

Flyers Creek

WIND FARM

Environmental Assessment

APPENDIX C

C1 - Visual Assessment

C2 - Shadow Flicker



Flyers Creek Shadow Flicker Assessment

December 2010

Flyers Creek Wind Farm Pty Ltd

Revision	Details	Date	Amended By
00	Original	13/12/2010	Ben Inkster
01	Amended	15/12/2010	Adam Trethowan
02	Amended	17/12/2010	Ben Inkster

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Glossary

FCWF	Flyers Creek Wind Farm
BoM	Bureau of Meteorology
MW	Megawatt
WTG	Wind Turbine Generator
RPM	Revolutions per minute

Executive summary

Flyers Creek Wind Farm Pty Ltd has requested that Parsons Brinckerhoff (PB) perform a shadow flicker assessment on the Flyers Creek Wind Farm (FCWF) in central New South Wales. Flyers Creek Wind Farm Pty Ltd is a wholly owned subsidiary of Infigen Energy who is effectively managing the development of the project. Infigen have supplied the location of 157 residences surrounding the wind farm to be included in the assessment. The assessment was completed using a turbine layout supplied by Infigen composed of 44 GE 2.5xl wind turbines which is a 2.5 MW turbine with a 100 m blade diameter and 85 m hub height.

The shadow flicker assessment conducted by PB consisted of a “worst case” and a realistic case for shadow flicker impact on each dwelling. The realistic case was performed using conservative assumptions using monitored data from the Bureau of Meteorology to represent average sunlight hours per day; however, a number of parameters are still set at what are considered conservative values. Several sites were considered for realistic data, but Canberra Airport was selected as the most appropriate reference site to use in the realistic shadow flicker calculation due to the geographic similarity, duration of recorded data and the higher level of experienced daylight at Canberra Airport (conservative choice). The results of the worst case and realistic calculations of shadow flicker are included in Table 1. Of the 157 residences supplied, 25 have been predicted to experience levels of shadow flicker due to FCWF. No residence experienced more than 10 hours of shadow flicker in the realistic case including residence involved in the wind farm project. For the ‘worst case’, no neighbouring residences will experience over 30 hours of shadow flicker per year.

However, the worst case assessment uses conservative model parameters that are very unlikely to occur in combination over annual timescales. The results show that for most residences, even under these conservative conditions, shadow flicker is below recommended levels of both aggregate annual hours and maximum daily hours of shadow flicker time.

The shadow hours per day provide an estimate of the maximum shadow experienced by a dwelling on a single day of the year. There is no realistic and worse case scenarios associated with this parameter since, unlike shadow hours per year where the actual occurrence is cumulated over an entire year (and hence a range of environmental conditions), the shadow hours per day may well occur on a day that is conducive to the ‘worst case’ for shadow flicker (i.e. assuming no cloud cover is present on the given day that this occurs). Results of Shadow hours per year and per day are also shown in Table 1.

Table 1: Summary of shadow flicker results; affected residences only

No.	Map Ref.	Residence	Property use	Worst case shadow flicker hours per year	Shadow hours per day	Realistic shadow flicker hours per year
				[h/year]	[h/day]	[h/year]
3	D	Glen Ayr	Windfarmer residence	34:36	0:26	8:58
4	E	Lochewen	Windfarmer residence	22:04	0:22	4:10
11	L	Rhondda Villa	Non windfarmer residence	5:18	0:14	1:11
14	O	Willow Park	Windfarmer residence	28:48	0:35	8:00
17	R	Triangle Park	Non windfarmer residence	9:47	0:15	1:22
22	W	Wallaby	Windfarmer residence	14:03	0:21	1:47
23	X	Towradgee	Non windfarmer residence	10:45	0:17	1:52
24	Y	Windella	Windfarmer residence	7:16	0:22	0:26
28	AC	Hillview	Non windfarmer residence	2:27	0:11	0:04

No.	Map Ref.	Residence	Property use	Worst case shadow flicker hours per year	Shadow hours per day	Realistic shadow flicker hours per year
45	AT	Castle Hill	Non windfarmer residence	1:36	0:09	0:04
50	AY	Nullawonga	Windfarmer residence	13:32	0:21	1:33
51	AZ	Beulah Park	Windfarmer residence	26:40	0:18	6:57
52	BA	Carramar	Windfarmer residence	25:59	0:32	7:33
54	BB	Hillcrest	Windfarmer residence	3:10	0:08	0:53
56	BD	Cooramilla	Windfarmer residence	5:34	0:13	0:53
71	BS	House	Windfarmer residence	38:26	0:26	9:32
72	BT	House	Non windfarmer residence	7:05	0:16	0:28
74	BV	House	Windfarmer residence	5:00	0:14	1:12
76	BX	House	Windfarmer residence	14:42	0:17	2:58
79	CA	House	Windfarmer residence	41:25	0:32	9:22
88	CJ	House	Windfarmer residence	3:50	0:14	1:02
89	CK	House	Non windfarmer residence	12:43	0:20	1:08
90	CL	House (empty)	Non windfarmer residence	0:30	0:03	0:07
100	CV	House	Non windfarmer residence	4:21	0:12	1:06
158	FA		Non windfarmer residence	11:45	0:15	2:08

1. Introduction

Flyers Creek Wind Farm Pty Ltd is developing a wind farm located approximately 25 km south of the town of Orange, NSW. The Flyers Creek Wind Farm (FCWF) has selected the GE 2.5MWxl wind turbine as its “indicative” turbine for the purposes of this shadow flicker assessment. The wind farm is therefore proposed to consist of 44 GE 2.5xl wind turbines which are 2.5 MW wind turbine generators (WTG) with a hub height of 85 m and a blade diameter of 100 m. Aurecon, a consultant working on the FCWF project, has provided the location of 157 residences in the region of the FCWF. PB has not assessed these locations for completeness or accuracy.

1.1 Description of shadow flicker

Shadow flicker is the fluctuating light levels caused by intermittent (moving or changing) shadows. If a location is in the shadow of a moving object, then there will be a momentary reduction in light intensity as the shadow passes by. This is most noticeable in an enclosed room that is lit by the sun, when the shadow falls across the window that is providing the light. Wind turbines can cause shadow flicker from the moving shadow of the wind turbine blades. Shadow flicker can also be caused by any moving objects that cast a shadow, such as vehicles or aeroplanes.

The rate of flicker for a three bladed, horizontal axis wind turbine is 3 times the rotational speed of the wind turbine rotor. For example a three bladed wind turbine with a rotor speed of 20 revolutions per minute (rpm) results in a flicker frequency of 1 Hertz (once per second). If the alternating light levels caused by the shadow flicker are of significant intensity and affect the whole light source of a room (i.e. the whole window is shadowed), it can disturb reading and other light-sensitive tasks, thus causing annoyance.

In order for a wind turbine to cause shadow flicker at a given location, the following conditions have to be satisfied. If any one of these conditions is not met, then shadow flicker will not occur, or will have a diminished impact, at that location.

- The sun must be in the correct position in the sky to cast a shadow of the turbine onto the location. This will only occur for certain times of day and days of the year.
- Wind direction will have an impact on shadow flicker impact, as the area of the shadow cast by the wind turbine will depend on which direction the wind turbine is pointing (yaw), which in turn is dependent on the wind direction.
- There has to be unobstructed line of sight between the wind turbine and the location.
- The sun must not be significantly obscured by cloud or diffused by the atmosphere (significant diffusion typically occurs for angles of less than 3° above the horizon).
- The wind turbine has to be operating (i.e. the blades rotating).
- The dimension of the part of the blade causing the shadow has to be large enough to cast significant shadow. The largest dimension of blades is the chord near the root, which may be up to 3.5 m on large turbines, and the smallest is the depth of the blade near the tip, which may be 0.3 m or less. The latter is not sufficient to cast any

noticeable shadow. If the blade is edge-on to the sun, then the shadow will be very small.

- The shadow must fall over most of a room's natural light source, i.e. window or skylight. If the windows are large (compared to the size of the shadow), or do not face the wind turbine, then the room's light levels will not vary significantly.

The sun's position varies with the time of day and the time of year. This means that the locations affected by shadow flicker from wind turbines vary with the time of day and time of the year.

The shadow flicker usually occurs to the east and west of the turbines or to the south if there is a large height difference between the turbines and the observer location.

Flicker effects will be strongest closest to the wind turbines, as the shadows cast by the rotating blades will be strongest. As the distance from the wind turbines increases, the shadows cast by the rotor blades will become less distinct, reducing the impact of the flicker. At about 10 times the rotor diameter (1 km for a 100 m rotor diameter) the effect is reduced, and at a distance of 2 kilometres the proportion of light blocked by the wind turbine blades becomes so small that flicker is not discernable.

1.2 Scope

The scope undertaken in this report is part of the Flyers Creek wind farm layout optimisation project. The scope for this shadow flicker report, as given in the proposal *Flyers Creek Wind Farm Layout Optimisation, 23/02/2010*, includes:

- A description of the shadow flicker phenomenon and potential effects, and methods of management and mitigation
- Results of assessment of shadow flicker effects on residences for worst case and realistic scenarios (based on on-site measurements and publicly available wind and cloud data)
- Maps showing the area and the duration of shadow flicker effect created by the FCWF

1.3 Input data

The following input data was supplied by Infigen to produce the shadow flicker assessment model:

- Wind Farm layout coordinates
- WTG details; including hub height and rotor diameter
- Map contour data
- Residential property coordinates

2. Methodology

PB has used the sophisticated WindPro wind farm modelling software to assess shadow flicker on supplied residences at the FCWF. The model used for the calculation of flicker effects contains a mathematical model of the sun's position in the sky for a given location and time of year. Also contained in the model is information relating to the three-dimensional positions and sizes of the turbines and the locations where the flicker is to be calculated. This information is combined to calculate the times for which the turbine rotors will cast shadows over the locations of interest. Flicker is assumed to occur when the centre of the sun passes behind any part of a turbine rotor.

The worst case assessment involves calculations for all the provided dwelling locations based on the following (worst-case) assumptions:

- There is direct sunlight during all daylight hours (i.e. no clouds are ever experienced over the wind farm site).
- All the turbines are visible except those screened by the topography.
- The wind turbines are always operating (i.e. it is always windy, and the turbines are never inoperable due to maintenance or faults).
- The wind turbines are always turned in the horizontal plane to face the sun (i.e. the turbine rotor casts the maximum possible shadow).
- Shadow flicker is nil beyond 2 km.
- Shadow flicker is nil when the angle of the sun above the horizon is less than 3 degrees or below the horizon.
- The dwellings are represented by a vertical rectangle facing each turbine; termed as a "Greenhouse" configuration, 10 m wide and 2 m high, centred 1.5 m off the ground (any shadow on any part of this rectangle is included in the count).

In addition to the above assumptions, these calculations are based on the following wind turbine parameters:

- Turbine maximum rotor diameter 100 m.
- Turbine maximum hub height 85 m.

The worst case assessment for each dwelling results in the number of shadow flicker hours that the dwelling could potentially experience in a year. However, the occurrence of all these assumptions at one time is considered highly unlikely as cloud cover will occur over the project site, for example. Therefore, the worst case shadow flicker results serve as a starting point from which a more realistic situation is derived using measured data from reference sites recording sunlight information.

PB has applied a reduction factor to account for cloud cover at the FCWF to convert the worst case shadow flicker results to a more realistic annual estimate. This is based on recorded information on sunlight and cloud cover by the Bureau of Meteorology (BoM). The two closest reference sites are Richmond Airport, located 159 km east of FCWF and Canberra Airport, located 194 km south of FCWF. Both of these reference sites have long

term recorded data for average daily sunshine hours, however, Richmond Airport data is inclusive of the years 1975 to 1987. This information is applied to the worst case shadow flicker assessment on a monthly average basis. The average daily sunshine hours for Richmond and Canberra Airport are shown in Table 2.

Table 2: Average daylight hours per day on a monthly mean basis (Bureau of Meteorology)

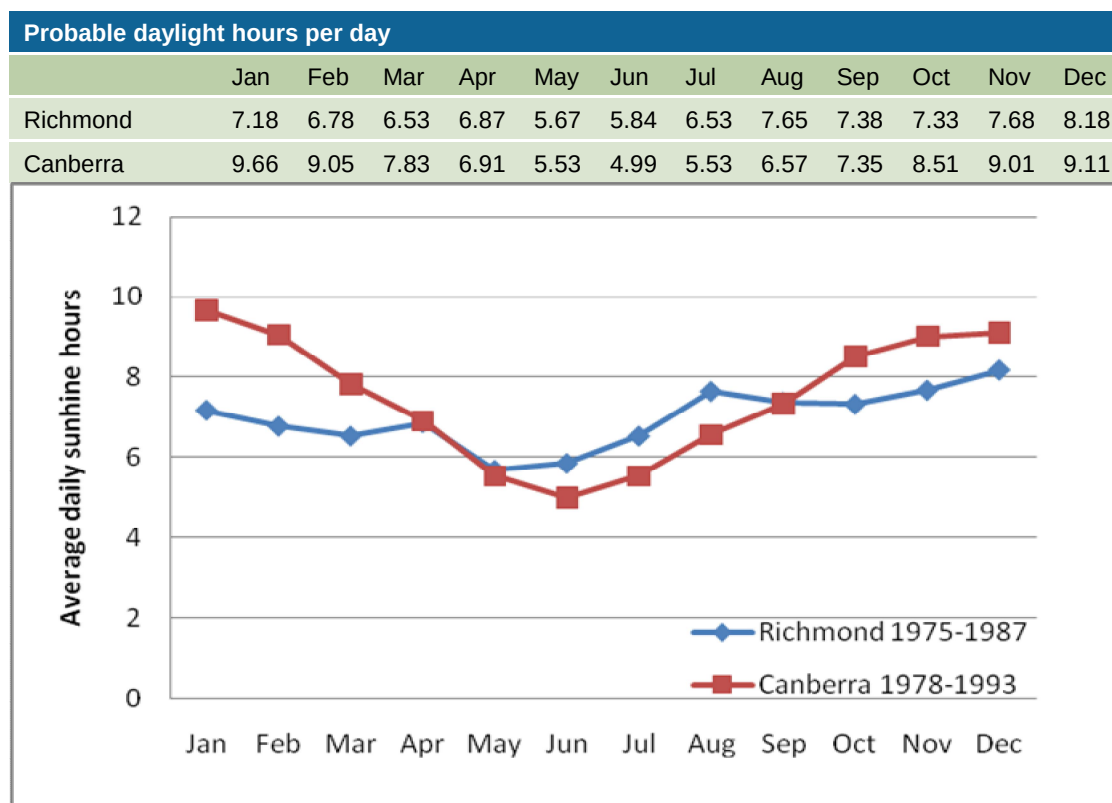


Figure 1: Average daylight hours per day for Richmond and Canberra Airport (Bureau of Meteorology)

Both data sets shown above were applied to the shadow flicker calculation and assessed for impact on FCWF. PB has included the results from the Canberra Airport reference site only in this report. Several factors influenced this decision, including:

- The conservatism of the Canberra daylight figures (i.e. Canberra experiences more daylight on average than Richmond);
- The geographic similarity between Canberra and FCWF, such as the similar distance to the coast. Richmond is a coastal site close to an urban centre and may experience different climate mechanisms influencing cloud cover;
- The duration of the recorded data at each reference site.

The cloud cover reduction factor is applied to the worst case results for the annual aggregate value only. The worst case shadow hours experienced in a day remains a realistic assumption as a dwelling may experience no cloud cover on the day of the year that has the maximum shadow flicker.

3. Results

The results of the shadow flicker assessment including worst case results and realistic results using average sunshine statistics are shown below in Table 3.

Table 3: FCWF shadow flicker results

No.	Map Ref.	Residence	Property type	Worst case shadow flicker hours per year	Worst case shadow hours per day	Realistic shadow flicker hours per year
				[h/year]	[h/day]	[h/year]
0	A	Stokefield	Non windfarmer residence	0:00	0:00	0:00
1	B	Hillcrest	Non windfarmer residence	0:00	0:00	0:00
2	C	Haverton	Windfarmer residence	0:00	0:00	0:00
3	D	Glen Ayr	Windfarmer residence	34:36	0:26	8:58
4	E	Lochewen	Windfarmer residence	22:04	0:22	4:10
5	F	Glenarvon	Non windfarmer residence	0:00	0:00	0:00
6	G	Tettenhall	Non windfarmer residence	0:00	0:00	0:00
7	H	Glendale	Non windfarmer residence	0:00	0:00	0:00
8	I	Rockdale	Non windfarmer residence	0:00	0:00	0:00
9	J	Sunnyview	Non windfarmer residence	0:00	0:00	0:00
10	K	Hill View	Non windfarmer residence	0:00	0:00	0:00
11	L	Rhondda Villa	Non windfarmer residence	5:18	0:14	1:11
12	M	Errowanbang	Non windfarmer residence	0:00	0:00	0:00
13	N	Old Errowanbang	Non windfarmer residence	0:00	0:00	0:00
14	O	Willow Park	Windfarmer residence	28:48	0:35	8:00
15	P	Stockton	Non windfarmer residence	0:00	0:00	0:00
16	Q	Meribah Cottage	Non windfarmer residence	0:00	0:00	0:00
17	R	Triangle Park	Non windfarmer residence	9:47	0:15	1:22
18	S	Meribah	Non windfarmer residence	0:00	0:00	0:00
19	T	South Log	Non windfarmer residence	0:00	0:00	0:00
20	U	North West	Non windfarmer residence	0:00	0:00	0:00
21	V	Rembo	Windfarmer residence	0:00	0:00	0:00
22	W	Wallaby	Windfarmer residence	14:03	0:21	1:47
23	X	Towradgee	Non windfarmer residence	10:45	0:17	1:52
24	Y	Windella	Windfarmer residence	7:16	0:22	0:26
25	Z	Bromley	Non windfarmer residence	0:00	0:00	0:00
26	AA	Thrushley	Windfarmer residence	0:00	0:00	0:00
27	AB	Willow Creek East	Non windfarmer residence	0:00	0:00	0:00
28	AC	Hillview	Non windfarmer residence	2:27	0:11	0:04
29	AD	Fairview	Non windfarmer residence	0:00	0:00	0:00
30	AE	Vermont	Non windfarmer residence	0:00	0:00	0:00
31	AF	Strathfield	Non windfarmer residence	0:00	0:00	0:00
32	AG	Loloma	Non windfarmer residence	0:00	0:00	0:00
33	AH	Dogwind	Non windfarmer residence	0:00	0:00	0:00
34	AI	Westerham	Non windfarmer residence	0:00	0:00	0:00
35	AJ	Timaru	Non windfarmer residence	0:00	0:00	0:00
36	AK	Willow Creek	Non windfarmer residence	0:00	0:00	0:00

No.	Map Ref.	Residence	Property type	Worst case shadow flicker hours per year	Worst case shadow hours per day	Realistic shadow flicker hours per year
37	AL	Braithwaite	Non windfarmer residence	0:00	0:00	0:00
38	AM	Carlingford	Non windfarmer residence	0:00	0:00	0:00
39	AN	Hillview	Non windfarmer residence	0:00	0:00	0:00
40	AO	The Cottage	Non windfarmer residence	0:00	0:00	0:00
41	AP	Crenvor	Non windfarmer residence	0:00	0:00	0:00
42	AQ	Euronga	Non windfarmer residence	0:00	0:00	0:00
43	AR	Bellevue	Non windfarmer residence	0:00	0:00	0:00
44	AS	Willow Dale	Non windfarmer residence	0:00	0:00	0:00
45	AT	Castle Hill	Non windfarmer residence	1:36	0:09	0:04
46	AU	Bulwarra	Non windfarmer residence	0:00	0:00	0:00
47	AV	Weston	Non windfarmer residence	0:00	0:00	0:00
48	AW	Fairbanks	Non windfarmer residence	0:00	0:00	0:00
49	AX	Wattlecomb	Windfarmer residence	0:00	0:00	0:00
50	AY	Nullawonga	Windfarmer residence	13:32	0:21	1:33
51	AZ	Beulah Park	Windfarmer residence	26:40	0:18	6:57
52	BA	Carramar	Windfarmer residence	25:59	0:32	7:33
54	BB	Hillcrest	Windfarmer residence	3:10	0:08	0:53
55	BC	House	Windfarmer residence	0:00	0:00	0:00
56	BD	Cooramilla	Windfarmer residence	5:34	0:13	0:53
57	BE	School	School	0:00	0:00	0:00
58	BF	Ridge End	Non windfarmer residence	0:00	0:00	0:00
59	BG	House	Non windfarmer residence	0:00	0:00	0:00
60	BH	Carradowns	Non windfarmer residence	0:00	0:00	0:00
61	BI	Caithness	Non windfarmer residence	0:00	0:00	0:00
62	BJ	Tralee	Non windfarmer residence	0:00	0:00	0:00
63	BK	Long View	Non windfarmer residence	0:00	0:00	0:00
64	BL	Sunnyside	Non windfarmer residence	0:00	0:00	0:00
65	BM	Greenbank	Non windfarmer residence	0:00	0:00	0:00
66	BN	Ferndale	Non windfarmer residence	0:00	0:00	0:00
67	BO	Karinya	Non windfarmer residence	0:00	0:00	0:00
68	BP	Mirraweena	Non windfarmer residence	0:00	0:00	0:00
69	BQ	Narrawong	Non windfarmer residence	0:00	0:00	0:00
70	BR	Warrengong	Non windfarmer residence	0:00	0:00	0:00
71	BS	House	Windfarmer residence	38:26	0:26	9:32
72	BT	House	Non windfarmer residence	7:05	0:16	0:28
73	BU	House	Non windfarmer residence	0:00	0:00	0:00
74	BV	House	Windfarmer residence	5:00	0:14	1:12
75	BW	House	Non windfarmer residence	0:00	0:00	0:00
76	BX	House	Windfarmer residence	14:42	0:17	2:58
77	BY	House	Non windfarmer residence	0:00	0:00	0:00
78	BZ	House	Non windfarmer residence	0:00	0:00	0:00
79	CA	House	Windfarmer residence	41:25	0:32	9:22
80	CB	House	Non windfarmer residence	0:00	0:00	0:00
81	CC	House	Non windfarmer residence	0:00	0:00	0:00
82	CD	House	Non windfarmer residence	0:00	0:00	0:00
83	CE	House	Non windfarmer residence	0:00	0:00	0:00

No.	Map Ref.	Residence	Property type	Worst case shadow flicker hours per year	Worst case shadow hours per day	Realistic shadow flicker hours per year
84	CF	House	Non windfarmer residence	0:00	0:00	0:00
85	CG	House	Non windfarmer residence	0:00	0:00	0:00
86	CH	House	Windfarmer residence	0:00	0:00	0:00
87	CI	House	Non windfarmer residence	0:00	0:00	0:00
88	CJ	House	Windfarmer residence	3:50	0:14	1:02
89	CK	House	Non windfarmer residence	12:43	0:20	1:08
90	CL	House (empty)	Non windfarmer residence	0:30	0:03	0:07
91	CM	House	Non windfarmer residence	0:00	0:00	0:00
92	CN	House	Non windfarmer residence	0:00	0:00	0:00
93	CO	House	Non windfarmer residence	0:00	0:00	0:00
94	CP	House	Non windfarmer residence	0:00	0:00	0:00
95	CQ	House	Non windfarmer residence	0:00	0:00	0:00
96	CR	House	Non windfarmer residence	0:00	0:00	0:00
97	CS	House	Non windfarmer residence	0:00	0:00	0:00
98	CT	House	Non windfarmer residence	0:00	0:00	0:00
99	CU	House	Non windfarmer residence	0:00	0:00	0:00
100	CV	House	Non windfarmer residence	4:21	0:12	1:06
101	CW	House	Non windfarmer residence	0:00	0:00	0:00
102	CX	House	Non windfarmer residence	0:00	0:00	0:00
103	CY	House	Non windfarmer residence	0:00	0:00	0:00
104	CZ	House	Non windfarmer residence	0:00	0:00	0:00
105	DA	House	Non windfarmer residence	0:00	0:00	0:00
106	DB	House	Non windfarmer residence	0:00	0:00	0:00
107	DC	House	Non windfarmer residence	0:00	0:00	0:00
108	DD	House	Non windfarmer residence	0:00	0:00	0:00
109	DE	House	Non windfarmer residence	0:00	0:00	0:00
110	DF	House	Non windfarmer residence	0:00	0:00	0:00
111	DG	House	Non windfarmer residence	0:00	0:00	0:00
112	DH		Non windfarmer residence	0:00	0:00	0:00
114	DI		Non windfarmer residence	0:00	0:00	0:00
115	DJ		Non windfarmer residence	0:00	0:00	0:00
116	DK		Non windfarmer residence	0:00	0:00	0:00
117	DL		Non windfarmer residence	0:00	0:00	0:00
118	DM		Non windfarmer residence	0:00	0:00	0:00
119	DN		Non windfarmer residence	0:00	0:00	0:00
120	DO		Non windfarmer residence	0:00	0:00	0:00
121	DP		Non windfarmer residence	0:00	0:00	0:00
122	DQ		Non windfarmer residence	0:00	0:00	0:00
123	DR		Non windfarmer residence	0:00	0:00	0:00
124	DS		Non windfarmer residence	0:00	0:00	0:00
125	DT		Non windfarmer residence	0:00	0:00	0:00
126	DU		Non windfarmer residence	0:00	0:00	0:00
127	DV		Non windfarmer residence	0:00	0:00	0:00
128	DW		Non windfarmer residence	0:00	0:00	0:00
129	DX		Non windfarmer residence	0:00	0:00	0:00
130	DY		Non windfarmer residence	0:00	0:00	0:00

No.	Map Ref.	Residence	Property type	Worst case shadow flicker hours per year	Worst case shadow hours per day	Realistic shadow flicker hours per year
131	DZ		Non windfarmer residence	0:00	0:00	0:00
132	EA		Non windfarmer residence	0:00	0:00	0:00
133	EB		Non windfarmer residence	0:00	0:00	0:00
134	EC		Non windfarmer residence	0:00	0:00	0:00
136	ED		Non windfarmer residence	0:00	0:00	0:00
137	EE		Non windfarmer residence	0:00	0:00	0:00
138	EF		Non windfarmer residence	0:00	0:00	0:00
139	EG		Non windfarmer residence	0:00	0:00	0:00
140	EH		Non windfarmer residence	0:00	0:00	0:00
141	EI		Non windfarmer residence	0:00	0:00	0:00
142	EJ		Non windfarmer residence	0:00	0:00	0:00
143	EK		Non windfarmer residence	0:00	0:00	0:00
144	EL		Non windfarmer residence	0:00	0:00	0:00
145	EM		Non windfarmer residence	0:00	0:00	0:00
146	EN		Non windfarmer residence	0:00	0:00	0:00
147	EO		Non windfarmer residence	0:00	0:00	0:00
148	EP		Non windfarmer residence	0:00	0:00	0:00
149	EQ		Non windfarmer residence	0:00	0:00	0:00
150	ER		Non windfarmer residence	0:00	0:00	0:00
151	ES		Non windfarmer residence	0:00	0:00	0:00
152	ET		Non windfarmer residence	0:00	0:00	0:00
158	EU		Non windfarmer residence	0:00	0:00	0:00
153	EV		Non windfarmer residence	0:00	0:00	0:00
154	EW		Non windfarmer residence	0:00	0:00	0:00
155	EX		Non windfarmer residence	0:00	0:00	0:00
156	EY		Non windfarmer residence	0:00	0:00	0:00
157	EZ		Non windfarmer residence	0:00	0:00	0:00
158	FA		Non windfarmer residence	11:45	0:15	2:08

Appendix A

WindPro shadow flicker reports

Project:	Description:	Printed/Page
Infigen_011_SHADOW	Flyers Creek, NSW	6/12/2010 11:13 AM / 2
		Licensed user:
		Parsons Brinckerhoff
		Level 7, 457 St Kilda Road, PO Box 7209
		AU-3004 VIC Melbourne
		+61 3 9861 1250
		Adam Trethowan / trethowana@pbworld.com
		Calculated:
		3/12/2010 2:35 PM/2.7.473

SHADOW - Main Result**Calculation:** Shadow 30Nov10 Canberra BoM Data

...continued from previous page

UTM GDA94 Zone: 55				WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	RPM [RPM]
East	North	Z	Row data/Description	Valid	Manufact.					
UTM GDA94 Zone: 55			[m]							
37	695,178	6,283,099	904.1 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
38	695,285	6,282,880	907.5 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
39	695,383	6,282,655	899.0 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
40	695,229	6,282,331	889.7 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
41	696,494	6,283,966	933.1 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
42	696,745	6,283,761	911.9 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
43	696,940	6,283,488	897.6 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0
44	697,221	6,283,308	873.8 GE WIND ENERGY GE...	Yes	GE WIND ENERGY	GE 2.5xl-2,500	2,500	100.0	85.0	14.0

Shadow receptor-Input

UTM GDA94 Zone: 55									
No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
A	697,170	6,277,991	693.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
B	695,480	6,279,583	784.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
C	695,919	6,280,995	797.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
D	693,290	6,281,079	797.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
E	691,740	6,280,418	727.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
F	689,988	6,279,727	692.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
G	686,673	6,280,542	670.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
H	686,729	6,281,398	649.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
I	686,895	6,281,635	660.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
J	687,863	6,281,361	690.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
K	688,196	6,283,545	675.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
L	688,548	6,284,390	663.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
M	689,697	6,285,992	659.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
N	689,493	6,286,700	669.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
O	691,859	6,287,385	716.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
P	688,049	6,286,778	697.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
Q	688,498	6,288,144	727.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
R	688,810	6,288,422	677.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
S	687,479	6,287,542	710.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
T	686,400	6,286,566	685.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
U	688,821	6,291,307	742.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
V	689,845	6,289,617	723.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
W	691,254	6,290,797	789.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
X	693,998	6,290,034	852.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
Y	694,504	6,290,794	891.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
Z	693,794	6,291,840	896.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AA	692,827	6,292,548	934.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AB	692,030	6,292,590	905.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AC	694,887	6,290,992	921.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AD	695,725	6,291,229	934.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AE	695,003	6,292,497	913.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AF	695,822	6,292,571	932.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AG	694,991	6,293,599	916.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AH	694,654	6,293,413	919.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AI	693,441	6,293,402	942.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AJ	692,095	6,293,649	901.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AK	690,975	6,292,913	895.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AL	690,622	6,292,862	892.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AM	697,744	6,291,449	908.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AN	697,156	6,290,613	923.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AO	697,253	6,291,238	917.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AP	696,957	6,289,196	903.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AQ	695,744	6,290,256	937.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AR	695,308	6,288,867	908.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"

To be continued on next page...

Project: Infigen_011_SHADOW
Description: Flyers Creek, NSW

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Level 7, 457 St Kilda Road, PO Box 7209
AU-3004 VIC Melbourne
+61 3 9861 1250
Adam Trethowan / trethowana@pbworld.com
Calculated:
3/12/2010 2:35 PM/2.7.473

SHADOW - Main Result

Calculation: Shadow 30Nov10 Canberra BoM Data

...continued from previous page

UTM GDA94 Zone: 55

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
AS	694,827	6,288,747	897.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AT	696,576	6,287,157	874.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AU	695,613	6,286,034	912.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AV	697,517	6,285,936	859.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AW	696,357	6,285,318	878.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AX	695,841	6,284,902	888.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AY	694,452	6,284,339	860.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
AZ	696,637	6,281,968	803.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BA	691,683	6,285,950	702.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BB	692,331	6,284,482	849.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BC	695,336	6,285,112	890.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BD	694,850	6,288,242	887.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BE	690,243	6,286,658	665.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BF	691,558	6,277,254	669.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BG	693,818	6,276,240	694.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BH	697,959	6,287,754	866.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BI	698,124	6,288,446	903.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BJ	698,615	6,287,506	899.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BK	698,286	6,289,654	911.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BL	695,193	6,294,854	927.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BM	696,414	6,294,288	940.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BN	696,920	6,293,544	941.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BO	691,781	6,294,883	920.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BP	691,505	6,294,942	920.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BQ	690,656	6,294,539	880.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BR	690,073	6,294,640	853.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BS	693,808	6,280,666	768.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BT	687,821	6,282,338	696.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BU	687,953	6,284,796	653.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BV	690,651	6,285,519	691.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BW	689,275	6,286,492	664.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BX	694,469	6,284,864	901.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BY	694,049	6,285,751	872.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
BZ	694,012	6,285,598	875.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CA	692,359	6,288,256	707.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CB	695,362	6,289,589	935.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CC	693,283	6,295,029	930.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CD	694,183	6,292,036	890.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CE	694,241	6,293,494	925.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CF	693,969	6,293,621	930.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CG	690,447	6,291,187	746.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CH	690,308	6,290,617	730.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CI	689,734	6,290,127	706.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CJ	689,502	6,289,460	697.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CK	693,550	6,289,600	838.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CL	694,219	6,289,645	912.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CM	693,030	6,293,126	957.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CN	693,277	6,292,929	948.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CO	692,306	6,293,308	932.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CP	692,314	6,293,160	939.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CQ	690,018	6,280,556	695.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CR	694,850	6,291,802	926.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CS	698,279	6,290,936	914.3	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CT	695,904	6,290,084	938.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CU	694,392	6,289,672	938.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CV	694,772	6,290,052	914.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CW	697,785	6,286,217	837.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CX	697,065	6,281,327	789.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
CY	696,332	6,279,079	739.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"

To be continued on next page...

Project: Infigen_011_SHADOW
 Description: Flyers Creek, NSW

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 Level 7, 457 St Kilda Road, PO Box 7209
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 Adam Trethowan / trethowana@pbworld.com
 Calculated:
 3/12/2010 2:35 PM/2.7.473

SHADOW - Main Result

Calculation: Shadow 30Nov10 Canberra BoM Data

...continued from previous page

UTM GDA94 Zone: 55

No.	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
CZ	696,683	6,278,525	700.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DA	690,596	6,277,280	650.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DB	688,728	6,279,860	660.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DC	687,977	6,285,007	648.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DD	694,704	6,285,394	885.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DE	688,500	6,290,500	762.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DF	690,318	6,277,598	660.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DG	690,304	6,277,759	668.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DH	687,709	6,288,967	715.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DI	695,751	6,290,438	935.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DJ	695,087	6,292,048	922.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DK	695,091	6,292,246	916.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DL	693,441	6,293,890	970.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DM	694,196	6,293,386	916.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DN	692,045	6,295,040	920.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DO	694,438	6,293,383	916.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DP	694,640	6,293,698	916.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DQ	694,220	6,294,171	944.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DR	693,138	6,294,634	928.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DS	693,533	6,294,569	958.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DT	692,443	6,294,799	930.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DU	687,625	6,283,504	670.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DV	691,799	6,293,599	890.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DW	688,104	6,287,804	705.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DX	688,852	6,286,757	681.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DY	687,105	6,282,971	649.9	10.0	2.0	0.5	0.0	90.0	"Green house mode"
DZ	685,837	6,280,004	680.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EA	688,837	6,279,448	663.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EB	696,510	6,279,699	778.4	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EC	697,944	6,280,180	691.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
ED	699,920	6,286,420	860.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EE	696,604	6,291,909	932.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EF	693,623	6,294,311	960.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EG	693,835	6,294,380	960.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EH	693,913	6,294,091	960.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EI	693,957	6,294,212	960.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EJ	693,165	6,294,750	927.7	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EK	693,788	6,294,889	949.8	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EL	692,299	6,294,767	930.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EM	691,475	6,294,777	920.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EN	691,058	6,294,683	900.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EO	697,406	6,286,869	847.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EP	698,405	6,288,043	922.2	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EQ	698,465	6,288,564	899.1	10.0	2.0	0.5	0.0	90.0	"Green house mode"
ER	698,346	6,288,483	906.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
ES	698,324	6,288,379	900.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
ET	696,605	6,291,705	925.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EU	690,162	6,291,224	761.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EV	692,763	6,294,447	914.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EW	692,694	6,294,781	928.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EX	692,513	6,295,017	926.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EY	689,967	6,294,937	881.6	10.0	2.0	0.5	0.0	90.0	"Green house mode"
EZ	689,987	6,295,452	922.5	10.0	2.0	0.5	0.0	90.0	"Green house mode"
FA	696,967	6,282,107	822.0	10.0	2.0	0.5	0.0	90.0	"Green house mode"

Project:

Infigen_011_SHADOW

Description:

Flyers Creek, NSW

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Adam Trethowan / trethowana@pbworld.com

Calculated:

3/12/2010 2:35 PM/2.7.473

SHADOW - Main Result**Calculation:** Shadow 30Nov10 Canberra BoM Data**Calculation Results**

Shadow receptor

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	0:00	0	0:00	0:00
B	0:00	0	0:00	0:00
C	0:00	0	0:00	0:00
D	34:36	120	0:26	8:58
E	22:04	77	0:22	4:10
F	0:00	0	0:00	0:00
G	0:00	0	0:00	0:00
H	0:00	0	0:00	0:00
I	0:00	0	0:00	0:00
J	0:00	0	0:00	0:00
K	0:00	0	0:00	0:00
L	5:18	29	0:14	1:11
M	0:00	0	0:00	0:00
N	0:00	0	0:00	0:00
O	28:48	73	0:35	8:00
P	0:00	0	0:00	0:00
Q	0:00	0	0:00	0:00
R	9:47	57	0:15	1:22
S	0:00	0	0:00	0:00
T	0:00	0	0:00	0:00
U	0:00	0	0:00	0:00
V	0:00	0	0:00	0:00
W	14:03	60	0:21	1:47
X	10:45	80	0:17	1:52
Y	7:16	42	0:22	0:26
Z	0:00	0	0:00	0:00
AA	0:00	0	0:00	0:00
AB	0:00	0	0:00	0:00
AC	2:27	18	0:11	0:04
AD	0:00	0	0:00	0:00
AE	0:00	0	0:00	0:00
AF	0:00	0	0:00	0:00
AG	0:00	0	0:00	0:00
AH	0:00	0	0:00	0:00
AI	0:00	0	0:00	0:00
AJ	0:00	0	0:00	0:00
AK	0:00	0	0:00	0:00
AL	0:00	0	0:00	0:00
AM	0:00	0	0:00	0:00
AN	0:00	0	0:00	0:00
AO	0:00	0	0:00	0:00
AP	0:00	0	0:00	0:00
AQ	0:00	0	0:00	0:00
AR	0:00	0	0:00	0:00
AS	0:00	0	0:00	0:00
AT	1:36	15	0:09	0:04
AU	0:00	0	0:00	0:00
AV	0:00	0	0:00	0:00
AW	0:00	0	0:00	0:00
AX	0:00	0	0:00	0:00
AY	13:32	53	0:21	1:33
AZ	26:40	114	0:18	6:57
BA	25:59	66	0:32	7:33
BB	3:10	34	0:08	0:53
BC	0:00	0	0:00	0:00
BD	5:34	34	0:13	0:53
BE	0:00	0	0:00	0:00
BF	0:00	0	0:00	0:00

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Project:

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Description:

Flyers Creek, NSW

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Calculated:

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SHADOW - Main Result**Calculation:** Shadow 30Nov10 Canberra BoM Data

...continued from previous page

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
BG	0:00	0	0:00	0:00
BH	0:00	0	0:00	0:00
BI	0:00	0	0:00	0:00
BJ	0:00	0	0:00	0:00
BK	0:00	0	0:00	0:00
BL	0:00	0	0:00	0:00
BM	0:00	0	0:00	0:00
BN	0:00	0	0:00	0:00
BO	0:00	0	0:00	0:00
BP	0:00	0	0:00	0:00
BQ	0:00	0	0:00	0:00
BR	0:00	0	0:00	0:00
BS	38:26	149	0:26	9:32
BT	7:05	38	0:16	0:28
BU	0:00	0	0:00	0:00
BV	5:00	28	0:14	1:12
BW	0:00	0	0:00	0:00
BX	14:42	82	0:17	2:58
BY	0:00	0	0:00	0:00
BZ	0:00	0	0:00	0:00
CA	41:25	108	0:32	9:22
CB	0:00	0	0:00	0:00
CC	0:00	0	0:00	0:00
CD	0:00	0	0:00	0:00
CE	0:00	0	0:00	0:00
CF	0:00	0	0:00	0:00
CG	0:00	0	0:00	0:00
CH	0:00	0	0:00	0:00
CI	0:00	0	0:00	0:00
CJ	3:50	22	0:14	1:02
CK	12:43	56	0:20	1:08
CL	0:30	14	0:03	0:07
CM	0:00	0	0:00	0:00
CN	0:00	0	0:00	0:00
CO	0:00	0	0:00	0:00
CP	0:00	0	0:00	0:00
CQ	0:00	0	0:00	0:00
CR	0:00	0	0:00	0:00
CS	0:00	0	0:00	0:00
CT	0:00	0	0:00	0:00
CU	0:00	0	0:00	0:00
CV	4:21	34	0:12	1:06
CW	0:00	0	0:00	0:00
CX	0:00	0	0:00	0:00
CY	0:00	0	0:00	0:00
CZ	0:00	0	0:00	0:00
DA	0:00	0	0:00	0:00
DB	0:00	0	0:00	0:00
DC	0:00	0	0:00	0:00
DD	0:00	0	0:00	0:00
DE	0:00	0	0:00	0:00
DF	0:00	0	0:00	0:00
DG	0:00	0	0:00	0:00
DH	0:00	0	0:00	0:00
DI	0:00	0	0:00	0:00
DJ	0:00	0	0:00	0:00
DK	0:00	0	0:00	0:00
DL	0:00	0	0:00	0:00
DM	0:00	0	0:00	0:00

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Project: **Infigen_011_SHADOW** Description: **Flyers Creek, NSW**

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Adam Trethowan / trethowana@pbworld.com
Calculated:
3/12/2010 2:35 PM/2.7.473

SHADOW - Main Result

Calculation: Shadow 30Nov10 Canberra BoM Data

...continued from previous page

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
DN	0:00	0	0:00	0:00
DO	0:00	0	0:00	0:00
DP	0:00	0	0:00	0:00
DQ	0:00	0	0:00	0:00
DR	0:00	0	0:00	0:00
DS	0:00	0	0:00	0:00
DT	0:00	0	0:00	0:00
DU	0:00	0	0:00	0:00
DV	0:00	0	0:00	0:00
DW	0:00	0	0:00	0:00
DX	0:00	0	0:00	0:00
DY	0:00	0	0:00	0:00
DZ	0:00	0	0:00	0:00
EA	0:00	0	0:00	0:00
EB	0:00	0	0:00	0:00
EC	0:00	0	0:00	0:00
ED	0:00	0	0:00	0:00
EE	0:00	0	0:00	0:00
EF	0:00	0	0:00	0:00
EG	0:00	0	0:00	0:00
EH	0:00	0	0:00	0:00
EI	0:00	0	0:00	0:00
EJ	0:00	0	0:00	0:00
EK	0:00	0	0:00	0:00
EL	0:00	0	0:00	0:00
EM	0:00	0	0:00	0:00
EN	0:00	0	0:00	0:00
EO	0:00	0	0:00	0:00
EP	0:00	0	0:00	0:00
EQ	0:00	0	0:00	0:00
ER	0:00	0	0:00	0:00
ES	0:00	0	0:00	0:00
ET	0:00	0	0:00	0:00
EU	0:00	0	0:00	0:00
EV	0:00	0	0:00	0:00
EW	0:00	0	0:00	0:00
EX	0:00	0	0:00	0:00
EY	0:00	0	0:00	0:00
EZ	0:00	0	0:00	0:00
FA	11:45	65	0:15	2:08

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3697)	8:51	1:04
2	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3698)	15:01	1:36
3	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3699)	13:17	2:21
4	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3700)	9:08	1:11
5	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3701)	7:02	0:17
6	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3702)	0:00	0:00
7	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3703)	24:53	7:56
8	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3704)	7:49	1:50
9	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3705)	2:39	0:13
10	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3706)	16:48	4:09
11	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3707)	31:41	5:01
12	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3708)	5:34	0:53
13	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3709)	1:36	0:04
14	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3710)	0:00	0:00
15	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3711)	30:59	8:45

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Project:

Infigen_011_SHADOW

Description:

Flyers Creek, NSW

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3/12/2010 2:35 PM/2.7.473

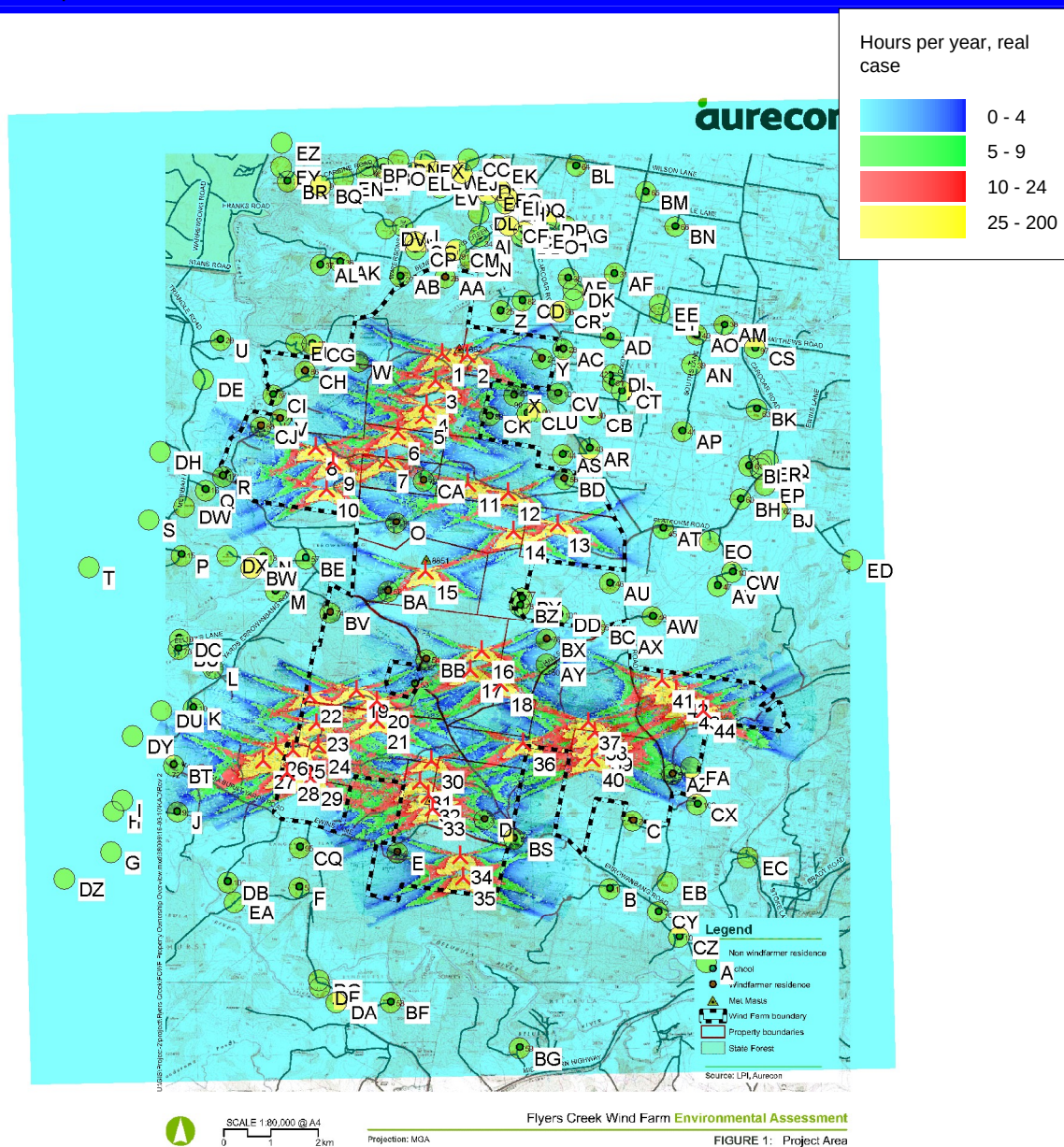
SHADOW - Main Result**Calculation:** Shadow 30Nov10 Canberra BoM Data

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
16	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3712)	13:55	2:00
17	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3713)	14:18	2:28
18	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3714)	0:00	0:00
19	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3715)	3:08	0:52
20	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3716)	0:00	0:00
21	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3717)	0:00	0:00
22	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3718)	5:17	1:11
23	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3719)	0:00	0:00
24	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3720)	0:00	0:00
25	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3721)	0:00	0:00
26	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3722)	3:07	0:21
27	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3723)	3:58	0:07
28	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3724)	0:00	0:00
29	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3725)	0:00	0:00
30	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3726)	0:00	0:00
31	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3727)	10:24	3:11
32	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3728)	23:59	6:44
33	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3729)	16:57	3:26
34	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3730)	29:35	5:04
35	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3731)	13:46	3:41
36	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3732)	0:00	0:00
37	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3733)	0:00	0:00
38	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3734)	17:46	4:55
39	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3735)	12:26	3:00
40	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3736)	8:12	1:01
41	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3737)	0:00	0:00
42	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3738)	0:00	0:00
43	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3739)	0:00	0:00
44	GE WIND ENERGY GE 2.5x1 2500 100.0 !O! hub: 85.0 m (3740)	0:00	0:00

SHADOW - Map

Calculation: Shadow Map 30Nov10 Canberra BoM Data



Map: test , Print scale 1:125,000, Map center UTM GDA 94 Zone: 55 East: 692,820 North: 6,285,920
 Shadow receptor

Appendix B

Residence locations

Table 4: Location of residence

Map Ref.	Residence	Property Use	Easting	Northing	Z
			UTM GDA94 Zone: 55		[m]
A	Stokefield	Non windfarmer residence	697,170	6,277,991	693.4
B	Hillcrest	Non windfarmer residence	695,480	6,279,583	784
C	Haverton	Windfarmer residence	695,919	6,280,995	797.8
D	Glen Ayr	Windfarmer residence	693,290	6,281,079	797.1
E	Lochewen	Windfarmer residence	691,740	6,280,418	727.6
F	Glenarvon	Non windfarmer residence	689,988	6,279,727	692.3
G	Tettenhall	Non windfarmer residence	686,673	6,280,542	670
H	Glendale	Non windfarmer residence	686,729	6,281,398	649.2
I	Rockdale	Non windfarmer residence	686,895	6,281,635	660
J	Sunnyview	Non windfarmer residence	687,863	6,281,361	690.3
K	Hill View	Non windfarmer residence	688,196	6,283,545	675
L	Rhondda Villa	Non windfarmer residence	688,548	6,284,390	663.4
M	Errowanbang	Non windfarmer residence	689,697	6,285,992	659.5
N	Old Errowanbang	Non windfarmer residence	689,493	6,286,700	669.2
O	Willow Park	Windfarmer residence	691,859	6,287,385	716.3
P	Stockton	Non windfarmer residence	688,049	6,286,778	697.5
Q	Meribah Cottage	Non windfarmer residence	688,498	6,288,144	727.2
R	Triangle Park	Non windfarmer residence	688,810	6,288,422	677
S	Meribah	Non windfarmer residence	687,479	6,287,542	710
T	South Log	Non windfarmer residence	686,400	6,286,566	685.7
U	North West	Non windfarmer residence	688,821	6,291,307	742.8
V	Rembo	Windfarmer residence	689,845	6,289,617	723.4
W	Wallaby	Windfarmer residence	691,254	6,290,797	789.3
X	Towradgee	Non windfarmer residence	693,998	6,290,034	852.2
Y	Windella	Windfarmer residence	694,504	6,290,794	891.2
Z	Bromley	Non windfarmer residence	693,794	6,291,840	896.4
AA	Thrushley	Windfarmer residence	692,827	6,292,548	934.9
AB	Willow Creek East	Non windfarmer residence	692,030	6,292,590	905.7
AC	Hillview	Non windfarmer residence	694,887	6,290,992	921.2
AD	Fairview	Non windfarmer residence	695,725	6,291,229	934.1
AE	Vermont	Non windfarmer residence	695,003	6,292,497	913.5
AF	Strathfield	Non windfarmer residence	695,822	6,292,571	932.8
AG	Loloma	Non windfarmer residence	694,991	6,293,599	916.8
AH	Dogwind	Non windfarmer residence	694,654	6,293,413	919.8
AI	Westerham	Non windfarmer residence	693,441	6,293,402	942.3
AJ	Timaru	Non windfarmer residence	692,095	6,293,649	901.4
AK	Willow Creek	Non windfarmer residence	690,975	6,292,913	895
AL	Braithwaite	Non windfarmer residence	690,622	6,292,862	892.9
AM	Carlingford	Non windfarmer residence	697,744	6,291,449	908
AN	Hillview	Non windfarmer residence	697,156	6,290,613	923
AO	The Cottage	Non windfarmer residence	697,253	6,291,238	917.1
AP	Crenvor	Non windfarmer residence	696,957	6,289,196	903.2
AQ	Euronga	Non windfarmer residence	695,744	6,290,256	937.5

Map Ref.	Residence	Property Use	Easting	Northing	Z
AR	Bellevue	Non windfarmer residence	695,308	6,288,867	908.4
AS	Willow Dale	Non windfarmer residence	694,827	6,288,747	897.6
AT	Castle Hill	Non windfarmer residence	696,576	6,287,157	874
AU	Bulwarra	Non windfarmer residence	695,613	6,286,034	912
AV	Weston	Non windfarmer residence	697,517	6,285,936	859.8
AW	Fairbanks	Non windfarmer residence	696,357	6,285,318	878.9
AX	Wattlecomb	Windfarmer residence	695,841	6,284,902	888
AY	Nullawonga	Windfarmer residence	694,452	6,284,339	860.9
AZ	Beulah Park	Windfarmer residence	696,637	6,281,968	803
BA	Carramar	Windfarmer residence	691,683	6,285,950	702.1
BB	Hillcrest	Windfarmer residence	692,331	6,284,482	849.5
BC	House	Windfarmer residence	695,336	6,285,112	890
BD	Cooramilla	Windfarmer residence	694,850	6,288,242	887.1
BE	School	School	690,243	6,286,658	665.8
BF	Ridge End	Non windfarmer residence	691,558	6,277,254	669.2
BG	House	Non windfarmer residence	693,818	6,276,240	694.2
BH	Carradowns	Non windfarmer residence	697,959	6,287,754	866
BI	Caithness	Non windfarmer residence	698,124	6,288,446	903.4
BJ	Tralee	Non windfarmer residence	698,615	6,287,506	899.1
BK	Long View	Non windfarmer residence	698,286	6,289,654	911.3
BL	Sunnyside	Non windfarmer residence	695,193	6,294,854	927.7
BM	Greenbank	Non windfarmer residence	696,414	6,294,288	940
BN	Ferndale	Non windfarmer residence	696,920	6,293,544	941
BO	Karinya	Non windfarmer residence	691,781	6,294,883	920
BP	Mirraweena	Non windfarmer residence	691,505	6,294,942	920
BQ	Narrawong	Non windfarmer residence	690,656	6,294,539	880
BR	Warrengong	Non windfarmer residence	690,073	6,294,640	853.3
BS	House	Windfarmer residence	693,808	6,280,666	768.2
BT	House	Non windfarmer residence	687,821	6,282,338	696.7
BU	House	Non windfarmer residence	687,953	6,284,796	653.5
BV	House	Windfarmer residence	690,651	6,285,519	691.8
BW	House	Non windfarmer residence	689,275	6,286,492	664.8
BX	Hart	Windfarmer residence	694,469	6,284,864	901.6
BY	House	Non windfarmer residence	694,049	6,285,751	872.5
BZ	House	Non windfarmer residence	694,012	6,285,598	875
CA	House	Windfarmer residence	692,359	6,288,256	707.4
CB	House	Non windfarmer residence	695,362	6,289,589	935.3
CC	House	Non windfarmer residence	693,283	6,295,029	930
CD	House	Non windfarmer residence	694,183	6,292,036	890
CE	House	Non windfarmer residence	694,241	6,293,494	925
CF	House	Non windfarmer residence	693,969	6,293,621	930.5
CG	House	Non windfarmer residence	690,447	6,291,187	746
CH	House	Windfarmer residence	690,308	6,290,617	730
CI	House	Non windfarmer residence	689,734	6,290,127	706
CJ	House	Windfarmer residence	689,502	6,289,460	697.7
CK	House	Non windfarmer residence	693,550	6,289,600	838.9
CL	House (empty)	Non windfarmer residence	694,219	6,289,645	912
CM	House	Non windfarmer residence	693,030	6,293,126	957.7

Map Ref.	Residence	Property Use	Easting	Northing	Z
CN	House	Non windfarmer residence	693,277	6,292,929	948.9
CO	House	Non windfarmer residence	692,306	6,293,308	932
CP	House	Non windfarmer residence	692,314	6,293,160	939.1
CQ	House	Non windfarmer residence	690,018	6,280,556	695
CR	House	Non windfarmer residence	694,850	6,291,802	926.7
CS	House	Non windfarmer residence	698,279	6,290,936	914.3
CT	House	Non windfarmer residence	695,904	6,290,084	938
CU	House	Non windfarmer residence	694,392	6,289,672	938.9
CV	House	Non windfarmer residence	694,772	6,290,052	914.5
CW	House	Non windfarmer residence	697,785	6,286,217	837.7
CX	House	Non windfarmer residence	697,065	6,281,327	789.5
CY	House	Non windfarmer residence	696,332	6,279,079	739.4
CZ	House	Non windfarmer residence	696,683	6,278,525	700
DA	House	Non windfarmer residence	690,596	6,277,280	650
DB	House	Non windfarmer residence	688,728	6,279,860	660.5
DC	House	Non windfarmer residence	687,977	6,285,007	648.8
DD	House	Non windfarmer residence	694,704	6,285,394	885.4
DE	House	Non windfarmer residence	688,500	6,290,500	762.2
DF	House	Non windfarmer residence	690,318	6,277,598	660
DG	House	Non windfarmer residence	690,304	6,277,759	668.2
DH		Non windfarmer residence	687,709	6,288,967	715.6
DI		Non windfarmer residence	695,751	6,290,438	935
DJ		Non windfarmer residence	695,087	6,292,048	922.8
DK		Non windfarmer residence	695,091	6,292,246	916.6
DL		Non windfarmer residence	693,441	6,293,890	970
DM		Non windfarmer residence	694,196	6,293,386	916.8
DN		Non windfarmer residence	692,045	6,295,040	920
DO		Non windfarmer residence	694,438	6,293,383	916
DP		Non windfarmer residence	694,640	6,293,698	916
DQ		Non windfarmer residence	694,220	6,294,171	944.5
DR		Non windfarmer residence	693,138	6,294,634	928.7
DS		Non windfarmer residence	693,533	6,294,569	958.4
DT		Non windfarmer residence	692,443	6,294,799	930
DU		Non windfarmer residence	687,625	6,283,504	670
DV		Non windfarmer residence	691,799	6,293,599	890.8
DW		Non windfarmer residence	688,104	6,287,804	705.2
DX		Non windfarmer residence	688,852	6,286,757	681.7
DY		Non windfarmer residence	687,105	6,282,971	649.9
DZ		Non windfarmer residence	685,837	6,280,004	680
EA		Non windfarmer residence	688,837	6,279,448	663.2
EB		Non windfarmer residence	696,510	6,279,699	778.4
EC		Non windfarmer residence	697,944	6,280,180	691.7
ED		Non windfarmer residence	699,920	6,286,420	860
EE		Non windfarmer residence	696,604	6,291,909	932
EF		Non windfarmer residence	693,623	6,294,311	960
EG		Non windfarmer residence	693,835	6,294,380	960
EH		Non windfarmer residence	693,913	6,294,091	960
EI		Non windfarmer residence	693,957	6,294,212	960

Map Ref.	Residence	Property Use	Easting	Northing	Z
EJ		Non windfarmer residence	693,165	6,294,750	927.7
EK		Non windfarmer residence	693,788	6,294,889	949.8
EL		Non windfarmer residence	692,299	6,294,767	930
EM		Non windfarmer residence	691,475	6,294,777	920
EN		Non windfarmer residence	691,058	6,294,683	900
EO		Non windfarmer residence	697,406	6,286,869	847.5
EP		Non windfarmer residence	698,405	6,288,043	922.2
EQ		Non windfarmer residence	698,465	6,288,564	899.1
ER		Non windfarmer residence	698,346	6,288,483	906.6
ES		Non windfarmer residence	698,324	6,288,379	900
ET		Non windfarmer residence	696,605	6,291,705	925.6
EU		Non windfarmer residence	690,162	6,291,224	761
EV		Non windfarmer residence	692,763	6,294,447	914.5
EW		Non windfarmer residence	692,694	6,294,781	928.5
EX		Non windfarmer residence	692,513	6,295,017	926
EY		Non windfarmer residence	689,967	6,294,937	881.6
EZ		Non windfarmer residence	689,987	6,295,452	922.5
FA		Non windfarmer residence	696,967	6,282,107	822

Appendix C

WTG location

Table 5: WTG locations

Map Ref	Eastings	Northings	Z
	UTM GDA94 Zone: 55		[m]
3	692,738	6,290,953	914.4
4	693,188	6,290,906	944.7
5	692,610	6,290,375	886
6	692,438	6,289,879	850.8
7	692,375	6,289,621	843
8	691,922	6,289,293	850.5
9	691,710	6,288,716	837
10	690,463	6,289,008	814.1
11	690,764	6,288,686	822.1
12	690,638	6,288,139	789.3
13	693,146	6,288,195	837.6
14	693,850	6,287,994	855.3
15	694,720	6,287,294	895.6
16	693,932	6,287,163	880.2
17	692,356	6,286,368	808.8
18	693,315	6,284,663	900
19	693,106	6,284,262	908.1
20	693,633	6,283,962	942.1
21	691,091	6,283,878	844.6
22	691,440	6,283,635	863
23	691,436	6,283,205	851.8
24	690,258	6,283,778	807.4
25	690,357	6,283,178	847.8
26	690,381	6,282,714	829
27	689,933	6,282,625	830
28	689,635	6,282,686	810.7
29	689,403	6,282,413	786.1
30	689,820	6,282,149	809
31	690,231	6,282,050	825.2
32	692,382	6,282,353	869.4
33	692,173	6,281,920	903.7
34	692,320	6,281,639	896.4
35	692,379	6,281,358	888.2
36	692,852	6,280,328	885.4
37	692,897	6,279,893	820.9
38	694,007	6,282,678	868.1
39	695,178	6,283,099	904.1
40	695,285	6,282,880	907.5
41	695,383	6,282,655	899
42	695,229	6,282,331	889.7
43	696,494	6,283,966	933.1
44	696,745	6,283,761	911.9
45	696,940	6,283,488	897.6
46	697,221	6,283,308	873.8