Public Submission

Jupiter Wind Farm EIS

Visual Impact Assessment Supplement

Date: 5 February 2017

Table of Contents

Index of Tables

List of Figures

INTRODUCTION

Statistical analysis can be utilised to help identify patterns and trends in larger volumes of data. It can also assist in analysis of data to provide more meaningful results and useful information. Initial analysis of the Visual Impact Assessment for the Jupiter Wind Farm proposal identified anomalies in the results presented for each residence.

For example, why does J33 have an impact of High when it has nine (9) turbines in one 60 degree sector within 3450m? Yet J194 only has a rating of Moderate/High with a similar level of screening, and has five (5) turbines within 2300m, with the closest turbine being over 1000m closer to the residence?

Note: Within this assessment, distances of 2300m and 3450m have been used. This is based on a WTG height of 173m and the Departments draft framework. Assessments of other wind farms would need to adjust these distances based on the WTG height.

Statistical Analysis of Original Data

In this chapter statistical analysis is presented of the original data.

Expected Results

Certain relationships should be present within the data. For example, a general trend should be represented between the impact rating and the closest turbine. While this is not going to be true for all circumstances (for example, extensive vegetation may block the views around a residence), the trend should still be present. Table 1 contains a list of the expected trends in the data.

Rating Compared to...	Expected General Trend
Closest Wind Turbine	The closer the nearest wind turbine is to a residence, the higher the impact.
Number of turbines within 2300m	The higher the number of turbines within 2300m of a residence, the higher the impact.
Number of turbines within 3450m	The higher the number of turbines within 3450m of a residence, the higher the impact.
60 degree sectors within 2300m	The higher the number of 60 degree sectors with turbines in them within 2300m, the higher the impact
60 degree sectors within 3450m	Similar to 60 degree sectors within 2300, however the relationship may not be as strong.
Vegetation / Landscape screening	The higher the level of vegetation or landscape screening, the lower the impact.
Elevated position	The greater the elevated position, the higher the impact.

Table 1: Predicted results in statistical analysis of ratings against WTG properties

Analysis Method

Data was extracted from the Visual Impact Assessment provided in the Jupiter Wind Farm EIS. The impact rating was scaled as per Table 2. The description used within the assessment against each residence was also analysed for key terms / features, and used to provide a coarse level of ratings for vegetation and landscape screening. Some example descriptions and ratings are included in Table 3. Additionally, where a description referred to “slightly elevated” or “elevated” position of the residence itself, this was also extracted as additional data (either being 1 or 2 respectively).

Impact Rating	Scale Used
Negligible	0
Low	1
Moderate/Low	2
Moderate	3
Moderate/High	4
High	5

Table 2: Scale conversion for impact ratings

Residence	Description	Rating Used
J3	Property on elevated terrain with sweeping panoramic views over landscape.	0
J237	Some screening vegetation to north west of dwelling.	1
J234A	Dense vegetation along nearby creek will filter some views of the base of WTGs to south although much of the turbines may be still be visible.	2
J216	Property surrounded by screening vegetation to north, east and south which are likely to block/heavily filter views	3
J16	Abundant tree planting surrounding property with more distant groups of trees also providing screening.	4
J241	Dwelling surrounded by very dense tree planting. No views of WTGs.	5

Table 3: Translation of vegetation / landscape screening to values

Additional data was obtained from the main EIS, including residence locations and turbine locations. Analysis was conducted to identify the following for every residence:

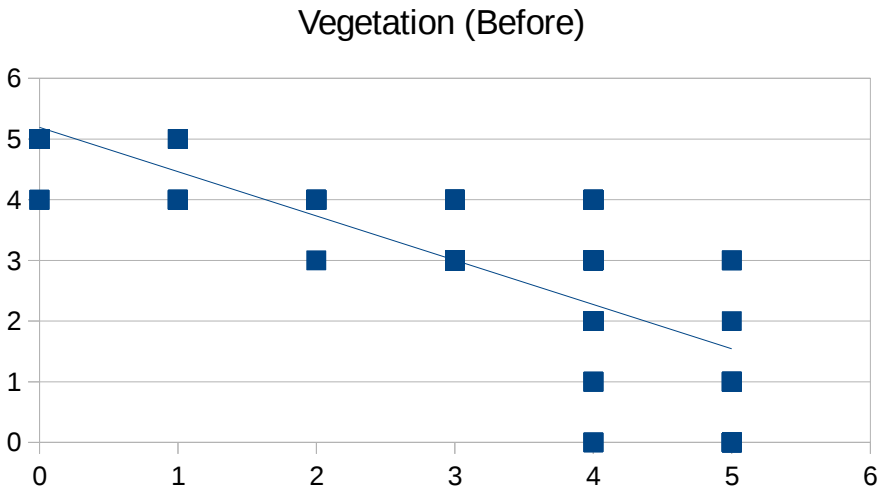
- Distance to each WTG;
- Angle to each WTG;
- Average distance to each WTG;
- Standard deviation of the spread of WTG proximity to a residence;
- Number of 60 degree sectors in which WTGs exist (within 2300m and 3450m); and
- Number of turbines within 2300m and 3450m.

A random sample of two residences and several wind turbines were then selected in order to validate the data analysed on a map was sensible, and a second online tool was used to validate distances and angles between some residences and some WTGs. A small number of errors were identified and corrected and a second random sample of data was used to validate calculations. No further errors were identified.

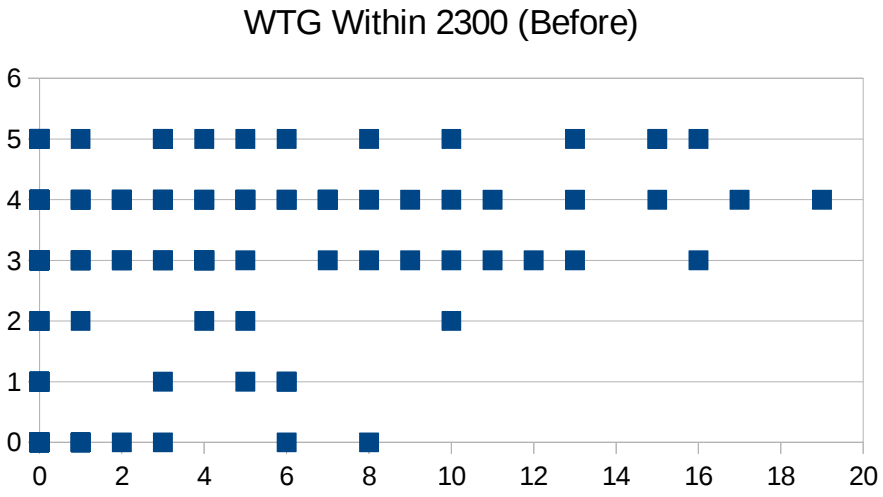
A basic X-Y scatter-plot was used for basic correlation of the data. While this is a fairly simplistic analysis method, any trend in the data should be visually apparent to the reader.

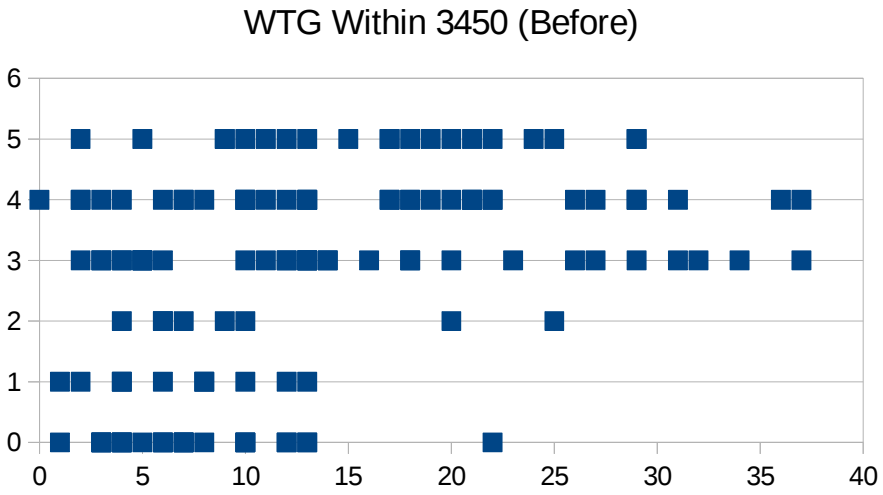
Results of Analysis of Original Data

The results of the analysis is contained in the following graphs. Trend lines have been included where a trend is visually apparent.


Vegetation (Before)
6
5
4
3
2
1
0
0
1
2
3
4
5
6


Closest WTG (Before)
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
3500
4000


WTG Within 2300 (Before)
6
5
4
3
2
1
0
0
2
4
6
8
10
12
14
16
18
20



Discussion

Only one graph showed significant correlation: the relationship between the impact rating and vegetation and landscape screening. There may be a minor relationship between the number of turbines within 2300m and the impact rating, and a minor relationship of turbines within 3450m and the impact rating – however the variability in the data shows the relationship is not significant.

The distance to the closest turbine showed absolutely no relationship with the impact rating. Effectively you could have two houses with no vegetation screening at 3000m from a turbine and 1000m from a turbine, and still have the same impact rating.

Other analysis of the number of 60 degree sectors affected also do not appear to have been taken into account. As such a residence with three 60 degree sectors affected with no screening would be rated the same as a residence with one 60 degree sector affected with no screening.

> *From this analysis, the primary factor used in the impact analysis for the Jupiter Wind Farm was the level of vegetation screening or landscape screening surrounding a residence.*

Considering the visual impact on individuals is a highly personal thing – viewer sensitivity to their landscape features are important. However an individual is unlikely to choose to live in a property where the views are not what they enjoy. Thus elevated views of a flat landscape will be enjoyed by people who enjoy those views. Yet dense forest will be enjoyed more by people who enjoy dense forests.

Conclusions

Based on this analysis, **the visual impact assessment used for the Jupiter Wind Farm is statistically unreliable**. From this type of analysis, it is obvious why visual impact analysis often causes significant argument within the community – a lack of analytic rigor surrounding visual impact assessments opens them up to debate and anger as to why one person's residence was rated much higher than another residence when the first residence has a much larger number of turbines in close proximity.

We can also rule out viewer sensitivity from the analysis based on an individual is only likely to purchase or build in a location where they enjoy the view. Thus “wide open farmland” is no more scenic than “rolling lightly wooded hills” - each is as valuable to the individual who purchased or built a property in that location.

Using a more analytic approach can provide a justification as to the impact assessment for each residence. This can also be used to back up the analysis when questions are raised.

Generating a Formula

A reasonable formula can be developed based on Table 1 - as this provides a basis of reasonable assumptions. It would be difficult to argue that a wind turbine further away is going to mean less impact!

Certain other assumptions must be made within the calculations. These assumptions include:

- The maximum WTG density is 5 WTGs per 1km2.

Each factor was given a scaled factor from approximately 0 to 100. A score of 100 would mean a higher visual impact, and a score of 0 means no visual impact. For example where there is no vegetation screening, a score of 100 is obtained. Partial screening may be 50, and full screening would be 0. The following factors were used in the assessment:

- Elevated Residence
- Vegetation / Landscape Screening
- Closest WTG
- Number of sectors within 2300
- Number of turbines within 2300
- Number of sectors within 3450
- Number of turbines within 3450
- Average Distance
- Standard Deviation

The average distance and standard deviation were performed to provide a level of “density” of WTGs in the calculation.

The factors were then weighted based on a best guess as to the highest visual impact to the lowest visual impact. Table 4 contains the weightings used.

Factor	Weighting	Maximum Value
Level of vegetation	2.5	250
Elevation	3	300
Number of sectors within 2300m	2.2	220
Number of turbines within 2300m	2.1	210
Number of sectors within 3450m	1.8	180
Number of turbines within 3450m	1.6	160
Average distance	1.2	120
Standard deviation	1.2	120
Closest turbine	2	200

Table 4: Weighting factors used for various factors

Using this information, we can then calculate the worst case, and determine ratings (such as “high”). For example, the worst case would be on elevated terrain, no screening, nearest turbine 20m, 83 turbines within 2300m/6 sectors and 187 turbines wtihin 3450m/6 sectors. This results in a score of about 1600 out of 1760.

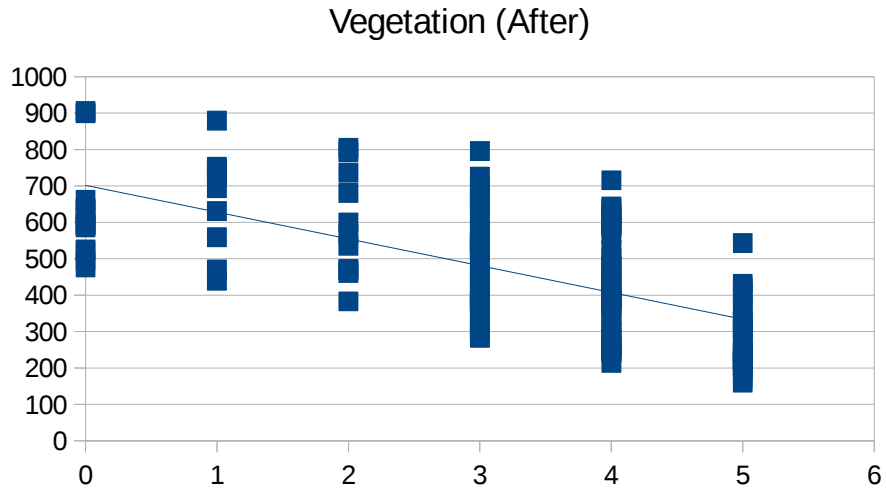
Based on NSW Draft Wind farm Framework, Table 5 contains the ratings developed.

Rating	**Low**	**High**
Negligible	0	210
Very Low	211	290
Low	291	436
Moderate	437	549
High	550	659
Very High	660	795
Unacceptable	796	1760

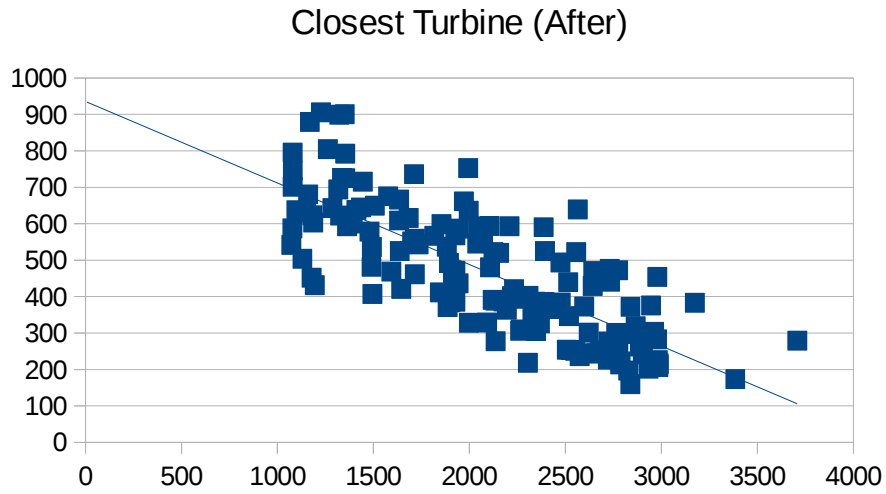
Table 5: Ratings developed

Statistical Analysis of New Assessment

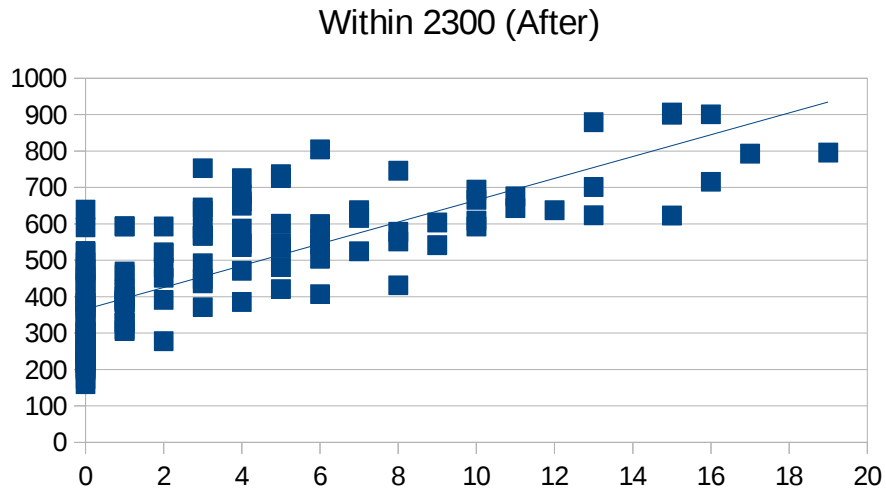
Using the same analysis technique conducted on the original EIS Visual Impact Assessment, the scores received for each property were assessed against the same categories to determine if correlations are now present in the data.



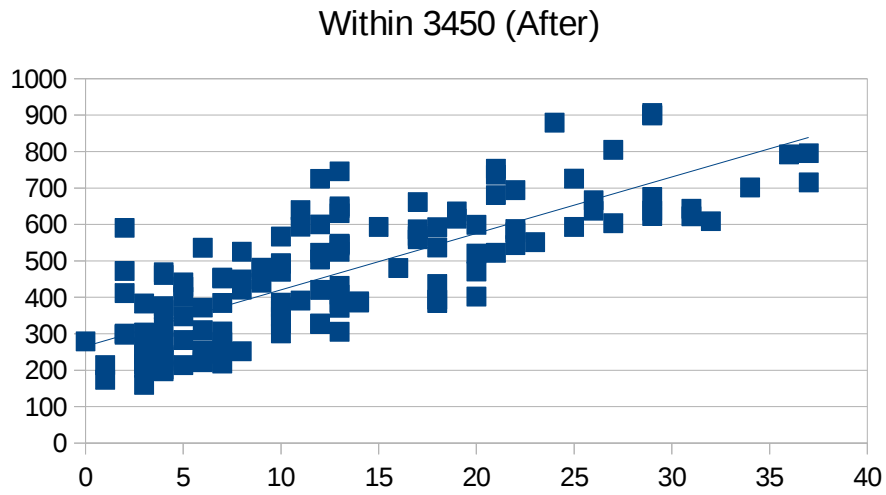
The relationship between vegetation / landscape screening has been maintained (0 being no screening, 5 being very dense screening). The less the screening, the higher the impact is clearly demonstrated. As such the relationship contained in the existing EIS has been maintained.



A definite relationship is now clearly visible between the closest turbine and the residence. As the distance of the closest turbine increases, the impact on the residence decreases. The original assessment method showed no relationship.



The number of turbines within 2300m of a residence now clearly shows a relationship in the data. The higher the number of WTGs within 2300m, the higher the impact on a property.



Similar to WTGs within 2300m, the WTG number within 3450m shows a clear trend. The higher the number of turbines, the higher the impact on a residence.

Other similar charts for other factors also show similar trends in the data. Variability in the data is still maintained, shown by the variance of the points around the trend lines. For example it is still possible for a residence with only a small number of turbines within 3450m to still score a higher impact (such as a value of 600).

This analysis approach demonstrates a assessment which is more balanced compared to that contained in the existing EIS. It is interesting to note that even modifying the factors a little did not substantially change the rankings of individual residences. This suggests the formula developed provides an assessment that can demonstrate relative comparisons – in other words the impact on various residences can be compared fairly.

Alternative Visual Impact Assessment for Jupiter Wind Farm

Assessment of the Jupiter Wind Farm visual impact for properties within 3kms of a WTG identified five properties where the impact was unacceptable. A further fourteen (14) properties were assessed as “Very High”. Table 6 contains the number of properties in each assessment category.

Category	Residences
Unacceptable	5
Very High	14
High	26
Moderate	27
Low	37
Very Low	21
Negligible	5

Table 6: Number of residences in each category

The five properties found to have an “Unacceptable” assessment were on elevated terrain with minimal screening (or in one case a large number of sectors had turbines visible). All of these residences also had turbines within 1226m to 1351m of the residence. Table 7 contains a summary of the visual impact from these residences.

Residence	Visual Impact
J76A	No vegetation on an elevated position. Almost thirty turbines covering 180 degree views within 3450m with the closest turbine being 1226m.
J3	Same as J76A with the closest turbine being 1351m.
J76B	Same as J76A with the closest turbine being 1323m.
J162	A small amount of vegetation on an elevated position. Almost twenty-five turbines covering 180 degree view within 3450m, and 13 turbines covering 180degree view within 2300m.
J145	Some vegetation, with almost thirty turbines covering about 300 degrees of their view within 3450m. There are a further six turbines covering 240 degree view within 2300m.

Table 7: Impact on residences classed as "Unacceptable"

A further fourteen (14) residences were found to have a “Very High” rating. While three of these properties were elevated, they typically exhibited a large number of turbines in close proximity to the residence. In some cases four to five 60 degree sectors were occupied. The closes turbines were between 1079m and 1972m.

27 residences were identified in the “High” category. The factors in this (and lower impact ratings) vary considerably including some on elevated terrain with higher levels of screening, through to substantial numbers of turbines within various distances.

Mitigation

Properties with an “Unacceptable” impact rating have no reasonable mitigation available.

While mitigation may be suitable for some properties assessed as “Very High”, it is unlikely these owners would find vegetation screening as acceptable – they purchased their properties on the basis of the view as one factor. Given vegetation screening is unlikely to be acceptable, other mitigation strategies include reducing the size of the turbines, or removal of those turbines in close proximity to the residences.

However the fact remains that these wind turbines will dominate the landscape – a fact that the original EIS highlights: “strong vertical forms”.

RECOMMENDATIONS

EPYC must undertake a more detailed visual impact analysis for the Jupiter Wind Farm using an approach similar to that contained in this submission. Their current impact ratings vary considerably and do not take into account multiple factors affecting the impact.

The properties listed in Table 8 must be offered voluntary acquisition rights. If the owners of those properties choose not to undertake acquisition, the associated turbines listed in the same table must be removed from the project, or an alternative agreed arrangement.

Property ID	Impact	Associated WTGs
J76A	Unacceptable	29 Within 3450: 1, 5, 7, 12, 13, 16, 21, 22, 23, 25, 27, 33, 34, 41, 42, 43, 48, 49, 50, 51, 52, 53, 74, 76, 77, 78, 79, 80, 81
J3	Unacceptable	29 Within 3450: 1, 5, 7, 12, 13, 16, 21, 22, 23, 25, 27, 33, 34, 41, 42, 43, 48, 49, 50, 51, 52, 53, 74, 76, 77, 78, 79, 80, 81
J76B	Unacceptable	29 Within 3450: 1, 5, 7, 12, 13, 16, 21, 22, 23, 25, 27, 33, 34, 41, 42, 43, 48, 49, 50, 51, 52, 53, 74, 76, 77, 78, 79, 80, 81
J162	Unacceptable	23 Within 3450: 3, 8, 20, 26, 30, 38, 39, 45, 46, 54, 55, 56, 57, 58, 69, 70, 71, 72, 82, 83, 84, 85, 86
J145	Unacceptable	27 Within 3450: 2, 4, 6, 8, 10, 11, 13, 20, 24, 27, 28, 32, 38, 44, 51, 52, 53, 54, 59, 68, 70, 72, 73, 75, 82, 83, 87
J208	Very High	17 Within 2300: 3, 30, 31, 37, 45, 46, 55, 56, 57, 58, 60, 66, 69, 71, 84, 85, 86
J217	Very High	17 Within 2300: 3, 26, 37, 40, 45, 46, 55, 56, 57, 58, 60, 66, 69, 71, 84, 85, 86
J247	Very High	2 Within 2300: 17, 86
J237	Very High	6 Within 2300: 18, 19, 35, 36, 65, 88
J234A	Very High	5 Within 2300: 20, 54, 72, 82, 83
J40	Very High	4 Within 2300: 44, 68, 75, 87
J87	Very High	2 Within 2300: 73, 87
J226	Very High	11 Within 2300: 3, 40, 46, 55, 57, 58, 60, 71, 84, 85, 86
J216	Very High	13 Within 2300: 9, 17, 31, 37, 40, 55, 60, 66, 69, 71, 84, 85, 86
J20	Very High	9 Within 2300: 2, 9, 10, 11, 24, 31, 40, 67, 68
J144	Very High	3 Within 2300: 4, 20, 32
J142	Very High	10 Within 2300: 4, 8, 20, 24, 28, 32, 59, 68, 72, 82
J147	Very High	7 Within 2300: 4, 6, 8, 20, 28, 72, 82
J130	Very High	4 Within 2300: 16, 25, 33, 79

Table 8: Properties to be offered voluntary acquisition rights

Other Benefits and Comments

This approach offers additional benefits for the Department and wind farm developers. Not only does it provide a method which can be backed up by calculations, it also provides a method by which the visual impact of wind farms can be compared. Thus a Moderate rating in one assessment is the same as a Moderate rating in another assessment.

Another benefit is the Department can set a threshold by which certain activities must take place. For example, Table 9 contains suggested approaches that can be used by such an assessment method.

Rating	**Suggested Actions**
Unacceptable	Remove all turbines within 3450m or voluntary acquisition
Very High	Remove all turbines within 2300m or voluntary acquisition
High	Remove significant numbers of turbines or reduce size
Moderate	Remove some turbines, move turbines or reduce size
Low	Move turbines or reduce size
Very Low	Consider moving turbines or reducing size
Negligible	Nil

Table 9: Suggested approaches to ratings

This method should be expanded to conduct an assessment similar to that used for Bush Fire assessments for new constructions[1]. Four cardinal directions are used to assess foliage density, slope of the land etc. By collecting detailed information for each residence in the cardinal directions, a far more accurate assessment can be conducted.

For example, Figure 1 contains diagrams demonstrating how to assess slope in relation to the house being assessed. This document contains extensive diagrams on how to conduct such assessments, and such a guide developed for wind farms and visual impact would provide invaluable to removing the bias in the assessments.

1 http://www.rfs.nsw.gov.au/__data/assets/pdf_file/0017/4355/Guidelines-for-Single-Dwelling-Development-Applications.pdf

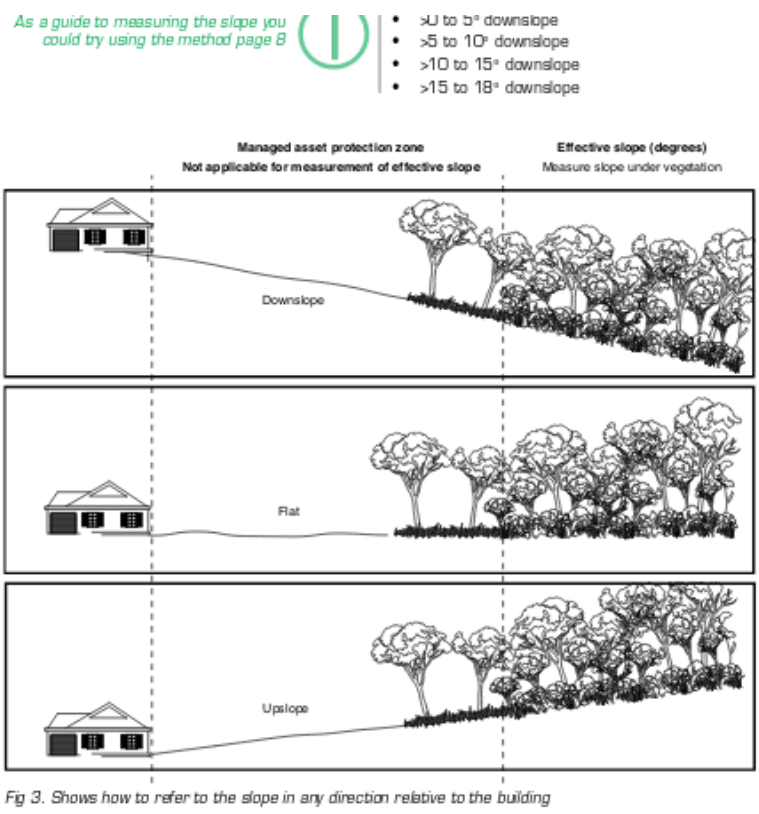


Figure 1: Extract from NSW RFS guidelines on assessing construction requirements for bushfires

It is recognised this method would require more detailed data collection by the wind farm developers, however this more detailed information is required to ensure a consistent approach and assessment is conducted. It is also recognised this would also require access to properties. However modern topographic mapping and satellite imagery should be able to provide the majority of information required to undertake such an assessment of each residence.

CONCLUSION

Analysis of the Jupiter Wind Farm EIS Landscape and Visual Assessment demonstrates it is based purely on a subjective judgment in relation to existing vegetation surrounding a residence. There is no correlation between the assessed visual impact, and other factors where a correlation is expected (such as the distance to the nearest turbine).

Improved methods can be used, especially if additional data was collected accurately by the proponent, and assessed using a formal method. Individual bias can be ruled out due to the simple fact that an individual is not likely to purchase a property where they do not enjoy the view.

Using an example method based on a formal calculation and the draft NSW wind framework, an assessment was conducted of the proposed Jupiter Wind Farm and the visual impact. While some error may exist due to insufficient data, the impact can be demonstrated to be unacceptable in the case of five residences and very high in the case of a further 14 residences.

The Jupiter Wind Farm must be rejected. There is a substantial impact on 19 residences, which if the turbines are removed from the project, would result in just eight (8) turbines remaining. The Jupiter Wind Farm (or other wind farms proposed for this location) are completely unsuitable due to the higher density of residences.