Appendix C

Shadow Flicker Assessment: Plum Creek Wind Farm

Plum Creek Wind Farm, LLC
Docket No. IP6997 / WS-18-700
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ReGenerate
RENEWABLE ENERGY CONSULTING

Shadow Flicker Assessment

PROJECT: PLUM CREEK (MN)

DATE: OCTOBER 28, 2019

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Contents

Revision History

Issue	Date	Revision Purpose
1	27-Sep-19	Original
2	02-Oct-19	Minor Revisions and Correction for Typos
3	28-Oct-19	Update to WTG Layouts

1. Executive Summary

The Plum Creek Wind Farm in southwestern Minnesota has been studied for the impact of shadow flicker on surrounding residences. Modeling and topographic reviews were completed to determine potential results at receptor locations in and around the project.

The Project was reviewed for three different layout configurations:

- 74 Vestas V162-5.6 turbines at 125 m hub-height,
- 74 Vestas V150-5.6 turbines at 105 m hub-height and
- 110 GE-127-2.8 turbines at 89 m hub-height.

ReGenerate used WindPRO to model shadow flicker for 461 receptors. This model is likely to overestimate the shadow flicker experienced due to conservative assumptions.

The maximum value of shadow flicker at receptor locations is presented in the table below.

Layout	Participating		Non-Participating	
	0 – 30 hr/yr	30+ hr/yr	0 – 30 hr/yr	30+ hr/yr
V162-5.6 h125	124	19	318	0
V150-5.6 h105	117	26	318	0
GE-127-2.8 h89	135	8	318	0

The maximum value of shadow flicker for any layout was found to be 28.1 hr/yr for non-participating receptors while the maximum value for all receptors was found to be 114.8 hr/yr.

Appendix I shows the spatial mapping for shadow flicker results. Appendix II shows turbine coordinates provided for the Plum Creek Wind Farm. Appendix III shows the results at each receptor analyzed for this study.

2. Introduction

The Plum Creek Wind Farm (Project) is being developed by Geronimo Energy (Geronimo) in southwestern Minnesota. Merjent (on behalf of Geronimo) has retained ReGenerate Consulting (ReGenerate) to carry out an independent analysis of the shadow flicker effects caused by the proposed Project.

The Project was reviewed for three different layout configurations, these being:

- 74 Vestas V162-5.6 turbines at 125 m hub-height;
- 74 Vestas V150-5.6 turbines at 105 m hub-height; and
- 110 GE-127-2.8 turbines at 89 m hub-height.

These layouts were provided by Geronimo and dated 24-Oct-19. These turbines can cause shadow flicker throughout the Project area and this effect was studied at sensitive locations (receptors) to quantify the impact before the proposed Project is constructed. The impact was calculated for 461 receptors, 143 of which are participating receptors and 318 are non-participating.

The objective of this assessment is to predict the shadow flicker levels generated by the project at all receptors within or near the project area and in accordance with any applicable regulations as described in further detail later in the report. This report describes the Project site, shadow flicker methodology and results of the analysis.

3. Background

The cumulative effects of turbine generated shadow flicker throughout the Project area were studied to determine the impact on sensitive receptors. This effect occurs when wind turbine blades cast a moving shadow across the ground and nearby structures; this is perceived as a flickering effect due to the constant rotation of the blades. Flicker occurs when the following conditions are met: turbine is operating, sun is shining with insignificant cloud cover, turbine blades are positioned directly between the sun and receptor, and the receptor is close enough to distinguish the shadow created.

ReGenerate used the WindPRO software to model shadow flicker for this project. [1] Calculation of potential shadow impact is carried out by simulating the position of the sun relative to the turbine rotor swept area with the resulting shadow calculated in steps of 1 minute throughout a complete year. If the shadow at any time casts a shadow reflection on the window defined for the receptor, this step will be registered as 1 minute of potential shadow impact. Information required in this calculation includes: position of wind turbines, turbine hub height and rotor diameter, position of receptor, terrain elevation, window information (height, size, azimuth and tilt), time zone and daylight saving time information and simulation model which holds information about the earth's orbit and rotation relative to the sun. A diagram of this simulation is presented in Figure 1 below.

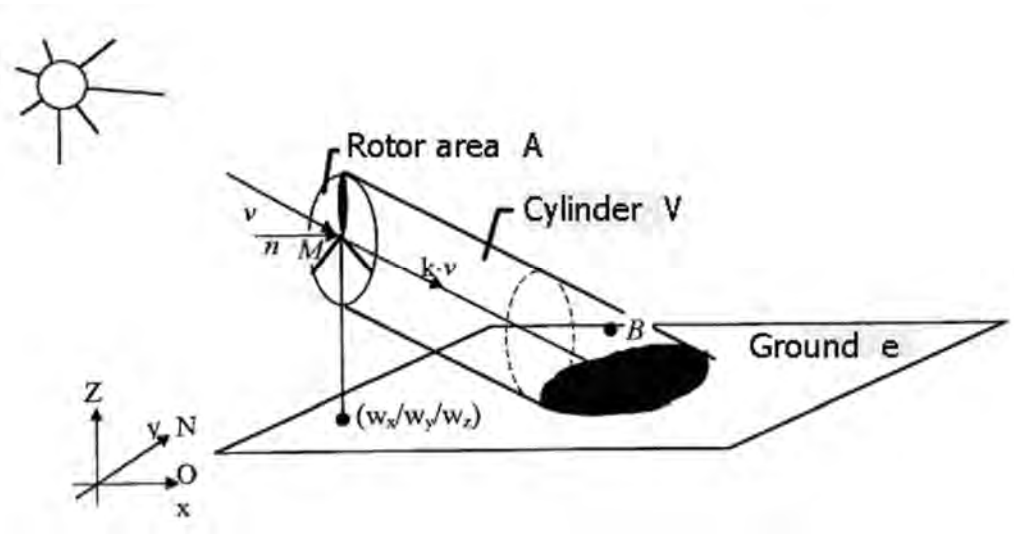

Figure 1: Diagram of Shadow Flicker Model Simulation [1]

This simulation will provide worst case results, to determine a more realistic scenario the wind direction and cloud cover may be incorporated. In the absence of wind direction data, the model will assume that the rotor swept area is always perpendicular to the sun. Wind direction data are generally gathered from on-site meteorological mast measurements or a nearby reference data set. Measured monthly sunshine data from local data sources may also be incorporated in order to account for cloud cover and visibility at times when the solar disk is not prominent enough perceive shadow flicker.

Available scientific evidence suggests that shadow flicker impact from wind turbines is unlikely to affect human health. [2] It can however be considered a nuisance for homeowners near wind turbines, especially those that frequently experience shadow flicker.

4. Project Details

The Project is located near Tracy, Minnesota in agricultural land consisting mostly of rolling hills. There are scattered dwellings, farm buildings and trees throughout the project area.

Geronimo provided ReGenerate with the coordinates of turbines and receptors for the Project. The layouts feature 74 Vestas V162-5.6 turbines at 125 m hub-height, 74 Vestas V150-5.6 turbines at 105 m hub-height or 110 GE-127-2.8 turbines at 89 m hub-height. Both Vestas layouts share the same turbine coordinates. The coordinates provided for turbines are shown in Appendix II; coordinates for receptors can be found in Appendix III.

No information on neighboring projects was provided. A cursory review by ReGenerate did not indicate any operating wind farms with the immediate project area that would have an impact on the shadow flicker results.

5. Project Regulations

Geronimo has identified an internal design standard limiting non-participating receptors to 30 hours per year of shadow flicker. [3] There are no known state or local regulations establishing a shadow flicker limit.

6. Modeling Procedures

ReGenerate used the WindPRO software to model shadow flicker. [1] Modeling assumptions for the shadow flicker analysis include:

- Turbine is operating 100% of the time;
- Flicker is modeled out to ten times the rotor diameter from each respective turbine;
- Flicker is ignored if sun is less than 3° above horizon;
- Default observer eye level is 1.5 m;
- Receptors are perpendicular to all turbines, also known as greenhouse mode;
- Monthly sunshine probability has been modeled from nearest meteorological station;
- Data source for monthly sunshine hours was from the Minneapolis-St. Paul, MN location of usclimatedata.com with data from 1981 – 2010 annual climate normals;
- Turbine orientation is taken into account; and
- Obstacles (like trees or buildings) are not taken into account.

ReGenerate studied nearby meteorological reference stations available from usclimatedata.com (USCD) historical norms and from the Global Historical Climatology Network (GHCN) for this analysis; see Table 1, below. [4,5]

Station	State	Average Sunshine [hr/day]	Distance from Project [km]
Minneapolis-St. Paul	MN	7.1	233
Sioux Falls	SD	7.0	75
Des Moines	IA	7.3	335

Table 1: Meteorological reference stations

Though the closest station, the Sioux Falls station exhibited numerous days of erroneous data and was therefore excluded from the analysis. Based on the proximity and more similar latitude, the Minneapolis-St. Paul meteorological station was chosen as most representative. Monthly average sunshine hours per month for the Minneapolis-St. Paul station are shown in Table 2 below:

Minneapolis-St. Paul Average Sunshine [hr/month]											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
140	166	200	231	272	302	343	296	237	193	115	112

Table 2: Average sunshine hours per month

The wind direction frequency was considered to account for turbine orientation of the rotor area relative to the sun. This data was provided by Geronimo from the 1801 on-site met mast from the Project. The wind frequency rose is shown below as Figure 2.

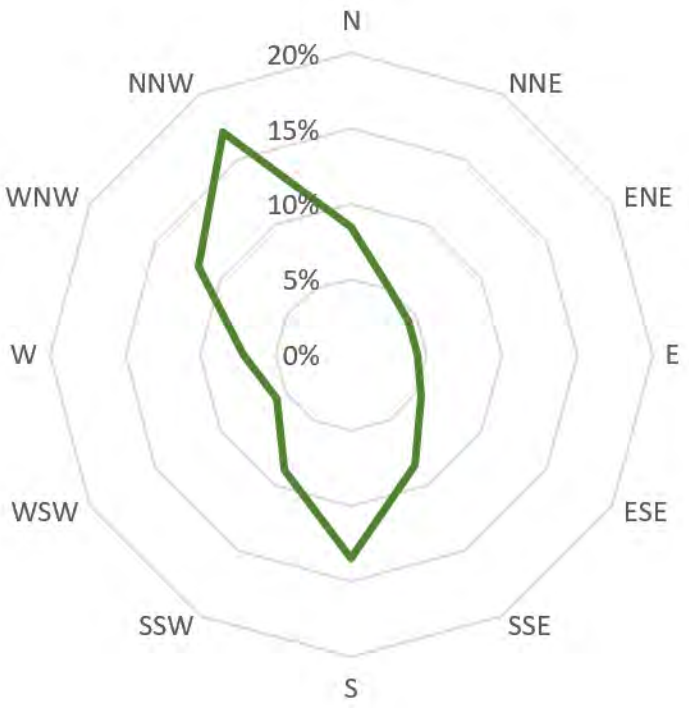

Figure 2: Wind Frequency Rose for Plum Creek Project

This model is still likely to produce estimates higher than those which will actually be experienced. Factors that will lower the impact, but not modeled include:

- Availability of the turbines;
- Turbines not operating below cut-in and above cut-out;
- Obstacles (like trees or buildings) obstructing shadow flicker; and
- Dust or aerosols in the air which reduce the impact of shadow flicker.

The methodology implemented as part of these models is realistic enough to be recommended for turbine siting purposes by ReGenerate Consulting.

7. Modeling Results

The effect on receptors has been quantified using the methodology described above and the maximum value of shadow flicker was found to be 28.1 hr/yr for non-participating receptors while the maximum value for all receptors was found to be 114.8 hr/yr . A summary of the results can be seen below in Table 3 - Table 6; detailed results can be found in Appendix III.

Layout	Maximum Shadow Flicker [hr/yr]	
	Participating	Non-Participating
V162-5.6 h125	114.8	22.0
V150-5.6 h105	100.7	18.0
GE-127-2.8 h89	62.2	28.1

Table 3: Maximum Shadow flicker results

Shadow Flicker [hr/yr]	Participating		Non-Participating		Total	
	№ Receptors	% of Receptors	№ Receptors	% of Receptors	№ Receptors	% of Receptors
0	76	53.15%	278	87.42%	354	76.79%
0.1 to 20	29	20.28%	39	12.26%	68	14.75%
20.1 to 30	12	8.39%	1	0.31%	13	2.82%
30.1 to 40	10	6.99%	0	0.00%	10	2.17%
40.1 to 50	8	5.59%	0	0.00%	8	1.74%
50.1 to 60	2	1.40%	0	0.00%	2	0.43%
60.1 to 100	5	3.50%	0	0.00%	5	1.08%
100.1 or more	1	0.70%	0	0.00%	1	0.22%

Table 4: Shadow flicker results summary for V162-5.6 h125

Shadow Flicker [hr/yr]	Participating		Non-Participating		Total	
	№ Receptors	% of Receptors	№ Receptors	% of Receptors	№ Receptors	% of Receptors
0	79	55.24%	284	89.31%	363	78.74%
0.1 to 20	32	22.38%	34	10.69%	66	14.32%
20.1 to 30	13	9.09%	0	0.00%	13	2.82%
30.1 to 40	9	6.29%	0	0.00%	9	1.95%
40.1 to 50	5	3.50%	0	0.00%	5	1.08%
50.1 to 60	2	1.40%	0	0.00%	2	0.43%
60.1 to 100	2	1.40%	0	0.00%	2	0.43%
100.1 or more	1	0.70%	0	0.00%	1	0.22%

Table 5: Shadow flicker results summary for V150-5.6 h105

Shadow Flicker [hr/yr]	Participating		Non-Participating		Total	
	№ Receptors	% of Receptors	№ Receptors	% of Receptors	№ Receptors	% of Receptors
0	60	41.96%	236	74.21%	296	64.21%
0.1 to 20	64	44.76%	79	24.84%	143	31.02%
20.1 to 30	11	7.69%	3	0.94%	14	3.04%
30.1 to 40	4	2.80%	0	0.00%	4	0.87%
40.1 to 50	2	1.40%	0	0.00%	2	0.43%
50.1 to 60	1	0.70%	0	0.00%	1	0.22%
60.1 to 100	1	0.70%	0	0.00%	1	0.22%
100.1 or more	0	0.00%	0	0.00%	0	0.00%

Table 6: Shadow flicker results summary for GE-127-2.8 h89

8. Conclusions

The maximum value of shadow flicker was found to be 28.1 hr/yr for non-participating receptors, this is below the limit of 30 hr/yr at all non-participating receptors. The maximum value for all receptors was found to be 114.8 hr/yr

9. References

[1] EMD International A/S. (Apr 2019). WindPRO 3.3 User Manual – 6 Environment. Retrieved from http://help.emd.dk/WindPRO/content/windPRO3.3/c6-UK_WindPRO3.3-Environment.pdf.

[2] Knopper, Loren D et al. "Wind turbines and human health." *Frontiers in public health* vol. 2 63. 19 Jun. 2014, doi:10.3389/fpubh.2014.00063.

[3] Phone call with Brie Anderson, Chris Nuckols and Ryan McDevitt. 07-Aug-2019.

[4] U.S. Climate Data. (2018). Climate Minneapolis – Minnesota. Retrieved from https://www.usclimatedata.com/climate/minneapolis/minnesota/united-states/usmn0503.

[5] National Oceanic and Atmospheric Administration. (May 2018). Global Histroical Climatoligy Network (GHCN). Retrieved from https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/global-historical-climatology-network-ghcn.

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Appendix I – Maps

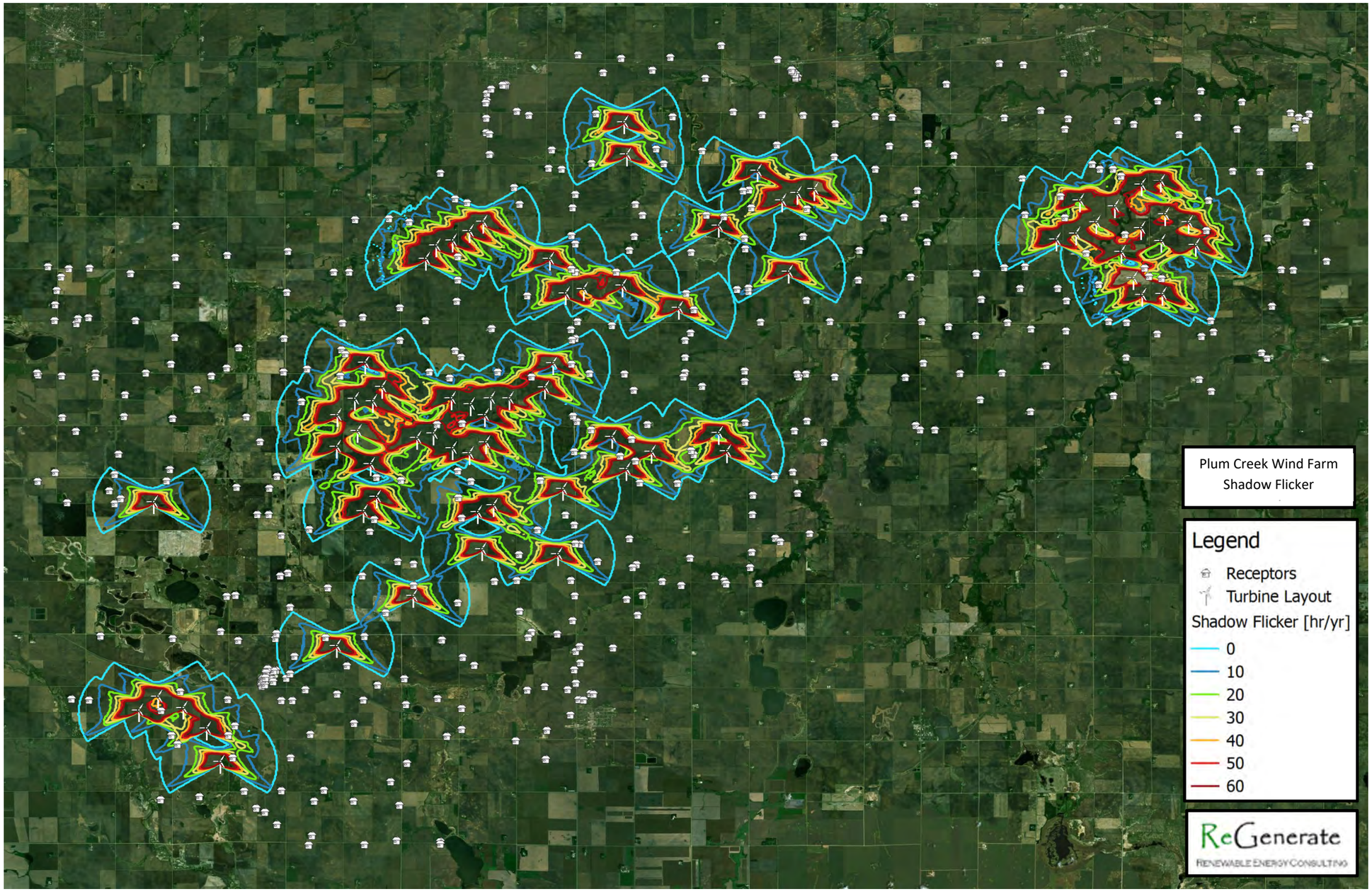

Figure 3: Shadow Flicker Map of Plum Creek Wind Project – V162-5.6 h125

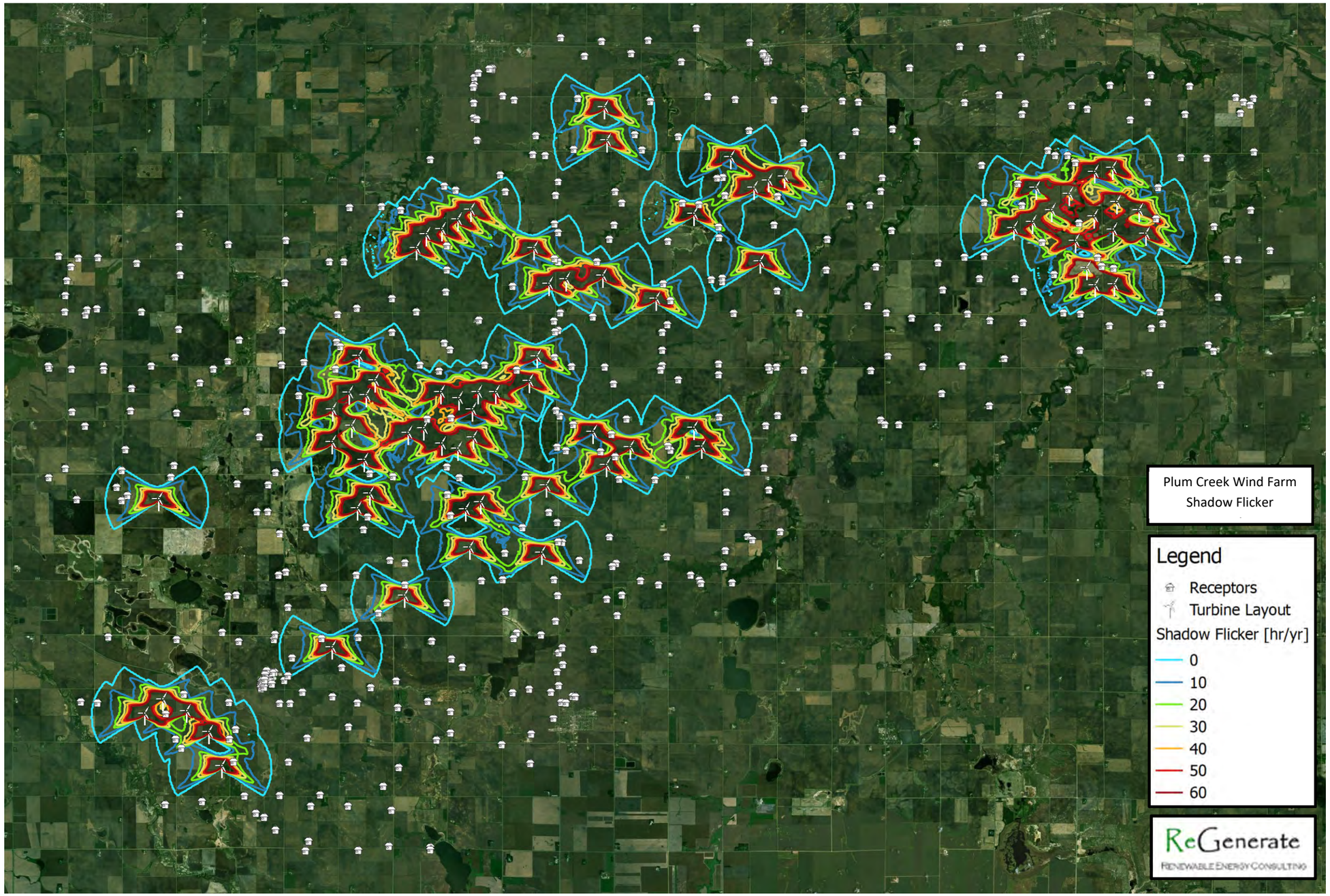

Figure 4: Shadow Flicker Map of Plum Creek Wind Project – V150-5.6 h105

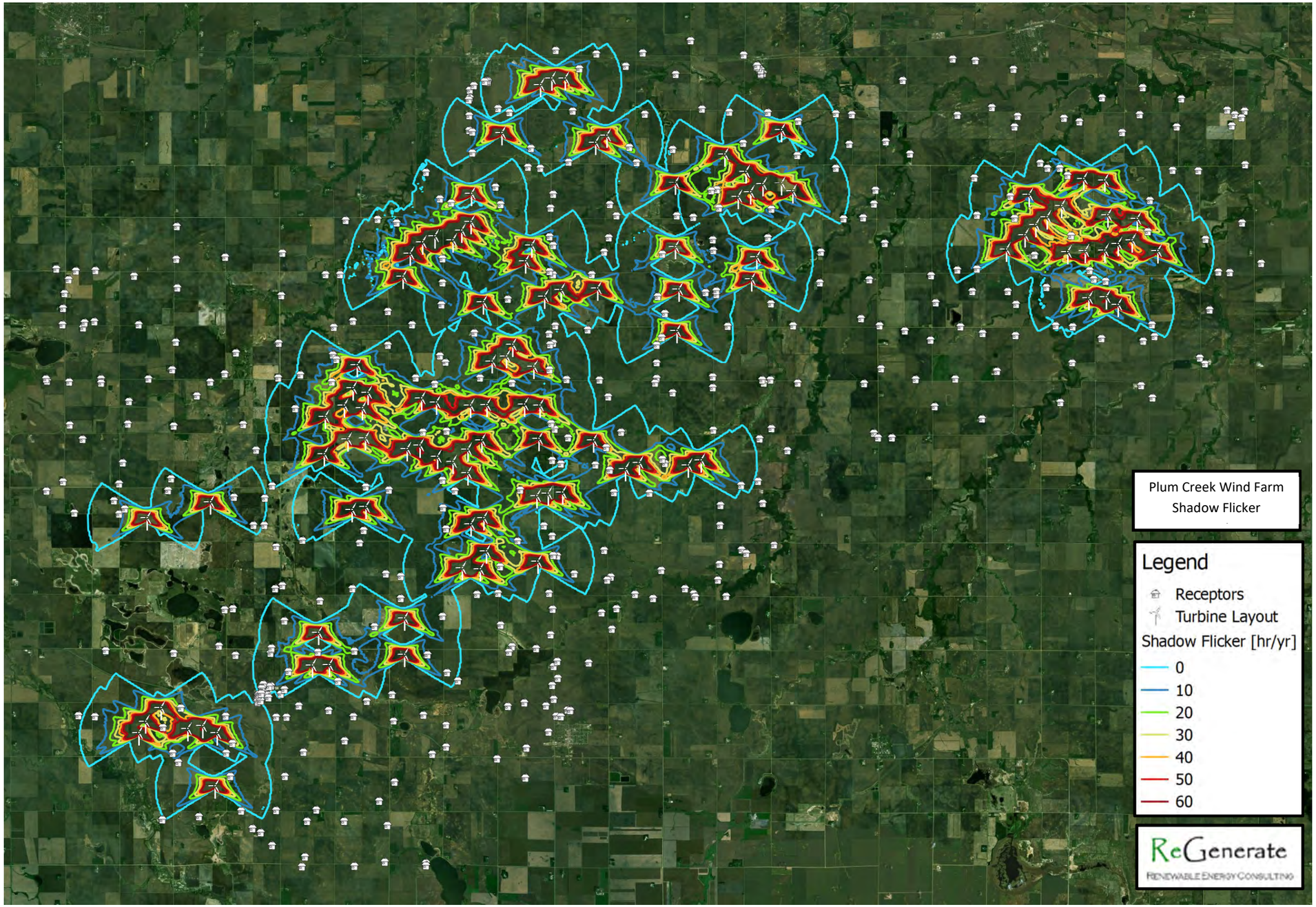

Figure 5: Shadow Flicker Map of Plum Creek Wind Project – GE-127-2.8 h89

Appendix II – Project Turbine Coordinates

(UTM WGS84 Zone 15)

V162-5.6 h125/V150-5.6 h105					
Turbine ID	X [m]	Y [m]	Turbine ID	X [m]	Y [m]
T-1	294318	4878345	T-41	304015	4890343
T-2	293968	4879379	T-42	298751	4890532
T-3	292079	4879996	T-44	307570	4891973
T-4	293336	4880040	T-45	320544	4891990
T-5	292634	4880420	T-46	321118	4892011
T-6	297697	4881809	T-47	306024	4892697
T-7	299875	4883282	T-48	304443	4892500
T-8	303967	4884442	T-49	320324	4892526
T-10	301855	4884664	T-50	304932	4892707
T-11	302221	4886032	T-52	310680	4892993
T-12	301756	4885826	T-54	320003	4893338
T-13	298571	4885956	T-55	322082	4893495
T-14	298942	4886381	T-56	304008	4893576
T-15	292699	4886411	T-57	321134	4893642
T-16	304173	4886468	T-59	300549	4893692
T-18	305963	4887034	T-60	318189	4893775
T-19	298812	4887402	T-61	318746	4893941
T-20	308797	4887495	T-63	300843	4894091
T-21	306687	4887547	T-64	320571	4894059
T-22	301587	4887647	T-65	321911	4894192
T-23	301118	4887810	T-66	301310	4894232
T-24	302061	4887879	T-67	319321	4894272
T-25	297882	4887951	T-68	321252	4894462
T-26	305588	4888029	T-69	308765	4894469
T-27	308584	4888064	T-70	301789	4894495
T-28	300604	4888284	T-71	319860	4894745
T-29	298478	4888421	T-72	302188	4894781
T-30	302045	4888801	T-73	318882	4894958
T-31	297918	4888929	T-74	320619	4895388
T-32	301658	4889155	T-75	310556	4895181
T-33	302762	4889305	T-77	310995	4895399
T-34	302229	4889315	T-78	321164	4895492
T-35	298929	4889330	T-79	311479	4895505
T-36	301137	4889348	T-80	309903	4896130
T-37	298430	4889416	T-81	306266	4896745
T-38	303753	4889605	T-82	306220	4897736
T-40	299202	4889759	T-83	300133	4888168

GE-127-2.8 h89								
Turbine ID	X [m]	Y [m]	Turbine ID	X [m]	Y [m]	Turbine ID	X [m]	Y [m]
T-1	294206	4878187	T-38	298989	4888424	T-75	308374	4893866
T-2	294309	4879744	T-39	297825	4889102	T-76	300499	4893901
T-3	291992	4879824	T-40	304206	4889239	T-77	318754	4893924
T-4	293452	4879902	T-41	303755	4889291	T-78	304103	4894030
T-5	293899	4879983	T-42	302638	4889301	T-79	319075	4894215
T-6	292197	4880172	T-43	302148	4889310	T-80	300871	4894226
T-7	292670	4880565	T-44	298929	4889330	T-81	301771	4894258
T-8	297710	4881687	T-45	298400	4889419	T-82	322090	4894312
T-9	297205	4881698	T-46	301144	4889431	T-83	301243	4894398
T-10	299967	4881931	T-47	300696	4889571	T-84	319415	4894442
T-11	297421	4882665	T-48	299109	4889782	T-85	321229	4894445
T-12	300001	4883012	T-49	298671	4889933	T-86	302036	4894538
T-13	301760	4884454	T-50	304053	4890414	T-87	319856	4894754
T-14	302286	4884402	T-51	302829	4890615	T-88	302324	4894795
T-15	304008	4884591	T-52	298812	4890618	T-89	318913	4895121
T-16	302490	4884929	T-53	303263	4890753	T-90	310650	4895425
T-17	302442	4885940	T-54	303446	4891096	T-91	311898	4895427
T-18	302059	4885779	T-55	308345	4891366	T-92	321164	4895492
T-19	292438	4886250	T-56	321452	4891781	T-93	320541	4895555
T-20	298527	4886302	T-57	320590	4891989	T-94	302359	4895629
T-21	298942	4886381	T-58	321118	4892011	T-95	311023	4895665
T-22	304030	4886559	T-59	304932	4892686	T-96	311568	4895675
T-23	304380	4886623	T-60	302622	4892384	T-97	310519	4896063
T-24	304796	4886629	T-61	306024	4892697	T-98	306084	4897062
T-25	306691	4887275	T-62	304438	4892499	T-99	311617	4897273
T-26	302001	4887296	T-63	308440	4892591	T-100	304504	4898826
T-27	308564	4887333	T-64	310601	4892843	T-101	305249	4898991
T-28	301579	4887648	T-65	300254	4893222	T-102	304847	4899003
T-29	308950	4887482	T-66	320004	4893378	T-103	310266	4895304
T-30	297758	4887988	T-67	322674	4893334	T-104	309912	4896596
T-31	301118	4887810	T-68	321101	4893392	T-105	308426	4895781
T-32	302023	4887997	T-69	320522	4893406	T-106	306435	4897256
T-33	305764	4888158	T-70	310772	4893485	T-107	307114	4887446
T-34	300613	4888169	T-71	318194	4893502	T-108	303323	4897429
T-35	304144	4888256	T-72	303903	4893565	T-109	294330	4886670
T-36	302448	4888267	T-73	321514	4893593	T-110	300224	4888077
T-37	298481	4888418	T-74	321922	4893686			

Appendix III – Individual Receptor Results

(UTM WGS84 Zone 15)

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_001	302440	4898831	Non-Participating	0	0	0
R_002	302434	4898600	Non-Participating	0	0	0
R_003	302410	4898539	Non-Participating	0	0	0
R_004	302410	4898068	Non-Participating	0	0	5.1
R_005	303263	4898256	Non-Participating	0	0	5.6
R_006	302569	4898952	Non-Participating	0	0	0
R_007	302991	4899048	Non-Participating	0	0	1.2
R_008	302935	4899048	Non-Participating	0	0	1.1
R_009	302993	4899080	Non-Participating	0	0	1.2
R_010	302938	4899080	Non-Participating	0	0	1.0
R_011	302889	4899071	Non-Participating	0	0	0.9
R_012	303607	4898119	Non-Participating	0	0	0
R_013	305486	4898110	Non-Participating	14.7	12.2	4.3
R_014	305709	4899371	Participating	0	0	22.6
R_015	305029	4899934	Non-Participating	0	0	0
R_016	306229	4899784	Non-Participating	0	0	4.7
R_017	307085	4899404	Participating	0	0	0
R_018	307602	4899778	Non-Participating	0	0	0
R_019	308573	4899106	Non-Participating	0	0	0
R_020	309321	4898056	Non-Participating	0	0	0
R_021	310114	4897936	Non-Participating	0	0	1.2
R_022	310503	4896999	Non-Participating	0	0	16.5
R_023	311268	4897890	Participating	0	0	0
R_024	312160	4897614	Participating	0	0	13.8
R_025	312103	4896593	Participating	0	0	1.0
R_026	313241	4896184	Non-Participating	0	0	1.4
R_027	313653	4896880	Non-Participating	0	0	0
R_028	313286	4897805	Non-Participating	0	0	0
R_029	313755	4897756	Non-Participating	0	0	0
R_030	315290	4898733	Non-Participating	0	0	0
R_031	316889	4897657	Non-Participating	0	0	0
R_032	316794	4899329	Non-Participating	0	0	0
R_033	317467	4899274	Non-Participating	0	0	0
R_034	318580	4898982	Non-Participating	0	0	0
R_035	317909	4897852	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_036	320044	4897476	Participating	0	0	0
R_037	320488	4897361	Participating	0	0	0
R_038	321192	4898051	Participating	0	0	0
R_039	321755	4897005	Participating	0	0	0
R_040	322294	4897529	Non-Participating	0	0	0
R_041	323375	4897131	Non-Participating	0	0	0
R_042	323532	4897971	Non-Participating	0	0	0
R_043	322408	4898331	Non-Participating	0	0	0
R_044	324880	4897592	Non-Participating	0	0	0
R_045	325401	4897546	Non-Participating	0	0	0
R_046	325107	4897456	Non-Participating	0	0	0
R_047	325309	4897354	Non-Participating	0	0	0
R_048	325381	4895945	Non-Participating	0	0	0
R_049	323979	4895800	Non-Participating	0	0	0
R_050	323227	4895846	Non-Participating	0	0	0
R_051	319512	4895997	Non-Participating	6.3	4.8	4.2
R_052	319882	4895985	Non-Participating	22.0	18.0	13.0
R_053	318665	4897583	Non-Participating	0	0	0
R_054	318571	4897256	Non-Participating	0	0	0
R_055	318392	4895181	Participating	40.1	30.9	25.0
R_056	317339	4895765	Non-Participating	0	0	0
R_057	314740	4896929	Non-Participating	0	0	0
R_058	315441	4896547	Non-Participating	0	0	0
R_059	314397	4895470	Non-Participating	0	0	0
R_060	311291	4895001	Participating	22.9	17.6	9.5
R_061	309727	4895074	Participating	26.5	20.9	30.9
R_062	309691	4895631	Participating	14.6	11.4	29.9
R_063	309516	4895594	Non-Participating	10.3	7.9	25.5
R_064	308968	4894821	Participating	36.8	26.4	2.7
R_065	308479	4894880	Participating	36.3	26.9	0
R_066	308415	4896879	Non-Participating	0	0	1.2
R_067	307332	4896515	Non-Participating	8.9	6.8	6.8
R_068	307616	4897952	Non-Participating	3.4	2.5	2.2
R_069	307129	4896978	Non-Participating	9.0	7.4	28.1
R_070	305314	4896593	Non-Participating	10.7	8.1	0.8
R_071	304105	4896480	Non-Participating	0	0	0
R_072	304473	4896440	Participating	0	0	0
R_073	304206	4897040	Participating	0	0	13.0
R_074	302391	4897623	Non-Participating	0	0	4.7
R_075	302489	4897566	Participating	0	0	6.3

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_076	302467	4896951	Participating	0	0	3.7
R_077	301787	4895466	Participating	0	0	26.9
R_078	301465	4895588	Participating	5.1	1.5	10.0
R_079	301488	4893806	Participating	45.2	41.3	9.5
R_080	301469	4893094	Participating	4.3	4.1	5.3
R_081	301409	4892442	Non-Participating	0	0	2.9
R_082	300524	4891872	Participating	0	0	0
R_083	299816	4892289	Non-Participating	0	0	0
R_084	300155	4894922	Non-Participating	8.5	4.3	9.9
R_085	299782	4891280	Non-Participating	7.3	5.8	4.5
R_086	300578	4890267	Non-Participating	3.4	2.3	1.1
R_087	301479	4890717	Participating	0	0	1.7
R_088	301316	4890916	Non-Participating	0	0	1.1
R_089	302494	4890211	Participating	10.9	3.4	4.8
R_090	301148	4890065	Participating	6.6	5.1	10.7
R_091	303429	4890039	Participating	54.6	42.5	6.2
R_092	304563	4890401	Participating	29.4	23.2	27.2
R_093	304577	4891475	Non-Participating	0	0	4.2
R_094	304698	4891201	Non-Participating	0	0	3.6
R_095	304602	4891163	Participating	0	0	4.5
R_096	304777	4891721	Participating	0	0	1.5
R_097	302364	4891566	Non-Participating	0	0	8.0
R_098	303389	4892554	Non-Participating	9.7	5.7	11.5
R_099	304750	4893244	Participating	35.7	32.1	13.0
R_100	304645	4893333	Participating	45.0	38.1	14.8
R_101	304787	4894112	Non-Participating	12.7	10.9	14.7
R_102	304688	4894375	Participating	0	0	11.5
R_103	304824	4895632	Non-Participating	0	0	0
R_104	304736	4895223	Non-Participating	0	0	0
R_105	303116	4895888	Non-Participating	0	0	7.0
R_106	303259	4895373	Non-Participating	5.6	4.5	13.5
R_107	305729	4891565	Non-Participating	0	0	0
R_108	305898	4893203	Participating	12.3	5.7	4.1
R_109	306437	4894291	Non-Participating	0	0	0
R_110	306286	4893869	Non-Participating	0	0	0
R_111	306691	4894942	Non-Participating	0	0	0
R_112	306493	4895268	Participating	0	0	0
R_113	308018	4893754	Participating	0	0	51.2
R_114	307842	4892489	Participating	8.0	0.3	17.4
R_115	308030	4891978	Participating	43.0	36.1	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_116	307920	4891279	Participating	0	0	47.5
R_117	307763	4891048	Participating	0	0	8.6
R_118	307749	4890507	Participating	0	0	0
R_119	307740	4890046	Participating	0	0	0
R_120	307680	4889909	Non-Participating	0	0	0
R_121	308195	4889597	Non-Participating	0	0	0
R_122	309261	4892567	Non-Participating	4.1	2.8	8.8
R_123	309578	4892507	Participating	13.3	11.3	8.5
R_124	309591	4892613	Participating	10.9	7.4	7.4
R_125	309534	4893820	Non-Participating	6.1	4.6	6.6
R_126	309523	4894130	Participating	30.8	27.9	4.6
R_127	309883	4891551	Non-Participating	0	0	1.1
R_128	311188	4892176	Non-Participating	0	0	0
R_129	311835	4891505	Non-Participating	0	0	0
R_130	312659	4892764	Participating	0	0	0
R_131	311165	4894146	Participating	0	0	0
R_132	312724	4893680	Participating	0	0	0
R_133	313418	4894654	Non-Participating	0	0	0
R_134	314000	4894665	Non-Participating	0	0	0
R_135	314335	4895070	Non-Participating	0	0	0
R_136	317374	4894651	Participating	11.1	0.8	3.0
R_137	318490	4894518	Participating	18.1	12.8	21.8
R_138	319300	4896162	Non-Participating	3.9	0	2.3
R_139	319057	4893415	Participating	40.8	28.3	11.6
R_140	320098	4895767	Participating	38.7	35.0	29.6
R_141	322522	4894937	Non-Participating	10.8	7.7	4.5
R_142	322432	4894021	Participating	70.1	57.8	23.9
R_143	325012	4897124	Non-Participating	0	0	0
R_144	314615	4893885	Participating	0	0	0
R_145	314125	4892813	Participating	0	0	0
R_146	315963	4892890	Non-Participating	0	0	0
R_147	316091	4892068	Non-Participating	0	0	0
R_148	316760	4893037	Non-Participating	5.2	0	1.6
R_149	317329	4893046	Participating	0	0	6.3
R_150	317173	4892383	Participating	0	0	0
R_151	318240	4892349	Non-Participating	0	0	0
R_152	318463	4891955	Non-Participating	0	0	0
R_153	318428	4891036	Participating	0	0	0
R_154	317450	4891118	Non-Participating	0	0	0
R_155	317839	4889972	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_156	316601	4889775	Non-Participating	0	0	0
R_157	315906	4890969	Non-Participating	0	0	0
R_158	316792	4891336	Non-Participating	0	0	0
R_159	315139	4891258	Non-Participating	0	0	0
R_160	314401	4891442	Non-Participating	0	0	0
R_161	313855	4891664	Non-Participating	0	0	0
R_162	315970	4888971	Non-Participating	0	0	0
R_163	315422	4889795	Non-Participating	0	0	0
R_164	314406	4890141	Non-Participating	0	0	0
R_165	314138	4888222	Non-Participating	0	0	0
R_166	314253	4888085	Non-Participating	0	0	0
R_167	314675	4888072	Non-Participating	0	0	0
R_168	313897	4889718	Non-Participating	0	0	0
R_169	311913	4889779	Non-Participating	0	0	0
R_170	311105	4889903	Participating	0	0	0
R_171	310907	4889813	Non-Participating	0	0	0
R_172	310867	4889907	Non-Participating	0	0	0
R_173	311094	4888449	Participating	0	0	0
R_174	310737	4888155	Participating	0	0	0
R_175	311557	4887777	Non-Participating	0	0	0
R_176	310774	4886232	Non-Participating	0	0	0
R_177	310659	4886894	Non-Participating	0	0	0
R_178	310154	4886791	Non-Participating	12.1	0	8.3
R_179	311074	4884972	Participating	0	0	0
R_180	310109	4884845	Non-Participating	0	0	0
R_181	310239	4884745	Participating	0	0	0
R_182	309440	4884436	Non-Participating	0	0	0
R_183	309489	4885610	Non-Participating	0	0	0
R_184	309523	4886206	Participating	0	0	0
R_185	309603	4883480	Non-Participating	0	0	0
R_186	309375	4883975	Non-Participating	0	0	0
R_187	308656	4883585	Non-Participating	0	0	0
R_188	308396	4883744	Non-Participating	0	0	0
R_189	308687	4883487	Non-Participating	0	0	0
R_190	307699	4884311	Non-Participating	0	0	0
R_191	307441	4883475	Non-Participating	0	0	0
R_192	306902	4883620	Non-Participating	0	0	0
R_193	306336	4883196	Non-Participating	0	0	0
R_194	305898	4883087	Non-Participating	0	0	0
R_195	306192	4882604	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_196	305466	4881612	Non-Participating	0	0	0
R_197	309373	4888459	Participating	10.4	8.7	0
R_198	309397	4889720	Non-Participating	0	0	0
R_199	309397	4890037	Participating	0	0	0
R_200	307908	4887500	Non-Participating	16.6	12.9	23.5
R_201	307839	4887630	Participating	18.3	15.3	19.2
R_202	307426	4886633	Non-Participating	4.1	0	0
R_203	306366	4886685	Participating	0	0	1.0
R_204	306265	4887354	Participating	65.0	61.3	35.7
R_205	305837	4887518	Participating	19.3	10.1	7.9
R_206	306171	4888030	Participating	53.5	45.0	62.2
R_207	305053	4888360	Participating	25.7	22.6	13.8
R_208	304662	4888619	Participating	8.9	7.0	19.3
R_209	304563	4888793	Participating	8.8	7.0	9.3
R_210	304555	4887703	Participating	15.7	8.7	3.9
R_211	304822	4887585	Non-Participating	8.5	7.9	0.1
R_212	303588	4886835	Participating	25.0	18.8	35.5
R_213	301649	4886866	Participating	0	0	0
R_214	301288	4887203	Participating	0	0	10.9
R_215	301276	4886371	Participating	28.6	21.4	11.6
R_216	301342	4885743	Participating	78.2	70.4	16.4
R_217	299523	4884438	Participating	0	0	0
R_218	299957	4884360	Non-Participating	0	0	0
R_219	299682	4886958	Participating	33.3	29.6	9.5
R_220	300754	4888643	Participating	65.5	48.5	8.7
R_221	301445	4888665	Participating	70.8	55.8	14.8
R_222	304492	4885437	Non-Participating	0	0	0
R_223	304253	4885748	Non-Participating	0	0	0
R_224	304623	4884826	Non-Participating	14.5	12.6	10.6
R_225	304499	4884845	Participating	22.9	19.9	16.1
R_226	305112	4884283	Non-Participating	7.0	5.3	4.3
R_227	304353	4883725	Participating	0	0	0
R_228	304444	4883240	Non-Participating	0	0	0
R_229	304356	4882484	Non-Participating	0	0	0
R_230	302829	4883767	Non-Participating	0.8	0.8	2.5
R_231	302882	4882812	Non-Participating	0	0	0
R_232	303201	4882162	Non-Participating	0	0	0
R_233	303103	4882008	Non-Participating	0	0	0
R_234	303920	4882082	Non-Participating	0	0	0
R_235	304422	4881532	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_236	304528	4881679	Non-Participating	0	0	0
R_237	301564	4881199	Participating	0	0	0
R_238	301254	4881443	Participating	0	0	3.1
R_239	299607	4880051	Non-Participating	0	0	0
R_240	299598	4880835	Participating	0	0	0
R_241	300686	4882004	Participating	0	0	8.7
R_242	301168	4883123	Non-Participating	4.9	3.6	2.5
R_243	302208	4883746	Non-Participating	0	0	0
R_244	302916	4884561	Participating	15.3	11.9	16.3
R_245	303460	4885312	Participating	8.8	7.5	12.8
R_246	306021	4884959	Non-Participating	0	0	0
R_247	306197	4884156	Participating	0	0	0
R_248	306090	4884064	Participating	0	0	0
R_249	306631	4888472	Participating	6.1	4.8	5.1
R_250	306288	4889543	Non-Participating	0	0	0
R_251	306037	4890049	Non-Participating	0	0	0
R_252	305062	4890086	Participating	13.1	9.9	7.1
R_253	298424	4893434	Participating	0	0	0
R_254	298512	4884026	Participating	3.5	0	0
R_255	299933	4883698	Participating	16.2	1.8	0
R_256	299134	4882883	Participating	8.0	8.0	7.1
R_257	297541	4883702	Non-Participating	0	0	0
R_258	296436	4884193	Non-Participating	0	0	0
R_259	296213	4884106	Non-Participating	0	0	0
R_260	297075	4885531	Participating	3.7	0	2.1
R_261	296279	4885349	Participating	0	0	0
R_262	295949	4886025	Participating	0	0	0
R_263	295991	4886821	Non-Participating	0	0	1.1
R_264	296212	4887189	Non-Participating	0	0	0
R_265	296971	4889470	Non-Participating	11.3	8.4	6.9
R_266	296499	4890396	Non-Participating	0	0	0
R_267	297162	4890469	Participating	2.7	0	4.8
R_268	296552	4891448	Participating	0	0	0
R_269	296672	4892865	Non-Participating	0	0	0
R_270	298000	4893446	Participating	0	0	0
R_271	298199	4891867	Non-Participating	0	0	0
R_272	298148	4891041	Participating	23.4	19.6	10.0
R_273	298237	4890899	Participating	28.0	25.9	14.3
R_274	298761	4892031	Non-Participating	0	0	0
R_275	298085	4890223	Participating	30.3	25.2	20.7

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_276	296466	4883131	Non-Participating	0	0	3.9
R_277	296541	4881622	Non-Participating	6.2	4.5	12.4
R_278	296290	4880956	Non-Participating	0	0	2.7
R_279	296398	4881086	Non-Participating	2.6	2.1	3.5
R_280	295886	4881211	Non-Participating	0	0	2.2
R_281	296003	4881212	Non-Participating	0	0	3.7
R_282	296810	4880595	Non-Participating	0	0	0
R_283	296427	4880265	Participating	0	0	0
R_284	296130	4880273	Participating	0	0	0
R_285	297701	4880422	Participating	0	0	0
R_286	297993	4881280	Participating	0	0	16.7
R_287	297432	4882178	Participating	45.3	34.8	0
R_288	298520	4882167	Non-Participating	9.9	8.2	15.6
R_289	298829	4880667	Non-Participating	0	0	0
R_290	298426	4880214	Non-Participating	0	0	0
R_291	298767	4885402	Participating	0	0	0
R_292	298902	4885776	Participating	36.8	44.1	0
R_293	299001	4887076	Participating	0	0	0
R_294	299590	4895047	Non-Participating	6.1	0	1.9
R_295	298643	4895038	Non-Participating	0	0	0
R_296	295420	4889048	Non-Participating	0	0	0
R_297	295783	4888265	Non-Participating	0	0	0
R_298	295629	4886034	Non-Participating	0	0	4.3
R_299	296019	4882191	Participating	0	0	4.1
R_300	296054	4882340	Non-Participating	0	0	4.0
R_301	300511	4880208	Non-Participating	0	0	0
R_302	301172	4879873	Non-Participating	0	0	0
R_303	301158	4879218	Non-Participating	0	0	0
R_304	302662	4878821	Non-Participating	0	0	0
R_305	303544	4879111	Non-Participating	0	0	0
R_306	303028	4880384	Non-Participating	0	0	0
R_307	303524	4880479	Non-Participating	0	0	0
R_308	304152	4880363	Non-Participating	0	0	0
R_309	304392	4880555	Non-Participating	0	0	0
R_310	304365	4880978	Non-Participating	0	0	0
R_311	304540	4881184	Non-Participating	0	0	0
R_312	304801	4880223	Non-Participating	0	0	0
R_313	304893	4880211	Non-Participating	0	0	0
R_314	304875	4880203	Non-Participating	0	0	0
R_315	304458	4880046	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_316	304595	4880027	Non-Participating	0	0	0
R_317	304215	4879572	Non-Participating	0	0	0
R_318	303476	4878235	Non-Participating	0	0	0
R_319	320154	4893962	Participating	114.8	100.7	25.5
R_320	320681	4892907	Participating	43.9	30.1	0.9
R_321	320794	4892643	Participating	29.4	25.7	0
R_322	321147	4892580	Participating	24.4	19.0	2.6
R_323	319375	4892433	Non-Participating	16.0	12.4	2.5
R_324	319627	4891295	Non-Participating	0	0	3.7
R_325	320122	4891247	Participating	0	0	2.5
R_326	320971	4890880	Non-Participating	0	0	0
R_327	320080	4890163	Non-Participating	0	0	0
R_328	319697	4888987	Non-Participating	0	0	0
R_329	317368	4888570	Non-Participating	0	0	0
R_330	301074	4896416	Participating	0	0	1.9
R_331	296734	4894119	Non-Participating	0	0	0
R_332	295033	4894051	Non-Participating	0	0	0
R_333	293638	4895016	Non-Participating	0	0	0
R_334	293591	4894038	Non-Participating	0	0	0
R_335	292315	4893575	Non-Participating	0	0	0
R_336	291174	4893786	Non-Participating	0	0	0
R_337	290378	4893537	Non-Participating	0	0	0
R_338	290231	4893127	Non-Participating	0	0	0
R_339	290602	4893783	Non-Participating	0	0	0
R_340	290017	4893869	Non-Participating	0	0	0
R_341	290179	4892686	Non-Participating	0	0	0
R_342	290153	4892196	Non-Participating	0	0	0
R_343	290761	4892086	Non-Participating	0	0	0
R_344	291091	4892258	Non-Participating	0	0	0
R_345	290810	4892239	Non-Participating	0	0	0
R_346	292400	4892119	Non-Participating	0	0	0
R_347	293591	4893187	Non-Participating	0	0	0
R_348	295273	4891191	Non-Participating	0	0	0
R_349	293490	4891579	Non-Participating	0	0	0
R_350	294914	4890560	Non-Participating	0	0	0
R_351	294475	4890336	Non-Participating	0	0	0
R_352	293355	4890737	Non-Participating	0	0	0
R_353	292641	4890487	Non-Participating	0	0	0
R_354	291246	4890532	Participating	0	0	0
R_355	291230	4890414	Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_356	290290	4890466	Non-Participating	0	0	0
R_357	289627	4890515	Non-Participating	0	0	0
R_358	289608	4890582	Non-Participating	0	0	0
R_359	290271	4889187	Non-Participating	0	0	0
R_360	290011	4887500	Non-Participating	0	0	0
R_361	289512	4887252	Non-Participating	0	0	0
R_362	290315	4886569	Non-Participating	0	0	0
R_363	291648	4886488	Non-Participating	7.2	5.5	6.4
R_364	291825	4886638	Participating	10.1	8.0	11.4
R_365	291503	4886894	Non-Participating	5.2	4.0	4.5
R_366	291675	4887391	Non-Participating	5.4	3.2	0
R_367	291799	4888012	Non-Participating	0	0	0
R_368	291990	4889164	Non-Participating	0	0	0
R_369	290632	4888748	Non-Participating	0	0	0
R_370	292052	4889840	Non-Participating	0	0	0
R_371	293353	4889057	Participating	0	0	0
R_372	294068	4889931	Non-Participating	0	0	0
R_373	293219	4887500	Non-Participating	0	0	3.0
R_374	293120	4887152	Participating	0	0	2.0
R_375	295080	4886893	Non-Participating	0	0	7.2
R_376	294943	4883554	Non-Participating	0	0	0
R_377	294689	4883523	Non-Participating	0	0	0
R_378	294494	4882448	Non-Participating	0	0	0
R_379	294981	4882162	Non-Participating	0	0	0
R_380	295596	4880736	Non-Participating	0	0	1.3
R_381	293146	4882280	Non-Participating	0	0	0
R_382	291118	4882412	Non-Participating	0	0	0
R_383	290244	4880506	Non-Participating	0	0	0
R_384	290735	4880458	Non-Participating	4.2	3.2	3.9
R_385	293170	4879002	Participating	21.2	18.5	4.9
R_386	293020	4879293	Non-Participating	14.9	7.7	12.5
R_387	292743	4880064	Participating	48.3	39.2	39.6
R_388	293301	4880632	Participating	18.6	15.7	22.8
R_389	294624	4880352	Non-Participating	4.0	3.2	9.6
R_390	294798	4879518	Participating	15.8	8.8	42.0
R_391	294604	4879244	Participating	35.3	28.1	7.4
R_392	294704	4878550	Participating	36.8	33.4	17.6
R_393	294996	4877510	Participating	0	0	0
R_394	296046	4877497	Non-Participating	0	0	0
R_395	296328	4878491	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_396	296903	4879190	Participating	0	0	0
R_397	293731	4877392	Non-Participating	0	0	0
R_398	292652	4877320	Non-Participating	0	0	0
R_399	295559	4876854	Participating	0	0	0
R_400	295312	4876988	Non-Participating	0	0	0
R_401	295879	4876470	Non-Participating	0	0	0
R_402	296755	4875816	Non-Participating	0	0	0
R_403	296860	4876092	Non-Participating	0	0	0
R_404	298324	4875771	Non-Participating	0	0	0
R_405	299227	4875871	Non-Participating	0	0	0
R_406	300456	4875798	Non-Participating	0	0	0
R_407	300441	4875720	Non-Participating	0	0	0
R_408	298142	4879496	Participating	0	0	0
R_409	300728	4879025	Participating	0	0	0
R_410	299591	4878225	Non-Participating	0	0	0
R_411	299116	4877671	Participating	0	0	0
R_412	299340	4876952	Participating	0	0	0
R_413	298047	4877108	Non-Participating	0	0	0
R_414	297228	4877478	Non-Participating	0	0	0
R_415	296951	4877144	Non-Participating	0	0	0
R_416	295720	4881173	Non-Participating	0	0	1.4
R_417	295777	4881187	Non-Participating	0	0	1.6
R_418	295845	4881210	Non-Participating	0	0	1.9
R_419	295844	4881182	Non-Participating	0	0	2.0
R_420	295840	4881163	Non-Participating	0	0	2.1
R_421	295946	4881204	Non-Participating	0	0	2.9
R_422	295778	4881256	Non-Participating	0	0	1.5
R_423	295722	4881136	Non-Participating	0	0	1.5
R_424	295600	4880808	Non-Participating	0	0	0
R_425	295598	4880827	Non-Participating	0	0	0
R_426	295600	4880855	Non-Participating	0	0	0
R_427	295601	4880885	Non-Participating	0	0	0
R_428	295647	4880889	Non-Participating	0	0	0
R_429	295651	4880930	Non-Participating	0	0	0
R_430	295647	4880773	Non-Participating	0	0	1.2
R_431	295590	4880771	Non-Participating	0	0	0.2
R_432	295685	4880774	Non-Participating	0	0	0
R_433	295880	4880943	Non-Participating	0	0	0.7
R_434	295918	4880862	Non-Participating	0	0	0
R_435	295608	4880969	Non-Participating	0	0	0

Receptor ID	X [m]	Y [m]	Status	V162-5.6 h125	V150-5.6 h105	GE-127 2.8 h89
R_436	295607	4880944	Non-Participating	0	0	0
R_437	295649	4880980	Non-Participating	0	0	0
R_438	295707	4880992	Non-Participating	0	0	2.0
R_439	311154	4899063	Non-Participating	0	0	0
R_440	311084	4899038	Non-Participating	0	0	0
R_441	311085	4899067	Non-Participating	0	0	0
R_442	311094	4899148	Non-Participating	0	0	0
R_443	311086	4899178	Non-Participating	0	0	0
R_444	311028	4899235	Non-Participating	0	0	0
R_445	310969	4899266	Non-Participating	0	0	0
R_446	310982	4899306	Non-Participating	0	0	0
R_447	310603	4899627	Non-Participating	0	0	0
R_448	309031	4900100	Non-Participating	0	0	0
R_449	322551	4890896	Non-Participating	0	0	0
R_450	322478	4891236	Non-Participating	8.5	0	11.7
R_451	322205	4890762	Non-Participating	0	0	0
R_452	324146	4893748	Non-Participating	0	0	1.1
R_453	325243	4894199	Non-Participating	0	0	0
R_454	324499	4892766	Non-Participating	0	0	0
R_455	324832	4892729	Non-Participating	0	0	0
R_456	325775	4892983	Non-Participating	0	0	0
R_457	324215	4891646	Non-Participating	0	0	0
R_458	322116	4889430	Non-Participating	0	0	0
R_459	323874	4890208	Non-Participating	0	0	0
R_460	324031	4890035	Non-Participating	0	0	0
R_461	322437	4889055	Non-Participating	0	0	0