	06:29		07:00	07:31	07:07	07:40
	17:15	17:53	19:26	20:00	20:31 25	07:32 (1) 20:58 26	07:34 (1)	21:01 31	07:44 (1)	20:34		19:45	18:54	17:12	16:56
11	07:51	07:27	07:45	06:54	06:12	07:06 (1) 05:52	07:09 (1)	06:02	07:12 (1)	06:30		07:01	07:32	07:09	07:41
	17:16	17:54	19:27	20:00	20:32 27	07:33 (1) 20:58 26	07:35 (1)	21:01 31	07:43 (1)	20:33		19:43	18:52	17:11	16:56
12	07:51	07:26	07:44	06:52	06:11	07:05 (1) 05:52	07:09 (1)	06:02	07:12 (1)	06:31		07:02	07:33	07:10	07:42
	17:17	17:55	19:28	20:01	20:33 28	07:33 (1) 20:59 26	07:35 (1)	21:00 32	07:44 (1)	20:31		19:41	18:51	17:10	16:56
13	07:51	07:24	07:42	06:50	06:10	07:04 (1) 05:52	07:10 (1)	06:03	07:12 (1)	06:32		07:03	07:35	07:11	07:43
	17:18	17:56	19:29	20:02	20:34 30	07:34 (1) 20:59 25	07:35 (1)	21:00 33	07:45 (1)	20:30		19:40	18:49	17:09	16:56
14	07:50	07:23	07:40	06:49	06:09	07:04 (1) 05:52	07:10 (1)	06:04	07:12 (1)	06:33		07:04	07:36	07:12	07:44
	17:19	17:58	19:31	20:03	20:35 31	07:35 (1) 21:00 25	07:35 (1)	20:59 32	07:44 (1)	20:29		19:38	18:48	17:08	16:57
15	07:50	07:22	07:39	06:47	06:08	07:03 (1) 05:52	07:11 (1)	06:05	07:12 (1)	06:34		07:05	07:37	07:13	07:44
	17:21	17:59	19:32	20:04	20:36 32	07:35 (1) 21:00 24	07:35 (1)	20:59 33	07:45 (1)	20:27		19:36	18:46	17:07	16:57
16	07:50	07:20	07:37	06:46	06:07	07:03 (1) 05:52	07:11 (1)	06:05	07:12 (1)	06:35		07:06	07:38	07:15	07:45
	17:22	18:00	19:33	20:05	20:37 32	07:35 (1) 21:01 24	07:35 (1)	20:58 34	07:46 (1)	20:26		19:35	18:44	17:06	16:57
17	07:49	07:19	07:35	06:44	06:06	07:02 (1) 05:52	07:11 (1)	06:06	07:12 (1)	06:36		07:07	07:39	07:16	07:46
	17:23	18:01	19:34	20:06	20:38 33	07:35 (1) 21:01 24	07:35 (1)	20:58 34	07:46 (1)	20:25		19:33	18:43	17:05	16:57
18	07:49	07:18	07:34	06:43	06:05	07:03 (1) 05:52	07:11 (1)	06:07	07:12 (1)	06:37		07:08	07:40	07:17	07:46
	17:24	18:02	19:35	20:07	20:39 34	07:37 (1) 21:01 24	07:35 (1)	20:57 34	07:46 (1)	20:23		19:31	18:41	17:04	16:58
19	07:48	07:16	07:32	06:41	06:04	07:02 (1) 05:52	07:12 (1)	06:08	07:12 (1)	06:38		07:09	07:41	07:18	07:47
	17:25	18:04	19:36	20:09	20:40 35	07:37 (1) 21:02 23	07:35 (1)	20:56 34	07:46 (1)	20:22		19:29	18:40	17:04	16:58
20	07:47	07:15	07:30	06:40	06:03	07:02 (1) 05:52	07:13 (1)	06:09	07:12 (1)	06:39		07:10	07:42	07:19	07:48
	17:26	18:05	19:37	20:10	20:41 34	07:36 (1) 21:02 23	07:36 (1)	20:56 34	07:46 (1)	20:20		19:28	18:38	17:03	16:59
21	07:47	07:13	07:29	06:38	06:02	07:02 (1) 05:52	07:13 (1)	06:10	07:12 (1)	06:40		07:11	07:44	07:20	07:48
	17:28	18:06	19:38	20:11	20:42 34	07:36 (1) 21:02 23	07:36 (1)	20:55 35	07:47 (1)	20:19		19:26	18:37	17:02	16:59
22	07:46	07:12	07:27	06:37	06:01	07:02 (1) 05:52	07:13 (1)	06:11	07:12 (1)	06:41		07:12	07:45	07:22	07:49
	17:29	18:07	19:39	20:12	20:43 34	07:36 (1) 21:03 23	07:36 (1)	20:54 35	07:47 (1)	20:17		19:24	18:35	17:02	17:00
23	07:46	07:11	07:25	06:35	06:01	07:02 (1) 05:53	07:13 (1)	06:11	07:12 (1)	06:42		07:13	07:46	07:23	07:49
	17:30	18:09	19:40	20:13	20:44 35	07:37 (1) 21:03 23	07:36 (1)	20:53 35	07:47 (1)	20:16		19:23	18:34	17:01	17:00
24	07:45	07:09	07:24	06:34	06:00	07:02 (1) 05:53	07:13 (1)	06:12	07:13 (1)	06:43		07:14	07:47	07:24	07:50
	17:31	18:10	19:42	20:14	20:45 35	07:37 (1) 21:03 23	07:36 (1)	20:52 34	07:47 (1)	20:14		19:21	18:32	17:00	17:01
25	07:44	07:08	07:22	06:32	05:59	07:02 (1) 05:53	07:13 (1)	06:13	07:13 (1)	06:44		07:15	07:48	07:25	07:50
	17:32	18:11	19:43	20:15	20:46 34	07:36 (1) 21:03 24	07:37 (1)	20:52 34	07:47 (1)	20:13		19:19	18:31	17:00	17:01
26	07:43	07:06	07:20	06:31	05:58	07:03 (1) 05:54	07:13 (1)	06:14	07:12 (1)	06:45		07:17	07:49	07:26	07:50
	17:34	18:12	19:44	20:16	20:47 34	07:37 (1) 21:03 24	07:37 (1)	20:51 34	07:46 (1)	20:11		19:17	18:30	16:59	17:02
27	07:43	07:05	07:19	06:29	05:58	07:03 (1) 05:54	07:14 (1)	06:15	07:13 (1)	06:46		07:18	07:51	07:27	07:51
	17:35	18:13	19:45	20:17	20:47 33	07:36 (1) 21:03 24	07:38 (1)	20:50 33	07:46 (1)	20:10		19:16	18:28	16:59	17:02
28	07:42	07:03	07:17	06:28	05:57	07:03 (1) 05:54	07:13 (1)	06:16	07:13 (1)	06:47		07:19	07:52	07:28	07:51
	17:36	18:15	19:46	20:18	20:48 34	07:37 (1) 21:03 25	07:38 (1)	20:49 33	07:46 (1)	20:08		19:14	18:27	16:58	17:03
29	07:41		07:15	06:27	05:57	07:03 (1) 05:55	07:13 (1)	06:17	07:14 (1)	06:48		07:20	07:53	07:30	07:51
	17:37		19:47	20:19	20:49 33	07:36 (1) 21:03 25	07:38 (1)	20:48 31	07:45 (1)	20:06		19:12	18:26	16:58	17:04
30	07:40		07:14	06:25	05:56	07:04 (1) 05:55	07:13 (1)	06:18	07:14 (1)	06:49		07:21	07:54	07:31	07:52
	17:39		19:48	20:20	20:50 33	07:37 (1) 21:03 26	07:39 (1)	20:47 31	07:45 (1)	20:05		19:11	18:24	16:58	17:05
31	07:39		07:12		05:55	07:04 (1)		06:19	07:15 (1)	06:50			07:55		07:52
	17:40		19:49		20:51 32	07:36 (1)		20:46 29	07:44 (1)	20:03			18:23		17:05
Potential sun hours	297	297	370	399	449	453	460	429	375	345	297	287
Total, worst case					80	7 71	7 75	9 39	1			
Sun reduction					0.62	0.62	0.69	0.65				
Oper. time red.					0.87	0.87	0.87	0.87				
Wind dir. red.					0.66	0.66	0.66	0.66				
Total reduction					0.36	0.36	0.40	0.38				
Total, real					77	2 75	2 88	3 2		5		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

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8/28/2010 7:34 PM / 10

Licensed user:
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8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** H - Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (8)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	January		February		March		April		May		June
1	07:52		13:44 (1)	07:38		13:47 (1)	07:01		13:40 (1)	07:10		15:33 (1)	06:24	05:55
	17:06	170	16:34 (1)	17:41	194	17:01 (1)	18:16	202	17:02 (1)	19:50	101	17:14 (1)	20:21	20:52
2	07:52		13:44 (1)	07:37		13:47 (1)	07:00		13:40 (1)	07:08		15:34 (1)	06:23	05:54
	17:07	170	16:34 (1)	17:42	194	17:01 (1)	18:17	201	17:01 (1)	19:51	98	17:12 (1)	20:23	20:52
3	07:52		13:45 (1)	07:36		13:47 (1)	06:58		13:41 (1)	07:07		15:37 (1)	06:21	05:54
	17:08	170	16:35 (1)	17:44	195	17:02 (1)	18:18	200	17:01 (1)	19:52	94	17:11 (1)	20:24	20:53
4	07:52		13:45 (1)	07:35		13:46 (1)	06:57		13:41 (1)	07:05		15:39 (1)	06:20	05:54
	17:09	171	16:36 (1)	17:45	197	17:03 (1)	18:19	198	16:59 (1)	19:53	90	17:09 (1)	20:25	20:54
5	07:52		13:45 (1)	07:34		13:46 (1)	06:55		13:42 (1)	07:03		15:41 (1)	06:19	05:53
	17:10	172	16:37 (1)	17:46	197	17:03 (1)	18:20	197	16:59 (1)	19:55	85	17:06 (1)	20:26	20:55
6	07:52		13:45 (1)	07:33		13:46 (1)	06:54		13:43 (1)	07:02		15:44 (1)	06:18	05:53
	17:11	173	16:38 (1)	17:47	198	17:04 (1)	18:21	195	16:58 (1)	19:56	81	17:05 (1)	20:27	20:55
7	07:52		13:45 (1)	07:32		13:46 (1)	06:52		13:43 (1)	07:00		15:45 (1)	06:16	05:53
	17:12	174	16:39 (1)	17:49	198	17:04 (1)	18:23	193	16:56 (1)	19:57	78	17:03 (1)	20:28	20:56
8	07:52		13:46 (1)	07:30		13:46 (1)	07:50		14:44 (1)	06:59		15:48 (1)	06:15	05:52
	17:13	174	16:40 (1)	17:50	199	17:05 (1)	19:24	192	17:56 (1)	19:58	74	17:02 (1)	20:29	20:57
9	07:52		13:46 (1)	07:29		13:45 (1)	07:49		14:45 (1)	06:57		15:50 (1)	06:14	05:52
	17:14	175	16:41 (1)	17:51	200	17:05 (1)	19:25	190	17:55 (1)	19:59	70	17:00 (1)	20:30	20:57
10	07:52		13:46 (1)	07:28		13:45 (1)	07:47		14:46 (1)	06:55		15:51 (1)	06:13	05:52
	17:15	175	16:41 (1)	17:53	200	17:05 (1)	19:26	187	17:53 (1)	20:00	67	16:58 (1)	20:31	20:58
11	07:51		13:46 (1)	07:27		13:45 (1)	07:45		14:48 (1)	06:54		15:54 (1)	06:12	05:52
	17:16	177	16:43 (1)	17:54	201	17:06 (1)	19:27	184	17:52 (1)	20:00	62	16:56 (1)	20:32	20:58
12	07:51		13:47 (1)	07:26		13:45 (1)	07:44		14:49 (1)	06:52		15:55 (1)	06:11	05:52
	17:17	177	16:44 (1)	17:55	201	17:06 (1)	19:28	182	17:51 (1)	20:01	59	16:54 (1)	20:33	20:59
13	07:51		13:46 (1)	07:24		13:44 (1)	07:42		14:50 (1)	06:50		15:58 (1)	06:10	05:52
	17:18	179	16:45 (1)	17:56	201	17:05 (1)	19:29	179	17:49 (1)	20:02	55	16:53 (1)	20:34	20:59
14	07:50		13:47 (1)	07:23		13:44 (1)	07:40		14:52 (1)	06:49		16:00 (1)	06:09	05:52
	17:19	179	16:46 (1)	17:58	202	17:06 (1)	19:31	176	17:48 (1)	20:03	51	16:51 (1)	20:35	21:00
15	07:50		13:48 (1)	07:22		13:44 (1)	07:39		14:54 (1)	06:47		16:01 (1)	06:08	05:52
	17:20	180	16:48 (1)	17:59	202	17:06 (1)	19:32	172	17:46 (1)	20:04	48	16:49 (1)	20:36	21:00
16	07:50		13:47 (1)	07:20		13:43 (1)	07:37		14:55 (1)	06:46		16:04 (1)	06:07	05:52
	17:22	181	16:48 (1)	18:00	203	17:06 (1)	19:33	169	17:44 (1)	20:05	43	16:47 (1)	20:37	21:01
17	07:49		13:47 (1)	07:19		13:43 (1)	07:35		14:58 (1)	06:44		16:06 (1)	06:06	05:52
	17:23	182	16:49 (1)	18:01	203	17:06 (1)	19:34	165	17:43 (1)	20:06	39	16:45 (1)	20:38	21:01
18	07:49		13:48 (1)	07:18		13:42 (1)	07:34		15:00 (1)	06:43		16:09 (1)	06:05	05:52
	17:24	182	16:50 (1)	18:02	203	17:05 (1)	19:35	161	17:41 (1)	20:07	34	16:43 (1)	20:39	21:01
19	07:48		13:47 (1)	07:16		13:42 (1)	07:32		15:03 (1)	06:41		16:11 (1)	06:04	05:52
	17:25	184	16:51 (1)	18:04	204	17:06 (1)	19:36	155	17:38 (1)	20:09	29	16:40 (1)	20:40	21:02
20	07:47		13:48 (1)	07:15		13:42 (1)	07:30		15:06 (1)	06:40		16:16 (1)	06:03	05:52
	17:26	184	16:52 (1)	18:05	204	17:06 (1)	19:37	151	17:37 (1)	20:10	21	16:37 (1)	20:41	21:02
21	07:47		13:48 (1)	07:13		13:41 (1)	07:29		15:08 (1)	06:38		16:21 (1)	06:02	05:52
	17:28	185	16:53 (1)	18:06	204	17:05 (1)	19:38	147	17:35 (1)	20:11	11	16:32 (1)	20:42	21:02
22	07:46		13:48 (1)	07:12		13:41 (1)	07:27		15:10 (1)	06:37			06:01	05:52
	17:29	185	16:53 (1)	18:07	204	17:05 (1)	19:39	143	17:33 (1)	20:12			20:43	21:03
23	07:46		13:48 (1)	07:11		13:40 (1)	07:25		15:12 (1)	06:35			06:01	05:53
	17:30	187	16:55 (1)	18:09	205	17:05 (1)	19:40	139	17:31 (1)	20:13			20:44	21:03
24	07:45		13:48 (1)	07:09		13:41 (1)	07:24		15:15 (1)	06:34			06:00	05:53
	17:31	188	16:56 (1)	18:10	204	17:05 (1)	19:42	135	17:30 (1)	20:14			20:45	21:03
25	07:44		13:48 (1)	07:08		13:40 (1)	07:22		15:17 (1)	06:32			05:59	05:53
	17:32	188	16:56 (1)	18:11	204	17:04 (1)	19:43	130	17:27 (1)	20:15			20:46	21:03
26	07:43		13:48 (1)	07:06		13:40 (1)	07:20		15:19 (1)	06:31			05:58	05:54
	17:34	189	16:57 (1)	18:12	204	17:04 (1)	19:44	126	17:25 (1)	20:16			20:47	21:03
27	07:42		13:48 (1)	07:05		13:40 (1)	07:19		15:22 (1)	06:29			05:58	05:54
	17:35	190	16:58 (1)	18:13	203	17:03 (1)	19:45	122	17:24 (1)	20:17			20:47	21:03
28	07:42		13:47 (1)	07:03		13:41 (1)	07:17		15:24 (1)	06:28			05:57	05:54
	17:36	191	16:58 (1)	18:14	202	17:03 (1)	19:46	118	17:22 (1)	20:18			20:48	21:03
29	07:41		13:47 (1)				07:15		15:26 (1)	06:27			05:57	05:55
	17:37	192	16:59 (1)				19:47	114	17:20 (1)	20:19			20:49	21:03
30	07:40		13:47 (1)				07:14		15:29 (1)	06:25			05:56	05:55
	17:39	193	17:00 (1)				19:48	109	17:18 (1)	20:20			20:50	21:03
31	07:39		13:47 (1)				07:12		15:31 (1)				05:55	
	17:40	193	17:00 (1)				19:49	105	17:16 (1)				20:51	
Potential sun hours	297			297			370			399			449	453
Total, worst case		5610			5626			5037			1290			
Sun reduction		0.36			0.41			0.41			0.57			
Oper. time red.		0.87			0.87			0.87			0.87			
Wind dir. red.		0.66			0.66			0.66			0.66			
Total reduction		0.21			0.24			0.24			0.33			
Total, real		1181			1346			1201			426			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

THE RENAISSANCE GROUP — A Conserve First Company

Printed/Page
8/28/2010 7:34 PM / 11

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

SHADOW - Calendar

Calculation: Shadow081410**Shadow receptor:** H - Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (8)

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
Minimum sun height over horizon for influence	3	°
Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
380	329	251	247	262	379	436	377	417	706	782	866	679	631	491	423	7,656

Idle start wind speed: Cut in wind speed from power curve

	July		August		September		October		November		December	
1	05:56		06:20		06:51		07:22		06:56		07:32	
	21:03		20:45		20:02	62	15:53 (1)	181	14:29 (1)	200	13:15 (1)	177
							16:55 (1)		17:30 (1)		16:35 (1)	
							19:09		17:22		16:57	
												16:25 (1)
2	05:56		06:21		06:52		07:23		06:58		07:33	
	21:03		20:44		20:00	67	15:50 (1)	184	14:27 (1)	199	13:15 (1)	176
							16:57 (1)		17:31 (1)		16:34 (1)	
							19:07		17:21		16:57	
												16:25 (1)
3	05:57		06:22		06:53		07:24		06:59		07:34	
	21:03		20:43		19:57	70	15:48 (1)	186	14:25 (1)	199	13:15 (1)	175
							16:58 (1)		17:31 (1)		16:34 (1)	
							19:05		17:19		16:57	
												16:24 (1)
4	05:57		06:23		06:54		07:25		06:59		07:35	
	21:03		20:41		19:55	74	15:45 (1)	189	14:23 (1)	198	13:16 (1)	174
							16:59 (1)		17:32 (1)		16:34 (1)	
							19:04		17:18		16:57	
												16:24 (1)
5	05:58		06:24		06:55		07:26		07:00		07:36	
	21:03		20:40		19:53	78	15:42 (1)	190	14:22 (1)	198	13:16 (1)	174
							17:00 (1)		17:32 (1)		16:34 (1)	
							19:02		17:17		16:56	
												16:24 (1)
6	05:58		06:25		06:56		07:27		07:02		07:37	
	21:02		20:39		19:52	81	15:40 (1)	193	14:20 (1)	197	13:16 (1)	173
							17:01 (1)		17:33 (1)		16:33 (1)	
							19:00		17:16		16:56	
												16:24 (1)
7	05:59		06:26		06:57		07:28		07:04		07:38	
	21:02		20:38		19:50	85	15:37 (1)	194	14:19 (1)	196	13:17 (1)	172
							17:02 (1)		17:33 (1)		16:33 (1)	
							18:59		17:15		16:56	
												16:24 (1)
8	06:00		06:27		06:58		07:29		07:05		07:39	
	21:02		20:37		19:48	90	15:34 (1)	196	14:17 (1)	196	13:17 (1)	172
							17:04 (1)		17:33 (1)		16:33 (1)	
							18:57		17:14		16:56	
												16:24 (1)
9	06:00		06:28		06:59		07:30		07:06		07:39	
	21:01		20:35		19:47	93	15:32 (1)	198	14:16 (1)	194	13:18 (1)	171
							17:05 (1)		17:34 (1)		16:32 (1)	
							18:56		17:13		16:56	
												16:24 (1)
10	06:01		06:29		07:00		07:31		07:07		07:40	
	21:01		20:34		19:45	97	15:29 (1)	199	14:15 (1)	194	13:18 (1)	171
							17:06 (1)		17:34 (1)		16:32 (1)	
							18:54		17:11		16:56	
												16:24 (1)
11	06:02		06:30		07:01		07:32		07:09		07:41	
	21:01		20:33		19:43	101	15:26 (1)	200	14:14 (1)	193	13:19 (1)	170
							17:07 (1)		17:34 (1)		16:32 (1)	
							18:52		17:10		16:56	
												16:24 (1)
12	06:02		06:31		07:02		07:33		07:10		07:42	
	21:00		20:31		19:41	105	15:22 (1)	201	14:14 (1)	192	13:19 (1)	169
							17:07 (1)		17:35 (1)		16:31 (1)	
							18:51		17:10		16:56	
												16:24 (1)
13	06:03		06:32		07:03		07:35		07:11		07:43	
	21:00		20:30		19:40	109	15:19 (1)	201	14:14 (1)	192	13:19 (1)	168
							17:08 (1)		17:35 (1)		16:31 (1)	
							18:49		17:09		16:56	
												16:23 (1)
14	06:04		06:33		07:04		07:36		07:12		07:44	
	20:59		20:29		19:38	113	15:17 (1)	202	14:13 (1)	191	13:20 (1)	169
							17:10 (1)		17:35 (1)		16:31 (1)	
							18:47		17:08		16:57	
												16:24 (1)
15	06:05		06:34		07:05		07:37		07:13		07:44	
	20:59		20:27		19:36	117	15:14 (1)	203	14:12 (1)	191	13:20 (1)	168
							17:11 (1)		17:35 (1)		16:31 (1)	
							18:46		17:07		16:57	
												16:24 (1)
16	06:05		06:35		07:06		07:38		07:15		07:45	
	20:58		20:26		19:35	121	15:11 (1)	203	14:12 (1)	189	13:21 (1)	168
							17:12 (1)		17:35 (1)		16:30 (1)	
							18:44		17:06		16:57	
												16:25 (1)
17	06:06		06:36		07:07		07:39		07:16		07:46	
	20:58		20:25		19:33	125	15:08 (1)	204	14:11 (1)	188	13:21 (1)	167
							17:13 (1)		17:35 (1)		16:29 (1)	
							18:43		17:05		16:57	
												16:24 (1)
18	06:07		06:37		07:08		07:40		07:17		07:46	
	20:57		20:23		19:31	129	15:05 (1)	204	14:12 (1)	188	13:22 (1)	167
							17:14 (1)		17:36 (1)		16:30 (1)	
							18:41		17:04		16:58	
												16:25 (1)
19	06:08		06:38		07:09		07:41		07:18		07:47	
	20:56		20:22		19:29	134	15:02 (1)	204	14:12 (1)	187	13:22 (1)	166
							17:16 (1)		17:36 (1)		16:29 (1)	
							18:40		17:04		16:58	
												16:25 (1)
20	06:09		06:39		07:10		07:42		07:19		07:48	
	20:56		20:20		19:28	138	14:59 (1)	204	14:12 (1)	185	13:23 (1)	166
							17:17 (1)		17:36 (1)		16:28 (1)	
							18:38		17:03		16:59	
												16:25 (1)
21	06:10		06:40		07:11		07:44		07:20		07:48	
	20:55		20:19		19:26	142	14:56 (1)	204	14:12 (1)	185	13:23 (1)	166
							17:18 (1)		17:36 (1)		16:28 (1)	
							18:37		17:02		16:59	
												16:26 (1)
22	06:11		06:41	16:24 (1)	07:12		07:45		07:22		07:49	
	20:54	13	20:17	16:37 (1)	19:24	146	14:53 (1)	205	14:11 (1)	184	13:24 (1)	166
							17:19 (1)		17:36 (1)		16:28 (1)	
							18:35		17:01		17:00	
												16:26 (1)
23	06:11		06:42	16:19 (1)	07:13		07:46		07:23		07:49	
	20:53	23	20:16	16:42 (1)	19:22	150	14:50 (1)	203	14:13 (1)	184	13:24 (1)	166
							17:20 (1)		17:36 (1)		16:28 (1)	
							18:34		17:01		17:00	
												16:26 (1)
24	06:12		06:43	16:15 (1)	07:14		07:47		07:24		07:50	
	20:52	29	20:14	16:44 (1)	19:21	154	14:47 (1)	203	14:13 (1)	182	13:25 (1)	166
							17:21 (1)		17:36 (1)		16:27 (1)	
							18:32		17:00		17:01	
												16:27 (1)
25	06:13		06:44	16:11 (1)	07:15		07:48		07:25		07:50	
	20:52	35	20:13	16:46 (1)	19:19	159	14:44 (1)	203	14:13 (1)	182	13:25 (1)	167
							17:23 (1)		17:36 (1)		16:27 (1)	
							18:31		17:00		17:01	
												16:28 (1)
26	06:14		06:45	16:08 (1)	07:16		07:49		07:26		07:50	
	20:51	40	20:11	16:48 (1)	19:17	163	14:41 (1)	202	14:13 (1)	181	13:26 (1)	167
							17:24 (1)		17:35 (1)		16:27 (1)	
							18:30		16:59		17:02	
												16:29 (1)
27	06:15		06:46	16:06 (1)	07:18		07:51		07:27		07:51	
	20:50	43	20:10	16:49 (1)	19:16	167	14:38 (1)	202	14:14 (1)	180	13:27 (1)	167
							17:25 (1)		17:36 (1)		16:27 (1)	
							18:28		16:59		17:02	
												16:29 (1)
28	06:16		06:47	16:03 (1)	07:19		07:52		07:28		07:51	
	20:49	48	20:08	16:51 (1)	19:14	171	14:35 (1)	202	14:14 (1)	178	13:27 (1)	167
							17:26 (1)		17:36 (1)		16:26 (1)	
							18:27		16:58		17:03	
												16:30 (1)
29	06:17		06:48	16:00 (1)	07:20		07:53		07:30		07:52	
	20:48	52	20:06	16:52 (1)	19:12	174	14:33 (1)	201	14:15 (1)	178	13:26 (1)	168
							17:27 (1)		17:35 (1)		16:26 (1)	
							18:26		16:58		17:04	
												16:30 (1)
30	06:18		06:49	15:58 (1)	07:21		07:54		07:31		07:52	
	20:47	55	20:05	16:53 (1)	19:11	178	14:31 (1)	201	14:14 (1)	177	13:28 (1)	168
							17:29 (1)		17:35 (1)		16:25 (1)	
							18:24		16:58		17:05	
												16:31 (1)
31	06:19		06:50	15:55 (1)			07:55		07:31		07:52	
	20:46		20:03	16:54 (1)			18:23		17:35 (1)		17:05	
												16:33 (1)
Potential sun hours	460		429		375		345		297		287	
Total, worst case			397		3593		6162		5679		5252	
Sun reduction			0.65		0.55		0.51		0.27		0.20	
Oper. time red.			0.87		0.87		0.87		0.87		0.87	
Wind dir. red.			0.66		0.66		0.66		0.66		0.66	
Total reduction			0.38		0.32		0.30		0.16		0.12	
Total, real			150		1151		1835		903		617	

Appendix B Attachment B2

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Kenston

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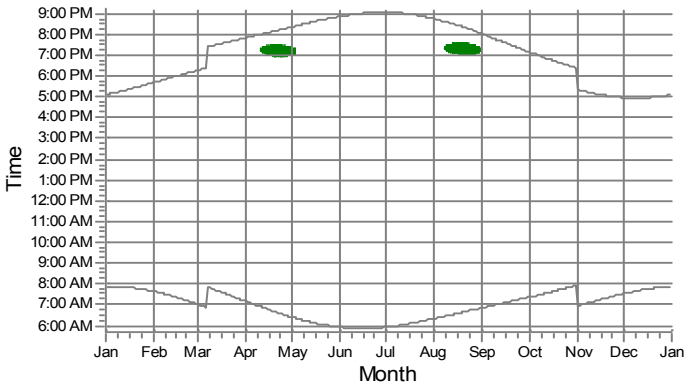
Calculated:
8/28/2010 7:33 PM/2.7.473

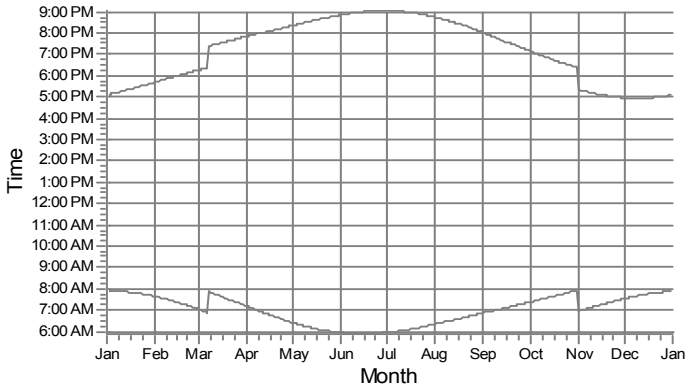
SHADOW - Calendar, graphical

Calculation: Shadow081410

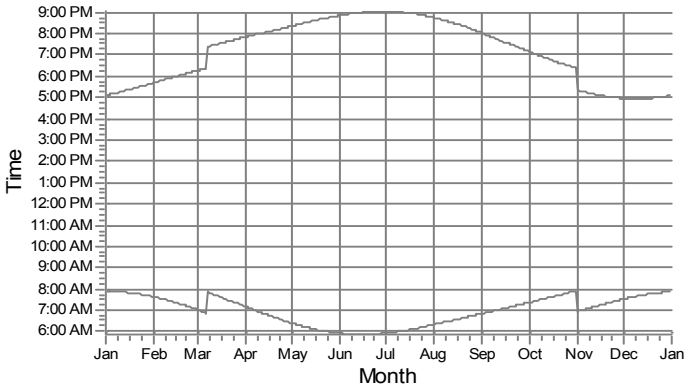
A: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (1)



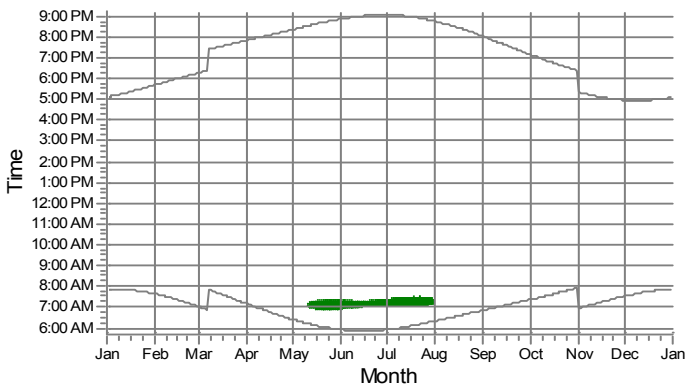
B: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (2)



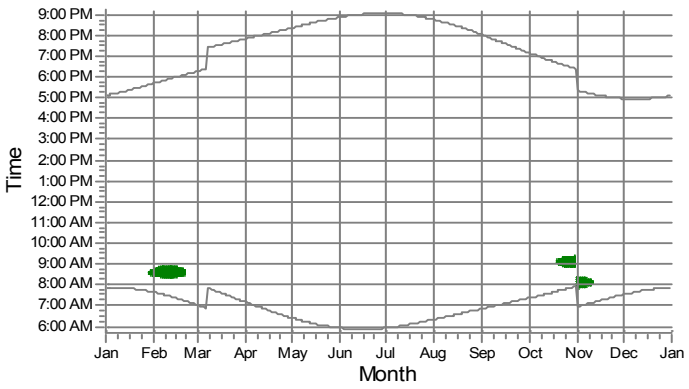
C: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (3)



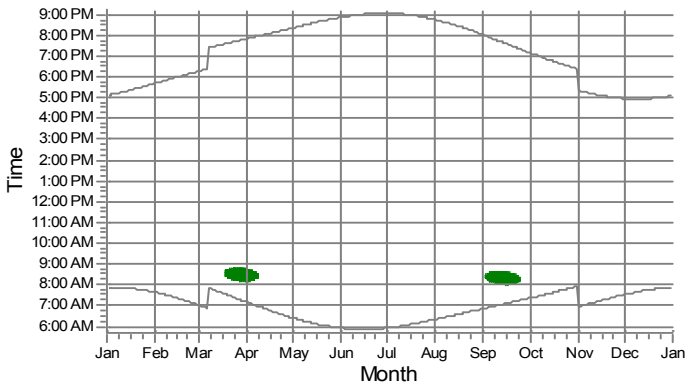
D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (4)



E: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (5)



F: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (6)



WTGs

1: Kenston WTG

Project:
Kenston

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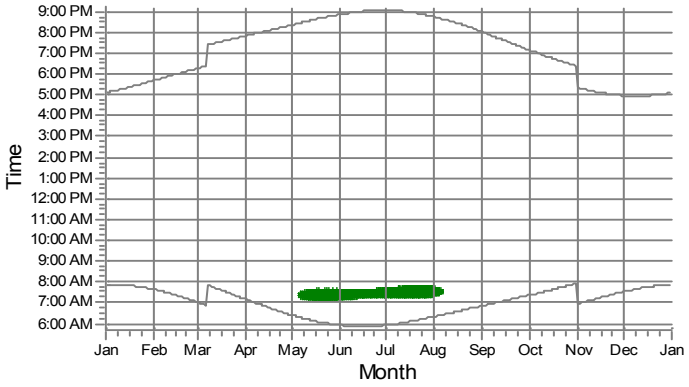
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 7:33 PM/2.7.473

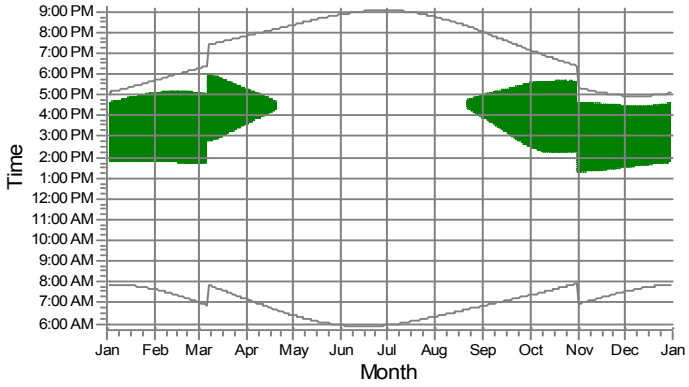
SHADOW - Calendar, graphical

Calculation: Shadow081410

G: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (7)



H: Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (8)



WTGs

1: Kenston WTG

Turbine Use, Safety Policies and General Background

Security:

- Tower Climbing: The wind turbine utilizes a smooth exterior monopole tower with no climbing surfaces or apparatus. Tower climbing is only achieved through the use of an internal ladder system. This system is only reachable through a locked plate steel door.
- Availability: Only preauthorized personnel will be given access to the internal tower and turbine systems.

Tower Climbing Safety:

- Safety Climb: For maintenance personnel climbing of the tower, an OSHA approved "safety climb" system is included in the tower climbing system. This system is comprised of a ladder, a steel cable for the safety climb device, a full body harness designed and approved for the purpose, a locking safety climb device, safety lanyards with self-locking clips and additional tie-in points throughout the turbine system where a cable system is not available.
- OSHA approved safety equipment such as hardhats will be worn by all maintenance personnel climbing or working on the turbine.
- No individual shall climb the tower without a partner.

Electrical Safety:

- All electrical components and their installations shall meet all Local, State and Federal applicable laws and regulations.
- The turbine system shall meet UL1741 and IEC requirements for Utility Grid Protection in case of Grid power failures or power quality abnormalities.
- All electrical supply/grid interconnect services to and from the turbine shall be in buried conduits.
- The turbine system will have a staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.

- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- All safety sensors and equipment shall fault to a turbine fault state in case of their own failure.

Fire:

- The turbine shall have fire detection devices at the tower base and within the nacelle that shall be linked to the Site's existing fire detection/alarm systems (if present).
- The local fire department shall be contacted and a fire/emergency response plan shall be adopted.
- Although formal fire suppression systems are extremely rare for wind turbines, the site shall investigate passive and active fire suppression systems for possible implementation in the turbine system.
- Local fire department approved fire extinguishers shall be located within the tower base and within the nacelle.
- The turbine system will have staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- Safety zones similar to any fire related incident will be utilized, if a fire should occur.

Lightening:

- The turbine system is equipped with a full grounding loop meeting or exceeding all Local, State and Federal regulations concerning grounding and lightening protection.
- Surge suppressing technology will be utilized to protect key electronics.
- See fire policies above.

Icing:

- Although icing of wind turbines is very rare and safety issues related to icing even rarer, it can occur, similar to any built structure (roofs, power lines, stadium lights, etc.).
- Although not an absolute brake, blade icing induced airfoil shape spoiling will naturally reduce the efficiency of the blades and thus reduce their rotational speed.
- Although formal icing detection systems are extremely rare for wind turbines, the site shall investigate active icing detection systems for possible implementation in the turbine system.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- The turbine's nacelle will have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system will automatically melt snow and ice accumulation on top of the nacelle.
- The turbine system will have a staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.
- All icing related turbine shut-downs will require a direct inspection and an on-site manual restart.
- The site personnel and the system maintenance personnel will shut down the turbine in the event of an icing condition.
- The site shall adopt an ice safety zone around the turbine for implementation during icing events, if they should occur.

High Wind:

- The turbine automatically shuts down in high winds and turns itself out of the wind.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration,

over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.

Aviation Safety:

- The project has been review by both FAA and ODOT and "No Hazard to Aviation" determinations were issued.
- An FAA approved red obstruction marking light will be located on top of the nacelle.

Shadow Flicker:

- Although all structures cast shadows, shadows from wind turbines that reach occupied structures or areas can be considered a nuisance due to the fact that they move or flicker as the blades rotate in front of the Sun.
- A formal shadow flicker study has been conducted for the site based on the turbine's rotor diameter and height, the site latitude and longitude, weather records, existing site topography and the existing area obstructions.
- Per international standards, shadow flicker impacting a particular location above 30 hours per year is considered a potential nuisance. While the turbine's shadow will reach some of the area properties, no residential or business property locations will receive more than 30 hours of shadow per year. Other factors that mitigate the shadows' impact include:
    - Shadow intensity drops off with distance. Shadow edges soften and shadow bodies become more muted. Shadows beyond ten rotor diameters from the tower base are considered insignificant with shadows within five rotor diameters being the most significant.
    - Shadows move and do not remain in one spot for extended periods of time.
    - The longest extended period shadows occur in the winter when there are fewer sunny days.
    - Many local natural and built environmental elements such as trees will block or significantly diffuse shadows.
- If extended adverse shadows should impact a particular dwelling, the wind turbine site owner will take one or more of the following mitigating measures:
    - Plant evergreen trees to block the shadow.
    - Provide blinds for the dwelling.
    - Turn off the turbine during the shadowing periods that excessively affect the dwelling.

Sound:

- Wind turbines of the size to be installed are inherently quite devices, especially over distance, and are typically very hard to hear over the wind itself and the existing ambient area noise levels.
    - Sound from a single wind turbines typically comes from the following areas:
        - Wind noise off of the blades as they are driven by the wind (swooshing that drops off over distance and typically competes with the area's natural wind noise).
        - Drive-train noise (mechanical sound typically not heard outside the immediate vicinity of the turbine).
        - Yaw system noise (mechanical sound typically not heard outside the immediate vicinity of the turbine and that is only present when the turbine turns into the wind).
        - Electrical noise from the turbine's electrical equipment and transformer (buzz, typically not heard outside the immediate vicinity of the turbine).
- Sound modeling for the proposed wind turbine supports that turbine produced audio levels will not exceed any local code or ordinance at the site's property lines. To be conservative, this modeling was done at an 8 mps/17.9 mph wind speed, well above site averages.
- Sound measurement of existing ambient sound levels for both day and evening periods at multiple locations surrounding the site show existing ambient sound levels above what the wind turbine will produce.

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[i] The only known shadow flicker regulation to date was enacted in Germany, where a court ruled that the maximum allowable flicker would be 30 hours per year (Klepinger, 2007). In addition, Dobesch and Kury (2001) recommended that shadow flicker should not exceed 30 hours per year, and the guidelines for wind power development in the State of Victoria, Australia state that shadow flicker may not exceed 30 hours per year at any dwelling in the surrounding area (Sustainable Energy Authority Victoria, 2003). Since there are no known national or local regulations that govern shadow flicker in the United States, New York State, or Steuben County, the 30-hour per year threshold is used in this analysis to determine potentially impacted structures.
http://www.eon.com/en/downloads/Appendix_M_Shadow_Flicker_Modeling_Report.pdf

[ii] Epilepsy Foundation. (n.d.). Photosensitivity and Epilepsy.
http://www.epilepsyfoundation.org/about/photosensitivity/

[iii] As there is a possibility of a turbine model change on the project, the worst case largest model under consideration was used for the shadow flicker models.