FINAL REPORT

AERONAUTICAL IMPACT ASSESSMENT
AVIATION IMPACT STATEMENT
QUALITATIVE RISK ASSESSMENT
AND
OBSTACLE LIGHTING REVIEW

SAPPHIRE WIND FARM

J0466

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Report to:

CWP Renewables Pty Ltd

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AMBIDJI
AIR TRANSPORT INNOVATION

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EXECUTIVE SUMMARY

CWP Renewables has engaged the Ambidji Group (Ambidji) to prepare an Aeronautical Impact Assessment (AIA), Aviation Impact Statement (AIS), Qualitative Risk Assessment (QRA) and an Obstacle Lighting Review (OLR) for the proposed Sapphire Wind Farm (SWF) located in the New England Region of New South Wales, between Inverell and Glen Innes.

The proposed SWF comprises 159 turbines, located in three clusters, with a tip height not exceeding 200m (656ft) Above Ground Level (AGL). The highest turbine (#115) is 1357.79m above the Australian Height Datum (AHD). For aviation purposes this is rounded up to an altitude of 4455ft.

The AIS includes the AIA and finds that the SWF will NOT impact upon the following:-

- The OLS published for any registered or certified aerodrome;
- The operation of any Navigation Aids and Communication facilities; and
- The operation of any Airspace Surveillance facility.

However the Wind Farm WILL impact upon the following:

- The 25 nm Minimum Sector Altitude (MSA) for Glen Innes Aerodrome.

It will be recommended that AsA be requested to increase the 25 nm MSA to 5500 ft.

As the 10 nm MSA is 6100ft, and the altitude at the Initial Fix (IF) for the RWY 14 NDB approach is 6100ft, aircraft would be required to be no lower than 6100ft within 10nm. It is considered that the increase in the 25nm MSA to 5500ft will have minimal impact on flight operations.

The QRA investigated the aviation activity that occurs in the area of the SWF and at Inverell (YIVL) and Glen Innes (YGLI) aerodromes. The risk to this aviation activity posed by the SWF was assessed through a series of stakeholder interviews.

The QRA demonstrates that the SWF will *not be a hazard to aircraft safety* and therefore “not of operational significance” to aircraft operations.

The QRA findings are summarised in the table below.

Risk Element	Assessed Level of Risk	Comment
Airport Operations	LOW	
Inverell (YIVL)	LOW	
Glen Innes (YGLI)	LOW	
Aircraft Landing Area Operations	LOW	Pilot responsibility. One identified within 30nm
Known Highly Trafficked Routes	LOW	None identified
Published Air Routes	LOW	Nil impact
Restricted Airspace	LOW	None in the area
Promulgated Flying Training Areas	LOW	None in the area
Night Flying	LOW	
Emergency Services Flying	LOW	
Commercial Flying	LOW	Daily freight flight weekdays
Recreational and Sport Aviation	LOW	By day only
Recreational Pilot Training (RA-AUS)	LOW	By day only
GA Flying	LOW	
GA Pilot Training	LOW	Usually by day only
Weather and Topographical Issues	LOW	The nearby ranges are a known area for marginal VMC. There are sufficient aerodromes in the area suitable for landing to avoid proceeding into marginal VMC

Risk Assessment Summary

The Risk Assessment finds that the overall risk to aviation in the area of the SWF is LOW. On this basis no further mitigation is required. Obstacle lighting is not required.

1. INTRODUCTION

CWP Renewables Pty Ltd has engaged the Ambidji Group Pty Ltd (Ambidji) to prepare an Aeronautical Impact Assessment (AIA), Aviation Impact Statement (AIS), Qualitative Risk Assessment (QRA) and an Obstacle Lighting Review (OLR) for the proposed wind farm at Sapphire in northern New South Wales.

The areas of investigation for the AIA and the AIS are the same with the addition of Communications, Navigation and Surveillance (CNS) in the AIS. The AIS was submitted to Airservices Australia (AsA) as a separate report. The AIS is now incorporated into this document and jointly reported with the AIA under the AIS heading. The AsA response to the AIS for the Sapphire Wind Farm is shown at Appendix C. The Department of Defence response is shown at Appendix D.

The QRA analyses the risks to aviation posed by the proposed wind farm development through facilitated interviews with stakeholders and outside experts, as to their probability of occurrence and impact expressed using non-numerical terminology. The basis for the QRA is ASNZS ISO 31000-2009 *Risk Management – Principles and Guidelines.*

The OLR follows from the QRA and establishes the need or otherwise for the turbines in the wind farm to be lit with aviation obstruction lighting as a risk mitigator.

1.1 Location

The proposed Sapphire Wind Farm (SWF) is located approximately 18km west of Glen Innes and 28km east of Inverell in New South Wales. The SWF will comprise up to 159 turbines with a tip height of 200m Above Ground Level (AGL) arranged in three clusters. The highest turbine tip height is turbine 115 at 1357.79m above the Australian Height Datum (AHD). For aviation purposes this is rounded up to an altitude of 4455ft.

1.2 Aerodromes and Airstrips

Aerodromes fall into four categories:

- Military or Joint (combined military and civilian);
- Certified;
- Registered; and
- Uncertified or Aeroplane Landing Areas

A Military aerodrome is operated by the Department of Defence and is suitable for the operation of military aircraft. A Joint User aerodrome is a Military aerodrome used by both military and civilian aircraft, for example Darwin International and Townsville International Airports.

A Certified Aerodrome, certified under Civil Aviation Safety Regulation (CASR) 139.040, is available for Regular Public Transport and Charter operations and has a runway suitable for use by an aircraft having a maximum carrying capacity of more than 3,400kg or a passenger seating capacity of more than 30 seats, for example

Sydney International Airport, Coffs Harbour Airport and Armidale Airport.

A Registered Aerodrome, registered under CASR 139.260, is one to which CASR 139.040 does not apply and the operator has applied to the Civil Aviation Safety Authority (CASA) to have it registered, for example Glenn Innes, Inverell and Gunnedah Airports.

An Uncertified Aerodrome is any other aerodrome or airstrip and is referred to as an Aeroplane Landing Area (ALA). These range in capability and size from having a sealed runway with lighting capable of accommodating corporate jet aircraft to a grass paddock that is smooth enough to land a single engine light aircraft or a purpose built aerial agricultural aircraft.

Military, Certified and Registered aerodromes are listed in the Aeronautical Information Publication[1] (AIP) and are subject to a NOTAM[2] service that provides the aviation industry with current information on the status of the aerodrome facilities. This information is held in the public domain, is available through aeronautical publications and charts and is kept current by mandatory reporting requirements.

Uncertified aerodromes (ALA) are not required to be listed in the AIP so information about them is not held in the public domain, is not available through aeronautical publications and charts and is not required to be reported. Where ALA information is published in the AIP it is clearly annotated that it is not kept current. Consequently ALA can come into use and fall out of use without any formal notification to CASA or any other authority. Airstrips that appear on survey maps often no longer exist; others exist but do not feature on maps. Similarly a grass paddock used as an ALA is not usually discernable on satellite mapping services such as Google Earth.

Military, Joint, Certified and Registered aerodromes usually have Obstacle Limitation Surfaces (OLS) and Procedures for Air Navigation – Operations (PANS-OPS) surfaces prescribed to protect the airspace associated with published instrument approach and landing procedures. An uncertified aerodrome or ALA cannot have a published instrument approach and landing procedure so cannot have associated prescribed airspace protected by OLS or PANS-OPS. All operations into ALA therefore, must be conducted in accordance with the Visual Flight Rules (VFR) and in Visual Meteorological Conditions (VMC).

1.3 Aerodromes in the Area

There are two registered or certified aerodromes within 30nm (56km) of the wind farm:

- Glen Innes (YGLI) 7.75nm (17.33km) to the East of the Wind Farm boundary; and
- Inverell (YIVL) 15.59nm (28.87km) to the South West of the Wind Farm boundary.

[1] AIP; a mandatory worldwide distribution system for the promulgation of aviation rules, procedures and information
[2] NOTAM (Notice to Airmen); a mandatory reporting service to keep aerodrome and airways information current and available to the aviation industry world wide

1.4 Air Routes in the Area

There are several published air routes in the area of the SWF.

The highest turbine tip is 4455ft, and when the Minimum Obstacle Clearance (MOC) of 1000ft is applied the result is 5455ft, which is below the minimum Lowest Safe Altitude (LSALT) of 5800ft on W893.

1.5 Airspace

The SWF is located in Class G non – controlled airspace, beneath Class E controlled airspace with a lower limit of 8500ft.

There is no Prohibited, Restricted or Danger Area airspace within the vicinity.

2. SCOPE

To meet CWP Energy Pty Ltd requirements, the study required Ambidji to examine the proposed SWF development and undertake the following tasks.

2.1 Aviation Impact Statement

In August 2014, Airservices Australia (AsA) re-released a letter detailing requirements for an Aviation Impact Statement (AIS) for wind farm developments. The AsA letter requires that all developers of proposed wind farms prepare an Aviation Impact Statement, and submit this to AsA for evaluation and consideration. A copy of this letter is shown at Appendix A.

The AIS required the following tasks to be undertaken: -

- Provide the coordinates and elevations of the Obstacles and associated topographical drawings;
- Specify all registered and certified aerodromes within 30nm (55.6km):
  - Nominate all instrument approach and landing procedures;
  - Confirm that the obstacles do not penetrate the Annex 14 OLS;
  - Confirm that the obstacles do not penetrate the PANS-OPS;
- Specify any published air routes over or near the obstacles
- Specify the airspace classification of the airspace surrounding the development
- Investigate any impact on aviation Communications, Navigation and Surveillance (CNS) facilities

Details of Aerodromes, OLS, PANS-OPS procedures, Lowest Safe Altitudes, Navigation and Airspace Surveillance facilities were obtained from the Australian Aeronautical Information Publications (AIP), AsA sources and CASA publications.

2.2 Qualitative Risk Assessment

The QRA required the following tasks to be undertaken: -

- The identification and assessment of potential aviation risk elements through:
  - Reference to CASA publications;
  - Reference to the AIP;
  - Reference to the National Airports Safeguarding Framework (NASF) guidelines;
  - Consultations with key relevant stakeholders;
- Assessment of the perceived impacts of the turbines on the operation of aerodromes and airstrips in the immediate vicinity of the wind farm;

- Assessment of the perceived impacts of the turbines on aviation activity including:
  - General Aviation training;
  - Recreational/Commercial flying activity;
  - Air Ambulance Operations;
  - Police Aviation Operations;
  - Aerial Fire Fighting Operations;
  - Aerial Agricultural Operations;
  - Known highly trafficked VFR routes;
  - Night flying for light aircraft;
- Assessment of any implications for the above from topographical, weather and visibility issues;
- Assessment of other issues as identified through consultations and the assessment process;
- Conclusions on the degree of aviation risk posed by the above described issues with commensurate recommendations on any mitigating actions; and
- An assessment of the need, against the outcomes of the Qualitative Risk Assessment, for obstacle lighting of the wind farm.

2.3 Obstacle Lighting Review

The OLR reviews the outcome of the QRA to determine the need or otherwise for risk mitigation by the lighting of turbines in the wind farm with aviation obstruction lighting.

3. METHODOLOGY

The following methodology was use to complete the tasks outlined in the scope.

3.1 Aviation Impact Statement

To meet Airservices Australia requirements for an Aviation Impact Statement the following methodology was used: -

- The obstacle (turbines and meteorological masts) coordinates and elevations were listed to the requisite accuracy and associated drawings and charts were obtained;
- The AIP was reviewed to determine;
  - All registered/certified aerodromes located within 30nm (55.6km) of the wind farm
  - Any associated Instrument Departure and Approach Procedures (DAP);
  - The extent of the OLS and PANS-OPS surfaces for the identified DAP;
  - Published air routes located over or near the wind farm;
  - The classification of the airspace surrounding the wind farm;
- Ascertain the locations of CNS facilities that may be impacted and analyse the impact on;
  - Communications facilities;
  - Navigation facilities;
  - Surveillance facilities (in accordance with EUROCONTROL Guidelines); and
- Compile a report for review by Airservices Australia.

3.2 Qualitative Risk Assessment

A Qualitative Risk Assessment is the analysis for risks, through facilitated interviews or meetings with stakeholders and outside experts, as to their probability of occurrence and impact expressed using non-numerical terminology; for example low, medium and high. The basis for the QRA is ASNZS ISO 31000-2009 *Risk Management – Principles and Guidelines.*

The methodology for the Qualitative Risk Assessment was as follows:

- The Australian AIP and CASA documents were reviewed to identify relevant physical and operational aviation issues that may impact on the requirement for lighting of the wind farm;
- Current topographical maps were studied to assess the local terrain and identify any local airstrips and any other relevant features;
- Key stakeholders, including local operators, recreational aviation groups and State Government Police Air Wing, Air Ambulance and Fire Services,

were identified, contacted and surveyed to ascertain the extent of local aviation activity in the vicinity of the proposed wind farm. This included any informal low flying areas and highly trafficked unpublished air routes that may exist within the vicinity of the proposed wind farm;

- Based on the above, the nature of any impacts as a consequence of the operation of the wind farm was considered and discussed in regard to;
  - General Aviation training;
  - Recreational and sport aviation activities;
  - Approved low flying activities (including aerial agricultural applications)
  - Any known highly trafficked VFR routes; and
  - Emergency Services (air ambulance, police and fire service);
- In addition, further consideration was given to the consequences (for the above elements) of the potential influence of topography and poor weather; and
- Consideration of the NASF, Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* in relation to the QRA findings.

3.3 Obstacle Lighting Review

The Obstacle Lighting Review investigates the current International and Australian standards and regulatory requirements for obstacle lighting of wind farms. From this review an assessment of the need or otherwise for aviation obstruction lighting is made.

The methodology for the Obstacle Lighting Review was as follows: -

- Summarise current International standards and regulatory requirements;
- Review the Australian regulatory requirements and standards;
- Review the NASF Guidelines for wind farms; and
- From the QRA, assess the need for aviation obstruction lighting as a risk mitigator.

4. AVIATION IMPACT STATEMENT

4.1 Location

The proposed Sapphire Wind Farm (SWF) is located approximately 18km west of Glen Innes and 28km east of Inverell in New South Wales. Figure 4.1 below shows the location of the wind farm and its proximity to the nearby towns of Glen Innes and Inverell.

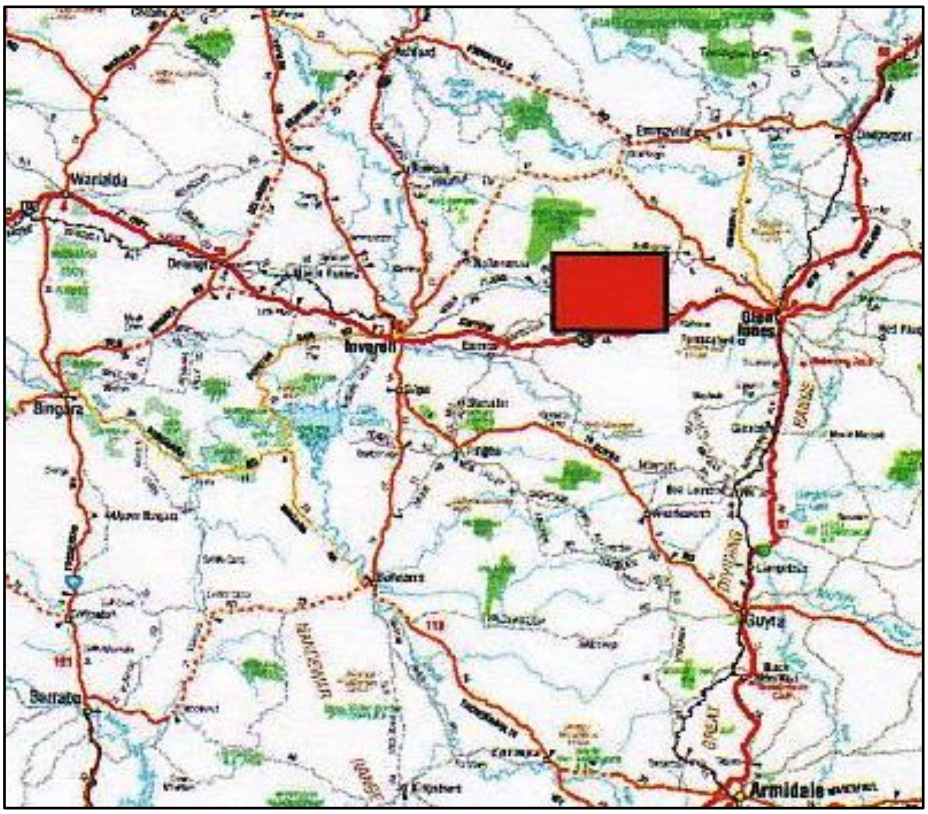

Figure 4.1.1 General Location of the Proposed Sapphire Wind Farm

4.2 Obstacles

A list of the proposed wind turbine locations and heights is shown at Appendix B.

Coordinates are in WGS 84, accurate to 0.1 second of arc and elevations Above Mean Sea Level (AMSL) are accurate to 0.3 metres.

The highest obstacle, turbine 115 at 1340.7963m or 4455ft. AHD is shown in yellow shading (Appendix B.)

4.3 Drawings

A basic drawing of the proposed wind turbine locations is shown in Figure 4.3.1 below.

The wind turbines are located in three clusters, and the boundaries of the clusters are shown in Table 4.3.1.

A Google Earth image of the cluster boundaries is shown in Figure 4.4.1.

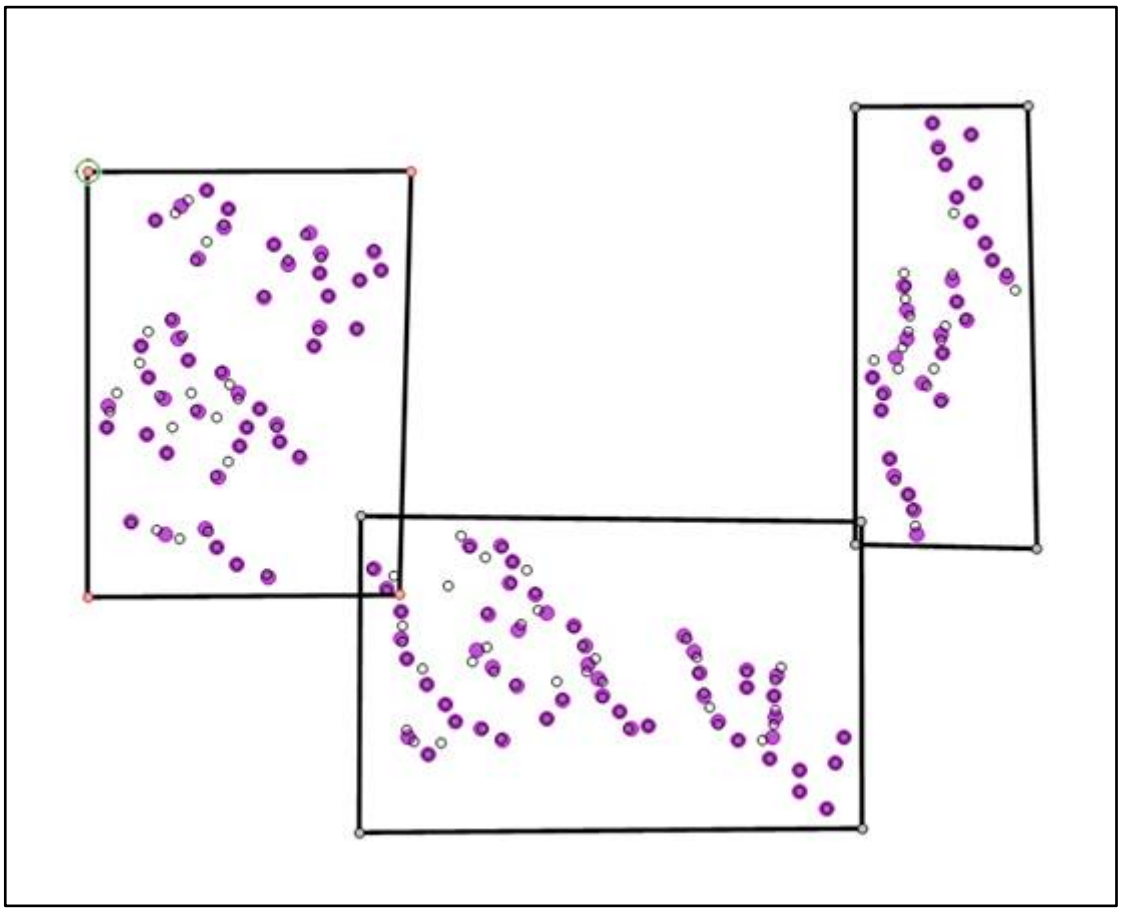

Figure 4.3.1 Sapphire Wind Farm Layout showing the Wind Turbine Clusters

Cluster	X (l)	Y (l)	Lat	Long
Sapphire	342585.85941173	6718393.03410272	-29.6545	151.3736
	342585.85941173	6711073.78074956	-29.7205	151.3725
	347950.94318031	6711109.31110564	-29.7209	151.4280
	348152.36766028	6718408.14620636	-29.6550	151.4311
Swan Vale	347284.74900375	6712468.34722583	-29.7085	151.4213
	347258.10123669	6707023.32015606	-29.7576	151.4203
	355909.74294298	6707094.38086822	-29.7580	151.5097
	355901.06096922	6712373.87433532	-29.7104	151.5103
Wellingrove	355794.26928571	6719512.24031935	-29.6460	151.5102
	355794.26928571	6711979.80482968	-29.7140	151.5092
	358920.94062104	6711908.74411752	-29.7150	151.5415
	358761.05401867	6719530.00549739	-29.6462	151.5408

Table 4.3.1 Sapphire Wind Farm Cluster Boundaries

4.4 Aerodromes within 30nm

There are two registered or certified aerodromes within 30nm of the wind farm:

- Glen Innes (YGLI) 7.75nm (17.33km) to the East of the Wind Farm boundary; and
- Inverell (YIVL) 15.59nm (28.87km) to the South West of the Wind Farm boundary.

Figure 4.4.1 shows the locations of the SWF Cluster Boundaries and distances to the Glen Innes and Inverell Aerodrome Reference Points (ARPs). The location of the highest wind turbine (T115) at 4455ft is also shown.

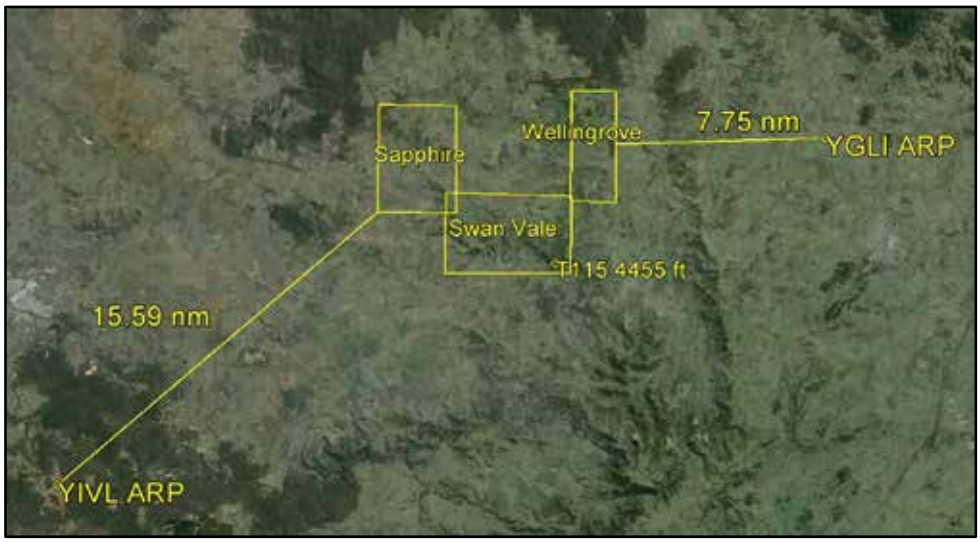

Figure 4.4.1 Glen Innes and Inverell Aerodrome Reference Points in relation to the SWF

4.5 Obstacle Limitation Surfaces

The Obstacle Limitation Surfaces (OLS) for Inverell and Glen Innes aerodromes are not impacted by the Sapphire Wind Farm.

4.5.1 Inverell

The OLS for Inverell (YIVL) extend to 5.5km from the runway thresholds. As this aerodrome is 29.3km from the nearest SWF boundary, the wind farm is clear of the OLS.

4.5.2 Glen Innes

The OLS for Glen Innes (YGLI) extend to 5.5km from the runway thresholds. As the nearest YGLI runway threshold is 13.4km from the SWF boundary, the wind farm is clear of the OLS.

4.6 PANS-OPS Surfaces

All altitudes in PANS-OPS procedures are in feet (ft.) AHD, distances are in Nautical Miles (nm) and bearings are in degrees magnetic (M). The magnetic variation in the area is 11° east. Aircraft performance category (CAT) is published in the CASA MOS Part 173.

All PANS-OPS calculations made in this report are made in accordance with ICAO Doc 8168 PANS-OPS and CASA MOS Part 173.

4.6.1 Inverell

MINIMUM SECTOR ALTITUDE (MSA)

The MSA is 6200ft within 25nm of the IVL NDB in the sector over the SWF (see Figure 4.6.1).

When the Minimum Obstacle Clearance of 1000ft is applied to the highest tip AHD of 4455ft, the result is 5455ft which is below the 25nm MSA.

The MSA is not impacted by the Sapphire Wind Farm.

GNSS ARRIVAL

A copy of this procedure extracted from the AIP DAP is shown in Figure 4.6.1.1. The approximate vertical dimension of the SWF is also shown – not to scale.

The SWF is located between 15.42nm and 16.13nm from the IVL NDB. When the 1nm tolerance is applied to these distances they are decreased to 14.42nm to 15.13nm, which places the SWF just inside the Initial Approach Segment of this procedure.

For Sector A and Sector B the minimum altitude is 6200ft between 15nm and 11nm and between 15nm and 12nm respectively. When the MOC of 1000ft is applied to the highest tip height of 4455ft the result is 5455ft, which is below the minimum altitude of

6200ft.

The SWF turbines are below the minimum altitudes for the Inverell GNSS ARRIVAL PROCEDURE.

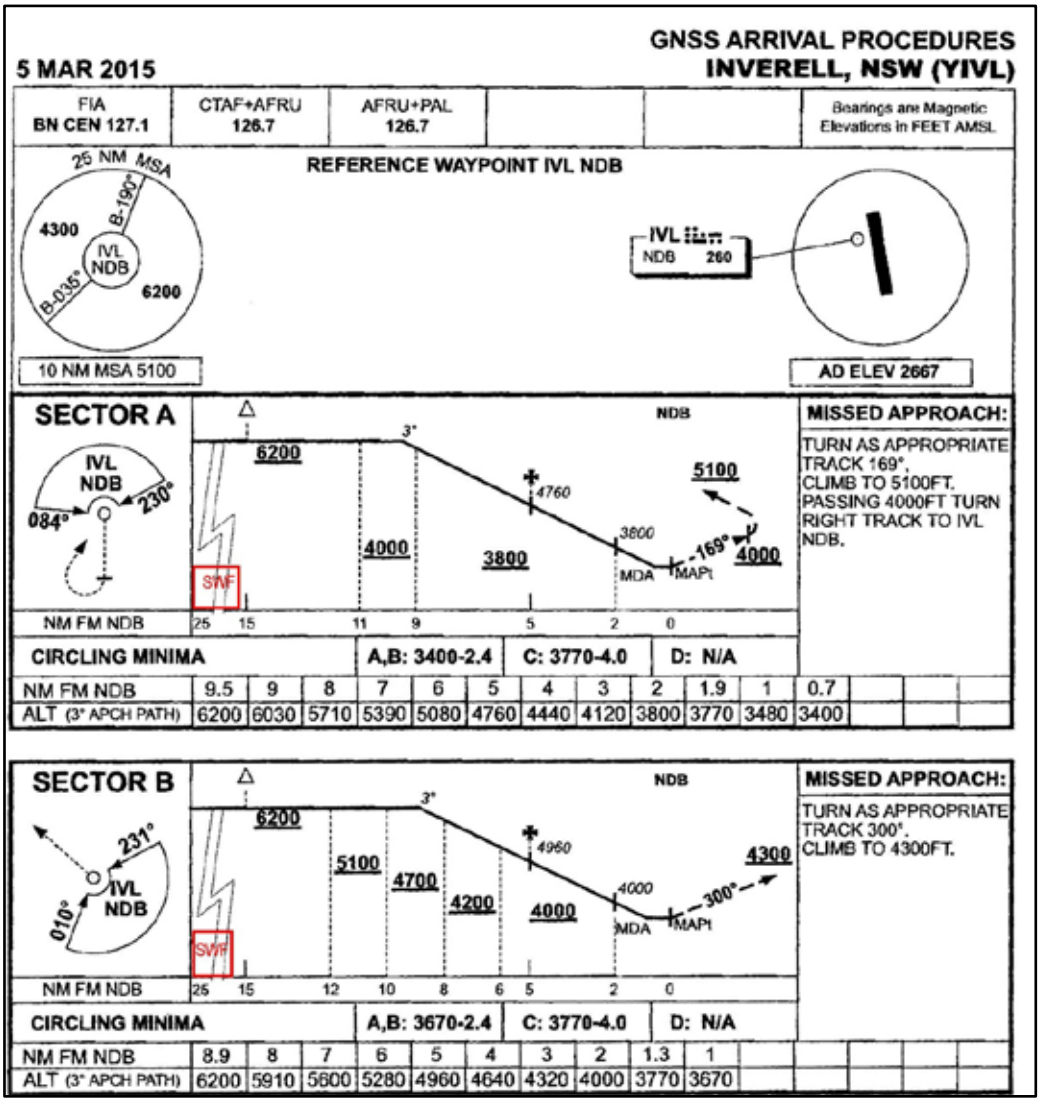

Figure 4.6.1.1 Inverell GNSS ARRIVAL PROCEDURE

RNAV (GNSS) RWY 34 and NDB RWY 16

The applicable navigation tolerances for these approach procedures are well clear of the SWF.

4.6.2 Glen Innes

MINIMUM SECTOR ALTITUDE (MSA)

The MSA in the Sector over the SWF is 5300ft within 25nm of the GLI NDB and is 6100ft within 10nm. The MSA is shown in Figure 4.6.2.1. The SWF is impacted by the 25nm and 10nm MSA.

When the Minimum Obstacle Clearance of 1000ft is applied to the highest tip AHD of 4455ft, the result is 5455ft. This height will penetrate the 25nm MSA by 155ft.

It will be recommended that AsA is requested to increase the 25nm MSA to 5500ft.

As the 10nm MSA is 6100ft, and the altitude at the IF for the RWY 14 NDB approach is 6100ft, aircraft would be required to be no lower than 6100ft within 10nm. It is considered that the increase in the 25nm MSA to 5500ft will have minimal impact on flight operations.

INSTRUMENT APPROACH PROCEDURES

A number of Instrument Approach Procedures are published for YGLI. These are:

- GNSS ARRIVAL
- RNAV (GNSS) RWY 14
- RNAV (GNSS) RWY 32
- NDB RWY 14

GNSS ARRIVAL

A copy of this procedure extracted from the AIP DAP is shown in Figure 4.6.2.1. The approximate vertical dimension of the SWF is also shown – not to scale.

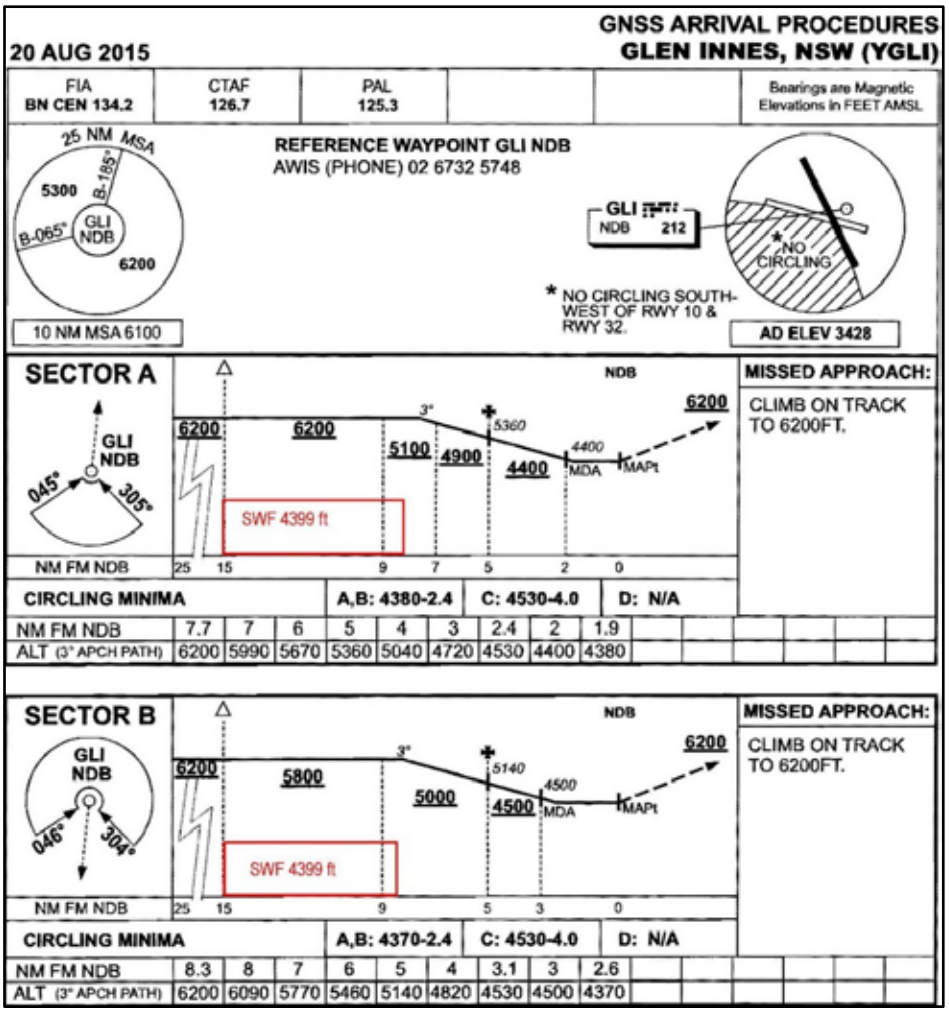

Figure 4.6.2.1 Glen Innes GNSS ARRIVAL PROCEDURE

The nearest boundary of the SWF is 8.08nm from the GLI NDB. After applying the 1nm buffer to the SWF boundary, aircraft will be clear of the SWF at 7nm from the NDB.

Initial Approach Segment

The Initial Approach Segment from 15nm to 9nm will be over the SWF. After the MOC of 1000ft is applied to the highest wind turbine 115 at 4455ft, the result is 5455ft.

This is below the minimum altitudes of 6200ft for Sector A, and 5800ft for Sector B.

Intermediate Approach Segment

The Intermediate Approach Segment is from 9nm to 7nm and will be over the SWF. After the MOC of 500ft is applied to the highest wind turbine 115 at 4455ft, the result is 4955ft.

This is below the minimum altitudes of 5100ft for Sector A, and 5000ft for Sector B.

The SWF turbines are below the minimum altitudes for the Glen Innes GNSS ARRIVAL PROCEDURE.

RNAV (GNSS) RWY 14

A copy of this procedure extracted from the AIP DAP is shown in Figure 4.6.2.2. The approximate nearest SWF eastern boundary is also shown – not to scale.

Holding and Final Approach

These segments are well clear of the SWF.

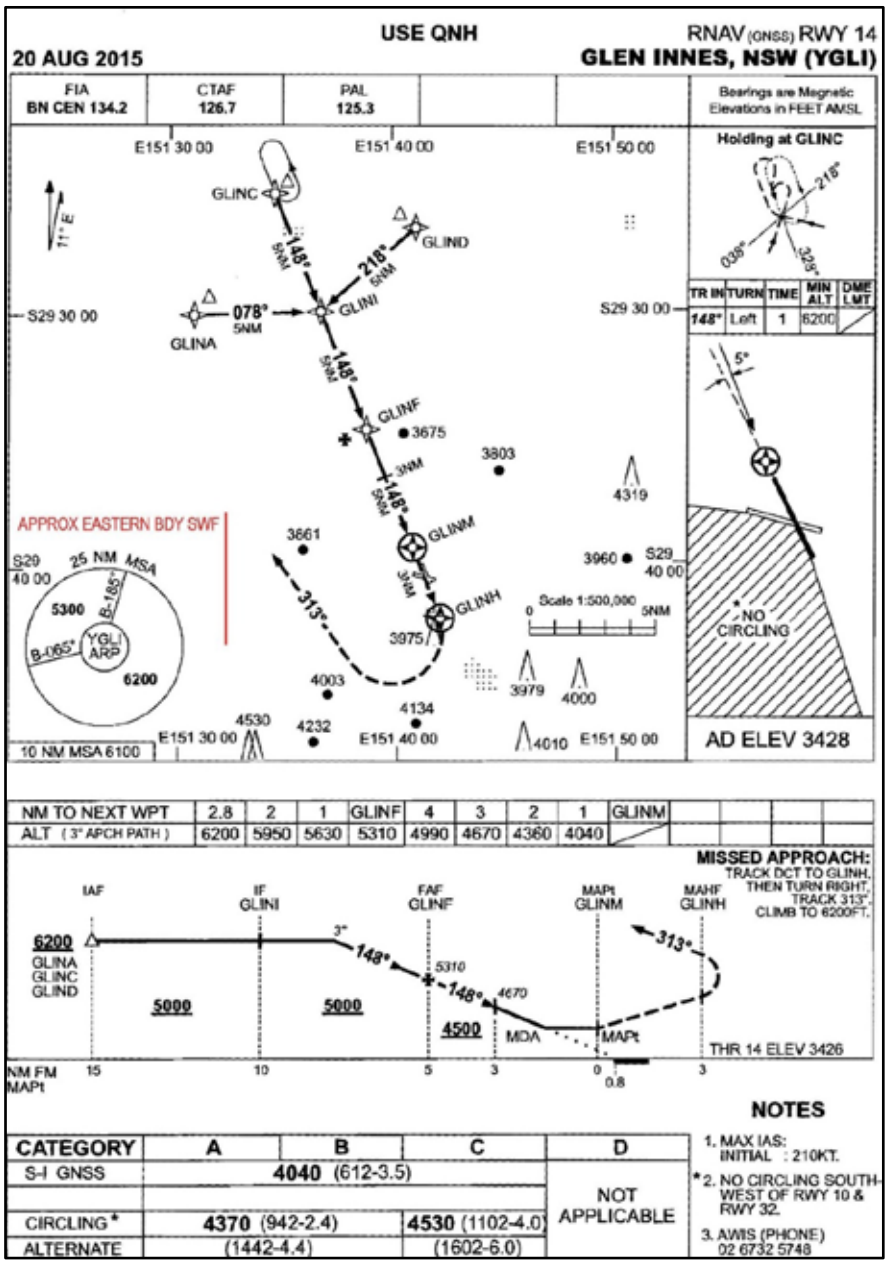

Figure 4.6.2.2 YGLI RWY 14 RNAV (GNSS) Approach

Missed Approach

(Note that all calculations for the missed approach area were made in accordance with ICAO Doc 8168 PANS-OPS Volume 2 Part 1 Section 4 Chapter 6.)

The missed approach commences at GLINM and tracks straight ahead to GLINH, then turns right to track 313º M.

CAT C aircraft conducting this manoeuver will fly over the SWF area as far west as 10.32nm from GLINH (turn diameter 8.23nm plus waypoint area width of 2nm).

Figure 4.6.2.3 shows the navigation tolerances for the missed approach segment of the approach (in red), the start of climb (SOC) point, and the shortest distance of 48424ft (in magenta) from the SOC to the nearest boundary of the SWF.

At the missed approach climb gradient of 2.5%, the minimum altitude gain in feet from the SOC to the nearest SWF boundary is calculated as follows:

48424ft X 0.025 = 1210ft

When this is added to the MDA altitude of 4040ft, the result is 5250ft, which is the minimum altitude reached at the SWF boundary.

The highest turbine tip is 4455ft (T115), and when the missed approach MOC of 164ft is applied, the result is 4619ft. This is 631ft below the minimum aircraft altitude of 5250ft.

The RWY 14 RNAV (GNSS) approach is not impacted by the Sapphire Wind Farm.

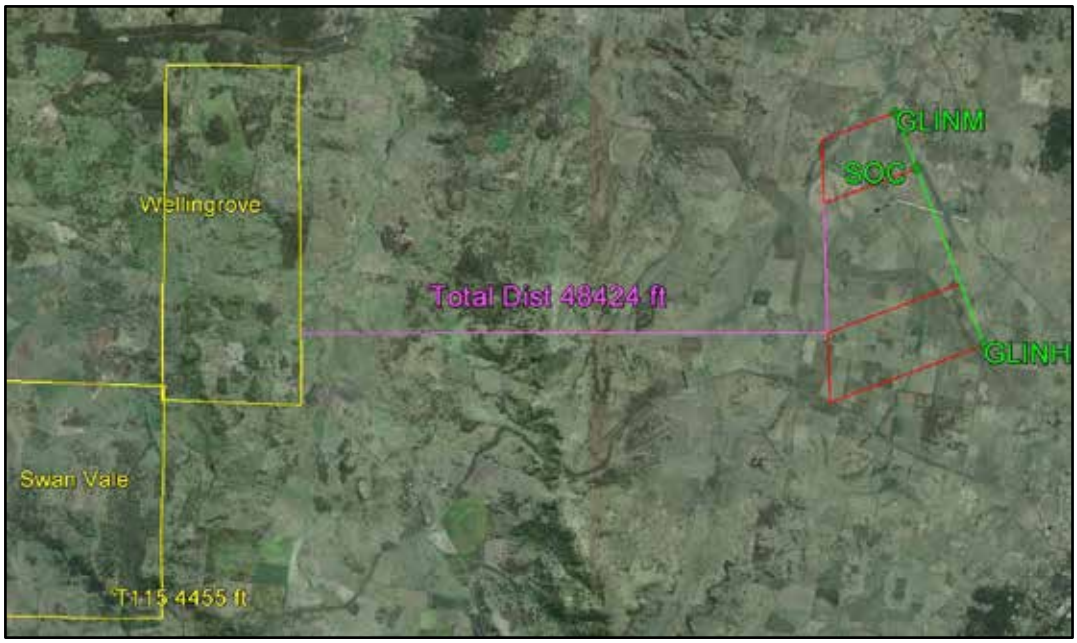

Figure 4.6.2.3 RWY 14 RNAV (GNSS) MISSED APPROACH and the SWF

RNAV (GNSS) RWY 32 and NDB RWY 14

The applicable navigation tolerances for these approach procedures are well clear of the SWF.

4.7 Air Routes and Lowest Safe Altitudes

A number of published air routes are in the vicinity of the SWF and are shown in Figure 4.7.1 below.

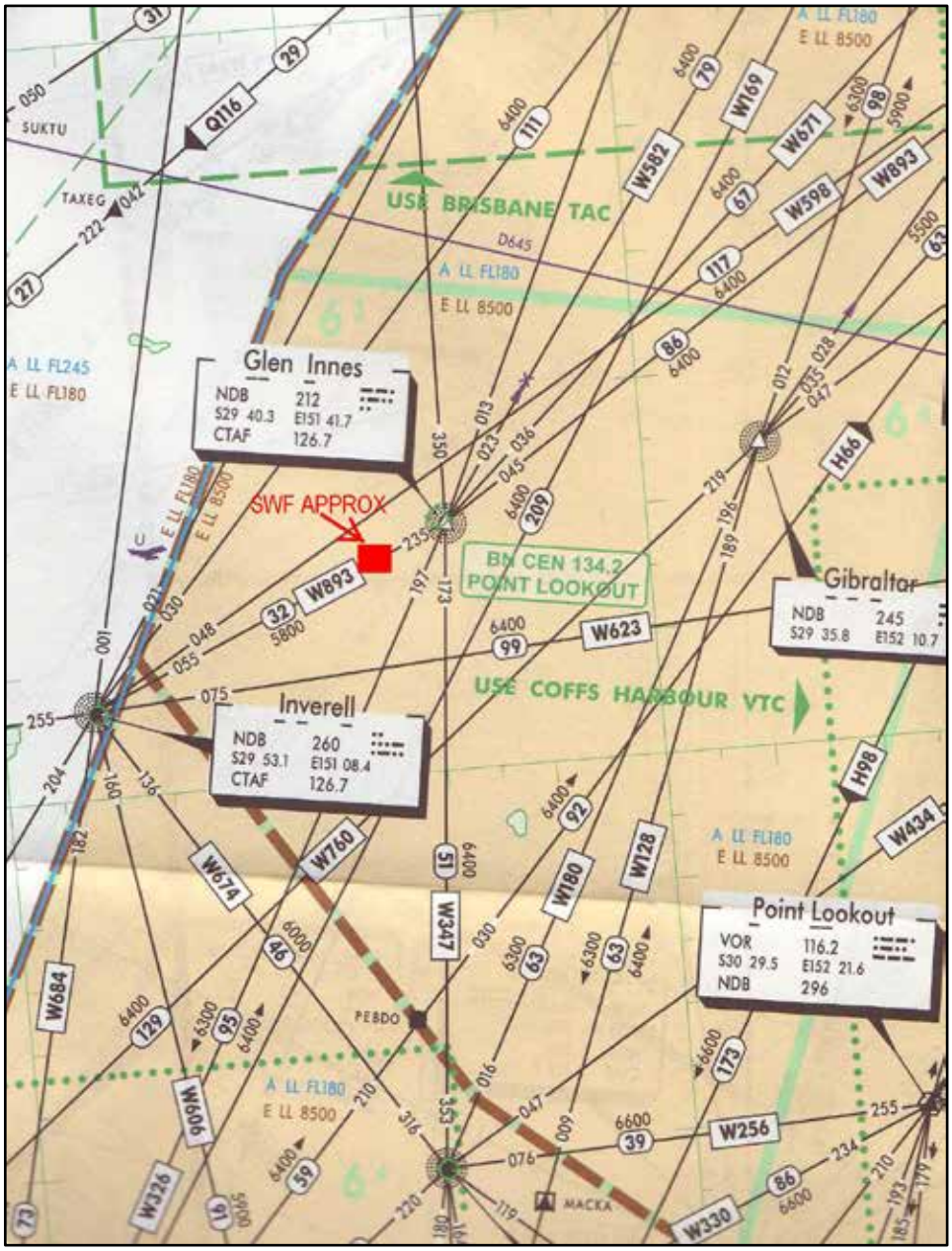

Figure 4.7.1 Air routes in the vicinity of the Sapphire Wind Farm (approximate boundaries)

The GRID LSALT and significant air routes and LSALTs are shown in Table 4.7.1.

Route	Section	LSALT ft.
GRID		6300
W893	IVL-GLI	5800
W598	IVL-GAMBL	6400
W623	IVL-GFN	6400
W267	IVL-VILLA	6400
W326	GLI-TW	6300

Table 4.7.1 LSALTs

The highest turbine tip is 4455ft, and when the MOC of 1000ft is applied the result is 5455ft, which is below the lowest LSALT of 5800ft on W893.

The SWF will not impact the LSALTs of the nearby Air Routes.

4.8 Airspace

The SWF is located in Class G non – controlled airspace, beneath Class E controlled airspace with a lower limit of 8500ft. There is no Prohibited, Restricted or Danger Area airspace within the vicinity.

4.9 Communications Navigation and Surveillance Facilities

4.9.1 Communications

There are no AsA air traffic control communications facilities located at or within 30nm of the wind farm.

4.9.2 Navigation Aids

CASR Part 139 Manual of Standards – Aerodromes, Chapter 11, sets out the general requirements for navigation aid sites and air traffic control facilities, including the clearance planes for planned and existing facilities.

There are two Navigation Aids in the vicinity, both Non Directional Beacons (NDBs), located on the Glen Innes and Inverell aerodromes.

GLI NDB

The GLI NDB is located 15 km to the east of the wind farm boundary.

The restricted area applicable to an NDB is 150m (Part 139 MOS, paragraph 11.1.13.1 refers).

As the wind farm is well beyond the above restricted area, it will not impact on the performance of the GLI NDB.

IVL NDB

The IVL NDB is located 27.8 km to the south west of the wind farm boundary.

The restricted area applicable to an NDB is 150m (Part 139 MOS, paragraph 11.1.13.1 refers).

As the wind farm is well beyond the above restricted area, it will not impact on the performance of the IVL NDB.

4.9.3 Surveillance

The nearest AsA Radar installations are an SSR at The Round Mountain, 105 km to the South East, and a combined PSR/SSR at Mt Somerville, 245 km to the north east.

Both of these radars are too far from the SWF for the wind turbines to have any impact on radar performance.

4.10 AIS Conclusions

The SWF development will NOT impact upon the following:

- The OLS published for any registered or certified aerodrome;
- The operation of any Navigation Aids and Communication facilities; and
- The operation of any Airspace Surveillance facility.

However the SWF WILL impact upon the following:

- The 25nm MSA for Glen Innes Aerodrome;

It will be recommended that AsA is requested to increase the 25nm MSA to 5500ft.

As the 10nm MSA is 6100ft, and the altitude at the Initial Fix (IF) for the RWY 14 NDB approach is 6100ft, aircraft would be required to be no lower than 6100ft within 10nm. It is considered that the increase in the 25nm MSA to 5500ft will have minimal impact on flight operations.

4.11 Airservices Australia Response to the AIS

AsA responded to the AIS on 22 February 2016 (see Appendix E) and agree with the Ambidji findings. AsA have included a note that procedures not designed by Airservices at Glen Innes and Inverell aerodromes were not considered in their assessment. The RWY23 RNAV-Z Instrument Approach procedure at Glen Innes aerodrome is the only procedure at either Inverell or Glen Innes aerodromes that is not designed by Airservices Australia.

4.11.1 Inverell Aerodrome

All procedures at Inverell aerodrome are designed by Airservices Australia. None of the instrument approach and departure procedures, nor any sector or circling altitude will be affected by any of the three wind farm clusters.

4.11.2 Glen Innes

AsA advise that to accommodate a maximum tip height of 1357.8m (4455ft) AHD in the *Swan Vale cluster* the Glen Innes aerodrome 25nm MSA in the NW sector will need to be raised from 5300ft to 5500ft. A permanent NOTAM would be required to implement this increase.

CWP Renewables, or Ambidji on their behalf, will need to consult with the aerodrome operator and CASA to secure agreement and to ensure the increase in the 25nm MSA (NW sector) from 5300ft to 5500ft will not adversely impact on the operations of Glen Innes aerodrome.

Ambidji notes that the 25nm MSA (NW sector) is common to all four instrument approach procedures at Glen Innes. A NOTAM raising this MSA will do so for all procedures.

4.11.3 CNS Facilities

The proposed Sapphire wind farm as outlined in this AIS will not adversely impact the performance of any Airservices Precision/Non-Precision Nav Aids, Anemometers, HF/VHF/UHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

4.12 Department of Defence Response to the AIS

The Department of Defence responded to the AIS on 5 February 2016 (see Appendix F) and advise that they have assessed the updated proposal and have no concerns at this time. The department remind the proponent that the proposed wind turbines meet the definition of tall structures and must be reported in accordance with AC139-08(0) *Reporting of Tall Structures*.

5. QUALITATIVE RISK ASSESSMENT

The expression "in the vicinity of the aerodrome" is considered by CASA to mean within the boundaries of either the OLS or the PANS-OPS surfaces.

The NASF Guideline D considers 30km (16.2nm) from a certified or registered aerodrome to be "in the vicinity."

More generally the impact on any aerodrome within 56km (30nm) of a wind farm is considered.

The SWF uses turbines of 200m (656ft) in height which is well above the 110m used by CASA and the 150m used by the NASF Guideline D as trigger heights for reporting as tall structures and consideration as an obstacle and therefore a hazard to aircraft safety.

The MOS 139[3] requires any object of 150m or taller to be regarded as an obstacle unless assessed otherwise by CASA.

5.1 Certified or Registered Aerodromes within 30nm

There are two registered or certified aerodromes within 30nm of the wind farm:

- Inverell (YIVL) 15.59nm (28.87km) to the South West of the Wind Farm boundary; and
- Glen Innes (YGLI) 7.75nm (17.33km) to the East of the Wind Farm boundary.

5.1.1 Inverell

Inverell Aerodrome has the following Instrument Departure and Approach Procedures (DAP):

- GNSS ARRIVAL Procedures;
- NDB RWY 16; and
- RNAV (GNSS) RWY 34.

The OLS for YIVL extends to 5.5km from the runway thresholds. As the aerodrome is 15.59km from the SWF boundary, the wind farm is clear of the OLS.

The MSA for these approaches is 6200ft within 25nm of the IVL NDB in the sector over the SWF (see Figure 4.6.1). When the MOC of 1000ft is applied to the highest tip AHD of 4455ft, the result is 5455ft which is below the 25nm MSA.

The MSA is not impacted by the Sapphire Wind Farm.

Night Visual Flight Rules operations are also governed by published LSALT. Descent into an aerodrome for VFR at night should not normally proceed below the LSALT until the aircraft is within 3nm from the aerodrome and in VMC. The SWF is more than 10nm from YIVL; **therefore Night VFR operations will not be impacted.**

[3] CASR Part139 Manual Of Standards - Aerodromes

The SWF is sufficiently distant from YIVL to "*not be a hazard to aircraft safety"* and therefore *"not of operational significance"* to aircraft operations. Obstacle lighting is not required.

5.1.2 Glen Innes

Glen Innes Aerodrome has the following Instrument Departure and Approach Procedures (DAP):

- GNSS ARRIVAL Procedures;
- NDB RWY 14;
- RNAV (GNSS) RWY 14; and
- RNAV-Z (GNSS) RWY 32.

The OLS for YGLI extends to 5.5km from the runway thresholds. As the aerodrome is 17.33km from the SWF boundary, the wind farm is clear of the OLS.

The MSA in the Sector over the SWF is 5300ft within 25nm of the GLI NDB and is 6100ft within 10nm. The MSA is shown in Figure 4.6.2.1. The SWF is impacted by the 25nm MSA.

When the MOC of 1000ft is applied to the highest tip AHD of 4455ft, the result is 5455ft. This height will penetrate the 25nm MSA by 155ft.

To overcome this penetration it is recommended that AsA be requested to increase the 25nm MSA to 5500ft.

As the 10nm MSA is 6100ft, and the altitude at the IF for the RWY 14 NDB approach is 6100ft, aircraft would be required to be no lower than 6100ft within 10nm. It is considered that the increase in the 25nm MSA to 5500ft will have minimal impact on flight operations.

Night Visual Flight Rules operations are also governed by published LSALT. Descent into an aerodrome for VFR at night operations does not normally proceed below the LSALT/MSA until the aircraft is within 3nm from the aerodrome and in VMC. Assuming AsA amends the 25nm MSA for YGLI **night VFR operations will not be impacted.**

5.2 Identified ALA within 30nm

There is an ALA located on the Gwyder Highway approximately 6km east of Inverell and 21km west south west of the wind farm boundary. This ALA is known as Inverell North (YINO). There are no details for YINO published in the EnRoute Supplement Australia (ERSA).

There is an ALA located on the New England Highway approximately 25.5km south east of the Swan Vale cluster. No details for this ALA were found in ERSA.

5.4 Airspace

The SWF is located in Class G non – controlled airspace, beneath Class E controlled airspace with a lower limit of 8500ft. There is sufficient Class G airspace above the SWF to facilitate general, recreational and sport aviation activities in non-controlled airspace.

There is no Prohibited, Restricted or Danger Area airspace within the area.

5.5 Relevant Air Routes

As explained in Section 4.7, there are several published air routes over the SWF. The maximum tip height of the highest turbine in the SWF is safely below the LSALT's for all of these air routes.

The SWF will not impact on the LSALT for any of these air routes.

5.6 Night Flying

Aircraft flying at night under either IFR or VFR are protected by published or calculated LSALT and descent below the LSALT is restricted to within 3nm (5.4km) of the aerodrome for a visual approach to land. Where an IFR aircraft is using a published instrument approach it is protected by PANS-OPS surfaces.

5.7 General Aviation Flying Training

There is a flying training school at Inverell that conducts ab-initio flying training. They use the route between Inverell and Glen Innes as part of the training and also conduct some low level training in the Emmaville, Swan Valley and Wellingrove areas.

There are flying schools at Tamworth and Armidale who occasionally use the area around Inverell and Glen Innes for navigation training purposes.

All ab-initio flying training is conducted in accordance with the Visual Flight Rules (VFR) as defined in Division 3 of the Civil Aviation Regulations 1988 (CAR). VFR operations may be flown in accordance with CAR 157 *Low Flying*, which states, in part, that an aircraft must not be flown lower than 500ft (152m) above the highest terrain or obstacle on or within a radius of 600m for fixed wing aircraft and 300m for helicopters. This requirement does not apply if the aircraft is engaged in approved low flying activity.

5.8 Recreational and Sport Aviation

There is recreational and sport aviation, using Recreational Aviation – Australia (RA-Aus) registered aircraft at Inverell and Glen Innes and the surrounding areas. These aircraft are limited to VFR flight by day in VMC.

5.9 Approved Low Flying Activities

There are no promulgated flying training areas depicted on the relevant aeronautical charts that will impact the Sapphire Wind Farm.

There are no Military, Restricted, Danger or Low Flying areas depicted on the relevant aeronautical charts that will impact on the Sapphire Wind Farm.

5.10 Aerial Agricultural Aviation Activities

The Aerial Agricultural Association of Australia opposes wind farm developments unless the developer has (inter alia):

- Consulted in detail with local operators;
- Received independent expert advice on safety and economic impacts; and
- Considered the impacts on the aerial application industry.[4]

An aerial agricultural operator made the comment that *"the decision to host wind turbines is one made by the landholder who must accept that there will most probably be limitations to any aerial applications on the property[5]."*

Discussion with an Aerial Agricultural operator at Armidale revealed that the majority of aerial agricultural work in the Inverell, Glen Innes area is top dressing pastures. This operator has a fleet of aircraft set up for top dressing. These aircraft are available for firefighting. The operator advised that the wind farm would impact on his ability to operate in the area and he would definitely not operate in the close vicinity of the wind farm. This would impose economic hardship on his business.

5.11 Known Highly Trafficked Areas

There are no known highly trafficked areas in the vicinity of the SWF.

There is a regular freight aircraft flight between Armadale, Inverell, and Glen Innes and beyond five days a week. This aircraft often transits between Inverell and Glen Innes as a VFR flight below cloud in order to obviate the need to conduct an instrument approach on arrival to land. This flight would cross the bottom corner of the SWF, however following the Gwyder Highway as a visual reference would keep the aircraft clear of the SWF.

5.12 Emergency Services Flying

All emergency services flying undergo ongoing dynamic risk assessment for the duration of the flight. Wind turbines are another obstacle that needs to be considered during the planning and conduct of the flight. Where the risk is considered unacceptable to the pilot in command, the flight will not continue. This risk assessment considers weather, terrain and obstacles such as powerlines, mobile phone towers, radio masts and wind turbines.

[4] http://www.aerialag.com.au/ResourceCenter/Policies.aspx
[5] Expert opinion obtained by the author during previous QRA work

5.13 Firefighting

5.13.1 Aerial Firefighting

"It is important to remember that aircraft alone do not extinguish fires."[6]

Concern about the inability to utilise aerial firefighting in the wind farm area was expressed by some stakeholders. From previous work undertaken by Ambidji regarding firefighting within wind farms it is noted that the rural firefighting agencies in Victoria, New South Wales, South Australia and Western Australia all view wind turbines and wind farms to be 'just another hazard' that has to be considered in the risk management process associated with aerial firefighting[7].

The State rural firefighting agencies made submissions to the recent Senate Select Committee on Wind Turbines. All these submissions attached the Australian Fire and Emergency Service Authorities Council (AFAC) *Wind Farms and Bushfire Operations Position Paper 30 October 2014* document. A copy of this paper is at Appendix E.

The AFAC paper states:

> *"Aerial firefighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks."*[8]

All these agencies make the point that firefighting aircraft operate to the Visual Flight Rules so can only operate during daylight hours and must remain clear of smoke in order to maintain the required visibility of the ground and obstacles such as trees, power lines, radio masts, houses and ground based fire fighters. The Victorian Country Fire Authority (CFA) recommends:

> *"… … a minimum distance between turbines of 300 metres. This provides adequate distance for aircraft to operate around a wind energy facility given the appropriate weather and terrain conditions. Fire suppression aircraft operate under the 'Visual Flight Rules'. As such, fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Wind turbines, similar to high voltage transmission lines, are a part of the*

[6] NSW Rural Fire Service submission to the Senate Select Committee on Wind Turbines, 6 March 2015, page 2
[7] Expert opinion formed by the author from previous QRA work
[8] AFAC *Wind Farms and Bushfire Operations Position version 2.0 30 October 2014, page 2*

landscape and would be considered in the incident action plan."[9]

The South Australian Country Fire Service has published a fact sheet titled *Understanding Aerial Firefighting* which explains the use and limitations of aircraft in firefighting. The major point made is that:

> *"The popular perception amongst much of the population is that aircraft alone can put out bushfires. This is not true. CFS firefighters and fire appliance for the vast majority of instances are the primary and only method of controlling bushfires.*[10]*"*

A further point made by the CFS is that firefighting aircraft are a limited resource and are not routinely allocated to every fire. A copy of the fact sheet is at Appendix F.

5.13.2 Ground Based Firefighting

From previous work done regarding firefighting within wind farms it is noted that the rural fire fighting agencies in Victoria, New South Wales, South Australia, and Western Australia all make the point that access for fire trucks and personnel, and consequently their ability to fight the fire within a wind farm, is greatly enhanced by the access roads built for the construction and maintenance of the turbines. These roads also act as fire breaks which will slow or contain the fire spread across the open ground. The area around the base of each tower is kept clear of vegetation and as such offers a refuge for fire fighters and their vehicles.

The CFA recommends:

> *"To enable access for fire appliances the following provisions should be considered:*
>
> - *Constructed roads should be a minimum of 3.5 metres in trafficable width (with 0.5m each side) with a four (4) metre vertical clearance for the width of the formed road surface*
> - *Roads should be constructed to a standard so that they are accessible in all weather conditions and capable of accommodating a vehicle of 15 tonnes and 30 tonne, if a CFA aerial appliance, is within the District, for the trafficable road width."*[11]

The CFA further recommends:

> *Wind Energy Facility operators must ensure that the following fuel*

[9] CFA Emergency Management Guidelines for Wind Energy Facilities May 2015 section 2
[10] SA CFS Fact Sheet 10-01, *Understanding Aerial Firefighting,* March 2015
[11] CFA Emergency Management Guidelines for Wind Energy Facilities May 2015 section 3

management measures are included in their plans during the Fire Danger Period:

- *Grass should be no more than 100mm in height and leaf litter no more that 10mm deep for a distance of thirty (30) metres around constructed buildings and viewing platforms;*
- *A fuel reduced area of four (4) metres width should be maintained around the perimeter of electricity compounds and substation type facilities;"*[12]

5.14 Topography and Marginal Weather Considerations

Aircraft operating under Instrument Flight Rules (IFR) can operate in poor weather conditions and in cloud which precludes visual acquisition of obstacles and terrain. These operations are protected by PANS OPS surfaces and LSALT's that are designed to keep the aircraft clear of obstacles and terrain.

Otherwise CAR 157 states (in part) that an aircraft operating under VFR must not fly lower than 152m/500ft over a non-populated area being terrain or obstacles on that terrain and within, for an aircraft other than a helicopter, 600m horizontally and, in the case of a helicopter, 300m horizontally to the same, unless:

- Due stress of weather or any other avoidable cause it is essential that a lower height be maintained; or
- It is engaged in approved low flying private or aerial work; or
- It is engaged in flying training and flies over part of a flying training area in respect of which low flying is authorised by CASA under sub regulation 141(1); or
- It is undertaking a baulked approach; or
- It is flying in the course of actually taking-off or landing at an aerodrome.

In this regard, the Aeronautical Information Publication (AIP) states that a pilot of a fixed wing aircraft operating under VFR (by day in Class G airspace[13]) must have 5km forward visibility and remain clear of clouds and in sight of ground or water when operating below 3000ft AMSL. Helicopters are approved in the regulations to operate with 800m visibility if operating at a reduced speed.

In regard to the first bullet point above it is possible that due to lowering cloud base, and if through poor airmanship the aircraft had pressed on to the point that it was unable to execute a turn and fly away from the weather, an aircraft could find itself lower than 152m/500ft above the terrain or obstacles.

Concern has been expressed by the flying instructors at Inverell and Glen Innes about the impact 200m (656ft) turbines may have on low level flight in the transition area between the Western Plains and the Dividing Range around Glen Innes. There is often low cloud along the ranges that reduces the clearance available to aircraft flying

[12] CFA Emergency Management Guidelines for Wind Energy Facilities May 2015 section 9

[13] Class G: IFR and VFR flights are permitted and do not require an airways clearance. IFR flights must communicate with air traffic control and receive traffic information on other IFR flights and a flight information service. VFR flights receive a flight information service on request.

in accordance with the VFR. Often pilots will "push on" trying to find a gap in the cloud and the ranges that will permit them to continue flight to the coast. Having the additional hazard of tall wind turbines in the area increases the risk to low flying aircraft caught in marginal VMC. The rules governing VFR require that pilots remain clear of cloud and do not get into such situations by turning around and terminating the flight at the nearest suitable aerodrome.

5.15 NASF Guidelines

The National Airports Safeguarding Framework – Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides guidance for the siting and marking of the turbines and meteorological monitoring towers associated with wind farms.

5.15.1 Notification to Authorities

Paragraph 20 of Guideline D advises that:

> *When wind turbines over 150m above ground level are to be built within 30km (16.2nm) of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.*

The turbines and meteorological monitoring towers used in the SWF must be reported to CASA and the RAAF in accordance with AC 139-08(1) *Reporting of Tall Structures*.

The turbines are greater than 150m and are within 30km (16.2nm) of YIVL and YGLI so should be considered as a hazardous obstacle.

5.15.2 Risk Assessment

The NASF Guideline has the following requirements for a risk assessment.

> *26. Following preliminary assessment by an aviation consultant of potential issues, proponents should expect to commission a formal assessment of any risks to aviation safety posed by the proposed development. This assessment should address any issues identified during stakeholder consultation.*

The preliminary risk assessment for the SWF indicates that the overall risk to aviation is LOW. A risk assessment of LOW indicates that the wind farm is *'not a hazard to aircraft safety'.*

> *27. The risk assessment should address the merits of installing obstacle marking or lighting. The risk assessment should determine whether or not a proposed structure will be a hazardous object. CASA may determine, and subsequently advise a proponent and relevant planning authorities that the structures have been determined as:*

> *(a) Hazardous but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or*
>
> *(b) Hazardous and should not be built, either in the location and/or to the height proposed as an unacceptable risk to aircraft safety will be created; or*
>
> *(c) Not a hazard to aircraft safety.*

By day the SWF turbines are conspicuous by their size and colour. The turbines are sufficiently distant from YIVL and YGLI to not impact on the prescribed airspace associated with the DAP at each. The SWF does not impact on any LSALT in the area. Night operations for aircraft do not occur below the LSALT for IFR and VFR at night. IFR aircraft are protected by the LSALT and DAP at each aerodrome. Where an approach to land is undertaken operating to VFR at night, descent below the LSALT does not occur until within 3nm of the airport and in VMC.

Given the above, the SWF does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.

Overall the risk assessment demonstrates that the SWF is a LOW risk to aviation and is therefore *not a hazard to aircraft safety.*

> *28 If CASA advice is that the proposal is hazardous and should not be built, planning authorities should not approve the proposal. If a wind turbine will penetrate a PANS-OPS surface, CASA will object to the proposal. Planning decision makers should not approve a wind turbine to which CASA has objected.*

The SWF does not penetrate the OLS for either YGLI or YIVL.

The SWF does not penetrate the PANS-OPS surfaces for YIVL. It is proposed that the 25nm MSA for YGLI be raised to 5500ft. The 10nm MSA for YGLI is currently 6100ft and the IF is to be passed at 6100ft.

Once this is achieved the SWF will not penetrate the PANS-OPS surfaces for YGLI or YIVL.

> *29 In the case of military aerodromes, Defence will conduct a similar assessment to the process described above if required. Airservices, or in the case of a military aerodrome, Defence, may object to a proposal if it will adversely impact on Communications, Navigation or Surveillance (CNS) infrastructure. Airservices/ Defence will provide detailed advice to proponents on request regarding the requirements that a risk assessment process must meet from the CNS perspective.*

There is no military or civil CNS infrastructure that will be impacted by the SWF.

5.15.3 Lighting of Wind Turbines

> *31 Siting of wind turbines in the vicinity of an aerodrome is strongly discouraged, as these tall structures can pose serious hazards to aircraft taking off and landing. Where a wind turbine is proposed that will penetrate the OLS of an aerodrome, the proponent should conduct a risk assessment. The risk assessment to be conducted by a suitably qualified person, should examine the effect of the proposed wind turbines on the operation of aircraft. The study should be made available to CASA to assist assessment of any potential risk to aviation safety.*

The SWF does not penetrate the OLS for either YGLI or YIVL.

The SWF does not penetrate the PANS-OPS surfaces for YIVL. It is proposed that the 25nm MSA for YGLI be raised to 5500ft. The 10nm MSA for YGLI is currently 6100ft and the IF is to be passed at 6100ft.

Once this is achieved the SWF will not penetrate the PANS-OPS surfaces for YGLI or YIVL.

The SWF is assessed as a LOW risk to aviation and is therefore *not a hazard to aircraft safety.*

> *32 CASA may determine that the proposal is:*
>
> *(a) Hazardous and should not be built, either in the location and/or to the height proposed, as an unacceptable risk to aircraft safety will be created; or*
>
> *(b) Hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking.*

The SWF does not penetrate the OLS for either YGLI or YIVL.

The SWF does not penetrate the PANS-OPS surfaces for YIVL. It is proposed that the 25nm MSA for YGLI be raised to 5500ft. The 10nm MSA for YGLI is currently 6100ft and the IF is to be passed at 6100ft.

Once this is achieved the SWF will not penetrate the PANS-OPS surfaces for YGLI or YIVL.

By day the SWF turbines are conspicuous by their size and colour. The turbines are sufficiently distant from YIVL and YGLI to not impact on the prescribed airspace associated with the DAP at each. The SWF does not impact on any LSALT in the area. Night operations for aircraft do not occur below the LSALT for IFR and VFR at night. IFR aircraft are protected by the LSALT and DAP at each aerodrome. Where an approach to land is undertaken operating to VFR at night, descent below the LSALT does not occur until within 3nm of the airport and in VMC.

Given the above, the SWF does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.

5.17 QRA Findings

Risk Element	Assessed Level of Risk	Comment
Airport Operations	LOW	
Inverell (YIVL)	LOW	
Glen Innes (YGLI)	LOW	
Aircraft Landing Area Operations	LOW	Pilot responsibility. One identified within 30nm
Known Highly Trafficked Routes	LOW	None identified
Published Air Routes	LOW	Nil impact
Restricted Airspace	LOW	None in the area
Promulgated Flying Training Areas	LOW	None in the area
Night Flying	LOW	
Emergency Services Flying	LOW	
Commercial Flying	LOW	Daily freight flight weekdays
Recreational and Sport Aviation	LOW	By day only
Recreational Pilot Training (RA-AUS)	LOW	By day only
GA Flying	LOW	
GA Pilot Training	LOW	Usually by day only
Weather and Topographical Issues	LOW	The nearby ranges are a known area for marginal VMC. There are sufficient aerodromes in the area suitable for landing to avoid proceeding into marginal VMC

Table 5.1 – Risk Assessment Summary

The Sapphire Wind Farm will not be a hazard to aircraft safety as shown in table 5.1 above.

The wind farm must be reported to aviation authorities in accordance with AC 139-08(0) *Reporting of Tall Structures* and marked on the appropriate aeronautical charts.

Additionally, formal notification of the location and height of the SWF should be made to:-

- Local aviation operators;
- Local Aerial Agricultural Applications Operators at Armidale and surrounding area;
- NSW Police Air Wing;
- NSW Ambulance Service;
- NSW Rural Fire Service;
- Aerial Agricultural Association of Australia (AAAA); and
- Recreational Aviation Australia (RA-Aus).

The QRA demonstrates that the SWF will "*not be a hazard to aircraft safety*" and therefore "*not of operational significance*" to aircraft operations.

6. OBSTACLE LIGHTING REVIEW

6.1 Summary of International Standards for Obstacle Lighting of Wind Farms

6.1.1 International Civil Aviation Organisation

The relevant International Civil Aviation Organisation (ICAO) recommendations regarding wind farms are detailed in *Annex 14 – Aerodromes*.[14]

ICAO has recommended that a wind turbine shall be marked and/or lit if it is determined to be an obstacle. Section 4.3 of the Annex refers to *"Objects outside the Obstacle Limitation Surface"* and Section 4.3.2 in particular states inter-alia: -

> *4.3.2* **Recommendation** – *In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150m or more above ground level should be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.*
>
> *Note – This study may have regard to the nature of operations concerned and may distinguish between day and night operations.*
>
> *6.2.4* ***Wind Turbines***
>
> ***Markings***
>
> *6.2.4.1 A wind turbine shall be marked and/or lit if it is determined to be an obstacle.*
>
> *Note – See 4.3.1 and 4.3.2*
>
> *6.2.4.2* ***Recommendation*** *– The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.*
>
> ***Lighting***
>
> *6.2.4.3* ***Recommendation*** *– When lighting is deemed necessary, medium-intensity obstacle lights should be used. In the case of a wind farm, i.e. a group of 2 or more wind turbines, it should be regarded as an extensive object and the lights should be installed*
>
> > *a) To identify the perimeter of the wind farm;*
> >
> > *b) Respecting the maximum spacing, in accordance with 6.2.3.15*, between the lights along the perimeter, unless a dedicated assessment shows a greater spacing can be used;*
> >
> > *c) So that, where flashing lights are used, they flash simultaneously; and*
> >
> > *d) So that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located.*

[14] ICAO Annex 14 Aerodromes Vol 1 Aerodrome Design and Operations Sixth Edition 14 November 2013

6.2.4.4 ***Recommendation*** *– The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.*

**6.2.3.15 recommends medium intensity lights be spaced at longitudinal intervals not exceeding 900m.*

6.1.2 Other International Aviation Regulatory Authorities

A review of the standards and recommendations regarding wind farms as obstacles from several countries, including the US FAA, CAA UK, CAA NZ, Transport Canada and the Irish Aviation Authority shows that wind turbines shall be painted white or off-white so that they contrast with the surrounding landscape unless a risk assessment indicates a different colour should be used.

The review also shows there is a wide variation as to the determining criteria related to the location, height and spacing of wind turbines that should be lit. A number of countries are now taking into account the *visual amenity* associated with required obstacle lighting of wind farms by assessing the hazard to aviation safety posed by its *nature and location*. In essence, a wind farm is required to be lit unless a risk assessment shows that it is not a hazard to aviation safety.

Several countries, including Canada, Norway and the USA have approved the use of radar based Obstacle Collision Avoidance Systems (OCAS)[15] to activate obstacle lighting in the presence of an aircraft. This system allows the obstacle lighting to be in a quiescent state until activated by the system sensing the presence of an aircraft.

Throughout the world the accepted obstacle marking for wind turbines is to paint them white or off-white so that they contrast to the surrounding landscape and where a risk assessment considers them to be a hazard to aviation they shall be lit at night.

6.2 Australian Regulatory Framework for Obstacle Lighting of Wind Farms

CASA is Australia's aviation safety regulator and is responsible for setting standards applicable to the protection of airspace and the safety of aircraft and airport operations. Australia, as a member state, applies the ICAO Standards and Recommended Practices to Australian aviation except where it formally lodges a "difference."

CASA issued Advisory Circular AC139-18 (0) *Obstacle Marking of Wind Farms* in July 2007. CASA withdrew this AC in October 2008 after consideration of its legality and complaints to CASA's Industry Complaints Commissioner.

6.2.1 Civil Aviation Safety Regulations

The Civil Aviation Safety Regulations (CASR) Part 139 – Aerodromes, Section E contains the regulations governing obstacles. These regulations are applicable to the protection of airspace and aircraft operations in the vicinity of aerodromes. They are not applicable to obstacles that are beyond the vicinity of aerodromes.

[15] OCAS technology is now owned by Vestas; see http://www.ocas-as.no/us/

CASR 139.360 - Notice of obstacles

(1) An aerodrome operator must take all reasonable measures to ensure that obstacles at, or within the vicinity of, the aerodrome are detected as quickly as possible.

(2) If the operator becomes aware of the presence of an obstacle, the operator must:

(a) Tell the NOTAM Office immediately; and

(b) Give the NOTAM Office details of:

(i) The height and location of the obstacle; and

(ii) amended declared distances and gradients, if applicable.

Penalty: 10 penalty units.

(3) If the operator becomes aware of any development or proposed construction near the aerodrome that is likely to create an obstacle, the operator must:

(a) Tell CASA as soon as practicable; and

(b) Give to CASA details of the likely obstacle.

Penalty: 10 penalty units.

139.365 Structures - 110 metres or more AGL

A person who proposes to construct a building or structure the top of which will be 110 metres or more AGL must inform CASA of that intention and the proposed height and location of the building or structure.

Penalty: 10 penalty units.

139.370 - Hazardous objects etc.

(1) CASA may determine, in writing, that:

(a) An obstacle, or any proposed development or other proposed construction that is likely to create an obstacle; or

(b) A building or structure the top of which is 110 metres or more AGL; or

(c) A proposed building or structure the top of which will be 110 metres or more AGL;

is, or will be, a hazardous object because of its location, height or lack of marking or lighting.

(2) CASA may determine, in writing that a gaseous efflux having a velocity exceeding 4.3 metres per second is, or will be, a hazard to aircraft operations because of the velocity or location of the efflux.

(3) If CASA makes a determination under sub regulation (1) or (2), it

must:

(a) Publish in AIP or NOTAMS particulars of the hazardous object or gaseous efflux to which the determination relates; and

(b) Give written notice of the determination in accordance with sub regulation (4).

(4) CASA must give a copy of the notice:

(a) In the case of a hazardous object that is a proposed building or structure:

(i) to the person proposing to construct the building or structure; and

(ii) to the authority or, if applicable, one or more of the authorities whose approval is required for the construction; and

(c) in any other case, if a person who owns or is in occupation or control of the hazardous object, or owns or is in control of the installation that produces the gaseous efflux, can reasonably be identified to that person.

6.2.2 Manual of Standards Part 139 – Aerodromes

The authority of the Manual Of Standards (MOS) is outlined below.

1.1.1 Background and Scope

Under section 3 of the Civil Aviation Act 1988, an aerodrome is an area authorised by the regulations for use as an aerodrome. Paragraph 92 (1) (b) of the Civil Aviation Regulations 1988 has the effect of authorising a place for use as an aerodrome if it is certified or registered under Part 139 of the Civil Aviation Safety Regulations 1998 (CASR 1998). This document is the Manual of Standards (MOS) — Part 139 Aerodromes (the MOS) made under regulation 139.015 of CASR 1998. The MOS *comprises specifications (Standards) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation. In those parts of the MOS where it is necessary to establish the context of standards to assist in their comprehension, the sense of parent regulations has been reiterated.*[16]

1.1.2 Document Set

1.1.2.1 The document hierarchy consists of:

(a) the Civil Aviation Act 1988 (the Act);

(b) relevant Civil Aviation Safety Regulations (CASRs);

[16] CASA Manual of Standards Part 139 – Aerodromes Version 1.12 November 2014 Section 1.1 General

(c) the Manual of Standards (MOS); and

(d) Advisory Circulars (ACs).

1.1.2.2 The Act establishes the Civil Aviation Safety Authority (CASA) with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

1.1.2.3 CASRs establish the regulatory framework (Regulations) within which all service providers must operate.

1.1.2.4 The MOS comprises specifications (Standards) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation. In those parts of the MOS where it is necessary to establish the context of standards to assist in their comprehension, the sense of parent regulations has been reiterated.

1.1.2.5 Readers should understand that in the circumstance of any perceived disparity of meaning between MOS and CASRs, primacy of intent rests with the regulations.

1.1.2.6 Service providers must document internal actions (Rules) in their own operational manuals, to ensure the maintenance of and compliance with standards.

1.1.2.7 ACs are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means of complying with the Regulations. ACs may explain certain regulatory requirements by providing interpretive and explanatory materials. It is expected that service providers will document internal actions in their own operational manuals, to put into effect those, or similarly adequate, practices.

1.1.3 Differences between ICAO Standards and those in MOS

1.1.3.1 Notwithstanding the above, where there is a difference between a standard prescribed in the ICAO standards and one in the MOS, the MOS standard shall prevail.

1.1.4 Differences published in AIP

1.1.4.1 Differences from ICAO Standards, Recommended Practices and Procedures are published in AIP Gen 1.7

Chapter 7 of MOS 139 deals with obstacles in the vicinity of aerodromes. The relevant part is: -

7.1.5 Objects Outside the OLS

7.1.5.1. Under CASR Part 139 any object which extends to a height of 110m or more above local ground level must be notified to CASA.

Note: *For instrument runways, obstacle monitoring includes the PANS-OPS surface which extends beyond the OLS for that aerodrome.*

7.1.5.2 Any object that extends to a height of 150m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.

7.1.6 Objects That Could Become Obstacles

7.1.6.1 If a proposed object or structure is determined to be an obstacle, details of the proposal must be referred to CASA, the Authority to determine whether it will be a hazard to aircraft operations.

7.1.6.2 Shielded Obstacle. A new obstacle that is shielded by an existing obstacle may be assessed as not imposing additional restrictions to aircraft operations.

7.1.6.3 Marking and Lighting Obstacles

a) CASA may direct that obstacles be marked and or lit and may impose operational restrictions on the aerodrome as a result of an obstacle;

b) If directed by CASA, lighting and/or marking of obstacles, including terrain must be carried out in accordance with the standards set out in Chapter 8 and Chapter 9.

Chapter 8 of MOS 139 deals with the Visual Aids provided by Aerodrome Marking, Markers, Signals and Signs. Section 8.10 Obstacle Marking provides guidance for obstacle marking.

8.10.1 General

8.10.1.1 Fixed objects, temporary and permanent, which extend above the obstacle limitation surfaces but are permitted to remain; or objects which are present on the movement area, are regarded as obstacles, and must be marked. The aerodrome operator must submit details of such obstacles to CASA, for hazard assessment and particular requirements for marking and lighting. This information must be included in the Aerodrome Manual.

8.10.1.2 CASA may permit obstacles to remain unmarked;

a) when obstacles are sufficiently conspicuous by their shape, size or colour;

b) when obstacles are shielded by other obstacles already marked; or

c) when obstacles are lighted by high intensity obstacle lights by day.

8.10.2 Marking of Obstacles

8.10.2.1 A structure must be marked when more than 150 m higher than the surrounding terrain. Surrounding terrain means the area within 400m of the structure. Structures above 90m may need to be marked, and inconspicuous structures 75m above ground level should also be marked. Fixed objects on the aerodrome movement area, such as ILS buildings, must be marked as obstacles.

6.2.3 National Airports Safeguarding Framework

The Australian National Airports Safeguarding Advisory Group (NASAG) produced a set of guidelines called the National Airports Safeguarding Framework (NASF) in 2012.

The purpose of the National Airports Safeguarding Framework (the Safeguarding Framework) is to enhance the current and future safety, viability and growth of aviation operations at Australian airports, by supporting and enabling:

- the implementation of best practice in relation to land use assessment and decision making in the vicinity of airports;
- assurance of community safety and amenity near airports;
- better understanding and recognition of aviation safety requirements and aircraft noise impacts in land use and related planning decisions;
- the provision of greater certainty and clarity for developers and land owners;
- improvements to regulatory certainty and efficiency; and
- the publication and dissemination of information on best practice in land use and related planning that supports the safe and efficient operation of airports.

Guideline D *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation* provides information regarding wind farms. This guideline provides the following information: -

20 When wind turbines over 150m above ground level are to be built within 30km (16.2nm) of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.

Lighting of wind turbines in the vicinity of an aerodrome

31 Siting of wind turbines in the vicinity of an aerodrome is strongly discouraged, as these tall structures can pose serious hazards to aircraft taking off and landing. Where a wind turbine is proposed that will penetrate the OLS of an aerodrome, the proponent should conduct a risk assessment. The risk assessment to be conducted by a suitably qualified person, should examine the effect of the proposed wind turbines on the operation of aircraft. The study should be made available to CASA to assist assessment of any potential risk to aviation safety.

32 CASA may determine that the proposal is:

(a) Hazardous and should not be built, either in the location and/or to the height proposed, as an unacceptable risk to aircraft safety will be created; or

(b) Hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking.

6.3 Obstacle Lighting Summary

The Sapphire Wind Farm does not penetrate the OLS for either YGLI or YIVL.

ICAO recommends in areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150m or more AGL should be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.

The NASF Guideline D recommends that any structure of 150m or taller AGL be notified to CASA.

CASR 139.365 requires any structure 110m or taller AGL to be notified to CASA.

MOS 139 paragraph 7.1.5.2 requires that any object that extends to a height of 150m or more AGL must be regarded as an obstacle unless it is assessed otherwise by CASA. CASA may direct that obstacles be marked and/or lit.

The SWF turbines have a tip height of 200m AGL and therefore can be regarded as an obstacle and be subject to a Risk Assessment to ascertain whether they constitute a hazard to aviation safety.

This Risk Assessment finds that the overall risk to aviation in the area of the SWF is LOW. On this basis no further mitigation is required.

7. CONCLUSIONS

7.1 AIS

The Sapphire Wind Farm development will NOT impact upon the following:

- The OLS published for any registered or certified aerodrome;
- The operation of any Navigation Aids and Communication facilities; and
- The operation of any Airspace Surveillance facility.

However the Wind Farm WILL impact upon the following:

- The 25 nm Minimum Sector Altitude (MSA) for Glen Innes Aerodrome.

It will be recommended that AsA be requested to increase the 25 nm MSA to 5500 ft.

As the 10 nm MSA is 6100ft, and the altitude at the Initial Fix (IF) for the RWY 14 NDB approach is 6100ft, aircraft would be required to be no lower than 6100ft within 10nm. It is considered that the increase in the 25nm MSA to 5500ft will have minimal impact on flight operations.

7.1.1 AsA Response to AIS

AsA responded to the AIS on 22 February 2016 (see Appendix E) and agree with the Ambidji findings. AsA have included a note that procedures not designed by Airservices at Glen Innes and Inverell aerodromes were not considered in their assessment. The RWY23 RNAV-Z Instrument Approach procedure at Glen Innes aerodrome is the only procedure at either Inverell or Glen Innes aerodromes that is not designed by Airservices Australia.

Inverell Aerodrome

All procedures at Inverell aerodrome are designed by Airservices Australia. None of the instrument approach and departure procedures, nor any sector or circling altitude will be affected by any of the three wind farm clusters.

Glen Innes Aerodrome

AsA advise that to accommodate a maximum tip height of 1357.8m (4455ft) AHD in the *Swan Vale cluster* the Glen Innes aerodrome 25nm MSA in the NW sector will need to be raised from 5300ft to 5500ft. A permanent NOTAM would be required to implement this increase.

CWP Renewables, or Ambidji on their behalf, will need to consult with the aerodrome operator and CASA to secure agreement and to ensure the increase in the 25nm MSA (NW sector) from 5300ft to 5500ft will not adversely impact on the operations of Glen Innes aerodrome.

Ambidji notes that the 25nm MSA (NW sector) is common to all four instrument approaches at Glen Innes. A NOTAM raising this MSA will do so for all procedures.

7.1.2 Defence Response to AIS

The Department of Defence responded to the AIS on 5 February 2016 (see Appendix F) and advise that they have assessed the updated proposal and have no concerns at this time.

7.2 Risk Assessment

The QRA demonstrates that the SWF will "*not be a hazard to aircraft safety"* and therefore *"not of operational significance"* to aircraft operations.

7.3 Obstacle Lighting

The SWF turbines have a tip height of 200m AGL and therefore can be regarded as an obstacle and be subject to a Risk Assessment to ascertain whether they constitute a hazard to aviation safety.

The Risk Assessment finds that the overall risk to aviation in the area of the SWF is LOW. On this basis no further mitigation is required. Obstacle lighting is not required.

7.4 Reporting of Tall Structures

The turbines proposed for the SWF have a tip height of 200m (656ft) AGL; therefore they need to be reported to CASA in accordance with MOS 139 paragraph 7.1.5.2 for assessment as an obstacle.

CASR 139.365 requires the turbines and the meteorological monitoring masts to be reported as tall structures in accordance with AC 139-08(0) *Reporting of Tall Structures* for inclusion on appropriate aeronautical charts.

8. DUTY OF CARE

As a part of corporate responsibility and duty of care, it is appropriate for the proponent to formally advise all relevant stakeholders of:

- the locations and heights of the turbines and meteorological masts and when they would be constructed or decommissioned; and
- the developer's intentions regarding marking and lighting of the wind farm turbines.

CWP Renewables' attention is also drawn to the following determination of the New South Wales Court of Appeal, in the case of Sheather vs Country Energy, where, inter-alia, the court determined the following.[17]

> *"Mr Sheather, the owner of the helicopter which crashed into a Country Energy owned spur line while flying well below the mandatory height regulations for aircraft, appealed an earlier decision on the grounds that Country Energy had failed to provide sufficient warning of the spur line. Despite Country Energy observing all legal compliance requirements, the NSW Court of Appeal held that Country Energy owed a duty of care to pilots and aircraft owners and had breached its duty of care."*

Due cognisance of this decision should be taken by CWP Renewables Pty Ltd and its legal and insurance advisors in considering this report.

[17] Sheather v Country Energy [2007] NSWCA 179

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APPENDIX A

Airservices Australia

Aviation Assessments for Wind Farm Developments

19 August 2014

airservices

Corporate & International Affairs
25 Constitution Avenue
(GPO Box 367)
CANBERRA ACT 2600

t 02 6268 5101
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www.airservicesaustralia.com

ABN 59 698 720 886

To Whom It May Concern

Airservices Aviation Assessments for Wind Farm Developments

Guidelines to manage the risk to aviation safety from wind turbine installations (Wind Farms/Wind Monitoring Towers) are under development by the National Airports Safeguarding Advisory Group (NASAG). NASAG is comprised of high-level Commonwealth, State and Territory transport and planning officials and has been formed to develop a national land use planning regime to apply near airports and under flight paths.

The wind farm guidelines will provide information to proponents and planning authorities to help identify any potential safety risks posed by wind turbine and wind monitoring installations from an aviation perspective.

Potential safety risks include (but are not limited to) impacts on flight procedures and aviation communications, navigation and surveillance (CNS) facilities which require assessment by Airservices.

To facilitate these assessments all wind farm proposals submitted to Airservices must include an Aviation Impact Statement (AIS) prepared by an aeronautical consultant in accordance with the AIS criteria set out below.

AIS must be undertaken by an aeronautical consultant with suitable knowledge and capabilities to provide a reliable and comprehensive report. All data is to be supplied in electronic form. If you are not familiar with any aeronautical consultants, you may wish to view the list on the Civil Aviation Safety Authority (CASA) website:

http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90412

AIS Criteria

The AIS must provide a detailed analysis covering, as a minimum:

Airspace Procedures:

1. Obstacles
   - Co-ordinates in WGS 84 (to 0.1 second of arc or better)
   - Elevations AMSL (to 0.3 metres)
2. Drawings
   - Overlayed on topographical base not less that 1:250,000. Details of datum and level of charting accuracy to be noted.
   - Electronic format compatible with Microstation version 8i.
3. Aerodromes
   - Specify all registered/certified aerodromes that are located within 30nm (55.56km) from any obstacle referred to in (1) above.
   - Nominate all instrument approach and landing procedures at these aerodromes.
   - Confirmation that the obstacles do not penetrate Annex 14 or OLS for any aerodrome. If an obstacle does penetrate, specify the extent.
4. Air Routes
   - Nominate air routes published in ERC-L & ERC-H which are located near/over any obstacle referred to in (1) above.
   - Specify two waypoint names located on the routes which are located before and after the obstacles.
5. Airspace
   - Airspace classification – A, B, C, D, E, G etc where the obstacles are located.

Navigation/Radar:

1. Detect the presence of dead zones
2. False target analysis
3. Target positional accuracy
4. Probability of detection
5. Radar coverage implications
6. We would expect the analysis to follow the guidelines outlined in the EUROCONTROL Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors.

http://www.eurocontrol.int/sites/default/files/field_tabs/content/documents/events/guidelines-to-assess-potential-impact-of-wind-turbines.pdf

NOTE: Within the Eurocontrol Guidelines there are specific assumptions about the type of Wind Turbine for which the Guidelines are applicable (i.e. 3 blades, 30-200 m height, and horizontal rotation axis). For any deviations to the Wind Turbine characteristics listed within the Eurocontrol Guidelines, the proponent should justify to Airservices why the Eurocontrol Guidelines are still applicable.

Airservices Review of AIS

Airservices will review the quality and completeness of an AIS and will undertake limited modelling and analysis to confirm the findings and recommendations of the report.

Provided the AIS is of sound quality and is complete in accordance with the above criteria, there will be no charge for the review or limited modelling and analysis.

If the AIS is not of sound quality or is not complete in accordance with the above criteria, no modelling or analysis will be undertaken. Airservices will advise the proponent that the AIS does not meet the requirements and that the proposal cannot be assessed by Airservices.

If Airservices review of an AIS confirms impacts identified in the report (or identifies additional impacts), Airservices will advise the proponent of the impacts and the required mitigating actions (where mitigation is feasible). The proponent will also be advised that there will be charges for any mitigation actions to be undertaken by Airservices.

These charges may be advised at the time but it is likely that a detailed quote will be needed and this will only be provided on request from the proponent.

Please contact Airport Relations on 02 6268 4725 or airport.developments@airservicesaustralia.com if you have any questions.

Current as at 19 August 2014

APPENDIX B

Sapphire Wind Farm

Site Identification, Coordinates and Elevations

SAPPHIRE WIND FARM							
WIND TURBINE IDs, COORDINATES and HEIGHTS							
WTG_ID	X (I)	Y (I)	Latitude (I)	Longitude (I)	Ground AHD m	Turbine AHD m	Turbine AHD ft
1	347266.41	6716525.17	-29.6719	151.4217	957.7964	1157.7964	3799
2	344448.00	6716872.00	-29.6684	151.3926	901.4930	1101.4930	3614
3	344926.03	6717491.08	-29.6629	151.3976	937.2979	1137.2979	3732
4	344998.00	6717747.00	-29.6606	151.3984	941.4944	1141.4944	3746
5	345798.00	6717147.00	-29.6661	151.4066	950.7899	1150.7899	3776
6	346048.00	6716872.00	-29.6686	151.4091	949.5896	1149.5896	3772
7	345625.31	6716269.03	-29.6740	151.4047	941.8945	1141.8945	3747
8	344648.00	6717197.00	-29.6655	151.3947	910.5931	1110.5931	3644
9	346577.52	6716638.85	-29.6708	151.4146	968.2923	1168.2923	3833
10	347523.00	6717047.00	-29.6673	151.4244	954.1955	1154.1955	3787
11	347648.00	6716697.00	-29.6704	151.4256	968.7947	1168.7947	3835
12	346598.00	6716922.00	-29.6683	151.4148	961.6951	1161.6951	3812
13	346323.73	6717322.28	-29.6646	151.4121	949.7943	1149.7943	3773
14	347223.00	6715697.00	-29.6794	151.4211	992.1963	1192.1963	3912
15	346548.00	6715672.00	-29.6795	151.4141	950.4922	1150.4922	3775
16	346473.00	6715397.00	-29.6820	151.4133	952.8928	1152.8928	3783
17	344023.00	6715872.00	-29.6774	151.3881	870.1916	1070.1916	3512
18	344223.00	6715572.00	-29.6801	151.3901	870.5917	1070.5917	3513
19	344323.00	6715147.00	-29.6840	151.3911	890.4947	1090.4947	3578
20	343623.00	6714847.00	-29.6866	151.3838	879.7942	1079.7942	3543
21	343498.00	6715397.00	-29.6816	151.3826	870.1916	1070.1916	3512
22	343623.00	6715647.00	-29.6794	151.3839	862.2919	1062.2919	3486
23	343473.00	6715097.00	-29.6843	151.3823	873.6996	1073.6996	3523
24	343823.00	6714547.00	-29.6893	151.3858	890.8948	1090.8948	3580
25	342923.00	6713997.00	-29.6942	151.3764	850.0002	1050.0002	3445
26	343598.00	6713872.00	-29.6954	151.3834	862.1988	1062.1988	3485
27	343948.00	6713547.00	-29.6984	151.3870	862.5989	1062.5989	3487
28	345198.00	6713672.00	-29.6974	151.3999	902.4980	1102.4980	3618
29	345323.00	6713997.00	-29.6945	151.4012	940.3964	1140.3964	3742
30	345173.00	6714497.00	-29.6900	151.3998	910.1930	1110.1930	3643
31	342968.90	6714263.03	-29.6918	151.3770	845.4967	1045.4967	3431
32	343092.66	6714576.07	-29.6890	151.3783	852.6986	1052.6986	3454
33	344774.33	6713167.39	-29.7019	151.3955	872.3969	1072.3969	3519
34	345018.21	6713396.71	-29.6999	151.3980	870.8988	1070.8988	3514
35	344042.69	6714008.23	-29.6942	151.3880	875.1976	1075.1976	3528
36	345542.37	6714321.27	-29.6916	151.4036	931.5941	1131.5941	3713
37	345023.00	6714722.00	-29.6879	151.3982	897.5943	1097.5943	3601
38	344873.00	6714947.00	-29.6859	151.3967	887.2939	1087.2939	3568
39	344798.00	6714172.00	-29.6929	151.3958	912.1936	1112.1936	3649
40	344448.00	6714297.00	-29.6917	151.3922	910.0907	1110.0907	3642

SAPPHIRE WIND FARM							
WIND TURBINE IDs, COORDINATES and HEIGHTS							
WTG_ID	X (I)	Y (I)	Latitude (I)	Longitude (I)	Ground AHD m	Turbine AHD m	Turbine AHD ft
41	344373.00	6714597.00	-29.6890	151.3915	888.4942	1088.4942	3572
42	345898.00	6713747.00	-29.6968	151.4071	940.9919	1140.9919	3744
43	345848.00	6713997.00	-29.6946	151.4067	932.4967	1132.4967	3716
44	346223.00	6713497.00	-29.6991	151.4105	933.0922	1133.0922	3718
45	345673.00	6711472.00	-29.7173	151.4045	890.1970	1090.1970	3577
46	345148.00	6711647.00	-29.7157	151.3991	880.3990	1080.3990	3545
47	344798.00	6711922.00	-29.7131	151.3955	890.6994	1090.6994	3579
48	344673.00	6712197.00	-29.7107	151.3943	874.8999	1074.8999	3527
49	344171.51	6712089.49	-29.7116	151.3891	860.5984	1060.5984	3480
50	343788.44	6712221.05	-29.7103	151.3851	857.3975	1057.3975	3470
51	343328.37	6712358.73	-29.7090	151.3804	870.6941	1070.6941	3513
52	347723.00	6711197.00	-29.7201	151.4256	991.0890	1191.0890	3908
53	347973.00	6710822.00	-29.7235	151.4282	984.6966	1184.6966	3887
54	347998.00	6710572.00	-29.7257	151.4284	982.9939	1182.9939	3882
55	347998.00	6710297.00	-29.7282	151.4284	992.8942	1192.8942	3914
56	348073.00	6710022.00	-29.7307	151.4291	1001.7896	1201.7896	3943
57	347848.00	6711447.00	-29.7178	151.4270	971.2884	1171.2884	3843
58	348794.00	6711276.00	-29.7195	151.4367	960.3925	1160.3925	3808
59	347498.00	6711572.00	-29.7166	151.4234	980.7886	1180.7886	3874
60	348340.00	6709830.60	-29.7325	151.4318	994.7924	1194.7924	3920
61	348428.57	6709583.98	-29.7347	151.4327	1009.9871	1209.9871	3970
62	348750.05	6709222.93	-29.7380	151.4360	1022.3904	1222.3904	4011
63	349698.00	6708647.00	-29.7433	151.4457	1022.2881	1222.2881	4011
64	349373.00	6708822.00	-29.7417	151.4424	1030.9881	1230.9881	4039
65	348923.00	6708922.00	-29.7407	151.4377	1021.6926	1221.6926	4009
66	348673.00	6708572.00	-29.7439	151.4351	972.8888	1172.8888	3849
67	348448.00	6708372.00	-29.7456	151.4327	972.1910	1172.1910	3846
68	348198.00	6708597.00	-29.7436	151.4302	940.3964	1140.3964	3742
69	348073.00	6708797.00	-29.7417	151.4289	922.1962	1122.1962	3682
70	350498.00	6708972.00	-29.7405	151.4540	1022.3028	1222.3028	4011
71	351173.00	6709797.00	-29.7331	151.4611	1020.4954	1220.4954	4005
72	350664.32	6709622.28	-29.7346	151.4558	1031.7036	1231.7036	4041
73	350748.00	6709322.00	-29.7373	151.4567	1028.0995	1228.0995	4030
74	351458.01	6709627.49	-29.7347	151.4640	1030.4951	1230.4951	4038
75	352223.00	6708847.00	-29.7418	151.4718	1010.4957	1210.4957	3972
76	351898.00	6708822.00	-29.7420	151.4685	1017.7040	1217.7040	3996
77	351748.00	6709097.00	-29.7395	151.4670	1031.2010	1231.2010	4040
78	351454.53	6709353.08	-29.7371	151.4640	1019.5008	1219.5008	4001
79	351323.00	6710022.00	-29.7311	151.4627	1020.1959	1220.1959	4004
80	351096.77	6710240.55	-29.7291	151.4604	1037.7035	1237.7035	4061

SAPPHIRE WIND FARM							
WIND TURBINE IDs, COORDINATES and HEIGHTS							
WTG_ID	X (I)	Y (I)	Latitude (I)	Longitude (I)	Ground AHD m	Turbine AHD m	Turbine AHD ft
81	350945.67	6710556.63	-29.7262	151.4589	1015.5971	1215.5971	3989
82	349451.47	6710805.00	-29.7238	151.4435	992.0940	1192.0940	3912
83	350035.01	6710600.06	-29.7257	151.4495	986.6995	1186.6995	3894
84	349573.00	6709797.00	-29.7329	151.4446	1022.2881	1222.2881	4011
85	349448.00	6710222.00	-29.7291	151.4433	1002.7945	1202.7945	3947
86	349198.00	6709972.00	-29.7313	151.4407	1010.8897	1210.8897	3973
87	349953.88	6709563.14	-29.7351	151.4485	1032.0860	1232.0860	4043
88	350351.10	6710839.73	-29.7236	151.4528	999.0949	1199.0949	3934
89	350285.10	6711138.45	-29.7209	151.4521	1008.7952	1208.7952	3966
90	349873.00	6711322.00	-29.7192	151.4479	995.3879	1195.3879	3922
91	349898.00	6711697.00	-29.7158	151.4482	998.9888	1198.9888	3934
92	350142.46	6711527.37	-29.7174	151.4507	1002.9986	1202.9986	3947
93	349726.45	6711926.99	-29.7137	151.4465	989.4886	1189.4886	3903
94	349003.40	6712128.38	-29.7118	151.4390	981.4958	1181.4958	3877
95	349149.28	6711937.34	-29.7135	151.4405	991.2937	1191.2937	3909
96	349420.21	6711770.62	-29.7151	151.4433	992.0940	1192.0940	3912
97	353073.00	6710047.00	-29.7311	151.4808	1015.2014	1215.2014	3987
98	353098.00	6709772.00	-29.7336	151.4810	1032.0993	1232.0993	4043
99	353198.00	6709422.00	-29.7367	151.4820	1040.0029	1240.0029	4069
100	353432.66	6708880.80	-29.7416	151.4843	1059.5959	1259.5959	4133
101	353923.00	6709522.00	-29.7359	151.4895	1060.9969	1260.9969	4138
102	353923.00	6709797.00	-29.7334	151.4895	1050.6977	1250.6977	4104
103	354398.00	6709372.00	-29.7373	151.4944	1090.7929	1290.7929	4235
104	354423.00	6709647.00	-29.7348	151.4947	1068.4940	1268.4940	4162
105	354523.00	6709872.00	-29.7328	151.4958	1050.9009	1250.9009	4104
106	354423.00	6709122.00	-29.7396	151.4946	1070.7934	1270.7934	4170
107	354398.00	6708872.00	-29.7418	151.4943	1050.4945	1250.4945	4103
108	352897.79	6710348.58	-29.7283	151.4790	999.5013	1199.5013	3936
109	353299.97	6709173.63	-29.7390	151.4830	1034.1955	1234.1955	4050
110	354198.00	6708622.00	-29.7441	151.4922	1067.7989	1267.7989	4160
111	354323.00	6708297.00	-29.7470	151.4935	1122.6957	1322.6957	4340
112	353774.29	6708605.51	-29.7442	151.4878	1055.7992	1255.7992	4121
113	355441.04	6708220.71	-29.7478	151.5050	1152.2992	1352.2992	4437
114	355598.00	6708672.00	-29.7438	151.5067	1131.3907	1331.3907	4369
115	354842.81	6707728.26	-29.7522	151.4988	1157.7963	1357.7963	4455
116	354848.00	6708097.00	-29.7489	151.4989	1149.6896	1349.6896	4429
117	355298.00	6707422.00	-29.7550	151.5034	1123.6903	1323.6903	4343
118	356398.00	6713447.00	-29.7008	151.5156	1062.9006	1262.9006	4144
119	356473.00	6713097.00	-29.7040	151.5163	1101.4984	1301.4984	4270
120	356698.00	6712847.00	-29.7062	151.5186	1059.8953	1259.8953	4134

SAPPHIRE WIND FARM							
WIND TURBINE IDs, COORDINATES and HEIGHTS							
WTG_ID	X (l)	Y (l)	Latitude (l)	Longitude (l)	Ground AHD m	Turbine AHD m	Turbine AHD ft
121	356773.00	6712597.00	-29.7085	151.5194	1050.4945	1250.4945	4103
122	356839.82	6712309.15	-29.7111	151.5200	1023.2975	1223.2975	4014
123	356248.00	6714297.00	-29.6931	151.5142	1059.2964	1259.2964	4132
124	356273.00	6714572.00	-29.6906	151.5145	1061.0932	1261.0932	4138
125	356083.74	6714856.79	-29.6880	151.5125	1032.0031	1232.0031	4042
126	356123.00	6715147.00	-29.6854	151.5130	1017.7040	1217.7040	3996
127	357283.84	6715264.48	-29.6845	151.5250	1020.7948	1220.7948	4006
128	357148.00	6714997.00	-29.6869	151.5236	1012.4956	1212.4956	3978
129	357024.00	6714704.00	-29.6895	151.5222	1012.6988	1212.6988	3979
130	357263.81	6714450.44	-29.6918	151.5247	1020.1959	1220.1959	4004
131	357698.00	6715872.00	-29.6791	151.5294	1023.8001	1223.8001	4016
132	357348.00	6715747.00	-29.6801	151.5257	1020.3029	1220.3029	4004
133	357273.00	6715497.00	-29.6824	151.5249	1012.4956	1212.4956	3978
134	356542.22	6715009.00	-29.6867	151.5173	1023.8001	1223.8001	4016
135	356598.00	6715372.00	-29.6834	151.5179	1014.6025	1214.6025	3985
136	356698.00	6715647.00	-29.6810	151.5190	1010.7951	1210.7951	3973
137	356650.46	6716206.12	-29.6759	151.5186	1010.4957	1210.4957	3972
138	356644.36	6716645.36	-29.6720	151.5186	1012.0036	1212.0036	3977
139	356662.67	6716437.94	-29.6738	151.5187	1011.2015	1211.2015	3974
140	356720.62	6715925.50	-29.6785	151.5193	1009.8005	1209.8005	3970
141	357548.00	6716147.00	-29.6766	151.5278	1040.1954	1240.1954	4069
142	357473.00	6716622.00	-29.6723	151.5271	1041.2007	1241.2007	4073
143	358148.00	6716872.00	-29.6701	151.5341	1048.7941	1248.7941	4098
144	358398.00	6716647.00	-29.6721	151.5367	1011.0946	1211.0946	3974
145	358548.00	6716347.00	-29.6749	151.5382	995.8009	1195.8009	3924
146	358023.00	6717172.00	-29.6674	151.5329	1013.8966	1213.8966	3983
147	357798.00	6717547.00	-29.6640	151.5306	1010.1000	1210.1000	3971
148	357797.86	6719040.41	-29.6505	151.5308	1000.3997	1200.3997	3939
149	357223.00	6718797.00	-29.6526	151.5248	1003.8007	1203.8007	3950
150	357348.00	6718522.00	-29.6551	151.5261	1007.8968	1207.8968	3963
151	357863.30	6718209.39	-29.6580	151.5314	1001.5975	1201.5975	3943
152	357548.00	6717947.00	-29.6603	151.5281	1009.8005	1209.8005	3970
153	357483.07	6717682.38	-29.6627	151.5274	1000.1965	1200.1965	3938
154	357123.91	6719242.18	-29.6486	151.5239	1007.3942	1207.3942	3962
155	344633.00	6718073.00	-29.6576	151.3947	932.0965	1132.0965	3715
156	343761.00	6717550.00	-29.6622	151.3856	889.3968	1089.3968	3575
157	344316.00	6717905.00	-29.6591	151.3914	914.3988	1114.3988	3657
158	344086.00	6717689.01	-29.6610	151.3890	901.8931	1101.8931	3616
159	346737.33	6716251.99	-29.6743	151.4162	977.0946	1177.0946	3862

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APPENDIX C
Airservices Australia
Response to AIS

Appendix C

Ian Jennings

From: Barrie Slingo
Sent: Monday, 22 February 2016 11:43 AM
To: Ian Jennings
Cc: Ian Jennings; Bruce Robinson
Subject: FW: AIRSERVICES RESPONSE: Sapphire Wind Farm - Aviation Impact Statement (NSW-WF-059) [SEC=UNCLASSIFIED]

Hi Ian

To note response from Airservices. Ed Mounsey of CWP rang this morning to query progress with AsA and our final Report. He was copied on Airservices advice. As we now have both Defence and AsA comments, suggest we now raise our Report to A Final Version.

Kind regards

Barrie Slingo
Senior Associate
The Ambidji Group Pty Ltd

This message and any attachments are confidential and may be privileged or otherwise protected from disclosure. If you have received it by mistake, please let us know by reply email and then delete it from your system; you should not use, copy, distribute or disclose the contents of this message.

From: Airport Developments [mailto:Airport.Developments@AirservicesAustralia.com]
Sent: Monday, 22 February 2016 11:36 AM
To: Barrie Slingo
Cc: Ed Mounsey; Bruce Robinson
Subject: AIRSERVICES RESPONSE: Sapphire Wind Farm - Aviation Impact Statement (NSW-WF-059) [SEC=UNCLASSIFIED]

Hi Barrie,

I refer to your request for Airservices assessment of the Sapphire Wind Farm to be located in Northern New South Wales.

-- AIRSPACE PROCEDURES --

Glenn Innes Aerodrome
With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 1357.8m (4455ft) AHD the Swan Vale wind farm cluster *will affect* the following MSA at Glenn Innes aerodrome:

- 25NM MSA – NW Sector.

The maximum height of any turbine within the Swan Vale cluster without affecting any procedures at Glen Innes aerodrome is 1315.5m (4316ft) AHD however, subject to agreement by the aerodrome operator and CASA, the 25NM MSA – NW Sector could be raised to 5500ft. A permanent NOTAM would be required to increase 25NM MSA – NW Sector from 5300ft to 5500ft.

The proponent will need to consult with the aerodrome operator and CASA to secure agreement and to ensure the above change will not adversely impact on the operations of Glen Innes aerodrome.

1

With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the various heights provided, the turbines within Sapphire and Wellingrove clusters will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Glen Innes aerodrome.

Inverell Aerodrome
With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at various heights, all three wind farm clusters will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Inverell aerodrome.

Note: procedures not designed by Airservices at Glen Innes and Inverell aerodromes were not considered in this assessment

-- CNS FACILITIES --
This proposal for the wind farm as outlined in the AIS will not will not adversely impact the performance of any Airservices Precision/Non-Precision Nav Aids, Anemometers, HF/VHF/UHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

Kind regards

Carly

Carly Fiumara
Airport Development Assistant
Corporate and Industry Affairs
t 02 6268 4725 | e carly.fiumara@airservicesaustralia.com

NOTE: I work part-time from Monday to Wednesday and between the hours of 0730 and 1400. Apologies for any inconvenience.

From: Barrie Slingo [mailto:BSlingo@ambidji.aero]
Sent: Monday, 4 January 2016 4:04 PM
To: Airport Developments <Airport.Developments@AirservicesAustralia.com>
Cc: Fiumara, Carly <carly.fiumara@AirservicesAustralia.com>; Ed Mounsey <ed.mounsey@windprospect.com.au>; Bruce Robinson <brobinson@ambidji.aero>
Subject: Sapphire Wind Farm - AviationImpact Statement

Good afternoon Tony

This application is submitted by The Ambidji Group Pty Ltd (Ambidji) on behalf of CWP Renewables Pty Ltd (CWP) and seeks your consideration of the attached Aviation Impact Statement (AIS) for the proposed Sapphire Wind Farm. This proposed wind farm is located in northern New South Wales, and the nearest airports are Inverell and Glen Innes.

The Sapphire Wind Farm proposal has been the subject the subject of previous consideration by Airservices Australia – your reference WF – 041 of 21 September 2009 refers. At that time, CWP was considering two proposals with maximum turbine tip heights of 1315 m AHD and 1305 m AHD and which comprised 3.3 MW and 2 MW turbines. These proposals allowed for a wind farm with up to 159 turbines.

CWP is currently considering the use of higher turbines with a maximum tip height of 200 m AGL which represents a maximum tip height of 1357.8 m (4455 ft) AHD . Although the final number of turbines and

turbine layout have yet to be determined, it will be fewer than the earlier proposal. The attached Aviation Impact Statement is for the current 200 m AGL turbine proposal.

Should you have any queries regarding the AIS, do not hesitate to contact the undersigned or Bruce Robinson of our office.

Your early consideration of the attached AIS would be appreciated.

Yours faithfully

Barrie Slingo
Senior Associate

The Ambidji Group Pty Ltd
Suite 11, 622 Ferntree Gully Road
Wheelers Hill VIC 3150
Australia

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APPENDIX D
Department of Defence
Response to AIS

Appendix D

Australian Government
Department of Defence
Estate and Infrastructure Group

Lorraine Garlin
Acting Director Estate Planning ACT/NSW/ QLD/VIC/TAS
Estate Planning Branch
Brindabella Business Park (BP26-1-A029)
PO Box 7925
Department of Defence
CANBERRA BC ACT 2610
☎: (02) 6266 8549
💻: lorraine.garlin@defence.gov.au

REF: AF24261399

Barrie Slingo
The Ambidji Group Pty Ltd
Suite 11, 622 Ferntree Gully Road
Wheelers Hill VIC 3150

Dear Mr Slingo

RE: Sapphire Wind Farm Aviation Impact Statement

The Department of Defence (Defence) would like to thank the Ambidji Group Pty Ltd for referring this matter to Defence. Defence understands that Ambidji Group Pty Ltd has prepared an Aviation Impact Statement on behalf of CWP Renewables Pty Ltd for the proposed changes to the Sapphire Wind Farm located in northern New South Wales.

Defence has assessed the updated proposal and has no concerns at this time.

However, there is an ongoing need to obtain and maintain accurate information about tall structures. The risk posed by a tall structure to aircraft safety can be minimised if information on the tall structure is conveyed to pilots so that they can fly at a safe margin above the structure. Airservices Australia is responsible for recording the location and height of tall structures. The information is held in a central database and relates to the erection, extension or dismantling of tall structures the top of which is:

a. 30 metres or more above ground level - within 30 kilometres of an aerodrome, or

b. 45 metres or more above ground level elsewhere.

The proposed wind turbines will meet the above definition of tall structure. Defence therefore requests Airservices Australia be provided with "as constructed" details of the wind turbines. The "as constructed" information can be emailed to Airservices Australia via vod@airservicesaustralia.com.

Defending Australia and its National Interests

Should you have any questions my point of contact on this matter is Mr Sean Wilkinson who can be contacted on (02) 6266 8690 or via DSRGIDEP.ExecutiveSupport@defence.gov.au.

Yours faithfully

Lorraine Garlin

Acting Director Estate Planning ACT/NSW/QLD/VIC/TAS

5 February 2016

Defending Australia ***and its National Interests***

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APPENDIX E

Australian Fire and Emergency Services Authorities Council Wind Farms and Bushfire Operations

Appendix E

Wind Farms and Bushfire Operations

POSITION
Version 2.0
30 October 2014

Version Control

Version	Author	Edits	Date
0.1	Gary Featherston	First draft requested by the Rural and Land Management Group at its meeting of 7 May 2013	28 August 2013
0.2	Gary Featherston	Updated wind farm numbers and included comments from earlier reviewers.	30 August 2013
0.3	Gary Featherston	Approved by the RLM group before edits to include EMR and Total fire ban legislation.	9 September 2013
0.4	Gary Featherston	Added comments provided by the Clean Energy Council.	19 September 2013
1.0	Gary Featherston	Approved by Council	24 October 2013
1.1	Gary Featherston	Minor revision to add monitoring towers.	15 September 2014
2.0	Gary Featherston	Approved by Council, published.	30 October 2014

Australasian Fire and Emergency Service Authorities Council Limited (ABN 52 060 049 327)
Level 5, 340 Albert Street
East Melbourne Victoria 3002
Telephone: 03 9419 2388
Facsimile: 03 9419 2389

Email: afac@afac.com.au
Internet: http://www.afac.com.au

Table of Contents

1 Introduction

Wind power is a rapidly expanding mode of renewable energy production in Australia with installed capacity doubling in the past five years. As of September 2013, Australia has 64 wind farms with an installed capacity of 3058 megawatts (MW), with another ten wind farms under construction.

The increasing number of wind farms makes it important for AFAC member agencies to clarify their position and to identify those issues important for their operations in and around these facilities.

2 Purpose

This is a position to state AFAC member agencies attitude towards wind farms and their development. It aims to clarify the risks in order to inform stakeholders including regulators, members of the community and the wind farm industry.

3 Scope

The scope of this paper is limited to the issues relating to planning for bushfire prevention, preparedness, response and to recovery operations in and around existing and planned wind farms.

It excludes the environmental, social and economic issues associated with wind farms. It does not provide any judgments on the values or otherwise of wind farms.

4 Position

Bushfire management issues are best treated at the planning stage of a wind farm project. This includes the impact of bushfires on the wind farm and the potential for fires to start within the development boundaries. Local planning controls are in place to regulate these issues with respect to any infrastructure development and some local planning controls refer specifically to wind farms.

Wind monitoring towers associated with wind farm investigations and planning can be very much taller than the planned turbines and can be less visible. The location and height of monitoring towers should be noted during aerial firefighting operations.

Wind farms can interfere with local and regional radio transmissions by physical obstruction and radio frequency electromagnetic radiation. Any interference can be minimised or eliminated though appropriate turbine siting at the planning stage and by moving away from the tower if experiencing local interference during operations.

Wind farms are an infrastructure development that must be considered in the preparation of Incident Action Plans for the suppression of bushfires in their vicinity. These considerations are routine and wind farms are not expected to present elevated risks to operations compared to other electrical infrastructure.

Title: Wind Farms and Bushfire Operations

Date Approved: 30/10/2014
Page 1

Aerial fire fighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.

Wind farms are not expected to adversely affect fire behaviour in their vicinity. Local wind speeds and direction are already highly variable across landscapes affected by turbulence from ridge lines, tall trees and buildings.

Turbine towers are not expected to start fires by attracting lightning.

Turbines can malfunction and start fires within the unit. Automatic shutdown and isolation procedures are installed within the system. Although such fires may start a grass fire within the wind farm, planning for access and fire breaks can reduce the likelihood of the fire leaving the property. This risk from such fires is less than that of many other activities expected in these rural environments.

Wind farms may operate on days of Total Fire Ban subject to relevant national, state and territory legislation.

Liaison with wind farm operators and energy industry representatives during and after bushfires should aim to ensure minimal disruption to generation capacity and rapid resumption of essential services to the community.

5 Supporting Documentation

There's power in the wind: national snapshot.
Clean Energy Council, April 2012

There's power in the wind: fact sheet.
Clean Energy Council, June 2011

Both sourced from
http://www.cleanenergycouncil.org.au/resourcecentre/factsheets.html
on 29 August 2013

Emergency Management Guidelines for Wind Farms
Country Fire Authority, April 2007

Fact Sheet 10. Wind Farming, Electromagnetic Radiation & Interference.
Australian Wind Energy Association.
Sourced from
http://www.synergy-wind.com/documents/10Electromagnetic.pdf
9 September 2013

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APPENDIX F

South Australian Country Fire Service
Understanding Aerial Firefighting

Appendix F

South Australian
COUNTRY FIRE SERVICE
Aircraft SUPPORT, Firefighters SUPPRESS

Understanding Aerial Firefighting

The CFS combats bush, grass, scrub and forest fires primarily through the deployment of fire appliances and firefighters for the protection of life, property and the environment. These resources are complimented in a number of areas of the State with farm fire units, as they are a valuable resource in the overall control strategy when available.

At times, firefighting operations may be supported by firefighting aircraft and/or earth moving plant and equipment. Firefighting aircraft are a limited resource and therefore CFS places these aircraft in locations where life and assets are at the highest risk. There is no guarantee that every fire in the State will be serviced by aircraft, and the primary form of fire suppression has, and will always be, firefighters on the ground.

Community expectations

The popular perception amongst much of the community is that aircraft alone can put out bushfires. This is not true. CFS firefighters and fire appliances for the vast majority of instances are the primary and only method of controlling bushfires.

In many cases smoke from the fire ahead of the fire front makes it very difficult, if not impossible, for aircraft to identify and bomb specific targets. Aircraft cannot fly through heavy smoke, as there is a real danger that dense smoke will cause a 'flameout' of the jet turbine engine which is used to power each rotary or fixed wing aircraft in the firefighting fleet.

Deployment of aircraft to fires

The deployment of aircraft to any fire is made after consideration of many variables, risks, aircraft suitability and aircraft availability. Once committed, the decision to attack a fire is made by the air attack supervisor and the CFS Officer on the ground, based on firefighting tactics and a dynamic risk assessment. This will include an assessment of localised weather conditions, the fire's behaviour, obstructions to aircraft in the area, smoke and its effect on visibility, assets at risk, and aircraft performance parameters.

The final decision to fly or not fly the mission remains with the pilot in command of the firefighting aircraft.

In some circumstances aircraft cannot be deployed due to other higher priority fires, unfavourable wind and weather conditions, adverse terrain or obstructions that prevent safe flying environments.

Where vertical obstructions exist in the airspace around a fire, such as powerlines, weather masts, radio and television transmission towers, tall trees and wind turbines, a dynamic risk assessment is undertaken prior to the aircraft being committed to fire bombing operations. In some circumstances aircraft will not be utilised because risks caused by vertical obstructions exceed safe operating conditions.

Remotely Piloted Aircraft and Drones

In the event that a Remotely Piloted Aircraft RPA *(this includes Unmanned Aerial Vehicles (UAVs) or Drones)* is detected operating within the vicinity of a fire, **CFS may suspend aerial firefighting operations until it is considered safe to resume.** If aerial firefighting operations are suspended, the CFS will instigate an immediate media alert to request that the drone operator cease operations, or if members of the community are aware of the drone operator to immediately contact Police.

For further information on Aerial Firefighting go to:
http://www.cfs.sa.gov.au

www.cfs.sa.gov.au

Government of South Australia

APPENDIX G

Glossary of Terms and Abbreviations

APPENDIX G

AERONAUTICAL STUDY GLOSSARY

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies. A full list of terms and abbreviations used in this report is included in this Appendix. It should be noted that, within aviation, the International standard unit for altitude is feet (ft.) and distance is nautical mile (nm).

AC (Advisory Circulars) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

AHD (Australian Height Datum) is the datum to which all vertical control for mapping is to be referred. The datum surface is that which passes through mean sea level at the 30 tide gauges and through points at zero AHD height vertically below the other basic junction points.

AIP (Aeronautical Information Publication) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, the AIP may be issued by CASA or Airservices Australia.

Air routes exist between navigation aid equipped aerodromes or waypoints to facilitate the regular and safe flow of aircraft operating under Instrument Flight Rules (IFR).

Airservices Australia is the Australian government-owned corporation providing safe and environmentally sound air traffic management and related airside services to the aviation industry.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

AMSL (Above Mean Sea Level) is the elevation (on the ground) or altitude (in the air) of any object, relative to the average sea level datum. In aviation, the ellipsoid known as World Geodetic System 84 (WGS 84) is the datum used to define mean sea level.

ATC (Air Traffic Control) service is a service provided for the purpose of:

a. preventing collisions:
   1. between aircraft; and
   2. on the manoeuvring area between aircraft, vehicles and obstructions; and
b. expediting and maintaining an orderly flow of air traffic.

CASA (Civil Aviation Safety Authority) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation safety standards. As Australia is a signatory to the ICAO *Chicago Convention,* CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

CASR (Civil Aviation Safety Regulations) are promulgated by CASA and establish the regulatory framework *(Regulations)* within which all service providers must operate.

Civil Aviation Act 1988 (the Act) establishes the CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

ICAO (International Civil Aviation Organization) is an agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the *Chicago Convention*. Australia is a signatory to the *Chicago Convention.*

IFR (Instrument Flight Rules) are rules applicable to the conduct of flight under IMC. IFR is established to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals. It is also referred to as, “a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying,” such as an IFR or VFR flight plan.

IMC (Instrument Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, less than the minimum specified for visual meteorological conditions.

LSALT (Lowest Safe Altitudes) are published for each low level air route segment. Their purpose is to allow pilots of aircraft that suffer a system failure to descend to the LSALT to ensure terrain or obstacle clearance in IMC where the pilot cannot see the terrain or obstacles due to cloud or poor visibility conditions. It is an altitude that is at least 1,000 feet above any obstacle or terrain within a defined safety buffer region around a particular route that a pilot might fly.

MOS (Manual of Standards) comprises specifications *(Standards)* prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation.

NASAG (National Airports Safeguarding Advisory Group) set up in May 2010 to implement the Australian Government’s National Aviation Policy White Paper, *Flight Path to the Future* initiatives relating to safeguarding airports and surrounding communities from inappropriate development. NASAG comprises representatives from state and territory planning and transport departments, the Civil Aviation Safety Authority (CASA), Airservices Australia, the Department of Defence and the Australian Local Government Association (ALGA) and is chaired by the Department of Infrastructure and Regional Development (DIRD).

NASF (National Airports Safeguarding Framework) is the set of guidelines, adopted in July 2012, developed by NASAG to safeguard airports and surrounding communities.

NOTAMs (Notices to Airmen) are notices issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Obstacles - All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

OLS (Obstacle Limitation Surfaces) are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.

PANS-OPS (Procedures for Air Navigation Services - Aircraft Operations) is an Air Traffic Control term denominating rules for designing instrument approach and departure procedures. Such procedures are used to allow aircraft to land and take off under Instrument Meteorological Conditions (IMC) or Instrument Flight Rules (IFR). ICAO document 8168-OPS/611 (volumes 1 and 2) outlines the principles for airspace protection and procedure design which all ICAO signatory states must adhere to. The regulatory material surrounding PANS-OPS may vary from country to country.

PANS-OPS Surfaces - Similar to an Obstacle Limitation Surface, the PANS-OPS protection surfaces are imaginary surfaces in space which guarantee the aircraft a certain minimum obstacle clearance. These surfaces may be used as a tool for local governments in assessing building development. Where buildings may (under certain circumstances) be permitted to penetrate the OLS, they cannot be permitted to penetrate any PANS-OPS surface, because the purpose of these surfaces is to guarantee pilots operating under IMC an obstacle free descent path for a given approach.

Prescribed airspace is an airspace specified in, or ascertained in accordance with, the Regulations, where it is in the interests of the safety, efficiency or regularity of existing or future air transport operations into or out of an airport for the airspace to be protected. The prescribed airspace for an airport is the airspace above any part of either an OLS or a PANS OPS surface for the airport and airspace declared in a declaration relating to the airport.

Regulations (Civil Aviation Safety Regulations)

VFR (Visual Flight Rules) are rules applicable to the conduct of flight under VMC. VFR allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to maintain visual contact with the terrain and to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minima. If the weather is worse than VFR minima, pilots are required to use instrument flight rules.

VMC (Visual Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima

ABBREVIATIONS

Abbreviations used in this report, and the meanings assigned to them for the purposes of this report are detailed in the following table:

Abbreviation	Meaning
AC	Advisory Circular (document support CASR 1998)
ACFT	Aircraft
AD	Aerodrome
AHD	Australian Height Datum
AHT	Aircraft height
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALA	Aircraft Landing Area
Alt	Altitude
AMSL	Above Minimum Sea Level
A(PofA)R	Airports (Protection of Airspace) Regulations, 1996 as amended
APARs	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
DAP	Departure and Approach Procedures (charts published by AsA)
DER	Departure End of (the) Runway
DEVELMT	Development
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIRD	Department of Infrastructure and Regional Development. (Formerly Department of Infrastructure and Transport)
DoIT	Department of Infrastructure and Transport. Also called “Infrastructure”. (Formerly Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG) and previously the Department of Transport and Regional Services (DoTARS))
DITRDLG	See DoIT above
DOTARS	See DITRDLG above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix

Abbreviation	Meaning
FAP	Final Approach Point
ft	feet
GA	General Aviation
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LONG	Longitude
LSALT	Lowest Safe Altitude
m	metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards, published by CASA
MSA	Minimum Sector Altitude
SSR	Monopulse Secondary Surveillance Radar
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NASF	National Airports Safeguarding Framework
NDB	Non Directional Beacon
NE	North East
NM or nm	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North North East
NOTAM	NOtice To AirMen
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface
OIS	Obstacle Identification Surface
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PRM	Precision Runway Monitor

Abbreviation	Meaning
PROC	Procedure
PSR	Primary Surveillance Radar
QNH	An altimeter setting relative to height above mean sea level
Rnnn	Restricted Airspace – promulgated in AIP as R with 3 numbers
REF	Reference
RL	Relative Level
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
SSR	Secondary Surveillance Radar
STAR	Standard ARrival
TAR	Terminal Area Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VFR	Visual Flight Rules
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range