

Project:
Nyvallsåsen

EI19276PO
Ramström Vind AB

Description:
This calculation was made without visiting the site and is based on information provided by the customer. In case of discrepancies of site coordinates or other relevant data, ENERCON does not take any responsibility for calculated shadow flickering at considered shadow receptors (SR). The calculation does include an elevation model. The results represent a calculation for the customer only and are not to be submitted to authorities.

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ENERCON GmbH Aurich
Dreerkamp 5
DE-26605 Aurich
04941/927-0
Christian Meckenhäuser / Wind Farm Engineering
Calculated:
2019-09-06 07:03/3.3.261

SHADOW - Main Result

Calculation: Initial Shadow Flickering - A01a
Assumptions for shadow calculations

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

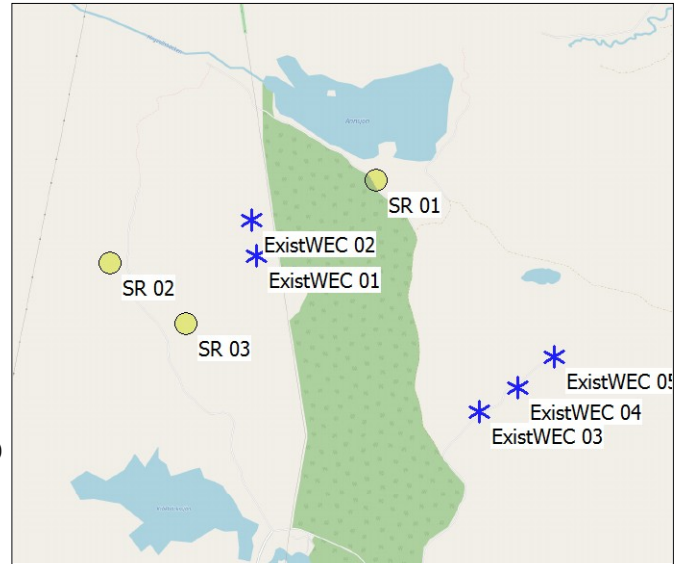
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Höhenlinien: CONTOURLINE_ONLINEDATA_0.wpo (1)
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
Swedish UTM 33-SWREF99 (SE)

WTGs

	Easting	Northing	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
ExistWEC 01	604 033	6 886 605	336.3	VESTAS V90 2000 90.0 !...Yes	Yes	VESTAS	V90-2 000	2 000	90.0	105.0	1 506	14.9
ExistWEC 02	603 974	6 886 970	322.1	VESTAS V90 2000 90.0 !...Yes	Yes	VESTAS	V90-2 000	2 000	90.0	105.0	1 506	14.9
ExistWEC 03	606 298	6 885 134	300.0	VESTAS V90 2000 90.0 !...Yes	Yes	VESTAS	V90-2 000	2 000	90.0	105.0	1 506	14.9
ExistWEC 04	606 680	6 885 381	320.0	VESTAS V90 2000 90.0 !...Yes	Yes	VESTAS	V90-2 000	2 000	90.0	105.0	1 506	14.9
ExistWEC 05	607 032	6 885 702	330.0	VESTAS V90 2000 90.0 !...Yes	Yes	VESTAS	V90-2 000	2 000	90.0	105.0	1 506	14.9



Scale 1:75 000
* Existing WTG 🟡 Shadow receptor

Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
SR 01	Nordanstig Bergsjö Prastgård 1:10	605 207	6 887 387	189.7	5.0	5.0	2.0	0.0	"Green house mode"	2.0
SR 02	Nordanstig Åkern 5:5	602 582	6 886 491	241.9	5.0	5.0	2.0	0.0	"Green house mode"	2.0
SR 03	Nordanstig Västertanne 5:3	603 356	6 885 909	257.7	5.0	5.0	2.0	0.0	"Green house mode"	2.0

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case		
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
SR 01	Nordanstig Bergsjö Prastgård 1:10	8:05	39	0:17
SR 02	Nordanstig Åkern 5:5	8:24	43	0:15
SR 03	Nordanstig Västertanne 5:3	0:00	0	0:00

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

No.	Name	Worst case [h/year]
ExistWEC 01	VESTAS V90 2000 90.0 !O! NH: 105.0 m (Ges:150.0 m) (6)	7:38
ExistWEC 02	VESTAS V90 2000 90.0 !O! NH: 105.0 m (Ges:150.0 m) (7)	8:51
ExistWEC 03	VESTAS V90 2000 90.0 !O! NH: 105.0 m (Ges:150.0 m) (8)	0:00
ExistWEC 04	VESTAS V90 2000 90.0 !O! NH: 105.0 m (Ges:150.0 m) (9)	0:00
ExistWEC 05	VESTAS V90 2000 90.0 !O! NH: 105.0 m (Ges:150.0 m) (10)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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Christian Meckenhäuser / Wind Farm Engineering
Calculated:
2019-09-06 10:45/3.3.261

SHADOW - Main Result

Calculation: Additional Shadow Flickering - A01a
Assumptions for shadow calculations

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

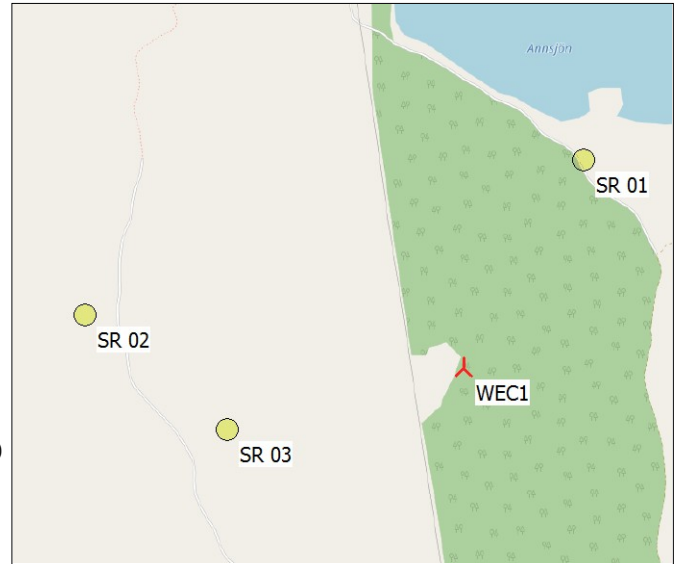
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Höhenlinien: CONTOURLINE_ONLINEDATA_0.wpo (1)
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
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WTGs

	Easting	Northing	Z	Row data/Description	WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.					Calculation distance [m]	RPM [RPM]
WEC1	604 603	6 886 275	310.3	ENERCON GmbH E-160...	Yes	ENERCON GmbH	E-160 EP5-4 600	4 600	160.0	166.6	1 747	9.3



Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
SR 01	Nordanstig Bergsjö Prastgård 1:10	605 207	6 887 387	189.7	5.0	5.0	2.0	0.0	"Green house mode"	2.0
SR 02	Nordanstig Åkern 5:5	602 582	6 886 491	241.9	5.0	5.0	2.0	0.0	"Green house mode"	2.0
SR 03	Nordanstig Västertanne 5:3	603 356	6 885 909	257.7	5.0	5.0	2.0	0.0	"Green house mode"	2.0

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case		
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
SR 01	Nordanstig Bergsjö Prastgård 1:10	15:42	41	0:30
SR 02	Nordanstig Åkern 5:5	0:00	0	0:00
SR 03	Nordanstig Västertanne 5:3	18:31	48	0:30

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

No.	Name	Worst case [h/year]
WEC1	ENERCON GmbH E-160 EP5 4600 160.0 !O! NH: 166.6 m (Ges:246.6 m) (3)	34:13

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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2019-09-06 07:05/3.3.261

SHADOW - Main Result

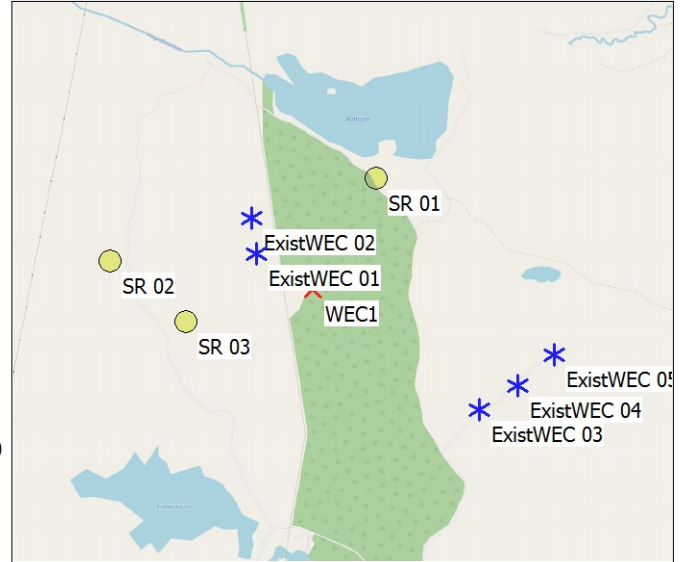
Calculation: Total Shadow Flickering - A01a
Assumptions for shadow calculations

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

Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
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Obstacles used in calculation
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Scale 1:75 000
New WTG Existing WTG Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.					Calculation distance [m]	RPM [RPM]
ExistWEC 01	604 033	6 886 605	336.3	VESTAS V90 2000 90....	Yes	VESTAS	V90-2 000	2 000	90.0	105.0	1 506	14.9
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WEC1	604 603	6 886 275	310.3	ENERCON GmbH E-16...	Yes	ENERCON GmbH	E-160 EP5-4 600	4 600	160.0	166.6	1 747	9.3

Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
SR 01	Nordanstig Bergsjö Prastgård 1:10	605 207	6 887 387	189.7	5.0	5.0	2.0	0.0	"Green house mode"	2.0
SR 02	Nordanstig Åkern 5:5	602 582	6 886 491	241.9	5.0	5.0	2.0	0.0	"Green house mode"	2.0
SR 03	Nordanstig Västertanne 5:3	603 356	6 885 909	257.7	5.0	5.0	2.0	0.0	"Green house mode"	2.0

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case		
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
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SR 02	Nordanstig Åkern 5:5	8:24	43	0:15
SR 03	Nordanstig Västertanne 5:3	18:31	48	0:30

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

No.	Name	Worst case [h/year]
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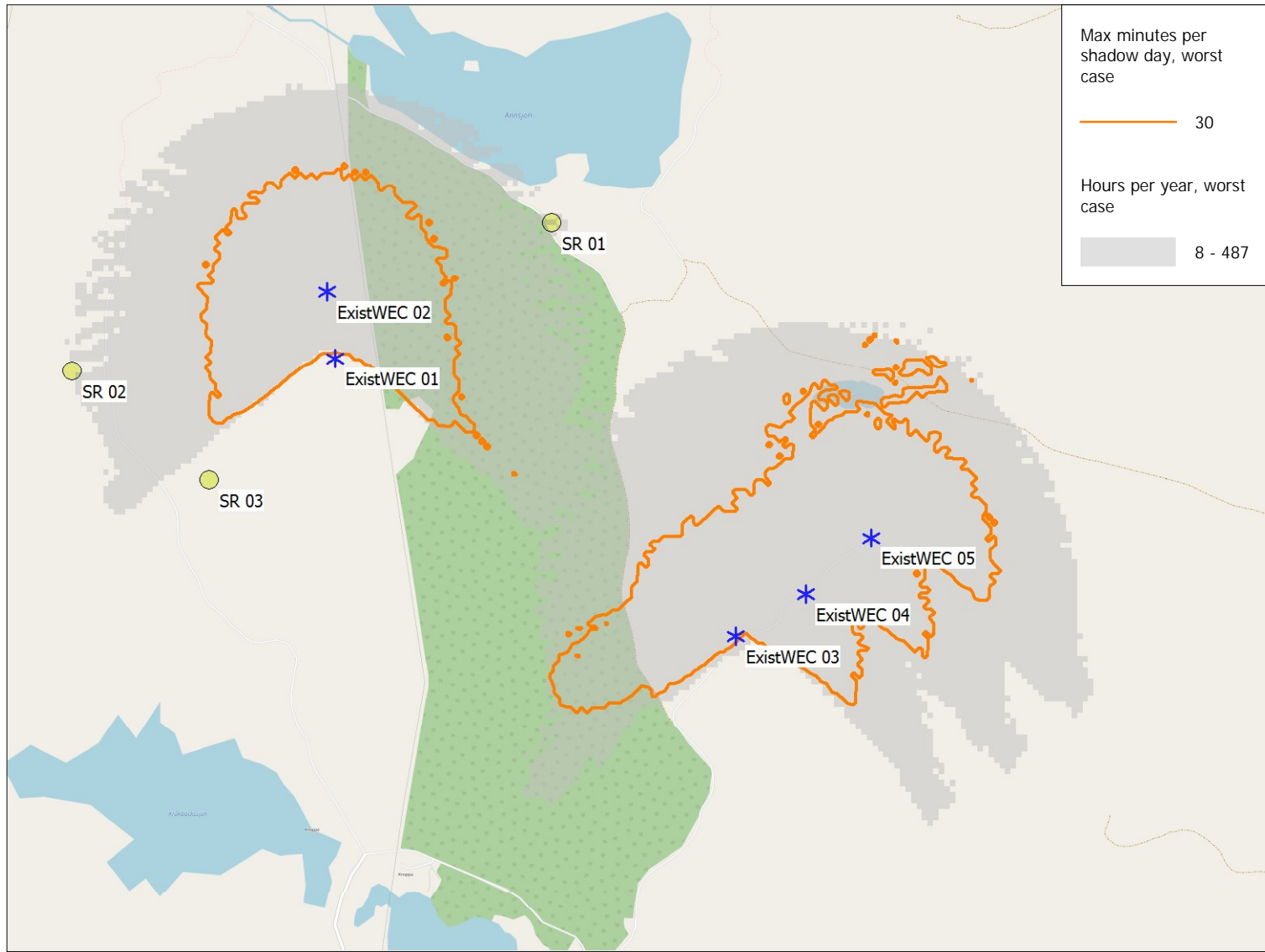
Calculated:

2019-09-06 07:05/3.3.261

SHADOW - Main Result

Calculation: Total Shadow Flickering - A01a

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.



Max minutes per shadow day, worst case
 — 30

Hours per year, worst case
 ■ 8 - 487

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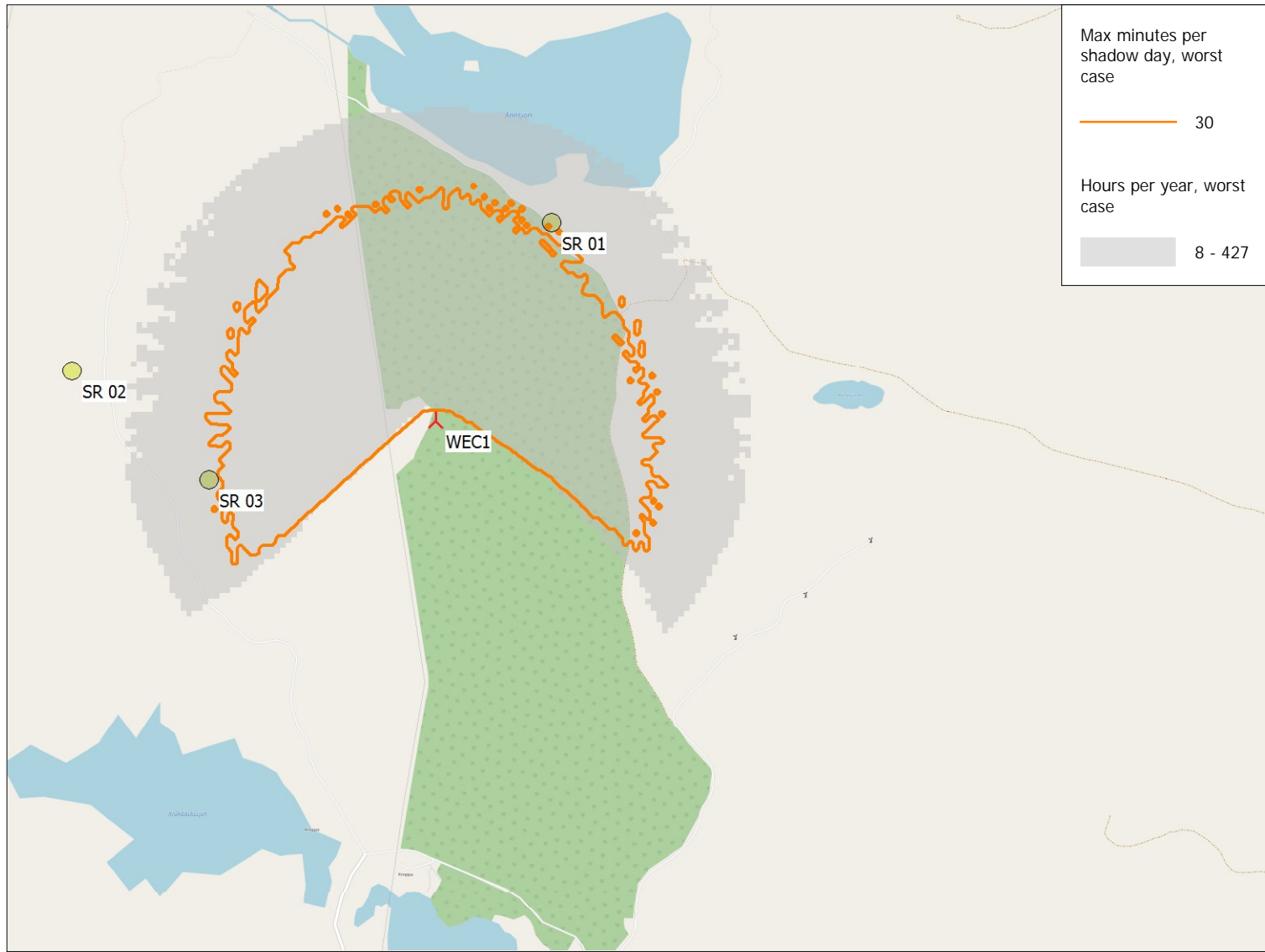
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SHADOW - Map
 Calculation:
 Initial Shadow Flickering - A01a

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 DE-26605 Aurich
 04941/927-0
 Christian Meckenhäuser / Wind Farm Engineering
 Calculated:
 2019-09-06 07:03/3.3.261

* Existing WTG ● Shadow receptor

Map: EMD OpenStreetMap , Print scale 1:35 000, Map center Swedish UTM 33-SWREF99 (SE) East: 605 631 North: 6 885 889
 Flicker map level: Höhenlinien: CONTOURLINE_ONLINEDATA_0.wpo (1)



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**SHADOW -
Map**

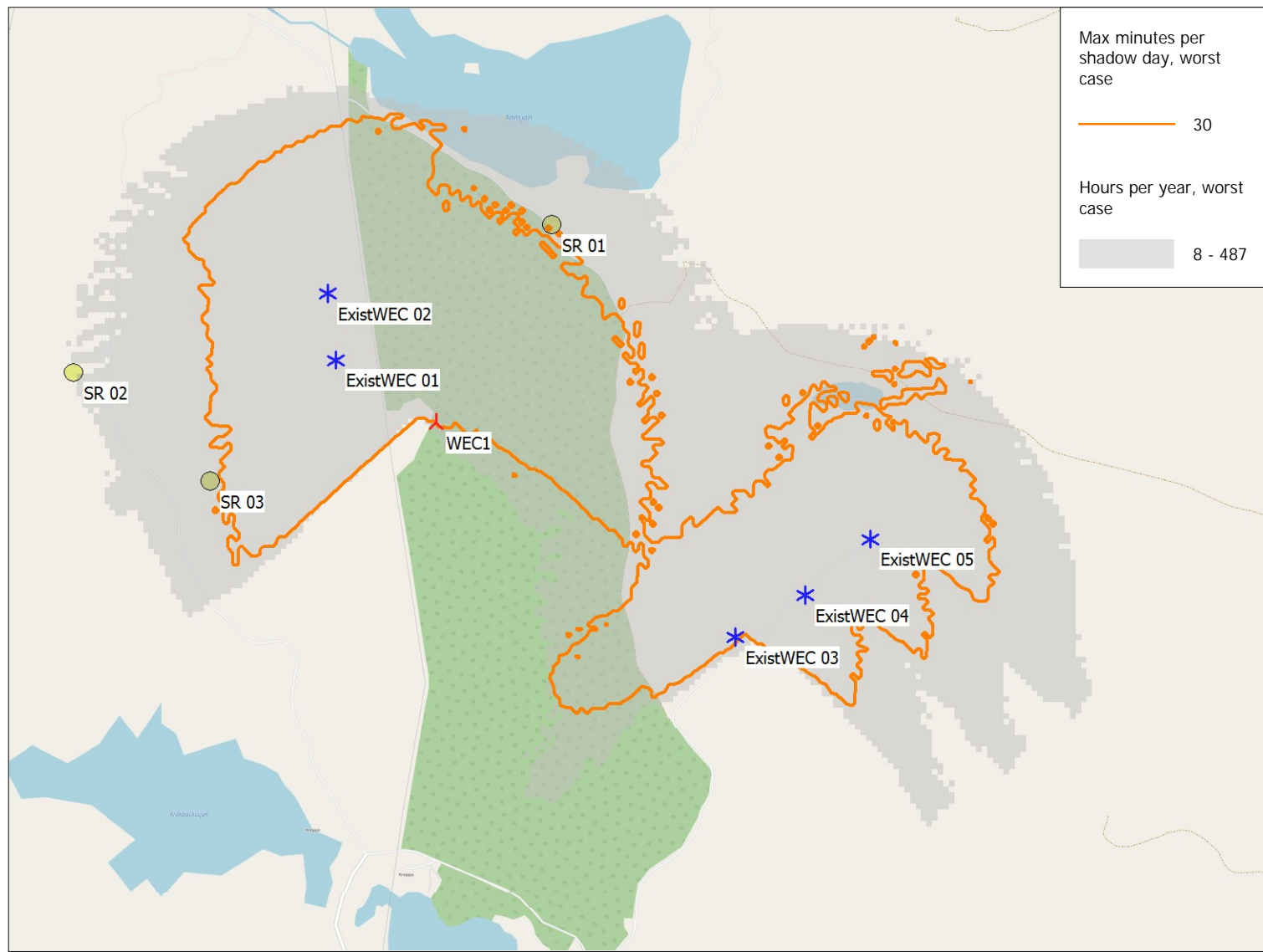
Calculation:
Additional Shadow Flickering - A01a

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Map: EMD OpenStreetMap , Print scale 1:35 000, Map center Swedish UTM 33-SWREF99 (SE) East: 605 631 North: 6 885 889
Flicker map level: Höhenlinien: CONTOURLINE_ONLINEDATA_0.wpo (1)

New WTG

Shadow receptor



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**SHADOW -
Map**
Calculation:
Total Shadow Flickering - A01a

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04941/927-0
Christian Meckenhäuser / Wind Farm Engineering
Calculated:
2019-09-06 07:05/3.3.261

Map: EMD OpenStreetMap , Print scale 1:35 000, Map center Swedish UTM 33-SWREF99 (SE) East: 605 631 North: 6 885 889
 * Existing WTG ● Shadow receptor
 Flicker map level: Höhenlinien: CONTOURLINE_ONLINEDATA_0.wpo (1)