8. **Noise impacts**

Noise from wind farms has, for some time, been a matter about which some people living near wind farms have expressed concern. The level of concern seems to have escalated recently with the widespread publicity given to the recently commissioned Waubra WEF and alleged effects of noise on public health. This in turn has caused apprehension amongst persons living near the proposed Stockyard Hill WEF site.

We were consequently presented with a substantial amount of detailed evidence and a considerable number of submissions on noise and health issues. We have endeavoured to provide a comprehensive and detailed account and analysis of the issues put before us on this matter. It has been necessary to deal with material from opposing and often quite often contrary positions.

Noise from wind farms is of course a complex issue with a considerable number of factors influencing its propagation, measurement and assessment. Our response is therefore necessarily rather lengthy.

Our aim has been to balance the objective of the Guidelines to facilitate the development of WEFs, whilst also ensuring that nearby residents are protected from unreasonable levels of noise; and most importantly that night time indoor noise levels meet internationally accepted standards for sleep protection.

In making this assessment, we accept that changes will occur to the acoustic environment near a WEF. However we believe that the critical issue is the assessment of whether the noise levels are contained within defined boundaries of acceptability having regard to background levels and the internal amenity of dwellings.

We realise that some of our recommendations concerning noise may be controversial. The Applicant may feel that we have gone beyond mere technical compliance with the New Zealand; submitters may believe that we have not gone far enough. Importantly in this case, we believe that the background noise levels need to be re-assessed with greater attention to detail in order to provide a more comprehensive and reliable reference against which noise limits can be established.
We have given particular attention to minimising the likelihood of complaints about noise such as have arisen in relation to some recent WEFs. We know complaints probably cannot be avoided completely. Some submitters will be sensitive to noise and may consider that any noise is unreasonable. However, we understand that NZS 6808:1998 recognises that compliance does not mean inaudibility; rather it seeks to set a noise limit intended to provide protection against sleep disturbance and hence related adverse effects.

This chapter addresses compliance with NZS 6808:1998. The next chapter addresses claims of adverse health effects from WEFs, submitted to us as being noise-related.

8.1 Introduction

The Policy and planning guidelines for development of wind energy facilities in Victoria of September 2009 (the Guidelines) provide that noise assessment of proposed wind farms is to be undertaken in accordance with the methodology prescribed in NZS 6808:1998.

Broadly the Applicant submitted that the proposed facility has been designed to comply with the noise criteria set by those Guidelines and the New Zealand standard and hence would not result in an unreasonable impact. Many submitters challenged that assessment and the adequacy of the Guidelines and the standard.

We were presented with many written and oral submissions, and heard five expert witnesses on these topics.

During the Panel hearing period, the Victorian Civil and Administrative Tribunal (VCAT) made a decision on The Sisters Wind Farm proposal near Terang in which it held that a more recent version of the New Zealand noise standard applied. That has required our consideration.

Specific issues relevant to this WEF proposal include the following:

- The Applicant has nominated a geometrical envelope for a turbine with a significantly larger rotor diameter than that used for the noise assessment. Thus, the final turbine type may have different acoustic features from that evaluated here;

- It was regularly proposed that recent reported ill health near the Waubra WEF is related to noise - particularly to low frequency noise and ultrasound. This has been accompanied by suggestions of inadequate response to complaints;
Many reservations have been expressed about the New Zealand noise standard- in particular its assessment methodology and the difficulties associated with enforcement;

Mandated separation distances from turbines to dwellings and property boundaries were proposed inter alia for the control of noise in lieu of, or as well as, noise performance standards. These separation distances have been from 2 km and upwards; and

The possibility of vibration from turbines affecting dwellings by transmission through rock was also raised.

Figure 5 of this report shows the Application as proposed by the Applicant, amended as agreed by consent during the course of the Panel hearing (except for the deletion of T218), as well as the dwellings near and on the site.

The construction, operation and maintenance of a wind energy facility can all create environmental noise. The focus of this section of the report is the noise associated with the operation of the WEF since that is the noise of most concern and that specifically required to be considered by the Guidelines. This section also considers construction noise.

The focus is on determining whether the Planning Permit Application Report (PPAR) demonstrates compliance with the Guidelines, (ie: compliance with NZS 6808:1998). However, because of current heightening of WEF noise concerns and the large size of this proposal we look beyond minimal technical compliance with that standard, to measures that might be considered to improve the rigour of its application for an improved noise outcome.

8.2 Documentary sources and evidence

The following information sources and evidence have been used in preparing this section:

- The Policy and planning guidelines for development of wind energy facilities in Victoria, September 2009 (the Guidelines) and the May 2003 version. In particular Part B 3 (a), p30 of the current document refers to noise and presents the criteria for assessment;
- Submission from Department of Planning and Community Development (Exhibit DPCD3);
- NZS 6808:1998 Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators;
- NZS 6808:2010 Acoustics – Wind Farm Noise;
- AS 4959: 2010 Acoustics – Measurement, prediction and assessment of noise from wind turbine generators;
The Planning Permit Application Report (PPAR) main document, October 2009, prepared by Environmental Resources Management Australia (ERM) and particularly Chapter 15;


Submissions on behalf of the Applicant on noise (Exhibits A11 and A220);

Expert evidence given by Mr Christophe Delaire of Marshall Day Acoustics called by the Applicant including his expert witness statement (Exhibit A23) and copy of his written presentation (Exhibit A22);

Additional information from Mr Delaire dated 27 April 2010 in response to a request from us (Exhibit A97);

Calibration certificates for noise loggers from Mr Delaire dated 13 May 2010 (Exhibit A224);

Additional information from Mr Delaire dated 25 May 2010 in response to a request from us about compliance noise levels and responding to some matters raised by Mr Cox for Lowell Pty Ltd (Exhibit A224);

Expert evidence from Mr W L (Les) Huson of L Huson and Associates Pty Ltd for Lowell Pty Ltd including his expert witness statement (Exhibit L117) and copy of his written presentation (Exhibit L116);

Supplementary information from Mr Huson dated 13 May 2010 responding to the information from Mr Delaire dated 27 April 2010 (Exhibit L155);

Expert evidence from Dr Robert Thorne of Noise Measurement Services for Mr and Mrs Hawker including his expert witness statement (Exhibit H70) and copy of his presentation (Exhibit H71);

Expert evidence from Dr Thorne for Lowell Pty Ltd (Exhibit L157);

Submission from Pyrenees Shire Council (Exhibit PSC112);

Submission from Ararat Rural City Council (Exhibit ARCC111);

Submission by the Applicant of material from Garrad Hassan on noise propagation under conditions of temperature inversions and atmospheric stability (Exhibit A223);

Wind rose from data at on-site meteorological mast (Exhibit A66);

Expert evidence from Professor David Dunt for Lowell Pty Ltd (Exhibit L114) and copy of his written presentation (L115);

Submissions by Mr A Cox of Pointon Partners for Lowell Pty Ltd (Exhibit L160);
- Site layout plans submitted by the Applicant showing revised noise contours for amended layout other than deletion of T218 (Exhibit A227a (A3) and A227b (A1));
- Document titled ‘Second Agreement Reached at Acoustic Expert Caucusing 22 March 2010’ submitted by the Applicant (Exhibit A226);
- Submission by Mr P and Ms S Hawker (Exhibit H73), written copy of their presentation (Exhibit H72a) and appendices (Exhibit H72b);
- Submission by Ms T Smith (Exhibit S87);
- Submission by Mr P Mitchell (Exhibit 152b) and copy of written presentation (Exhibit L161);
- Submission by Mr D Jackson (Exhibit J171);
- Submission by Ms B Wehl (Exhibit W177);
- Submission by Ms M and Mr W Read (Exhibit R196); and
- A number of submissions from other individuals as a response to the public exhibition of the PPAR or to us, or both, referring to concerns about noise with little detail and/or in the context of health issues.

Wind farm noise has been discussed in a number of other WEF panel reports including those for Bald Hills Wind Farm, the Waubra Wind Farm, the Macarthur Wind Farm and the Lal Lal Wind Farm. The Panel has also referred to those for background information.

We accept that much of the detailed assessment of the operational noise impact of the proposed wind farm must await the final configuration and final turbine selection for the WEF. It must therefore be done following the grant of any permit – to the satisfaction of the Minister or his delegate. However, noise is so important in the successful development of the wind farm that we consider it necessary to address the key performance criteria for that further approval process at this stage given we have been dealing in depth with noise information. We believe also that the further noise assessment processes must involve specialist acoustic input.

By contrast, construction noise is likely to be a lesser issue - limited both in time and to specific areas. Much of the construction noise management can be adequately dealt with by inclusion in the environmental management plan (EMP) required by condition of any permit granted.
8.3 **Noise sources and applicable standards**

In this part of our report we present and discuss the major noise issues as presented to us.

8.3.1 **Wind farm noise sources**

**Construction noise**

Construction would extend over about four years in total but less for various parts the site. Noise will be generated by the construction of some 200 km of access tracks, upgrading of local roads, intersection reconstruction, building of crossovers, preparation of turbine foundations, concrete manufacture, cutting of cable trenches, bringing construction materials and components onto the site, and turbine assembly and erection. This noise would not be expected to be substantially different from other major construction works and from some farming activities. Much of it will be generated at places distant from neighbouring properties. It can be managed in part by standard construction noise control measures including control over times of activity, and noise limits on certain activities. These controls could be included in the ‘best practice’ site EMP that should be prepared in consultation with key stakeholders or their representatives.

**Post construction background noise**

Some noise is generated from the post-construction maintenance and servicing of the WEF, but this would be expected to be slight. Maintenance would primarily involve occasional light vehicle travel to the turbines and servicing of turbines. Any noise would probably be largely indistinguishable from noise sources from normal farming activities. Greater noise might be associated with any major component replacement, but that would be expected to be uncommon.

A further source could be the on site electrical sub-stations. Any noise from these is likely to be slight, and we note that the proposed sites are distant from dwellings.

**Turbine Noise**

The major noise source is from turbine operation including:

- the rotor blades; and
- the machinery for generating the electrical energy.
Rotor blades have an aerofoil shape similar to an aircraft wing. At a typical operational speed of 14 rpm the blade tips of a turbine with a 104m rotor diameter is about 260 km/h. This creates aerodynamic noise. We understand that developments in blade design and in turbine control systems have reduced this noise compared with that generated by earlier machines. Also, modern machines can be operated in noise management modes to reduce noise, albeit with some loss of energy output, for different wind speeds and directions, and times of day.

The second wind turbine noise source is the generating machinery in the nacelle immediately behind the turbine rotor, above the tower. It includes the electrical generator, pumps and fans, and probably a gearbox - depending on the turbine type. Although the nacelle is elevated at a height of 80 m, good equipment design and regular maintenance should ensure that it is not a major noise source. It would normally be in the operator’s interest to avoid obvious noise from the nacelle since that may indicate wear or potential equipment failure. A transformer within the tower at ground level or pad mounted adjacent to the tower would not normally be a significant source of noise.

8.3.2 The Guidelines

The State WEF Guidelines are an incorporated document of all planning schemes in the State. They apply irrespective of whichever land use zone applies. In the Farming Zone which applies to most of the WEF site and surrounds, there is no further identified noise constraint particular to the zone - which in the main supports activities associated with the use of the land for agriculture.

The Guidelines require applicants to assess the noise impact of WEF proposals.

The 2009 version of the Guidelines at Part B 3 (a) p30 establish the evaluation criteria for noise as:

A wind energy facility should comply with the noise levels recommended for dwellings in the New Zealand Standard NZ6808:1998 Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators. www.standards.co.nz

During the assessment phase of the noise impact, particular attention to the following matters within the Standard is required:

- Separate correlation of the background sound levels with the wind speed for different wind directions and/or time of day [clause 4.5.5 of the Standard] and
· Wind speed measurements at the hub height of the proposed turbines as recommended in the Note to Clause 4.5.6.

The now superseded version of the Guidelines of May 2003 stated:

A wind energy facility should comply with the noise levels recommended for dwellings in New Zealand standard NZ6808:1998 Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators (www.standards.co.nz).

The Noise Impact Assessment report for the current proposal was prepared prior to the date of the revised Guidelines. We have, however, had regard to both versions of the Guidelines in our evaluation. In doing so we note that the changes viz. separately evaluating all time and night time background noise and using wind speed measurements at hub height, have already become usual practice in wind farm noise assessments.

Although not specified in the Guidelines, we understand that the noise requirement is to be applied to ‘non-stakeholder’ dwellings only. Some stakeholder dwellings, notably those within the site, may incur higher noise impacts, but as financial beneficiaries of the project we believe that a reduction in noise amenity is accepted as a part of their agreement with the Applicant.

The Planning Scheme requirements are now such that as a minimum a condition giving effect to the noise standard specified in the Guidelines is appropriate in any permit granted.

8.3.3 Recommendation

The Panel recommends that:

Any permit granted must include the following ‘base’ noise condition:

The wind farm must comply with the noise levels recommended for non-stakeholder dwellings in the New Zealand standard NZ6808:1998 Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators, that is, at any of the nominated wind speeds, it must not exceed, at any non-stakeholder residential site, the background sound level (L95) by more than 5dBA L95, or a level of 40dBA L95, whichever is the greater.
8.3.4 **NZS 6808:1998**


NZS 6808:1998 describes, *inter alia*:

- the preliminary assessment, or prediction, method to identify the likely noise sensitive receptors in the vicinity of the proposed wind energy facility;
- the method for measuring background noise at a selection of those identified noise sensitive receptors and the analysis of the data to generate background noise levels at those receptors;
- the procedure for developing the acceptable noise limit from the background noise level to meet the specified noise performance standard;
- the mathematical method for modelling the noise at the selected receptors from the proposed wind energy facility;
- how to deal with special audible characteristics;
- post-construction noise monitoring;
- determining compliance with the standard; and
- necessary documentation of the proposal and the noise assessment.

NZS 6808:1998 and the *Noise Impact Assessment* both discuss the challenge in assessing wind farm noise. Noise measurement specified by other acoustic standards requires noise to be measured under calm or low speed wind conditions, typically less than 5 m/s, to reduce the influence of wind noise on the measurement itself. This situation is not suitable for operating wind farms which only operate in wind speeds typically greater than about 3 m/s. NZS 6808:1998 has been developed to assess wind farm noise over a wide range of turbine operating speeds, which can lead to wind effects on the microphone and fluctuations in background noise.

In early 2010 a revised version of NZS 6808:1998 was released as NZS 6808:2010. This has some important changes in substance. Many submitters favoured adoption of this standard. This matter is discussed in further detail later in this chapter.

Dr Robert Thorne of Noise Measurement Services, who appeared as an expert witness for submitters advised us that NZS 6808:1998 and NZS 6808:2010 should be interpreted with caution, since they had been developed to complement the New Zealand *Resource Management Act 1991*. 
A number of submitters suggested inadequacies in the standard, difficulties associated with interpretation and in its implementation in the PPAR.

### 8.3.5 The noise standard

The noise criterion is stated in 4.4.2 (page 9) of NZS 6808:1998 as:

*As a guide to the limits of acceptability, the sound level from the WTG (or windfarm) should not exceed, at any residential site, and at any of the nominated windspeeds, the background sound level (L_{50}) by more than 5dBA L_{50}, or a level of 40dBA L_{50}, whichever is the greater.*

WTG is ‘wind turbine generator’ in the above.

This statement recognises the relationship between wind speed and wind noise. Section 4.4.1 (pp 8–9) of NZS 6808:1998 explains that the internationally accepted indoor sound level to protect against sleep disturbance is 30–35dBA L_{50}. If attenuation between outdoor and indoor sound levels of 10dB is reasonably assumed an outdoor level of 40dBA L_{50} provides for that sleep protection. At low wind speeds where outdoor noise levels might be expected to be below 40dBA L_{50} that level is set as the criterion. At higher wind speeds where the noise level would be higher than that level, a 5dB increment on the background level is allowed. Hence the acceptable noise limit for a particular location is established as a curve and is, by definition, tied to the background noise level.

It is important to understand that the noise criterion is set at a level to provide protection against sleep disturbance in a dwelling. It does not provide for no audible wind turbine noise to occur under all wind speeds and locations.

These limits are suggested in NZS 6808:1998 as a ‘guide to acceptability’. Some submitters suggested that this gives us scope to set lower noise limits. Given that the Guidelines refer to the ‘……noise levels recommended……’ in that standard and do not indicate any variation from them, we have adopted the noise criteria from the New Zealand standard for this assessment. Other WEF panels have done similarly.

### 8.3.6 NZS 6808:1998 v NZS 6808:2010

The *Policy and planning guidelines for development of wind energy facilities in Victoria* (the Guidelines) of September 2009 require the noise impact of the proposed wind energy facility to be assessed in accordance with, and to comply with, *NZS 6808:1998 Acoustics – The assessment and measurement of sound from wind turbine generators* (ref 4.8, page 25 under ‘Written reports’ for assessment, and 4.9.1 3(a), page 30 for compliance).

With regard to the status of this latest standard it notes, in the context of New Zealand law, at page 6:

The Standards Act 1988 states that a reference made to a Standard in any Act, regulation, or bylaw refers to the latest edition of that Standard. However section 23 of the Act also makes an exception where the context otherwise requires. The Environment Court has held that where a New Zealand Standard has been incorporated by reference or cited in a district plan or a condition of consent, its version (and that of any included documents, for example another New Zealand Standard, ISO, or foreign Standard), is the version current at the date of publication of the plan or condition.

and as commentary:

If this were not the case, a district plan or resource consent condition could be altered, not by the appropriate planning authority and processes provided by the Resource Management Act, but by the Standards Council and its processes under the Standards Act.

The Sisters decision by VCAT

The question arose in the course of the Panel hearing as to which of the two New Zealand standards should be used to assess the current Application before the Panel. The issue was triggered by the decision by the VCAT decision in The Sisters Wind Farm Pty Ltd v Moyne Shire Council and Ors, VCAT P2107/2009 [27 April 2010].

That decision related to a proposed 12 turbine wind farm west of Terang in the Farming Zone of the Moyne Planning Scheme, close to part of the proposed Mortlake WEF.

In considering the noise impacts of the wind farm, VCAT said at paragraphs 16 and 17:

The New Zealand standard referenced in the Victorian Planning Guidelines for Wind Energy Facilities 2009 and in Clause 52.32-2 of the Planning Scheme was superseded on 1 March with standard 6808:2010. The new standard retains the limits contained in the 1998 Standard with the substitution of L90 percentile for the L95 in that standard as being more robust. The standard however does allow for, in quiet locations, the
provision of a lower more stringent limit where a local authority has identified in its district plan the need to provide a higher degree of acoustic amenity’. The standard recommends that the sound from a wind farm in such locations during the evening and night-time not exceed the background sound level by more than 5dB(A) or 35dB(A) L90 (10min) whichever is the greater. The question then arises as to whether we should have regard to this standard and if so whether the subject site warrants special consideration as a quiet location.

With respect to the appropriate standard to apply we accept Ms Marshall’s [Ms Marshall appeared for the Shire Council] submission that under the Interpretation of Legislation Act 1984 the reference to the 1998 New Zealand Standard in the Policy Guideline and the Planning Scheme should be read as a reference to the 2010 New Zealand Standard. The New Zealand Standard is the one referred to in the 2009 Guidelines. It is the adopted standard for the State of Victoria and we find the fact that it is adopted from New Zealand of no particular relevance. We further find that the area impacted by The Sisters proposal is a quiet location as evidenced by the background noise level measurements made by the applicant which were below 35dB(A) at wind speeds up to 6 m/sec.

It is not our role to make a ruling on VCAT’s reasoning, but even if we wished to do so, the particular arguments advanced at the VCAT hearing with which the Tribunal agreed are not apparent in the Tribunal’s reasons.

We have considered the matter afresh based on the submissions put to us.

Mr Gobbo urged us not to adopt the same approach to the application of the 2010 standard as VCAT while others such as Mr Cox urged us to adopt that standard.

Mr Gobbo’s position was that NZS 6808:1998 was the appropriate standard as specifically identified in the Guidelines and that that had been used by the Applicant.

Mr Cox argued that NZS 6808:2010 should be used otherwise the Minister for Planning as the responsible authority would be creating a ‘two track’ system by departing from the VCAT interpretation unless and until that decision is overturned by the Supreme Court. He submitted that it is therefore undesirable for the Minister to adopt a different position from VCAT until the legal issue is resolved. Mr Cox stated that NZS 6808:2010 sets out in greater detail matters which a responsible authority can take into account under NZS 6808:1998, and hence which is the applicable version of the standard ought not make a difference to the Panel’s recommendations.
It is our view that NZS 6808:1998 is the appropriate standard to apply for assessing the noise impact. Our reasons include the following considerations:

- The Guidelines are quite specific in identifying the relevant standard: they specify not only the generic identifier ie NZS 6808, but the particular version ie NZS 6808:1998;
- The latest version of the Guidelines postdates NZS 6808:1998 which suggests that the version of the standard that should apply would be that extant at the time of publication of the current Guidelines; and
- We have considered whether the consequences of our approach would lead to a sensible or an absurd outcome. In our view, to find that the 2010 standard had been introduced in a statutory planning scheme in this State as a consequence of an action by an organisation in another country rather than by a deliberate decision by authors of the scheme, we believe is untenable and would set a poor precedent. The precedent set for all manner of referred and incorporated documents of the scheme would be problematic.

Nevertheless, Mr Gobbo, for the Applicant, said that there is no impediment to our using explanatory material from the 2010 version where that assists in understanding, but does not change, NZS 6808:1998.

**Comparison of the 1998 and 2010 noise standards**

In this section we compare the two standards. In doing so we are mindful that NZS 6808 complements the (New Zealand) *Resource Management Act* 1991 and makes references to that Act and to New Zealand practice. Hence we have been careful to compare the technical issues that are relevant to the application of the standard under the Guidelines. In his expert witness statement Mr Delaire at Annexure J, item a, (Exhibit A21), in response to a direction from us, provided an overview of the major similarities and differences between NZS 6808:1998 and NZS 6808:2010. That material has been helpful to us.

Relevant to the issues we have considered are the following:

- NZS 6808:2010 is more clearly written and presented than NZS 6808:1998. The material is substantially re-organised and more descriptive. Nonetheless understanding the standard and noise from wind farms generally remains challenging;
- NZS 6808:1998 uses the $L_{95}$ noise descriptor; NZS 6808:2010 uses $L_{90}$. The numerical values of the noise standards remain unaltered. Hence 40dBA $L_{95}$ becomes 40dBA $L_{90}$;
- NZS 6808:2010 introduces the concept of a ‘high amenity area’ and a ‘high amenity noise limit’ for such areas. This appears to be a development of the NZS 6808:1998 provision at 4.4.4 on page 9 that a ‘Territorial Local
Authority’ can set an alternative compliance level that takes account of individual circumstances and characteristics. The high amenity noise limit allows for consideration of a lower noise limit not exceeding the background sound level by more than 5dB or a level of 35dBA L	ext{eq}, whichever is the greater, under certain defined circumstances. Those circumstances include providing a greater protection of amenity during the evening and night time in areas where provision exists in a plan for a higher degree of amenity protection.

Critically, it provides guidance to assist in such a decision. At C5.3.1, point (d), page 21, it specifies that:

If the average difference in an evening or night-time prescribed time frame is less than 8dB then a high amenity noise limit is unlikely to be justified;

and conversely at point (e):

If the average difference in an evening or night-time prescribed time frame is greater than 8dB then a high amenity noise limit is likely to be justified.

C5.3.2, page 22 of NZS 6808:2010 recommends that:

...even when a high amenity noise limit is justified in accordance with 5.3.1 it is appropriate to restrict application of that limit by conditions of consent to wind conditions when the wind farm wind speed falls below a fixed threshold. It is recommended that the high amenity noise limit should apply when the wind farm wind speed is 6 m/s or lower. An alternative wind farm speed threshold may be applied where justified on meteorological, topographical, and acoustical grounds.

In the additional information provided by Marshall Day Acoustics of 25 May 2010 at item 3.2, page 3 (Exhibit A224), Mr Delaire provides an analysis of the ‘prescribed time frame’ referred to in NZS 6808:1998. He calls this a ‘noise perception index’. Mr Delaire provides the data for evening and night at five dwellings at which background noise levels were measured; for evening the results range from 4.1dB to 7.0dB, and for night from 5.2dB to 6.9dB;

- NZS 6808:2010 provides for a 6dB noise penalty for special audible characteristics compared with 5dB in NZS 6808:1998. Usefully, at Appendix B it provides a more comprehensive methodology for assessing these characteristics than does the earlier standard;

- At 5.6 NZS 6808:2010 provides a process for assessing the cumulative noise effects of a wind farm that is built in stages or of a new wind farm that will impact on noise sensitive locations impacted by an existing facility. NZS 6808:1998 does not include such a provision;

6808:1998. The principal differences are that the revised method incorporates ground attenuation and screening by topography and barriers, whereas the earlier method assumed no ground attenuation of sound and no screening; and


Panel response

We believe that the consequence of the change of the descriptor from $L_{95}$ to $L_{90}$ is to make the standard slightly more restrictive, by about 0.5dB.

We are conscious that some submitters appeared to believe that the adoption of NZS 6808:2010 would carry with it acceptance of the area proposed for the Stockyard Hill Wind Farm as a high amenity area for noise. A number referred to the quietness of the area and the distance at which they could sometimes hear noises. Noise measurements provided by Mr Delaire and Dr Thorne showed noise levels at times below 25dBA.

If NZS 6808:2010 was to be considered for application at the proposed Stockyard Hill Wind Farm, the material submitted to us, and our analysis of the information, suggests that the application of a high amenity noise limit would not be justified. The prescribed time frame results are all less than the 8dB criterion below which the application of a high amenity noise limit is likely to be justified, and there is no provision in the Farming Zone that suggests any greater protection of noise amenity than elsewhere is warranted. Indeed, we were not presented with any evidence purporting to show that the acoustic environment in the area is atypically low for land in the Farming Zone.

For special audible characteristics we have taken advantage of the methodology of Appendix B of NZS 6808:2010 by adopting that in our recommendations to assist with the assessment of those characteristics whilst retaining the NZS 6808:1998 5dB penalty.

The NZS 6808:2010 assessment methodology for cumulative noise impacts of stages in a wind farm or for adjoining facilities is potentially helpful. As indicated before, the proposed Stockyard Hill Wind Farm can be seen as having four turbine groups and it is possible that construction could be staged. Beyond that, we are aware of two other instances where panels have had to consider cumulative noise impacts of proposed closely located wind farms.
We believe that the method for noise predictions for initial screening and noise modelling of NZS 6808:2010 is likely to give more accurate results by removing some of the more conservative assumptions in the NZS 6808:1998 method. But that does not directly impact on compliance. Compliance is independent of the prediction method used: it rests on establishing the acceptable noise limits at each noise sensitive receptor from measured background noise levels, and after commissioning of the wind farm determining by measurement at those same receptors whether the noise levels comply with those acceptable noise limits. However, we suggest that the less conservative modelling may result in any margin between predicted noise and the acceptable noise limit being reduced and post commissioning compliance may be by a smaller margin than otherwise. We believe that this could be clarified by a number of wind farm examples being modelled using both the NZS 6808:1998 and NZS 6808:2010 approaches and comparing the results.

We have referenced the ‘on/off’ compliance method in our recommendations in the event that it offers greater certainty of post commissioning compliance assessment.

Conclusions

In his expert witness statement at Annexure J, item a, (Exhibit A21), Mr Delaire said that the methodology used for the proposed Stockyard Hill Wind Farm for background noise measurements, determination of noise limits, and noise predictions are all consistent with that of NZS 6808:2010. Further, he advised that the predicted noise levels are also in accordance with that standard assuming no ground attenuation. We accept that advice that the noise impact assessment, whilst carried out in compliance with NZS 6808:1998, is also compliant with NZS 6808:2010.

We conclude that although NZS 6808:2010 is an improvement on NZS 6808:1998 in many ways, the difference that it makes in noise levels is probably small, and that difference is likely to only marginally reduce acceptable noise limits.

Given that the currently referenced wind farm standard NZS 6808:1998 has been superseded by NZS 6808:2010, and AS 4959:2010 on wind farm noise has recently been published, we believe that it would be appropriate for the Guidelines to be revised to reflect these developments. However, we suggest that that should be done only after identification and assessment of any implications. It is our experience that wind farm noise assessment is a particularly difficult issue for submitters. It is technically complex; but it is also made difficult by shortcomings in the standards; for example NZS 6808 is a complementary document to the (New Zealand) Resource Management Act.
1991 and needs is most clearly read in the context of New Zealand statutory arrangements; and AS 4959:2010 does not provide numerical noise standards.

8.3.7 Recommendation

The Panel recommends that:

The Guidelines should be revised after close consideration of available methods and performance standards for wind farm noise to incorporate either NZS 6808:2010 or AS 4959:2010 with such additional material as is needed to provide for an unequivocal methodology for assessing noise from wind farms.

8.4 The indicative turbine

It is normal in planning applications for an applicant to nominate an ‘indicative’ turbine model rather than specify the particular one which would be used. The reason is that during the (often several) years between project approval and commitment to proceed there can be major changes in utility scale turbine types available on the market. The emergence of new models that may have improved energy output and noise characteristics can be expected as the industry continues to change rapidly. We therefore understand the Applicant’s reluctance to commit to a turbine type at this point.

Consequently, we will consider the Application based on the features of the turbine put before us and make recommendations accordingly, including for approval of the selected turbine type by secondary consent in the context of conditions designed to guide that secondary consent process.

In this PPAR, the Applicant has sought approval for a three bladed, horizontal axis, upwind turbine type with a height to rotor hub of no greater than 80 m and a rotor diameter of up to 104 m. This geometrical description is sufficient to assess visual impact, landscape issues and shadow flicker. However, it is not sufficient to assess noise.

As turbine types differ in their acoustic characteristics, a specific turbine type must be nominated for the noise assessment. This is necessary so that test data on the sound power levels vs. wind speed, and on the octave sound power level spectrum (the sound frequency characteristic) is available. The Applicant has nominated the REpower MM92-Evo/2MW for this purpose.

We are conscious that the nominated turbine type has a rotor diameter of 92m compared with the maximum 104m applied for. Further, the PPAR suggests
that a turbine rated power of 3 MW compared with the 2 MW of this machine might be considered. We are aware that a larger diameter rotor and an increased power rating do not necessarily mean a greater noise output. However, there is clearly an inconsistency between this indicative turbine for noise assessment and the maximum turbine dimensions in the Application.

The Panel’s position is that it is acceptable that the noise assessment presented by the Applicant uses the REpower MM92-Evo/2MW turbine, but once a final turbine model is selected, the noise assessment must repeated using the acoustic characteristics of that chosen model to establish compliance with NZS 6808:1998 (or the noise standard specified in the statutory documents at the time), and its approval then can be considered under secondary consent. We consider this issue in more detail later in this section.

8.5 Initial noise predictions

8.5.1 Preliminary noise assessment

The first aspect of the noise assessment is preliminary noise modelling to identify noise sensitive receptors, or ‘assessable sites’. This is necessary to determine receptors that may be affected by wind farm noise and require detailed evaluation. It also assists with identifying suitable sites for background noise monitoring as ‘representative sites’, and the similarity of other sites for selected background noise measurements to be translated from those ‘representative sites’ to others.

The assessment is done using a simple modelling approach. The outcome is a set of noise contours out to 35dBA that identify the predicted noise from the wind farm vs. distance under likely ‘worst case’ conditions.

The Guidelines refer to ‘dwellings’ as noise sensitive sites. NZS 6808:1998 is a little broader in referring to ‘residences and noise sensitive areas’ and ‘locations of interest’. The Applicant has not identified any receptors near the proposed wind farm other than dwellings. No evidence was identified of any other sites, such as schools, although some submissions suggested that farm working areas should be considered. Our inspection of the area did not identify any other sites for consideration.

We understand that the noise compliance requirement applies to the exterior of existing ‘non-stakeholder’ dwellings and the area immediately surrounding them (the curtilage), and not to the whole of land outside the site boundaries including the working areas of farms. Further, we interpret the requirement as to apply to dwellings that exist at the time of the planning Application, or any proposed dwellings at that time for which substantive evidence exists of
the intention to build a dwelling. Some submitters suggested that the whole of their property should meet the noise criteria. We do not believe that the Guidelines are intended to apply to private or public land other than stakeholder dwellings and any other similar noise sensitive locations.

We also understand that the criterion specified by NZS 6808:1998 should not apply to the dwellings of stakeholders. The matter of whether a less demanding criterion should be applied at those dwellings, as suggested and evaluated by Marshall Day Acoustics, is discussed later. Some stakeholder dwellings are likely to be closer to wind turbines than those of non-stakeholders. We are of the view that in exchange for the financial benefit that they are receiving stakeholders should be prepared to accept some loss of noise amenity, and we understand that this is included in their agreement with the Applicant. By contrast, those who are not financial beneficiaries should be afforded protection from noise that might cause sleep disturbance.

As required by NZS 6808:1998 a preliminary, or screening, prediction has been carried out to determine those dwellings that need to be assessed for possible noise impact.

The screening predictions are carried out using a simple model described in Section 4.3.2 of NZS 6808:1998. The modelling depends on assessing the noise propagation from each turbine to each of the identified receptors and mathematically summing those to give the total noise impact at each site. The model assumes that sound from the source spreads uniformly (ie. essentially in a hemisphere), with reductions as the sound spreads outwards and is absorbed by air. The model includes noise attenuation due to air absorption but Section 4.3.3 refers to the model ignoring acoustic absorption and reflection due to vegetation. It suggests that the outcome could be expected to be conservative for propagation across flat sites ie it over-estimates the noise level.

The simple model requires the sound power level of the turbine type referenced to hub height and the air absorption coefficient of sound.

The sound power levels are obtained from the turbine manufacturers as the sound power level vs. hub height wind speed turbine characteristic. These are shown in Figures 1 - 2, page 6 of the Noise Impact Assessment Report at Annexure X of the PPAR.

NZS 6808:1998 suggests an air absorption coefficient of 0.005dBA/m but allows the choice of a coefficient that suits the sound spectrum of the wind turbine. The Noise Impact Assessment report at Section 6.2, page 7 states:
Spectral content can be important as some larger modern wind turbines emit noise with more low frequency content. Low frequency sound attenuates at a relatively slow rate in air; hence the proposed typical atmospheric absorption rate of 0.005dBA/m (5dBA/km) in NZS 6808:1998 may, at times, be too great.

For this reason, octave band sound power levels together with the appropriate air absorption coefficient for each octave band in accordance with ISO 9613 - 1:1993 were used to predict noise emissions from each selected wind turbine more accurately [Note: this standard is International Standards Organisation ISO 9613 Acoustics – Attenuation of sound during propagation outdoors – Part 1; Calculation of the absorption of sound by the atmosphere (1993)].

At Table 1 on page 7, the report provides the air absorption coefficients. This indicates a dramatic decrease in air absorption coefficient with decreasing frequency. We support this approach which otherwise could tend to some under-prediction.

The preliminary noise assessment was carried out using the indicative turbine model. The noise contours from this prediction are shown in Appendix C of the Noise Impact Assessment report. Table 2 pp 7-10 of that report provides these noise predictions for the dwellings to be assessed.

We note that the modelling was undertaken at an estimated hub height wind speed of 10 m/s. Our calculation suggests that this corresponds to a ground level wind speed of approximately 7 – 8 m/s in a turbulent boundary layer. There is some confusion in the report which otherwise suggests the modelling was carried out at a hub height wind speed of 12 m/s, an issue commented on by some submitters. Mr Delaire advised that the sound power level plateaus at 10 m/s and hence this inconsistency makes no practical difference, and that the data used corresponds to the peak sound pressure level for that turbine type.

These predicted noise contour maps are shown at Appendix C of the report by Marshall Day of 27 April 2010 titled Stockyard Hill Wind Farm Panel Hearing - Additional Information (Exhibit A93). The 35, 40 and 45dBA contours for the revised wind farm layout proposed by the Applicant (except that T218 has not been removed) are given in Exhibit A227.

This preliminary noise assessment identified 93 dwellings as potentially sensitive to noise impact ie those with a predicted wind farm noise impact of 35dBA or greater. Fifty two of these were identified as being occupied or rented stakeholder houses. For 25 of these stakeholder dwellings the NZS 6808:1998 noise limit of 40dBA would be exceeded and the Applicant has an
option to purchase two of those. In his expert witness statement Mr Delaire advised that that 25 should be 29 and that the 2 should be 3. The remainder are non-stakeholder dwellings.

Given that a number of changes were made by the Applicant to the proposed WEF configuration during the hearing we have attempted our own analysis of dwellings within the revised 35dBA predicted WEF noise contour. We have had to base that on several documents. The Panel’s focus is particularly on non-stakeholders, in which we now include a small number of ex-stakeholders on properties where turbines have now been deleted.

We conclude that there will be 79 dwellings within the 35dBA contour. Of these, 44 will be stakeholder dwellings (some on the site and some off-site) and 35 will be non-stakeholder dwellings. Of these non-stakeholder dwellings, one is on the 40dBA contour and the remainder are between 35 and 39dBA.

**Panel response**

The Panel acknowledges that the preliminary sound level predictions have been carried as specified by NZS 6808:1998. However this is qualified by a number of concerns generated by the evidence and submissions about noise from WEFs that has been put before the Panel.

For this initial prediction of wind turbine noise these concerns are specifically whether the maximum sound power level of the indicative turbine has been used, whether an attempt should have been made to use a more sophisticated predictive approach, and whether any consideration should have been given to atmospheric conditions that might have enhanced noise. Regarding the latter point, we are cognisant of the material in the note from Garrad Hassan on wind shear and atmospheric stability and noise propagation (Exhibit A223) and the evidence of Dr Thorne on noise predictions (Exhibit L157, pp12 -17).

Nonetheless, we note that the predictive model includes conservative assumptions, and that the air absorption has been calculated using the spectral characteristics of the indicative turbine which better accommodates the lesser absorption of low frequency sounds than the single NZS 6808:1998 factor allows.

The role of the 35dBA noise contour causes us some difficulty. In the Noise Impact Assessment report at Annexe X of the PPAR it states at p1;

> Implicit in the standard is that residents who experience a worst-case noise level of 35dBA or less will automatically comply with the standard.
This position is repeated in that report. At 4.5.2 (page 9) of NZS 6808:1998 it says;

This Standard recommends that background sound level measurements be carried out where predicted sound levels of 35dBA or higher are calculated for the relevant locations.

It is clear from the predictive procedure that the sound level estimates are for the noise of the WEF only, since they are calculated from the sound power level of the indicative turbine type. They do not seem to include background noise and hence do not represent the ‘environmental noise’ at each site. We have attempted to calculate a ‘background adjusted noise level’ to understand what this might mean as total noise level. We have done this on the basis that protection against unacceptable noise and, in particular providing for undisturbed sleep, needs to be considered in the context of the overall noise level rather than noise from one particular source. In doing this we are limited by the technical complexity of wind farm noise issues. We estimate total noise could be up to 4dBA higher but in many circumstances would be less.

The predictive modelling is a technically complex issue on which we have received a great deal of evidence, not all of it congruent. It is an important issue because it provides the initial assessment of sensitive locations, in this case non-stakeholder dwellings that may be affected by wind turbine noise. Our conclusion is that the 35dBA noise contour for wind farm noise provides a satisfactory initial identification of dwellings that may hear noise from wind turbines at times (we note again that the aim of NZS 6808:1998 is to protect against unacceptable levels of wind turbine noise and protect against sleep disturbance, it does not seek to ensure inaudibility).

We believe that the noise modelling provides a satisfactory assessment of the likely spatial impact of wind turbine noise. We do not believe that the use of a more complex model is justified, but are inclined to view it as indicative rather than prescriptive. Further, we note that it is the WEF noise only.

8.6 Background noise measurements

We turn now to the measurement of background noise, the analysis of the data, and its application to the nearby dwellings.

8.6.1 The importance of correct background noise measurement

Establishing the background noise levels is critical. This is the foundation upon which the acceptable noise levels, the modelled compliance assessment, and the post-construction compliance monitoring and enforcement rests.
The fundamental approach to wind farm noise assessment is to establish the background noise levels at various locations in the absence of the WEF, use these levels as the basis for a specified noise increment, and hence determine the ‘acceptable noise limit’. This limit then defines the maximum level for the initial assessment of expected noise for the WEF planning. Vitaly, it is the noise limit that must be shown to be met for post construction monitoring and hence demonstration of compliance. Thus the importance of well established background noise measurements is apparent.

8.6.2 The method of measurement


As indicated previously, measurements of environmental noise are generally done under conditions of calm or very low wind speeds. This avoids measurement problems of wind across the microphone and noise variability at higher wind speeds. Conversely, background noise measurement for wind turbine noise evaluation presents challenges because it has to be measured over a wide range of wind speeds typical of turbine operation. Unlike other environmental noise measurements it must establish the relationship between noise at the monitored site and wind speed at the WEF site. That requirement brings with it greater measurement difficulties and uncertainties than is usually the case with other noise measurements. Measurement of background noise at calm to low wind speeds, as is sometimes suggested by submitters, is inappropriate since under those conditions wind turbines would be unlikely to be operating.

NZS 6808:1998 suggests that 10 minute $L_{A95}$ noise measurements be taken at selected representative noise sensitive locations and corresponding average wind speeds, preferably at wind turbine hub height, on the wind farm site for a period of 10 to 14 days. This gives a minimum of 1440 ‘data pairs’ (there are 1440 10 minute periods in 10 days). This technique is designed to ensure that a wide range of wind speeds are encompassed including the whole operating wind speed range of the turbines and the critical lower wind speed range of about 5-8 m/s at which wind turbine noise is most likely to be audible.

The noise data as $L_{A95}$ for each ten minute period and the corresponding 10 minute mean wind speeds are plotted and a ‘line of best fit’ constructed. This is the background noise level. It is to be expected that there will be considerable scatter of the data points around such a line. Specifically, noise data at any particular wind speed will be expected to be spread quite widely. Further, when noise is low some points might be grouped at a low noise level at the limit of detection of the instrument, the so called ‘noise floor’. These features
do not necessarily indicate a failure to measure according to NZS 6808:1998; they can be a characteristic of the measurement method. However, a wide data scatter can lead to reduced confidence in the background noise level. Effort is justified to ensure that this level is as robust as possible; this is discussed further later in this section.

An important feature of this background noise level is that, unlike other noise measurements, there is no single figure that represents background noise, rather it is all points along this best fit curve relating measured noise at the receptor to wind speed at turbine hub height.

It is usual practice to monitor at a selection of dwellings, and any other noise sensitive sites, rather than all assessable ones. The sites are selected on the bases of suitable monitoring positions being available, permission being granted to use them, and, importantly, a similarity in the assessed ‘acoustic environment’ of dwellings so that results at non-monitored dwellings can be confidently estimated by the data from a selected ‘representative site’.

Thirteen sites were used for background noise monitoring. The PPAR advises that these were selected by the Applicant and confirmed as representative of the area by Marshall Day. These were dwellings #B39, #B41, #H1, #H4, #H30, #H32, #I4, #I15, #L7, #M5, #N16, #N26 and #N32. Eleven of these are stakeholder dwellings. Monitoring was carried out at the sites for different time intervals over the period 16 June to 2 October 2008, all for about 14 days.

Coincident wind speed measurements were taken from a nominal 60 m meteorological mast on the wind farm site. The mast had anemometers at three levels up to and including 62 m. Data from these were used by Marshall Day to estimate wind speed at 80 m hub height by a technique that involves calculating the difference in wind speeds at the 40 and 62 m horizons and applying this to the 62 m wind speed to extrapolate to 80 m. We note that the meteorological mast, the only one on site at the time of the background noise measurements, would range in distance from about 0.5 to 14 km from the measurement sites at dwellings. A spatial separation is usual and inevitable, but this separation seems greater than might have been experienced elsewhere. A number of submitters, and particularly Mr Huson in his expert evidence, suggested that the strength of the relationship between background noise data and estimated hub height wind speed weakened as the separation distance increased and this was deficiency in the assessment.

At our request Mr Delaire provided copies of calibration certificates for the noise loggers. These show calibrations by an accredited laboratory.
The results of the background monitoring are presented in Figures 1 - 26, pp 13 - 25 of the Noise Impact Assessment report at Annexe X of the PPAR. These 26 figures show the background noise for the 13 monitored dwellings presented separately as 24 hour and night time noise for each of those sites. Night time noise is 10 pm to 7 am. Producing a separate night time noise limit is a desirable (as recommended by the 2009 Guidelines) part of the assessment because it gives a limit, expected to be lower than that for 24 hour noise, against which compliance can be assessed at that time of the day when lower noise levels are justified for sleep.

No analysis has been made according to wind direction; we discuss this as a particular matter later in this section.

Each of these figures show the individual data points (in green), the line of best fit through those points (ie: the background noise level) (in red), the equation of that line, the coefficient of determination (\(R^2\)), and the noise limit derived from that curve (in black). That noise limit derivation will be discussed in the next part of this chapter.

**Particular aspects of methodology**

We now comment on these specific elements other than the noise limit.

**Individual data points**

The individual data points each show a data pair of \(L_{A95}\) noise measured at the nominated location and the corresponding wind speed from the meteorological mast extrapolated to turbine hub height of 80 AGL (above ground level).

Mr Delaire explained that periods when rain had been recorded at the Bureau of Meteorology monitoring site at Ballarat were removed from the data set because of the direct noise impact of rain on the microphone. Otherwise the data set is intact and represents the raw data for analysis.

We note that the data points are well distributed across various wind speeds as advised by NZS 6808:1998. In addition, the important wind speed range of about 5-9 m/s is well populated with data points. This is the range at which turbines will be operating but background masking noise will be relatively low: the conditions at which it is anticipated that wind farm noise is likely to be most noticeable, particularly at night.

Inspection of these results indicates a generally increasing trend of background noise with increasing wind speed, as would be expected from experience. However, the data are widely scattered. The data appear less
scattered at some dwellings than others, and some individual dwellings show differences between 24 hour and night time data scatter. For a given wind speed the scatter of data points can be 20dBA or even greater. From the Panel’s experience this scatter is quite typical of such background noise measurements for WEF sites.

The data scatter may be attributed to a number of causes including the distance between wind speed and noise measurement points, atmospheric conditions particularly stability, and local noises near the noise monitoring location.

Examples of elevated noise levels occur at quite low hub height wind speeds which could suggest the presence of some local noise sources not strongly related to wind speed. There are also data points at reasonably elevated hub height wind speeds and quite low background noise levels. We understand that turbines could operate under these conditions with diminished masking noise at the receptor and hence might be most audible.

We observe that the data set for night time noise is not as robust as that for 24 hour noise. Because it is a sub-set of the data, it has about one third the number of measurements and hence less than the suggested number of data pairs. This is an inevitable consequence of preparing a night time data sub-set. It could only be remedied by extending the measurement period.

This scatter of background noise data is not a reflection on the measurement program as such. Rather it is an outcome (perhaps an inevitable one) of the methodology for assessing wind turbine noise. We believe that the scatter might be partially reduced by a closer proximity of wind speed and background noise monitoring sites, measuring wind speed at hub height, perhaps segmentation by wind direction, and possibly removing any noise data that might be affected by prolonged atypical events.
Figure 21  Example of 24 hour background noise curve (House 39)
Source: Marshall Day Acoustics Report – Appendix X to PPAR

Figure 22  Example of nighttime background noise curve (House 39)
Source: Marshall Day Acoustics Report – Appendix X to PPAR
The noise floor

Another characteristic of the data points alluded to previously is that of the noise logger ‘noise floor’. A noise logger has a lower limit to noise measurement; any noise lower than that will be recorded at that limit. This is the so called ‘noise floor’. Different noise logger classes can have different noise floors. The noise floor can be discerned from inspection of the figures as the horizontal row of points at a low noise level and below which there are no further points. This is more apparent to the left of the figures, (ie: at low wind speeds). That is to be expected since as wind speed increases the background noise increases. Inspection of the figures shows a ‘noise floor’ range for the data loggers of 23 to 30dBA with about 26dBA being typical.

Background noise level

This is the ‘line of best fit’ of the data points, or regression curve, for the individual measured data points. These background noise levels are shown as the red curves in Figures 1 - 26, pp 13 - 25 of the Noise Impact Assessment report at Annexe X of the PPAR. The scatter of individual data points about this background noise level is clear, as is the upward trend of the curve with increasing wind speed.

It has been stated before that the background noise level is defined by this line; it is not a single value. Inspection of any of the figures will make this clear. If one takes a single hub height wind speed on any of the figures there will be a corresponding noise level shown by the background noise level (red) curve. That does not mean that the background noise will always be that value at that wind speed; it is clear that it may be many, perhaps 10 or so, dBA above or below that at different times. It does mean that that noise level read from the background noise level curve at that given wind speed is, approximately the average, or typical noise level. Further, if a wind farm is operational, a single noise reading that is above that line does not mean that that is due to wind farm noise; it may be, but it could be due to other causes such as those that cause the higher noise individual data points.

The diagrams showing the background noise levels at Figures 1 - 26, pp 13 - 25 of the Noise Impact Assessment report at Annexe X of the PPAR are rather ‘busy’ given the amount of information on them. It is not possible to easily compare the background noise levels at the various dwellings where measurements were made. We asked Mr Delaire to place the thirteen 24 hour curves on a single figure and similarly with the night time levels. This data is shown as Figures 1 and 2, page 2 of the report from Marshall Day of 27 April
2010 titled *Stockyard Hill Wind Farm Panel Hearing - Additional Information* (Exhibit A93).

The Panel is conscious of not trying to analyse these results beyond what might be reasonable. They all show the expected background noise increasing with wind speed, at a rate of very approximately one dBA per one m/s increase in wind speed or slightly greater, but with some variations. The most noticeable feature is the spread of the background noise levels: for both 24 hour and for night time noise it seems to be about 10dBA.

We can offer no cogent explanation of this spread nor was any suggested by the expert witness. Dr Thorne indicated that from his experience, it is about what he would expect. The location of the dwellings does not suggest that any are located close to identifiable noise sources such as major roads. It is possible that some of the apparent variation at low wind speeds is due to the different noise floors for the data meters. At higher wind speeds vegetation near the data logger may be a contributor, inspection of the photographs of noise logger locations suggest that might have had some role. Background noise monitoring was carried out over four distinct time periods at groups of dwellings: examination of the results do not show any apparent link by date of monitoring and any grouping of the background noise curves.

The range of these background noise monitoring curves seems to be an artefact of the assessment method. It may be indicative of the scatter of the experimental data and the uncertain repeatability of that method over short time periods.

Furthermore, it is apparent from closely comparing the two sets of curves that the night time background noise curves are generally somewhat lower than those for 24 hour as might be expected. This can also be seen from Figures F1 - F13 Appendix F of the *Noise Impact Assessment* report at Annexe X of the PPAR. Typically, over much of the wind speed range the night time background noise curves are about 1 to 4dBA lower than the 24 hour curves.

**Mathematical equation of curve**

Each figure has imprinted on it the mathematical equation of the background noise level curve. NZS 6808:1998, at 4.5.5, does not specify the ‘order’ of this curve, although more recent standards tend to be more prescriptive. It is left to the discretion if the investigator to decide which ‘order’ curve best fits the data. The ‘order’ is shown by the index for ‘x’ in the equations and this is reflected in the shape of the curve. A ‘first order’ (or linear) equation is a straight line. A ‘second order’ (or quadratic) equation is a curve with a single point of inflexion, and a ‘third order’ one is a curve with two points of
inflexion. In this case all equations are ‘third order’ other than one ‘second order’.

In his expert evidence Mr Huson argued that second order equations are most suitable and should be used throughout. We were not presented with evidence, such as from an analysis of data, of what difference this would make.

The coefficient of determination (R²)

This parameter measures the ‘goodness of fit’ of the regression line and hence the confidence that can be had in that background noise limit curve. An R² of one demonstrates a perfect correlation between two variables and hence that very high confidence can be had in the correlation and hence the curve in representing the relationship between the measured data. An R² of zero indicates no correlation whatever between the parameters and no confidence can be had in any curve which might purport to show any relationship between the data.

It should be noted that the figures in Appendix E of the Noise Impact Assessment report at Annexe X of the PPAR showing the measured background noise levels and estimated hub height wind speed vs. time include a correlation coefficient. This is a different statistical factor than R²; the coefficient of determination will be a smaller number.

The R² results range from 0.21 to 0.67 for 24 hour noise and from 0.24 to 0.80 for night time noise. A number of the curves show a moderate correlation, say those above about 0.4, but a number are poor.

To help it better understand these background noise data, the Panel asked Mr Delaire to provide a 90% confidence interval analysis of the data. Mr Delaire provided this analysis for all 13 dwellings for 24 hour noise. This is presented in Figures 31 - 43, pp 19 - 25 of the report from Marshall Day of 27 April 2010 titled Stockyard Hill Wind Farm Panel Hearing - Additional Information (Exhibit A93). Examination of these, whilst not mirroring the coefficients of determination, confirms the substantial spread of the results of the measurements. Mr Huson, in his supplemental report at Exhibit L155, commented that these confidence intervals at low wind speeds are substantially influenced by the instrument noise floor and the 90% confidence intervals are more like 10dBA rather than the lower average figures presented by Mr Delaire in Table 1, page 18 of his further report.
Panel response on methodology

We are concerned about a number of aspects of the background noise monitoring, although we acknowledge that it has been undertaken in line with the requirements of NZS 6808:1998.

Monitoring sites

Our specific responses regarding the number and selection of sites for background noise monitoring are as follows:

- We believe that the number of monitored sites is too few for a proposed WEF of such size. The proposed WEF may be viewed as four wind farm sectors as described in Section 2.2 hence the background noise monitoring provides an average of about three sites per sector. We note that NZS 6808:1998 gives no guidance at 4.5.1 on the selection on the number or distribution of sites for such monitoring. Hence the number and selection of sites for background noise monitoring is in compliance with that standard;

- We are satisfied that the chosen background noise monitoring sites are geographically well distributed around the WEF site;

- We recognise the concept of ‘representative sites’ by which results may be used at other sites that are judged to have a similar acoustic amenity;

- We also acknowledge the inevitability of using this concept, as it is not reasonable to monitor all possible assessable receivers. However, we consider this translation of site data to have an element of subjectivity that requires caution in use. We believe that more background noise monitored sites are desirable as this decreases the need for information transfer;

- The number of non-stakeholder dwellings monitored (ie: two) is too few. Whilst a level of acoustic protection should be afforded to those with a financial interest in the project (ie. the stakeholders), the focus must be on meeting noise limits at non-stakeholder dwellings. Item 5.2.1 of NZS 6808:1998 states:

  Sound from WTGs (wind turbine generators) shall, where practical, be measured at the same locations where the background sound levels were determined.

The consequence is that background noise levels are available at only two non-stakeholder sites, with others depending on translated ‘representative site’ data, for post construction compliance monitoring. We find this to be unsatisfactory.
The location for the wind speed measurements

- NZS 6808:1998 is silent on the appropriate distance between a noise monitoring location and an anemometer other than that the measurement of wind speed ‘…shall be taken within the wind farm site…’;

- We are aware that correlations of background noise levels and hub height wind speed at other sites with lesser separation distances have not been strong. In the absence of a well designed investigation of this issue we are not convinced that this separation is a major factor affecting the correlation. But neither can we conclude that greater distance is not a contributor to weaker correlations than might otherwise be the case;

- We recognise that the correlation of measured background noise has been done with wind speed at hub height, albeit estimated, rather than surface wind speed as has sometimes been done elsewhere. Estimation of wind speed at hub height, however, rather than measuring it, does not comply with the 2009 version of the Guidelines. The revised Guidelines specifically require that it be measured though we note that the work was done before the release of the recent Guidelines.

   We are not satisfied with the appropriateness of establishing correlations between background noise measurements and estimated hub height wind speed at separation distances of up to about 14 km, nor of estimating hub height wind speed by extrapolation.

   However, having said that we acknowledge that the use of the single meteorological mast and the estimation of hub height wind speed is technically consistent with the requirements of NZS 6808:1998.

- We are informed, and have observed that two further meteorological masts (60m and 80m high) have been erected on site more recently. Any further background noise measurements would have the opportunity of being correlated with wind speed measurements from this 80 m anemometer. That would overcome the extrapolation to hub height issue, but not the separation distance to noise monitoring sites.

- We are advised that it is intended to use 10 meteorological masts in total across the site, the 3 existing masts plus 7 more. For greatest technical certainty and public confidence in monitored noise assessments, it is our position that all masts for background noise correlations should have an anemometer at hub height. Also, as far as practicable masts should be sited clear of wind turbine induced turbulence, and the nearest anemometer to a noise monitoring site should be used.
NZS 6808:1998 states at 4.5.4:

*For the measurement of background levels, the same location should be used for the measurement of windspeed and direction before and after installation.*

For this to be applied, the same mast would have to be used for post construction compliance monitoring. That could worsen the existing shortcomings of distance to background monitoring sites if further non-stakeholder background sites are added, retain the lack of hub height data, and that a turbine (T105) is proposed to be constructed adjacent to the mast which could create turbulence interfering with the free flow air stream.

Assessment of background noise at dwellings

Regarding the assessment of background noise at each dwelling, we have a number of specific comments:

- We are satisfied that the assessment of background noise at each nominated dwelling has been carried out as required by NZS 6808:1998. Dr Thorne acknowledged that;
- We are satisfied that generally the data covers the likely wind speed ranges sufficiently;
- We note that the background noise curves have the expected characteristics. They increase with wind speed, they also do so at about the expected rate, and the night time background noise is lower than the 24 hour noise;
- We have noted the size of the spread of the individual data points in our discussion. The spread is confirmed by the coefficients of determination (R²'s) and the 90% confidence intervals;
- We note that NZS 6808:2010 contemplates the use of ‘bin’ analysis as possible means of preparing the background noise curves with improved certainty. The data placed in integer wind speed ‘bins’, the mean of each bin determined, and the line of best fit determined using those points. That technique might be used to advantage;
- We are aware that the sort of spread of background noise identified here is not unusual in wind farm background noise assessment: the noise at receptors and hub height wind speed are often not strongly correlated;
- Indifferent coefficients of determination do affect confidence in the assessment of background noise levels, however. Importantly it has implications for post construction noise assessment and determining compliance;
We believe that the issue of the order of the equation for the regression curve is an issue of little moment when compared with the level of uncertainty in that background noise curve;

We consider as far as possible, that all aspects of wind farm noise testing and assessment should be conducted using NATA (National Association of Testing Authorities) endorsed testing facilities and instruments calibrated by NATA accredited laboratories. This would be ‘best practice’ and is in accord with the Memorandum of Understanding between the Victorian Government and NATA that testing for statutory activities to be NATA accredited. This would include the calibration of noise meters (which has been done), anemometers and wind vanes, and the accreditation of the testing authority to carry out the noise measurements and assessments according to codified methods;

Based on the spread of the background noise level curves we are not comfortable about the repeatability of these measurements and the confidence that can be had in them as the essential foundation for ultimately determining compliance with NZS 6808:1998. The evidence, limited though it is, suggests a possible uncertainty of several dBA; and

Similarly, given the range of the background noise level curves, we are not confident that the somewhat subjective process of translating background data from a ‘representative site’ to another dwelling gives reliable information. We have commented on this before in presenting our findings on the selection of sites for background noise monitoring. This data supports our discomfort with that process. It is our view that uncertainty in establishing the background noise level at one dwelling is likely to be compounded in using that at another site, possibly to the extent of seriously compromising the value of the assumed background noise for that other site.

General comments

The Applicant has submitted that the number of background noise monitoring sites, the predominant use of stakeholder dwellings, the use of the single meteorological mast, and the estimation of wind speed data by extrapolation to hub height are all consistent with NZS 6808:1998. We agree that this is so. However, given recent well publicised concerns about wind farm noise and suggested health impacts we are disappointed that the Applicant has not gone beyond technical compliance to provide background noise monitoring data that provides as robust and comprehensive information as possible. This would provide a firmer foundation for assessing noise compliance and reducing the likelihood of an unsatisfactory noise outcome. We are of the view that the background noise monitoring that has been presented, while technically defensible in terms of NZS 6808:1998 requirements, does not have
a ‘good look’ in the present wind farm public image. The planning system is best served by more comprehensive background noise monitoring.

In coming to our conclusion on background noise monitoring, and other noise matters we have considered ‘measurement uncertainty’. This is the estimated difference between a measured or a calculated result, and the real value. It assists in understanding the confidence that can be had in a measurement. In the context of assessment of WEF noise, an understanding of measurement uncertainty is of particular importance in so far as uncertainties tend to compound: an uncertainty in the background noise measurement is likely to be similar to that in the post-construction noise measurement which then increases the uncertainty in ascertaining if compliance with the performance standard has been achieved.

While the NZS 6808:1998 does not require the uncertainty to be estimated, we have been presented with uncertainty figures for noise measurements of possibly + or – 4dB.

We are not satisfied that this uncertainty for wind farm noise measurements has been well characterised, but based on material presented to us we accept an uncertainty of a few dB.

As discussed above, we consider that a number of matters contribute to measurement uncertainty. These include the separation distances from the meteorological mast to background noise monitoring sites, the estimation rather than measurement of hub height wind speed, and the need to translate background noise levels from ‘representative’ non-stakeholder sites to others. Further, we consider that the number of background noise measurement sites leads to some uncertainty in the characterisation of the noise background over such a large WEF site.

We therefore believe that more substantial background noise monitoring is needed prior to construction. Indeed Mr Delaire foreshadowed the need for some repeat background noise monitoring. We believe that it should be required to be consistent with a plan approved by the Minister for Planning. In Section 8.5.2 we provide the basic elements which must be included in that background noise monitoring plan and we note that the additional monitoring could be staged to provide for staged WEF development. Further, we consider that the plan and the results should be made publicly available within specified times.
8.6.3 Noise monitoring ‘noise floor’

This matter has been mentioned in the noise measurement discussion above, and was identified in evidence and submissions.

Noise loggers have a lower ‘floor’ limit below which further changes in sound pressure levels do not register. Hence any ‘true values’ below the ‘floor’ level record at that level.

The ‘floor’ is seen in Figures 1 - 26, pp 13 - 25 of the Noise Impact Assessment report at Annexe X of the PPAR as a horizontal line of dots at the lower left of the figures, and the true value of some measurements will be below the floor level. The figures show a noise floor range for the data loggers used of 23 to 30dBA, typically about 26dBA.

These noise floors are typical of Type 2 meters that are commonly used for environmental and occupational noise measurements. ‘Type 1’ meters with a noise floor of about 18dBA, can be used where measurement of lower noise levels is needed.

We are aware in the current case that some background noise levels fall below the ‘floor’. We therefore asked Mr Delaire to provide us with a ‘sensitivity analysis’ on the background noise data to enable us to consider if the use of a Type 1 noise logger might improve the noise assessment, including for post-construction noise measurements. We asked Mr Delaire for minimum of three examples of background noise measurements to randomly distribute all points at or near the noise floor between that noise floor and not less than 18dBA, (ie: typical for Type 1 unit). We then asked him to fit the regression curve to the new data set to show the reconstructed background noise levels, construct the revised noise limit curve based on that new background noise curve, and to provide these new curves overlaid on the original data. We asked for this to be provided before evidence was given by Mr Huson and Dr Thorne to enable them to comment.

We are not suggesting that this approach of sensitivity testing of measured data using the lower artificial noise floor would give identical results had a Type 1 meter been used. We are also conscious that the background noise measurements have been carried out using a noise meter as required by NZS 6808:1998: that standard does not mandate the use of a class 1 (Australian Type 1) meter.

Mr Delaire provided the analysis for all 26 data sets and for each set replaced each data point within 3dB of the lowest background noise level with a randomly generated number not less than 18dBA. The results are shown in

Figures 21 and 22 are examples of background noise curves.

The 27 April 2010 Marshall Day Acoustics report states at page 4:

*We consider that this will provide a generally conservative estimate of the effects of using equipment with a noise floor below 20dBA.*

*As discussed in my evidence, it can be seen from the figures below that the knee (point of transition between minimum noise limit and background noise dependent noise limit) of the derived noise limit tends to be displaced towards higher wind speeds with the artificially reduced noise floor.*

*The effect of the artificial reduction of noise floor is only marginal.*

*The artificial reduction of noise floor does not affect compliance of the proposed Stockyard Hill wind farm with the NZS6808:1998 noise limits as predicted noise levels at all non-stakeholder properties comply with the lowest possible NZS6808:1998 noise limit of 40dBA at all wind speeds.*

These results are best understood by reference to Figure 21. In that figure:

- The green dots are the original measured data pairs of background noise in dBA $L_{50}$ against extrapolated hub height wind speed in m/s as 10 minute averages. These have been discussed under ‘background noise’;
- The solid red line is the original background noise level curve;
- The solid black line is the original noise limit derived from that background noise curve (the derivation of acceptable noise limits is discussed in the next section);
- The pink points are the artificial background noise data pairs taken from those original pairs at which the noise level was within 3dB of the noise floor and distributed randomly between that level and 18dBA but kept at the original hub height wind speed;
- The purple line is the artificial background noise level constructed using those pink points and the green points that have not been varied; and
- The dotted pink line is the artificial noise limit derived from that artificial background noise level curve shown in purple.

As expected the background noise level at low wind speeds has decreased, in this case by about 5dB. However, the critical issue is what the impact is on the noise limit. It will be seen that there is no alteration, nor could there be, in the noise limit of 40dBA $L_{50}$ at lower wind speeds. Also the ‘knee’ in the curve has moved to the right from about 11 to 12 m/s hub height wind speed. Also
above that wind speed, the variation in the noise limit does not exceed 2dB and is in some places above and others below the original noise limit curve.

Both Mr Huson and Dr Thorne were critical of the use of Type 2 noise loggers.

Mr Huson said in his witness statement at page 8 (Exhibit L117):

The use of sound measurement equipment having a noise floor around 28dB(A) in rural areas where ambient sound levels are very low (often below 16dB(A) in low wind conditions) can produce misleading results that can, if not removed, have a significant effect upon the subsequent analysis described in NZS6808, where a trend curve is required to be generated from the background measurement data.

At page 19 of his expert witness statement (Exhibit L157) Dr Thorne stated:

In my view, a background sound level survey taken using an ARL 215 or 315/316 sound logger will not measure true ‘quiet’ background levels as it cannot go below 24dB(A) and at this level it is recording the inherent noise within the electronics of the system. It is standard practice to select a sound level meter that has a very low inherent noise floor. In my view the Marshall Day Acoustics Report does not present a reliable analysis of the background levels at the residences cited in their Report and a further, longer term survey is warranted. The levels presented should not be accepted, in my view, as a foundation for setting conditions.

In his expert witness statements for Mr and Mrs Hawker (Exhibit H70) and for Lowell Pty Ltd (Mawallok) (Exhibit L157), Dr Thorne provided ambient noise data at each site with a Type 1 meter for non-coincident periods of about 10 days. These show minimum noise levels at night of about 16dBA.

We asked both Mr Huson and Dr Thorne for any response to the sensitivity analysis that we had requested of Mr Delaire. Whilst not criticising the principle, both had a comment on the detail:

- Mr Huson suggested that the redistributed data points would not be uniformly vertically distributed between the original and the artificial noise floor, but would be thinner towards that lower noise floor; and
- Dr Thorne believed that the distribution of the points would get thinner as one moved horizontally to higher wind speeds.

We agree with these comments. We note, however, that the effect of both would be to move the artificial background noise level closer to the original. This supports the proposition that the sensitivity analysis leads to a conservative outcome (ie: it overstates the difference in the noise limit curve that would be generated by a Type 1 noise logger).
Panel response

Mr Huson and Dr Thorne both noted that the background noise levels were at times below the noise floor of the Type 2 noise loggers used. They suggested that therefore the background noise measurements on which the noise limits are based are flawed and hence the noise limit curves would also be flawed. We agree that the noise floor has affected the background noise curves, but because of the method of derivation of the acceptable noise limit curves we do not agree that this invalidates the noise limit curves.

We must satisfy ourselves:

- whether the noise loggers used are consistent with the requirements of NZS 6808:1998 and hence the Guidelines;
- whether there is any particular feature of the noise environment that might have justified the use of Type 1 meters beyond arguing that this is the case because background noise levels are sometimes below the Type 2 meter noise floor.

On the first count we conclude that the selection of Type 2 meters for this use is compliant with NZS 6808:1998 since it does not specify otherwise.

On the second issue we find from the sensitivity analyses of the data at all 13 measuring locations that the effect of using Type 1 loggers would be to make only a trivial difference to the noise limit. Also, since the analyses are conservative, the demonstrated differences will overstate the actual differences. We believe that any difference is so minor that it is well within the uncertainty of the noise limit curves.

Hence we do not support the argument that background noise levels and derived acceptable noise limits are flawed because of the use of Type 2 noise meters rather than Type 1, and should be repeated on that score. We do not believe that the use of Type 2 meters invalidates the derivation of the acceptable noise limit curves.

Our effort to resolve this matter has necessarily been based on a sensitivity analyses approach which has limitations. We suggest that this could be resolved quite simply, and further uncertainty avoided, by an experimental procedure involving the co-location of a Type 1 and a Type 2 noise logger at each of a number of typical sites. The data collected would then be analysed to determine the difference in the acceptable noise limits developed as prescribed in NZS 6808:1998.

In addition to the sensitivity testing that we have had undertaken which does not provide any technical justification for the use of a Type 1 meter, we also
note that the WEF is in the Farming Zone in which agricultural activities, which can create considerable noise, are as of right. The nature of the zone therefore also does not provide any particular justification for the use of a Type 1 noise monitor for noise measurements.

Notwithstanding our position that there is no strong technical case for the use of Type 1 noise meters in the current circumstances such meters when properly calibrated are slightly more accurate than Type 2 meters, and their use may present an improved ‘image’.

Hence for repeat background noise and post construction noise measurements we recommend that, subject to an important qualification, the Applicant consider the use of Type 1 noise loggers. As noise meters must operate outside and unattended for extended periods, under moderately harsh conditions, Type 1 noise meters should be considered only if they are robust, reliable and able to hold their calibration under such circumstances.

Our earlier recommendation that background noise monitoring should be repeated is based on a number of issues. The use of Type 2 noise loggers is not one of those.

8.6.4 Wind direction

NZS 6808:1998 notes at 4.5.5 (page 10):

*It may be necessary to separately correlate background sound levels with windspeed for different wind directions and/or time of day (our emphasis).*

and the 2009 Guidelines state:

*During the assessment phase of the noise impact, particular attention to the following matters within the Standard is required:*

- Separate correlation of background sound levels with the wind speed for different wind directions and/or the time of day (Clause 4.5.5 of the Standard)…(our emphasis).

We recognise that these requirements do not mandate background noise analysis by wind direction. While some put to us that wind direction should be included in the background noise assessment, Mr Delaire stated that he saw no evidence from inspection of the background noise data points to suggest a relationship between these two factors. He supported this with an example of a background noise/hub height wind speed data set that showed a clear bimodal distribution that indicated a wind direction dependency.
However, we believe that background noise data and post construction noise monitoring data should be analysed against wind direction. It is our position that this may improve the background noise versus hub height wind speed correlations, and will serve to increase confidence in the credibility in the background noise levels.

In proposing this we are conscious of the following:

- The Lal Lal Wind Farm panel recommended use of 45° wind direction sectors and prescribed minimum requirements for data points;
- The national Wind Farm Development Guidelines – Public Consultation Draft (EPHC, October 2009) at page 80 suggests analysing background noise data by wind direction, and suggests that there should be four wind direction bins centred on north, east, south and west; and
- As the wind sector increases in size, the directional discrimination decreases, but as it decreases in size the number of data points available for a valid analysis decreases.

Hence a balance is required between the conflicting aspects of a reasonable monitoring time, sufficient data points for the least populated sector, and sufficiently narrow wind direction sectors to be useful. We have limited information available to us on which to strike that balance. An annual wind rose provided by the Applicant (Exhibit A66) shows no predominant wind direction, but rather an omnidirectional distribution least favoured by winds from the east. Thus the wind direction/time sector that is least populated with data points is likely to be night time winds from the east. We are disinclined to prescribe wind direction sectors that are overly narrow in the absence of sufficient information to support it, or to prescribe a minimum number of data points and their distribution, or to set a minimum value for the coefficient of determination ($R^2$).

We believe that a suitable balance as a part of the background noise level reassessment must include:

- four wind direction sectors to be within ± 45° of 0°, 90°, 180°, and 270°;
- wind directions determined by a wind vane (or equivalent) at hub height co-located with the anemometer used to measure wind speed; and
- the collection of a minimum of 4000 data points (about 28 days of 10 minute pairs).

NZS 6808:1998 recommends a minimum of 1440 data points as adequate for 24 hour ‘all wind direction’ data collection. That results in about 540 data pairs as the subset for night time noise assessment. While this is usually accepted as adequate, more points would be preferable. 1440 data points would result in an average of 135 points per wind direction sector at night. However it is
likely that one or more sectors would be significantly less populated, which would be too few points. A data set of 4000 points would result in an average of 375 points per night time sector, again with one or more sectors having fewer points. Whilst even more data points would be preferable, we believe that in the absence of more information that might inform the design of such a data collection program, 4000 points would provide a reasonable and sufficiently rigorous balance.

In recommending that data collection design, we are aware that the wind rose supplied by the Applicant is annualised. A background noise monitoring program over a single 28 day period may have a significantly different wind direction characteristic.

### 8.6.5 Recommendations

The Panel recommends that:

- **Background noise curves must be re-determined.**

- **To this end, prior to construction commencing a program for revised background noise monitoring must be submitted to the Minister for Planning for approval.** That revised program may include background monitoring in stages if the wind farm is to be constructed in stages.

- **When approved by the Minister for Planning the revised background noise monitoring program is to be made publicly available.**

- **The revised program must include noise monitoring at (subject to access being granted), or near, sufficient non-stakeholder dwellings for background noise measurements to accurately characterise the surrounding area and provide an adequate number of ‘representative’ sites. Not less than 20 non-stakeholder sites and a small number of stakeholder dwellings predicted to be exposed to higher noise levels must be included unless with the consent of the Minister.**

- **Background noise monitoring data should be correlated with hub height wind speed at the nearest available anemometer that will be available for post construction noise monitoring.**

- **A minimum of 4000 data points must be collected for each site and analysed by the regression technique of NZS 6808:1998 or ‘bin analysis’ as appropriate.**
Data must be analysed by 24 hour and night (10 pm to 7am) only periods; and for each time sector data is to be analysed for wind directions of ± 45° of 0°, 90°, 180° and 270°.

The resultant background noise curves must be submitted to the Minister for Planning and made publicly available.

8.7 Acceptable noise limits

8.7.1 Background

The background noise limit curves for 24 hour and night time noise, and the noise standard in NZS 6808:1998, have been used to construct the acceptable noise limit for each dwelling.

We have earlier quoted the noise criterion from the 1998 New Zealand standard.

The acceptable noise limits at each dwelling are shown by the solid black lines in Figures 1 - 26, pp. 13 - 25 of the Noise Impact Assessment report at Annexe X of the PPAR. The construction of these acceptable noise limit curves in accord with what the standard requires, from the left of a figure, sets a horizontal line at 40dBA LA95 until it is 5dBA above the background noise curve, and then tracks at that level above the curve. This transition gives what is usually called a ‘knee’ in the curve. There can be exceptions to this typical shape. If the background noise curve is always at or above 35dBA LA95 there will be no horizontal portion of the acceptable noise limit curve. That would be unusual, particularly in a rural environment. If the background curve is never above 35dBA LA95 the acceptable noise limit curve will remain a horizontal line at 40dBA LA95. That would be unlikely since noise increases with wind speed.

As with the background noise levels, we asked Mr Delaire to place the thirteen 24 hour acceptable noise limit curves on a single figure and similarly with the night time curves. These are shown as Figures 3 and 4 (page 2) of the report from Marshall Day of 27 April 2010 titled Stockyard Hill Wind Farm Panel Hearing - Additional Information (Exhibit A93).

These acceptable noise limit curves have a similar shape to the background noise curves, except that they are truncated at the 40dBA L95 noise limit below the ‘knee’, and have the 5dBA L95 increment added beyond that. Like the background noise levels they illustrate the spread of the acceptable noise limits. They also show that the night time noise limits are lower than those for the 24 hour periods. Hence meeting the acceptable noise limit for night-time noise would usually be more demanding than that for 24 hour noise.
Interestingly, they show a wide variation of the position of the ‘knee’, spread over a wind speed range of about 6 m/s.

As with the background noise levels, the acceptable noise limit is necessarily presented as a curve rather than a single figure or a number of numerical limits. This is a consequence of having to deal with measuring noise in the presence of wind and the scatter of background noise measurements.

It should be noted that an acceptable noise limit curve for a given location shows the maximum noise level allowed from the wind farm at various wind speeds at that location. The level is derived from an analysis of a set of background noise and hub height wind speed data. It does not indicate that at any particular wind speed the noise will always be at or less than the level shown by that acceptable limit curve. The variability of noise at any particular wind speed as indicated by the individual background noise measurements is such that the noise level on individual occasions, with or without the wind farm operating, may exceed the level shown by the curve.

**Stakeholder dwellings**

The issue arises of how to treat stakeholder dwellings vis-à-vis acceptable noise limits. While some of these are on the WEF site and exposed to higher noise levels, those parties have a beneficial interest in the project.

At page 29 of the *Noise Impact Assessment* report at Annexe X of the PPAR it is stated:

> For stakeholders, there can be some flexibility in the application of the limits from NZS 6808:1998, by agreement with the stakeholder. The detailed study on which NZS 6808:1998 is based is presented in the document ETSU-R-97 by the European Working Group on Noise from Wind Turbines.

> In this document, the increased tolerance to noise shown by residents who gain financially from a project is given in Note 24 on Page viii of the summary by the European Working Group on Noise from Wind Turbines (ETSU-R-97). It states:

> The Noise Working Group recommends that both day- and night-time lower fixed limits can be increased to 45dBA and that consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the wind farm.

> Twenty three (23) of the twenty five (25) stakeholders’ properties exceeding the NZS 6808:1998 noise limits comply with the ETSU-R-97.
recommended noise limits. The ETSU-R-97 recommended noise limits are shown as a dashed orange line in Appendix F.

The remaining two (2) stakeholder’s properties exceeding the ETSU-R-97 recommended noise limits will be rented by Wind Power for the life of the farm. These two (2) properties together with the properties with options to purchase by Wind Power will be utilised for wind farm operational purposes. (Note: Wind Power was the original developer of the site.)

A number of submitters including Ms B Wehl argued that allowance of this higher limit should be treated with caution, as there may be children in some houses who cannot make an informed decision. Also some dwellings are rented, and the renters (and owners) may not be fully aware of the consequences of these higher noise levels.

### 8.7.2 Panel discussion

In general we are satisfied that the acceptable noise limits have been prepared as required by NZS 6808:1998. However, since these acceptable noise limit curves are derived from the background noise level curves, the reservations that we have expressed previously about the robustness of those background noise level curves apply similarly to these derived curves (viz., distances from meteorological mast, correlations, questionable repeatability, and transferring background/noise limit curves from ‘representative sites’ to other locations).

**Wind farm v environmental noise**

We feel that we need to make it clear here what noise we believe the acceptable noise limit curve applies to.

Under our discussion on initial noise predictions we have indicated that those predictions clearly relate to the noise for the wind farm only, and that to determine total noise at a receptor it is necessary to add the background noise to that. This would also be true of the noise environment when the wind farm would be operational: it would be a composite of wind farm and other noise.

The question which has bothered the Panel and which arose tangentially in the hearing is whether the noise limits which are set by the Guidelines and in

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29 Mr Gobbo submitted during the hearing that it was possible to guarantee that the wind farm noise levels would not exceed 40dBA $L_{95}$ at any non-stakeholder dwelling. We understand that was a reference to wind farm noise only. It caused us to invite submissions on this matter from submitters who had called expert noise evidence. We understand and accept this position since the maximum sound power of a wind turbine typically plateaus at a wind speed of about 10 m/s at which wind speed the wind turbine only noise will be near the ‘knee’ of the acceptable noise limit curve. However, as discussed previously this noise does not ensure that the external environmental noise at a non-stakeholder dwelling will be less than 40dBA $L_{95}$. 
turn the New Zealand standard are a reference to total noise and set the total acceptable noise at a receptor with the wind farm operational (ie. the background noise plus that from the wind farm – ‘environmental noise’), or apply to the noise from the wind farm only.

This is generally an important issue because post-construction compliance assessment rests on it.

It is our view that NZS 6808:1998 (and NZS 6808:2010) is somewhat unclear on this matter. We believe ‘…an upper limit of acceptable WTG sound levels…’ and similar phrases in NZS 6808:1998 (and NZS 6808:2010) might be interpreted as meaning the sound of the wind farm alone, or it could be interpreted as the sound after the wind farm is commissioned, consisting of the background noise (ie: the noise existing before the wind farm commenced operation) plus the wind farm noise itself. The clauses in the standard(s) neither say ‘an upper limit of noise from the wind farm only’ nor ‘an upper limit of noise with the wind farm operating’.

These phrases in NZS 6808:1998 seem to have been interpreted by others in this proceeding and other panels as meaning the wind farm noise only. A reference in NZS 6808:1998 to possibly subtracting background noise from measured post-construction noise to determine compliance (if that compliance is not shown without that subtraction), favours that interpretation.

While we have not departed from the approach adopted by others that the noise limit applies to the WEF noise alone, we would point out that if this is the case (rather than its being total environmental noise - wind farm plus background), the objectives of the Guidelines and the New Zealand standard to achieve acceptable noise limits and in particular to avoid sleep disturbance may not be met. On one view, the alternative interpretation (ie. environmental noise with the wind farm operating) might more logically be the subject of a defined noise limit.

The background noise outside a rural dwelling is a composite of a many noises including wind noise around structures, rustling leaves, conversation, and animal and machinery sounds common in a farming area. It will be highly variable, as evidenced by background noise monitoring.

The introduction of a WEF must inevitably increase noise at some times and places, even if not discernible at some other times and places. We believe, that the total A-weighted noise level (leaving aside here the issue of any particular characteristic noise issues of wind turbines) should be ‘acceptable’ by objective criteria even if at times it might be audible – just as are other noises (eg.
tractors, agricultural aircraft). We understand that an ‘acceptable’ noise level is also the aim of NZS 6808:1998.

The standard then goes on to define noise limits which we presume are designed to give such an acceptable outcome.

Importantly, it seems that the 40dBA $L_{95}$ element of the noise limit referred to in the standard is health based.

Clause 4.4.1 at pp 8 - 9 of NZS 6808:1998 states:

In order to determine acceptability of predicted WTG $L_R$ or windfarm sound levels it is necessary to compare these predicted levels with background sound levels measured in accordance with 4.5. The measured background sound levels are used to quantify the existing sound climate which can be quite low as WTG sites are often located in areas with a rural character. In order to provide a satisfactory level of protection against the potential adverse effects of WTG sounds, this Standard recommends an upper limit of acceptable WTG sound levels outdoors at the residential locations of 40dBA $L_{95}$ (refer to 4.4.2). This has been based on an internationally accepted indoor sound level of 30 to 35dBA $L_{eq}$ commonly used as a design level to protect against sleep disturbance (refer Berglund & Lindvall). See 4.4.2, Notes (1) and (2) for the relationship between $L_{eq}$ and $L_{95}$. A reduction from outdoors to indoors of typically 10dB with open windows has been assumed (Panel emphasis).

and, in support of that, 5.1.2 at page 20 of NZS 6808:2010 says:

To provide a satisfactory level of protection against sleep disturbance, this Standard recommends a limit of wind turbine sound levels outdoors at noise sensitive locations of 40dB $L_{A90/10 min}$ (our emphasis)

and at C5.1.2 (page 20) of the same standard is added:

This is based on an internationally accepted indoor sound level of 30dB $L_{Aeq}$ to protect against sleep disturbance (refer to Berglund, Lindvall, and Schwala). This assumes a reduction from outdoors to indoors of typically 15dB with windows partially open for ventilation (our emphasis). The typical reduction of 15dB would reduce an external level of 40dB $L_{A90}$ to 25dB $L_{A90}$. Given that the internal target is 30dB $L_{Aeq}$ this allows for the difference between LEQ and L90, and for variations in the outside to inside reduction.

It is clear from the above that the overall ‘acceptable noise’ goal is a noise level inside a dwelling of not greater than 30dBA $L_{eq}$ to protect against sleep disturbance.
disturbance. That in turn is achieved by an external noise level that does not exceed 40dBA $L_{95}$ on the assumption of 10dB noise attenuation with open windows.

At Note (2) of 4.4.2 of NZS 6808:1998 (page 9) it is also advised that $L_{95}$ is typically 1.5 to 2.5dB lower than $L_{65}$ measured over the same period. Applying that adjustment, we arrive at an outdoor level of 37.5 - 38.5dBA $L_{95}$. That seems to suggest that the acceptable noise limit is for total environmental noise, not wind farm noise only. Use of the NZS 6808:2010 information would seem to corroborate this. We understand that the difference between $L_{95}$ in NZS 6808:1998 and $L_{65}$ in NZS 6808:2010 is to make the latter marginally more conservative, by approximately 0.5dB. That standard assumes a greater noise attenuation, which then seems to suggest a slightly greater outdoor noise level.

If the acceptable noise limit is wind farm noise only, then depending on the background noise level, the total noise could be several dBA greater than wind farm noise only. That would then seem to set an ‘acceptable’ total noise level at greater than 5dBA above the background sound level or 40dBA $L_{95}$, whichever is the greater.

It does not seem logical to set a limit designed to avoid unacceptable noise indoors at identified sensitive receptors which might lead to sleep disturbance, and then adopt an approach which allows the external noise limits to potentially exceed the levels which can be successfully reduced to the desired indoor level.

Our experience in environmental standard setting elsewhere is that a numerical exposure limit is set on the basis of protecting health and/or environmental issues. A new entrant is required to limit emissions so that the standard is not exceeded (ie. the pre-existing level plus the additional contribution), not that that new entrant is entitled to itself take up the whole of the standard. If it were otherwise, each contributor would be assessed against the standard to the exclusion of other contributors such that the environmental standard could be breached. It seems anomalous that an acceptable noise limit could be set ostensibly premised on health and environmental issues against which the noise contribution of the new entrant only, the wind farm, is to be assessed.

In related vein, it would seem that the Guidelines’ requirement for consideration of cumulative effects of WEFs would of necessity involve consideration of a ‘joint’ noise outcome – an environmental noise outcome - rather than sequential consideration of the noise from single facilities.
We would further say that it is desirable that compliance with prescribed noise limits can be illustrated by as straight-forward a means as is possible. We think that it would be preferable to be able to demonstrate post construction compliance at nominated sensitive locations by measurement that shows that actual noise is no greater than the relevant acceptable noise limit for that location without having to subtract background noise from that measured noise to determine the wind farm noise and hence whether compliance is achieved.

We do recognise that if noise limits are set for environmental noise instead of wind farm only noise then the wind farm would potentially run the risk of being liable for rectification of a breach of the noise limit caused by other contributors to the total noise. This would be unfair. However, we think that the prospect of this in a rural area is slight and might be accounted for in the design of the standard and compliance arrangements. We are also concerned that if the noise limit is viewed as applying to total noise, it would require the wind turbines to be constantly adjusted to respond to the changes in other background noises – assuming that the noise is close to the permissible limits. This again is perhaps unreasonable or at least difficult.

This being said, as we have earlier indicated, we have taken the view that the Guidelines and standards do currently refer to wind farm noise only when setting noise limits. Given we find this to be unsatisfactory for the reasons set out above, we recommend that this is a matter which should be reviewed by government. It may be that if sleep disturbance is to be avoided that the limits of the wind farm noise may need to be reduced to allow for the total environmental noise to meet the acceptable limit.

Whatever is the correct interpretation of the Guidelines’ and standard’s provisions concerning noise limits, the noise which is being limited (as to whether it is environmental or wind farm only noise) should be made clear in the conditions of any permit granted.

**Noise limits and wind direction**

In Section 9.6.4 we discussed discrimination of background noise by wind direction. The consequence of this for acceptable noise limits is that for each monitored background noise site the number of background noise curves and hence acceptable noise limit curves would change from two (24 hour and night time) to eight (each time period by four wind sectors).

As we indicated in that earlier discussion we believe that approach is required.
Noise limits for stakeholder dwellings

Stakeholder dwellings will often be closer to wind turbines than other dwellings by virtue of those parties having agreed to host turbines. Hence some of these dwellings may be subject to higher noise levels - especially where the dwelling is on the notional WEF site.

The preliminary noise assessment discussed earlier, identified a number of stakeholder dwellings, including some currently uninhabitable or rented, within the 45dBA wind farm only noise contour. The number of these dwellings and the estimated noise exposure may have changed as a result of the Applicant’s removal of turbines from the Application, and some proposed repositioning. That could change further if recommendations of this report for further turbine deletions are accepted.

The Applicant submitted that the applicable noise limit at stakeholder dwellings should be that recommended in ETSU-R-97. The recommendation is for a 45dBA L95 rather than 40dBA L95 noise limit. We presume that in practice this means that the wind farm noise only at those sites should not exceed the background sound level (L95) by more than 5dBA, or a level 45dBA L95, whichever is the greater. Further, we expect that this varied standard for these dwellings would mean that they would also be assessed post construction for special audible characteristics and noise would be monitored for establishing compliance.

We note that the Guidelines make no reference to using a different noise limit for stakeholder dwellings. It references NZS 6808:1998, which in turn uses the term ‘…any residential site...' in 4.4.2 (page 9) for specifying the recommended acceptable noise limit. NZS 6808:1998 lists ETSU-R-97 as a related document (page 2) but makes no reference to treating any residential sites differently from others on the basis of any financial link between the owner of dwelling and the wind farm.

The Applicant also submitted that the owners of dwellings who have a beneficial interest in the wind farm have a lesser sensitivity to changes in amenity such as noise, shadow flicker and visual impact than would otherwise be the case. Expert evidence that we have heard supports that. We also understand that stakeholders have entered into agreements with the Applicant whereby they agree to have wind turbine(s) on their property and have been informed that the impacts of those turbines might exceed otherwise applicable criteria.

Some other wind farm panels have accepted application of the ETSU-R-97 noise concession at stakeholder dwellings. We have not been provided with
any evidence on outcomes of this varied standard for stakeholders at other WEFs.

Three courses of action appear to be possible:

- Require compliance with the standards as for all other dwellings;
- Accept the ETSU-R-97 variation;
- Propose no noise performance standard for these dwellings.

This situation creates a dilemma for us. On one hand the Guidelines appear to make no provision for this variation. Conversely, it seems unreasonable that stakeholders receiving a financial benefit should expect to be protected in the same way as those who receive no financial gain. We are also conscious that stakeholder houses may be occupied by children and others including renters who may not have been participants in the decision to accept higher levels of turbine noise at those houses.

While we accept that in exchange for a beneficial interest in the wind farm a stakeholder may accept a compromised noise amenity and be less sensitive to that impact, we are not convinced that a stakeholder should not be afforded some level of protection from unreasonable noise. It is also not clear to us to what extent any agreement between the WEF operator and a stakeholder can absolve the operator from providing protection.

If we accept that the same noise standard should apply for all dwellings we would seem to be applying the Guidelines but denying a nexus between an amenity and financial benefit trade off. That could also have the effect of removing many turbines from the proposal or vacating a number of stakeholder dwellings. If we propose no noise standard at stakeholder dwellings, we are ignoring the adverse effects of higher levels of noise on sleep protection.

On balance our position is that the ETSU-R-97 limit should apply. To that extent we agree with the decision of other wind farm panels. We nevertheless believe, and recommend, that the Guidelines should be reviewed to provide specific direction on the noise standard to be applied at stakeholder dwellings.

In a later section we discuss the prospect of developing an active noise management system to reduce noise impacts, particularly of special audible characteristics and the ‘van den Berg effect’, at non-stakeholder dwellings. We believe that the same system may be able to be used to decrease noise at stakeholder dwellings if needed.
8.7.3 Conclusions

Our conclusions on the development of the acceptable noise limits are:

- The acceptable noise limits have been developed for this project as required by NZS 6808:1998;
- The recommended acceptable noise limits in the recent NZS 6808:2010 are essentially identical to those in NZS 6808:1998, which is cited in the Guidelines. The change from L₉₅ to L₉₀ is a minor change that makes NZS 6808:2010 slightly more conservative;
- The acceptable noise limits for non-stakeholder dwellings of not exceeding a level of 5dBA L₉₅ above the background sound level (L₉₅) of 40dBA L₉₅ or, whichever is the greater, should be interpreted as referring to WEF noise only;
- For stakeholder dwellings the noise standard should be that at any of the nominated wind speeds, the noise of the WEF must not exceed background noise level (L₉₅) by more than 5dBA L₉₅, or a level of 45dBA L₉₅, whichever is the greater;
- Any stakeholder dwellings that exceed this specified noise level should not be occupied for residential purposes; and
- There is a need for a review of the setting of noise limits for WEFs so as to better achieve the amenity objectives intended. This should consider the matter of the relationship of wind farm only noise to total environmental noise and establish acceptable noise limits having regard to the need to attenuate total noise from exterior to interior of dwellings.

8.7.4 Recommendations

The Panel recommends that:

The derived acceptable noise limits of not exceeding a level of 5dBA L₉₅ above the background noise level (L₉₅) or 40dBA L₉₅, whichever is the greater, should be interpreted for non-stakeholder dwellings as referring to wind farm noise only.

At stakeholder dwellings, the noise standard shall be that the noise level from the wind farm only shall not exceed, at any of the nominated wind speeds, the background sound level (L₉₅) by more than 5dBA L₉₅, or a level of 45dBA L₉₅, whichever is the greater.

The acceptable noise limit curves should be submitted to the Minister for Planning, along with the background noise curves, and be made publicly available.
The procedure for the setting of noise limits for WEFs so as to better achieve the amenity objectives intended should be reviewed. This should include consideration of whether the standard if it is to regulate wind farm noise only requires review so as to ensure acceptable noise limits having regard to total environmental noise and attenuation to the interior of dwellings.

8.8 Wind farm noise modelling

8.8.1 Background

NZS 6808:1998 requires that for each of the nominated noise sensitive receptors the noise from the proposed WEF is to be mathematically modelled over the normal range of wind turbine operational wind speeds, and the result compared with the determined acceptable noise limit at each of those sites. That confirms design compliance, or otherwise, with the standard.

In Section 9.5 we have discussed initial noise predictions for wind farm noise only. These provide a measure of the likely spatial extent of the noise effect of the proposed wind farm. The predictions thus enable an identification of dwellings and other sensitive sites that might need to be considered in the noise assessment.

When acceptable noise limits are established from the background noise measurements, modelling can then be used to predict likely compliance of the proposed wind farm with the noise criteria. The model to be used is the same as that for the initial noise predictions except that it is not done at a single wind speed (10 m/s) but over a range of wind speeds. The wind speeds used are usually from turbine cut in wind speed to the wind speed at which turbine noise plateaus. This modelling requires use of the sound power levels of the indicative turbine over that wind speed range. As described in Section 8.5 this data is obtained from the turbine manufacturers as the sound power level versus hub height wind speed turbine characteristic, which is shown in Figure 1, page 6, of the Noise Impact Assessment report at Annexe X of the PPAR.

The results of this modelling for the 13 dwellings at which background noise level curves were developed, are shown in Figures F1 to F13 of Appendix F of the Noise Impact Assessment report. Table 4, pp 26-28 of that report presents the results for the reference wind condition of 12 m/s.
8.8.2 Discussion

We are satisfied that the Applicant has followed the prescribed NZS 6808:1998 method to predict noise from the proposed wind farm over the necessary range of wind speeds.

We accept that some of the simplifications in the predictive model may lead to a conservative outcome. Indeed it is preferable that the predictive model be slightly conservative than otherwise. If the model were to underestimate the actual wind farm noise that might be produced, post construction noise monitoring may indicate non-compliance with acceptable noise levels and the need to implement remedial actions then arises. However, we are conscious of suggestions that it may not always be conservative. Ms Wehl (Exhibit W177) submitted to us that that conservativeness had been eroded as turbine sizes had increased.

We are satisfied that the predictive model gives a reasonable simulation of the likely noise from the proposed WEF within the limitations imposed by the approximations and assumptions of the method and by the available data. However, we are cautious about ascribing to the results any substantial and consistent conservatism.

In each of the Figures F1 to F13, the red line is the 24 hour background noise level at the nominated dwelling, the yellow line the night time noise level, and the dotted black and red lines the derived acceptable noise limit curves for 24 hour and night time noise respectively. These curves have all been reported previously in Figures 1 to 26 and have been discussed in previous sections. The dotted yellow line on all figures except Figures F7 and F8 is the ETSU-R-97 45dBA L95 noise limit applicable to stakeholder dwellings that has been discussed in 9.7.2. The curves in blue or green are the predicted noise levels for dwellings identified in each figure. To simplify understanding of these figures the background noise curves can be ignored. The other curves are relevant for assessing the acceptability or otherwise of the likely noise impact.

The purpose of these curves is to predict the likely noise compliance or otherwise of the proposed WEF at the nominated sites by comparing the predicted noise against the acceptable noise limit. Compliance is shown if the predicted noise level curve is, at all wind speeds, below the acceptable noise limit curve. Conversely non-compliance is demonstrated if that predicted noise level curve is anywhere above the acceptable noise limit curve.

The dwellings shown are those identified in Table 3 of the Noise Impact Assessment report. Thirteen are sites at which background monitoring was
carried out, and eight are dwellings that are considered to be represented by the noise measured at another dwelling.

Our examination of the results in Figures F1 to F13 shows the following:

- In many cases the predicted noise curves and the acceptable noise limits are closest at a hub height wind speed of about 10 m/s. We estimate that this corresponds to a surface wind speed of about 7 m/s (about 25 km/h) in a turbulent atmosphere. This is the condition at which background masking noise is low and any turbine audibility most likely. This wind speed is typically the most critical for wind farm noise; and

- The apparent margin of predicted compliance is quite variable, as might be expected with different distances to dwellings; for some situations it can be many dBA and in others the margin is quite narrow. For a number of stakeholders the predicted noise is, marginally above or 1 – 2dBA below the 45dBA L95 acceptable noise limit. Similarly for a number of stakeholders the apparent margin is small, appearing to range from zero to about 2dBA.

The results, for a hub height wind speed reference condition of 10 m/s, are presented in tabular form in Table 4, pp 26-28 of the Noise Impact Assessment report for all dwellings identified within the 35dBA wind farm noise only contour for both 24 hour and night time noise. Non-assessed dwellings more distant from the site would have a lower noise level and would be expected to be compliant with NZS 6808:1998.

In the additional information from Marshall Day Acoustics dated 25 May 2010, Mr Delaire provided a table giving variations to noise at assessable dwellings as a consequence of the Applicant removing 29 turbines from the proposal and micrositing 8 others. Since then the Applicant also proposed removing turbine T218. If recommendations made elsewhere in this report are accepted further changes may eventuate with consequent changes in noise levels for some dwellings.

We have some concerns regarding the modelled noise levels in the figures and the assessment in the tables. We understand that the modelled noise is a Leq. Since L95 is typically 1.5 to 2.5dB lower than its Leq level according to NZS 6808:1998 at 4.2.1, page 7, for this may create a small margin between the curves. Further, there are the issues of whether the prediction is conservative or not and, if it is so, to what extent. There is also uncertainty in establishing the acceptable noise limit curve and the modelled noise estimates which may amount to several dBA (although NZS 6808:1998 does not require uncertainty to be considered). Finally if the background noise measurements are repeated as we recommend this could make some alteration to the background noise
levels and hence the acceptable noise limits. Some of these factors may serve in part to negate each other.

At Appendix B, pp 33-34 of the additional information supplied by Marshall Day Acoustics dated 27 April 2010, Mr Delaire provided several examples of predicted noise levels for WEFs and post construction measured noise. These do not state whether the predicted noise is WEF noise only, or the measured noise has had the background noise subtracted from it.

Given the closeness in many cases of the WEF noise-only predictions to the acceptable noise limit curves, we are not persuaded that the Noise Impact Assessment has demonstrated with sufficient robustness that the noise of the WEF will comply with the acceptable noise limits for stakeholder and non-stakeholder dwellings. We do note that the examples referred to in the paragraph above provided by Mr Delaire provide some comfort about the accuracy of noise predictions and that they usually seem conservative.

We consider that demonstrating predicted compliance is a vital issue, and we heard many submissions about WEF noise. It is important that the adjoining property owners can be assured that the WEF design is such that the NZS 6808:1998 noise standards will be confidently met.

We do not believe that it is necessary to refuse the issue of a permit on this basis. But any permit granted should be subject to a condition requiring this work to be done and thoroughly assessed, approved by the Minister for Planning, and made publicly available before construction starts. That also has the possible advantage that the selected turbine model can be used in the assessment which gives enhanced confidence.

We believe that that design should aim to show at each stakeholder and non-stakeholder dwelling expected to have some wind farm noise exposure that the noise from the WEF will comply with the acceptable noise limit, and preferably by a minimum of 3dBA, to allow for estimation and measurement uncertainty.

### 8.8.3 Conclusions

We advise that the key aspects of demonstrating predicted compliance are:
- Use the revised acceptable noise limits recommended in 9.6 derived from the new background noise measurements;
- If the final turbine model has been selected, use the sound power level from this for the predictions;
- Use the simple predictive model of NZS 6808:1998 at 4.3.2, pages 7-8, or the more complex ISO 9613 model as described in Appendix D, pp 41-43.
of NZS 6808:2010 (NZS 6808:1998 also appears to allow use of this approach by the Note to 4.3.3, p8.);

- Assess the adequacy of predicted noise levels against the acceptable limits at each receptor for each acceptable noise limit curve (24 hour and night time and 4 wind direction sectors for each);

- Provide discussion of estimated uncertainty in acceptable noise limits and predicted noise to assist in understanding the risk of non compliance and to demonstrate that the prediction is robust and will likely ensure compliance with some margin (We recognise that this may be controversial. NZS6808:1998 does not require an assessment of uncertainty, NZS 6908:2010 mentions this issue. It is accepted scientific practice, however, to estimate uncertainty); and

- If it is proposed that an active noise management system (as discussed later in this section) be used to complement the predictions to achieve compliance, discuss how this will be done reliably.

8.8.4 Recommendations

The Panel recommends that:

The pre construction noise modelling should be repeated prior to construction commencing. That should compare predicted noise against the revised acceptable noise limit curves. If possible the noise characteristics of the selected turbine model should be used.

Prior to construction commencing the results of the noise modelling must be submitted to and approved by the Minister for Planning. That may include modelling by stages if the wind farm is to be constructed in stages.

When approved by the Minister for Planning, the noise modelling results should be made publicly available.

8.9 Special audible characteristics

8.9.1 Background

NZS 6808:1998 at sections 4.4.3 (page 9) and 5.3 (page 11) advises that in some circumstances wind turbines might generate tones, impulses, or modulated noise that can be disturbing. It prescribes methods for assessing these and a noise penalty to be applied if these audible characteristics are present in order to reduce their effect.
The sources of wind turbine noise and the prediction of turbine noise discussed in the preceding parts of this section of the report are for the noise produced continuously when the turbines are operating. As discussed previously, that is due largely to aerodynamic noise from the rotor blades and mechanical noise from the rotating machinery in the nacelle. However, it is possible for a WEF to exhibit so-called special audible characteristics (or SACs). These are audible features that are distinct from the usual noise and may sometimes be discontinuous noises repeated at regular intervals. They may include distinctive tones, impulsive sounds and amplitude modulation of sound levels. This issue has been discussed in other wind farm panel reports.

NZS 6808:1998 advises that the presence of any of these SACs is likely to result in an adverse community response at lower noise levels than for noise that does not have those characteristics. It requires that the presence of such audible characteristics be responded to by the imposition of a penalty of up to 5dB. This penalty is applied by the arithmetic addition of 5dB to the noise measured from post installation noise compliance testing, or by addition to the predicted noise level (4.4.3).

NZS 6808:1998 notes that there is no simple objective method available to measure these SACs. It advises that subjective assessment is therefore necessary and should be supported, by objective analysis where possible.

NZS 6808:2010 also discusses this at 5.4 (page 23). In that case, the special audible characteristic penalty is changed to 6dB. Usefully, at Appendix B (pp 38 -39) that revised standard provides a more comprehensive description of assessing special audible characteristics. That reduces, but does not eliminate, the subjectivity of determining the presence or otherwise of these features and the penalty, if any, to be applied. Dr Thorne said:

Methodologies and instrumentation are readily available to test for and measure modulation, tonality and impulsiveness of sound from wind turbines. The methods require audio recording in uncompressed form of the sound.

It was submitted to the Panel that as a precautionary measure the special audible characteristics penalty should be included at the outset (ie: added to the predicted noise level). Dr Thorne believed that sound modulation was likely to occur.

We understand that turbine manufacturers guarantee their machines being free of certain undesirable acoustic characteristics, notably distinctive tones.
In this section it is appropriate to refer to the so-called ‘van den Berg effect’, although it is arguably not a special audible characteristic as is normally understood.

In 2003 Dr Van den Berg investigated noise effects from a WEF near the Germany - Netherlands border. He found that when the air was stable, usually at night, the noise levels were higher than anticipated and there was some modulation of noise. This matter is discussed in the Noise Impact Assessment report at section 4.0, page 3:

Dr van den Berg undertook a study of this kind at only one particular site with very specific characteristics such as topography and wind turbines....

The increase in noise emissions reported by Dr van den Berg is mostly due to an increase in air stability which leads to a change in wind profile (wind speed vs. height). As an example, for a constant wind speed at hub height, where the noise is generated, the wind speed at 10m can vary significantly. However, it is very difficult to quantify the change in wind speed at 10m in relation to the change in air stability.

As noise emissions from the wind farm are dependent on the wind speed at hub height, the noise impact assessment for the Stockyard Hill Wind Farm was undertaken with wind speeds referenced at this height (80m) in order to eliminate the potential effect of air stability on predicted noise levels.

We consider that where a noise assessment uses wind speed data collected at the hub height, any potential stable air effects will be better represented in the assessment process. Where an assessment is carried out with 10m AGL (note; above ground level) wind speed data, there is a greater risk that stable air effects will not be considered during the assessment process.

Dr Thorne, in his evidence for both Mr and Mrs Hawker and Lowell Pty Ltd (Exhibits H70, H71 and L157), discusses the issue of stable air (inversions) and possible adverse noise consequences.

The Applicant provided us with an analysis 'Impact of temperature inversions and high atmospheric stability on noise propagation at the proposed Stockyard Hill Wind Farm' prepared by Garrad Hassan (Exhibit A223). This provides a description of temperature inversions and atmospheric stability, noise propagation under conditions of high wind shear and temperature gradients, and an assessment of the frequency of stable atmospheric conditions.

Several paragraphs of that analysis are particularly relevant here:

In the context of wind farm noise, there are two potential impacts of temperature inversions and high atmospheric stability that will be discussed here. The first impact is that a temperature inversion and/or
8.9.2 Discussion

We consider special audible characteristics to be an essential, but difficult, part of the noise assessment for the proposal. Submissions suggested that these potentially unusual and repetitive noises may cause annoyance, particularly at night. It was suggested that they may contribute to some alleged unreasonable noise and claimed adverse health aspects being experienced by some neighbours of wind farms (We note that have heard no unequivocal evidence to that effect).

A difficulty that arises is the largely subjective nature of describing and hence assessing special audible characteristics, and the associated issue of a lack of unambiguous definition. Dr Thorne described a characteristic noise as ‘rumble-thump’. NZS 6808:1998 and NZS 6808:2010 both describe examples of
special audible characteristics (eg: tonality, impulsive sound such as bangs and thumps, and amplitude modulation), but do not, and perhaps cannot, provide a definition that encompasses all such characteristics. However, a maximum noise penalty of +5dB is set regardless of how many, and to what extent, such characteristics are present.

Our understanding from submissions to us is that special audible characteristics might be seen to be those distinctive, unusual or repetitive noises that go beyond the steadier broadband rotor blade aerodynamic noise.

Dr Thorne indicated that special audible characteristics could arise from a single turbine, and could be caused by the interaction from multiple turbines. Our understanding is that the special audible characteristics result from interference of sound waves emanating from different parts of a turbine, or turbines. Dr Thorne agreed that this suggested a changing noise pattern in space and time, with changes in wind direction and speed. This suggests to us the importance of individual turbine design and selection of the most appropriate type, and of the design of turbine sitings including turbine spacing and relationship to topography.

We are not persuaded that it is reasonable or fair to apply the special audible characteristic penalty, and to do so in full, prior to construction. To simply transfer some experiences from elsewhere to this proposal is, in our judgement, not responsible. We are aware of advances in wind turbine design and of better understanding of and improved techniques in wind farm design. These may lead to less likelihood of such undesirable noise features occurring. To impose a special audible characteristics penalty up front would deny the possibility of WEF design improvements, and selecting the turbine model to generate least noise. It would not provide encouragement to the permit holder to exercise good design practice.

We note that at 4.4.3 of NZS 6808:1998 reference is made to applying the noise penalty to any turbine type with ‘known special audible characteristics’. We think it unlikely that an operator would buy, or a manufacture offer, a turbine with known characteristics when the consequence could be a substantial noise penalty. Similarly we think it unlikely that a wind farm operator would design a configuration with known special audible characteristics. We believe that design will seek to reduce the likelihood of special audible characteristics but their existence is essentially unknown until a post construction assessment is made. This reinforces our position that it is not appropriate to apply the special audible characteristic penalty, and to do so in full, prior to construction.
We observe that imposing a+5dB penalty for special audible characteristics to be added to the predicted WEF noise levels prior to construction would appear to have a similar effect to altering the standard from not exceeding the background sound level (L95) by more than 5dBA L95, or a level of 40dBA L95, whichever is the greater, to not exceeding the background sound level (L95), or a level of 35dBA L95, whichever is the greater.

In reaching this position on pre versus post construction assessment of special audible characteristics, we have heard submissions suggesting that the considerable increase in height and size of turbines and in the size of WEFs over recent times may have resulted in various noise concerns that were not so evident before, including special audible characteristics. We would expect changes in scale would be considered in the design of the wind farm to minimise the likelihood of special audible characteristics.

We believe that it is the best interests of all parties for special audible characteristics to be eliminated, as far as possible, by design, than to have to be assessed and controlled after commissioning.

In summary, we believe that a penalty for special audible characteristics should not be applied prior to construction, and that elimination or minimisation of these potentially annoying acoustic characteristics should be achieved, wherever possible by design.

The control of special audible characteristics is an important issue for the Panel, particularly given the current high profile of claims of unreasonable noise near some wind farms. However we have to deal with a matter where there is a lack of clear definition, subjectivity in assessment, substantial implications for both the operator and neighbouring non-stakeholders, and for which the causes seem not to be well understood. These uncertainties provide much potential for controversy.

We have not been provided with any information on experience with applying the special audible characteristics penalty at WEFs in Australia that would have been helpful. We are conscious that having an up to 5dB noise penalty imposed on a section of a wind farm could be a substantial penalty. We have therefore given considerable thought to how to deal with special audible characteristics that is as fair as possible to all parties.

We are satisfied that special audible characteristics can be managed by conditions on any permit granted. In this context we recognise that no matter how thorough the design effort to avoid special audible characteristics, post construction assessment is essential.
We have therefore turned our mind to how this might best be done to give the greatest certainty of outcome. We recommend that a special audible characteristics assessment would need to be done as soon as possible post construction as part of the compliance testing required at that time.

A consideration is the spatial component of assessing and imposing any noise penalty for special audible characteristics. NZS 6808:1998 refers to adding the penalty to the ‘measured sound level of the source...’ However, the source is not well defined. This could be interpreted as meaning that the detection of a special audible characteristic at any dwelling could result in the facility wide imposition of the penalty. For such a large proposal as this, this would be unreasonable. We believe that it should be that special audible characteristics are assessed at each non-stakeholder dwelling where post construction noise monitoring is carried out and any penalty applied to the measured noise level at that site only.

We recommend that the assessment should be done at all those dwellings at which compliance testing is to be carried out and under a protocol that includes a wide range of varying conditions of wind speed, wind direction, atmospheric stability and turbine operations that might be conducive to these characteristics. The evaluation would need to be carried out by a suitably qualified noise expert with relevant experience and the resources needed for the task. (ie: the person assessing the presence or otherwise of the special audible characteristics should be a member of an appropriate professional association that provides proficiency accreditation).

Given the implications and sensitivity of this assessment it would seem appropriate that that person should be independent of the permit holder and, preferably, should not have previously worked for the permit holder on this project or for submitters to the project.

In addition, we recommend that a special audible characteristic assessment should be done at any non-stakeholder dwelling at which noise monitoring is not carried out on the receipt of a complaint that is judged as justified.

The protocol for this post construction assessment of special audible characteristics, including for responding to complaints of these characteristics, and the person engaged to undertake the assessment should both be approved by the Minister for Planning.

The special audible characteristics assessment must use objective methods where possible to complement this largely subjective assessment, and in particular Appendix B (pp 38-39) of NZS 6808:2010 should be applied, other
than where a reference in that standard is specifically to requirements of NZS 6808:2010 or to the New Zealand *Resource Management Act*.

The independent noise expert should than submit a report to the Minister for Planning certifying the absence or presence of any special audible characteristics and the penalty to be applied, if any. If a penalty is to be applied, it should be determined by arithmetic addition to the post compliance measured sound level as determined at each receiver as specified in NZS 6808:1998.

We believe that, as with other facets of noise assessment and evaluation, the protocol for special audible characteristics assessment and the results of the assessments should be made publicly available.

In a subsequent section we discuss the prospect of developing and implementing an active noise management system as a means of managing unreasonable wind farm noise, regardless of whether it arises from special audible characteristics or otherwise. Such a system is not prescribed by NZS 6808:1998, but we see it as having the potential to develop a sophisticated way of managing noise with least lost energy production. We see the possibility of the operator integrating the assessment of and any needed control of special audible characteristics with an active noise management system. By understanding the conditions of occurrence of unreasonable noise the operator may be able to control the wind farm without the imposition of a noise penalty at times when it might not be needed. We suggest that the outcome could desirably be both an acceptable acoustic environment for residents, least energy loss for the operator, and reduced controversy.

Finally we turn to the so-called ‘van den Berg effect’.

The ‘normal’ condition of the lower atmosphere is unstable or neutral. Wind speed increases with height above the surface, and temperature decreases, and there is vertical mixing of air. Sometimes the atmosphere can be stable with little vertical mixing and low ground level wind speeds. A temperature inversion can sometimes occur under those conditions - with temperature increasing with height. It is under those conditions that there can be concern about noise propagation.

If the wind speed at hub height is below wind turbine cut-in speed (about 3 m/s) the wind farm will not be operating, and notwithstanding low ground level wind speeds and hence low background noise levels, there will be no wind farm noise.
However conditions can occur when due to high wind shear (change of wind speed with altitude) turbines will be operating but ground level wind speeds will be low with low background noise. Under these conditions noise levels may be higher and heard over a greater distance. This is the van den Berg effect. The central, and unsurprising, part of this is that when background noise levels are low there will be less masking of another noise and hence it will be able to be heard more clearly.

We were not made aware of any local evidence of this van den Berg effect, and how, if at all the observations might translate to different circumstances.

Preparing the acceptable noise limits using hub height wind speed is an important factor in assessing this issue. The effect of that seems to be to move the curves to the right compared with what they would have been at lower ground level wind speeds, and hence lower.

We believe that assessing whether wind turbine noise when stable atmospheric conditions are present in conjunction with the wind turbines operating should be done, and that this could probably be done under similar conditions to that discussed for special audible characteristics. Specifically, the assessment should be done by the qualified and experienced expert, at the same locations, using the proposed method included in the protocol. Any remedial action should be identified including possible integration with the active noise management system.

Within this topic we mention a concern brought to us by Mr and Ms Kirkby of Old Shirley Road, a few kilometres to the north of the wind farm site. Mr and Ms Kirkby live in an approximate east-west orientated valley which they observe, and demonstrated to us, has discernable echoes. They expressed concern that the echo might accentuate wind turbine noise received at their property. We observed that there is a ridge and some distance between their dwelling and proposed wind turbines. We received no expert evidence to support their concerns. We believe that it is unlikely that wind turbine noise would be audible at the Kirbys’ given strict compliance with noise requirements. Further, we believe that any unanticipated acoustic impact should be able to be dealt with by the active noise management system which we discuss later in this section of the report.
8.9.3 **Recommendations**

The Panel recommends that:

Post construction, and coincident with the post construction noise monitoring, special audible characteristics be assessed by a suitably qualified and experienced person.

The protocol for that assessment, the results, and any recommended noise penalty be advised to the Minister for Planning.

When approved by the Minister for Planning that the special audible characteristics assessment results be made publicly available.

8.10 **Post construction noise measurement**

8.10.1 **Background**

Once the facility would be constructed and commissioned, or a specific stage of it were commissioned (assuming staged development), it would be essential to ensure that the operating wind farm complies with the acceptable noise limits.

We were presented with little material on this topic. The focus of evidence and submissions to us was on the noise assessment by the Applicant, and critiques of that from submitters, including criticism of NZS 6808:1998 itself, rather than features of post construction noise assessment should a permit be issued.

It was apparent that the Applicant would accept a condition requiring post construction noise monitoring as has been required in other WEF permits. Further, it was clear that submitters would expect demonstration of compliance with NZS 6808:1998.

A number of submitters criticised the absence of publicly available post construction noise compliance monitoring data from other WEFs by which they might understand whether compliance is achieved.

In the report from Marshall Day Acoustics of 27 April 2010 titled *Stockyard Hill Wind Farm Panel Hearing - Additional Information* (Exhibit A93) at Appendix B, pp 33-34, Mr Delaire provided post construction noise monitoring results at two sites at two WEFs. These are unattributed because of confidentiality considerations. Each figure shows the acceptable noise limit, the predicted noise (which we assume is for wind farm only), and measured post
construction noise (which is not identified as total noise or wind farm only after the subtraction of background noise).

8.10.2 Discussion

In this report we emphasise the design aspects of the proposal including developing robust acceptable noise limits and credible noise predictions. We have done so in the belief, based on the evidence and submissions and on our experience, that it is preferable to get the design right and minimise the likelihood of post construction problems, than to try to rectify problems after construction.

The noise predictions rest on a number of assumptions and approximations such as noise attenuation in air, reflection at the ground, absence of screening, atmospheric stability, special audible characteristics and turbine sound power level. We have attempted to have the predictions refined by our earlier recommendations on modelling in Section 9.8. However a rigorous post construction noise monitoring program is essential. This is because there can sometimes be a small margin between acceptable noise limits and predicted post construction WEF, and because of measurement uncertainty. Vitally, such post construction noise measurements are the arbiter of compliance with the noise standards recommended in NZS 6808:1998.

We recommend that post construction noise testing should be carried out as soon as the facility would be commissioned. That commissioning involves the installation of all turbines and any necessary work to bring them into full operational condition. In the event of staged construction and commissioning, the post construction noise testing should be conducted progressively as the stages would be commissioned, and for the wind farm as whole as soon as full commissioning was achieved. Such staged development testing might require testing more than once at some dwellings - aimed at ensuring compliance with NZS 6808:1998 at each stage of development. We recommend that prior to the commencement of construction a detailed noise testing program be submitted to the Minister for Planning for approval, and that on approval that program be made publicly available.

As the results of the post construction noise monitoring would be compared with the acceptable noise limit curves (derive from background noise measurements) for each noise sensitive receptor, the monitoring method would need to be as close as possible to that used for the background noise monitoring. Clause 5.2.1, page 11, of NZS 6808:1998 requires that to occur.

Ideally the post construction noise monitoring should be carried out under the same circumstances as for the background noise measurements, apart from the
WEF operation. Hence, the same monitoring sites (subject to availability) should be used, the same anemometer locations for the hub height wind speed measurements for the background noise curves should be employed, monitoring should occur over a similar time period covering a similar range of wind conditions producing the same number of data points. Further, the same type of noise logger should be used, the measurements should be undertaken at a similar time of the year, and the regression lines should be fitted to the data using the same order equation and discriminated by 24 hour and night time noise and wind direction sector. Bin analysis if has earlier been used to assist with fitting the regression lines should again be used. The coefficients of determination must be reported. This consistency of approach accords with good scientific practice that only one variable, in this case the operating wind farm, be changed at a time to enable measurement of change associated only with that factor.

In practice this ideal position may not be able to be achieved. For example, monitoring may need to follow immediately upon commissioning of a stage of the wind farm rather than being deferred to the same time of the year as earlier measurements, and an anemometer location may become unsuitable if its measurements are interfered with by a nearby wind turbine. These variations have to be accommodated by good practice.

We have recommended that an assessment for special audible characteristics, discussed in Section 9.9, be made at the noise monitoring sites during the post construction noise monitoring. This should cover the range of operational wind speeds and the wind direction sectors required for the noise monitoring.

The noise testing must be carried out with all turbines operational. If during the testing, it is necessary for one or more turbines near to any noise monitoring location to be shut down, the testing should be repeated or the data during that period discarded.

We derive comfort from the sample post construction noise monitoring results provided by Mr Delaire. In all cases they show a reasonable ‘fit’, and generally they have the post construction noise monitoring curve lower than the predicted noise curve. That provides some useful level of validation of the noise predictions, and suggests that reasonable confidence can be had in them.
8.10.3 Recommendations

The Panel recommends that:

Any permit granted should require that before development begins, the Applicant/permit holder must submit to the Minister for Planning a detailed plan for post construction noise monitoring including by stages if development is to be completed in stages.

Post construction noise monitoring must be done as soon as practicable after the wind farm or any relevant stage of it is commissioned.

To this end, the Applicant/permit holder must advise the Minister for Planning when the wind farm, and if relevant each stage of it, is commissioned i.e. the date of first energy supply to the grid.

Noise monitoring should be carried out as soon as practicable after commissioning of the facility, or, if it is constructed in stages, after the commissioning of each stage.

Special audible characteristics should be assessed concurrently, and if found to be present the noise penalty added to the measured noise levels.

Within six months of commissioning of the wind farm or any relevant stage, the results of the monitoring must be submitted to the Minister for Planning for approval.

When approved by the Minister for Planning, the post construction noise monitoring results should be made publicly available.

8.11 Compliance

8.11.1 Background

This section should be read in conjunction with Section 9.10, since it discusses the use of the post construction noise measurements to determine noise compliance.

Compliance is determined similarly to that used for assessing design compliance of the proposed WEF. Section 8.11 above describes the requirements for post construction noise monitoring. For each of the eight noise compliance assessments required at each monitored noise sensitive receptor, the line of best fit of the measurements of noise and hub height wind
speed, adjusted by the appropriate noise penalty if special audible characteristics are identified, is compared to the acceptable noise limit curve determined for that location.

Compliance is shown if the actual noise level curve is, at all wind speeds below the acceptable noise limit curve, and it is non-compliant is if that noise level curve is anywhere above the acceptable noise limit curve. Further, if compliance is not so demonstrated, it is permissible to subtract background noise levels from the post construction measured total noise levels to obtain a wind farm noise only curve for comparison to compare with the acceptable noise limits. We have earlier discussed in Section 1.7.2 our assessment of wind farm noise only versus total environmental noise.

The Marshall Day Acoustics report of 27 April 2010 titled Stockyard Hill Wind Farm Panel Hearing - Additional Information (Exhibit A93) at Appendix B, pp 33-34 presents results from other wind farm sites as referred to in Section 8.10. The figures also provide the acceptable noise limit curves. In all cases up to the maximum wind speeds in the figures (9-11 m/s) compliance is demonstrated.

A number of submitters expressed reservations about compliance. Dr Thorne, in particular, provided evidence on the challenges of demonstrating compliance for NZS 6808:1998.

8.11.2 Discussion

While demonstrating compliance with NZS 6808:1998 is not straightforward, it is required. In order to handle measurements over the wind turbine operating wind speed range, two regression lines, both with some uncertainty, are required to be compared. This contrasts with the much simpler approach in many other noise compliance assessments, such as in the case of many types of industrial noise, where compliance is ascertained by comparing single measurements after the changed operations with measurement results taken before the change, both done under calm or low wind speed conditions.

If compliance is not shown, we recommend that action must be taken expeditiously to bring the WEF, or the relevant stage of it, into compliance, and monitoring repeated until compliance is demonstrated. To give effect to that, it is our view that, the submission to the Minister for Planning of the post construction noise monitoring results and any unsatisfactory compliance assessment should be accompanied by a strategy for how compliance is to be achieved and a time frame for achieving it. That time should not be greater than 180 days after commissioning of a section or sections of the WEF. We have proposed that period acknowledging the importance of effective noise
management to wind farm neighbours and recognising that 30 days
monitoring is required post commissioning and another 30 days monitoring to
establish compliance after remedial measures have been taken.

Should it prove difficult to establish confidently if compliance is achieved, the
use of ‘on/off’ or ‘shut down’ testing should be considered. This is described
in 7.6 pp 31-32 of NZS 6808:1998. Essentially it involves monitoring at the
receptor with the wind farm operating and then turning one or more close
turbines off for repeat testing.

8.11.3 Recommendations

The Panel recommends that:

A statement of compliance should be submitted to the Minister for
Planning with the post construction monitoring results.

If the results show non-compliance, the Minister for Planning should
be provided with a detailed plan of how compliance is to be achieved
and demonstrated within a period of no greater than 180 days and,
when approved by the Minister for Planning, the plan should be made
publicly available.

8.12 Active noise management system

8.12.1 Background

The Panel was informed by parties to the hearing of the technical capability of
contemporary turbines to be placed in a noise control mode. We understand
that characteristics of a turbine such as the pitch of the blades can be varied
remotely and quickly to decrease noise emissions. The penalty for taking such
action is a reduction in energy output. It was suggested that requiring the
WEF operator to develop and implement a comprehensive system of reducing
noise by operating turbines in this way at times when it is justified, could be a
successful way to respond to or minimise noise complaints.

We believe that critical to an understanding of the links between noise levels
at any particular receptor and wind farm operations are: relevant
meteorological conditions such as wind speeds (at hub height and ground
level), wind direction and atmospheric stability; knowledge of which
turbine(s) are the major noise contributors; the extent of control needed to
abate excessive noise; and how to achieve that desired noise control with least
loss of energy production.
In this report we style this concept of limiting the operation of critical turbine(s) quickly and effectively to manage noise at an affected location as needed from time to time as an ‘active noise management system’.

Dr Thorne, Mr Cox and Mr Mitchell provided submissions on this proposal.

8.12.2 Discussion

In principle we are attracted to the concept of an active noise management system.

We are not aware of such a system having been implemented, although Dr Thorne suggested a trial of such a system in New Zealand. Although that does not give us a solid precedent, we believe that given some effort and time by the Applicant, and good will from neighbouring landholders and the Applicant, it should be possible to develop and refine an effective noise management tool. We believe that it has such substantial merit that it warrants development.

We are confronted with a number of issues. There is strong government policy support for WEF developments in appropriate locations. We also have submissions and some evidence expressing concern about noise from WEFs and associated ill health. It is apparent that this has been strongly influenced by recent allegations of noise issues linked to the Waubra WEF; but it is not limited to that case: suggestions have also been made of noise concerns with other recently constructed WEFs in Australia and New Zealand.

The Guidelines specify the use of NZS 6808:1998, and we have submissions suggesting shortcomings in that standard, especially in dealing with some particular acoustic characteristics of wind turbines. We also have submissions advocating a separation distance of 2 km or greater from turbines to non-stakeholder dwellings to allow for greater attenuation of noise.

It appears to us that an effective active noise management system could help alleviate, although probably not eliminate, concerns about noise while not unnecessarily reducing energy output. It may be able to complement measures to ensure compliance with NZS 6808:1998, to help implement any control needed for special audible characteristics, and assist in responding to complaints.

We therefore believe that an active noise management system should be developed to the satisfaction of the Minister for Planning and implemented based on with compliance with NZS 6808:1998. This should achievable by design of the WEF including the selection of the turbine type. The active noise
management system can be viewed as a supplementary noise management measure.

The recommendation of previous panels for a condition for a noise complaints system seems to be a tacit acknowledgement that compliance with NZS 6808:1998 cannot of itself ensure completely effective control of noise from a wind farm. We envisage that a well developed and conscientiously implemented active noise management system could provide an effective response to justified complaints. Even better, we are optimistic that such a system could reduce possible complaints, as knowledge is gathered, by putting turbines into noise control mode when conditions favouring increased noise are forecast.

In principle, the concept of an active noise management system for a WEF is little different from control systems that are common place elsewhere including in chemical processing industries where they have been used for decades. While it may present practical challenges, we are not convinced these would be insuperable given the sophistication of contemporary wind turbine design and control systems.

We suggest that it is initially desirable, to cap the extent to which the operator could be expected to forego energy production to achieve the improved acoustical climate under the plan.

We suggest that for any calendar year the capped loss be set initially at, say, no greater than 10% of the otherwise estimated energy output in total from those turbines at or within 2 km of non-stakeholder dwellings. The limit could be varied by the Minister for Planning if experience demonstrated that a change was necessary to achieve effective control of any unreasonable noise.

We emphasise that we see the successful development of such a system being dependent on successful consultation between the operator and neighbouring non-stakeholders.

### 8.12.3 Recommendations

The Panel recommends that:

- An active noise management system should be developed, refined and implemented.

- The program for the development of that system and the stages in its development and application should be advised to the Minister for Planning and made publicly available.
8.13 Final turbine selection

8.13.1 Background

In Section 8.4 we discuss the concept of an ‘indicative turbine’ and what has been presented to the Panel in relation to this. We discuss the need for reassessment of noise impacts on selection of the final turbine type and subsequent approval of WEF design.

We questioned Mr Delaire and Mr Huson on the requirements for the further assessment. Their advice was similar. If both the sound power level profile of the selected turbine model is less than that of the REpower MM92-Evo/2MW indicative turbine at all wind speeds used in the initial assessment, and if the octave sound power level spectrum is less at all the frequencies used in the modelling, then no repeat predictive modelling would be needed. The reassessment would only require providing to the Minister for Planning that information on the basis that the wind farm noise from the proposed turbine model could not be greater than that for the indicative one.

However, in the event that either or both of these conditions are not met, a complete re-assessment is required that should include all the steps discussed in Section 9 of the report as required to predict compliance with NZS 6808:1998.

8.13.2 Discussion

Several submitters advocated the entire exclusion of secondary consents in the approvals process for this WEF. This was on the basis that secondary consent processes might provide an avenue for substantial changes to the proposal without the critical input provided by the public processes of exhibition and hearing.

In this case, as explained in Section 8.4, it is not possible to entirely avoid secondary consent processes. However, we are satisfied that if, in the assessment of noise impact of the selected turbine model, there is a conscious comparison between it and the indicative one used in the PPAR, then the process would be satisfactory.

If the two conditions recommended by Mr Huson and Mr Delaire above demonstrate that no modelling of wind farm noise is justified (ie: via use of a quieter turbine model than the indicative model), the reassessment can be limited to providing that information to the Minister for Planning.
If one or both of the above conditions are not met then formal re-assessment would be required. That would include repeating the initial noise predictions discussed in Section 8.5 and the wind farm noise modelling in Section 8.8.

With regard to the former, the contours of the predicted wind farm noise levels using the selected turbine model would then show whether further dwellings have to be considered in the detailed noise assessment, and whether some that were previously considered might be excluded.

The noise modelling part of the re-assessment should occur as in the PPAR, but at the revised dwellings at which the background noise (which we are recommending should be repeated) has been conducted. The demonstration of compliance would be against the revised acceptable noise limit curves which will be based on the new background noise measurements and be discriminated as presented before (ie: by 24 hour and night time and 4 wind direction sectors for each time period). In each case predicted compliance must be shown as discussed in Section 8.8. We believe it preferable that the modelling should allow for a margin of 3dB to accommodate measurement and prediction uncertainty. Further, we recommend that predicted compliance should be shown to be achievable without the use of turbine noise management, unless otherwise approved by the Minister for Planning who is satisfied that it can be consistently and reliably implemented to achieve compliance.

We recommend that that re-assessment must be carried out by a suitably qualified noise expert with relevant experience. We recommend that the person doing this work should be a member of an appropriate professional association that provides proficiency accreditation.

### 8.13.3 Recommendations

The Panel recommends that:

**When the Applicant/permit holder selects the turbine model to be used, the noise predictions described in Section 9.5 and the modelling described in Section 9.8 of this report must be repeated and submitted to the Minister for Planning.**

The noise modelling must show compliance with the recommended noise limits of NZS 6808:1998 for all existing non-stakeholder dwellings.

Re-assessment should be carried out by a suitably qualified noise expert with relevant experience who should be a member of an
appropriate professional association that provides proficiency accreditation.

When approved by the Minister for Planning, the noise predictions and modelling should be made publicly available.

8.14 **Cumulative impact**

The Guidelines at page 21 of the 2003 version and page 26 of the 2009 version require:

*A description of the proposal including …written reports including…the cumulative effects of the proposal having regard to other existing or proposed wind energy facilities in the area.*

The *Noise Impact Assessment* report does not address cumulative impact for noise. The Applicant provided to the Panel a plan showing operating, approved and proposed WEFs within about a 70 km radius of the site to assist the assessment of various cumulative impacts. The closest operating facilities are at Challicum Hills and Waubra, and the proposed Chepstowe WEF is several kilometres east. Given the rapid attenuation of noise with distance there is no possibility of any dwelling being affected by noise from any of these WEFs in addition to that from the Stockyard Hill WEF.

8.15 **Complaints**

8.15.1 **Background**

WEF planning permit applications focus on compliance with the acceptable noise limits specified in NZS 6808:1998. This position is premised on the standard ensuring that the World Health Organisation recommendation for the indoor noise would not be exceeded.

Panels assessing WEF applications have generally considered that the possibility of noise complaints cannot be ruled out. Accordingly, they have tended to recommend a detailed condition for a complaints system whereby complaints of alleged wind farm noise can be made, the justification considered objectively, and if justified, remedial action taken. We adopt a similar position.

Further, like the Lal Lal Wind Farm Panel we propose that there need not be separate complaints systems for noise and other issues, but a single system.

A number of submitters asserted that they had limited confidence in the handling of wind farm noise complaints based on their claimed experience.
No other submissions or evidence was provided to us of experience with wind farm noise complaints and resolution.

8.15.2 Discussion

A complaints management system able to deal promptly and effectively with noise complaints is essential. We expect that a system to deal with noise complaints will acknowledge, *inter alia*, that noise is technically complex, that the assessment of wind farm noise is very complex, that perceived noise has a substantial subjective component, that prompt response is required, that effective communication with the complainant will be sought, and that a consultative approach may be the most effective way to develop successful response mechanisms.

We believe that a protocol should be developed for receipt and response to noise complaints. We suggest that Pyrenees Shire Council should be consulted about its preparation.

8.15.3 Recommendations

The Panel recommends that:

A complaints system protocol should be developed that includes noise complaints. It should be submitted to the Minister for Planning for approval and when approved by the Minister for Planning, should be made publicly available.

8.16 Construction noise

8.16.1 Background

Construction work will inevitably generate noise from machinery and heavy vehicle traffic.

Apart from concrete batching, the noise from construction traffic and activities will not be concentrated in particular areas over the whole construction period of perhaps four years. Any noise impact on any particular non-stakeholder dwellings will be temporary. Further, the turbine construction sites are, at their closest, about one km from non-stakeholder dwellings.

The proposed on-site concrete batching plants will also be well away from non-stakeholder dwellings. We are aware that most construction equipment and machinery is now designed to control noise more effectively than
previously and suggest that machinery used should meet contemporary noise standards and be well maintained.

8.16.2 Discussion

We expect that noise generated will not be markedly different in intensity to that from many farming activities, although the duration may be longer. We do not believe that construction noise will significantly detract from the amenity of the area.

We consider that an important aspect of construction noise management will to inform non-stakeholders of nearby noise generating activities and of a contact point for any complaints.

We believe that a plan to manage construction noise is an essential part of the Environmental Management Plan. This should complement the Traffic Management Plan within the EMP because heavy vehicle traffic is likely to be a major part of the construction noise. The construction noise management plan should be developed with Pyrenees Shire Council and detail the construction noise management procedures. EPA can take enforcement action for unreasonable construction noise.

We recommend that construction noise must comply with the requirements of the Interim Guidelines for Control of Noise from Industry in Country Victoria, N3/89 (EPA Vic, 1989) and the construction noise management plan should have regard to:

- *Draft Noise from Industry in Regional Victoria,* (EPA Vic, 2009, publication 1316); and

8.16.3 Recommendations

The Panel recommends that:

A construction noise plan should be prepared as part of the Environmental Management Plan and submitted to the Minister for Planning for approval.

When approved by the Minister for Planning, the Environmental Management Plan should be made publicly available.
9. Health impacts

In the previous chapter we have considered noise generated from the proposed wind farm. We have assessed compliance with NZS 6808:1998 as is required by the Guidelines, and made recommendations on how that compliance may be improved. We have also had evidence and submissions presented on health concerns, as has been the case at other wind farm panels. These health concerns are invariably strongly linked to noise issues, as they have been in this case. It has been suggested by a number of submitters that NZS 6808:1998 is inadequate in protecting health. Some submitters suggest an association between claimed adverse health effects and infrasound. Infrasound is sound that is below a frequency of 20 Hz and is normally inaudible to the human ear.

In this report we have separated noise, that is compliance with NZS 6808:1998 as required by the Guidelines, from health considerations, although they are closely linked and there is considerable overlap.

9.1 Introduction

We have dealt with both noise and health considerations in detail. We have done so because wind farm noise and health concerns have recently assumed a high public profile, with media reporting on alleged public health problems linked to wind farms. Many Stockyard Hill residents have become particularly aware of claimed noise and linked adverse health effects given the proximity to the recently commissioned Waubra Wind Farm. Many submitters at the hearing expressed a high level of concern about health issues and some retained expert witnesses. Much of the material submitted to us has been very detailed. The Pyrenees Shire Council is also conscious of these health concerns since both the proposed Stockyard Hill Wind Farm and most of the Waubra Wind Farm are in that Shire.

The Victorian and Australian Governments both strongly support renewable energy. Wind energy is at present the most commercially developed type of renewable energy. The government support, including recent changes to the Renewable Energy Target, is likely to see an increase in the development of wind energy facilities.

Health issues have been discussed at some other wind farm panels recently. The attention that these health concerns are now attracting and the extent of
submissions and evidence that we received are such that we must give this careful consideration.

Assessing these claims of health impacts, or lack of any credible evidence to support such claims, has been particularly difficult for us. The evidence and submissions put before us are so disparate, the matters so complex, and the uncertainties so great that we have had to listen to and question the material, balance the opposing views, to form a preferred position on the matter.

We believe that the recommendations that we have made on the stringent management of noise should minimise annoyance and thereby the likelihood of allegations of health impacts. Adequate management of noise is a crucial aspect of responding to health concerns. Further, recommendations made in Section 6 of this report for providing vegetation screening around dwellings are a part of reducing perceived noise annoyance.

Given the material presented to us and the often passionate concerns about health, it is not, however, possible to be certain that claims of adverse health effects, whether supportable or not, will not arise. But we believe that our recommendations will reduce that likelihood and may alleviate some concerns.

9.2 Submissions

We received many submissions, a number in considerable detail, and have heard five expert witnesses on this topic.

9.2.1 Documentary sources and evidence

The following sources have been used in preparing this section of the report:

- the Policy and planning guidelines for development of wind energy facilities in Victoria, September 2009 and the May 2003 version (the ‘Guidelines’);
- NZS 6808:1998 Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators;
- NZS 6808:2010 Acoustics – Wind Farm Noise;
- the Planning Application Report (PPAR) main document, October 2009 prepared by Environmental Resources Management Australia (ERM) and particularly Chapter 15;
- the Noise Impact Assessment report (July 2009) prepared by Marshall Day Acoustics at Annexe X of the PPAR;
- submissions from the Applicant specifically on noise (Exhibits A11 and A220);
expert evidence from Mr G White of Garrad Hassan called by the Applicant including his expert witness statement (Exhibit A12), copy of his presentation (Exhibit A13), and six documents on wind turbines, infrasound, low frequency sound and public health (Exhibit A17);

expert evidence from Mr C Delaire of Marshall Day Acoustics called by the Applicant including his expert witness statement (Exhibit A23) and copy of his presentation (Exhibit A22);

a paper by Pedersen et al Response to noise from modern wind farms in the Netherlands, published in the Journal of the Acoustical Society of America, 126 (2), 634-43, August 2009 (Exhibit L159);

a book titled Wind Turbine Syndrome – A Report on a Natural Experiment by Dr Nina Pierpont (Exhibit WPLG49);

copy of Chapter 2 of above book in lieu of expert witness statement by Dr Pierpont (Exhibit WPLG84a);

executive summary from above book (WPLG84b);

expert evidence from Dr R Thorne of Noise Measurement Services for Mr and Mrs Hawker including his expert witness statement (Exhibit H70) and copy of his presentation (Exhibit H71);

expert evidence from Dr R Thorne of Noise Measurement Services for Lowell Pty Ltd (Exhibit L157);

submission from Pyrenees Shire Council (Exhibit PSC112);

expert evidence from Professor David Dunt of Dunt Health Evaluation Services for Lowell Pty Ltd (Exhibit L114) and copy of his presentation (L115);

submissions from Mr A Cox of Pointon Partners for Lowell Pty Ltd (Exhibit L160);

submission from Mr D and Ms J Jackson (Exhibits J171 and J172);

submission from Mr P Mitchell (Exhibit 152b) and copy of presentation (Exhibit L161);

submission from Ms B Wehl (Exhibit W177);

submission from Mr A Gabb (Exhibit G169); and

a number of submissions from other individuals as a response to the public exhibition of the PPAR or to the Panel, or both, referring to concerns about health with little detail and/or in the context of noise issues. Some of these submissions included media and internet reports and material from the recent NSW Parliament General Purpose Standing Committee No 5 titled ‘Rural Wind Farms’.

The Applicant called Mr Christophe Delaire of Marshall Day Acoustics and Mr Graham White of Garrad Hassan as expert witnesses on the generation of
low frequency sound and infrasound from wind turbines. Mr Delaire and Mr White provided expert witness statements.

Professor David Dunt was called by Lowell Pty Ltd and Dr Robert Thorne by Mr and Mrs Hawker and Lowell Pty Ltd. Both provided expert witness statements. Dr Nina Pierpont was called by Mr Andrew Gabb for the Western Plains Landscape Guardians.

In summary the Applicant submitted that the PPAR meets all statutory requirements including for noise and that there is no credible evidence that wind farms have adverse health effects. This position was strongly contested by many submitters and the expert witnesses that they called.

9.2.2 The Guidelines

The Guidelines do not specifically identify health impacts of wind farms as a matter for consideration. They do acknowledge, however, that a wind farm can affect the amenity of a surrounding area due to noise and require the applicant to assess the noise impact of the proposal. The Guidelines also require the protection of critical values and amenity impacts.

9.2.3 Low frequency sound and infrasound

Objectors to wind farms often cite low frequency sound and/or infrasound as the cause of alleged health issues. Low frequency sound is usually regarded as sound within the 20 to 100 Hz range. It is audible but at the lower end of the audibility range. Infrasound, by contrast is sound below 20 Hz. This is normally inaudible.

During transmission, sounds of lower frequency are attenuated less than high frequency sounds.

Objectors suggest that wind turbines are major sources of sound at these lower frequencies and are the cause of claimed health concerns.

A number of submitters suggested that NZS 6808:1998 is deficient in not considering infrasound. That standard does not disregard such sound, however. At the note of 1.3, page 5 it states:

WTGs may produce sound at frequencies below (infrasound) and above (ultrasound) the audible range. Ultrasound attenuates rapidly over moderate distances. Reference to overseas studies reveals that:

a. Sound spectra for modern WTGs indicate that compliance with the limits of this Standard (clause 4.4.2) will ensure that
infrasound pressure levels will be well below the threshold of perception.

b. Any potential adverse effect of infrasound would occur at levels greater than the threshold of perception (see Related Documents).

A similar perspective is presented in NZS 6808:2010 at 5.5 and C5.5.2, pp 23-24.

9.2.4 Submissions and evidence

Applicant

We asked the Applicant to address the issue of health effects of wind farms including reference to low frequency noise and infrasound and current Government investigations.

In his submission Mr Gobbo, for the Applicant, said that ‘there is not a scintilla of evidence’ to support the contention that wind farms affect health. He submitted that there is no credible evidence from health authorities, expert panels or standards authorities suggesting that wind turbines have any deleterious effect on health. Further, he submitted, a suggestion that low frequency sound and infrasound are responsible for claimed health impacts is not supported by any evidence. The Applicant also submitted that Dr Pierpont’s widely publicised material about ‘wind turbine syndrome’ and her postulated ‘visceral vibratory vestibular disturbance’ are unproven hypotheses that have not been confirmed by appropriate research studies.

Mr Gobbo said at item 33, page 7 of his submission of 9 April 2010 (Exhibit A11) that:

There is no credible evidence to suggest that the operation of the Proposal will affect the health of people through ‘wind turbine syndrome’, nor that low frequency sound emissions either occur or are likely to affect people’s health.

In his expert witness statement Mr Delaire of Marshall Day Acoustics at Annexure D (Exhibit A22) provided information on low frequency sound and infrasound from wind turbines.

He advised that sounds at these frequencies are generated by a wide range of natural and man-made sources. He said that:

Human perception of sound energy in the infrasound frequency range is much less acute than other frequency bands. Significant energy is
required to produce levels of infrasound which are high enough to be perceived by humans.

Mr Delaire informed the Panel that the literature indicates that wind turbines produce only low levels of low frequency sound and of infrasound.

Mr White of Garrad Hassan, in his witness statement at 4.1, pp 4-6 (Exhibit A12), provided the Panel with a description of low frequency sound and infrasound, the nature of noise generation by a wind turbine, and his review of the literature. He advised that studies had shown that it has been found that humans can tolerate high levels of low frequency sound and infrasound, over 120dB, without direct physiological problems. He compared that with the typical infrasound levels generated by large wind turbines said to be about 55 – 75dB. Mr White stated:

*From our work in measuring and assessing noise at wind farms, discussions with other industry experts on wind farm noise emissions, and a review of international literature on the issues relating to infrasound and low frequency sound produced by wind turbines, it is my view that modern wind turbines at well designed wind farms will not produce infrasound or low frequency sound at an intensity that could be above levels that are known to cause direct physiological harm.*

Mr White provided the Panel with six papers and expert reviews on the subject.

In his closing submission Mr Gobbo, for the Applicant, advocated that there is no credible evidence supporting claims of health impacts from wind farms.

**Victorian Department of Health**

Prior to the hearing the Chair of the Panel wrote to the Chief Health Officer at the Victorian Department of Health seeking advice on the Department’s current position on wind farms and health. In a letter dated 7 April 2010 (circulated to the parties) the Director Health Protection and Chief Health Officer of the Department advised that:

*Having reviewed the available peer reviewed scientific literature on the subject of wind farms on health the Department of Health has not been able to confirm the presence of direct health effects arising from wind farms.*

*In an effort to obtain an independent and authoritative view on the subject, I referred the questions of health impacts of wind farms to the national Health and Medical Research Council (NHMRC) Australia’s premier agency for health and medical research.*
I am awaiting the results of the review by NHMRC. In the meantime we in the Department of Health will continue to monitor published medical papers on the subject of wind farms so that we are aware of the latest research on the topic.

The Department of Health did not give evidence to the Panel. Given the profile of health concerns from wind farms, it may have assisted the Panel to have had the benefit of a presentation. The Department did, however refer the matter to the National Health and Medical Research Council, Australia’s premier health advisory body, for response.

National Health and Medical Research Council

On 2 July 2010, after the completion of the hearing, the National Health and Medical Research Council (NHMRC) released a general public statement on wind farms and public health. This consists of ‘NHMRC Public Statement - Wind Turbines and Health’ and a report headed ‘Wind Turbines and Health – A Rapid Review of the Evidence’.


The review indicates that the NHMRC sought to ascertain if the statement:

There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines

30 can be supported.

The review concluded:

The health effects of many forms of renewable energy generation, such as wind farms, have not been assessed to the same extent as those from traditional sources. However, renewable energy generation is associated with few adverse health effects compared with the well documented health burdens of polluting forms of electricity generation (Markandya & Wilkinson, 2007).

This review of the available evidence, including journal articles, surveys, literature reviews and government reports supports the statement that: ‘There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines’.

We had earlier been provided with a copy of the Expert Panel Review report prepared for the American Wind Energy Association and the Canadian Wind Energy Association and a commentary on that by Professor Dunt.

After viewing this publicly released material the Panel decided that it would not invite comment on it by parties to the hearing, as no new material of note is provided in the statement, and our recommendations (based as they are on quite extensive material) are generally consistent with the NHMRC conclusions. It is nevertheless appropriate to recognise the existence of this review in this report.

Professor David Dunt

Professor David Dunt appeared before the Panel as an expert witness called by Lowell Pty Ltd. He provided a review to the Panel of health issues associated with wind farms. The paper very largely focussed on the possible association between wind farm noise and health effects because noise stress generally is identified as having potential adverse health effects. It also referred to flicker sensitivity (shadow flicker, blade flicker and blade glint); and to the potential health benefits of both reductions in fine particle emissions from the alternative fossil fuel generation of electricity and of reduced unemployment in the region brought about by wind farm employment.

Professor Dunt drew attention to the World Health Organisation’s definition of health:

*Health should be understood as ‘not only the absence of infirmity and disease but as a state of physical, mental and social well-being.*

In his review of the literature Professor Dunt considered peer reviewed research literature, expert reports and other non-peer reviewed surveys.

Professor Dunt identified a series of studies by Pedersen et al as the most important peer reviewed material. In the most significant study of 725 respondents living within 2.5 km of wind turbines in The Netherlands, and published in 2009, Pederson et al sought to investigate the relationship between annoyance from wind turbine noise and the predicted A-weighted sound pressure levels. This work found a statistically significant relationship between noise levels and noise annoyance both outside and inside dwellings. Pederson et al also found that high turbine visibility enhances negative response, and having wind turbines visible from the dwelling significantly increased the risk of annoyance. Annoyance was found to be strongly correlated with a negative attitude toward the visual impact of wind turbines on the landscape. The study also showed that people who benefit
economically from wind turbines are significantly less annoyed notwithstanding exposure to similar sound levels. In a separate study Pederson et al found that wind turbine noise was more annoying than other noise sources at similar sound levels (except for railway shunting yards); it was suggested that this may be due to the specific sound properties of wind farm noise such as its ‘swishing’ quality, temporal variability, and lack of night time abatement.

Professor Dunt referred particularly to four reports from expert panels:

- Wind Turbine Sound and Health Effects: an Expert Panel Review prepared for the American Wind Energy Association (AWEA) and the Canadian Wind Energy Association (CWEA);
- Public Health Impacts of Wind Turbines prepared by the Environmental health Division of the Minnesota Department of Health;
- Environmental Impacts of Wind Energy Projects prepared by the Committee on Environmental Impacts of Wind Energy Projects, Board of Environmental Studies and Toxicology, Division of Earth and Life Studies of the National Research Council; and
- The Health Impact of Wind Turbines: A Review of the Current White, Grey and Published Literature by the Chatham-Kent Public Health Unit, Ontario.

Professor Dunt advised the Panel that the Expert Panel Review for the AWEA and the CWEA concluded, *inter alia*, that:

*There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects and ...the sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel’s experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences.*

Further, the Expert Panel Review commentary includes a description of the so-called ‘nocebo’ effect (opposite to the placebo effect) which it defines as ‘... an adverse outcome, a worsening of mental or physical health, based on fear or belief in adverse effects. They include a range of reactions including drowsiness, nausea, fatigue, insomnia, headache, weakness, dizziness, gastrointestinal complaints and difficulty concentrating.’

The Expert Panel Review concludes that:

*...an annoyance factor to wind turbine sounds undoubtedly exists, to which there is a great deal of individual variability. Stress has multiple*
causes and is additive. Associated stress from annoyance, exacerbated by rhetoric, fears, and negative publicity generated by the wind turbine controversy, may contribute to the reported symptoms described by some people living near rural wind turbines.

Professor Dunt said that he did not agree with the Expert Panel Review position that consideration of wind turbines and health effects should be viewed as concluded.

Professor Dunt advised that the Minnesota Department of Health report found:

…the most common complaint in various studies of wind turbine effects on people is annoyance or an impact on quality of life. Sleeplessness and headache are the most common health complaints and are highly correlated (but not perfectly correlated) with annoyance complaints. Complaints are more likely when turbines are visible or when shadow flicker occurs. Most available evidence suggests that reported health effects are related to audible low frequency noise. Complaints appear to rise with increasing outside noise levels above 35dB(A).

Professor Dunt informed the Panel that the National Research Council report noted that the most problematic element of wind turbine noise is a broadband ‘whooshing’ sound produced by interaction of turbine blades with the wind. The report notes that newer turbines have upwind rotor blades, minimising low frequency ‘infrasound’ (ie. air pressure changes at frequencies below 20-100 Hz that are inaudible). However, the report notes that during quiet conditions at night, low frequency modulation of higher frequency sound, such as those produced by turbine blades, is possible. The report concludes that noise produced by wind turbines is generally not a major concern beyond a half mile.

With regard to the Chatham-Kent Public Health Unit report, Professor Dunt advised the Panel that the report concluded that as long as the (Ontario) Ministry of Environment Guidelines for locations of wind farms are followed there will be negligible adverse health effects on Chatham-Kent citizens; and commented that although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition on the basis of potential adverse health consequences is not justified by the evidence.

Three un-refereed studies were reviewed by Professor Dunt. These were the studies by Harry, Phipps and Pierpont.

He informed the Panel that the study by Harry in the UK had surveyed a self selected group of 42 people reportedly suffering from wind farm health
related problems who lived between 300 m and 2 km of a wind turbine. Their most frequent responses were that their health was affected (81%), they had gone to their doctor (76%) and that their quality of life had been affected (73%).

Professor Dunt advised that Phipps had conducted a survey of 619 households living up to 10 km from wind farms in mountainous areas of New Zealand. Most households lived between 2 and 2.5 km from the turbines. Of the 287 households responding, 92 said that their quality of life was affected by turbine noise - 51 occasionally, 36 frequently and 5 most of the time. 68 households reported sleep disturbances - 42 occasionally, 21 frequently and 5 most of the time.

Professor Dunt told the Panel that Pierpont had studied 10 families consisting of 38 adults and children where in all cases one member of the family had reported suffering health symptoms apparently related to noise from the nearby wind farm. Those symptoms were in all cases sufficiently severe for the family to have moved out of the area. Common symptoms included sleep disturbance, headache, tinnitus, dizziness and fatigue, and risk factors for these included pre-existing migraine and inner-ear sensitivity. He said that Pierpont postulates that these symptoms constitute ‘wind turbine syndrome’ or ‘visceral vibratory vestibular disturbance’. Professor Dunt told us that there is not strong evidence for the existence of ‘vibro-acoustic disease’31, and that it is not a concept or disease entity otherwise recognised in clinical medicine.

In his commentary Professor Dunt said that of the non-peer reviewed studies that by Phipps appeared to be the most useful. Unlike the other two studies it did not rely in the same way on self-reporting of symptoms and the sample size was much larger. He said that the significance of these studies was the prima facie evidence that they provided of effects in some people exposed to wind turbines.

He informed us at 3.4, page 21 (Exhibit L113) that:

There are few peer reviewed studies of noise effects of wind turbines and the effect of this on health. Studies of noise-related health effects of wind turbines focus almost entirely on noise annoyance that should be understood as a stressor situation that could be expected to produce other symptoms. There appear to be no studies on the effects of wind turbines on

31 The Panel is aware that Dr Pierpont states that ‘vibro-acoustic disease’, which arose from a study by an investigator in Portugal of aircraft technicians exposed to low frequency noise, is not the same condition as ‘visceral vibratory vestibular disturbance’ which she postulates as being caused by exposure to wind turbines.
health outcomes either as stress related physical or mental symptoms or as well recognised diseases.

Professor Dunt said that in this situation noise annoyance should be seen as a ‘marker’ as is used in other studies such as the projected health impact of noise from a proposed freeway.

Professor Dunt said that the expert commentaries are not as discrepant as first appears. The Expert Panel reported that ‘…the main health effect of noise stress is disturbed sleep, which may lead to other consequences’.

In his expert witness statement at 3.4, page 22 (Exhibit L113), in reviewing the study by Pedersen et al, Professor Dunt said:

The dose-response relationship indicates noise effects become unacceptable judged by the common metric of 10% very annoyed at outside levels of 40-45dB(A) whether indoors or outdoors. The dose-response relationship indicates noise effects are acceptable judged by this metric inside or outside, for levels between 30-35dB(A). The dose-response relationship indicates noise effects are intermediary between acceptable and unacceptable judged by this metric for inside and outside levels of between 35-40dB(A). Complaints appear to rise with increasing outside noise levels above 35dB(A).

and he concluded at 3.4, page 23 (Exhibit L113):

It is concluded that noise and health effects may occur between 35-40dB(A) – assessed by the ISO method – and need to be carefully studied. This needs to be done bearing in mind the association between noise annoyance effects and attitude toward the visual impact of wind turbines and economic benefit from the wind turbines.

In his presentation to the Panel, Professor Dunt added that ‘These conclusions are broadly in line with Victorian Standards’.

With regard to the apparent lack of studies on the effects of wind turbines on health outcomes as distinct from annoyance, Professor Dunt said at 3.4, page 21 (Exhibit L113):

While absence of this latter group of studies means that there is little evidence of the impact of wind turbines on health outcomes, this is primarily the result of an absence of studies rather than no evidence following the conduct of a number of high quality studies. It is important, given reports of ill health reported in the un-refereed case studies (described above) and elsewhere e.g. community members in towns like
Waubra and elsewhere, that studies with robust epidemiological designs be conducted for the existence or otherwise of these health outcomes.

Professor Dunt also provided expert evidence of health effects from flicker and blade glint. By ‘flicker’ we understand this to encompass blade flicker i.e. the regular rotational movement of the turbine blades particularly with a well lit sky background, and shadow flicker i.e. the repetitive passage of shade and light on an observer within the shadow of the rotor, and perhaps also observing the rotor shadow on an object distant from the observer. ‘Blade glint’ is the reflection of the sun of the moving blades.

He informed the Panel that the issue of concern is the triggering of flicker sensitive epilepsy. He said that this is a comparatively rare condition with a prevalence of about 1 in 10,000, but once triggered a full convulsive seizure is likely to be experienced. He commented that television is the most potent source for triggering this condition. Professor Dunt referred to work that showed that flicker frequency, not viewing distance is the critical risk factor. He advocated that the flicker frequency should be no greater than three per second and that this should be ensured by avoiding a cumulative flicker frequency of that level. He also said that turbine blades should not be reflective. He concluded that with rotational speeds of contemporary wind turbines and non-reflective blades, wind farm induced flicker sensitive epilepsy should be non-problematic.

Professor Dunt referred the Panel to a study by Holm Pedersen which reported that the perception of shadows and the perception of flicker were among the subjective factors affecting levels of noise annoyance. He therefore advised that it is important to minimise shadow flicker, not only because it is unpleasant in itself, but also because it exacerbates annoyance to noise generated by wind farms. He commented that the shadow flicker is non-problematic if the guidelines requirement of not more than 30 hours per year shadow flicker at any dwelling is met.

Professor Dunt postulated possible health benefits from a reduction in fine particle matter emissions from fossil fuel power generation if displaced by wind power, and health benefits from reduced unemployment linked to wind farm construction.
Dr Robert Thorne

Dr Thorne was called as an expert witness by Mr and Mrs Hawker, and by Lowell Pty Ltd.

Much of the evidence from Dr Thorne was on noise issues and on the noise assessment. Dr Thorne has investigated wind farm noise and related health impacts, however, largely in New Zealand.

The evidence from Dr Thorne included at 7.1 and 7.2, page 27 (Exhibit L157):

Investigations in New Zealand have proven that the sound(s) of wind turbines are audible at low amplitude inside homes. Such sound has readily identifiable perceptual dissonance and has a direct relationship to annoyance and sleep disturbance (Panel emphasis).

My observations and measurements indicate that a wind farm is a source of noise (sound and vibration). It is a highly complex source of noise and is, in my opinion, unique due to its complexity and human perception. The receivers of that noise (that is, people) are highly complex in response. People do not respond to ‘single number’ sound levels or noise levels for that matter. In the event, the installation of turbines at Makara (New Zealand) has resulted in widespread complaint concerning sleep disturbance due to unreasonable noise. My observations within a Makara residence show that outdoor levels of modulated sound below $L_{eq}30 dB(A)$ are clearly audible within the home at night under calm weather conditions outside.

and at 8.1 and 8.2, page 29 (Exhibit L157):

Unreasonable or disturbing noise will occur when the sound from a wind farm disturbs sleep and thereby causes anxiety, annoyance and stress. That unreasonable or disturbing noise can occur is well documented in peer-reviewed and impartial research. My research over 5 years in New Zealand and Australia indicates the existence of noise induced sleep disturbance and adverse health effects due to wind farm noise (Panel emphasis)....

There is an extensive world-wide debate between acousticians, health professionals and the community (primarily affected persons) concerning potential adverse health effects due to the influence of wind farms. Sound and noise from wind farms is becoming more intensely debated and the last few years has seen a substantial increase in peer-reviewed acoustical and health-impact related reports and evidence to regulatory authorities nearing applications for wind farm planning permissions.
and again at 7.20 and 7.21, page 29 (Exhibit L157):

I am of the opinion, based on my own research, that wind farm noise can and does create unreasonable noise within residences and consequential adverse effects in the sense of sleep disturbance, annoyance and potential adverse health effects to residents living within 2000 metres of large wind turbines set in a wind farm. These risks are quantifiable and are of high probability. The effect is significantly more than minor.

Based on my observations within the Manawatu and Makara I am of the opinion that wind farm sound can be heard and recorded within residences situated within 3500 metres of large wind turbines set in a wind farm. The risk of adverse effect due to sleep disturbance and annoyance is quantifiable and is of high probability. The effect is significantly more than minor.

Dr Thorne described to the Panel his observation that wind turbines generated unusual and distinctive noise that seemed to contribute to annoyance at sound levels below that prescribed in the standard.

Dr Thorne advocated separation distances from non-stakeholder dwellings to the nearest wind turbine of at least 2 km and noise mitigation to be offered for dwellings out to 3.5 km. He also commented, based on his observations, on the visual impact of turbines affecting the perception of noise.

Dr Thorne said that, in his experience, sound can reverberate in a room thus enhancing the noise. He said that for lower frequency sound neither upgraded glazing or heavier insulation were effective noise control measures.

**Dr Nina Pierpont**

Dr Pierpont was called to give expert evidence by Mr Gabb representing the Western Plains Landscape Guardians (WPLG). This was arranged by video conferencing from USA.

Dr Pierpont has become internationally known for her reported study on ill health associated with wind farms. She studied 10 families totalling 38 people in several countries who had moved from their homes, or were likely to do so, because of health effects that they associated with nearby wind turbines. Dr Pierpont has suggested that low frequency sound and infrasound cause a physiological response which she has called ‘visceral vibratory vestibular disturbance’. She has titled the effect ‘wind turbine syndrome’ and has written a book under that title. Her work has not been published in scientific journals. Her work has been criticised for its small sample size and the
sampling methodology. Her physiological explanation is considered controversial.

We were provided with a copy of her book, its executive summary and a copy of the major chapter from her book. We were not provided with an expert witness statement notwithstanding our request that one should be provided.

Dr Pierpont presented her study and findings to the Panel and was subject to questioning by the Applicant, some submitters and the Panel. She described the approaches to her study, the analyses and the conclusions. She commented that there appeared to be certain risk factors to ‘wind turbine syndrome’. These seemed to a pre-existing tendency to motion sickness, migraine disorder, inner ear damage and balance problems.

She presented her findings as indicative of a health problem. Her book and her evidence acknowledge certain limitations of the study, including that it is not an epidemiological study. She informed the Panel that she believed that more comprehensive studies were being planned over three countries to better understand any association between wind farms and health impacts.

Dr Pierpont’s position is that to guard against ‘wind turbine syndrome’, a minimum separation distance of wind turbines from dwellings of two kilometres is indicated.

Mr Andrew Cox

Mr Andrew Cox of Pointon Partners, Lawyers for Lowell Pty Ltd, made submissions on noise, but with reference to matters of health, amenity and nuisance. Mr Cox invited the Panel to recommend that the permit be refused and said at item 1, page 1 (Exhibit L160):

...the proposed development is an overdevelopment of the subject land. In the context of noise and health it will have an unreasonable impact on the environment, an unreasonable social impact, an unreasonable impact on community amenity and is an inappropriate location for a WEF because of the real and substantial risk of nuisance to both stakeholders and non-stakeholders.

Mr Cox said that in the event that the Minister would decide to approve the Application, a number of changes to noise assessment to ensure that noise requirements were met, health impact thereby minimised, nuisance reduced and amenity enhanced should be included. Furthermore, he advocated a 2 km separation distance between non-stakeholder dwellings and wind turbines.
Mr Cox’ submission included reference to Section 4 of the Planning and Environment Act 1987 thus:

The objectives of planning in Victoria include ‘…to secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria…and to balance the present and future interests of all Victorians.

He made reference to Clause 15.05 of the State Planning Policy Framework that says:

Planning and responsible authorities should ensure that development is not prejudiced and community amenity not reduced by noise emissions, using arrange of building design, urban design, and land use separation techniques as appropriate to the land use functions and character of the area.

Mr Cox provided us with a copy of relevant excerpts of the Public Health and Wellbeing Act 2008.

Mr Cox also advised that he had conducted a personal experiment in relation to noise from wind farms. He advised that he had slept the night near the Waubra Wind Farm and had suffered from a headache the next morning. Mr Gobbo, in his reply suggested this was an example of the ‘nocebo’ effect.

**Mr Peter Mitchell**

In his presentation to the Panel, Mr Mitchell said, *inter alia*, at page 24 (Exhibit L161):

There are proven health problems associated with living too close to turbines. That is a fact. No quibbling by proponents or politicians nor the Department of Health’s apparent ducking for cover and state of ignorance can dissolve or camouflage that fact.

Essentially, Dr Pierpont collected sufficient data to demonstrate a link between wind turbines and human health problems. She then proposed a theory linking the certain cause and the observed effect. This theory is of no importance to our consideration. What is important now is to ensure avoidance of symptoms from this project.

The industry, and government wind enthusiasts will continue to attempt to remain in denial, and response with ad hominem criticisms and pedantic mini-criticisms of work published on the subject. Regardless of their ‘assurances’ it is imperative that precautionary action is taken in this project so that the 12% of exposed families affected at Waubra is not repeated at SYH.
Mr Mitchell advocated separation distances of 3 km between dwellings and wind turbines as a pro tem health standard, setbacks of 2 km from farm workplaces, and greater setbacks from property boundaries.

**Mr David and Ms Janet Jackson**

Mr and Ms Jackson made separate submissions to the Panel.

Both expressed great concern for possible adverse impacts on the health and well being of their family and supplied supporting medical documentation indicating pre-existing health and behavioural problems in a family member. Their concerns included that audible noise would cause sleep disturbance, and that there would be health effects from infrasound, flicker and the motion of rotating blades and aviation lights, as well as electromagnetic radiation. These concerns were presented to the Panel in detail by Ms Jackson.

Mr and Ms Jackson submitted that the Application should be rejected. In the event that this did not occur, they requested a separation distance of at least 2km between dwellings and wind turbines and preferably 3.5 km, and that there should be a setback of 2km of turbines from property boundaries.

**Cr David Clarke**

Cr Clarke made a submission to the Panel in his personal capacity as well as participating in the presentation for Pyrenees Shire Council. He is a resident of Waubra. Cr Clarke provided a diagram to the Panel, Exhibit PS112b, in which he has attempted to relate sites of noise and health complaints to proximity of turbines and land gradients.

**Ms Belinda Wehl**

Ms Wehl made a detailed submission to the Panel about widespread allegations of ill health linked to wind farms. She advocated a minimum 2km separation distance from wind turbines to dwellings.

**Mr Noel Dean and Mr Donald Thomas**

Neither Mr Dean nor Mr Thomas lodged submissions in response to public notice of the Application. Both were introduced at the Panel hearing by submitters. Mr Dean and Mr Thomas are non-stakeholder neighbours of the recently commissioned Waubra Wind Farm.

Both have claimed ill heath since the commencement of operation of that wind farm. Mr Dean now no longer lives on his farm (though he still works there). Mr Thomas told the Panel that initially he did not oppose the wind farm. Both
described their experiences. Mr Thomas observed that the days on which he feels most unwell can be occasions when the wind turbines are barely audible.

9.3 Panel response

We found the evidence from Professor Dunt particularly useful in its examination of available information and its dispassionate presentation. We have found it useful to help structure our response on health issues.

Lack of detailed research

We understand Professor Dunt’s comment about the apparent lack of studies investigating any effects of wind turbines on health outcomes, and note the reliance having to be placed on studies of annoyance and using this as a health effects marker. Indeed, from what has been presented to the Panel it appears that studies of annoyance from wind turbine noise come largely from the refereed work of Pedersen and co-workers, with some independent corroboration from the non peer reviewed study of Phipps. It is not clear if the various reviews cited by Professor Dunt are as robust as might be desired, or whether they are limited by the scope of the fundamental investigations on which they may depend.

This limitation was also apparent in evidence and submissions from other parties. Ms Russell referred to a comprehensive investigation being planned or undertaken in Japan. We were not provided with any further information about that. In her evidence Dr Pierpont said that she was anticipating a study would be undertaken in USA and mentioned a possible total of three studies, but again we were not supplied with any further details.

This sentiment also seems to be apparent in the recently released public statement of July 2010 on wind turbines and health from the NHMRC which states:

Concerns regarding the adverse health effects of wind turbines focus on infrasound noise, electromagnetic interference, shadow flicker and blade glint produced by wind turbines.…

Reported health concerns primarily relate to infrasound (sound that is generally inaudible to the human ear) generated by wind turbines.…

While there is currently no evidence linking these phenomena with adverse health effects, the evidence is limited.

Therefore it is recommended that relevant authorities take a precautionary approach and continue to monitor research outcomes. (Complying with standards relating to wind turbine design,
manufacture, and site evaluation will minimise any potential impacts of wind turbines on surrounding areas). (Panel emphases)

On the basis of the evidence and submissions that we have heard from various parties, we support the recommendation of Professor Dunt that ‘... studies with robust epidemiological designs be conducted to provide evidence or otherwise of these health outcomes.’

From responses to our question to some experts and submitters, we understand that such a study would not necessarily need to be conducted in Australia, but it would need to be well designed, well executed, comprehensive, independent, peer reviewed and published. The aim would be to determine if there is an absence of health impacts - which is the current position of many experts - or whether there is support for the opposite views of some other parties.

Noise standards

Given some level of uncertainty in defining adverse noise and associated health effects, the opinion of Professor Dunt seems broadly consistent with the position that we have adopted in Chapter 8 on noise. We have framed recommendations that are directed towards ensuring that NZS 6808:1998 recommended noise standards are met; that special audible characteristics are thoroughly evaluated and any indicated noise penalty applied; and that an active noise management system is developed and used to manage any untoward acoustic issues.

We have also reviewed the Pedersen et al data as it relates to the NZS 6808:1998. NZS 6808:1998 is clear that the aim is to prevent sleep disturbance; to do that it uses an indoor sound level of 30dBA Leq and an assumed noise attenuation of 10dB from outdoors to indoors. This results in an acceptable outdoor level of 40dBA Leq. Inspection of the Pedersen et al data on perception of annoyance and summing the ‘rather annoyed’ and ‘very annoyed’ categories for indoor noise levels, we find that at less than 30dBA 1% are rather or very annoyed, at 30 – 35dBA 4%, from 35 – 40dBA 8%, from 40 - 45dBA 16%, and for more than 45dBA it shows (strangely) 5%. If we take the ‘very annoyed’ category, as Professor Dunt has in using the 10% ‘very annoyed’ metric described before, the results are 1%, 1%, 4% 10% and (again oddly) 2% respectively. The pattern and numbers of respondents consistently point to 40dBA as the threshold at which annoyance increases markedly.

We believe that these reported annoyance data support the recommended standards of NZS 6808:1998 in providing protection against sleep disturbance, and our recommendations for ensuring that that standard is complied with.
We anticipate that strict compliance with that standard, the knowledge that that will be achieved, and the provision of noise information publicly may moderate perceived health concerns.

**Health impacts of flicker**

With regard to other possible health concerns we understand the review and conclusions by Professor Dunt on flicker sensitive epilepsy. We are aware that the normal rotational speed of contemporary utility scale wind turbines is about 15 revolutions per minute. Given that such a turbine has three blades, that rate corresponds to about 45 flickers per minute. Whether the flicker sensitive epilepsy might be caused by blade flicker, shadow flicker or viewing the moving shadows, this frequency is about 4 times less than the critical 3 Hz lower limit that might trigger an epileptic seizure. We do not envisage a circumstance whereby shadows or flickers might be superimposed to generate that critical minimum frequency. Further, blades are typically treated in a non-reflective finish to avoid observer discomfort which further reduces that health risk. We also note that there are many ubiquitous sources of flicker. We do not believe, on the basis of evidence before us, that the evidence supports flicker frequency as a reasonable health concern.

**Visual impact**

The study by Pederson et al found that high turbine visibility enhances negative responses to turbines by respondents, and having wind turbines visible from the dwelling significantly increased the risk of annoyance. We find that result important. Elsewhere in this report we have discussed the visual impact of wind turbines by day and the visual impact by night from aviation hazard lighting. We have discussed plantings to screen views of turbines, where feasible and agreed by the landowner, and we have recommended that aviation lighting not be allowed. This finding adds a further dimension to screening; it suggests that such screening may diminish the extent of annoyance. By implication that may benefit symptoms that might arise from annoyance. For those dwellings having potential views of wind turbines and where the residents have a concern about health issues linked to wind farms, screening may have this benefit as well as offering visual relief.

**Other matters**

Professor Dunt advised us about unacceptability being ‘...judged by the common metric of 10% very annoyed...’ with regard to noise levels, and that that metric has widespread application in the health field. We understand that metric is recognition that with any substantial project it is highly likely
that there will be some people who will suffer annoyance as a consequence of that change.

We benefited from the evidence from Dr Thorne in better understanding the unusual noise that may be attributable to wind turbines and the effect that this might have on sleep disturbance. That supports our view about the importance of identifying any special audible characteristics.

As we have said, Dr Pierpont appears to have concluded that there can be a direct health impact from wind farms upon certain individuals, perhaps those with certain sensitivities. While we have a number of concerns about her evidence, we record that we do not dismiss her evidence on the basis of its not having been published in a peer reviewed journal but it has led us to put somewhat less weight on it.

We do have other concerns about her evidence and did not find it particularly helpful for a number of reasons.

First, we found that in presenting her evidence, Dr Pierpont appeared less than measured and under questioning seemed simply to want to promote her views to the Panel rather than to respond frankly to questions from the Panel and other parties.

Second, we also note that amongst Dr Pierpont’s sample families, some lived closer to wind turbines than would be the case for dwellings near Stockyard Hill. Further the locations under study cover a range of types of topography – some of which would not be relevant here.

Our third and principal concern about Dr Pierpont’s work so far as its utility to the Panel is concerned, is that it relied on a small self-selected sample (many of the respondents contacted her), the sample only included persons who had moved away from the wind farm (potentially those most affected or believing themselves to be so) and it relied on self-reporting and recall of symptoms during telephone interviews (minimising the reliability of the data).

We are not able to conclude from Dr Pierpont’s work that there will be, or are likely to be, health problems amongst the general population living near this proposed wind farm which can be attributed to the wind farm and in particular its noise emissions. At best, together with other material presented to the Panel, it does seem that some people living near wind farms have suffered health impacts. We cannot comment on the association of those health problems with pre-existing propensities to ear related health problems nor the causal explanation that Dr Pierpont suggests.
The submissions from Lowell Pty Ltd on aspects of use of NZS 6808:1998 to achieve the best noise outcome in the interests of health effects has some congruence with our views.

The concerns expressed by Mr and Ms Jackson that the wind farm would compound their existing family health problems were affecting for many persons at the hearing. Toward the close of the hearing the Applicant informed us that the turbine closest to the Jackson’s dwelling, T218, was withdrawn. We note that that withdrawal increases the separation distance from their dwelling to the nearest proposed turbine from about 1 km to about 1.5 km. Elsewhere in this report we recommend that aviation hazard lighting not be permitted on the turbines.

We put little weight on Mr Cox’ self reported result of sleeping over for a night near the Waubra Wind Farm. We respond similarly to the response from Mr Cox’ colleague and the statement from the photographer who did some photographic work for Mr Gabb, both of whom reported adverse health impacts when at that facility. We give much greater weight to the evidence of experts and the results of well designed and conducted studies that are appropriately reported and critiqued.

9.4 Conclusions

We make the following general comments on the health issue as presented to us.

- It is not possible for this Panel to make a definitive assessment of the wind farm and alleged heath impacts conundrum. It is not our task to provide advice on government policy on health issues of wind farms.

As we have been presented with extensive submissions and evidence on the issue, however, we think it is appropriate to record what has been put to us (as above) and to make some observations.

- Nor do we take a position on whether the allegations of adverse health effects linked to Waubra Wind Farm are justified or not. We simply believe that it is not in the interests of any party to have further similar claims, again whether justified or otherwise, arise at another facility.

- In reviewing the material put to us, the Panel has placed greater weight on advice from health authorities, evidence of expert witnesses, relevant papers in the peer reviewed literature and reviews of expert panels than on media articles, internet items and anecdotal material.

We nevertheless are appreciative, of the submissions and material from all submitters, much of which has been thoughtful, thorough and useful. We
have been made very aware of the level of concern held by a number of submitters about possible health impacts should the proposal go ahead. We also do not doubt the sincerity of those persons who claim that they are suffering ill health since Waubra Wind Farm starting operating.

However, we have been provided with quite limited material by way of documented evidence from professional advisors or the like that clearly link wind farm noise exposure to the claimed ill health.

- The Applicant has submitted that there is no peer reviewed evidence supporting direct adverse health effects from wind farms. It is said that in fact there is strong support for there being no such adverse effects. Submitters have provided material to us, however, which suggests a substantial incidence of health problems which they say can be attributed to the proximity of a wind farm. Based on the evidence presented to the Panel, we are not inclined to accept either position outright.

- It is apparent to us that the understanding of health issues of wind farms is limited, there is a dearth of reliable information, and there is a disparity of views. Much of the material that we have had brought before the Panel acknowledges that there are large areas of uncertainty and of controversy.

- Some submitters have therefore suggested that application of the Precautionary Principle should be cause for rejection of the Application on the grounds that there can be no absolute certainty that there will be no adverse effects. On the other hand the Applicant has submitted that there is no credible evidence to support claimed health impacts, and that any such issues can be dealt with by conditions.

We consider that the information before us does lead to the view that this is a matter warranting further investigation but as it stands at present, despite there being perceived problems at Waubra and in some other places, the evidence does not warrant refusal of the present Application.

From what we have been told, the causes of direct health effects of wind farms if they do exist are not clear and there can be no expectation that they will be experienced here. In particular we accept the evidence of Professor Dunt that there is no credible evidence of any direct physiological impact from wind farms.

The advice that we have received from the Victorian Department of Health, the National Health and Medical Research Council, and the Expert Panel Review prepared for the American Wind Energy Association and the Canadian Wind Energy Association cited by Professor Dunt, all seem to be clear that there is no evidence to confirm the presence of direct health effects from wind farms. We would say that while the evidence from Dr Pierpont may suggest that direct effects occur in some circumstances, we
are disinclined to accept the general occurrence of direct effects given the limitations of Dr Pierpont’s study (discussed above) and the possibility that even the reported symptoms in those cases were indirectly caused.

- Evidence from Professor Dunt, Dr Pierpont and Dr Thorne, however, did suggest that wind turbines may cause noise and noise characteristics sufficient to cause sleep disturbance and that that in turn can lead to other health consequences. If that is so it then perhaps it could be argued that noise might lead indirectly to health impacts as defined by WHO and provided earlier in this chapter.

Earlier in our report we have focussed our attention on effective management of wind farm noise. Assuming this is successful, this should help alleviate problems of this kind. The key elements of the noise management system are:

- ensuring that the wind farm design for noise at dwellings meets the NZS 6808:1998 recommended noise criterion of 40dBA L95 (for other than high wind speeds), and preferably does so by a margin, including careful assessment of the noise impact of the turbine model selected for the proposed facility;
- comprehensive after construction noise monitoring to ensure compliance;
- rigorous assessment of special audible characteristics and application of an appropriate noise penalty if found to be present;
- developing and using an active noise management system that can recognise conditions conducive to unacceptable noise and adjust the control of wind turbines to ameliorate that noise;
- communicating effectively with wind farm neighbours about noise management; and
- implementation of an effective complaints system, including in relation to noise.

- We were given no clear evidence of any measurable scale for unacceptable community levels of claimed adverse effects from wind farms. As noted Professor Dunt submitted to us what he described as the use of a common metric of more than 10% very annoyed as unacceptable.

We accept that there may be some individuals in the general population who may suffer health effects (whether direct or indirect) from wind farms, but it is a policy decision as to what numbers or proportion of the community have to be affected for it to be assessed as unacceptable. This is a matter beyond the responsibility of this Panel.

- We observe that all instances mentioned to us of people allegedly suffering health impacts from wind farms appear to be from
neighbouring properties, and then apparently only some of those. No submission indicated any such impact on stakeholders or those employed at the wind farm. This would appear to be consistent with the report from Pedersen et al of significantly less annoyance by those with a beneficial interest in such a project.

- The instances of claimed ill health from exposure to wind turbines appear to refer to Australia, New Zealand, North America, the United Kingdom and Ireland only. Apart from the wind farm in Germany studied by Dr van den Berg, we have not been made aware of this being a concern elsewhere. We are unsure of whether this means that this is the extent of the problem or it is merely an artifice of limited information exchange between English speaking communities.

- The community apprehension of adverse health consequences from the proposed Stockyard Hill Wind Farm is nevertheless a problem in itself. The Rapid Review of the Evidence by the National Health and Medical Research Council of July 2010 at p4 says:

  *It has been suggested that if people are worried about their health they may become anxious, causing stress related illnesses. These are genuine health effects arising from their worry, which arises from the wind turbine, even though the turbine may not objectively be a risk to health (Chapman 2010). The measurement of health effects attributable to wind turbines is therefore very complex.*

One study of wind turbine noise and annoyance found that no adverse health effects other than annoyance could be directly correlated with noise from wind turbines. The authors concluded that reported sleep difficulties, as well as feelings of uneasiness, associated with noise annoyance could be an effect of the exposure to noise, although it could just as well be that respondents with sleeping difficulties more easily appraised the noise as annoying (Pedersen and Persson Waye, 2007).

In similar vein, Professor Dunt’s commentary on the Expert Panel Review prepared for the American Wind Energy Association and the Canadian Wind Energy Association at 3.2, page 19 (Exhibit L113) includes:

*Its commentary includes a description of the Nocebo effect (opposite to the placebo effect) which it defines as an adverse outcome, a worsening of mental or physical health, based on fear or belief in adverse effects. They describe arrange of reactions including drowsiness, nausea, fatigue, insomnia, headache, weakness, dizziness, gastrointestinal complaints and difficulty concentrating.*
They conclude the section with the comment that an annoyance factor to wind turbine sounds undoubtedly exists, to which there is a great deal of individual variability. Stress has multiple causes and is additive.
Associated stress from annoyance, exacerbated by rhetoric, fears and negative publicity generated by the wind turbine controversy, may contribute to the reported symptoms described by some people living near rural wind turbines.

We conclude from those views that providing clear, comprehensive and timely public reports on all aspects of noise assessment may contribute to alleviating health impact anxieties. We have also recommended public reporting in Chapter 8.

- We were impressed by the straightforward investigation by Cr Clarke into the Waubra issues. He identified sites of claimed noise or health concerns near the Waubra Wind Farm vis-à-vis proximity to turbines and land gradients. We do not accept this as proof of cause and effect, but his approach could be further developed as a means of identifying the circumstances that may lead to noise problems. We would see that approach being a part of the active noise management system for Stockyard Hill Wind Farm which we have also recommended in Chapter 8.

- In addition to our recommendations on noise assessments and public information on those, we believe that it would be worthwhile conducting a properly designed and professionally conducted epidemiological study at existing wind farms to try to identify any combination of physical circumstances that seem to be associated with ill health claims so that these similar circumstances might be minimised at the Stockyard Hill Wind Farm and other WEFs.

- We received many submissions advocating a minimum separation distance between dwellings and wind turbines of 2km to minimise noise and perceived health concerns. Some suggested much greater distances. Dr Thorne recommended such a separation. He said at 5.21, page 25 of Exhibit L157:

  Setback distances are best practice to manage noise because they give certainty of application to the applicant, residents, and approving authority, and incorporate known levels of noise reduction. They do not require extensive and expensive sound monitoring, nor do they require compliance monitoring. Setback distances incorporate the ‘background-plus’ approach to acceptable levels in NZS6808.

Whilst 2km is a distance that was widely quoted, we were provided with limited material to justify its derivation. The current Victorian approach in the Guidelines is performance based: noise and shadow flicker are
required to meet specified standards. In practice that usually leads to a separation distance of about one km or a little greater between non-stakeholder dwellings and turbines. We estimate that a 2km separation distance would result in the removal of about 35 turbines from the amended proposal for the Stockyard Hill WEF.

We conclude that there is no basis for us to recommend such a separation distance.

- A number of submitters, including Ms Russell, suggested that the layout of the proposed wind farm is conducive to generating unreasonable noise. They suggested that the distance between some turbines and the gradient of the slopes where some are intended to be located are outside manufacturers’ recommendations. They expressed the opinion that the turbulence from this siting would generate noise in excess of what it would otherwise be.

We believe that this element of the wind farm design is an issue for the Applicant and the turbine supplier to ensure that warranty conditions are met. Our assessment of the PPAR focuses on the environmental performance of the WEF and sets standards to be met. We conclude that this does not require our further consideration.

- On the evidence and submissions that we have heard on health impacts we have no basis to recommend that a permit should not be approved. We recognise that some people are apprehensive about possible health impacts, those impacts are uncertain and that suggests a case for caution. We cannot ensure that there will be no perceived impacts. But since the case for adverse health consequences rests so clearly on acoustic issues we have been painstaking in our analysis of the noise evidence and our framing of recommendations.
9.5 Recommendations

The Panel recommends that:

Health concerns should be addressed by rigid adherence to the recommended noise limits of NZS6808:1998; by making all reports of noise assessment publicly available; by developing an active noise management system to minimise noise, and thereby perceived health concerns; by putting in place a responsive noise complaints system; and by offering visual screening on nearby properties for its benefits in reducing perceived health concerns.

An properly designed and professionally conducted epidemiological investigation funded by the government and the wind industry should be undertaken at wind farms where there have been health complaints to see if any physical factors might be identified that are common to those complaints and thereby similar circumstances minimised at the proposed Stockyard Hill Wind Farm and other WEFs.

As advised by the National Health and Medical Research Council, research outcomes should continue to be monitored that might lead to a better understanding of any impact of wind turbines on health.
10. **Flora and fauna**

10.1 **Policy and regulatory framework**

The *Policy and planning guidelines for development of wind energy facilities in Victoria* (the Guidelines) provide the assessment criteria for flora and fauna, and in particular:

*The flora and fauna found at a site should be considered in relation to:*

- whether the species and communities are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Flora and Fauna Guarantee Act 1988* (FFG Act)
- the sensitivity of any protected species to disturbance, and
- the potential loss of habitat of species protected under the EPBC Act or FFG Act.

The Guidelines provide advice on surveys that might be needed and require management measures be developed as appropriate.

The Guidelines also remind responsible authorities that consideration of *Victoria’ Native Vegetation – A Framework for Action* is required. This is called up by Clause 52.17 of the planning scheme as discussed in Section 3.3.2.

As outlined in Section 5.6, the proposed Stockyard Hill Wind Farm is a ‘controlled action’ pursuant to the EPBC Act due to potential impacts on listed threatened species and communities and listed migratory species. The reasons include that the proposed wind farm is likely to have a significant impact on:

- The Natural Temperate Grassland of the Victorian Volcanic Plains (NTGVVP);
- The Spiny Rice Flower;
- The Striped Legless Lizard;
- The Golden Sun Moth; and
- Listed migratory species in particular the Sharp-tailed Sandpiper.
10.2 Flora

Information about the flora on the project site was drawn from the following sources:

- Stockyard Hill Wind Farm, Application for Planning Permit, Volumes 1 and 2, Origin/ERM, October 2009 (PPAR);
- Proposed Stockyard Hill Wind Farm, Flora and Fauna Assessment, Brett Lane & Associates, November 2009. (Flora and Fauna Assessment Report);
- Proposed Stockyard Hill Wind Farm, Assessment of Matters of National Environmental Significance, Brett Lane & Associates, March 2010. (AMNES Report);
- The expert witness statement of Mr Brett Lane (A40);
- The expert witness statement of Mr Simon Mustoe (A46);
- The expert witness statement of Mr Ian Smales (A47);
- Peer review of flora and fauna matters of national environmental significance (EPBC: 2009/4719) for Stockyard Hill Wind Farm, Biosis Research Pty. Ltd., February 2010. (NES peer review report); and
- Submissions from neighbouring landowners, members of the community and community organisations, government departments and agencies and local government.

The assessment of flora and fauna was based on the permit application for 242 wind turbines. As discussed in Section 2.2.1, the Applicant has reduced this to 212 wind turbines. Elsewhere in this report, the Panel has made recommendations for a further reduction in the number of turbines. This should have the effect of further reducing the impact of the wind farm on flora and fauna, and this has not been taken into account in the following assessment.

10.2.1 Permit Application - vegetation and flora issues

The southern end of the wind farm development site is mostly cleared of native vegetation and the main land use is agriculture. However, some high quality remnant native grassland remains as well as native vegetation associated with wetlands. The northern part of the development site contains remnant patches of heathy dry forest amongst partially cleared grazing land and some pasture still contains remnant native vegetation.

The wind farm proposal has the potential to impact on threatened flora and native vegetation in the following ways:
• Construction of wind turbines and access tracks to wind turbines;
• Intersection widening, road access and cross-overs for large vehicles;
• Undergrounding of reticulated cabling between wind turbines;
• Construction of five 33/132kV substations;
• Construction of the internal overhead powerline between substations;
• Construction of three temporary staging areas and temporary concrete batching plants and one permanent maintenance facility; and
• Construction of wind monitoring masts.

The Flora and Fauna Assessment Report describes the approach taken by Brett Lane & Associates, to the vegetation assessment. This involved a two stage review involving a site survey, database search and literature review and vegetation mapping of the site (Spring 2007) followed by a more detailed assessment at proposed turbine locations, construction pads, roadside crossings and access tracks identified as supporting native vegetation (Spring 2008). A further targeted survey at two locations to determine the presence of the EPBC Act listed volcanic plains native grassland was also undertaken. For the internal powerline, inspection of routes was undertaken by vehicle with selected foot based inspections. Areas not accessible were inspected from nearby roads and vantage points.

The development footprint was based on the construction design and the following approach to the area assessed was adopted:
• At each turbine location (where construction pads were proposed) an area of 0.15 hectares was assessed; and
• An area 4 metres either side of the centreline of proposed access tracks (5 metres in width) was assessed.

The approach adopted the principles of the Victorian native vegetation management framework to first avoid clearing native vegetation; then minimise impacts; and finally to offset where clearing can not be avoided. The Flora and Fauna Assessment Report describes locations where the development footprint was altered to avoid sensitive areas and indicates that most remnant native vegetation has been avoided.

The Flora and Fauna Assessment Report summarises the key findings of the assessment as follows:

Eleven listed threatened flora species (FFG Act and EPBC Act) are thought to be present or potentially present in the study area: Small Milkwort, Australian Anchor Plant, Clover Glycine, Ben Major Grevillea, Adamson’s Blown-grass, White Sunray, Spiny Rice-flower, Salt-lake Tussock-grass, Hairy Tails, Button Wrinklewort and Swamp Everlasting.
Clover Glycine was recorded within the study area, as was Golden Cowslips at Habitat Zones K and N, a species listed as endangered on the DSE Advisory List of Threatened Flora and Fauna.

21 habitat zones were identified as belonging to the following EVCs: Grassy Woodland(CVU), Grassy Woodland/Heathy Dry Forest Complex (CVU), Heathy Dry Forest (CVU), Heavier-soils Plains Grassland (VVP), Plains Grassy Wetland (VVP), Plains Grassy Woodland (CVU), Stony Rises Woodland(VVP).

Two listed vegetation communities were identified. Western (Basalt) Plains Grassland was identified as being present in habitat zones W and Y and Western Basalt Plains (River Red Gum) Grassy Woodland Floristic Community habitat zone X.

There is not likely to be any significant impact on any Matters of National Environmental Significance under the EPBC Act.

Initial scoping (Phase 1) was used to site turbines and infrastructure away from areas of native vegetation, wherever possible. This was not possible in all cases. Further micrositing of turbines was done during more detailed Phase 2 surveys, to avoid impacts on the highest quality vegetation, in particular, wherever possible, native grassland.

The residual consequence is an estimated 5.31 hectares of native vegetation to be removed, which can be offset by 3.09 habitat hectares, equivalent to 16 hectares of remnant vegetation of equivalent EVCs.

Ten trees were assessed in the development footprint. Of these, one was very large from Heathy Dry Forest, two are large from Valley Grass Forest, four are small from Heathy Dry Forest and three are small from Plains Grassy Woodland. The two large trees from the Valley Grass Forest were situated in habitat zone Q, whilst the remaining trees were scattered. The two large trees identified as requiring removal in habitat zone Q can be offset by protecting four trees and recruiting (planting) 20 trees. The scattered large tree can be offset by recruiting 10 new trees, whilst the seven scattered trees do not require offsetting.

The AMNES Report summarises the findings in relation to threatened flora as follows:

Eight species listed under the EPBC Act were identified as potentially occurring in the proposed wind farm boundary. These were Adamson’s Blown-grass, Ben Major Grevillea, Button Wrinklewort, Clover Glycine, Salt-lake Tussock Grass, Spiny Rice-flower, Swamp Everlasting and White Sunray. A spring survey for these species was undertaken in remnant native vegetation. Micrositing of some turbines and access tracks
was undertaken based on results from these surveys to avoid impacts on the habitats of threatened flora.

Native vegetation mapping has shown that unvegetated areas cover the majority of the site at the proposed location of wind turbines, access tracks and other infrastructure. Only very limited areas of native vegetation (i.e., potential threatened flora habitat) need to be removed. Where native vegetation removal was unavoidable, a late spring targeted survey for rare and threatened flora species was undertaken. Results of the targeted survey indicated that no threatened flora species listed on the EPBC Act would be affected. In addition, no Natural Temperate Grassland of the Victorian Volcanic Plain, and listed EPBC Act threatened community will be affected.

The Flora and Fauna Assessment Report did not report on any native vegetation clearance requirements that would arise from other wind farm infrastructure such as the internal power line, underground cabling (that will run beside the access track), intersection widening, road access and crossovers, sub-stations, monitoring masts, the maintenance depot and the temporary staging and construction facilities.

On the internal power line, the Flora and Fauna Assessment Report concludes, the routes generally avoid native vegetation and direct impacts on significant fauna habitats. In the unused road reserve southeast of the Old Geelong Road, the location of the powerline on adjacent private land would avoid impacts on native vegetation. Reference in the Report is also made to a small area of Plains Grassland along the internal powerline route at the eastern end of Dunnets Road and the Report recommends this also be avoided.

10.2.2 Evidence and submissions

Submitters (WPLG 82, Submission 306 and Submission 94) expressed concern that the flora survey work underestimates the likely number of threatened species in the study area. Concerns were expressed about the lack of field survey at the relevant times, information sources ignored and inadequate use of local knowledge. The Department of Sustainability and Environment (DSE - Submission 306) considered that there was a reasonable expectation that many (twenty-two) other flora species not listed in the Flora and Fauna Assessment Report could occur within the wind farm area.

The Western Plains Landscape Guardians and other submitters raised the following concerns:
The importance of Blacks Creek Nature Conservation Reserve as a significant remnant native grassland was not given sufficient attention (G169, WPLG82, E126);

Loss of native grassland remnants as a result of the wind farm development (G169, WPLG82);

A significant grassland remnant at Blake Lake had not been identified and is threatened by the development (G169, WPLG82);

Important information sources ignored, for example, DSE Biodiversity Action Planning (The Lake Goldsmith Landscape Zone (D103c)) in the Draft DSE Strategic Overview of the Victorian Volcanic Plains, 2003 and the Map of Biodiversity Significance in the Pyrenees Shire, January 2004. The latter document includes a schedule of proposed habitat and remnant vegetation protection overlays (WPLG 82);

Concern about spread of invasive weeds through construction activities (Upper Mount Emu Creek (UMEC) Landcare Group, Submission 289); and

Estimated disturbance footprint around proposed turbines is not realistic and the assessment of the impact is not accurate (WPLG 82).

In his expert witness statement (A40), Mr Lane stated that significant impacts are not expected on threatened plant species or communities from the wind farm. He submitted that the scale of the proposed vegetation removal (5.31 hectares) does not represent a significant impact on the local and regional extent and connectivity of remnant vegetation. In response to submissions, Mr Lane considered that the timing of flora surveys in November (2007 and 2008) was the most appropriate time for surveying rare and threatened flora species. One exception was identified; the Spiny Rice-flower and Mr Lane recommended that pre-construction surveys be undertaken during peak flowering times (April-August) for this species.

In response to criticisms about the lack of adequate field work and failure to identify a large number of plant species and grassland communities, Mr Lane indicated that the staged survey approach adopted allowed the survey effort to be targeted to the development footprint. This represented 2% of the wind farm area and a full survey of every property in the area was not required. He further indicated that as the Guidelines only require assessment of EPBC Act and FFG Act threatened species, targeted surveys need to be timed to coincide with the flowering of these threatened species. As a consequence, significant areas that were not directly impacted by the wind farm, such as Blacks Creek Nature Conservation Reserve have not been profiled in the Flora and Fauna Assessment Report although it is considered by Mr Lane as part of a wider network of core habitat where impacts have been avoided.
In a further response to submissions (A232), Mr Lane indicated the Plains Grassland at Black Lake is recorded in Figure 3 and also in Figure 11 of the Flora and Fauna Assessment Report, and the report indicates that a small area of this native grassland will be removed for T139. This area includes a patch of NTGVVP that will not be affected (page 32). He also indicated that the loss of grassland habitat in the wind farm study area would be 0.5 hectares and this represented 0.03% of the available grassland habitat in the study area.

On the matter of use of data from sources referred to by the Western Plains Landscape Guardians (the Sites of Biodiversity Significance and DSE Biodiversity Action Planning), Mr Lane indicated that fauna information had been used from the former source and that the Biodiversity Action Planning did not contain any geographically specific data which had not been used in the original assessment.

A peer review assessment and report on the Flora and Fauna Assessment Report was provided by Mr Mustoe in his Expert Witness Statement (A46). His review was limited to the report findings, presentation and process. Mr Mustoe concluded:

> Despite some minor omissions, this assessment is founded on a thorough and rigorous process of baseline data collection, ecological wisdom and independent assessment.

> The few inconsistencies in the report appear to be of minor consequence, though some clarification, in places, may assist public understanding. As an assessment of impacts, I believe it meets the standards of rigour and credibility and is a sound basis for decision making. Further detailed investigation would not significantly alter the risk assessment.

> The omission of detailed reference to the Glenelg Hopkins Catchment Management Strategy is something that will need to be corrected as it has direct policy relevance to the outcomes of the assessment and approval. When done, it will provide for a final residual significance assessment and yield more confidence in the outcomes.

Mr Mustoe indicated that the greatest strength of the Flora and Fauna Assessment Report is its use of iterative scoping and the focusing of survey and assessment effort on the most relevant ecological constraints. In this way knowledge from surveys has been used to inform the siting and re-siting of turbines to avoid, where practical, areas of ecological importance. He goes on to state that the project can clearly demonstrate a process by which vegetation impacts were first avoided and then minimised. On native vegetation Mr Mustoe states:
The assessment finds limited native vegetation on site. The vast majority of the land proposed for development is heavily modified farmland, typical in its ecological communities, to farmland throughout Victoria. Following refinement of turbine sites, the total area of native vegetation proposed for removal is estimated at a little over five hectares.

None of the native vegetation EVC communities represent ‘normal’ or ‘ideal’ habitat for protected species so I would agree with the consultants that it is reasonable to assume that a significant impact on these species is unlikely.

The expert witness statement of Mr Smales (A47), *inter alia*, provides a peer review report of the AMNES Report (NES peer review report). The NES peer review report was undertaken in conjunction with Mr Mueck and in essence they agree with the assessments provided in the AMNES Report. They state that:

> There would appear to be little likelihood of significant impacts, as defined by the EPBC Act Policy Statement 1.1 Significant Impacts Guidelines: Matters of National Environmental Significance (DEWHA 2009) or by EPBC Act policy statements for particular species or ecological communities, or any matters of national environmental significance that are controlling provisions for the proposed wind farm.

The NES peer review report recommended surveys for Spiny Rice Flower in accordance with the EPBC Act Policy Statement and sought clarification of grassland definitions. These matters were subsequently addressed in Mr Lane’s expert witness statement (A40) including agreement on the need for pre-construction habitat mapping and species surveys.

In commenting on the definition of native grassland used in the Flora and Fauna Assessment Report and the AMNES Report and distinguishing between NTGVVP and Plains Grassland as defined under the Victorian Native Vegetation Management Framework, the NES peer review report states:

> The use of a number of small (1m x 1m) plots to assess the presence of this community is not supported. The observer should be able to utilise the criteria in the EPBC Act Policy Statement 3.8 and make a judgement on the patches of native vegetation identified under the Frameworks definition and decide if this matches the EPBC Act definition. It is our experience that they correlate well although there are some instances where patches defined using state criteria will not match the EPBC Act policy criteria.

> The interpretation of this definition could also impact the assessment of powerline routes.
Not withstanding this view, Mr Smales concludes (A47):

*I consider that the information provided to me is sufficient to draw the conclusion that there is little likelihood of significant impacts on EPBC Act listed flora and fauna, provided that the precise locations of wind farm infrastructure, powerpoles and associated infrastructure are selected to ensure micro-siting avoids any potential for impacts on the Striped Legless Lizard and any species or communities of flora listed under the EPBC Act.*

The DSE submission (DSE68) indicated that it was comfortable with the overall approach to native vegetation impacts and accepts the general conclusion that finding of offsets is feasible and notes that this will be subject to the approval of a vegetation offset plan. DSE recommended that, as suggested by the Applicant, pre-construction surveys for all listed threatened flora be required to inform detailed design and micrositing.

On the matter of access road upgrading and the potential impact on native vegetation, the Flora and Fauna Assessment Report (page 44) indicates that:

*Consideration will be given to avoiding the use of roads that support higher quality native vegetation in the northern part of the study area. This would avoid any requirement to widen or alter roads to permit construction vehicle access. Excluding those mentioned in the sections above, no scattered trees will be removed. These measures will avoid significant impacts to threatened flora and vegetation communities.*

Two road reserve crossings (Thompsons Road and Stockyard Hill Road) were previously identified in the Flora and Fauna Assessment Report, where a permit under the FFG Act will be required to remove protected flora for road access. In the presentation of his expert witness statement to the Panel, Mr Lane (A41) indicated that an assessment of nine intersections where upgrades may be required was undertaken to determine the impact on native vegetation. The assessment indicated four areas where vegetation may be affected. Following further design work, vegetation impacts were able to be avoided on all but the Skipton and Stockyard Hill Roads intersection. However, the Applicant indicated that the access direction will be from the south thus avoiding the need for vegetation clearance (due to the geometry of the intersection).

At the request of the Panel, Mr Lane (A238) provided an assessment of the vegetation impacts of alternate access track and reticulation cabling route options. The assessment identified limited areas of native vegetation potentially affected and indicated that through mitigation measures it had been feasible to avoid any additional impacts on native vegetation. These
mitigation measures involved micrositing to avoid small patches of native vegetation and moving cabling and access tracks to private land.

The Applicant’s map of the proposed power line route alignment (A165) for both the internal and external powerlines, appears to present an alignment of the internal power line that avoids the unused road reserve of the old Geelong Road.

10.2.3 Panel response

Native vegetation clearance

We agree that the phased vegetation assessment and the progressive focus of the survey effort on the significant remnant habitat areas identified is a sound approach. Twenty-one remnant patches of native vegetation were identified in the study area. We note that the area proposed to be cleared contains six ecological vegetation classes and although small in area, includes some remnants of high to very high conservation significance, being:

- Heathy Dry Forest (2.95 ha)(Low conservation significance);
- Grassy Woodland/Heathy Dry Forest Complex (0.94 ha)(Very high conservation significance);
- Plains Grassy Woodland (0.2 ha)(High conservation significance);
- Grassy Woodland (0.54 ha)(High conservation significance);
- Heavier-soils Plains Grassland (0.53 ha)(Very high conservation significance); and
- Stony Rises Woodland (0.33 ha) (Medium conservation significance).

We agree that the Applicant has employed the avoid clearing, then minimise clearing approach, as required in the Victorian native vegetation framework during the siting of the wind farm infrastructure.

Based on the information provided, we understand that the vegetation clearing for the project predominantly arises from the construction of wind turbines and access tracks. No vegetation clearing appears to be required for sub-stations, temporary staging areas (concrete batching plants), wind monitoring masts or the maintenance facility.

We were advised that the underground reticulated cabling is located on the side of the access tracks and so any requirement for native vegetation clearance would have been assessed with the access tracks. There appeared to be no requirement for vegetation clearance for underground reticulated cabling not associated with an access track.
We were also advised that through design and traffic management the impacts on native vegetation from road access and widening for construction vehicles will be avoided. On our inspection we travelled along several roads, particularly in the north of the wind farm site, that were identified as access roads, that contained considerable overhanging roadside vegetation and that we consider would require upgrading to cope with over-dimensional construction vehicles. The Flora and Fauna Assessment Report states that the roads in the northern part of the study area should be avoided because they support higher quality native vegetation but it is not clear to us what roads are to be avoided. It appears to us that the assessment of the clearing required on roadways for access is incomplete. Consequently we recommend when routes are finalised under the Traffic Management Plan vegetation clearance needs to be re-assessed and a further permit may need to be sought.

We were advised that the routes generally avoid native vegetation along the internal powerline route. While it is suggested that the route in the unused road reserve southeast of the Old Geelong Road is to be avoided because of native vegetation, so that it is unequivocal, we recommend that the internal powerline be located on adjacent private land and to avoid impacts on native vegetation. Reference in the Flora and Fauna Assessment Report is also made to a small area of Plains Grassland along the internal powerline route at the eastern end of Dunnets Road and we recommended this also be avoided.

We also suggest that where the route of the internal and external powerlines coincide, the lines should be co-located on common poles wherever possible.

We agree with DSE that the overall approach to considering native vegetation impacts is appropriate and that finding offsets is feasible and can be managed through the development of a native vegetation offset management plan.

We note that the wind farm study area of 23,150 hectares contains 3,639 hectares of native vegetation. We agree that the scale of the proposed vegetation removal (5.31 hectares) as a result of the impact of the wind farm does not represent a significant impact on the local and regional extent and connectivity of remnant vegetation. We note that the area of Plains Grassland that will be cleared (0.5 hectares) represents 0.03% of the grassland habitat in the study area. The mitigation measures to reduce further potential impacts that are identified in Section 2.5 of the Flora and Fauna Assessment Report should be adopted.
Threatened species (FFG Act)

We note the advice that significant impacts are not expected on threatened plant species or communities from the wind farm. We recognise that not all species may have been reported and this is a potential shortcoming. However, we agree with DSE that this could be overcome by targeted pre-construction surveys, at the appropriate time, to inform detailed design and micrositing.

However, we note the most of the listed threatened flora species are grassland or woodland species and that the focus of the targeted surveys is in previously identified patches of native vegetation. In Section 21.3 of his report and in a submission by Mr Lane (A44), the difficulty in identifying all the native grassland remnants where a shift in grassland composition is influenced by seasonal conditions is discussed. As a consequence of this together with the criticism of the survey approach adopted in the Flora and Fauna Assessment Report to the identification of NTGVVP NES peer review report page 10), we recommend that further habitat observation and assessment be undertaken during the pre-construction surveys, including outside the previously identified remnant grassland areas, in areas proposed for disturbance, as a precursor to targeted surveys. The identification of additional remnant native grassland areas is relevant to the detection of listed threatened flora species as well as protection of the remnants themselves.

We agree that the most appropriate timing for pre-construction flora surveys is in spring with the exception of pre-construction surveys for Spiny Rice-flower which should be undertaken between April and August.

Matters of national environmental significance

We note the advice that no area of NTGVVP will be affected. We understand that the criteria to assess native grassland under the Victorian native vegetation management framework have a lower threshold and differ from those used to assess the presence of NTGVVP under the EPBC Act. Therefore the detection of Plains Grassland is likely to reveal, subject to further survey, if NTGVVP is present. While we agree with the conclusion of Mr Lane and the peer review advice of Mr Smales that there would appear to be little likelihood of significant impacts on EPBC Act listed flora or ecological communities, we note that the validity of the peer review assessment is dependent on the accuracy of the original survey in identifying the extent of the relevant areas that might be impacted by the wind farm.

We endorse the approach taken to identifying native grassland remnants that is outlined in the NES peer review report (page 10) on matters of national
environmental significance. There is clearly some uncertainty in ensuring that all remnant native grassland has been identified (see Section 21.3) and we recommend that the approach described in the peer review report be adopted in all pre-construction habitat surveys. This will clarify the presence of NTGVVP. We also consider that the pre-construction surveys be undertaken in areas that are to be impacted on by the development, that are outside the previous native grassland areas identified.

We agree that the most appropriate timing for pre-construction surveys for Spiny Rice-flower should be between April and August.

We agree with the recommendation of Mr Smales, that the precise location of wind farm infrastructure and any other associated infrastructure be selected with the advice of a qualified botanist and zoologist and that areas to be avoided are clearly demarcated in advance of construction activities.

Other matters

We agree that Blacks Creek Nature Conservation Reserve is important grassland and the fact that it has been acquired by the State for incorporation into the public land parks and reserves system is evidence of its significance. However, we note that it is not directly impacted on by the wind farm.

We have examined the mapping of Sites of Biodiversity Significance in the Pyrenees Shire, promoted by the WPLG (Mr Edney), and we consider this is a helpful approach to facilitate consideration of biodiversity information in planning schemes. We note that the Shire did not proceed to implement the proposals in that project for various reasons. We note also that the source of the data for the mapping was the Corporate Geospatial Data Library, DSE, 2003. This would have included the same sources of information identified in the Flora and Fauna Assessment Report, namely the Atlas of Victorian Wildlife and the Flora Information System. We have also the examined the Lake Goldsmith Landscape Zone Plan that is part of Biodiversity Action Planning – Landscape Plan of the Victorian Volcanic Plain Bioregion- draft May 2003. We recognise the importance of landscape scale approaches to setting priorities for biodiversity actions. Data sources for Biodiversity Actions Plans, however, are again the same data sources as described above, to which the Applicant had access.

We agree that measures should be adopted in the Construction and Operation Management Plan to manage the spread of invasive weeds as recommended by UMEC.
10.2.4 Recommendations

Having considered the submissions and evidence on flora, the Panel recommends that:

When routes are finalised under the Traffic Management Plan, vegetation clearance associated with road access and upgrading be reassessed and a further permit applied for if necessary.

With respect to the unused road reserve southeast of the Old Geelong Road, we recommend that the internal power line be located on adjacent private land and to avoid impacts on native vegetation. We also recommend that the small area of Plains Grassland along the internal power line route at the eastern end of Dunnets Road be avoided as suggested in the Flora and Fauna Assessment Report.

As a consequence of the seasonal influence on the identification of grassland remnants, further habitat assessment should be undertaken during pre-construction surveys. These must include areas outside previously identified remnant grassland that are likely to be disturbed during development as a precursor to targeted flora surveys.

The survey approach to identifying Natural Temperate Grassland of the Victorian Volcanic Plains remnants outlined in the Matters of National Environmental Significance peer review report (page 10) should be adopted in all preconstruction habitat surveys.

The precise location of wind farm infrastructure and any other associated infrastructure must be selected with the advice of a qualified botanist and zoologist and that areas that are to be avoided and not disturbed, must be clearly demarcated in advance of construction activities.

The mitigation measures to reduce further potential impacts on flora and native vegetation that are identified in Section 2.5 of the Flora and Fauna Assessment Report should be adopted.

Measures should be adopted in the Construction and Operation Management Plan to manage the spread of invasive weeds as recommended by UMEC.
10.3 **Fauna other than Brolga**

The wind farm has the potential to impact on fauna and its habitat by destruction of habitat during construction and by collision of avifauna (birds and bats) with turbines.

Information about the fauna on the project site was drawn from the following sources:

- Stockyard Hill Wind Farm, Application for Planning Permit, Volumes 1 and 2, Origin/ERM, October 2009 (PPAR);
- Proposed Stockyard Hill Wind Farm, Flora and Fauna Assessment, Brett Lane & Associates, November 2009. (Flora and Fauna Assessment Report);
- Proposed Stockyard Hill Wind Farm, Assessment of Matters of National Environmental Significance, Brett Lane & Associates, March 2010. (AMNES Report);
- The expert witness statement of Mr Brett Lane (A40);
- The expert witness statement of Mr Simon Mustoe (A46);
- The expert witness statement of Mr Ian Smales (A47);
- Peer review of flora and fauna matters of national environmental significance (EPBC: 2009/4719) for Stockyard Hill Wind Farm, Biosis Research Pty. Ltd., February 2010. (NES peer review report); and
- Submissions by neighbouring land owners, members of the community, community organisations, government departments and agencies and local government.

The Flora and Fauna Assessment Report (page 47) describes the approach to the fauna assessment. This included an assessment of the existing conditions and identification of fauna habitat types for the north and south of Stockyard Hill. Five habitat types were identified and following a review of the existing historical information on the fauna likely to be found in the wind farm site, habitat was identified that had the potential to support eight listed threatened species including those of national environmental significance. Targeted surveys were then undertaken on those threatened species where impacts were considered likely. Birds and bats (including migratory species listed under the EPBC Act) were also surveyed because of the vulnerability of these species to colliding with turbines and mast guys.

As outlined in Section 5.6, the proposed Stockyard Hill Wind Farm has been determined as a ‘controlled action’ pursuant to the EPBC Act relating to listed threatened species and communities and listed migratory species. The fauna species of concern in this determination are:
The Striped Legless Lizard; The Golden Sun Moth; and Listed migratory species in particular the Sharp-tailed Sandpiper.

The Flora and Fauna Assessment Report summarises the key findings as follows:

Five habitat types were identified:

- Remnant woodland;
- Cleared agricultural land;
- Plantation;
- Aquatic habitat; and
- Rocky rise.

These habitats were found to have the potential to support the following eight species: Australasian Shoveler, Brown Treecreeper, Hardhead, Brush-tailed Phascogale, Fat-tailed Dunnart, Growling Grass Frog, Striped Legless Lizard and Golden Sun Moth.

Of these, impacts were considered likely for Striped Legless Lizard and Golden Sun Moth, Birds and Bats. Targeted surveys were undertaken for these species.

Survey results indicated that:

- Striped Legless Lizards were recorded twice in close proximity to Grid 4.
- Fat-tailed Dunnarts were recorded at Grid 5.
- No Golden Sun Moths were observed during targeted surveys.

Nine bat species were recorded during bat surveys, with activity concentrated in areas of remnant vegetation, scattered trees or plantations. Bat activity was lowest in farmland, the location of the proposed wind turbines.

Historical bird activity at Lake Goldsmith, Black Lake, Buln Gherin Meadow and Slate (sic) Lake indicated that migratory bird species were active in these areas. Species included Sharp-tailed Sandpiper, Curlew Sandpiper, Common Greenshank and Red-necked Stint. State-listed threatened species included Brolga, Gull-billed Tern and species listed on the DSE Advisory List of Threatened Fauna including Australasian Shoveler and Whiskered Tern.
Additional information from BOCA demonstrated that the migratory bird activity at Lake Goldsmith was relatively low and represented less than 0.3% of the Australian population.

During the bird utilisation survey, common bird species were observed regularly using the site.

These results were used to identify areas of listed threatened species activity and inform the wind farm design process. As such, areas of native grassland, woodland and rocky rise were avoided, wherever possible.

Four potential sources of impact were identified: habitat loss, displacement and disturbance, collision risk with wind turbines and collision risk with mast guys. None of these were assessed as significantly impacting the fauna populations.

The AMNES Report summarises the key findings in relation to threatened and migratory fauna as follows:

Targeted surveys were undertaken pre referral for Striped Legless, Golden Sun Moth, bats and birds. Additional surveys have been conducted post referral for Golden Sun Moth. Targeted Striped Legless Lizard survey located two individuals in the Stockyard Hill area, one potentially a gravid female which would represent a breeding population. Two Golden Sun Moth surveys undertaken in 2008 and 2009 did not identify any individuals in the two areas of suitable habitat which were identified. Impacts are therefore considered unlikely especially considering these habitat patches are situated outside the proposed development footprint. No threatened bat species were found during the bat survey. During the fauna surveys, one migratory species, Latham’s Snipe, was recorded.

Additional historical data on listed migratory species was kindly provided by DSE and BOCA for Lake Goldsmith and important surrounding wetlands and lakes. These indicated a high level of activity at these sites until 1994 when the lake dried up as a result of drought. Within Lake Goldsmith, 36 waterbird species were found to EPBC Act and listed on the Japan and Australia, China and Australia and Republic of Korea Australia Migratory Bird Agreements, and four were protected under be active at the site, five of which were listed migratory species protected under the Commonwealth legislation.

Lake Black (sic) supported 10 species, Slate Lake (sic) supported 11 species, and finally, bird species richness at Buln Gherin Meadow was similar to that of Lake Black(sic) with 10 species frequenting the site. Discussions with the BOCA indicated that bird activity was mainly confined to the southern quarter of Lake Goldsmith, where suitable habitat was present. However isolated records of shorebirds were found north-
west of the site. During the surveys undertaken by BOCA, species were dominated by Sharp-tailed Sandpiper and Red-necked Stint. In addition to these two species, species recorded on the majority of visits included Curlew Sandpiper, Marsh Sandpiper and Greenshank, the Pectoral Sandpiper also occurred regularly.

Impacts of the proposed wind farm.

The Striped Legless Lizard was found to occur in remnant native grassland on Stockyard Hill. Where construction of the wind farm is proposed close to this habitat, a salvage protocol is proposed to translocate salvaged individuals to nearby habitats.

As no Golden Sun Moths have been found on the proposed wind farm site, including during additional surveys in late 2009, consistent with the EPBC Act policy statement survey requirements for this species, no impact is expected from this species for this project.

Annual bird and bat collision mortality is likely to range between 0.4 and 4 individuals per wind turbine per year, based on figures for other wind farms elsewhere in southern Australia and overseas. The birds and bats most likely to be affected regularly are the most abundant species in the area, which surveys confirmed comprised common farmland birds and low activity levels of bats.

No EPBC Act listed species, were observed using the site in any important numbers. Occasionally, several thousand Sharp-tailed Sandpipers, a listed migratory species under the EPBC Act, have been observed on Lake Goldsmith. The likely irregularity with which this species occurs at this wetland in high numbers, combined with the low likelihood of turbine collision during its time spent at the wetland (due to a sufficient separation buffer) and the generally high altitude of migratory flight indicate that collision-related mortality of this species is most likely only very rarely and, therefore, that the impact of the wind farm is unlikely to be of consequence at a population scale.

Based on the foregoing findings, it has been concluded that, no impacts of consequence for the regional or wider populations of any species listed on the EPBC Act are likely to arise from the project.
10.3.1 Evidence and submissions

Submitters raised the following concerns about the assessment of fauna in the wind farm site:

- The assessment ignored local sources of information; the field survey effort was inadequate and as such did not provide a comprehensive understanding of the fauna of the area (WPLG 82, M89);
- Surveys were undertaken during an extensive period of drought and also when species would have been seasonally absent and this has lead to an under-estimation of species using the wind farm area (Submission 170, Submission 94, WPLG 82, B88, WPLG 80);
- Bird utilisation surveys were conducted at an inappropriate time (WPLG 80);
- Survey effort for bats was not adequate (Submission 94);
- Impacts on raptors were not adequately addressed. Raptor numbers will increase when Lake Goldsmith holds water (Submission 94, B88). The assessment understates raptor activity (Submission 289);
- Proposed overlays of sites of biodiversity significance to protect bird habitat, including information on Powerful Owl, has not been considered in the assessment (WPLG 82);
- The assessment does not address the impact of migratory birds flying at night, particularly the migration of large numbers of birds to Lake Goldsmith (Submission 77, WPLG 82);
- There is a lack of recognition in the assessment of the Wedge–tailed Eagle (Submission 94, J171);
- The collision impact on birds from the wind farm is not adequately addressed. Mortality monitoring is not addressed (WPLG 82);
- The significance of Lake Goldsmith for water birds is underestimated because it is dry. Significant numbers of birds (25,000 to 30,000) have been seen on the Lake including up to 2,000 individuals of the EPBC Act listed shorebird species and the lake satisfies the draft Commonwealth guidelines for a wetland of national significance for migratory birds.(B88, Submission 289, WPLG 82, G169, M89);
- Grid survey for Striped Legless Lizard and Fat-tailed Dunnart only surveyed a small percentage of potential habitats for these species (Submission 306);
- Lake Goldsmith Landscape Zone – Biodiversity Action Plan overlooked in the assessment (WPLG 82, E126);
- Assessment does not recognise Blacks Creek Nature Conservation Reserve as an important fauna habitat (WPLG82, G169, E126);
- There are no setbacks from turbines proposed for Black Lake like the 450 metres proposed for Lake Goldsmith and waterbirds using the Lake will be impacted (B 88, G169, E 126); and
- A science-based monitoring program should be established and an independent technical advisory committee established to assist with the development and refinement of monitoring protocols (B88).

In his expert witness statement (A40) and presentation to the Panel (A41), Mr Lane indicated that the targeted surveys for threatened fauna species were directed at those habitats (and hence species) likely to be directly impacted by the wind farm. For two aquatic species, Hardhead and Growling Grass Frog, wind farm infrastructure is located away from suitable habitat and control measures to further minimise risk will be implemented during construction. The grassland habitat at Stockyard Hill where the Striped Legless Lizard was recorded will not be impacted on, as the wind farm layout had been adjusted to avoid the remnant grassland in that area. As described in the Flora and Fauna Assessment Report, a population of Fat-tailed Dunnarts was recorded as being present in the study area in remnant patches of Plains Grassland and this habitat will also be avoided and further pre-construction measures implemented. Golden Sun Moth was not recorded and Mr Lane indicated that as only a small amount of potential native grassland habitat (0.5 hectares approximately) was likely to be impacted, it was unlikely to be affected. Mr Lane was of the view (A 41) that there would be no significant impacts on threatened ground fauna species.

DSE (DSE 68) supported the proposal from the Applicant to undertake pre-construction targeted surveys for threatened fauna (Striped Legless Lizard, Fat-tailed Dunnart and Golden Sun Moth) to inform detailed design and micrositing. DSE also noted that Striped Legless Lizards could occupy areas of non-native grassland adjacent to native grassland. DSE acknowledged that impacts on the Growling Grass Frog would be avoided by locating infrastructure outside habitat areas for this species.

In response to issues raised in submissions, Mr Lane (A 41) indicated that the lack of extensive suitable foraging habitat (treed vegetation) and the low level of bat activity in the areas surveyed where turbines were proposed to be located, confirms that bat activity is low and further surveys are not warranted. Raptors were detected during the bird utilisation survey including Wedge-tailed eagles. Mr Lane indicated that raptor activity was low and the utilisation rate for Wedge-tailed eagles at the site was also low (0.035 birds per
hectare per hour) compared with elsewhere in Victoria (0.001 to 0.44 birds per hectare per hour).

In relation to timing of fauna surveys and the extended drought conditions, Mr Lane (A235) indicated that historical records from DSE, the Atlas of Victorian Wildlife, Birds Australia, EPBC Act Protected Matters Search Tool and BOCA were used to determine whether threatened species were likely to occur. Habitat suitability for these threatened species was then assessed and targeted surveys then undertaken at the appropriate times of the year.

Mr Lane (A41) agreed that the larger wetlands on and near the proposed wind farm occasionally support significant numbers of migratory shorebirds and other waterbird species, in particular Lake Goldsmith. In acknowledging the 2009 draft Commonwealth guidelines for assessing wetlands of national significance for migratory birds, Mr Lane indicated that Lake Goldsmith has the potential to support 0.1% of the flyway population of the Sharp-tailed Sandpiper. However he indicated this occurred fifteen years ago and given the varying nature of this habitat it is unlikely to occur regularly. Furthermore Mr Lane indicated (A41) that the wind farm is well set back from the lake (450 metres to the nearest turbine) and based on migration flight behaviours and observations of local movements, the impacts of collisions with turbines are unlikely to result in significant disruption to the population or movements of an ecologically significant proportion of the known populations of the species that occasionally inhabit Lake Goldsmith in large numbers. Mr Lane (A 41) advised that nocturnal migration of birds to Lake Goldsmith would only occur when the lake supports large numbers of waterbirds and this is unlikely to occur regularly.

The Applicant’s response to the utilisation of information from the Biodiversity Action Planning and the Landscape Plan for Lake Goldsmith and also the Sites of Significance overlay information has been described previously in Section 10.2. In relation to the Powerful Owl information, Mr Lane (A235) indicated that the study area supports very little suitable habitat and the species is unlikely to be present on the site on a regular basis.

The Applicant’s, response to the Blacks Creek Nature Conservation Reserve is provided previously in Section 10.2.

The Flora and Fauna Assessment Report states that the degree of impact on birds and bats (i.e. mortality from collisions) depends on site characteristics. These include habitat and topography, which influence animal density, and the location of specific movement corridors. The report indicates that Australian studies of bird mortality correspond to a collision rate of between one and four birds per turbine per year and for overseas studies the range is
0.04 to 4 birds per turbine per year. Mr Lane concluded (A42) that taking into account bird diversity and abundance, and the highly modified landscape, the wind farm is unlikely to have a significant impact on bird populations. He further indicated that the most regularly affected birds will be common farmland birds adapted to modified landscapes. He noted that the model planning permit conditions for wind farms in Victoria require formal impact monitoring of collision mortality and this will be undertaken at the Stockyard Hill Wind Farm. Mr Lane indicated (A235) that should bird mortality numbers exceed an agreed threshold, appropriate mitigation measures would be applied during identified periods.

The Flora and Fauna Assessment Report states that impacts on bats from wind farms are similar to those for birds. Overseas studies demonstrated that bat fatalities ranged from 0.07 bats per turbine per year to 2.04 bats per turbine per year. The proposed Stockyard Hill wind farm is primarily situated away from suitable habitat in areas that lack native vegetation. Turbines are located in the north of the wind farm site near forested areas where bat activity was higher, but these turbines are 250 metres from suitable habitat and this is considered sufficient to minimise impacts. Given that bat activity across the site is low and the primarily cleared nature of the land, the likelihood that significant numbers of bat species would be affected is considered low. Furthermore no species listed under national or state threatened species legislation were recorded during bat surveys.

Mr Lane (A235) indicated that the closest turbine to Black Lake is 100 metres and taking into consideration that the wind resource is significant in this area, Black Lake has been considered as an exemption to the 450 metre buffer as proposed by BOCA (B88).

A peer review of the Flora and Fauna Assessment Report was provided by Mr Mustoe in his expert witness statement (A46). His findings have previously been summarised in Section 10.2 of this Report. On fauna risk matters he states:

> Baseline bat and bird surveys were done following Auswind standards (Auswind, 2006). These appear suitably robust as a basis for assessment and were rigorously applied by the consultants. Similarly, the work on Brolga is very thorough. I agree with the survey findings that the biodiversity components of greatest residual concern were:

- Relatively small areas of native vegetation; and
- Brolgas and collision risk from turbines.

I also agree with the consultant’s findings that waterfowl are not likely to be a significant matter. Historical data on waterfowl numbers is an
indication of historically low densities and coupled with the absence of turbines through main wetland corridors, is evidence of negligible risk.

Other protected fauna

I concur with conclusions regarding protected species. The absence of suitable habitat within areas directly affected by wing turbines for Golden Sun Moth, Striped Legless Lizard, Growling Grass Frog and a range of other Victorian protected species, including waterfowl, is a suitable basis for assuming a significant impact is unlikely.

The expert witness statement of Mr Smales (A47), inter alia, provides a peer review report (NES peer review report) of the AMNES Report. The findings have also been previously summarised in Section 10.2 of this Report. The NES peer review report concludes that there would appear to be little likelihood of significant impacts on any matters of national environmental significance that are the controlling provisions for the proposed wind farm.

The conclusion drawn in the Flora and Fauna Assessment Report that there is unlikely to be a significant impact on the population of migratory shorebirds that occasionally inhabit the lake, as described above, is drawn from flight behavioural observations of movements to and from suitable habitat. The NES peer review report notes that the information about movements of these species is largely conjectural. The review suggests the most relevant aspect in consideration of the likelihood of shorebird collisions with turbines is that most of the wind farm site itself and much of the local surrounding area offer little suitable habitat for shorebirds. The NES peer review report concludes (page 9):

It would thus appear that, regardless of flight heights, relevant species are likely to fly through or over the limited portions of the site only and that this will occur only during periods when local environmental conditions are suitable for shorebirds. The immediate and specific locations of turbines offer no resources of use to shorebirds but that does not preclude the potential for birds to fly through the airspace where turbines are situated on occasions when they move between habitats.

The review report recommended that an evaluation of the likely effects on the Sharp-tailed Sandpiper using the specific criteria set out in the EPBC Act Policy Statement 3.21 Significant impact guidelines for 36 migratory shorebird species – Migratory species (DEWHA November 2009) be undertaken.

Notwithstanding these comments Mr Smales concludes (A47):

I consider that the information provided to me is sufficient to draw the conclusion that there is little likelihood of significant impacts on EPBC
Act listed flora and fauna, provided that the precise locations of wind farm infrastructure, powerpoles and associated infrastructure are selected with the advice of a qualified botanist and zoologist to ensure micro-siting avoids any potential for impacts on the Striped Legless Lizard and any species or communities of flora listed under the EPBC Act.

10.3.2 Panel Response

Threatened species (FFG Act)

We agree with the advice that significant impacts are not likely on threatened fauna species from the wind farm.

We note that in undertaking this assessment, the Applicant has utilised historical information from a number of sources, albeit not from all the local sources that were available. This approach assists in overcoming seasonal variations in distribution and abundance of species caused by events such as drought. We note that the classification of habitats in the area then facilitated a stratified approach to targeted surveys for ground fauna. We are generally satisfied with this approach to the identification of threatened species subject to the qualification about the adoption of the approach to the identification of remnant native grassland habitat that is discussed in Section 10.2 of this report and outlined on page 10 of the NES peer review report. We support DSE’s response to threatened fauna and that pre-construction surveys be undertaken to inform detailed design and micrositing including in areas of non-indigenous grassland linked to remnant native grassland habitat.

We note that the bat survey indicated a low level of bat activity and no species of bat listed as threatened under State legislation were detected.

Matters of national environmental significance

Threatened species

We agree with the approach to mitigate the impacts on the Striped Legless Lizard and the Golden Sun Moth and that pre-construction surveys must be undertaken in appropriate potential habitat. We recommend that these surveys adopt the approach to identifying remnant native grassland discussed in Section 10.2 of this report (and as set out in the NES peer review report page 10).

We note that no nationally listed threatened species of bat was detected.

We agree with the conclusion of Mr Lane (A41) and Mr Smales (A47) that there is unlikely to be significant impacts on EPBC Act listed fauna. We also
support the proposal that the precise locations of wind farm infrastructure, power poles and associated infrastructure are selected with the advice of a qualified botanist and zoologist to ensure micrositing avoids any potential for impacts on the Striped Legless Lizard.

**Migratory shorebirds**

We agree with a number of submitters that Lake Goldsmith is a significant wetland. While in recent times it has been dry, the historical records indicate its importance for EPBC Act listed shorebirds and particularly the Sharp-tailed Sandpiper. Given the right environmental conditions the lake is likely to be a haven for migratory shorebirds again and we consider the wind farm proposal should anticipate this eventuality. We note the advice in the NES peer review report (page 9) and while we agree with the conclusions that the wind farm is unlikely to have an ecologically significant impact on the populations of shorebird species that inhabit the lake, we support the need for a comprehensive science based monitoring program and the development of contingency turbine shut down protocol in the event of a major migration of shorebirds to and from the lake. Furthermore we recommend that an evaluation of the likely effects of the wind farm on the Sharp-tailed Sandpiper be undertaken in accordance with EPBC Act Policy Statement 3.21.

**Other matters**

We note that page 89 of the Flora and Fauna Assessment Report indicates that raptors are considered vulnerable to collision with turbines; of particular concern is the Wedge-tailed Eagle. We note the low utilisation rate of the wind farm site compared with other localities, however, a residual risk remains. While not a threatened species, we recognise that the Wedge-tailed Eagle is somewhat of an icon species for the community and the impact of the wind farm on this species will need to be assessed as part of the bird monitoring program. We note the assessment that the impact of the wind farm on bird and bat mortality is unlikely to be significant. However, we recommend that threshold levels for bird and bat mortality be established and if exceeded mitigation measures be put in place.

Our comments on the Sites of Biodiversity Significance in the Pyrenees Shire and Biodiversity Action Planning have been provided previously in Section 10.2.3.

We note the comments regarding Black Lake and the reason provided for exemption from buffering because of the significant wind resource in the area. Our response to this issue is discussed in the following section on Brogla.
10.3.3 Recommendations

Having considered the submissions and evidence on fauna (other than Brolga), the Panel recommends that:

As a consequence of the seasonal influence on the identification of grassland remnants, further habitat assessment should be undertaken during pre-construction surveys. These must include areas outside previously identified remnant grassland that are likely to be disturbed during development as a precursor to targeted fauna surveys.

The survey approach to identifying Natural Temperate Grassland of the Victorian Volcanic Plains remnants outlined in the Matters of National Environmental Significance peer review report (page 10) be adopted in all preconstruction habitat surveys.

Pre-construction surveys for threatened fauna should be undertaken to inform detailed design and micrositing including in areas of non-indigenous grassland linked to remnant native grassland habitat.

The precise location of wind farm infrastructure and any other associated infrastructure be selected with the advice of a qualified botanist and zoologist and that areas that are to be avoided and not disturbed, are clearly demarcated in advance of construction activities.

A comprehensive science-based bird and bat monitoring program should be developed. Threshold levels for bird and bat mortality should also be established for the wind farm and if exceeded agreed mitigation measures are to be put in place.

The development of a contingency turbine shut down protocol in the event of a major migration of shorebirds to and from Lake Goldsmith should be developed and implemented. Further an evaluation of the likely effects of the wind farm on the Sharp-tailed Sandpiper is to be undertaken in accordance with EPBC Act Policy Statement 3.21.

10.4 Brolga

The Brolga is listed as a threatened species under the FFG Act. It is estimated there are between is 600-650 birds in Victoria and most birds are now restricted to the south-west of the State. They are dependent on shallow, grass or herb-dominated freshwater wetlands for breeding and permanent freshwater areas and a regular food supply at flocking sites. Drainage (mostly for agriculture) has resulted in the loss of 79% of all shallow freshwater marshes (which are the preferred Brolga breeding wetlands in the western
district of Victoria) and a loss 66% of deep freshwater marshes (which are used during drier periods to a lesser extent for breeding (Action Statement No. 119, Brolga, *Grus rubicunda*, *Flora and Fauna Guarantee Act* 1998)).

Information about Brolga was drawn from the following sources:

- Stockyard Hill Wind Farm, Application for Planning Permit, Volumes 1 and 2, Origin/ERM, October 2009 (PPAR);
- Proposed Stockyard Hill Wind Farm, Flora and Fauna Assessment, Brett Lane & Associates, November 2009 (The Flora and Fauna Assessment Report);
- Draft Guidelines for the Assessment of Potential Wind farm Impacts on the Brolga, Department of Sustainability and Environment, June 2009 (the Brolga Guidelines);
- The expert witness statement of Mr Brett Lane (A40);
- The expert witness statement of Mr Simon Mustoe (A46);
- The expert witness statement of Mr Ian Smales (A47);
- Modelled risk of Brolga collisions with turbines at the proposed Stockyard Hill Wind Farm Biosis Research (2009);
- Evaluating risk of Brolga collisions with powerlines for the proposed Stockyard Hill Wind Farm Biosis Research (2009);
- Predicting impacts of the Stockyard Hill wind farm on the Victorian Brolga population, Final Report; Michael McCarthy (2009); and
- Submissions by neighbouring land owners, members of the community, community organisations, government departments and agencies and local government.

### 10.4.1 Brolga issues and permit Application

Wind farms have the potential to impact on the Brolga in the following ways:

- Habitat loss by removal of wetlands and nearby pasture habitats as a result of the construction of wind farm infrastructure;
- Collision with wind turbines, power lines and monitoring equipment;
- Disturbance of birds leading to displacement and exclusion from areas of suitable habitat or changes in behaviour; and
- Creation of barriers to flying birds, interrupting migratory movements between important habitat areas or disrupting local flight paths.

The Flora and Fauna Assessment Report (page 95) describes the approach to the targeted assessment of the Brolga that was agreed with DSE.
This agreed approach comprised:

- Data collection on site and a search of region specific data on the status and behaviour of Brolga;
- The application of collision risk modelling to the findings of these investigations to predict the number of Brolgas potentially affected by the proposed wind farm; and
- The development and application of a Population Viability Analysis (PVA) model to assess the impact on the population.

A three staged assessment has been undertaken consistent with the interim risk assessment standards for wind farms and birds outlined in the Auswea guidelines (Australian Wind Energy Association, Wind Farms and Birds: Interim Standards for Risk Assessments, 2005).

The level 1 assessment identified the Brolga as a species of concern that would be potentially impacted by the wind farm. The level 2 assessment involved a review of existing data to identify known Brolga nesting and flocking sites and migration patterns within twenty kilometres of the wind farm. The level 3 assessment involved more detailed investigations to gain an understanding of the movements and behaviour of the Brolga population in the region.

Field work was undertaken during the breeding season, migration season and flocking season in 2007 and 2008. This provided information that formed the basis for defining the Brolga home range and wind turbine exclusion zones around breeding and flocking sites. The results from these investigations were also used subsequently in collision risk modelling. The Flora and Fauna Assessment Report (page 140) states that the principal means of mitigating impacts on Brolga is through appropriate separation distances between turbines and birds. To mitigate the potential barrier effects of the wind farm, the Report also describes the establishment of two movement corridors in the northern part of the wind farm (1.5 kilometres wide) and the southern part (2 kilometres wide) to facilitate Brolga movements between breeding and flocking sites in this part of their range.

The key findings of the targeted Brolga assessment were:

- No direct removal of habitat is expected as turbines are sited well up-slope of breeding sites.
- Indirect (disturbance) effects on Brolgas during the breeding season may occur from operating wind turbines and these have been mitigated through the adoption of turbine exclusion zones comprising 400 metres of pasture, plus a 300 metres disturbance exclusion around
a core breeding home range linking all useable wetlands within 3.2 kilometres of all useable historic and current known breeding sites.

- Migration season impacts may arise as a consequence of collision with operating turbines. They are considered to be very low. Barrier effects during the migration seasons may occur so these have been mitigated through the adoption of a turbine exclusion zone comprising a northern (>1.5 kilometres wide) and a southern (>2 kilometres wide) movement corridor for Brolgas.

- In the flocking season, a 5 kilometre exclusion zone around traditional flocking sites (as distinct from one-off stopover sites) has been adopted to prevent indirect disturbance of habitats used by flocking Brolgas.

- The residual impacts of the project on the Brolga have been modelled using a collision risk model and the resulting potential population effects have been evaluated using PVA (McCarthy 2008). This has estimated that across all seasons, the total likely annual collision rate of Brolga with operating wind turbines at the proposed Stockyard Hill Wind Farm is 0.2 birds per year (Smales 2008). Powerline collisions (internal and external) have been estimated at another 0.03 birds per year (Smales 2009).

- PVA modelling (McCarthy 2008) indicates that this order of mortality would result in the loss of an extra one or two birds from the population over 20 years and that an increase of 0.22 birds recruited to the adult population per annum would be sufficient to mitigate this impact. The impact of the powerline collision would not significantly alter this effect.

- Further, specific mitigation measures will be developed to offset the modelled population impacts arising from the project, including provision of additional breeding habitat through wetland restoration and reduced adult mortality from marking powerlines near flocking sites.

- Detailed mitigation plans will be developed if Brolgas breed or flock within critical distances from the proposed wind farm to further reduce risk.

10.4.2 Evidence and submissions

Submitters raised the following concerns about the targeted Brolga assessment:

- Breeding and flocking site information is inaccurate and not comprehensive. Not all the historical and available data has been...
considered. The assessment under-estimates the extent of Brolga activity. Local information has not been taken into account. Field observation methods and survey techniques lack precision. Field observations on Brolga behaviour were of insufficient duration and intensity (E 126, M154, J 171, WPG 82, G 169, WPLG79, C199);

- The assessment of Notman’s Swamp (wetland 39) as being unsuitable habitat for Brolga is incorrect. Brolga have nested on the wetland (N175, J 171);
- Black Lake should not be excluded from buffering from turbines. The assessment does not recognise the evaluation of Black Lake by the Land Conservation Council (M154, E126, J171, WPG 82, G 169, B 88);
- Powerlines impact on Brolga and the internal powerline passes through a buffer zone. They intersect with flight paths and should be put underground (Submission 289, DSE68, R 173, G169, J 171, Submission 294);
- Population estimates of the Brolga are inaccurate (C199, WPLG82, WPLG79);
- The Atlas of Victorian Wildlife (AVW) records are not up to date. The most up to date records were not used (WPG 82, E126, WPLG79, C199);
- The proposed wind farm project does not compliment the Brolga Action Statement (C199);
- Buffer zones are flawed. Buffer zones need to be increased to 3 kilometres for breeding sites and 5 kilometres for flocking sites (C199, WPLG 82);
- Need to consider a third corridor for Brolga movement south from Lake Goldsmith and increase the width of the existing corridors to 3 kilometres (Submission 289);
- No information provided about Brolga movements at night or in poor light conditions (H106, C199);
- Seasons in which the survey work was undertaken are not representative and there are gaps in the seasons studied (B88, WPLG79);
- The cumulative impact on the Brolga is not assessed (B88, WPLG82);
- The modelling undertaken for Brolga is flawed because of the lack of knowledge about Brolga ecology, flight movements, flight heights and collision avoidance rates. The model is a poor predictor of bird mortality as shown elsewhere. The modelling under-estimates bird mortality. An alternative bird impact model was advocated (C199, B88);
- Mitigation measures to offset the impacts Brolga deaths are unrealistic (C199);
- Shut down procedures should be established for when Brolgas are at risk of collision (B88);
- The wetland mapping is not accurate and some wetlands are missing from the report (C199);
- A science base monitoring program should be established and an independent technical advisory committee established to assist with the development and refinement of monitoring protocols (B88); and
- Penalties should apply to Brolga deaths attributed to the wind farm (C199).

In his expert witness statement (A40), Mr Lane clarified the extent of the targeted Brolga surveys indicating that surveys were undertaken in 2007, 2008, 2009 and 2010 covering periods of the breeding, flocking and migration seasons.\(^{32}\) He explained how the behavioural studies of the Brolga had informed the development of the breeding home range from which wind turbines had been excluded to mitigate the effects on Brolgas during the breeding season. All current and useable historical breeding records had been identified from the Atlas of Victorian Wildlife records for the region. He indicated that the only exception to this was the exclusion of Black Lake due to the highly valuable wind resource in that area. He re-iterated the key findings of the assessment, summarised above, and indicated that collision risk modelling suggests that residual impacts will be less than two birds affected on average every 10 years.

In his presentation to the Panel, Mr Lane (A 42) provided an assessment of 56 additional Brolga records that were provided to the Applicant by DSE just prior (26 March 2010) to the Panel hearing commencing. DSE (DSE 68) acknowledged that the records had only recently been provided but nevertheless submitted that the data are relevant to the consideration of the impacts of the proposal.

Mr Lane’s assessment indicated that of the 56 records, 48 sites were discarded because they could not be linked to a wetland, were drained or assessed as low potential for breeding. The remaining potential 8 Brolga breeding sites were within the existing mapped home ranges or outside the boundary of the proposed wind farm with the exception of one wetland (wetland 37) where no home range mapping had been undertaken. His assessment also excluded Notman’s Swamp (wetland 39) that had been identified by submitters (N175, J171) as a Brolga breeding site. The basis for excluding Notman’s Swamp was that it was drained and cropped and partly covered with Poa tussocks and there was no likelihood of future breeding attempts.

\(^{32}\) We note that in A235, Mr Lane indicates that surveys were undertaken in 2007, 2008 and 2010.
In response to submissions, Mr Lane (A41) clarified that the Brolga analysis includes all historical records both pre and post 1988 in accordance with the decision of the Brolga Scientific Panel (convened by DSE of which he, Mr Hill from DSE, Mr Smales and Mr Mustoe are members) and this would cover a wide range of seasonal conditions, not covered by the survey period.

The targeted assessment studies were undertaken in accordance with the Auswea guidelines and the survey effort was undertaken over a period of three years. He indicated that information was sought from local residents through a questionnaire and the responses analysed. In answer to questions from the Panel, Mr Lane indicated there were 13 responses and no additional Brolga localities were identified through this survey. Mr Lane indicated that all wetlands within three kilometres of the site were accessed for assessment where the landowner permitted access (in one case this was not granted). This was combined with an analysis of DSE databases, air photo interpretation and examination of topographic maps. On the issue of the width of flight corridors, Mr Lane relied on observations of the behaviour of the European Crane to wind turbines to support the design width of the proposed corridors and advised that the corridors would prevent a barrier effect occurring.

Mr Lane (A235) stated that the closest proposed turbine to Black Lake is 100 metres and taking into consideration the wind resource is significant in this area, Black Lake has been considered as an exception from buffering.

In his expert witness statement and presentation to the Panel, Mr Smales (A47, A48) provided an assessment of the modelling of turbine collision risk for Brolga (Modelled risk of Brolga collisions with turbines at the proposed Stockyard Hill Wind Farm, Biosis Research, September 2009). The assessment is based, in part, on the behaviour of Brolga derived from data collected during the Brolga field surveys undertaken in 2007 and 2008 reported in the Flora and Fauna Assessment Report. A range of projections for the annual average numbers of Brolga mortalities - contingent on the size of turbines used, mean avoidance capacity of Brolgas and routes used by Brolgas during migratory movements - were provided. Two scenarios were modelled for migrations through the site. The first assumes birds fly by any random route and thus it is possible to encounter all of the turbines on the site (Scenario 1). The second assumes the birds preferentially utilise lower-lying and generally the most direct route through the site (Scenario 2). For the turbine type proposed for Stockyard Hill and a 95% avoidance rate the estimated annual number of Brolga collisions ranged from 0.196 (Scenario 1) to 0.101 (Scenario 2).

Mr Smales indicated that there are currently no data available for actual interactions between the Brolga and wind turbines. However the ecology of Brolga suggests it is likely to use direct routes over low-lying ground in
migration movements between breeding and flocking sites. Mr Smales stated that turbine collision avoidance rates are virtually all above 90% for the majority of bird species, with many species being above 98%. While brolgas are known to collide with powerlines, he considered that avoidance capacity for Brolgas is likely to be above 95%. However, he indicated that there is no empirical data obtained from operating wind farms about the capacity for Brolga to avoid collisions with turbines. In conclusion, Mr Smales noted that the model cannot forecast the frequency of collisions around the predicted annual average. It should be expected that, if collisions actually occur, the number may vary from year to year in a fashion that cannot be predicted. As Brolga frequently fly in flocks and because collisions entail whole birds, more than one individual may be involved on a particular incident.

Mr Cumming (C199) in his presentation to the Panel, argued that the Biosis model underestimated the collision risk and presented an alternative bird impact model that demonstrated significantly higher bird collisions. The alternative bird impact model did not contain any factor for collision avoidance as Mr Cumming advised that there was no empirical basis for determining this for Brolga.

Several submitters expressed concern about the impact of powerlines on Brolga. Brolga are known to occasionally collide with powerlines in Victoria although published documentation is limited and not recent. Collision with powerlines was considered to be a significant threat to the Brolga population in Victoria (DSE 68). In his expert witness statement (A47) Mr Ian Smales provided a report on the modelling of powerline collision risk (Evaluating risk of Brolga collisions with powerlines for the proposed Stockyard Hill Wind Farm, Ian Smales, Biosis Research, 2009). This report indicates that there is no empirical data about Brolga collisions with powerlines in south-western Victoria that might provide a basis for quantifying them. An approach based on available information was devised. The collision risk report included both powerlines internal to the wind farm and the external line. The modelling encompassed seventeen breeding sites near the internal powerline and two breeding sites and one flocking site near the external line. The impact of the external powerline was not modelled separately. Mr Smales indicated that as a consequence of including both the internal and external lines the collision modelling results are marginally higher than projections would be for just the internal powerline. Results suggest that an approximate average of 0.0324 Brolga fatalities per annum may collide with the proposed powerline. The report indicates that this annual value predicted is a forecast over the long term and the model does not have the capacity to predict the frequency of such events. In response to submissions, Mr Lane (A40) advised that the internal powerline route passes within 3 kilometres of up to 17 Brolga
breeding sites and, while modelling had indicated impacts are likely to be low, mitigating impacts by powerline marking should be considered. Bird Observation and Conservation Australia (B88) supported the use of powerline marking suggesting this would require some investigation to determine the most appropriate locations and that advice be sought from DSE. This was supported by Mr Smales (A47); however he indicated powerline marking had not been tested with Brolga and it would need to be evaluated. DSE (DSE 68) recommended that all new powerlines within 3 kilometres of Brolga habitats be either placed underground or marked to reduce collision risk.

In response to submissions from Mr Cumming and BOCA (C199, B88) about the lack of accuracy of the Biosis model in predicting Wedge-tailed Eagle collisions at a wind farm in Tasmania, Mr Smales provided advice that this was incorrect and the model did predict a mortality level that was within the 95% confidence interval for the annual average of actual mortalities. However, we note that this was only achieved after the avoidance rate was reduced from 95% to 90%. Submissions (C199, B88) were also critical of the use of a collision avoidance rate in the model. Mr Cumming (C199) considered that there was little basis for utilising a collision avoidance rate in the model and that there was no accounting for Brolga flights and collisions in poor light conditions. Mr Smales stated that the international literature indicates that a majority of bird species have an avoidance capacity higher than 90%. On the basis of indications of other crane species in Europe he considered it reasonable to apply an avoidance rate of 95% to Brolgas in the absence of empirical data about the capacity of Brolga to avoid collisions with wind turbines. Submitters (C199, B88) were critical of the inputs to the collision risk model which were based on data collected from limited field studies in the preparation of the Flora and Fauna Assessment Report. Mr Smales advised that he had no reason to doubt the veracity of the data and since the field program did not allow for the assessment of inter-year variation, an 80% confidence bound was applied to values required for use in the model. This approach, in his view, provided for a substantial increase in potential risk factors likely to affect collision risk for Brolgas and is sufficient to account for considerable variation over and above values supplied directly from the base data. Mr Smales also provided an assessment of the sensitivity of the wind farm avian risk model (A94) indicating that the model appears to have stable responses to minor errors in input values.

Mr Smales (A47) provided advice from Dr Michael McCarthy on the combined risks of the projected average number of Brolga collisions with turbines and powerlines on the south-western Victorian population of Brolgas using Population Viability Analysis (PVA) (Predicting impacts of the Stockyard Hill wind farm on the Victorian Brolga population. Final Report, Michael McCarthy,
Over a twenty year period the PVA indicates that collisions could result in a very minor increase in the overall mortality rate of the population by 0.039%. The effect of this on increasing extinction risk from the population is considered to be marginal and the PVA indicates that this effect could be prevented by implementing mitigation measures that would result in increasing annual recruitment to the population by approximately 1%.

In his expert witness statement (A46) Mr Mustoe provided a peer review assessment of the Flora and Fauna Assessment Report. On the Brolga he states:

*Other than the breeding season, the spatial distribution of Brolga is largely outside the area likely to be affected by the wind farm. Within the breeding season, Brolgas occupy habitat that is mostly beyond the risk of collision. Additional field work, data analysis and modelling are unlikely to alter the fact that:

- turbines have been located outside corridors of wetland habitat;
- that Brolgas largely gravitate to these locations;
- they do fly frequently or at rotor swept(sic) height; and
- outside the breeding season, they flock at sites a long way distant from the proposed wind farm.*

Mr Mustoe further indicated that:

*The modelling is based on a series of assumptions and there is the potential for deviations from the predictions. The report does adequately consider this measure of confidence in the assumptions made, or the implications for management of Brolgas on site.

Management of Brolga mortality may become necessary, if in reality, mortality levels are higher than expected. Nevertheless, whether any such deviations are likely to be significant or not, will depend not just on the level of mortality, but whether the problem can be managed. Evidence of management potential is missing from the reports... Predator control could be sufficient to offset any residual uncertainty about mortality rates.*

In response Mr Lane (A40) indicated that specific Brolga mitigation measures will be developed including the provision of additional breeding habitat through wetland restoration and co-ordinated baiting for foxes, and reduced mortality from marking powerlines near flocking sites. Furthermore Mr Lane indicated contingency plans will be developed if Brolgas breed or flock within critical distances from the proposed wind farm.
Submitters, including Mr Cumming (C199) questioned the practicality of such mitigation measures indicating that to create effective new habitat for Brolgas would require the fencing off of large areas of both wetland and adjoining pasture. DSE (DSE68) advised that attempting to improve nesting success by habitat management or predator control is untested and the only study which examined Brolga nest success found a negative association between fox control and Brolga nest success.

The estimates of the size of the regional population of Brolga and the number of breeding pairs used in the collision risk modelling was challenged by submitters (WPLG 82, WPLG79). The modelling used a regional Brolga population of 58 and a breeding population of six pairs within 3 km of the Stockyard Hill wind farm, based on information provided in the Flora and Fauna Assessment Report. Various population estimates from 85 to 120 were suggested by submitters and they sought to understand the implications of this under-estimation on the collision impact modelling predictions.

Concerns were expressed about the incomplete accounting for all Brolga breeding sites with submitters identifying breeding records that were not included in the Flora and Fauna Assessment Report, particularly local land owner records (e.g. WPLG 81).

In its submission DSE (DSE 68) referred to the Brolga guidelines, attached to their submission. DSE indicated that the Brolga guidelines were developed to provide a standard approach to assessing and mitigating any impacts of wind energy development on Brolgas. The guidelines endorse a series of steps as follows:

- Remove all significant impacts from flocking and nesting sites within the area of concern with turbine free buffers;
- Develop a site specific collision risk model for Brolgas;
- Model the collision risk through PVA; and
- Mitigate the collision risk to produce a zero net impact for the Victorian Brolga population.

DSE (DSE 68) indicated that their aim was that each wind farm development should have a zero net impact on the Victorian Brolga population. The objective of the zero net impact for each wind farm development is the method DSE have adopted to manage the cumulative impact of multiple wind farms in Victoria, an issue raised by submitters (B88, WPLG82).

DSE (DSE 68) supported the preparation of a mitigation plan to offset residual impacts, however, as discussed previously, DSE indicated the difficulty of quantifying the contribution of offsets by mitigation measures such as
predator control and habitat management. This difficulty was also identified by other submitters (C199). DSE recommended mitigation be done primarily through powerline marking.

DSE (DSE 68) considered that the framework of the assessment methodology undertaken in the Flora and Fauna Assessment Report was consistent with the Brolga guidelines. Pre and post 1988 Brolga records had been considered, despite earlier advice from DSE to consider only records from 1988 onwards. The home range mapping methodology used to develop turbine free buffers was considered satisfactory and DSE supported the use of the models developed to assess the impacts. However, DSE identified concerns with the treatment of the additional Brolga records that had been provided to the Applicant, reported on by Mr Lane (A42) and described earlier in this section of the Report. With reference to the Brolga guidelines, DSE indicated that the aim was to achieve a zero net impact on Brolgas from wind farm development and that this could only be achieved if all important Brolga habitats are protected from potential wind turbine impacts by appropriate turbine free buffers. Importantly DSE recommended appropriate turbine free buffering using the home range methodology described in the Flora and Fauna Assessment Report be applied to five wetlands (wetlands 200, 201, 202, 51, 37) that currently were not buffered. These wetlands were located in the general vicinity of Black Lake. In addition to this, DSE recommended that if during the course of the Panel hearing conclusive evidence is provided of other Brolga nest sites within area proposed for wind turbines that the proponent also consider these nest sites and apply appropriate turbine free buffering consistent with the Brolga guidelines.

We had already been advised of landowner Brolga records by Mr Edney (WPLG 81) as well as other possible records that emerged during presentations by submitters. It was not clear to us if these additional records overlapped with the additional 56 records from DSE or were new records or indeed were valid records. Mr Lane’s assessment (A42) of the additional Brolga records provided by DSE, excluded some 48 records as potential nest sites for reasons including poor habitat condition and alterations to hydrology. This assessment was disputed by some submitters. Furthermore concerns had been raised about the accuracy of the regional Brolga population estimates and the implications for the collision risk modelling.

Given the uncertainty about the information on the Brolga, the Panel issued the following written direction on 30 April 2010:

In light of the various potentially incomplete and/or overlapping sets of information about brolga in and around the proposed wind farm site that have emerged during the course of the Panel hearing, which data sets are
relevant to our assessment of the impact of the proposed wind farm on brolga, the Panel gives the following directions.

1 DSE is to provide an assurance to the Panel that there are no brolga records in and around the site known to DSE beyond those in the attached list of data sets and that all brolga records known to DSE have been provided to the Applicant.

2 Mr Richard Hill of DSE and Brett Lane of BLA for the Applicant are so far as is possible to jointly carry out the following tasks:
   · Within the same agreed distance around the wind farm site as previously used for the home range assessment by the Applicant:
     - Compile a complete list of all known brolga records (in which each site appears only once) – including sites earlier used in the buffering analysis in accordance with the Guidelines for the Assessment of Potential Windfarm Impacts on the Brolga (the Guidelines) and the sites in the documents in the list below.
     - Identify which sites are nesting, flocking or staging sites where this is known.
     - Review the list to identify which of these sites are to be used in the identification of brolga buffers in accordance with the Guidelines using the home range methodology already applied by BLA.
     - Specify the criteria used to select and discard each site.
   · Redo the identification of brolga buffers in accordance with the Guidelines and using the brolga home range methodology applied already by BLA.
   · Map and describe the relationship of the buffers to all elements of the proposed wind farm development.
   · Review the estimates of the size of the regional brolga population recently provided to the Panel (WPG82 page 11 and DSE68 page 7). Advise the Panel whether or not the results of the already completed collision risk assessment and population viability assessment are likely to be substantially altered by the revised population estimates and the revised brolga site identification and whether the models should be rerun to properly establish the likely impacts. (We note that Mr Hill has in part already addressed this matter.)

3 Should there be any disagreement between DSE and BLA about any aspect of the above analysis, they must document the matters of disagreement and describe the reasons for that disagreement.
4 These tasks are to be completed and a report (or reports) on them circulated to the Panel and witness circulation list no later than 2 working days prior to the day upon which Mr Hill and Mr Lane are to appear again before the Panel.

5 Mr Hill and Mr Lane are to jointly attend the Panel hearing in Melbourne on May 11 or such later date (being no later than May 24) as may be agreed by the Panel. (A revised timetable is to be issued shortly.)

Additional brolga records identified in course of Panel hearing

- Records referred to in BLA memorandum to Vaughan Hulme of 14 April 2010 – 56 additional records provided by DSE (A42)
- Records referred to in DSE submission of 20 April 2010, specifically wetlands 200, 201, 202, 51 and 37 (DSE 68)
- Additional breeding site information – local landholder records – 26 April 2010 presented by Western Plains Guardians (WPG 81- page 11)
- Records referred to in WPG submission Flora and Fauna Assessment 27 April 2010 (including Wills swamp, Sheldon 2004 flocking records)
- DSE records included in Sites of Biological Significance map referred to by WPG as obtained from DSE (Map later circulated by email on 30 April 2010).

DSE (DSE 205) and Mr Lane (A201) responded to the Panel direction. In responding DSE assured us that all known relevant Brolga records had been provided to the Applicant. Furthermore DSE indicated they had collaborated with Mr Lane in compiling a complete list of all known records within a 3 kilometre area of interest into a single dataset. On the matter of excluding sites, DSE indicated that a potential nest site is not defined in the Brolga guidelines but had been defined by the Brolga Scientific Panel as:

Any historical or current site which retains the potential to be nesting habitat in the future. This excludes previously occupied sites which have been permanently modified to prevent appropriate wetland filling (i.e. drained, dammed upstream etc).

DSE indicated that it agreed with Mr Lane’s assessment of the records into nesting, flocking or other records except for his assessment of Notman’s Swamp (wetland 39). DSE considered that the wetland should remain a potential nest site and requires appropriate turbine free buffering.
DSE also advised that it did not have the modelling capacity to undertake the analysis itself and had relied on the Applicant to conduct the analysis including defining the home ranges.

Advice from Mr Smales provided by Mr Lane (A201) indicated that the change in the regional population estimate (58 to 80+) will not materially influence the results as the modelling and estimates of risk encompass the possibility for occasional events of 80+ Brolgas. Mr Smales did not specifically address the question of whether the estimates of risk change by increasing the breeding number for 6 pairs to 8 pairs as recommended by DSE (DSE 205).

As noted, the Panel direction required that the turbine free buffering be undertaken on the agreed consolidated Brolga data set in accordance with the Brolga guidelines, using the Brolga home range methodology that had previously been applied in the Flora and Fauna Assessment Report. The Panel direction also required that areas of disagreement between DSE and the Applicant be identified.

DSE (DSE 205) indicated that the Applicant, in their response (A201) to the Panel Direction, had identified Brolga buffers in accordance with the Brolga guidelines and using the home range methodology previously described. However, there was a key area of disagreement relating to the Brolga guidelines. The Applicant sought exceptions from applying the home range turbine free buffers for certain potential nest sites around Stockyard Hill. The Applicant indicated that Stockyard Hill was important to the wind farm proposal because of the significant wind resource in the area and that DSE had acknowledged its significance in the past and agreed to exclude Black Lake from home range mapping in recognition of this. DSE stated that the Brolga guidelines do not currently give any guidance about applying flexibility in exceptional circumstances, e.g. where particular Brolga assets coincide with particularly advantageous wind conditions and that the guidelines are to be applied without exception (DSE 205, A201). DSE further indicated that it had previously agreed to a reduction in buffer distances in the case of one Brolga nest where the home range methodology included Black Lake in the home range buffer, but this was before the Brolga guidelines were developed. At the time, DSE had accepted that the home range would be reduced in the case of Black Lake, and the additional risks posed to Brolga modelled through collision risk, but acknowledged that the increased disturbance risk to this nest site could not be modelled.

In responding to the Panel direction, the Applicant applied the home range mapping methodology to all agreed breeding sites including the sites they were seeking exemption from buffering (wetlands 37 and 202). The implementation of revised home range turbine free buffers (including
wetlands 37 and 202) would have the effect of removing 56 turbines and associated access tracks currently in the project (A201).

Mr Lane’s submission (A201) indicates 31 of these turbines are located in the highest wind energy part of the project around Stockyard Hill.

By contrast, the application of turbine free buffering to the agreed Brolga records, with wetland sites 37 and 202 exempted, had the effect of providing a partial or reduced buffer to seven breeding sites (wetlands 23, 24, 160, 161, 162, 163 and 200). Mr Lane indicated that complete home range buffering to the remaining breeding sites south of Stockyard Hill would be provided by the removal of seventeen turbines which were specifically identified as follows: T134, T145, T161, T164, T167, T172, T174, T176, T178, T180, T183, T184, T185, T186, T187, T189, and T190.

It was further proposed to remove three other turbines (T73, T83, T181) which were situated in Brolga home ranges elsewhere on the site and to microsite an additional eight turbines (T74, T84, T132, T149, T170, T173, T175, T179) so they were located outside Brolga home ranges. In total the Applicant proposed to remove twenty wind turbines from the project and re-locate 8 turbines. Mr Lane indicated that the removal of this number of turbines from many of the new home ranges will ensure the risk of collision is within the bounds of the current collision risk modelling parameters.

DSE (DSE 205) identified three nest sites where there was disagreement on the required turbine free buffering (wetlands 37, 202 and 209). Wetlands 37 and 202 were identified by Mr Lane as sites where exemption from buffering was sought. It was not clear in his submission what Mr Lane proposed for wetland 209 although Figure A in his submission indicated that the home range mapping had been applied to wetland 209 and it overlapped with 8 turbines (T222, T227, T228, T230, T231, T234, T236 and T237). Furthermore, wetland 39 identified by submitters (N175, J171) was also recognised by DSE (DSE 205) as a potential nest site that required turbine free buffering. This wetland had been excluded by Mr Lane from the home range analysis, as in his assessment it had been cropped and drained and would not be available for future Brolga nesting.

DSE (DSE 205) made reference to new research that suggested that a 1.1 kilometre radius turbine free buffer may be appropriate but this standard had not yet been adopted for inclusion in the Brolga guidelines.

In his closing submission for the Applicant (A220), Mr Gobbo indicated that the Applicant proposed that, together with wetlands 37 and 202, wetland 39 be exempted from buffering and that wetland 209 be partially buffered only.
He advised that that turbine free buffering of wetlands 37 and 202 would remove at least 12 more turbines in a highly productive area and that this part of the wind farm (around Stockyard Hill in the central sector) is critical to the project. He considered that the main area of disagreement related to the application of the Brolga guidelines. In his submission he:

- Re-iterated Mr Lane’s view that the Brolga guidelines do not provide adequate scope or guidance for dealing with the residual impacts of individual projects where buffers based on universal principles cannot be agreed with DSE;
- Suggested that DSE’s position that the Brolga guidelines be applied without exception is not sustainable. The guidelines are a guide and cannot be taken to have mandatory application. They are draft and have not been through a public process. There is no reasonable basis for the inflexible and strict application that DSE seeks. To do so would be to assume a control within the Planning Scheme that does not exist;
- Indicated where there were examples of VCAT departing from the strict letter of other guidelines having regard to the facts of a particular case; and
- Suggested that the application of the guidelines must cater for informed and intelligent consideration on a case by case analysis.

10.4.3 Panel response

We understand from the advice provided to us that it is common ground that the most significant habitats for the conservation of the Brolga are breeding sites and traditional flocking sites and that the assessment of wind farm projects needs to take account of these two critical habitats. We recognise that the targeted Brolga assessment in the Flora and Fauna Assessment Report did focus on these critical habitats.

Brolga guidelines

Having reviewed the evidence and submissions we believe that there are two broad approaches that might be taken to the Brolga in relation to the Stockyard Hill wind farm.

The Applicant has proposed that an exception be granted from the turbine free buffering requirement outlined in the Brolga guidelines for eleven wetlands: three (wetlands 37, 39 and 202) would have no buffering and eight (wetlands (23, 24,160,161,162,163, 200 and 209) would have partial buffering.
The first approach that might be taken is that the exemptions sought by the Applicant for turbine setbacks to certain wetlands should be allowed for the following reasons:

- The Applicant has demonstrated a willingness to adjust the design of the wind farm in the initial indicative site layout plan. The adjustment made included provision of buffering around the then known breeding and flocking sites and the creation of movement corridors to prevent the occurrence of barrier effects and to allow movement by migrating Brolgas;
- In the development of the initial response to mitigating the impacts on Brolgas, the Applicant has worked in partnership with DSE, and this initial approach was endorsed by DSE as being consistent with the Brolga guidelines and was based on a shared understanding between DSE and the Applicant of all the relevant Brolga records at that time;
- The Applicant made an effort to access local sources of information but achieved a low response that did not identify new additional records;
- The Applicant has been subsequently advised of additional records, very late in the permit application process, some from submitters but the majority of which were brought forward from DSE. DSE requested that these records be considered in accordance with the Brolga guidelines without exception. As DSE had been working in partnership with the Applicant, the late notice to the Applicant and the adjustment that this would necessitate to the wind farm layout are unreasonable and unfair;
- The Applicant has responded to the additional records and further demonstrated a willingness to adjust the wind farm layout to mitigate the impacts on Brolgas by offering the removal of 20 turbines and the relocation of a further 8 turbines; and
- The compromise sought is that the Brolga guidelines not be applied strictly as sought by DSE. Exemption from the guidelines is appropriate because:
  - The guidelines are a guide and they have no statutory weight;
  - The guidelines have not been developed through a public process;
  - The guidelines should not be applied inflexibly as they are a draft based on best available knowledge at this time and are subject to future change;
  - The guidelines are silent on the issue of dealing with exemptions;
  - In the absence of guidance on exemptions there is a need to consider the balance of interests in terms of net community benefit on a case by case basis;
- The impact of strict application of the guidelines will be to remove further turbines from Stockyard Hill, a key wind productivity area which is critical to the project;

- A significant renewable energy project should not be compromised;

- Movements of Brolga are variable in that they are responsive to local conditions and will make temporary use of irregularly available resources in an area. The wetlands may not recover and Brolga may not return to the wetlands identified for exemption and opportunistically seek alternative areas in response to conditions;

- The modelled level of collision risk with turbines is low and likely to be further reduced with fewer turbines;

- The Applicant has identified that detailed contingency plans will be developed if Brolgas breed or flock within critical distances from the wind farm; and

- The Applicant will develop specific mitigation measures to offset potential impact on Brolgas, including the provision of additional breeding habitat through wetland restoration, fox control and powerline marking.

The alternative view which could be taken in relation to this issue is that the exemptions being sought by the Applicant not be allowed for the following reasons:

- The late advice of additional Brolga records is regrettable but the information is now before the Panel and cannot be ignored;

- The Brolga guidelines have been specifically developed to provide a standard approach to mitigating the potential impacts of wind farms on Brolga;

- The selective application of the guidelines across a wind farm site for the purpose of protecting a valuable wind resource, as proposed by the Applicant, would set a poor precedent for other wind farm developments, and would undermine the objectives of mitigating the impacts of wind farms on Brolgas;

- The application of the guidelines is necessary to manage the cumulative impact on Brolga of multiple wind farm developments. Meaningful cumulative impact assessment of wind farms can only be undertaken if the impact assessments among proposals are undertaken in a consistent manner;

- The guidelines are the best available advice at this time and have been developed by experts in the biology of Brolgas and wind farm impacts on avifauna;
Modelling of the increased risk to Brolga if exemptions to buffering were granted for turbines is problematic, albeit the risk may be low;

A conservative approach to reliance on mitigation measures to offset wind farm impacts on the Brolga should be adopted as such mitigation measures are untested and no metrics to quantify offsets have been developed; and

The Brolga is a threatened species and the protection of potential breeding and flocking sites, even if not utilised by Brolga now, is necessary to provide for the future population.

On balance we think the latter approach is the appropriate response. We accept the importance of State wind farm policy and its support for facilitating development of wind energy facilities. While consideration needs to be given to the broader benefits of wind energy, the Wind Energy Guidelines require that, at the same time, appropriate standards need to be put in place to protect critical environmental values. Also, while in relation to visual amenity and landscape effects, the policy states that that visual impact should be weighed or read down having regard to the Government’s policy in support of renewable energy development, this does not apply to other considerations such as addressing conservation measures for species listed under the FFG Act or EPBC Act.

The Brolga is a threatened species under the FFG Act and as such a specific assessment of the impact of the proposed wind farm on this species is required under the Wind Energy Guidelines. We note that approximately three quarters of its breeding habitat has been lost through drainage and the key strategy for the conservation of the species is to protect the remaining breeding and flocking sites, even where they have not been utilised in recent times. We consider every effort should be made to support this strategy. Evidence of Brolga records is likely to continue to change in response to changes in environmental conditions and as a result of the difficulty of recording their utilisation of private land, but new data cannot be excluded because of this.

Modelling of the collision risk is problematic at this stage as we were advised that there is no empirical data on the behaviour of Brolga and their capacity to avoid collisions with wind turbines. Even though the estimated risk is low, the increased risk of exempting turbines from full or partial buffering and offsetting that risk by mitigation measures is also problematic at this stage. We heard evidence that the mitigation measures proposed are untested. Furthermore the development of metrics (a measuring framework) around the proposed mitigation measures has not been done and would be difficult and complex to do. In these circumstances our preference is to take a conservative approach and not rely upon mitigation measures that are not yet tested.
In adopting this approach we are in effect supporting the application of the Brolga guidelines. In so doing we are not giving the Brolga guidelines any particular statutory weight other than we find they are a useful tool and a helpful approach to mitigating the impacts of wind farms on Brolgas. While they may be refined by the results of future research on the Brolga, they represent the best available practice at this time.

We recognise they have not been through a public process, but they are a technical document and have been prepared by a scientific panel comprising independent experts in the biology of Brolga and wind farm impacts on avifauna. Indeed we note that expert witnesses for the Applicant were members of the scientific panel that contributed to the Brolga guidelines.

The purpose of the guidelines is to develop a standard approach to mitigating impacts on Brolgas for consideration by wind farm proponents in the design of wind farms. The guidelines also provide the basis for the management of the cumulative effects of wind farm developments on the Victorian Brolga population, by establishing a zero net impact goal for each wind farm development. We consider that this is an important objective that should not be weakened by the selective application of this standard approach across this wind farm development.

In supporting the ‘application’ of the Brolga guidelines we recommend that turbine free buffers be applied to the wetlands for which the Applicant has sought exemptions (wetlands 37, 39, 202, 209) in accordance with the Brolga guidelines and using the home range methodology described in the Flora and Fauna Assessment Report.

We understand that this will substantially reduce the number of wind turbines in the project. In assessing this impact we have relied on the response by Mr Lane to the Panel direction of the 30 April 2010 (A201) and in particular Map A in that response. We did not have access to the Brolga home range mapping methodology and so we have compared the home ranges identified in Map A with the revised indicative site layout plan (A202a) to identify the wind turbines that are likely to be affected. We recognise that this lacks precision but it is indicative of the likely scale of the impact on the reduction in the number of turbines by the application of the Brolga home range mapping and exclusion of turbines. Furthermore, home range mapping for wetland 39 was not undertaken by Mr Lane for the reasons given earlier. As a consequence we have made an estimate of the wind turbines that may be impacted by the application of home range mapping for this wetland.

In our estimate, the application of home range mapping and turbine exclusion buffers to wetlands 37 and 202 will impact on the following 31 turbines.
The application of the Brolga home range mapping and turbine free buffers to those wetlands identified by DSE, in accordance with the Brolga guidelines and without the exemptions sought by the Applicant, will impact on 61 wind turbines including the 20 turbines identified for removal by the Applicant. We re-iterate that this estimate has been compiled without the benefit of access to the Brolga home range methodology which would provide a more precise assessment. However we consider that the estimate is indicative of the likely scale of the response to the application of the Brolga guidelines to the complement of wetland sites identified jointly by the Applicant and DSE, without any exemptions being granted.

The reduction in the number of turbines as proposed may have implications for the location of substations and the powerline routes. We have not given consideration to these matters other than we think if reconfiguration of the wind farm is considered necessary, it would be desirable to relocate powerlines outside Brolga home ranges as far as practicable.

Management of Brolga records

We heard during the conduct of the hearing many criticisms of the inadequacy of the data that had been used to undertake the targeted Brolga assessment.

The assessment was undertaken collaboratively with DSE and we think it is reasonable that the Applicant should have been able to rely with some confidence on the corporate data bases (e.g. AVW) of DSE as a primary source of records for the Brolga.

However we also see the need for the Applicant to access local sources of information, particularly in this instance where the Brolga’s distribution is largely on private land. We were advised that movements by Brolgas are quite variable in that they are responsive to local conditions and within an area temporary use of irregularly available resources will occur. Consequently there are likely to be many anecdotal observations by local residents and landowners in an area.

The Applicant in this case did make an effort to access local sources of information but achieved a low response that did not identify any additional records. We heard in submissions about the reluctance of landowners to provide information either to DSE or to wind farm proponents so the difficulty of consolidating a comprehensive set of records is compounded. We also heard criticisms about the AVW and currency of the information available from it.
It is apparent to us that there needs to be better management of Brolga records and we recommend that a comprehensive and accurate data base of Brolga records be maintained by DSE, incorporating appropriate custodial and reliability standards, and that an active management program of acquiring records from local landowner and community sources be implemented.

**Brolga field work and modelling capacity**

During the Panel hearing submitters criticised the assessment process including the lack of adequate field work. We note that a three staged assessment was undertaken that is consistent with the Auswea guidelines and the Brolga guidelines. Indeed field work for the Flora and Fauna Assessment Report took place in 2007 and 2008 before the Brolga guidelines were prepared. The empirical information on the behaviour of the Brolga, collected during this period, was used to inform the Brolga home range methodology for turbine exclusion that has been adopted in the Brolga guidelines. We understand that this type of information has not been previously collected and additional research into Brolga behaviour in the field would contribute to a validation of the home range model that has been applied. However as this is the standard that is currently required by the Brolga guidelines, we accept that this is an appropriate approach. We note, however, that DSE does not have the capability of undertaking the type of home range analysis that is described in the Brolga guidelines.

Consequently we recommend that DSE should develop an independent capacity to undertake Brolga home range analysis of the type required from time to time by the Brolga guidelines. This would allow DSE to undertake its own analysis in the course of discussions with wind farm proponents early in the planning and design stages of wind farm projects, rather than reacting to modelling undertaken by applicants.

We understand that due to the various uncertainties in the available information a conservative approach was adopted in the modelling. We also recognise that the predicted impacts of collision risk are low. Nevertheless we recommend that a comprehensive science-based monitoring program be implemented which incorporates turbine shutdown protocol at a pre-determined level of threat or when an unacceptable level of collisions occurs. We also recommend the preparation of a mitigation plan that incorporates a program of powerline marking and evaluation. The evaluation plan should incorporate methodologies to quantify the offset contribution of all mitigation measures that are proposed including powerline marking. DSE should consider the establishment of an independent technical advisory committee to assist with the development of monitoring protocols.
10.4.4 Recommendations

Having considered the submissions and evidence in relation to Brolga, the Panel recommends that:

The exemptions sought by the Applicant to home range buffering around wetlands 37, 39, 202 and 209 not be agreed and that turbine free buffers are to be applied to those wetlands as well as the others agreed by the Applicant (as set out in Section 10.4.3 of the Panel report) in accordance with the Brolga guidelines and using the home range methodology described in the Flora and Fauna Assessment Report prepared by Brett Lane and Associates.

A comprehensive and accurate database of Brolga records should be maintained by DSE, incorporating appropriate custodial and reliability standards, and that an active management program of acquiring records from local landowner and community sources be implemented.

DSE should develop an independent capacity to undertake Brolga home range analysis of the type required, from time to time, by the Brolga guidelines.

A comprehensive science-based Brolga monitoring program should be implemented which incorporates a turbine shutdown protocol at a pre-determined level of threat or when an unacceptable level of collisions occurs.

An independent technical advisory committee should be established to assist with the development and ongoing refinement of monitoring protocols.

A mitigation plan for Brolga should be prepared that includes a program of powerline marking and evaluation and also provides for a program to develop metrics to enable the assessment of the contribution of all mitigation measures that are proposed for implementation.
11. Heritage and Mawallok

As referred to above in Section 6, Mawallok is a large historic rural property principally used for grazing, located on either side of (Old) Geelong Road and for the most part west of its intersection with the Beaufort-Carranballac Road. Mawallok is therefore situated west of most of the proposed area to be developed as the WEF but is also directly south of the north-western sector of the WEF.

Mawallok includes an original station homestead complex constructed in 1858 and extended in the 1860s, original station outbuildings and infrastructure (including stables, coach house, laundry, men’s quarters, manager’s house, cottage, blacksmith shop, pump house, woolshed and meat house), a 1907-1908 Arts and Crafts house designed by Klingender and Alsop, a 2.8 hectare garden designed by William Guilfoyle at about the same time and a lake dating from around 1912\(^{33}\) designed by John Monash (later to be Sir John Monash).

The Mawallok property is included both on the National Estate Register (since 1992) and the Victorian Heritage Register (to the extent of the Mahkwallok Pre-emptive Right granted in 1858) (since 2008).

The essential issue to be addressed with respect to the Mawallok property is whether the significance of the place and in particular the 1908 house and its associated Guilfoyle-designed garden, the central vista of which looks northwards towards Mt Cole and the Pyrenees Range some 20 kilometres away, would be adversely affected by the construction of wind turbines in that view; and, even if it were so affected, whether or not the balance of policies suggests that this loss of significance would be acceptable.

11.1 Policy and regulatory framework

As earlier noted the Pyrenees Planning Scheme contains policies at Clause 15.11 relating to cultural heritage. They have the following objective:

> To assist the conservation of places that have natural, environmental, aesthetic, historic, cultural, scientific or social significance or other special value important for scientific and research purposes, as a means of

\(^{33}\) Described in some material as 1927—we believe this is incorrect. The date does not affect our reasoning.
understanding our past, as well as maintaining and enhancing Victoria’s image and making a contribution to the economic and cultural growth of the State.

The general implementation measures include:

*Planning and responsible authorities should identify, conserve and protect places of natural or cultural value from inappropriate development.* These include:

- Places of botanical, zoological or other scientific importance, rare or endangered plants and animals.
- Places and sites of geological, palaeontological or other scientific importance, including rock formations and fossil sites.
- Places of Aboriginal cultural heritage significance and historical and archaeological sites.
- *Sites associated with the European discovery, exploration and settlement of Victoria.*
- *Important buildings, structures, parks, gardens, sites, areas, landscapes, towns and other places associated with the historic and cultural development of Victoria, including places associated with pastoral expansion, gold mining, industrial development and the economic expansion and growth of Victoria.*

*Planning and responsible authorities should take account of the findings and recommendations of the Victorian Heritage Council and the provisions of the Heritage Act 1995* (Emphasis added).

The key issues identified in Clause 21.03-1 of the Planning Scheme also refer to heritage matters. A key planning issue is: *The protection of the cultural and heritage assets of the Shire.*

Clause 52.32 of the Planning Scheme contains particular provisions related to applications for WEFs designed:

*To facilitate the establishment and expansion of wind energy facilities, in appropriate locations, with minimal impact on the amenity of the area.*

The application requirements specified in the clause require the provision of a design response which is to include an assessment of the impacts upon Aboriginal or non-Aboriginal cultural heritage. The decision guidelines of that clause refer to consideration of the *impact of the facility on cultural heritage.*
The policy and planning guidelines for the development of wind energy facilities in Victoria 2009 (the Guidelines), which are also required to be considered and which are an incorporated document of the Pyrenees Planning Scheme, refer at page 14 to:

Protecting critical values

Wind energy facilities should not lead to unacceptable impacts on critical environmental or cultural values. Critical values are those protected under Commonwealth or Victorian legislation.

This section goes on to refer to landscape, biodiversity and Aboriginal heritage values but makes no further specific mention of non-Aboriginal cultural heritage matters. The recommended content of a site analysis for a WEF at page 24 of the Guidelines does refer, however, to including cultural heritage sites generally where they occur in the surrounding area. The design response is also recommended to include:

An assessment of the impacts upon Aboriginal and non-Aboriginal cultural heritage.

Also relevant to the consideration of this matter are the Planning Scheme local policies relating to heritage quoted earlier.

The heritage policies of the Scheme are of course not the only ones which are to be considered when the wind farm application is assessed – including for its impact on Mawallok. The range of policies relating to support for renewable energy and economic growth as well as others must also be considered. Importantly Clause 11.01 provides:

It is the State Government’s expectation that planning and responsible authorities will endeavour to integrate the range of policies relevant to the issues to be determined and balance conflicting objectives in favour of net community benefit and sustainable development.

Clause 11.02 also requires that planning decisions are to:

…integrate relevant environmental, social and economic factors in the interests of net community benefit and sustainable development.
11.2 What is the significance of Mawallok

The State Heritage Register statement of cultural significance for Mawallok is as follows:

What is significant?

Mawallok (also spelt Mawallock, Mahkwallok and Mawhallock) station of about 28,000 acres (now 5,851 acres) was acquired by Alexander Russell and Co. in 1847 and remained in the Russell family until 1980 when it was purchased by the present owners. Alexander’s brother George Russell established Golf Hill in 1842 and other family members settled at Stoneleigh, Elderslie, Carngham, Barunah Plans, Native Creek No. 2 and Langi Kal Kal.

The pre-emptive right for Mawallok was granted in 1858. By this time the first wing of the homestead was built, as were the woolshed, stables, overseer’s hut, dip and two dams. The dams were fed by a spring, reputedly the third largest spring in Victoria.

The original homestead was extended in the 1860s with a bluestone wing and cellar. A number of early structures remain on the property including the original homestead and outbuildings, the bluestone gable-roofed and dormer windowed stables, bluestone coach house, the stone and iron woolshed and iron meat house.

Alexander Russell died in 1869 and his son Philip Russell inherited Mawallok. Phillip Russell, and then from 1932 his son Alex Russell (1892-1961), were responsible for major changes at Mawallok. In 1907-08 the Arts and Crafts homestead was built to a design prepared by architects Klingender and Alsop, and the garden laid out to a plan prepared by William Guilfoyle, Director of the Melbourne Botanic Gardens in 1909.

The large house was constructed in reinforced concrete, an early use of this material for a domestic residence. It has an asymmetrical composition with a dominant steep roof form featuring gables, gabled dormers and tall chimneys. The interior includes notable elements such as the handsome Arts and Crafts inspired timber staircase leading to a timber-balustraded upstairs gallery which overlooks the large living space below. Around 1927 the Melbourne engineer and World War I General Sir John Monash was commissioned to extend a small dam into a 22 acre lake. The pump house and a small shed were built in similar materials and style to the 1908 house. The raised terrace of the house looks across the sweep of lawn and lake to the distant vista of the Pyrenees Ranges and Mt Cole.
Alex Russell studied engineering at Cambridge and later served in both World Wars. In 1932 Alex and his wife Jess moved to Mawallok. Alex, pastoralist, soldier, golfer and golf course designer, developed Mawallok’s merino stud. In the 1930s the view to the lake and beyond to Mt Cole was enhanced with the removal from the main lawn of several Canary Island Date Palms included on Guilfoyle’s plan and the construction of a ha-ha wall between the garden and a six-hole golf course.

The Guilfoyle garden is protected by windbreaks of Monterey Pines, Aleppo Pines, Monterey Cypress, Sugar Gums, and Osage Orange, Cypress and Privet hedges and stone walls. The designed landscape reflects 18th century English picturesque design principles and later gardenesque elements, and includes both formal and informal design features. The design included a lawn and ent‐tou‐cas tennis courts, curved and straight paths, rockery and pond, terrace flagstones and bluestone steps, pergola, sundial, urns and informally shaped shrubberies around the edge of a broad sweeping lawn. Later garden changes include a ha‐ha wall, stone and timber pergola, and redesign of the terrace steps. A pleached lime walk designed by John Patrick was established in 1992. The former rose parterre on the east lawn has been removed and replaced with a Copper Beech. In March 1996 James Guilfoyle, grandson of William Guilfoyle, planted a Chinese Windmill Palm.

The garden is planted with a vast array of trees and shrubs, and herbaceous plants and bulbs. The plantings include conifers, palms, deciduous and evergreen species, with variegated and coloured foliage, strap and contrasting leaves, and colourful flowering plants. An outstanding Horse Chestnut dominates the main lawn, and the lawn is framed with Algerian Oaks and Pin Oaks and densely planted shrubberies with Pittosporum, Waterhousea, Laurus, Prunus, Arbutus, Corynocarpus, Alectryon, Cupressus, Erythrina, Fraxinus, Magnolia, Ulmus, and Cedrus. There are fine specimen trees of Liriodendron, Liquidambar, Betula, Metasequoia, Tilia, Cedrus, Platanus, Populus, Quercus, Ulmus and 3 old Morus nigra trees.

How is it significant?

Mawallock is of historical, aesthetic, architectural and social significance to the State of Victoria.

Why is it significant?

Mawallock is of aesthetic and historical significance as an outstanding example of a designed landscape. Mawallock, with its
extensive windbreak plantings, hedges, stones walls, gateways, drives, gravel courtyard, its Guilfoyle garden, lake and views to Mt Cole, is amongst the finest and largest gardens in Victoria.

William Guilfoyle, arguably Australia greatest garden designer, laid out the Royal Botanic Gardens from 1873-1909. Mawallok is his last known, and perhaps his grandest, homestead garden design, completed towards the end of his remarkable career.

Mawallok is of historical significance for its associations with the early pastoral settlement of Victoria and with the Russell family, important pastoralists in the early settlement of rural Victoria. The different phases of construction of the original homestead and the 1908 Arts and Crafts house and 1909 garden demonstrate the development of a successful pastoral station. The significance of the place is enhanced by the retention of the original homestead, woolshed, stables, coach house and other outbuildings and the intactness of the house and garden.

The 1908 house at Mawallok is of architectural significance as an important example of the Arts and Crafts style and for its early use of concrete in Victoria.

Mawallok is of social significance as an exceptional example of the Guilfoyle style, important in the study of garden history and landscape design in Victoria. It is highly valued by students, visitors and the community (Panel emphases).

Figure 23: Mawallok Arts and Crafts Homestead showing northern terrace with steps to lawn (Source: Panel Photo)
As earlier noted, in determining that no EES was required to be prepared for the WEF, the Minister required a report on the potential effects of the wind farm on the cultural heritage significance of Mawallok to be prepared taking into account the Heritage Victoria statement of cultural heritage significance. The Minister’s reasons for not requiring an EES included that ‘there is scope to modify the wind farm design if significant effects on heritage values are identified in more detailed investigations.’

As also noted earlier a report was subsequently prepared (by Mr Allan Willingham, architectural historian) to the satisfaction of the Minister.

11.3 Evidence and submissions

In considering the issue of the impact of the proposed WEF on the heritage significance of Mawallok, we have had regard to the large volume of evidence and submissions received directly dealing with this heritage issue.

It included:

- PPAR WEF Appendix Q: Heritage Impact Statement, Proposed Stockyard Hill Wind Farm, Mawallok Homestead by Allan Willingham 28 January 2008;
PPAR WEF Appendix R: Addendum to Heritage Impact Statement, Proposed Stockyard Hill Wind Farm, Mawallok Homestead by Allan Willingham 4 June 2009;

- Expert witness statement April 2010 and oral evidence by Mr Peter Lovell for the Applicant;
- Expert witness statement April 2010 and oral evidence of Mr Bryce Raworth for Lowell Pty Ltd;
- Expert witness statement April 2010 of Mr John Patrick and oral evidence for Lowell Pty Ltd;
- Expert witness statement April 2010 and oral evidence of Mr Peter Watts for Lowell Pty Ltd;
- Expert witness statement April 2010 and oral evidence of Dr Harriet Edquist for Lowell Pty Ltd;
- Expert Witness Statement dated April 2010 of Mr Dennis Williamson for Lowell Pty Ltd (L139);
- Submissions by Mr Jeremy Gobbo QC for the Applicant and by Mr Paul Connor for Lowell Pty Ltd;
- Submissions by the more than 80 submitters who wrote on the Mawallok issue alone and those others submissions which referred to the Mawallok heritage issue amongst other matters;
- Oral presentations made solely on Mawallok by a number of persons such as Mr Richard Barley, former Director, Melbourne Gardens, Royal Botanical Gardens, Victoria; and by Dr John Dwyer QC, Chairman, Australian Garden History Society; and
- Oral presentations at the Panel hearing which also addressed the Mawallok issue as well as others.

11.3.1 Submissions and evidence for the Applicant

Early in the Panel hearing, Mr Gobbo advised that the Applicant proposed that six of the originally-proposed 242 turbines – being the six closest turbines in the northern view from the Mawallok garden - should be deleted.

The current northern view from the Mawallok northern terrace is shown in Figure 15 above. It largely corresponds with the two central segments of a four segment northern view from that terrace shown on the original Guilfoyle plan for the garden (copy at Exhibit L132 and A50a). The most easterly segment of the four segments which generally looked north-east and was much wider than the other segments on the Guilfoyle plan is no longer available – the layout of this easterly sector of the garden which was to include a tennis court does not accord with the plan and trees and other vegetation
largely block views to the landscape beyond the garden. The westernmost sector of the four segment northern view has also been lost due to tree growth. Of the two remaining central segments of the northern view, the eastern one in particular is also somewhat laterally reduced - by a large oak on the lawn below the house. Mount Cole and the Pyrenees Range nevertheless remain clearly visible beyond the Monash Lake at the garden edge in these two remaining central segments of the view from the terrace. The view is undoubtedly one which would score highly on any systematic survey of view quality as was referred to in Mr Williamson’s evidence.

We were presented with plans prepared both by Lowell and by the Applicant showing the remaining northern view segments extended northwards from Mawallok into the surrounding landscape. There was little difference between the plans. The Lowell plan (L141) conveniently shows the relationship of proposed turbines north of Mawallok to the lateral edges of the northern view so extended. The six turbines proposed by the Applicant to be deleted are coloured yellow on that plan.

The proposed deletion of those six closest proposed turbines was in response to the expert advice received from Mr Peter Lovell who was later called to give evidence on the significance of Mawallok and the effects of turbines in the northern view upon the heritage significance of the property.

Those six turbines were to be located less than five kilometres from the Mawallok garden (the closest at around 3.5 km away) on an elevated ridge running across the viewline near Toppers Lane. They are turbines – T32, T35, T36, T38, T42 and T49.

Of the 242 originally proposed turbines, well over 20 turbines would have been potentially visible in the view north from various parts of the Mawallok garden. From the northern terrace of the homestead, however, which is the point from which the central viewlines in the plan for the garden prepared by Guilfoyle34 depart, and within the Guilfoyle plan’s two central segments of view, some 20 turbines would have been visible. With the six closest deleted, this is reduced to 14 turbines extending from T5 in the west to T29 in the east. The proposed deletion of the six closest turbines now means that the closest remaining proposed turbine would be approximately 5km from the Mawallok garden. Five of the remaining turbines would be situated between five and six km away; two between six and seven km; two between seven and eight km; three close to seven km; and two at least seven km away (Exhibit A143).

34 The plan in question is not signed. While there had earlier been some expert disagreement whether the plan was prepared by Guilfoyle, by the time of the Panel hearing there was not dissent from that view.
The following photomontage from Mr Wyatt’s witness statement gives some idea of the visual impacts of all of the original turbines proposed in the Mawallok northern view. As we have indicated in Section 6, based on the field comparison of modelled and actual landscape at Challicum Hills, we believe that photomontages ‘under cook’ elements in the middle and further distance and thus the visual impact of the turbines which would actually occur.

Figure 25: Northern view from Mawallok with turbines superimposed
Source: A Wyatt witness statement page 45.

The effects on the view are more clearly illustrated by Exhibits L125 and L140B (though they are still subject to the same under-representation). Figures A4-2 and A4-4 of Mr Williamson’s expert witness report (Exhibit L139) show (subject to reduced middle distance) the comparative visual impacts of the original 20 and the remaining turbines after the closest ones are removed.

Submissions

Mr Gobbo’s submissions for the Applicant addressed the Mawallok issue in some detail (Exhibit A220). They included the following:

- Mr Lovell’s approach to the significance of Mawallok, which did not seek to rank the elements which lend to the significance of the property, is to be preferred to that of others. Thus consideration of the impacts should recognise that other elements would remain unaffected;
- The Panel cannot assume that the current occasional opening of Mawallok to the public will remain and thus the views will be available to be enjoyed. Nor can it be assumed that the current levels of upkeep of the house and garden would fall away if the turbines intruded in the view;
- The garden layout is now different to some extent from that shown on the original plan and thus precise adherence to the views contemplated in the original plan is reduced. In particular he said:

  …there must necessarily be flexibility in assessing the physical form and parameters of views within gardens. They change. Aspects come and go. Guilfoyle’s original five central vista lines are no longer as he visualised them. Further alteration is likely if not certain. It is in this context that man-made intrusion must be considered.
He said it was not a reasonable expectation, therefore, that a view be preserved in perpetuity;

- Loss (due to age) of more remote trees which currently frame the view would be likely to occur exposing further turbines in the view (see for example Figure A4-8 of Exhibit L139);
- Clumped screen planting should be introduced;
- There is no Planning Scheme control protecting the more distant land in the view line, that is the land beyond HO33, and Heritage Victoria had deliberately chosen not to apply Heritage Register protection to this land. Application of statutory controls protecting views from a place only rarely occurs in any case. It would be unfair on the owners of land in the view line to have a defacto overlay applied;
- No precedent is set by the protection of views from the Ercildoune Homestead kitchen garden by the Waubra Wind Farm panel as this had been volunteered by the proponent of that WEF;
- The view itself can be altered by other buildings and works;
- The Panel should take the view that the vista which is to be considered is only that available from the northern terrace of the homestead rather than the wider views from points further north into the garden or elsewhere around the periphery;
- A hard-line approach of no turbines in the viewline is purist and unreasonable. Consideration should be given to different arrangements of turbines and such factors as distance to the turbines; whether they would break the skyline; are central or peripheral to the view; or would be in front of Mt Cole itself; and
- The evidence of some of the experts presenting for Lowell should be given no or little weight because they had been submitters in their own right (Patrick and Watts); had had a close personal association with the property (Patrick); or did not take a balanced view in the context of the decision-making framework (Edquist and Watts). The approach taken by Mr Raworth, however, was judged to be professional, considered and generally consistent with that taken by Mr Lovell – though drawing a different conclusion.

Evidence

Mr Peter Lovell in his statement of evidence (A122) referred the Panel to a number of Victorian examples of where view protection of highly significant heritage places had been introduced and to guidelines applying in New South Wales and England concerning wind energy facilities and heritage. No such guidelines exist in Victoria.
The NSW Heritage Council Advice of 2003 includes that ‘generally, a wind farm design should seek to ameliorate visual impacts when in the vicinity of heritage items’. The English Heritage 2005 publication identifies factors which should be considered in assessing impacts. They include visual dominance, scale, intervisibility, vistas and sightlines, movement, sound or light effects and unaltered settings. In relation to views and vistas it is said:

\[
\text{Designed landscapes invariably involve key vistas, prospects, panoramas and sight-lines, or the use of topography to add drama. Location of turbines within key views, which may often extend beyond any designated area, should be avoided.}
\]

Mr Lovell comments that neither of these guideline documents nor others referred to in competing evidence provides explicit advice on how to assess the degree of impact.

Mr Lovell suggested that in the assessment the key consideration is the significance of the heritage place and the manner in which values which go to that significance are affected. He accepts the State significance of Mawallok and that a key aspect of the design of the Alsop house (and its main reception rooms in particular) and the Guilfoyle garden is the orientation of both to the northern views. However, Mr Lovell goes on to identify a range of elements lending to the significance of Mawallok which would remain unaffected by changes to the northern view. He further argued that the views are essentially private and not public realm views.

It is to be noted that Mr Lovell nevertheless conceded in response to a Panel question that while there are a number of elements or factors affording Mawallok its heritage significance, the northern viewline through the garden was ‘probably’ the most significant of these.

Mr Lovell’s written evidence included the following helpful analysis of the issue to be considered:

73. The views from Mawallok have reasonably been established as contributing to the significance of the place. Insertion of new tall built elements within those views, which are clearly intended to take in the natural and rural landscape, will have an impact. They will challenge a key plank of the design and impact to a greater or lesser extent dependant upon the degree to which they distract and intrude. Gauging the level of impact and degree of adversity is however difficult and notwithstanding the useful and structured assessment contained in the Williamson evidence, ultimately involves a degree of informed subjective judgement.
74. On the basis of observation both from the north terrace and in the location of the closer turbines to the south of Toppers Lane it is evident that these turbines will be strongly visible in the broader northern vista (Figure 9 & Figure 10). While they do not rise up in front of Mt Cole their presence will be more strongly felt as a result of the lack of foreground vegetation on the north shore of the lake, which might otherwise provide some partial screening. The closely spaced north-south linear grouping or tighter array will also emphasise their presence.

76. Their impact from a heritage perspective is that they will strongly intrude and draw the eye in a vista which is important to the significance of the second homestead and garden. Accepting that the northerly views are one of a number of factors which contribute to the significance of Mawallok my assessment is that this group of turbines would have an unacceptably adverse impact on the heritage place. The turbines (T32, T35, T36, T38, T42 & T49) sit within a range of 3.5 to 5.0km from the north face of the house.

77. Beyond the five kilometre distance a further group of turbines (T25, T26, T28, T29 & T31) are located in the five to six kilometre band. These rise up behind the hill upon which the southern group are located and are spaced slightly more widely. My assessment is that while still visible from the house and north terrace they are located at a sufficient distance such that their impact is not as great. Accepting that any intrusion into the Mawallok northern views will impact on the significance of the place the impact in this case is less, with the foreground vegetation and landscape tending to read more prominently.

78. The final grouping is that which sits in the 6 to 8km band. Some of these turbines will also be seen and at least two (T28 and T17), depending on viewing point, will be silhouetted against Mt Cole. As with the former intermediate group, this larger more distant group will also impact and impose a new element in this important vista. The fact of their visibility however is not such that the importance of the view from the homestead and garden design cannot be understood or that it is unacceptably impaired. Accepting that the setting of a heritage place is often important and that that setting may extend well beyond the place which is explicitly protected, management of that setting has to be reasonable and not extend beyond what is soundly based having regard to the assessed significance of the place.
79. *Mawallok is a place which is considered to be of a high order of cultural heritage significance. Contributing to that overall significance is the historical and aesthetic significance of the place as ‘an outstanding example of a designed landscape’. That landscape incorporates many features, one of which is the view to Mt Cole. The construction of wind turbines to the north of Mawallok will alter and interrupt this view. Dependant on weather, haze, background, blade movement and the like the turbines will draw the eye and alter the appreciation of the vista; a vista which was clearly a pivotal consideration in the overall garden concept.*

80. *From a heritage perspective the construction of any new visible structure within this vista has the potential to adversely impact on the significance of the place. The critical test becomes one of the degree of impact and the manner in which the overall significance of the place is diminished. In considering the degree of impact there are various terms which can be applied but perhaps a useful one is the notion of ‘significant harm’, that is harm which would unacceptably alter significance.*

81. *My assessment of the proposed turbine installation is that it will cause harm to the significance of the heritage place and that that harm would be ‘significant harm’ in relation to the turbines located between Toppers Road and Mawallok. The harm which arises from the turbines to the north of Toppers Road is that they will impose on and alter a vista which is key to one aspect of the overall significance of the place. This change, however, is not such that the combined values which go to that significance are no longer sufficiently intact to justify the high level of recognition for cultural heritage reasons that the place achieves. Ultimately the values which go to the recognition of Mawallok as a place of state significance will remain in large part intact.*

11.3.2 Submitters’ presentations and evidence

Submissions

As noted earlier a very large number of submitters wrote concerning the heritage value of Mawallok and their concerns about the potential erosion of the property’s significance by turbines in the northern view to Mt Cole and the Pyrenees Range. Written submissions were received from many persons and organisations with expertise in garden design and heritage gardens. These submissions have carried some greater weight in our decision than submissions from less informed or less expert submitters. We have, however,
considered all the written (and oral) submissions including the two groups of 42 and 14 pro-forma submissions.

A number of submitters made presentations to the Panel at the hearing and Mr Connor, who appeared for Lowell in relation to heritage matters, called evidence from four persons who are expert in heritage places including designed landscapes.

Some of the individual submissions advanced against allowing turbines in the northern view from Mawallok included:

- The very high level of significance of Mawallok and the garden in particular indicated by the following:
  - Mawallok is one of few Australian places in a recent international book: ‘1001 gardens to see before you die’ (Sub 1);
  - It is said to be the best remaining example of Guilfoyle’s private garden designs (Sub 5), a magnificent garden (Sub 14); few Guilfoyle gardens have survived and others are in decline (Sub 43); a masterpiece amongst Guilfoyle’s private commissions (Sub 173);
  - The presence of the Monash designed lake (Sub 18); and
- The importance of the ‘designed vista’ around which the (house and) garden are laid out (Sub 1) (Sub 5); ‘Guilfoyle’s clever use of long vistas (to external landscape features) and shorter internal views’ (Sub 45); the framing of the view to maximize its value and impact (Sub 152); the importance of the siting of the later homestead so as to capture the view (Sub 152); the ‘unique, harmonious vista which is unparalleled in Victoria’ (Sub 196).

The CEO of Australia’s Open Garden Scheme (Sub 173) wrote:

> Anyone who has visited Mawallok will have been as much struck by its setting and the way in which Guilfoyle framed the vista by the planting and design in the foreground. … Here he [Guilfoyle] designed a garden to complement the house, which in turn had been sited to enjoy the vista. The addition of Sir John Monash’s lake and the resultant changes to the planting only serve to highlight the dramatic qualities of Mawallok’s natural setting.

He also noted in submission at the hearing (Exhibit B146) the visual connection of the garden to the hills was important from its earliest conception and it is those very hills upon which the turbines are proposed to be built.

- The garden retains its essential layout and is true to the original design (Sub 3) (Sub 5); it has been painstakingly restored and revived principally
by Mrs Jocelyn Mitchell (Sub 43); pathways restored to original locations (Mrs Mitchell oral evidence and Sub 43); the design of the garden can now be read (Sub 43); relative intactness of garden – remarkably true to original design (Sub 173).

The Australian Garden History Society (Victoria) wrote (Sub 196) (also Exhibit D145):

Because of the ephemeral nature of gardens it is fortunate that the integrity of this country property has been maintained and the dominant feature of the garden, the main vista, remains unimpeded.

- The turbines would dominate the garden and intrude on its unique atmosphere and character (Sub 1)(Sub 5), would decrease the beauty of the garden (Sub 9); damage the dominant feature of the garden and breathtaking nature of view (Sub 188); visually intrusive turbines and diminution of significance (Sub 196).

- Dr Dwyer’s submissions for the Australian Garden History Society (Exhibit D145) also suggested that the proposed removal of the six closest turbines to Mawallok ‘would be better than nothing’ but ‘really does no more than show that the removal of obtrusive towers is the way to go’. He said that as a minimum all 17 of the towers shown in Mr Williamson’s montage should be removed.

Mr Connor’s submission for Lowell, which company owns and operates Mawallok, noted the provisions of the Guidelines and the Planning Scheme which direct attention to appropriate siting of WEFs and their elements and call for minimising impacts. He noted the decision in relation to the Waubra WEF which resited turbines in consideration of views from ‘Ercildoune’ heritage place.

Mr Connor’s submissions (L147) referred to how the Mawallok garden is laid out in the English landscape or picturesque tradition and integrates the landscape beyond the garden itself. He contrasted this with the design of enclosed or ‘paradise’ gardens. Mr Connor referred to how the Mawallok garden is designed to surprise the visitor with the Mt Cole vista, thereby enhancing its impact. He also noted the Arts and Crafts association with things natural rather than mechanical or industrial to emphasis the adverse effects of the turbines on the view from the Arts and Crafts inspired place. Relying on the evidence he called, Mr Connor submitted that the Mawallok garden is ‘a unique heritage asset which cannot be replaced if it is damaged or destroyed’.

Mr Connor also noted that Mr Lovell did not describe himself as a landscape architect and indicated respect for Watts and Patrick. He was critical of Mr
Lovell’s fragmentation of the significance of Mawallok into various elements and that some of the factors lending to significance cannot be affected in any case – such as the property’s historic significance. He submitted that the same reasons given for removal of the closest six turbines to Mawallok applied to the others proposed to remain in the view. He noted that Mr Lovell accepted that there would be an adverse effect on the significance of Mawallok but simply described it as ‘acceptable’. Instead he recommended that all two further groups of turbines identified by Mr Lovell should be deleted.

Evidence

As noted, Mr Connor called four expert witnesses on heritage matters (with Mr Williamson making some reference also to these matters).

Consistent with the submissions made to us by the Applicant we have found the evidence of Mr Raworth (Exhibit L135) to be of most assistance.

Dr Edquist, who is an expert in Arts and Crafts architecture and design, gave evidence (Exhibit L144) which was helpful in reinforcing our understanding of the importance of the heritage place and the viewline from the house; Mr Patrick (Exhibit L133) also argued for the importance of the garden and the integral role of the northern vista. While we note that Mr Patrick had put in his own submission in response to the public notice of the WEF Application and hence his independent expert role in appearing before the Panel was rather sullied, as was submitted by Mr Gobbo, his expertise in relevant fields cannot be doubted and he provided some useful comparative material to the Panel. We found Mr Watts’ (Exhibit 134) current expert view about the importance of this garden to be unshakable based as it was on his comparative research on Australian gardens of more than 20 years earlier. The Mawallok garden was included in his later book on Australian heritage gardens. Mr Watts described the Mawallok garden as ‘sublime’ – purportedly not lightly ascribed by him; and amongst the ‘top’ 9 or 10 heritage gardens in Australia. Mr Watts has undoubted expertise in garden history and his views on what would be damaging to the garden’s significance – which Mr Gobbo described as closed minded and extreme – have to be given considerable weight.

Mr Raworth’s evidence to the Panel included the following:
- The combination of significant house and significant garden means that Mawallok is of the highest order of heritage significance in Victoria;
- A key aspect of the integrated design of the house and garden is the vista north from the house and related portion of the garden to Mt Cole;
He contrasted the Mawallok view with that from the Ercildounewalled garden (considered by the Waubra Wind Farm Panel) and suggested that the Mawallok terrace view is:

...a fundamental design consideration in the generation of an important garden by an important designer, rather than simply being a view available from a particular part of an important garden.

He recognised that land in the viewline was outside the area included on the Heritage Register and thus there was no State control affording protection to the view but noted that the decision guidelines of Clause 52.32 directly called up consideration of visual matters and heritage impacts;

He accepted that individual turbine visual impacts on the garden may be more or less severe but that the remaining wind turbines (after the closest six had been removed) would be highly visible and would make a substantial change to the historic and hitherto unaltered view of the pastoral and natural landscape beyond the garden. The removal of the six turbines was in his view insufficient to remove the impact;

He recommended that all of the turbines visible from the northern terrace and the neighbouring garden areas should be removed from the plan. He nevertheless said that the key view was that from the northern terrace of the house not further into the garden where wider views to the external landscape occur; and

He accepted under cross examination that balance had a role to play in assessing heritage impacts against other policies.

11.4 Panel response and recommendations

We have considered all that has been put before us and have conducted an accompanied site inspection of the Mawallok Klingender and Alsop house and Guilfoyle garden to better understand the issues put to us.

We have formed the view that the submissions for Lowell should be upheld for the following reasons.

- There was no assertion made by anyone that Mawallok is not a heritage place with at least State level importance. We are persuaded that this is at least the case. Indeed the combination of important house and important garden makes it as of the highest significance in the State as opined by Mr Raworth and supported by Mr Watts and Dr Edquist;

- No submissions or evidence were presented that suggest that the northern vista from Mawallok is other than a key feature of the Guilfoyle garden design as is indicated in the Heritage Register citation. Mr Watts perhaps most eloquently described the importance of the central vista:
Consciously and spectacularly, [the garden] looks outward and embraces the landscape as its main organising principle, whilst creating a green oasis. In doing so it has achieved a grandeur almost unknown in Australian garden design.

Mr Lovell agreed under questioning that the northern vista was probably the key design element. We are persuaded that this is the case having regard to the siting of the house itself and the careful framing of the view in the Guilfoyle plan. This view is not just any view from the Mawallok garden, as Mr Raworth said, but is: a fundamental design consideration in the generation of an important garden by an important designer.

- It is this key element of the garden design which would be affected by the 14 or so remaining turbines north of Toppers Lane – there would therefore be a substantial erosion of the significance of the place in as much as the hitherto unaltered view to a pastoral scene and natural landscape would be severely intruded upon. We agree with Mr Watts that:

  The massive height and scale of the towers and their blades will ‘throw out’ the scale of the landscape and quite dramatically impact on the vista from Mawallok…it will effectively destroy the principal feature of this very significant garden.

We found no proposed alteration to the siting or re-colouring of the turbines considered by Mr Williamson to be satisfactory – the breaking of the skyline and the placement of turbines in front of Mt Cole itself were particularly problematic under all options. We also believe that that the movement of the turbine blades will further draw attention to the towers and compound the imposition on the view. Regularly-blinking red aviation hazard lighting potentially would further detract from the view.

- We recognise that the view itself has been and may yet be further altered by other developments on adjoining land but these are and would likely in future be of a scale and nature consistent with other ‘usual’ elements in the rural landscape;

- Mr Lovell sought to argue that with the six closest turbines removed, the level of erosion of heritage significance would be acceptable. He sought to suggest that the loss was reduced because other elements of significance would remain unaffected. We agree with Mr Connor, however, that some of the other elements are such that they cannot be affected in any case and given the concession about the import of the view we think that there is no real diminution or offset in this regard;

- We are conscious that the area affected by the view is not included in any heritage control itself and note the changes that were made to the (non-statutory) Heritage Victoria permit policy statement for Mawallok as it was being developed (at the time registration was being considered). This was
referred to by Mr Lovell (A122 page 11). The final version of the permit policy indicates that management of the registered place (itself) should seek to retain and protect the view across the Monash lake and the distant vista of the Pyrenees ranges and Mt Cole. An earlier expression of this objective placed less emphasis on the place itself.

We are not troubled by the absence of a statutory control over the vista, however. Consideration of the effects of use and development on one site upon another site is a fundamental element of planning decision-making and is supported in this case by the decision guidelines relevant to wind farm projects referring to the effects on views and vistas as well as cultural heritage;

- Nor are we bothered by any prospect that the garden might no longer be available for public viewing (though we think it should be), as its heritage significance does not depend on whether or not it is seen by the public;

- Alterations made to the garden also make little impact on our view on this matter. It is in the nature of gardens that they will alter somewhat over time from an original plan. The critical issue is in the case of a heritage garden whether the ‘bones’ of the garden remain (such as layout of beds, general path locations, broad planting themes, vistas and viewlines and the like) and that alterations are complementary to the garden’s significance or at least neutral in terms of effects on elements of significance. We consider the changes made to the garden at Mawallok under Mrs Mitchell’s directorship to have been restorative and positive in terms of the garden’s significance. We do note that there has been unplanned lateral closing-in of the Mt Cole view by flanking vegetation (trees in the lawn to the south of the ha ha wall and the loss of the outer segments of the four segment view) but there is no doubt that the attractive central vista – so fundamental to the garden’s significance – remains;

- We recognise that as one moves into the garden a wider external view becomes available in which peripheral turbines would be seen even if the ones in the terrace view were to be removed. We think that new plantings should be considered as appropriate to deal with those turbine views (as the views are less essential to the significance of the garden) and the views of other turbines which may become available as ageing windbreaks die off and are removed. We were advised that replanting of the older windbreaks is already occurring. We also think that views in other directions from the Mawallok property (some of which were referred to by Mr Peter Mitchell in his personal submission) which are less critical to its significance can also be dealt with by screen planting if required;
Mr Lovell also suggested that heritage conservation has to be ‘reasonable’ – apparently a reference to trade off against other considerations – though failed to identify what issues were involved in that trade-off. Mr Raworth also conceded the need for ‘balance’ in dealing with heritage.

This raises the matter of how these heritage impacts which we regard as severe are to be treated in the context of other Planning Scheme policies and, in particular, the support for the development of renewable energy facilities and, in some measure, the policies supporting continued sustainable agricultural use of the land in the Farming Zone.

In relation to agricultural policies and farming diversification in support of sustainable agriculture, we acknowledge that, if the Mawallok view is protected by deletion of turbines as we recommend, this would lead to a loss of opportunity for turbines to be proposed on an extensive area of farming land in other ownerships. We do not see that this would, however, lead to an erosion of the capacity of the other landowners to continue to use their land for agricultural purposes. It is true that the leasing of land for turbines would give a financial fillip to some farming enterprises in the area affected by the view line, but if such financial benefits were not to be forthcoming it does not mean that agriculture cannot continue – whether or not by the same owner.
We would also say that the scheme policies, while they require a reading down of visual amenity and landscape impacts in the context of the policy support for wind energy facilities, do not require this lesser weight to be applied to other considerations, including of cultural heritage matters.

It is our view that the importance of the Mawallok house and garden and the nature and severity of the erosion of the cultural significance of the place are such that on balance this outweighs the benefits to the community of the development of those wind turbines which could have been seen in the central view from the Mawallok terrace and in particular their contribution to renewable energy.

11.4.1 Recommendations

The Panel recommends that:

In any permit granted for the WEF, the 20 turbines visible within the central viewing cone from the Mawallok northern terrace be required to be deleted, that is turbines T32,35,36,38, 42 and 49 (already agreed by the Applicant); and turbines T5, 12, 13,14,15,17,18,21,23,25,26,28,29 and 31.
12. Traffic

12.1 Introduction

Due to its large area (156 sq km), the WEF site contains a substantial network of ‘boundary’ and internal roads. A significant proportion of these will need to be used in some capacity if the widely dispersed WEF is constructed. However before development starts, a traffic management plan must be prepared in consultation with the relevant municipalities and VicRoads to the satisfaction of the Minister for Planning. The Plan would potentially require a security deposit or bond held by the Pyrenees Shire for 12 months to cover works required under the traffic management plan.

Broadly, the Western and Glenelg Highways pass across the northern and southern ends of the site respectively, and the Skipton-Beaufort Road passes south-north through it. Other connector roads also pass through the site, primarily in a north-south and east-west grid. The most prominent ‘deviation’ from this is the diagonal Stockyard Hill Road / Geelong Road, a broad ‘three chain’ road reserve that directly links Skipton to Ararat through the south western portion of the WEF site. Whilst currently lightly trafficked, it was historically part of the major direct route linking the Port of Geelong with the goldfields in the Ararat/Stawell area and further to Adelaide. It was also a main stock route.

The two main highways and the Skipton-Beaufort Road are controlled by VicRoads. The other roads in the WEF site area are controlled by the Pyrenees Shire. The Rural City of Ararat and Corangamite Shire also have interests in the proposal relating to the transport of parts and supplies to the WEF. In the case of Corangamite the electrical transfer station at Berrybank, and the power line to it, will be in the municipality and will have associated traffic implications particularly through the construction phase.

The bulk of the following discussion relates to the WEF site (and hence Pyrenees Shire) except where otherwise identified.

12.1.1 Proposal for transport and traffic

The Applicant engaged Parsons Brinkerhoff (PB) to analyse traffic generation associated with the WEF development and estimate the impacts of the proposed development on the road network. The process was split into three parts: assessment of existing conditions; traffic impact assessment; and preparation of a route access plan.
The following policy and engineering guidelines were considered during the compiling of the report:

- *VicRoads Road Design Guidelines Part 3 – Cross section Elements;*
- *VicRoads Publication Number 0083 - Additional Permit Conditions.*

The primary findings of the PB reports include the following:

- All roads will have sufficient capacity to carry the extra traffic volumes generated by the project at all stages of the development, and no significant adverse traffic impacts are expected. Under an accepted Traffic Management Plan this can occur without need for capital investment on road infrastructure;
- While construction may occur over four years, there will be only limited times when significant truck volumes are accessing the site.
- Most local roads identified for transport can cater for expected truck flows subject to regular maintenance and traffic management measures being followed;
- Modifications and redevelopment of some intersections may be required prior to construction to provide for heavy axle traffic, subject to detailed investigation on upgrade requirements closer to the commencement of construction; and
- All internal access tracks (ie: on participating properties) will be constructed to required specifications, and construction traffic impacts will be managed through a Construction Traffic Management Plan within the project’s Environmental Management Plan (EMP).

In addition to current and proposed traffic volume projections, key matters underpinning the above findings include the following:

- VicRoads managed arterials are considered geometrically adequate to carry OD vehicles, heavy duty cranes, and other truck loading;
- The primary connector roads expected to carry much of the WEFs construction traffic are the Glenelg Highway, Skipton- Beaufort Road and the Western Highway, as declared State Highways controlled by VicRoads. The Glenelg Highway / Skipton Road intersection was previously used for the Waubra WEF;
- While neither the Glenelg nor the Western Highway provide direct access to the site, Skipton Road (an Access Management Category - AMP4 road[^35]) will provide direct access at up to 12 points (This was later

[^35]: VicRoads Access Management Policies Version 1  Dec 2005, Table 1
revised to 15 points). This road classification requires that any direct access to Skipton Road be assessed for management of potential conflict (eg: sight lines for turning or slowing vehicles), and to be included in a project Traffic Management Plan. However as Skipton Road is considered a low traffic road, ample opportunities exist to safely access properties;

- Some roads regulated by the Pyrenees Shire that need to be used have restrictions for large transport vehicles. For example, a restriction on Skipton Road denies entry from the northern (Beaufort) end without prior agreement from the Shire. The other roads with restrictions are identified in Table 18; and

- A detailed assessment of the nominated route will be required prior to construction, to include assessment of horizontal and vertical geometry, and assessment of the load rating of the structures and mitigation measures if required.

### 12.1.2 External access routes to the WEF site.

The proposed external access routes for transporting main construction materials to the WEF project area are identified in Table 17.

<table>
<thead>
<tr>
<th>Supply need</th>
<th>Likely transport route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine components (Nascelles, hub, rotor, blades, tower sections)</td>
<td>Henty Hwy/Glenelg Hwy, with LH turn to north at Glenelg Hwy/ Skipton Road intersection (The northern connections of the Eurambeen-Streatham Road and Skipton Road with the Western Highway are not suitable for transport of turbine components on OD trucks.)</td>
</tr>
<tr>
<td>Concrete</td>
<td>Mainly produced on site for transport on local roads and internal access tracks, but if external supplies are needed, the most likely route is from Ballarat via Western Hwy/Skipton Road and/or Glenelg Hwy/Skipton Road.</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Supply is most likely from quarries at Dunnstown, with carriage via Glenelg Hwy/Skipton Road or Western Hwy/Skipton Road, and then via local access roads.</td>
</tr>
<tr>
<td>Sand</td>
<td>Supply is most likely from Buninyong via Colac-Ballarat Road, then either Western or Glenelg Highways and Skipton Road onto local access roads.</td>
</tr>
<tr>
<td>Water</td>
<td>As per negotiations with local farmers or cartage from off-site sources.</td>
</tr>
</tbody>
</table>

Source: Compiled from information on pp135, 136; Vol 1: Stockyard Hill Wind Farm, Application for Planning Permit, October 2009
12.1.3 Internal access within the WEF site

Main local internal access roads within the WEF site (all in the Pyrenees Shire) are identified in Table 18.

Table 18: Local Access Roads - Pyrenees Shire

<table>
<thead>
<tr>
<th>Road</th>
<th>Condition (No. of Lanes)</th>
<th>2008AADT (v/day) and (Roadway capacity in both directions (v/hr))</th>
<th>Statutory truck restrictions *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaufort-Carranballac Road</td>
<td>Sealed and unsealed (1 each way)</td>
<td>No count available (&lt;1,000)</td>
<td>Trucks banned between Thompsons Road intersection and Glenelg Road intersection</td>
</tr>
<tr>
<td>Carngham-Lake Goldsmith Road</td>
<td>Sealed (1 in total)</td>
<td>43 (&lt;500)</td>
<td></td>
</tr>
<tr>
<td>Eurambeen-Streatham Road</td>
<td>Sealed (1 each way)</td>
<td>172 (&lt;1,000)</td>
<td></td>
</tr>
<tr>
<td>Geelong Road</td>
<td>Unsealed (1 in total)</td>
<td>No count available (&lt;500)</td>
<td></td>
</tr>
<tr>
<td>Mt William Road</td>
<td>Sealed / unsealed (1 each way)</td>
<td>105 (&lt;1,000)</td>
<td></td>
</tr>
<tr>
<td>Stockyard Hill Road</td>
<td>Sealed / unsealed (1 each way)</td>
<td>34 (&lt;1,000)</td>
<td></td>
</tr>
<tr>
<td>Stockyard Hill – Wangatta Road</td>
<td>Unsealed (1 in total)</td>
<td>No count available (&lt;500)</td>
<td></td>
</tr>
<tr>
<td>Streatham - Carngham Road</td>
<td>Unsealed (1 each way)</td>
<td>355 (&lt;1,000)</td>
<td>Trucks banned between Glenelg Hwy intersection and Mt William Road intersection</td>
</tr>
<tr>
<td>Streatham-Mortchup-Mount Emu Road</td>
<td>Unsealed (1 in total)</td>
<td>356 (&lt;500)</td>
<td></td>
</tr>
</tbody>
</table>

* Routes with statutory truck restriction signs may still be able to carry over dimensional (OD) loads subject to agreement with Shire to assess maintenance requirements for duration of construction program.

Source: Table 11.1, P134 Vol 1: Stockyard Hill Wind Farm, Application for Planning Permit, October 2009

One-way traffic movements will be required on narrow connector roads of less than 4.5m wide to eliminate the need for their upgrading since those roads would be unable to carry simultaneous two way truck traffic (eg: where property fences abut the edge of carriageways, and where tight corners and dips and rises occur). Also, while some main intersections (refer Table 19) would not constrain the movement of raw materials, further investigation is
needed to determine their adequacy for accommodating the transport of turbine and tower components.

Table 19: Deficient intersections for transport of wind turbine components.

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt William/ Streatham Carngham Road</td>
<td></td>
</tr>
<tr>
<td>Eurambeen – Streatham Road / Meadows Lane</td>
<td></td>
</tr>
<tr>
<td>Eurambeen – Streatham Road / Geelong Road</td>
<td></td>
</tr>
<tr>
<td>Skipton Road / Carngham-Lake Goldsmith Road</td>
<td></td>
</tr>
<tr>
<td>Skipton Road / Mount Emu Settlement Road</td>
<td></td>
</tr>
<tr>
<td>Skipton Road / Stockyard Hill Road</td>
<td></td>
</tr>
<tr>
<td>Mt William Road / Skipton Road</td>
<td></td>
</tr>
</tbody>
</table>

Various other considerations and adjustments apart from dealing with statutory truck restrictions would be needed in establishing a final Traffic Management Plan. These include the following:

- Elimination of conflict with existing bus routes west of Skipton Road, and with grain traffic mainly on the EURambeen-Streatham Road and Mt William Road or the Carngham Streatham Road, and in relation to a grain facility on the corner of Mt William and EURambeen-Streatham Roads;
- Some (unspecified) sections of roads controlled by the Pyrenees Shire may require upgrading, subject to audit identification if a development permit is granted;
- Low overhead wires along Shire roads would need to be raised prior to construction; and
- Close attention is needed to site distances that may require some tree lopping and pruning.

During the hearing, the Panel requested additional information regarding access points off Skipton Road and this was provided prior to inspections at the end of the hearing.

12.1.4 Traffic impact

The 2008 PB traffic report proposed that the construction traffic would generate an extra 140 two-way trips per day. However this was increased in the witness statement by Mr Peter Kelly of PB to 252 trips per day (ie: 178,200 additional traffic movements over the construction period; and including ~25-30 trips in the peak hour) as presented in Table 20 (The numbers include delivery and exit trips as two trips). The revision resulted from altered assumptions including the following matters that had not previously been considered:
The potential need to source road construction materials and water from outside the WEF site;

- A site compound with 40 car parking spaces adjacent to Stockyard Hill Road near the former Stockyard Hill church has been added, to cater for 32 maintenance staff;

- During the WEF’s operational phase, a maintenance office adjacent to Stockyard Hill Road near the former Stockyard Hill church is likely to accommodate around 32 staff with 40 car parking spaces;

- A higher number of labour trips; and

- Inclusion of internal trips around the site for water and concrete that will in part be on public roads.

Table 20: Total trips to and from WEF site over construction period

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Total trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 axle rigid truck</td>
<td>87,600</td>
</tr>
<tr>
<td>Semi-trailer truck</td>
<td>5,500</td>
</tr>
<tr>
<td>OD truck</td>
<td>7,100</td>
</tr>
<tr>
<td>4WD</td>
<td>78,000</td>
</tr>
<tr>
<td><strong>Total trips</strong></td>
<td><strong>178,200</strong></td>
</tr>
</tbody>
</table>

Source: P9, Expert Witness Statement of Peter Kelly 23 March 2010

The detail of the proposed trip generation, as in Mr Kelly’s statement at the hearing is shown in Table 21. The materials quantity figures also indicate the large scale of the project.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Material (Quantity or Units)</th>
<th>Vehicle Type (Total vehicle movements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation concrete batching</td>
<td>Cement (32,900t)</td>
<td>3 axle rigid truck (2,860)</td>
</tr>
<tr>
<td></td>
<td>Aggregate (97,300t)</td>
<td>3 axle rigid truck (8,460)</td>
</tr>
<tr>
<td></td>
<td>Sand (52,200t)</td>
<td>3 axle rigid truck (4,540)</td>
</tr>
<tr>
<td></td>
<td>Water (14,200kL)</td>
<td>Semi-trailer truck (835)</td>
</tr>
<tr>
<td>Foundation construction</td>
<td>Concrete (82,280 m³)</td>
<td>3 axle rigid truck (16,456)</td>
</tr>
<tr>
<td></td>
<td>Reinforcing steel (8,470t)</td>
<td>OD truck (484)</td>
</tr>
<tr>
<td></td>
<td>Formwork</td>
<td>OD truck (484)</td>
</tr>
<tr>
<td>Road construction</td>
<td>Sand (203,500t)</td>
<td>3 axle rigid truck (1,7696)</td>
</tr>
<tr>
<td></td>
<td>Aggregate (215,500t)</td>
<td>3 axle rigid truck (18,740)</td>
</tr>
<tr>
<td></td>
<td>Water around site (44,500kL)</td>
<td>3 axle rigid truck (5,850)</td>
</tr>
<tr>
<td></td>
<td>Water delivered</td>
<td>Semi-trailer truck (2,618)</td>
</tr>
<tr>
<td>Hardstand construction</td>
<td>Sand (48,700t)</td>
<td>3 axle rigid truck (4,234)</td>
</tr>
<tr>
<td></td>
<td>Aggregate (71300t)</td>
<td>3 axle rigid truck (6,200)</td>
</tr>
<tr>
<td></td>
<td>Water around site (10,600kL)</td>
<td>3 axle rigid truck (1,950)</td>
</tr>
<tr>
<td></td>
<td>Water delivered</td>
<td>Semi-trailer truck (624)</td>
</tr>
<tr>
<td>WTG installation</td>
<td>Tower sections (726)</td>
<td>OD truck (1,452)</td>
</tr>
<tr>
<td></td>
<td>Nacelle (242)</td>
<td>OD truck (484)</td>
</tr>
<tr>
<td></td>
<td>Hub (242)</td>
<td>OD truck (484)</td>
</tr>
<tr>
<td></td>
<td>Blades (726)</td>
<td>OD truck (2,178)</td>
</tr>
<tr>
<td></td>
<td>Step-up transformer (242)</td>
<td>Semi-trailer truck (484)</td>
</tr>
<tr>
<td></td>
<td>Cranes</td>
<td>OD truck (1,452)</td>
</tr>
<tr>
<td>Electrical construction</td>
<td>Transmission poles (280)</td>
<td>Semi-trailer truck (56)</td>
</tr>
<tr>
<td></td>
<td>Transformers (5)</td>
<td>OD truck (10)</td>
</tr>
<tr>
<td></td>
<td>Cabling (582 coils)</td>
<td>Semi-trailer truck (388)</td>
</tr>
<tr>
<td></td>
<td>Sub-stations (5)</td>
<td>Semi-trailer truck (520)</td>
</tr>
<tr>
<td>Compound/batching/parking</td>
<td>Sand (1,300t)</td>
<td>3 axle rigid truck (114)</td>
</tr>
<tr>
<td>construction</td>
<td>Aggregate (1,700t)</td>
<td>3 axle rigid truck (148)</td>
</tr>
<tr>
<td></td>
<td>Water (600kL)</td>
<td>3 axle rigid truck (390)</td>
</tr>
<tr>
<td></td>
<td>Buildings</td>
<td>OD truck (40)</td>
</tr>
<tr>
<td>Construction labour</td>
<td>Labour (20 cars 4 times/day)</td>
<td>4WD (7,8000)</td>
</tr>
</tbody>
</table>

Mr Kelly also proposed that where possible, to reduce traffic external to the WEF site, sands and aggregate should be sourced from excavation of footings, or from existing sand and gravel pits in the local area, to minimise transportation load on public roads, and their potential upgrade at considerable capital cost.

On site access tracks

On site (ie: on farm) access tracks will be unsealed but formed to access turbines, staging areas, substations and the maintenance facility. Track formation will be 5m wide by 0.7m deep comprised of three different aggregate layers. Firm stable hardstand areas will also be needed at each turbine site for crane operation during construction. If needed OD transport vehicles can be turned by crane lifting at turbine sites to reduce the size of or impact on turning areas.

12.2 Evidence and submissions

The Applicant advised that consultation had occurred with the local councils and with VicRoads throughout the planning process to identify the most appropriate transport routes and traffic management techniques, and that VicRoads does not object to the proposal.

Mr Gobbo noted that in such projects it is normal for the access routes and intersections to be used to be iterative, and that traffic and transport routes, and the Traffic Management Plan presented in the PPAR would be finalised into a comprehensive plan for submission to VicRoads for approval. Such approval would be sought following the detailed design of the proposal, in consultation with DPCD, the Councils and VicRoads. Further, all matters raised in submissions can be mitigated as needed, he said, by use of approval conditions.

Transport and traffic matters raised in submissions can be identified in two categories: from municipalities and from private submitters.

The following main concerns were identified in submissions by residents of the area:

- The highways and Shire road systems are inadequate for the safe transportation of tower components;
- Some roads proposed for transport are too narrow with tight bends, and provide no opportunities for passing or overtaking;
- The roads are also used by B-doubles to transport grain and heavy machinery; and
Consultation is needed with local community (including bus drivers, milk deliveries, and farmers with oversized machinery) for production of a timetable for construction traffic to work around rural traffic such as grain trucks, school buses and farm equipment that will have to compete with over dimensional vehicles.

The Pyrenees Shire identified that some roads proposed for use will have 'minimal pavement layers'. It will be necessary for the Applicant to advise the council of any defects due to heavy vehicle use before major patch repairs are required. The Shire was also concerned about road shoulder maintenance and loss of effective seal on roads with minimal seal widths. The Council noted that the main concrete batching plant to the west of Black Lake will be adjacent to a minor local road, and requested the Panel to require the facility to be accessed via an (unspecified) main road.

Neither the Rural City of Ararat nor the Corangamite Shire focussed on traffic as a substantive issue in their submissions.

During the hearing Mr David Hocking of Berrybank cross examined Mr Kelly on his traffic figures and related matters, particularly regarding the transport of aggregate for roading and concrete construction. On review it was conceded that truck numbers were under calculated by about 50 per cent. While this led to a significant revision of the relevant figures, Mr Kelly proposed that the roads would still easily cater for the increased number within the design capacities of the road network.

Mr Kelly also made the following responses to questions by Mr Hocking and the Panel.

- The route plan detail will be determined when final sites of turbines are selected;
- Current calculations are conservative (eg based on water and other natural resources needing to be brought in) given that supply sources of sand, aggregate, and water are not finalised;
- While the source of water is not determined, carriers would be required to use main roads before minor roads;
- The final traffic management plan will deal with the transport of blades on OD transports, and some upgrading of some minor roads and intersections may be required for OD use. The turning of OD transports which often have steerable rear bogeys will be carefully managed, and ODs will not need to remain on the left hand side at intersections. Pilot vehicles and traffic management applications will be required and trained traffic management personnel would be used where needed.
These requirements will be incorporated into the traffic management plan;

- Turning movements of OD transports will generally occur on site, not on local roads, as most turbines will not be in crowded sites;
- OD vehicles may typically require 5m height clearance, and some vegetation trimming and raising of power lines may be required;
- 80 trips per day are estimated for construction labour at individual turbine sites;
- Internal access tracks are calculated at an average of 1km per turbine (ie: around 240 km total for the full permit application proposal), and will typically be 5m wide by 0.7m deep. No allowance is made for soft spots. Differences will even out across the 242 turbines and determinations are considered conservative;
- Half of the proposed water consumption will be on road construction and management including dust control, but vehicle wash-down had not been considered; and
- Roads would be left in at least as good a condition as at the start of the project. This is a normal requirement of Councils and VicRoads. Roads used are expected to be adequate but some roads or road sections may need reconstruction. This is considered in development of a route plan within the Traffic Management Plan.

Mr Kelly stated that while not an expert on traffic safety, in relation to shadow flicker he does not see much difference between passing shadows from blades and that of trees from a moving vehicle despite blade tip movement potentially being at over 200km/hr. He cannot see how it could be a huge distraction given the range of distractions experienced from vehicles. He also said that road warning signs concerning flicker or turbines close to the road could provide information to road users but may not necessarily be beneficial in a road safety context.

12.3 Panel response and conclusions

The Panel recognises that final approval of VicRoads must be obtained regarding for the substantial number of access points to properties from Skipton Road. We also accept that the external and internal road network has ample capacity to accommodate the additional temporary traffic flow associated with the construction and ongoing operation phases of the WEF in its proposed or a modified form. While some disruption will occur to local residents and to some other road users throughout the construction phase, we do not consider this to be unreasonable where occurring in accordance with an approved Traffic Management Plan.
The Panel would prefer to be considering a final draft Traffic Management Plan with definitive identification of site access points (mainly off Skipton and Geelong Roads). However during the Panel hearing around 30 proposed turbines were deleted from the project for various reasons. This in turn has flow-on implications for the numbers and placement of internal access tracks and the site access points off main roads. It also affects gross vehicle movement numbers particularly during the WEF construction phase, in some parts of the site more so than others. We therefore need to regard the figures put to us as indicative, and consider them at a strategic level.

The only general information available at this stage is also a function of the scale and complexity of the site spread and across four distinct sectors.

We regard the matters of the entry and management of OD vehicles onto and within the site and associated impacts on the functionality of the local and regional communities as the main matter for attention. We are less concerned about the heavy trucks transporting sand, aggregate, concrete and water on local roads. The farming community is familiar with heavy and slow moving vehicles on local roads mainly as grain and stock transport, and agricultural plant and equipment including tractors, as every-day occurrences. The only difference here is the increased numbers of trucks in some parts of the WEF site potentially over a four year period. As the design capacity of the roads can cater for this, we do not regard the imposition as unreasonable in its own right. This is particularly so given that the timing and location of movements will need to be regulated through a traffic management plan. Local residents will need to be familiar with the Traffic Management Plan to the extent that is relevant to them. Part of the plan should be dissemination of its arrangements.

We note that high levels of large truck movements have been associated with the development of other WEFs and we are not aware of situations where significant difficulties have emerged for local residents.

With regard to access onto the site for the OD transport of wind turbine components, we need to consider whether there is likely to be an impact on the local community and infrastructure that cannot be reasonably managed.

We have not been provided with any evidence of safety-related matters on roads relating to regulated OD movements. ODs are large, generally slow moving vehicles that are seen from considerable distance, and their access to and movement within the WEF site will be restricted in public places to the Skipton and Geelong Roads and Eucambeen-Streatham Road via the Glenelg Highway south of the WEF site. We were also informed that traffic management techniques would be in place as required at intersections such as the turn onto Skipton Road from the Glenelg Highway, and that VicRoads
approval is needed for OD access points off and onto Skipton Road from WEF properties. We are also not aware of any issues that emerged at this or other intersections and roads when Skipton Road and the Skipton Road/Glenelg Highway intersection were used for the transport of components for the Waubra WEF.

Around eleven access points are currently intended off Geelong Road north-east of Stockyard Hill. Geelong Road is sealed through that area and carries low traffic volumes for the dimensions of the road reserve, and no issues have been raised specific to it. Therefore, subject to access and egress matters from that road being incorporated into an approved traffic management plan, we do not foresee the emergence of unreasonable or unmanageable issues relating to that road itself or to users of it.

We have also considered the matter of shadow flicker from turbines. Flicker across roads will occur at some locations where turbines are close to roads (eg: along Skipton and Geelong Roads. We were provided by the Applicant with plans showing areas subject to shadow flicker. It is our view that road users normally experience a range of distractions including shadow flicker experienced when driving along a road in a treed area. Turbine shadow flicker would be another one of these. The roads on which flicker would occur are not heavily used in context of road design capacity, and shadow flicker would be confined to limited times. We further note that the removal of turbines from the central sector which we recommend in Section 10 would reduce the flicker substantially.

We have also considered the requirement in the draft permit conditions for a Traffic Management Plan and its specified components. We consider these to cover the central matters for attention. Therefore, subject to approval of all or part of the WEF proposal, the onus will be on the Applicant to satisfy the relevant municipalities and VicRoads that the final Traffic Management Plan responds to the permit requirements. We have also taken into account the submissions by the Shire of Pyrenees concerning road matters.

Specifically we find that:

- The road network within and accessing the Stockyard Hill WEF area can accommodate the additional traffic loads and the types of traffic (from private vehicles through to Over Dimensional vehicles) that will need to access the area during the construction and operational phases;
- All traffic routes and movement will need to comply with a Traffic Management Plan to be finalised by the Applicant in collaboration with the Pyrenees and Corangamite Shire Councils and VicRoads for endorsement by the Minister for Planning to form part of the planning permit. Key
elements of the Traffic Management Plan as indicated in the draft conditions provided to the Panel include the following:

- An existing conditions audit of relevant public roads proposed for use by construction transport in the vicinity of the WEF;
- The designation of appropriate construction and transport vehicle routes to the WEF site;
- The designation of operating hours and speed limits for trucks, to avoid school bus routes and times as relevant, and to provide for resident safety;
- The identification and timetabling of any required pre-construction works;
- The designation of all vehicle access points to the WEF from surrounding roads, and associated detailed design in order to avoid traffic conflicts;
- Recommendations regarding the timing of any required road and intersection upgrades, and associated detailed designs to accommodate additional temporary or ongoing traffic or site access requirements;
- Measures required to manage traffic impacts associated with the ongoing operation of the WEF on traffic volumes and flows.
- A regular inspection program during the WEF construction to identify necessary maintenance works resulting from construction traffic use;
- A program to rehabilitate roads at least to the condition identified in the audit required above;
- If required by the Pyrenees Shire Council, the payment of a security deposit or bond for a 12 month maintenance period regarding works covered by the traffic management plan; and
- It follows that any traffic management, and road upgrade and maintenance works need to be in accordance with the approved Traffic Management Plan, or any approved revision to it.  

36 If roadworks require removal of additional areas of native vegetation, separate permission may be required for this.
13. **Greenhouse issues and energy output**

Victorian Government policy, expressed through a number of policy statements and action plans, is strongly supportive of renewable energy as a means of reducing greenhouse gas emissions from fossil fuel powered electricity generation.

### 13.1 Introduction

In this section we discuss the Guidelines requirements, the estimated electrical energy output from the proposed Stockyard Hill Wind Farm, the calculated greenhouse gas benefits, the submissions and our conclusions.

We heard from Sustainability Victoria, one expert witness was called by the Applicant and we were presented with a substantial submission.

**Documentary Sources**

The following sources have been used in preparing this chapter:

- the *Policy and planning guidelines for development of wind energy facilities in Victoria*, September 2009 and the May 2003 version (the Guidelines);
- the Planning Application Report (PPAR) main document, October 2009, prepared by Environmental Resources Management Australia (ERM) and particularly Chapter 6;
- the Greenhouse Gas Abatement Report (October 2009) prepared by the Applicant at Annexe C of the PPAR;
- submissions from the Applicant specifically on shadow flicker (Exhibits A7 and A220);
- presentation by Mr Michael Williamson of Sustainability Victoria (Exhibit SV4);
- response from Mr Michael Williamson of Sustainability Victoria to our request for advice on a submission as a result of exhibition from Mr Paul Miskelly and a document from Mr Peter Lang supplied by Mr Mitchell (part of Exhibit M152);
- expert evidence from Mr G White of Garrad Hassan called by the applicant including his expert witness statement (Exhibit A12), and copy of his presentation (Exhibit A13);
- submission from Mr Peter Mitchell (Exhibit M152b) and copy of presentation (Exhibit M161); and
a number of submissions from other individuals as a response to the public exhibition of the PPAR or to us, or both, referring to concerns about greenhouse gas displacement.

The applicant called Mr Graham White from Garrad Hassan as an expert witness. Mr White provided an expert witness statement and copy of his presentation.

13.2 Discussion

The Guidelines

The support for the development of wind energy facilities in Victoria is expressed at Section 1.1, page 4 of the Guidelines as:

The purpose of the Policy and planning guidelines for development of wind energy facilities in Victoria is to outline how the Victorian Government will facilitate the appropriate development of wind energy facilities, balancing environmental, social and economic outcomes.

The policy position is further developed in Section 3.2, page 10-12 of the Guidelines.

At Section 4.8, page 25 on application requirements there is a requirement for written reports from the applicant which include:

- The amount of electricity to be exported from the site
- Expected greenhouse gas savings

The Applicant

The Applicant submitted that the proposal should generate approximately 1,890,000 MWh of electricity per year with an estimated capacity factor of 44% based on nominal 2 MW turbines. It estimated that that would provide electricity for about 270,000 dwellings, i.e. equivalent to about 21% of Melbourne’s homes. (Note: we have rounded the foregoing figures). The Applicant suggested that with larger 3 MW turbines the energy output would be greater but at a lower capacity factor.

The Applicant estimated that the greenhouse gas abatement at 1,890,000 t CO$_2$-e per year (figure rounded) using a conversion factor of 1 tCO$_2$-e/MWh from a 2006 report prepared by McLellan Magasanik Associates Pty Ltd for Sustainability Victoria.

The applicant called Mr Graham White of Garrad Hassan as an expert witness.
Mr White informed us that the average long-term mean wind speed predicted for the site is 8.2 m/s. He advised that the energy production modelling had been done using the indicative REpower MM92-Evo/2MW machine. He said that if larger rotor diameter machine is used the energy output increases approximately in proportion to the swept area. He estimated the energy output to be equivalent to that needed for 354,000 homes.37

Mr White stated that no increase in instantaneous reserve generation capacity would be needed for the proposed facility to cope with wind farm variability; and that because variations in wind energy output over 10 minutes are likely to be smaller than variations in load, no increase in frequency control arrangements would be needed. He said that the present wind generation power component of the Victorian capacity is about 5%, Stockyard Hill Wind Farm would take that to approximately 10%. At page 7 of Exhibit A12 Mr White said:

The electricity system operates to cater for variability, both in consumption and for generators such as wind.

Sustainability Victoria

Mr Michael Williamson of Sustainability Victoria made a presentation to us. Sustainability Victoria is the Victorian government agency with responsibility, inter alia, to promote renewable energy.

Mr Williamson described the Victorian and Commonwealth governments’ renewable electricity and greenhouse gas reduction policies, the status of wind energy in Victoria, wind energy in the National Electricity Market (NEM), and provided data on wind farm performance. He informed us that in estimating the greenhouse gas reduction from wind energy, reliance was placed on the work of McClellan Magasanik Associates Pty Ltd (MMA). MMA has specialist knowledge in modelling the operation of the NEM. In a detailed study, MMA calculated the greenhouse gas reduction due to wind generation in Victoria entering the electricity system. Mr Williamson told us that MMA concluded:

An increase in wind capacity in the Victorian region will certainly reduce greenhouse gas emissions.

We were also told that it predicts wind energy to reduce greenhouse gas emissions by between 0.93 and 1.09 tCO₂-e/MWh of wind generation, depending on the wind energy penetration. Further, it commented that increased levels of wind energy have a proportionately greater impact on brown coal generation.

37 The PPAR estimate is 270,000.
Mr Peter Mitchell

Mr Mitchell, in a comprehensive and closely argued submission, challenged the claimed greenhouse gas savings from wind energy, and the effect of the variability of wind energy output on the operation of the electricity grid.

Mr Mitchell provided us with a copy of a paper ‘Costs and Quantity of Greenhouse Gas Emissions Avoided by Wind Generation’ by Peter Lang (part of Exhibit M152).

Mr Mitchell submitted that the greenhouse gas saving attributed to wind energy is incorrect. He argued that the variability of wind power output requires open cycle gas turbine plant to be available for shadowing the wind facilities; plants which are less energy efficient than closed cycle gas turbine plant which otherwise might be used. He argued that this lower efficiency of the open cycle gas turbine compared to other generating plant, and hence its higher greenhouse gas emissions per unit of electricity energy output, largely negates the claimed greenhouse gas benefits of wind farms. Moreover, Mr Mitchell submitted that wind energy significantly increases the cost of electrical energy.

Mr Mitchell provided us with his analysis of electricity generation costs and estimated greenhouse gas savings at the Mortlake gas turbine power station now being constructed and the proposed Stockyard Hill Wind Farm to illustrate his position of higher costs and lower greenhouse gas savings for wind generation.

Mr Mitchell further submitted that the variability of wind energy makes the distribution grid less stable and harder to manage, a problem which would increase as the installed wind energy capacity would increase.

Further, Mr Mitchell submitted that Stockyard Hill Wind Farm is an unnecessary addition to the facilities generating electricity from renewable resources and wind power in particular, as construction of other approved and likely to be approved wind farms will take wind farm capacity above the government’s target level of 20%.

13.3 Panel response

In submissions to the public exhibition of the PPAR we receive a comprehensive submission from Mr Paul Miskelly questioning the claimed greenhouse gas benefits of wind energy and suggesting heightened risk in managing the electricity grid - both allegedly consequences of the variability of wind farm output. Mr Miskelly did not present to us.
Mr Mitchell informed us that the paper by Lang is similar to the submission from Mr Miskelly. When Mr Williamson presented we asked him to provide a response to this material to assist us.

Mr Williamson responded by e-mail dated 21 May 2010 which was distributed to the parties. Mr Williamson advised us that he had sought the views of the Australian Energy Market Operator (AEMO). AEMO is the independent operator responsible for managing the National Electricity Market (NEM) which involves the interconnected electricity grids of all the eastern states plus South Australia. It is responsible for the planning and management of this complex system.

In his response Mr Williamson said at page 3:

*The material provided by AEMO below deals with most issues raised in the Lang paper in unequivocal terms and Sustainability Victoria has little to add to this material. While individuals will form views on the subject based on what they believe to be so, or what they may have heard from others, it is difficult to dispute the viewpoint of AEMO which manages the system on a day to day basis. This is a highly specialised field in which individuals may hold strong views, but where specific expertise should be relied on. Papers from interested individuals with related, but not specific expertise may not add value to the body of knowledge on the topic generated by the International Energy Agency and the Australian Energy Market Operator.*

The response from AEMO said at pp 5-7:

*It is important to note that gas generators would have an economic role in the market with or without intermittent generation. To imply that that the sole purpose of all of the open cycle generators in the market is to backup the variability of wind is patently not correct. The mix of plant in the market could change in response to a whole range of matters.*

*We need to be clear that Governments are not mandating wind power. Energy to meet the Renewable Energy Target can come from a range of eligible renewable energy sources. Wind is, at this stage, one of the cheapest, commercially available forms of renewable energy that meets the criteria. Its intermittency does present some issues but its contribution to the reduction of greenhouse gas emissions in the energy sector is demonstrable.*

*Any new entrant where their output exceeds the demand of their immediate area will potentially change loading on the network. The NER has provisions that prevent the power system from being degraded as a*
result of any new connection and wind farms must comply with this the same as any other generator.

......

The historical record of South Australia’s emissions over recent years clearly demonstrates the contribution wind can make to supplying customer demand and reducing emissions.

......

With respect to the conclusions in the (Miskelly) paper, the assertions of very limited greenhouse gas abatement from wind turbines is based on a limited analysis of the behaviour of the overall generation supply portfolio to match demand and the false assumption about coal consumption not varying with generation output. Overall it is recognised that wind power is more expensive than conventional forms of generation and that the output of wind generation is volatile. However, through its forecasting system, AEMO is demonstrating that wind generation is reasonably predictable and can be securely managed within the generation mix. Importantly wind offers some of the lowest cost, low emissions energy available with current technology and it is offsetting production from fossil fuel generation.

Our task is to assess the PPAR for the proposed Stockyard Hill Wind Farm. It is not to review Victorian government policy on wind energy facilities. The submissions on these matters really go to the appropriateness of the policy - which is clearly stated. The responses that we asked for and received from Sustainability Victoria and AEMO to the papers from Mr Lang and Mr Miskelly, and the submission from Mr Mitchell, indicate that claims that Stockyard Hill Wind Farm would no lead to a useful reduction in greenhouse gas emissions and could lead to difficulties in grid operation are not supported by them.

With regard to the evidence from Mr White we observe that the average annual wind speed that he has reported of 8.2 m/s indicates the presence of a good wind resource at the site. His evidence on estimated energy output and its relationship to rotor diameter suggests that with 104m rotor machines, rather than the 92m rotor diameter of the indicative turbines, the energy output might increase from an estimated 1890 GWh/a to about 2400 GWh/a (an increase of about 25%) and if that was accompanied by a change from 2 MW to 3 MW machines the capacity factor would change from about 44% to 38%.
However, during the course of the hearing, the Applicant withdrew 30 turbines from the proposal. We observe that will reduce the estimated energy output by about 12% if we simply pro rata the estimated energy generation.

### 13.4 Conclusions

We conclude that the estimates made by the Applicant in fulfilment of the requirements in the Guidelines of the amount of electricity to be exported from the site and the greenhouse gas savings are credible. We were provided with estimates in the PPAR, but we were not provided with revised estimates when a number of turbines were withdrawn. By making the simple assumption that the energy output from all turbines would be identical the estimated wind farm electricity output would be approximately 1,660,000 MWh/a, and the greenhouse gas abatement about 1,660,000 tCO2-e/a.

On the balance of the evidence and submissions we are not persuaded that the greenhouse gas abatement estimate is not robust.

The Guidelines at section 4.9, page 28 provides as a decision guideline:

> Considerable weight should be given to the contribution to Government policy objectives in relation to the development of renewable energy.

We give weight to this estimated greenhouse gas abatement from the proposed Stockyard Hill Wind Farm

### 13.4.1 Recommendations

The Panel recommends that:

> Annual electricity production and estimated greenhouse gas abatement from the Stockyard Hill Wind Farm should be made publicly available.
14. Fire

Fire in relation to the Terminal Station is discussed in Section 20 of this report.

In considering this matter of the relationship of the WEF to fire, information was drawn from the following sources:

- Stockyard Hill Wind Farm Planning Application Report, Volume 1, Origin/ERM, October 2009 (PPAR);
- Expert witness statement of Mr Graham White (A12);
- Expert witness statement of Mr John Nicholson (A37);
- Submission from the CFA, Mr B Brown (Submission 304); and
- Submissions by neighbouring land owners, members of the community, community organisations, other government departments and agencies and local government.

The PPAR indicates that the potential for fire damage to wind turbines or fires being caused by the operation of a wind farm is very low. The Application report suggests that the following factors reduce the potential for fire attributed to wind farm operations:

- The flammable components are located high above the ground.
- There is no vegetation around the base of the turbine.
- High-voltage connections are underground.
- Access tracks act as firebreaks and provide fire fighting access.
- Lightning protection factors are installed on every wind turbine.
- Dedicated monitoring and control systems shut down the wind turbines when threshold temperatures of critical components are reached.

The PPAR further indicates that the Environmental Management Plan will include provisions to avoid certain operations (such as the external use of welders, angle grinders) during high fire-risk periods. The Application report concludes that the development of the wind farm will not significantly increase the potential for fire.
14.1 Evidence and submissions

The following matters were raised in submissions:

- The wind farm landscape is vulnerable to fire particularly fast running grass fires (M151, WPLG85);
- The wind farm will add to the fire risk (M151, WPLG85);
- Fires are known to start in nacelles and are not manageable. A nacelle fire is likely to spread ignited oil over the surrounding landscape (M151);
- Increased risk of fire fighter safety if turbines start fires in stony rises country as this country is difficult to traverse. Turbines should not be placed within or adjacent to timbered areas or stony rises country (WPLG85, C102);
- Reliance on aerial support to fight fires is not realistic (WPLG85);
- Increased length of powerlines will add to fire risk. Underground cabling should be mandatory for any new power installations (WPLG85, K180);
- Responding to wind farm fires will place an increased burden on volunteers. Capacity of local brigades is already limited (WPLG85); and
- Wind farm must avoid certain operations regarding use of equipment in periods of high fire danger (WPLG85).

In his expert witness statement for the Applicant, Mr Graeme White (A12) advised that the potential for fires occurring in wind turbines or fire caused by the operation of a wind farm is very low for the following reasons:

- Wind farms do not store or use combustible fuels (i.e. coal, diesel, petrol, natural gas etc) on site;
- Turbines are manufactured with high quality mechanical and electrical components which rarely cause fires;
- All electrical components are appropriately insulated, grounded and protected;
- All turbine electrical wiring and most of the switch gear is in the steel tower which provides protection to the surrounding environment;
- Electrical protection equipment cuts-off power to the turbine if any electrical faults occur;
- The SCADA system monitors component temperatures and shuts down turbines when threshold temperatures of critical components is reached;
- There is limited vegetation around the base of the turbine;
- The electrical reticulation system of the wind farm is underground;
- Access tracks act as fire breaks and provide fire fighting access;
- Lightning protection systems are installed on every wind turbine.

Mr White indicated that that during the construction of wind farms certain operations are banned during high fire risk periods. In response to submitters’ concerns about increased fire risk, Mr White advised that turbines are under constant supervision (by SCADA systems) and are accessible by road so in the event of a fire in a wind turbine, fire-fighters should be able to arrive on the site relatively quickly and the risk of fire spreading is low.

Mr J Nicholson (A37) in his expert witness statement stated he had reviewed the Emergency Management Guidelines for Wind Farms (Emergency Management Guidelines for Wind Farms, CFA, version 3, April 2007), and the model planning permit conditions for wind farms available on the DPCD website. He considered that, subject to certain additional management recommendations, there was nothing to militate against establishing the wind farm as proposed. Additional matters he identified included the need to amend Condition 11(e) of the model permit conditions to ensure planning for fire prevention and response is a year round consideration; amend Condition 11(e) (iv) to require the wind farm operator to explain emergency services procedures prior to commencement of operation of the facility; and amend Condition 8 to include advice to the State Aircraft Unit of the endorsed wind farm layout plans. Mr Nicholson made further recommendations about developing arrangements with the CFA in relation to the bushfire management plan, fire detection and notification, bushfire prevention training for wind farm employees and contractors and representation on local fire management planning committees. In response to submitters concerned about increased fire risk, Mr Nicholson indicated that there could be no guarantee that a fire would never occur in a wind turbine nacelle. He advised that in this eventuality, sensors would shut down the turbine and the risk of potential spread of fire would be managed by having response arrangements in place with the CFA, appropriate to different weather conditions. Mr Nicholson also proposed that the wind farm operator liaise with the State Aircraft Unit on the use of aircraft to protect assets in the area. He supported training of employees and contractors on the requirements for operations on high fire risk periods as identified by Mr Chapman (WPLG85). Mr Nicholson also indicated that an effective maintenance regime would minimise the risk of pole top and powerlines as a source of fire.
Mr B Brown from the CFA (submission 304) in answer to questions from the Panel said that wind farms present no tactical disadvantage in fighting fires. He considered that the high standard of construction and maintenance associated with wind farms indicated a reduced level of fire risk. Strong liaison between the wind farm operator and the CFA for training and to develop appropriate response arrangements was required. He agreed with Mr Chapman (WPLG85) about the difficulty of fighting fires in the stony rises country. He indicated that the CFA’s approach to fires in stony rises country - which was to let the fire burn out - was unlikely to change as a result of turbines in the landscape. Mr Brown’s submission recommends a number of permit conditions relating to road access for fire fighting, provision of an adequate water supply, vegetation management, lightning protection on each turbine, undergrounding of electrical and communication cables and dedicated monitoring systems that detect temperature increases for automatic shutdown.

14.2 Panel response

The Panel recognises the threat of wildfire is a major concern among rural landowners and communities. High standards of fire preparedness and response are an essential part of living in rural landscapes where it is well recognised that even farming equipment can cause fires if not used sensibly.

We appreciate that wind farm components and increased vehicle movements associated with a wind farm can increase the risk of fire and require appropriate management. We consider the increased risk not to be substantial, however.

We also recognise the concern of submitters that the increased length of powerlines might add to the fire risk for the area but we support the response of Mr Nicholson, called by the Applicant, that effective maintenance would minimise this risk.

We have nevertheless been conscious of the investigations (and now recommendations of recent weeks) by the Victorian Bushfire Royal Commission, 2009, relating to electricity lines and fire. We understand that, as was recommended by some submitters in the Panel hearing, undergrounding of powerlines is now recommended by the Commission to reduce fire risk (as well as aerial bundling of cable and other technology). The State government has yet to formally respond to these and other recommendations by the Commission but we expect that their response may need to be considered during the further processing of the permit Applications for this project.
Generally, based on the advice of the CFA, we are satisfied that fire prevention and emergency response can be effectively managed through planning permit conditions requiring the preparation of a Fire and Emergency Response Plan and additional conditions advised by the CFA.

14.2.1 Recommendations

The Panel recommends that:

Conditions should be included on any permit granted for the WEF requiring the preparation of a Fire and Emergency Response Plan and incorporating the conditions recommended by CFA.
15. Hydrogeology and water

15.1 The Guidelines

The demand for water use during construction of the wind farm has been raised as an issue in this case.

The Guidelines are entirely silent on consideration of the effects of a wind farm on surface water and hydrogeology (ie groundwater) except for the need to prevent siltation. This is, however, a matter for consideration under the environmental decision guidelines of the Farming Zone and the decision guidelines of Clause 52.32 relating to WEFs.

15.2 Overview

15.2.1 Water requirement

Water will be needed for construction and operation of three temporary concrete batching plants proposed for the WEF site, and for dust suppression during the WEF’s construction. About 60-70ML of water would be needed over about 45 months. While this amount is stated for the full proposal as described for the PPAR, the final amount would depend in part on the final number of turbines approved. The 60-70ML equates to a temporary supply of about 0.043 ML/day.

While the source of water has not yet been determined, options include groundwater, local surface water supplies or transport from external sites. The most likely source is considered to be groundwater from the basalt areas. However, as one concrete batching plant is proposed in the higher sedimentary landscape other water supply options, including trucking/piping may need to be considered for that site.

The site EMP would include a range of standard type erosion and sedimentation control methods based on approaches in the EPA Guidelines for Major Construction Sites. This would include the management of water from batching plants as recommended by URS.
15.2.2 Surface water

The PPAR including its appendices identifies that the main watercourses associated with the WEF site are the Mount Emu and Fiery Creeks. Both are classified as ephemeral by the Royal Australian Survey Corps. Several smaller ephemeral feeder creeks flow to lakes following rainfall events.

The two major lakes in the WEF area in the area are Lake Goldsmith and Black Lake. Lesser water bodies include Slater Lake, Buln Gherin Swamp and farm dams. Many other natural depressions occur in the basalt landscape that in their natural state capture surface water.

Some basalt areas act as groundwater recharge areas. In other areas water emerges from the aquifers as permanent springs. The Panel noted during inspections that St Enoch’s Reservoir (which formerly provided Skipton’s potable water supply) is spring fed and remains controlled by Central Highlands Water which has a licence to draw about 100ML per annum from it. Similar springs occur at Mawallock (see later discussion) with an extraction licence of a similar scale.

The closest proposed turbine to Lake Goldsmith is T83, about 500m from the lake’s edge, with a further three within 1 km (T74, T77, and T102). At Black Lake, the closest turbine (T108) is about 320m from the lake edge, while 13 more turbines are within 1 km. The closest proposed turbine to Slater Lake (T218) at about 1.3 km is now intended to be deleted from the project. Mount Emu Creek has ten proposed turbines within about 1km while no turbines are proposed within 1 km of Fiery Creek.

These distances are adequate to prevent direct impact on surface waters from turbine construction.

15.2.3 Groundwater

Groundwater use is administered by Southern Rural Water (SRW), and extraction licenses are required for the drilling of bores in accordance with SRW guidelines for other than low volume stock and domestic bores.

Of 357 groundwater bores identified within 20km of the WEF site, 27 are licensed for investigation and observational uses, 139 are observation bores drilled by the Department of Minerals and Energy, 109 are unlicensed low volume bores for stock and domestic use, and 81 did not have a use listed. Depths vary from 2 to 127 m below ground surface.
In issuing licences, SRW must be satisfied that there will be no unacceptable risk to the environment or existing licensed users. As the WEF site is not in a Groundwater Management Area, a Groundwater Supply Area, or a Water Supply Protection Area, there is no imposed extraction cap for the area.

**Investigations**

The Applicant engaged URS Australia Pty Ltd to:

- review previous data, information and reports;
- conduct a site specific investigation via 8 drilling sites on the depth to groundwater and salinity in the constructed monitoring bores; and
- assess the potential impacts on the groundwater systems from the construction and placement of the access tracks and turbine foundations.

The work was directed by Mr Brian Chadwick of URS. Mr Chadwick later provided expert evidence to the Panel at the hearing.

The URS report titled *Hydrogeological Investigation - Stockyard Hill Wind Farm* is dated 22 March 2010. It concludes that there will be little potential for any observable change in the groundwater flow regime. The reasons for that view are as follows.

The report records that eight holes were drilled under licence in the WEF area. Two of the holes were not constructed as bores as no water was encountered by 20m depth, and were backfilled. Data for the drilled sites are in the report which identifies that the WEF site overlies two regional scale aquifers:

- the *Newer Volcanics* fractured rock basalt aquifer is the main local aquifer and is the source of a number of local springs; and
- the underlying *St Arnaud Group* fractured sedimentary rock aquifer.

Ephemeral and smaller local aquifers may also exist in the shallow thin alluvial/colluvium sediments associated with the surface water features and fractured granitic bedrock.

The URS report states that the Newer Volcanics basalt aquifer is recharged from rainfall accessions through generally very porous and/or shallow soils that tend not to shed much surface water. The main local ground water recharge points within this land type will include the former eruption points of Stockyard Hill and Monmot Hill and their associated stony rises landforms. Locally, ground waters flow radially outwards from the eruption points, and towards various water bodies such as Fiery Creek and Lake Goldsmith. Deeper regional ground waters are considered to flow south slowly towards Lake Fyans and Lake Bolac elsewhere in the region. Deeper groundwater
under the sedimentary land forms towards the northern end of the WEF site is believed to move to the north.

Salinity varies from 1,500 mg/L Total Dissolved Solids (TDS) west of Lake Goldsmith (associated with the basalt landscape) to around 7,000 mg/L TDS in the north-west (associated with the marine sedimentary geology). This salinity range falls into Segments B (1,001 -3,000 mg/L TDS) and C (3,501-12,000 mg/L TDS) under the State Environmental Protection Policy on Groundwater (SEPP).

From the above, local groundwater from the Newer Volcanics areas is identified as the most suitable for use in the batching plants in terms of its quality. These waters have lower salinities and experience in the Newer Basalts is that bores can generally yield the required average release of 0.5L/sec.

On the matter of extraction rates from bores in the basalt, in a letter of 1 June 2009 from URS to Mr Peter Lausberg, Development Executive, Stockyard Hill Wind Farm Pty Ltd from URS hydrogeologists, the following is stated:

Information on the sustainable yield from the aquifer is more difficult to determine, and the yield from an individual bore is dependent on the degree of fracturing and vesicularity of the basalt, and the extent to which these secondary porosity features are connected. Anecdotal evidence indicates that yields are likely to be in the order of 0.5-1 L/sec (pers comm., Ernie Welsh, 14 May 2009). The GMS data indicates that yields could be up to 10 L/sec, however this is considered to be an exception.

In the same letter, URS notes that it knows of a 20m deep artesian bore on a property near the corner of Beaufort-Carranballac Road and Mt William Road in the Newer Volcanic (stony rises) landscape. The bore yields a free flow of 12.5L/sec and a salinity of 1,000 mg/L TDS.

The letter also states that:

The springs most likely occur as a result of permeable portions of the Newer Volcanics outcropping, which allows groundwater to discharge to the surface. The presence of rocky basalt outcrops and the low salinity groundwater also suggests that this area is a zone of preferential rapid recharge into the aquifer.

and

The utilisation of the Newer Volcanics basalt as a water supply for the SHWF could lower the water table and therefore potentially lead to a reduction in flow within springs and/or available yields from landowner
bores installed in this aquifer. However, considering the low extraction rates estimated (0.5L/sec) and the relatively short time period for extraction (45 months), the water table is likely to be only depressed in a local area around the production bore and no significant impact on the regional water table is expected. Aquifer testing would need to be completed to confirm the sustainable yield.

Consideration was also given to the depth to the water table addressing the issue of whether the turbine bases would intercept groundwater flows. The stated maximum foundation depth of turbine bases is 2m. Depth to groundwater was found to vary from 2m to over 20m beneath the WEF site, and was considered to be at least 5m below most proposed turbine locations. This is in part due to the location of many proposed turbines sites on ridge lines and on locally high land. Of the 242 turbine locations proposed in the Application, 12 are identified as being at sites where they may intersect groundwater. The permit Application documents state that if there is potential for such intersection in the final design, the foundation of the subject turbine tower could incorporate piles rather than a slab.

Impacts of WEF construction on hydrogeology and ground waters

Access to turbine sites will be via existing roads, farm tracks that may require upgrading, and other tracks that will have to be constructed as part of the development. It was said that the foundations and access tracks for 100 of the 242 turbines would cover about 0.6 percent of the principal recharge area between Fiery Creek and Mount Emu Creek. Any rains falling on the turbine foundation/hard stand areas or access roads, however, will likely flow off them to enter the groundwater system beside them. It was said that little or no reduction in net recharge volumes is expected to occur. The amount of rain for which this does not apply would be negligible in the context of the land area and recharge volumes.

Also, minimal potential impacts are expected on the aquifers and groundwater from turbine construction as foundations will be above the water table. More specifically:

- No change or restriction is expected to the groundwater flow path, within any of the aquifers across the WEF site, as foundations will not intercept the water table; and
- No impact to the aquifer properties is expected from the installation of turbines, since while excavation works could in theory cause localised rock fracturing if a rock breaker is used, this is not expected to have any negative impacts.
The use for wind farm construction purposes of the deeper ‘deep lead’ sediments underlying the Newer Basalts is said to be unlikely to have any significant impacts on surface water bodies, springs or existing bores. This is because this aquifer is considered to be hydraulically isolated from the newer basalts aquifer. However:

- Bore installation into the deep lead will be significantly more expensive given the greater depth involved (ie: over double the costs of a bore into the basalt);
- The thickness and extent of the deep lead sediments beneath the site are not well understood and there is a risk that they will not be encountered; and
- The PPAR also states that creeks and surface water bodies tend to be ephemeral with brackish water and are considered likely to act generally as groundwater recharge zones rather than as groundwater discharge points. They are therefore considered unlikely to reliable sources of suitable water but are also unlikely to be impacted by additional groundwater extraction from the basalt and/or deep lead aquifer should these be used for on-site supply.

The URS report contains the following key recommendations relevant to this topic:

*Water for use during the construction phase and as required during ongoing maintenance may be sourced from groundwater or, as a less preferred option, from farm dams.*

The most likely source of suitable groundwater in the area would be from the Newer Volcanics aquifers. While groundwater quality and potential yields from the Newer Volcanics aquifer is indicated to be variable, low salinity groundwater is indicated to occur at the site, particularly within the stony rise deposits (such as to west of Lake Goldsmith), which are often associated with areas of groundwater recharge. Yields from the Newer Volcanics aquifer are dependent on the extent of fracturing (which is the principal characteristic determining hydraulic conductivity), and lateral and vertical extent of the aquifer.

*Any proposal to extract groundwater from the site must be in accordance with SRW requirements including Bore Construction Licence (BCL) for any wells required, and most likely a hydrogeological assessment in accordance with SRW Guidelines. An assessment for potential groundwater supply could normally include installation of groundwater wells in accordance to the BCL and may require pumping tests to be required to obtain time-drawdown data for analysis of aquifer characteristics and long term sustainable yield evaluations. Groundwater*
quality (including pH, TDS, major cations and anions) would also be investigated as a basis to confirm suitability of water for supply for use at the site. It is recommended that consideration be given to these requirements in respect to potential water supply as the development proceeds.

Temporary concrete batching plants are required on site to provide concrete for the construction phase of the project. These plants have the potential to generate quantities of wastewater which can cause increased acidity and turbidity and must be managed appropriately to protect the surrounding environment. A mitigation measure recommended is a collection pond where wastewater can be collected and treated by a licensed EPA wastewater treater.

Implementation of a site EMP (will be needed) to manage construction activities to protect the sites groundwater and surface water.

Site works would be required to collate site-specific data to confirm the groundwater suitability, and to provide supporting information which demonstrates that impacts of the temporary groundwater extraction would be minimal.

In addition, any proposal to extract groundwater would require an Extraction Licence from SRW. It is likely that SRW would require a more detailed hydrogeological assessment to be completed prior to the issue of the Extraction Licence, in accordance with SRW’s requirements for licensing.

The report also contains a range of recommendations relating to drainage and erosion control involving adherence to the EPA Guidelines for Major Construction Sites. These are recognised in the Applicant’s planning permit Application.

15.3 Witness report

Origin Energy engaged Mr Brian Chadwick (B. Sc. (Geology); M. App. Sc. (Hydrogeology) of URS to comment on hydrogeology and water matters, including responses to submissions on water-related matters. The technical content of his evidence aligns with the URS report directed by him. Key elements of his evidence are:

- Use of groundwater for the batching plants is not expected to create significant impacts on the regional water table given the low volumes required; and
- Significant effects are not expected on springs that potentially support wetlands in the area.
These views are based on the temporary yields required, the distance between the proposed concrete batching plants and springs, and in the context of current apparent utilisation of the Newer Volcanics aquifer.

Mr Chadwick’s evidence also included that while groundwater levels are in general falling across the area due to below average rainfall (and may continue to fall with similar rainfall patterns), the placement of turbines and the access tracks will not contribute to an additional fall in groundwater levels within the aquifers across the WEF site, and turbine placement at Black Lake/Stockyard Hill will not intersect groundwater and therefore ‘will not reduce aquifer recharge to any observable degree’.

In response to submitter concerns that a comprehensive and thorough review of the aquifer system may not have been undertaken, Mr Chadwick considered the URS review investigations and works to be appropriate and of acceptable standard. He stated that while he was unable to respond to specific concerns expressed regarding the natural water supply to Mawallok (see below), he believed overall that there is no unacceptable risk to groundwater or to users of groundwater from the proposed WEF.

Mr Chadwick’s recommendations for draft permit conditions which relate to potential impacts to groundwater include the following:

- Comply with EPA Publication 628 ‘The Environmental Guidelines for the Concrete Batching Industry’, to ensure any impacted water is not discharged from the concrete batching plant to surface waters, groundwater or land.
- Ensure the final design of the foundations and access tracks does not prohibit rain to runoff and enter the subsurface.

15.4 Submissions

Some submitters expressed concern that water required for the construction of the WEF is excessive and would impact on water tables and groundwater sustainability, and water availability for existing users. More specifically it was proposed that:

- Groundwater extraction may cause a watertable drawdown cone on the surface of the aquifer that may lower water within the cone area to below the depth of local bores; and
- Construction and operation of the WEF may disrupt the hydrogeology of the district including the springs on the Mawallok property, potentially caused by earthworks and blasting during construction, vibration of turbines during their operation causing cracking of bedrock, and
diversion of surface waters by access roading and any other associated structures.

Particular concerns relating to the above included the following:

- Lack of detailed analysis in the URS hydrogeological report;
- No calculations or associated methodology were provided to support the volumes of water required before during or after construction;
- No reference is made to transporting water in from a more viable and sustainable location;
- Concern regarding the extensiveness of the network of roads and turbines constructed on, around and over the main recharge area and its impact on water infiltration;
- Concern about the ability of Southern Rural Water to adequately assess the cumulative impact of the extraction of groundwater and the interference with the recharge system above;
- Overall disregard for the extensive but ecologically sensitive area that the local basalt aquifer sustains, in relation to waterways dependent on it;
- Water tables have lowered over the past decade, and some local bores have ceased production and required renewal or deepening of existing bore holes; and
- Turbines will cause vibration in the base rock that over time will affect the fracture system potentially plugging water pathways.

The matter of the drawdown cone was raised by the Western Plains Landscape Guardians. The group advised that at the Ballarat West borefield a cone of depression had lowered the watertable by 15m at 1km from the pumping site, and that the influence of the cone extended out to over 15km. The WPLG proposed that sustained pumping by Origin energy from considerable depth could create a drawdown cone that over time could lower and expand.

Mr Peter Mitchell and Mr Stephen Mitchell challenged the adequacy of Mr Chadwick’s identification of springs in the area and their importance. They stated that there are three springs from the aquifer recharge area around the Black Lake/Stockyard Hill area over which it is planned to site many turbines. They advised that at Mawallok, one spring that permanently issues 10,000 gallons (46,000 litres) per hour, waters the heritage gardens at the property and supplies four houses. Another spring of 18,400 litres per hour, waters the stock troughs for the 2,400ha property via a reticulation pipeline and holding tanks. The WPLG produced a map to identify an additional eight springs and 10 significant waterways.
The Mitchells requested the Panel to apply the ‘precautionary measure’ to ensure that no turbines are placed in water recharge areas or within a 100m corridor between the sources (Black Lake) and the major springs in the region.

Mr Peter Mitchell also indicated that Mawallok has a licence for the use of about 100 ML per annum for the springs.

The WPLG, represented by Mr Gabb on this issue, requested that an independent organisation be asked to investigate the impacts of water extraction for the project. The group also requested that:

- detailed research be conducted into the potential impact on groundwater systems from the construction and placement of roads and turbines;
- an analysis of transporting water into the development from another viable and sustainable source; and
- any turbine foundation identified as intersecting with groundwater should not be constructed.

The WPLG further requested that if an extraction licence were granted to the wind farm the following should be required:

- **Origin** to provide a written guarantee that they will not interfere with natural flows of this fragile system.
- **An extensive system of monitoring bores in and around the designated extraction points.**
- **Monitoring and flow assessment of all springs prior to (12 months) and during construction.** (SRW)
- **Regular updates and full disclosure of total water use.**
- **A local consultative committee be formed to oversee the water management and receive quarterly updates of bore and spring monitoring results from Southern Rural Water.**
- **Extraction of water to stop immediately if SRW and/or the local consultative committee deem that specified buffers have been breached or targeted extraction exceeded.**
- **Origin guarantee compensate or remedy for any detrimental effects to users of the local water supply as a result of over extraction.**
15.5 **Panel response**

Overall we accept the evidence provided by Mr Chadwick that the construction and operation of the WEF will not impact on the hydrogeology or groundwater within the WEF area.

We consider that comment is needed on two matters:
- Water requirements; and
- Potential for the construction and operation of wind turbines to impact on the regional and local surface and ground waters.

**Water requirements**

We do not consider the wind farm’s estimated construction water requirement over the four year period of 60-70 ML to be significant in the regional or local context of surface water and groundwater. We also note that if application is made to use groundwater, SRW has statutory obligations to address most of the concerns identified by submitters.

We provide the following context statements based on the upper stated requirement of 70ML over 45 months (18.7ML over 12 months on average):
- 18.7ML per year on average is about 1.5ML (about the volume of two Olympic Swimming pools) per month;
- The surface area of Lake Wendouree is 238ha. If 70ML of water is spread over this area it would fill to a depth of 2.9mm. For one year this would be 0.77mm. Across an area of 10sq.km this is around 0.2mm per annum, 0.02mm over 100sq.km, or around 0.013mm across the 150sq.km total area of the proposed WEF;
- We were informed that Central Highlands Water retains a largely unused 100ML per annum entitlement to extract water from the spring-fed former Skipton Water Supply reservoir at the Bains’ property (‘St Enoch’s’) adjacent to Stockyard Hill Road. This annual entitlement is over five times the average annual requirement stated for construction of the WEF. It is conceivable (but has not been canvassed with us) that unused water could be ‘sold’ by that water authority to the Applicant for construction of the WEF; and
- The annual water entitlement at Mawallok is stated to be about 110ML per annum. This is around six times the average annual requirement for the WEF construction over four years.
Impacts of water use

We do not consider it likely that a drawdown cone could be caused as suggested by WPLG. We have identified the relatively small amount of water required when considered on a regional scale. Further, groundwater pumping for WEF construction will not be sustained over the long term and we believe it would be insufficient in volume and longevity to cause such an effect.

We are also of the view that:

- the hard surface area created by the turbines and associated infrastructure (roads, tracks, hard stand areas and the like) covers a very small proportion of the project area and any runoff from foundation and tracks will continue to access groundwater.
- turbine foundation construction to a depth of around two metres is unlikely to create any hydrogeological impact on the bedrock.
- any potential threat to surface or ground waters (eg: as a consequence of possible siltation) during the operation of the WEF should be managed in accordance with an approved Environmental Management Plan.

As a consequence of the above we accept that the potential for the construction or operation of the WEF will not impact on local springs fed from the Newer Volcanics (stony rises) areas.

It also seems that there may be potential for access to the currently unused water at St Enoch’s Reservoir, Stockyard Hill licensed to Central Highlands Water.
16. Enforcement and management

A matter raised in a number of submissions, and in particular in the submissions by the three local councils - for Ararat Rural City and Pyrenees and Corangamite Shires - was the difficulties which would be associated with enforcement of the permits if granted – that for the wind farm in particular.

The enforcement issue as presented to the Panel had two elements. The first was the legal issue of who has responsibility for enforcement of wind energy facility permits granted by the Minister for Planning. The second issue relates to the difficulty of managing a project of this magnitude with limited municipal resources.

16.1 Legal responsibility for enforcement

We were told that there is currently a dispute between the State government and some local governments about whether the responsibility for enforcement of permits for WEFs over 30 megawatts lies with State or local government.

This debate arises from the awkward wording of the schedule to Clause 61.01 of the Planning Scheme.

The Panel dealing with the Mt Mercer Wind Farm (Mt Mercer Wind Farm (PCI) [2006] PPV 94 (20 December 2006)) discussed this matter at some length at Section 14.2 of its report and suggested that the clause is to be read as indicating that local councils have that responsibility. As we understand it, this is currently the State government position. We understand that there may also have been subsequent independent legal advice to the State which supports this position.

We were told at the Panel hearing that subsequently there has been independent legal advice provided to some local councils which indicates that the correct or preferable interpretation of the enforcement matter that responsibility lies with the Minister for Planning.

We do not propose to revisit this issue but have proceeded on the basis that there will be an agency or agencies responsible for enforcement and that enforcement can be effected. This is the only practical approach which can be taken when considering whether a permit ought be granted.
16.2 Improvements to management and enforcement

This is not to say, however, that we believe that current arrangements for enforcement of a major wind farm permit such as is proposed here are satisfactory.

The management and enforcement of permits for a substantial project such as this has the potential to absorb a large proportion of the human and financial resources of relevant planning departments. In the case of smaller municipalities it could well absorb all of the time and resources of a limited planning department if undertaken conscientiously.

As was said (albeit in relation to the Application itself) in the officer report to the meeting of Corangamite Shire Council on 22 September 2009 which related to the matter of referral of aspects of the project to the Minister:

This is a large infrastructure project...

A wind farm application takes an enormous amount of administrative resources that challenge the current structure and staffing of the planning department

Even if the management (including administration of secondary consents) and enforcement responsibilities are instead undertaken at State level, regional planning office resources available for the task can be limited.

We would also emphasise that the assessment and enforcement tasks can also require an understanding of quite complex technical matters such as the nature of wind farm noise which are not necessarily skills that local planning personnel will have.

The Panel was advised that a number of municipalities and the Municipal Association of Victoria met with the Minister for Planning on 22 April 2010 to discuss this matter and recommended to the State government that there should be a partnership established between councils and the State government to deal with monitoring and enforcement matters relating to wind energy facilities. As we understand it, it is proposed that the councils would contribute funding on a rate per turbine ($100) to help build a shared resource of technical expertise available to both the State and councils. The technical advice from a Technical Reference Group is envisaged as helping inform assessment, monitoring and enforcement. We assume that, unless it is proposed that there be special enabling legislation, the existing decision-making bodies and enforcement agencies would retain their current roles.

The Panel understands that the Minister responded to the partnership proposal by letter to the MAV dated 10 June 2010, indicating partial support.
for the proposals and that the Guidelines (or the Victorian supplement to the proposed National Wind Farm Development Guidelines) might be revised to reflect an agreed program of work for the provision of revised guidance on assessment and enforcement of WEFs; resources would be specifically allocated to pilot regional coordination and a dedicated wind farm project manager; models of co-funding of independent technical expertise would be examined; and the establishment of a regional-scale data set for south-west Victoria to assist in the assessment of cumulative impacts investigated. The Minister did not support the establishment of a technical reference group on the basis that sufficient independent expertise exists within the State government.

The Panel strongly supports the proposal that specialist technical resources, whether employed with or consulting to government, be allocated to the administration and enforcement wind farm permits. The Panel cannot stress to strongly the enormity of the assessment task and the high level of technical knowledge required to effectively make assessments of permits and compliance issues.
17. **Other issues**

17.1 **Shadow flicker**

Shadow flicker can be defined as the occurrence of periodic changes in light intensity due to the shadow of a wind turbine blade passing over a point of interest i.e. an observer. This shadow cast by the moving turbine blades causes sufficient variation in light levels that it may cause annoyance. Shadow flicker should not be confused with the view of the shadow of the rotor on the ground but not passing over the observer, or of the direct view of the moving rotor against a contrasting background sometimes called ‘blade flicker’.

17.1.1 **Introduction**

In this section we discuss the nature of shadow flicker and the issues involved, the performance standard, the assessment for Stockyard Hill Wind Farm, the submissions and our conclusions.

In assessing this planning permit Application we are specifically required to consider shadow flicker from wind turbines. We received few submissions, and heard one expert witness on this topic.

**Documentary Sources**

The following sources have been used in preparing this section of the report:

- the Policy and planning guidelines for development of wind energy facilities in Victoria, September 2009 and the May 2003 version (the ‘Guidelines’);
- the Planning Application Report (PPAR) main document, October 2009, prepared by Environmental Resources Management Australia (ERM), particularly Chapter 13;
- the Shadow Flicker Assessment report (January 2009) prepared by Garrad Hassan at Annexe U of the PPAR;
- submissions from the Applicant specifically on shadow flicker (Exhibits A11 and A220);
- expert evidence from Mr G White of Garrad Hassan called by the Applicant including his expert witness statement (Exhibit A12) and copy of his presentation (Exhibit A13);
- revised shadow flicker map from Garrad Hassan with a road base (Exhibit A55);
• submission from Pyrenees Shire Council (Exhibit PSC112);
• submission from Mr J and Ms G Keating (Exhibit K180);
• paper by McBride and Rapley tendered by Mr J and Ms G Keating;
• submission from Mr D and Ms J Jackson (Exhibits J171 and J172);
• submission from Mr A Gabb (Exhibit G169); and
• a number of submissions from other individuals as a response to the public exhibition of the PPAR or to us, or both, referring to concerns about shadow flicker or more generally to flicker with little detail and in the context of possible health consequences.

The Applicant called Mr Graham White of Garrad Hassan as an expert witness. Mr White provided an expert witness statement and copy of his presentation.

The Applicant submitted that the PPAR meets all statutory requirements including for shadow flicker.

17.1.2 Discussion

The Guidelines

The Guidelines at Part B 3 (c), page 31 establish the evaluation criteria for shadow flicker as:

\[\text{The shadow flicker experienced immediately surrounding the area of a dwelling (garden fenced area) must not exceed 30 hours per year as a result of the operation of the wind energy facility.}\]

The superseded version of the Guidelines state:

\[\text{The shadow flicker experienced at any dwelling in the surrounding area must not exceed 30 hours per year as a result of the operation of the wind energy facility.}\]

The \textit{Shadow Flicker Assessment} was prepared prior to the date of the revised Guidelines. Nonetheless, we understand that it should be assessed against the current Guidelines.

Those new Guidelines differ from the earlier ones by applying the numerical standard to the immediate surroundings (the curtilage) of the dwelling rather than the dwelling only.
The Applicant

Mr Gobbo for the Applicant submitted on shadow flicker at paragraphs 66-80, pp 13-15 of Exhibit A11. He said that the standard for shadow flicker is one of the few substantive changes from the 2003 to the 2009 version of the Guidelines. He said that the initial shadow flicker assessment in the PPAR was prepared against the 2003 requirement because that was then in force, but he advised that the evidence of the expert witness had been prepared against the 2009 Guidelines. He also commented that the revised Guidelines provided no definition of the area ‘immediately surrounding’ a dwelling; in the absence of this the applicant had adopted the area within 50 metre of the centre of a dwelling as recommended by the draft National Wind Farm Development Guidelines.

Mr Gobbo also advised that the initial shadow flicker assessment had been done for a rotor diameter of 92.5m; in the witness statement that had been varied to 104m as proposed in the PPAR.

Mr Graham White of Garrad Hassan who was then called as an expert witness informed us that shadow flicker is assessed from a geometrical standpoint using a software package. This package is described at page 9 of Exhibit A12 as follows:

…incorporates a model which describes the path of the sun throughout the year, and can calculate the relative position of the sun, wind turbines, dwellings and terrain to predict the shadow flicker durations in the vicinity of the wind farm. Such a style of calculation tends to be conservative as there are a number of factors the analysis does not consider. These factors include the presence of cloud cover, the presence of vegetation or screening structures, the orientation of the turbine and periods where the turbine is not operating.

Mr White said that the horizontal extent of the shadow at which variations of light intensity become moderate and annoyance is diminished has long been taken as one kilometre. The draft National Wind Farm Development Guidelines recommends the use of a distance of 265 blade chords (the blade cord is the maximum width of the blade). Wind farm blade chords are typically 3 to 4 m; hence this translated to a distance of 800 to 1050 m. Other parties have used a figure of 10 rotor diameters; in this case 1040 m. Mr White said that he had adopted a distance of 1040 m.

In his expert witness statement at pp 10-11 of Exhibit A12, Mr White discussed the mechanisms by which shadow intensity diminishes with distance and said at page 11:
It is acknowledged that it is possible for turbines to cast shadows beyond the distance limit proposed here, however it is expected that these shadows will generally be faint, and are unlikely to have sufficient intensity to cause annoyance for an observer.

At section 3, pp 3-4 of the Shadow Flicker Assessment report at Annexe U of the PPAR, a description is provided of the various elements of conservatism in the geometric assessment.

The shadow flicker diagram with 104 m rotor diameter turbines is presented at Figure 2, page 13 of Mr White’s expert witness statement (Exhibit A12). This diagram does not show roads. We asked for that diagram to be resubmitted with a road base to improve our understanding of it; that is presented at Exhibit A55.

The result of the analysis assessed against the 2009 guidelines is that no non-stakeholders will experience shadow flicker. For stakeholders, 21 will experience shadow flicker. Five of these properties are rented. Of the 21 properties, 14 will experience shadow flicker in excess of 30 hours per year including the 5 rented dwellings. The highest estimated incidence is 132 hours per year.

Mr Andrew Gabb

Mr Gabb discussed shadow flicker at Exhibit G169 and showed us a professionally produced video of shadow flicker falling across roads at the Waubra Wind Farm. He questioned the road safety issues of flicker which would be caused by turbines proximate to the Beaufort-Skipton and Streatham–Carngham Roads.

Mr David and Ms Janet Jackson

Mr and Mrs Jackson expressed apprehension about shadow flicker as a part of their concern about the health and well being of their family, particularly at page 12 of Exhibit J171.

Mr Jack and Ms Gabrielle Keating

Ms Keating made their presentation to us. She said that the shadow flicker performance standard should also apply to public areas including public roads, intersections and community gathering places. In particular Ms Keating single out shadow flicker that would occur along the Beaufort-Skipton and Streatham–Carngham Roads.
Ms Keating quoted from Dr Bruce McBride and Bruce Rapley in their paper ‘Blade Flicker, Shadow Flicker and Glint: Potential Hazards of Wind Turbines’ in recommending that where shadow flicker is expected to fall on a roadway it may be acceptable under the following circumstances (at page 9 of Exhibit K180):

1. The flicker or glint will not exceed 10 hours per year.
2. The flicker or glint will fall more than 100 metres from an existing residence.
3. The traffic volumes are fewer than 500 vehicles per day on the roadway.
4. The flicker will not fall on an intersection.
5. If shadow flicker or blade glint exceeds any of these conditions, the source shall be shut down until the flicker or glint problem is remedied.

Ms Keating added:

We query a duty of care by Origin Energy to remove all turbines that create shadow flicker in particular areas of concern to stakeholders including intersections and all public roads.

17.1.3 Panel response

We understand that, unlike the shadow of a building or a wind turbine tower which moves slowly as the position of the sun changes, a moving wind turbine rotor casts a regularly moving shadow at a point. The repetitive change in light intensity and the visual movement of the shadow can be apparent. Further, we understand that shadow flicker can be perceptible outdoors where the regularly recurring shadow passes over an observer, but it is more likely to be a concern indoors where light levels are typically lower. In that case the blade can intercept direct sunlight into a dwelling and a large variation in light levels can result. Thus the focus of the shadow flicker performance requirement is to minimise the flicker on dwellings.

It is logical to expect, and apparent from the shadow flicker diagram, that it is dwellings, properties and roads generally to the east and/or west of turbines that are more likely to experience shadow flicker than those more generally to the north and/or south.

We are satisfied with the analysis and understand its substantial conservativeness. In practice we expect the incidence of shadow flicker to be much less that those estimates.
With regard to the extent of the shadow flicker, the evidence acknowledges, and we accept, that under some circumstances faint shadow may be apparent to some sensitive observers at distances greater than the 1040 m modelled. We accept that the shadow flicker would be faint and not a source of annoyance and would decrease with increasing distance. Although the Guidelines are silent on the effective horizontal limit we are not persuaded that there is a basis for extending the horizontal extent beyond that used for assessing the shadow flicker impact.

We are satisfied that shadow flicker will comply with the requirements of the 2009 guidelines for all non-stakeholders.

We are pleased that the design of the wind farm is that such none of these dwellings should experience any shadow flicker. That is preferable to estimating possible shadow flicker for less than 30 hours per year using the conservative analysis, and much better than estimating greater than 30 hours per year and then depending on estimates of wind direction, cloud cover and the like to demonstrate compliance.

However, we are aware that the length of exposure to shadow flicker is quite sensitive to the position of the turbines influencing that flicker. To ensure protection of dwellings and, as far as possible their immediate surroundings, from shadow flicker (and noise and visual impact) we believe that any micrositing of turbines should prohibit movement of positions towards non-stakeholder dwellings.

We have discussed shadow flicker as a suggested contributor to claimed adverse health effects of wind farms, and in Section 8. Suggestions of shadow flicker initiating epilepsy attacks are also discussed in that chapter.

We note that the Applicant’s decision to remove turbine T218 from the Application should free Mr and Mrs Jackson’s dwelling from any shadow flicker impact.

With regard to shadow flicker on stakeholder dwellings, it is the usual practice of panels and applicants to adopt a position that stakeholders have entered an agreement with the applicant and are understood to have given informed consent to this impact. This is supported by the 2003 Guidelines which refer to ‘…shadow flicker experienced in the surrounding area…’ (our emphasis, which has been taken to mean dwellings in the area outside that nominated as the ‘site boundary’. At paragraph 74, page 14 of Exhibit A11, Mr Gobbo said that ‘The performance standard of 30 hours of shadow flicker at a dwelling only applies to dwellings in the ‘surrounding area’, not the site of the wind farm itself’.

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We are not so sanguine. The 2003 Guidelines refer to ‘surrounding area’, the 2009 Guidelines do not. The current version of the Guidelines refers to ‘...shadow flicker experienced immediately surrounding the area of a dwelling...’ (our emphasis), but not to the ‘surrounding area’. We believe that this could be interpreted as meaning that the shadow flicker standard now applies to all dwellings - stakeholder and non-stakeholder. This would appear to be a much more significant change than that to include the curtilage of a dwelling. If applied it would have the potential to remove many turbines from the proposal. We believe that this is perhaps not an intentional change. Here we will adhere to accepted practice, but we believe that this apparent uncertainty in the Guidelines might be rectified.

With regard to shadow flicker on roads and road safety, we note the comments of submitters. We acknowledge that a shadow from wind turbines may be argued to have something of a different character to that from other objects by virtue of its speed and repetition. However, we have no substantive evidence to suggest that road safety is compromised by shadow flicker on roads. We note that for a number of previous wind farm applications, shadows would have fallen on lightly trafficked local roads. In this case shadows would fall on the designated C class Beaufort-Skipton and Streatham-Carngham Roads. We had no submission from VicRoads on this matter from which we might have benefited. We believe that it would be useful for VicRoads to develop a policy position on wind farm shadow flicker on road user safety.

The decision by the Applicant to delete a number of turbines from the proposal and to increase the setback of turbines from roads will eliminate shadow flicker on the Streatham-Carngham Road and reduce it on the Beaufort-Skipton Road.

We observe that the shadow flicker criterion in the Guidelines does not specify a method of assessing shadow flicker that could provide a means of enforcement – the horizontal extent of flicker is an example.

We consider that to be unsatisfactory, more so in the current climate of enhanced submitter interest in shadow flicker. We take the view that a performance criterion should be accompanied by an unambiguous method for assessment so that there can be no dispute, and that thereby provides a means of assessing the outcome and ensuring compliance. We recognise that there seems to be no documented standard test method.

In the absence of a published standard method we suggest that the Guidelines might incorporate some of the important elements for determining shadow flicker for the assessment, including definition of shadow flicker in terms of
light intensity variation, and a method for compliance determination and enforcement.

The Guidelines do not require consideration of shadows other than shadow flicker from moving blades because of its potential to cause annoyance. For completeness here we observe that the turbine towers, nacelles and rotor when stationery will all cast shadows some distance. These will be similar to shadows from other structures, there will be no periodic variation in light intensity and they will move slowly as the sun moves. We would expect the major impact of these shadows to be on-site with some on public roads. There would be no effect on non-stakeholder dwellings.

17.1.4 Conclusions and recommendations

We conclude that the assessment has shown that, evaluated in accordance with the 2009 Guidelines, there will be no shadow flicker on non-stakeholder dwellings or their curtilage. It is estimated conservatively that there will be shadow flicker impact exceeding 30 hours per year on 14 stakeholder dwellings and their curtilages, in practice the impact is likely to be substantially less. We accept that this impact is accepted by those stakeholders by virtue of their agreements with the Applicant.

We conclude that micrositing of specific turbines near the site boundary closer to non-stakeholder dwellings could increase shadow flicker on those and their immediate surroundings. Although that may remain within the criterion we believe that that should be avoided.

We conclude that the shadow flicker requirement in the 2009 version of the Guidelines, unlike the 2003 version, is able to be interpreted as not excluding stakeholder dwellings from the performance criterion, and, further, we conclude that this has probably not been intended.

We conclude that the performance criterion for shadow flicker should be accompanied by a codified method of assessment.

We believe that it would be beneficial to have a policy position from VicRoads on wind farm shadow flicker and any implications for road safety.
17.1.5 Recommendations

The Panel recommends that:

No turbines should be microsited so that shadow flicker on non-stakeholder dwellings and their immediate surroundings is increased.

The shadow flicker requirement in the 2009 version of the Guidelines be redrafted to make it unambiguous that, as with the 2003 version, it excludes stakeholder dwellings from the performance criterion.

The criterion for shadow flicker in the Guidelines should have a method of assessment developed including a means of determining compliance.

We recommend that VicRoads be asked to develop a policy position on shadow flicker from wind farms on roads and any implications for road safety.

17.2 Blade Glint

Blade glint is the reflection of sunlight off the blades of a wind turbine.

17.2.1 Introduction

In this section we discuss the nature of blade glint and the issues involved, the performance standard, the assessment for Stockyard Hill Wind Farm, the submissions and our conclusions.

Documentary Sources

The following sources have been used in preparing this section of the report:

- the Policy and planning guidelines for development of wind energy facilities in Victoria, September 2009 and the May 2003 version (the Guidelines);
- the Planning Application Report (PPAR) main document, October 2009, prepared by Environmental Resources Management Australia (ERM), particularly Chapter 19; and
- a number of submissions from individuals as a response to the public exhibition of the PPAR or to us, or both, referring to concerns about blade glint usually in the context of shadow flicker or other visual impacts.
17.2.2 Discussion

The Guidelines

The Policy and planning guidelines for development of wind energy facilities in Victoria, September 2009 at Part B 3 (b), page 31 establish the evaluation criteria for blade glint as:

Blades should be finished with a surface treatment of low reflectivity to ensure that glint is minimised.

The Applicant

At 19.2.3, page 197, of the PPAR, it is said:

The blades used on the project will be finished in a non-reflective material ensuring that any potential impact from blade glint will be minimised or avoided completely.

Submitters

A number of submitters referred to blade glint either directly or indirectly in the context of visual effects and/or road safety.

17.2.3 Panel response

Blade glint can result from reflection of the sun from the turbine blades depending on the orientation of the sun, the observer and the turbine. It can affect the amenity of the surrounding area.

It is standard practice to provide a non reflective surface on turbine blades as well as other parts of the turbine structure. It is usual to finish the structure in an off-white or light grey colour.

17.2.4 Conclusion and recommendation

We note that the turbine blades normally have a non reflective surface to minimise blade glint.

17.2.5 Recommendation

The Panel recommends that:

The turbine blades should be required by condition to have a non-reflective surface.
17.3 Economic and social impacts

There are a number of other matters which were raised in submissions which can be grouped as of an economic or social nature. They are employment issues, corporate responsibility matters, consultation and social division.

17.3.1 Employment effects

The Guidelines include the following in relation to employment effects of the development of WEFs:

The Victorian Government is committed to supporting industries that can provide significant employment and regional development benefits for the State.

The construction of wind energy facilities provides employment in steel tower fabrication and other areas of engineering.

The wind energy industry is one of the fastest growing industries in the world. The world’s demand for energy is projected to grow by 50 per cent in the next 20 years, with a significant proportion of the growth in the Asian region. A number of countries in the region, most notably China and India, have committed to ambitious renewable energy targets. With a rising demand for wind energy in the Asian region, there will be an increasing need for wind generation components as well as expertise in the design and installation of wind energy facilities.

In light of Victoria’s VRET scheme and the introduction of the Commonwealth’s expanded Renewable Energy Target there is scope to expand the manufacturing base in Victoria to build wind energy facility components. The development of the wind industry has the potential to attract substantial investment and create more jobs in regional areas, as this is generally where the best wind resources are located. The addition of wind energy expertise to Victoria’s already considerable capability in the development of energy infrastructure will increase the ability of Victorian companies to compete internationally and open up new export markets for the State.

Mr Peter Mitchell submitted that the employment benefits of wind energy development are overstated. He argued that wind farm developers ‘trot out jobs and investment’ as a justification for wind energy technology but the argument about construction jobs is flimsy (workers simply moving from place to place) giving only a temporary boost to local economies and that (unspecified) indirect on-going jobs probably amount to work for existing businesses rather than truly new jobs. He also suggested that the increased
cost of power to the community which would result from subsidies to the wind energy industry would also cause an indirect loss of jobs.

So far as this matter is concerned, we are of the view that Mr Mitchell is correct that net rather than gross employment effects need to be considered when assessing the benefits of wind energy facilities. We nevertheless would say that his treatment of this issue is at a general level (such that we cannot discern the net change); and, in any case, this matter, as is also true in relation to his submission challenging greenhouse savings, goes to the issue of the appropriateness of the government policy to facilitate WEF development rather than being a consideration in relation to a particular project such as that at Stockyard Hill.

17.3.2 Origin’s corporate responsibility

As part of his presentation Mr Peter Mitchell submitted the Applicant’s approach to the development of the proposal was uncaring and inconsistent with Origin Energy’s stated corporate goals. The same broad theme was also generally addressed by the WPLG via Ms Franzose, and by Mr Stephen Mitchell.

So far as this matter is concerned we think that it is outside the considerations relevant to decision-making on the WEF Application.

17.3.3 Consultation and community division

Submissions were made that there had been poor consultation with affected persons living around the site of the proposed WEF. We were told of a cancelled public meeting, some objectors claimed not to have formal notification about the wind farm development, a lack of detailed information provided in response to enquiries or in the public arena. Mr Peter Mitchell for example submitted that that no effective consultation had occurred with rural families relating to key matters such as vista/amenity and health effects, setbacks from boundaries and houses, and water use and sources. He said that these omissions were inappropriate and disrespectful to Panels and objectors.

We were also told, as other panels dealing with wind farm applications have been told, of the social consequences of the breakdown in trust and cooperation in the affected community. This seems to come about in part because discussions with stakeholders are confidential and only become known some time later (sometimes years later) leading to a sense of betrayal by others. It also seems to lead to a general disaffection and a feeling that the outcome of the application for the WEF is a foregone conclusion – as was asserted by Mr Peter Mitchell.
Mr Mitchell went on to say that as Panels do not operate under the rules of evidence, or require sworn testimony, and because of an imbalance in resources applied to cases across applicants and other submitters, Panel hearings cannot be fair or achieve natural justice. Consequently the results of the process are resented by those subject to adverse findings against which there can be no appeal.

Mr Gobbo submitted that the submissions made about lack of community consultation should not be given much weight as any additional consultation would not have led to any different outcome in community views. He also pointed to the strong policy support for wind farms and the inevitability that some people would be adversely affected. This, he said, generally happens with major projects of all kinds. The wider community benefit should nevertheless prevail.

The Panel notes that the Guidelines encourage consultation on the part of applicants for wind farms.

We are familiar with the arguments about poor or inadequate community consultation by applicants for major projects, as they are often presented during Panel processes. We note, however, that they are always presented during hearings concerning wind energy facilities. While we have some sympathy with Mr Gobbo’s submission that further consultation would not likely have forestalled claims of a lack of adequate consultation, it does seem that there is room for improvement.

It is clear also that in this case, as in other WEF proposals, community division has occurred to levels that may not have occurred locally in the past. This generally revolves around peoples’ perspectives of themselves or others as ‘winners’ or ‘losers’ (stakeholders v non-stakeholders) and the impact of this in rural communities is undoubtedly very stressful to individuals and the community as a whole. Close knit networks that have generally developed over generations operate in rural communities which are put under threat. That differs from contemporary urban situations where social linkages tend to be more geographically dispersed.

We were told of some rather extreme instances of recent anti-social and criminal behaviour in the community living around this and other wind farms (arson, interference with brakes on equipment, threats, and carcasses being left on doorsteps etc).

In considering the issue of social division, we can do no more than adopt the comments of the panel in the Oaklands Hill Wind Farm matter (Southern Grampians Planning Scheme Permit Application 2007/0370). At page 125 –
126 of its report, the Panel provided an extract from the Mt Mercer Wind Farm panel report as to why social division might be a particular problem with wind farm projects – more so than with other large infrastructure developments. The extract provides as follows:

So far as social impacts are concerned, however, we would observe that a potentially negative ‘social division’ is already apparent between those who are participating in the project and those who are not. It seems to us that those in the community who are non-participants in the project are perhaps feeling that they have suffered or will suffer an injustice. They perhaps see themselves as potentially bearing a range of impacts from this project – with no compensation, while their neighbours are receiving financial recompense for the same impacts.

The social impacts of the wind farm project might be said to be no different or more acute than for other major rural projects with potential off-site impacts, such as intensive animal industries. It seems to us, however, that there may be a difference. Rather than there being merely one (or two) landowner(s) benefiting from the project whose position is opposed by a large proportion of the community, there are multiple owners of this substantial wind farm site. The benefiting landowners therefore make up a sizable part of this small community – especially if their extended families and friends are included. In this way it could be said that two opposing Mt Mercer ‘communities’ have been created rather there being one or two outsiders to an otherwise cohesive group.

So far as this social division is concerned, we comment that it is regrettable but it is not necessarily immutable or important. It is not possible for us to judge its consequences or its manifestations in the social life of the community. It may be that social ties within the group arising from other factors are stronger – at least in the longer term. It is also possible that even if the wind farm permit was to be refused or the project did not proceed for some other reason, the social division might remain.

In the end, while we recognise the social fact of the community split, we are unable to give it great weight especially having regard to the range matters for consideration before us including the intent of the Guidelines to strongly promote wind energy development.

So far as this Panel’s role in the processing of wind farms is concerned, we advise that we have endeavoured to afford natural justice to the parties to the hearing and those making written submissions by listening to or reading their arguments, considering the arguments carefully and by endeavouring to balance all that has been put before us in the manner required by the statutory framework.
17.4 Other cultural heritage issues

The cultural heritage issues associated with the Mawallok property are discussed in Section 11 of this report. This section relates to Aboriginal cultural heritage and other non-Aboriginal heritage.

17.4.1 Aboriginal heritage

A desktop assessment of Aboriginal and non-Aboriginal heritage was carried out in 2008 by Tardis Enterprises Pty Ltd for the area covered by the proposal (Appendix P to the PPAR). This involved identification and determination of the geographic region, review of relevant reports and records relating to the activity area region, review of geomorphology of the area, review of land use history, identification of any potential impacts and mitigation measures and a preliminary site visit.

The report on this investigation includes that that there were two previously recorded Aboriginal sites in the activity area and four non-Aboriginal historic structures previously recorded. The archaeological potential for Aboriginal stone scatters/campsites in areas adjacent to water sources (including around Lake Goldsmith and Black Lake and along Mount Emu Creek) and elevated sites was assessed as moderate to high and the potential for additional non-Aboriginal material in close proximity to known historic sites was also assessed as moderate to high.

The report further includes that statutory areas of cultural heritage sensitivity lie within the impact area of the wind farm which is listed as a high impact activity in the Aboriginal Heritage Regulations 2007 (AH Regulations), mandating the preparation of a Cultural Heritage Management Plan (CHMP) under the Aboriginal Heritage Act 2006 (AHA). The report noted the statutory protection to all Aboriginal artefacts provided by the AHA.

The report also recommended that activities associated with the wind farm should avoid impact on previously recorded non-Aboriginal sites and that investigations should be undertaken in areas to be impacted to identify other features requiring protection.

As part of his submissions for the Applicant, Mr Gobbo acknowledged that a CHMP is required for the proposed development under the AHA and the associated regulations in so far as:

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38 The provisions of section 52 of the AHA have the effect that no decision can be made in relation to a planning permit until a relevant CHMP has been approved.
a) all or part of the activity area is an area of cultural heritage sensitivity, including land within 200 metres of waterways and is within 50 metres of a registered cultural heritage place (rr, 22(2), 2 of the AH Regulations); and

b) all or part of the activity is a high impact activity, as it will result in significant ground disturbance and is for land used for a wind energy facility (r 6, 43(1)(xxvi) of the AH regulations).

He advised that statutory notice had been given of the intention to prepare a CHMP for the project.

We were advised that at the time the CHMP was commenced, there was no Registered Aboriginal Party (RAP) for the site. Mr Gobbo said that the Applicant had consulted with RAP applicant representatives from the Ballarat and District Aboriginal Cooperative Ltd (BADAC) and the Wathaurung Aboriginal Cooperative (WAC) throughout the preparation of the CHMP and the previous desktop assessment and these parties had participated in the fieldwork.

The Wathaurung Aboriginal Cooperative was registered as the RAP on 21 May 2009 but as the CHMP had commenced before registration, Mr Gobbo said, the CHMP was required to be assessed by Aboriginal Affairs Victoria in consultation with the Cooperative.

On 21 October 200939 the Applicant lodged a CHMP (AAV CHMP No 10530) with AAV for approval.

Mr Gobbo advised that on 22 October 2009 the CHMP was approved under section 65 of the AHA.

During the Panel hearing, however, he acknowledged for the Applicant that fresh approval would be required under that Act for the revised proposal, as the AHA otherwise has no provisions dealing with amendments to CHMPs.

In particular Mr Gobbo advised that there are three areas that the internal overhead power lines traverse that are not part of the activity area currently covered by the mandatory CHMP. AAV has advised that a CHMP must be submitted to cover these areas because:

- All or part of the windfarm activity area is an area of cultural heritage sensitivity including land within 200m of waterways; and

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39 In the PPAR WEF this date is said to be 23 September 2009.
• All or part of the activity is a high impact activity that will result in significant ground disturbance, and is a linear utility installation with an overhead powerline exceeding 1 km. (r6, 43(1)(xxiii)(A) of the AH Regulations).

*The Minister is not able to issue a planning permit for the proposal* until this second CHMP is approved under section 65 of the AHA.

### 17.4.2 Recommendations

The Panel recommends that:

No determination should be made on Pyrenees Planning Scheme Application PL-SP/05/0548 (wind energy facility) until a Cultural Heritage Management Plan or Plans for the amended proposal is approved that includes the final routes of the internal powerlines.

The recommendations made in the 2008 report by Tardis Enterprises Pty Ltd for the avoidance of adverse impacts on the significance of places of cultural heritage on the wind farm site should be implemented where not inconsistent with the Cultural Heritage Management Plan.

### 17.4.3 Langi Willi

Submissions to the Panel, most notably by Mr Mark Mackinnon who represented the estate of the late George Russell at the hearing raised the matter of the visual impacts of the turbines proposed to the north of the Langi Willi property on visual amenity and in turn the effect of this upon the heritage values of the property.

Mr Mackinnon called Mr Dennis Williamson of Scenic Spectrums to give expert evidence concerning these matters – which, as in the case of Mawallok, were somewhat intertwined.

In Section 6 we have considered the visual impacts for the property. In this section we address the heritage implications.

Langi Willi is an extensive grazing property important in the settlement history of the locality. The property was purchased by the Russell family in 1859 and the principal homestead in the federation Queen Anne style and its garden date from 1903. Despite the property’s apparent contribution to the settlement and grazing history of the area, it is not afforded statutory heritage recognition nor protection. Accordingly there is no agreed statement of significance for the property.
Mr Williamson provided his views on the heritage significance of the property to the Panel. He agreed to a suggestion by Mr Gobbo when under cross examination, however, that heritage assessment was not his area of expertise. While we raised the matter with Mr Gobbo as to what did afford a witness expertise in heritage matters and received no satisfactory response, we nevertheless have not placed great store on Mr Williamson’s views concerning heritage matters as heritage assessments have clearly not been the focus of his professional work.

We have made our own assessment of the heritage significance of the property and the impacts upon it with such assistance as is offered by submissions and other evidence.

We would say that the significance of this property is quite apparent on inspection and from material presented at the hearing. It clearly has had an important role in the pastoral settlement of the area and the fabric of the place continues to illustrate the lifestyle of the past owners. We have also noted that the house was placed on the interim list for the Register of the National Estate in 199240. Further, Mr Williamson reported that Mr Peter Watts (see Section 11 of this report) had assessed the Langi Willi garden as amongst the top 50 heritage gardens in Australia in his comparative study 30 years ago.

As earlier indicated, the material placed before the Panel by Mr Williamson included that some 36 proposed turbines would be located in the main northern view from the upper level of the house and 2341 or so when viewed from the ground level. Ten or twelve turbines would be sited close to and along the northern boundary of the site arranged perpendicularly to the viewline.

Mr Williamson also noted that the house may have been intended to look northwards to Nanimia Hill but the hill is slightly off to the north-west and now largely screened by cypresses. He noted that another axial view to the north appears to have been created more recently with the planting of two symmetrically placed deciduous trees on either side of a garden gate leading down to Mount Emu Creek.

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40 This list has since been frozen.
41 This number of turbines in the northern view contrasts with the only 12 or so turbines which Mr Wyatt claims would be seen in the Langi Willi northern view. This difference appears to be due to the reference only to the closer group.
Figure 27: Langi Willi homestead (Source: Panel photo)

Figure 28: View north from upper bedroom in Langi Willi homestead
(Source: Panel photo)
We have concluded in Section 6 that from a visual perspective alone, the impacts on this property are moderate and might be ameliorated by additional screen planting.

The question here is whether even these moderate visual impacts would translate into unacceptable impacts on the heritage value of this property (as we found in the case of the Mawallok house and garden) and whether and to what extent the screen planting we recommend would be detrimental to those values.

We have formed the view that the intrusion of the turbines into the northern view from the Langi Willi property would not cause such loss of heritage significance that changes to the siting of turbines or turbine deletions are required. The following are our reasons:

- While there is a similarity between the circumstances of the Langi Willi house and garden and those at Mawallok (in both cases there being a view to a wider landscape beyond the house curtilage being available), the State or national importance of the Langi Willi garden design has not been confirmed in the same way at Mawallok;

- The main contribution to the significance of the garden of the Mawallok Arts and Craft house of the central view line out of the garden towards Mr Cole was not resisted by the Applicant and strongly supported by others appearing before us including Messrs Lovell, Raworth and Watts. This importance of a key view line out of the garden is not repeated at Langi Willi.

Despite the relatively recent plantings creating a focus on the central gate in the northern fence to the garden, it seems to us that the layout of the Langi Willi garden is not designed around a key viewline as is the Guilfoyle garden at Mawallok.

Importantly, the view to the north from the Langi Willi house and garden is to rising land with the Mount Emu Creek valley walls running east-west across the view relatively close by. This creates a sense of enclosure rather than being a picturesque view to a distant range ‘embracing’ the broader landscape;

- The Langi Willi garden is a charming garden complementing the early 20th century house, much as occurs at Mawallok, but we are of the view that it would be no less charming and no less complementary if the perimeter of the garden were more densely planted in whole or in part to screen the views to turbines or screen planting was undertaken outside the garden on higher land to assist in that regard; and

- Given the nature of the views that would be screened, we do not regard such any change which might be brought about by screening as
detrimental to the heritage values of the property. While Mr Williamson sought to afford the hillside itself heritage value and include it in the heritage place, it would seem from the other material he presented that the house may have been intended to be oriented to Nanimia Hill. This did not occur. If it had it may have resulted in a different assessment of the view and heritage impacts.

17.5 Aerial agriculture

17.5.1 Introduction

No verbal expert advice was provided to the Panel on the interface between wind turbines and aerial agriculture operations (ie: the spreading of fertiliser and other materials). However, two submitters (Mr and Mrs Hawker, and the Mitchell family/Lowell Pty Ltd) argued that the location of some of the proposed turbines would adversely interfere with or prevent aerial agriculture operations on their properties. The Hawkers also argued that adjacent turbines would interfere with the operation of their private air strip more generally.

17.5.2 Submissions

Mr and Mrs Hawker proposed that Turbines T54 and T47 as shown on the site layout plan for the Application would present a particular hazard to agricultural pilots.\(^\text{42}\) It was said that those turbines and the monitoring mast near T47 would prevent aerial application of nitrogenous and trace element fertilisers and agricultural chemicals for cropping and weed control to the western half of their property. They claim that aerial application is essential in winter due to water logging and surface stoniness, and that their private airstrip (or Authorised Landing Area (ALA)) is used for aerial agriculture, and that there is no alternative to private air transport for themselves and their neighbours. Turbines T52, T40 and T54 are potentially in the aircraft ‘splay’ areas and present a danger.

Other matters raised by Mr and Mrs Hawker include the following:

- Turbines take energy out of the air, causing down-wind reductions in air speed of up to around 45% at 1km downwind, and 37% at 1.6km downwind, and this can result in sudden reductions in air speed; and
- The turbines would also prevent the use of the Hawkers airstrip to treat other local farms.

\(^{42}\) Both T54 and T47 have now been nominated by the Applicant for deletion from the proposal.
Mr and Mrs Hawker indicated that there had been 21 (unspecified) aircraft movements on their airstrip since 1 January 2010, and provided five letters in support of this.

A one page letter of 6 April 2010 from a James O’Brien, Operations Manager, Air Fields Air Sales and Maintenance Pty Ltd of Ballarat stated that the proposed turbines would impact on the potential for low level agricultural flying on the surrounding agricultural land, and that towers T47, T54 and the nearby wind mast would particularly impact on the conduct of aerial agricultural operations on the Hawker property, and the safety of the Hawkwood airstrip. He said that consequently, the towers should be located further away from that property boundary to reduce the risk of aircraft impact.

A letter of 14 April 2010 from Barry Foster Chief Pilot, Woorayl Air Services of Leongatha also tendered by the Hawkers included the following main points:

A standard agricultural aircraft loaded to maximum capacity takes approximately 500m to complete this turn. This would have an impact on the direction at which some of the spraying operations would need to be conducted. An area of 500m adjacent to the windfarm would be required as a buffer zone for this operation.

This will require considerably more time on the ground in the pre-planning process of any spraying operation conducted by an operator in this area. As the 500m buffer zone will have to be incorporated in all areas adjacent to the windfarm.

The required way to spray the fields on the western half of the Hawkwood Farm is in a north south direction. This is because [there is] the house on the eastern side of the property and an aircraft spraying cannot fly over or near houses. For this reason T54 and T47 and the wind monitoring mast propose to be located near T47 all being within the 500m buffer zone would make aerial spraying prohibitive on the western side of the property.

In relation to the authorised landing area (ALA) YBTF, the Civil Aviation Safety Authority (CASA) sets down minimum standards for the use of Authorised Landing Areas. The standards can be found in CAAP 92.1.1.

The standard for this ALA (YBTF) would be climb out gradient from the end of the runway 3.3% extending out a minimum of 1000m and the lateral display angle of 5%. Even though T52, T47, T54 and T40 are bordering on the edges of these display angles they still create a significant risk especially at night or operations in low or minimum visibility.

The normal circuit procedure for this type of ALA is a height of 1000 feet AGL. However this height can be reduced to 500 feet AGL due to weather
considerations. Taking into consideration the height of the towers themselves at approximately 430 ft (132 m) this leaves an unacceptably small margin of error for each circuit.

In my opinion ........the removal of T54, T47, the wind monitoring mast located near T47, and T34 is required. Also T52 and T40 are required to be repositioned further to the west.

A letter of 15 March 2010 from Todd Miller, Chief Pilot, Western Aerial Pty Ltd in part stated that many factors can affect how to spray paddocks if turbines are installed, but most of the western half of the farm would become untreatable. The letter stated that while 500m is needed to conduct a procedure turn from the paddock boundary, this may be 600km or more in undulating country depending on the conditions on the day. In this context turbines T54, T47, and the proposed monitoring mast near T47 would prevent north-south treatment of the western part of the property. Further, east west operation also presents problems, as climbing would be necessarily be towards higher terrain, trees and power lines. The added risk from pylon placement would prevent working of the western paddocks.

An undated letter of from Graham Brice, Chief Pilot and Flying Instructor with the Ballarat Aero Club included that the requirements of the CAAP 92 should be regarded as the absolute minimum to achieve regulations. He also suggests that:

- Turbines outside the splay area but within the circuit pattern pose a danger in conditions where the weather requires a low level circuit;
- If the turbines are erected as planned, a caution note should be inserted in the ‘Vic/Tas Country Airstrip Guide Book to avoid a possible or breach of duty of care;
- The turbines would present more of a danger for multi engine aircraft operations; and
- The turbines ‘would also prevent any possibility of safe night time operations’.

An undated letter of April 2010 from (objector) Roger and Caroline Pescott confirms that the Hawkers’ airstrip is used by the Pescotts for treatment of crops and pastures on their property ‘Trawalla’, and that the landing area is valuable for visitors coming by plane to their property. They state that pilots have confirmed that turbines T59, T52, T40, T54, T47 and T34 represent a danger for aircraft.

Mr and Mrs Hawker proposed that their airstrip is available for fire fighting and other emergency use including aerial evacuation of injured or sick people.
In his final closing address, Mr Gobbo for the Applicant put to the Panel that the existence of the Hawkers’ private airstrip is not relevant to the current proceedings. Mr Gobbo referred to the VCAT case of Upson v Corangamite SC VCAT 2267 [2005] concerning an airstrip that had been installed without a planning permit. While VCAT determined that a permit was not needed, it was said:

Just because no permit is required and the airstrip has been constructed and is in use, does not guarantee that it will always remain suitable for use as an aeroplane landing area.

and:

The CAPP 92-(1) civil aviation ‘Guidelines for Aeroplane Landing Areas’ are advisory guidelines to be used by pilots in command of aircraft to determine the suitability of a place for the landing and taking off of airplanes. They have no regulatory status and offer no ongoing protection in a planning sense for an airstrip. The onus rests with the owner to construct an airstrip in a location that can retain its suitability for use as a place for taking off and the landing of aeroplanes irrespective of what may occur on adjoining land. A landowner who constructs an airstrip close to adjoining land cannot necessarily expect to constrain the future use of that land in order to protect the usability of that airstrip. The situation is different with respect to public facilities where protection of their usability is justified in the community interest and which is one reason for the Airport Environ Overlay. But a private airstrip is no different than any other private use of land. The effects on its use by a competing use must be weighed up in the same way as in any other planning permit assessment.

On the matter of aeronautical operations, Mr Gobbo stated that while some additional preparations may be required, ‘there is no issue of substance to the claims that have been put forward in terms of impacts on air agriculture.’ He proposed that it follows that the above-mentioned VCAT position regarding airstrips should apply equally to complaints about impact on air agriculture.

The Applicant’s final two arguments on this matter were that:

- while the use of a private airstrip for purposes associated with the property in question is ancillary, use for neighbours or commercial purposes is not, and requires separate planning permission; and
- one has no right at common law to fly over a neighbour’s airspace.

During his final submission the Applicant, Mr Gobbo also tabled a written response from the Ambidji Group Pty Ltd of Melbourne to the claims by Mr and Mrs Hawker including the content of the supporting letters described above. The report concludes that the positions of the proposed turbines and
meteorological mast do not infringe the protective surfaces identified in the abovementioned CASA CAAP 92-1(1) for ALAs.

Key relevant elements of the response include the following:

- The Hawker airstrip appears to have been constructed in late 2009 to early 2010;
- As CASA regulations do not apply to unregistered or uncertified airstrips on private property there is no formal protective Obstacle Limitation Surfaces (OLS) for the Hawker airstrip. While the CASA CAAP 92-1.1 is a guideline for aircraft landing areas, it has no legal status relevant to the Hawker airstrip. However, if the guidelines were to be followed for such airstrips, CASA has provided recommended physical characteristics for varying operations to provide for ‘Obstacle Free Areas’ for the safe operation of aircraft. It was said that two such layouts are applicable to the Hawker strip given that twin and single engine flights and daytime and night time operations are reported to occur on the strip. The letter also said that the protective physical surface areas are not extensive and it appears that all proposed turbines are located outside of the physical boundaries of the surfaces;
- Further, in operating from an authorised airstrip such as the Hawkers, pilots need to consider all relevant safety factors in assessing whether it is safe to take off or land at the facility. Agricultural pilots need to identify manmade and natural obstacles relevant to proposed operations;
- Turbine T54 (*now proposed for deletion from the proposal*) would not impact on take-off or landing of agricultural aircraft as it is outside of a right hand turn after take-off to the west. This is because agricultural aircraft are highly manoeuvrable around natural and man-made obstacles compared with other private or commercial aircraft;
- However, turbine T54 would make take-offs and landings to and from the west less safe for normal private and commercial operations, despite it being clearly visible and avoidable. The other turbines would not present the same safety issues; and
- It is unclear why north-south aerial spraying and dusting operations cannot be undertaken on the Hawker property irrespective of turbines T54 and T47, apart from in the immediate north-west corner where T54 could have some impact. This impact could be overcome by conducting east-west operations subject to a full topographical study.

Other matters covered in the letter include the following:

- If wind turbines are installed, additional cautionary advice regarding the airstrip could be added to existing industry information including in the FlightAce *Country Airstrips Guide*;
- Aerial fertilising is conducted at 40-50 feet height (13-16m) and spraying can occur down to 1m. Limiting wind speeds for spraying are 15-20 knots, while fertiliser is more tolerant to winds, depending on the area being worked. While the agricultural spraying preference is to conduct the longest run possible, even a heavily laden aircraft could turn well within 500km (although in practice the distance within this is dependent on a range of environmental and human factors);

- There is no restriction to flying over other people’s land either in transit or in conducting aerial agricultural operations, including low level flying at more than 100m from buildings. However notification and agreement is needed to operate over buildings;

- Aerial spraying and fertiliser application are not necessarily restricted to low wind speeds when turbines are not operating, but night time agricultural operations are not undertaken in Victoria;

- The Hawker house would normally have to be avoided whichever direction was being used for aerial operations. However, the owner can give permission for operations over buildings; and

- There are no known incidents or accidents in Australia relating to aerial operations as a result of perceived or proven turbulence events from WEFs, and CASA does not have regulations regarding aviation operations and turbulence associated with wind farms. Further, the potential issue of unsafe operations from turbulence from turbines has not emerged as an issue in qualitative risk assessments undertaken by the Ambidji Group with sub-contracted pilots.

The Applicant also tabled an Ambidji Group response to the aerial operations matters at Mawallok, raised by Mr Stephen Mitchell. Key points in this include the following:

- Ambidji is not aware of any CASA regulation, standard or advisory circular regarding the setbacks from property boundaries for low level agricultural operations in runs toward or adjacent to obstacles. It therefore questions the basis of setbacks suggested by Pyrenees Shire and Field Air;

- While it has no information on topographic or man-made obstacles on Mawallok or adjacent properties that may dictate spraying in only one direction or another, it is likely that spraying and dusting could be applied parallel to the property boundaries at the north eastern, eastern south eastern and south western boundaries; and

- While there may be some aerial application inefficiencies adjacent to turbines in some (unspecified) sections of the property up to a maximum distance of 500m, given proper pre planning and procedures, aerial
operations adjacent to the wind farm boundary do not represent an unsafe aircraft operation situation.

Mr Stephen Mitchell of ‘Mawallok’ stated that the only effective way to control weeds, fertilise, and seed the stony rises around Mawallok is by air, and that this has occurred eight times in the past 10 years (between June 2000 and July 2004). He proposed that CASA and the Pyrenees Shire recommend a 750m to 850m buffer zone for agricultural aircraft to turn around safely. Mr Mitchell produced a letter from Mr Glen Harding, Operations Manager of Field Air (Operations) Pty Ltd of Ballarat, that stated that wind towers would ‘definitely make any future aerial spraying/spreading operations at Mawallok (and neighbouring properties) either very difficult or impossible’.

Mr Mitchell provided a map indicating the turbines within 750 m, 850m and 1000m of the southern and eastern boundaries of Mawallok. These are:
- Within 750m: 7 turbines ((T122, T125, T126, T117, T106, T99, T98);
- Within 750-850m: 3 turbines (T131, T138, T141);
- Within 850-1000m: 4 turbines (T142, T130, T107, T97).

Other turbines are just outside this range.

17.5.3 Panel response

We accept the legal and planning arguments put to us by Mr Gobbo to the effect that a person installing a private airstrip cannot expect to dictate land use matters over adjacent lands, and that there are no CASA-prescribed or proposed buffer distances for wind turbines adjacent to property boundaries.

We also concur with the Applicant’s reference to there being no planning status for a private airstrip to be used for other applications such as a base for aerial agriculture on other properties.

We have noted the arguments put to us regarding buffers between wind turbines and boundary fences to enable safe operations, and that distances stated were generally upwards of 500m. We do not accept, however, that, on a property the size of Mawallok, the currently proposed location of turbines would make future aerial operations potentially impossible.

With regard to the Hawker property, we have concluded that the main issues relating to the interface between wind turbines and aviation has been rectified through the proposed deletion by the Applicant of turbines T54, T47 and T34. Mr and Mrs Hawker’s written submission and overhead presentation at the hearing specifically focussed on turbines T54 and T47 and the proposed
anemometer close to T47, in the context of their impact on aerial agricultural operations in the north-west of the property.

Turbines T40 and T52 were also referred to as being ‘potentially’ in the airfield splay areas. It was generally acknowledged that these turbines would add to matters needing consideration in flight planning, and it would be appropriate for information to be added into relevant pilot information guides. However we have not sensed this to be a critical matter. We therefore propose that the micro-siting of these turbines should be a matter for discussion, as it may be the case that relatively short shifts to alternative positions could significantly alleviate any potential issue with these turbines.

At Mawallok, of the seven turbines appearing to be within 750m of the boundary, about five appear to be with 500m. While there is no guideline on this, as information provided to us suggests that around 500m space from turbines may be important for aerial agriculture operations, we consider that there may be potential for micro-siting to alleviate this position. However, as previously indicated, we do not have information on buffer distances required between aerial agriculture operations and neighbouring properties for management of drift and a 500m buffer between turbines and property boundaries may not be required to establish a suitable buffer between turbines on one property and aerial operations on an adjoining property.

17.5.4 Conclusions

We accept the Applicant’s position that that there is no legal requirement for land use on adjoining properties to provide for the ongoing operation of a private airstrip on a property.

The proposed removal of turbines T54, T47, and T34 will alleviate most of the stated problems relating to the conduct of aerial agriculture operations at the Hawker property.

Turbines T40 and T52 present additional safety considerations rather than critical issues and, given the short distances involved to improve this situation, the micro-siting of these turbines to nearby locations could potentially have significant benefits for the overall operation of the private airstrip on the Hawker property.
17.6 Air safety

In this section we discuss the wind farm as an obstacle to safe air navigation. Aviation hazard lighting has been presented in Section 7 because of its links to landscape and visual impact issues. Aerial agriculture including the use of private air strips is discussed in Section 17.5.

No expert witnesses were called on this matter. Submissions received on operational and safety issues for aerial agriculture and private aviation are presented in the previous section on aerial agriculture.

17.6.1 Introduction

In this section we discuss any issues of air safety for Stockyard Hill Wind Farm, the submissions and our conclusions.

In assessing this planning permit application we are specifically required to consider air safety related to wind farms.

Documentary Sources

The following sources have been used in preparing this chapter:

- the Policy and planning guidelines for development of wind energy facilities in Victoria, September 2009 and the May 2003 version (the Guidelines);
- the Planning Application Report (PPAR) main document, October 2009, prepared by Environmental Resources Management Australia (ERM) and particularly Chapter 14;
- submission from the Applicant specifically on air safety (Exhibit A11);
- the Review of Obstacle Lighting Requirements – A Risk Assessment report (September 2009) prepared by The Ambidji Group Pty Ltd at Annexe W of the PPAR; and
- addendum (May 2010) to the above report prepared by Ambidji (Exhibit A233).

The Guidelines

The Guidelines at Part A, section 4.8, page 26 on written reports require provision of material on:

The impact on aircraft safety including the views of the Civil Aviation Safety Authority if within a 30 kilometres radius of an airfield or if one or more turbines are more than 110 metres in height (to the tip of the turbine blade from ground level)
and at Part B, section 4.9, item 4, page 32 state:

The height of wind energy facilities can be substantial, resulting in potential impact upon nearby airfields and air safety navigation. Aircraft safety issues should be addressed by considering the proximity of the site to airports, aerodromes, or landing strips. Consultation with the Civil Aviation Safety Authority (CASA) by proponents is required for wind energy proposals that:

- are within 30 kilometres of a declared aerodrome or airfield;
- infringe the obstacle limitation surface around a declared aerodrome, or;
- include a building or structure the top of which will be 110 metres or more above natural ground level (height of a wind turbine is that reached by the tip of the turbine blade above ground level).

The Guidelines establish the evaluation criteria for air safety as:

Other private airstrips may not be identified by consultation with CASA. These may be identified using aerial photographs, discussions with the relevant council, or consultation with local communities.

Upon consultation, CASA may require appropriate safeguards to ensure aviation safety. These may include changes to turbine locations, turbine heights and/or the provision of aviation safety lighting.

The Applicant

The Applicant advised at page V111 of the PPAR:

A qualitative risk assessment has been undertaken and, as a consequence, the proposed wind farm is not anticipated to have an impact on aircraft safety, including protected airspace, for the following reasons:

- The proposed site is located more than 30 km from any designated aerodromes;
- The height of the turbines are well under the minimum height of Visual Flight Rules;
- The site is void of obstacle limitation surfaces; and
- The site is located outside navigation and air traffic control clearance zone.
At section 14.2, page 148 of the PPAR it states:

The aeronautical impact assessment of the Stockyard Hill Wind Farm has determined that there is no impact on protected airspace due to the following:

- the highest turbine will be 567m (1861ft) AMSL. This is approximately 683m (2239ft) below the minima for aircraft operating under Instrument Flight Rules (IFR);
- the maximum height of the wind turbines (to rotor tip) will be 132m (433ft) AGL which is below the minimum height of 152m (500ft) AGL (other than for specifically endorsed low level operations) for aircraft operating under Visual Flight Rules (VFR) by day;
- the wind farm site is clear of all Obstacle Limitation Surfaces;
- there are no Penetrations of Procedures for Air Navigation – Aircraft Operations (PANS OPS) surfaces; and
- the wind farm is located outside navigation aid and air traffic control radar clearance zones.

In his submission for the Applicant, at Exhibit A11 p 2-3, Mr Gobbo said on air safety:

Part of direction 13 was for the Proponent to make submissions in relation to the current status of aviation lighting on wind turbines and the current status of the review by the CASA of its lighting guidelines.

CASA’s Advisory Circular 139 – 18 was withdrawn in 2008 and no new guidelines have been released to date. The federal Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG) released a discussion paper ‘Safeguards for airports and the communities around them’, in June 2009 which identified the need for agreement between federal, state and local governments as to rules and notification procedures for assessing the impact of wind turbines on aviation.

The document suggested that:

- all proposed wind turbine sites should be notified to CASA prior to application for planning permission;
- planning authorities should forward all proposals for wind turbine sites within 30km of an aerodrome to the aerodrome operator concerned;
g) there is a need to address potential impacts on aircraft safety of wind turbine sites more than 30km away from aerodromes, particularly where turbines are more than 152m above ground level to ensure safety of aircraft flying at low level. The need to balance aircraft safety with limiting visual impact was noted; and

h) where a proposed development has been determined to have a potential impact on navigational or aeronautical systems, it is common for simulation or other interference modelling to be undertaken.

On 16 December 2009 DITRDLG released the National Aviation Policy White Paper titled ‘Flight Path to the Future’. The White Paper indicates that the federal government intends to develop a risk based national safeguarding framework. Following on from the discussion paper ‘Safeguards for airports and the communities around them’ the federal government initiatives relating to wind energy facilities set out in the White Paper relevantly include a proposal that the Australian Government will work cooperatively with state, territory and local planning authorities to:

c) develop national guidelines to address technical and navigation issues relating to wind turbine developments, with regard to the potential for electromagnetic interference as well as the potential physical obstruction for aircraft; and

d) establish consultative processes to ensure that the potential effect of any new windfarm on aviation operations is considered and addressed prior to approval.

CASA advised Origin Energy on 23 March 2010 that these national guidelines and consultative process are awaiting further development by DITRDLG and CASA and no further policy guidance is expected to be released at least for some months. Based on the submission by DPCD (paragraph 204), it would seem that this may take considerably longer.

17.6.2 Panel response

The submissions made to us by the Applicant make it clear that the Applicant has consulted CASA as required by the Guidelines.

In the Review of Obstacle Lighting Requirements – A Risk Assessment Report (September 2009) prepared by the Ambidji Group Pty Ltd at Annexe W of the PPAR, the Applicant advised that the proposal was beyond 30 km of the nearest registered airport at Ballarat. In the addendum (May 2010) to the above report prepared by Ambidji (Exhibit A233), it advised that Ararat is also
a registered airport and is 25.5 km distant. However, in both cases the
obstacle limitation surface extends 15 km from the airport.

We are satisfied that the Applicant has carried out an aeronautical impact
assessment that has identified that there is no impact on protected airspace
from the proposal.

The submission from the Applicant was principally directed towards aviation
hazard lighting, which we have discussed in Section 7, but is relevant here in
that it advises that the Commonwealth Government is conducting a major
review of civil aviation management through preparation of a White Paper. It
would therefore appear prudent for the Applicant to be conscious of any
policy or legislative changes that may flow from this. The submission
suggests that any changes may be some time off.

We agree that should the proposal proceed to construction the relevant
authorities must be notified so that the wind farm can be placed on air
navigation charts. Further, we agree that operators from local airports, aerial
agricultural operators, owners of private air strips and the like should be
notified.

17.6.3 Conclusions

We conclude that the Applicant has consulted with CASA as required and
conducted an aeronautical impact assessment that identifies that the proposed
Stockyard Hill Wind Farm has no impact on protected airspace.

17.6.4 Recommendation

The Panel recommends that:

Should the proposal proceed to construction that the then permit
holder must notify the Civil Aviation Safety Authority and the
Department of Defence of the location and nature of the facility.

If constructed, the permit holder should notify local and regional users
of the airspace of the facility.
17.7 Permit Application issues and secondary consent

The submission made by Corangamite Shire Council (C74a) included the Shire’s concerns about the lack of detail in the NV Application. Mr Mason noted that the Application and the DPCD submission had overlooked the fact that a section of the Hamilton Highway affected by the power line vegetation removal is included in a Vegetation Protection Overlay (Schedule 2). The overlay identifies roadsides with significant vegetation. He said that the decision guidelines for the schedule include consideration of relocating buildings and works to clear areas and ‘given that detailed plans have not been provided for the power line it is unclear if this is possible or proposed’. Mr Mason further said that there is a potential permit trigger for works within the Environmental Significance Overlay (Schedule 1) which relates to Mount Emu Creek and again a lack of detailed plans showing the location of power lines and associated works ‘makes it difficult to assess what, if any, works will require a permit under the overlay’. Indeed, we have commented on the uncertainties surrounding clearing in that VPO area (discussed in Section 11) and we found advice given by representatives of the Applicant on the site inspection, that clearing at the Emu Creek crossing ‘should’ be able to be avoided depending on the span lengths between poles, also uncertain.

The submissions by Corangamite Shire reflect a more general difficulty faced with these Applications and applications for wind farms in general. The difficulty is that there is such a lack of detail at the Panel stage (which is the only permit assessment stage) that it is often difficult to properly assess what is proposed and its effects. The applicants say that this lack of detail is a product of the magnitude of the projects and the need to defer aspects of the planning to later stages.

In the present case, some of the uncertainties about the design of the project as it was presented to us are the following:

- Only just before the Panel inspection, we were provided with information about which side of the relevant roads the external powerline would be located in order that vegetation impacts could be assessed (this was despite the Applicant’s ecological consultant apparently having this information available to him much earlier in order to calculate clearance rates). Even now the route of the powerline remains uncertain as, so long as no further vegetation removal is required (or if it is allowed with a further or amended permit), the route of the as of right power line can be altered in future by the electricity company;
- The routes to be used for construction traffic have not been finalised;
The road crossover points and internal powerline routes have been modified on a number of occasions and seem likely to change in response to micro-siting;

It has been apparent that DPCD and the Applicant anticipate that micro-siting of turbines and associated infrastructure such as hard stand areas, access tracks and road crossovers and electricity reticulation lines will be allowed by any permit granted. Micro-siting is where turbines may be relocated by a radius of up to 100 metres from the site shown on the endorsed plans with consequential changes to associated infrastructure. If applied to the maximum extent for a large number of turbines, micro-siting has the potential to impact on visual effects, noise and other matters;

The turbine type has not been nominated and the various expert assessments made different assumptions about capacity and height;

It is unclear whether the turbines would be fitted with aviation safety lighting. It was argued by the Applicant that no lights are required for safety reasons but was said that they may be ultimately be recommended or required by the Civil Aviation Safety Authority depending on the outcome of the present CASA review of the lighting issue generally. Further at the outset of the hearing, the Panel was advised that if safety lighting was required it would be installed on 119 turbines but by the conclusion of the hearing we were advised by the Applicant that only 44 turbines would need to be lit. Despite this substantial (and largely unexplained) reduction, the uncertainty has remained about the ultimate lighting outcome; and

Only a notional site layout plan of the terminal station has been provided and no elevations (even though works up to 38 metres above ground level are proposed). While these works are much less visually imposing than the proposed wind farm turbines (and received less submitter attention in this regard), they are nevertheless not insubstantial (equivalent in height to a 12 storey building) and are located remote from the taller presence of the turbines (though close to those of the proposed Berrybank WEF).

These uncertainties were coupled with strong arguments by submitters, including the Western Plains Landscape Guardians, that any permit granted should minimise secondary consents. It seems that submitter aversion to inclusion of consents has arisen from the informal approvals which have been given without public notice at the Bald Hills and Waubra wind farms for increases in turbine height and lighting installation, with consequential

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43 It is the Panel’s experience with other wind farm panels that where CASA recommends the installation of safety lighting, while it is not legislatively mandated, it is installed because of the demands of the wind farm’s insurers.
changed visual impacts; and change of turbine type, with possible consequences for noise. We believe that this concern about secondary approvals reflects dissatisfaction by the community with wind farm approvals processes generally.

17.7.1 Panel response

In preparing the permit for this wind farm we have been mindful of the matter of the extent of secondary consents and think requests that major changes to wind farm layout and design should not be able to be effected via this process are reasonable given the scale of potential impacts.

It has not been possible to exclude some use of secondary approvals processes, however, because much of the detailed planning of the project has not yet been undertaken. It is necessary that such things as traffic management, ongoing environmental management and fire be dealt with in subsequent plans to be approved when other matters are finalised. We have also necessarily included secondary consent as a mechanism to allow modifications to the plans which are required engineering constraints and the like. At the same time we have included some key elements of approval, such as the total number of turbines, their height and the prohibition on lighting in a manner that these can only be modified by the formal amendment process under section 72 of the Act. This process allows third party input.

So far as the absence of detail available at the Panel stage of the assessment process is concerned, we agree with Mr Mason’s concerns. The approach which is taken to wind farm applications currently is rather close to a process where the first step is an approval in principal followed by scrutiny of the detail as a second stage. That process is really not contemplated in the processing of applications for permits under the Victorian planning system.

In the Panel’s view it would be desirable that in any review of the State Guidelines for development of wind energy facilities or the Victorian supplement to the draft national guidelines that this matter be addressed.

17.8 Land valuation

A number of the oral and written submissions in relation to the WEF raised concern that the value of the submitter’s property would be reduced as a consequence of the proximity to the turbines.

This matter was of particular concern to the Keohes whose house has attractive views to the south from the front of their house and main living rooms which would be disrupted by proposed turbines two kilometres away.
Mr Hankin, who appeared for the Kehoes at the hearing (K192), submitted that:

If the Wind Farm were to proceed, the impact on the value of the Kehoes’ property would be significant, they would lose their right to quiet enjoyment of the Property and their quality of life would be significantly diminished.

He recounted how the property had been recently put on the market and initial buyer interest evaporated when the proposed wind farm became known to prospective purchasers. The Kehoes are seeking acquisition by the Applicant company at a price as if the wind farm were not proposed with any loss on resale then passed on to the Applicant.

Mr Stephen Mitchell (M151) also addressed this issue of loss of property value. He submitted that the Mawallok property was valued a few years ago at $13-15 million. He provided us with a letter from Mr Shayne McIntyre, National Sales Manager, of Elders Estate Agents which provided that a conservative estimate of a 30 per cent reduction in value would be caused by the wind farm. Mr McIntyre’s letter included his view that:

To have a density of towers erected immediately adjacent to a holding of such significance as ‘Mawallok’ has a devastating effect on the value of such a unique property.

The letter referred to the turbines as ‘visually repulsive’ to potential buyers and to noise intrusion from the wind farm. He referred to the effect being estimated to be a 30 per cent loss of value.

Mr Mitchell also submitted that there is a small pool of potential purchasers for an historic property of this kind and that although it may be possible to sell the property piecemeal to neighbours, the ‘icon’ status of the property would be lost – rendering the historic infrastructure worthless.

17.8.1 Panel response

The effects on the value of neighbouring land of development proposals is commonly raised as an issue in submissions on permits or scheme amendments. This was recognised by the panel in the Oaklands Hill Wind Farm report, and the comments of that panel (at pages 127 – 128) are extracted and adopted here:

Frequently there are also demands for financial compensation for disamenity. To the Panel’s knowledge neither has ever been taken into account in a planning decision of this kind. The reasons are set out in the cases referred to in the Bald Hills Wind Farm Panel Report: there is a
combination of influences: recognising land valuation as an imprecise science requiring specialist evaluation and not wisely embarked upon by persons not appropriately trained; amenity effects not necessarily being mirrored in changes in land value; and town planning almost never concerning itself with private economic matters. We would say that planning decisions are driven by objectives relating to conservation and enhancement of environmental values and the amenity of land but as viewed through the lens of community interest. If economics have a role to play in a planning decision they must be matters to do with wider public economics. See Kentucky Fried Chicken v Gantidis [1979] HCA 20; (1979) 140 CLR 675; and also the planning commentary on the Planning and Environment Act contained in Butterworths Pty Ltd Planning and Environment Service (Victoria) page 3279 (1.105).

In the present case, we have not been persuaded that this established precedent is a poor one. We similarly adopt the established view that the issue of land values cannot be considered as a relevant matter in deciding the Application.

17.9 Proximity of turbines to boundaries

The matter of turbine proximity to external property boundaries and roadsides was raised in a number of submissions. Mr Peter Mitchell, for example, referred to turbines being lined up along his northern boundary. The Pyrenees Shire submission (PS112A) opposed turbines being sited closer than 400m from neighbouring property boundaries. This was based on a concern about blade shear and restrictions on land use options for the development of the neighbouring property.

17.9.1 Panel response

So far as Mawallok is concerned, the Panel has recommended the removal of 20 turbines from the northern view from the main house and garden (six of these already being proposed by the Applicant for removal). This should in some measure address this concern. We also discuss the related matter of restrictions on aerial agriculture more fully addressed by Mr Stephen Mitchell in Section 17.5.

So far as blade shear is concerned we adopt the view of the panel considering the Oaklands Hill wind farm that the level of risk to persons on neighbouring properties is trivial given the required coincidence of a rare turbine rotor failure occurring at the same as a person would be present on a nearby part of a large farming property and the blade or part of it being thrown in the relevant direction.
So far as the assertion that development might be restricted on neighbouring properties, we were not presented with any analysis of the extent of that problem based on holding size, siting limitations on the neighbouring properties or Planning Scheme dictates.

Nevertheless the Applicant did not oppose a permit condition requiring a minimum setback of turbines of 100m from neighbouring property boundaries including roads.

17.10 Payment to non-stakeholders

The possibility of payment to non-stakeholders for disamenity was raised in submissions as it has been in other Panel Hearings.

While we are of the view that there may be some merit in such an arrangement (based in part on the advice at the hearing that Pedersen at al had found those with a financial interest in the wind farm were less annoyed by its noise and partly because of the significant environmental changes brought about for some neighbouring householders), the development of a system to distribute ‘compensation’ in this way is likely to be problematic or impossible - even if the money for it were to be raised by diverting some from payments to stakeholders.

The principal difficulty is that the planning system in the State does not contemplate payment for disamenity and the precedent which might be established would have to be carefully considered and perhaps legislatively avoided. The other difficulty is that developing an equitable basis for allocation of such payments would be difficult. It would potentially not only involve consideration of distance from turbines, but also the levels of noise, visual and other impacts to be experienced. Topographic considerations would also have to come into play. All of this would be overlain by the non-stakeholder attitude to wind turbines and the issue raised by some that this amounted to ‘buying-off’ opposition.

It may be a matter worth investigating but we make no particular recommendation in this regard.
17.11 Decommissioning

The PPAR notes that the leasing agreements with the landowners provide SHWF with a 25 year tenure to operate wind turbines. It states that while it is not possible to predict occurrences in 25 years, the options following this are to either continue ongoing operations, upgrade the turbines and continue on-site, or remove the turbines in accordance with an Environmental Management Plan.

The PPAR states that decommissioning would occur in consultation with the landholders, and to a decommissioning plan that would include the following:

- Removal of turbine infrastructure apart from foundations which would be topsoiled and returned to pasture;
- Underground cabling to remain underground;
- Access tracks to have running surface removed and to be covered with topsoil and returned to pasture (unless landowners request the retention of these access tracks for their continued use);
- Substation infrastructure to be removed, with foundations topsoiled and returned to pasture;
- Maintenance facility infrastructure to be decommissioned;
- New accesses to Road Zone 1 to have running surface removed and to be topsoiled and returned to pasture (unless landowners request the retention of these access tracks for their continued use); AND
- Anemometer infrastructure (monitoring masts) to be removed, with foundations topsoiled and returned to pasture.

17.11.1 Submissions

A common concerned was that redundant infrastructure may not be removed after periods of non-use or after permanent cessation of operations, including if the WEF operator were insolvent. It was also proposed that a decommissioning plan be prepared for implementation before the use ceases, rather than following partial closure or full cessation of operations.

A further concern was that if the turbine towers are to be of reinforced concrete rather than steel (a matter that was not clarified for the Panel) this could diminish the scrap potential of the towers, with potential implications for their removal.

Mr Peter Mitchell, Mrs Hawker and Ms Franzose for the WPLG all proposed the imposition of a decommissioning bond if the proposal gains approval.
Mr Gobbo for the Applicant argued that a decommissioning bond is not warranted, and referenced previous planning panel reports for the Mt Mercer, Lal Lal and Hawkesdale proposals. He also proposed that the matter involves a range of considerations that have not been discussed in detail with the Panel, and potentially involves millions of dollars.

At Mt Mercer, the panel considered that the enforcement provisions of the Planning and Environment Act 1987 to be adequate to deal with any non-compliance issue in terms of removal of buildings and works after decommissioning.

The Lal Lal panel agreed in principle that a bond should be required, but was ‘conscious that the necessary administrative framework is not in place and the development of such a framework would require detailed consideration.’ The panel noted that bonds had not previously been required, that no review of a bond regime had been conducted, and that findings on ‘multiple proposals’ since 2004 had relied only on permit conditions.

At Hawkesdale the panel was ‘satisfied that the enforcement provisions of the Act are adequate to deal with any non-compliance issue.

The Lal Lal report also identified that the applicant for that proposal had presented the following points in arguing against the imposition of a bond:

- the scrap value of the material in the wind turbines and towers would lead to decommissioning and removal even in the absence of a permit condition to that effect;
- unlike uses such as mining, there is no significant environmental legacy or modification of landform;
- conditions, which run with land, are enforceable;
- agreements with host landowners establish obligations on the WEF operator to rehabilitate the land and indemnify the landowners from associated liabilities; and
- no other WEF permits to date have required a bond.

17.11.2 Panel discussion

We consider this matter is a serious one, due to both the scale of individual and multiple turbines within a district, and the potential for disintegration if turbines are abandoned following decommissioning.

We have considered the matters before us including our review of the above mentioned panel reports. We see the following as key issues:
- the current absence of a review on the matter, or an established industry standard to provide guidance to panels;
- uncertainties relating to the future economics of removal (ie: benefit-cost ratios from salvage values of towers and turbine components; and removal costs);
- the timeframes for decommissioning and the most appropriate time for the preparation of a decommissioning plan;
- the content of the decommissioning plan; and
- whether a bond or another form of financial guarantee should be required to ensure removal of above ground infrastructure, and acceptable site rehabilitation.

We have little information to assess on this matter which was not progressed in detail during the Panel hearing to the point of discussing options and associated merits. For example, it was suggested by a submitter Ms Russell) that turbine towers may be imported and of reinforced concrete rather than the traditional steel, but this was not clarified by the Applicant. Relevant to this, we have no information on the recycling potential and value for either product now or in the future.

However, we agree with the principle expressed by the Bald Hills panel and adopted by other panels that:

**….the only justification for considerable visual amenity and landscape effects of wind turbines is that they are productive – making electricity.**

*If this should cease then the Panel considers that the turbines should be removed. Further, there appears no reason why the wind farm operator should not be charged with the obligation of removal and making good in an environmentally responsible manner.*

We accept that there are many unknowns about the salvage or scrap value of turbines and associated infrastructure in 25 years or longer time. We also consider, however, that the post closure impacts, particularly visual impacts of remnant decommissioned wind turbines - individually and cumulatively - would be significant. Like other panels we therefore believe that local communities should not be expected to have to continue to face the visual impacts of a WEF when it ceases to fulfil its intended function. This is similar to the reasons for requiring mining and extractive industries to provide an assurance that appropriate rehabilitation will occur additional to that imposed by a permit condition to rehabilitate.

We note that the Lal Lal WEF panel proposed that within one month of ceasing to use turbines, the operator should inform the Minister, and that
within the following 6 months, the operator should prepare a
decommissioning plan to the Minister’s satisfaction. This should include
measures for rehabilitating the land, and a decommissioning traffic plan.

We consider this notion to be appropriate, but that definition is required as to
when the operation of a turbine or turbines can be considered to have ceased.
It is conceivable for example that temporary cessation (say for over one or
several months) of a turbine or turbines could occur for repair, maintenance or
short term economic reasons, without them being decommissioned.

We also consider that the points put to us by the Applicant (see above) as key
works elements of the plan to be appropriate. While some submitters
proposed that non-removal of concrete footings of turbines is unacceptable,
we consider these to be inert and no different to rocks in the ground. Their
retention will have no external community impact and there may be instances
where landholders could have an ongoing use for them. We consider that the
area they cover both individually and collectively is inconsequential in a
landscape context. Further, they have no impact on local hydrology or
hydrogeology.

We do consider, however, that a decommissioning plan must at least provide
timeframe parameters and cost estimates ‘audited’ by an appropriate third
party (eg; a member of an appropriate professional body such as the
Australian Cost Engineering Society), and that can be refined from time to
time as needed.

While we consider in principle that a financial guarantee for infrastructure
removal and site rehabilitation is highly appropriate, we are unable to
recommend a preferred model. To do so would initially require a decision on
the principle of a financial assurance requirement, followed by detailed
targeted consultation between relevant parties, on viable potentials and
options.

We agree with the Lal Lal WEF panel that since the purpose of a financial
decommissioning guarantee is to provide assurance that infrastructure
removal and site rehabilitation will actually occur, activation triggers would
need to be identified in the event of the WEF operator defaulting on removal.
Such triggers could include:
- failure of the WEF operator to complete the works in the time required;
- the WEF operator becoming un-financial and unable to implement the
required works; and
- the WEF operator selling or removing any item which has been valued
for offsetting the cost of decommissioning.
These are indicative only, and would require expansion and definition through a consultation process in establishing an acceptable scenario and the form of the guarantee.

We consider that an industry standard or at least clear guidelines on this matter need to be incorporated into the Guidelines for the development and operation of WEFs.

17.11.3 Recommendations

The Panel recommends that:

The Draft Permit condition relating to decommissioning be amended to require the submission of a WEF decommissioning plan no later than 6 months after notice of the cessation of generation has been lodged or, except with the written consent of the Responsible Authority, when turbines have not operated for a continuous period of 12 months.

The merits of establishing a policy for a WEF decommissioning guarantee be evaluated to cover infrastructure removal and site rehabilitation for wind turbines, electrical transfer stations, and meteorological masts following decommissioning and according to trigger points written into the WEF decommissioning plan.

17.12 Geomorphology and geotechnical issues

Environmental Geosurveys Pty Ltd was engaged broadly to report on the geomorphology (geological and landform features) of the WEF site, and their significance and suitability for the siting of wind turbines. The report was prepared by geomorphologist Mr Neville Rosengren.

Hardrock Geotechnical Pty Ltd, Consulting Geotechnical Engineers, was also engaged to provide an initial geotechnical assessment of the proposed WEF site.

17.12.1 Geomorphological assessment

The geomorphology study used an initial desktop literature review and examination of geological and topographical maps, vertical aerial photographs, satellite images and a digital elevation model. Field studies were also conducted with particular attention given to sites of potentially higher geoscience significance. An aerial inspection also occurred and photographs of key areas of volcanic terrain were used in the report.
The report concludes that the wind farm layout, construction and operation can be structured to take account of and minimise degradation to the significant geoscience features, and it recommends the following:

To minimise the degradation of sites and features, it is recommended that:

(i) No towers or construction or excavation including underground cabling are located on Monmot Hill above the 340 metre contour on the northern side and the 330 metre contour on the western and southern side.

(ii) Towers constructed on Stockyard Hill should be sited well above the rim of the inner crater on the western and northern side and above the lower levels of the outer crater on the northeast. Towers may be located on the higher points of the outer rim.

(iii) Excess excavated rock should be removed from all sites on the rim and outer upper slopes of Stockyard Hill and other stony lava flow sites.

(v) Micro-siting of turbines, cables and roadways at design stage should be developed to avoid construction on or across enclosed depressions on the lava flow surfaces.

(vi) Micro-siting of turbines, cables and roadways should be designed to avoid removing the free-standing boulders on the crest, southern and western slopes of Naminia Hill.

(vii) Implement a construction environment management plan that conforms to the above requirements to minimise impacts on the geoscience features identified.

The study area enclosing the proposed wind farm comprises (in summary) five broad geological units:

- Folded sedimentary hills and ridges in the north (around 500 million years old) interface between the higher ridges and plateau of the Pyrenees Ranges to the north, and the lava plains to the south, being the more elevated land in the northern end of the WEF site. South of Beaufort the elevation of the hills ranges from 350m to 500m, and rock outcrops are mainly limited to ridge crests. The lower slopes are very gentle and the bedrock ridges grade out onto alluvial or volcanic plains;

- Several low volcanic (lava and scoria) hills occur, some with craters and locally steep slopes. The volcanic activity occurred intermittently over about six million years, to form at least 350 eruption points across Victoria’s Western District. Monmot Hill represents the most recent volcanic activity in the WEF area, and is probably between 50,000 to 100,000 years old;
Undulating basalt plains in the north-central, central and southern areas comprised of deeply weathered to relatively fresh, blocky, stony-rise lava flows that issued from the above mentioned eruption points. These vary in thickness from around 50m to over 100m. The lava flows surround areas of higher bedrock relief such as the granites at Nanimia Hill and abut sedimentary hills in the north.

The ‘stony rises’ form a prominent feature of the volcanic plains. While some soil development and some small ephemeral lakes, swamps and wetlands have formed in the depressions, significant surface drainage systems are still in early stages of development. The immature soils and drainage systems result in these areas being high groundwater recharge areas;

- Within the WEF area, Mt Emu and Nanimia Hill (80m above the surrounding plain) occur as part of a 25 km long granitic zone that appears intermittently between Beaufort to Skipton. In the wider area Mount Cole and Mount Buangor (in the southern Pyrenees) occur as elevated granitic plateaus. Mt Emu (500m elevation) rises 150m above the valley of Mount Emu Creek). Mt Emu and Nanimia Hill contain extensive visible outcrop including large freestanding rounded boulders, and are surrounded by broad sandy outwash fans merging with the basalt land; and

- Alluvial drainage valleys and enclosed depressions with active or drained wetlands occurring across all landform types. Broadly, many of the shallow lakes and wetlands are formed from lava flows blocking off former (now underlying) drainage systems.

Approximately half of the proposed wind turbine sites are on the volcanic geology.

**Geological significance and potential impact**

The crater and surrounds of Stockyard Hill and the craters and ‘spatter ramparts’ of Monmot Hill are assessed as having the highest volcanic geoscience significance in the WEF area. The proposed wind farm has the potential to degrade aspects of these sites by reshaping the surfaces. The weathering features on the small area of granite at Nanimia Hill are also sensitive to construction disturbance.

Otherwise, in the context of western Victoria’s volcanic complex, the spatial impact of the WEF proposal is small and all known volcanic features in the WEF area are represented elsewhere in Victoria. The stony rises are stated as lacking the diversity of features and degree of preservation of younger lava
surfaces in western Victoria (eg: from Mount Rouse, Mount Eccles and Mount Napier further south west).

The following Table is abridged from Table 1 in the geomorphological report:

**Table 22: Significance of main geological features in the proposed WEF site.**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Assessed significance</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambrian-Ordovician marine sediments and tectonic structures exposed on hills and ridges in northern part of wind farm proposal area</td>
<td>Not significant</td>
<td>No specific management recommended.</td>
</tr>
<tr>
<td>Outcrops and landforms developed on the granites at Nanimia Hill</td>
<td>Regional Significance</td>
<td>Outcrops with fluted and grooved surfaces and weathering depressions should be left intact and not excavate or covered. Free-standing boulders should be left intact and undisturbed.</td>
</tr>
<tr>
<td>Eruption point features – craters, outcrop. Eight eruption centres in or adjacent to WEF proposal area. Vary from smooth convex hills to more complex crater and cone features.</td>
<td>Stockyard Hill: High Regional Significance (possibly State Significance) Monmot Hill: High Regional Significance</td>
<td>Stockyard Hill: No towers or other structures to be built inside crater (below crater rim). Monmot Hill: No towers or other structures on rim or inside craters. Towers and excavations to be to be located to avoid altering the form of the outcropping volcanic rocks. Exposure in old quarry to be left open.</td>
</tr>
<tr>
<td>Lava flow surfaces and boundaries around Stockyard Hill</td>
<td>Local Significance</td>
<td>Avoid siting towers on crests of rockiest hilltops and reshaping extensive stone piles.</td>
</tr>
<tr>
<td>Deep lead mining remnants Depressions with bordering relict wave and wind-blown shoreline features or deep alluvial/organic deposits. One area is in the north and others are dispersed across the stony rise surfaces</td>
<td>Not significant</td>
<td>No specific management recommended. Avoid excavation of enclosed depressions with peat or organic sediments.</td>
</tr>
</tbody>
</table>

Source: Table 1, page 32. *Stockyard Hill Wind Farm: Geology, Geomorphology and Geoscience Values.* N Rosengren, Environmental GeoSurveys Pty Ltd

**Significance ratings**

As background, geological significance ratings range from *Local* to *International*, and the potential and actual significance of features needs to be evaluated against the cohort of comparable features at Local to National/International scale. A subjective rating procedure is used that depends on a range of factors including the context in which the sites or study area have been selected, the detail or resolution of the study, the existing geoscience information, the specific professional skills, interests and experience of the investigator(s) and their knowledge of the region. Accessing
private property can be a limiting factor to comparing like features in and beyond a study area. The allocation of a significance level is therefore subject to limitations.

17.12.2 Geotechnical assessment

The Hardrock Geotechnical Pty Ltd Report provides an initial desktop geotechnical assessment of the proposed WEF site, by commenting on the anticipated foundation systems and pavement options based on experience in the region and its geology. It notes that site investigations will be needed to confirm the assumptions made, and for any design purpose.

The main points from the report are as follows:

- ‘At this stage’, no unusual difficulties are expected to be associated with the construction of wind turbine foundations;
- The engineering properties of the Quaternary ‘Newer Volcanics’, Ordovician ‘Castlemaine Supergroup’, and Devonian granites and their associated residual soil profiles are well documented. The geological materials have also been widely used and adapted for a wide range of engineering structures and their properties and characteristics are thoroughly understood;
- The geology is favourable regarding interaction between the soil, rock mass and groundwater regime. Unstable underground features (such as caverns present in limestone ‘karst’ regions found in south-west Victoria) are not present in this region;
- Loading conditions are relatively light for wind turbines, and either the natural clay soils or residual rock should readily accommodate such loads;
- It is expected that mass pad footings are the most practicable foundation type for the structures. Piled foundations and rock/cable anchors would provide further alternatives, however, the final foundation design will be based on economics with all alternatives providing a stable foundation;
- Rock excavation for foundations would normally be minimised wherever practicable, but if needed would occur using conventional methods, with any impact short term localised. Where present, bedrock at the foundation level would provide the best founding option and would be left in place with minimal disturbance;
- While traffic frequency and loading conditions on access roads from heavy construction vehicles and large cranes may be high during the construction period, post-construction traffic is likely to be low and comprise light vehicles for maintenance purposes only; and
Sub-grade properties within the region may range from poor to good, and some sub-grade improvements may be needed in the ‘Newer Volcanics’. This could include either in situ lime/cement stabilisation as a construction base, or placement of a geo-fabric on the stripped surface. These are common practices for pavement construction.

17.12.3 Panel comment

We note that the WEF design in the permit Application respects the recommendations regarding the positions of proposed turbines. We also accept that while there are no expected significant technical geotechnical obstacles to the construction and ongoing location of wind turbines in the WEF area as proposed, this will need to be the subject of site analysis at individual turbine, access track and road locations.

We conclude that subject to site analysis at individual turbine, access track and road locations, the geomorphology of the WEF site is suitable for the siting of a wind farm and that on information provided, the site is unlikely to present significant geotechnical complications.
18. Conclusions and recommendations on WEF

The forgoing analysis of the issues has led us to the view that the wind energy facility should be permitted to proceed but only if subject to considerable changes in layout and more stringent conditions than are normally applied. The main changes relate to the deletion of 85 turbines in the interests of natural and built heritage conservation and the imposition of rather more stringent conditions relating to noise than have typically been applied. Of these 85 turbines, 30 were suggested by the Applicant to be removed.

We have also made a number of recommendations which go beyond the matter of this particular permit. They relate to concerns we have and suggestions made about required broader investigations and improvements to the statutory system and assessment of applications for wind energy facilities.

Based on the reasons set out in this report, we recommend that Planning Permit Application P2009/104 under the Pyrenees Planning Scheme should be granted subject to the conditions which are set out in Appendix 4 of this Panel report.
PART C:
VEGETATION REMOVAL FOR THE POWER LINE

19. Vegetation removal for external power line

19.1 Permit application

This native vegetation Application seeks approval for the removal of native vegetation along the proposed 58km external powerline route to facilitate the development of a 132kV powerline connecting the Stockyard Hill Wind Farm to the terminal station, at Berrybank, and then to the existing 500kV national electricity grid high voltage powerline.

The external powerline route crosses parts of both the Pyrenees Shire (13 km approximately) and the Corangamite Shire (45 km approximately).

In considering this Application, information on the powerline was drawn from the following sources:

- Application for Removal of Native Vegetation (132kV Powerline), Origin/ERM, October 2009. (PPARNV);
- Proposed Stockyard Hill Wind Farm, Flora and Fauna Assessment, Brett Lane & Associates, November 2009. (Flora and Fauna Assessment Report);
- Proposed Stockyard Hill Wind Farm, Assessment of Matters of National Environmental Significance, Brett Lane & Associates, March 2010. (AMNES Report);
- The expert witness statement of Mr Brett Lane (A 40);
- The expert witness statement of Mr S Mustoe (A46);
- The expert witness statement of Mr Ian Smales (A47);
- Peer review of flora and fauna matters of national environmental significance (EPBC: 2009/4719) for Stockyard Hill Wind Farm, Biosis Research Pty. Ltd., February 2010. (NES peer review report);
- Evaluating risk of Brolga collisions with powerlines for the proposed Stockyard Hill Wind Farm. Biosis Research (2009);
- Stockyard Hill Panel Hearing: Response to questions of 16 April 2010, Mr Brett Lane (A44); and
• Submissions by neighbouring land owners, members of the community, community organisations, government departments and agencies and local government.

As noted earlier, the external powerline route to the terminal station overlaps with a section of the powerline route connecting the sub-stations within the wind farm (the internal powerline). This overlap is shown on the indicative site layout plan (A202a) and extends from the substation east of Black Lake for approximately 12 km south to Mount Emu Settlement Road.

According to the PPARNV (page 1), no native vegetation will be removed as a result of development of the powerlines along the route in Pyrenees Shire, and the Application was made only for the 45km of the external powerline route under the Corangamite Planning Scheme. The PPARNV indicates that the preferred route is generally within roadside reserves surrounded by agricultural land and has been determined to minimise the loss of native vegetation. The PPARNV describes that various route options that were considered before determining the preferred route referred to as the ‘western option’ (Figure 39, Transmission Line Route Options).

The assessment of the route options are presented in the Flora and Fauna Assessment Report. The assessment provided information on the extent and condition of native vegetation and fauna habitat along both sides of the road reserves along which the powerline would be constructed.

Matters arising from that investigation for the preferred powerline route were the identification of suitable habitat for threatened flora and fauna species, the need for removal of an area of remnant native vegetation of very high conservation significance and the removal of a Red Gum and pruning of some trees. The Flora and Fauna Assessment Report summarises (page 144) the key findings as:

• Suitable habitat was identified for five EPBC Act and FFG Act listed threatened species: Clover Glycine, Hairy Tails, Large-headed Fireweed, Small Milkwort and Spiny Rice-flower.

• Three EVCs in 12 remnant patches of vegetation were identified in the study area: Plains Grassland (EVC 132) and two patches of Creekline Grassy Woodland (EVC 68) and Grassy Woodland (EVC 175).

• Suitable habitat was found for three EPBC Act, FFG Act, DSE Threatened Species Advisory List species: Striped Legless Lizard (EPBC Act), Brolga (FFG Act) and Fat-tailed Dunnart (DSE Advisory List).
Impacts to Striped Legless Lizard and Fat-tailed Dunnart were assessed as not being significant.

A collision risk analysis indicated that 0.018 Brolga per year are at risk of colliding with the powerline. However this is considered to be a very limited impact to the Brolga population.

Approximately 0.021 hectares (0.009 habitat hectares) of Plains Grassland EVC will need to be removed for the construction of the preferred powerline route.

Total offsets required for the proposed removal of native vegetation along the preferred route includes 0.019 habitat hectares of Very High Conservation Significance Plains Grassland. As a rule of thumb, based on 20% improvement of the offset site, an area of 0.1 hectares of Plains Grassland would be required to compensate for this loss. In addition, two large trees are to be protected and 10 new trees are to be recruited to account for the loss of one scattered River Red Gum.

Significant impacts to species listed under the EPBC Act are not considered to be significant (sic).

A planning permit is required under Clause 52.17 of the Planning Scheme for the removal of any native vegetation or scattered native flora within the study area. A planning permit would also be required to carry out works under ESO1 and ESO2 in the following areas:
- Along Dunnets Road, Stockyard Hill Road and the northern part of Skipton Road; and
- In the vicinity of Mount Emu Creek.

As outlined in Section 5.6, the proposed Stockyard Hill Wind Farm has been determined as a ‘controlled action’ pursuant to the EPBC Act relating to listed threatened species and communities and listed migratory species. The reasons provided for this decision were that the proposed wind farm is likely to have a significant impact on:
- The Natural Temperate Grassland of the Victorian Volcanic Plains (NTGVVP);
- The Spiny Rice Flower;
- The Striped Legless Lizard;
- The Golden Sun Moth; and
- Listed migratory species in particular the Sharp-tailed Sandpiper.

A summary of the findings of the AMNES Report (page 115) is as follows:
The proposed powerline route assessment identified one listed threatened community, Natural Temperate Grassland of the Victorian Volcanic Plains, as being present in the powerline search region. Approximately 90 square metres of this habitat will be impacted by the proposed development.

Five EPBC Act listed threatened flora species were found to be potentially present along the powerline route, though none of these were identified during field survey. The proposed development is unlikely to have a significant impact on these. One listed threatened fauna species was identified as being potentially present along the powerline route. However no individuals of Striped Legless Lizard were found during targeted survey.

Mitigation measures are proposed to minimise potential impacts which could occur on the listed threatened species as a precautionary measure.

The Flora and Fauna Assessment Report (Table 44) identified six sites for native vegetation removal within the preferred powerline route. Two sites (Hamilton Highway- between Calverts Road and McLeans Road and Skipton Road between Skipton and Mt Bute Road) require the removal of 0.021 hectares of Plains Grassland, and pruning of trees is required at three sites, including two River Red Gums at the eastern end of Murray Street and the removal of a scattered Red Gum in Park Road near Skipton.

19.2 Policy and regulatory framework

The Planning Scheme provisions relevant to this Application are outlined in the DPCD submission (Exhibit DPCD 3a) and in Sections 3 and 4 of this report.

As earlier noted, a minor utility installation is an as of right use in the Farming Zone of the Planning Schemes and there is no planning permission required for the construction of buildings or works associated with a minor utility installation including a powerline of less than 220kV. Any removal of native vegetation necessary to construct the powerline does, however, require permission.

Overlay provisions in the Planning Scheme also apply to the land including a Vegetation Protection Overlay in Corangamite Shire not identified by DPCD. Furthermore, as explained later in this section, a permit for clearance of native vegetation is now recognised as required under the Pyrenees Planning Scheme as well as the Corangamite Planning Scheme.
Mr Gobbo advised that at the time of the hearing, a mandatory CHMP was being prepared for the construction of the external powerline to the grid (AAV CHMP No. 10739). This is to cover the activity area that is subject to the native vegetation clearance permit Application, and is mandatory for the same reasons as apply to the wind farm itself as described earlier. The Minister is not able to issue a planning permit or permits for the removal of the vegetation until CHMP 10739 (and any other required CHMP for the clearing of areas not earlier identified - including those in Pyrenees Shire) is/are approved under section 65 of the AHA.

19.3 Issues raised and Panel response

In his Expert Witness Statement (A40), Mr Lane restated the key findings of the Flora and Fauna Assessment Report (without reference to the impact on Brolga) and indicated that only three remnant patches of native vegetation were recorded within the preferred powerline route option (as opposed to the powerline route study area) and these were classified as Plains Grassland (EVC 132).

19.3.1 Native vegetation

A number of submitters (C74 a, Submission 298, WPG 82, Submission 106) indicated that it was difficult to assess the implications of the powerline route options because of the lack of specific details of the powerline alignment and because the mapping scale used did not allow a determination of what side of the road the powerlines were to be located. As can be seen below a number of queries were raised as a result of this lack of clarity about the route.

Submitters also questioned the adequacy of the flora and fauna assessments indicating that important species may have been missed (DSE306, Submission 37b, Submission 298, WPLG82) and a more thorough assessment should be undertaken covering additional seasons. The need for pre-construction surveys to be undertaken to determine the final location of powerline infrastructure was supported by Corangamite Shire (C74 a). VicRoads (Submission 37b) indicated the likely presence of significant grasslands along the Beaufort-Skipton Road and along the Rokewood-Skipton Road and that this area needed to be assessed. Corangamite Shire (Submission 298) specifically identified the need for specific details of the alignment of the powerline and removal of vegetation on the Rokewood-Skipton Road, Mount Bute Road and Rowlands Road. The Shire also indicated the need for further assessment to determine the presence of Legless Lizard, Spiny Rice Flower and White Sun Ray on the Mount Bute Road, Calverts Road and the
Rokewood - Skipton Road. The assessment of the impact on River Red Gum as a result of the powerline crossing of Mount Emu Creek was not considered adequate by submitters (Submission 106, Submission 294).

DSE (Submission 306) did not agree with the statement in the Flora and Fauna Assessment Report that no EPBC listed vegetation community was recorded in the powerline study area. The Plains Grassland identified in Table 44, may require referral under the EPBC Act as Natural Temperate Grassland of the Victorian Volcanic Plains (NTGVVP) as it is classified as critically endangered under that Act. DSE (Submission 306) also identified that the potential presence of Striped Legless Lizard within the powerline route also needs to be considered and advised of seven additional species likely to occur in the powerline study area including species that have the potential to occur within Plains Grassland.

Corangamite Shire (C74a) and other submitters (WPLG 82) identified the need to consider the Vegetation Protection Overlay that applies along the Hamilton Highway for the protection of significant roadside vegetation.

In response to matters raised in submissions, in his expert witness statement (A 40), Mr Lane indicated that no native vegetation was recorded during the assessment along the section of the Beaufort – Skipton Road where the powerline is proposed. However subsequently Mr Lane (A44) acknowledged that this section did contain Plains Grassland and 0.004 ha would need to be removed for the construction of the powerline. At the same time he also identified a remnant of Plains Grassland at Murray Street, not previously described in the Flora and Fauna Assessment Report, and indicated that 0.0004 ha would need to be removed(A44). The reason cited for not previously identifying these remnants was that favourable seasonal conditions had led to the recovery of previously-undetected native grasses, over introduced grasses. Both of the additional grassland sites will need approval under the Pyrenees Planning Scheme. This further evidence by Mr Lane now suggests that there are four native grassland sites in the powerline route. The Applicant subsequently indicated that all four native grassland sites impacted by the powerline route would need to be referred under the EPBC Act as they qualified as Natural Temperate Grassland of the Victorian Volcanic Plains confirming the earlier advice provided by DSE (Submission 306).

19.3.2 Panel response on native vegetation

We agree that the lack of specific details of the powerline alignment (side of road) and the scale of mapping contributed to the difficulty in assessing the implications for vegetation removal. As earlier noted, it was not until the day before the field inspection at the end of the Panel hearing that we were
provided with a powerline route map (A165) that detailed the preferred roadside alignment.

The preferred route described in A165, commences at the central substation near Stockyard Hill, and then runs south on the western side of Skipton Road, taking a deviation across Skipton Road at Mount Emu Road, returning to the western side of Skipton Road to Skipton, north of Skipton via the northern side of Murray St and south down Park St along an existing powerline alignment and then continuing south to the terminal station via the northern side of Rokewood – Skipton Road, Mount Bute Road (crossing from eastern side to western side), Crawford’s Road (crossing north and south), Rowlands Road (eastern side and then through the centre of an unfenced road reserve), Barr’s Road (southern side), Frost’s Road (eastern side), Calvert’s Road (western side crossing to the eastern side), Hamilton Highway (northern side) and crossing the Highway to McLeans Road (eastern side).

Submitters indicated that some important grassland remnants had not been identified in the powerline route assessment and as we have noted two additional sites were subsequently added (A44). The two additional native grassland sites are located in Pyrenees Shire. The apparent limitation on identification of grassland areas and the explanation for not recording these sites previously (A44), suggests to us that there is a need to undertake further habitat assessment and checking during pre-construction surveys, including outside the previously identified remnant grassland areas. The identification of additional remnant grassland areas is relevant to the detection of the threatened flora and fauna species identified as potentially occurring along the powerline route as well as the protection of native grassland remnants. We record also that on our inspection of the preferred powerline route, the DSE representative on the inspection, identified native grassland along Barrs Road that had not be recorded on the proposed powerline alignment map (A165).

Part of the powerline route along the Hamilton Highway (between Calverts Road and McLeans Road) has been identified in the Flora and Fauna Assessment Report as Plains Grassland. In his Expert Witness Statement (A40), Mr Lane indicated that the southern side of the Highway would be used by the powerline to avoid the remnant native grassland on the northern side. This change to the southern side of the highway was acknowledged by DSE in their submission (DSE68). We were subsequently advised by Mr Lane (A44), however, that the south side of the road is too narrow for the powerline and thus the impact on the northern side is unavoidable. On our inspection we observed that the southern side was indeed narrow and agree with Mr Lane’s advice. We also noted that there is an existing powerline in the road reserve on the northern side. We recommend that overbuilding on the
existing powerline be undertaken, as much as practicable, so as to minimise
the impact on the native grassland on the northern side of the road.

We note that the area required for native vegetation clearance was assessed on
the basis of 1.5 square metres disturbance for each pole in the PPARNV. Mr
Lane’s Expert Witness Statement (A40), however, indicates (page 16) that an
area of 2.25 square metres disturbance will occur for the placement of each
pole. This has led to some uncertainty as to whether the amount of clearance
indicated is accurate. In view of this, we consider that a further assessment of
the required area of vegetation clearance be undertaken in the preparation of
the offset management plan. We also recommend that a clear map of the areas
for vegetation removal be prepared in conjunction with DSE prior to
construction commencing in order that on the ground demarcation and
protective works can be implemented.

We agree that the Applicant has adopted an approach that avoids and
minimises the impact on native vegetation, as outlined in the Native
Vegetation Management Framework. Notwithstanding the ambiguity in
assessment of the disturbance area, we accept that the area of vegetation
clearance is likely to be small (0.03 hectares approximately) and can be further
minimised by micro-siting. We also recommend that for those parts of the
routes of the internal and external powerlines where the lines run in parallel,
the lines should be co-located on common poles to minimise any further
requirements for clearing.

The Panel is of the view that a permit should be granted for the amended
amount of vegetation removal sought.

Permission to remove vegetation requires the preparation and approval of a
vegetation offset management plan. The Flora and Fauna Application Report
canvases in general terms the approach to finding offsets. We agree with DSE
(DSE 68) on this approach and accept that finding offsets is feasible and can be
required by condition.

19.3.3 Threatened species (FFG Act)

Mr Lane’s expert witness statement recommends that that targeted surveys of
the external powerline route should be conducted in the winter and spring for
threatened flora and fauna species as a condition of the planning permit and
detection would allow populations to be avoided by micro-siting of power
poles. This would also enable the possible detection and avoidance of the
additional species that were identified by submitters (e.g. Submission 306) as
being likely to occur in the powerline study area. In particular Mr Lane’s
submission recommends that surveys for Spiny Rice-Flower be undertaken in
the period April to August in the proposed powerline line route, with the micro-siting of power pole positions to avoid any detected occurrences.

DSE’s submission (DSE 68) on the powerline route assessment acknowledged that further well-timed surveys are proposed of the external powerline route to identify any threatened flora and fauna. It was accepted that this would assist detailed design and allow micro-siting within areas of native vegetation. DSE indicated it was satisfied with the route recommendations on this basis.

A submitter (Submission 306) advised that the Striped Legless Lizard has the potential to occur within the powerline route although it was not recorded during the fauna and habitat assessment. In response, Mr Lane (A40) recommended that targeted surveys should be carried out to inform micro-siting of power poles and indicated the need to develop and implement salvage and translocation protocols if necessary.

19.3.4 Panel response on threatened species

We agree that targeted surveys of the route should be conducted in the relevant months for threatened flora and fauna, but as discussed above, only after all the remnant grassland along the route has been identified. We agree that the survey requirements for Spiny Rice-Flower need to be incorporated in these surveys.

19.3.5 Matters of national environmental significance

An assessment of EPBC Act matters was undertaken and the findings are presented in the AMNES Report. A summary of the findings of the AMNES Report has been provided earlier in Section 21.1 of this report. Mr Lane’s witness statement (A40) also summarises the key findings of this assessment. He concludes that significant impacts are not expected on threatened plant communities or flora and fauna species listed as matters of national environmental significance under the EPBC Act.

Key findings on EPBC species are:

- Two stands of the listed community- Natural Temperate Grassland of the Victorian Volcanic Plains (NTGVVP) were recorded within the powerline route and will be impacted by the powerline. Specifically the AMNES Report identifies a remnant along the Skipton – Rokewood Road and the grassland adjacent to the Hamilton Highway;

- As described earlier, two additional grassland remnants that will be impacted were later identified along the powerline route by Mr Lane (A44).
The AMNES Report recommends that areas of potential habitat for the Striped Legless Lizard should be surveyed before construction to inform micro-siting to avoid or minimise impacts;

Potential habitat for Golden Sun Moth was considered to occur along the route and four separate surveys were undertaken in accordance with the survey protocol pursuant to the EPBC Act (policy requirements) for this species and none were detected; and

Of the listed flora species, pre-construction surveys between June and August are recommended for Spiny Rice Flower to facilitate micro-siting.

The NES peer review report prepared for the Applicant, was presented in the Expert Witness Statement of Mr I Smales (A 47). His statement notes that the Applicant intends to undertake pre-construction surveys for Striped Legless Lizard and threatened species of flora that could occur along the powerline route with a view to micro-siting wind farm infrastructure and power poles to avoid any impact.

Mr Smales further concludes that:

*I consider that information provided to me is sufficient to draw the conclusion that there is little likelihood of significant impacts on EPBC Act listed flora or fauna, provided that the precise locations of wind farm infrastructure, powerpoles and any associated infrastructure are selected with the advice of a qualified botanist and zoologist to ensure micrositing avoids any potential impacts on the Striped Legless Lizard and any species or communities of flora listed under the EPBC Act.*

Advice from the NES peer review report (page 10) on the survey approach to identifying native grasslands, adopted in the Flora and Fauna Assessment Report and its relevance to the powerline route assessment, has been referred to earlier in this Report (Section 11.4).

19.3.6 Panel response on matters of national environmental significance

We note that one listed grassland community, NTGGVVP, occurs at four sites along the powerline route, a number of listed flora species were potentially present and one listed fauna species (Striped Legless Lizard) was potentially present. We understand the criteria to assess Plains Grassland under the State Native Vegetation Management Framework have a lower threshold and differ from those used to assess the presence of NTGVVP under the EPBC Act. Therefore the detection of Plains Grassland is likely to reveal, subject to further survey, NTGVVP. There appears to be some uncertainty that all the remnant native grassland that is likely to be impacted on has already been identified and we recommend the approach described in the NES peer review
report be adopted in all pre-construction habitat surveys (Section 11.5.3). This will clarify the presence of NTGVVP. We also recommend that pre-construction habitat surveys be undertaken in areas that are to be impacted on by the powerline that are outside the previous native grassland areas identified.

As we have indicated above, pre-construction habitat surveys should be undertaken at the appropriate time to ensure that all the grassland remnants have been identified before targeted surveys begin for threatened flora and fauna species. Subject to these requirements, we agree with the conclusion of Mr Lane and the peer review advice of Mr Smales (A 47) that there would appear to be little likelihood of significant impacts on EPBC Act listed flora or fauna that are matters of national environmental significance. We agree with the recommendation of Mr Smales that the precise location of powerline infrastructure should be selected with the advice of a qualified botanist and zoologist, and that close to those areas where vegetation is to be removed, areas of vegetation that require protection from damage should be clearly demarcated on the ground in advance of construction activities as required.

19.3.7 Other matters

A number of other matters were raised by submitters that were beyond the scope of consideration of the native vegetation removal Application and related to the powerline itself which is strictly not before the Panel. We provide a brief record here.

Fire

Concern about the increased risk of fire posed by powerlines as an ignition source was raised by a number of submitters (K180, K179, WPLG85a). There was a proposal by Mr Chapman (WPLG85a) that power lines be placed underground to eliminate the risk. Mr Chapman made reference to the fires on Black Saturday in 2009 and the suggestion that certain of those fires started from powerlines. In response to questions at the Panel hearing, Mr Nicholson (A37), the expert witness on fire for the Applicant, stated that with good maintenance powerlines do not pose a fire risk.

Alternative powerline route

An alternative route for the external powerline was proposed by Ms Miller (M89a). The proposed easterly alternative route avoids taking the powerline south through Skipton and thus avoids the remnant grasslands along the Beaufort Skipton Road and Murray Street, and the crossing of Mount Emu Creek. The easterly route takes the powerline down Rankin Road. This was
also supported in submissions (Submission 42). The alternative route also avoids the need for the deviation at Mount Emu Settlement Road. Concern (J171) (J172) was expressed about this deviation and the location of the powerline. An assessment of the alternative powerline route proposed by Ms Miller, was undertaken by Brett Lane and Associates Pty Ltd, at the request of the Panel. The response (A44) indicated that the Rankin Road section contained Plains Grassland and possible Striped Legless Lizard habitat on both sides of the road and that no surveys have been conducted on the route section along the Rokewood-Skipton Road. No other parts of the route option supported native vegetation. In his closing submission (A 220), Mr Gobbo QC, for the Applicant, stated:

…that there are limits upon the Panel in recommending alternative route options and that the permit application is for vegetation removal and that the Panel should not entertain the line route suggested by Ms Miller.

Power line route and Sugar Gums

Corangamite Shire submitted (C74 a) that Sugar Gums are a significant landscape feature and are important economically for landowners in the area. While recognising that planning approval for the removal of Sugar Gums was not required, the Shire sought a flexible approach to the location of the powerline to avoid impacts on Sugar Gums.

Power line impacts on Brolga

Several submitters expressed concern about the impact of powerlines on Brolga and other fauna including personal observations of Brolga collisions with powerlines (Submission 289, C102, B88, Submission 77, Submission 294, H106, Submission 101, R173, DSE68). Brolgas are known to occasionally collide with powerlines in Victoria although published documentation is limited and not recent. Collision with powerlines was considered to be a significant threat to the Brolga population in Victoria (DSE 68). This matter is discussed in Section 11.11 of this Report.

19.3.8 Panel response to other matters

As noted earlier in this section, this Application relates to permission to remove native vegetation within the external powerline route to facilitate the development of the 132kV powerline. No planning approval is required for the construction of the external powerlines themselves. As a consequence matters raised by submitters that do not relate to the vegetation removal for those lines are not matters that the Panel can make recommendations on in this report on the permit Application.
We note the alternative route alignment proposed by Ms Miller was assessed by Mr Lane, but the Applicant subsequently indicated that it was not prepared to entertain this alignment.

The powerline impacts on Brolgas have been modelled in conjunction with the internal power line and are discussed elsewhere in this report.

While the clearing of Sugar Gums does not require a permit under the Native Vegetation Management Framework, we appreciate their value as a community resource. We note that the powerline route largely avoids impacts on Sugar Gums.

On our inspection we noted that many locations along the proposed route contained existing power line infrastructure. We consider that the co-location of infrastructure or over-building to accommodate the proposed powerline rather than duplication of lines is the preferable outcome. Furthermore, during powerline construction, there were several locations where the placement of power poles on adjoining private property rather than in the road reserve would minimise impacts on native vegetation.

19.4 Recommendations

The Panel recommends that:

As a consequence of the seasonal influence on the identification of grassland remnants, further habitat assessment and checking be undertaken during pre-construction surveys, including areas outside the previously identified remnant grassland areas that are proposed for disturbance by the development, as a precursor to targeted surveys.

The survey approach to identifying NTGVVP that is outlined in the NES peer review report (page 10) be adopted for pre-construction surveys.

A map of areas of native vegetation to be cleared along the powerline route be prepared in conjunction with DSE prior to construction commencing and areas for removal v protection be demarcated in the field if necessary.
PART D:
TERMINAL STATION

20. Proposed terminal station

A description of the proposed terminal station is provided earlier in Section 2.2.2 of this report.

In considering this Application, information was drawn from the following sources:

- Application for a Terminal Station, Origin/ERM, October 2009 (PPARTS);
- The expert witness statement of Mr Christophe Delaire (A21);
- The expert witness statement of Mr John Nicholson (A37);
- The expert witness statement of Mr Allan Wyatt (A28A);
- Proposed Stockyard Hill Wind Farm, Flora and Fauna Assessment, Brett Lane & Associates, November 2009 (Flora and Fauna Assessment Report);
- Proposed Stockyard Hill Wind Farm, Assessment of Matters of National Environmental Significance, Brett Lane & Associates, March 2010 (AMNES Report);
- The expert witness statement of Mr Brett Lane (A40);
- The expert witness statement of Mr S Mustoe (A46);
- The expert witness statement of Mr I Smales (A47); and
- Submissions by neighbouring land owners, members of the community, community groups and other organisations and Corangamite Shire.

The Panel undertook a field inspection and visited the site of the proposed terminal station, Lake Struan and the roads surrounding the site.

20.1 Policy and Regulatory Framework

For the most part this has earlier been set out at Sections 3 and 4 of this report.

In addition Mr Gobbo indicated that there is no statutory area of cultural heritage sensitivity in the activity area that would trigger a mandatory CHMP under the Aboriginal Heritage Act. He said that notwithstanding this, the Applicant has prepared a voluntary CHMP. Preparation had occurred in
consultation with Kuuyung Marr Aboriginal Corporation and Framlingham Aboriginal Trust, and the CHMP was approved on 5 November 2009 by the Acting Deputy Director, AAV, under delegated authority of the Secretary, DPCD.

20.2 Provision of notice

20.2.1 Submissions

Concern was expressed by the nearby residents Mr G and Mrs C Keating (K179) and Mr J and Mrs G Keating (K180) that they did not receive notice of the terminal station planning Application and only recently became aware of the proposed development.

20.2.2 Panel response to provision of notice.

Having regard to the pattern of settlement in this area and the presence of the Keatings and Mr Hocking at the hearing, the Panel was not persuaded that the notice had generally been inadequate.

20.3 Noise

20.3.1 Submissions and evidence

Mr G and Ms C Keating (exhibit K179) and Mr J and Ms G Keating (exhibit K180) raised concerns about the potential noise impacts of the terminal station in a naturally quiet area, the lack of noise measurement and modelling, and the estimation of noise levels when details of the transformer are not known. The potential impact of noise on the fauna at Lake Struan State Game Reserve was also raised.

The expert witness statement of Mr Delaire (exhibit A21) for the Applicant, refers to the report prepared by Marshall Day Acoustics in the Terminal Station PPAR, Annex H (Stockyard Hill Wind Farm Terminal Station Noise Assessment Report, January 2009) on the assessment of the noise impacts of that proposed terminal station.

Mr Delaire’s statement indicates that the EPA N3/89 Interim Guidelines for Control of Noise from Industry in Country Victoria was used to determine the noise limits. These guidelines set noise limits for country Victoria and specify methodologies for estimating and measuring noise levels in those environments where background noise levels may be quite low, particularly at night. The guidelines specify that where background noise levels are very low, specifically less than 25dBA at night or 30dBA during the day or evening,
then the night time limit should be 32dBA, for evening 37dBA, and for day time 45dBA.

Marshall Day Acoustics considered that the ambient noise levels in the vicinity of the terminal station site were expected to be very low, although no measurements were made, and as the terminal station would be operating 24 hours per day, 7 days per week, it applied the N3/89 minimum night time noise limit of 32dBA at dwellings adjacent to the terminal station. The nearest dwelling is at a distance of approximately 1.5 km. As noise from a transformer, the most significant noise source in the terminal station, is generally tonal in character, Marshall Day Acoustics considered that a penalty of +5dB should be applied to modelled and measured noise levels.

Mr Delaire advised that the potential noise impacts of the terminal station had not been modelled because details of the proposed equipment, including transformer noise data, were not available. To meet the environmental noise limit Marshall Day Acoustics estimated that the sound power level of the transformer should not be more than 95dBA measured in accordance with Australian Standard AS2374.6 1994: Power transformers Part 6 – Determination of Transformer and Reactor Sound Levels (AS 2374.6). The Terminal Station PPAR indicates that in the eventuality that the proposed transformer has a sound power level which exceeds 95dBA, mitigation measures such as noise barriers, would need to be implemented on site to achieve the required noise limit.

In his expert witness statement, Mr Delaire proposed that noise emissions from the terminal station should be revised once sufficient information was available. This was supported by Corangamite Shire Council (Doc C74a).

The submission of Mr J and Ms C Keating supported the minimum noise requirements for the terminal station as outlined above.

20.3.2 Panel response on noise

The N3/89 noise limits, by reference to State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No N-1, are predicated on measurements at calm or low wind speed conditions when wind is not a confounder to noise measurements. We agree with the Marshall Day Acoustics position that environmental noise with the proposed terminal station operating must not exceed a noise level of 32dBA, including a 5dB penalty for tonality, at any nearby dwelling.

We note that no attempt was made by the Applicant or submitters to assess an existing comparable terminal station to facilitate a comparison of noise. We consider that this would have been helpful.
We undertook an inspection of the Warrenheip terminal station just east of Ballarat. The inspection took place at dusk on a cool evening in still weather conditions. At that time of the day we expect it would have been a period of high electricity demand. The terminal station was surrounded by a cyclone mesh fence approximately 2 m in height covered with a green cloth but no noise attenuation structures were apparent. We noted that there were houses directly opposite the terminal station within 30 m of its boundary. The noise level from the terminal station, a low electrical humming sound, was detectable at the terminal station boundary and at the fenced boundary of the nearest adjoining property. At a distance of about 100 – 200 m from the terminal station boundary it was not readily detectable by us. We have no knowledge of the size of this operating terminal station at Warrenheip compared with that proposed at Berrybank. While we do not suggest the experience of this inspection provides us with an empirical basis for making an assessment of the noise emissions from the proposed SHWF terminal station, it did provide us with some appreciation of the evidence from Mr Delaire of the likely audible noise at a distance of 1.5 km, the distance to the nearest dwelling.

We note that in the Marshall Day Acoustics terminal station noise assessment report and Mr Delaire’s witness statement reference is made to the proposed ‘transformer’. Our understanding is that two 300 MVA transformers are proposed. In that event we expect that the estimation of maximum sound power level at source of 95dBA relates to both transformers and that the maximum sound power level of each would be somewhat less, possibly about 92dBA.

We are satisfied that the anticipated night time background noise limit of less than 25dBA has been appropriately selected as the basis to determine the noise limits from N3/89. This requires a 32dBA noise limit, including a penalty of 5dB for tonality, at the nearest dwelling (1.5 km away). We consider that is acceptable.

We believe that the sound power level of the transformers is not of great importance itself; the transformer selection and any measures to reduce sound at the source has to be appropriate to meet the required N3/89 noise level.

We agree that the noise emissions from the terminal station should be re-assessed in the process of selecting the final equipment such that the noise limits do not exceed or are less than 32dBA with a 5dB penalty for tonality. We also agree that sound mitigation measures should be implemented if required.

On the matter of noise impacts on the fauna at Lake Struan State Game Reserve, as it is well over 200m away at the closest point from the terminal
station, we suggest that the disturbance to water birds outside the game season would be unlikely.

We observe that N3/89 also sets construction noise limits. Given the expected low background noise at the site those limits would be the day time operational limit of 45dBA plus an allowance of 10dB ie 55dBA and no allowance for the evening and night noise limits. We suggest that these construction noise limits should be included in the environmental management plan for the terminal station.

20.4 Fire

20.4.1 Submissions and evidence

Concerns were expressed by submitters (K179, K180) about the increased hazard of fire involving the terminal station and the lack of local CFA capacity and training to fight fires in the terminal station. It was said that the proximity of Blue Gum plantations increased the fire risk which was considered significant - as evidenced by the existence of a Wildfire Management Overlay. Submitters considered the terminal station proposal had not responded to the overlay.

Mr John Nicholson’s expert witness statement on behalf of the Applicant (A37), indicated that outbreak of fire in a terminal station should be able to be minimised through good design, quality control, suitable safety management arrangements including fire detection and notification in accordance with best practice. Spread of fire from the terminal station can be minimised through a comprehensive bushfire management plan, he said. If the eventuality arose, Mr Nicholson stated that the local CFA brigades would be able to contain a fire involving a terminal station using equipment normally issued to brigades until the arrival of more qualified people. The CFA would provide the necessary training to local brigades. He did not consider that fire in the terminal station was a significant issue.

In response to questions at the Panel hearing, Mr Nicholson suggested that the Applicant and the CFA should develop a fire response agreement. This assessment was supported by Mr Brendan Brown from the CFA (Submission 302), who in response to questions at the Panel hearing stated that the terminal station presented no unusual challenges above other facilities, training could be provided if required and that an emergency response plan should be developed with the wind farm facility manager. He also indicated that the location of the terminal station near Blue Gum plantations presented no particular requirements for fire management and would be managed through a bushfire management plan.
20.4.2 Panel response on fire

Submitters referred to concerns about the location of the terminal station within an area where there are abandoned plantations and this represents an increased fire risk. We note that a Wildfire Management Overlay (WMO) applies. As earlier noted, the WMO does not generate the need for a permit for the terminal station. Nevertheless it does indicate fire is an issue in this area.

We are satisfied with the evidence of Mr Nicholson and Mr Brown that arrangements can be put in place to manage fire risk from and within the terminal station. We agree that consultation with the CFA is required prior to the preparation of a Construction and Operational EMP to ensure the proposal is consistent with Clause 15.07 (Protection from Wildfire) of the planning scheme and that the EMP would also address appropriate emergency response arrangements with the wind farm operator.

20.5 Car parking

20.5.1 Submissions

A submitter (K180) queried the necessity for car parking to be 10% of the total site (200-300 cars). Under Clause 52.06-1 (Particular Provisions) of the Corangamite Planning Scheme, Utility Installations are required to have 10% of the site area set aside for car parking spaces and access lanes. The clause provides for the issuing of a permit to reduce this requirement. In a submission (A53) to the Panel the Applicant indicated that they would be seeking a reduction of the scheme requirement for car parking and would be requiring approximately 20 parking spaces.

20.5.2 Panel response on car parking

We are satisfied with the Applicant’s explanation of required car parking and believe a reduction under the Planning Scheme should be allowed.

20.6 Co-location of terminal stations

20.6.1 Submission

Corangamite Shire (C74 a) requested that the Panel give consideration to a permit condition that would require the co-location of the proposed Berrybank Wind Farm terminal station with the Stockyard Hill terminal station as they will be in close proximity to each other. It was suggested that the Panel might defer consideration of this element of the wind farm until agreement was
reached. Furthermore Corangamite Shire suggested that consideration be given to amending the Wind Energy Guidelines to require co-location of infrastructure if possible.

20.6.2 Panel response on co-location of terminal stations

The role of this Panel is to consider the application before us and as such we are not constituted to consider or join with another proposal for which a separate panel has been established. However, we agree with desirability of the co-location of wind farm infrastructure as far as possible and we would recommend that the Minister give consideration to encouraging this including through the amendment of the Guidelines.

20.7 Landscape

20.7.1 Evidence

The expert witness statement of Mr Wyatt (A 28) for the Applicant, proposes that the existing plantations and other vegetation adjacent to the terminal station site will filter views to the site from locations east, north and south of the site. Given the potential to establish screening vegetation along the perimeter of the site, together with the existing vegetation in the general area, Mr Wyatt’s assessment is that the overall visual impact of the proposed terminal station will be low.

20.7.2 Panel response on landscape

We are satisfied that the landscape impact of the proposed terminal station will be low and we note that perimeter screening of the proposed site with suitable vegetation will be undertaken.

20.8 Flora and fauna (FFG Act) and matters of national environmental significance

20.8.1 Evidence

The Flora and Fauna Assessment Report states that the proposed terminal station site is dominated by exotic vegetation (pasture and crops) as a consequence of past agricultural development and does not support habitat for native flora and fauna species of significance. The expert witness statement of Mr B Lane (A40) indicates that the terminal station is situated at a site where no remnant native vegetation or indigenous fauna habitat exists.
and so no impacts are anticipated on indigenous flora and fauna, or on native vegetation.

On Matters of National Environmental Significance, the AMNES Report indicates that none of the listed flora species under the EPBC Act that may potentially occur within the powerline area are likely to occur at the terminal station site. Furthermore the report states that no rare or threatened species of fauna are considered likely to occur at the terminal station site due to the highly modified nature of the habitat. The peer review of the AMNES Report contained in the expert witness statement of Mr Smales (A47) agrees with the assessments in the AMNES Report.

20.8.2 Panel response to flora and fauna (FFG Act) and matters of national environmental significance

Given the condition of the proposed site, we agree with the Applicant’s assessment that the construction of the terminal station is unlikely to have any significant impact on species or communities under the EPBC Act and the FFG Act and will unlikely to lead to any loss of habitat of species listed under those Acts.

20.9 Additional bays

20.9.1 Submissions

In the conduct of the Panel Hearing the Applicant was asked why the plans for the terminal station depicted additional bays and whether this was contingency planning for future expansion of the wind farm. The Applicant advised (A220) that the terminal station had been designed to accommodate the connection of two 132 kV lines to the 500kV network. The Applicant further advised:

This layout was designed in consultation with the Transmission Network Services Provider (TSNP) SP Ausnet, who will own and operate the Shared Network Asset component of the Terminal Station upon completion of construction. The Shared Network Asset component will consist of a 500 kV bus bar and protection equipment to allow the connection of the SHWF 132 kV lines (and transformers). As the terminal station will form part of SP AusNet’s assets, it has required that additional bays on the 500 kV bus are constructed to allow for any future connection or expansion of the electricity network.
As the terminal station was designed for a connection of two 132 kV lines and the additional bays were a requirement of SPAusNet, the Applicant advised it would be satisfied with a permit with the additional bays deleted.

20.9.2 Panel response on additional bays

We note that the additional substation bays in the terminal station are not required for this proposal. However, we note that the PPARTS indicates that the terminal station is intended to reticulate power produced from various energy generator sources. Furthermore, the Applicant previously indicated that the additional bays are to allow for any future connection or expansion of the electricity network. We have previously indicated our support for Corangamite Shire’s proposal for co-location of infrastructure and as such we consider the additional bays should be constructed as proposed in the PPARTS to allow for this eventuality in the future.

20.10 Traffic management

20.10.1 Evidence

A desk top assessment of the traffic considerations was provided in Annex I of the Terminal Station PPAR. The significant additional traffic will be predominately generated during the construction phase. The assessment indicates that:

- The construction phase will include activities such as transport of materials and equipment to the site, civil works for access track construction, excavation for footings and trenching for cables, installation of transformers using large mobile cranes, construction of power reticulation lines and cables;
- Over-dimensional vehicles would be used for the carriage of the major components, for example the two transformers and the movement of large cranes;
- Forecast traffic volumes for the construction phase are not known;
- The traffic volume generated from the operational phase will be low;
- While permanent access to the site is proposed to be off Four Tree Road, the exact routes to be used by construction traffic have not been determined; and
- The potential feeder roads that could be used to access the site are all one lane wide and are unsealed apart from Lower Darlington Road which is sealed. Of the sealed VicRoads arterial roads identified as possible access routes, all are one lane each way other than Foxhow Road which is one lane in total.
The assessment indicated that a route access plan would need to be developed to provide guidance on the most suitable route to transport materials and the large equipment during the construction phase of the terminal station. This would be incorporated into a Traffic Management Plan to be developed in consultation with Corangamite Shire Council and VicRoads.

20.10.2 Panel response on traffic management

Given the limited nature of the desk top assessment of traffic as presented to us, we are not able to fully assess the traffic implications arising out of the construction phase of the terminal station. It is clear that regardless of the access route chosen, feeder road upgrading will be necessary for the construction phase. We agree that the preparation of a Traffic Management Plan is essential and we expect that Council as a representative of the local community will ensure that local concerns are fully considered in the plan. We expect that the plan would address, but would not be limited to:

- Development of a route access plan (and operating times) and the additional traffic volumes (standard axle loads) to be generated by the construction phase;
- Pre-construction evaluation of route access road condition;
- Safety issues associated with bus routes and the railway level crossing;
- Load limits on structures, sight distances and turning at intersections particularly for over-dimensional vehicles; and
- Road access upgrades for road works relating to the terminal station construction.

Given the location of the terminal station site in close proximity to the Hamilton Highway and it’s relative isolation from other traffic, we are satisfied that the Traffic Management Plan will provide an appropriate mechanism for the implementation and enforcement of traffic management issues associated with the terminal station. Particular consideration will need to be given to the safety arrangements associated with the rail crossing.

20.11 Other matters

We note that land and water management issues associated with construction and operation will be addressed in accordance with a Construction and Operational EMP. We also note that the terminal station compound will be a level site and a concrete bund will be constructed to provide containment in the event of oil spillage together with an oil/water separator to remove traces of oil from stormwater collected in the bund.
20.12 Recommendations

The Panel recommends that:

The noise emissions from the terminal station should be re-assessed in the process of selecting the final equipment such that the noise limits do not exceed or are less than 32dBA at the nearest dwelling with a 5dBA adjustment for tonality. We also recommend that sound mitigation measures should be implemented if required.

We agree with the co-location of wind farm infrastructure as far as possible and we recommend that the Minister give consideration to encouraging this through the amendment of the Guidelines.
PART E:
OVERALL COMMENTS AND RECOMMENDATIONS

21. Overall conclusions and consolidated recommendations

The Panel has considered the extensive submissions and evidence presented in relation to the three related Applications for the Stockyard Hill Wind Farm, the external powerline proposed to connect it to the existing national electricity grid and the terminal station at Berrybank.

More than 300 written submissions were received in response to public notice of the Applications; in excess of 50 presentations were made at the Panel hearing; and over 200 exhibits were placed before us, including three books. Some of the evidence presented has to our knowledge been more in depth than in previous wind farm hearings (at least before panels in Victoria): no less than six experts gave tested evidence relating to wind farm noise, some in relation to the public health effects of that noise; seven experts presented on the impacts of the wind farm on the heritage significance of Mawallok house and garden; competing evidence was called on visual impacts. In an effort to better understand aspects of the voluminous evidence and submissions, we made over four days of site inspections.

We have as a consequence produced a rather lengthy report covering the issues.

We identified during the hearing that there were a number of aspects of the background research in relation to this project that were not satisfactorily undertaken and we required some investigations to be redone following identification of flaws and missing inputs.

Overall we have concluded that the project should be permitted to proceed but only if it is made subject to some substantial modifications. Those modifications relate to the deletion of no less than 85 turbines and their associated accessways, reticulation lines and other infrastructure. Thirty of the turbines recommended for deletion as proposed by the Applicant to be deleted. The deletion of the turbines has principally arisen from consideration of impacts on Brolga and on the heritage significance of Mawallok. Some
others were voluntarily removed by the Applicant in light of submitters’ visual concerns and one was unconditionally removed. We have also imposed some new or recently developed conditions in relation to noise - some of which are likely to be viewed by the Applicant as demanding.

We are conscious in making our recommendations that the changes to the wind farm effected by the permit conditions are of major significance and might result in the project being abandoned or at least substantially revised. We make these recommendations conscious of the strong policy support for the development of wind energy facilities. However there are other policies required to be considered in assessing wind projects: many of them are referred to specifically in the Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria, 2009. In our view the recommendations strike the appropriate balance of policy – allowing an outcome of net community benefit and sustainable development.

Our overall recommendation is that all three permits: the wind energy facility permit (PL-SP/05/0548 under the Pyrenees Planning Scheme), the permit for removal of native vegetation for the external power line (P2009/105 under the Corangamite Planning Scheme) and the terminal station permit (P2009/104 under the Corangamite Planning Scheme) all should be granted subject to the recommended permit conditions set out in Appendix 4 and subject to the recommendations additional to permit conditions as set out below.

21.1 Consolidated recommendations

Please note that the recommendations below are listed in the order as they appear in the body of this report (according to Part and Section). Where a recommendation relates specifically to a permit condition it is highlighted in grey) shading.

Also the recommendations concerning permit conditions may have been slightly reworded on the draft permits themselves. The wording in Appendix 4 is to be preferred.

PART A: THE PROJECT AND ASSESSMENT CONTEXT

Section 2: What is proposed

A permit condition should be included on any permit granted that would require that the endorsed plan for the WEF permit should be generally consistent with the plan submitted to the Panel as Exhibit A202 subject also to the deletion of turbine T218 and such other changes as are recommended by the Panel.
A permit condition should be included on any permit granted for the WEF requiring that there be no turbine-mounted logos and the signage be confined to a single business identification sign and any as of right signs.

The Application for the WEF under the Pyrenees Planning Scheme should be amended or a separate application lodged for the removal of native vegetation for the external powerline in Pyrenees Shire and processed as required.

Section 5: The Applications and the Panel process

The adequacy of the notice of the WEF Application should be considered by the Minister and if necessary further notice given and submissions considered before the Application is finally determined.

PART B: THE WIND ENERGY FACILITY

Section 7: Aviation hazard lighting:

Aviation hazard lights should be prohibited by condition on any permit granted for the WEF.

Any subsequent application for aviation hazard lights should be made and processed under section 71 of the Act.

Should aviation hazard lighting need to be reconsidered at some time, technological developments that may be available, such as the capability to turn lights on only when needed (when an aircraft is detected in the vicinity), should be part of that assessment.

Section 8: Noise impacts:

With regard to noise sources and applicable standards:

A permit condition should be included on any permit granted that would require that the wind farm must comply with the noise levels recommended for non-stakeholder dwellings in the New Zealand standard NZ6808:1998 Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators, that is, at any of the nominated wind speeds, it must not exceed, at any residential site, the background sound level (L95) by more than 5dBA L95, or a level of 40dBA L95, whichever is the greater.
The Guidelines should be revised after close consideration of available methods and performance standards for wind farm noise to incorporate either NZS 6808:2010 or AS 4959:2010 with such additional material as is needed to provide for an unequivocal methodology for assessing noise from wind farms.

With regard to background noise measurements:

**Background noise curves must be re-determined.**

Prior to construction commencing a plan for revised background noise monitoring must be submitted to the Minister for Planning for approval. That revised plan may include background monitoring in stages if the wind farm is to be constructed in stages.

When approved by the Minister for Planning the revised background noise monitoring plan is to be made publicly available.

The revised plan must include noise monitoring at (subject to access being granted), or near, sufficient non-stakeholder dwellings for background noise measurements to accurately characterise the surrounding area and provide an adequate number of ‘representative’ sites. Not less than 20 non-stakeholder sites and a small number of stakeholder dwellings predicted to be exposed to higher noise levels must be included unless with the consent of the Minister.

Background noise monitoring data should be correlated with hub height wind speed at the nearest available anemometer that will be available for post construction noise monitoring.

A minimum of 4000 data points must be collected for each site and analysed by the regression technique of NZS 6808:1998 or ‘bin analysis’ as appropriate.

Data must be analysed by 24 hour and night (10 pm to 7am) only periods; and for each time sector data is to be analysed for wind directions of ± 45° of 0°, 90°, 180° and 270°.

The resultant background noise curves must be submitted to the Minister for Planning and made publicly available.

With regard to acceptable noise limits;

The derived acceptable noise limits of not exceeding a level of 5dBA L95 above the background noise level (L95) or 40dBA L95, whichever is
the greater, should be interpreted for non-stakeholder dwellings as referring to wind farm noise only.

At stakeholder dwellings the noise standard shall be that the noise level from the wind farm only shall not exceed, at any of the nominated wind speeds, the background sound level (L95) by more than 5dBA L95, or a level of 45dBA L95, whichever is the greater.

The acceptable noise limit curves should be submitted to the Minister for Planning, along with the background noise curves, and be made publicly available.

The procedure for the setting of noise limits for WEFs so as to better achieve the amenity objectives intended should be reviewed. This should include consideration of whether the standard if it is to regulate wind farm noise only requires review so as to ensure acceptable noise limits having regard to total environmental noise and attenuation to the interior of dwellings.

With regard to wind farm noise modelling:

The pre construction noise modelling should be repeated prior to construction commencing. That should compare predicted noise against the revised acceptable noise limit curves. If possible the noise characteristics of the selected turbine model should be used.

Prior to construction commencing the results of the noise modelling must be submitted to and approved by the Minister for Planning. That may include modelling by stages if the wind farm is to be constructed in stages.

When approved by the Minister for Planning, the noise modelling results should be made publicly available.

With regard to special audible characteristics:

Post construction, and coincident with the post construction noise monitoring, special audible characteristics should be assessed by a suitably qualified and experienced person.

The protocol for that assessment, the results, and any recommended noise penalty be advised to the Minister for Planning.

When approved by the Minister for Planning that the special audible characteristics assessment results be made publicly available.
With regard to post construction noise measurement:

Any permit granted should require that before development begins, the permit holder must submit to the Minister for Planning a detailed plan for post construction noise monitoring including by stages if development is to be completed in stages.

Post construction noise monitoring must be done as soon as practicable after the wind farm or any relevant stage of it is commissioned.

The permit holder must advise the Minister for Planning when the wind farm, and if relevant each stage of it, is commissioned ie. the date of first energy supply to the grid.

Noise monitoring should be carried out as soon as practicable after commissioning of the facility, or, if it is constructed in stages, after the commissioning of each stage.

Special audible characteristics should be assessed concurrently, and if found to be present the noise penalty added to the measured noise levels.

Within six months of commissioning of the wind farm or any relevant stage, the results of the monitoring must be submitted to the Minister for Planning for approval.

When approved by the Minister for Planning, the post construction noise monitoring results should be made publicly available.

With regard to compliance:

A statement of compliance should be submitted to the Minister for Planning with the post construction monitoring results.

If the results show non-compliance, the Minister for Planning should be provided with a detailed plan of how compliance is to be achieved and demonstrated within a period of no greater than 180 days and, when approved by the Minister for Planning, the plan should be made publicly available.

With regard to an active noise management system:

An active noise management system should be developed, refined and implemented.
The program for the development of that system and the stages in its development and application should be advised to the Minister for Planning and made publicly available.

With regard to final turbine selection:

When the permit holder selects the turbine model to be used, the noise predictions described in Section 9.5 and the modelling described in Section 9.8 of this report must be repeated and submitted to the Minister for Planning.

The noise modelling must show compliance with the recommended noise limits of NZS 6808:1998 for all existing non-stakeholder dwellings.

Re-assessment should be carried out by a suitably qualified noise expert with relevant experience who should be a member of an appropriate professional association that provides proficiency accreditation.

When approved by the Minister for Planning, the noise predictions and modelling should be made publicly available.

With regard to complaints:

A complaints system protocol should be developed that includes noise complaints. It should be submitted to the Minister for Planning for approval and when approved by the Minister for Planning, should be made publicly available.

With regard to construction noise:

A construction noise plan should be prepared as part of the Environmental Management Plan and submitted to the Minister for Planning for approval.

When approved by the Minister for Planning, the Environmental Management Plan should be made publicly available.

Section 9: Health impacts:

Health concerns should be addressed by rigid adherence to the recommended noise limits of NZS6808:1998; by making all reports of noise assessment publicly available; by developing an active noise management system to minimise noise, and thereby perceived health concerns; by putting in place a responsive noise complaints system;
and by offering visual screening on nearby properties for its benefits in reducing perceived health concerns.

A properly designed and professionally conducted epidemiological investigation funded by the government and the wind industry should be undertaken at wind farms where there have been health complaints to see if any physical factors might be identified that are common to those complaints and thereby similar circumstances minimised at the proposed Stockyard Hill Wind Farm and other WEFs.

As advised by the National Health and Medical Research Council, research outcomes should continue to be monitored that might lead to a better understanding of any impact of wind turbines on health.

Section 10: Flora and Fauna:

With regard to flora:

When routes are finalised under the Traffic Management Plan vegetation clearance associated with road access and upgrading be re-assessed and a further permit applied for if necessary.

With respect to the unused road reserve southeast of the Old Geelong Road, we recommend that the internal power line be located on adjacent private land and to avoid impacts on native vegetation. We also recommend that the small area of Plains Grassland along the internal power line route at the eastern end of Dunnets Road be avoided as suggested in the Flora and Fauna Assessment Report.

As a consequence of the seasonal influence on the identification of grassland remnants, further habitat assessment should be undertaken during pre-construction surveys. These must include areas outside previously identified remnant grassland that are likely to be disturbed during development as a precursor to targeted flora surveys.

The survey approach to identifying Natural Temperate Grassland of the Victorian Volcanic Plains remnants outlined in the Matters of National Environmental Significance peer review report (page 10) should be adopted in all preconstruction habitat surveys.

The precise location of wind farm infrastructure and any other associated infrastructure must be selected with the advice of a qualified botanist and zoologist and that areas that are to be avoided and not disturbed, must be clearly demarcated in advance of construction activities.
The mitigation measures to reduce further potential impacts on flora and native vegetation that are identified in Section 2.5 of the Flora and Fauna Assessment Report should be adopted.

Measures should be adopted in the Environmental Management Plan to manage the spread of invasive weeds as recommended by UMEC.

With regard to fauna other than Brolga:

As a consequence of the seasonal influence on the identification of grassland remnants, further habitat assessment should be undertaken during pre-construction surveys. These must include areas outside previously identified remnant grassland that are likely to be disturbed during development as a precursor to targeted fauna surveys.

The survey approach to identifying Natural Temperate Grassland of the Victorian Volcanic Plains remnants outlined in the Matters of National Environmental Significance peer review report (page 10) be adopted in all preconstruction habitat surveys.

Pre-construction surveys for threatened fauna should be undertaken to inform detailed design and micrositing including in areas of non-indigenous grassland linked to remnant native grassland habitat.

The precise location of wind farm infrastructure and any other associated infrastructure be selected with the advice of a qualified botanist and zoologist and that areas that are to be avoided and not disturbed, are clearly demarcated in advance of construction activities.

A comprehensive science-based bird and bat monitoring program should be developed. Threshold levels for bird and bat mortality should also be established for the wind farm and if exceeded agreed mitigation measures are to be put in place.

The development of a contingency turbine shut down protocol in the event of a major migration of shorebirds to and from Lake Goldsmith should be developed and implemented. Further, an evaluation of the likely effects of the wind farm on the Sharp-tailed Sandpiper is to be undertaken in accordance with EPBC Act Policy Statement 3.21.

With regard to Brolga:

The exemptions sought by the Applicant to home range buffering around wetlands 37, 39, 202 and 209 not be agreed and that turbine free buffers are to be applied to those wetlands as well as the others agreed
by the Applicant (as set out in Section 10.4.3 of the Panel report) in accordance with the Brolga guidelines and using the home range methodology described in the Flora and Fauna Assessment Report prepared by Brett Lane and Associates.

A comprehensive and accurate database of Brolga records should be maintained by DSE, incorporating appropriate custodial and reliability standards, and that an active management program of acquiring records from local landowner and community sources be implemented.

DSE should develop an independent capacity to undertake Brolga home range analysis of the type required, from time to time, by the Brolga guidelines.

A comprehensive science-based Brolga monitoring program should be implemented which incorporates a turbine shutdown protocol at a predetermined level of threat or when an unacceptable level of collisions occurs.

An independent technical advisory committee should be established to assist with the development and ongoing refinement of monitoring protocols.

A mitigation plan for Brolga should be prepared that includes a program of powerline marking and evaluation and also provides for a program to develop metrics to enable the assessment of the contribution of all mitigation measures that are proposed for implementation.

Section 11: Heritage and Mawallock

In any permit granted for the WEF, the 20 turbines visible within the central viewing cone from the Mawallock northern terrace, be required to be deleted that is turbines T32,35,36,38, 42 and 49 (already agreed by the Applicant); and turbines T5, 12, 13,14,15,17,18,21,23,25,26,28,29 and 31.

Section 12: Traffic

A Traffic Management Plan is to be developed and implemented.
Section 13: Greenhouse issues and energy output

Annual electricity production and estimated greenhouse gas abatement from the Stockyard Hill Wind Farm should be made publicly available.

Section 14: Fire

Conditions should be included on any permit granted for the WEF requiring the preparation of a Fire and Emergency Response Plan and incorporating the conditions recommended by CFA.

Section 17: Other issues

With regard to shadow flicker:

No turbines should be microsited so that shadow flicker on non-stakeholder dwellings and their immediate surroundings is increased.

The shadow flicker requirement in the 2009 version of the Guidelines be redrafted to make it unambiguous that, as with the 2003 version, it excludes stakeholder dwellings from the performance criterion.

The criterion for shadow flicker in the Guidelines should have a method of assessment developed including a means of determining compliance.

VicRoads be asked to develop a policy position on shadow flicker from wind farms on roads and any implications for road safety.

With regard to blade glint:

The turbine blades should be required by condition to have a non-reflective surface.

With regard to economic and social impacts:

No determination should be made on Pyrenees Planning Scheme Application PL-SP/05/0548 (wind energy facility) until a Cultural Heritage Management Plan or Plans for the amended proposal is approved that includes in part the final routes of the internal powerlines.

No determination should be made on Pyrenees Planning Scheme Application PL-SP/05/0548 (native vegetation removal) and any
application lodged for native vegetation under the Corangamite Planning Scheme for native vegetation removal for the external powerline until a Cultural Heritage Management Plan or Plans covering native vegetation removal along the final routes of the external powerlines is approved.

The recommendations made in the 2008 report by Tardis Enterprises Pty Ltd for the avoidance of adverse impacts on the significance of places of cultural heritage on the wind farm site should be implemented where not inconsistent with the Cultural Heritage Management Plan.

With regard to air safety:

Should the proposal proceed to construction that the then permit holder should notify the Civil Aviation Safety Authority and the Department of Defence of the location and nature of the facility.

If constructed, the permit holder should notify local and regional users of the airspace of the facility.

With regard to decommissioning:

Amend the Draft Permit condition relating to decommissioning to require the submission of a WEF Decommissioning Plan no later than 6 months after notice of the cessation of generation has been lodged or, except with the written consent of the Minister for Planning, when turbines have not operated for a continuous period of 12 months.

Evaluate the merits of establishing a policy for a WEF decommissioning guarantee to cover infrastructure removal and site rehabilitation for wind turbines, electrical transfer stations, and meteorological masts following decommissioning and according to trigger points written into the WEF Decommissioning Plan.
PART C: VEGETATION REMOVAL FOR THE POWER LINE

Section 19: Vegetation removal for the powerline

As a consequence of the seasonal influence on the identification of grassland remnants, we recommend that further habitat assessment and checking be undertaken during pre-construction surveys, including areas outside the previously identified remnant grassland areas, that are proposed for disturbance by the development, as a precursor to targeted surveys.

The survey approach to identifying NTGVVP that is outlined in the NES peer review report (page 10) be adopted for pre-construction surveys.

A map of areas of native vegetation to be cleared along the powerline route be prepared in conjunction with DSE prior to construction commencing.

PART D: TERMINAL STATION

Section 20: Terminal station

The noise emissions from the terminal station should be re-assessed in the process of selecting the final equipment such that the noise limits do not exceed or are less than 32dBA at the nearest dwelling, with a 5dBA adjustment for tonality. We also recommend that sound mitigation measures should be implemented if required.

We agree with the co-location of wind farm infrastructure as far as possible and we recommend that the Minister give consideration to encouraging this through the amendment of the Wind Energy Guidelines.