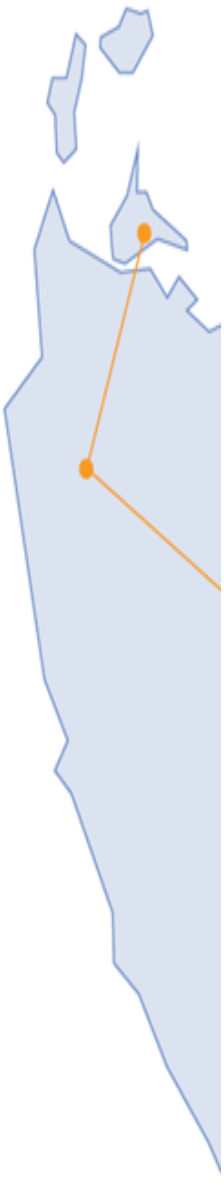
UPC AC Renewables AUSTRALIA

Jim's Plain & Robbins Island
Renewable Energy Parks



Robbins Island Renewable Energy Park

Appendix FF

Aviation Impact Assessment

UPC Robbins Island Pty Ltd

Aeronautical Impact Assessment

Robbins Island Renewable Energy Park
Tasmania

Client

GHD

LB00253

Final Version 1
10 April 2019

Version No.	Basis of issue	Author	Date	Reviewers
001	Draft report for submission to Client	CA	25 Sep 2018	JW
002	Second draft considering Client comments	PW	10 October 2018	CA
Final V1	Final Report	PW	10 April 2019	CA

Contents

1 Introduction

1.1 The Development

GHD, on behalf of Robbins Island Pty Ltd (the Proponent), has tasked Landrum & Brown Worldwide (Australia) Pty Ltd to prepare an Aeronautical Impact Assessment (AIA) for the proposed development located approximately 20km north west of Smithton in northern Tasmania.

The WTGs will have a maximum height from ground level to the tip of a WTG blade of 270 m AGL. A WTG situated on the highest nominated location of 64.7 m AHD will have a maximum tip height of 334.7 m AHD (1098.1 ft). The location of each WTG is indicative only and may change. Final layout may vary on the island however the maximum tip height of 334.7 m AHD represents the highest possible on the site.

Table 1 shows the distances from the proposed renewable energy park to the airports and aerodromes within the vicinity. Figure 1 maps the development in relation to these airfields.

Table 1: Airports in the vicinity

Airport	Direction and distance from site
Smithton ALA	16.7 km southeast
Wynyard Airport (certified)	70.2 km northwest
Three Hummock Island ALA	21.6 km north
Hunter Island strip	20.5 km northwest
King Island Airport (certified)	122.8 km northwest

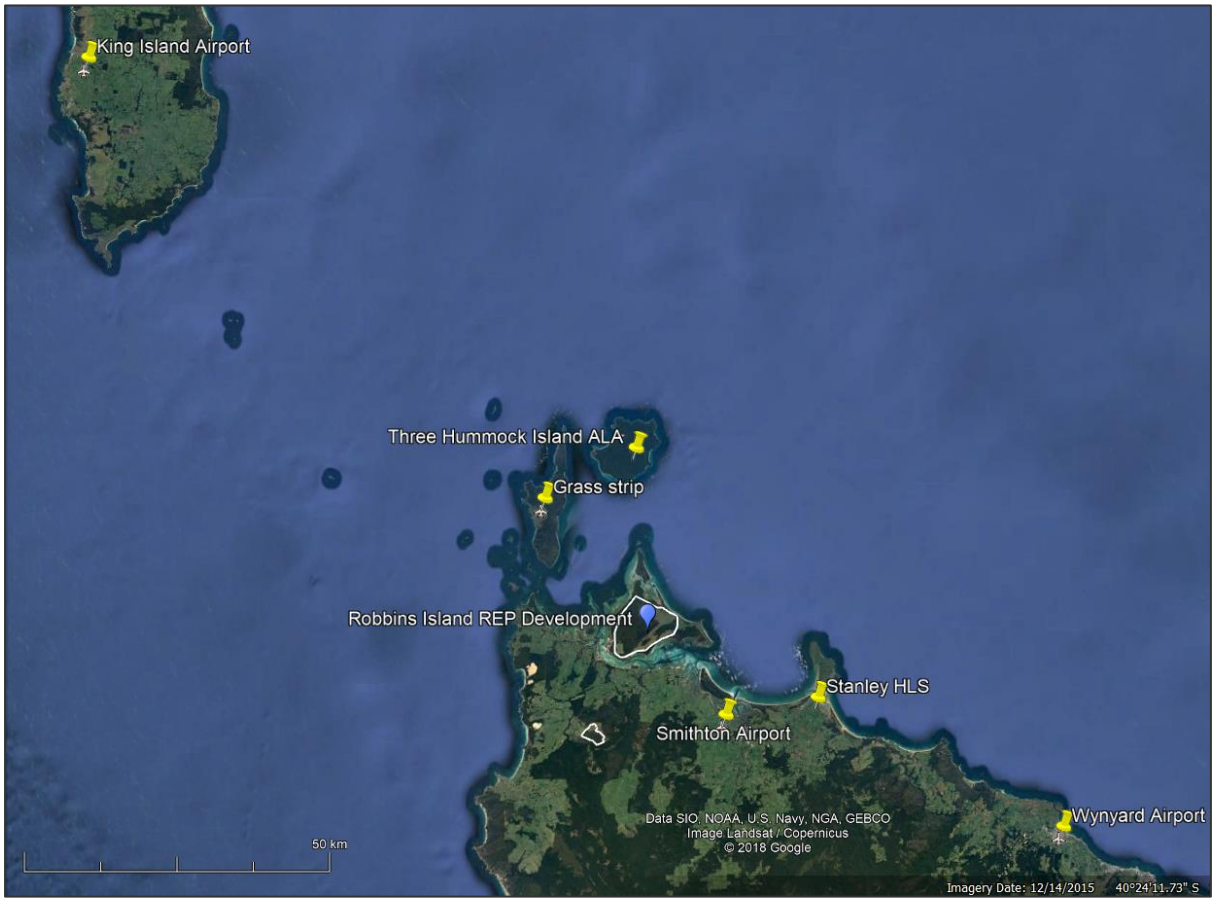


Figure 1: Development site in relation to the closest airports

Of these airports, Wynyard and King Island are the only ones provided with instrument approach procedures.

Smithton, Hunter Island and Three Hummock Island are airports that cater for Visual Flight Rules (VFR) operations. Considering the distance to the proposed development it will not impact the take-off and landing procedures at these airports.

There may be other privately-owned airstrips in the area that are not published in the Aeronautical Information Publication (AIP). The owners of these airstrips and the pilots that use them are responsible for ensuring that the condition of the airstrip and the surrounding terrain and obstacle environment are suitable for the safe operation of the aircraft using them.

Ongoing consultation by the developer, together with the construction of the renewable energy park, will have created a community awareness of any impact the park will have on these airstrips.

Several Instrument Flight Rules (IFR) air routes exist in the vicinity of the Robbins Island Renewable Energy Park. These routes and the clearances from the renewable energy park are discussed in detail later in this report.

2 Airspace Protection

2.1 Overview

Protected airspace for an airport is the airspace above any part of either an Obstacle Limitation Surface (OLS), a PANS OPS (Procedures for Air Navigation Services – Aircraft Operations) surface, or the Radar Terrain Clearance Chart (RTCC) protection surfaces.

The OLS are conceptual surfaces associated with an airport's runways that are designed to protect aircraft operations at the airport from unrestricted obstacle growth. Depending on the type of instrument flight procedures provided at the airport, the OLS can extend to a maximum of 15 km from the airport.

All of the local airports with OLS are in excess of 15 km from the renewable energy park and therefore their OLS are not infringed.

PANS OPS surfaces are designed around instrument approach and departure flight paths with a prescribed minimum obstacle clearance from terrain and structures. They designate an obstacle-free flight path to enable safe and efficient aircraft operations in Instrument Meteorological Conditions (IMC), where the pilot is not guaranteed to be able to see the ground, water or obstacles on or near their flight path.

Airspace within the lateral navigation tolerances of an air route, and the vertical allowance is also protected from terrain or obstacle intrusion to ensure safe flight operations during IFR flight on those routes.

Infringement by an infrastructure development or crane into protected airspace requires the approval of the aerodrome operator or Airservices Australia, and the Civil Aviation Safety Authority (CASA).

Infringement of PANS OPS protection surfaces are not supported by the aviation authorities.

2.2 PANS OPS Surfaces

Wynyard (YWYY) and King Island (YKII) airports have PANS OPS protection surfaces extending to 55 km from the relevant point on or near the airport, however the development is outside of these protection surfaces.

This investigation reveals that the proposed development of the Robbins Island Renewable Energy Park does not infringe the PANS OPS surfaces for any airport in the vicinity.

2.3 Air Routes

One air route, W519 from Smithton to King Island has navigation tolerances in close proximity to the Robbins Island Renewable Energy Park.

The Lowest Safe Altitude (LSALT) published for the route is the lowest altitude that an IFR aircraft can fly on that route, without visual reference to the ground or water. W519 has a LSALT of 1900 ft.

A Grid LSALT of 2200 ft, shown in green adjacent to the W519 label (refer to Figure 2), is above the renewable energy park. The grid is based on a whole 1-degree longitude x 1-degree latitude square.

LSALT protection surfaces for these routes and the Grid LSALT, with the relevant clearances above the renewable energy park are detailed in Table 3.

The Robbins Island Renewable Energy Park does not infringe the LSALT protection surface for the relevant Grid LSALT.

The Robbins Island Renewable Energy Park does infringe the LSALT protection surface for one air route: W519.

Table 3: Air Routes Clearances

Air Route (LSALT)	Height of Protection Surface (m AHD)	Clearance of development at 335 m AHD (in metres)
W519 (580 m)	275 m	– 60 m
Grid LSALT (671 m)	366 m	31 m

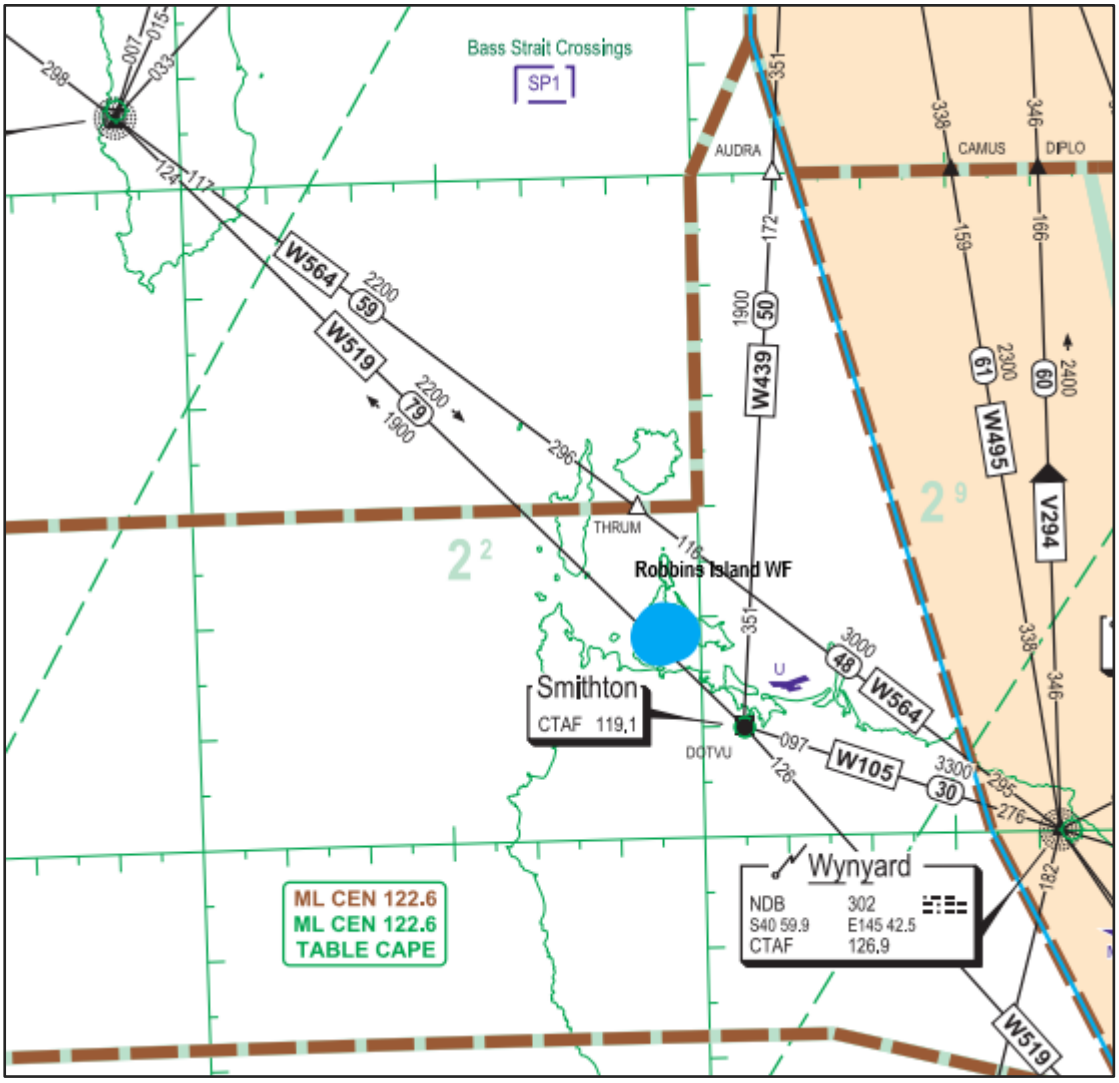


Figure 2: Air Routes and development site (AIP ERC 1 – 8 November 2018)

3 ATC Surveillance System and Navigation Aids

Energy parks have the potential to cause both electro-magnetic and reflective type interference to ATC radar surveillance systems and to the accuracy of aeronautical navigation aids.

The nearest ATC surveillance system is located on the mainland of Australia, at Round Mountain in Victoria.

The development is located outside of the clearance zones associated with Air Traffic Control surveillance facilities.

The nearest aeronautical navigation aid is located at Wynyard Airport, 70km from the development. The windfarm is located outside the clearance zones associated with all navigation aids.

Details of the renewable energy park should be provided to Airservices Australia to enable their engineers to confirm that the renewable energy park does not interfere with ATC communications, surveillance or navigations systems.

4 Aviation Activity in the Vicinity of the Energy Park

4.1 VFR operations

It is difficult to assess the level of aviation activity in the vicinity of the Robbins Island Renewable Energy Park due to the lack of reporting requirements for VFR flights in this area.

VFR flights between airports normally operate at a comfortable altitude above terrain for their transit over the rugged terrain on the west coast of Tasmania to their destinations. They are required to maintain visual reference to the ground or water at all times.

VFR scenic and local flights might operate at lower altitudes in calm conditions, but the prominent renewable energy park turbines will be readily identifiable and avoidable, serving as a navigation feature. The existence of other renewable energy parks in the region will have already influenced pilot behavior due to an increased level of awareness of their presence.

Mechanical turbulence can be created due to the effect of wind on surrounding terrain. Most prudent pilots will avoid exposure either by remaining out of the area in windy conditions or flying above the mechanical turbulence. Wind conditions conducive to the creation of turbulence can also have a negative effect on renewable energy parks, resulting in lower outputs.

There are four aircraft operators based at Smithton Airport including one offering flying training of light recreational aircraft. There is also some ultralight activity in the region. Due to the close proximity to King Island there may be some charter passenger and freight flights between King Island and Smithton, however the majority operate out of Wynyard and Launceston, with Sharp Airlines operating up to two times per day.

Glider flying training and cross-country soaring activity occurs around the Australia. Glider flights are conducted by day only and in good weather conditions using either thermal or mountain wave type updrafts to conduct cross-country flights away from the airfield. Gliding operations in mountainous areas requires careful consideration of the weather conditions for the entire period of the planned flight and constant awareness of available landing areas should the conditions change adversely. The glider flights will either be at an altitude well above the renewable energy park or be landing in paddocks if they cannot get back to Smithton. Either way, the renewable energy park is a prominent feature that will enable pilots to avoid it if they need to land nearby or use it as a prominent navigation feature.

4.2 Low level operations

Pilots undertaking authorised low level operations such as crop dusting, aerial firefighting, aerial cattle mustering, search and rescue, power line survey, gas pipe line monitoring and military low level flying in the area undergo specialised training and are required to take account of obstacles when planning and conducting low level operations. Depiction of the renewable energy park on aeronautical charts will provide sufficient information for pilots planning to operate in the vicinity of the Robbins Island Renewable Energy Park, to be aware of its presence and to plan their flights in order to either avoid the location altogether or consider its impact upon their proposed flight operations.

4.3 IFR Operations

IFR pilots operating in the area are required to maintain minimum altitudes published on aeronautical charts and instrument approach charts. As shown in section 2.2, the protection surfaces for these airports are outside of the location of the development, however, the track LSALT for one air route, W519, is infringed. Airservices Australia will need to review this assessment to determine what action will be required as a result of the energy park development.

4.4 Contingency Procedures – Engine Inoperative Flight Paths

In the context of the aircraft and airport operations in the vicinity of the proposed development of the Robbins Island Renewable Energy Park and the physical environment, it is considered to be sufficiently distant from nearby airports to have no impact on contingency procedures and engine inoperative flight paths in the area.

5 Obstacle Marking and Lighting

Previous experience suggests that obstacle marking of the wind turbines will not be required as CASA considers that WTGs are sufficiently conspicuous by day due to their shape, size and colour. CASA is likely to impose a condition that the WTGs are painted in a colour that is visually conspicuous against the prevailing background.

If CASA or DoD require obstacle lighting for Robbins Island Renewable Energy Park, shielding of the lights to avoid distraction to residents may be installed, however the lights must remain visible above a horizontal plane. CASA and DIRD are reviewing the requirements for lighting of wind farms.

Discussion notes regarding the lighting of wind farms can be found in Appendix C.

As Robbins Island Renewable Energy Park turbine tip heights will exceed the height of 110m AGL, formal notification to CASA and the Department of Defence (DoD) is required in accordance with:

- CASA Advisory Circular AC 139-08(0) “Reporting of Tall Structures” to enable inclusion of the wind farm location and height of turbines in relevant aeronautical information publications; and
- CASA Form 406 – “Operational Assessment of Existing and Proposed Structures”.

This aeronautical impact assessment and review of obstacle marking and lighting requirements supports this formal notification requirement.

Formal notification of the intention to develop the renewable energy park at Robbins Island should also be provided to local aviation parties and relevant aviation stakeholders.

6 Conclusion

The proposed Robbins Island Renewable Energy Park development in northwestern Tasmania, to a maximum height of 335 m AHD:

- will not infringe any OLS;
- will not infringe the PANS OPS surfaces of any airport;
- will not impact on contingency procedures;
- is located outside the clearance zones associated with all ATC surveillance systems;
- does infringe the LSALT protection surfaces for one air route;
- does not infringe the Grid LSALTS in the area;
- is outside the clearance zones associated with any aeronautical navigation aids;
- will have little or no impact upon local flying activities; and
- will provide a significant visual navigation feature in the region.

Details of the renewable energy park should be provided to CASA and the Department of Defence, for assessment of the need for obstacle lighting.

This report will need to be referred to Airservices Australia for review of the impact on the LSALT for W519 air route, as well as for inclusion on aeronautical charts.

Appendix A: Indicative Site Coordinates and Terrain Elevations

WTG ID	Easting	Northing	Elevation (m AHD)
1	320664	5494590	4.59
2	320675	5489920	1.82
3	320856	5494000	8.81
4	321010	5491770	12.26
5	321078	5489510	3.42
6	321307	5490730	5.53
7	321360	5489020	4.63
8	321528	5491440	10.04
9	321626	5493730	12.46
10	321978	5493230	21.06
11	321993	5494680	11.27
12	322139	5488900	40.28
13	322417	5491000	54.25
14	322490	5489710	38.71
15	322682	5490460	49.83
16	322757	5494530	23.36
17	322810	5488680	19.41
18	322822	5493160	31.62
19	322842	5496050	12.92
20	323011	5494030	29.75
21	323020	5496750	8.82
22	323292	5489570	44.56
23	323304	5492790	53.05
24	323596	5495920	28.01
25	323600	5491520	62.85
26	323674	5490330	62.11
27	323871	5495420	49.09
28	323880	5493990	41.74
29	323922	5491060	64.09
30	323943	5497560	34.45
31	324040	5492300	64.70
32	324058	5494820	46.78
33	324093	5496980	24.95
34	324213	5498300	34.81
35	324402	5493060	43.97
36	324471	5493720	41.27
37	324661	5496690	35.91
38	324814	5489900	5.82
39	324924	5496200	42.47
40	324942	5494770	53.91
41	325022	5490660	6.90
42	325037	5495630	47.11
43	325059	5491330	9.06
44	325099	5497930	4.02
45	325197	5492630	8.17
46	325374	5492070	7.72
47	325518	5497530	3.47
48	325530	5493830	7.01
49	325924	5494810	6.90
50	326071	5493510	7.54
51	326123	5496450	6.64
52	326131	5490740	4.66
53	326189	5497320	7.04
54	326321	5495920	6.44
55	326458	5493080	6.76
56	326565	5491880	5.27
57	326622	5492530	7.68
58	326636	5494620	6.96
59	327035	5497260	6.68
60	327039	5495520	6.08
61	327134	5494280	7.79
62	327317	5496780	4.39
63	327324	5491310	3.52
64	327625	5493920	7.04
65	327644	5492100	3.58
66	327744	5493320	4.04
67	327772	5495340	6.72
68	327878	5496480	2.93
69	328267	5494990	5.97
70	328661	5496320	2.02
71	328754	5494650	8.76
72	328839	5494050	3.43
73	328859	5492560	2.45
74	329084	5495930	2.57
75	329448	5492290	3.63
76	329704	5495670	3.59
77	329999	5495200	4.91
78	330026	5494580	4.39

Indicative WTG Coordinates and Terrain Elevations
Source: GHD

Appendix B: Assessment Methodology

In preparing aeronautical impact assessments associated with airport safeguarding and protection, it is necessary to observe the requirements of the relevant aviation authorities including:

- The Department of Infrastructure, Regional Development and Cities (DIRDC);
- The Civil Aviation Safety Authority of Australia (CASA);
- Airservices Australia (ASA);
- Airport Operators; and
- Department of Defence where appropriate.

Relevant Acts and Regulations applicable to developments near airports and air traffic routes were referenced during this assessment.

The major relevant documents include:

- The Airports Act 1996, Airports (Protection of Airspace) Regulations 1996;
- Civil Aviation Safety Regulation (CASR) Part 139 Manual of Standards – Aerodromes;
- Aeronautical Information Publication (AIP);
- Airservices Australia's Airways Engineering Instruction – Navigation Aid Building Restricted Areas and Siting Guidance (BRA);
- International Civil Aviation Organisation (ICAO) DOC 8168 Procedures for Air Navigation – Aircraft Operations (PANS OPS).

A Glossary of Aeronautical Terms and Abbreviations is shown at Appendix C.

Appendix C: Discussion of Obstacle Lighting

The aeronautical requirements for marking and lighting of wind farms are currently undergoing review by the International Civil Aviation Organization (ICAO), the Department of Infrastructure, Regional Development and Cities (DIRDC) and CASA.

It is understood that ICAO will be issuing an amendment to ICAO Annex 14 (Aerodromes) later this year that addresses, inter alia, wind farms.

DIRDC recently issued a Discussion Paper "Safeguards for airports and the communities around them" that implies an amendment to the criteria for wind turbine heights from 110m to 152m AGL as being applicable to wind farms in the vicinity of aerodromes. In addition, CASA is currently reviewing its withdrawn Advisory Circular AC139-181 "Obstacle Marking and Lighting of Wind Farms". The outcomes of these various reviews may result in:

- Revised criteria for wind farms; and
- Wind farms that are in remote locations, away from aerodromes, not requiring obstacle lighting, depending on the findings of a qualitative risk assessment to be undertaken by the proponent.

While the DIRDC Discussion Paper applies specifically to wind farms within the vicinity (generally accepted as 30km) of aerodromes, CASA is also currently reviewing the requirements for marking and lighting of obstacles and hazards remote from aerodromes. CASA has informally advised the renewable energy industry that a qualitative risk assessment approach to the potential hazards, as presented by wind farms, may be considered.

CASA's current position on obstacle lighting of wind farms that are remote from an aerodrome (which is the situation for Robbins Island Renewable Energy Park) is summarised as:

- CASA cannot mandate obstacle lighting for wind farms that are not within the vicinity of an aerodrome;
- provision of obstacle lighting is the responsibility of the proponent;
- any associated requirements placed on proponents by planning authorities, insurers or financiers are beyond CASA's scope;
- a wind farm proponent may have a duty of care to the aviation industry and local operators in terms of ensuring obstacles are made conspicuous; and
- obstacle marking and lighting requirements as specified in the CASA Manual of Standards Part 139, Chapters 8 and 9 applies.

CASA Manual of Standards (MOS) 139, Chapter 9, Section 9.4 indicates that for structures more than 110m AGL, the proponent should expect that obstacle lighting will be required unless there are unusual circumstances. The turbines to be installed at Robbins Island Renewable Energy Park will have a maximum height of 335 m AGL. However, there have been situations where CASA has acknowledged non-provision of obstacle lighting of wind farms in Australia where the turbine height exceeds 110m AGL. Such installations have been the subject of a hazard risk assessment that takes into account such factors as location of the wind farm with respect to nearby airfields and air routes, potential impact on navigable airspace, surrounding terrain, local aviation activity in the area, and environmental considerations. The wind farms concerned are sited in mountainous area are remote from regulated airports and were assessed as not presenting a hazard to aircraft operations.

As indicated above, Australian policy, standards and recommended practices for obstacle marking and lighting of wind farms are currently under review. A current proposal includes a change to the criterion height of 110m (361ft) to 152m (500ft) AGL for wind farms within the vicinity of a certified or registered aerodrome.

Appendix D: Glossary of Aeronautical Terms and Abbreviations

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.

Advisory Circulars (AC) 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 Information Publication (AIP) 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 within the applicable country. AIP Australia is produced by Airservices Australia under contract to CASA.

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

Air routes exist between navigation aids or waypoints to facilitate the regular and safe flow of aircraft operating under the IFR.

Airservices Australia (ASA) is the Australian government-owned corporation Air Navigation Service Provider (ANSP) providing safe, secure, efficient and environmentally sound air traffic management and related airside services including telecommunications, aeronautical data, navigation services and aviation rescue and firefighting services to the aviation industry within the Australian flight information region.

Air Traffic Control (ATC) service is a service provided in controlled airspace for the purpose of preventing collisions between aircraft and between aircraft and obstructions on the manoeuvring area of controlled aerodromes whilst maintaining an expeditious and orderly flow of air traffic.

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

Area navigation (RNAV) A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Circling approach An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

Civil Aviation Safety Authority (CASA) 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.

Civil Aviation Safety Regulations (CASR) 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.

Decision altitude (DA) or decision height (DH) A specified altitude or height in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. *Note— Decision altitude (DA) is referenced to mean sea level and decision height (DH) is referenced to the threshold elevation.*

Elevation The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

Height The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

Instrument Flight Rules (IFR) are rules applicable to the conduct of flight under IMC. IFR are established to govern flight under conditions in which flight by outside visual reference is not available due to cloud cover or restricted visibility. IFR flight depends upon a qualified instrument rated pilot flying by reference to instruments located in the flight deck. 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. IFR flights can and do regularly operate in VMC but remain an IFR flight for rule and ATC requirements. Regular Public Transport flights are required to file an IFR flight plan, irrespective of the weather conditions.

Instrument Meteorological Conditions (IMC) are meteorological conditions that are less than the minimum specified for visual meteorological conditions.

International Civil Aviation Organization (ICAO) 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.*

Lowest Safe Altitude (LSALT) 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.

Manual of Standards (MOS) comprises specifications (Standards) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation in relation to a particular segment of the aviation regulations. For example, MOS 139 relates to CASR Part 139 – Aerodromes.

Minimum descent altitude (MDA) or minimum descent height (MDH) A specified altitude or height in a 2D instrument approach operation or circling approach operation below which descent must not be made without the required visual reference. Note: Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

Minimum Obstacle Clearance (MOC) is the minimum distance above an obstacle or terrain that aircraft conducting instrument approach or departure procedures are not allowed to fly below in IMC. The MOC varies depending on the distance from the runway or in mountainous areas.

Notices to Airmen (NOTAMs) 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.

Obstacle assessment surface (OAS) is a defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific APV or precision approach procedure.

Obstacle Limitation Surfaces (OLS) 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.

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.

Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) is an ICAO 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) using the 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, below the nominal flight path of the aircraft, which guarantee a certain minimum obstacle clearance above the ground or man-made obstacles. 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 in IMC an obstacle free descent or climb path for a given approach, holding procedure or departure.

Regulations (Civil Aviation Safety Regulations)

Threshold (THR). The beginning of that portion of the runway usable for landing.

Visual Flight Rules (VFR) are rules applicable to the conduct of flights that are only permitted in VMC due to aircraft equipment and pilot qualifications. The visual flight rules allow a pilot to operate an aircraft in weather conditions that allow the pilot to navigate by visual reference to the ground or water by maintaining visual contact with the terrain and obstacle environment in order to be able to see and avoid other aircraft, terrain, obstacles or other hazards. Specifically, the weather must be equal to or better than basic VFR weather minima. If the weather is worse than VFR minima, IFR qualified pilots operating an IFR qualified aircraft are able to operate under the IFR.

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

Visual Segment Surface (VSS) A PANS-OPS design segment of a straight-in instrument approach procedure, which needs to be monitored and kept clear of any penetrations by obstacles.

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 CAR 1998)
ACFT	Aircraft
AD	Aerodrome
ADS-B	Automatic Dependent Surveillance - Broadcast
AHD	Australian Height Datum
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALT	Altitude
AMSL	Above Mean Sea Level
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
BARO-VNAV	Barometric Vertical Navigation
BRA	Building Restricted Area
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
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIT	Department of Infrastructure and Transport. (Formerly Dept. of Infrastructure, Transport, Regional Development and Local Government and Department of Transport and Regional Services (DoTARS))
DOTARS	See DIT 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
FAS	Final Approach Surface of a BARO-VNAV approach
ft	feet
GBAS	Ground Based Augmentation System (satellite precision landing system)
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
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
LNAV	Lateral Navigation criteria
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
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NDB	Non Directional Beacon
NE	North East
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

Abbreviation	Meaning
OLS	Obstacle Limitation Surface
PANS OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PBN	Performance Based Navigation
PRM	Precision Runway Monitor
QNH	An altimeter setting relative to height above mean sea level
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
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	STandard ARrival
SGHAT	Solar Glare Hazard Analysis Tool
TAR	Terminal Approach Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VNAV	Vertical Navigation criteria
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart