AERONAUTICAL IMPACT ASSESSMENT

ARNCLIFFE BANKSIA AREA, NSW

APP Corporation Pty Limited

J0445

FINAL REPORT V1.0

23 JUNE 2015

AMBIDJI

A.C.N. 053 868 778

Suite 11, 622 Ferntree Gully Road, Wheelers Hill,
VIC, 3150, Australia

DOCUMENT RELEASE APPROVAL

Approved for Release: Final Report V 1.0

Name: Barrie Slingo

Title: Senior Associate

Date: 25 June 2015

Distribution: APP Corporation

DOCUMENT CONTROL

REV NO	DESCRIPTION	DATE	Prepared	QA
V0.1	Draft Report	22 April 2015	BR	BWS
V0.2	Revised Draft Report	28 April 2015	BR	BWS
V1.0	Final Report	23 June 2015	BR	BWS

Table of Contents

1. INTRODUCTION

The Ambidji Group Pty Ltd was tasked by the APP Corporation to prepare a Preliminary Aeronautical Impact Assessment (AIA) for the proposed development of the Arncliffe Banksia area in NSW.

This final Report has been prepared following comments on the revised draft report by APP Corporation.

It was not possible to use the exact precinct area, as streets shown on the precinct chart do not match those provided by the Sydney Airport OLS and PANS-OPS charts. However a compromise area was constructed and this area contains the precinct chart boundaries.

The precinct area is located to the west of Sydney Airport. Figure 1.1 shows the boundaries of the precinct area in red in relation to the Airport.

Figure 1.1 - Location of the development area in relation to Sydney Airport.

2. METHODOLOGY

The methodology employed for the preparation of this report primarily focuses on the consideration of the key elements of:

- the Airports Act 1996 (Part 12, Protection of airspace around airports);
- the Airports (Protection of Airspace) Regulations 1996;
- Civil Aviation (Building Control) Regulations 1988; and
- Civil Aviation Safety Regulations (CASR) Part 139 Manual of Standards (MOS), Chapter 7 Obstacle Restriction and Limitation and Chapter 11 Standards for Other Aerodrome Facilities.

The key elements of the report involve a preliminary assessment of:

- the Obstacle Limitation Surfaces (OLS);
- the Procedures for Air Navigation Services – Aircraft Operations (PANS OPS) Surfaces;
- the Standards for Siting and Clearance Areas for Airways Facilities on Airports; and
- The requirement for a plume rise assessment by CASA.

3. PROPOSED DEVELOPMENT HEIGHTS

Figure 3.1 shows the proposed development heights and topography as provided by APP. These heights will need to be examined and modified if necessary to ensure that there is no penetration of the Sydney Airport Prescribed Airspaces, which are shown in the following sections and are attached in Appendices.

It may be possible to obtain approval to penetrate the Inner horizontal Surface (IHS) of the OLS Prescribed Airspace and this is examined in Section 5.

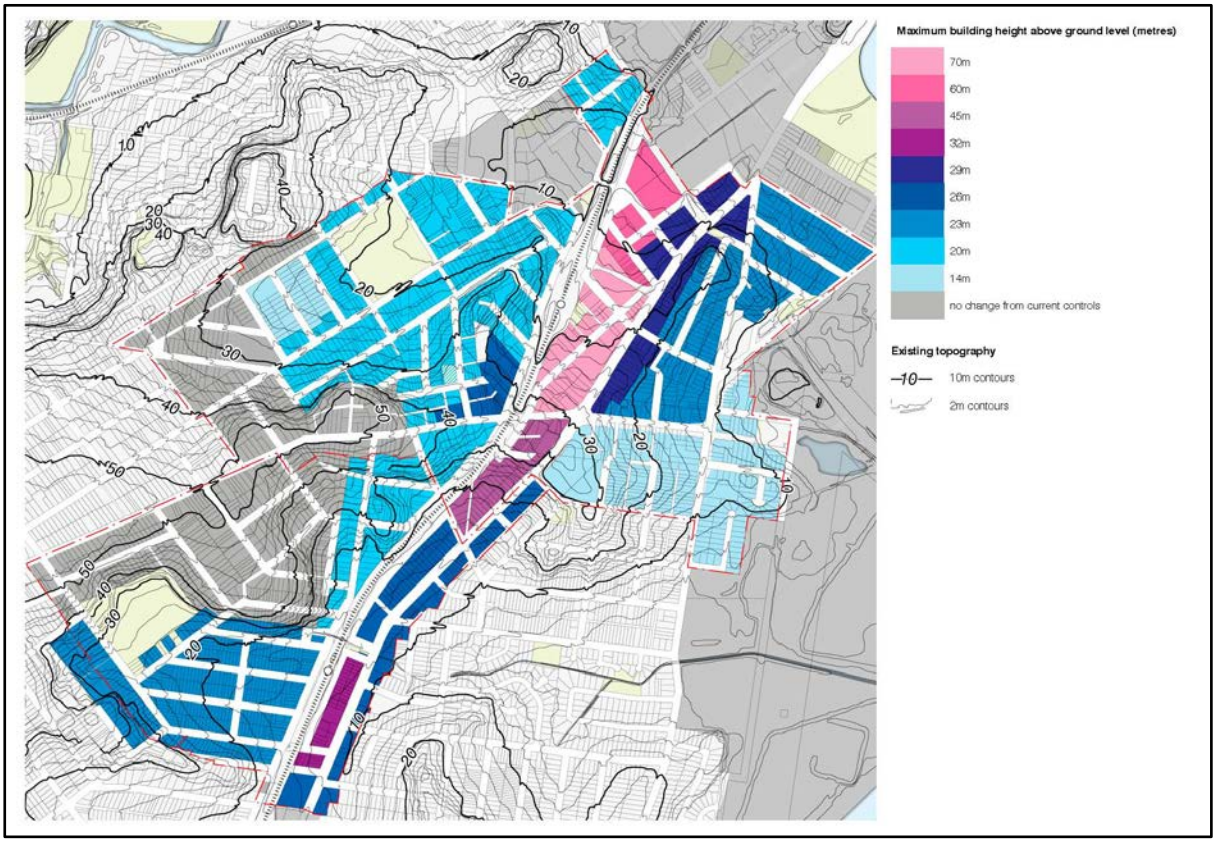

Figure 3.1 Proposed Development Heights and Topography from APP

4. SYDNEY AIRPORT PRESCRIBED AIRSPACE

In accordance with the Airports Act 1996 (Part 12, Protection of airspace around airports), on March 20 2015 Sydney Airport Corporation Limited (SACL) published revised Prescribed Airspace Charts for the airport.

The Prescribed Airspace was declared by the Commonwealth Department of Infrastructure and Regional Development.

The charts for the OLS and PANS-OPS surfaces for the airport were examined in relation to the Arncliffe Banksia precinct area to determine the maximum development heights to avoid penetration of the surfaces. It should be noted that the maximum heights on the charts are Above the Australian Height Datum (AHD) and include construction cranes.

This report includes the OLS and PANS-OPS charts in PDF format, to allow for zooming to more accurately determine the ground locations in relation to the height limiting surfaces.

5. ANALYSIS OF OBSTACLE LIMITATION SURFACES (OLS)

The object of the OLS is to define a volume of airspace in proximity to the airport which should be kept free of obstacles that may endanger aircraft in visual operations, or during the visual stages of an instrument approach. The intention is not to restrict or prohibit all obstacles, but to ensure that either existing or potential obstacles are examined for their impact on aircraft operations and that their presence is properly taken into account.

Since they are relevant to visual operations, it may sometimes be sufficient to ensure that the obstacle is conspicuous to pilots, and this may require that they be marked or lit.

Figure 5.1 shows the development area (green) in relation to the OLS. This figure is aligned 329°/149° (T), in accordance with the published OLS chart. A PDF version of this chart is included at Appendix B to permit zooming for more detailed examination.

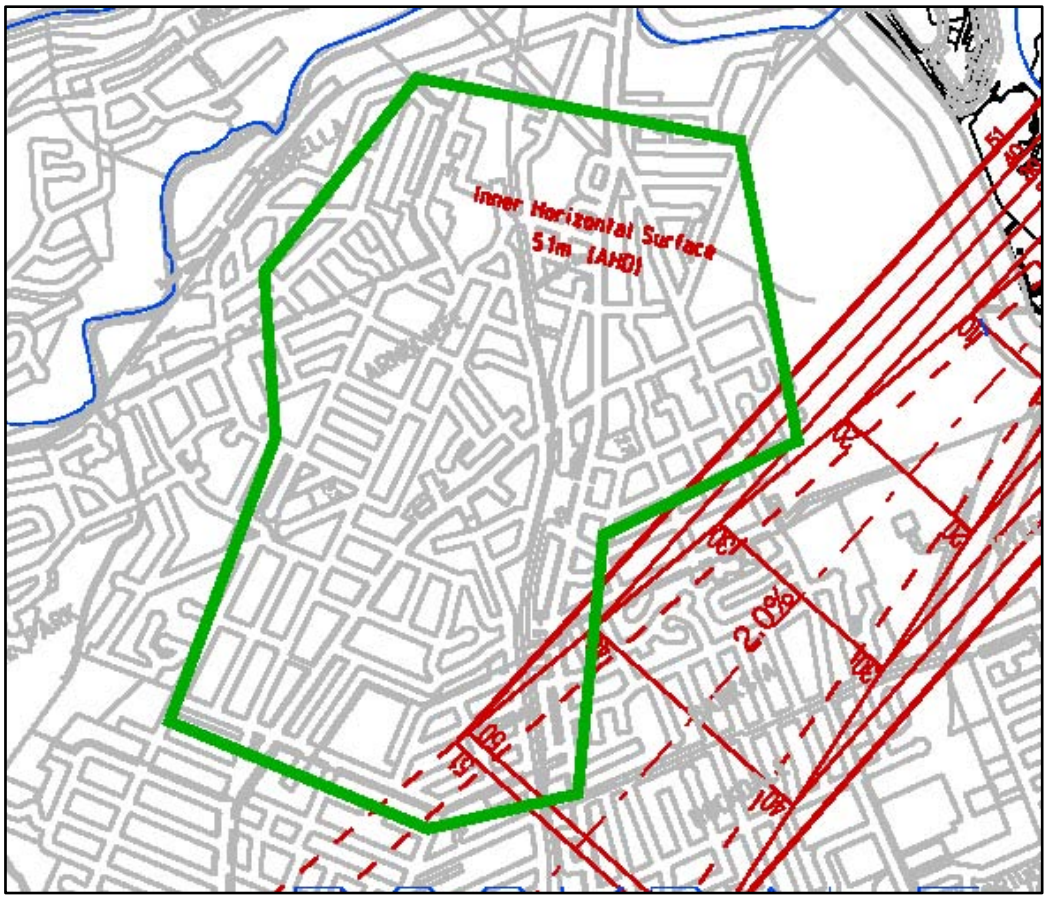

Figure 5.1: Sydney Airport – Development Area Obstacle Limitation Surfaces (Source: SACL)

Most of the precinct area is located below the Inner Horizontal Surface (IHS) at 51 m AHD. The sloping Approach surface for RWY 07 and the Take Off Climb surface for RWY 25 shown in red in the east and south east of the area are more limiting than the IHS.

It may be possible to obtain approval to penetrate the IHS surface in accordance with the recommendations of ICAO Doc ANNEX 14 Volume 1 Aerodrome Design and Operations, Para 4.2.20, which states:

> *New objects or extensions of existing objects should not be permitted above the Conical Surface and the Inner Horizontal Surface except when, in the opinion of the appropriate authority, an object would be shielded by an existing immovable object, or after an aeronautical study it is determined that the object would not adversely affect safety or significantly affect the regularity of operations of aeroplanes.*

ICAO Airport Services Manual Part 6 Control of Obstacles states in Para 1.2.2.4:

In assessing the operational effect of proposed new construction, tall structures would not be of immediate significance if they are proposed to be located in:

a) *An area already substantially obstructed by terrain or existing structures of equivalent height*
b) *An area which would be safely avoided by prescribed procedures associated with navigational guidance where appropriate*

Any requests to penetrate the IHS would be subject to a safety case being prepared and submitted to SACL. The safety case would have to show that any proposed development height above the IHS *"would not adversely affect safety or significantly affect the regularity of operations of aeroplanes."*

Requests and safety cases are required to be submitted for individual buildings or small groups of buildings. SACL will forward the requests to DIRD, CASA, AsA and industry stakeholders.

The DIRD is the final legal approving authority for approvals to penetrate declared Prescribed Airspaces at airports, and this authority would base approvals on reports by CASA and AsA regarding the safety and regularity of operations. Conditions may be imposed on any approval.

CASA as Australia's safety regulator has the responsibility to ensure that any approvals to penetrate Prescribed Airspace do not impact on the safety of operations. CASA will take into account any comments by industry stakeholders such as airlines on the impact of contingency procedures, which are published for pilots to follow in the event of engine failure on take-off.

AsA prepare instrument approach and departure procedures for airports in Australia. These procedures determine the PANS-OPS limitation surfaces published by SACL. AsA will examine any requests to penetrate the IHS to determine that the PANS-OPS surfaces are not penetrated. It will also ensure that there will not be any adverse impact on traffic handling by Air Traffic Control (ATC) and the regularity of operations.

It would not be possible for approval to be granted to penetrate the Approach and Take Off climb surfaces (shown in red on Figure 5.1, and also the PANS-OPS surfaces, which are examined in the next section.

6. ANALYSIS OF PANS OPS SURFACES

PANS OPS surfaces detail essential areas and obstacle clearance requirements for the achievement of safe, regular instrument flight operations. The instrument flight procedures enable pilots to either descend from the high en-route environment of cruise type flight to establish visual contact with the landing runway, or climb from the runway after take-off to the en-route environment, with a prescribed safe margin above terrain and obstacles, by use of aircraft instruments and radio navigation aids or GPS in conditions where the pilot cannot maintain visual contact with the terrain and obstacles due to inclement weather conditions.

Figure 6.1 shows the development area (green) in relation to the PANS-OPS surfaces. This figure is aligned True North. The area in blue on this figure is the 51 m boundary of the IHS as shown in Figure 5.1 in the OLS section above. The PANS-OPS surfaces are not below the OLS surfaces, so the OLS surfaces are the limits to the development height.

If any request is made to penetrate the IHS as discussed in section 5, the PANS-OPS surface at the site then becomes the limiting surface.

A PDF version of this chart is included at Appendix C to permit zooming for more detailed examination.

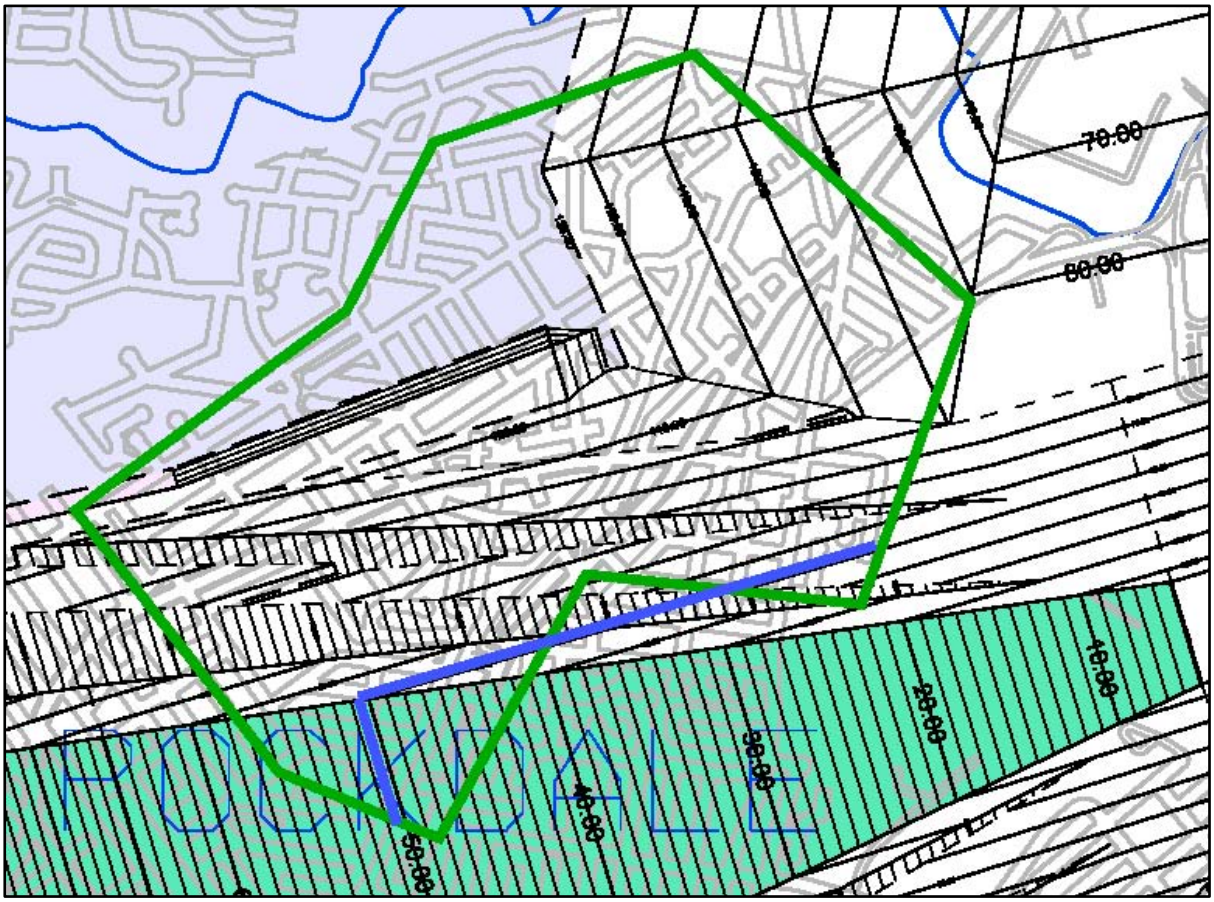

Figure 6.1 Sydney Airport PANS-OPS surfaces and the development site (source SACL)

7. CONTINGENCY PROCEDURES – ENGINE INOPERATIVE FLIGHT PATHS

Contingency procedures are proprietary procedures developed by airline operators to cover the situation of a failure of a critical engine, called one engine inoperative (OEI) condition. As they are proprietary procedures, Ambidji is unable to assess any impact that a proposed building development may have on contingency procedures.

The airline operators that use Sydney Airport would need to determine whether the existing contingency procedures need modification to allow for the additional height of the proposed development over that of the existing buildings in the area. This assessment would normally occur during consideration of the building proposal development application by Sydney Airport and the airline operators at the airport.

8. RADAR PERFORMANCE IMPACT

The Sydney Airport Terminal Area Radar (TAR), comprising of Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) is located on the airport 2730 m from the nearest development precinct area boundary, at an antenna elevation of 34.5 m AHD.

The location of the Sydney TAR is shown in Figure 9.1.

There is another TAR located at Cecil Park, approximately 30 km from the building site, at an antenna elevation of 161.27 m AHD. This radar is too far from the development site for impact on its performance.

8.1 CLEARANCE REQUIREMENTS FOR RADARS

CASA Manual of Standards (MOS) Part 139 Aerodromes publishes the clearance requirements for radars. The section of the MOS that applies to the development site is:

> *11.1.14.4*
>
> *The following clearance requirements are to be maintained:*
>
> *(a) No intrusion within 1 km of the radar into a height surface 5 m below the bottom of the antenna. No intrusion between the radar and the possible location of any desired targets, i.e. roughly speaking above 0.5 degrees elevation at any distance.*
>
> *(b) No metallic or other electrical reflective surfaces anywhere which subtend an angle of more than 0.5 degrees when viewed from the radar, e.g. fences, power lines, tanks as well as many buildings. All overhead power lines within 1 km must be aligned radially from the radar or be located at least 10 degrees below horizontal from the antenna.*

The Sydney TAR protection plane at 0.5° is 58.3 m AHD at the nearest precinct boundary, and as the maximum building height in area is 51 m AHD (IHS surface), building development in the area will not penetrate the radar protection plane. Any requests to penetrate the IHS would have to be examined to determine if there is any penetration of the Sydney Airport radar 0.5° plane.

If building development does penetrate the radar protection plane, Airservices Australia may require engineering analysis to be undertaken to determine what impact this penetration would have on the Sydney TAR. If this is done by Airservices the developer would be charged. Ambidji can also provide a qualified radar engineer to undertake this task under commercial arrangements with the developer.

However there are alternative airspace surveillance sensors that could be utilised to minimise any impact on the performance of the Sydney TAR. These are:

- The Cecil Park TAR provides similar radar coverage in the airspace in the vicinity of the two buildings site and in fact is coverage backup for the Sydney TAR;

- In addition to the radars, a Wide Area Multilateration (WAM) surveillance system is installed in the Sydney region, and this provides airspace surveillance for Mode S transponder equipped aircraft in the airspace in the vicinity of the development site. WAM is a distributed sensor system and is not subject to the same clearance requirements and building impact on performance as radars are. As most aircraft operating in the Sydney controlled airspace are required to be equipped with Mode S transponders, the WAM system is another suitable coverage alternative to the Sydney TAR; and

- Automatic Dependant Surveillance – Broadcast (ADS-B) surveillance is also provided for ADS-B equipped aircraft in the Sydney terminal airspace and this system is also another surveillance alternative to the Sydney TAR, but only for ADS-B equipped aircraft.

The Cecil Park TAR is 161.27 m AHD, and its protection plane is well above any building development in the precinct area.

9. POTENTIAL IMPACT ON AIRPORT NAVIGATION AIDS

The locations of the navigation aids that have restricted areas that require examination to determine if these penetrate the precinct area boundaries are shown in Figure 9.1.

Figure 9.1 Navigation Aids and TAR locations

Instrument Landing Systems (ILS)

All Runways at Sydney Airport are served by an ILS with associated Localiser (LOC) and Glide Path (GP). The RWY 07 ILS is the nearest to the building site.

The Building Restricted Areas (BRA) specified in the Air Services Australia document Navigation Aid Building Restricted Areas and Siting Guidance AEI-7.1613 Issue 2 contain the following building development limitations.

RWY 07 Localiser (LOC)

The LOC BRA limit extends to 500 m west of the threshold of RWY 07. As the nearest precinct boundary is at least 1000 m from the BRA, the LOC BRA will not be infringed.

RWY 07 Glide Path (GP)

The GP Building Restricted Area (BRA) extends to 1500 m in front of the RWY 07 GP antenna at a width of 310m. As the nearest precinct boundary is 140 m north the BRA, the GP BRA will not be infringed.

Ground Based Augmentation System (GBAS)

A GBAS is installed at Sydney and GLS approach procedures are published for all runways. The BRA for the VHF Data Broadcast Unit (VDB) and Remote Satellite Measurement Unit (RSMU) antennas associated with GBAS is a 3000 m radius.

As the nearest precinct boundary is 3770 m from the BRA, the GBAS BRA will not be infringed.

The precinct area will not infringe the Building Restricted Areas for all Navigation Aids at Sydney Airport.

10. LIGHTING OF BUILDINGS

For any proposed development requested and approved at a height that exceeds the OLS it would be likely that lighting conditions will be imposed. CASA may also require the construction cranes to have obstruction lights.

11. DEPARTMENT OF DEFENCE REQUIREMENTS

The nearest Department of Defence airport with publicly available PANS OPS procedures is RAAF Base Richmond. Due to its distance from the proposed development (approximately 47 km) and ATC arrangements in the area, the proposed development is unlikely to impact on Defence operations.

The Australian Army has a helicopter base at the Holsworthy Army Barracks, approximately 24km south-west of the proposed development site. Holsworthy does not have any PANS OPS procedures available and operations there will not be affected by the proposed development.

12. PLUME RISE ASSESSMENT

If there will be a plume rise exceeding 4.3 m/s. at any building development a plume rise assessment will be conducted by CASA. If the rise is less then no assessment will be required.

13. CONCLUSION

This preliminary aeronautical assessment was conducted to consider the height limitations and impacts of the proposed Arncliffe Banksia development.

The assessment concludes that:

- The Sydney Airport Prescribed Airspaces for OLS and PANS-OPS extend over the development area.
- The limiting surface over most of the development area is the IHS OLS surface at 51 m.
- The sloping RWY 07 approach surface and the RWY 25 Take Off climb surface are lower than the IHS.
- The PANS-OPS surfaces are not lower than the OLS surfaces.
- Requests can be made to penetrate the IHS, but these must be supported by an aeronautical safety case.
- Such requests are normally restricted to individual buildings or small groups of buildings.
- It will not be possible to penetrate the PANS-OPS and the OLS approach and take off climb surfaces.
- The clearance plane of the Sydney Airport Terminal Airspace Radar is not infringed if approved building heights are restricted to 58.3 m. Airservices Australia may require an engineering study of the impact on radar performance for buildings above this height.
- The restricted areas for the Sydney Airport navigation aids are not infringed.
- If there will be roof top plume rises exceeding 4.3 m/s a plume rise assessment will be conducted by CASA. If the rise is less then no assessment will be required.

This report includes the OLS and PANS-OPS charts in PDF format.

APPENDIX A

Glossary of Aeronautical Terms and Abbreviations

APPENDIX A

GLOSSARY OF AERONAUTICAL TERMS and ABBREVIATIONS

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.

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.

AIPs (Aeronautical Information Publications) are publications promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. They contain details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, AIPs 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 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.

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 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 are 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.

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.

Appendix

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.

Appendix

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
AHD	Australian Height Datum
AHT	Aircraft height
AIP	Aeronautical Information Publication
AIRPORTS ACT	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALT	Altitude
AMSL	Above Minimum 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
BRA	Building Restricted Area (for GP)
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
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
FAP	Final Approach Point
ft	feet
GLS	Ground Based Augmentation Landing System
GNSS	Global Navigation Satellite System
GP	Glide Path

Abbreviation	Meaning
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
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
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – 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
RWY	Runway
SFC	Surface

Appendix

Abbreviation	Meaning
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	Standard ARrival
TAR	Terminal Approach Radar
TAS	True AirSpeed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart

Appendix

APPENDIX B

OLS PDF Version

Appendix

Appendix

APPENDIX C

PANS-OPS PDF Version

Appendix