

In the matter of the Berrybank Wind Farm

Planning Panels Victoria

Proponent: Berrybank Development Pty Ltd

**Expert Witness Statement of  
Keith Tonkin**

100402-03 Berrybank Wind Farm Expert Report – Obstacle Lighting

Expert of Berrybank Development Pty Ltd

## 1. NAME AND ADDRESS

My name is Keith Neil Tonkin. I am the Principal Consultant and Managing Director of Aviation Projects Pty Ltd.

My address is 19/200 Moggill Road, Taringa, Queensland 4068.

## 2. QUALIFICATIONS AND EXPERIENCE

**Annexure A** contains a statement detailing my qualifications and expertise and addressing the matters set out within Planning Panels Victoria's Guide to Expert Evidence.

My Curriculum Vitae is provided at **Annexure B**.

## 3. SCOPE

### 3.1. Role in preparation of the Amendment Application

- 3.1.1. My firm, Aviation Projects, was responsible for the preparation of the report titled '100402-02 Aeronautical Impact Assessment Berrybank Wind Farm', dated 22 February 2016, which was submitted by Berrybank Development Pty Ltd as part of its Amendment Application.
- 3.1.2. My role in the preparation of the report was to provide overall supervision and direction of the authoring and production task, provide relevant input based on my knowledge of the project and risk management context, and take responsibility for releasing the document on behalf of Aviation Projects Pty Ltd.

### 3.2. Instructions

- 3.2.1. My instructions to prepare this witness statement are set out in **Annexure A**.

### 3.3. Process and methodology

- 3.3.1. In preparing this report, I have:
  - a) reviewed the relevant planning documents;
  - b) reviewed publicly available material as noted;
  - c) reviewed the submissions; and
  - d) provided my opinion about the various matters set out in my Instructions.
- 3.3.2. Additional documents provided in the letter of instruction and references used to inform this report are listed in **Annexure A**.

### 3.4. Acronyms

ADLS	Aircraft Detection and Lighting System
ATSB	Australian Transport Safety Bureau
CASA	Civil Aviation Safety Authority
FAA	Federal Aviation Administration (of the United States of America)
IFR	Instrument Flight Rules
MOS	Manual of Standards
NASF	National Airport Safeguarding Framework
NTSB	National Transportation Safety Bureau
RPT	regular public transport
VFR	Visual Flight Rules

## 4. FINDINGS

### 4.1. Summary of opinions

- 4.1.1. I have reviewed '100402-02 Aeronautical Impact Assessment Berrybank Wind Farm' report in preparing this expert witness statement.
- 4.1.2. Save where otherwise indicated I adopt the '100402-02 Aeronautical Impact Assessment Berrybank Wind Farm' report as the basis of my evidence before Planning Panels Victoria.
- 4.1.3. My conclusions can be summarised as follows:
- a) The Civil Aviation Safety Authority (CASA) has recommended low intensity, steady red obstacle lighting at night, although it has not determined that the wind turbines will be hazardous objects without obstacle lighting;
  - b) CASA has provided a recommendation, rather than a specific requirement, because it does not have the regulatory authority to impose such a requirement;
  - c) I remain of the view that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Berrybank Wind Farm; and
  - d) In the event that obstacle lighting is required, an appropriate solution has been provided.

### 4.2. Any additional work undertaken since submission of Amendment Application

- 4.2.1. Since the Amendment Application was submitted, I have been involved in the preparation of several other aviation impact assessments for wind farms with a similar planning and regulatory context. In the course of this work, I have identified additional information that serves to better inform the decision about the need for obstacle lighting.
- 4.2.2. The need for obstacle lighting has been considered according to the applicable rules of flight and time of day, as set out in sub-section 4.3, and a summary of accident statistics relevant to the risk management context is provided in **Annexure D**.
- 4.2.3. Further to this additional information, my findings in relation to the issues nominated in my letter of instruction are documented later in this section.

### 4.3. CASA recommendation regarding obstacle lighting

- 4.3.1. CASA has recommended steady red low intensity lighting at night as per Section 9.4 of MOS 139.

### 4.4. Technical requirement for obstacle lighting

- 4.4.1. National Airport Safeguarding Framework (NASF) Guideline D 'Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers' infers that a

distance of 30 km defines the concept of 'within (or not within) the vicinity of an aerodrome', which is used to inform consideration of the hazard posed by wind farms.

- 4.4.2. There are no registered or certified aerodromes within 30 km of the wind farm site.
- 4.4.3. NASF Guideline D provides the following guidance regarding the lighting for wind turbines not in the vicinity of an aerodrome with a height of 150 m or more:

*33. Where a wind turbine 150m or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment.*

*34. The risk assessment, to be conducted by a suitably qualified person(s), should examine the effect of the proposed wind turbines on the operation of aircraft. The study must be submitted to CASA to enable an assessment of any potential risk to aviation safety. CASA may determine that the proposal is:*

*(a) hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or*

*(b) not a hazard to aircraft safety.*

- 4.4.4. The consideration of whether or not an object "is, or will be, a hazardous object because of its location, height or lack of marking or lighting", stems from Civil Aviation Safety Regulation (1998) 139.370.

- 4.4.5. On 20 October 2015 a letter that included a draft of the '100402-02 Aeronautical Impact Assessment Berrybank Wind Farm' report was addressed by Aviation Projects to Mr Dilip Mathew (Manager Aerodromes of CASA), seeking CASA's position in relation to the proposed development, with specific reference to potential aviation impacts. On 19 February 2016, Mr Mathew responded in a letter to Mr Michael Juttner (Senior Planner, Department of Environment, Land, Water and Planning). An extract of the correspondence is copied below:

*"CASA recommends that the wind farm is lit with steady red low intensity lighting at night as per Section 9.4 of the CASA Manual of Standards Part 139. Characteristics for low intensity are stated in subsection 9.4.6.*

*CASA agrees that the turbines that should be lit are those identified in the drawing '100402-02 Berrybank Wind Farm Obstacle Lighting Design v0.3 151019'.*

*CASA recommends that the proponent makes the notifications described in the NASF Guideline D."*

- 4.4.6. It is noteworthy that CASA, in its letter dated 19 February 2016, did not determine that the proposed development will be 'hazardous'.
- 4.4.7. It is my understanding that CASA has provided a recommendation, rather than a specific requirement, because it does not have the regulatory authority to impose such a requirement.
- 4.4.8. Aircraft can be operated under either instrument flight rules (IFR) or visual flight rules (VFR) and either during the day or at night. A simple breakdown of the scopes of operation and extent of the obstacle lighting issue is provided at Table 1.

Table 1 Scope of operation and extent of issue

<i>Scope of operation</i>	<i>Visual Flight Rules</i>	<i>Instrument Flight Rules</i>
<b>Day</b>	CASA recommended obstacle lighting at <u>night</u> (not during the day). <b>Conclusion: Obstacle lighting not applicable.</b>	CASA recommended obstacle lighting at <u>night</u> (not during the day). <b>Conclusion: Obstacle lighting not applicable.</b>
<b>Night</b>	CASA did not find that the proposal was hazardous and that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking.  Due the requirement to fly at least 1000 ft above the highest obstacle within a specified horizontal distance from the planned track, aircraft operating under the VFR at night will not be affected providing that the location and heights of the wind turbines are published on aeronautical charts. <b>Conclusion: No requirement for obstacle lighting.</b>	CASA did not find that the proposal was hazardous and that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking.  Due the requirement to fly at least 1000 ft above the highest obstacle within a specified horizontal distance from the planned track, aircraft operating under the IFR at night will not be affected providing that the location and heights of the wind turbines are published on aeronautical charts. <b>Conclusion: No requirement for obstacle lighting.</b>

4.4.9. If the locations and heights of the wind turbines are published in aeronautical documentation, since aircraft are required to maintain a minimum vertical separation from obstacles at night whether operating under the visual or instrument flight rules, there is no need to have obstacle lighting on the wind turbines.

4.4.10. Notwithstanding the recommendation of CASA in its letter dated 19 February 2016, I remain of the view that obstacle lighting is not required on the wind turbines of Berrybank Wind Farm to provide an acceptable level of aviation safety. This view has been formed based on the detailed and thorough risk assessment documented in the '100402-02 Aeronautical Impact Assessment Berrybank Wind Farm' report, and my subsequent further enquiries.

#### 4.5. Aviation obstacle lighting for other Victorian wind farms

4.5.1. I am not aware of any other wind farms in Victoria that have operational obstacle lighting systems.

4.5.2. My recent experience is that CASA's determinations have been inconsistent in the justification of and recommended arrangements regarding obstacle lighting on wind farms in Victoria.

#### 4.6. Aviation obstacle lighting design

4.6.1. In the event that obstacle lighting is required, the design that has been proposed is documented in Recommendations 7-9 of the '100402-02 Aeronautical Impact Assessment Berrybank Wind Farm' report. These recommendations are copied below.

*“7. If obstacle lighting is required (for example, as a requirement of CASA), obstacle lighting would be installed on the following 35 turbines: 1, 3, 9, 12, 14, 15, 18, 20, 21, 23, 31, 36, 39, 42, 44, 45, 46, 48, 52, 55, 61, 62, 66, 67, 72, 73, 75, 80, 82, 84, 86, 88, 93, 99 and 100.*

*8. If obstacle lighting is required (for example, as a requirement of CASA), the wind turbines should be lit with steady red low intensity lighting at night as per MOS 139 Section 9.4, while minimising visual impact. To ensure the ongoing availability of obstacle lights (if required), a monitoring, reporting and maintenance program should be established in accordance with the guidance in MOS 139 Section 9.4.10.*

*9. Department of Defence requested that if LED lighting is used for obstacle lighting, then emitted light should fall within the wavelength range of 655 to 930 nanometres for night vision devices compatibility.”*

4.6.2. Proposed amended Conditions 8 b) and 8 c) reflect the guidance (example permit condition 27) published in the Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria, January 2016, with the following exceptions:

- a) The guideline specifies medium intensity, flashing red obstacle lighting whereas amended condition 8 b) specifies low intensity, steady red obstacle lighting; and
- b) The guideline specifies that the light spread below the horizon (for medium intensity obstacle lighting) must be restricted to not more than 1.0 degree, whereas amended condition 8 c) (ii) limits the light spread to 0.5 degrees below the horizon and is applicable to low intensity, steady red obstacle lighting.

4.6.3. Paragraph 9.4.3.4A (e) of MOS 139 sets out the limits on the downward component of obstacle lighting, noting that medium intensity obstacle lighting is specifically referenced in the introductory sentence:

*(e) the downward component of obstacle lighting may be shielded to the extent mentioned in either or both of the following sub-subparagraphs:*

*(i) so that no more than 5% of the nominal light intensity is emitted at or below 5° below horizontal;*

*(ii) so that no light is emitted at or below 10° below horizontal;*

4.6.4. Strict accordance with MOS 139 Section 9.4 as per proposed amended Condition 8 b) conflicts with preferred proposed amended Condition 8 c) (ii).

4.6.5. In the absence of any justification for the differing guidance in example permit condition 27 of the Victorian Guidelines, the MOS 139 specification regarding shielding should be complied with.

## **4.7. Appropriate permit condition for amended planning permits**

4.7.1. I have reviewed the recently amended planning permits for Mortlake South Wind Farm (notably Conditions 6-8) and Woolsthorpe Wind Farm (notably Condition 36).

4.7.2. The following aspects of the permit conditions for Mortlake South Wind Farm are highlighted:

- a) The maximum permitted overall height for the wind turbines at Mortlake South Wind Farm is 186 m above natural ground level;
- b) Aviation obstacle lighting is not permitted unless the written consent of the Minister for Planning has been obtained. If such consent has been obtained, then the obstacle lighting must meet specified requirements;
- c) According to Condition 8 a), in the first instance, the aviation obstacle lighting must be activated at night when an aircraft is in the immediate vicinity of the wind energy facility and during low visibility daytime conditions, unless the technology that enables these requirements to be met is not proven or available;
- d) Condition 8 c) specifies obstacle lighting must be medium intensity flashing red and that the vertical spread of light is to be restricted to not more than 3 degrees and light spread below the horizontal to not more than 1.0 degree; and
- e) Condition 8 f) allows CASA to recommend the ambient light conditions under which the lights are to switch on and off.

4.7.3. The following aspects of the permit conditions for Woolsthorpe Wind Farm are highlighted:

- a) The maximum permitted overall height for the wind turbines at Woolsthorpe Wind Farm is 168 m above natural ground level;
- b) The permit conditions do not specifically exclude or require obstacle lighting, but if such lighting is installed, it must meet specified requirements;
- c) Condition 9 b) specifies that each light shall be to the specification as defined by CASA, and the vertical spread of light is to be restricted to no more than 5% of the nominal light intensity at or above and below 5 degrees above and below horizontal, and such that no light is emitted at or above and below 10 degrees above and below horizontal;
- d) Condition 9 c) specifies the lights are to switch on and off at times or ambient lighting conditions as directed by CASA; and
- e) Condition 36 requires that written evidence must be provided to the Minister for Planning that satisfies the Minister that the wind energy facility structures and any night lighting are sited and designed in accordance with any applicable CASA code or regulation.

4.7.4. The conditions applicable to obstacle lighting at the two wind farms are different to each other and to those proposed for Berrybank Wind Farm.

4.7.5. If obstacle lighting is required on the wind turbines of Berrybank Wind Farm, the proposed amended Condition 8 will be satisfactory, subject to the changes proposed at sub-section 4.9.

## 4.8. Condition 8 – ‘on demand aviation obstacle lighting’

4.8.1. The proposed amended Condition 8 removes the requirement to have aviation lighting activated only, if at night, when an aircraft is in the immediate vicinity of the wind energy facility. This sub-

section explains the concept of ‘on demand aviation lighting’ and the potential difficulties associated with implementing such a requirement.

- 4.8.2. A Wind Energy Facility Panel was appointed under Section 97E, 153 and 155 of the Planning and Environment Act 1987 to consider submissions and make recommendations to the Minister for Planning. The Panel released a report titled Berrybank Wind Energy Facility dated May 2010. With respect to obstacle lighting, 10.1.3 of the report noted the following conclusions and recommendation:

*The Panel concludes that ‘all-night’ aviation obstacle lighting is unnecessary and an unacceptable impost on the regional community. If the aviation regulatory authority or other body requires aviation obstacle lighting then it should only be illuminated on demand, whether in the detected presence of aircraft or in low visibility daytime situations (fog or smoke).*

*The Panel recommends:*

*27. Aviation obstacle lighting of the Berrybank Wind Farm should in the first instance be prohibited via condition, and only allowable via secondary consent on the basis of ‘on demand’ illumination.*

*The Panel has recommended a draft condition accordingly.*

- 4.8.3. Condition 7 of the subsequent planning permits is as follows:

*“Aviation obstacle lighting must not be installed unless the written consent of the Minister for Planning has been obtained.”*

- 4.8.4. Condition 8 of the subsequent planning permits is as follows:

*“If consent to install aviation lighting is obtained, it must be installed under the following conditions:*

- a) *The aviation obstacle lighting must be installed such that it is activated only:
  - i. *if at night, when an aircraft is in the immediate vicinity of the wind energy facility; and*
  - ii. *during low visibility daytime conditions such as the existence of smoke and fog;**
- b) *for each lit turbine, the lighting must consist of a pair of lights mounted above the nacelle so that one is visible from an aircraft approaching from any direction;*
- c) *each light must be a red medium intensity, flashing light as defined by Civil Aviation Safety Authority (CASA); each light must be shielded so as to restrict the vertical spread of light to not more than 3 degrees and light spread below the horizontal to not more than 1.0 degree;*
- d) *all lights must flash in unison;*
- e) *the duration of the light flash must be the minimum period recommended by CASA and the duration of the period between flashes must be the maximum period recommended by CASA;*

f) *before the wind farm is commissioned, a lighting maintenance plan must be prepared to the satisfaction of the Minister for Planning.*

4.8.5. NASF Guideline D at paragraph 38 incorporates a one-paragraph discussion of the concept of 'on-demand aviation obstacle lighting systems':

*"In some circumstances, it may be feasible to install obstacle lights that are activated by aircraft in the vicinity. This involves the use of radar to detect aircraft within a defined distance that may be at risk of colliding with the wind farm. When such an aircraft is detected, the wind farm lighting is activated. This option may allow aviation safety risks to be mitigated where obstacle lighting is recommended while minimising the visual impact of the wind farm at night."*

4.8.6. To my knowledge there are no wind farms in Australia equipped with on-demand aviation obstacle lighting systems.

4.8.7. In October 2016, the Federal Aviation Administration (FAA) of the United States of America (USA) published a revised Advisory Circular (AC) AC 70/7460-1L CHG1 – Obstruction Marking and Lighting. Chapter 14 of this AC provides general standards for Aircraft Detection Lighting Systems (ADLS). Such a system generally comprises a primary surveillance (non-cooperative) radar, controller units and a communications network.

4.8.8. To my knowledge Laufer Wind is the only organisation approved by the FAA to operate an ADLS, according to the general standards published in AC AC 70/7460-1L, in the USA. According to a Laufer Wind press release, this approval was secured in late 2016. According to the White Paper published by Laufer Wind on the subject in March 2016, the trial system experienced 'lights-off' approximately 98% of the time, and demonstrated an acceptable level of reliability.

4.8.9. I am aware that Terma, a Danish company, operates a similar system in Europe and has experienced 'lights-off' approximately 96-97% of the time. The system has a range of approximately 25 km, and is able to resolve interference caused by wind turbines such that it can identify targets that are operating in close proximity to wind turbines.

4.8.10. A system appropriate to the size and scale of the Berrybank Wind Farm would cost in the order of approximately \$500,000 to \$1,000,000. The operator would need to secure approval from the Australian Communications and Media Authority (ACMA) to operate the radar (transmit a radio frequency). The actual operation of the ADLS would likely require CASA approval (as per the FAA model), but there is no published guidance on which to rely for the purposes of seeking this approval.

4.8.11. In the circumstances, incorporation of an ADLS in the permit conditions would limit the potential for visual impact arising from an obstacle lighting system, but may be costly and difficult to implement in the short term.

## 4.9. Amended Planning Permit Conditions

4.9.1. I have reviewed the draft amended planning permit conditions relevant to Berrybank Wind Farm obstacle lighting, and suggest minor changes to Condition 8 a) and 8 c) as set out in Table 2.

Table 2 Amended planning permit conditions

<i>Proposed condition</i>	<i>Recommended Condition</i>	<i>Reason for Modification</i>
<p>Condition 8.</p> <p>Obstacle lighting for aviation safety must meet the following requirements, to the satisfaction of the Minister for Planning:</p> <p>a) The number of lit turbines are kept to the minimum required, and generally in accordance with the Obstacle Lighting Design V0.3 151019 included in the 'Berrybank Wind Farm Aeronautical Impact Assessment' (Ref. 100402-02 V1.0 dated 22 February 2016) prepared by Aviation Projects. The lighting design herein is subject to confirmation of the final turbine layout as any changes to the layout could potentially affect which turbines should be lit in accordance with the 900 metres interval consideration such that the wind farm is not declared a hazard to aviation.</p>	<p>Condition 8.</p> <p>Obstacle lighting for aviation safety must meet the following requirements, to the satisfaction of the Minister for Planning:</p> <p>a) The number of lit turbines are kept to the minimum required, and generally in accordance with the Obstacle Lighting Design V0.3 151019 included in the 'Berrybank Wind Farm Aeronautical Impact Assessment' (Ref. 100402-02 V1.0 dated 22 February 2016) prepared by Aviation Projects. The lighting design herein is subject to confirmation of the final turbine layout as any changes to the layout could potentially affect which turbines should be lit in accordance with the 900 metres interval consideration <del>such that the wind farm is not declared a hazard to aviation.</del></p>	<p>The wind farm has not been declared a hazard to aviation.</p>
<p>Condition 8</p> <p>c) The impact minimisation features allowed that should be installed including, but not limited to:</p> <p>(i) Treatment of the rear of the blade to avoid reflection of aviation lights; and</p> <p>(ii) Shielding of the lights on the top and bottom such that the maximum intensity of light is limited to a beam of 3 degrees, with only 0.5 degrees of this beam width below the horizon.</p>	<p>Condition 8</p> <p>c) The impact minimisation features allowed that should be installed including, but not limited to:</p> <p>(i) Treatment of the rear of the blade to avoid reflection of aviation lights; and</p> <p>(ii) Shielding of the lights on the top and bottom <del>such that the maximum intensity of light is limited to a beam of 3 degrees, with only 0.5 degrees of this beam width below the horizon as</del> allowed for in Section 9.4 of MOS 139 (or equivalent standard, as amended from time to time).</p>	<p>Resolves the ambiguity between draft amended Conditions 8 b) and 8c) and brings the recommendation into line with the relevant aviation safety specification.</p>

**4.10. Response to Submissions**

4.10.1. I have reviewed the following submissions which raise issues concerning Berrybank Wind Farm obstacle lighting: submissions 5 and 8.

4.10.2. My detailed response to the matters raised in these submissions is set out in **Annexure C**.

**4.11. Accident statistics**

4.11.1. Additional aviation accident data that serves to inform the analysis and recommendations provided in this report is provided in **Annexure D**.

## 5. DECLARATION

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.



Keith N Tonkin

03 November 2017

## ANNEXURE A – RESPONSE TO PPV GUIDE TO EXPERT EVIDENCE

### Expert's qualifications

Keith Tonkin is the Managing Director and Principal Consultant of Aviation Projects. Keith has spent nearly 30 years in the aviation industry, starting out as a pilot first in the military and then as an international and domestic airline pilot with Qantas. Since then, Keith has applied his knowledge of flying and airport operations to the task of planning and implementing airport-related projects and aviation safety matters. Keith has the ability to think critically and formulate and articulate arguments based on relevant knowledge and understanding of key issues, enabling the development and implementation of practical solutions to complex problems.

### Qualifications and Accreditations

- Master of Business Administration (Aviation Management) – RMIT University
- Certified Practising Risk Manager – Risk Management Institution of Australasia
- Bachelor of Science – UNSW ADFA
- Graduate Certificate of Spatial Science Technology (Surveying) – University of Southern Queensland
- Advanced Diploma of Aviation (RAAF)
- CASR Part 139 approval to conduct Safety Inspections at Registered and Certain other aerodromes
- Quality/Safety Lead Auditor (Southpac Aerospace)
- WH&S Officer (QLD), WH&S Representative (NSW) and Rehab Return to Work Coordinator (QLD)

### Licenses/Endorsements

- Air Transport Pilot (Aeroplane) - ARN 419433
- MECIR B737-300 to 800 Command Class Endorsement

### Professional associations

- Risk Management Institution of Australasia – Member
- Aviation Law Association of Australia and New Zealand – member
- Australian Airports Association – corporate member
- Australian Airports Association – member of the Planning Working Group

**Employment history and achievements**

Aviation Projects Pty Ltd	December 2003 until present
	Managing Director and Principal Consultant
Qantas Airways Ltd	January 2001 until July 2009
	B747 Second Officer and B737 First Officer
	WHSO Brisbane B737 Base
RAAF	January 1986 until January 2001
	No 151 Pilots Course
	38 SQN – Caribous
	25 and 76 SQN – Intro Fighter Course
	1 and 6 SQN – F/RF-111C
	82WG – F-111 Aircrew Standards Officer

**Aeronautical Experience**

- Military – CT4-A, MB326-H, DHC-4, F-111
- Civil – B737-300 to 800 (First Officer), B747-200/300 (Second Officer)
- General Aviation – DH-82, C152/172, B55/58 Baron/Travelair, PA-43 Seneca, S2-A Pitts Special
- Total hours: 7371.8
- Command hours: 1387.8

## Expertise to make report

Aviation Projects has recently been involved in the following relevant projects:

<i>Project</i>	<i>Status</i>	<i>Description</i>
Berrybank Wind Farm, Vic	Approved	Consideration of issues associated with an aeroplane landing area within the wind farm site
Biala Wind Farm, NSW	Planning approval process	Aeronautical Impact Assessment with risk assessment and lighting design
Coopers Gap WF	Approved	Aeronautical lighting design to comply with planning permit
Crookwell 2 Wind Farm, NSW	Approved	Obstacle lighting risk assessment
Crookwell 3 Wind Farm, NSW	Planning approval process	Aeronautical Impact and Night Lighting Assessment
Dundonnell Wind Farm, Vic	Approved	Aeronautical Impact and Night Lighting Assessment
Gullen Range Wind Farm, NSW	Operational	Assessment of impacts on flying operations at Crookwell Aerodrome, including stakeholder consultation, advice on request for further information and provision of an obstacle survey and aerodrome safety inspection. Advice regarding requirement for night lighting in support of due diligence activities. Assistance with implementation of Statement of Commitments prior to construction. Statement of Impact re conditions of approval.
Hawkesdale Wind Farm, Vic	Approved	Obstacle lighting risk assessment
Jupiter Wind Farm, NSW	Planning approval process	Aeronautical Impact Assessment with obstacle lighting risk assessment and lighting design
Kennedy Energy Park Wind Farm, QLD	Approved	Project management of aviation impact issues including Aeronautical Impact Assessment with obstacle lighting risk assessment and lighting design
Lakeland Wind Farm, QLD	Preliminary	Preliminary Aviation Assessment with a summary overview of the initial analysis on possible constraints to development and applicable high-level risk mitigation options
Lincoln Gap Wind Farm, SA	Approved	Aeronautical Impact Assessment with obstacle lighting risk assessment

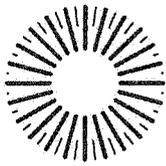
<i>Project</i>	<i>Status</i>	<i>Description</i>
Moorabool WF, Vic	Approved	Increase tip height and obstacle lighting risk assessment
Morton's Lane Wind Farm, Vic	Approved	Obstacle lighting risk assessment
Paling Yards Wind Farm, NSW	Planning approval process	Aeronautical Impact and Night Lighting Assessment
Ryan Corner Wind Farm, Vic	Approved	Obstacle lighting risk assessment
Salt Creek Wind Farm, Vic	Approved	Obstacle lighting risk assessment
Silverton Wind Farm - NSW	Approved	Assistance with initial obstacle lighting assessment
Waterloo 2 Wind Farm, SA	Approved	Aviation Impact Assessment
White Rock Wind Farm, NSW	Under construction	Aeronautical Impact Assessment with obstacle lighting risk assessment
Yaloak South Wind Farm, Vic	Planning approval process	Obstacle Lighting and Aviation Risk Assessment
Yass Valley Wind Farm, NSW	Approved	Obstacle Lighting and Aviation Risk Assessment

Relevant expert witness experience

<i>Matter</i>	<i>Description</i>
<b>Silverdale Airpark</b>	Aviation Expert – QLD Planning and Environment Court
<b>Gullen Range Wind Farm</b>	Aviation Expert – NSW Land and Environment Court
<b>Tungamull Airstrip</b>	Aviation Expert – QLD Planning and Environment Court
<b>Parklands Blue Metal</b>	Aviation Expert – QLD Planning and Environment Court
<b>Carrigan Helicopter Landing Site</b>	Aviation Expert – QLD Planning and Environment Court
<b>Old Bar Ferris Wheel</b>	Aviation Safety and Risk Management Expert – NSW District Court
<b>Port Macquarie Runway Defects</b>	Aviation Safety and Compliance Expert – to inform the owner about options to resolve identified issues
<b>Gold Coast Airport ILS</b>	Aviation Safety and Risk Management Expert – Administrative Appeals Tribunal
<b>Yeeha Tours &amp; Holidays</b>	Aviation Expert – QLD Civil and Administrative Tribunal
<b>Compost Works</b>	Aviation Expert – QLD Planning and Environment Court

**Instructions to prepare report**

A copy of the letter of instruction is provided after this page.



Keith Tonkin  
Managing Director – Aviation Expert  
Aviation Projects  
ktonkin@aviationprojects.com.au

11 September 2017  
Matter 82462501  
By Email

Dear Mr Tonkin

Confidential and Privileged

## **Berrybank Wind Farm Engagement of Expert Witness**

We are acting as legal advisors to Berrybank Development Pty Ltd in connection with the Berrybank Wind Farm, and specifically the following applications:

- application to amend the existing planning permit 20092821 relating to land within the Corangamite Shire; and
- application to amend the existing planning permit 20092820 relating to land within the Golden Plains Shire,

which make up the Berrybank wind farm, together, the **Amendment Applications**.

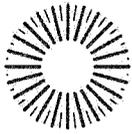
We are instructed that development of the wind farm has commenced under the relevant permit, in accordance with endorsed plans as required under the conditions of each permit.

### **1 Background**

The Amendment Applications include a number of changes to the existing planning permits including:

- (a) Amend condition 2 of each permit to provide a more comprehensive secondary consent and micro-siting power;
- (b) Amend the specifications set out in condition 3 of each permit to:
  - (1) Limit the number of wind turbines;
  - (2) Provide that the overall maximum height of the wind turbines must not exceed 180 metres;
  - (3) Delete the maximum height of the tubular steel and/or concrete tower mount;
  - (4) Delete the maximum blade length requirement and replace it with a with the lowest point of a rotor blade sweep, being 40 metres.
- (c) In each permit, provide a new permit condition regarding aviation obstacle lighting;
- (d) In each permit, amend the conditions relating to noise limits and noise compliance and delete the requirement relating to noise within 20 metres of a dwelling; and

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- (e) In each permit, amend the condition relating to blade shadow flicker to allow an agreement with a landowner for blade shadow flicker to exceed 30 hours per annum.

Our client has applied to amend each of the Permits pursuant to section 97I of the *Planning and Environment Act 1987* (Vic) (**Act**), and has also applied for approval of amended endorsed plans as specified in the Amendment Applications, to give effect to the proposed changes to the layout and specifications of each wind farm.

The Amendment Applications have been referred a Panel pursuant to section 97E of the Act and will be heard together as follows:

Hearing	Date	Location
Panel directions	20 October 2017	TBC but likely in proximity to the town of Berrybank
Panel hearing	Week of 13 November 2017	TBC but likely in proximity to the town of Berrybank

## 2 Scope

### 2.1 Expert witness statement

Your report should address the matters relating to aviation obstacle lighting, and in particular consider the following matters:

- your views about existing condition 8 of the planning permits, including:
  - the concept of "on demand" aviation obstacle lighting, including any difficulties with that requirement;
  - the general process for that lighting being implemented, including consideration of cost, any requirements that may be required by aircraft in order to activate the "on demand" lighting, and the success of that lighting;
  - examples (if any) of "on demand" aviation obstacle lighting in Australia;
- your view about the technical requirement for aviation obstacle lighting, having regard to the recommendation of CASA in its letter dated 19 February 2016;
- if aviation obstacle lighting is required, describe the design that has been proposed for the Berrybank wind farm;
- your comments regarding an appropriate permit condition for the amended planning permits, including having regard to:
  - the position of CASA;
  - the prospects of reaching agreement with CASA regarding an alternative form of lighting (or no lighting); and
  - examples of other recent permit conditions regarding aviation obstacle lighting, including condition 36 of the amended Woolsthorpe wind farm planning permit issued on 21 May 2017, conditions 6-8 of the amended Mortlake planning permit issued on 23 April 2017 and any other relevant conditions of which you are aware;
- your experiences regarding aviation obstacle lighting for any other Victorian wind farms; and
- any other matter which you consider relevant to the requirement for aviation obstacle lighting at the Berrybank wind farm.



The Amendment Applications are currently on exhibition and we expect that a number of submissions will be received in respect of the Amendment Applications. We request that you progress your expert witness statement before the submissions have been received. Once received we will forward you those submissions and we request you consider those submissions and respond to any relevant matters in your witness statement.

We would like you to prepare a witness statement in accordance with Planning Panel Victoria's *Guide to Expert Evidence (Guide)* which prescribes the content and form of expert witness statements. We enclose a copy of the Guide for your reference. You are required to review and understand the Guide and to ensure your witness statement addresses all matters set out in the Guide, in particular those matters listed under the heading 'Content and Form of Experts Report'. Please contact us if there is anything in this Guide which you do not understand, or if you have questions in relation to it. Your witness statement should include matters required as set out in the Guide such as:

- (a) A reference to any technical report or reports that you rely upon;
- (b) A statement to the effect that you adopt the findings in reports you helped to prepare and were submitted as part of the Amendment Application and identifying any departure from the findings and opinions you express in those reports;
- (c) Any key assumptions made in preparing your witness statement.

We have prepared a template to assist you to prepare and order your expert witness statement. You should treat the template as an aid and should not consider yourself constrained by it if you would prefer to structure your statement differently.

### 3 Timing

We expect that the Panel hearing will be in the week of 13 November 2017. We understand it is most likely that at least part of the Panel hearing will be conducted in the vicinity of the Berrybank township.

We anticipate that we will be required to exchange expert witness statements a week prior to commencement of the hearing, although this will not be confirmed until the directions hearing. We are aware that the timeframes are reasonably short, and appreciate your effort in assisting us to prepare for hearing in accordance with the Panel schedule.

We accordingly request you to:

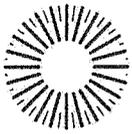
- prepare your draft expert witness statement by **mid-October 2017**;
- attend a meeting or phone conference with us and counsel **late October 2017** to consider the matter and any issues raised in the Panel directions hearing;
- update your draft expert witness statement to address any further submissions we send you after the date of this letter;
- finalise your expert witness statement by **early November 2017**;
- attend the Panel hearing as required to present your expert opinion in the week of 13 November 2017.

Any documents you prepare under this engagement should be marked '*Confidential and subject to legal professional privilege.*'

### 4 Fee estimate and invoicing

It is important to note that you will continue to be contractually engaged on behalf of/by our client. Our client will continue to be responsible for the payment of your fees and your accounts should be sent directly to the appropriate person nominated by our client.

Our client's contact details are as follows:



Shaq Mohajerani  
Projects Development Manager  
Email: [shaq.mohajerani@unionfenosa.com.au](mailto:shaq.mohajerani@unionfenosa.com.au)  
0400 403 282  
Global Power Generation Australia Pty Ltd  
Suite 4, Level 3, 24 Marcus Clarke Street  
Canberra, ACT 2600  
<http://www.globalpower-generation.com>

**5 Confidentiality**

Your expert report prepared in accordance with this retainer is confidential and is not to be copied or used for any purpose unrelated to the Panel hearing without our permission.

Material supplied by Herbert Smith Freehills is, unless it is already in the public domain, confidential and is not to be copied or used for any purpose unrelated to your retainer without our permission.

**6 Conflict of interest**

It is important that you are free from any possible conflict of interest in providing your advice. You should again ensure that you have no connection with any potential party to the panel hearing which could preclude you from providing your opinion in an objective and independent manner.

**7 Your duties and responsibilities as an expert witness**

As set out in the Guide, an expert witness has a duty to the Panel and not to the person engaging the expert. You are not an advocate for any party. Consequently, though you are retained by our client, you are retained as an expert to assist the Panel, and have an overriding duty to it. The Panel will expect you to be objective, professional and form an independent view as to the matters in respect to which your opinion is sought.

Until your report is in final form it should not be signed. You should, however, be aware that unsigned documents may need to be disclosed to other parties.

**8 Communications**

Unless advised otherwise, all communications, whether verbal or written, should be directed to our office so that we can coordinate, manage and integrate work activities with legal requirements and ensure legal professional privilege is maintained as appropriate.



If you have any questions about this letter, your role in the hearing, or the approval process, and would like to discuss your availability or the content of your report, please contact us.

Yours sincerely

*for J.*  
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Herbert Smith Freehills LLP and its subsidiaries and Herbert Smith Freehills, an Australian Partnership ABN 98 773 882 646, are separate member firms of the international legal practice known as Herbert Smith Freehills.

Attached

- 1 Guide to Expert Evidence
- 2 Pro forma expert witness statement

**Reports relied upon to prepare expert witness statement**

## Additional documents

In addition to the documents provided in the letter of instruction, I have been provided the following document:

- a. Berrybank Wind Energy Facility Panel Report, May 2010.

## References

The following references informed the development of this report:

- a. ATSB, National Aviation Occurrence Database, <https://www.atsb.gov.au/avdata/naod/>;
- b. ATSB, ATSB Transport Safety Report, Aviation Research Statistics AR-2016-122, Final – 11 January 2017;
- c. Federal Aviation Administration, AC\_70\_7460-1L\_Change\_1\_Obstruction\_Marking\_and\_Lighting\_10062016;
- d. Laufer Wind, Laufer Wind Detection System, Aircraft Tracking Performance and Lights-Off Statistics While Operating at US Department of Energy National Renewable Energy Laboratory, National Wind Technology Centre, Boulder Colorado, March 31, 2016;
- e. Mortlake South Wind Farm, Planning Permit 2008/0538/A, 23 April 2017
- f. National Transportation Safety Bureau, accident database, [https://www.nts.gov/\\_layouts/nts.aviation/index.aspx](https://www.nts.gov/_layouts/nts.aviation/index.aspx).
- g. Woolsthorpe Wind Farm, Planning Permit 2008/0220/A, 21 May 2017

## **ANNEXURE B – CURRICULUM VITAE**

A copy of my CV is provided after this page.

## KEITH TONKIN

### MANAGING DIRECTOR

Keith Tonkin is the Managing Director and Principal Consultant of Aviation Projects. Keith has spent nearly 30 years in the aviation industry, starting out as a pilot first in the military and then for Qantas. Since then, Keith has applied his knowledge of flying and airport operations to the task of planning and implementing airport-related projects. Keith has the ability to think critically, formulating and articulating arguments based on relevant knowledge and a superior understanding of key issues, enabling the development and implementation of practical solutions for complex problems.

Having been involved in numerous airport planning and upgrade studies, providing operations and managerial expertise to airports around Australia and the Asia Pacific, Keith has a unique understanding of airport planning and design and aviation safety problems.



### Qualifications

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- Master of Business Administration (Aviation Management) – RMIT University
- Certified Practising Risk Manager – Risk Management Institution of Australasia
- Bachelor of Science – UNSW ADFA
- Graduate Certificate of Spatial Science Technology - University of Southern Queensland
- Advanced Diploma of Aviation (RAAF)
- CASR Part 139 approval to conduct Safety Inspections at Registered and Certain other aerodromes
- Quality/Safety Lead Auditor
- WH&S Officer (QLD), WH&S Representative (NSW) and Rehab Return to Work Coordinator (QLD)

### Licenses/Endorsements

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- Air Transport Pilot (Aeroplane) – ARN 419433
- MECIR B737-300 to 800 Command Class Endorsement

### Professional Affiliations

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- Risk Management Institution of Australasia – Associate Fellow
- Aviation Law Association of Australia and New Zealand – member
- Australian Airports Association – corporate member
- Australian Airports Association – Standards and Planning Working Groups - member

## Work Experience

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Aviation Projects Pty Ltd	December 2003 until present Managing Director and Principal Consultant
Qantas Airways Ltd	January 2001 until July 2009 B747 Second Officer and B737 First Officer WHSO Brisbane B737 Base
RAAF	January 1986 until January 2001 No 151 Pilots Course 38 SQN – Caribous 25 and 76 SQN – Intro Fighter Course 1 and 6 SQN – F/RF-111C 82WG – F-111 Aircrew Standards Officer

## Aeronautical Experience

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- Military: CT4-A, MB326-H, DHC-4, F-111
- Civil: B737-300 to 800 (First Officer), B747-200/300 (Second Officer)
- General Aviation: DH-82, C152/172, B55/58 Baron/Travelair, PA-43 Seneca, S2-A Pitts Special
- Total hours: 7371.8
- Command hours: 1387.8

## ANNEXURE C - DETAILED RESPONSE TO SUBMISSIONS

<i>Issue</i>	<i>Submission No.</i>	<i>Response</i>	<i>Any Recommendations New or Modified Conditions</i>
No issues were raised in relation to obstacle lighting	1	N/A	N/A
No issues were raised in relation to obstacle lighting	2	N/A	N/A
No issues were raised in relation to obstacle lighting	3	N/A	N/A
No issues were raised in relation to obstacle lighting	4	N/A	N/A
Concerned about the for potential for further loss of visual amenity if obstacle lighting is required	5	Obstacle lights, if required, should be designed to minimise visual impact.	The proposed amended Condition 8 should minimise the visual impact of obstacle lighting if it is required.
No issues were raised in relation to obstacle lighting	6	N/A	N/A
No issues were raised in relation to obstacle lighting	7	N/A	N/A
No issues were raised in relation to obstacle lighting	8	N/A	N/A
<ul style="list-style-type: none"> <li>Do not harbour any particular objection to proposed amendment of Conditions 7 and 8</li> <li>Maintain earlier objections (28 October 2009), including the potential negative impact of the warning lights</li> </ul>	9	Obstacle lights, if required, should be designed to minimise visual impact.	The proposed amended Condition 8 should minimise the visual impact of obstacle lighting if it is required.
No issues were raised in relation to obstacle lighting	10	N/A	N/A

<i>Issue</i>	<i>Submission No.</i>	<i>Response</i>	<i>Any Recommendations New or Modified Conditions</i>
No issues were raised in relation to obstacle lighting	11	N/A	N/A

## ANNEXURE D – ACCIDENT STATISTICS

### General aviation operations

The general aviation (GA) operation type is considered by the Australian Transport Safety Bureau (ATSB) as all flying activities that do not involve scheduled (RPT) and non-scheduled (charter) passenger and freight operations. It may involve Australian civil (VH-) registered aircraft, or aircraft registered outside of Australia. General aviation encompasses:

- Aerial work. This includes flying for the purposes of agriculture (spraying and spreading), mustering, search and rescue, fire control, or survey and photography;
- Flying training; and
- Private, business and sports aviation. Sports aviation includes gliding, parachute operations, ballooning, warbird operations, and acrobatics.

### ATSB occurrence taxonomy

The ATSB uses a taxonomy of occurrence sub-type. Of specific relevance to the subject assessment are terms associated with **terrain collision**. Definitions sourced from the ATSB website are provided below:

- **Collision with terrain:** Occurrences involving a collision between an airborne aircraft and the ground or water, where the flight crew were aware of the terrain prior to the collision.
- **Controlled flight into terrain (CFIT):** Occurrences where a serviceable aircraft, under flight crew control, is inadvertently flown into terrain, obstacles, or water without either sufficient or timely awareness by the flight crew to prevent the event.
- **Ground strike:** Occurrences where a part of the aircraft drags on, or strikes, the ground or water while the aircraft is in flight, or during take-off or landing.
- **Wirestrike:** Occurrences where an aircraft strikes a wire, such as a powerline, telephone wire, or guy wire, during normal operations.

### National aviation occurrence statistics 2006-2015

The Australian Transport Safety Bureau recently published a summary of aviation occurrence statistics for the period 2006 to 2015 (AR-2016-122) Final, 11 January 2017.

According to the report, there were no fatalities in high capacity RPT operations, two in low capacity RPT operations and 17 in charter operations during the period 2006-2015.

Of the 360 fatalities recorded in the 10-year period, almost two thirds (231 or 64.17%) occurred in the general aviation segment. On average, there were 1.5 fatalities per aircraft associated with a fatality in this segment. Other than aerial survey and photography (2:1) and private/business (1.725:1), the fatalities to aircraft ratio ranges from 1:1 to 1.5:1. Whilst it can be inferred from the data that the majority of fatal accidents are single person fatalities, it is reasonable to assert that the worst credible effect of an aircraft accident in the general aviation category will be multiple fatalities (i.e. more than one).

A breakdown of aircraft and fatalities by general aviation sub-categories is provided in Table 3 (source: ATSB).

Table 3 number of fatalities by GA sub-category – 2006 to 2015

<i>Sub-category</i>	<i>Aircraft assoc. with fatality</i>	<i>Fatalities</i>	<i>Fatalities to aircraft ratio</i>
Agriculture	16	16	1:1
Mustering	13	14	1.08:1
Search and rescue	2	2	1:1
Fire control	3	3	1:1
Survey and photography	8	16	2:1
Other aerial work	6	9	1.5:1
Flying training	8	11	1.375:1
Private/business	80	138	1.725:1
Sport aviation (excluding gliding)	5	5	1:1
Gliding	12	16	1.33:1
<b>Totals</b>	<b>153</b>	<b>230</b>	<b>1.5:1</b>

According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 10-year reporting period ranged between 11.3 in 2012 and 5.9 in 2014. Figure 1 refers (source: ATSB).

**Figure 15: General aviation accident and fatal accident rate (per million departures, VH-registered aircraft only), 2006 to 2014**

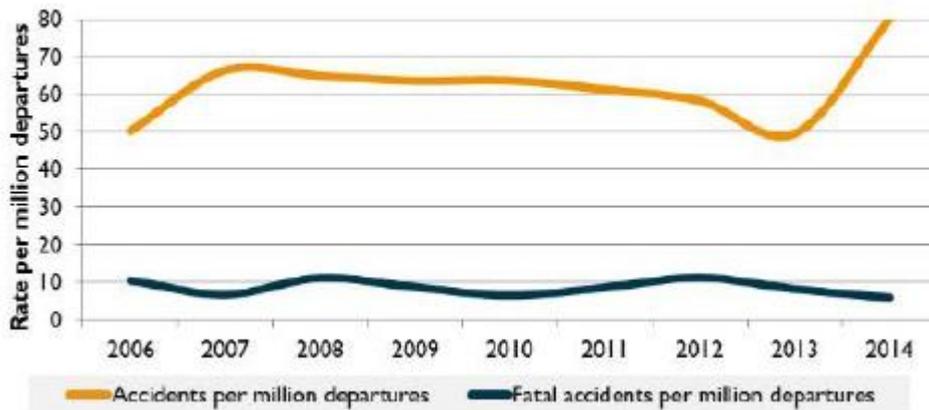


Figure 1 GA accident and fatal accident rate per million departures

In 2014, there were 11 fatal accidents and 19 fatalities involving GA aircraft, resulting in a rate of 5.9 fatal accidents per million departures and 9.3 fatal accidents per million hours flown.

In 2015, there were 1,849,000 departures, and 1,295,000 hours flown by VH-registered general aviation aircraft in Australia, with 13 fatal accidents and 15 fatalities. Based on these results, in 2015 there were 7.0 fatal accidents per million departures and 10.0 fatal accidents per million hours flown.

A summary of fatal accidents in 2015 by GA sub-category is provided in Table 4 (source: ATSB).

Table 4 Fatal accidents by GA sub-category – 2015

<i>Sub-category</i>	<i>Fatal accidents</i>	<i>Fatalities</i>
Aerial work	3	3
Aerial agriculture	1	1
Aerial mustering	2	2
Search and rescue	0	0
Fire control	0	0
Survey and photography	0	0
Flying training	1	1
Private/business	5	7
Sports	1	1
Foreign registered	0	0
<b>Totals</b>	<b>13</b>	<b>15</b>

Over the 10-year period, there were 16,689,000 general aviation departures in Australia, during which time no aircraft collided with a wind turbine or a wind monitoring tower.

Of the 3,761 incidents and accidents in GA operations in the 10-year period, 994 (26.4%) were terrain collisions.

There is an underlying fatality rate for GA operations that is considered tolerable within Australia's regulatory and social context.

#### **Fatal terrain collisions by GA aircraft in Victoria, 2007-2017**

According to the ATSB online occurrence database, in Victoria, over the 10 years from 01 January 2007 to 05 April 2017, there were 41 fatal accidents allocated the terrain collision occurrence type. Of these fatal accidents:

- 21 occurred within the vicinity of an aerodrome;
- 13 were ground collisions not within the vicinity of an aerodrome (including the Millbrook accident);
- five were wire strikes; and
- two were collisions with water.

## **Worldwide accidents involving wind farms**

To provide some perspective on the likelihood of an aircraft colliding with a wind turbine, a summary of the four accidents that involved an aircraft colliding with a wind turbine, and the relevant factors applicable to this assessment, is incorporated in this section.

Note that there are no recorded accidents involving an aircraft colliding with a wind turbine in Australia.

Global Wind Energy Council reports on its website there were 314,000 wind turbines operating around the world at the end of 2015.

Australia's Clean Energy Council reports on its website there were 2062 wind turbines in Australia at the end of 2015.

Aviation Projects researched public sources of information, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia, Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

Of the four known accidents, one was caused by inflight separation of the majority of the right canard and all of the right elevator resulting from a failure of the builder to balance the elevators per the kit manufacturer's instructions. The accident occurred overhead a wind farm, and the aircraft struck a wind turbine on its descent. This accident is not applicable to the circumstances under consideration.

There have been two accidents involving collision with a wind turbine during the day (in 2008 and 2017), and one at night (in 2014).

A summary of the four accidents is provided in Table 5.

Table 5 Summary of accidents involving collision with a wind turbine

<i>ID</i>	<i>Description</i>	<i>Date</i>	<i>Location</i>	<i>Fatalities</i>	<i>Flight rules</i>	<i>Turbine height</i>	<i>Obstacle lighting</i>	<i>Cause of accident</i>	<i>Relevance to obstacle lighting at night</i>
1	Diamond DA320-A1 D-EJAR Collided with a wind turbine approximately 20 m above the ground, during the day in good visibility. The mast was grey steel lattice, rather than white, although the blades were painted in white and red bands.	02 Feb 2017	Melle, Germany	1	Day VFR No cloud and good visibility	Not specified	Not specified	Not specified	Not applicable

<i>ID</i>	<i>Description</i>	<i>Date</i>	<i>Location</i>	<i>Fatalities</i>	<i>Flight rules</i>	<i>Turbine height</i>	<i>Obstacle lighting</i>	<i>Cause of accident</i>	<i>Relevance to obstacle lighting at night</i>
2	<p>The Piper PA-32R-300, N8700E, was destroyed during an impact with the blades of a wind turbine tower, at night in IMC.</p> <p>The wind turbine farm was not marked on either sectional chart covering the accident location; however, the pilot was reportedly aware of the presence of the wind farm.</p>	27 Apr 2014	10 miles south of Highmore, South Dakota	4	Night IMC Low cloud and rain	420 ft AGL overall	Fitted but reportedly not operational on the wind turbine that was struck	<p>The NTSB determined the probable cause(s) of this accident to be the pilot's decision to continue the flight into known deteriorating weather conditions at a low altitude and his subsequent failure to remain clear of an unlit wind turbine.</p> <p>Contributing to the accident was the inoperative obstruction light on the wind turbine, which prevented the pilot from visually identifying the wind turbine.</p>	An operational obstacle light may have prevented the accident

<i>ID</i>	<i>Description</i>	<i>Date</i>	<i>Location</i>	<i>Fatalities</i>	<i>Flight rules</i>	<i>Turbine height</i>	<i>Obstacle lighting</i>	<i>Cause of accident</i>	<i>Relevance to obstacle lighting at night</i>
3	<p>Beechcraft B55</p> <p>The pilot was attempting to remain in VMC by descending the aircraft through a break in the clouds. The pilot, distracted by trying to visually locate the aerodrome, flew into an area of known wind turbines.</p> <p>After sighting the turbines, he was unable to avoid them. The tip of the left wing struck the first turbine blade, followed by the tip of the right wing striking the second turbine.</p> <p>The pilot was able to maintain control of the aircraft and landed safely.</p>	04 Apr 2008	Plougin, France	0	<p>Day VFR</p> <p>The weather in the area of the wind turbines had deteriorated to an overcast of stratus cloud, with a base between 100 ft to 350 ft and tops of 500 ft.</p>	328 ft AGL hub height, 393 ft AGL overall	Not specified	<p>This pilot reported having been distracted by a troubling personal matter which he had learned of before departing for the flight.</p> <p>The wind farm was annotated on aeronautical charts.</p>	Not applicable

<i>ID</i>	<i>Description</i>	<i>Date</i>	<i>Location</i>	<i>Fatalities</i>	<i>Flight rules</i>	<i>Turbine height</i>	<i>Obstacle lighting</i>	<i>Cause of accident</i>	<i>Relevance to obstacle lighting at night</i>
4	VariEze N25063 The aircraft collided with a wind turbine following in-flight separation of the majority of the right canard and all of the right elevator	20 July 2001	Palm Springs, USA	2	Day VFR	N/A	N/A	The failure of the builder to balance the elevators per the kit manufacturer's instructions	Not applicable

 **AVIATION PROJECTS**

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