

June 2010



solar 

thermal 

wind 

# Nantucket High School Northwind 100 Shadow Flicker Report

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## Background

Alteris Renewables, Inc. (Alteris) was requested by Massachusetts Clean Energy Center (MassCEC) to evaluate predicted shadow flicker impacts surrounding the proposed Nantucket High School Wind Energy Project, located on the island of Nantucket, MA. The proposed wind energy project will consist of a single Northern Power Systems Northwind 100 wind turbine with a hub height of 37 meters and a rotor diameter of 21 meters.

Shadow flicker caused by wind turbines is commonly defined as alternating changes in light intensity caused by rotating blades casting shadows on the ground and stationary objects, such as a window at a dwelling. No flicker shadow will be cast when the sun is obscured by clouds or fog, or when the turbine is not rotating. Shadow flicker can occur in project area homes when the turbine is located near a home and is in a position where the blades interfere with very low angle sunlight. The most typical effect is the visibility of an intermittent light reduction in the rooms of the home facing the wind turbine and subject to the shadow flicker (Ref 1). Such locations are here referred to as shadow flicker receptors. Obstacles such as terrain, trees, or buildings between the wind turbine and a potential shadow flicker receptor significantly reduce or eliminate shadow flicker effects.

A study from the *Planning for Renewable Energy* guide from the United Kingdom stated the following: "Flicker effects have been proven to occur only within ten rotor diameters of a turbine. Therefore, if the turbine has a 21 meter rotor, the potential shadow flicker effect could be felt up to 210 meters from a turbine" (Ref 1). The distance of 10 rotor diameters equates to approximately 689 feet. Within a distance of 689 feet, Alteris identified seven receptors. Beyond 210 meters there would be minimal effect. Other properties and sections of the school are within 10 rotor diameters but because of their configuration with the absence of windows and/or the presence of bushes and trees in front of the windows, they will be mentioned but detailed analysis was not deemed necessary. Figure 1 is an aerial image that identifies the properties adjacent to the installation site. The nearest occupied dwelling to a proposed wind turbine is approximately 290 feet to the southwest. The potential shadow flicker impacts on these structures will be subsequently discussed.

## **Assessment of Shadow Flicker Impacts**

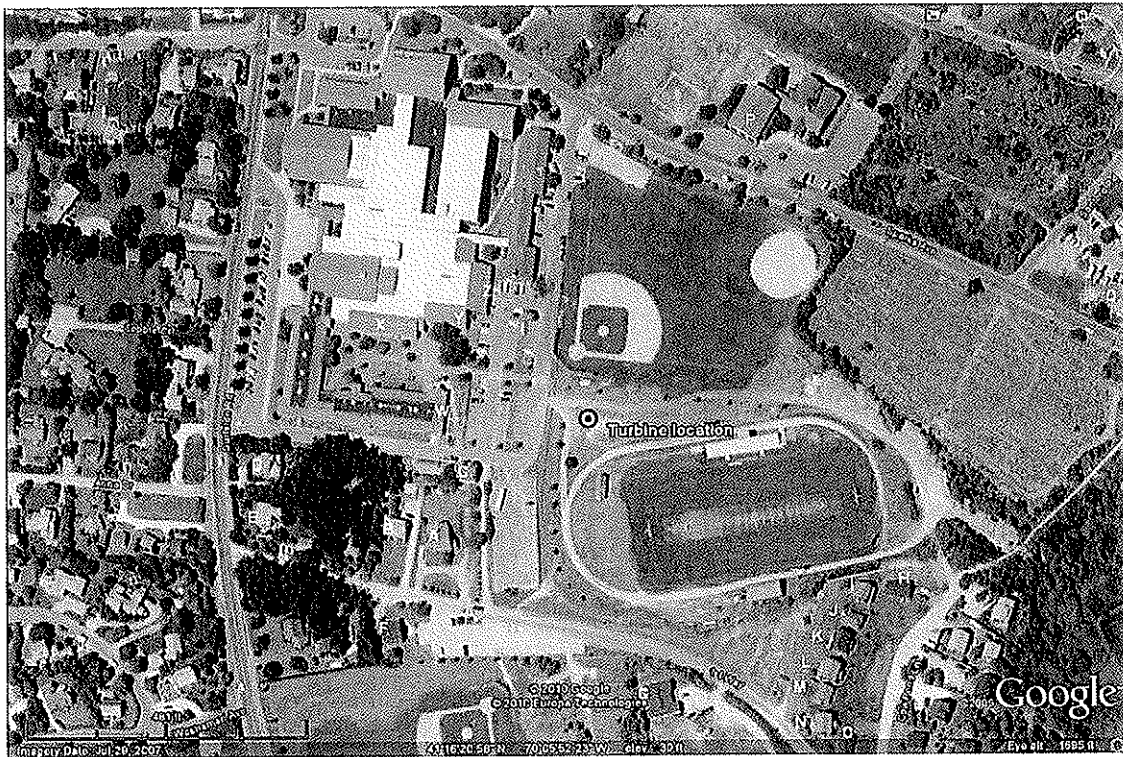
The shadow flicker assessment conducted by Alteris Renewables, Inc. is conservative in that it does not factor in fog or cloud cover, which would reduce the number of days that shadow flicker, may occur. Furthermore, the analysis does not account for wind turbine operation time. The wind turbine must be spinning in order to generate a shadow flicker effect. The wind turbine only spins when wind speeds exceed 3.5 m/s. Since the wind turbine will only be operating a percentage of the time, the shadow flicker effect will be less than what was estimated by this analysis. Finally, the analysis assumes that the turbine blades are operating perpendicular on a line from the sun path to the potential receptor. Depending on the wind direction, the alignment of the turbine blades will vary such that the flicker effect will be less than what was assumed for this analysis. The shadow flicker analysis does not account for trees or hedgerows blocking certain dwellings from shadows. The number of minutes included in the shadow flicker analysis encompasses the time when the turbine rotor shadow impacts the identified structure. The shadow plot image (Figure 2) on page 6 depicts the potential impact on receptors at a distance of 10 rotor diameters. That accounts for approximately 4380 hours per year which is based on an average length of day of twelve hours. The method for quantifying the actual times is described in the section below. While there can be some variability, the industry generally uses an annual time in excess of 30 hours as a point at which steps to mitigate flicker are required. Mitigation can be accomplished by the installation of shades or blinds, planting of obstructing foliage, building a fence or pergola, or by remotely controlling the time the turbine is in operation and shutting it down during the times of concern. The latter option typically has very minimal impact on the overall annual production from the installation.

## **Identified Properties Impacted by Shadow Flicker**

Using Google Sketch Up and Google Earth, geo-referencing specific coordinates allows us to determine the sun's azimuth and altitude for virtually any location on earth. We then use Pictometry to specify the dimensions for surrounding buildings before creating 3D models which are used in our shadow analysis. In Google Sketch Up we can create and import representative models of wind turbines and buildings to scale and include a shadow function which casts shadows in the correct direction at any time for any day of the year. The installation site is relatively flat with elevations at the site of the turbine and the seven receptors varying by only 5 to 6 feet (the turbine site elevation is lower than the receptors), therefore elevations were not adjusted and the site was assumed to be flat.

The impact on receptors is recorded as the date, time of day, duration, and cumulative hours and minutes per year (Fig. 3). The data for the sites is on pages 10 – 23. The sun's position was referenced to the turbine site location and all times are local.

## Site Map

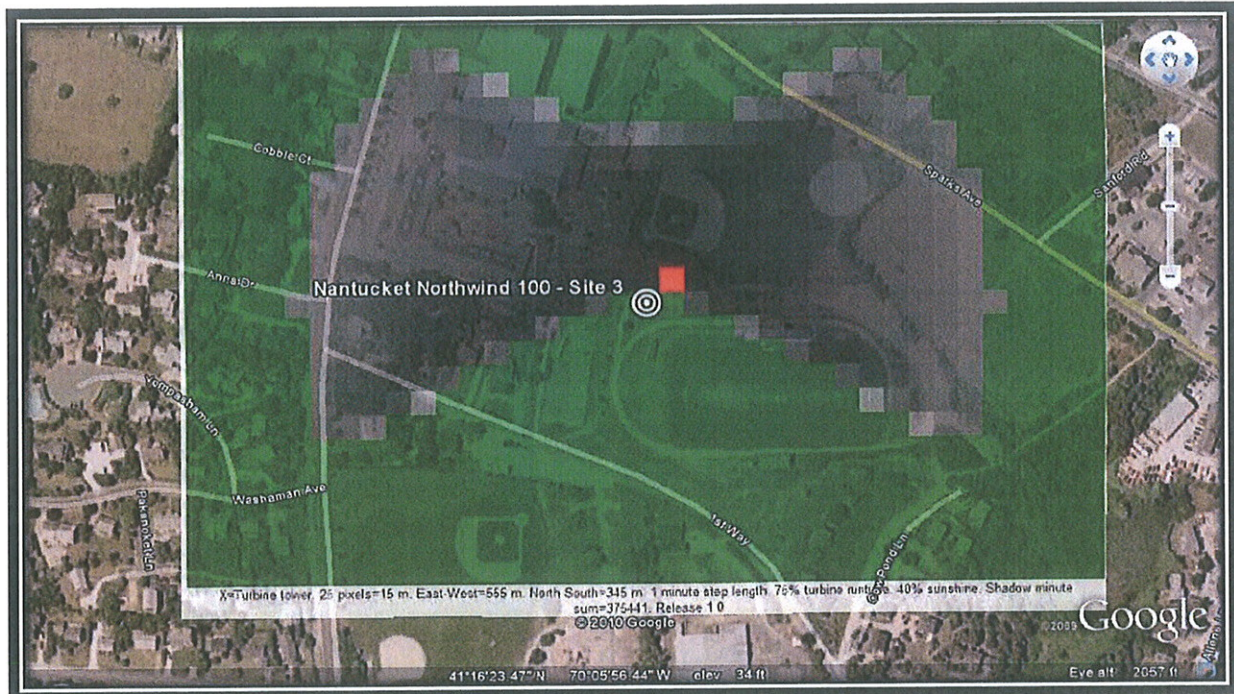


Above is a Google Earth image of the Nantucket High School installation site, including the surrounding properties. Listed below are the descriptions of the identified properties. (Fig. 1)

A:	Private Residence	G:	Nantucket Ice Board of Directors
B:	Private Residence	H-O:	Nantucket Public Schools
C:	Nantucket Public Schools	P:	Boys and Girls Club
D:	Private Residence	Q:	Restaurant
E:	Private Residence	W-Z:	Nantucket Public Schools
F:	Teen Center		
	Town of Nantucket		



## Shadow Plot



The image above is a shadow plot representing the extent of possible impact from shadow flicker at a distance of 210 meters from the wind turbine. (Fig. 2)

Green is a background overlay of the project site.

Gray is the area of potential impact. Darker gray represents more potential impact. Lighter gray represents less potential impact.

### Shadow Flicker Analysis Chart of Properties

Ref. Letter	Type of Structure	Shadow Flicker per Year hh:mm	Ref. Letter	Type of Structure	Shadow Flicker per Year hh:mm
A	Private Residence Landscapers Housing	00:00	W	Nantucket School Wood Shop	80:40
B	Private Residence	32:59	X	Nantucket School Class Room	35:45
D	Private Private Residence	19:31	Y	Nantucket School Nurses Office	78:50
E	Private Residence	18:13			

Table of the properties identified as sensitive and the potential annual flicker in hh:mm (Fig. 3). See data on pages 10 – 23.

## Discussion and Conclusions

Seven receptors were analyzed in detail to document the potential impact of flicker on the structures. The data for these sites begins on Page 10 of this report and lists the date, time, daily duration, and total annual time of flicker impact (hh:mm), as well as accompanying graphs of the times. As discussed previously the assumptions made for the purpose of documenting the timing and duration of the impact on the receptors are that the turbine rotor is always spinning, the sun is not obstructed by clouds or fog, the turbine rotor is perpendicular to the line of the sun path to the receptor, there is no vegetation between the turbine and the windows, and the room or rooms impacted are dominantly used in the structure and occupied during the time of shadow impact.

The structures examined for this study were A, B, D, E, W, X, and Y (Fig. 1). Structures A, B, D, and E are private residences. Working closely with the school's facilities department, sites W, X, and Y which are part of the Nantucket High School/Nantucket Middle School complex, were selected because of their location on the school property as potentially sensitive. Nantucket Public Schools has signed a waiver, per the recommendation of MassCEC, stating flicker would not be an issue for the school buildings or the school property. Structure C which is owned by Nantucket Public Schools is was not included in this report for that reason.

The residential houses A, B, D, and E were found to be effected as follows: House A is closest property not owned by Nantucket Public School but is sufficiently far south of the turbine to not be impacted by flicker. Houses B, D, and E under the ideal conditions described above would have annual flicker impact for 32:59, 19:31, and 18:13 respectively.

Site W is the wood shop in the Middle School, Site X is Middle School class rooms, and Site Y is the Nurses office. They see potential annual impact of 80:40, 35:45, and 78:50 respectively. Nantucket Public Schools controls the school properties and should steps to mitigate impact be required, blinds in the effected rooms could be closed to reduce or eliminate potential impact.

House B would exceed the industry standard by 2:59 under the ideal conditions discussed in paragraph 1 of this section and previously. There are two windows on the second floor and one door on the east side of House B. If necessary, steps to mitigate the impact described in section Assessment of Shadow Flicker Impacts can be addressed. In real-world conditions, though, we are confident the exposure will be less than 30 hours. Houses D and E, are below the 30 hour threshold and have a substantial growth of trees along the east edge of the properties that would further reduce impact.

As stated previously the Nantucket School sites, including the High School and the Middle School can mitigate any impact internally and have signed a waiver stating flicker will not be an issue. All identified properties were examined but due to their configuration and/or distance from the turbine were not considered sensitive. Site Z and the sections of the school continuing north toward Sparks Avenue were not analyzed in detail because of the nature of their use and potential exposure. Site Z is a loading dock, and the building immediately to the north is the mechanical room



which has no windows. The remaining structure that extends to the north is the High School auto shop and wood shop and those shops have garage bays, not windows that open to the east, and will not be affected by flicker.

The Boys and Girls Club (Site P) on Sparks Avenue has large shrubs in front of the building and it approaches the limit of influential range of flicker and the Restaurant (Site Q) is beyond the range of impact. Sites G through O are out of the zone of impact.

The conclusion of this report is that the turbine is well sited and that the impact of flicker will be minimal. In the case of House B where there is potential exposure 2:59 beyond the industry standard under the ideal conditions described previously, we are confident that the actual number of hours of impact will be less than 30 hours under real-world conditions. As the owners of the project, Nantucket Public Schools has waived any concern regarding impact on the school property and will self regulate any necessary mitigation practices.

## References

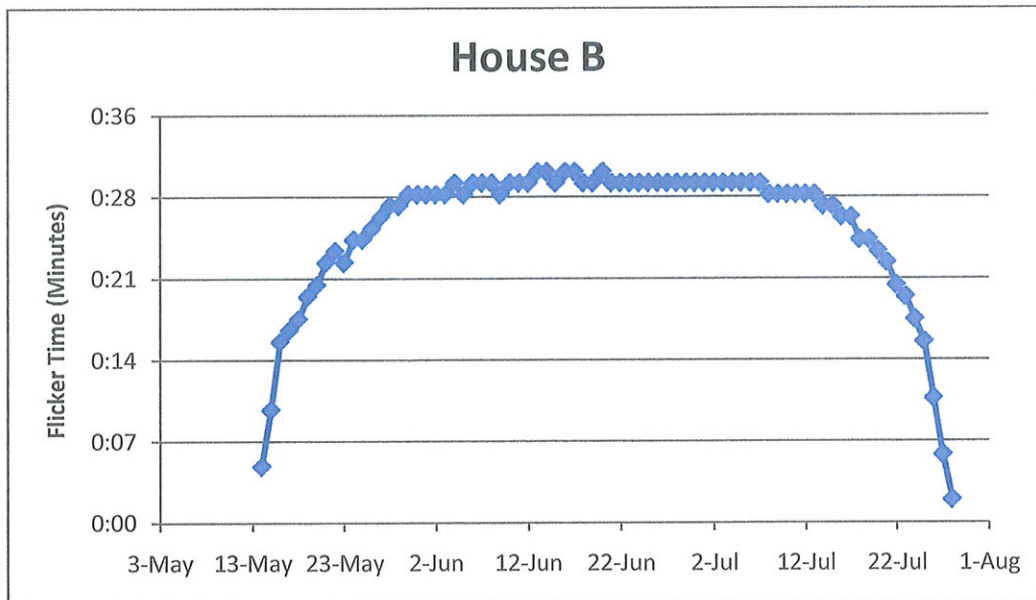
- 1) *Planning for Renewable Energy, A Companion Guide to PPS22*, Office of Deputy Prime Minister, Queen's Printer and Controller of Her Majesty's Stationary Office, 2004.

**House B**

Date	Start Time	End Time	Minutes of Flicker
15-May	6:23	6:28	0:05
16-May	6:23	6:33	0:10
17-May	6:22	6:38	0:16
18-May	6:22	6:39	0:17
19-May	6:22	6:40	0:18
20-May	6:21	6:41	0:20
21-May	6:21	6:42	0:21
22-May	6:20	6:43	0:23
23-May	6:20	6:44	0:24
24-May	6:21	6:44	0:23
25-May	6:20	6:45	0:25
26-May	6:20	6:45	0:25
27-May	6:19	6:45	0:26
28-May	6:19	6:46	0:27
29-May	6:18	6:46	0:28
30-May	6:18	6:46	0:28
31-May	6:18	6:47	0:29
1-Jun	6:18	6:47	0:29
2-Jun	6:19	6:48	0:29
3-Jun	6:19	6:48	0:29
4-Jun	6:19	6:48	0:29
5-Jun	6:19	6:49	0:30
6-Jun	6:20	6:49	0:29
7-Jun	6:20	6:50	0:30
8-Jun	6:20	6:50	0:30
9-Jun	6:20	6:50	0:30
10-Jun	6:21	6:50	0:29
11-Jun	6:21	6:51	0:30
12-Jun	6:21	6:51	0:30
13-Jun	6:21	6:51	0:30
14-Jun	6:21	6:52	0:31
15-Jun	6:21	6:52	0:31
16-Jun	6:22	6:52	0:30
17-Jun	6:22	6:53	0:31
18-Jun	6:22	6:53	0:31
19-Jun	6:23	6:53	0:30
20-Jun	6:23	6:53	0:30
21-Jun	6:23	6:54	0:31
22-Jun	6:24	6:54	0:30
23-Jun	6:24	6:54	0:30
24-Jun	6:24	6:54	0:30
25-Jun	6:24	6:54	0:30
26-Jun	6:24	6:54	0:30
27-Jun	6:25	6:55	0:30
28-Jun	6:25	6:55	0:30
29-Jun	6:25	6:55	0:30

30-Jun	6:25	6:55	0:30
1-Jul	6:25	6:55	0:30
2-Jul	6:25	6:55	0:30
3-Jul	6:25	6:55	0:30
4-Jul	6:25	6:55	0:30
5-Jul	6:25	6:55	0:30
6-Jul	6:25	6:55	0:30
7-Jul	6:25	6:55	0:30
8-Jul	6:25	6:55	0:30
9-Jul	6:26	6:55	0:29
10-Jul	6:26	6:55	0:29
11-Jul	6:26	6:55	0:29
12-Jul	6:26	6:55	0:29
13-Jul	6:26	6:55	0:29
14-Jul	6:26	6:55	0:29
15-Jul	6:27	6:55	0:28
16-Jul	6:27	6:55	0:28
17-Jul	6:28	6:55	0:27
18-Jul	6:28	6:55	0:27
19-Jul	6:29	6:54	0:25
20-Jul	6:29	6:54	0:25
21-Jul	6:30	6:54	0:24
22-Jul	6:30	6:53	0:23
23-Jul	6:31	6:52	0:21
24-Jul	6:31	6:51	0:20
25-Jul	6:32	6:50	0:18
26-Jul	6:32	6:48	0:16
27-Jul	6:33	6:44	0:11
28-Jul	6:33	6:39	0:06
29-Jul	6:33	6:35	0:02

Total Flicker  
Time 32:59:00



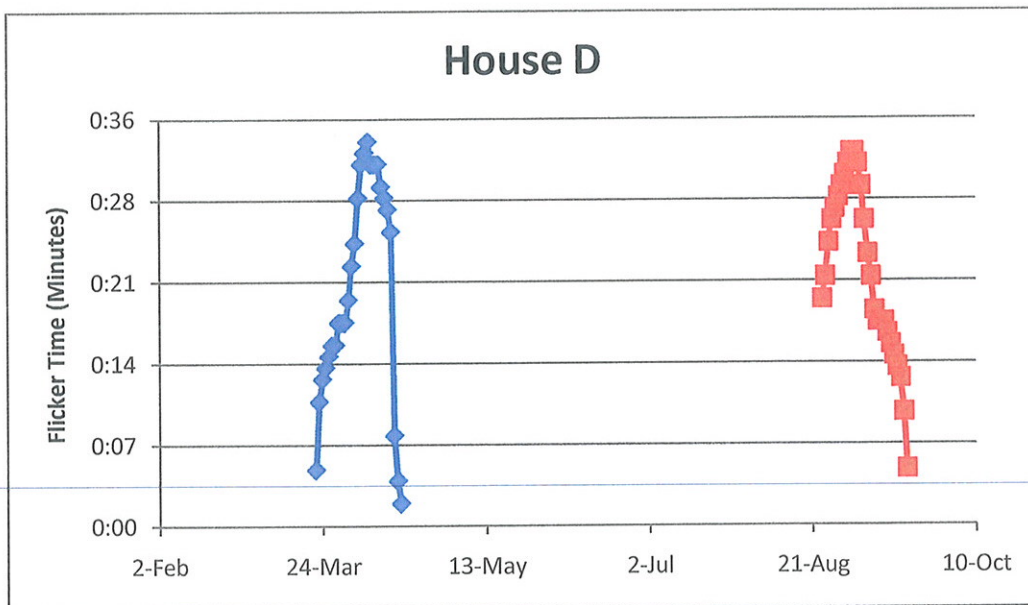
## House D

Date	Start Time	End Time	Minutes of Flicker
23-Mar	7:21	7:26	0:05
24-Mar	7:17	7:28	0:11
25-Mar	7:16	7:29	0:13
26-Mar	7:16	7:30	0:14
27-Mar	7:15	7:30	0:15
28-Mar	7:14	7:30	0:16
29-Mar	7:14	7:30	0:16
30-Mar	7:13	7:31	0:18
31-Mar	7:13	7:31	0:18
1-Apr	7:13	7:31	0:18
2-Apr	7:13	7:33	0:20
3-Apr	7:13	7:36	0:23
4-Apr	7:13	7:38	0:25
5-Apr	7:11	7:40	0:29
6-Apr	7:09	7:41	0:32
7-Apr	7:08	7:41	0:33
8-Apr	7:07	7:41	0:34
9-Apr	7:07	7:39	0:32
10-Apr	7:06	7:38	0:32
11-Apr	7:05	7:37	0:32
12-Apr	7:05	7:35	0:30
13-Apr	7:04	7:33	0:29
14-Apr	7:04	7:32	0:28
15-Apr	7:04	7:30	0:26
16-Apr	7:05	7:13	0:08
17-Apr	7:07	7:11	0:04
18-Apr	7:08	7:10	0:02
25-Aug	7:10	7:30	0:20
26-Aug	7:08	7:30	0:22
27-Aug	7:06	7:31	0:25
28-Aug	7:05	7:32	0:27
29-Aug	7:05	7:33	0:28
30-Aug	7:05	7:34	0:29
31-Aug	7:05	7:35	0:30
1-Sep	7:05	7:36	0:31
2-Sep	7:05	7:37	0:32
3-Sep	7:05	7:38	0:33
4-Sep	7:05	7:38	0:33
5-Sep	7:05	7:37	0:32
6-Sep	7:06	7:36	0:30
7-Sep	7:07	7:34	0:27
8-Sep	7:08	7:32	0:24
9-Sep	7:07	7:29	0:22
10-Sep	7:06	7:25	0:19
11-Sep	7:06	7:24	0:18



12-Sep	7:05	7:23	0:18
13-Sep	7:05	7:23	0:18
14-Sep	7:04	7:21	0:17
15-Sep	7:04	7:20	0:16
16-Sep	7:04	7:19	0:15
17-Sep	7:05	7:19	0:14
18-Sep	7:05	7:18	0:13
19-Sep	7:05	7:15	0:10
20-Sep	7:08	7:13	0:05

Total Flicker  
Time 19:31:00

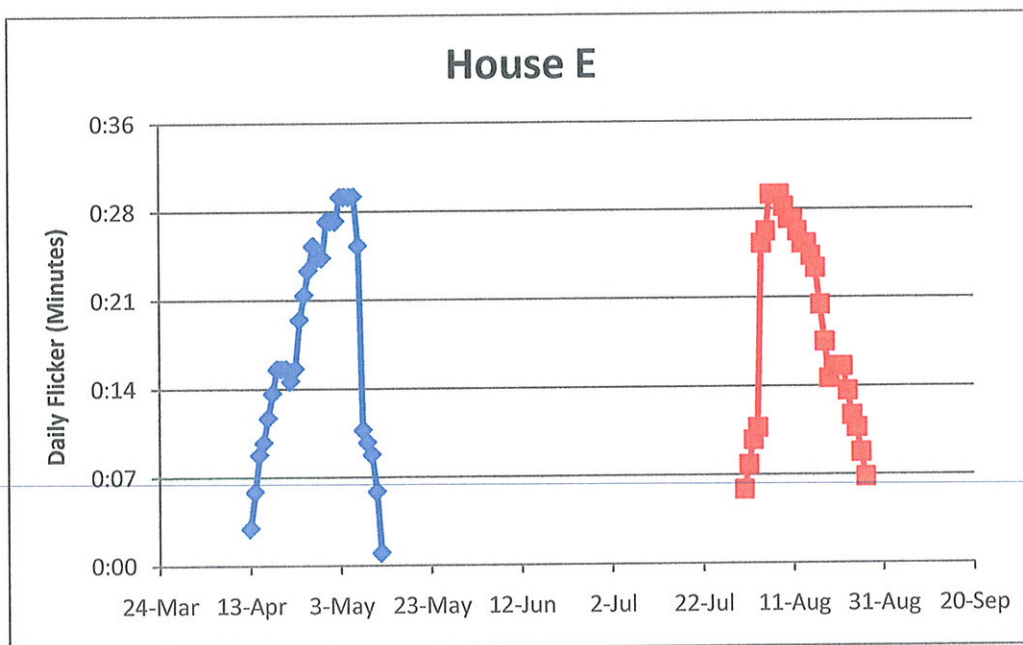


**House E**

Date	Start Time	End Time	Minutes of Flicker
14-Apr	6:51	6:54	0:03
15-Apr	6:49	6:55	0:06
16-Apr	6:47	6:56	0:09
17-Apr	6:46	6:56	0:10
18-Apr	6:44	6:56	0:12
19-Apr	6:42	6:56	0:14
20-Apr	6:41	6:57	0:16
21-Apr	6:41	6:57	0:16
22-Apr	6:41	6:57	0:16
23-Apr	6:42	6:57	0:15
24-Apr	6:42	6:58	0:16
25-Apr	6:42	7:02	0:20
26-Apr	6:43	7:05	0:22
27-Apr	6:43	7:07	0:24
28-Apr	6:42	7:08	0:26
29-Apr	6:42	7:07	0:25
30-Apr	6:42	7:07	0:25
1-May	6:39	7:07	0:28
2-May	6:39	7:07	0:28
3-May	6:39	7:07	0:28
4-May	6:36	7:06	0:30
5-May	6:35	7:05	0:30
6-May	6:34	7:04	0:30
7-May	6:33	7:03	0:30
8-May	6:33	6:59	0:26
9-May	6:33	6:44	0:11
10-May	6:33	6:43	0:10
11-May	6:33	6:42	0:09
12-May	6:35	6:41	0:06
13-May	6:36	6:37	0:01
31-Jul	6:45	6:51	0:06
1-Aug	6:44	6:52	0:08
2-Aug	6:43	6:53	0:10
3-Aug	6:43	6:54	0:11
4-Aug	6:42	7:08	0:26
5-Aug	6:42	7:09	0:27
6-Aug	6:43	7:13	0:30
7-Aug	6:44	7:14	0:30
8-Aug	6:45	7:15	0:30
9-Aug	6:46	7:15	0:29
10-Aug	6:47	7:15	0:28
11-Aug	6:47	7:15	0:28
12-Aug	6:48	7:15	0:27
13-Aug	6:49	7:15	0:26
14-Aug	6:49	7:15	0:26
15-Aug	6:49	7:14	0:25
16-Aug	6:48	7:12	0:24

17-Aug	6:48	7:09	0:21
18-Aug	6:47	7:05	0:18
19-Aug	6:47	7:02	0:15
20-Aug	6:46	7:02	0:16
21-Aug	6:46	7:02	0:16
22-Aug	6:45	7:01	0:16
23-Aug	6:46	7:00	0:14
24-Aug	6:47	6:59	0:12
25-Aug	6:48	6:59	0:11
26-Aug	6:49	6:58	0:09
27-Aug	6:50	6:57	0:07
28-Aug	6:51	6:56	0:05

Total Flicker  
Time 18:13:00



**Nantucket HS  
Wood Shop  
Site W**

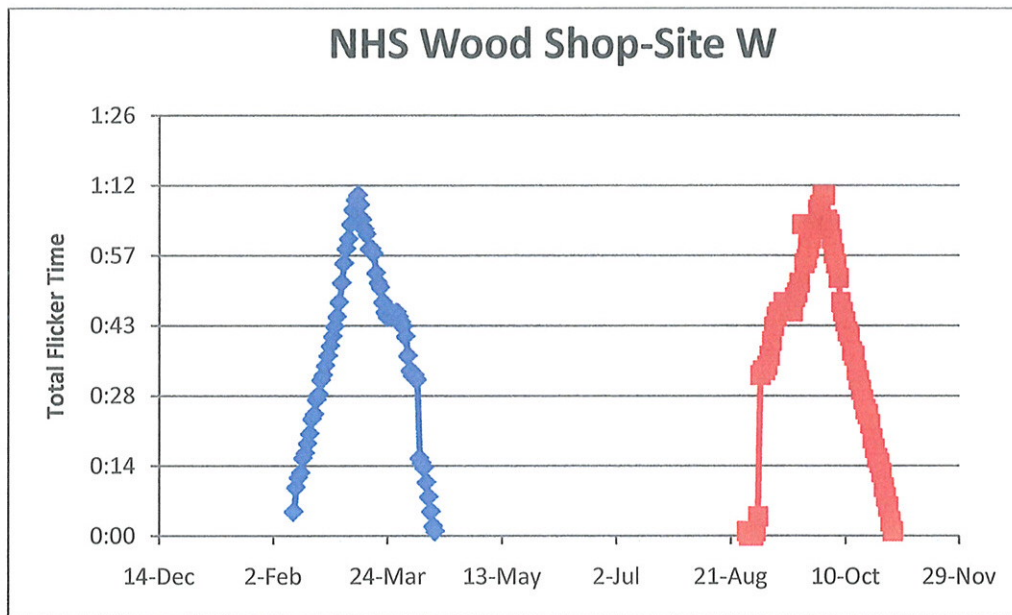
Date	Start Time	End Time	Minutes of Flicker
12-Feb	9:28	9:33	0:05
13-Feb	9:25	9:35	0:10
14-Feb	9:24	9:36	0:12
15-Feb	9:23	9:36	0:13
16-Feb	9:21	9:37	0:16
17-Feb	9:20	9:37	0:17
18-Feb	9:18	9:37	0:19
19-Feb	9:17	9:38	0:21
20-Feb	9:15	9:39	0:24
21-Feb	9:14	9:39	0:25
22-Feb	9:12	9:40	0:28
23-Feb	9:11	9:40	0:29
24-Feb	9:09	9:41	0:32
25-Feb	9:08	9:41	0:33
26-Feb	9:06	9:41	0:35
27-Feb	9:05	9:42	0:37
28-Feb	9:03	9:42	0:39
1-Mar	9:01	9:42	0:41
2-Mar	9:00	9:43	0:43
3-Mar	8:58	9:43	0:45
4-Mar	8:56	9:44	0:48
5-Mar	8:55	9:47	0:52
6-Mar	8:53	9:49	0:56
7-Mar	8:51	9:50	0:59
8-Mar	8:50	9:51	1:01
9-Mar	8:48	9:52	1:04
10-Mar	8:46	9:53	1:07
11-Mar	8:45	9:54	1:09
12-Mar	8:44	9:54	1:10
13-Mar	8:44	9:52	1:08
14-Mar	8:46	9:51	1:05
15-Mar	8:46	9:49	1:03
16-Mar	8:46	9:48	1:02
17-Mar	8:47	9:46	0:59
18-Mar	8:45	9:44	0:59
19-Mar	8:45	9:43	0:58
20-Mar	8:47	9:41	0:54
21-Mar	8:47	9:39	0:52
22-Mar	8:47	9:38	0:51
23-Mar	8:48	9:36	0:48
24-Mar	8:48	9:34	0:46
25-Mar	8:48	9:33	0:45
26-Mar	8:46	9:31	0:45



27-Mar	8:44	9:30	0:46
28-Mar	8:43	9:28	0:45
29-Mar	8:40	9:26	0:46
30-Mar	8:40	9:25	0:45
31-Mar	8:39	9:23	0:44
1-Apr	8:38	9:21	0:43
2-Apr	8:39	9:20	0:41
3-Apr	8:40	9:17	0:37
4-Apr	8:41	9:15	0:34
5-Apr	8:40	9:13	0:33
6-Apr	8:39	9:12	0:33
7-Apr	8:38	9:10	0:32
8-Apr	8:38	8:54	0:16
9-Apr	8:37	8:52	0:15
10-Apr	8:36	8:50	0:14
11-Apr	8:37	8:48	0:11
12-Apr	8:39	8:47	0:08
13-Apr	8:40	8:45	0:05
14-Apr	8:42	8:44	0:02
15-Apr	8:43	8:44	0:01
29-Aug	8:41	8:42	0:01
30-Aug	8:39	8:39	0:00
31-Aug	8:37	8:37	0:00
1-Sep	8:35	8:35	0:00
2-Sep	8:33	8:34	0:01
3-Sep	8:31	8:35	0:04
4-Sep	8:35	9:08	0:33
5-Sep	8:35	9:09	0:34
6-Sep	8:36	9:10	0:34
7-Sep	8:36	9:11	0:35
8-Sep	8:35	9:12	0:37
9-Sep	8:34	9:14	0:40
10-Sep	8:32	9:15	0:43
11-Sep	8:31	9:16	0:45
12-Sep	8:30	9:16	0:46
13-Sep	8:31	9:17	0:46
14-Sep	8:31	9:19	0:48
15-Sep	8:32	9:19	0:47
16-Sep	8:33	9:20	0:47
17-Sep	8:35	9:21	0:46
18-Sep	8:36	9:22	0:46
19-Sep	8:35	9:24	0:49
20-Sep	8:34	9:24	0:50
21-Sep	8:33	9:25	0:52
22-Sep	8:32	9:36	1:04
23-Sep	8:31	9:27	0:56
24-Sep	8:30	9:27	0:57
25-Sep	8:29	9:28	0:59
26-Sep	8:28	9:29	1:01
27-Sep	8:27	9:30	1:03
28-Sep	8:27	9:31	1:04
29-Sep	8:25	9:32	1:07
30-Sep	8:25	9:33	1:08

1-Oct	8:24	9:34	1:10
2-Oct	8:23	9:33	1:10
3-Oct	8:25	9:30	1:05
4-Oct	8:26	9:30	1:04
5-Oct	8:27	9:28	1:01
6-Oct	8:28	9:26	0:58
7-Oct	8:29	9:25	0:56
8-Oct	8:30	9:23	0:53
9-Oct	8:33	9:21	0:48
10-Oct	8:33	9:19	0:46
11-Oct	8:34	9:18	0:44
12-Oct	8:35	9:17	0:42
13-Oct	8:35	9:16	0:41
14-Oct	8:37	9:15	0:38
15-Oct	8:38	9:15	0:37
16-Oct	8:40	9:14	0:34
17-Oct	8:41	9:13	0:32
18-Oct	8:42	9:12	0:30
19-Oct	8:44	9:12	0:28
20-Oct	8:45	9:11	0:26
21-Oct	8:46	9:11	0:25
22-Oct	8:47	9:10	0:23
23-Oct	8:49	9:09	0:20
24-Oct	8:50	9:08	0:18
25-Oct	8:51	9:07	0:16
26-Oct	8:52	9:07	0:15
27-Oct	8:53	9:06	0:13
28-Oct	8:55	9:05	0:10
29-Oct	8:56	9:04	0:08
30-Oct	8:57	9:03	0:06
31-Oct	8:59	9:02	0:03
1-Nov	9:00	9:01	0:01

Total Flicker Time	80:40:00
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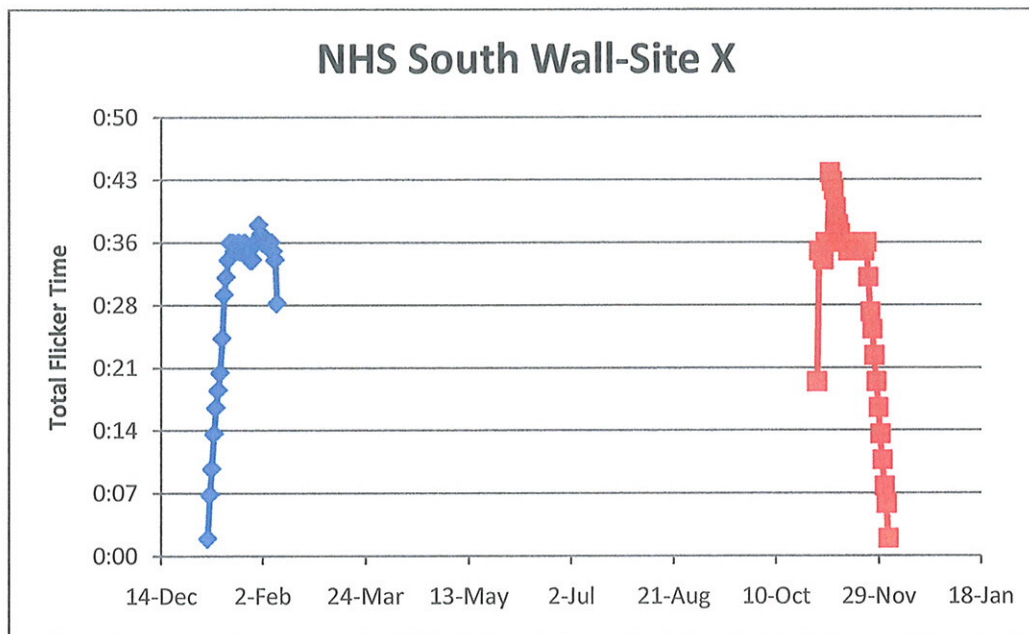
**Nantucket HS  
South Wall  
Site X**

Date	Start Time	End Time	Minutes of Flicker
31-Oct	9:16	9:36	0:20
1-Nov	9:00	9:35	0:35
2-Nov	8:59	9:34	0:35
3-Nov	8:58	9:32	0:34
4-Nov	8:56	9:32	0:36
5-Nov	8:55	9:31	0:36
6-Nov	8:46	9:30	0:44
7-Nov	8:46	9:29	0:43
8-Nov	8:46	9:28	0:42
9-Nov	8:47	9:27	0:40
10-Nov	8:49	9:27	0:38
11-Nov	8:49	9:26	0:37
12-Nov	8:50	9:26	0:36
13-Nov	8:50	9:26	0:36
14-Nov	8:50	9:26	0:36
15-Nov	8:50	9:25	0:35
16-Nov	8:50	9:25	0:35
17-Nov	8:49	9:25	0:36
18-Nov	8:49	9:24	0:35
19-Nov	8:49	9:24	0:35
20-Nov	8:49	9:24	0:35
21-Nov	8:49	9:24	0:35
22-Nov	8:49	9:24	0:35
23-Nov	8:49	9:24	0:35
24-Nov	8:48	9:24	0:36
25-Nov	8:52	9:24	0:32

26-Nov	8:56	9:24	0:28
27-Nov	8:58	9:24	0:26
28-Nov	9:01	9:24	0:23
29-Nov	9:04	9:24	0:20
30-Nov	9:07	9:24	0:17
1-Dec	9:10	9:24	0:14
2-Dec	9:13	9:24	0:11
3-Dec	9:16	9:24	0:08
4-Dec	9:18	9:24	0:06
5-Dec	9:21	9:23	0:02
7-Jan	9:37	9:39	0:02
8-Jan	9:34	9:41	0:07
9-Jan	9:32	9:42	0:10
10-Jan	9:29	9:43	0:14
11-Jan	9:27	9:44	0:17
12-Jan	9:25	9:44	0:19
13-Jan	9:23	9:44	0:21
14-Jan	9:20	9:45	0:25
15-Jan	9:16	9:46	0:30
16-Jan	9:15	9:47	0:32
17-Jan	9:13	9:47	0:34
18-Jan	9:12	9:48	0:36
19-Jan	9:13	9:49	0:36
20-Jan	9:14	9:49	0:35
21-Jan	9:15	9:50	0:35
22-Jan	9:15	9:51	0:36
23-Jan	9:16	9:51	0:35
24-Jan	9:17	9:52	0:35
25-Jan	9:17	9:53	0:36
26-Jan	9:18	9:53	0:35
27-Jan	9:19	9:54	0:35
28-Jan	9:20	9:54	0:34
29-Jan	9:21	9:55	0:34
30-Jan	9:20	9:56	0:36
31-Jan	9:21	9:57	0:36
1-Feb	9:22	10:00	0:38
2-Feb	9:23	10:00	0:37
3-Feb	9:24	10:00	0:36
4-Feb	9:25	10:01	0:36
5-Feb	9:26	10:02	0:36
6-Feb	9:27	10:03	0:36
7-Feb	9:28	10:04	0:36
8-Feb	9:30	10:05	0:35
9-Feb	9:31	10:05	0:34
10-Feb	9:37	10:06	0:29

Total Flicker  
Time 35:45:00





**Nantucket HS  
Nurses Office  
Site Y**

Date	Start Time	End Time	Minutes of Flicker
30-Sep	10:42	11:07	0:25
1-Oct	10:35	11:08	0:33
2-Oct	10:27	11:06	0:39
3-Oct	10:20	11:05	0:45
4-Oct	10:14	11:03	0:49
5-Oct	10:08	11:01	0:53
6-Oct	10:03	11:00	0:57
7-Oct	10:02	10:59	0:57
8-Oct	10:00	10:57	0:57
9-Oct	9:59	10:56	0:57
10-Oct	9:50	10:55	1:05
11-Oct	9:47	10:53	1:06
12-Oct	9:47	10:52	1:05
13-Oct	9:45	10:51	1:06
14-Oct	9:44	10:50	1:06
15-Oct	9:43	10:49	1:06
16-Oct	9:42	10:48	1:06
17-Oct	9:42	10:47	1:05
18-Oct	9:41	10:47	1:06
19-Oct	9:44	10:46	1:02
20-Oct	9:45	10:45	1:00
21-Oct	9:50	10:44	0:54
22-Oct	9:51	10:44	0:53
23-Oct	9:50	10:44	0:54
24-Oct	9:49	10:43	0:54

25-Oct	9:48	10:42	0:54
26-Oct	9:48	10:41	0:53
27-Oct	9:47	10:40	0:53
28-Oct	9:47	10:40	0:53
29-Oct	9:46	10:39	0:53
30-Oct	9:46	10:39	0:53
31-Oct	9:45	10:38	0:53
1-Nov	9:45	10:38	0:53
2-Nov	9:44	10:37	0:53
3-Nov	9:43	10:36	0:53
4-Nov	9:43	10:36	0:53
5-Nov	9:43	10:36	0:53
6-Nov	9:42	10:35	0:53
7-Nov	9:42	10:35	0:53
8-Nov	9:42	10:34	0:52
9-Nov	9:41	10:34	0:53
10-Nov	9:41	10:34	0:53
11-Nov	9:40	10:34	0:54
30-Jan	10:46	11:04	0:18
31-Jan	10:11	11:05	0:54
1-Feb	10:11	11:05	0:54
2-Feb	10:11	11:06	0:55
3-Feb	10:12	11:06	0:54
4-Feb	10:12	11:07	0:55
5-Feb	10:13	11:07	0:54
6-Feb	10:14	11:08	0:54
7-Feb	10:14	11:08	0:54
8-Feb	10:15	11:09	0:54
9-Feb	10:16	11:09	0:53
10-Feb	10:16	11:09	0:53
11-Feb	10:17	11:10	0:53
12-Feb	10:17	11:11	0:54
13-Feb	10:17	11:11	0:54
14-Feb	10:18	11:12	0:54
15-Feb	10:18	11:12	0:54
16-Feb	10:19	11:12	0:53
17-Feb	10:19	11:13	0:54
18-Feb	10:20	11:14	0:54
19-Feb	10:20	11:14	0:54
20-Feb	10:21	11:15	0:54
21-Feb	10:21	11:15	0:54
22-Feb	10:13	11:15	1:02
23-Feb	10:14	11:16	1:02
24-Feb	10:11	11:17	1:06
25-Feb	10:11	11:17	1:06
26-Feb	10:11	11:17	1:06
27-Feb	10:11	11:17	1:06
28-Feb	10:12	11:18	1:06
1-Mar	10:13	11:20	1:07
2-Mar	10:14	11:20	1:06
3-Mar	10:15	11:22	1:07
4-Mar	10:16	11:22	1:06
5-Mar	10:21	11:23	1:02

6-Mar	10:25	11:23	0:58
7-Mar	10:26	11:24	0:58
8-Mar	10:31	11:25	0:54
9-Mar	10:39	11:26	0:47
10-Mar	10:44	11:27	0:43
11-Mar	10:51	11:27	0:36
12-Mar	10:57	11:28	0:31
13-Mar	11:02	11:28	0:26
14-Mar	11:11	11:28	0:17
15-Mar	11:17	11:29	0:12
16-Mar	11:22	11:29	0:07

Total Flicker  
Time 78:50:00

