Shadow Flicker Report

Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler
Steuben County, New York

Prepared for:

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Table 3. Receptors Predicted to Receive Over 30 Hours of Shadow Flicker Annually

Receptor ID	Project Status	Receptor Type	Predicted Annual Shadow Flicker[1] (hh:mm/year)	Predicted Max Daily Shadow Flicker[2] (hh:mm/day)	Predicted Shadow Flicker (days/year)	Turbine Contributing to Shadow Flicker
1014	Non-participating	Residence Year-Round	30:36	1:00	122	T5, T6
1303	Non-participating	Residence Year-Round	30:39	1:06	165	T10, T12
1872	Non-participating	Residence Year-Round	30:53	1:16	139	T16, T23
607	Non-participating	Residence Year-Round	31:24	0:46	167	T25, T34, T40
962	Non-participating	Residence Year-Round	31:30	0:48	192	T9, T10, T12
2799	Non-participating	Utility Structure	32:32	1:21	107	T26
1088	Non-participating	Residence Seasonal	32:40	0:54	154	T1, T3
960	Non-participating	Residence Year-Round	33:09	1:08	185	T9, T10, T12
1087	Non-participating	Residence Seasonal	33:24	0:53	162	T1, T3
1302	Non-participating	Residence Year-Round	33:36	1:11	148	T10, T12
608	Non-participating	Residence Year-Round	34:32	0:47	181	T25, T34, T40
1173	Non-participating	Residence Year-Round	34:58	1:21	161	T21, T24
970	Non-participating	Residence Seasonal	35:48	0:55	134	T7, T9
1016	Non-participating	Residence Year-Round	35:54	1:08	113	T5
1095	Non-participating	Residence Year-Round	38:33	1:02	140	T1
569	Non-participating	Residence Year-Round	38:51	0:58	119	T40
1094	Non-participating	Residence Year-Round	39:06	1:23	87	T1
464	Non-participating	Residence Year-Round	39:25	1:08	129	T19, T26
1356	Non-participating	Residence Year-Round	39:31	1:10	166	T5, T6
2119	Non-participating	Residence Dilapidated	47:15	1:26	107	T10, T12
1313	Non-participating	Residence Year-Round	60:14	1:24	125	T1
551	Non-participating	Residence Year-Round	64:17	1:18	221	T32, T33, T38
544	Participating (Limited)	Residence Year-Round	31:53	0:48	136	T33, T38
454	Participating	Residence Year-Round	30:51	1:07	128	T19, T26

Receptor ID	Project Status	Receptor Type	Predicted Annual Shadow Flicker[1] (hh:mm/year)	Predicted Max Daily Shadow Flicker[2] (hh:mm/day)	Predicted Shadow Flicker (days/year)	Turbine Contributing to Shadow Flicker
1000	Participating	Residence Year-Round	32:10	1:26	157	T5, T7, T9
1955	Participating	Residence Seasonal	33:05	1:18	167	T32, T38
1342	Participating	Residence Year-Round	33:16	1:09	175	T9, T10, T12
1952	Participating	Residence Seasonal	33:25	1:22	152	T32, T38
1956	Participating	Residence Seasonal	35:05	1:23	157	T32, T38
1954	Participating	Residence Seasonal	35:19	1:17	197	T32, T33, T38
1362	Participating	Residence Year-Round	35:58	1:01	211	T9, T10, T12
1143	Participating	Residence Year-Round	36:08	0:58	108	T39
1081	Participating	Residence Seasonal	38:34	1:23	111	T3
882	Participating	Residence Year-Round	41:32	0:53	193	T8, T13
881	Participating	Residence Year-Round	41:45	0:52	194	T8, T13
1953	Participating	Residence Seasonal	41:55	1:20	203	T32, T33, T38
916	Participating	Residence Year-Round	42:17	1:26	183	T25, T34, T40
291	Participating	Residence Year-Round	43:08	1:27	95	T16, T23
1154	Participating	Residence Year-Round	43:36	1:53	154	T24, T35, T39
2479	Participating	Residence Year-Round	46:01	1:34	127	T23, T29
1070	Participating	Residence Year-Round	49:42	1:10	140	T3
552	Participating	Residence Year-Round	50:00	1:06	206	T32, T37, T38
553	Participating	Residence Year-Round	51:31	1:20	219	T32, T33, T38
455	Participating	Residence Year-Round	56:09	1:12	178	T19, T26
1298	Participating	Residence Year-Round	59:47	1:32	131	T10, T12
1071	Participating	Residence Year-Round	62:14	1:19	147	T3
2092	Participating	Residence Seasonal	63:46	2:21	149	T15, T28, T31
1961	Participating	Residence Seasonal	111:28	3:00	232	T33, T38
1009	Participating	Residence Seasonal	126:21	2:12	251	T7, T5
1951	Participating	Residence Year-Round	139:45	2:01	285	T33, T38

Receptor ID	Project Status	Receptor Type	Predicted Annual Shadow Flicker[1] (hh:mm/year)	Predicted Max Daily Shadow Flicker[2] (hh:mm/day)	Predicted Shadow Flicker (days/year)	Turbine Contributing to Shadow Flicker
738	Participating	Residence Seasonal	144:42	2:47	259	T3
662	Participating	Dilapidated Residence	266:45	4:00	246	T32, T37, T38

[1] Results do not account for the screening effect of trees, orientation of windows, hours of no turbine operation, or hours when turbines will be oriented to cast shadows away from the residences.

[2] The predicted maximum daily shadow flicker is a worst-case analysis and uses different assumptions than the predicated annual hours of shadow flicker that are also included in the tables listed in the request above. The predicted maximum daily shadow flicker does not take sunshine probabilities or wind direction data (from Attachment A) into account, While the annual predicted expected shadow flicker analysis is still conservative, it does take these real-world factors into consideration, so the annual predicted shadow flicker and maximum predicted shadow flicker are not comparable since they use different assumptions.

5.2 Phase II Predicted Shadow Flicker

Based on shadow flicker analysis described above, there are 18 non-participating or limited participating year-round residential receptors predicted to receive over 30 hours of shadow flicker per year. This is based on the conservative assumption that shadow flicker can be perceived at a receptor structure regardless of the screening effects of all surrounding trees and buildings. To account for screening provided by obstacles (i.e., trees, buildings, etc.) at non-participating year-round residential receptors where greater than 30 hours of shadow flicker was predicted, a Phase II shadow flicker analysis was conducted using the methodology detailed in Section 3.2. The site-specific data outlined in Attachment E regarding obstacles adjacent to each receptor were incorporated into the WindPro model, and the analysis of predicted shadow flicker at these receptors was recalculated.

The Phase II analysis suggested that shadow flicker at eight receptors will be reduced below the 30-hour per year threshold due to the screening effect of adjacent obstacles (e.g., vegetation, buildings, etc.), as shown in Table 4 below and in Figure 4. At the other 10 non-participating receptors, nearby obstacles are not predicted to reduce shadow flicker. This is due to the fact that these obstacles are too short and/or too far from the receptors to block shadows from the contributing turbines. The results of the Phase II Analysis are included in Attachment F.

Table 4. Phase II Shadow Flicker Results

Receptor ID	Project Status	Predicted Annual Shadow Flicker (hh:mm/year)	Phase II Predicted Annual Shadow Flicker (hh:mm/year)	Phase II Predicted Maximum Daily Shadow Flicker (hh:mm/day)
1303	Non-participating	30:39	0:00	0:00
1302	Non-participating	33:36	0:00	0:00
1016	Non-participating	35:54	0:00	0:00
569	Non-participating	38:51	0:00	0:00
960	Non-participating	33:09	11:55	0:41
1014	Non-participating	30:36	18:15	1:00
551	Non-participating	64:17	19:00	1:18
1173	Non-participating	34:58	28:25	1:21
1872	Non-participating	30:53	30:53	1:16
607	Non-participating	31:24	31:24	0:46
962	Non-participating	31:30	31:30	0:48
544	Participating (Limited)	31:53	31:53	0:48
608	Non-participating	34:32	34:32	0:47
1095	Non-participating	38:33	38:33	1:02
1094	Non-participating	39:06	39:06	1:23
464	Non-participating	39:25	39:25	1:08
1356	Non-participating	39:31	39:31	1:10
1313	Non-participating	60:14	60:14	1:24

5.3 Phase III Predicted Shadow Flicker

To more accurately calculate the amount of shadow flicker likely to occur at the 10 non-participating (or limited participating) residential year-round receptors where the Phase II analysis still predicted over 30 hours of shadow flicker per year, a Phase III analysis was conducted. As indicated in Table 5 below, the Phase III analysis suggested that shadow flicker at five additional receptors should be reduced below the 30-hour per year threshold due to the percentage of time that wind speeds are below the cut-in speed or above the cut-out speed. The other five non-participating receptors are predicted to receive reduced levels of shadow flicker due to wind speeds being outside the turbines operating range; however, not enough to fall below the 30-hour per year threshold. The results of the Phase III Analysis are included in Attachment G.

Table 5. Phase III Shadow Flicker Results

Receptor ID	Project Status	Phase II Predicted Annual Shadow Flicker (hh:mm/year)	Phase III Predicted Annual Shadow Flicker (hh:mm/year)
1872	Non-participating	30:53	26:25
607	Non-participating	31:24	25:01
962	Non-participating	31:30	27:08

Receptor ID	Project Status	Phase II Predicted Annual Shadow Flicker (hh:mm/year)	Phase III Predicted Annual Shadow Flicker (hh:mm/year)
544	Participating (Limited)	31:53	21:08
608	Non-participating	34:32	29:12
1095	Non-participating	38:33	32:47
1094	Non-participating	39:06	33:15
464	Non-participating	39:25	33:34
1356	Non-participating	39:31	33:41
1313	Non-participating	60:14	51:00

5.4 Potential Cumulative Impacts

Because the Project is proposed to be located adjacent to the existing Cohocton Wind Farm and the proposed Baron Winds Wind Farm, there exists the potential for cumulative shadow flicker impacts at certain receptors (i.e., those receptors occurring within a 10-rotor diameter distance of Prattsburgh Wind Farm turbines and also occurring within a 10-rotor diameter distance of turbines in the other existing and proposed wind farms). To evaluate the potential for cumulative shadow flicker impacts, a cumulative shadow flicker analysis was run for selected turbines. The turbine model used for the Cohocton Wind Farm is the GE 2.5 MW turbine with a rotor diameter of 116 meters (381 feet) and a hub height of 81 meters (266 feet). The Baron Winds Wind Farm was modeled with a combination of three wind turbine models: the Vestas V150 turbine, with a rotor diameter of 150 meters (492 feet) and a hub height of 120 meters (394 feet), the Nordex N117 turbine with a rotor diameter of 117 meters (384 feet) and a hub height of 91 meters (299 feet), and the Gamesa G114 with a rotor diameter of 114 meters (374 feet) and a hub heigh of 93 meters (305 feet).

To determine receptors that would be potentially affected by turbines from both projects, a buffer defining the maximum distance of potential effect (10-rotor diameters) was applied to the existing Cohocton turbines and the proposed Baron Winds turbines. Seventy-four receptors are located within the area where the existing and proposed wind farm buffers and the Prattsburgh Study Area overlap and have the potential for cumulative shadow flicker impacts (Figure 6).

The analysis was run using the same software and methodology as described in Section 3.1, along with latitude and longitude coordinates for the 74 receptors that were located in the area of potential cumulative impact. The receptors predicted to receive cumulative shadow flicker are presented in Table 6, below, with the "predicted" column representing shadow flicker from the Project only, and the "cumulative predicted" column representing the combined shadow flicker impacts from both the proposed Project and the proposed Baron Winds wind farm and the existing Cohocton Wind Farm. Only receptors that were originally predicted to have shadow flicker from the Prattsburgh Wind Farm are included in Table 6.[7] Results from the

[7] Receptors that were predicted to receive no shadow flicker from the Project will not receive any cumulative shadow flicker effects and any shadow flicker received at those receptors would be from other existing/proposed wind farms.

cumulative shadow flicker analysis at each receptor in the cumulative impact area are included in Attachment H.

Table 6. Effect to Structures with Potential Cumulative Shadow Flicker

Receptor ID[1]	Receptor Type	Receptor Status	Predicted Annual Shadow Flicker - Project Only (hh:mm/year)[2]	Predicted Annual Shadow Flicker - Cumulative (hh:mm/year)[2]	Predicted Maximum Daily Shadow Flicker - Project Only (hh:mm/day)[3]	Predicted Maximum Daily Shadow Flicker - Cumulative (hh:mm/day)[3]
311	Residence Year Round	Non-participating	0:46	16:35	0:16	0:52
306	Residence Year Round	Non-participating	2:07	12:47	0:18	0:36
310	Residence Seasonal	Non-participating	2:30	8:50	0:23	0:23
484	Residence Year Round	Non-participating	2:36	6:49	0:23	0:23
480	Residence Year Round	Non-participating	2:58	5:11	0:25	0:25
2305	Residence Year Round	Non-participating	3:32	6:48	0:24	0:25
880	Residence Year Round	Non-participating	3:33	6:50	0:24	0:25
879	Residence Year Round	Non-participating	3:42	7:06	0:24	0:25
2344	Residence Year Round	Non-participating	3:43	7:07	0:24	0:25
399	Residence Year Round	Non-participating	3:50	12:07	0:25	0:43
400	Residence Year Round	Non-participating	4:36	9:25	0:27	0:27
2327	Residence Year Round	Non-participating	4:46	6:51	0:31	0:31
1503	Residence Seasonal	Participating	4:47	4:47	0:24	0:24
884	Residence Year Round	Non-participating	5:28	7:18	0:26	0:26
397	Residence Year Round	Non-participating	5:34	5:34	0:35	0:35
476	Residence Year Round	Non-participating	6:04	20:48	0:33	0:39
309	Residence Year Round	Non-participating	7:28	24:45	0:33	1:10
434	Residence Year Round	Non-participating	9:22	9:22	0:40	0:40
308	Residence Year Round	Non-participating	9:51	26:12	0:35	1:10
307	Residence Year Round	Non-participating	10:03	23:02	0:33	0:53
885	Residence Seasonal	Non-participating	12:17	13:25	0:36	0:36
1963	Residence Seasonal	Non-participating	12:34	32:08	0:53	0:53

Receptor ID[1]	Receptor Type	Receptor Status	Predicted Annual Shadow Flicker - Project Only (hh:mm/year)[2]	Predicted Annual Shadow Flicker - Cumulative (hh:mm/year)[2]	Predicted Maximum Daily Shadow Flicker - Project Only (hh:mm/day)[3]	Predicted Maximum Daily Shadow Flicker - Cumulative (hh:mm/day)[3]
396	Residence Year Round	Participating	14:53	14:53	0:56	0:56
305	Residence Year Round	Non-participating	16:52	40:25	0:36	1:12
475	Residential Seasonal	Non-participating	17:45	25:11	0:55	1:05
1866	Residence Seasonal	Non-participating	18:45	39:50	1:04	1:04
945	Residence Year Round	Non-participating	18:49	18:49	0:41	0:41
1515	Residence Year Round	Participating (Limited)	1:58	33:47	0:18	1:00
1509	Residence Year Round	Participating	2:03	42:58	0:18	1:13
1955	Residence Seasonal	Participating	33:05	42:19	1:18	1:18
1952	Residence Seasonal	Participating	33:25	41:18	1:22	1:22
1956	Residence Seasonal	Participating	35:05	43:08	1:23	1:23
1954	Residence Seasonal	Participating	35:19	47:59	1:17	1:17
1953	Residence Seasonal	Participating	41:55	53:52	1:20	1:20
1961	Residence Seasonal	Participating	111:28	124:48	3:00	3:00

[1] There are receptors that were included in the WindPRO results for this analysis (see Attachment H) that are not included in this table. These receptors are receptors that were predicted to receive 0 hours of shadow flicker based on the analysis described in Sections 3.1 and 5.1 (see Attachment B). Since they don't receive shadow flicker from the Project, there will be no cumulative impacts, all impacts will be from the existing/proposed wind turbines.

[2] Predicted annual shadow flicker is based on Phase I analysis results, as described in Section 3.1.

[3] The predicted maximum daily shadow flicker is a worst-case analysis and uses different assumptions than the predicated annual hours of shadow flicker that are also included in the tables listed in the request above. The predicted maximum daily shadow flicker does not take sunshine probabilities or wind direction data (from Attachment A) into account, While the annual predicted expected shadow flicker analysis is still conservative, it does take these real-world factors into consideration, so the annual predicted shadow flicker and maximum predicted shadow flicker are not comparable since they use different assumptions.

Of the 74 receptors located in the potential cumulative impact area described above, 39 were originally predicted not to receive any shadow flicker from the proposed Project, and as such, are not included in Table 6. An additional five receptors were not predicted to receive any additional shadow flicker from the Baron Winds or Cohocton wind turbines. The cumulative shadow flicker analysis results indicated that 30 receptors could experience cumulative shadow flicker from the proposed Project and/or Cohocton or Baron Winds wind turbines. Five non-participating (or limited participating) receptors that were not originally predicted to exceed the 30-hour threshold from Project turbines are predicted to receive over 30 hours due to cumulative impacts. However, two of those receptors are seasonal residences. As described above, these receptors are anticipated to either be unoccupied or occupied only periodically, so occupants will not likely be present during all of the shadow flicker events throughout a given year. One non-participating year-round residential receptor was predicted to experience over 30 hours of shadow flicker per year from cumulative impacts.

6.0 CONCLUSIONS

Shadow flicker modeling software predicted that 52 receptors will receive more than 30 hours of shadow flicker per year from the Project wind turbines under the Phase I analysis. Of the 52 receptors, 29 are located on properties owned by Project participants, while the remaining 23 receptors are non-participating (or limited participants). However, five of the non-participating receptors are unoccupied or anticipated to be occupied only periodically (seasonal cabins, abandoned residences, utility structure). As a result, there is little, if any, likelihood that individuals will actually experience 30 hours per year of shadow flicker at these locations.

A Phase II Analysis was conducted for these 18 residences (the 23 non- or limited participating receptors less the five periodically occupied or unoccupied receptors) to account for screening provided by obstacles (i.e., trees, buildings). The analysis indicated that shadow flicker at eight receptors will be reduced below the 30-hour per year threshold due to the screening effect of adjacent obstacles, leaving 10 non-participating (or limited participating) year-round residential receptor predicted to have views of the Project and receive over 30 hours of shadow flicker per year.

A Phase III (operational reduction) shadow flicker analysis was conducted for the 10 non-participating (or limited participating) receptors still predicted to receive more than 30 hours shadow flicker per year after the Phase II analysis. The operational reduction included turbine stoppage when the winds are outside of the turbine operational cut-in/out wind speeds. This analysis revealed that predicted shadow flicker will be reduced below the 30-hour threshold at five additional receptors due to the percentage of time the turbines are not operating due to wind speeds below the turbine cut-in speed or above the cut-out speed. Consequently, five non-participating year-round residences are predicted to receive more than 30 hours of shadow flicker per year based on the currently proposed turbine model and layout. The Applicant will utilize shadow flicker detection software to automatically shut down turbines when the 30-hour per year shadow flicker limit is reached at non-participating receptors. No shielding or blocking measures are proposed for the Facility. See Section 7.0 and Attachment I for details on the shadow flicker detection software.

Because the Project is proposed to be located adjacent to the existing Cohocton Wind Farm and the proposed Baron Winds Wind Farm, there exists the potential for cumulative shadow flicker impacts at certain receptors. A cumulative analysis was run to determine if any receptors would be predicted to receive shadow flicker from multiple wind farms. Three non-participating (or limited participating) year-round residences were predicted to receive over 30 hours of shadow flicker per year as a result of cumulative impacts. Though two are anticipated to be participants are anticipated to receive more than 30 hours of shadow flicker per year from the Cohocton Wind Farm and are potentially participants in that project. The Applicant will utilize shadow flicker detection software to automatically shut down turbines when the 30-hour per year shadow flicker limit is reached at non-participating receptors. See Section 7.0 and Attachment G for details on the shadow flicker detection software.

More generally, the assumptions underlying the shadow flicker analysis are conservative. Although shadow flicker at these receptors is calculated to exceed the 30-hour per year threshold, the analysis does not take into account important real-world factors, including the actual location and orientation of windows. Also, the analysis assumes turbine rotors are in continuous motion within the turbines operational range. Given these assumptions, the predicted shadow-flicker frequency represents a conservative scenario and likely overstates the actual frequency of shadow flicker that would be experienced at any given receptor location. Furthermore, to provide a conservative worst-case analysis, this analysis evaluated the potential impact of 37 turbines with the largest rotor diameter under consideration for the Project. The actual shadow flicker to be produced will be dependent on the number of turbines, the turbine sites, and the final turbine model selected for the Project.

7.0 MITIGATION

7.1 Shadow Flicker Monitoring

In order to achieve compliance with the 30-hour-per-year annual shadow flicker limit at non-participating (or limited participating) year-round residential receptors, the Applicant will utilize shadow flicker detection technology, specific to the final turbine manufacturer selected for the Facility, that will measure the real-time, cumulative shadow flicker exposure to identified receptors. All of the turbine manufacturers and turbine models under consideration for the Facility have a form of shadow flicker detection software they can deploy. The technical documentation of this technology is included in Attachment I. The detection software will monitor real-time conditions, and automatically curtail specific wind turbines during times of potential exceedances of the 30-hour shadow flicker limit. The monitoring will evaluate the potential for shadow flicker exceedance at a receptor using the following conditions:

- Data from a light sensor installed on the wind turbine nacelle, determining if the sun is shining to a degree in which shadow flicker can occur; and
- There is sufficient sunshine to result in shadow flicker, determining if the sun is at an angle that could result in shadow flicker at the receptor; and

- The turbine is operating and the position of the rotor is oriented to cause shadow flicker at the receptor.

If shadow flicker is detected based on these parameters, the detection software will monitor the amount of time, on a yearly basis, that any specific receptor receives shadow flicker. When the maximum permissible annual shadow flicker exposure level is reached (i.e., 30 hours), the wind turbine(s) causing the shadow flicker will be shut down for the duration of any times when shadow flicker could potentially occur.

The shadow flicker will be monitored annually, and will be measured for a full year, either from the anniversary of the commercial operation date of the Facility, or at the beginning of each calendar year. At the end of a given one-year monitoring window, the cumulative shadow flicker measured at receptors will be reset.

7.2 Wind Turbine Curtailment

As discussed above, five non-participating year-round residences are predicted to receive more than 30 hours of shadow flicker per year based on the largest turbine model under consideration for the Facility and the maximum number of turbines proposed. An additional one non-participating year-round residence is predicted to receive more than 30 hours of shadow flicker per year due to cumulative effects of existing/proposed wind farms in the vicinity of the Project. A detailed summary of the shadow flicker impacts anticipated at these six receptors and the associated curtailment potentially needed to meet the 30-hour per year threshold is provided in Table 7.

Curtailment of the wind turbines during the associated date and time ranges listed above would mitigate the shadow flicker at the associated receptors to less than 30 hours per year. If the Applicant executes an agreement with respective landowners prior to Facility operation, curtailment of turbines for those specific windows would not be necessary as the parcel and associated receptor would be considered a Project participant.

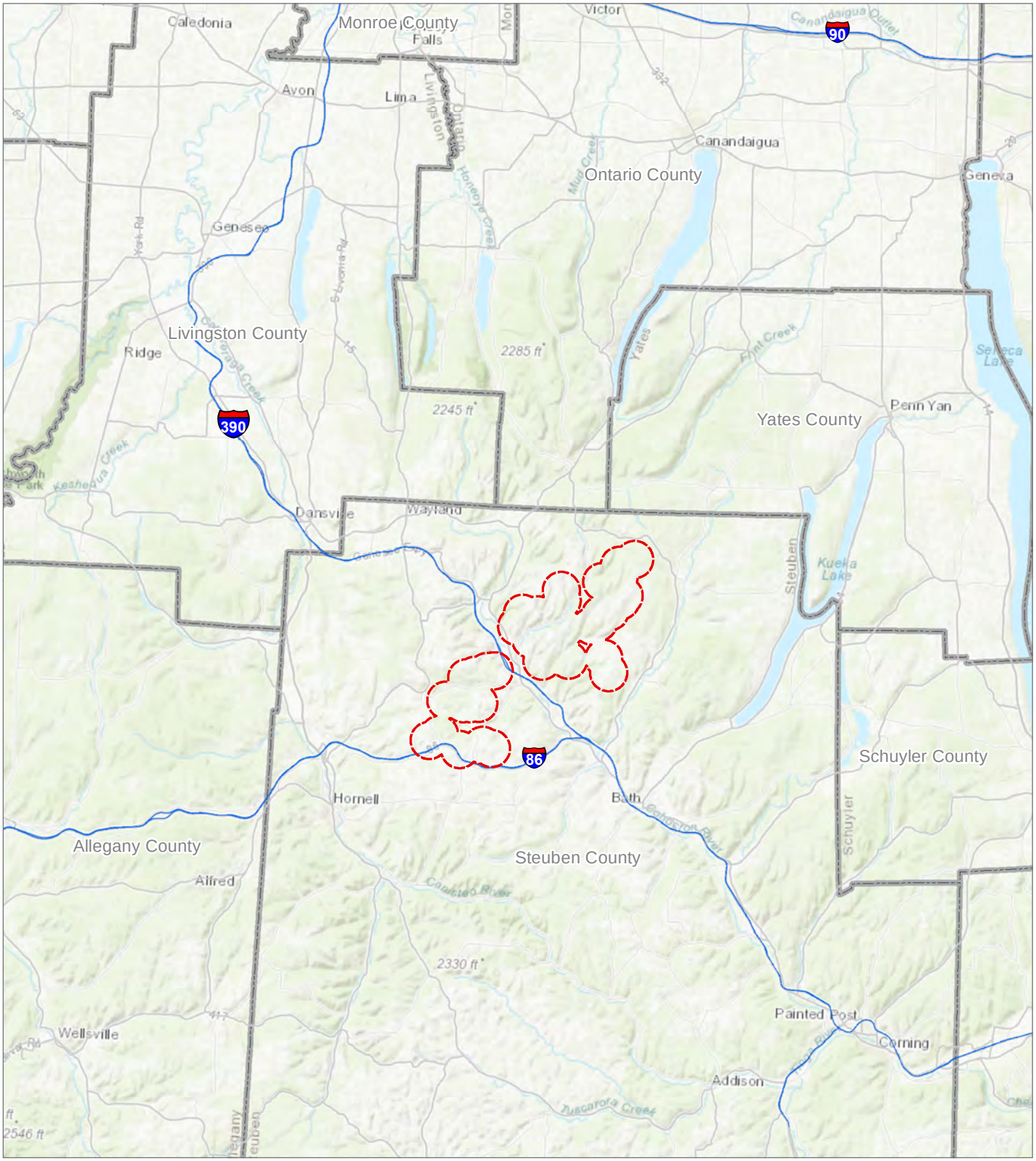
Table 7. Turbines Contributing Shadow Flicker at Receptors Predicted to Receive Over 30 Hours

Receptor ID	Receptor Type	Receptor Status	Predicted Annual Shadow Flicker	Predicted Shadow Flicker Post-Curtailment	Contributing Wind Turbine	Dates of Predicted Shadow Flicker	Times of Predicted Shadow Flicker[1]
1095	Year-Round Residence	Non-participating	32:47	30:00	T1	Apr 10–Aug 4	6:23 PM – 7:50 PM
1094	Year-Round Residence	Non-participating	33:15	30:00	T1	Apr 14 – Sep 30	6:15 PM – 7:26 PM
464	Year-Round Residence	Non-participating	33:34	30:00	T19	Feb 25–Mar 12	5:18 PM – 5:43 PM
						Oct 3–Oct 18	5:52 PM – 6:18 PM
					T26	May 5–Aug 9	6:58 PM – 8:13 PM
1356	Year-Round Residence	Non-participating	33:41	30:00	T5	Jan 23–Feb 24	4:09 PM – 4:52 PM
						Oct 19–Nov 21	3:40 PM – 4:21 PM 4:39 PM – 5:22 PM
					T6	Mar 19–May 6	5:43 PM – 6:54 PM
						Aug 8–Sep 26	5:40 PM – 6:52 PM
1313	Year-Round Residence	Non-participating	51:00	30:00	T1	Apr 21 – Aug 23	5:59 PM – 7:33 PM
305	Year-Round Residence	Non-participating	40:25[2]	30:00	T19	Mary 4 – Aug 11	6:23 AM – 7:08 AM

[1] The times presented represent the range of times during which each structure would potentially experience shadow flicker within the associated date range. The receptors will not experience shadow flicker during the full time window on every day of the associated date range.

[2] This represents the cumulative predicted shadow flicker from the Project and the existing Cohocton Wind Farm. The predicted shadow flicker from only Prattsburgh Wind at this receptor was 16 hours and 25 minutes per year.

Figure 1. Regional Project Location



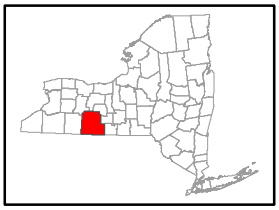
Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

1,700-meter Study Area

County Boundary



0 2.5 5 10

Miles

Prepared April 28, 2022

Basemap: ESRI ArcGIS Online "World Topographic Map" online map service.

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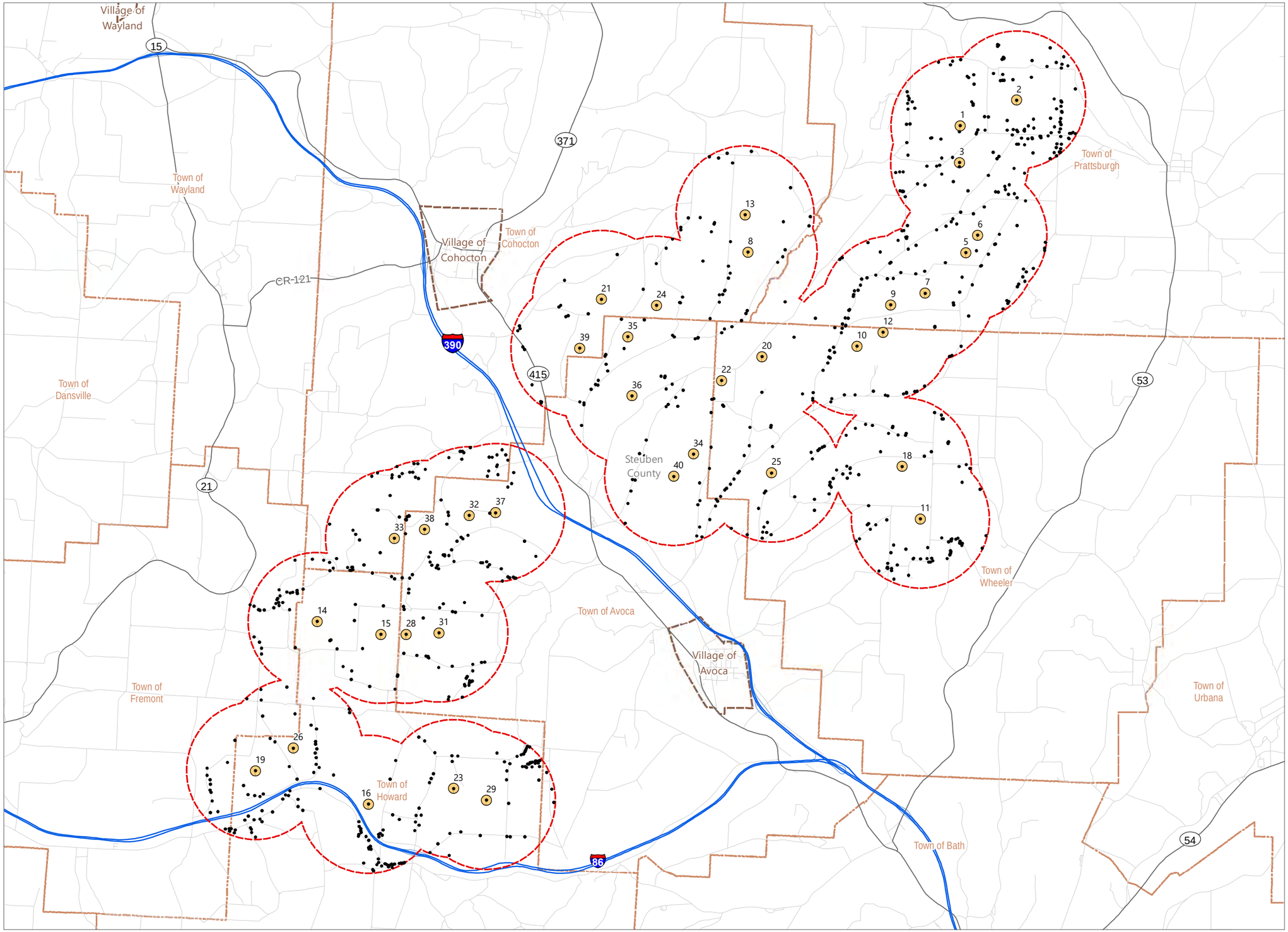
Figure 2. Project Layout



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

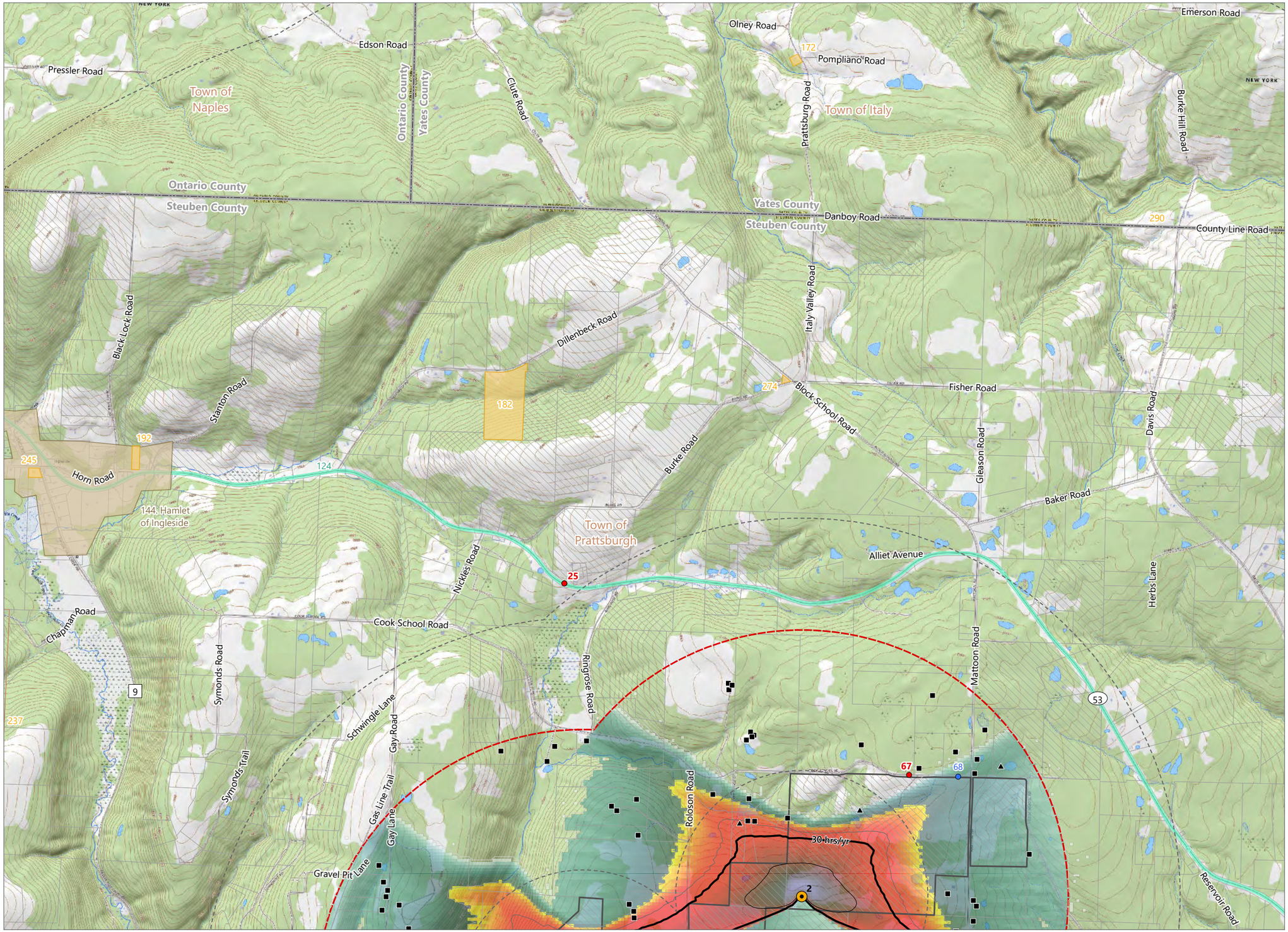
- Receptor
- Wind Turbine
- 1,700 meter Study Area
- Town Boundary

0 0.5 1 2
Miles

Prepared August 2, 2023
Basemap: ESRI StreetMap North America, 2008.

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

Visually Sensitive Resources

- State/US/Interstate Highway
- NRHP-Eligible Resource
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.

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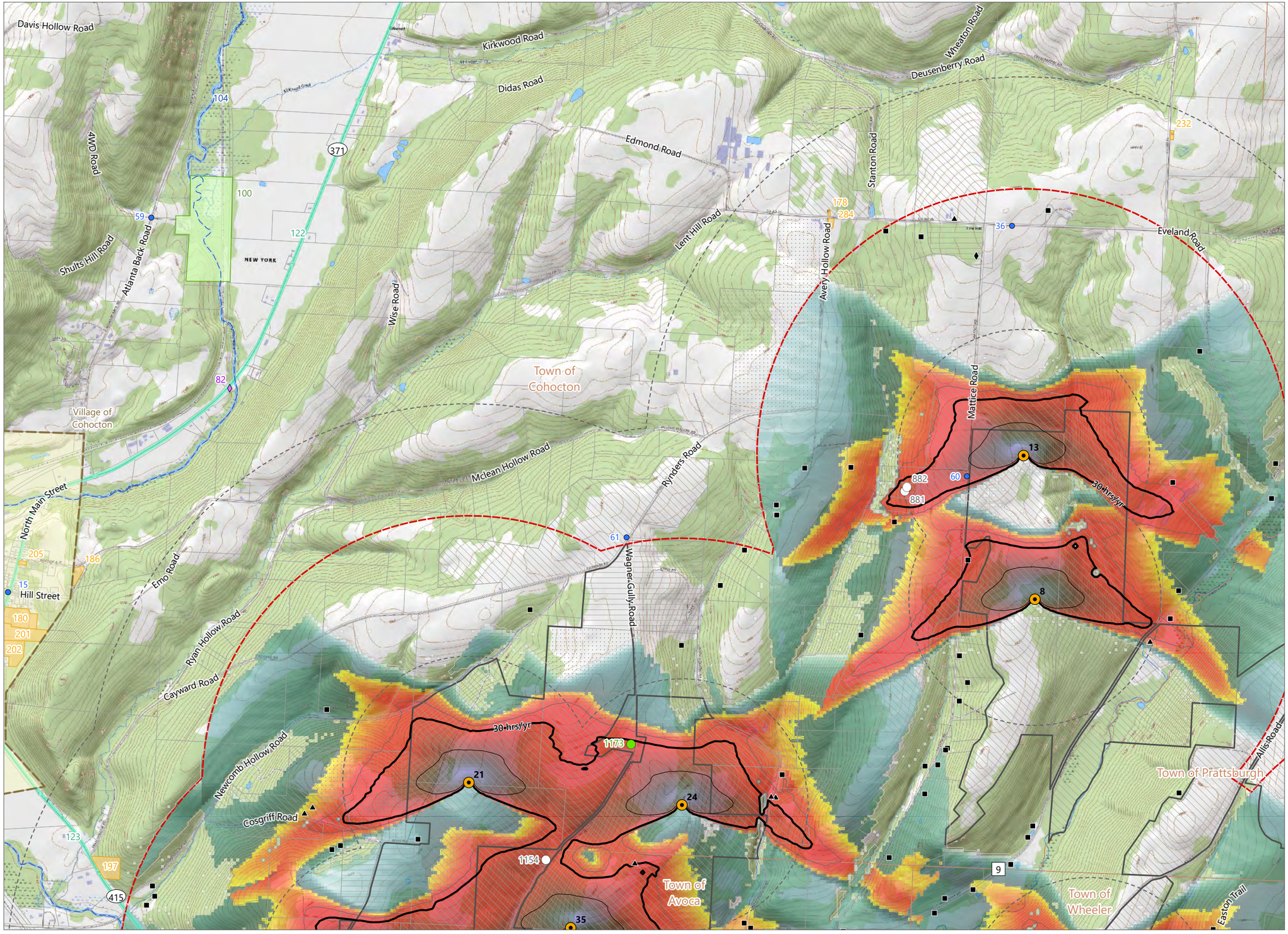
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

< 1	20 - 30
1 - 10	30 - 100
10 - 20	> 100

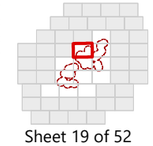
Visually Sensitive Resources

- State Fishing Waterway Access
- River/Stream with Fishing Access
- State/US/Interstate Highway
- NRHP-Eligible Resource
- Local Park/Recreation
- City/Village

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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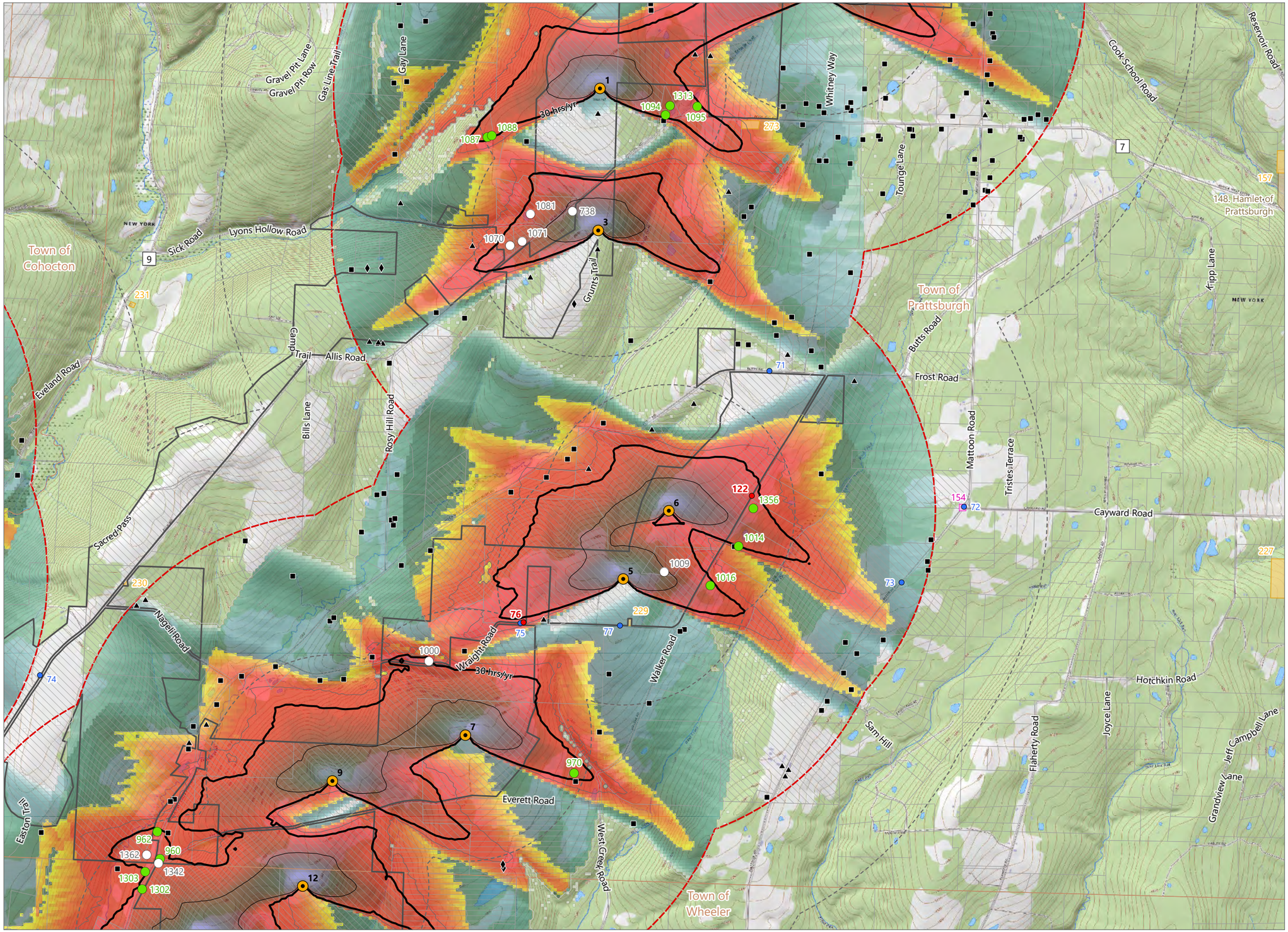
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

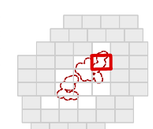
Visually Sensitive Resources

- Stakeholder Identified Resource (Point)
- NRHP-Eligible Resource
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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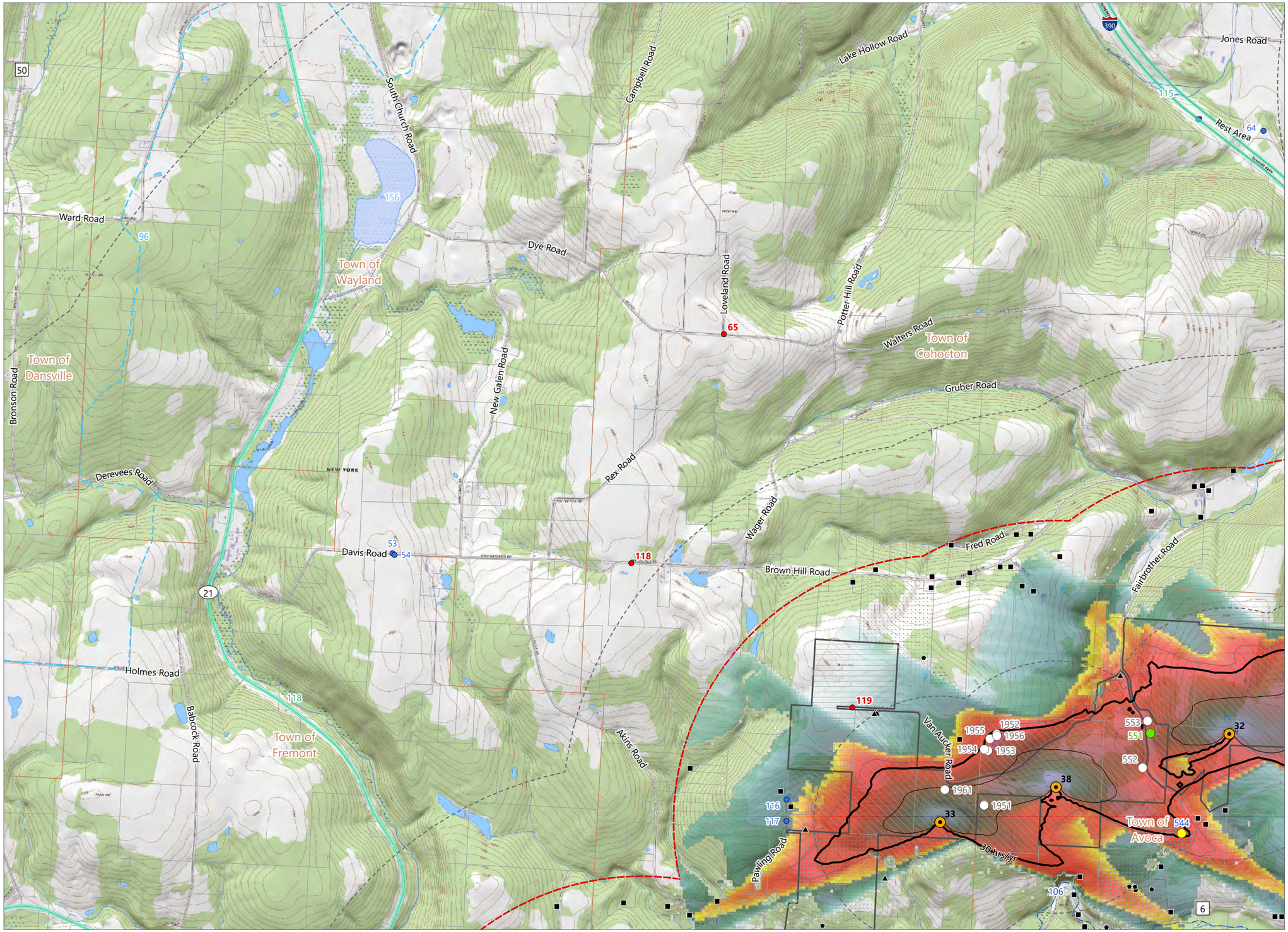
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

< 1	20 - 30
1 - 10	30 - 100
10 - 20	> 100

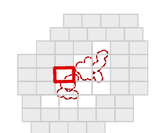
Visually Sensitive Resources

- River/Stream with Fishing Access
- Snowmobile Trail
- State/US/Interstate Highway
- Named Lake/Pond/Reservoir

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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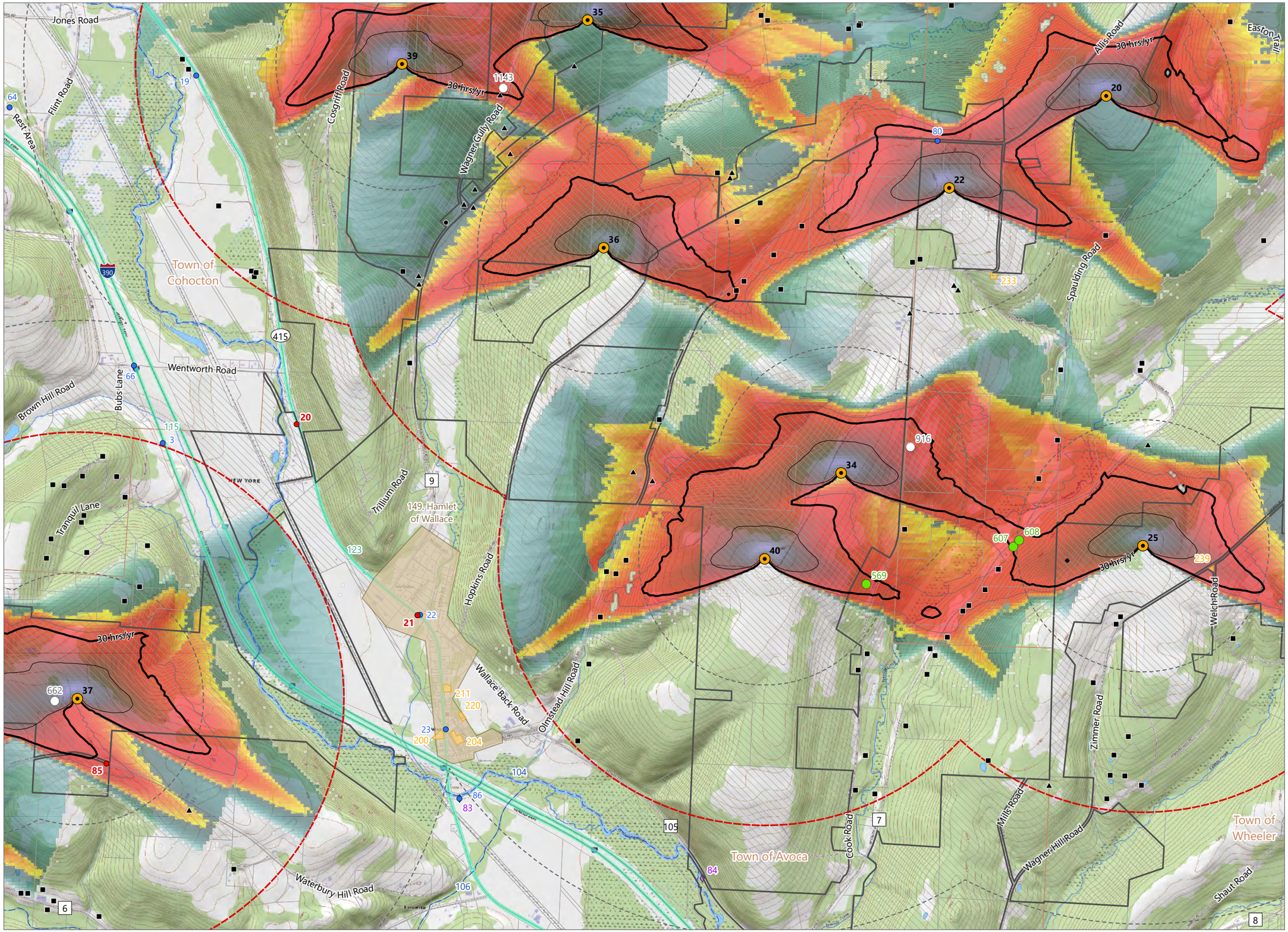
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

< 1	20 - 30
1 - 10	30 - 100
10 - 20	> 100

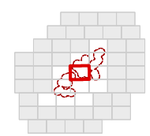
Visually Sensitive Resources

- State Fishing Waterway Access
- River/Stream with Fishing Access
- State/US/Interstate Highway
- NRHP-Eligible Resource
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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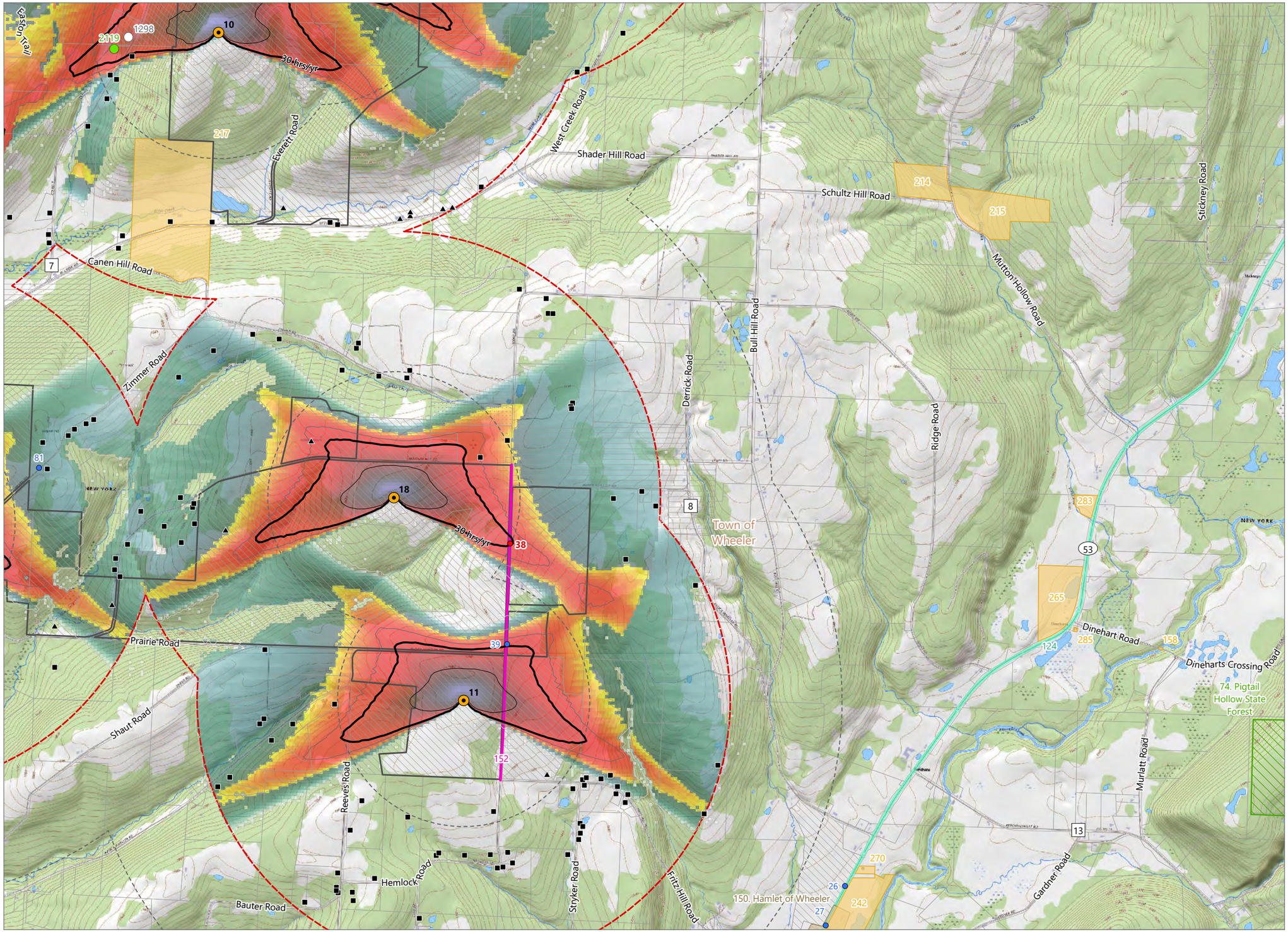
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

Visually Sensitive Resources

- State/US/Interstate Highway
- Stakeholder Identified Resource (Line)
- NRHP-Eligible Resource
- State Forest
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.

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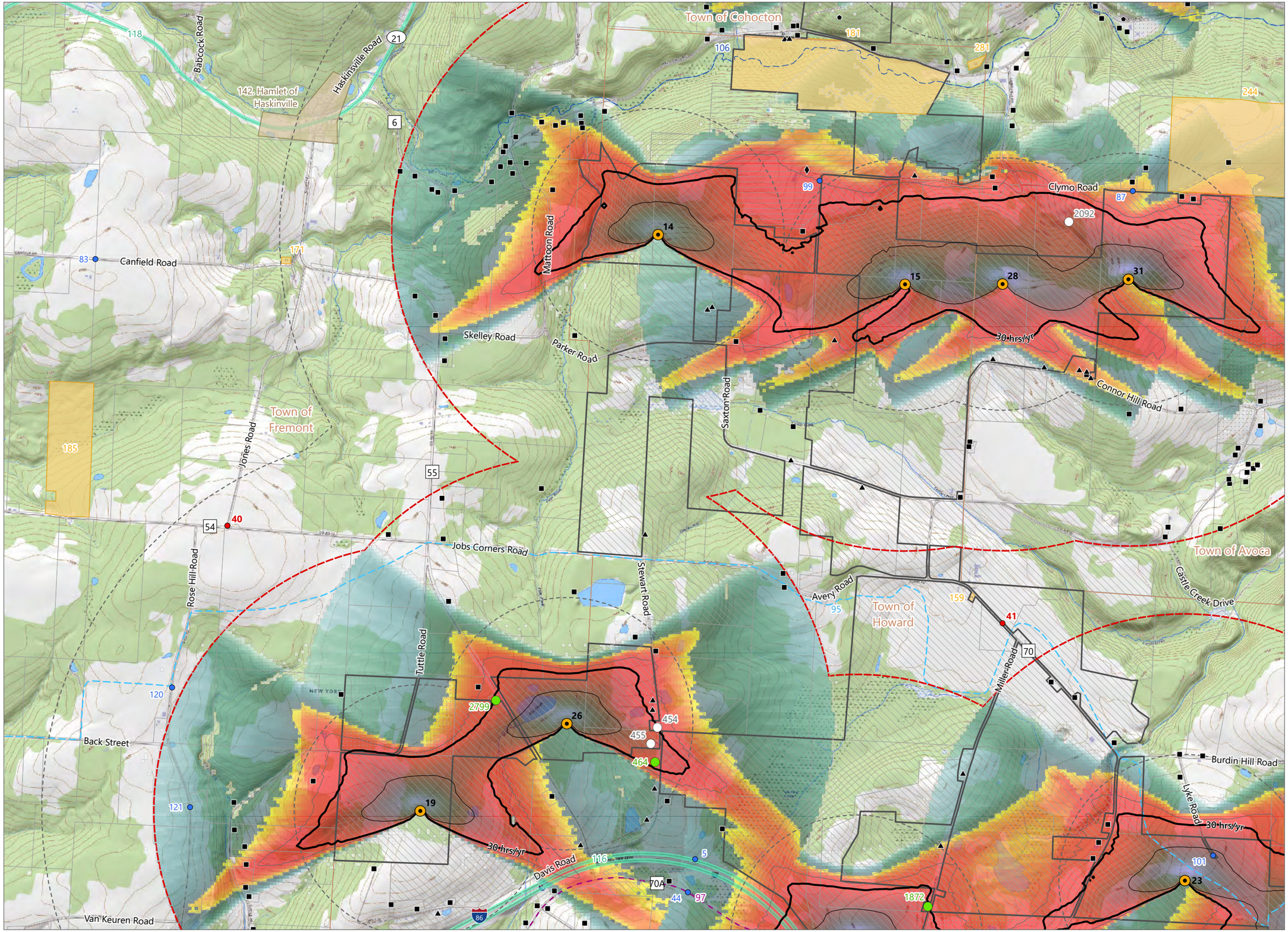
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

< 1	20 - 30
1 - 10	30 - 100
10 - 20	> 100

Visually Sensitive Resources

- State Bike Route
- River/Stream with Fishing Access
- Snowmobile Trail
- State/US/Interstate Highway
- NRHP-Eligible Resource
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.

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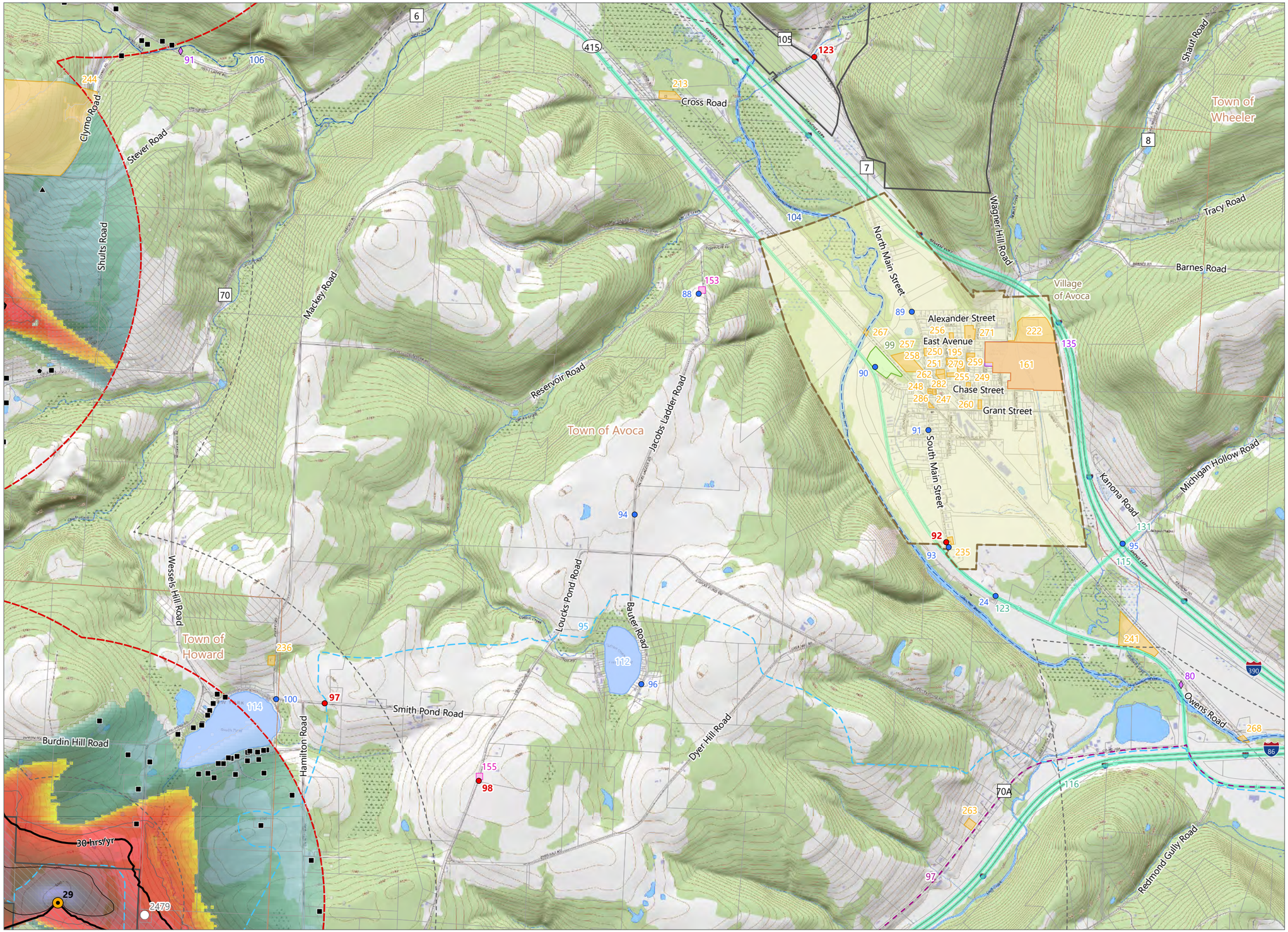
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

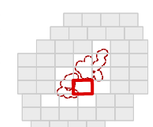
Visually Sensitive Resources

- State Fishing Waterway Access
- Stakeholder Identified Resource (Point)
- State Bike Route
- River/Stream with Fishing Access
- Snowmobile Trail
- State/US/Interstate Highway
- NRHP-Eligible Resource
- School
- Named Lake/Pond/Reservoir
- Local Park/Recreation
- City/Village

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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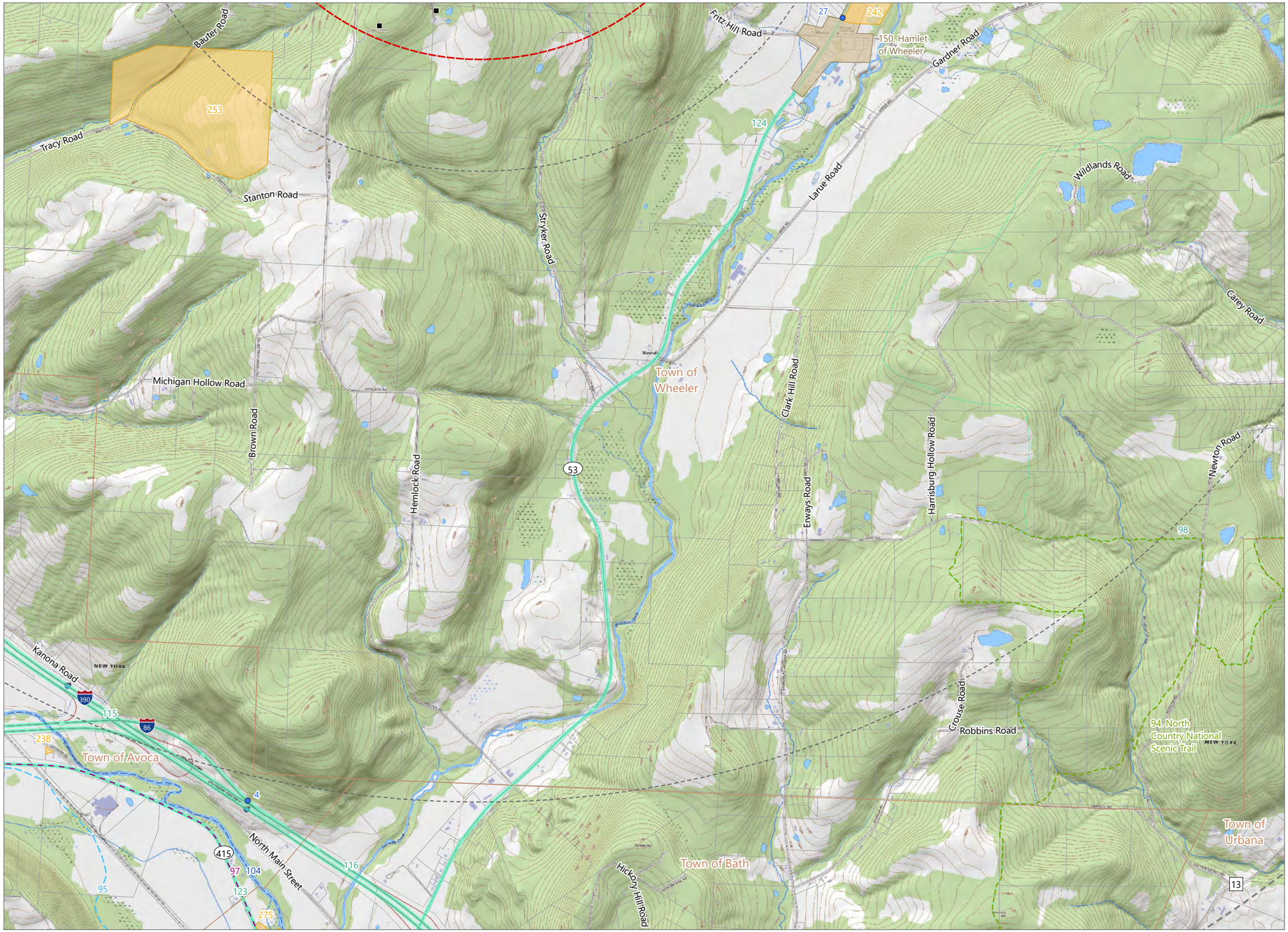
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

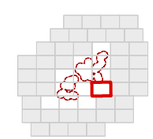
Visually Sensitive Resources

- State Bike Route
- State and Federal Trails
- River/Stream with Fishing Access
- Snowmobile Trail
- Other Trail
- State/US/Interstate Highway
- NRHP-Eligible Resource
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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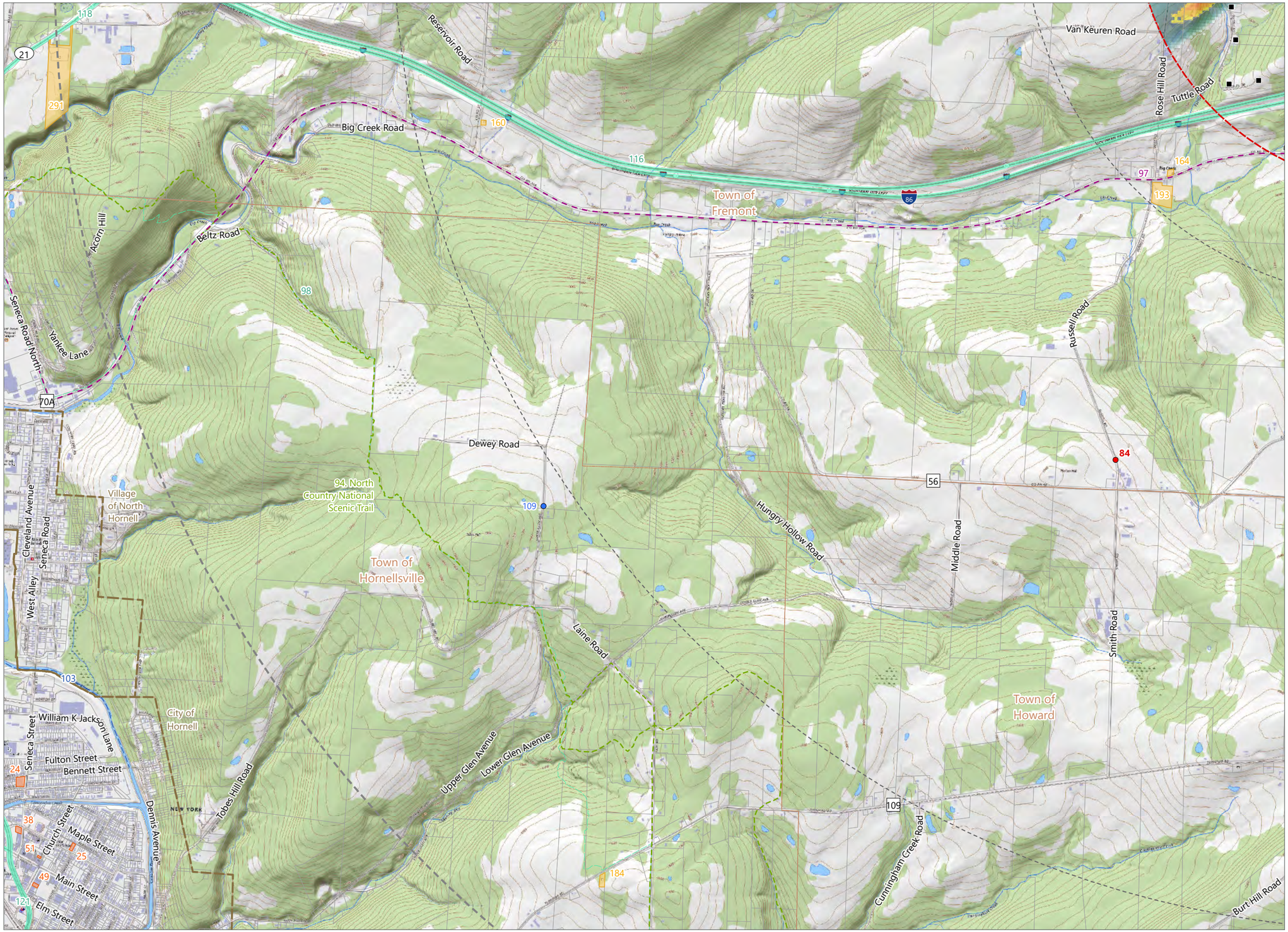
Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

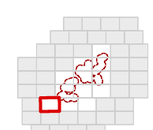
Visually Sensitive Resources

- State Bike Route
- State and Federal Trails
- River/Stream with Fishing Access
- Other Trail
- State/US/Interstate Highway
- NRHP-Listed Resource
- NRHP-Eligible Resource

Parcel Status

- Non-Participating Parcel

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



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Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker

Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

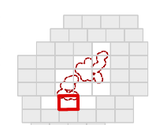
Visually Sensitive Resources

- State Bike Route
- State and Federal Trails
- Snowmobile Trail
- Other Trail
- State/US/Interstate Highway
- NRHP-Eligible Resource
- Named Lake/Pond/Reservoir
- Hamlet

Parcel Status

- Non-Participating Parcel
- Participating Parcel
- Potentially Participating Parcel
- Participating Parcel (Limited)

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



Sheet 39 of 52

Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 3. Projected Shadow Flicker

Prattsburgh Wind Farm

Towns of Avoca, Cohocton, Howard, Prattsburgh, and Wheeler
Steuben County, New York

Shadow Flicker Report

- Wind Turbine
- Non-participant > 30 Hours/Year
- Participant (Limited) > 30 Hours/Year
- Participant > 30 Hours/Year
- Non-participant < 30 Hours/Year
- Potential Participant < 30 Hours/Year
- Participant (Limited) < 30 Hours/Year
- Participant < 30 Hours/Year
- Simulation Viewpoint
- Viewpoint
- Facility Site
- 1,700-meter Study Area
- Distance Zone Transition

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100

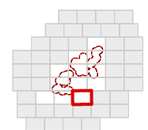
Visually Sensitive Resources

- State Bike Route
- State and Federal Trails
- River/Stream with Fishing Access
- Snowmobile Trail
- Other Trail
- State/US/Interstate Highway
- NRHP-Eligible Resource

Parcel Status

- Non-Participating Parcel

*Sheets shown in grey in the sheet locator inset are not included herein as they do not overlap the 1,700-meter Shadow Flicker Study Area.



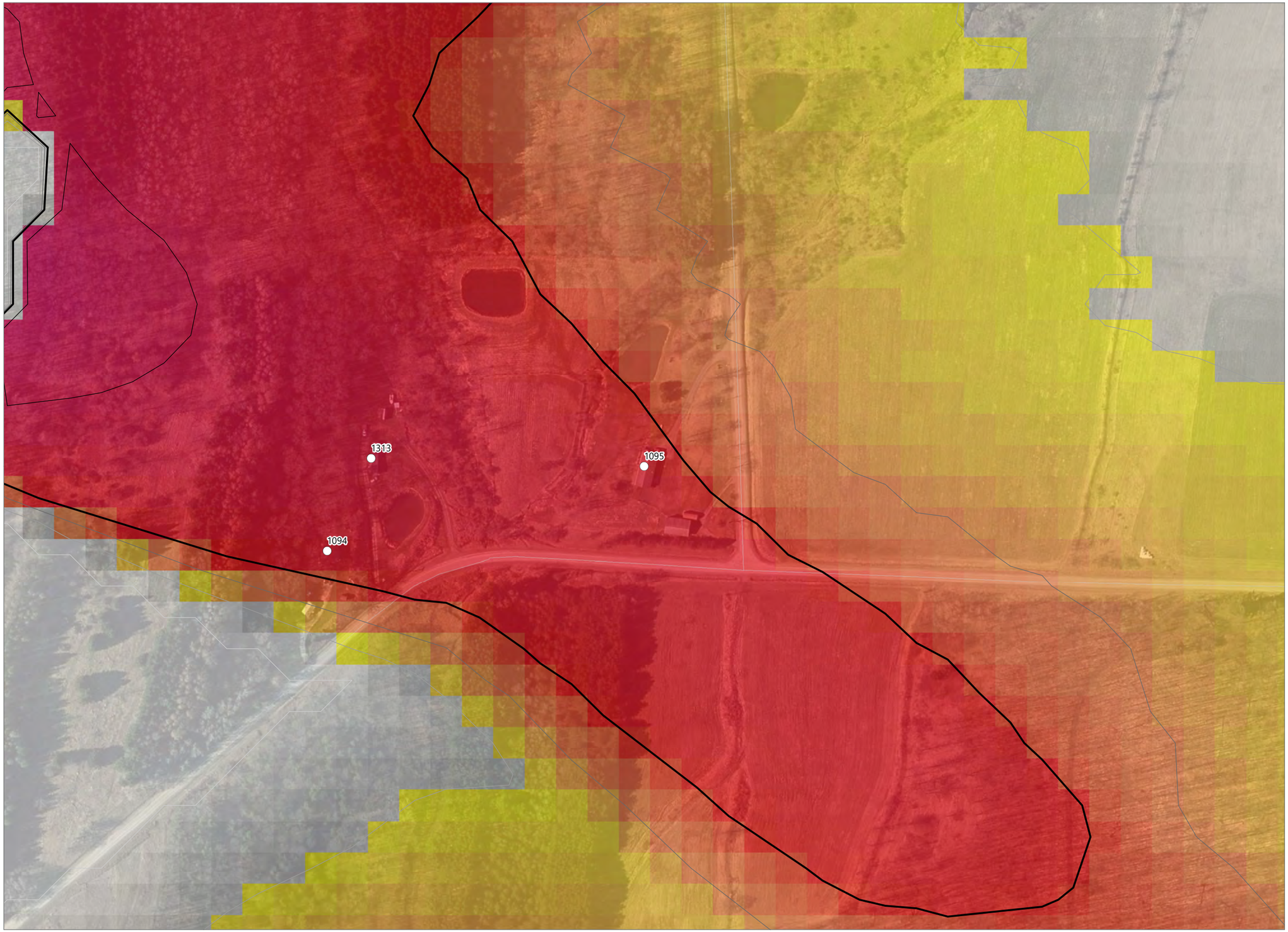
Sheet 40 of 52

Prepared August 16, 2023
Basemap: Esri "USGS Topo" map service

0 500 1,000 2,000
Feet

EDR

Figure 4. Phase II Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

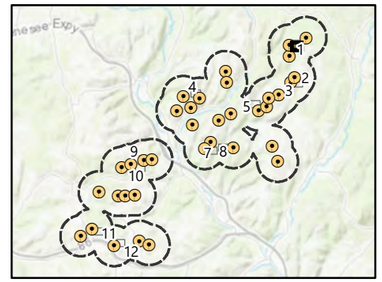
Phase II Receptor

Shadow Flicker Isolines

- 0 hours/year
- 10 hours/year
- 20 hours/year
- 30 hours/year
- 100 hours/year

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100



0 50 100 200

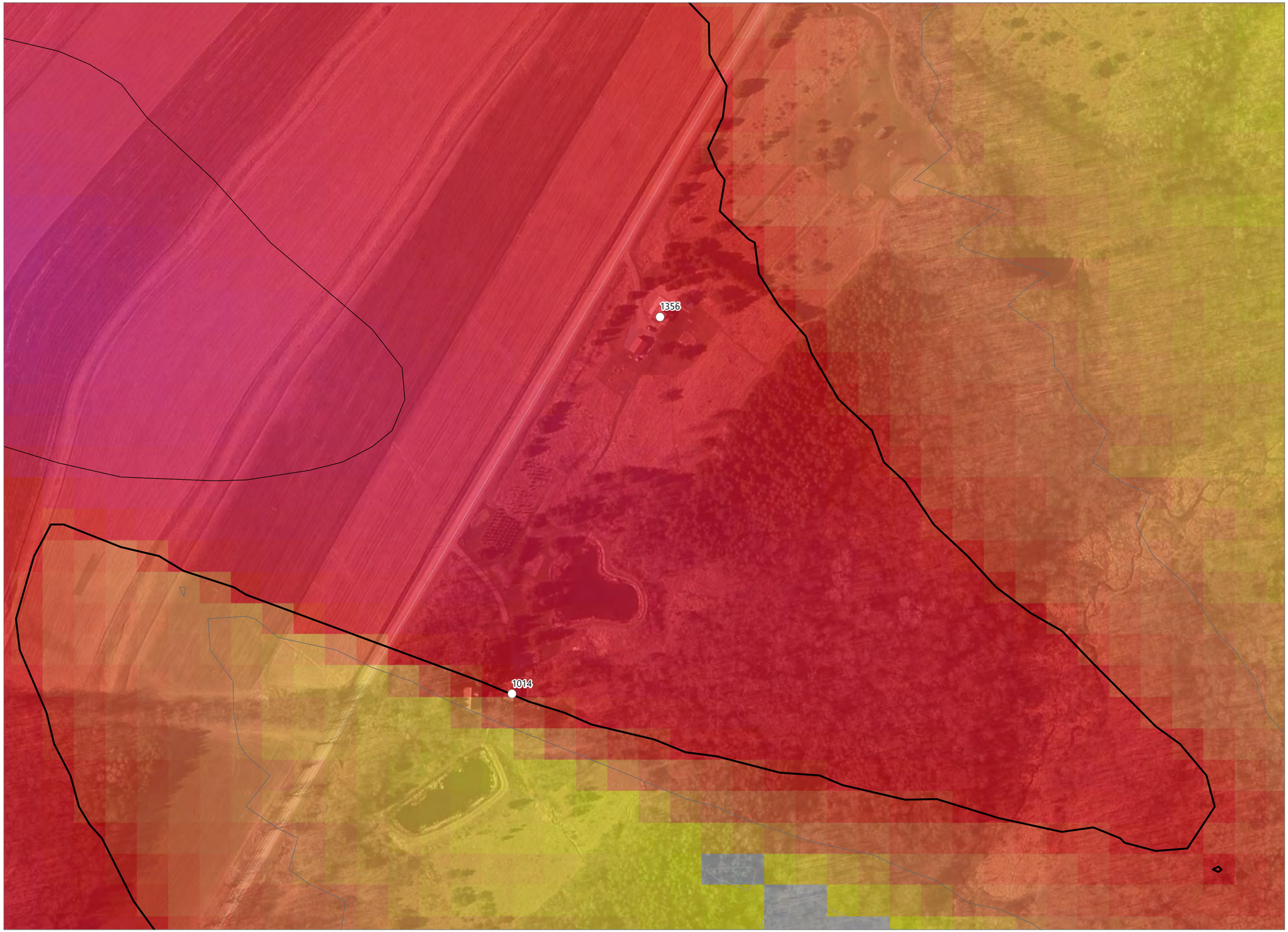
Feet

Prepared August 8, 2023

Basemap: NYSDOP "2020" orthoimagery map service.

EDR

Figure 4. Phase II Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

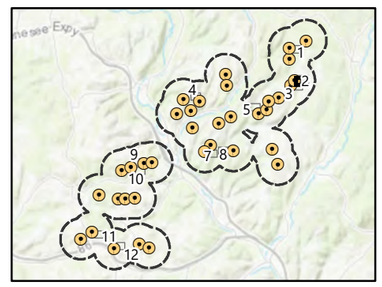
Phase II Receptor

Shadow Flicker Isolines

- 10 hours/year
- 20 hours/year
- 30 hours/year
- 100 hours/year

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100



0 50 100 200

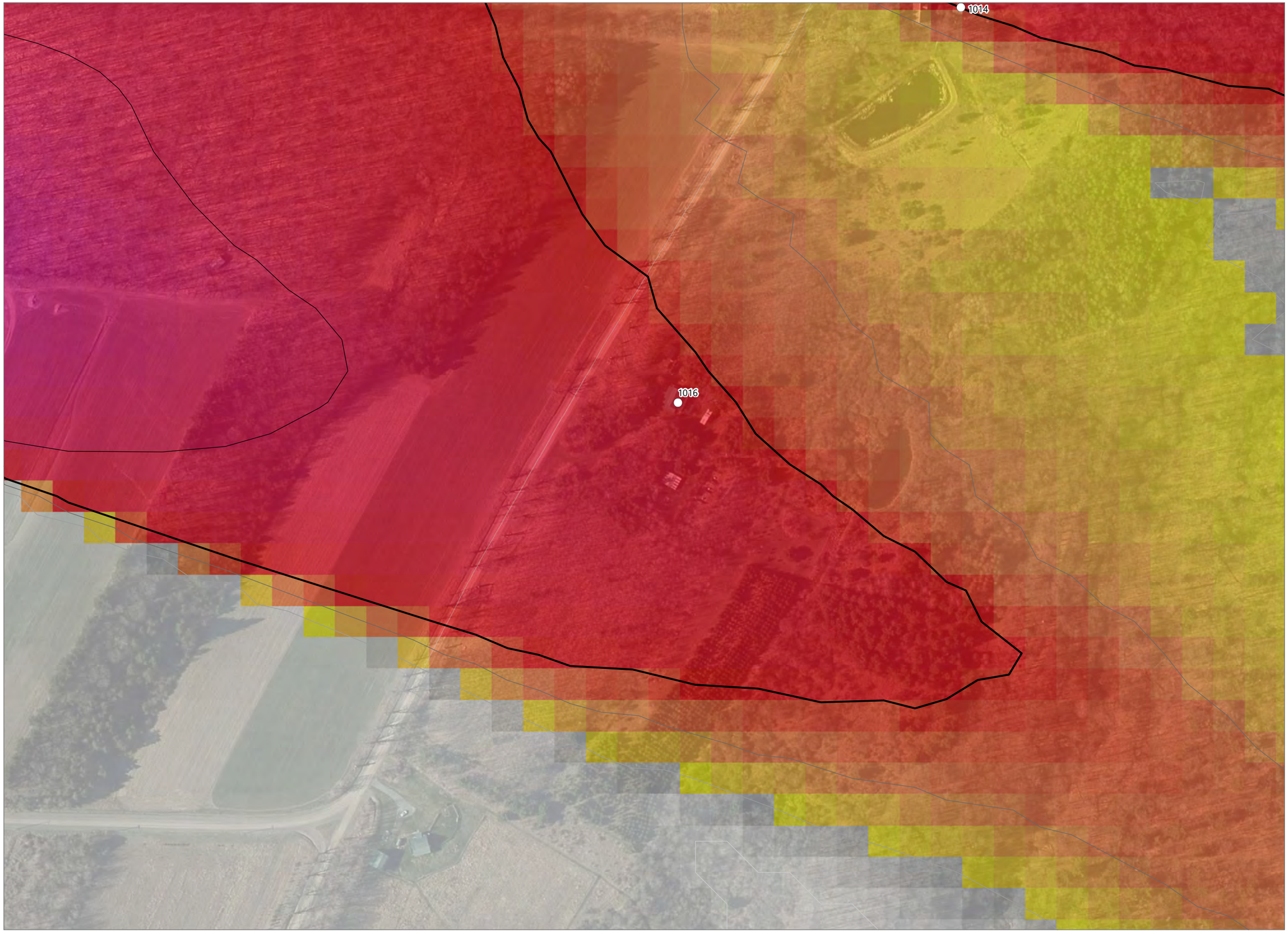
Feet

Prepared August 8, 2023

Basemap: NYSDOP "2020" orthoimagery map service.

EDR

Figure 4. Phase II Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

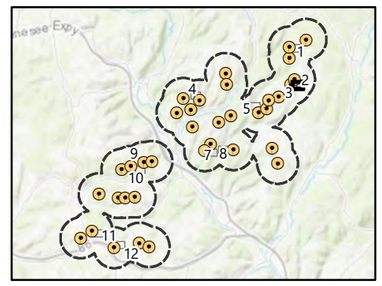
Phase II Receptor

Shadow Flicker Isolines

- 0 hours/year
- 10 hours/year
- 20 hours/year
- 30 hours/year
- 100 hours/year

Shadow Flicker (hours/year)

- < 1
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 100
- > 100



0 50 100 200

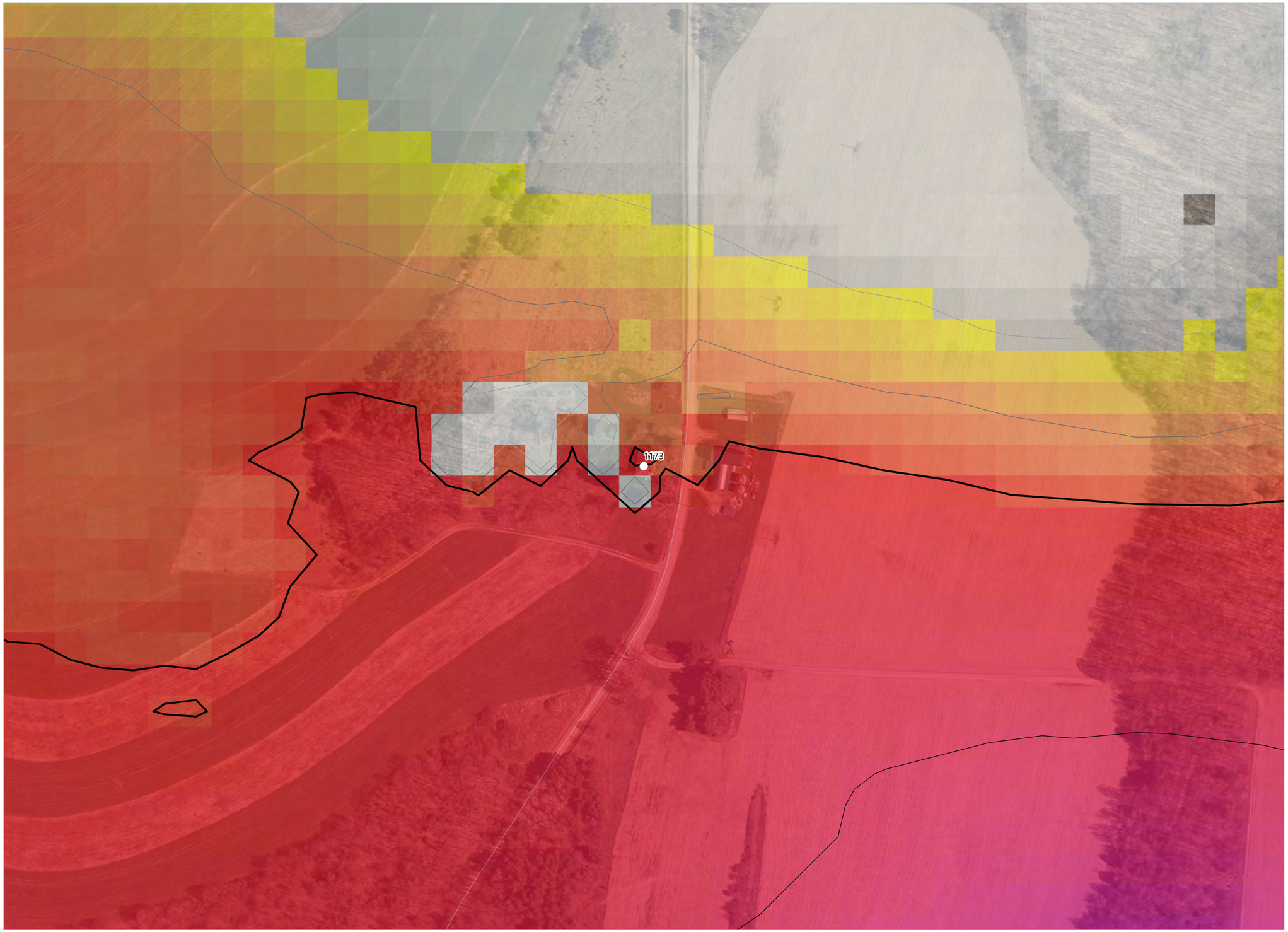
Feet

Prepared August 8, 2023

Basemap: NYSDOP "2020" orthoimagery map service.

EDR

Figure 4. Phase II Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

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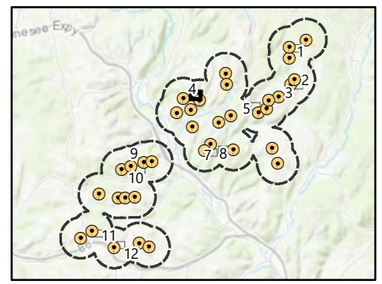

0 50 100 200
Feet

Prepared August 8, 2023
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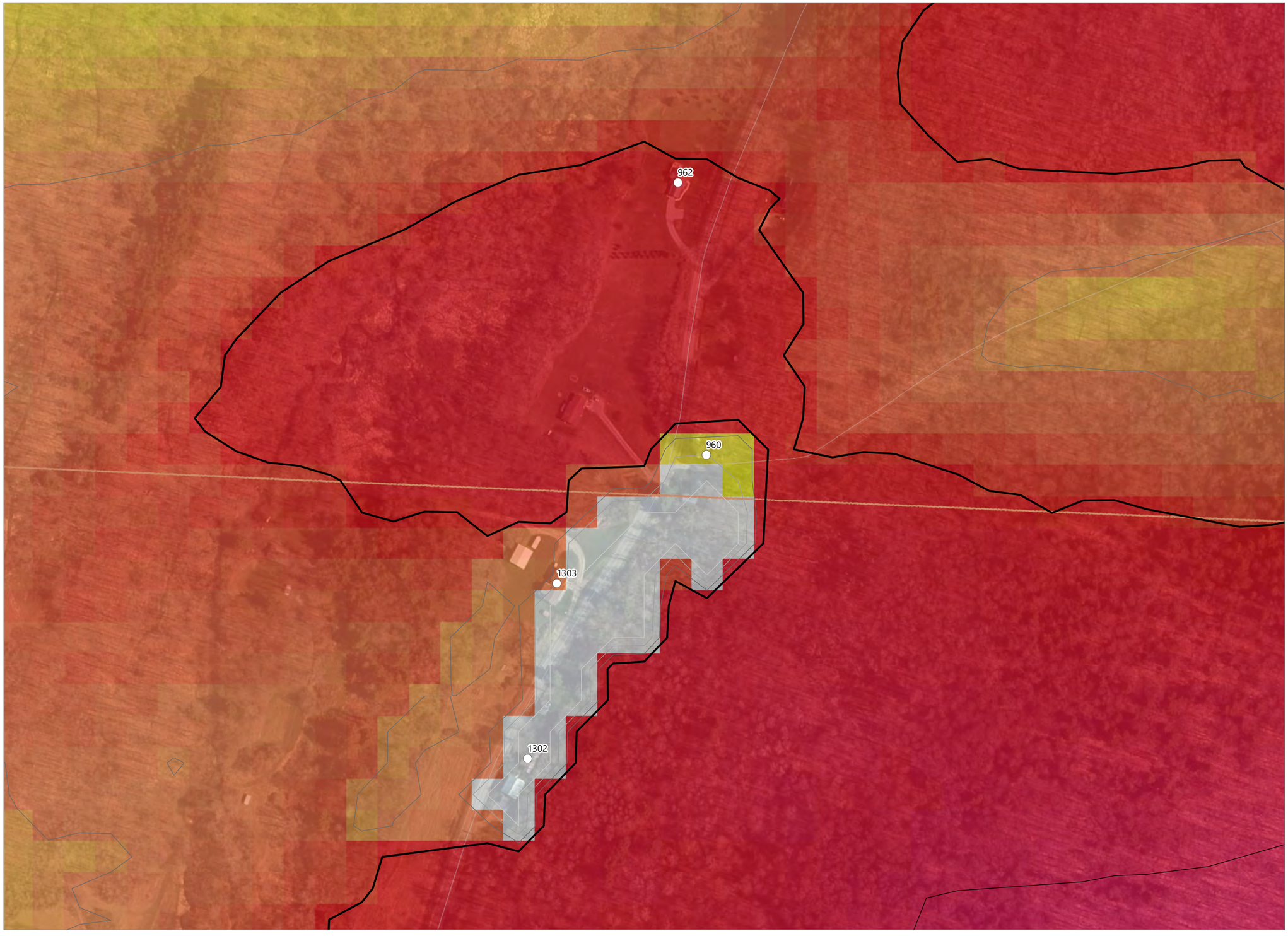
Figure 4. Phase II Projected Shadow Flicker



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

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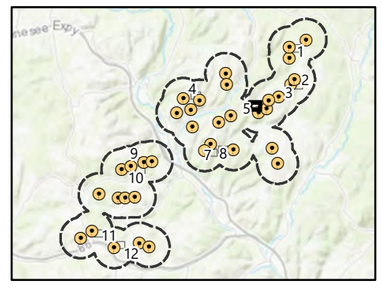

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Feet

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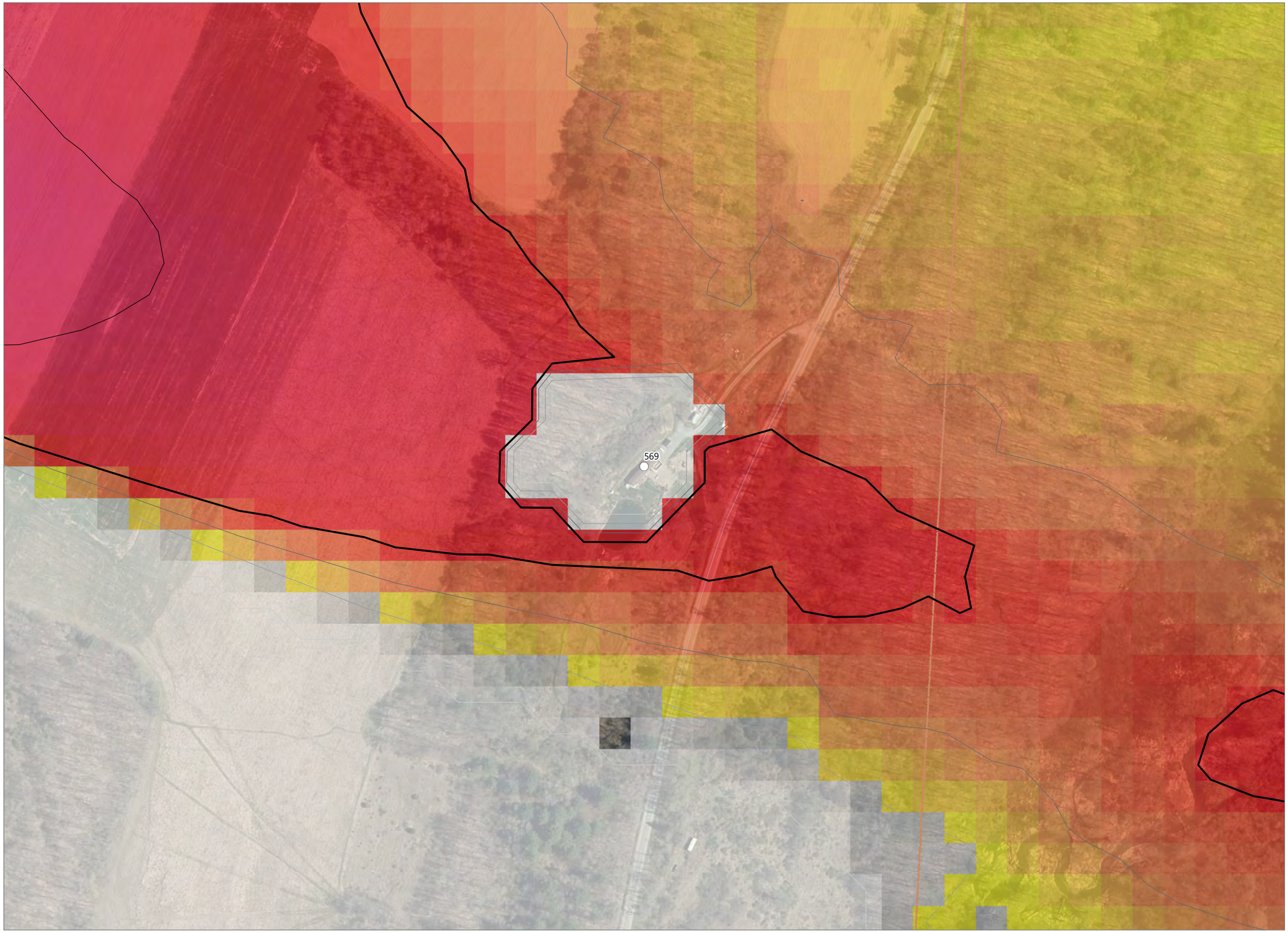

Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

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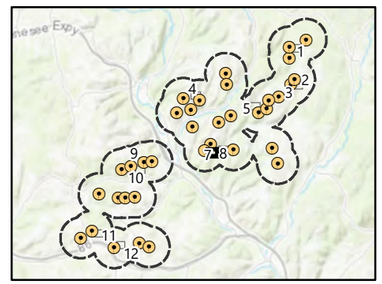

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Prepared August 8, 2023

Basemap: NYSDOP "2020" orthoimagery map service.

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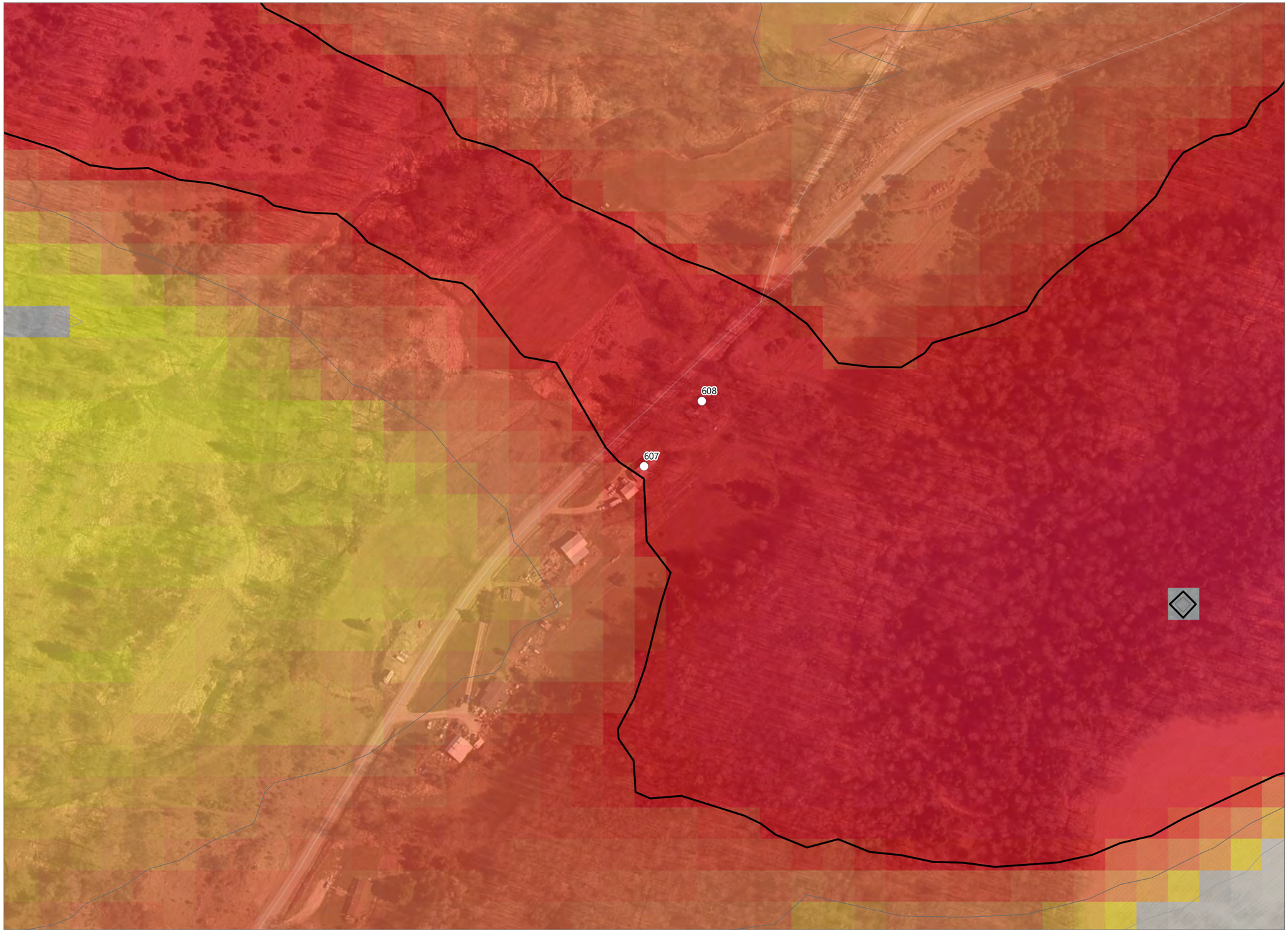

Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

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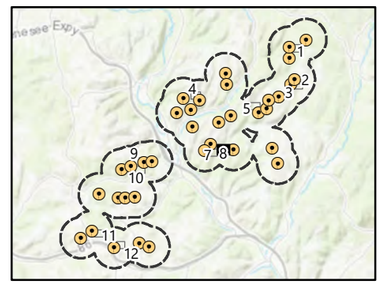

0 50 100 200

Feet

Prepared August 8, 2023

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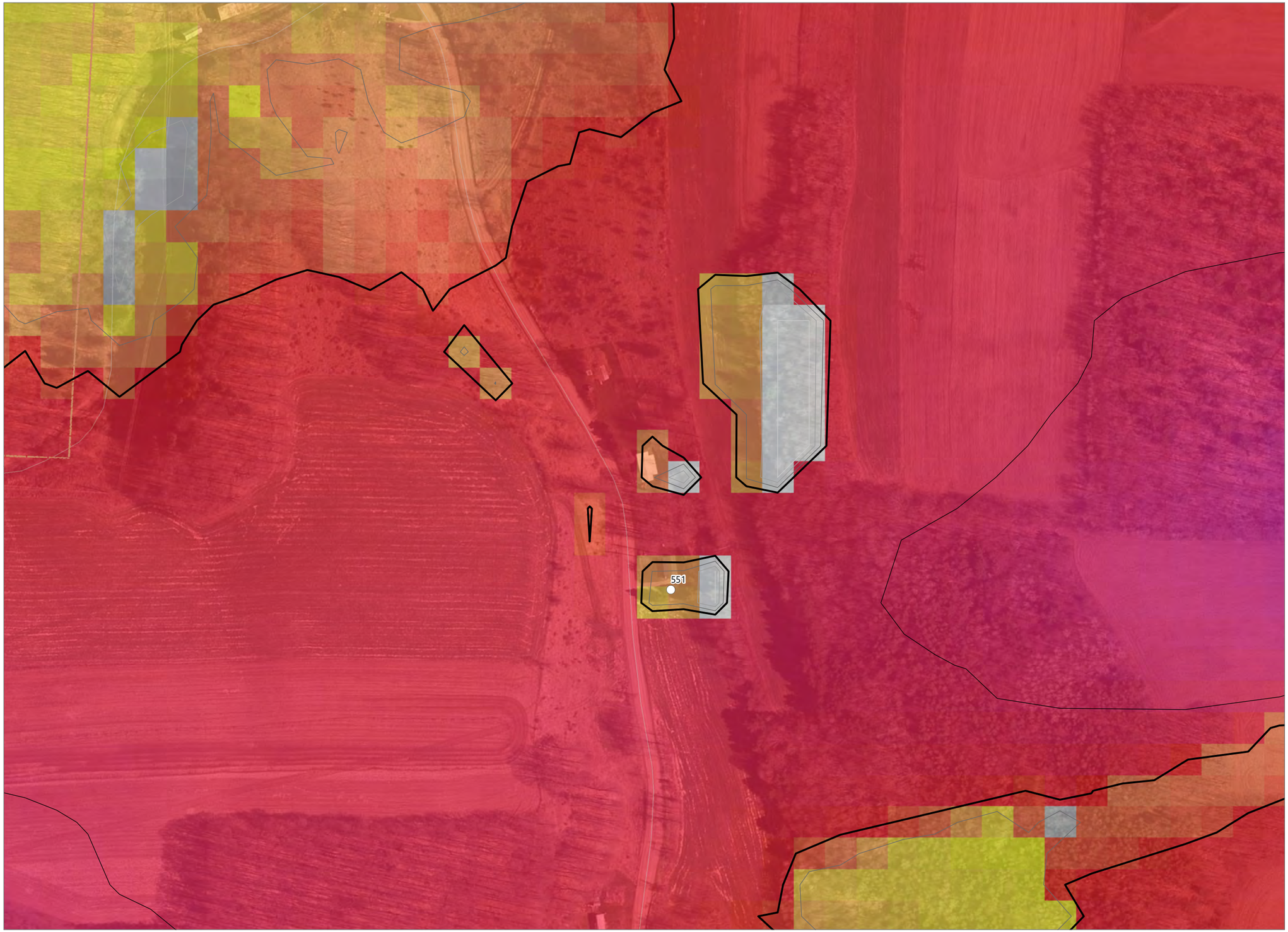

Prattsburgh Wind Farm

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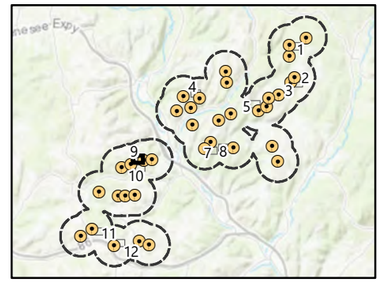

0 50 100 200

Feet

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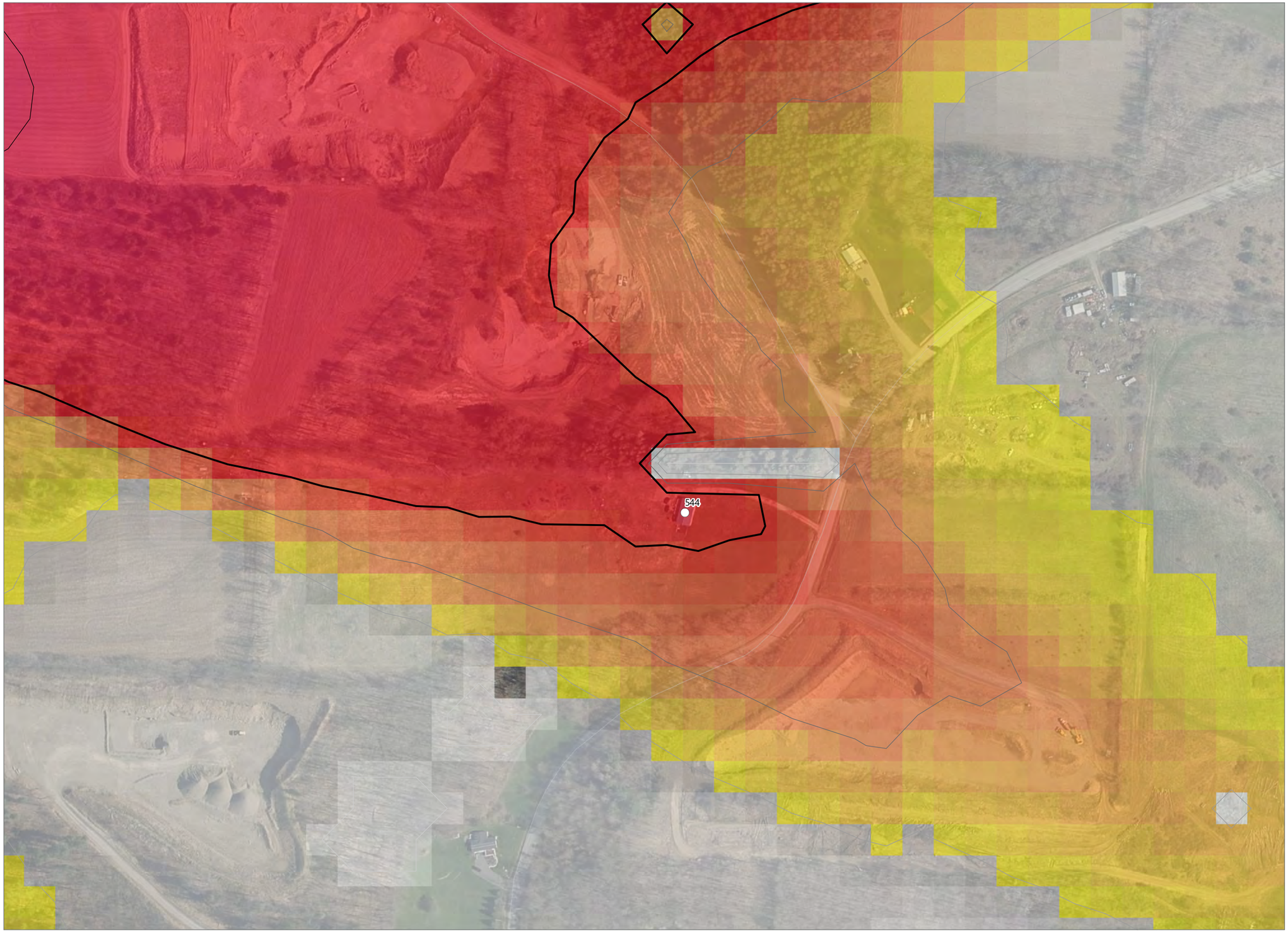

Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

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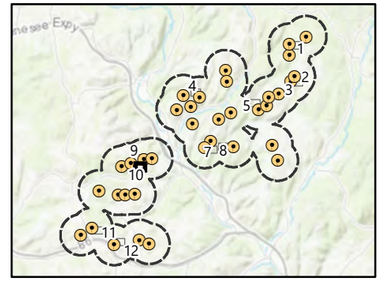

0 50 100 200

Feet

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EDR

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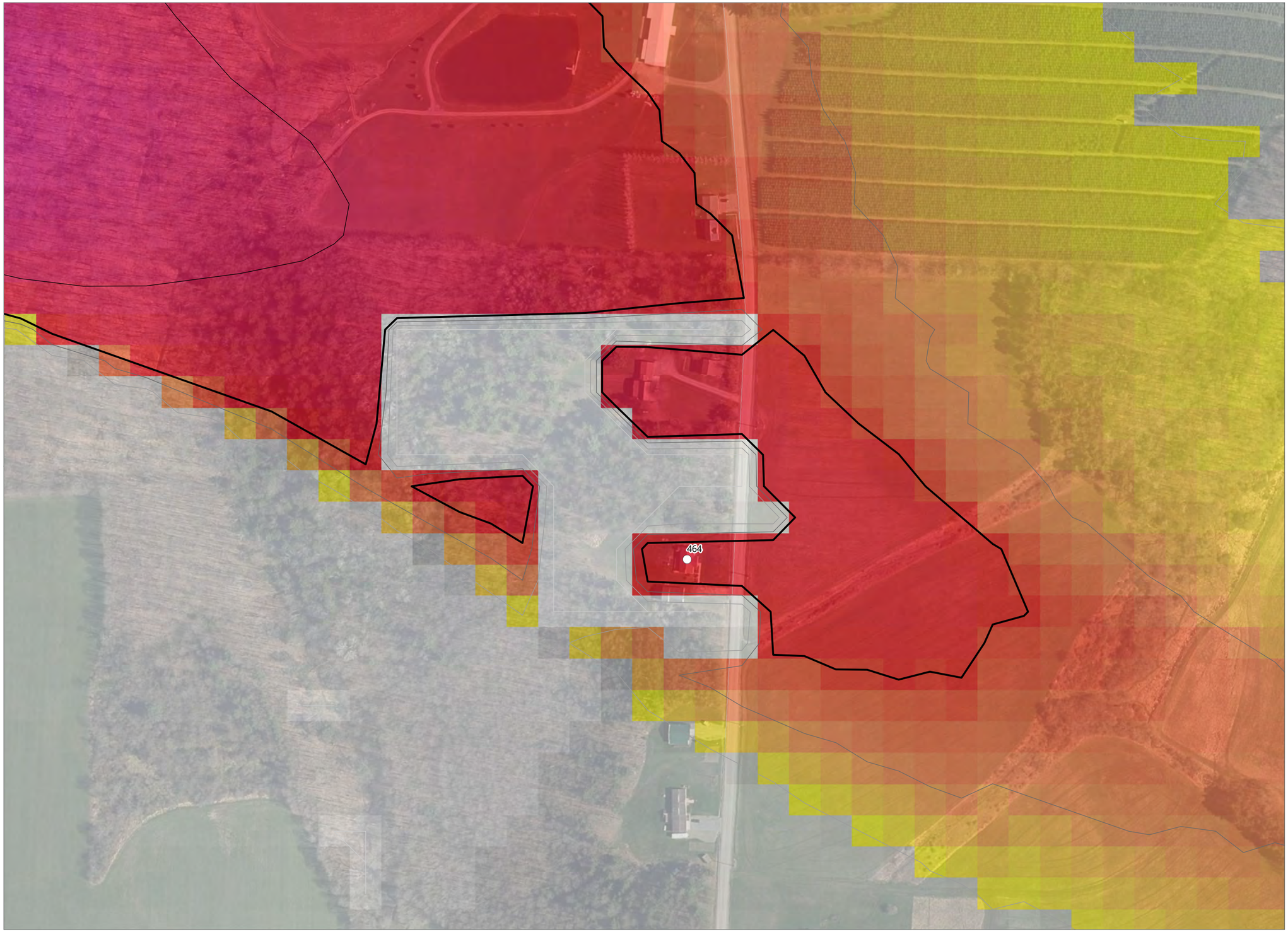

Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

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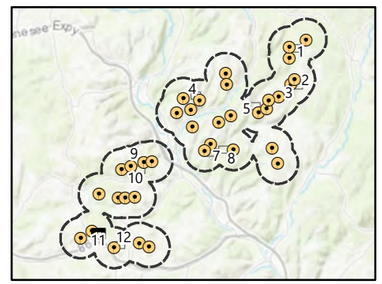

0 50 100 200

Feet

Prepared August 8, 2023

Basemap: NYSDOP "2020" orthoimagery map service.

EDR

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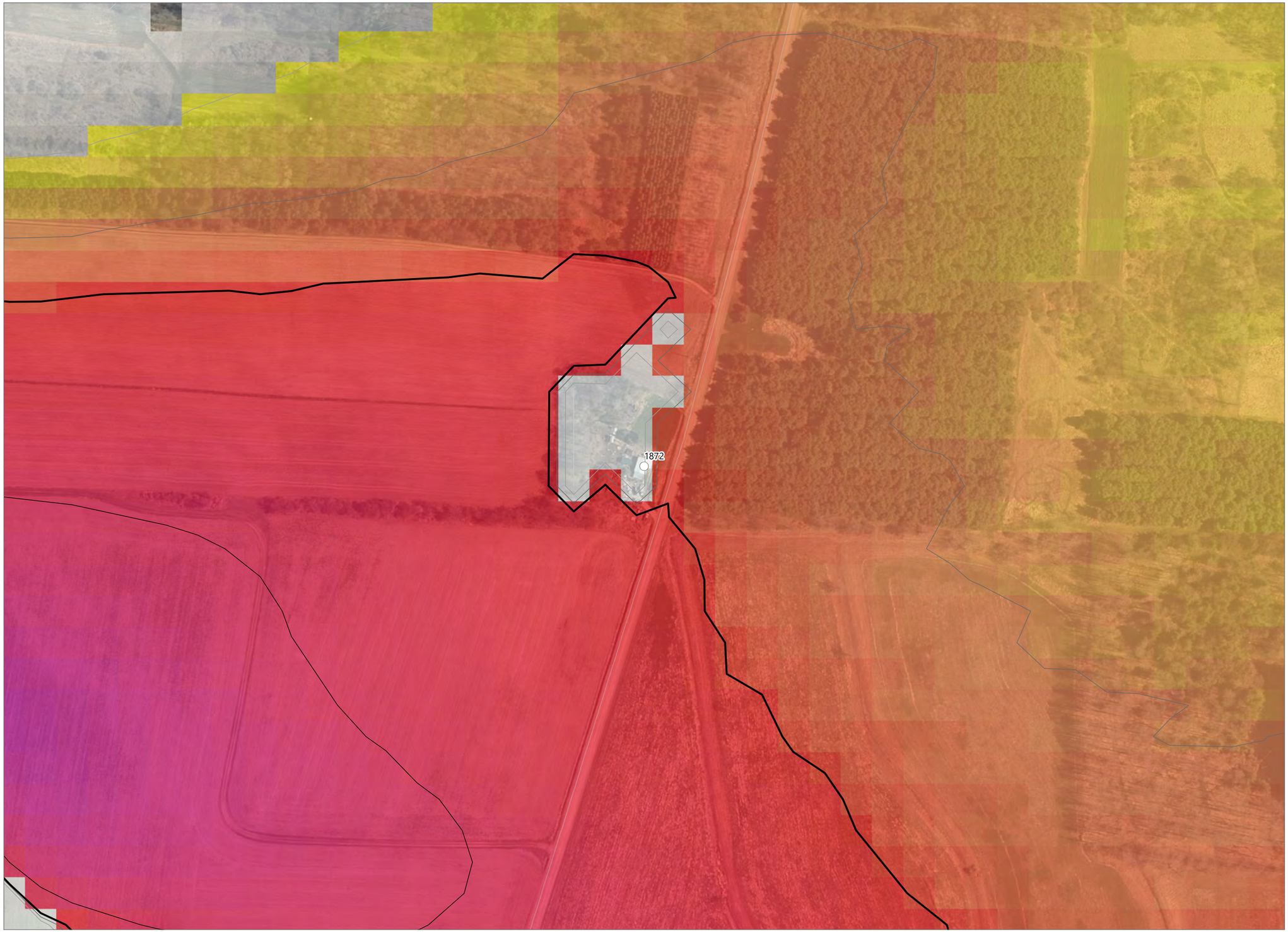

Prattsburgh Wind Farm

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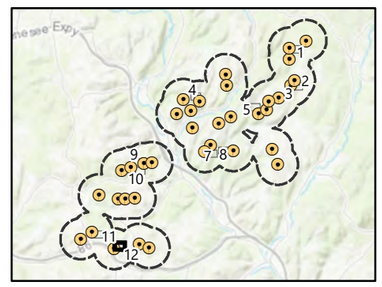


0 50 100 200

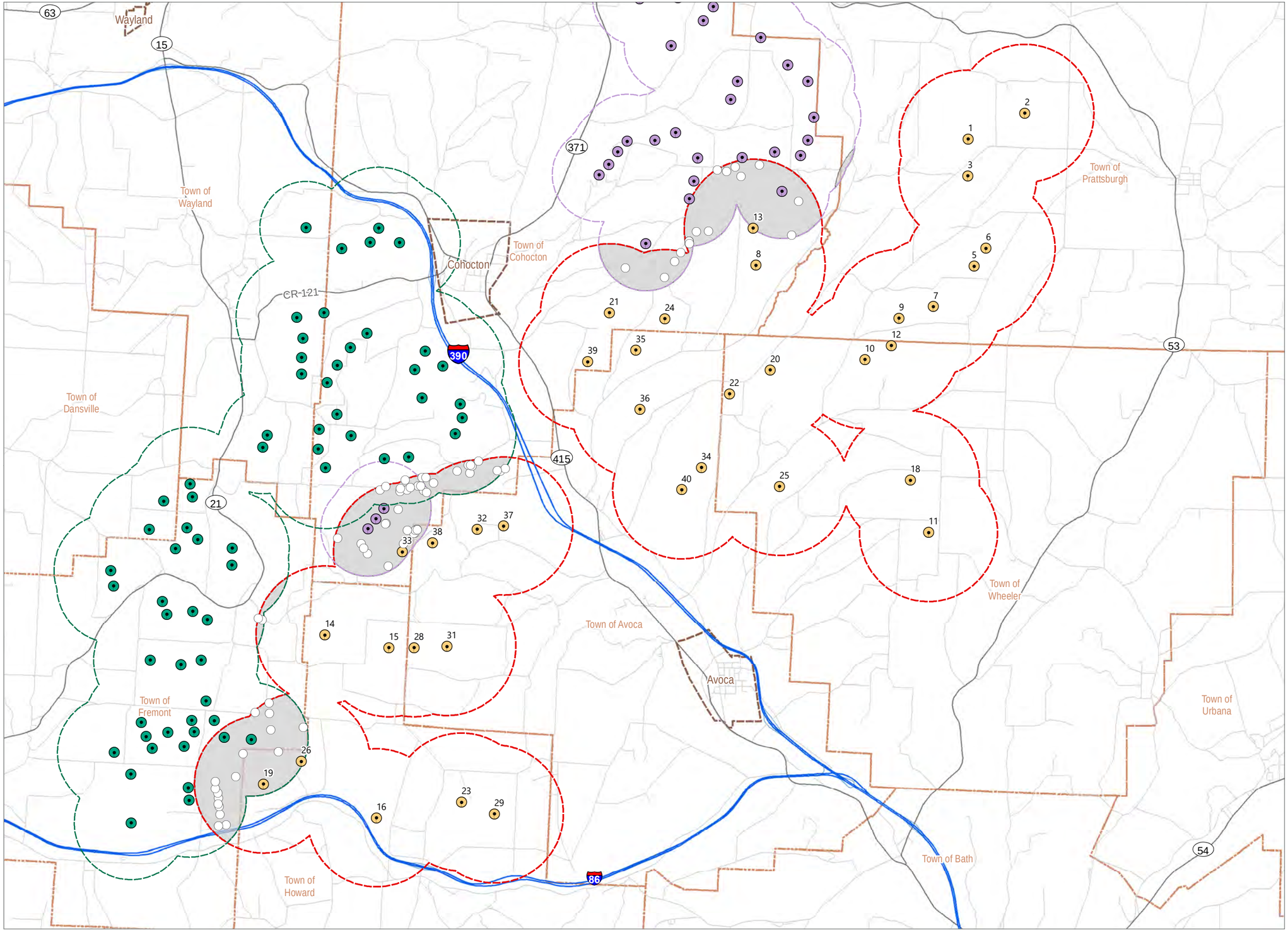
Feet

Prepared August 8, 2023

Basemap: NYSDOP "2020" orthoimagery map service.

EDR

Figure 5. Cumulative Impact Area



Prattsburgh Wind Farm

Towns of Prattsburgh, Avoca, Cohocton, Howard, and Wheeler, Steuben County, New York

Shadow Flicker Report

- Receptor for Cumulative Analysis
- Wind Turbine
- 1,700-meter Study Area
- Baron Winds Wind Turbine
- Baron Winds Study Area
- Cohocton Wind Turbine
- Cohocton Wind Study Area
- City/Village Boundary
- Town Boundary

0 0.5 1 2
Miles

Prepared August 8, 2023
Basemap: ESRI StreetMap North America, 2008.

EDR