Department of Planning, Industry and Environment

Snowy Mountains Special Activation Precinct - Airport

Infrastructure and Masterplanning Report

Issue 1

Job number 276436-00

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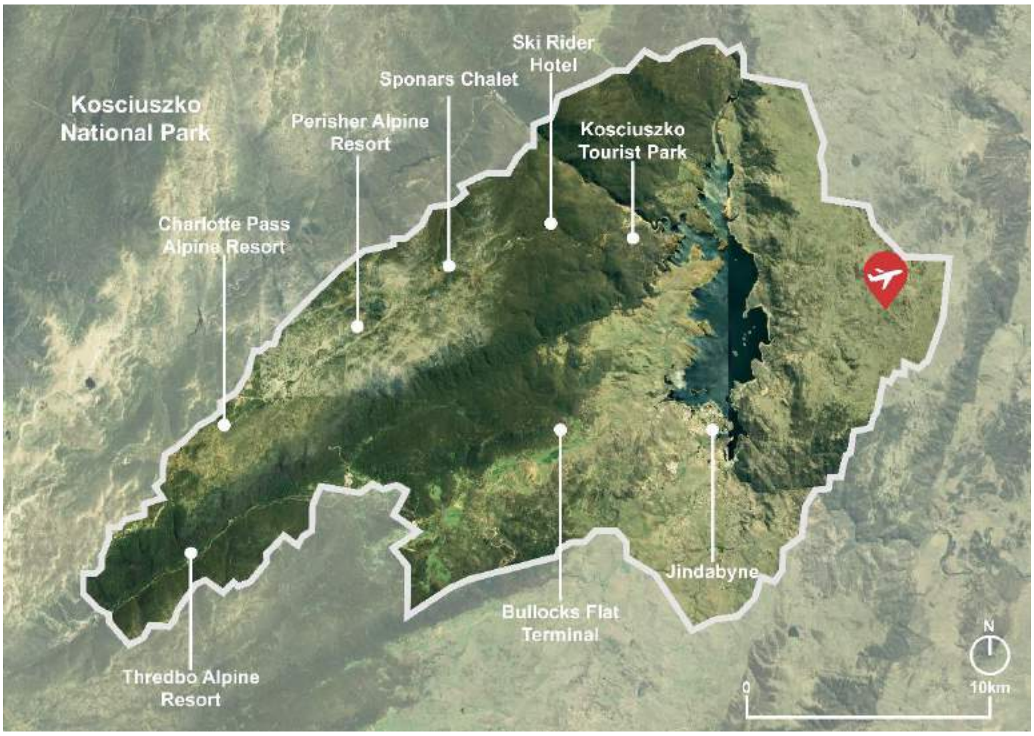
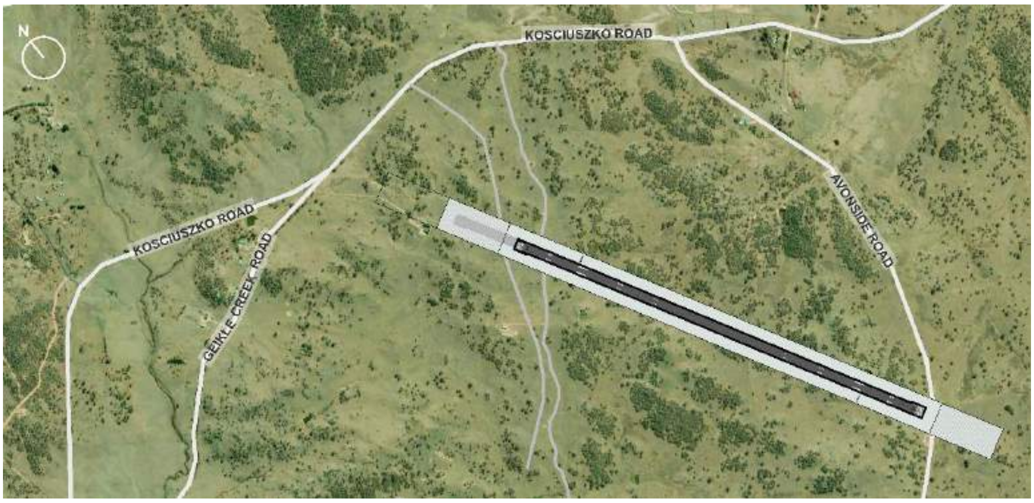
Executive Summary

Arup was commissed to develop a Airport Infrastructrue Report to undertstand the feasability of developing an Airport to support the Snowy Mountains SAP. This report sets out the process for selecting a proposed site, design requiremetns, preliminary airport plan and engineering considerations that have occurred to date.

The proposed airport site is located approximately 10km north east of Jindabyne. The site is located within the context of the Snowy Mountains SAP bounded by Avonside Road, Kosciusko Road.

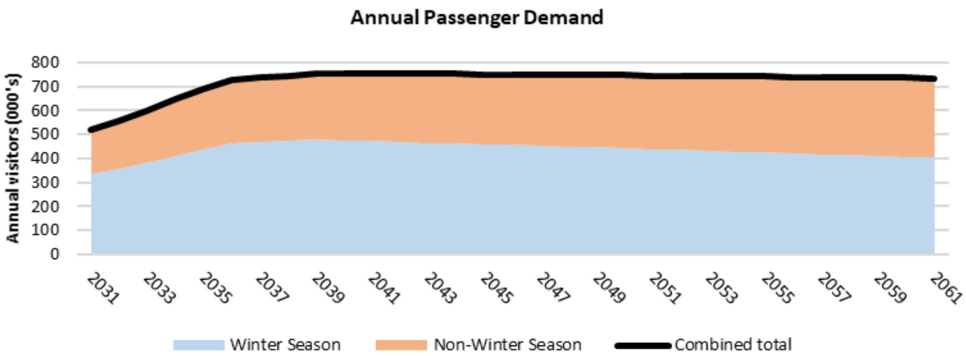




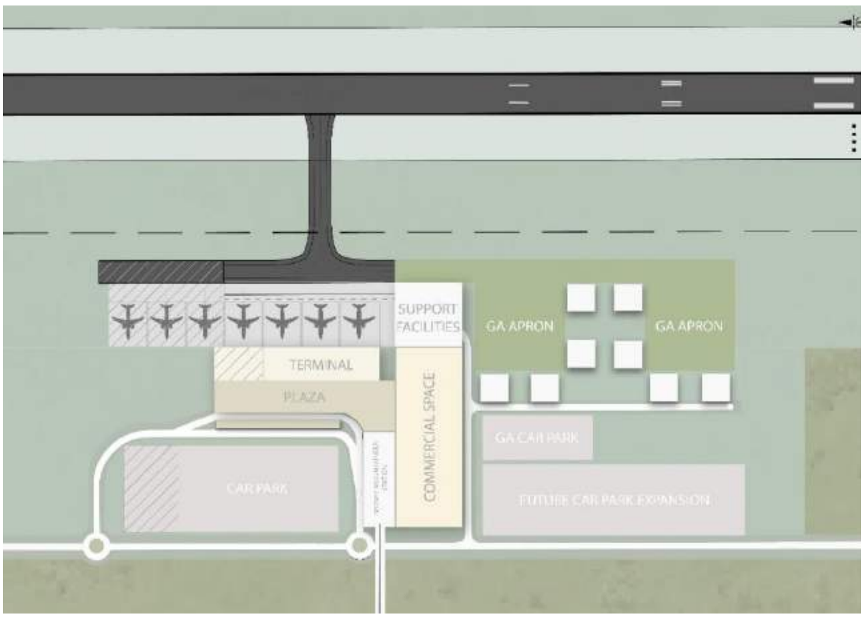
The airport has been planned in line with the strategic framework of the SAP with the strategies underpinning the airport including:

- Plan for a new airport at Avonside within the Snowy SAP Area to support growth
- To enable a commercially sustainable airport operation
- Plan for a jet capable airport to achieve the NSW Alpine vision
- Introduce sustainable aviation fuel and e-propulsion technology as part of the social licence to operate an airport (Carbon Negative and Climate Positive) near the National Parks eco-sensitive areas
- Align the regional infrastructure investment with the airport infrastructure.

To support the growth put forward in the Snowy SAP Tourism and Visitation Forecasts, the airport has been planned to accommodate up to 750,000 passengers per year from 2039. The opening day of the airport will be about 2031.



The Jindabyne Airport Masterplan has been prepared with the intent that this Airport is more than just a collection of transport infrastructure components. It is intended that the new Snowy Mountains SAP Airport will have its own sense of place, a thriving General Aviation presence and world class customer experieince.



1 Introduction

1.1 Overview

Arup was commissioned by the Department of Planning, Industry and Environment to develop a masterplan and investigate the feasibility of developing an Airport to support the Snowy Mountains Strategic Activation Precent (SAP). This report provides an overview of the work done in developing a masterplan for the Airport to integrate with the strategic vision of the Snowy Mountains SAP.

1.2 Methodology

The development of this report was underpinned by several studies including:

- Meteorological study;
- Site Selection study;
- Commercial study; and
- Aeronautical study.

In addition to the specific studies outlined above, the masterplan was developed alongside the other disciplines involved in the broader precinct study. This includes:

- transport and utilities;
- economics and demand forecasting;
- environment and heritage; and
- land use planning.

As part of this, Arup has had direct involvement in fortnightly workshops with the project team as well as input into stakeholder workshops facilitated by the project manager. Following the preliminary studies and alignment workshops, the following elements of the report were developed:

- facility requirements;
- preliminary airport plan; and
- airport safeguarding plan

1.3 Structure of Report

This report is set out as follows:

- Chapter 2 sets out the broader context for the Snowy SAP, strategic vision and the role of the airport
- Chapter 3 summarised the site selection process that took place
- Chapter 4 outlines the context of the preferred site.

- Chapter 5 provides a summary of the demand forecast and commercial study
- Chapter 6 sets out the design requirements for the airport
- Chapter 7 maps out the proposed airport plan including the different infrastructure laments to be constructed.
- Chapter 8 outlines the key airport safeguarding elements that are required to be implemented.

2 Strategic Framework

2.1 Snowy Mountains SAP

The Snowy Mountains Activation Precinct aims to develop the region into Australia's alpine capital, maintaining an unspoiled alpine landscape while developing the precinct in line with the vision for the region:

The broader SAP has a strategic framework to develop goals for each of the topics identified, which are linked to each of the technical studies. The topics include:

- Tourism
- Economic development, visitation and population
- Public realm
- Sports infrastructure
- Growth management
- Transport
- Airport
- Sustainability
- Housing and Tourist Accommodation
- Statutory planning
- KNP Carrying Capacity
- Social Infrastructure
- Environment and Heritage
- Bushfire
- Infrastructure
- Community, Lifestyle and Culture

In addition, the strategic framework has identified a range of key sites which demonstrate the opportunities for tourism and development. These include the airport, as well as sites linked to future sports infrastructure, accommodation

2.2 Role of the Airport

A new airport in the Snowy Mountains Region is central to the broader plan to support growth across the SAP. In helping to meet the growth ambitions for the region, the proposed airport will:

- support tourism growth by increasing capacity into the region;
- enhance accessibility to the region by reducing the time taken to travel from major cities;
- open new markets across Australia with a focus on Queensland and Victoria;

- act as a gateway into the region supported by the proposed Snowy Mountaineer;
- enable tourists to maximise their time in the alpine region;
- provide a catalyst for potential commercial development around the airport;
- create opportunities for tourism activities such as skydiving and scenic flights; and
- attract businesses and conferences who need to connect to the major cities and other supply chains;
- attract a skilled workforce to service the airport; and
- provide a platform for companies linked to the Snowy Hydro Scheme, Renewable Energy and Future Sustainable Aviation Technologies Research

Additional benefits beyond supporting the vision of the SAP include:

- creating a new staging position for RFS with a focus on aerial firefighting needs; and
- provide a new staging position for medical flights to the Alpine Region and ensuring that people can get to hospital quickly.

2.3 Strategies

To help realise this role within the SAP, the following strategies sit behind the planning for the site:

- Plan for a new airport at Avonside within the Snowy Mountains SAP Area to support growth
- To enable a commercially sustainable airport operation
- Plan for a jet capable airport to achieve the alpine vision this will help to realise:
  - More capacity
  - Increased route
  - More reliability
- Introduce sustainable aviation fuel and e-propulsion technology as part of the social licence to operate an airport (Carbon Negative and Climate Positive) near the National Parks eco-sensitive areas
- Align the regional infrastructure investment with the airport infrastructure.

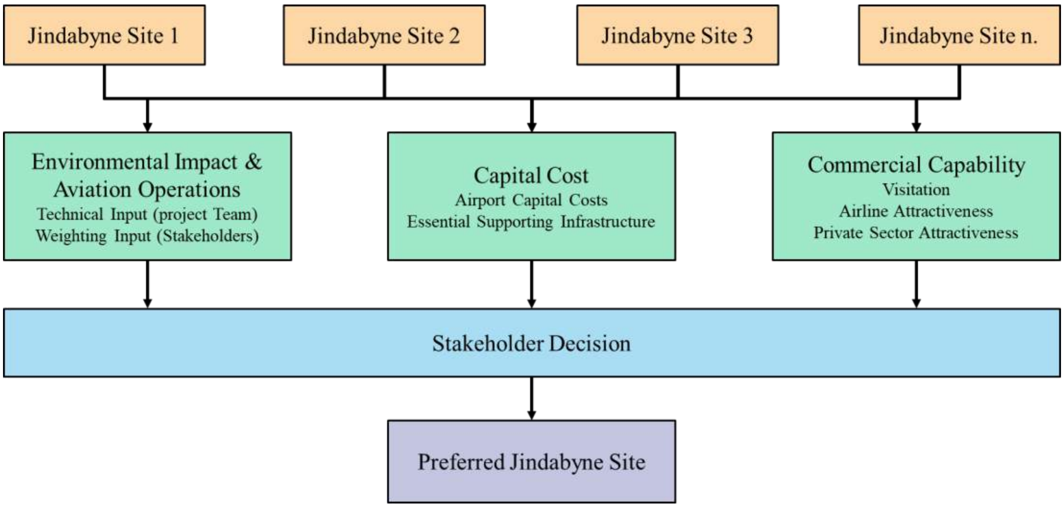
3 Site Selection

3.1 Methodology

To determine the final location of the airport, a two-stage assessment approach is was utilised as outlined in Figure 1. Stage 1 was a technical evaluation undertaken by Arup to provide information to the State Government Stakeholders to make an informed decision. The Arup assessment was limited to technical considerations around the airport site and did not consider the wider strategic needs of the SAP and integration with other proposed infrastructure.

To be sure that all potential sites are subject to assessment were appropriate, a feasibility test was undertaken to across all options. This feasibility test was focused on the ability for aircraft to operate safely and efficiently to the latest international standards in the wind conditions.

Following the technical assessment, the it a decision was then made by NSW Government on the preferred site.



This section sets out site options and results of the technical evaluation which acted as inputs into the stakeholder decisions.

A supporting site evaluation report outlines this in further detail and includes the evaluation criteria and details around scoring for all three sites.

3.2 Options

Thee sites were shortlisted for evaluation as part of the project. These sites are shown in Figure 1 below.

Option 1

Option 1 is located at the existing Jindabyne Community Airstrip and close to (within 2km) the town of Jindabyne. There are established residences, commercial areas and a sports/recreation centre near the site. Further development of the site may restrict or impact the surrounding land uses due to operational airport requirements and/or noise impacts.

Option 2

Option 2 is located approximately 9 km south of Jindabyne to the east of Moonbah, in rural grazing land. The site is bordered by existing roads – Barry Way to the east and Alpine Way to the north west. Neither are impacted by the proposed works. The site does not pass through any formal roads however there is an unnamed unsealed road to the south east that the runway crosses. The runway crosses over a waterway, a tributary to Steels Creek towards the south east.

Option 3

Option 3 is located in rural land to the north east of Jindabyne (currently zoned Primary Production). There are rural residential properties in the surrounding area, and an equestrian resort to the north east. The site passes through two identifiable roads – Avonside Road (unsealed) to the south east and an unnamed road (unsealed) the north west. Both would require relocation.

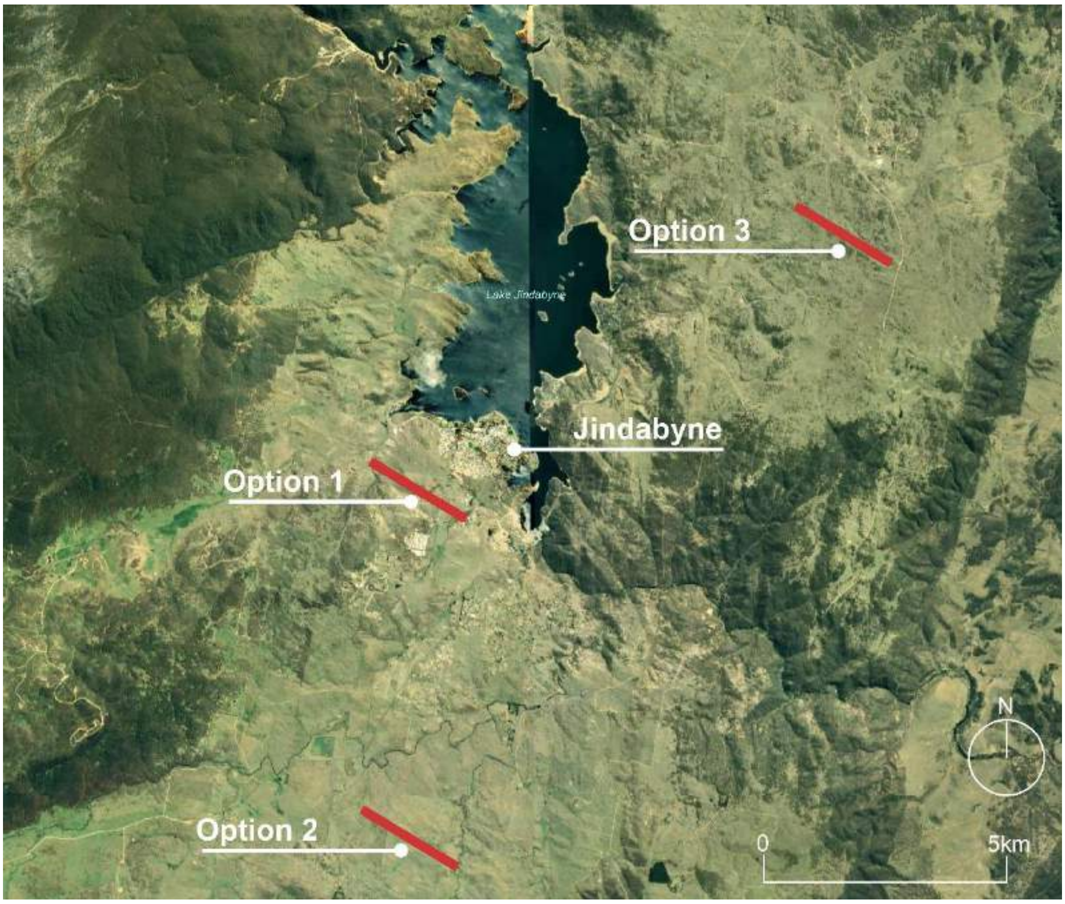
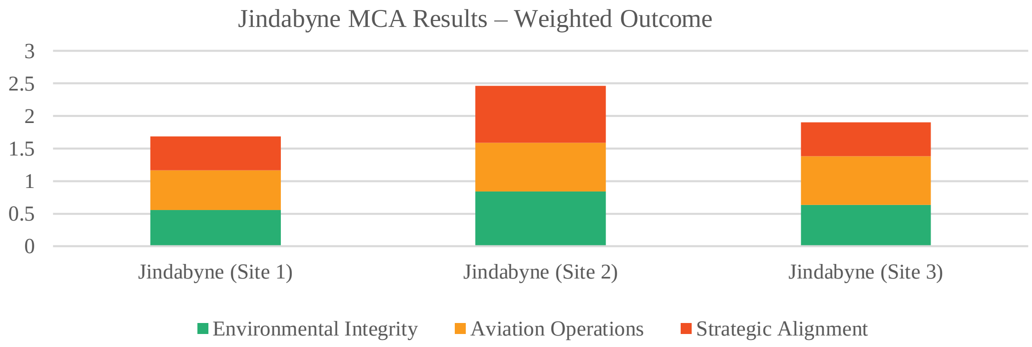


Figure 1: Airport Site Options

3.3 Technical Evaluation Outcomes

The technical evaluation outcomes are outlined below. Following the environmental and operations assessment it was determined that only site 2 and 3 should be subject to further evaluation.

Environmental Impact and Aviation Operations



The evaluation below was undertaken without consideration of the Snowy Mountaineer. The impact of this would be a higher strategic alignment for site 3 however this was not updated to reflect the outcomes of the evaluation at the time it was undertaken.

Capital Cost Considerations

A preliminary assessment was undertaken to try and determine if there were any capital cost considerations between the sites.. These are outlined below.

Criteria	Jindabyne (Site 2)	Jindabyne (Site 3)
Cooma Linkages	Site 2 is too far from Cooma to offer any advantage to going via Canberra. This may impact on patronage but will need to be tested	Site 3 is closer to Cooma and may attract some local residents. This could increase patronage and offer some competition to Canberra.
Distance to Snow Fields/Resorts	Site 2 is closer to the snowfields and may offer a more attractive opportunity for people to fly. This could have a positive impact on patronage but it is not expected to be significant.	Site 3 is further from the snowfields and may not be as competitive as site 2. This could have in impact on patronage but it is not expected to be significant.
Development Considerations	Site 2 provides a hub that offers an investment and development opportunity to invest around that is closer to the snowfields. There may be some impact to residential development to the south of Jindabyne as people may not want to live near an airport.	Site three does not significantly impact the development areas of the SAP.

Commercial Capability

A preliminary assessment was undertaken to try and draw out commercial differences between the two sites. These are outlined below.

Criteria	Jindabyne (Site 2)	Jindabyne (Site 3)
Cooma Linkages	Site 2 is too far from Cooma to offer any advantage to going via Canberra. This may impact on patronage but will need to be tested	Site 3 is closer to Cooma and may attract some local residents. This could increase patronage and offer some competition to Canberra.
Distance to Snow Fields/Resorts	Site 2 is closer to the snowfields and may offer a more attractive opportunity for people to fly. This could have a positive impact on patronage but it is not expected to be significant.	Site 3 is further from the snowfields and may not be as competitive as site 2. This could have in impact on patronage but it is not expected to be significant.
Development Considerations	Site 2 provides a hub that offers an investment and development opportunity to invest around that is closer to the snowfields. There may be some impact to residential development to the south of Jindabyne as people may not want to live near an airport.	Site three does not significantly impact the development areas of the SAP.

3.4 Preferred Site

Following the technical evaluation, NSW government advised that Site 3 was selected for inclusion in the Snowy Mountains SAP, as it aligned best with the overall SAP and it enabled the progression of the SAP Masterplan in a way that would not impact on other major infrastructure and attraction opportunities (like the Snowy Mountaineer Cableway).

4 Site Context

4.1 Overview

The proposed airport site is located approximately 10km north east of Jindabyne. Figure 2shows where the site is located within the context of the Snowy Mountains SAP.

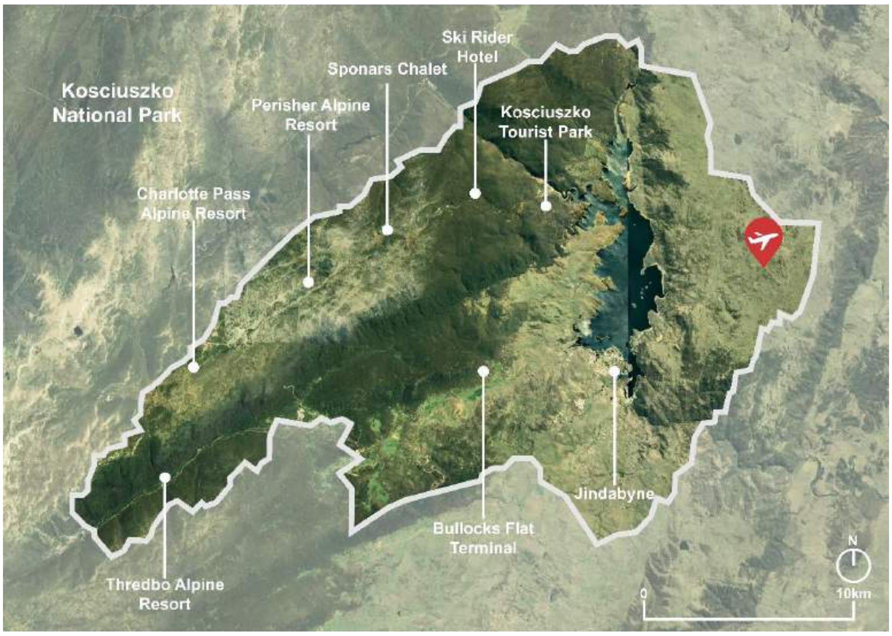


Figure 2: Jindabyne Airport Site

4.2 Land Use

The proposed airport is located in rural land to the north east of Jindabyne (currently zoned Primary Production). There are rural residential properties in the surrounding area, and an equestrian resort to the north east. Figure 3 sets out the property boundaries that make up the site. Any acquisition of land would need to consider if whole or partial sites would be acquired.

Figure 3: Property Boundaries

The current use of the land is predominantly for residential and farming purposes. There is mountainous terrain covered by trees, with private roads leading to residences.

4.3 Ground Transport

Road Network

The main mode of transport used to access Jindabyne is car access. The main road from Cooma to Jindabyne is Kosciusko Road, which also connected to Alpine Way in order to reach the snowfields, as well as Barry Way, which connects Jindabyne to Victoria.

Currently, parts of this network are near their peak capacity, especially Kosciusko Road over the Dam and around the Alpine Way connection. WSP has also proposed a connector road within Jindabyne to allow for a bypass of the town during the peak times.

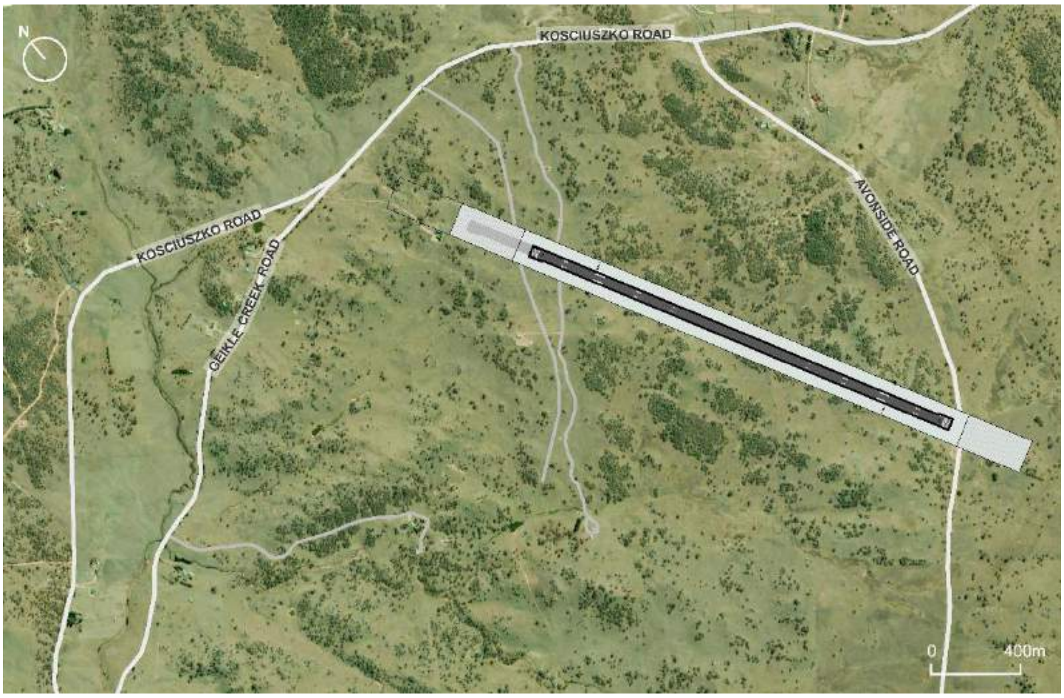


Figure 4: Surrounding Road Network

Public Transport

The current public transport consists of bus and coach routes throughout the area. Including buses which run directly past the site in question. These services include:

- Public buses to Canberra and Bombala
- Community Buses
- Shuttle buses
- Coaches to Sydney and Melbourne

Snowy Mountaineer

The Snowy Mountaineer proposal of a cable car connecting the airport to Jindabyne and on to the snow fields will cater for travel of airline passengers. This will provide additional capacity into the mountains. The current proposal for the Mountaineer includes a connection to the airport. At this stage, protection for such a connection has been made a station within the terminal precinct.

4.4 Meteorological

An appreciation of site weather, local and regional weather conditions are critical for the design on a new airport. They impact many planning and construction decisions; although of the highest importance is the determination of the optimum alignment of the main runway to enable the highest % of landings into the predominant wind direction (safety and efficiency driven), and to minimise the number that may be affected by high winds perpendicular to runway. This would also reduce the need for the provision of a 2nd crosswind runway, which would be costly, have a larger impact on the surroundings and increase the CAPEX and OPEX for the airport.

A detailed meteorological study was undertaken including CFD modelling to feed into the proposed site and help to define the runway orientation.

4.4.1 Temperature

The graph below shows the monthly mean maximum temperature for Snowy Mountains Airport near Cooma, provided by the Bureau of Meteorology (BOM). This uses a data set of the last 52 years (in 2019).

Figure 5 displays the temperature data from the Jindabyne Airport Weather Station (IJINDABY3). The profile to the formal data is very consistent. The key data point is the maximum mean month which is January at 26.7°C (BOM) and 27.8°C (IJINDABY3) for the two data sets. For the purposes of this study the formal BOM data has been used for this parameter.

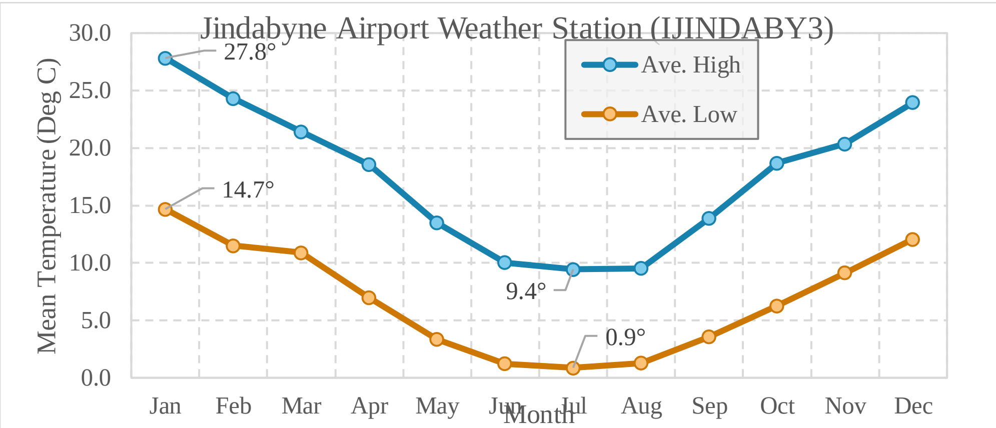


Figure 5: Temperature data from the Jindabyne Airport Weather Station

4.4.2 Wind

The data obtained from the three available BOM sites, namely Thredbo, Cooma and Perisher, show a large variation in predominant wind directions. A CFD (Computational Fluid Dynamic) model was created to calibrate measured data to allow for an appreciation of predominant wind direction at any location within the modelled boundary both at the airport surface and above (for landing / take off operations).

The topography surrounding the potential airport sites was modelled using 2m Elvis LiDAR GIS data with contours of 10 m elevation intervals closer to site options and 50 m further afield. The modelled domain is centred to the west to better capture the significant topographical features that will impact the flow patterns. The impacts of the change in topography due to the inclusion of the runway were not included in the analysis.

To assess the general wind climate for the region, the 8 closest weather stations to the potential site locations were analysed and compared. The arms of the wind rose point to the direction where the wind is coming from.

From the comparison between the wind roses of different weather stations, it is evident that:

- The anemometer measurements are affected by both large-scale (e.g. mountain range) and small-scale (e.g. hills, ridge) topographical features;
- For almost all stations, except Cooma Airport, prevailing winds are from the west and north-west quadrants. This is observed both to the west and east of the mountain range;
- Anemometers that are largely affected by local topography (e.g. Thredbo, Perisher Valley) show biased directional wind characteristics and recorded higher wind speeds with flow travelling along the ridges;
- Generally lower wind speeds are measured at weather stations to the west of the Snowy Mountain (i.e. Khancoban and Albury).

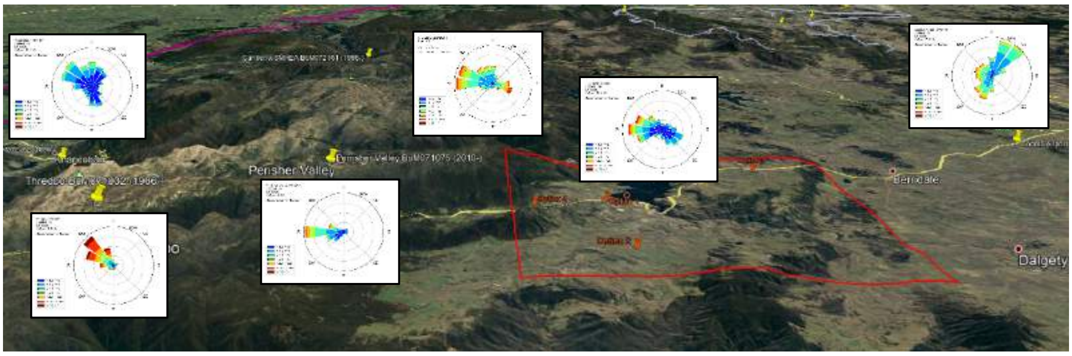


Figure 6. Wind roses for the NSW Snowy Mountain region (Google Earth)

Based on the topography and local wind analysis, the measured wind rose at Jindabyne Airport is considered appropriate as the global incident wind rose. Based on the wind rose, it is considered that the runway orientation should be aligned WNW/ESE (relative to true north) to minimise the probability of crosswind events.

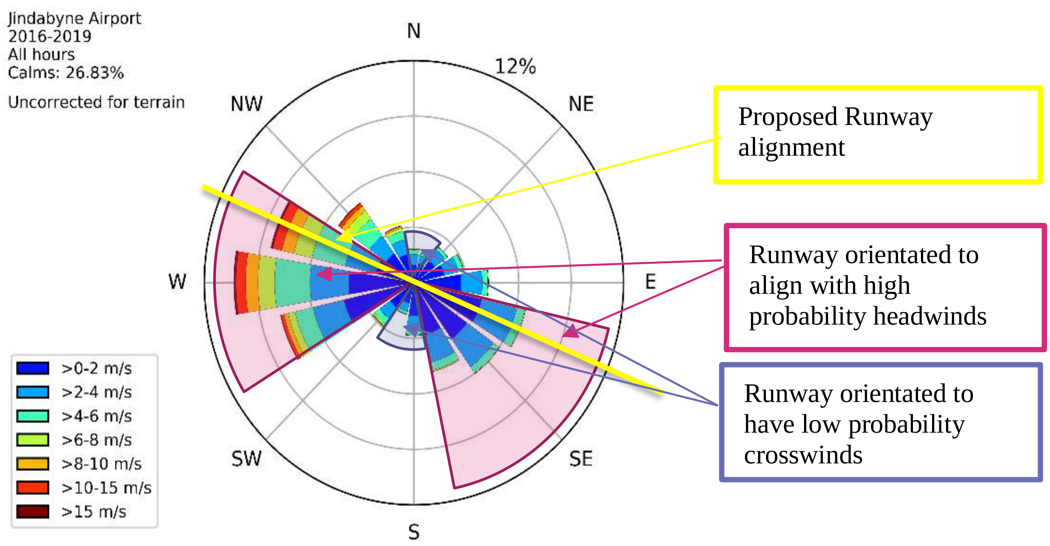


Figure 7. Jindabyne Airport wind rose and potential runway alignment

For the selected Jindabyne Airport location, the range of deviation of wind direction and the far-field direction that are getting deviated are similar to Jindabyne Airport. For prevalent winds from the west quadrant, the deviation is about -10° which means the optimal runway orientation based on the prevalent winds from west should be rotated °10 counter-clockwise from WNW.

4.4.3 Fog

Fog observational data from Cooma Airport suggests that the majority of fog days typically occur in the winter months. Data was analysed to predict the time of day that fog would be likely to occur. There are many different types of fog and the BoM acknowledge it is exceptionally difficult to forecast without observation[1]. A summary of the number of 10-mintue events that would have meteorological conditions to produce fog in a 3-year period at Jindabyne Airport are presented in Figure 8. The pattern of events indicates that fog would essentially burn-off by early morning.

The airport site is located on the crests of rolling countryside, where low lying ground fog is less likely to linger.

[1] http://media.bom.gov.au/social/blog/1807/explainer-what-is-fog/

	MONTH													
TIME	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**	**Hours**
0	37	44	45	32	33	87	8	12	13	39	68	31	**449**	**112.3**
1	39	56	48	46	46	103	12	17	19	41	70	43	**540**	**135.0**
2	45	63	67	64	47	111	14	22	28	48	80	32	**621**	**155.3**
3	43	66	74	75	163	235	73	60	32	72	84	38	**1015**	**253.8**
4	53	74	100	227	257	309	130	210	185	111	92	44	**1792**	**448.0**
5	72	80	146	238	263	300	134	215	239	208	136	49	**2080**	**520.0**
6	116	193	225	234	284	294	136	211	187	291	180	59	**2410**	**602.5**
7	40	120	188	102	174	259	91	85	25	97	73	30	**1284**	**321.0**
8	19	42	65	36	44	110	21	18	15	38	26	19	**453**	**113.3**
9	5	17	30	9	21	55	9	7	5	20	14	13	**205**	**51.3**
10	5	5	18	7	3	29	2	1	0	3	7	3	**83**	**20.8**
11	5	0	9	5	1	9	0	0	0	2	4	3	**38**	**9.5**
12	3	4	7	1	1	7	0	3	0	1	4	4	**35**	**8.8**
13	7	5	5	1	1	3	0	1	1	6	7	2	**39**	**9.8**
14	4	4	3	0	0	0	0	0	2	8	4	3	**28**	**7.0**
15	4	4	0	2	0	0	1	1	2	8	0	1	**23**	**5.8**
16	4	3	3	0	1	1	2	1	4	6	0	2	**27**	**6.8**
17	7	3	5	0	5	7	4	2	4	15	9	12	**73**	**18.3**
18	18	22	12	2	5	11	0	2	4	19	28	18	**141**	**35.3**
19	29	29	14	6	5	10	1	9	4	21	33	21	**182**	**45.5**
20	24	33	24	8	11	30	1	9	6	21	36	23	**226**	**56.5**
21	23	36	33	14	14	52	1	3	8	23	40	25	**272**	**68.0**
22	26	41	31	16	15	65	5	3	7	31	45	25	**310**	**77.5**
23	29	43	42	30	21	70	6	4	9	39	53	29	**375**	**93.8**
TOTAL	**657**	**987**	**1194**	**1155**	**1415**	**2157**	**651**	**896**	**799**	**1168**	**1093**	**529**	**12701**	**3175.3**

Figure 8. Number of 15-minute period when potential fog predicted at Jindabyne Airport during 3 years from 11 July 2016

4.4.4 Snow

There is no definitive BoM description of snow as a form of precipitation. The 3 years of available AWS from Jindabyne Airport have been analysed to estimate the amount of time that snow could occur as presented in **Error! Reference source not found.** .

These conditions would be expected to be similar for all site options.

	MONTH													
TIME	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**	**Hours**
0	0	0	0	0	1	0	0	1	0	1	0	0	**3**	**0.8**
1	0	0	0	0	1	4	0	1	0	0	1	0	**7**	**1.8**
2	0	0	0	0	0	1	1	2	1	0	1	0	**6**	**1.5**
3	0	0	0	0	0	3	0	0	0	1	1	0	**5**	**1.3**
4	0	0	0	0	1	0	0	3	0	0	1	0	**5**	**1.3**
5	0	0	0	0	1	2	0	2	0	0	0	0	**5**	**1.3**
6	0	0	0	0	1	1	0	0	0	0	0	0	**2**	**0.5**
7	0	0	0	0	2	0	2	1	2	1	1	2	**11**	**2.8**
8	0	1	0	2	2	1	2	1	1	1	1	0	**12**	**3.0**
9	0	0	0	0	4	2	1	0	1	0	2	0	**10**	**2.5**
10	0	0	0	0	2	1	0	2	1	0	0	0	**6**	**1.5**
11	0	0	0	0	0	0	0	3	2	0	0	0	**5**	**1.3**
12	0	0	0	0	0	0	0	2	1	0	0	0	**3**	**0.8**
13	0	0	0	0	0	0	0	2	2	1	1	0	**6**	**1.5**
14	0	0	0	0	0	1	0	0	3	1	0	0	**5**	**1.3**
15	0	0	0	0	0	0	1	1	4	2	0	0	**8**	**2.0**
16	0	0	0	0	2	0	0	1	4	0	0	0	**7**	**1.8**
17	0	0	0	0	1	2	0	2	3	0	0	0	**8**	**2.0**
18	0	0	0	0	2	0	0	6	2	0	0	0	**10**	**2.5**
19	0	0	0	0	0	2	0	4	2	0	3	0	**11**	**2.8**
20	0	0	0	0	3	2	0	0	4	0	3	0	**12**	**3.0**
21	0	0	0	0	0	5	0	2	2	1	1	0	**11**	**2.8**
22	0	0	0	0	1	4	0	3	1	0	1	0	**10**	**2.5**
23	0	0	0	0	2	3	0	1	2	0	3	0	**11**	**2.8**
TOTAL	**0**	**1**	**0**	**2**	**26**	**34**	**7**	**40**	**38**	**9**	**20**	**2**	**179**	**44.8**

Figure 9. Number of 15-minute periods when predicted precipitation as snow during 3 years from 11 July 2016 at Jindabyne Airport

4.5 Utilities

Existing utilities are considered around the airport location, it is also noted that WSP are reviewing the whole of the SAP for utilities / supply capacity and will review the airport connections within their work. From the desk top review, it was found that the existing utilities nearby the airport site, will have some capacity for the new airport. But it is likely that as the airport grows additional sewer, water and electrical supply are likely to be required.

Sewerage and Water

The airport could access water utilising the existing East Jindabyne to Berridale pipeline system, subject to available capacity. The new airport would likely require its own service reservoir/tanks (and potentially booster pump station, subject to topography) which would be supplied from this pipeline.

Wastewater could either be pumped to the SMRC East Jindabyne Catchment or treated and disposed of at the airport site. As the distance from the proposed airport terminal area is less than 5km from the catchment, pumping the wastewater is the ideal solution.

Electricity

The airport currently is nearby two overhead electrical lines, which could be used to supply the electricity. These will both need to be locally relocated to allow for the new airport location.

There is currently enough capacity in the network to facilitate an additional airport. Therefore, the only infrastructure required will be the connection from the existing electrical asset to the airport.

Stormwater

There are no stormwater assets located nearby to the airport. Due to the location of the airport on the ridge, there is minimal risk for any flooding. Therefore, no major stormwater infrastructure will be required. Local on airport storm water detention basin and filtration / settling ponds may be required. These will be reviewed in a later stage of the project.

Telecommunications

There is telecommunication using NBN Fixed Wireless at the airport location, however some of the surrounding area does not have coverage

Optus, Telstra and Vodafone all have cell tower coverage of the airport site

Gas

There is no gas infrastructure near the airport, with the closest LPG supply being located at Jindabyne. It is not economically feasible to create any large supply networks, so gas supply for the airport will require the use of LPG.

4.6 Local Airports and Airspace Considerations

The list of existing airports in the region include the following:

- Jindabyne Airport (Aero Club),
- Cooma Snowy Mountains Airport,
- Cooma Polo Flat Airport,
- Bunyan Airport,
- Bombala Airport and
- Adaminaby Airport.

The key airports that impact the proposed airport are Jindabyne and Cooma. Flight Path design and airspace control will need to consider both airport and any possible interaction between them.

Cooma Snowy Mountains Airport

Cooma 'Snowy Mountains' Airport currently has low number of passenger civil aviation operations and is the main airport in the region outside of Canberra. Currently, REX provide 6 flights a week, increasing to 31 flights during winter in the peak season. All these flights originate from Sydney.

The existing runway was initially constructed as a 45m wide runway. However, in 2016 seal and stabilisation work was completed on the 30m central to support Dash 8-400s. The line marking was changed to only show the 30m wide runway with 2x7.5m shoulders.

Jindabyne Airport

Jindabyne Airport (Aero Club) currently used for light general aviation (mostly gliders). The airport is close to the town and is not likely to have a major impact on the operations of the new airport.

There is a possibility that some of the GA services may shift to the proposed airport after constriction however this would require further consultation with GA operations.

Airspace Considerations

In addition to the airports outlined above there are other air routes were considered as part of the airport planning and airspace design. Currently, the high-level air routes between Sydney and Melbourne pass over the area, with the MEL-SYD flights travelling to the north of the site, while SYD-MEL flights travel to the south. The flight route design outlined in section ## provides further detail on this and the associated impact on the site.

4.7 Environment and Heritage

Environment

Generally, the airport location consists of woodland and grassland, including some rocky outcropping and fallen timber, which is common across the site. Ther is some disturbance evident including grazing, fenced paddocks, constructed dams, power lines, dirt roads and tracks. Approximately 20% of the site is still vegetated. In addition, tributaries of Kara Creek are present at the site.

As detailed by WSP, the vegetation is majority consisting of Snow Gum – candle bark woodland. The site features the likely presence of Monaro Tableland Cool Temperate Grassy Woodland, listed as Critically Endangered under the Biodiversity Conservation (BC) act, as well as potential occurrence of patches of Natural Temperate Grasslands, listed as Critically Endangered under the Environment Protection and Biodiversity Conservation (EPBC) Act. It is likely that the airport would impact a Serious and Irreversible Impact entity (SAII). In addition, 26 threatened fauna species are considered to have a moderate or high likelihood of occurring based on desktop assessment of habitat. WSP has estimated that there would be a relatively significant cost of offsetting the airport site(up to $21 million), based on the current credit price for the relevant vegetation.

The airport will not impact any Scenic Protection Zones. In addition, the airport is not expected to have any significant air quality impacts on local residents. There are no known records of contaminated soil at the airport.

As detailed by Blackash in the bushfire study, the airport location is not categorised as “bushfire prone land”, and therefore the risk of bushfire impacting the airport location is relatively low.

Heritage

There are two heritage impacts on the airport site which will need to be managed for the new airport.

There is a scarred tree with Aboriginal heritage on the site. The management of this will need to be completed during the next stage of design.

In addition, there is a heritage item potentially located in the airport site. The Snowy River LEP indicates a ‘hut and grave’ located around the airport site, however it is not known if the site is located inside or outside the proposed airport site. The precise location of the item would need to be determined at the further stage of design.

4.8 Stakeholders

The following stakeholder are to be considered within the site during the planning design and implementation of the proposed airport.

Department of Planning Industry and Environment	Client for feasibility review of Airport in SAP Snowy Mountains.
Regional Growth Development Corporation	RGDC will be responsible for delivery of the airport in the region; noting that the airport will be built and owned with a fully privatised mode. RGDC will therefore be responsible for studies to assist with planning approvals/ and likely delivering supporting infrastructure to the airport.
NSW Local Land Services	No direct interface with airport development at this level of planning
NSW National Parks and Wildlife Service	No direct consolation; noting likely concerns around; Wildlife both within airport and external to site (noise and removal of habitat); notably koalas in the region. Flight paths adjacent (or over TBC) to Kosciuszko National Park
NSW Environment, Energy and Science	No direct interface with airport development at this level of planning
NSW Crown Lands	No direct interface with airport development at this level of planning
NSW Environmental Protection Agency	No direct interface with airport development at this level of planning. Consideration to be made to align any specific requirements for airports (Airports Environment Protection Regulations, 1992) (relating to air, water and soil pollution and offensive noise).
NSW Natural Resources Access Regulator	No direct interface with airport development at this stage of planning. The airport may be included in TPA models. The exact extent of the model is unknown, and the airports influence is likely to be limited
Transport for NSW	No direct interface with airport development at this stage of planning. The airport may be included in TPA models. The exact extent of the model is unknown, and the airports influence is likely to be limited.
NSW Treasury	It is assumed that supporting infrastructure and land acquisition costs for a new airport in the region will be funded by NSW Treasury. All interface with NSW Treasury is being managed by Client and inputs to be fed back for includes
Destination Southern NSW	No direct interface with airport development. Airport development would provide enhanced visitation to the region; although the provision for facilities will be market driven.
Aboriginal Affairs NSW	No direct interface with airport development at this level of planning. No aboriginal heritage have been determined onsite from desktop studies; although other matters may need to be considered in future development.
NSW Health	No direct interface with airport development at this level of planning. It is envisaged that Royal Flying Doctor will use this airport for emergencies; along.
NSW Ambulance	No direct interface with airport development at this level of planning. It is assumed that NSW Ambulance will be part of a group of first responders for incidents at the airport.

NSW Police	No direct interface with airport development at this level of planning. The airport will be planned to align with relevant security to align with type and throughput of the infrastructure. It is assumed that NSW Police will be part of a group of first responders for incidents at the airport.
NSW Fire and Rescue	It is assumed that facilities will be provided at the airport for NSW Fire and Rescue; and facilities will be built and operated separately by NSW Fire and Rescue. The GA facility provided on the airport could be used for any facilities. In addition, a helipad can be provided (if needed). Allowance for helipad will be allowed for in planning for the airport.
NSW Rural Fire Service	It is assumed that the RFS will be part of a group of first responders for incidents at the Airport. Allowance for ARRFS will be provided onsite with the provision to be determined in future development. There may be some need for the RFS to use the facility for aerial firefighting.
NSW Department of Agriculture and Water Resources and Department of Home Affairs	No direct interface with airport development at this level of planning.
Snowy Monaro Regional Council	SMRC will primarily be responsible for planning approval for the initial airport built and approval of future masterplans (which will include changes to the airport infrastructure
Bureau of Meteorology (BoM)	An AWS will be provided onsite to BOM standards to achieve minimum. No direct interface with airport development at this level of planning.
Airservices Australia	Consultation with Airservices has occurred to discuss NAVAIDs for the airport
Aviation and Maritime Security (AMS)	No direct interface with airport development at this level of planning. Allowance is being made for airport security
Civil Aviation Safety Authority (CASA)	Engagement is occurring with CASA around an Airport in. Refer to Aeronautical Study for findings of OAR engagement
Utility Companies (i.e. Telstra, Endeavour Energy, Council Water/ Sewer)	No direct interface with airport development at this level of planning. Allowance will be made within SAP to provide supporting infrastructure for the airport to connect and use onsite with consideration for growth in demand.
Airlines (i.e. QANTAS, Virgin Australia, REX)	No engagement is formally being conducted with airlines. Consideration throughout the study is developing 'profitable' routes through uplift in year round tourist numbers as part of the SAP. Engagement will likely occur in the future if the airport is progressed
Office of Airspace Regulation (OAR) (Federal Dept under Airservices Australia)	Engagement is occurring with OAR around considerations on air routes and airways and their conditions of use for the airport within the current airspace in the Snowy Mountains. Refer to Aeronautical Study for findings of OAR engagement.

Table 1: Stakeholder List

5 Demand Forecast

5.1 Overview

The air demand forecast for the Snowy SAP region provides the basis of all airport planning studies completed within this report.

Visitation forecasts for the Snowy SAP region were prepared by CIE for the planning horizon up to 2061. As part of this forecast, CIE used a cost-based approach to determine the assumed a split of transport modes used to access the region; of which air travel was one.

Prior to New Jindabyne airport opening, the air demand is expected to be served through a combination of the existing Snowy Mountains airport at Cooma and alternate transport modes.

Beyond 2031, the air visitation is expected to be served solely from the New Jindabyne airport. The forecast demand for the region is not considered sufficient to support the operation of two airports.

The passenger forecasts by year and season were used to generate weekly and daily frequencies drawing from benchmarking and regional case studies. A combination of the annual, daily and peak hour demands provided the basis for the infrastructure requirements calculations. Critical years were selected to stage the provision of infrastructure in line with growth in demand.

5.2 Forecast Summary

5.2.1 Annual Passenger Demand

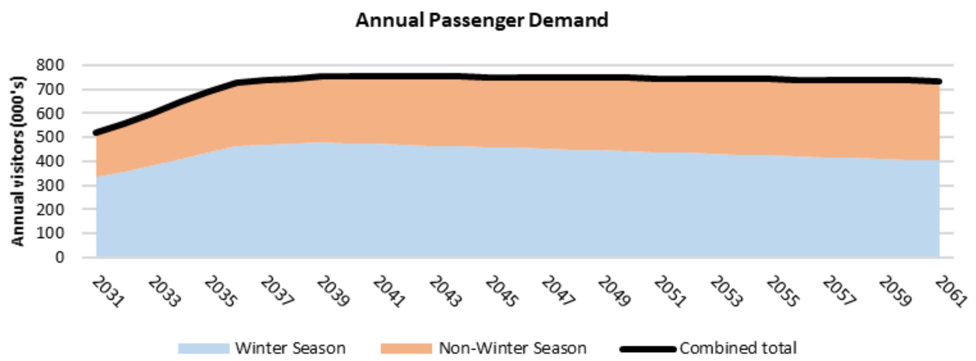


Figure 10: Annual Passengers demand at New Jindabyne airport

Expected to begin operations in 2031, demand at the New Jindabyne airport is forecast to grow significantly in the opening years. In particular, the winter season (approximately 91 days) is expected to be the main area of growth until 2039.

Beyond 2039, the non-winter season is forecast to represent an increasing share of the annual visitation, with the local investments stimulating a better distribution of visitors across the year.

5.2.2 Daily Passengers and Flights

As part of the Commercial workstream, Arup completed a viability assessment of the air demand into the region. The assessment considered whether the forecast visitation justified sufficient routes to attract airlines and whether the associated revenues generated by the airport would be sufficient to recover the initial investment costs. Further detail on this assessment can be found in the Airport Commercial Report.

To inform the transition from seasonal totals (e.g. winter 91 days) to a weekly schedule, the Airport Commercial report considered regional case study airports to determine the likely distribution of demand across the week. Existing fleets of the potential airline operators were considered as an estimation of the weekly demand, however further consultation with the airline community is required before the schedules can be confirmed.

Summarised below are the resulting weekly frequencies for the opening year and the ultimate design year.

Opening Year 2031

Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	11	5	2	6	14	5	14	**57**
BNE	Qantas/Jetstar A320-200	180	153	2	2	1	1	3	2	3	**14**
MEL	Qantas Q400	74	48	1	1	-	1	-	5	-	**8**
			Total Turnarounds	14	8	3	8	17	12	17	**79**

Figure 11: Winter Weekly Schedule - Opening Year 2031

Drawing from the existing operations at regional airports, the weekly distribution during the winter season (Figure 11**Error! Reference source not found.**) reflects a concentration of operations on the weekend to align with the expected ski visitation. Despite the increased attractions during the week and across seasons, the weekend during the winter is still the critical period for planning purposes in this initial opening phase.

Non-winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	1	2	1	1	1	2	1	**9**
BNE	Qantas/Jetstar A320-200	180	153	-	1	1	-	-	1	-	**3**
MEL	Qantas Q400	74	48	1	1	-	1	-	3	-	**6**
			Total Turnarounds	2	4	2	2	1	6	1	**18**

Figure 12: Non-Winter Weekly Schedule - Opening Year 2031

The non-winter period reflects a greater distribution of flights across the week to capture the assumed visitation from new initiatives in the area, including the business trips related to the conference facilities.

Ultimate Design Year – 2039 (Winter) and 2061 (Non-Winter)

The peak periods for each season were identified to determine the safeguarding requirements for the airport infrastructure. As a result of the changing balance across the forecast horizon, the weekly schedules for two different years were selected.

The most onerous period for the airport infrastructure is forecast to occur in 2039 during the winter season. The non-winter season is expected to grow up to 2061 but at no point is it expected to exceed the Winter season with regards to infrastructure requirements.

Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	4	3	2	4	31	3	31	**78**
BNE	Qantas/Jetstar A320-200	180	153	1	1	1	1	10	-	10	**24**
MEL	Qantas/Jetstar A320-200	180	153	-	-	-	-	1	-	1	**2**
MEL	Qantas Q400	74	63	-	1	-	-	-	3	-	**4**
			Total Turnarounds	5	5	3	5	42	6	42	**108**

Figure 13: Winter Weekly Schedule - Ultimate Design Year (2039)

The 2039 weekly schedule (Figure 13**Error! Reference source not found.**) considers a conservative approach, assuming a high concentration of flights during the weekends. This schedule provides a suitable upper bound for the planning of infrastructure requirements.

Non-winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	2	3	1	2	3	1	3	**15**
BNE	Qantas/Jetstar A320-200	180	153	1	1	-	1	1	1	1	**6**
MEL	Qantas Q400	74	63	1	3	1	1	-	5	-	**11**
			Total Turnarounds	4	7	2	4	4	7	4	**32**

Figure 14: Non-Winter Weekly Schedule - Ultimate Design Year (2061)

There is a notable growth in the Non-winter season from the opening year with the Snowy SAP initiatives generating greater visitation over this period. However, the weekly frequencies are much lower than the winter season and therefore fall within the capacity provided for the 2039 winter season.

6 Design Requirements

6.1 Planning Horizon

The planning horizon for the airport was determined through the broader forecasting work that was undertaken by the CIE.

Based on this, the following planning days have been adopted:

Opening Day – 2031 (Working assumption TBC).

- 2039 (maximum peak hour demand)
- Ultimate (2061 horizon – peak annual demand)

6.2 Design Aircraft and Destinations

The following indicative fleet mix has been considered in planning the airport:

- Turboprop:
  - Dash 8 (Q400)
  - Saab 340
- Code C jet aircraft:
  - 737-700
  - 737- 800
  - A320-200
  - B737MAX
  - A320NEO
  - A220
  - A321XLRs
- Code E are not likely to fly to Snowy Mountains as the region is too small to justify the investment and large capacity step.

The following destinations were considered in planning the airport.

- Category A: (Sydney, Melbourne, Adelaide and Brisbane) minimum destinations,
- Category B: (Perth and Darwin, and NZ) destinations and potential ability to reach
- Category C: (Jakarta, Indonesia) destination subject to demand.

Figure 15: Code C Ranges from Snowy Mountains Region

The critical aircraft used for planning are shown below. There is some variation between aircraft, but these groups are constrained to the envelopes nominated in ICAO.

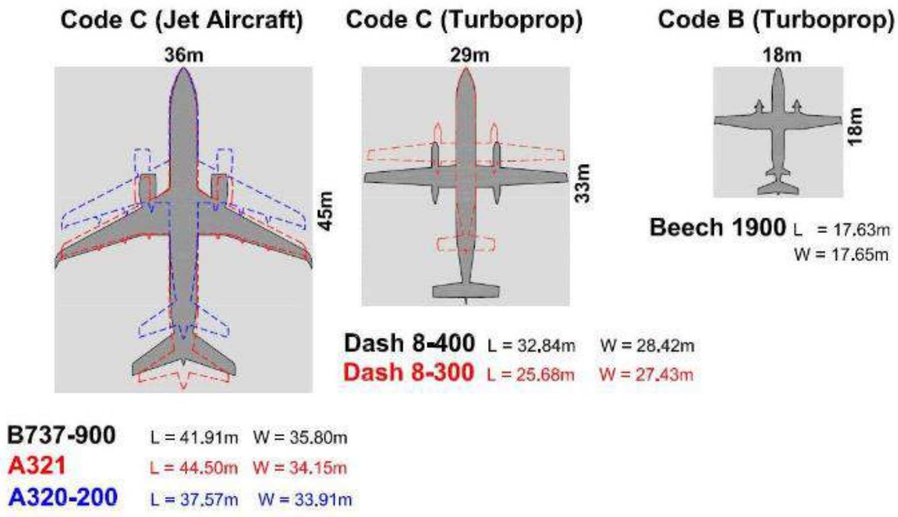


Figure 16: Aircraft Dimensions

6.3 Infrastructure Requirements

6.3.1 Runway

The runway length used aircraft performance analysis used the following environmental conditions:

- Airport reference temperature = 26.7°C

  This is a long term adopted temperature for the region and defined in the ICAO Annex 14 Aerodromes and the Australian standard MOS Part 139. The design temperature for the runway assessment is taken as the "monthly mean of the daily maximum temperatures for the hottest month of the year" which was taken from Cooma.

This will be considered with consideration for climate change in the future. As temperature increases, the density of the air decreases. This results in reduction of engine thrust performance and wing aerodynamic lift performance. It should be noted also in winter where the aircraft load factor may increase the engine performance will also increase

- Airport Reference elevation = 1,036 m

  As altitude increases, the air becomes less dense. This results in a reduction in engine and lift performance. The consequence of this is that the higher the altitude, the longer the runway needs to be to achieve the equivalent lift force to take off, when compared to lower elevation airports.

- Runway slope = 0%

  The maximum grade on a runway is 1% for a Code 4 runway and therefore the grade is considered negligible for runway length analysis

Based on the ranges and aircraft mix the following table sets out the required runway length to support certain the proposed fleet mix.

	Category A		**Category B**		**Category C**
Aircraft	370NM	500NM	1070NM	1750NM	3000NM
A220	1700m	1700m	1900m	2200m	*Not able to obtain 85% payload*
ERJ175	1500m	1600m	2100m	2600m	*Not able to obtain 85% payload*
ERJ195	1600m	1700m	2100m	2700m	*Not able to obtain 85% payload*
E195-E2	1500m	1600m	1700m	2000m	*Not able to obtain 85% payload*
B737-700	1500m	1600m	1600m	1800m	*Not able to obtain 85% payload*
B737-800W	2000m	2000m	2300m	2600m	*Not able to obtain 85% payload*
B737-8MAX	1700m	1700m	1900m	2100m	2600
A320-232	1700m	1800m	1900m	2200m	*Not able to obtain 85% payload*

Table 2: Required RWY Length Jet Aircraft

To facilitate Code C Aircraft flying to Category A destinations, a 2000 m runway length is required. A 2300m runway would be appropriate for category B for a newer fleet mix that would be more likely to use the airport. The requirements to facilitate Category C destinations are not considered viable and as most aircraft would not be able to achieve an 85% payload.

As such, the requirements for the runway are:

- 2000m - opening day
- 2300m – long term protection if required to facilitate Category B destinations

Further details regarding the runway requirements are set out in the infrastructure report.

Where the end of a runway is not served by a taxiway or a taxiway turnaround a runway turn pad is required facilitate a 180-degree turn of aircraft. The turn pad must be located on the right-hand side of a runway as viewed when looking in the direction of take-off from that runway end. As there is no parallel taxiway provided at the airport, turn pads will be required.

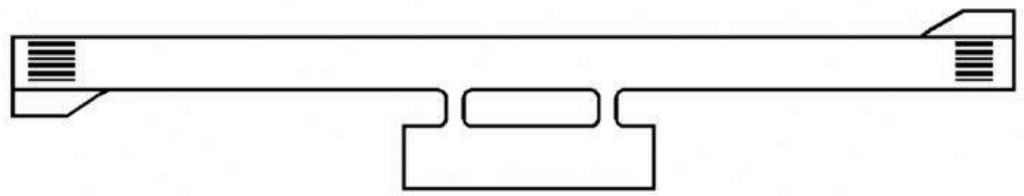


Figure 17: Typical Runway Turn Pads

6.3.2 Apron

The weekly frequencies outlined in the forecast section of this report provide the basis of the stand requirement calculations at the New Jindabyne Airport.

The following stand requirements were calculated on the assumption that each Code C stand can to process 6 turnarounds across the day:

Opening Year (2031) stand requirements

2031 – 3 Code C Stands

Ultimate Design Year (2039) stand requirements

2039 – 7 Code C Stands

6.3.3 Terminal

Annual passenger numbers were considered to determine the sizing of the terminal building. A benchmarking exercise was undertaken of Australian airports achieving a similar throughput. Despite a gradual growth of the non-winter season, the shorter winter season still represents a large proportion of the annual throughput. Recognising this concentration of traffic within the winter season a conservative ratio of 9,500 m^2 / Million Annual passengers was applied.

Opening Year (2031) Terminal Gross Floor Area (GFA)

2031 – 5,000 m^2

Ultimate Design Year (2039) Terminal Gross Floor Area (GFA)

2039 – 7,200 m^2

6.3.4 Landside

Annual passenger numbers were considered to determine the sizing of the car parking spaces. A benchmarking exercise was undertaken of Australian airports achieving a similar throughput.

Opening Year (2031) Parking requirements

2031 – 500 spaces

Ultimate Design Year (2039) Parking requirements

2039 – 725 spaces

6.4 Security

The requirements Aviation Transport Security Regulations 2005 (December 2019) must be met when planning the airport. The airport will be designated as Category 3 (domestic only) operation.

As a security-controlled airport, the operator will be required to develop and submit a transportation security program (TSP) to the Federal Aviation and Maritime Security (AMS) agency for approval. This would detail how the airport meets its security obligations.

Detailed below are key security requirements that need to be considered as part of the detailed planning and design of the proposed airport:

- A physical barrier is required to sufficiently delineate the airside area and control access. While not specified within the ATSR, this is typically a 2.4m high chain link type fence in accordance with AS 1725 (as a minimum).
- Manned access point(s) will be provided to facilitate legitimate access to the airside security zone.
- Measures must be provided to patrol and/or surveillance the barrier to monitor for damage and to deter and detect unauthorised access. This is typically an airside road, but the role may be fulfilled by electronic measures.
- While screening requirements for individual airports are provided by AMS on a case-by-case basis it is expected that a typical category 3 airport would be required to provide (as a minimum) provision for 50% of passengers and staff to be screened using a body scanner (remainder screened using walk through metal detector and explosive trace detection). All baggage and goods would be screened with multi view x-ray and automated explosive detection.

7 Proposed Airport Plan

7.1 Masterplan

The Jindabyne Airport Masterplan has been prepared with the intent that this Airport is more than just a collection of transport infrastructure. It is intended that the Snowy Mountains Airport will have its own sense of place, a thriving General Aviation presence and the integration of the proposed Snowy Mountaineer Cable Ropeway.

The addition of the General Aviation infrastructure will help to further tourism opportunities and support a year-round visitor economy through activities such as helicopter and scenic flights across the Snowy Mountains SAP. Furthermore, complimentary activities suc as retail and commercial space has been included to not only foster a world class user experience but also to provide the Airport with non-aviation revenue streams.

It is also important to note that the Masterplan configuration does not prevent future opportunities to provide for less/more growth that currently described. As seen below in Figure 18, multiple areas of the Airport have been marked for future growth including: runway extensions, planned extensions of the apron and terminal, and carparking.

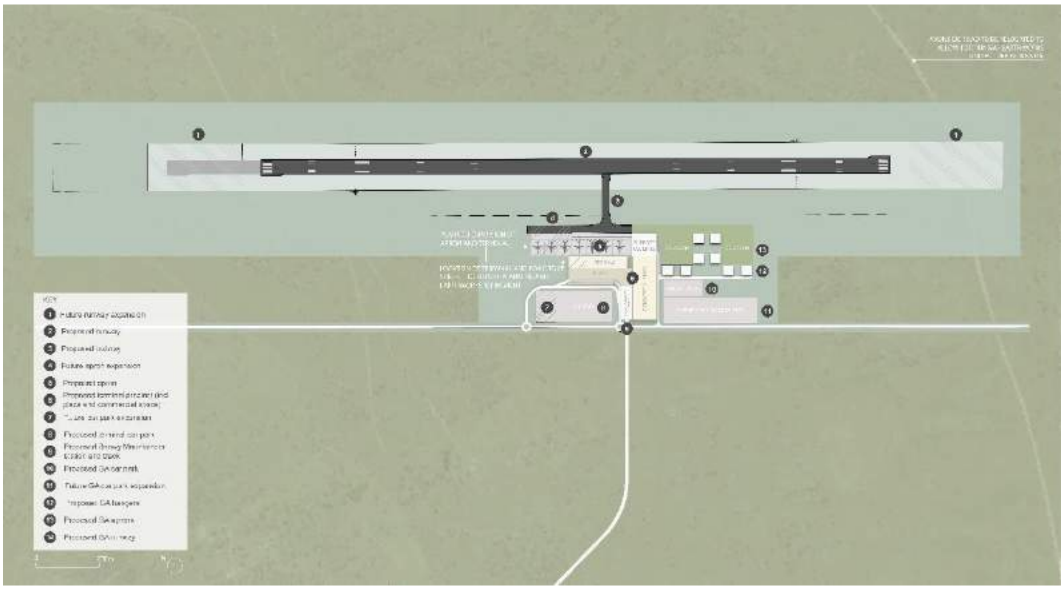


Figure 18: Jindabyne Airport Masterplan

7.2 Runway

The orientation of the runway faces north-west and is 2000 metres long. In its opening phase, the runway will be capable of supporting a code C aircraft travelling to a Category A destinations. A future 300m extension to allow for Category B destinations has been allowed for.

The runway also provides for 240m RESA (runway end safety areas) on either end to allow for emergency operation if necessary.

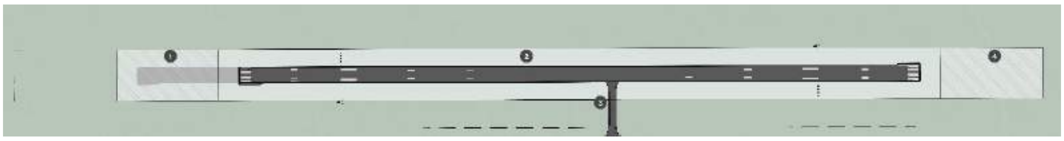


Figure 19: Jindabyne Airport Runway

The layout of the proposed runways is as follows:

1. Future extension of the runway (300m)
2. Proposed runway (2000m)
3. Proposed taxiway
4. RESA

7.3 Taxiways and Apron

Taxiway

A Code C taxiway is proposed to allow for surface movement of aircraft from apron to runway. Provision has been made to allow for a future Code C parallel taxiway to support increased traffic however it is not envisaged due to projected ATMs up to the planning horizon that a parallel taxiway would be required. The capital cost would be prohibitive for the limited benefit.

The minimum width of the straight section of taxiway is 22.5m and overall strip width of 26m for Code C. For both non precision and precision runway approach the distance from Runway CL to Taxiway CL is 158m for Code C.

Apron

4 Code C stands have been provided to support the opening of the airport. In addition to this, there is flexibility to expand this with a further 3 Code C stands. Each stand is 50 metres deep and 42 metres wide. No provision has bene made for aerobridges.

1. Future taxiway extension
2. Future apron extension/area for code C expansion
3. Proposed apron (4 stands on opening day)
4. Proposed taxiway

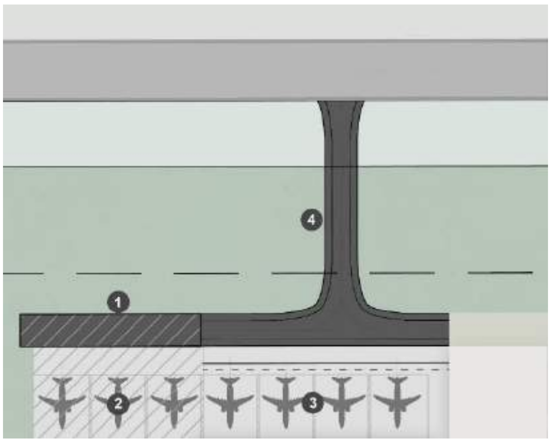


Figure 20: Taxiway and Apron

The requirement for clearance of taxiplane to object, structure, parked aircraft for Code C is 22.5m. The width of the taxilane is 30m (22.5m + 7.5m) with 4.5m shoulders. Minimum separation of 4.5m for Code C (and 7.5m for Code E) between aircraft parking positions is required.

There are several options available for the apron planning for regional airports. During the consideration of apron planning the principles that have been adopted are:

- Optimisation of stand operations and vehicle circulation (to allow for handling operational efficiency for optimal turn-around times)
- Maximise safety;
- Minimise risk of aircraft damage
- Align with anticipated expansion staging
- Minimise extent of pavement

Nose in stands were selected ahead of power in power out stands to support the anticipated jet operations.

The apron also allows for the provision of a TOS (Tail of Stand) for GSE movements between the Apron and GSE storage area. It is currently assumed that all GSE traffic included tugs will travel off TOS around aircraft and be able to travel between wingtips (4.5m). If the 4.5m is deemed sufficient; the width of separation could be increased.

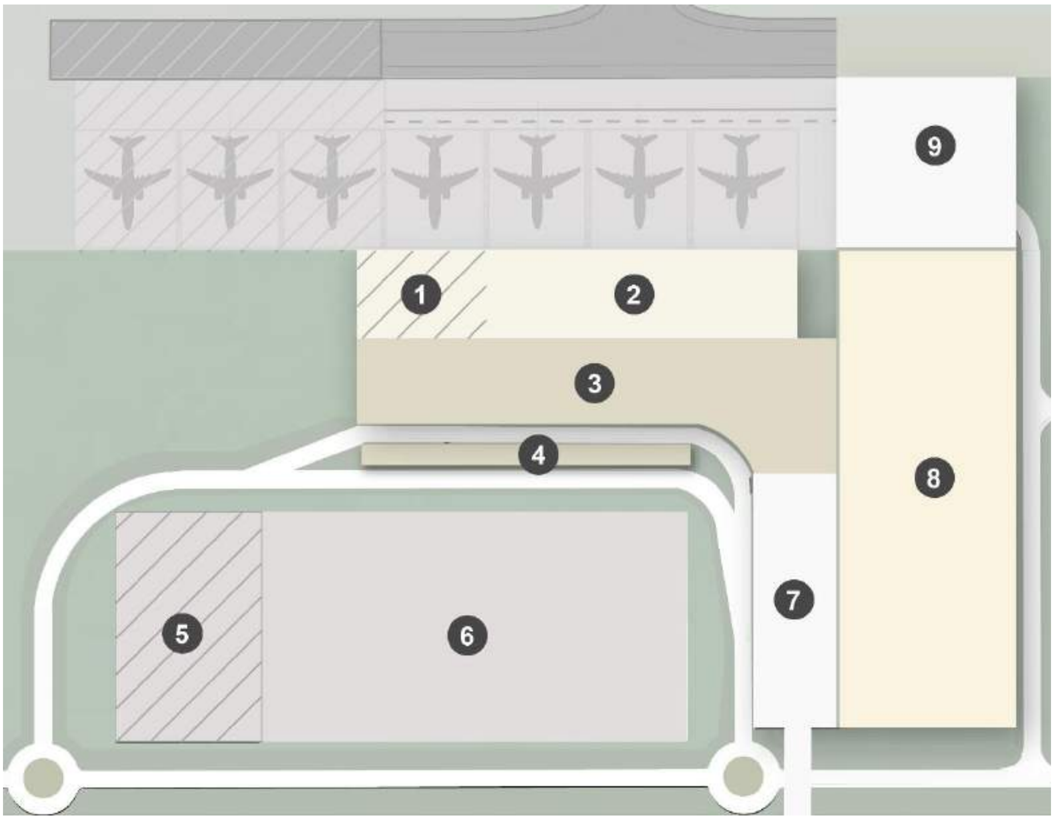
7.4 Terminal Precinct

The Terminal precinct will form the heart of the airport. It broadly makes up an integrated set of facilities including the passenger terminal, plaza, Snowy Mountaineer Station, commercial space service facilities and car parking.

The configuration of the Terminal Precinct has allowed for sufficient space and capacity for passenger processing, back of house facilities as well as commercial provisions (non-aeronautical revenue potential).

It is intended that with the provision of all these facilities, the Snowy Mountain Airport will offer a world-class user experience. Core to this has been the allowance to provide for sufficient space to allow for commercial expansion into the future if there is a desire to develop the site.

This could be paired with the development of the Snowy Mountaineer which could help to draw additional visitors and investment into the precinct. At this stage, provision for the Snowy Mountaineer has been made within the precinct however the site will still operate effectively without its development.



The Terminal Precinct masterplanning configuration comprises of the following

1. Future terminal expansion
2. Passenger terminal
3. Plaza
4. Plaza
5. Future terminal car park expansion
6. Passenger Carpark
7. Snowy Mountaineer Station
8. Commercial Development Zone
9. Support facilities

At this stage of design, the internal layout of the terminal has not been mapped out however it would be expected to include the following passenger processing facilities:

- Forecourt Plaza
- Check-in Area (including kiosks, bag drop and oversize bag drop, which have a higher activity than other airport due to the proximity to ski resort and leisure activities)
- Security checkpoint
- Gat lounge

- Baggage reclaim

In addition to this, terminals require extensive back of house facilities which will include:

- Baggage make-up
- Baggage drop off area
- Office space
- Terminal operations
- Security
- Commercial Provisions (Non-Aeronautical Revenue Potential)

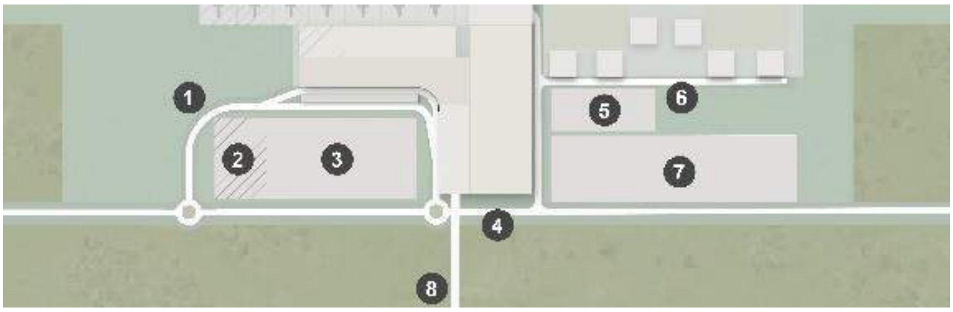
Part of a vibrant and memorable experience for passengers at an airport includes the ability to access commercial services such as; Retail, Food & Beverage Outlets, Tourism Services (Sight-seeing Tours), and office rentals. The proposed commercial model of the terminal includes a predominately landside operation.

This is similar to that used at Queenstown airport and provides the ability to maximise the number of passengers that have access to commercial facilities at any given time, increasing turnover and rental return.

Landside Retail		**Airside Retail**	
Pros	**Cons**	**Pros**	**Cons**
Reduces terminal size for airports with lower passenger numbers Minimises the number of retail outlets required Reduces the need to have security operating full time. All passengers (arrival and departure) as well as meeters and greeters can use the retail facilities. Facilities can be shared when international services come online	After passengers move through security, no retail is available. Security operation is more condensed	Passengers can use retail after moving through security. Passengers can use retail when they are in a more relaxed state. Appropriate at approx. 2-3maap. This is sufficient scale to support both airside and landside.	Requires security to be open for the retail to be open. At airports with few flights this can increase operational cost. Still requires some landside facilities – potentially duplicating the offer Requires more retail facilities to cater for both international and domestic if required.

7.5 Ground Transport

There is no existing transport infrastructure in this section of the Airport site. Therefore, new roads and accessory infrastructure will need to be constructed. It is proposed to have a road running along the length of the Airport, which will connect Avonside Road and Kosciuszko Road. Two roundabouts will facilitate the flow of vehicles to and from the main terminal precinct and car park. Smaller service roads will also need to be constructed for the General Aviation area and carpark. The layout of this is shown below



1. Proposed loop road leading into the proposed plaza and carpark
2. Future terminal carpark expansion
3. Proposed terminal carpark
4. Proposed road connecting the Airport with Avonside Road and Kosciuszko Road
5. Proposed General Aviation Carpark
6. Proposed road servicing the General Aviation area
7. Future provision for General parking expansion

In developing the ground transport system the following modes will need to be accounted for:

- Public pick up and drop off
- Taxi and Uber pick up and drop off
- General Aviation Vehicles
- Servicing and Loading
- Emergency Facilities

In addition to the network of roads shown above, a section of the car park or forecourt area will be set aside for public transport provision. This will include bus parking areas and passenger waiting bay.

The Snowy Mountaineer will essentially act as a ground transport mode to and from the airport. This may reduce the overall requirement for some other modes in the vicinity of the airport. There is a possibility, depending on the model used that it could attract traffic and generate addition parking requirements if it acts as a gateway to the mountains. This may mean that customers driving from Sydney choose to park at this location instead of closer to Jindabyne.

Car Parking

The number of carparks is driven by passenger profile, airport size, available space, alternate means of transportation to go to the airport (public transport), connection rate and airport's commercial strategy.

At this stage, it is not possible to determine the underlying mix of parking as it requires a detailed analysis of the proposed passenger and commercial models that underpin landside operations at the airport.

The overall parking provision for stage 1 is 500 space with protection within the primary terminal precinct for up to 750 spaces. Additional longer term parking has been provided for beyond this to allow for the potential demand generated by the Snowy Mountaineer.

Through the use of public transport connecting airport to Jindabyne; the provision for parking may be predominantly private residents; especially if the SAP goal is trying to limit combustion private vehicle use to meet sustainability outcomes.

The airport will need to support the following car parking products:

- Rental Facilities
- Terminal short-term

  Car park within walking distance of the terminal and intended for short stays. This is usually reserved for picking up and dropping off passengers.
- Terminal long-term

  Parking lot is located near the terminal and meant for longer stays over 24 hours.
- High-end: Recently, airports have begun offering additional services such as valet parking to increase revenue and attract more passengers into their car parks. Additional
- Staff parking

At regional airports, the peak hour passenger movements and extent of car rental facilities have a strong influence on the car parking requirements. In planning for the future car park planning, the following documents will be used with benchmarking:

Strategic Airports and Aviation Facilities (State Planning Policy)

Airports Act 1996

AAA Regional Airport Master Planning Guideline

Airports Council International Best Practice Report for Car Parking

7.6 General Aviation Precinct

The General Aviation area sits to the right of the main passenger terminal and apron. The GA masterplan configuration is comprised of taxiway runway, two GA aprons, four GA hangers on the perimeter of each apron and accessory carparking.

The provisions of a General aviation area provide Snowy Mountains SAP with future tourism and education opportunities. This GA area could accommodate a small flight school, similar to the Wanaka Airport in New Zealand or be a base for small charter aircraft providing scenic tours of the Snowy Mountain area.

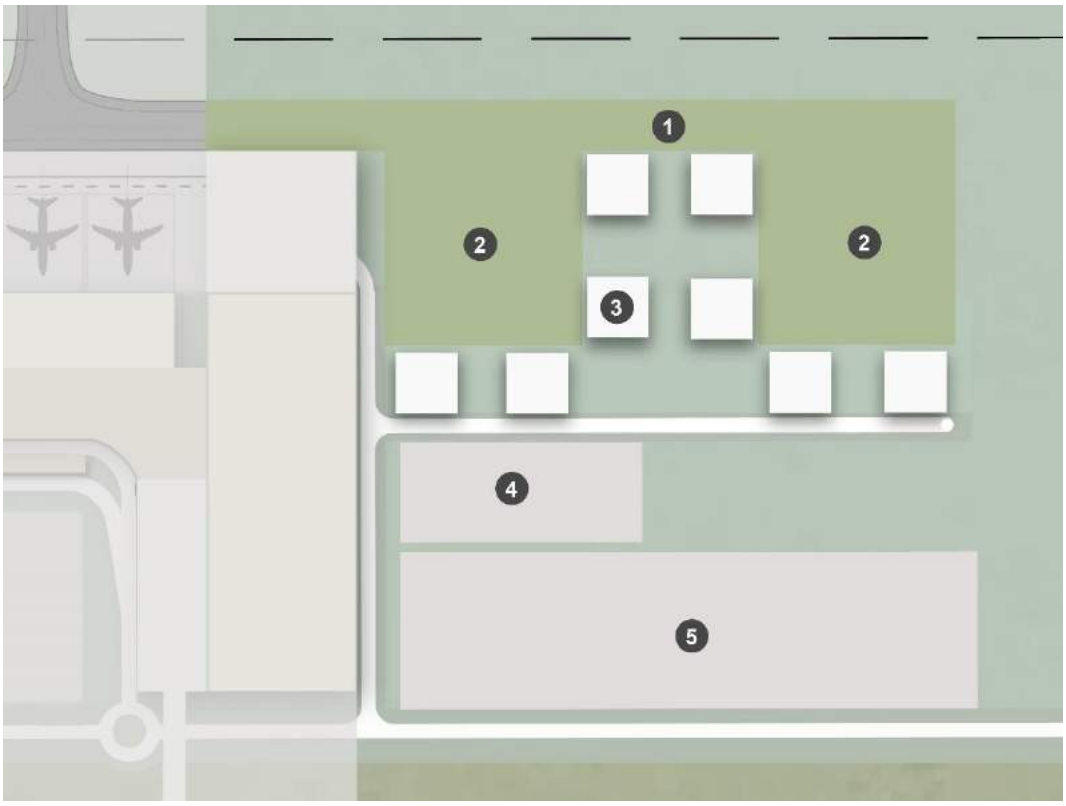


Figure 21: Potential General Aviation Precinct

1. Proposed General Aviation taxiway
2. Proposed General Aviation aprons
3. Proposed General Aviation hangers
4. Proposed General Aviation car park
5. Future General Aviation carpark expansion

At this point, the GA Area has not been considered as part of the costing for the airport to achieve its basic operation. These areas will be developed in line with the GA demand.

7.7 Support Facilities

In addition to runway/ taxiways and apron there are other facilities required at the airport. The type and provision for many of these facilities are largely driven by passenger demand/ GA requirements/ desired availability of airport for operations.

7.7.1 Air Traffic Control

ATC is a CASA regulated function, utilising licensed ATC's from an approved ATC facility. The role of ATC is to provide directions and instructions to aircraft to manage the flow of traffic.

Currently in Australia, there is a single Air Navigation Service Provider (ANSP) that provides ATC services at civilian aerodromes, Airservices Australia (ASA).

ATC at aerodromes such as JIN have traditionally been managed from ASA ATC Control Towers by locally based staff. These towers have a significant Capital and Operational Expense (CAPEX and OPEX) associated with their operations, which is passed on to users in the form of air navigation charges.

In recent years, Digital Towers have become more commonplace, and have the potential to utilise economies of scale to provide ATC services either at locations that potentially do not justify an "traditional" tower, or to provide services at a reduced cost at locations that require an ATC service. ASA is investigating the use of Digital Tower technology for future service delivery. Whilst it is not expected that an ATC service would be required for many years, this technology is the most likely that would be utilised.

The AAPS details the threshold criteria for changing the classification of a volume of airspace at an aerodrome. Current airspace classification in the JIN area is Class G. For there to be a review of airspace to change to Class D (ATC service) requires:

- Total annual movements of 80,000, or
- Total annual Passenger Transport Movements (PTO) of 15,000 or
- Total annual PTO passengers of 350,000

The actual achievement of any of the trigger values above does not mandate a change of airspace classification, it requires an aeronautical risk review to determine if a change of class is required.

For these reason, it is not expected that there will be ATC tower required at the airport on opening day however ATC services will be required to be managed remotely through a digital tower. The ATC services would likely be hosted out of Canberra.

7.7.2 Cargo

Requirement for cargo facilities will be from discussions with airlines. Noting that information may be limited provision will be provided in line with similar sized regional airports. There is unlikely to be a dedicated cargo facility at the airport. Some mail cargo and exports may take place, but these facilities are likely to be collocated with the terminal.

7.7.3 Catering

Catering facilities will need to be provided to support commercial service operations. The catering is likely to be supplied out of one of the major hubs so that airlines can maintain their standard service on the aircraft. This means that the facilities at the airport will be limited to storage for catering and catering trucks if required. It is noted that if a hotel or Convention centre were to be established with a large catering kitchen, then this could be considered as a back up source of catering for the airport, if the demand were to grow significantly.

7.7.4 Aircraft Re-Fuelling

Fuelling of aircraft will be completed via fuel tanker trucks on the apron due to the expense of in ground infrastructure hydrant re-fuelling systems. An onsite tank storage facility will be provided in the support facilities precincts.

Published data from airports indicates that hydrant re-fuelling systems are often not required until passenger volumes exceed 8-10 MMPA or annual aircraft movements exceed 100,000-150,000 movements annually.

The proposed fuel facility would allow for landside access, allowing the delivery via tanker. No direct fuel line will be provided to the facility.

7.7.5 GSE Storage

Staging and storage requirements for GSE facilities will be based on discussions with airline operators and their airside operator contractors that service the aircraft. Safe storage areas for GSE will be required adjacent to the aircraft stands.

An airside fuel station can be provided on airfield subject to GSE equipment chosen. If all electric fleet (preferred to align with sustainability outcomes) charging facilities (linked to a PV Array or to a source of renewable electric supply) will need to be provided.

7.7.6 De-icing

De-icing of aircraft may be necessary under certain conditions which result in ice building up on the wings of aircraft. This could be after aircraft are stored over night or after arriving in cold weather. Whilst there is no an expectation that aircraft will usually store at the airport overnight they may need to do so because of adverse weather or other operational reasons. For these reasons, it will be necessary to provide basic de-icing facilities at the airport.

De-icing operations will take place on-stand. This will be undertaken with a small fleet of dicing vehicles that is likely to be operated by the airport or contracted ground services operator. To support this, consideration will need to be given to the design of the stands to support flows dicing fluid and ensure it will not end up in the environment. As such, no dedicated de-icing facilities will be provided at the airport.

7.7.7 Aerodrome Rescue and Fire Fighting Services

The requirement for Aerodrome Rescue and Fire Fighting Services (ARFFS) at aerodromes is specified in MOS139H.

The requirement to have an ARFFS established at an aerodrome is based upon two different criteria (either can be met):

- International RPT operations.
- More than 350,000 passengers on RPT aircraft in the preceding financial year.

Response times by ARFFS are dictated both by ICAO and the MOS and must be met for all new facilities. Whilst not covering all of the requirements of the MOS, the basic requirement is that an ARFFS vehicle must be able to reach either end of the runway, in normal visibility within three minutes of a notification of an incident. This requirement dictates the placement of any ARFFS facility and must be considered in initial planning for the aerodrome.

The MOS does allow other providers than ASA to provide an ARFFS. Discussions with CASA have indicated that there is no regulatory requirement to have a stand-alone ARFFS facility at an aerodrome. There could be options to utilise a shared facility, for example with NSW Fire and Rescue. Any provider of ARFFS from a shared facility would be required to not only comply with MOS139H but to be approved by CASA as an ARFFS provider.

The advantages of a shared facility are that the CAPEX associated with the facility is not solely recovered through aerodrome operations, providing the potential to significantly reduce the charges required to be recovered by users. This would need to be offset against potential costs for NSW Fire and Rescue to obtain MOS139H certification, however investigation of this option would be worthwhile.

Figure 22: Ayers Rock ARRFs Building

Assumed for planning is one ARFF station comprising parking for 2 fire tenders, lookout tower, crew quarters/facilities and extinguishing agent (incl. water) storage – similar to the facility at Ayer's Rock (1,000 m2 building, largely singly storey) with external tanks. This would be located in the support facilities area of the terminal.

7.8 Navigational Aids

To support RPT jet operations from Day One, it is recommended that an APV-LNAV Approach be designed and published for Jindabyne Airport.

Potential operators should be canvassed to determine RPT need for required navigation performance. Both APV-LNAV and required navigation performance is a type of performance-based navigation that allows an aircraft to fly a specific path between two 3D-defined points in space. No additional ground infrastructure is required to support the potential benefits of an RNP-AR approach, the increased performance lies in both the aircraft navigational capabilities and the design of the approach. A RNP-AR approach could be designed and published for Option 3 with the same ground supporting infrastructure as required for an APV approach.

This type of operation would not require a instrument landing system which will save significant costs and allow for more flexibility in the set of up the airport. The navigation of the airport is

Based on this, to support day one jet operations the following Navigation Facilities are recommended as part of the airport infrastructure:

- Three windsocks
- Pilot Activated Lighting
- Precision Approach Path Indicator on Both Runway approaches
- Runway Threshold Identification Lights
- Protection of CAT1 lighting facilities
- Protection of area to support future GBAS installation

Further details on the requirements around Navigational Aids are outlined in the Aeronautical Report.

7.9 Utilities

The utilities requirements have been determined for the airport facility. The following utilities have been considered:

- Electrical
- Communications
- Gas
- Sewer
- Stormwater
- Water

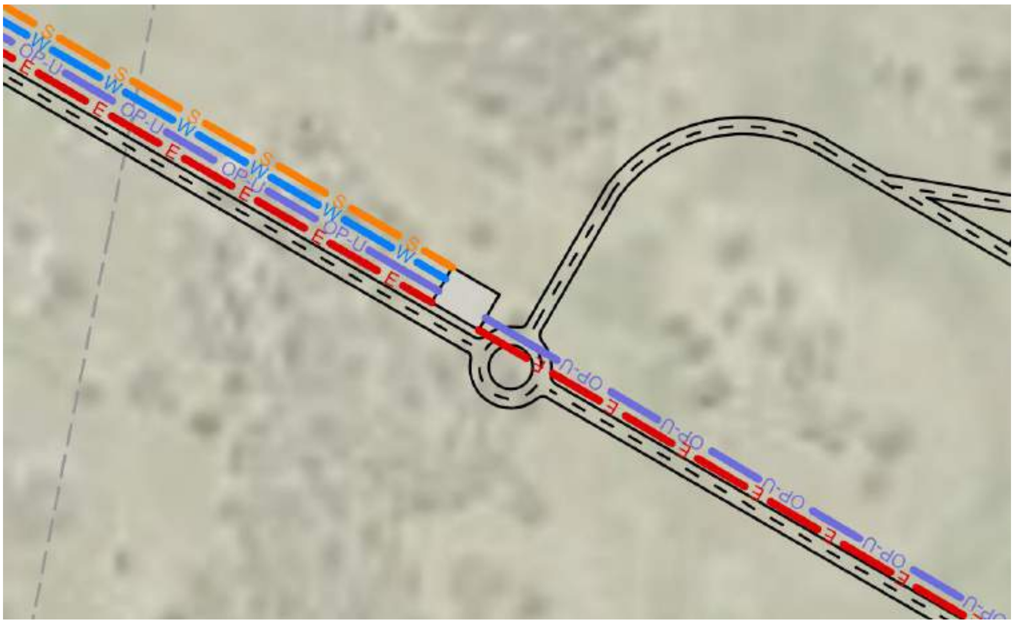


Figure 23: Utilities layout along entry road

The table of demands, in terms of requirements for peak usage as well as storage for the initial airport are shown below:

Utility Service	Transmission Infrastructure	Storage Infrastructure	Demand
Electrical	2 overhead or underground lines to airport	N/A	1600 MVA
Communications	2 lines of 6 optic fibre conduits each to airport	N/A	N/A
Gas	N/A	41,000L LPG Tank	16,800 MJ/day
Sewer	Sewer Main	N/A (assumed sewer pumped to nearby catchment)	12 kL/day
Water	Water Main	1,000,000L Storage for firefighting	16 kL/day

Table 3: Utilities Loading

Electrical

The electrical demand for the airport is estimated to be 1600 MVA for the initial build, increasing to 2500 MVA for the final build. This is based on the estimated sizes required in the initial and final layouts, including the carpark sizes, apron stand requirements, terminal and plaza sizes. This demand is only indicative and can be further developed in later design stages with further layout information.

The electrical connections to the airport can be overhead or underground. Two separate connections are required, preferably from two separate locations, to allow for redundancy due to damage to one of the connections. If this is not possible, two trenches along the same road can be used, at a minimum of 2m apart.

A generator is also recommended to be located on the airport site to act as redundancy for a power outage.

Communications

The airport required optic fibre communications connections. These would need to be constructed, as the area is primarily services by NBN Fixed Wireless, which does not meet the communications demands required for the airport. Two trenches, each consisting of six cables are required.

Two separate connections are required, preferably from two separate locations, to allow for redundancy due to damage to one of the connections. If this is not possible, two trenches along the same road can be used, at a minimum of 2m apart.

Gas

Gas infrastructure is required in the terminal building for use in the retail areas of the building. No gas infrastructure is located in this area, and therefore the gas needs to be stored on the airport site, and the storage should be refilled preferably on a monthly basis. The storage tank is assumed to not drop below 50%, however this will need to be further explored based on the ambient temperatures at the airport.

Sewer

The sewer demands for the airport have been estimated based on the assumed terminal size and areas required for retail and office space. This demand is only indicative and can be further developed in later design stages with further layout information.

The sewer main will run along the road and will be pumped to the nearest storage catchment (East Jindabyne). If this is not possible, sewage treatment will be required on site.

Water

The water demands for the airport have been estimated based on the assumed terminal size and areas required for retail and office space. This demand is only indicative and can be further developed in later design stages with further layout information.

The water main will run along the airport access road. In addition, 1,000,000 litres of storage is required for firefighting purposes is required on the airport site.

Stormwater

The sizes and requirements for the stormwater have not been detailed in this design stage. A culvert will be required on the east size of the runway to allow the existing flow path to be maintained, but the size of this culvert and other apron drainage will be considered at a later design stage.

7.10 Pavement

Airport pavements are designed and constructed to provide adequate support to cater for aircraft wheel loads and to provide a suitable surface free of debris or other particles that pose a Foreign Object Debris (FOD) risk. FODs can be potentially ingested by jet engines or blown and picked up by propeller wash or jet blast.

Airport pavements must also be durable enough to withstand repeated aircraft movements, all weather conditions particularly during extreme high and low temperatures and other deteriorating influences. This requires coordination of many design factors, construction, and maintenance to ensure the safety of aircraft and passengers. Pavements surfaces that are well maintained ensure minimal disruptions to airport operations.

Pavement Types

Airport pavements are typically rigid (concrete surfacing) or flexible (asphalt or sprayed seal surfacing). The selection of pavement types is dependent on various factors such as life cycle cost, traffic frequency, loading severity, maintenance requirements, ground conditions and environment.

Rigid pavements are more suitable for repeated channelised slow moving, turning or stationary heavy aircraft wheel loads such as on the aircraft parking stands and runway ends. When combined with extreme high ambient temperatures (>38°C), flexible pavements are not recommended as the risk of asphalt surface deformation (rutting) increases.

On taxiways, particularly at runway hold points where queuing of aircraft whilst waiting for clearance to enter the runway is relatively common, rigid pavements may be warranted due to the stationary wheel loads.

Flexible pavements are generally suitable in the mid-block section of the runway and taxiways. Due to the wing lift factor during take-off and landing, there is a load impact reduction on the pavement surface, hence rigid pavements are not necessarily warranted.

Historical temperature records obtained from the Bureau of Meteorology indicated that the mean maximum temperature and mean minimum temperature are 26.7°C and -2.1°C. Within this temperature range, the risk of asphalt surface deformation that are associated with extreme high temperatures (>38°C) and the risk of low temperature cracking are considered relatively low.

Based on the above and taking into consideration of the aircraft type and frequency, flexible pavements with an asphalt surfacing is considered to be most appropriate. Sprayed seal surfacing is not recommended for Jet Code C tyre pressures as the weight with contribute to aggregates loss from the sprayed seal surface. A comparison table between rigid and flexible pavements is provided in Table 4.

Table 4: Comparison between Flexible and Rigid Pavements

Element	Flexible Pavement	Rigid Pavement
Design Life	20 Year structural design life	40 Year structural design life
Performance	More suitable if ground conditions are prone to differential settlement. Susceptible to surface deformation due to twisting, stationary or slow-moving wheel loads particularly during extreme high temperatures. Highly dependent on quality of the underlying unbound layers. Susceptible to moisture damage, particularly if the underlying unbound layers are saturated. Asphalt surfaces are susceptible to damage caused by fuel or hydraulic oil spillages.	More resistant to surface deformation due to twisting, stationary or slow-moving wheel loads particularly during extreme high temperatures. Less susceptible to moisture damage. High ability to bridge imperfections in underlying areas. Resistant to surface damage caused by fuel and hydraulic oil spillage. Typically, costlier replacement or rehabilitation at the end of the design life.
Construction	Mobile asphalt plant required. Major asphalt suppliers have more than one mobile asphalt plant. Requires highly skilled and experienced crew. Surface defects are easier to fix by replacing upper 50mm wearing course layer with asphalt. Preferred construction period during drier/warmer months.	Supply of concrete mix must be within 60 minutes of site. It is unknown if mobile concrete batch plants are easily available. Requires highly skilled and experienced crew. Construction defects and errors in the concrete slab are difficult to fix and most likely requires full slab replacement.
Maintenance	Asphalt resurfacing typically required every 10 to 15 years, typically in the form of mill and replace upper 50mm or a 50mm overlay over existing asphalt. Resurfacing works typically undertaken during the night to minimise interruptions to aircraft operations.	Lower maintenance effort and cost. Replacement of joint sealant typically required every 10 years. Routine maintenance comprises localised joint sealant replacement and spall repairs at the concrete slab edges.

Element	Flexible Pavement	Rigid Pavement
	Sealing of open construction joints and cracks, as early as 5 years from opening. Asphalt patching may be required at aircraft parking positions and runway ends.	Concrete slab replacements are typically costlier and time consuming.

The pavement strength rating must be determined using the ACN - PCN pavement rating system described in Chapter 5 of the MOS. CASA does not specify a standard for runway bearing strength, however, the bearing strength must be such that it will not cause any safety problems to aircraft.

The pavement design will consider existing ground conditions (notably CBR), aircraft and loading % and forecast/ growth.

Runway & Taxiway

The runway pavement is proposed to be flexible pavement due to the reduced capital cost in line with the majority of regional airports in Australia; and the limited turning damage from Code C aircraft. If allowance for Code E's was considered; allowance at turning areas would need to be contemplated). To remediate this critical pavement; as this airport is not proposed to be a 24hr airport expediated works can be completed during normal shutdown hours (i.e. 9PM-5AM). These works are done readily at all 1 runway; non 24hr airports.

Apron

Due to limited heavy GSE manoeuvring around the apron for Code C aircraft it is proposed to that concrete panels are isolated to lead in line and under main gear only for Code C's; to limit cost of apron construction compared to flexible pavement. Turbo props power out can also be provided on stand as is shown in Figure 24: Code C Concrete Panel Extent (Hobart Airport, Google). If Code E's were contemplated the majority of the apron would be concrete panels to account for wider gears and larger GSE.

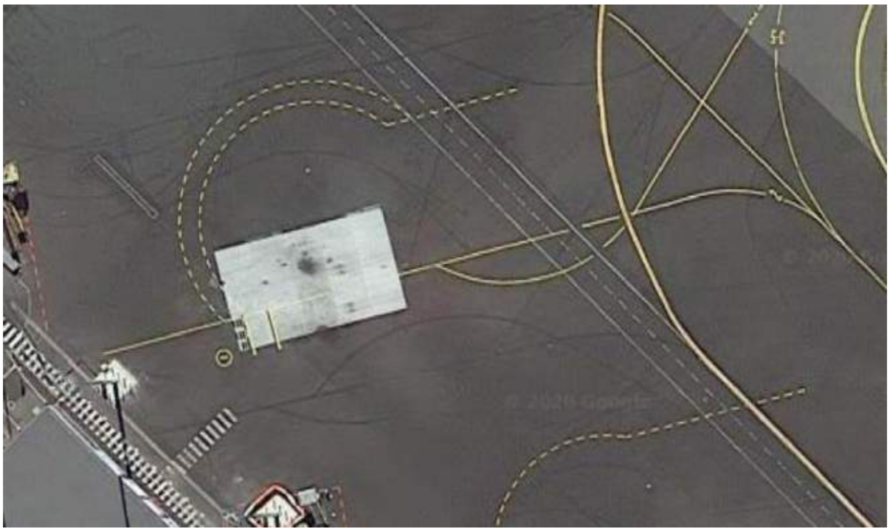


Figure 24: Code C Concrete Panel Extent (Hobart Airport, Google)

7.11 Earthworks

The earthworks estimates have been completed for the runway, as well as the terminal. The results are shown in the below table:

	Runway (m3)	Terminal Precinct (m3)
Cut	920,000	100,000
Fill	950,000	1,170,000
Net Volume	30,000	1,070,000
Total Volume	1,870,000	1,270,000
Combined Volume		3,140,000

The runway earthworks were completed with a balanced scenario. The terminal was completed as a fill scenario, with the terminal placed on the same level as the runway in this location. The earthworks have not been balanced between the terminal and runway since the layout is not confirmed. Once the layout is confirmed, a cut-fill balanced scenario can be completed between the runway and the terminal.

The terminal earthworks currently incorporate the following

- Taxiway
- Initial Stage Apron
- Support Facilities
- Initial Terminal
- Plaza
- Initial Carpark
- Commercial Space
- Airport Internal Roads

Geotechnical Information

Based on the lithology log of the following groundwater bores GW072255, GW110326, GW109210, GW100180, GW052745 the ground profile depth ranges encountered are summarized below:

- Base depth of 0.05 to 2 m of topsoil
- Base depth of 0.7 to 2 m clay
- Base depth of 9.4 to 17.6 m decomposed granite
- Granite underlying clay/decomposed granite

The decomposed granite is expected to have variable weathering and corestones are likely which may require blasting during excavation. Some allowance for blasting should be considered for the decomposed granite and allowance for blasting recommended for areas in granite.

Based on this information, some areas of the airport will have greater than 2m of cut, which may encounter granite. This may incur a higher cost for excavating and relocating for fill later.

Table 5: Geotechnical Data

Description	Top Depth	Base Depth
Topsoil	0	0.05-2
Clay	0.05-2	0.7-2
Decomposed Granite	0.3-2	9.4-17.6
Granite	2-17.6	-

8 Airspace Protection

8.1 Flight Paths

Airspace is designated a class to provide risk protection based upon traffic levels, type, and risk modelling. A profile view (shown below) of airspace is often referred to as an "upside down wedding cake". This vertical profile is designed to keep aircraft climb and descent profiles contained within the prescribed class of airspace.

The routes have been designed to link into high level air routes between Sydney and Melbourne

Potential Arrival Routes from the South

The MEL to JIN route will introduce some complexities for ATC, as the aircraft will be crossing the inbound route to MEL when they turn towards JIN. These are not insurmountable but will require liaison with ATC to ensure acceptable levels of safety are maintained.

The descent profiles of these aircraft should be such that conflictions with Q29 traffic to Melbourne are minimal.

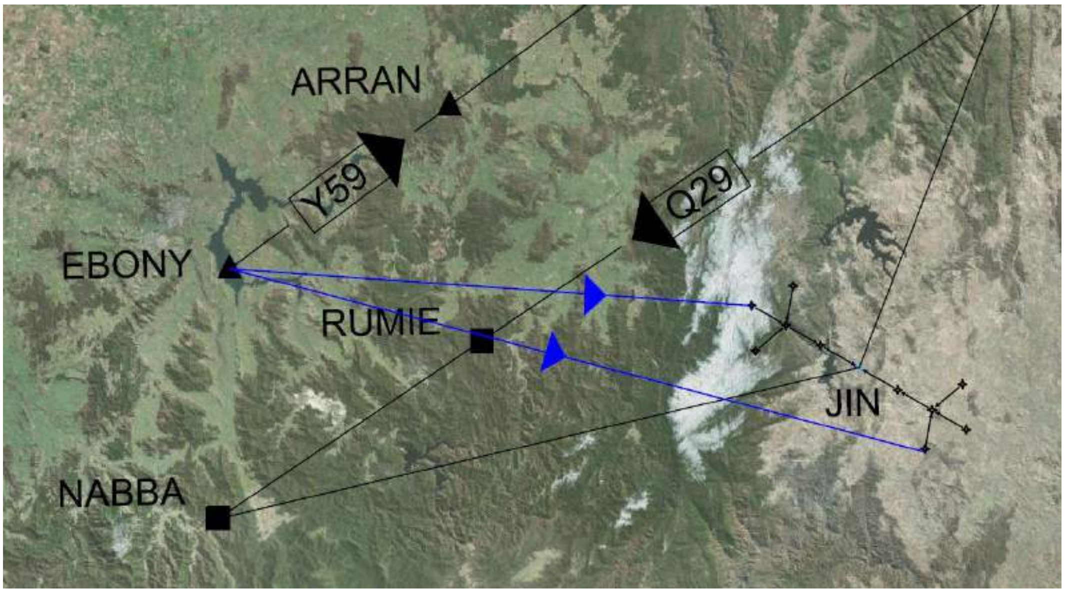


Figure 25: Potential Arrival Routes South[2]

Potential Arrival Routes from the North

Arrivals from Brisbane and Sydney could leave the existing high level route Q29 at RAZZI and track direct to the IAF for either RWY 12 or 30.

[2] Source: ATS

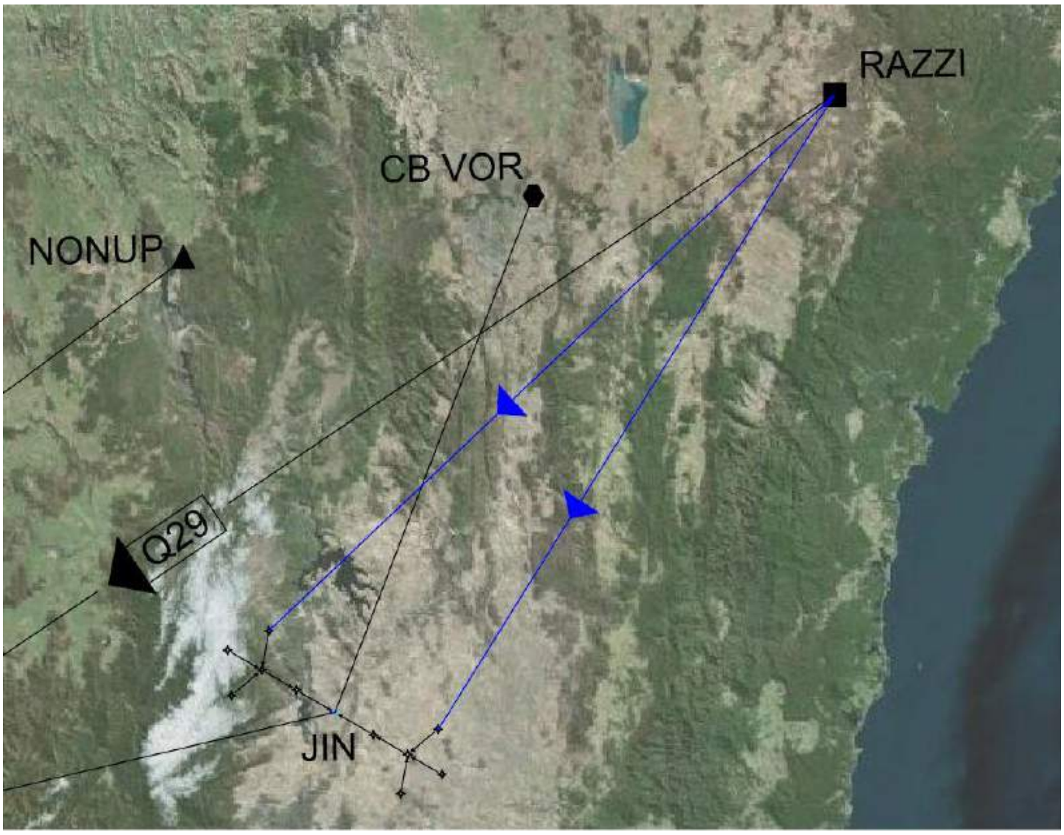


Figure 26: Potential Arrival Routes North[3]

Potential Departure Routes to the South

Departures from JIN could join the existing arrival route into Melbourne at NABBA, which conveniently has a holding pattern should the aircraft need to be delayed to fit into the arrival stream.

Due to high terrain immediately west of JIN, some variance to the proposed tracks may be required.

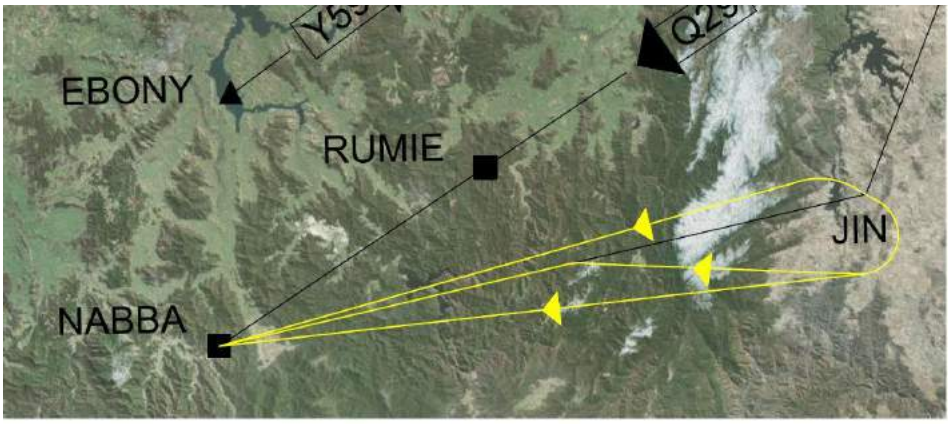
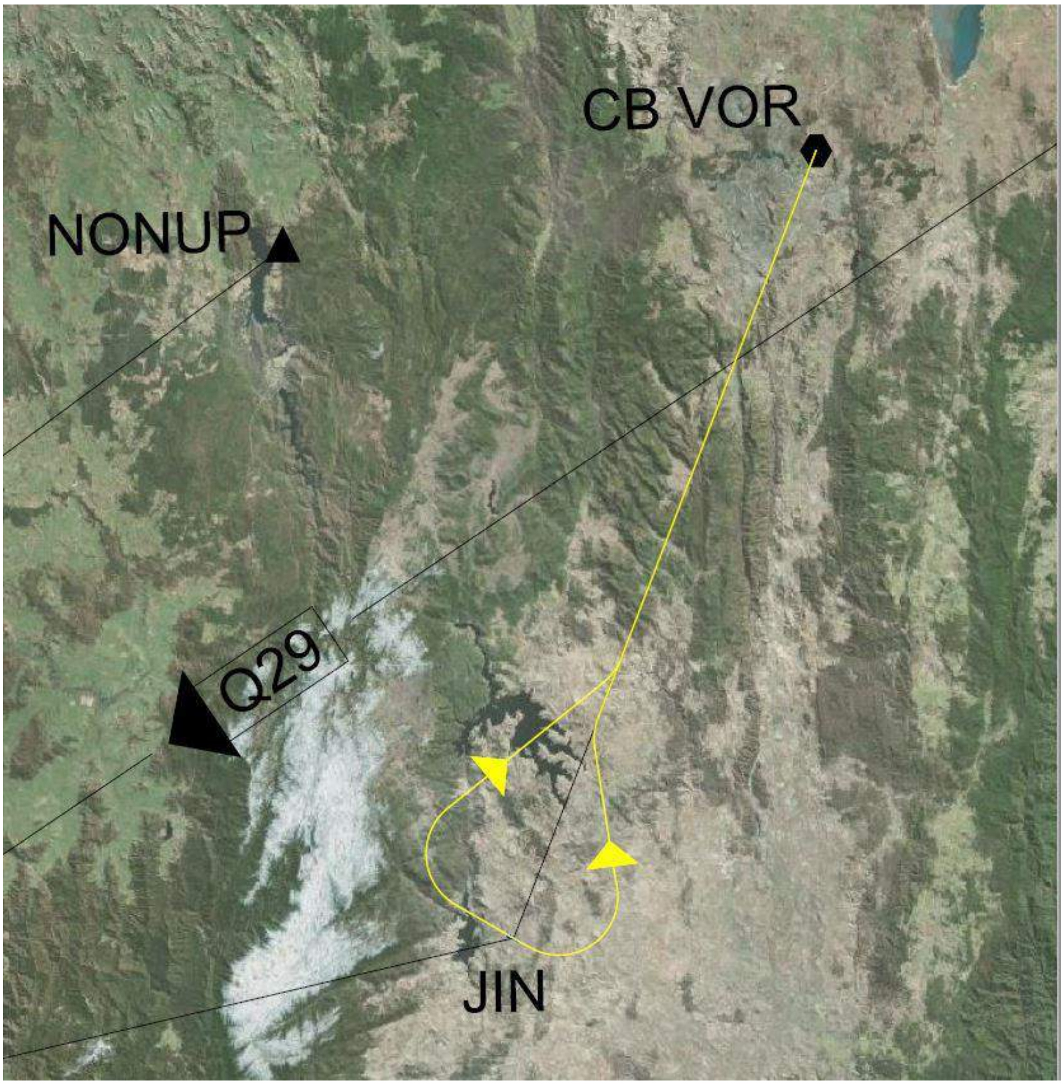


Figure 27: Potential Departure Routes South[4]

[3] Source: ATS
[4] Source: ATS

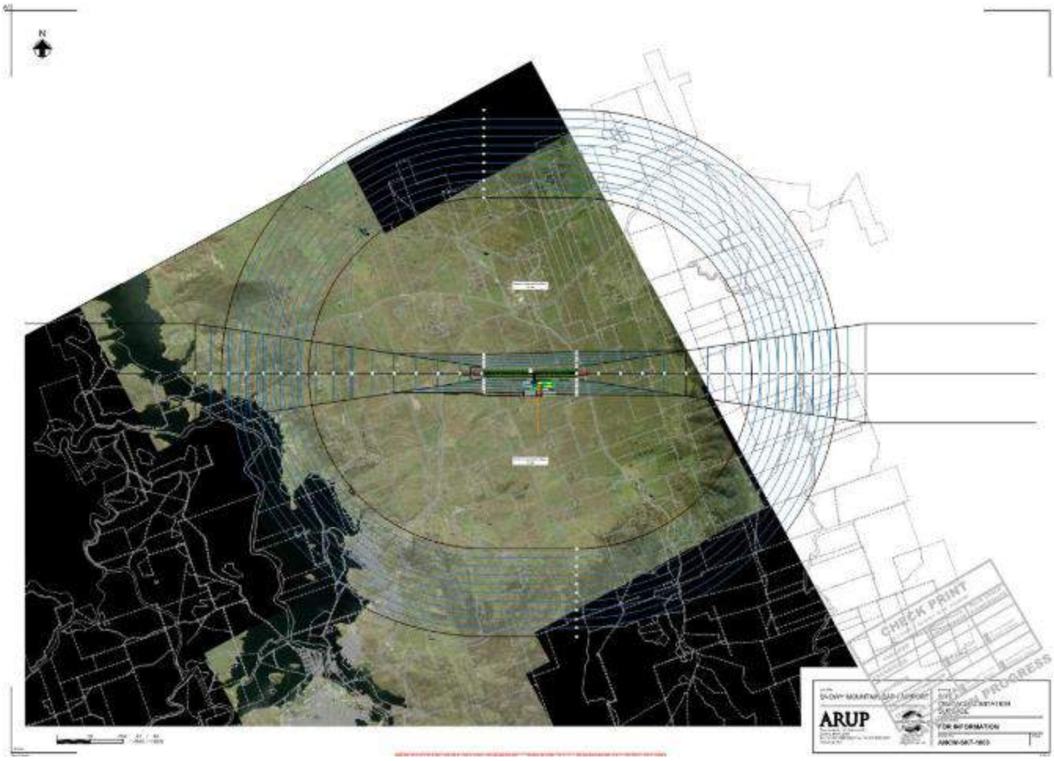
Potential Departure Routes to the North

Departures for Brisbane and Sydney could join the high level route structure at Canberra, the crossing of Q29 should not present significant issues for ATC as departing JIN traffic should be well below the levels of other traffic.



8.2 Obstacle Limitation Surface

The OLS is generally the lowest surface and is designed to provide protection for aircraft flying into or out of the airport when the pilot is flying by sight. The PANS-OPS surface is generally above the OLS and is designed to safeguard an aircraft from collision with obstacles when the aircraft's flight may be guided solely by instruments, in conditions of poor visibility.



The OLS and PANS-OPS surfaces will allow for any future expansion to avoid construction that may limit expansion in the future. Two OLS/PANS-OPS plans will be produced to show Day 1 requirements and Ultimate requirements (longer runway notably). These restrictions will need to be considered with land use plan around the airport.

8.3 Noise Protection

The assessment of aircraft noise effects is an important consideration in the planning on any new airport. This assessment will assess:

- Sensitive land uses are not subject to unacceptable aircraft noise
- The impact to acoustic amenity of surrounding developments due to aircraft noise; and
- Airport operations are protected long term from conflicts due to the encroachment of inappropriate development into noise affected areas.

This planning modelling will consider flight paths, flight frequency (with seasonal variations), number and type and also times of flights (Day – 6am to 6pm, Evening 6pm to 10pm; and Night 10pm and 6am) for landings and taxiing as well as other ancillary noise sources (e.g. engine runup tests). The result of the modelling is an Australian Noise Exposure Forecast[5] (ANEF) assessment showing the forecast of aircraft noise levels that are expected to exist around the airport in the future.

The ANEF is based on the US Noise Exposure Forecast (NEF) assessment method for aircraft noise but applies a different night-time penalty weighting (lowered to 6 dB from 12 dB) and night-time period (between 1900 hrs–0700 hrs rather than 22 00 hrs–07 00 hrs for NEF). The night penalty is used to emphasise the more severe impact of flights occurring during night hours.

Planning for additional land use within the ANEF contours is discussed in Australian Standard AS2021-2015[6] . These recommendations are summarised in Table 5 below. Existing receptors/ land uses will be reviewed against ANEF to confirm they are within acceptable or conditional values.

Table 5: Site Acceptability Based on ANEF Zones (Based on Australian Standard AS 2021-2015 Table 2.1)

Building Type	Acceptable	Conditional	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF

[5] Strictly speaking the term ANEF is reserved for the Airservices Australia endorsed forecast contours. Other terms ANEC (Concept) and ANEI (Information) are typically used to describe unendorsed assessments using the same methodology. To simplify discussion in this document, the use of the term ANEF has been adopted to describe the assessment methodology as outlined in AS 2021.

[6] AS 2021-2015, *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*

Building Type	Acceptable	Conditional	Unacceptable
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

* ‘Acceptable’ means that special measures are usually not required to reduce aircraft noise.
‘Conditional’ means that special measures (noise attenuation) are required to reduce aircraft noise.
‘Unacceptable’ means that the development should not normally be considered.

It should be noted that the ANEF does not, by itself, provide a complete picture of aircraft noise level impacts particularly with respect to the likelihood of sleep disturbance. The main concerns with the ANEF are:

- It was developed to address complaints around existing airports, and is therefore more suited to brownfield, rather than greenfield sites.
- It represents the ‘average day’ taken over a whole year and does not address potential ‘short term’ or seasonal impacts.
- It addresses the community’s response rather than individual response.
- It does not easily correlate with subjective experience and is therefore difficult for the public to ‘validate’ outcomes against the published ANEF contours.
- It adopts an absolute threshold and does not relate to the ambient noise level in an area – and so may be less valid in quieter rural areas.

Therefore, in recent aircraft noise assessments in Australia, the ANEF has been supplemented by additional metrics, to assist non-experts in understanding, in simpler terms, the extent of potential noise impacts from aircraft operations.

The N-contour system is a complementary aircraft noise metric that shows the potential number of aircraft noise events above 60dB(A), 65dB(A) or 70dB(A) per day. It has advantages over the ANEF system because it shows noise in a way that a person perceives it – as a number of single events per day above a certain decibel level.

Over-flights during the night period are likely to contribute to a more negative response from the community, largely due to potential sleep disturbance. While the ANEF does weight noise at night more heavily to account for this, it is generally understood that sleep disturbance is correlated with the L_{max} or maximum noise level of individual noise events (over-flights), during night hours.

For this reason, to quantify the areas where there is potential for sleep disturbance, the L_{max} contours should also form part of the analysis of aircraft noise.

In summary, in order to best assess and communicate the true noise impact of the proposed aerodrome, the noise should be quantified and communicated using several metrics, which should include those which correlate closely to an individual's subjective experience and are easily interpreted by the general population.

Preliminary Noise Assessment

A preliminary assessment of predicted noise levels to existing nearby sensitive receivers has been conducted in accordance with the method described in AS 2021-2015, Section 37. This assessment is normally intended to assess the suitability of new dwelling construction on land impacted by noise from a planned airfield and is not a substitute for the ANEF process outlined above. It has been implemented here as a high-level check of noise impacts to existing residences.

The LAmax,slow noise levels at 12 residences approximately on-axis and within 10 nautical miles of the ends of the Option 3 runway were manually checked. These residences are shown in Figure 28 and details of each is shown in Table 6.

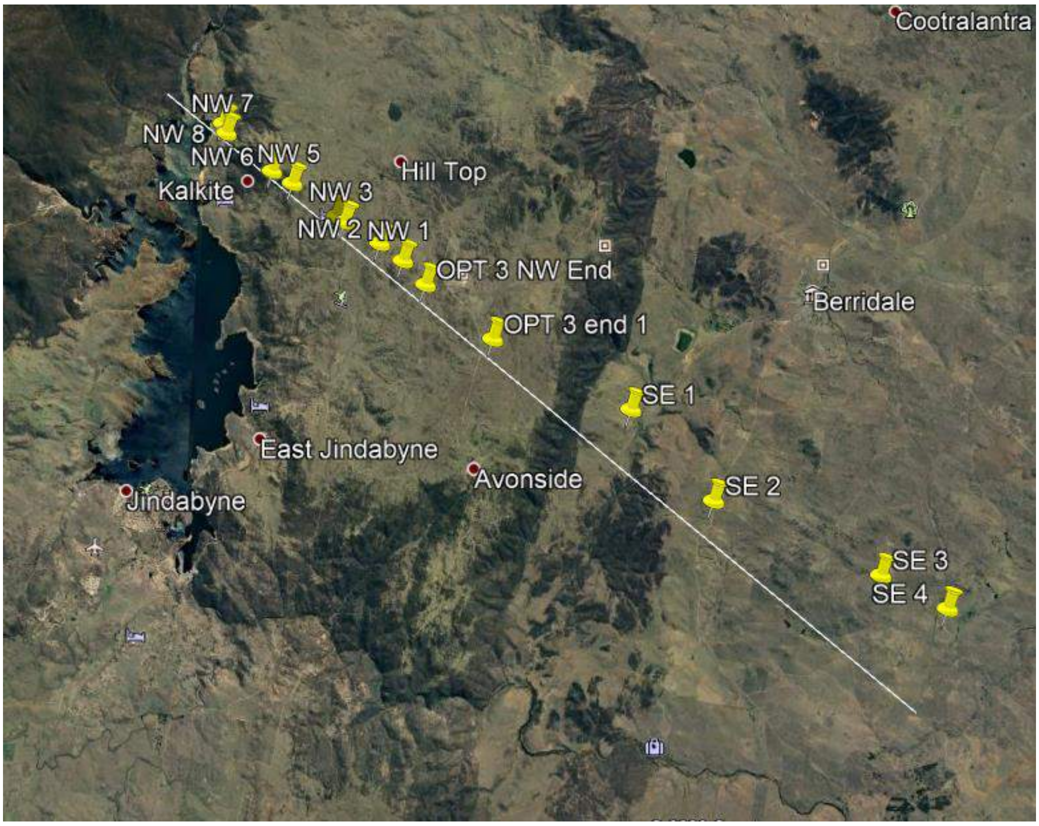


Figure 28: Residence Locations

7 AS 2021-:2015 Acoustics – Aircraft noise intrusion-Building siting and construction, *Section 3.1 Aircraft Noise Level*

ID	Name	Coordinates
NW 1	80 Manuders Ln	55 H 652057.00 m E 5974725.00 m S
NW 2	66 Tirrike Ln	55 H 651389.00 m E 5975252.00 m S
NW 3	217 Eucumbene Rd	55 H 650379.00 m E 5975914.00 m S
NW 4	23 Kalkite Rd	55 H 650144.00 m E 5976078.00 m S
NW 5	162 Kalkite Rd	55 H 648857.00 m E 5977097.00 m S
NW 6	286 Kalkite Rd	55 H 648241.00 m E 5977504.00 m S
NW 7	730 Kalkite Rd	55 H 646847.00 m E 5978735.00 m S
NW 8	772 Kalkite Rd	55 H 646744.00 m E 5979032.00 m S
SE 1	Coolamatong Rd	55 H 658491.00 m E 5970287.00 m S
SE 2	644 Rockwell Rd	55 H 660757.00 m E 5967640.00 m S
SE 3	Dalgety Rd West	55 H 665338.00 m E 5965455.00 m S
SE 4	Dalgety Rd East	55 H 667146.00 m E 5964493.00 m S
Option 3	Runway Ends for Option 3	55 H 654619.50 m E 5972373.70 m S 55 H 652708.02 m E 5974010.73 m S

Table 6: Residence Locations

AS 2021:2015 Appendix E provides a method to determine building site acceptability, based on the dB $L_{Amax,slow}$ noise levels due to aircraft flyovers, shown here in Table 7.

Number of flights per day	Aircraft noise level expected at building site, $L_{Amax,slow}$ dB		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park, school, university, hospital, nursing home			
>30	<70	70-75	>75
15-30	<80	80-85	>85
<15	<90	90-95	>95
Hotel, motel, hostel, public building			
>30	<75	75-80	>80
15-30	<85	85-90	>90
<15	<95	95-100	>100
Commercial building			
>30	<80	80-85	>85
15-30	<90	90-95	<95
<15	<100	100-105	>105

Table 7: Noise Level Acceptability

The predicted external noise levels at each receiver are shown in Table 8 and are coloured green for 'acceptable' noise levels, yellow for 'conditionally acceptable' and red for 'unacceptable' noise levels.

This assessment assumes less than 15 total overflights flights per day.

Noise Sensitive Receiver	Aircraft noise level expected at building site, dB $L_{Amax, slow}$	
	Turboprop (Dash 8)	Jet (737-800)
NW 1	72	90
NW 2	73	89
NW 3	70	85
NW 4	69	84
NW 5	64	79
NW 6	62	77
NW 7	60	74
NW 8	61	74
SE 1	52	73
SE 2	58	73
SE 3	46	63
SE 4	46	60

Table 8: Predicted noise levels at receiver locations

If the total daily jet overflights are increased to between 15 and 30, there is a potential for unacceptable noise levels at receivers NW 1, NW 2 and NW 3.

It is predicted that greater than 30 total daily turboprop overflights can be accommodated with the 'conditionally acceptable' noise levels.

Appendix A

Glossary

Term	Definition
°C	Degrees celcius
AAA	Australian Airports Association
AAPS	Australian Airspace Policy Statement
ACI	Airport Council International
ACP	Airspace Change Proposal
ADSB	Automatic Dependant Surveillance - Broadcast
AFRU	Aerodrome Frequency Response Unit
AFP	Australian Federal Police
AGL	Aeronautical Ground Lighting
AGL	Above Ground Level
AHIA	Australian Helicopter Industry Association
AHIMS	Aboriginal Heritage Information Management System
AMS	Aviation and Maritime Security
ALARP	As Low As Reasonably Practical
ALS	Approach Lighting System
AMS	Aviation and Maritime Security
ANEF	Australian Noise Exposure Forecast
ARFFS	Aviation Rescue Fire Fighting Services
ASA	Airservices Australia
ASIO	Australian Security Intelligence Organisation
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
ATM	Air Traffic Movements
ATM	Air Traffic Management
AWIB	Aerodrome Weather Information Broadcast
AWIS	Aerodrome Weather Information Service
BCR	Benefit Cost Ration
BNN	Backup Navigation Network
BOM	Bureau of Meteorology
CAGRS	Certified Air Ground Radio Service
CASA	Civil Aviation Safety Authority
CAPEX	CAPital EXpenditure
CAR	Civil Aviation Regulation
CAT	Category
CBR	California Bearing Ratio

Term	Definition
COM	Cooma Snowy Mountains Airport
CTAF	Common Traffic Advisory Frequency
CNS	Communication, Navigation and Surveillance
DH	Decision Height
DME	Distance Measuring Equipment
DPIE	Department of Planning, Industry and Environment
ERGL	Elevated Runway Guard Light
FL	Flight Level
FOD	Foreign Object Debris
GA	General Aviation
GBAS	Ground Based Augmentation System
GNSS	Global Navigations Satellite Systems
GPU	Ground Power Unit
GSE	Ground Servicing Equipment
GNSS	Global Navigations Satellite Systems
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
ISCA	Infrastructure Sustainability Council of Australia
JIN	Jindabyne Airport (Proposed new name for airport in Jindabyne)
LiDAR	Light Detection and Ranging
LNAV	Lateral Navigation
VNAV	Navigational Aid
MOS	Manual of Standards MOS Part 139
NASF	National Airport Safeguarding Framework
NDB	Non-Direction Beacon
NBN	National Broadband Network
NM	Nautical mile
NSW	New South Wales
MTOW	Maximum Design Takeoff Weight
NASF	National Airports Safeguarding Framework Principles
NAVAIDS	Navigational Aid
NEF	American Noise Exposure Forecast
OAR	Office of Airspace Regulation
OLS	Obstacle Limitation Surface

Term	Definition
OPEX	OPerational EXPenditure
PAL	Pilot Activated Lighting
PAPI	Precision Approach Path Indicator
PANS-OPS	Procedures for Air Navigation Services
PAPI	Precision Approach Path Indicator
PCA	Pre-conditioned Air
PSA	Public Safety Area
PSI	Pounds per Square Inch
PTO	Passenger Transport Operations
QNH	Pressure setting on an altimeter indicating vertical displacement AMSL
RESA	Runway End Safety Area
RFDS	Royal Flying Doctors Service
RTIL	Runway Threshold Identification Lights
RPT	Regular Public Transport
RWY	Runway
SAF	Sustainable Aviation Fuel
SAP	Special Activiation Precinct
SDG	Sustainable Development Goals
SMAC	Snowy Mountains Airport Corporation
TCH	Threshold Crossing Height
TDA	Temporary Danger Area
TODA	Takeoff distance available
TOS	Tail Of Stand
TORA	Take-off run available
UAM	Urban Air Mobility
UN	United Nations
UNICOM	UNIversal COMmunications
VDGS	Visual Docking Guidance System
VHF	Very High Frequency
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VTOL	Vertical Take-Off and Landing

Appendix B

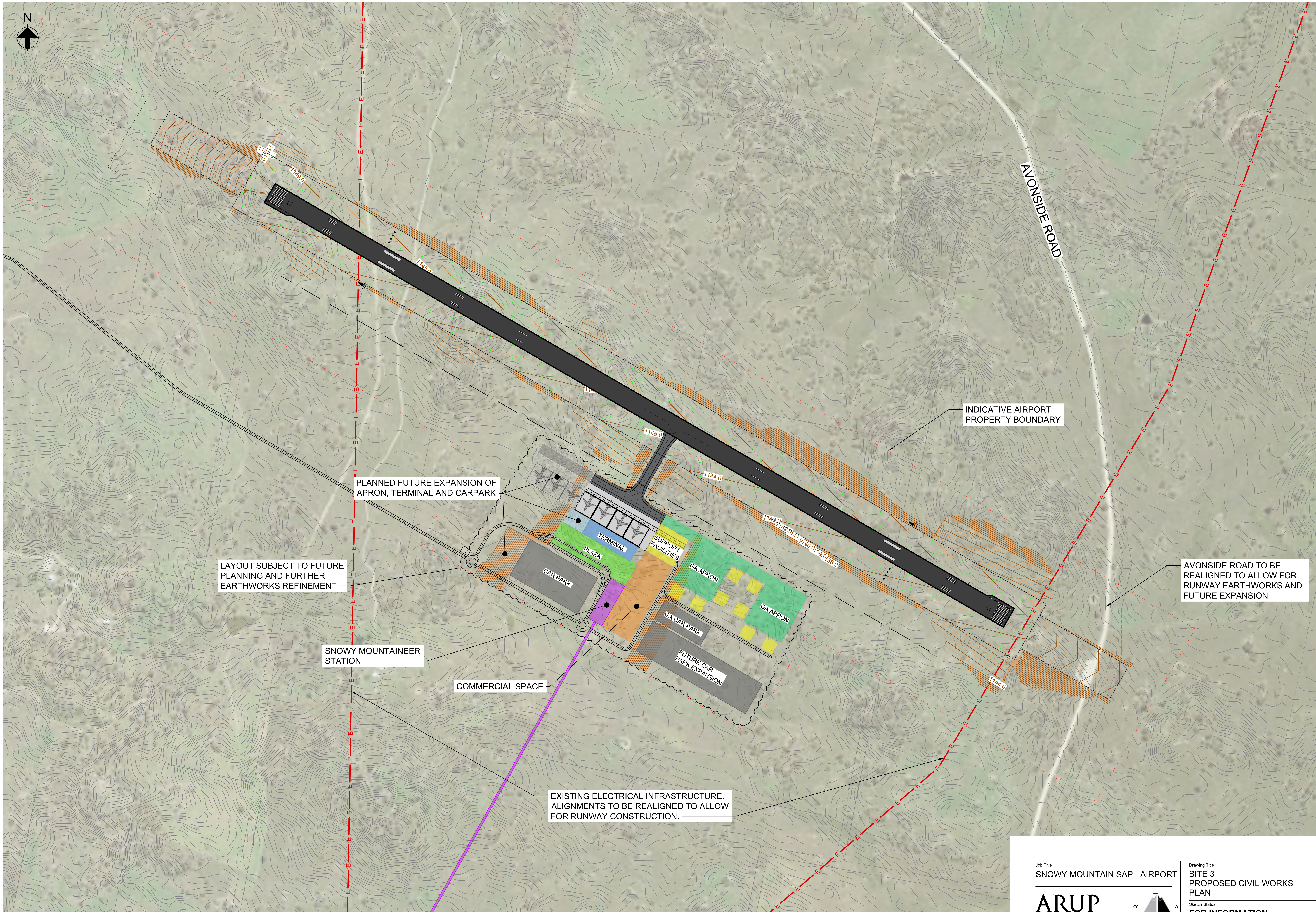
Masterplan Layouts


N
AVONSIDE ROAD
AVONSIDE ROAD TO BE RELOCATED TO
ALLOW FOR RUNWAY EARTHWORKS
AND FUTURE EXPANSION
1
2
1
3
4
PLANNED EXPANSION OF
APRON AND TERMINAL
5
SUPPORT
FACILITIES
GA APRON
GA APRON
13
TERMINAL
LOCATION OF TERMINAL AND ROAD TO BE
SUBJECT TO FUTURE PLANNING AND
EARTHWORKS REFINEMENT
PLAZA
6
COMMERCIAL SPACE
12
GA CAR PARK
10
CAR PARK
7
8
FUTURE CAR PARK EXPANSION
11
9
KEY
1 Future runway expansion
2 Proposed runway
3 Proposed taxiway
4 Future apron expansion
5 Proposed apron
6 Proposed terminal precinct (incl. plaza and commercial space)
7 Future car park expansion
8 Proposed terminal car park
9 Proposed Snowy Mountaineer station and track
10 Proposed GA car park
11 Future GA car park expansion
12 Proposed GA hangers
13 Proposed GA aprons
14 Proposed GA runway
0
200m

Appendix C

Civil Drawings

A1



Scales

Do not scale

Job Title	Drawing Title
SNOWY MOUNTAIN SAP - AIRPORT	SITE 3 PROPOSED CIVIL WORKS PLAN
ARUP Arup, Level 5, 151 Clarence St Sydney, NSW, 2000 Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321 www.arup.com	Sketch Status: **FOR INFORMATION**
ACENZ	Sketch No: **ANCW-SKT-1001** / Issue

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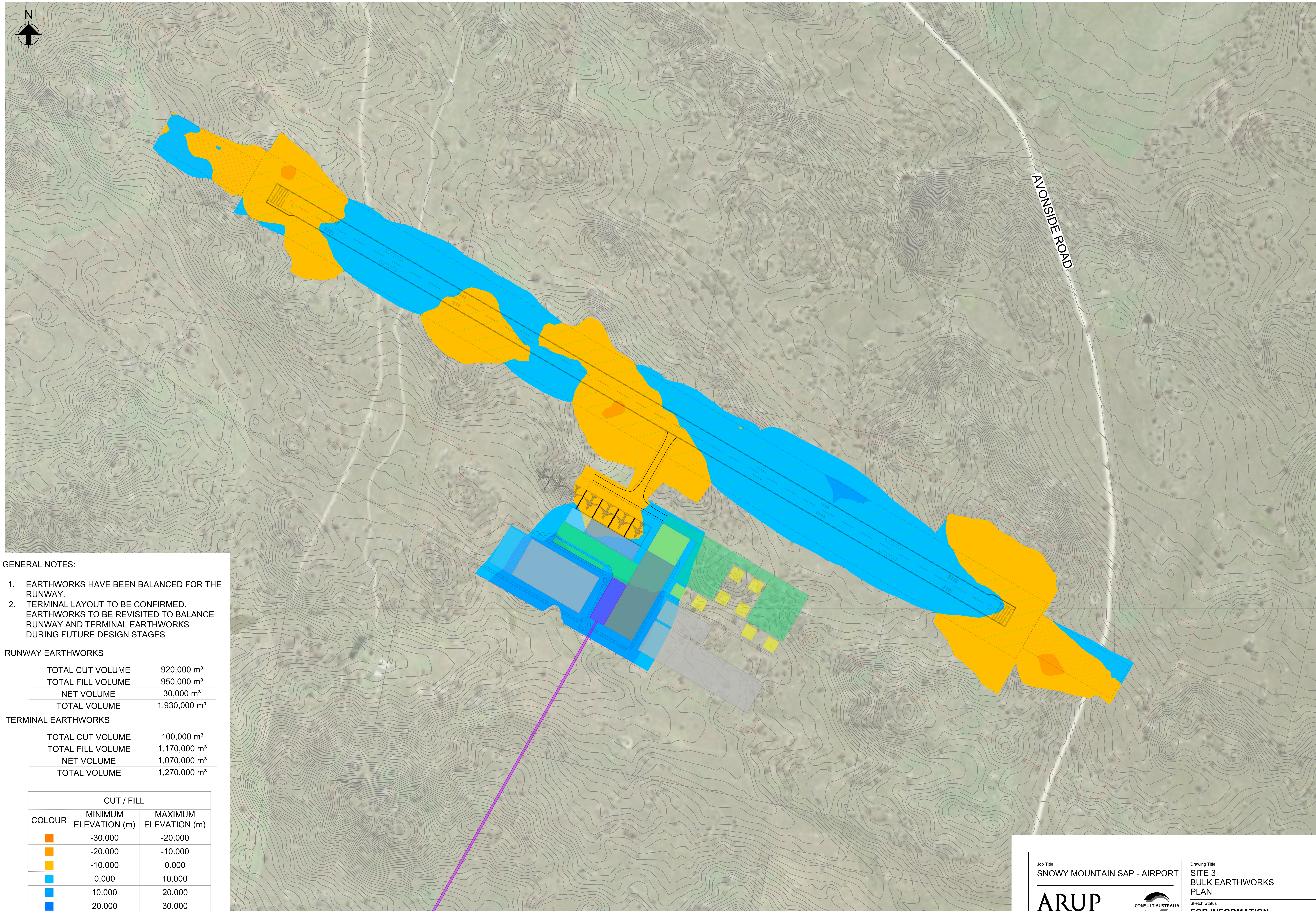

GENERAL NOTES:

1. EARTHWORKS HAVE BEEN BALANCED FOR THE RUNWAY.
2. TERMINAL LAYOUT TO BE CONFIRMED. EARTHWORKS TO BE REVISITED TO BALANCE RUNWAY AND TERMINAL EARTHWORKS DURING FUTURE DESIGN STAGES

RUNWAY EARTHWORKS

TOTAL CUT VOLUME	920,000 m³
TOTAL FILL VOLUME	950,000 m³
NET VOLUME	30,000 m³
TOTAL VOLUME	1,930,000 m³

TERMINAL EARTHWORKS

TOTAL CUT VOLUME	100,000 m³
TOTAL FILL VOLUME	1,170,000 m³
NET VOLUME	1,070,000 m³
TOTAL VOLUME	1,270,000 m³

CUT / FILL

COLOUR	MINIMUM ELEVATION (m)	MAXIMUM ELEVATION (m)
	-30.000	-20.000
	-20.000	-10.000
	-10.000	0.000
	0.000	10.000
	10.000	20.000
	20.000	30.000

0 100 200m A1 / A3
1:4000 / 1:8000

Scales

Do not scale

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ARUP Arup, Level 5, 151 Clarence St Sydney, NSW, 2000 Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321 www.arup.com CONSULT AUSTRALIA Member Firm Arup Pty Ltd ABN 18 000 966 165	Sketch Status **FOR INFORMATION** Sketch No **ANCW-SKT-1002** Issue

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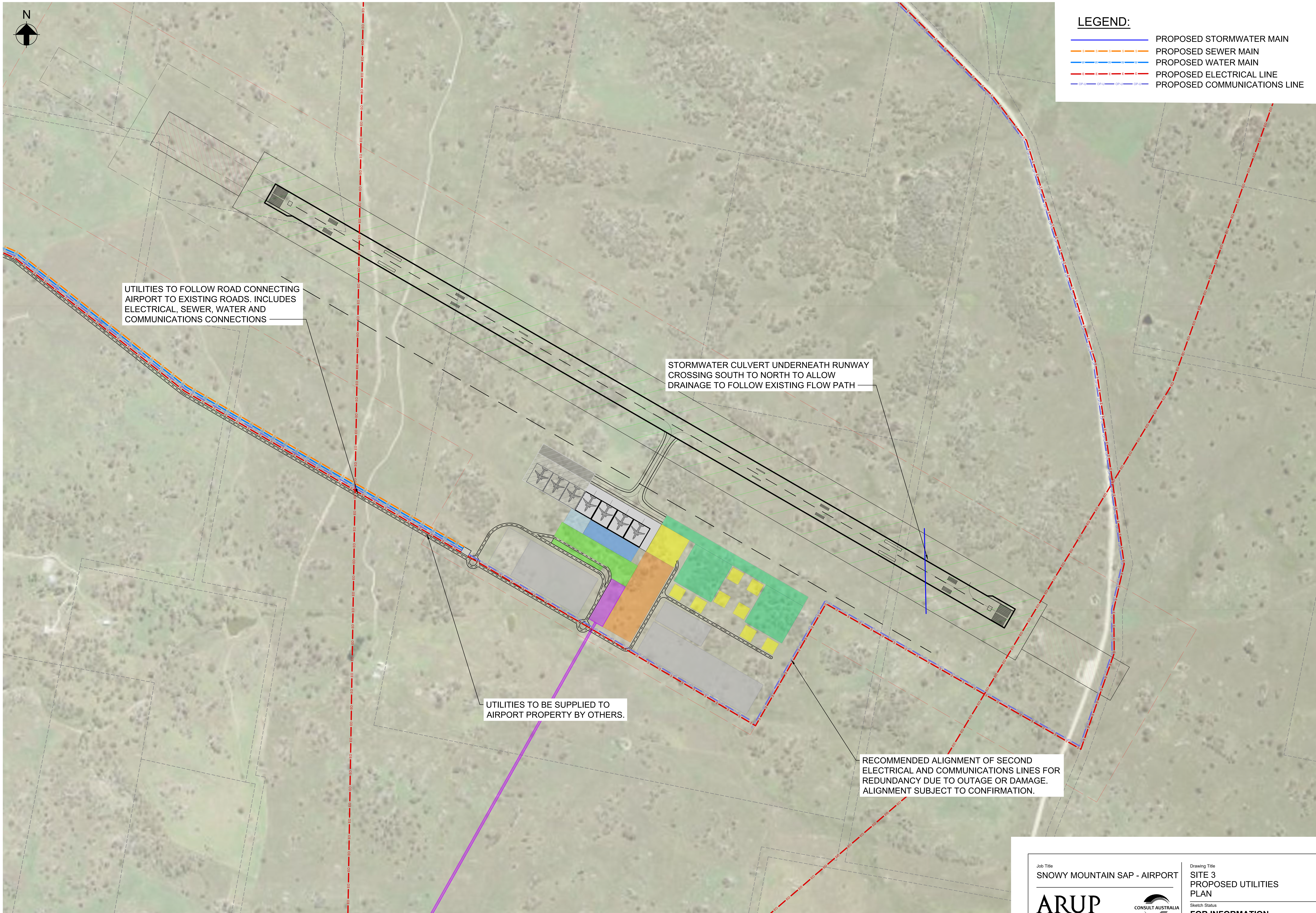

A1 / A3
1:4000 / 1:8000

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Job Title
SNOWY MOUNTAIN SAP - AIRPORT

ARUP
Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
SITE 3
PROPOSED UTILITIES
PLAN

Sketch Status
FOR INFORMATION

Sketch No
ANCW-SKT-1003

Issue

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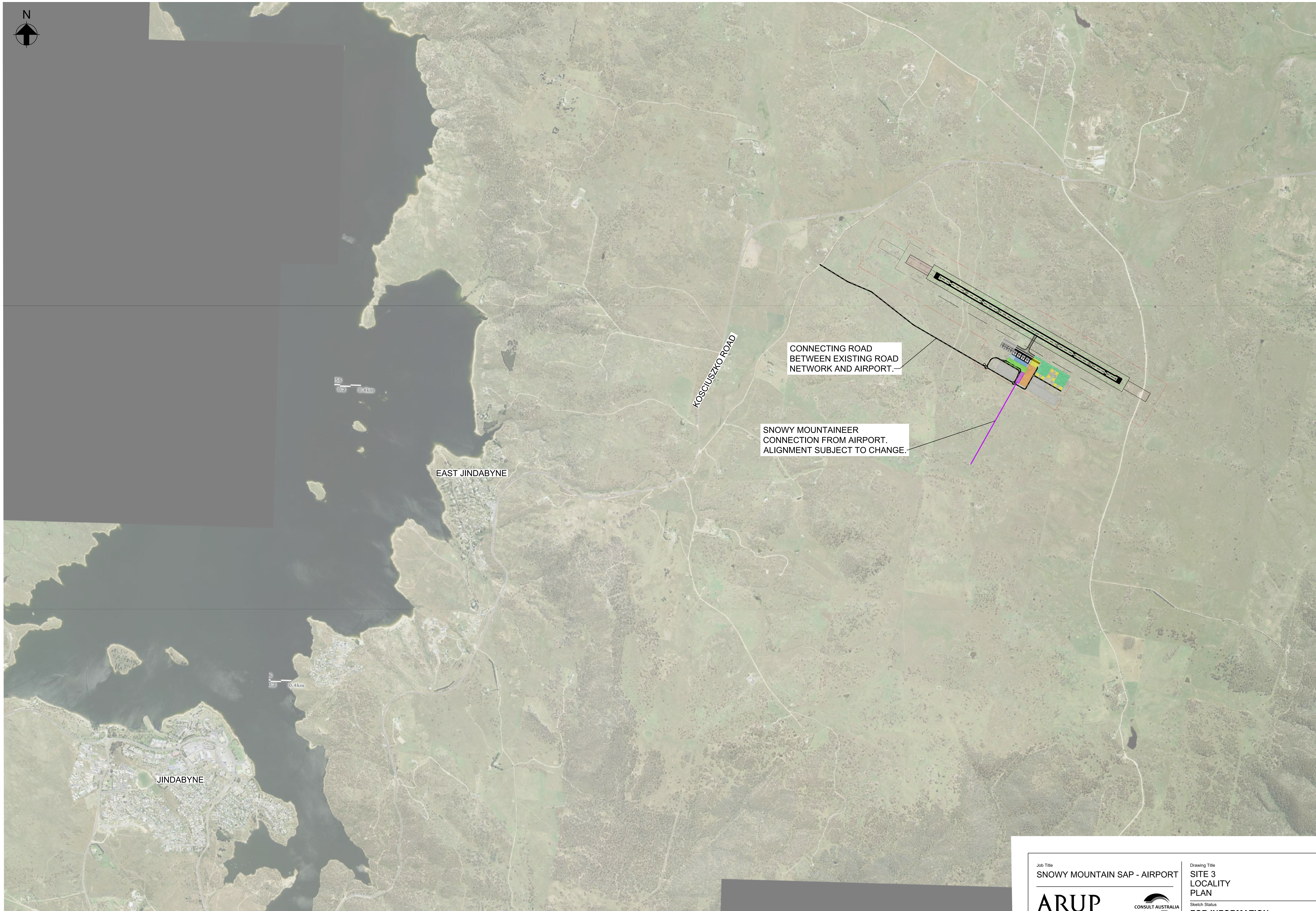

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ARUP Arup, Level 5, 151 Clarence St Sydney, NSW, 2000 Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321 www.arup.com CONSULT AUSTRALIA Member Firm Arup Pty Ltd ABN 18 000 966 165	Sketch Status **FOR INFORMATION**
	Sketch No **ANCW-SKT-1004** — Issue

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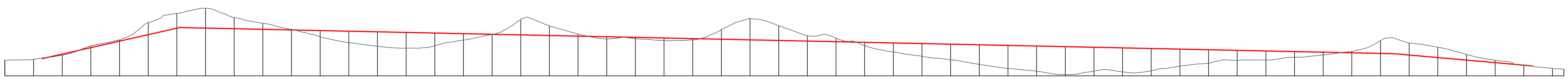
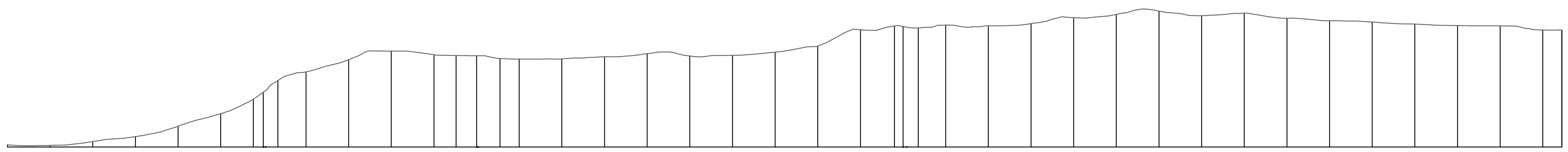


RUNWAY LONG SECTION
W-E

SCALE - H 1:4000
V 1:800

DATUM R.L. 1099.50



ROAD LONG SECTION
W-E

SCALE - H 1:4000
V 1:800

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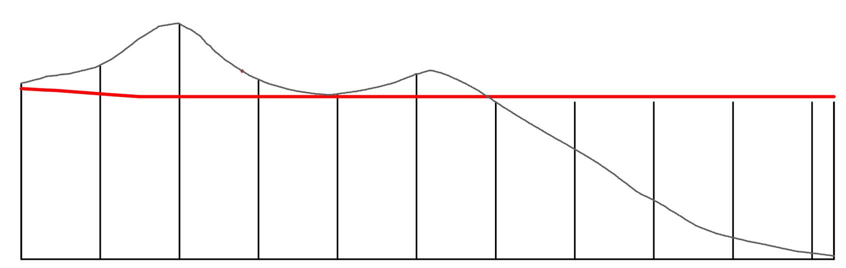

TAXIWAY AND TERMINAL LONG SECTION
N-S

SCALE - H 1:4000
V 1:800

Scales

0 100 200m A1 / A3
1:4000 / 1:8000

Do not scale

Job Title
SNOWY MOUNTAIN SAP - AIRPORT

ARUP
Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
SITE 3
PROPOSED CROSS SECTIONS

Sketch Status
FOR INFORMATION

Sketch No
ANCW-SKT-1005

Issue

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Appendix D

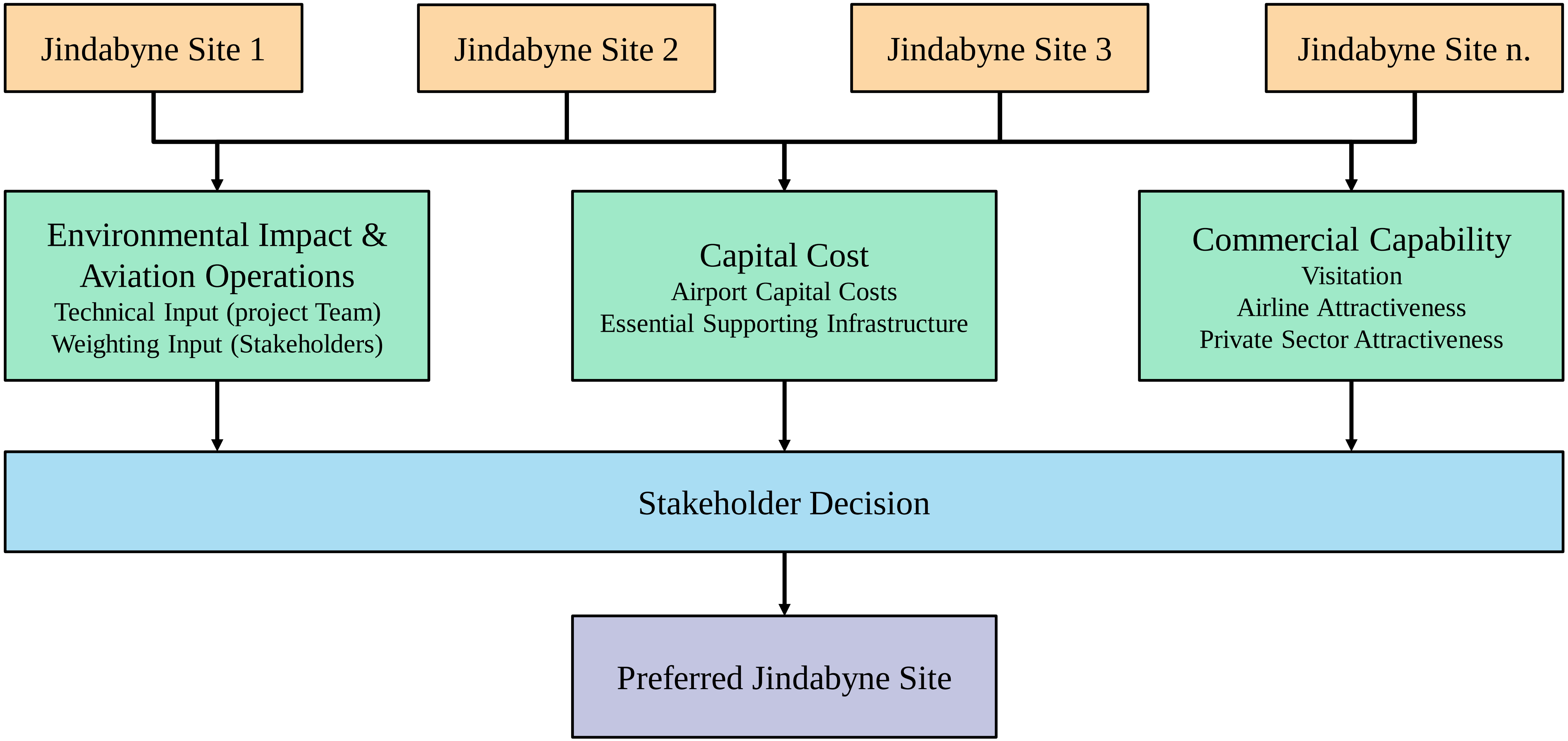
Site Selection Framework

Snowy Airport – MCA

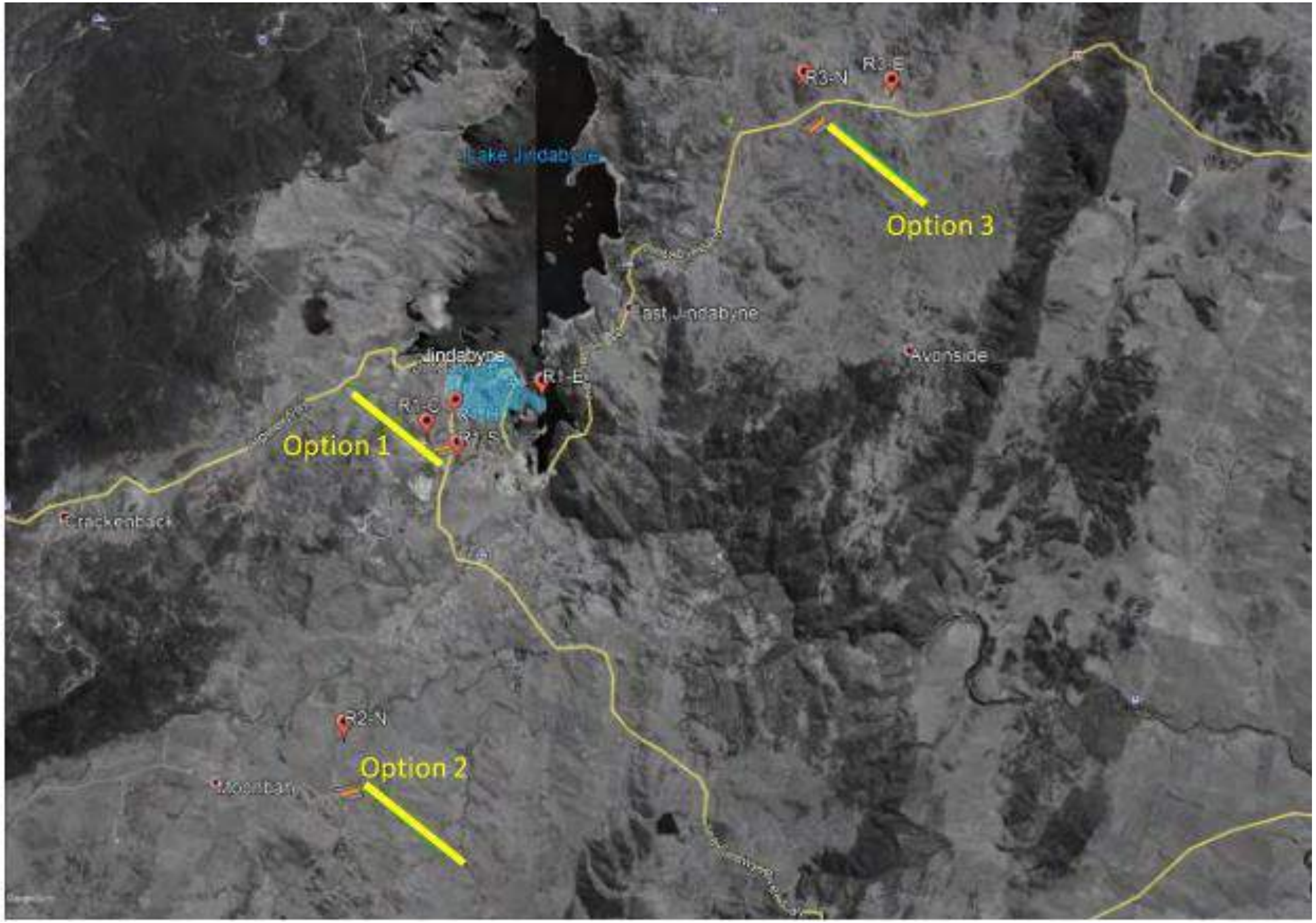
21 August 2020

ARUP

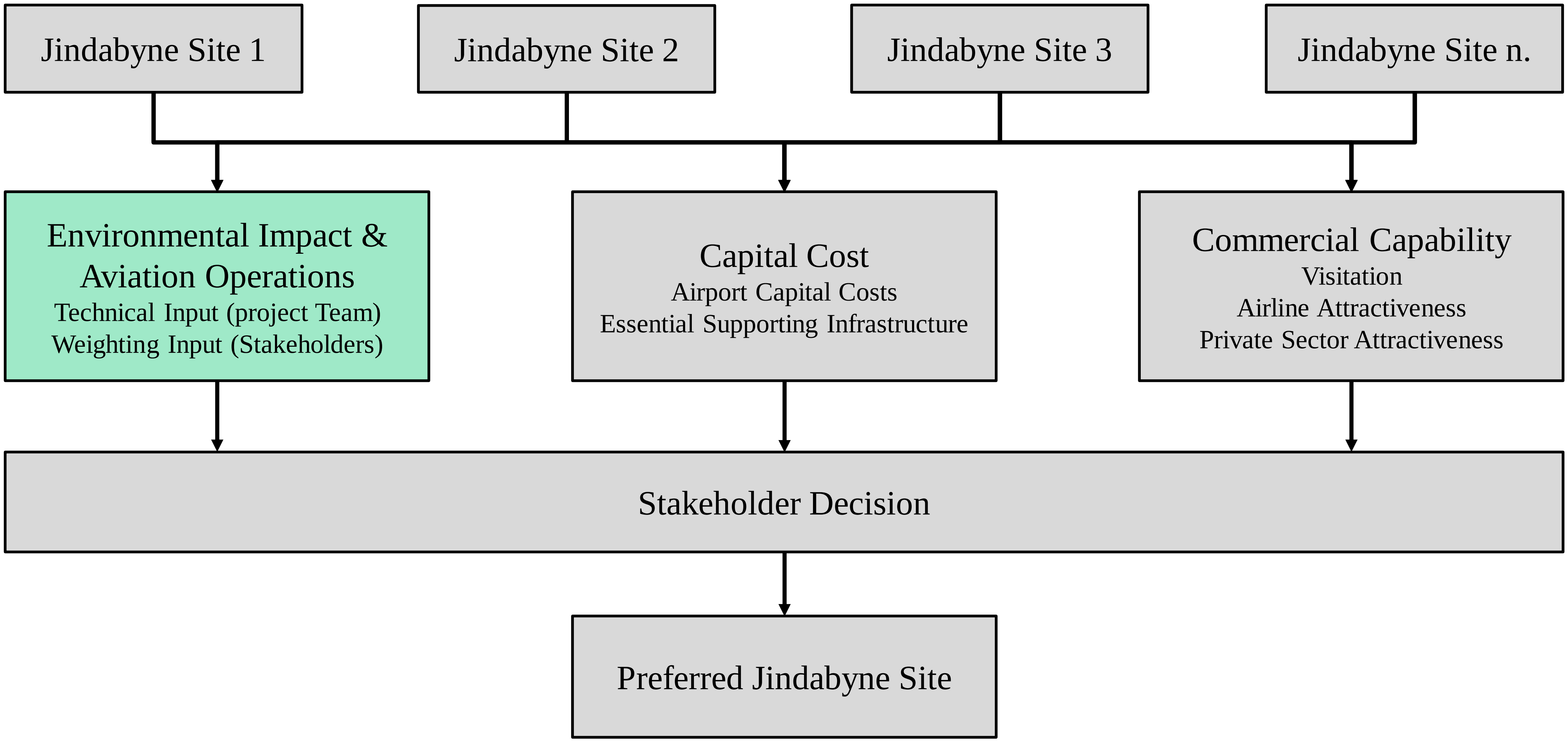
Site Selection Framework



Assessment Sites



Environmental Impact & Aviation Operations



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Environmental Impact and Aviation Operations – Criteria & Weighting

Category	Weighting	Criteria	3 Points	2 Points	1 Point
Environmental Integrity	35%	Impact on Natural Landscape (Visual)	Minimal impact of airport on natural landscape, and/or footprint of airport is not located in any Scenic Protection Zones	Minor impact of airport on natural landscape, and/or footprint of airport has a small section located within Scenic Protection Zones	Major impact of airport on natural landscape, and/or footprint of airport has a large section located within Scenic Protection Zones
		Impact on Local Ecology	No known threatened species or ecological communities impacted by the airport footprint, and a small amount of existing vegetation removal.	No known threatened species or ecological communities impacted by the airport footprint, and a large amount of existing vegetation removal.	Impacts on known threatened species or ecological communities, and/or a very large amount of existing vegetation removal.
		Air Quality / Emissions	Impact to local air quality for a small number of occupied areas, and/or few sensitive receptors in proximity.	Impact to local air quality for a moderate number of occupied areas, and/or small number of sensitive receptors in proximity.	Impact to local air quality for a large number of occupied areas, and/or large number of sensitive receptors in proximity.
		Aircraft Noise	Noise impact on a small number of occupied areas	Noise impact on a moderate number of occupied areas	Noise impact on a large number of occupied areas
		Heritage Impact	No impact to known heritage items/places, and/or low risk of encountering unknown heritage values	No impact to known heritage items/places, and/or moderate risk of encountering unknown heritage values	Impact to known heritage items/places, and/or high risk of encountering unknown heritage values
Aviation Operations	30%	Wind Shear	No impact of local topology on wind shear.	Minor impact of local topology on wind shear.	Major impact of local topology on wind shear.
		Surrounding Land Uses	No surrounding land use which would impact on airport operations.	Minor amount of surrounding land use which would impact on airport operations.	Major amount of surrounding land use which would impact on airport operations.
Strategic Alignment	35%	Alignment with NSW Government priorities	Site is highly aligned with State government objectives around the overall needs of the SAP.	Site is moderately aligned with state government objectives	Site is not aligned with state government objectives around the overall needs for the SAP
		Integration with master plan	Site is highly aligned with the masterplan and produces synergies with other infrastructure investment	Site is moderately aligned and can leverage some elements of investment	Site is not aligned with other parts of the masterplan. Requires dedicated infrastructure and does not promote any other synergies.

ARUP

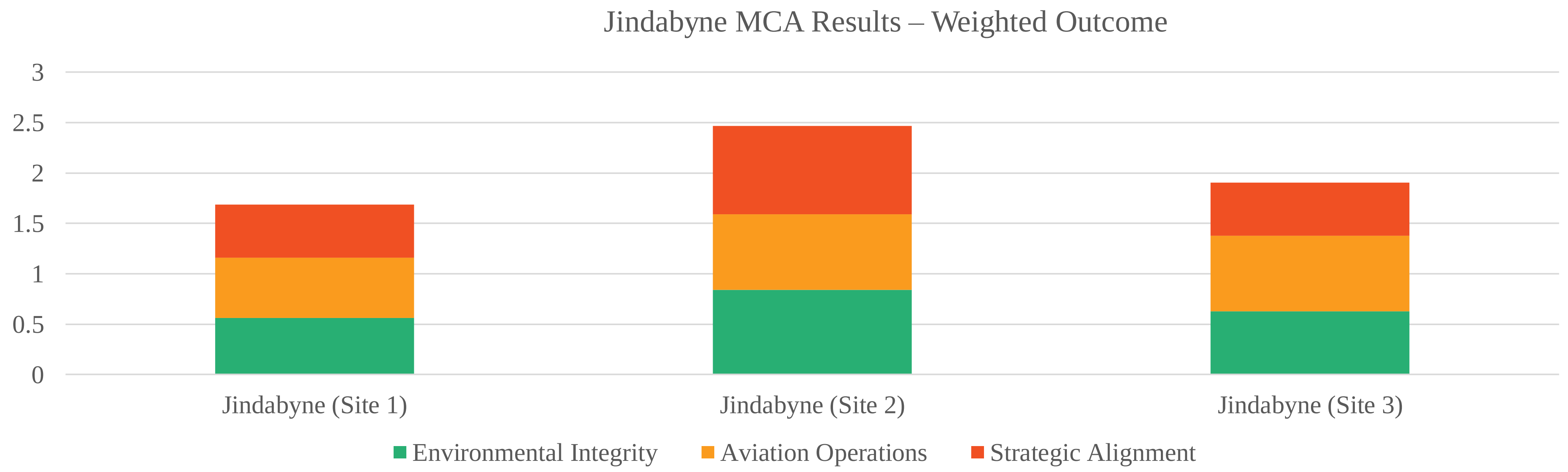
Environmental Impact and Aviation Operations

Category	Criteria	Jindabyne (Site 1)		Jindabyne (Site 2)		Jindabyne (Site 3)	
Environmental Integrity	Impact on Natural Landscape (Visual)	2	Site 1 is located in a developed area, but is located within two Scenic Protection zones.	2	Site 2 has a minor impact on the natural landscape due to its rural location	2	Site 3 has a minor impact on the natural landscape due to its rural location
	Impact on Local Ecology	2	Highly disturbed with significant clearing and canopy death of woodland Likely to contain patches of Critically Endangered Ecological Community	2	Moderate disturbance. Majority of grassland likely to be natural or derived grassland Likely to contain patches of Critically Endangered Ecological Community	1	Majority of site contains Critically Endangered Ecological Community Highest offset requirement and cost
	Air Quality / Emissions	2	Site 1 is in close proximity to local receptors and would have a minor impact on air quality	3	Site 2 is not located nearby to any sensitive receivers.	3	Site 3 is not located nearby to any sensitive receivers.
	Aircraft Noise	1	Site 1 is in close proximity to local receptors and would have a high noise impact	3	Site 2 is not nearby to any local receptors and has been identified by Arup to have the lowest noise impact	2	Site 3 has potential noise exceedance at one local receptor
	Heritage Impact	1	Site 1 impacts a local Aboriginal heritage item, as well as other heritage items	2	Site 2 impacts some other heritage items	1	Site 3 impacts a local Aboriginal heritage item, as well as other heritage items
Aviation Operations	Wind Shear	2	Site 1 has surrounding topology which may cause a minor increase of wind shear at this location	2	Site 2 has surrounding topology which may cause a minor increase of wind shear at this location	2	Site 3 has surrounding topology which may cause a minor increase of wind shear at this location
	Surrounding Land Uses	2	Site 1 has surrounding land uses which may impact airport operations.	3	Site 2 is in a undeveloped area which will not have any surrounding land uses impacting the airport.	3	Site 3 is in a undeveloped area which will not have any surrounding land uses impacting the airport.
Strategic Alignment	Alignment with NSW Government priorities	2	No differece between sites	2	No differece between sites	2	No difference between sites
	Integration with master plan	1	There is little desire through the planning process and masterplan alignment to expand the airport in this area.	3	Its southern location responds well to the growth plans around infrastructure. Helps to minimise the overall investment. There is risk associated with this being a future development site.	1	The site requires dedicated infrastructure away from the bulk of other investment. There is risk associated with the

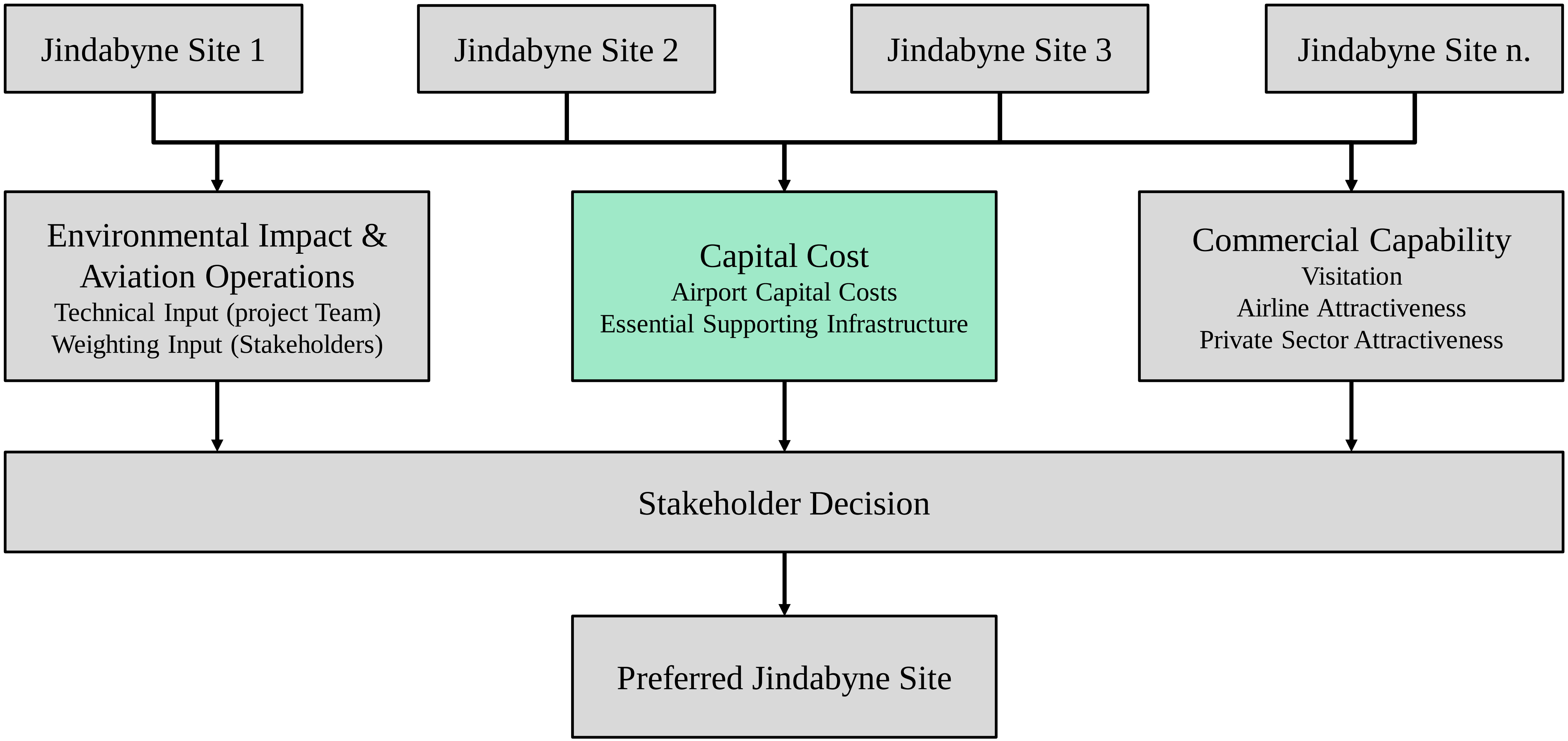
ARUP

Environmental Impact and Aviation Operations – Results

Category	Weighting	**Jindabyne (Site 1)**	**Jindabyne (Site 2)**	**Jindabyne (Site 3)**
Environmental Integrity	0.35	1.6	2.4	1.8
Aviation Operations	0.3	2.0	2.5	2.5
Strategic Alingment	0.35	1.5	2.5	1.5
Total	Unweighted Score	**3.6**	**4.9**	**4.3**
	Weighted Score	1.685	2.465	1.905



Capital Costs



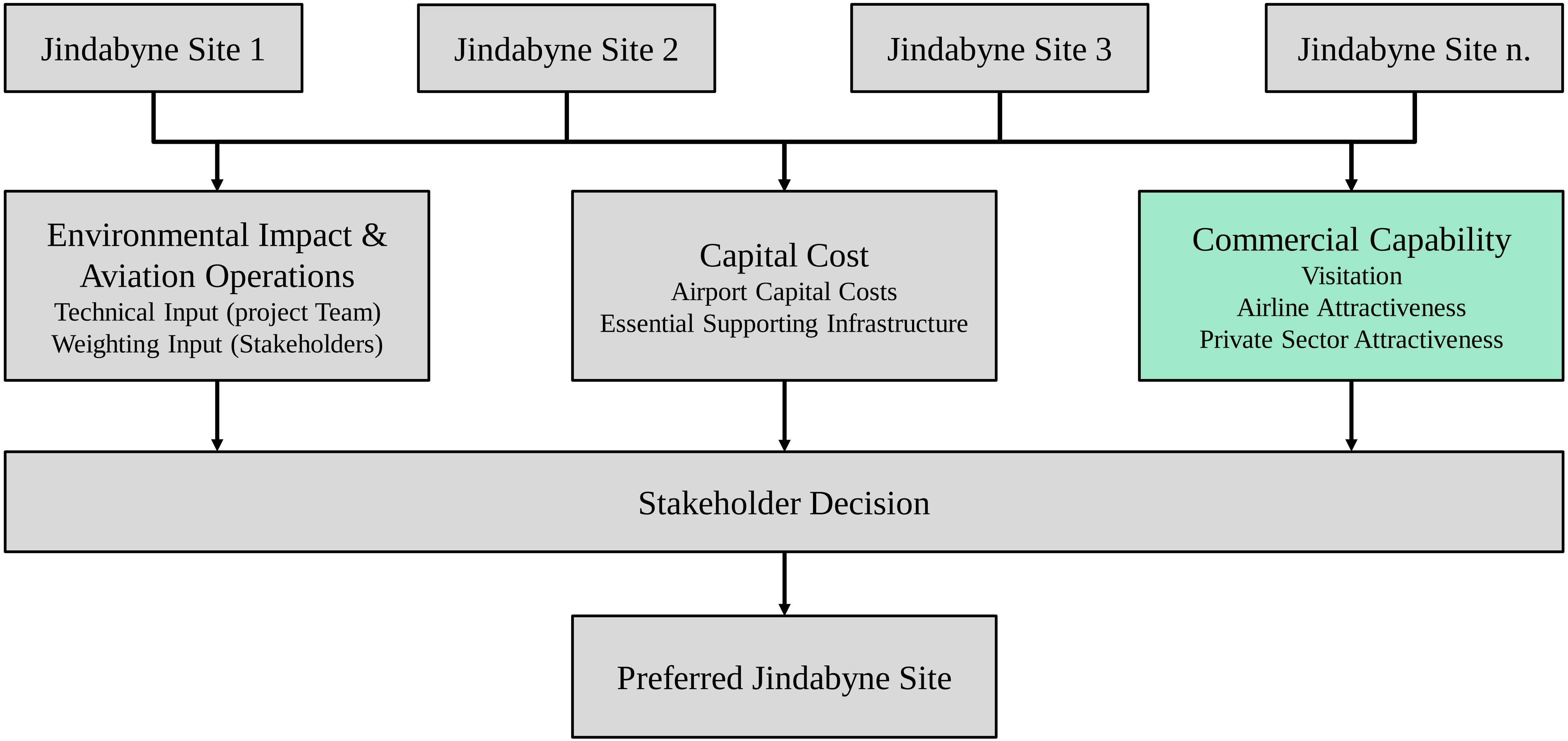
Capital Costs – Supporting Infrastructure Assessment

Criteria	Jindabyne (Site 1)	Jindabyne (Site 2)	Jindabyne (Site 3)
Service Relocation	Not Assessed	No significant service relocations are required through site 2	There is a significant powerline (66kv) running across the site. This will incur significant relocation costs >$10m
Ecology Offsets	Not Assessed	No significant offsets are required for site 2	Approx. $30m offset is required to mitigate the effects of clearing.
Utility Synergies	Not Assessed	Site 2 offers an opportunity for 'southern' development to the south of Jindabyne to offset some of the cost of the utilities. This will reduce the overall cost of the airport as some costs could be absorbed elsewhere.	Site 3 will require a dedicated trunk for Water and Sewerage from east Jindabyne. It is not expected that this will be able to be used by the majority of development to the south and west. This will increase the cost of the airport as none of the utilities costs can be absorbed elsewhere

Capital Costs – Summary Assessment

Criteria	Jindabyne (Site 1)	Jindabyne (Site 2)	Jindabyne (Site 3)
Earthworks	Not Assessed	$$$	$$$
Service Relocation	Not Assessed	Nil	Approx. $10m
Ecology Offsets	Not Assessed	Nil	Approx $30m
Utility Synergies	Not Assessed	Good Synergies with planning options	Minimal Synergies with planning options
Summary	Not Assessed	Lower	Higher

Commercial Capability



Commercial Capability

- As agreed in the meeting, at this stage, there is little discernible difference between sites from an airline or investor attractiveness perspective as this is linked to the broader demand profile for the region.
- Some broad commentary between sites 2 and 3 has been provided to assist state with decision making.
- Requires input from the broader SAP team to highlight other investment opportunity and catalyst infrastructure around each of the sites

Commercial Capability

Criteria	Jindabyne (Site 2)	Jindabyne (Site 3)
Cooma Linkages	Site 2 is too far from Cooma to offer any advantage to going via Canberra. This may impact on patronage but will need to be tested	Site 3 is closer to Cooma and may attract some local residents. This could increase patronage and offer some competition to Canberra.
Distance to SnowFields	Site 2 is closer to the snowfields and may offer a more attractive opportunity for people to fly. This could have a positive impact on patronage but it is not expected to be significant.	Site 3 is further from the snowfields and may not be as competitive as site 2. This could have in impact on patronage but it is not expected to be significant.
Development Considerations	Site 2 provides a hub that offers an investment and development opportunity to invest around that is closer to the snowfields. There may be some impact to residential development to the south of Jindabyne as people may not want to live near an airport.	Site three does not significantly impact the development areas of the SAP.

Appendix E

Aeronautical Report

AIR TRAFFIC SOLUTIONS

FOR EXCEPTIONAL AIR TRAFFIC MANAGEMENT

Snowy Mountains SAP Aeronautical Study

Version 0.2

Version prepared by:
Mike Lockwood-Air Traffic Solutions
Version approved by:

Document Change History

Version	Valid From	Details
0.1	23rd July 2020	Initial draft-pre site selection
0.2	22nd September 2020	Updates to initial draft incorporating feedback and extra information

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1 Executive Summary

Air Traffic Solutions (ATS) has been engaged by Arup on behalf of the NSW Department of Planning, Industry and Environment (DPIE) to conduct an Aeronautical Study regarding a NSW Government initiative to facilitate job creation and economic activity, the Special Activation Precincts (SAP) program. The SAP includes options for a new or re-developed airport in the Jindabyne vicinity.

This Aeronautical Study will support assessment by the regulator of any airspace changes required.

2 Introduction

The regulation of airspace in Australia is the responsibility of the Office of Airspace Regulation (OAR) which sits within the Civil Aviation Safety Authority (CASA). The OAR is responsible for administering the Australian airspace architecture under the Airspace Act 2007 and the Airspace Regulations 2007.

The administration of the airspace includes managing the establishment, amendment or disestablishment of:

- Various classes of airspace (A to G)
- Air routes
- Prohibited, restricted or danger areas

All of which have their own associated conditions and rules of use.

The various classes of airspace and PRD areas have defined volumes and boundaries that can be changed. Air routes are not volumes of airspace and their locations are defined by co-ordinates.

2.1 Purpose

The purpose of this study is to identify potential airspace and infrastructure changes that may be required to be made as a result of the new airport to support the Snowy Mountains SAP project.

2.2 Scope

The scope of this study includes assessment of:

- Aerodrome selection/changes
- Airspace considerations
- Air Traffic Management (ATM) requirements
- Communications, Navigation and Surveillance (CNS)
- PANS-OPS requirements

- Environment (noise)
- Obstacle Limitation Surfaces (OLS) impacts

3 Background

On 15th November 2019, the NSW Government announced its commitment to investigating the Snowy Mountains SAP, to revitalise the Snowy Mountains into a year-round destination and Australia's Alpine Capital, with Jindabyne at its heart. The Jindabyne SAP is shown below.

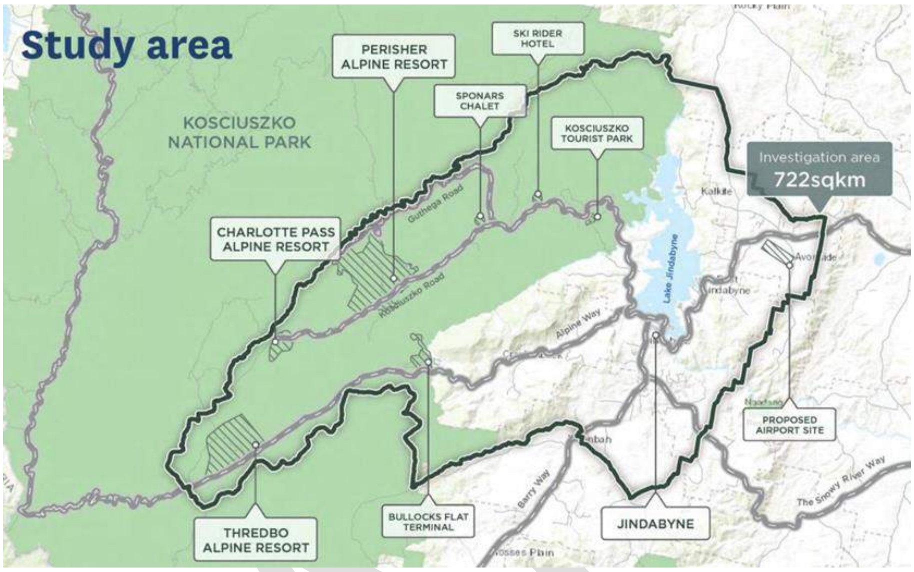


Figure 1: Snowy Mountains SAP Study Area

There are several separate streams to be implemented as a part of the SAP, this study relates to the Airport Stream.

3.1 Airport Requirements

Based upon previous studies and reports, the following assumptions were made in determining the airfield requirements for the new runway.

- Aircraft performance related to site conditions and loading (temperature, altitude, payload, runway slope)
  - Altitude– 950m
  - Temperature – 26.7°C
  - Payload – Allow commercially applicable payloads to de carried
  - Slope – 0%
- Indicative fleet mix (current fleet and known future changes to fleet)
  - Turboprops for initial stages of the airport until the demand increases to allow commercial viability for the jets to be put into service (i.e. Dash 8 (Q400), Saab 340)
  - Code 4C jet aircraft for the ultimate solution (i.e. 737-700, 737- 800, A320-200, B737MAX, A320NEO, A220 & A321XLRs)

- Code E are not likely to fly to Snowy Mountains as the region is too small to justify the investment and large capacity step.

- Range/destinations. Category A (Sydney, Melbourne, Adelaide and Brisbane) minimum destinations, preference for Category B (Perth and Darwin, and NZ) destinations and potential ability to reach Category C (Jakarta, Indonesia) destination subject to demand.

In summary, to enable Code C to be able to fly to Category A destinations, a 2000 m runway length was recommended. For Turboprops 1,900m was recommended.

Incorporating a new fleet mix that are more likely to fly into the Snowy Mountains region (A320NEO, B737MAX, A220, A321NEO/XLR) to cover Category B destinations a 2,300m runway is advised; although if Category A only is chosen runway could be limited to 2,000m. Currently data for A321XLR; although was added as from published data could make it to China; but with altitude of Snowy Mountains length of runway could potentially be approx. 3,500- 4,500 (considering A321NEO data). A runway of such length would likely result in a negligible return in investment and for such destination; transferring through Sydney/ Melbourne is more appropriate

Figure 2: Code C Ranges from Snowy Mountains Region

Aircraft	370NM	500NM	1070NM	1750NM	3000NM
A220	1700	1700	1900	2200	*Not able to obtain 85% payload*
ERJ175	1500	1600	2100	2600	*Not able to obtain 85% payload*
ERJ195	1600	1700	2100	2700	*Not able to obtain 85% payload*
E195-E2	1500	1600	1700	2000	*Not able to obtain 85% payload*
B737-700	1500	1600	1600	1800	*Not able to obtain 85% payload*
B737-800W	2000	2000	2300	2600	*Not able to obtain 85% payload*
B737-8MAX	1700	1700	1900	2100	2600
A320-232	1700	1800	1900	2200	*Not able to obtain 85% payload*

Table 1: Required RWY Length Jet Aircraft

Aircraft	Runway length required to achieve > 85% payload		
	370NM (Melbourne, Sydney)	**500 NM (Adelaide)**	**1070 NM (Brisbane)**
ATR 72-501	1,500m	1,6000m	*Not able to obtain 85% payload*
DHC-8-402	1,900m	2,000m	2,200m
Saab 340B	1,450m	1,600m	*Not able to obtain 85% payload*

Table 2: Required RWY Length Turboprop Aircraft

3.2 Airport Options

The Airport Stream is focused on looking to remove the ‘slow access to the region’ by investigating the potential for four alternative airport development sites to accommodate Regular Public Transport (RPT) jet aircraft operations. These options include upgrading the existing Cooma Snowy Mountains Airport (COM) or construction of an entirely new Jindabyne (JIN) Airport in three potential locations as shown below.

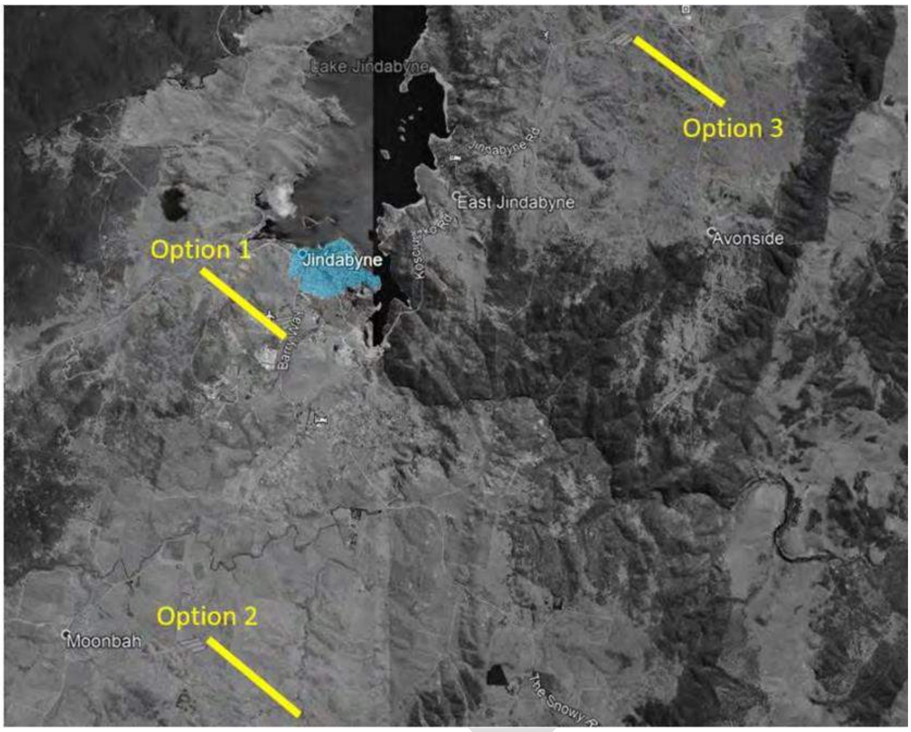


Figure 3: Jindabyne Airport Location Options

The existing Cooma-Snowy Mountains Airport, shown below is also being considered in the initial planning for re-development to allow jet operations.

Figure 4: Cooma-Snowy Mountains Airport[1]

3.3 Airport Selected

Following initial studies and reports, in September, Option 3 has been decided upon by the DPIE as the preferred site for the Snowy Mountains SAP Airport. The runway length for Day One operations will be 2000 m, oriented 12/30 with a 2300 m runway length protected for a potential future expansion.

[1] Source: Google Maps

4 Aerodrome

As Option 3 is a greenfields airport, the following areas should be considered as being required to meet the operational capability requirements for Day One operations.

4.1 Aerodrome Ground Lighting

Aerodrome ground lighting (AGL) supports the operations of aircraft in the vicinity of an aerodrome during hours of darkness, poor visibility or inclement weather. The Manual Of Standards (MOS) Part 139 details the requirements for aerodrome lighting.

For the purposes of the SAP Airport, aerodrome lighting meeting the minimum requirements for a non-precision instrument approach shall be installed.

4.2 Runway/Taxiway Lighting

To meet the requirements for RPT aircraft, the SAP Aerodrome must have as a minimum runway and taxiway lighting meeting MOS139 requirements. In addition, unless standby power or portable lighting is available, any aircraft wishing to land at night must plan to fly to an alternate aerodrome in the event of a power failure.

Pilot Activated Lighting (PAL) should be provided to allow for unattended night-time operations to be conducted.

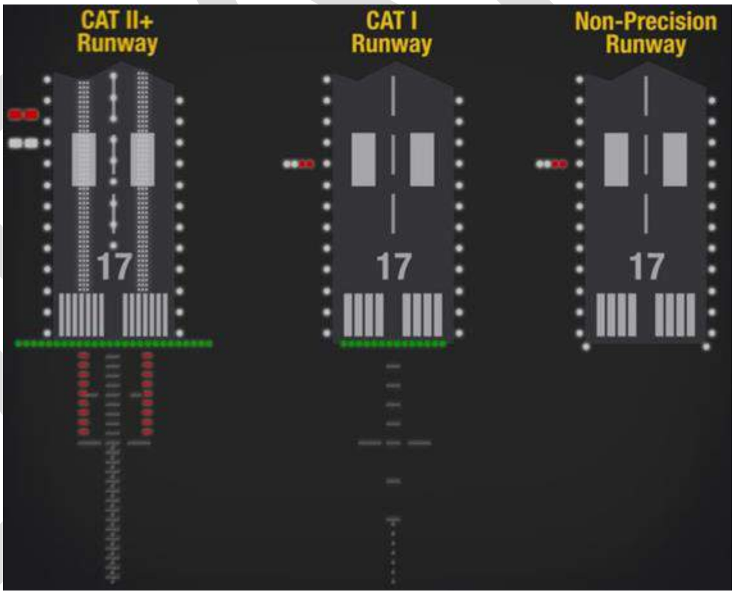


Figure 5: Examples of Runway Lighting Types

4.3 Approach Lighting

Visual glideslope assistance via a Precision Approach Path Indicator (PAPI) will be required for RPT operations. In addition, it is recommended to install a Runway Threshold Identification Lighting (RTIL) system to support approaches in lower visibility. RTIL are strobe lights at either side of the runway threshold that can assist in identification of the runway once becoming visual on an instrument approach.

Figure 6: PAPI

Although not required for Day One operations, provision for and protection of areas to support a CATI future lighting upgrade should allowed for. If CATI lighting was to be installed and commissioned, there would be potential extra CAPEX required for Airport Lighting Equipment Room (ALER) upgrades to support the switch over times necessary.

4.4 Other Lighting Issues

Other lighting to be considered includes:

- Apron lighting
- Obstruction lighting
- Existing lighting that may impact upon safe operations (eg existing street lights etc)

4.5 RPT Apron Parking

The RPT Apron will be a security restricted area, and ideally should be located separately to any other airport apron facilities.

RPT parking should be power in/out to minimise ground infrastructure requirements.

4.6 GA/Other Parking

Consideration will need to be made for a separate GA type apron facility. This will cater for any on airport operators (eg parachuting, scenic flights, helicopters) as well as itinerant aircraft. There will be significant potential for business jet and high performance turboprop charter aircraft operations, and these should be planned for.

Consideration should be given to providing a separate facility to support RFS Aerial Firefighting aircraft, including parking, refuelling and water/retardant resupply. Given the increase in size of these aircraft, allowance should be considered on this apron to cater for at least one B737 aircraft as well as additional aerial firefighting aircraft.

4.7 Helicopters

To support potential helicopter movements, a dedicated helipad outside of the runway strip should be established. This will facilitate simultaneous fixed wing and helicopter movements.

4.8 Other

In line with the move towards "greener" aviation activities, consideration should be given to providing electrical ground power and conditioned air to remove the requirements for aircraft Auxiliary Power Units (APU) to need to run continuously during ground stops.

5 Airspace

The International Civil Aviation Organisation (ICAO) specifies seven classes of airspace for use worldwide. Australian airspace is classified in accordance with the Australian Airspace Policy Statement (AAPS) which details seven classes of airspace available for use.

5.1 Australian Airspace Classes

The five classes of airspace currently utilised in Australian administered airspace are shown in the table below:

Class	Service
A	This high-level en route controlled airspace is used predominately by commercial and passenger jets. Only IFR flights are permitted and they require an ATC clearance. All flights are provided with an air traffic control service and are positively separated from each other.
C	This is the controlled airspace surrounding major airports. Both IFR and VFR flights are permitted and must communicate with air traffic control. IFR aircraft are positively separated from both IFR and VFR aircraft. VFR aircraft are provided traffic information on other VFR aircraft.
D	This is the controlled airspace that surrounds general aviation and regional airports equipped with a control tower. All flights require ATC clearance.
E	This mid-level en route controlled airspace is open to both IFR and VFR aircraft. IFR flights are required to communicate with ATC and must request ATC clearance.
G	This airspace is uncontrolled. Both IFR and VFR aircraft are permitted and neither require ATC clearance.

Table 3: Australian Airspace Classes

5.2 Design of Airspace

Airspace is designated a class to provide risk protection based upon traffic levels, type, and risk modelling. A profile view (shown below) of airspace is often referred to as an "upside down wedding cake". This vertical profile is designed to keep aircraft climb and descent profiles contained withing the prescribed class of airspace.

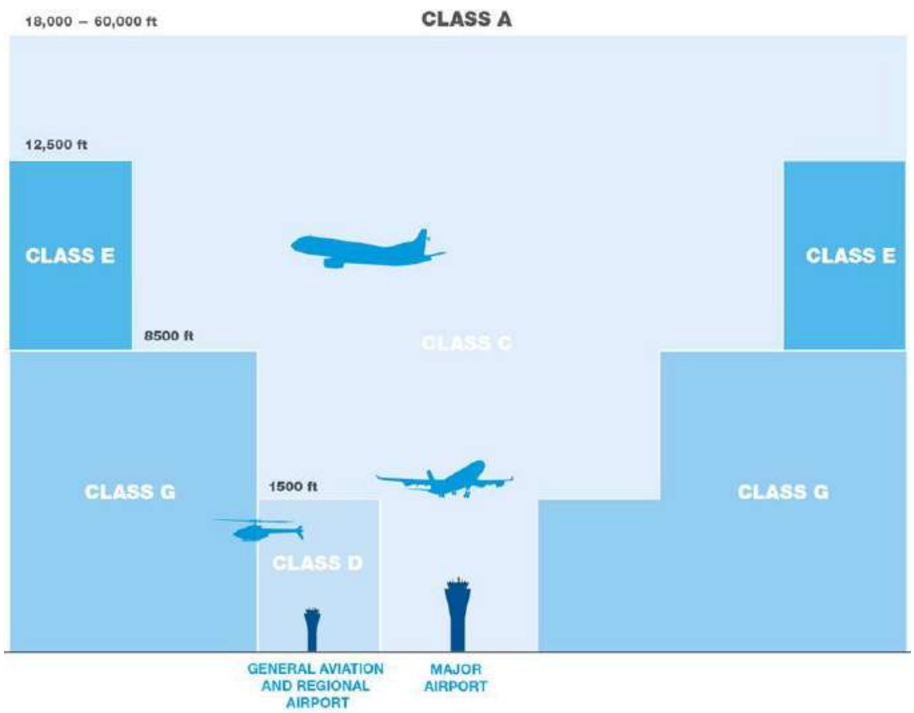


Figure 7: Australian Airspace Classes Profile View[2]

5.3 Current Snowy Mountains Airspace

The airspace in the Snowy Mountains SAP investigation area is Class G airspace. This classification is based upon the low density of traffic currently operating within the area.

5.3.1 Low Level Air Routes

The figure below shows the approximate area of the SAP highlighted. The white areas surrounding the SAP are Class G airspace up to Flight Level (FL) 125, Class E airspace between FL125 and FL245, with Class A airspace above.

The blue shaded areas to the north of the SAP are the busier Class C airspace steps between Melbourne, Albury, Canberra and Sydney.

The figure below also shows the existing low level air routes into COM Airport. These air routes form part of the Backup Navigation Network (BNN) and as such, it is highly unlikely that they will be amended as part of this project.

As a rule, routes within Class G airspace are more flexible and can be more “ad hoc” to meet the needs of General Aviation (GA) and other users.

[2] Source: Airservices Australia

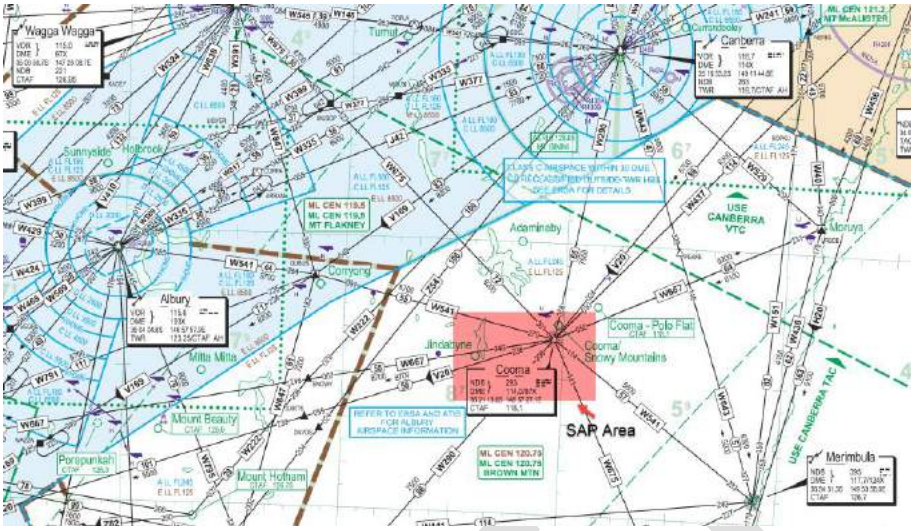


Figure 8: Low Level Air Routes Surrounding Snowy Mountains SAP[3]

5.3.2 High Level Air Routes

The SAP area is just to the south of the high level air routes between Sydney (SYD) and Melbourne (MEL). The SYD-MEL city pairing is consistently one of the busiest city pair air routes in the world.

The figure below shows the SYD-MEL route in red, and the MEL-SYD route in green. These air routes are set up in “racetrack” patterns between major city pairs to avoid head to head and crossing traffic as much as possible.

[3] Source: ERC L2

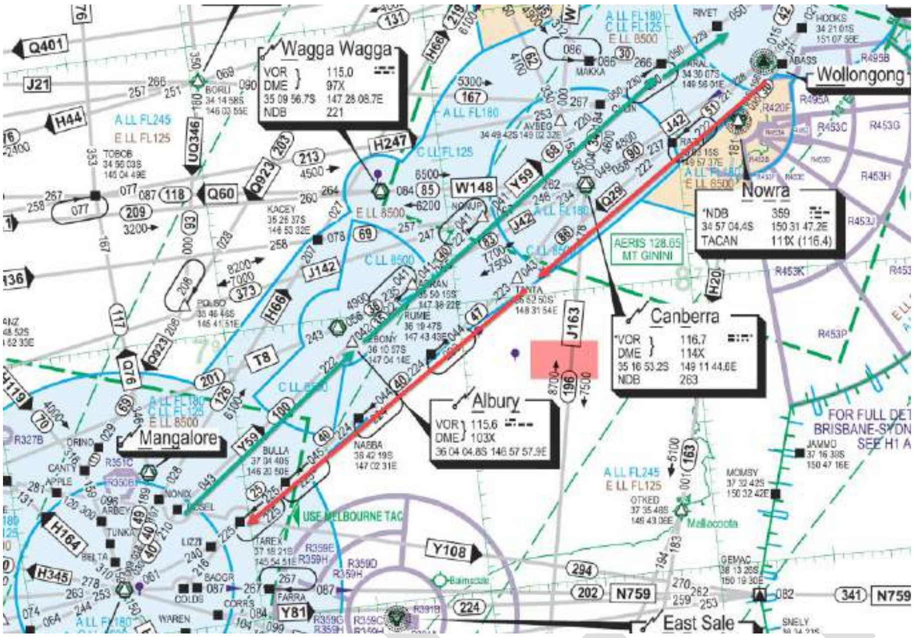


Figure 9: Sydney-Melbourne Routes[4]

High level air routes are very structured, and operations by jet aircraft into and out of JIN would be expected to flight plan via established, published routes. As the proponent of any changes to air routes, the SAP Project would be required to submit an [Airspace Change Proposal](#) (ACP) to OAR for establishment of new routes. Figure 8 below, shows potential routes for aircraft flying to JIN to or from SYD and MEL. The red arrows show the potential routes in and out of JIN for SYD and Brisbane (BNE) aircraft, whilst the green arrows indicate potential routes for MEL traffic. It is likely that Adelaide (ADL) traffic would simply fly the same routes as MEL aircraft.

4 Source: ERC H3

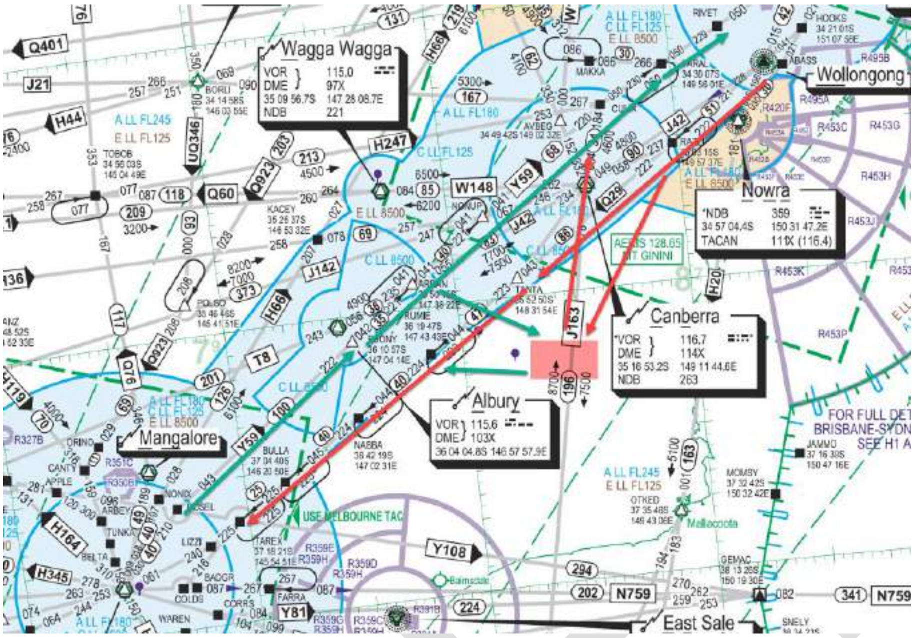
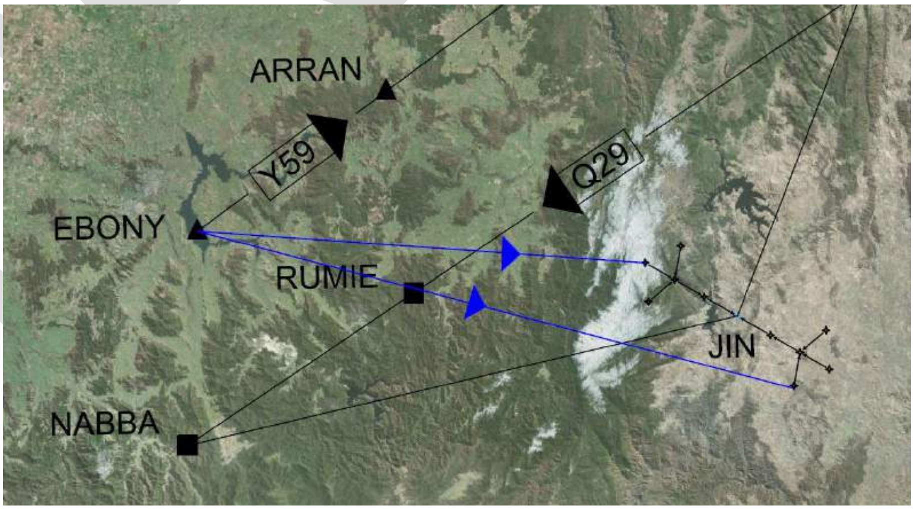


Figure 10: Potential Air Routes to Snowy Mountains SAP[5]

5.3.3 Potential Arrival Routes from the South

The MEL to JIN route will introduce some complexities for ATC, as the aircraft will be crossing the inbound route to MEL when they turn towards JIN. These are not insurmountable but will require liaison with ATC to ensure acceptable levels of safety are maintained.

The descent profiles of these aircraft should be such that conflictions with Q29 traffic to Melbourne are minimal.



[5] Source: ERC H3

Figure 11: Potential Arrival Routes South[6]

5.3.4 Potential Arrival Routes from the North

Arrivals from Brisbane and Sydney could leave the existing high level route Q29 at RAZZI and track direct to the IAF for either RWY 12 or 30.

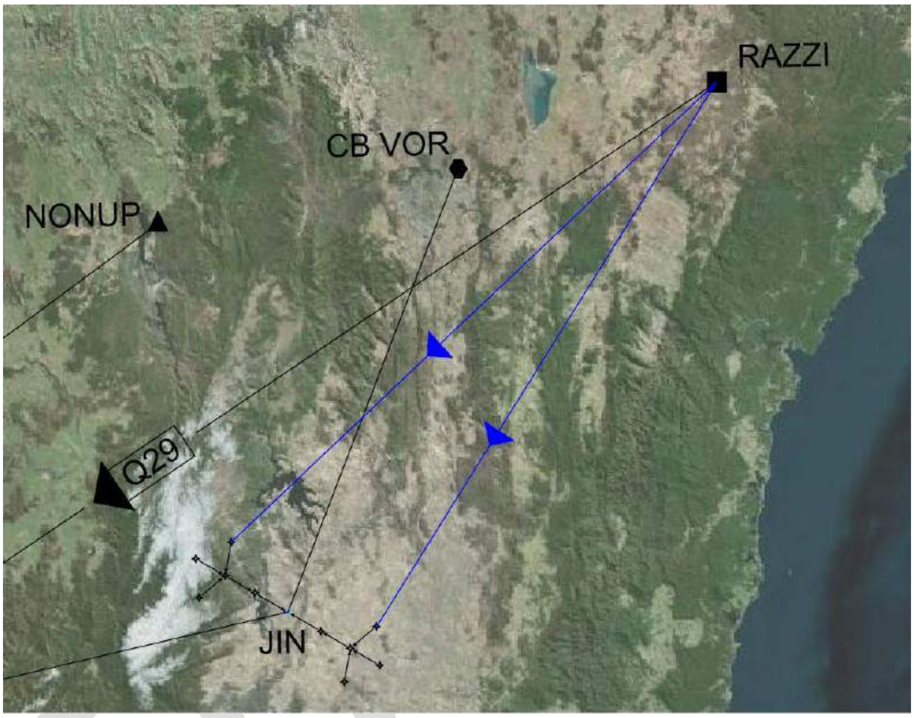


Figure 12: Potential Arrival Routes North[7]

5.3.5 Potential Departure Routes to the South

Departures from JIN could join the existing arrival route into Melbourne at NABBA, which conveniently has a holding pattern should the aircraft need to be delayed to fit into the arrival stream.

Due to high terrain immediately west of JIN, some variance to the proposed tracks may be required.

[6] Source: ATS
[7] Source: ATS

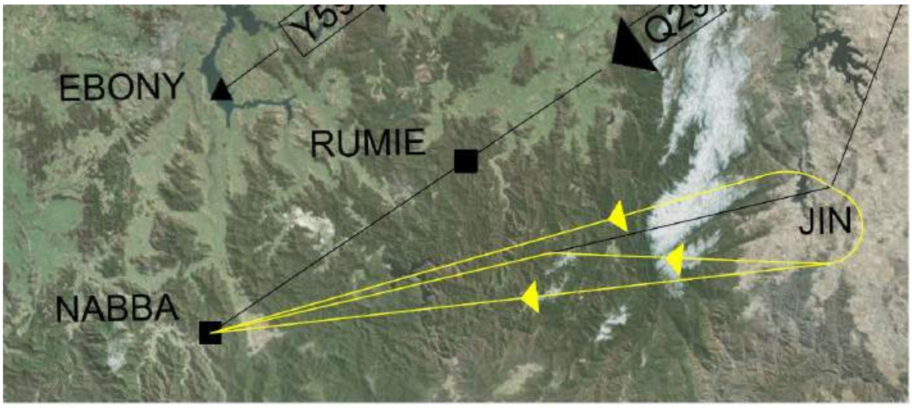
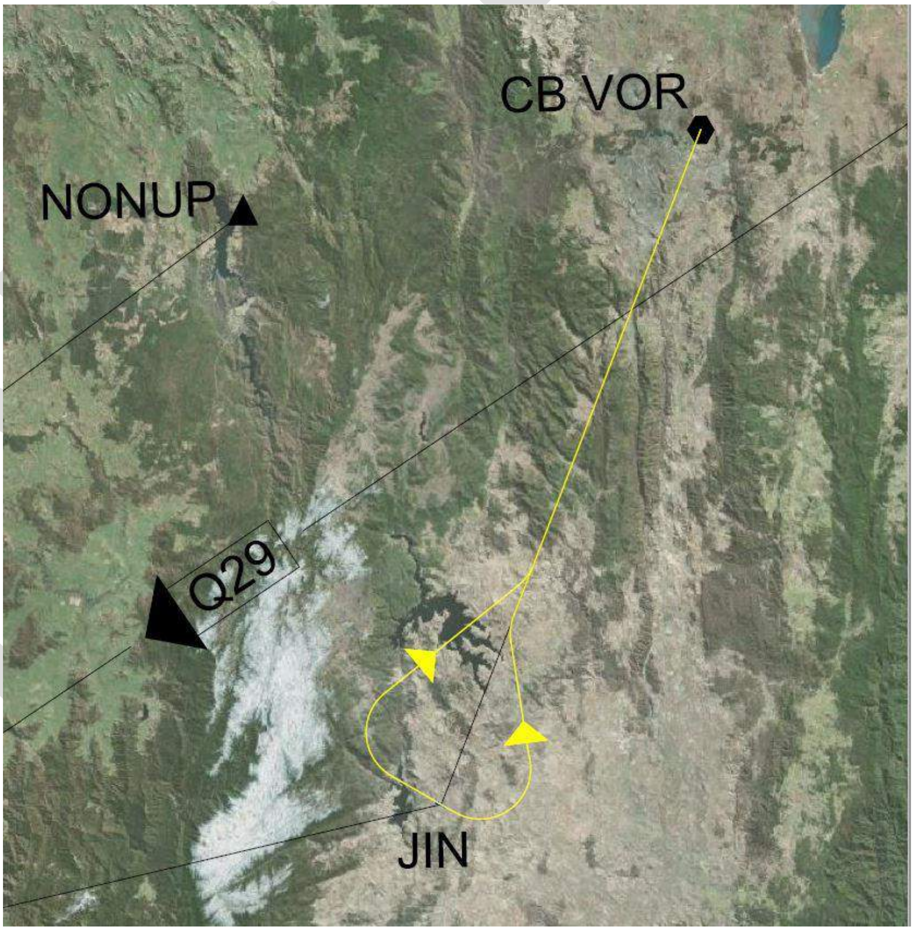


Figure 13: Potential Departure Routes South[8]

5.3.6 Potential Departure Routes to the North

Departures for Brisbane and Sydney could join the high level route structure at Canberra, the crossing of Q29 should not present significant issues for ATC as departing JIN traffic should be well below the levels of other traffic.



[8] Source: ATS

Figure 14: Potential Departure Routes North[9]

5.4 Class of Airspace

Given the projected traffic levels and aircraft type mix, it is not expected that any change to the class of airspace in the SAP will be required for initial operations. Discussions with CASA OAR have indicated that collision risk modelling is not required for the expected initial traffic levels.

5.5 Other Local Aviation Activities

There is potential for other aviation activities, such as parachuting, scenic flights etc to wish to operate from JIN if tourism development reaches a point to sustain such operations. If these activities commenced operation, the JIN operator would be required to determine any impact upon airspace and operations and liaise with OAR for any potential changes to airspace.

5.6 Existing Aviation Activities

There are existing activities within the SAP that may have an impact upon Regular Public Transport (RPT) flights into and out of JIN.

The Canberra Gliding Club holds an annual Wave Camp based out of Bunyan Airfield every year. This activity involves a high number of gliders operating at high altitude inside a Temporary Danger Area (TDA) established both inside and outside of Class A and E airspace. Whilst these types of activities do not preclude RPT operations into or out of JIN, it can be expected that input will be received from existing users of the airspace in the SAP to ensure that existing access is not unduly restricted by airspace changes. Figure 9 below shows the TDA.

It is the role of the OAR to arbitrate on any conflicting airspace requirements.

[9] Source: ATS

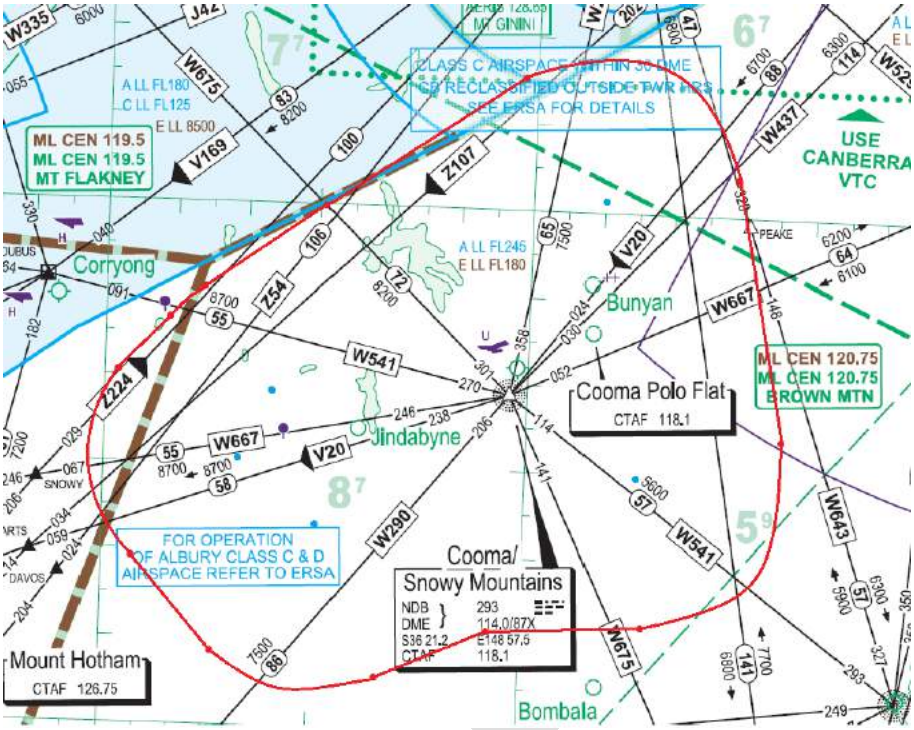


Figure 15: Bunyan Wave Camp Danger Area[10]

[10] Source: CASA OAR

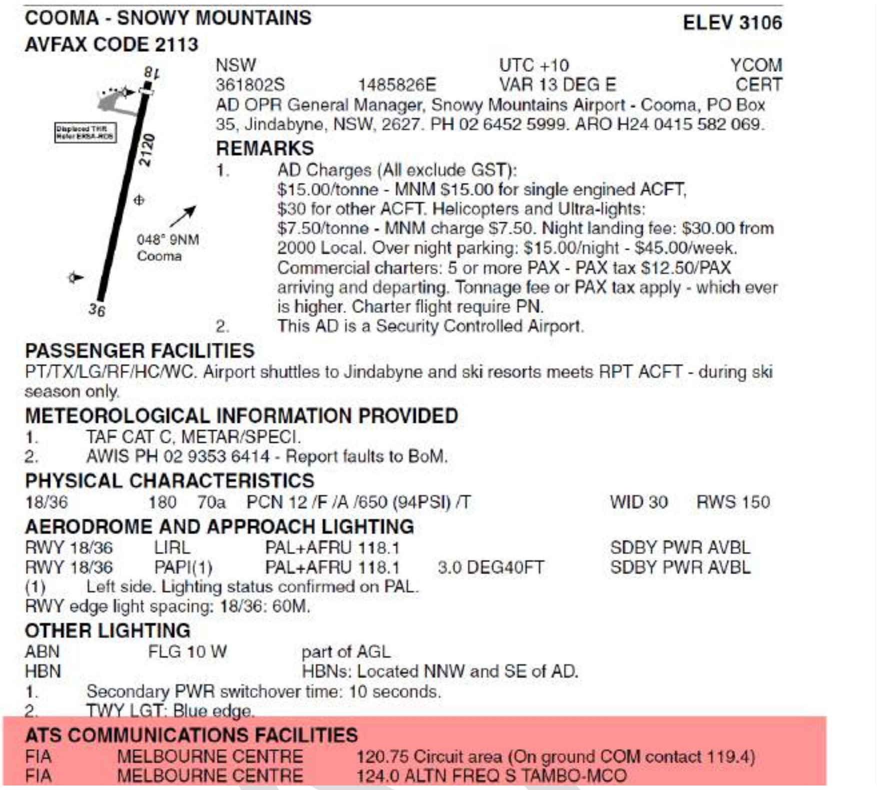
6 Communications, Navigation and Surveillance

Communications, Navigation and Surveillance (CNS) refer to the infrastructure supporting the safe operations of aircraft. CNS is established to ensure that ATC and other services can provide the required services necessary to ensure the safety of aircraft operations. The CNS facilities provided can vary depending on numerous factors, which can include:

- Type of traffic
    - Eg RPT, GA etc
- Density of traffic
- Class of airspace
- Mandated regulatory requirements

6.1 Radio Communications

The primary means of voice communications for ATC operations over continental Australia is Very High Frequency (VHF) radio communications. ASA has an established network of VHF ground stations with a duplicated network connecting these radios back to the applicable ATC facility. The frequencies available at an aerodrome are listed in the Aeronautical Information Publication (AIP) and En-Route Supplement Australia (ERSA), existing facilities for COM are shown below.


COOMA - SNOWY MOUNTAINS ELEV 3106
AVFAX CODE 2113

NSW UTC +10 YCOM
361802S 1485826E VAR 13 DEG E CERT
AD OPR General Manager, Snowy Mountains Airport - Cooma, PO Box 35, Jindabyne, NSW, 2627. PH 02 6452 5999. ARO H24 0415 582 069.

REMARKS
1. AD Charges (All exclude GST):
$15.00/tonne - MNM $15.00 for single engined ACFT,
$30 for other ACFT. Helicopters and Ultra-lights:
$7.50/tonne - MNM charge $7.50. Night landing fee: $30.00 from 2000 Local. Over night parking: $15.00/night - $45.00/week.
Commercial charters: 5 or more PAX - PAX tax $12.50/PAX arriving and departing. Tonnage fee or PAX tax apply - which ever is higher. Charter flight require PN.
2. This AD is a Security Controlled Airport.

PASSENGER FACILITIES
PT/TX/LG/RF/HC/WC. Airport shuttles to Jindabyne and ski resorts meets RPT ACFT - during ski season only.

METEOROLOGICAL INFORMATION PROVIDED
1. TAF CAT C, METAR/SPECI.
2. AWIS PH 02 9353 6414 - Report faults to BoM.

PHYSICAL CHARACTERISTICS
18/36 180 70a PCN 12 /F /A /650 (94PSI) /T WID 30 RWS 150

AERODROME AND APPROACH LIGHTING
RWY 18/36 LIRL PAL+AFRU 118.1 SDBY PWR AVBL
RWY 18/36 PAPI(1) PAL+AFRU 118.1 3.0 DEG40FT SDBY PWR AVBL
(1) Left side. Lighting status confirmed on PAL.
RWY edge light spacing: 18/36: 60M.

OTHER LIGHTING
ABN FLG 10 W part of AGL
HBN HBNs: Located NNW and SE of AD.
1. Secondary PWR switchover time: 10 seconds.
2. TWY LGT: Blue edge.

ATS COMMUNICATIONS FACILITIES
FIA MELBOURNE CENTRE 120.75 Circuit area (On ground COM contact 119.4)
FIA MELBOURNE CENTRE 124.0 ALTN FREQ S TAMBO-MCO

Figure 16: COM Aerodrome ERSA Extract[11]

The coverage (areas where radio communications are available) are shown on the Planning Chart Australia (PCA) shown below.

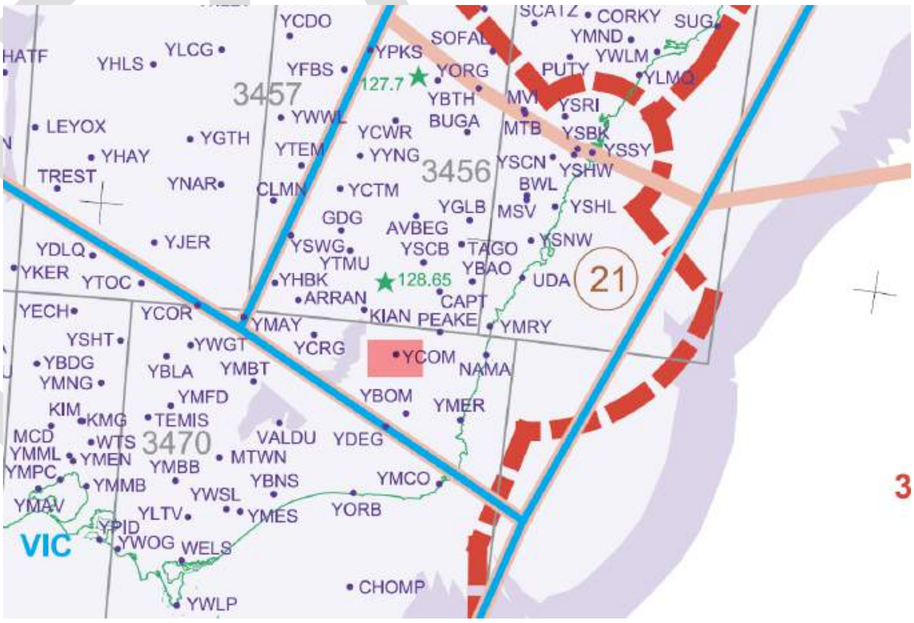


Figure 17: PCA Coverage COM Area[12]

[11] Source: ERSA
[12] Source PCA

The ATC facility and area serviced by these frequencies are also shown in ERSA

AIP Australia 21 MAY 2020 FAC M - 20

ACC/FIA	MELBOURNE CENTRE	134.65	Griffith Area
ACC/FIA	MELBOURNE CENTRE	135.25	Parkes/Orange/Katoomba area
ACC/FIA	MELBOURNE CENTRE	135.45	Bordertown area
FIA	MELBOURNE CENTRE	118.95	50-100NM N of Adelaide and 36-90NM to the West
FIA	MELBOURNE CENTRE	119.4	Cooma area
FIA	MELBOURNE CENTRE	120.3	36-80NM SE Perth
FIA	MELBOURNE CENTRE	121.2	Geraldton, Goulburn/Nowra area and over water E of Nowra BLW FL245
FIA	MELBOURNE CENTRE	122.4	Mangalore/Strathbogie area
FIA	MELBOURNE CENTRE	123.4	Merredin area
FIA	MELBOURNE CENTRE	123.9	Albany area
FIA	MELBOURNE CENTRE	124.8	Mt Singleton area
FIA	MELBOURNE CENTRE	124.9	Bunbury & Cobar-Wilcannia areas
FIA	MELBOURNE CENTRE	125.4	Tarin Rock area
FIA	MELBOURNE CENTRE	135.7	Within 30NM ML & S/SE quadrant to 40NM ML
VOLMET	AUSTRALIA(1)	6676	

ACC/FIA	MELBOURNE CENTRE	120.7	Oodnadatta area / Devonport area
ACC/FIA	MELBOURNE CENTRE	120.75	Cooma - Moruya - Mallacoota area
ACC/FIA	MELBOURNE CENTRE	121.2	Leigh Creek
ACC/FIA	MELBOURNE CENTRE	121.85	Ayers Rock area

Figure 18: ATC Radio Allocation[13]

Instrument Flight Rules (IFR) aircraft are required to be in two-way communication with ATC at all stages of flight. RPT aircraft that operate to or from JIN will operate IFR. Where VHF communications are not available, aircraft utilise High Frequency (HF) radio communications. HF communications are unreliable and require a higher workload from both pilots and ATC to utilise.

Depending upon the location of the new JIN aerodrome, consideration may be required to installation by ASA of a new VHF transceiver, it is likely that the recovery of these costs may be requested against the aerodrome operator.

6.2 Automatic Weather Information

Aerodrome Weather Information Service (AWIS) and Weather and Terminal Information Reciter (WATIR). AWIS and WATIR provide actual weather conditions via telephone and/or radio broadcast at specified locations. AWIS provides information from the Automatic Weather Station (AWS) only. WATIR combines the AWS information with additional terminal information from the airport operator.

Basic AWS provide wind direction and speed, temperature, humidity, pressure setting and rainfall. Advanced AWS provide automated cloud and visibility information. Information provided in AWIS will contain some of the following:

- Message identifier 'AWS aerodrome weather'
- Station identifier as a plain language station name
- Wind direction in degrees magnetic and wind speed in knots
- Altimeter setting (qnh)
- Temperature in whole degrees celsius

[13] Source ERSA

- Cloud below 10,000 ft*
- Visibility*
- Dew point in whole degrees celsius
- Relative humidity
- Runway visual range at selected locations
- Rainfall over the previous ten minutes and
- Present weather information*
    - *Provided as guidance material only

Information broadcast from the AWS and WATIR is considered to be ‘real time’ data.

The integrity of the barometric system in BoM-accepted AWS is such that they are an approved source of QNH. Therefore, QNH from these AWS may be used in accordance with AIP to reduce the published minima for instrument arrival procedures, and the published landing, circling and alternate minima. The use of AWS data will also allow the use of Vertical Navigation (VNAV) approaches, resulting in a potential lower landing minimum for aircraft.

Siting requirements can be found here.

6.3 Aerodrome Frequency Response Unit

To assist pilots’ awareness of inadvertent selection of an incorrect VHF frequency when operating into non-controlled aerodromes, a device known as an aerodrome frequency response unit (AFRU) may be installed. An AFRU will provide an automatic response when pilots transmit on the CTAF for the aerodrome at which it is installed.

The features of the AFRU are as follows:

- When the aerodrome traffic frequency has not been used for the previous five minutes, the next transmission over two seconds long will cause a voice identification to be transmitted in response, for example: ‘Goulburn CTAF’.
- When the aerodrome traffic frequency has been used within the previous five minutes, a 300 millisecond tone will be generated after each transmission over two seconds long.
- A series of three microphone clicks within a period of five seconds will also cause the AFRU to transmit a voice identification for the particular aerodrome.

If the transmitter in the AFRU is jammed for a period of more than one minute, the unit will automatically shut down.

The AFRU improves safety by confirming the operation of the aircraft’s transmitter and receiver, the volume setting, and that the pilot has selected the correct frequency for use at that aerodrome.

6.4 Surveillance

ATC surveillance is provided by multiple sources of data, with the ATC ATM System integrating this data into a visual display of aircraft positions for the ATC operator.

Historically, surveillance was provided by both Primary (PSR) and Secondary Surveillance Radar (SSR). PSR can observe aircraft without any on board equipment but has a limited range and information display capability. SSR interrogates an onboard aircraft transponder and has a greater range and data display capability then PSR. ASA has a network of PSR and SSR established around Australia to support ATC service provision.

Surveillance allows ATC to observe and provide instructions to aircraft to assist with the safe operations of flight.

Historically surveillance was provided in areas of higher traffic density, with ATC services outside of surveillance areas being based upon aircraft radio position reports.

PSR and SSR surveillance has both a significant CAPEX and OPEX expense.

6.4.1 Automatic Dependant Surveillance-Broadcast

Automatic Dependant Surveillance-Broadcast (ADSB) utilise an aircraft's onboard GNSS and broadcasts position and other data information. Both on ground systems and appropriately equipped aircraft can receive this information and display it to an ATC or other pilot. Since 2016 carriage of ADSB equipment has been mandatory for all IFR aircraft, and there has been a significant uptake in this equipment installation for other aircraft.

ASA has a national network of ADSB ground stations that receive ADSB information and present it to ATC for use in surveillance services. Current low level ADSB coverage is shown in the diagram below. Exact coverage in the JIN area is unable to be determined at this stage, however it is unlikely that coverage to ground level would be available.

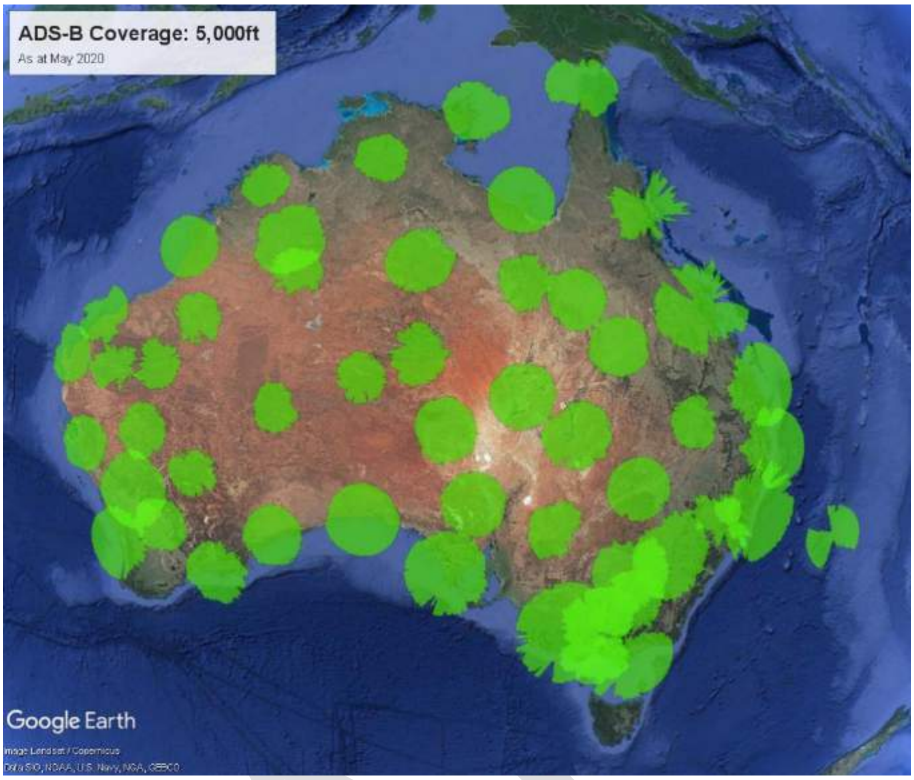


Figure 19: Low Level ADSB Coverage JIN Area[14]

Provision of an ADSB ground station at the new JIN aerodrome would be a potential mitigator to identified ATM issues as it would enable surveillance of ADSB equipped aircraft in the area by ATC.

6.4.2 Multi-Lateration

Multi-Lateration (MLAT) is a system that utilises a network of ground stations that triangulate aircraft transponder returns and enable display on ATC surveillance. As stated above, IFR aircraft are required to be ADSB equipped, however for Visual Flight Rules (VFR) aircraft this is not yet a requirement. Most VFR aircraft are equipped however with a transponder.

Provision of a MLAT system in the vicinity of the new JIN aerodrome would be a potential mitigator to identified ATM issues as it would enable surveillance of non ADSB equipped aircraft in the area by ATC if the aircraft was equipped with an operating transponder.

6.5 Current Australian Surveillance

ASA uses a combination of the above technologies to provide ATC surveillance services across Australia. The current surveillance coverage is shown below.

[14] Source: ASA website

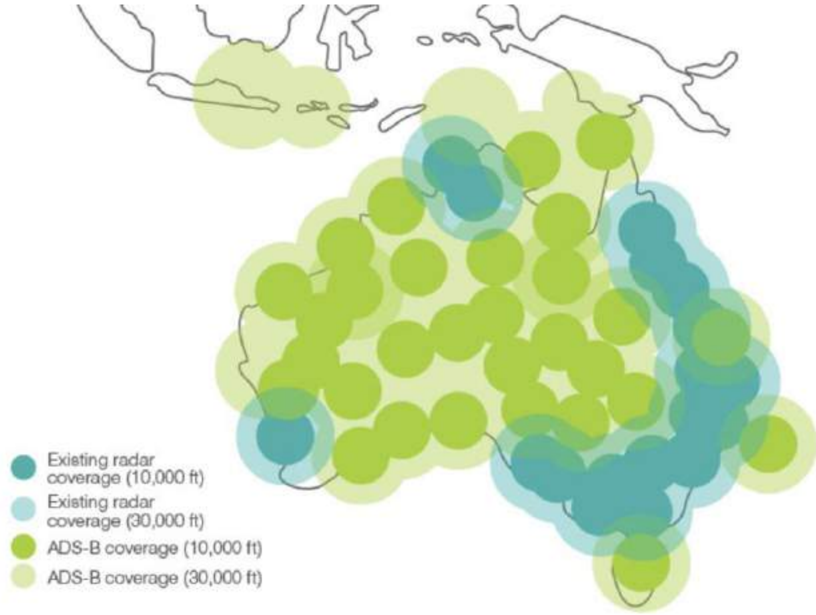


Figure 20: Australian Surveillance Coverage[15]

6.6 Terrestrial Navigation Aids

In 2016, Airservices (ASA) completed the Navigation Rationalisation Project. This project formed the basis of moving from a navigation system based upon the use of ground based navigational aids (NAVAIDS) to utilising GNSS as the primary means of navigation.

As such, there is no plan to install ground based NAVAIDS at JIN.

[15] Source: CASA website

7 Air Traffic Management

Air Traffic Management (ATM) is the process of ensuring a safe, efficient, and effective flow of air traffic, be it at an aerodrome, or in a volume of airspace. There are numerous methods of ensuring this flow, however all have risks and benefits, as well as considerable cost impacts. The simplest method is "self-announcing" by radio by pilots without any third party support. Various levels of ATM can be provided leading up to provision of a full Air Traffic Control (ATC) service. The overall aim is to ensure that the appropriate level of ATM is provided based upon risk modelling or other determinations are made that it is required to maintain safe levels of operation. The cost of providing ATC is significant, and under the financial model used in Australia, is passed onto the aircraft operator, and hence is added to the ticket cost for RPT. Establishment of ATC is not a requirement for RPT operations, and there are several airports where jet RPT operate without ATC services, eg Ayers Rock, Proserpine and Ballina-Byron Bay.

Shown below are the costs for a Qantas Boeing 737-800 aircraft for the provision of an ATC Tower at Broome Airport. These charges are passed onto passengers in the ticket price.

Charges:

	Terminal Nav	Rescue & Fire	En-route	Met Service	Total
Charges incl. GST	$1,184.27	$180.52	$1,116.97	$84.13	$2,565.89
GST	$107.66	$16.41	$101.54	$7.65	$233.26
Rates	$15.22	$2.32	$3.87	$0.265	

Figure 21: ASA ATC Charges[16]

7.1 Graduated Service Model

A graduated service model is one where the services for ATM provided are staged to meet the increases in traffic and hence maintain the risks at an acceptable level. Paragraphs 6.2-6.5 detail the levels of service that could be adopted to support operations at JIN. Apart from para 6.2, each of these alternatives comes at a cost, either borne directly by the aerodrome operator (6.3-4), or in a potential increase in ticket cost (para 6.5).

7.2 Common Traffic Advisory Frequency

The Common Traffic Advisory Frequency (CTAF) is the frequency on which pilots operating at a non-controlled aerodrome should make positional radio broadcasts. These frequencies are not normally monitored by ATS.

To achieve the greatest degree of safety, Civil Aviation Regulation (CAR) 166C requires pilots of aircraft carrying a serviceable radio which they are qualified to use, to make a

[16] Source: ASA website charges form

broadcast whenever it is reasonably necessary to do so to avoid a collision, or the risk of a collision, with another aircraft at a non-controlled aerodrome. In certain circumstances carriage of radio and being qualified to use it are mandatory.

7.3 UNICOM

Universal communications (UNICOM) is a non-ATS communications service to improve the information normally available about a non-controlled aerodrome.

The primary function of the frequency used for UNICOM services where the frequency is the CTAF is to give pilots the means to make standard positional broadcasts when operating in the vicinity of the aerodrome. Participation in UNICOM services must not inhibit the transmission of standard positional broadcasts.

7.4 Certified Air Ground Radio Service

A Certified Air/Ground Radio Service (CAGRS) is an aerodrome-based radio information service, which may operate at non-controlled aerodromes. The service provides pilots with operational information relevant to the aerodrome. The service is operated by or for the aerodrome operator within the published hours, on the CTAF assigned to the aerodrome. It is neither an Airservices Australia nor RAAF-provided air traffic service. The CAGRS does not provide any separation advice.

The callsign of the service is the aerodrome location followed by 'radio'; for example: 'Ballina Radio'. The radio operators of the service have been certified to meet a CASA standard of communication technique and aviation knowledge appropriate to the service being provided.

The CAGRS is provided to all aircraft operating within the designated broadcast area for the specific location. When a CAGRS is operating, pilot procedures are unchanged from the standard non-controlled operating and communication procedures. ERSA includes location-specific information related to procedures.

The CAGRS information helps pilots to make informed operational decisions. Pilots retain authority and responsibility for the acceptance and use of the information provided.

7.5 Air Traffic Control

ATC is a CASA regulated function, utilising licensed ATC's from an approved ATC facility. The role of ATC is to provide directions and instructions to aircraft to manage the flow of traffic.

Currently in Australia, there is a single Air Navigation Service Provider (ANSP) that provides ATC services at civilian aerodromes, Airservices Australia (ASA).

ATC at aerodromes such as JIN have traditionally been managed from ASA ATC Control Towers by locally based staff. These towers have a significant Capital and Operational

Expense (CAPEX and OPEX) associated with their operations, which is passed on to users in the form of air navigation charges.

In recent years, Digital Towers[17] have become more commonplace, and have the potential to utilise economies of scale to provide ATC services either at locations that potentially do not justify an "traditional" tower, or to provide services at a reduced cost at locations that require an ATC service. ASA is investigating the use of Digital Tower technology for future service delivery. Whilst it is not expected that an ATC service would be required for many years, this technology is the most likely that would be utilised.

The AAPS details the threshold criteria for changing the classification of a volume of airspace at an aerodrome. Current airspace classification in the JIN area is Class G. For there to be a review of airspace to change to Class D (ATC service), from Figure 12, it would require:

- Total annual movements of 80,000, or
- Total annual Passenger Transport Movements (PTO) of 15,000 or
- Total annual PTO passengers of 350,000

	Class B	Class C	Class D
Service provided	ATC	ATC	ATC
Total annual aircraft movements	750,000	400,000	80,000
Total annual PTO aircraft movements	250,000	30,000	15,000
Total annual PTO passengers	25 million	1 million	350,000

Figure 22: Airspace Review Criteria Thresholds[18]

The actual achievement of any of the trigger values above does not mandate a change of airspace classification, it requires an aeronautical risk review to determine if a change of class is required.

As an example, Ballina-Byron Bay Airport reached the trigger points listed above for an Aeronautical Review. One of the results of this review was that a CAGRS was established at Ballina as a means of mitigating identified risks associated with ATM. This resulted in the delay (and hence reduction in costs) of the potential establishment of an ATC service.

[17] ATC facility remote from aerodrome utilising video cameras
[18] Source: AAPS

7.6 Initial ATM Service

Based upon the best case scenario for Day 1 operations, utlising the criteria in Figure 12, neither the total annual movements nor PTO movements would be expected to exceed the trigger figures. As such, and based upon advice from CASA, an Aeronautical Risk review (collision risk modelling) is not required at this stage of the project.

JIN will be developed as a certified (or registered) airport, and as such, aircraft operating in the vicinity[19] must be radio equipped and broadcast their intentions. This is as per CTAF procedures (para 6.2).

Best practice from an aerodrome operator, in line with mitigating risk to As Low As Reasonably practical (ALARP) would be to install an Aerodrome Frequency Response Unit (AFRU) as a minimum, and to consider a UNICOM service to support RPT operations. Whilst neither of the above are mandated from a regulatory perspective, the addition of these two facilities helps to mitigate risks associated with CTAF operations.

[19] 10NM or at an altitude that may conflict with other traffic

8 Procedures for Air Navigation Services-Aircraft Operations

Procedures for Air Navigation Services-Aircraft Operations (PANS OPS) detail the methods in which instrument approaches can be designed to enable IFR aircraft to operate in inclement weather and be able to approach an aerodrome and land.

The requirements are detailed in ICAO DOC 8168 and the design of these approaches is regulated by MOS173.

To enable all weather operations, both day and night into JIN instrument approaches will be required to be designed and published for the aerodrome.

8.1 Existing Instrument Approaches In SAP

Currently COM Aerodrome, as part of the BNN, has terrestrial NAVAIDS located at it. COM has both a Non-Directional Beacon (NDB) as well as a Distance Measuring Equipment (DME). A NDB approach as well as a GNSS LNAV approach is published for COM.

The existing NDB approach for Runway (RWY) 36, shown below, allows descent by an aircraft to 3940' Above Mean Sea Level (AMSL), or height above the aerodrome of 853', and requires a visibility of 4.2 klms.

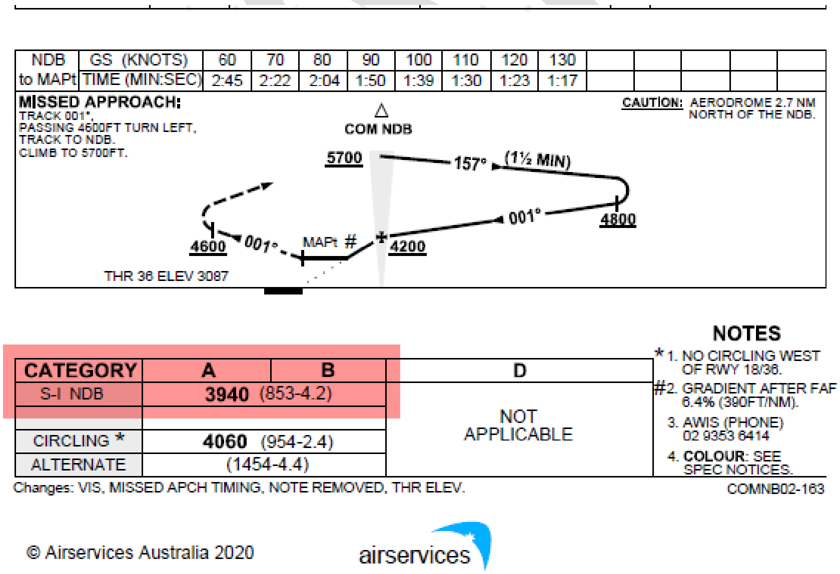


Figure 23: COM NDB RWY 36[20]

[20] Source: DAP

The corresponding GNSS LNAV approach allows descent by an aircraft to 3740’ AMSL, or height above the aerodrome of 653’ and a visibility of 3.7klms.

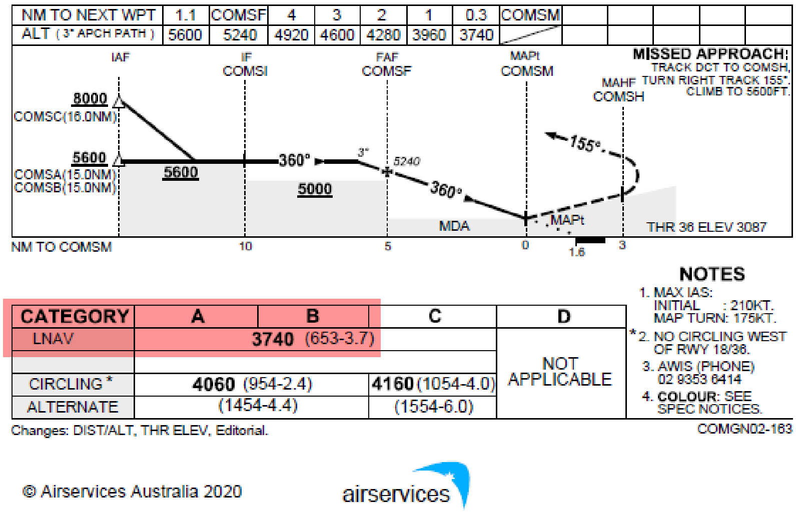


Figure 24: COM RNAV RWY 36 LNAV[21]

A VNAV capability for the GNSS approach into COM is not available to the lack of supporting ground infrastructure (AWIS).

8.2 Global Navigation Satellite Systems

Global Navigation Satellite System (GNSS) refers to a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. The receivers then use this data to determine location.

By definition, GNSS provides global coverage. Examples of GNSS include Europe’s Galileo, the USA’s NAVSTAR Global Positioning System (GPS), Russia’s Global'naya Navigatsionnaya Sputnikovaya Sistema (GLONASS) and China’s BeiDou Navigation Satellite System.

The performance of GNSS is assessed using four criteria:

1. Accuracy: the difference between a receiver’s measured and real position, speed or time;
2. Integrity: a system’s capacity to provide a threshold of confidence and, in the event of an anomaly in the positioning data, an alarm;
3. Continuity: a system’s ability to function without interruption;
4. Availability: the percentage of time a signal fulfils the above accuracy, integrity and continuity criteria[22]

IFR aircraft use GNSS in all phases of flight, with the required accuracy changing depending upon the type of operation, and phase of flight.

---

[21] Source: DAP

[22] Source: Europe GSA

8.3 Performance Based Navigation (PBN)

PBN approaches define a "family" of approaches that utilise the GNSS to provide the positional information required during an approach.

PBN captures both Area Navigation (RNAV) and Required Navigation Performance (RNP) capabilities.

More detailed information regarding PBN can be found here.

Approaches that are Non Precision Approach (NPA) or Approach with Vertical guidance (APV) labelled as RNAV GNSS approaches.

Approaches that are Authorisation Required (AR) are labelled RNAV RNP. RNAV RNP approaches are generally limited to higher performance aircraft such as business jets and airline aircraft.

The benefits of RNAV and RNP navigation are shown in the diagram below:

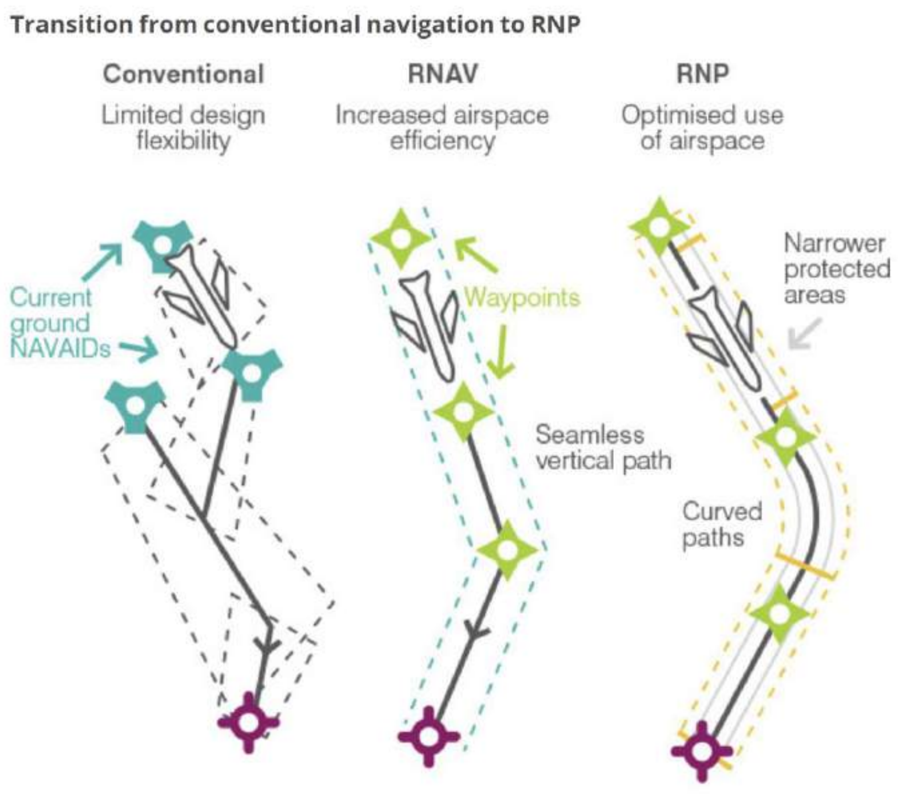


Figure 25: Transition from Conventional to RNP Navigation[23]

8.3.1 NPA-LNAV

LNAV refers to lateral (2D) guidance for a GNSS non-precision approach. An LNAV GNSS approach will get an IFR pilot on the correct lateral path, but the pilot must ensure that the aircraft is at the correct altitude (vertical path) at each fix. The aircraft must not descend below the minimum descent altitude (MDA) unless visual.

[23] Source: CASA

Some GNSS receivers (particularly Garmin models) are capable of displaying an advisory vertical profile. This is sometimes known as LNAV+V, and there are important difference between this and APV approaches.

With LNAV+V, the vertical component is generated by the receiver itself, rather than from a properly coded and validated underlying RNP APCH (RNAV GNSS) approved instrument approach procedure. The pilot must still respect stepdown fixes throughout the approach, and must also not descend below the LNAV MDA unless visual.

8.3.2 APV-LNAV/VNAV

Approaches with vertical guidance (3D approaches) offer a smooth and stabilised descent. They improve situational awareness and reduce workload. In Australia, APV-VNAV (LNAV/VNAV) is being rolled out in line with ICAO recommendations to establish safer approaches to landing.

LNAV/VNAV relies on highly accurate altimeter readings, which take account (among other things) both the aerodrome local QNH and temperature. Its use is also restricted to runways with a validated promulgated LNAV/VNAV RNP APCH instrument approach procedure.

The use of LNAV/VNAV also requires avionics including an air data computer—typically a certified flight management system (FMS) or other suitably certified area navigation system capable of computing barometric VNAV paths and showing relevant vertical deviations (within a range of plus or minus 75 feet) on the cockpit instrument navigation displays.

The addition of vertical guidance through LNAV/VNAV does not necessarily improve the landing minimums for a particular approach. However, in many cases, the landing minimums (i.e. the decision altitude, or DA, in the case of a LNAV/VNAV approach) is lower than that for a runway aligned LNAV approach (the MDA) at the same location.

8.3.3 Nominal RNAV GNSS Approach Option 3

Whilst not an exact representation of the final approach to be designed, the figure below shows an approximation of a RNAV approach that could be designed to support all weather operations into Jindabyne.

With appropriate ground equipment this approach could be designed as an APV-LNAV/VNAV approach.

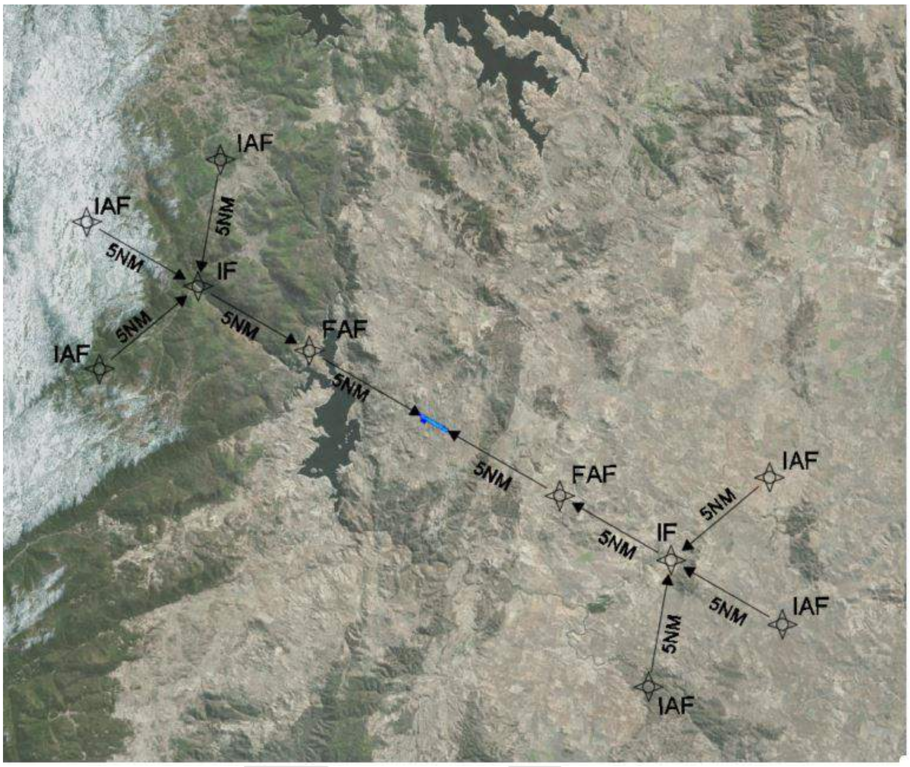


Figure 26: RNAV Approaches RWYs 12 and 30 Option 3[24]

[24] Source: ATS

8.3.4 Benefits of APV-LNAV/VNAV Approaches

The benefits of a LNAV/VNAV approach can be seen from the Mount Hotham (HOT) RNAV Z RWY 29 approach. By comparing both the LNAV/VNAV minimas (3.3% MAP with the LNAV only minima (3.3% MAP) the following can be observed.

For the LNAV/VNAV approach the aircraft can descend to 4700' AMSL, or height above the aerodrome of 471' and a visibility of 2.7km.

For the LNAV only approach the aircraft can descend to 4800' AMSL, or height above the aerodrome of 571' and a visibility of 3.2km.

By the inclusion of VNAV capability, an aircraft would still be able to land at HOT with the cloud base 100' lower and visibility 500m worse.

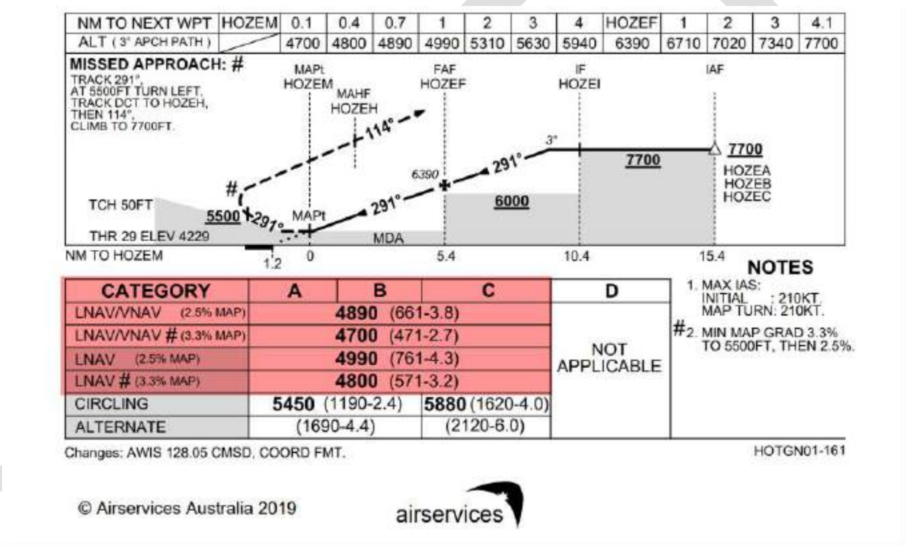


Figure 27: HOT RNAV Z RWY 29 Approach[25]

8.3.5 RNP-AR Approaches

Required navigation performance is a type of performance-based navigation that allows an aircraft to fly a specific path between two 3D-defined points in space. No additional ground infrastructure is required to support the potential benefits of an RNP-AR approach, the increased performance lies in both the aircraft navigational capabilities and the design of the approach. A RNP-AR approach could be designed and published for Option 3 with the same ground supporting infrastructure as required for an APV approach.

8.3.6 Benefits of RNP-AR Approach

Using an example of Brisbane Airport, the RNAV GNSS approach provides a minima of 430' and 2.3km visibility, shown below:

[25] Source: DAP

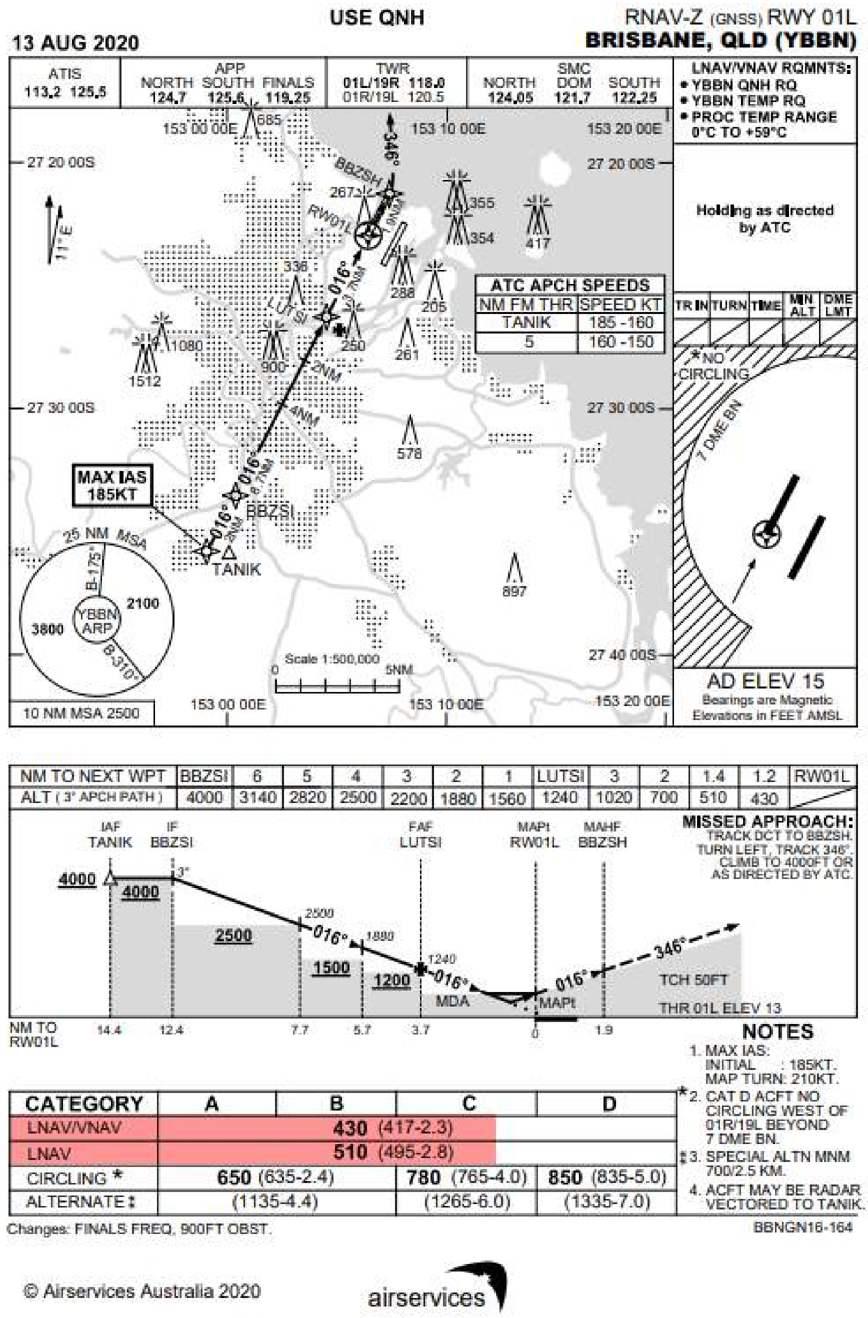


Figure 28: RWY 01L RNAV GNSS Approach[26]

The RNAV RNP approach to the same runway, provides for a lower minima of up to 280' and 1.5km visibility, shown below:

[26] Source: DAP

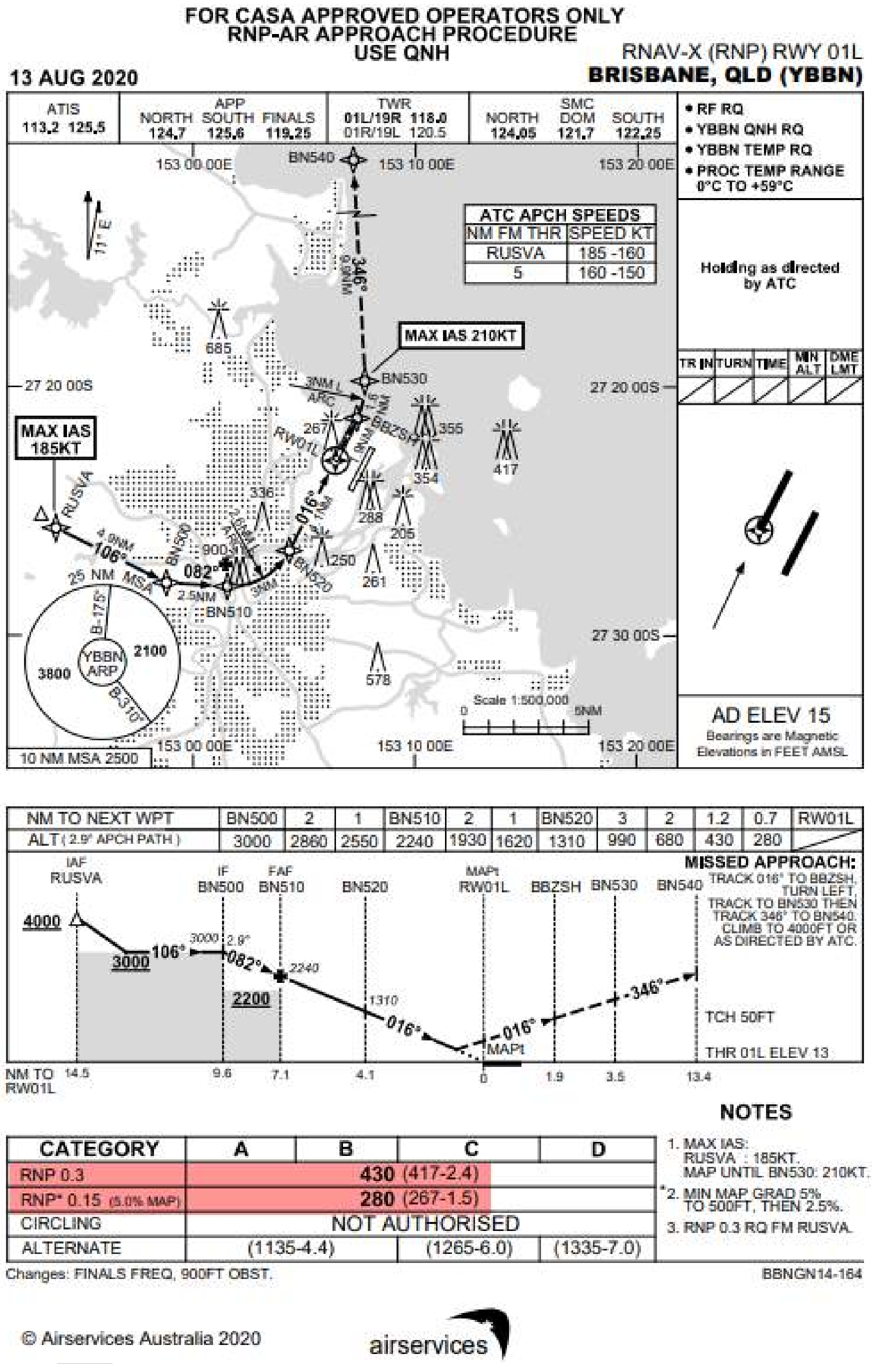


Figure 29: RWY 01L RNP AR Approach[27]

The landing minima provided by these approaches is close to that obtained by the use of a CATI ILS, at a fraction of the CAPEX required to install an ILS.

8.4 Ground Based Augmentation System

A Ground Based Augmentation System (GBAS) is one which provides differential corrections and integrity monitoring of Global Navigation Satellite Systems (Global Navigation Satellite System) data using as input data either three or four GNSS satellite

[27] Source: DAP

signals received at three of four antennae. The differential correction message computed from this data is then continually broadcast omni-directionally (twice every second) by a ground transmitter using a VHF frequency broadcast (VDB) which is effective within an approximate 23 nm radius of the host airport. GBAS is used primarily used to facilitate GNSS-based precision approaches which are more flexible in design than is possible with ILS. Whilst the main goal of GBAS is to provide signal integrity, it also increases signal accuracy, with demonstrated position errors of less than one meter in both the horizontal and vertical plane. One GBAS Ground Station at an airport supports aircraft approach and landing to multiple runway ends as well as departures from multiple runways and surface movement for all GBAS-equipped aircraft.[28]

A single GBAS installation can support up to 26 flight paths into multiple airports within a 42km radius.

It is expected that other time GBAS will mature to support up to CATIII landings for suitably equipped aircraft. Currently in Australia GBAS is approved to support CATI approaches.

Figure 30: GBAS Ground Infrastructure

8.5 Space Based Augmentation System

The performance of Global Navigation Satellite Systems (GNSS) can be improved by regional Satellite-Based Augmentation Systems (SBAS), such as the European Geostationary Navigation Overlay Service (EGNOS). SBAS improves the accuracy and reliability of GNSS information by correcting signal measurement errors and by providing information about the accuracy, integrity, continuity and availability of its signals.

[28] Source: Skybrary

SBAS uses GNSS measurements taken by accurately located reference stations deployed across an entire continent. All measured GNSS errors are transferred to a central computing centre, where differential corrections and integrity messages are calculated. These calculations are then broadcast over the covered area using geostationary satellites that serve as an augmentation, or overlay, to the original GNSS message.[29]

Currently SBAS is being trialled in Australia by Geoscience Australia.

8.6 Instrument Landing System (ILS)

An ILS provides both lateral and vertical guidance to an aircraft by the use of ground based navigational aids broadcasting radio signals. ILS have been used for decades as a reliable, accurate ground based navigational aid that can supports all weather operation by aircraft.

An ILS is both a CAPEX and OPEX intensive navigation aid. The initial costs to install the ground based equipment necessary can run into millions of dollars, with annual maintenance and required flight checks running to hundreds of thousands of dollars.

ILS are generally installed at high capacity airports, however there are several privately installed ILS throughout Australia. A typical ILS is shown below:

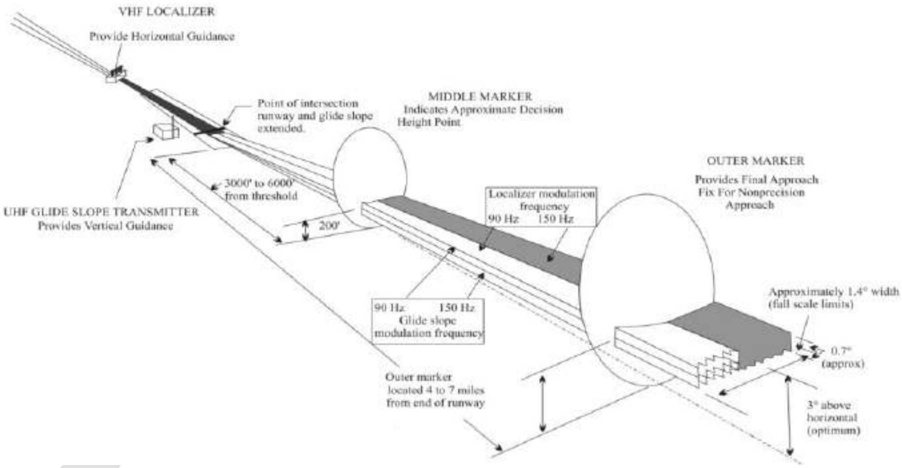


Figure 31: Typical ILS Installation

The advantage of an ILS over GNSS approached is the current lower minima allowed with an ILS. ILS minima's are referred to as "CAT" minima's, with the image below showing the applicable minima:

[29] Source: Europe GSA

Category of Operation	Decision Height (DH)	Runway Visual Range (RVR)
CAT I	DH ≥ 200 ft (60m)	RVR ≥ 550 m or VIS ≥ 800m RVR ≥ 1750 ft or VIS ≥ 2400 ft
CAT II	100 ft ≤ DH < 200 ft	RVR ≥ 300 m
CAT IIIA	No DH or DH < 100 ft	RVR ≥ 175 m
CAT IIIB	No DH or DH < 50ft	50 m ≤ RVR < 175 m
CAT IIIC	No DH	No RVR limitation

Figure 32: ILS CAT Minima

A "standard" ILS will support CATI, to go to a higher CAT there are additional ground infrastructure (lighting, electrical, weather) requirements, as well as aircraft equipment and crew requirements.

Currently in Australia there are two CATIIIB airports operating (Melbourne and Perth), with the remainder as CATI/II.

8.7 Weather Impacts Upon Instrument Approach

The type of approach and ground infrastructure installed at an airport need to meet several requirements:

- Type of aircraft operating
- Expected weather events below minima
- Cost
- Criticality of availability

Whilst it is possible to provide almost guaranteed assurance of an aircraft being able to arrive at an airport by installing a CATIIIB ILS, commercially the cost in most circumstances does not justify the increased availability of the airport. As an example, Sydney does not have CATIIIB capability, as it has determined that the cost of achieving and maintaining this is not justified by the number of days that weather precludes and aircraft from arriving at the airport. Melbourne, on the other hand with more fog events on average then Sydney has installed a CATIIIB ILS, as commercially it was a viable option.

Initial studies covering weather events at the proposed site are shown below. These will be updated following the installation of a temporary weather station which will provide more detailed reporting on the actual site.

Fog observational data from Cooma Airport suggests that the majority of fog days typically occur in the winter months. Data was analysed to predict the time of day that fog would be likely to occur. There are many different types of fog and the BoM acknowledge it is exceptionally difficult to forecast without observation . A summary of the number of 10-mintue events that would have meteorological conditions to produce fog in a 3-year period at Jindabyne Airport are presented in Figure 8. The pattern of events indicates that fog would essentially burn-off by early morning.

The airport site is located on the crests of rolling countryside, where low lying ground fog is less likely to linger.

	MONTH													
TIME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Hours
0	37	44	45	32	33	87	8	12	13	39	68	31	**449**	**112.3**
1	39	56	48	46	46	103	12	17	19	41	70	43	**540**	**135.0**
2	45	63	67	64	47	111	14	22	28	48	80	32	**621**	**155.3**
3	43	66	74	75	163	235	73	60	32	72	84	38	**1015**	**253.8**
4	53	74	100	227	257	309	130	210	185	111	92	44	**1792**	**448.0**
5	72	80	146	238	263	300	134	215	239	208	136	49	**2080**	**520.0**
6	116	193	225	234	284	294	136	211	187	291	180	59	**2410**	**602.5**
7	40	120	188	102	174	259	91	85	25	97	73	30	**1284**	**321.0**
8	19	42	65	36	44	110	21	18	15	38	26	19	**453**	**113.3**
9	5	17	30	9	21	55	9	7	5	20	14	13	**205**	**51.3**
10	5	5	18	7	3	29	2	1	0	3	7	3	**83**	**20.8**
11	5	0	9	5	1	9	0	0	0	2	4	3	**38**	**9.5**
12	3	4	7	1	1	7	0	3	0	1	4	4	**35**	**8.8**
13	7	5	5	1	1	3	0	1	1	6	7	2	**39**	**9.8**
14	4	4	3	0	0	0	0	0	2	8	4	3	**28**	**7.0**
15	4	4	0	2	0	0	1	1	2	8	0	1	**23**	**5.8**
16	4	3	3	0	1	1	2	1	4	6	0	2	**27**	**6.8**
17	7	3	5	0	5	7	4	2	4	15	9	12	**73**	**18.3**
18	18	22	12	2	5	11	0	2	4	19	28	18	**141**	**35.3**
19	29	29	14	6	5	10	1	9	4	21	33	21	**182**	**45.5**
20	24	33	24	8	11	30	1	9	6	21	36	23	**226**	**56.5**
21	23	36	33	14	14	52	1	3	8	23	40	25	**272**	**68.0**
22	26	41	31	16	15	65	5	3	7	31	45	25	**310**	**77.5**
23	29	43	42	30	21	70	6	4	9	39	53	29	**375**	**93.8**
TOTAL	**657**	**987**	**1194**	**1155**	**1415**	**2157**	**651**	**896**	**799**	**1168**	**1093**	**529**	**12701**	**3175.3**

Figure 8. Number of 15-minute period when potential fog predicted at Jindabyne Airport during 3 years from 11 July 2016

There is no definitive BoM description of snow as a form of precipitation. The 3 years of available AWS from Jindabyne Airport have been analysed to estimate the amount of time that snow could occur as presented in Error! Reference source not found. .

These conditions would be expected to be similar for all site options.

	MONTH													
TIME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Hours
0	0	0	0	0	1	0	0	1	0	1	0	0	**3**	**0.8**
1	0	0	0	0	1	4	0	1	0	0	1	0	**7**	**1.8**
2	0	0	0	0	0	1	1	2	1	0	1	0	**6**	**1.5**
3	0	0	0	0	0	3	0	0	0	1	1	0	**5**	**1.3**
4	0	0	0	0	1	0	0	3	0	0	1	0	**5**	**1.3**
5	0	0	0	0	1	2	0	2	0	0	0	0	**5**	**1.3**
6	0	0	0	0	1	1	0	0	0	0	0	0	**2**	**0.5**
7	0	0	0	0	2	0	2	1	2	1	1	2	**11**	**2.8**
8	0	1	0	2	2	1	2	1	1	1	1	0	**12**	**3.0**
9	0	0	0	0	4	2	1	0	1	0	2	0	**10**	**2.5**
10	0	0	0	0	2	1	0	2	1	0	0	0	**6**	**1.5**
11	0	0	0	0	0	0	0	3	2	0	0	0	**5**	**1.3**
12	0	0	0	0	0	0	0	2	1	0	0	0	**3**	**0.8**
13	0	0	0	0	0	0	0	2	2	1	1	0	**6**	**1.5**
14	0	0	0	0	0	1	0	0	3	1	0	0	**5**	**1.3**
15	0	0	0	0	0	0	1	1	4	2	0	0	**8**	**2.0**
16	0	0	0	0	2	0	0	1	4	0	0	0	**7**	**1.8**
17	0	0	0	0	1	2	0	2	3	0	0	0	**8**	**2.0**
18	0	0	0	0	2	0	0	6	2	0	0	0	**10**	**2.5**
19	0	0	0	0	0	2	0	4	2	0	3	0	**11**	**2.8**
20	0	0	0	0	3	2	0	0	4	0	3	0	**12**	**3.0**
21	0	0	0	0	0	5	0	2	2	1	1	0	**11**	**2.8**
22	0	0	0	0	1	4	0	3	1	0	1	0	**10**	**2.5**
23	0	0	0	0	2	3	0	1	2	0	3	0	**11**	**2.8**
TOTAL	**0**	**1**	**0**	**2**	**26**	**34**	**7**	**40**	**38**	**9**	**20**	**2**	**179**	**44.8**

Figure 9. Number of 15-minute periods when predicted precipitation as snow during 3 years from 11 July 2016 at Jindabyne Airport

9 Environment

Where aircraft flight paths are modified or new ones established, environmental impacts regarding noise must be considered.

9.1 Potential Arrival Routes and Altitudes

Potential arrival and departure routes and altitudes are described below. These routes and altitudes (AMSL) are indicative only and may not represent final flightpaths.

These images are based upon indicative B738 performance figures and expected departure paths.

Airline specific requirements for terrain and engine failure considerations may vary these indicative profiles and paths considerably.

9.1.1 Departure Routes to Brisbane and Sydney

For departures to the north, a turn towards Canberra would be expected shortly after take-off.

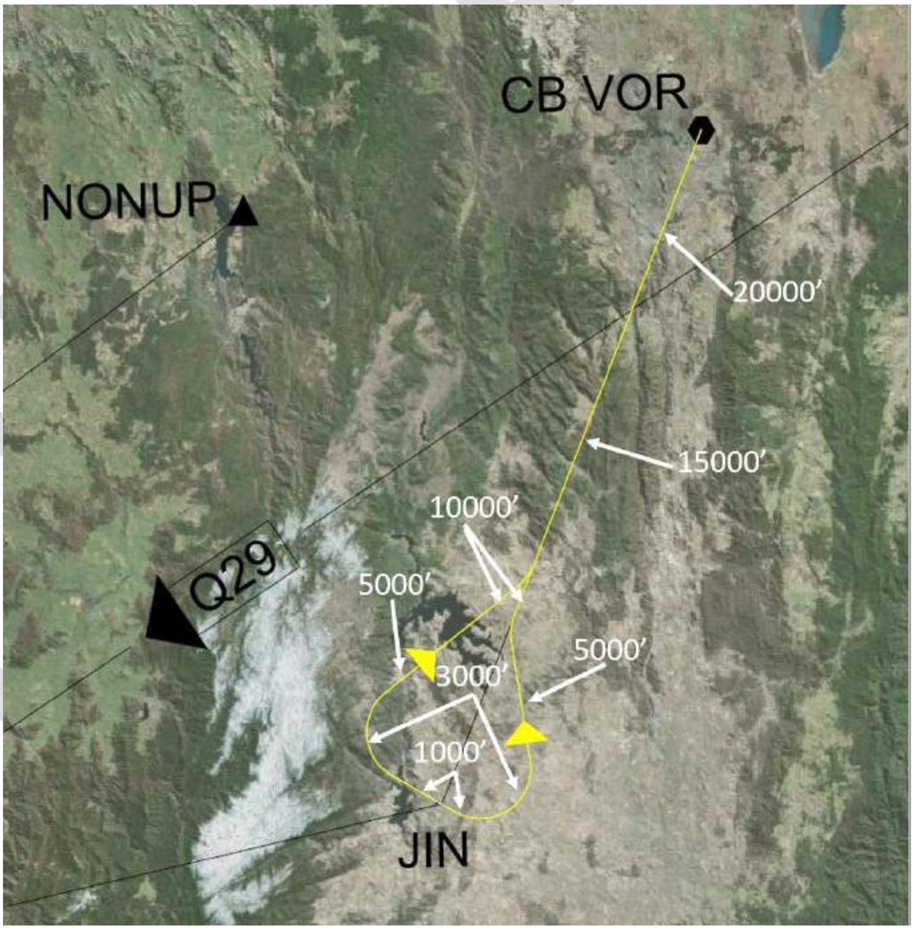


Figure 33: Departure Routes North[30]

9.1.2 Departure Routes to Adelaide and Melbourne

For departures to Adelaide and Melbourne, a turn towards NABBA would be expected shortly after take-off. For these departures, due to the high terrain immediately west of Option 3 it is likely that some manoeuvring prior to turning towards NABBA would be expected.

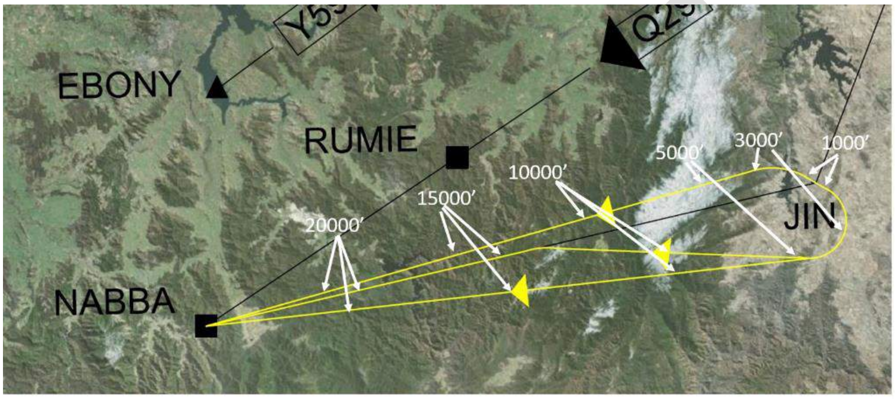


Figure 34: Departure Routes South[31]

[30] Source: ATS
[31] Source: ATS

9.1.3 Arrival Routes from Brisbane and Sydney

Aircraft arriving from the north east would most likely track direct towards the applicable IAF as soon as ATC allowed the tracking. In addition, a level off segment prior to the IAF would likely be flown to allow aircraft deceleration.

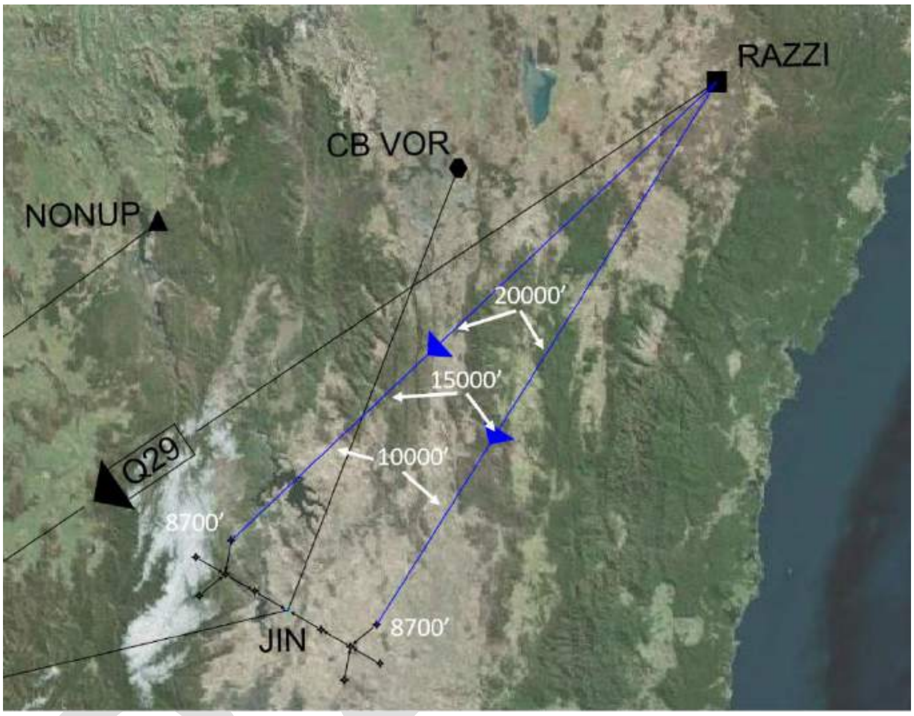


Figure 35: Arrival Routes North[32]

[32] Source: ATS

9.1.4 Arrival Routes from Adelaide and Melbourne

Aircraft arriving from the north west would most likely track direct towards the applicable IAF as soon as ATC allowed the tracking. Due to crossing route Q59 there may be some ATC requirements for an earlier then optimal descent point. In addition, a level off segment prior to the IAF would likely be flown to allow aircraft deceleration.

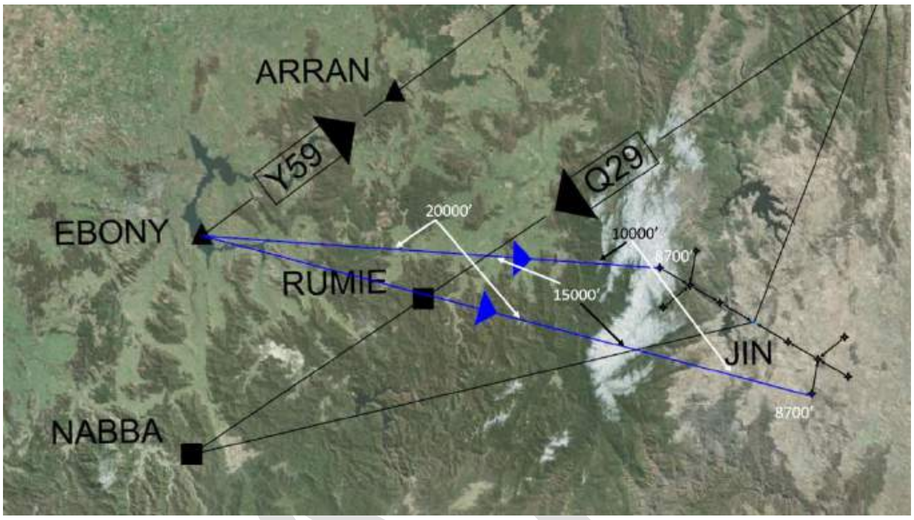


Figure 36: Arrival Routes South[33]

[33] Source: ATS

9.1.5 Expected Altitudes RNAV Approach

Aircraft tracking for the IAF would be planning to reach the IAF at 8700’ and configured for the approach.

The altitudes shown are indicative for the descent profiles expected on an instrument approach such as this.

Final MDA for a APV-LNAV/VNAV such as this would be expected to be somewhere in the region of 400-600’ depending upon final surveys and design.

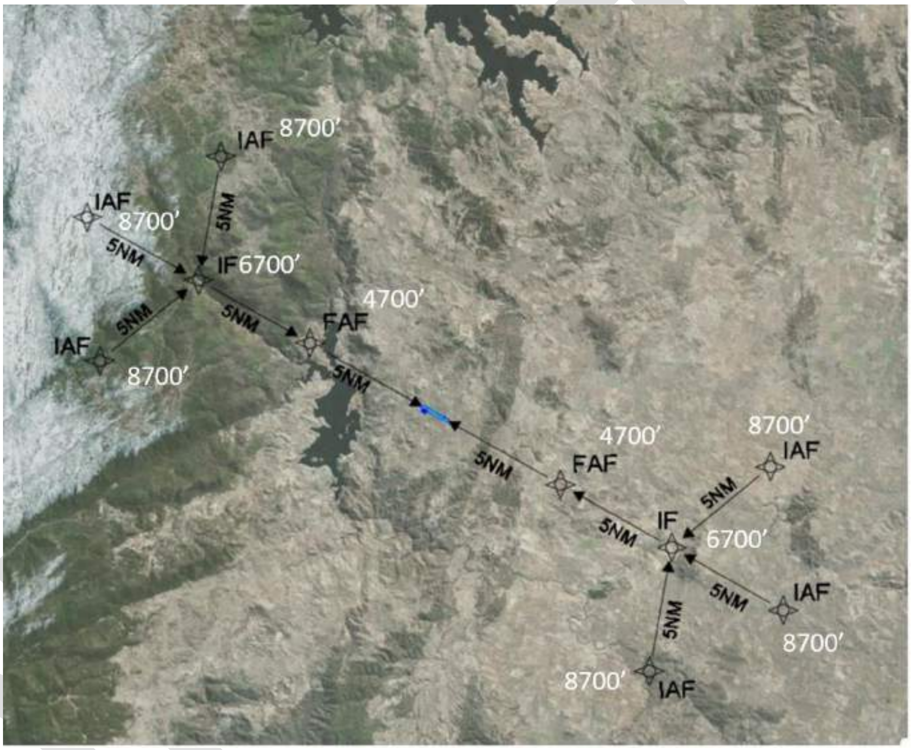


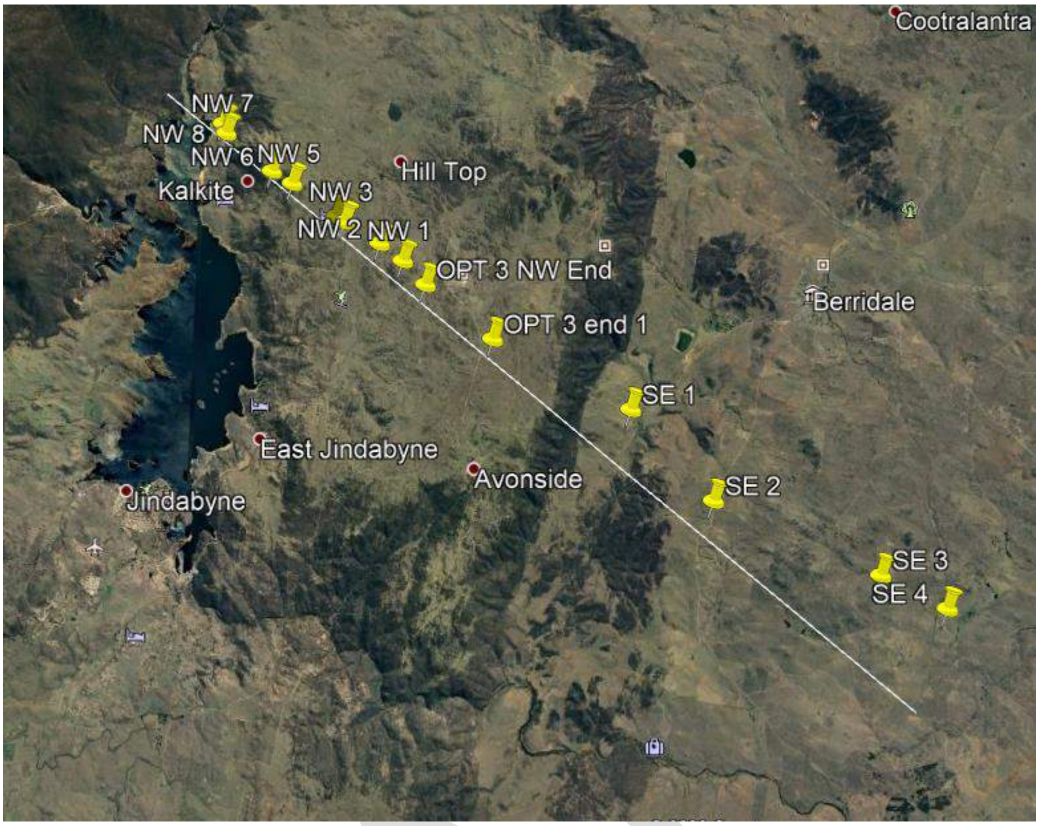
Figure 37: Profile Altitudes RNAV Approach[34]

9.2 Initial Noise Modelling

A preliminary assessment of predicted noise levels to existing nearby sensitive receivers has been conducted in accordance with the method described in AS 2021-2015, Section 3 . This assessment is normally intended to assess the suitability of new dwelling construction on land impacted by noise from a planned airfield and is not a substitute for the ANEF process outlined above. It has been implemented here as a high-level check of noise impacts to existing residences.

The LAmax,slow noise levels at 12 residences approximately on-axis and within 10 nautical miles of the ends of the Option 3 runway were manually checked. These residences are shown in Figure X and details of each is shown in Table X

[34] Source: ATS



ID	Name	Coordinates
NW 1	80 Manuders Ln	55 H 652057.00 m E 5974725.00 m S
NW 2	66 Tirrike Ln	55 H 651389.00 m E 5975252.00 m S
NW 3	217 Eucumbene Rd	55 H 650379.00 m E 5975914.00 m S
NW 4	23 Kalkite Rd	55 H 650144.00 m E 5976078.00 m S
NW 5	162 Kalkite Rd	55 H 648857.00 m E 5977097.00 m S
NW 6	286 Kalkite Rd	55 H 648241.00 m E 5977504.00 m S
NW 7	730 Kalkite Rd	55 H 646847.00 m E 5978735.00 m S
NW 8	772 Kalkite Rd	55 H 646744.00 m E 5979032.00 m S
SE 1	Coolamatong Rd	55 H 658491.00 m E 5970287.00 m S
SE 2	644 Rockwell Rd	55 H 660757.00 m E 5967640.00 m S
SE 3	Dalgety Rd West	55 H 665338.00 m E 5965455.00 m S
SE 4	Dalgety Rd East	55 H 667146.00 m E 5964493.00 m S
Option 3	Runway Ends for Option 3	55 H 654619.50 m E 5972373.70 m S 55 H 652708.02 m E 5974010.73 m S

Table 4: Residence Locations

AS 2021:2015 Appendix E provides a method to determine building site acceptability, based on the dB LAmax,slow noise levels due to aircraft flyovers, shown here in Table 5.

Number of flights per day	Aircraft noise level expected at building site, $L_{Amax,slow}$ dB		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park, school, university, hospital, nursing home			
>30	<70	70-75	>75
15-30	<80	80-85	>85
<15	<90	90-95	>95
Hotel, motel, hostel, public building			
>30	<75	75-80	>80
15-30	<85	85-90	>90
<15	<95	95-100	>100
Commercial building			
>30	<80	80-85	>85
15-30	<90	90-95	<95
<15	<100	100-105	>105

Table 5: Noise Level Acceptability

The predicted external noise levels at each receiver are shown in Table 6 and are coloured green for 'acceptable' noise levels, yellow for 'conditionally acceptable' and red for 'unacceptable' noise levels.

This assessment assumes less than 15 total overflights flights per day.

Noise Sensitive Receiver	Aircraft noise level expected at building site, dB $L_{Amax, slow}$	
	Turboprop (Dash 8)	Jet (737-800)
NW 1	72	90
NW 2	73	89
NW 3	70	85
NW 4	69	84
NW 5	64	79
NW 6	62	77
NW 7	60	74
NW 8	61	74
SE 1	52	73
SE 2	58	73
SE 3	46	63
SE 4	46	60

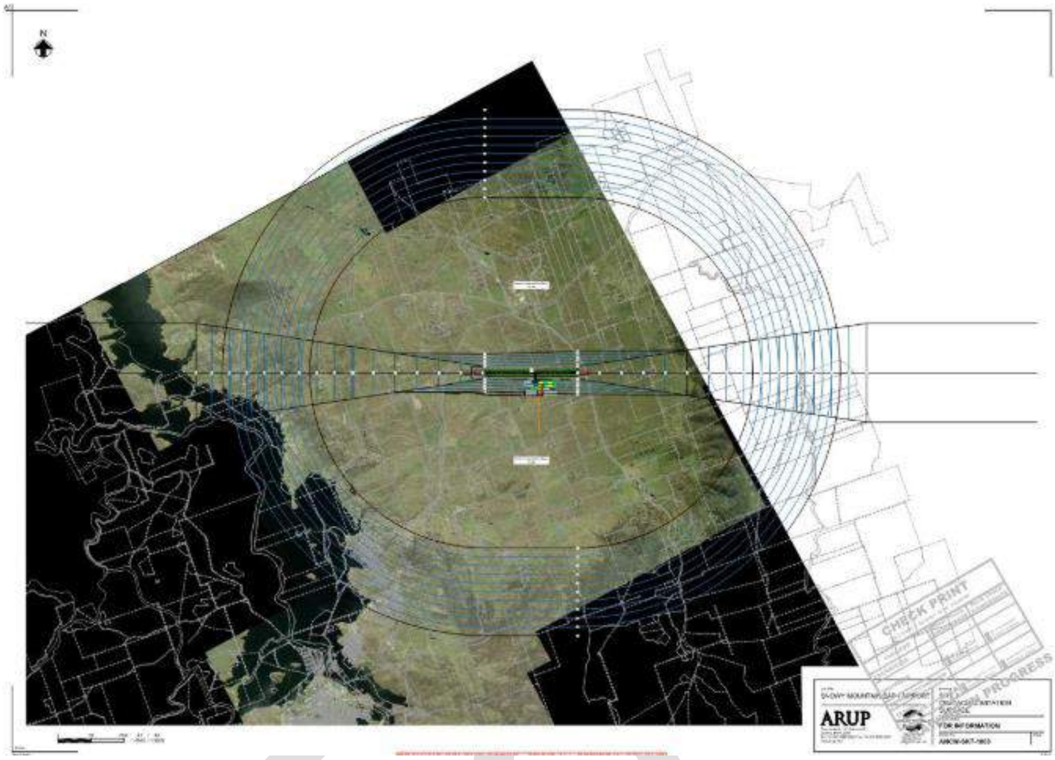
Table 6: Predicted noise levels at receiver locations

If the total daily jet overflights are increased to between 15 and 30, there is a potential for unacceptable noise levels at receivers NW 1, NW 2 and NW 3.

It is predicted that greater than 30 total daily turboprop overflights can be accommodated with the 'conditionally acceptable' noise levels.

10 Obstacle Limitation Surface

The OLS is generally the lowest surface and is designed to provide protection for aircraft flying into or out of the airport when the pilot is flying by sight. The PANS-OPS surface is generally above the OLS and is designed to safeguard an aircraft from collision with obstacles when the aircraft's flight may be guided solely by instruments, in conditions of poor visibility.



The OLS and PANS-OPS surfaces will allow for any future expansion to avoid construction that may limit expansion in the future. Two OLS/PANS-OPS plans will be produced to show Day 1 requirements and Ultimate requirements (longer runway notably). These restrictions will need to be considered with land use plan around the airport.

11 Aerodrome Rescue and Fire Fighting Services

The requirement for Aerodrome Rescue and Fire Fighting Services (RFFS) at aerodromes is specified in MOS139H. The requirement to have an ARFFS established at an aerodrome is based upon two criteria:

1. International RPT operations
2. More than 350,000 passengers on RPT aircraft in the preceding financial year

11.1 Initial Requirement for ARFFS

Based upon expected traffic levels and passenger numbers, it is not expected that an ARFFS will need to be established for Day 1 operations. This is confirmed by the MOS as passenger number criteria are retrospective financial years.

11.2 Future Planning

Forecast traffic levels and passenger numbers dictate that planning for an ARFFS may be required in the future, and as such provision for an on airport facility should be made. Response times by ARFFS are dictated both by ICAO and the MOS and must be met for all new facilities. Whilst not covering all of the requirements of the MOS, the basic requirement is that an ARFFS vehicle must be able to reach either end of the runway, in normal visibility withing three minutes of a notification of an incident.

This requirement dictates the placement of any ARFFS facility and must be considered in initial planning for the aerodrome.

For Day One operations (including jet aircraft if applicable), an on airport ARFFS will not be required to be established. Until a dedicated on airport ARFFS is established, the three minute requirement stated above is not required to be met by an off airport fire service supporting the Aerodrome Emergency Plan (AEP).

11.3 ARFF Service Provision Options

Currently, ARFFS are provided at most aerodromes in Australia by ASA. Like the provision of ATC services, ASA recovers costs for the provision of ARFFS. Shown below are the charges for provision of ARFFS at Broome Airport for the arrival of a Qantas B738 aircraft, $180.52. These charges are passed onto passengers through ticket prices.

Charges:

	Terminal Nav	Rescue & Fire	En-route	Met Service	Total
Charges incl. GST	$1,184.27	$180.52	$1,116.97	$84.13	$2,565.89
GST	$107.66	$16.41	$101.54	$7.65	$233.26
Rates	$15.22	$2.32	$3.87	$0.265	

Figure 38: ASA ARFFS Charges[35]

The MOS does allow other providers than ASA to provide an ARFFS. Discussions with CASA have indicated that there is no regulatory requirement to have a stand alone ARFFS facility at an aerodrome. There could be options to utilise a shared facility, for example with NSW Fire and Rescue. Any provider of ARFFS from a shared facility would be required to not only comply with MOS139H but to be approved by CASA as an ARFFS provider.

As an example, QLD Fire and Emergency Services is already approved by CASA as an ARFFS training provider under MOS139H.

The advantages of a shared facility are that the CAPEX associated with the facility is not solely recovered through aerodrome operations, providing the potential to significantly reduce the charges required to be recovered by users. This would need to be offset against potential costs for NSW Fire and Rescue to obtain MOS139H certification, however investigation of this option would be worthwhile.

[35] Source: ASA website charging form

12 Aeronautical Information Regulation And Control

Aeronautical Information Regulation And Control (AIRAC) refers to the production, distribution and maintenance of Aeronautical Information Management (AIM) and stems from ICAO Annex 15. The rules associated with AIRAC dates define a series of common dates and procedures for states to deal with the standard distribution of AIP data.

12.1 AIRAC Lead Times

AIRAC lead times for inclusion into aviation documentation can be very lengthy, sometimes greater than six months.

Careful planning with Airservices data teams will be required to ensure that relevant information is provided within the stated lead times to allow publication and distribution.

13 Recommendations

The flowing recommendations for Option 3 will provide a satisfactory level of infrastructure and services to allow jet RPT operations from Day One.

13.1 Aerodrome

To support Day One jet operations the following are recommended as part of the airport infrastructure:

- Three windsocks
- PAL
- PAPI
- RTIL
- Separate RPT and others apron facilities
- Dedicated helipad
- Protection of CATI lighting facilities
- Protection of area to support future GBAS installation
- Naming of Option 3 that is unique and clearly delineates it from COM and existing Jindabyne airstrip

13.2 Airspace

Due to the expected traffic levels from Day One, no changes to existing airspace classifications are recommended. Consideration should be given to publishing an extended CTAF area that encompasses COM, Option 3, and the existing Jindabyne airstrip.

13.3 CNS

The following are recommended to support Day One operations:

- AFRU
- Liaison with Airservices to determine VHF coverage on the ground
  - Protection of area if required
- Liaison with Airservices to determine ADSB coverage on the ground
  - Protection of area if required
- AWIS with continuous broadcast facility

13.4 ATM

The expected traffic levels from DAY One neither justify nor necessitate an ATC service.

Given that Option 3 will be a new aerodrome it is recommended that the aerodrome operator establish as a minimum a UNICOM service to operate during the times that RPT operations occur.

When traffic increases, this could potentially then be changed to a CAGRS to ensure risks are mitigated to the minimum possible.

13.5 PAN-OPS

To support RPT jet operations from Day One, it is recommended that an APV-LNAV/VNAV Approach be designed and published for Option 3. Potential operators should be canvassed to determine RPT need for an RNP-AR Approach.

13.6 ARFFS

An ARFFS will not be required for Day One operations. As a part of the development of the airport, the Part 139 Licence holder for the aerodrome will be required to develop an AEP which includes procedures for fire service access to the aerodrome in the event of an emergency.

In consultation with Airservices (or another ARFFS provider) a site should be protected for any potential on airport ARFFS facility in the future.

14 Summary

Option 3 provides an opportunity to establish a new aerodrome that can support jet RPT operations from Day One.

The recommendations in this Aeronautical Study will provide a robust and safe level of infrastructure and procedures that utilise modern and best practice systems that provide a highly cost effective, efficient and environmentally friendly airport.

Appendix A Acronyms

Abbreviation	Explanation
°C	Degrees Celsius
AAA	Australian Airports Association
AAPS	Australian Airspace Policy Statement
ACI	Airport Council International
ACP	Airspace Change Proposal
ADSB	Automatic Dependant Surveillance-Broadcast
AFRU	Aerodrome Frequency Response Unit
AGL	Aeronautical Ground Lighting
AGL	Above Ground Level
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation And Control
ALARP	As Low As Reasonably Practical
ALER	Airport Lighting Equipment Room
AMS	Aviation and Maritime Security
AMSL	Above Mean Sea Level
ANSP	Air Navigation Service Provider
APU	Auxiliary Power Unit
ARFFS	Aerodrome Rescue Fire Fighting Services
ASA	Airservices Australia
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Solutions Pty Ltd
AWIB	Aerodrome Weather Information Service
AWS	Aerodrome Weather Station
BCR	Benefit Cost Ration
BNN	Backup Navigation Network
BOM	Bureau of Meteorology
CAGRS	Certified Air Ground Radio Service
CAPEX	CAPital EXpenditure
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CAT	Category
CTAF	Common Traffic Advisory Frequency

Abbreviation	Explanation
DAP	Departure and Approach Procedure
DH	Decision Height
DME	Distance Measuring Equipment
DPIE	Department of Planning, Industry and Environment
ERSA	En-Route Supplement Australia
FAF	Final Approach Fix
FL	Flight Level
GA	General Aviation
GBAS	Ground Based Augmentation System
GNSS	Global Navigations Satellite Systems
GSE	Ground Servicing Equipment
IATA	International Air Transport Association
ICAO	International Civil Aviation Authority
IAF	Initial Approach Fix
IF	Intermediate Fix
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LiDAR	Light Detection and Ranging
LNAV	Lateral Navigation
MCA	Multi Criteria Analysis
MDA	Minimum Descent Altitude
MLAT	Multi-Lateration
MOS	Manual Of Standards
MTOW	Maximum Design Takeoff Weight
NASF	National Airports Safeguarding Framework Principles
NAVAID	Navigational Aid
NBN	National Broadband Network
NDB	Non-Direction Beacon
NM	Nautical Mile
NSW	New South Wales
OAR	Office of Airspace Regulation
OLS	Obstacle Limitation Surface
OPEX	OPerational EXPenditure
PAL	Pilot Activated Lighting
PANS-OPS	Procedures for Air Navigation Services-aircraft OPerationS
PAPI	Precision Approach Path Indicator

Abbreviation	Explanation
PBN	Performance Based Navigation
PCA	Planning Chart Australia
PRD	Prohibited, Restricted, Danger areas
PSA	Public Safety Area
PSI	Pounds per Square Inch
PSR	Primary Surveillance Radar
PTO	Passenger Transport Operations
QNH	Pressure setting on an altimeter indicating vertical displacement AMSL
RESA	Runway End Safety Area
RNP	Required Navigation Performance
RPT	Regular Public Transport
RTIL	Runway Threshold Identification Lights
RWY	Runway
SAP	Special Activation Precinct
SDG	Sustainable Development Goals
SMAC	Snowy Mountains Airport Corporation
SSR	Secondary Surveillance Radar
TCH	Threshold Crossing Height
TDA	Temporary Danger Area
TODA	Take-Off Distance Available
TORA	Take-Off Run Available
TWY	Taxiway
UAM	Urban Air Mobility
UN	United Nations
UNICOM	UNIversal COMmunications
VFR	Visual Flight Rules
VHF	Very High Frequency
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VTOL	Vertical Take-Off and Landing
WATIR	Weather and Terminal Information Reciter

Table 7: Acronyms

Appendix F

Meteorology and Computational Fluid Dynamics Study

Department of Planning Industry & Environment

Snowy Mountains SAP - Airport

Meteorology and Computational Fluid Dynamics Study

276436-ANAX-RPT-0020

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Executive Summary

The prevailing wind directions in the region are from the west and south-east quadrants. Fog tends to occur overnight and early morning, burning off by about 10 am. The potential for snow is relatively low at about 20 hours per annum.

A CFD analysis has been conducted to determine the preferred location and alignment of the proposed Snowy Mountain Airport with four potential sites. Option 4 near Crackenback has poor wind conditions and is not recommended. The wind conditions at the remaining three site experienced similar wind conditions. Based on the prevailing wind directions, the recommended runway alignment would along ESE/WNW (relative to true north). To minimise the impact of cross-flight wind conditions, whilst allowing flexibility for ground works and infrastructure, the Runway could be orientation between 90°/270° and 120°/300° true north or (78°/258° and 108°/288° magnetic north).

1 Local Meteorology

1.1 Wind speed and direction

Analysis of the wind climate for the region was conducted for seven Bureau of Meteorological (BoM) Automatic Weather stations and the anemometer at Jindabyne Airport. The BoM anemometers are mounted at a standard height of 10 m above ground level, while the Jindabyne anemometer is mounted above one of the terminal buildings. The wind climate for the region is dominated by prevailing winds from the west, Figure 1, which is typical for such latitudes in the southern hemisphere. Section 2.1 includes a more detailed discussion on the local wind microclimate.

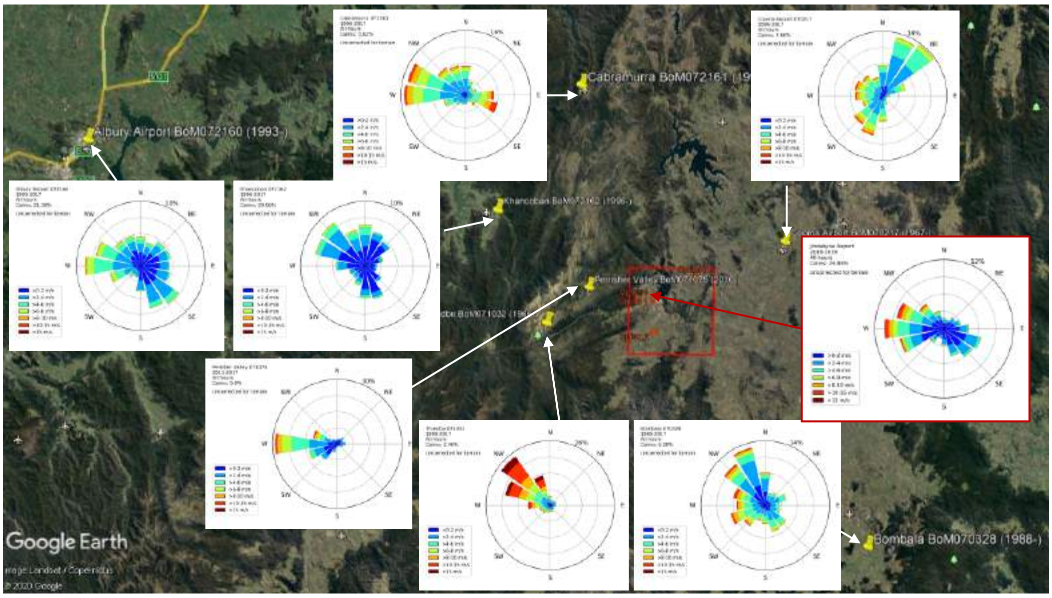


Figure 1. Wind roses for the NSW Snowy Mountain region (Google Earth)

There is limited Bureau of Meteorological (BoM) information available to the east of the dividing range with Cooma Airport being the closest station. This station measures a range of data but does not include cloud base height. The available data have been analysed to determine the potential for fog and snow in the region. Similarly, available data from Jindabyne Airport have been analysed.

1.2 Fog

Fog observational data from Cooma Airport from 1973 is presented in Figure 2, showing that the majority of fog days typically occur in the winter months. In addition, three years of Automatic Weather Station, ten-minute data from 21 July 2017 have been analysed to predict the time of day that fog would be likely to occur. There are many different types of fog and the BoM acknowledge it is exceptionally difficult to forecast without observation[1]. A summary of the number of 10-mintue events that would have meteorological conditions to produce fog in a 3-year period at Cooma Airport are presented in Figure 3. Similar results for 15-

[1] http://media.bom.gov.au/social/blog/1807/explainer-what-is-fog/

mintue data at Jindabyne Airport are presented in Figure 4. The pattern of events is similar between the two stations with results indicating that fog would essentially burn-off by early morning. The number of potential fog events at Jindabyne Airport is significantly greater than at Cooma.

Sites Options 1-3 tend to be located on the crests of rolling countryside, where low lying ground fog is less likely to linger. The location of Option 4 in the Crackenback Valley would determine the greater potential for low-lying fog, but current position at higher elevation would limit the risk for additional fog events.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1973										1	1	0	**2**
1974	0	1	3	3	8	7	3	3	4	2	2	0	**36**
1975	1	5	2	4	4	3	5	3	3	2	1	3	**36**
1976	3	1	3	6	9	6	7	2	1	0	0	1	**39**
1977	0	0	1	7	3	4	11	3	1	2	0	0	**32**
1978	1	0	1	3	3	6	2	5	2	1	0	0	**24**
1979	0	1	2	2	3	6	5	4	0	0	0	0	**23**
1980	0	0	4	7	8	6	4	4	0	1	0	1	**35**
1981	0	4	2	3	7	3	3	1	1	0	0	1	**25**
1982	0	0	4	5	6	8	8	3	0	0	0	0	**34**
1983	0	1	1	3	9	9	8	4	2	1	1	0	**39**
1984	2	1	2	6	12	10	5	1	5	1	1	0	**46**
1985	0	1	2	4	9	8	5	0	2	0	0	1	**32**
1986	1	1	0	4	7	8	5	3	2	0	1	0	**32**
1987	0	1	1	5	9	11	10	7	2	1	1	0	**48**
1988	1	2	5	2	10	9	11	6	3	0	0	4	**53**
1989	0	1	2	6	9	6	2	7	5	1	2	2	**43**
1990	2	3	7	1	11	12	3	2	1	0	4	0	**46**
1991	2	0	0	3	13	4	3	3	0	2	0	0	**30**
1992	0	1	5	6	14	18	11	6	0	0	0	1	**62**
1993	0	0	2	2	7	4	8	2	0	2	0	1	**28**
1994	0	1	2	1	4	9	9	0	0	0	0	0	**26**
1995	0	0	0	1	3	4	2	3	0	0	0	1	**14**
1996	0	0	2	1	6	5	3	1	0	0	1	0	**19**
1997	1	0	0	2	9	5	5	2	0	0	0	0	**24**
1998	1	0	2	7	3	0	1	2	1	1	0	0	**18**
1999	1	3	2	4	5	8	6	5	2	0	1	0	**37**
2000	0	1	5	6	11	11	12	7	0	1	0	0	**54**
2001	0	3	2	1	2	12	10	2	4	0	0	0	**36**
2002	0	1	1	4	9	8	6	8	0	0	0	0	**37**
2003	0	0	6	3	3	10	7	3	0	0	1	0	**33**
2004	1	2	5	6	1	5	6	6	4	2	0	0	**38**
2005	0	2	5	7	6	5	5	2	3	0	1	0	**36**
2006	0	0	7	1	3	17	8	4	0	2	1	0	**43**
2007	0	1	1	4	3	9	4	2	1	0	1	1	**27**
2008	0	2	7	4	11	4	11	7	1	3	0	0	**50**
2009	0	0	0	2	10	7	1	0	1	3	0	0	**24**
2010	0	1	2	5	6	5	5	2	1	2	0	0	**29**
2011	0	1	3	5	4	9	8	12	0	2	0	0	**44**
2012	0	2	7	4	8	5	6	1	2	0	0	0	**35**
2013	0	3	2	7	7	8	8	3	2	0	0	0	**40**
2014	1	0	3	1	4	5	6	6	4	1	0	0	**31**
2015	0	6	6	4	5	12	6	3	3	1	0	0	**46**
2016	1	2	5	5	3	2	5	3	5	0	0	0	**31**
2017	0	0	4	4	3	14	4	3	0	3	2	0	**37**
2018	1	1	4	2	3	5	5	2	1	2	0	0	**26**
2019	1	1	5	6	4	5	5	6	0	0	0	0	**33**
2020	0	0	1										**1**
Total	**21**	**57**	**138**	**179**	**297**	**337**	**273**	**164**	**69**	**40**	**22**	**17**	**1614**

Figure 2. Observational fog day data from Cooma Airport

	MONTH													
TIME	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**	**Hours**
0	0	11	12	24	25	32	23	25	12	28	10	10	**212**	**35.3**
1	1	12	24	38	19	39	24	15	3	45	15	10	**245**	**40.8**
2	4	3	32	34	32	45	48	12	15	37	22	12	**296**	**49.3**
3	6	7	28	41	24	40	15	21	22	17	33	14	**268**	**44.7**
4	8	11	22	36	23	47	23	11	25	26	21	11	**264**	**44.0**
5	7	11	24	30	37	50	18	16	27	25	27	10	**282**	**47.0**
6	2	10	16	26	40	40	23	23	37	29	10	1	**257**	**42.8**
7	0	4	13	28	40	44	20	39	22	6	0	0	**216**	**36.0**
8	0	1	0	9	37	22	16	10	2	0	1	0	**98**	**16.3**
9	0	0	0	1	7	9	9	1	0	0	0	0	**27**	**4.5**
10	0	0	0	0	0	4	1	0	0	0	0	0	**5**	**0.8**
11	0	0	0	0	0	2	0	0	0	0	0	0	**2**	**0.3**
12	0	0	0	0	1	0	0	0	0	0	0	0	**1**	**0.2**
13	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0.0**
14	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0.0**
15	0	0	0	0	0	0	0	0	0	1	0	0	**1**	**0.2**
16	0	0	0	0	0	0	0	0	0	1	0	0	**1**	**0.2**
17	0	0	0	0	1	3	3	0	0	0	0	0	**7**	**1.2**
18	0	0	0	0	0	10	0	0	0	0	0	0	**10**	**1.7**
19	0	0	0	0	3	12	4	0	0	1	0	2	**22**	**3.7**
20	0	0	0	1	7	17	12	3	0	0	0	1	**41**	**6.8**
21	3	1	1	7	17	31	18	3	3	14	2	1	**101**	**16.8**
22	1	0	8	15	26	32	13	13	11	25	6	0	**150**	**25.0**
23	0	1	11	24	23	30	27	18	3	35	5	6	**183**	**30.5**
TOTAL	**32**	**72**	**191**	**314**	**362**	**509**	**297**	**210**	**182**	**290**	**152**	**78**	**2689**	**448.2**

Figure 3. Number of 10-minute period when potential fog predicted at Cooma Airport during 3 years from 21 July 2017

	MONTH													
TIME	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTAL**	**Hours**
0	37	44	45	32	33	87	8	12	13	39	68	31	**449**	**112.3**
1	39	56	48	46	46	103	12	17	19	41	70	43	**540**	**135.0**
2	45	63	67	64	47	111	14	22	28	48	80	32	**621**	**155.3**
3	43	66	74	75	163	235	73	60	32	72	84	38	**1015**	**253.8**
4	53	74	100	227	257	309	130	210	185	111	92	44	**1792**	**448.0**
5	72	80	146	238	263	300	134	215	239	208	136	49	**2080**	**520.0**
6	116	193	225	234	284	294	136	211	187	291	180	59	**2410**	**602.5**
7	40	120	188	102	174	259	91	85	25	97	73	30	**1284**	**321.0**
8	19	42	65	36	44	110	21	18	15	38	26	19	**453**	**113.3**
9	5	17	30	9	21	55	9	7	5	20	14	13	**205**	**51.3**
10	5	5	18	7	3	29	2	1	0	3	7	3	**83**	**20.8**
11	5	0	9	5	1	9	0	0	0	2	4	3	**38**	**9.5**
12	3	4	7	1	1	7	0	3	0	1	4	4	**35**	**8.8**
13	7	5	5	1	1	3	0	1	1	6	7	2	**39**	**9.8**
14	4	4	3	0	0	0	0	0	2	8	4	3	**28**	**7.0**
15	4	4	0	2	0	0	1	1	2	8	0	1	**23**	**5.8**
16	4	3	3	0	1	1	2	1	4	6	0	2	**27**	**6.8**
17	7	3	5	0	5	7	4	2	4	15	9	12	**73**	**18.3**
18	18	22	12	2	5	11	0	2	4	19	28	18	**141**	**35.3**
19	29	29	14	6	5	10	1	9	4	21	33	21	**182**	**45.5**
20	24	33	24	8	11	30	1	9	6	21	36	23	**226**	**56.5**
21	23	36	33	14	14	52	1	3	8	23	40	25	**272**	**68.0**
22	26	41	31	16	15	65	5	3	7	31	45	25	**310**	**77.5**
23	29	43	42	30	21	70	6	4	9	39	53	29	**375**	**93.8**
TOTAL	**657**	**987**	**1194**	**1155**	**1415**	**2157**	**651**	**896**	**799**	**1168**	**1093**	**529**	**12701**	**3175.3**

Figure 4. Number of 15-minute period when potential fog predicted at Jindabyne Airport during 3 years from 11 July 2016

1.3 Snow

There is no definitive BoM description of snow as a form of precipitation. The 3 years of available AWS data from Cooma Airport and 3 years of data from Jindabyne Airport have been analysed to estimate the amount of time that snow could occur as presented in Figure 5 and Figure 6 respectively.

It is evident that the number of potential snow events at Jindabyne is less than at Cooma but is not significant through the year. These conditions would be expected to be similar for all site options.

	MONTH													
TIME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Hours
0	0	0	0	1	19	0	2	13	10	0	0	0	45	7.5
1	0	0	0	1	18	0	0	4	9	0	0	0	32	5.3
2	0	0	0	2	14	0	1	8	13	0	0	0	38	6.3
3	0	0	0	1	3	4	3	7	10	3	1	0	32	5.3
4	0	0	0	1	1	14	4	6	12	0	1	0	39	6.5
5	0	0	0	1	3	18	4	9	12	2	2	0	51	8.5
6	0	0	0	1	2	15	6	6	12	0	0	0	42	7.0
7	0	0	0	1	9	8	5	7	5	0	0	0	35	5.8
8	0	0	0	0	6	14	1	5	2	0	0	0	28	4.7
9	0	0	0	0	1	4	1	1	3	0	0	0	10	1.7
10	0	0	0	0	0	0	0	1	1	0	0	0	2	0.3
11	0	0	0	0	0	0	0	1	0	0	0	0	1	0.2
12	0	0	0	0	0	0	0	2	0	0	0	0	2	0.3
13	0	0	0	0	0	0	0	1	0	0	0	0	1	0.2
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
15	0	0	0	0	0	0	0	1	0	0	0	0	1	0.2
16	0	0	0	0	0	0	0	2	0	0	0	0	2	0.3
17	0	0	0	0	0	0	0	3	1	0	0	0	4	0.7
18	0	0	0	0	0	0	5	3	6	0	0	0	14	2.3
19	0	0	0	0	2	0	5	5	9	0	1	0	22	3.7
20	0	0	0	0	2	0	0	3	7	0	0	0	12	2.0
21	0	0	0	0	5	7	4	6	10	0	0	0	32	5.3
22	0	0	0	0	3	8	10	11	9	0	0	0	41	6.8
23	0	0	0	0	9	5	5	11	9	0	0	0	39	6.5
TOTAL	0	0	0	9	97	97	56	116	140	5	5	0	525	87.5

Figure 5. Number of 10-minute periods when predicted precipitation as snow during 3 years from 21 July 2017 at Cooma Airport

	MONTH													
TIME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Hours
0	0	0	0	0	1	0	0	1	0	1	0	0	3	0.8
1	0	0	0	0	1	4	0	1	0	0	1	0	7	1.8
2	0	0	0	0	0	1	1	2	1	0	1	0	6	1.5
3	0	0	0	0	0	3	0	0	0	1	1	0	5	1.3
4	0	0	0	0	1	0	0	3	0	0	1	0	5	1.3
5	0	0	0	0	1	2	0	2	0	0	0	0	5	1.3
6	0	0	0	0	1	1	0	0	0	0	0	0	2	0.5
7	0	0	0	0	2	0	2	1	2	1	1	2	11	2.8
8	0	1	0	2	2	1	2	1	1	1	1	0	12	3.0
9	0	0	0	0	4	2	1	0	1	0	2	0	10	2.5
10	0	0	0	0	2	1	0	2	1	0	0	0	6	1.5
11	0	0	0	0	0	0	0	3	2	0	0	0	5	1.3
12	0	0	0	0	0	0	0	2	1	0	0	0	3	0.8
13	0	0	0	0	0	0	0	2	2	1	1	0	6	1.5
14	0	0	0	0	0	1	0	0	3	1	0	0	5	1.3
15	0	0	0	0	0	0	1	1	4	2	0	0	8	2.0
16	0	0	0	0	2	0	0	1	4	0	0	0	7	1.8
17	0	0	0	0	1	2	0	2	3	0	0	0	8	2.0
18	0	0	0	0	2	0	0	6	2	0	0	0	10	2.5
19	0	0	0	0	0	2	0	4	2	0	3	0	11	2.8
20	0	0	0	0	3	2	0	0	4	0	3	0	12	3.0
21	0	0	0	0	0	5	0	2	2	1	1	0	11	2.8
22	0	0	0	0	1	4	0	3	1	0	1	0	10	2.5
23	0	0	0	0	2	3	0	1	2	0	3	0	11	2.8
TOTAL	0	1	0	2	26	34	7	40	38	9	20	2	179	44.8

Figure 6. Number of 15-minute periods when predicted precipitation as snow during 3 years from 11 July 2016 at Jindabyne Airport

2 Computational Fluid Dynamics Study

Computational Fluid Dynamic (CFD) modelling was conducted to determine the relative local wind speed and direction at the potential airport locations and along approach glideslopes to assist with the determination of the preferred runway alignment. The benefit of this study over wind tunnel testing or full-scale measurement using a physical anemometer is that the entire flow field is observed rather than a discrete location. A numerical model extending a diameter of 70 km and 4 km height above local ground was prepared for the study, Figure 7.

The CFD study only investigated the global wind field associated with large scale synoptic wind events and did not model local meteorological events such as thermal events, which are generally light in nature.

2.1 Modelling

The topography surrounding the potential airport sites was modelled using 2m Elvis LiDAR GIS data with contours of 10 m elevation intervals closer to site options and 50 m further afield, Figure 8. The modelled domain is centred to the west to better capture the significant topographical features that will impact the flow patterns. The impacts of the change in topography due to the inclusion of the runway were not included in the analysis.

A mesh sensitivity study was conducted for three levels of refinement with 17, 44, and 74 million cells. Measurable differences in wind speed and direction were observed on changing from 17 to 44 million cells, but were not observed when increasing the fineness of the mesh to 74 million cells. The CFD analysis was therefore conducted with a 44 million cell mesh.

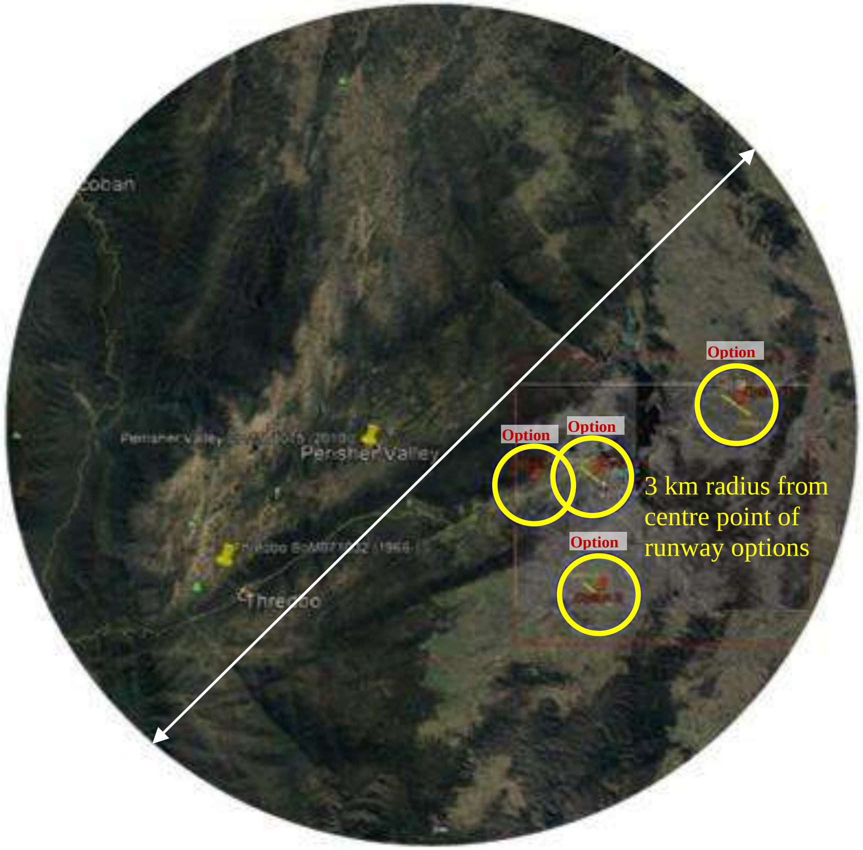


Figure 7. Extent of numerical modelled area

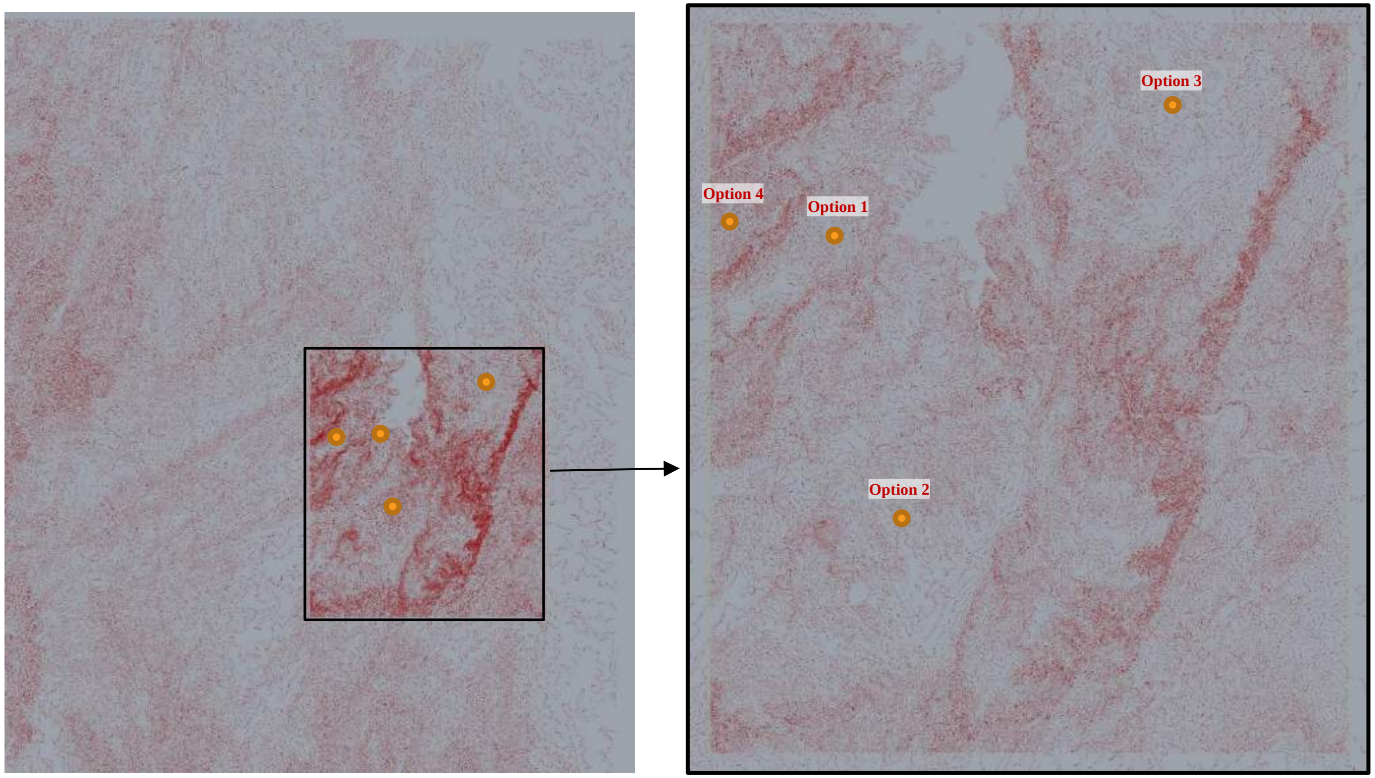


Figure 8. GIS data with 10 and 50 m elevation contours for regions close and far from the potential site options.

The horizontal resolution (X-Y) was set to 50 m and 150 m for the closer and remote regions, respectively. The mesh was constructed by extruding the ground mesh, Figure 9. The total height of the domain was 4000 m above the local ground level. The first vertical cells have a height of 1 m (i.e. CFD resolution accuracy of 1 m on the ground) with the growth ratio of 1.05. Steady-state Reynolds-averaged Navier–Stokes (RANS) simulations with k-ε *realizable* turbulence model were employed and atmospheric boundary layer profile was implemented at boundaries to simulate 16 wind directions. For the inflow boundary profile, a reference speed of 4 m/s at height of 10 m was set with the roughness height of 0.02 m corresponding to Terrain Category 2 of AS/NZS 1170.2:2011. The residuals of all relevant parameters and monitor points around potential site options were monitored until converged solution was achieved. The second-order scheme was used to more accurately capture the flow features.

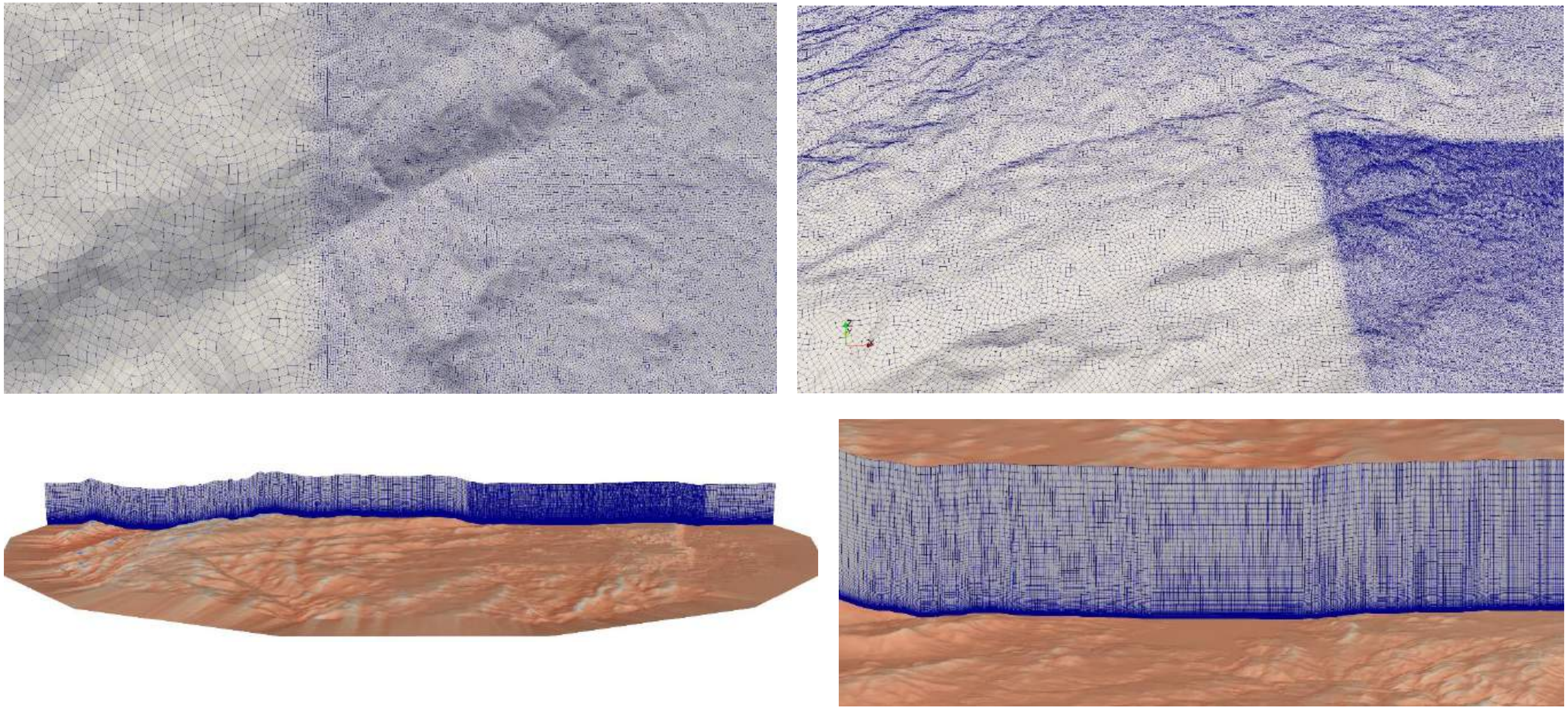


Figure 9. Mesh strategy and resolution

2.2 Global Wind Rose and Runway Alignment

To assess the general wind climate for the region, the 8 closest weather stations to the potential site locations were analysed and compared, Figure 1 and Figure 10. The arms of the wind rose point to the direction where the wind is coming from. From the comparison between the wind roses of different weather stations, it is evident that:

- The anemometer measurements are affected by both large-scale (e.g. mountain range) and small-scale (e.g. hills, ridge) topographical features;
- For almost all stations, except Cooma Airport, prevailing winds are from the west and north-west quadrants. This is observed both to the west and east of the mountain range;

- Anemometers that are largely affected by local topography (e.g. Thredbo, Perisher Valley) show biased directional wind characteristics and recorded higher wind speeds with flow travelling along the ridges;
- Generally lower wind speeds are measured at weather stations to the west of the Snowy Mountain (i.e. Khancoban and Albury).

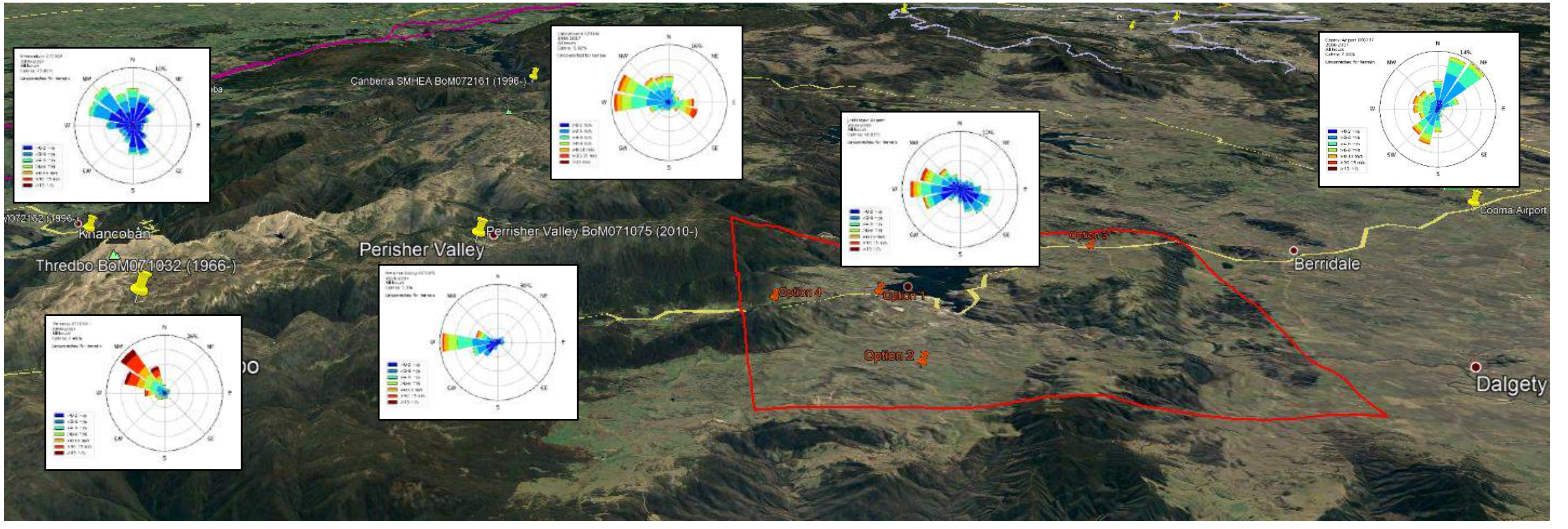


Figure 10. Wind roses for the NSW Snowy Mountain region (Google Earth)

For a more detailed study, the location of four weather stations closest to the potential site locations: Jindabyne Airport, Perisher Valley, Thredbo, and Khancoban were investigated using the results from the CFD analysis. Local wind speed and direction were determined for each station at heights of 10, 30, 60, 100, 150, 200 m above local ground level for all 16 incident wind directions. Local wind speeds and wind direction deviations at 10 m height are presented in Table 1. The deviation of local wind direction is the difference between the local wind direction and incident wind direction. If the deviation is positive, the local wind direction is clockwise from the far-field undisturbed wind direction, and if it is negative it is rotated counter-clockwise. The complete table of wind speed, direction and deviation of wind direction for weather stations for all selected heights are given in Appendix A1.

Table 1. Wind speed (T) and wind direction deviation (B) from incident wind direction at 10 m height from local ground.

Wind speed (m/s)

Weather station	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Jindabyne	3.0	3.9	3.4	3.5	3.8	4.5	3.8	3.9	3.5	3.1	2.8	2.3	3.1	2.5	3.5	3.2
Perisher Valley	3.5	4.6	4.7	3.2	2.4	1.8	1.6	2.2	3.3	3.4	2.9	3.2	1.8	1.7	2.8	3.2
Thredbo	2.8	3.1	2.6	3.4	4.2	4.7	5.4	3.8	4.2	3.6	3.2	2.0	3.0	2.5	2.6	2.8
Khancoban	3.8	4.4	2.3	4.3	3.3	2.3	3.1	3.4	4.1	4.8	4.3	3.3	2.6	2.0	2.3	2.8

Wind direction deviation (°)

Weather station	N 0	NNE 22.5	NE 45	ENE 67.5	E 90	ESE 112.5	SE 135	SSE 157.5	S 180	SSW 202.5	SW 225	WSW 247.5	W 270	WNW 292.5	NW 315	NNW 337.5
Jindabyne	2	2	5	10	7	-2	-4	-8	-12	-16	-7	-5	-1	-6	-1	-3
Perisher Valley	14	8	-7	-14	-19	-26	27	41	29	4	-11	-8	-11	-5	17	18
Thredbo	9	8	2	4	3	7	13	-9	-5	0	-3	-9	-5	-4	-5	9
Khancoban	12	3	17	7	-1	32	31	4	-7	-3	-15	-22	-12	-3	13	19

From Table 1, it is evident that the local wind direction is affected by local topography and deviates from the global incident wind direction. This is more significant for anemometers located in complex topography. For example, for winds from SSE at Perisher Valley, the local wind direction is rotated about 40° clockwise (i.e. local wind direction is from SSW). This is due to the orientation of the local ridgeline redirecting the flow as illustrated in Figure 11. Most instances of large deviation in wind direction are associated with wind shear (i.e. rate of change of wind speed with height, Appendix A1) which is a characteristic of such phenomena. In cases where significant wind shear is not present, the flow deviation is caused by the influence of large topographical features such as the anemometer located just downwind of the great mountain range (e.g. Khancoban for winds from the ESE and SE).

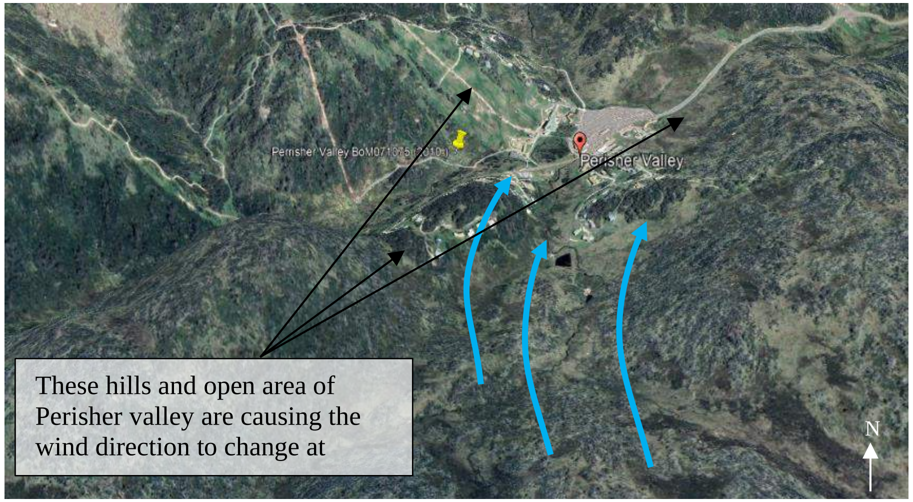


Figure 11. Topography surrounding Perisher Valley

An issue with measured anemometer data in regions of topographical influence, is that it is impossible to accurately determine the probabilistic contribution of each incident wind direction towards the local wind direction, particularly when the deviation is greater than 10°. To best assess the prevalent global wind directions, stations showing the smallest deviation in wind direction are more reliable. Perisher Valley and Khancoban show significant local wind direction deviations for most incident wind directions, especially for the measured prevailing wind directions. Perisher Valley weather station is located in a valley surrounded by a few hills and Khancoban is located to the immediate west of the mountain range. Thredbo shows deviation of in excess of 9° for a few wind directions, especially for prevailing winds from west and south-east. The deviation of 9° for winds from WSW with very low wind speed of about 2 m/s is an indicator of being in the wake of larger topography, which is confirmed as Thredbo located to the south-east of the ridgeline, Figure 12.

The results from the CFD analysis of Jindabyne Airport anemometer shows considerably less deviation in the local wind direction compared with the other weather stations. The largest deviations occur for winds from the south and south-south-west. This is caused by the hills to the immediate south and further north of the weather station redirecting the wind, Figure 13. At elevations above the local topography there is reduced impact, see Appendix A1. Above 100 m from local ground level, the deviation of wind direction reduces below 10°.

It can be seen from Table 1 that the measured local wind directions for winds from the south and south-south-west are mildly skewed clockwise. This means that to correct the wind rose, a portion of the probabilities in the south segment of the wind rose should be shifted to south-south-west and from south-south-east to the south. The winds from the south and south-south-west have low probability of occurrence of less than 5% of the time in total, Figure 14, hence would not alter local or global wind rose.

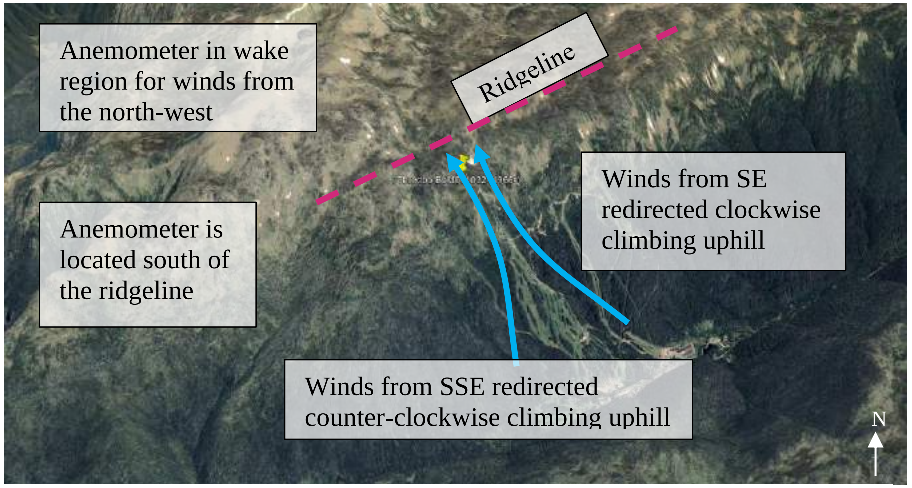


Figure 12. Topography surrounding Thredbo

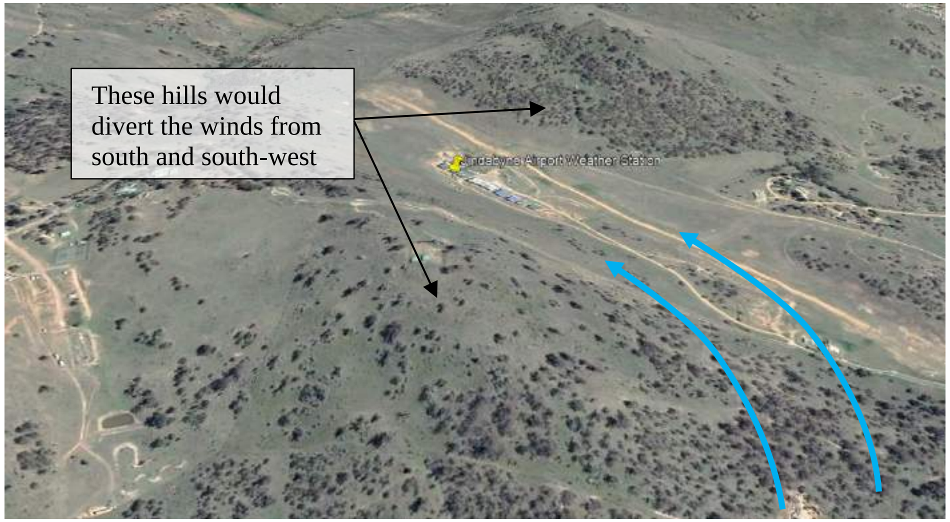


Figure 13. Topography surrounding Jindabyne Airport

Another indicator of Jindabyne Airport anemometer being better located and more reliable is that the CFD wind speeds at different heights above the Jindabyne Airport weather station show a similar pattern to the natural boundary distribution (i.e. little wind shear), or less variation in wind speed for different wind directions. This indicates that topographical impacts on the measured wind speeds are minimal.

Based on the above discussion, the Jindabyne Airport wind rose, Figure 14, does not require further correction to approximate the global wind rose, due to the lower wind direction deviation, and lesser wind shear.

Hence the measured wind rose at Jindabyne Airport is considered appropriate as the global incident wind rose. Based on the wind rose, it is considered that the runway orientation should be aligned WNW/ESE (relative to true north) to minimise the probability of crosswind events.

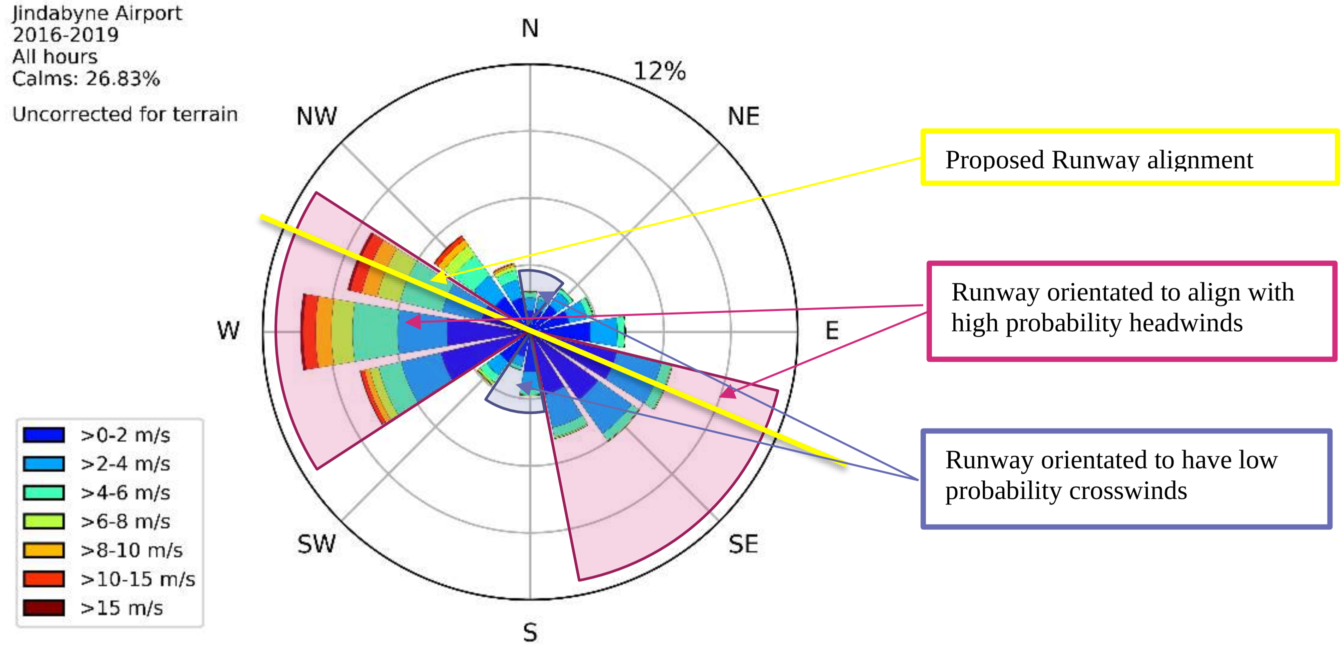


Figure 14. Jindabyne Airport wind rose and potential runway alignment

2.3 Wind climate for Assessing Site Options

2.3.1 Methodology

The wind speed and direction at the centre point of the four potential runway options, Figure 7, at a height of 10 m above local ground level (standard anemometer height) was evaluated. These results represent what would have been recorded if an anemometer was located at these locations. The single point data provides an estimate of the deviation of wind direction from the undisturbed far-field wind direction. However, single point measurement does not reflect the local wind condition around the potential site location or along the glide slopes to the runway. This is the inherent shortfall of full-scale site measurement with a single point anemometer. In addition, the point at the centre of the runway is an indicative representation of the local wind conditions and is not critical for aircraft operations; hence multiple points along runway should be monitored to yield a better estimation of local wind direction deviation. This is where CFD simulation is beneficial, as it evaluates the wind conditions in the entire modelled computational domain allowing area averaging over surface of interest. The surface of most interest would be along the preferred flight path to the runway depending on the runway alignment. Hence an iterative approach has to be used with of the following steps.

- **Step 1** - Assess the local wind direction deviation from the incident wind direction at the centre of potential runway options at a height of 10 m above the local ground level to estimate the suitability of the runway and preferred runway alignment. This would be a high-level assessment of runway alignment (±22.5°) as it is reliant on a single point.
- **Step 2** - To refine the preferred runway alignment, the variation of local wind direction in a surface containing potential glide-slopes for a headwind for each incident wind direction would be evaluated. This surface encompasses a segment centred at the centre of runway with a radius of 3 km and the angle ±22.5° from the preferred runway alignment defined during Step 1, Figure 15. The averaged deviation of the local wind direction in this segment would show if the initial runway alignment needs adjusted.

It is important to state that since the scenarios are simulated for 16 wind directions (interval of 22.5°), the resolution of runway alignment is at best about ±10°.

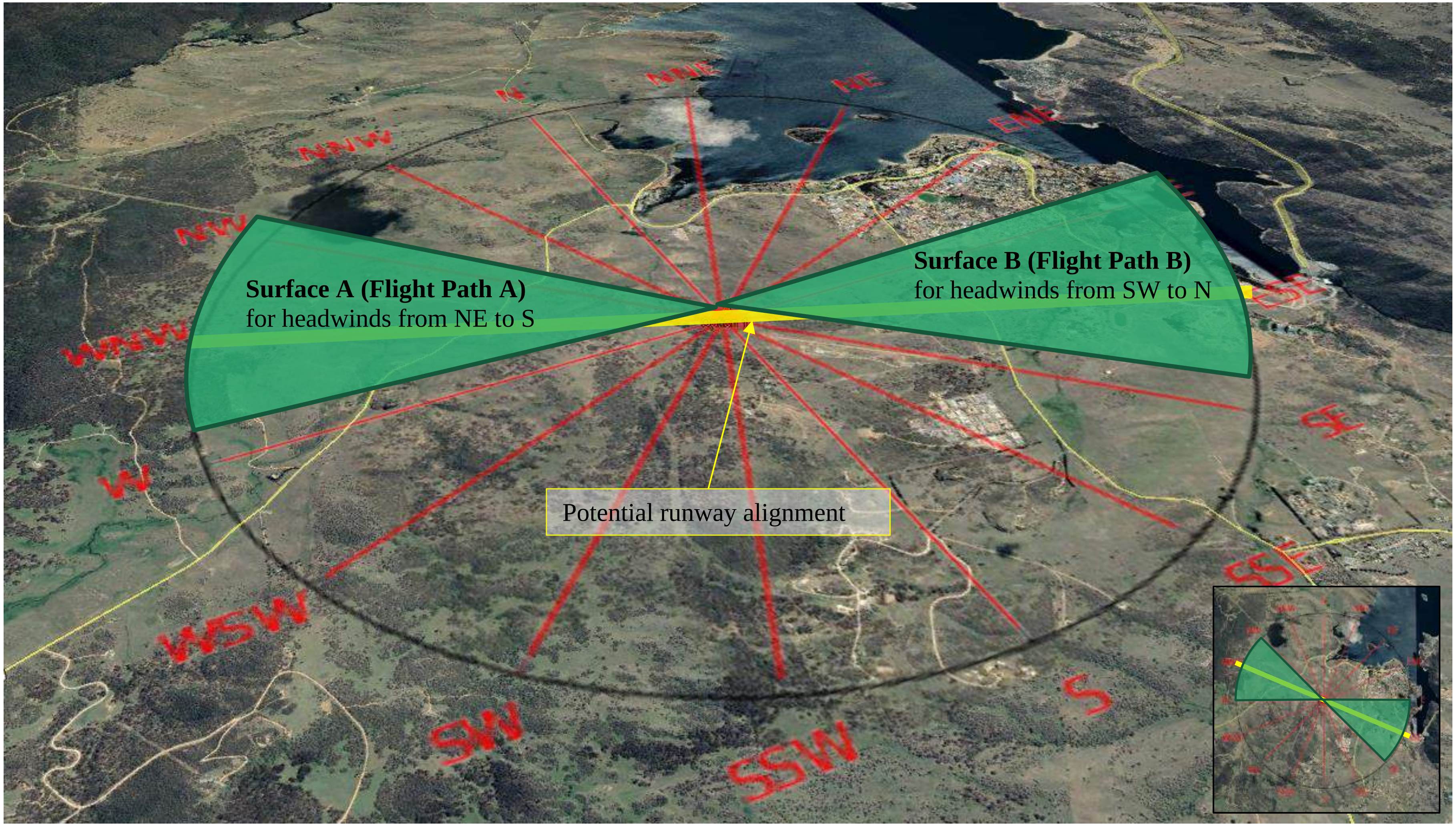


Figure 15. Example of directional averaging area for Option 1 for Step 2 assessment

2.3.2 Step 1. Runway alignment with single point data

Local wind speed, wind direction, and deviation of local wind direction from incident wind direction for Options 1 to 4 for all wind directions and elevations are provided in Appendix A2. The wind speed and directional deviation data at 10 m height above the centre of the runway for all site options are shown in Table 2. The positive and negative deviation values indicate whether the local wind direction has been redirected clockwise, or anti-clockwise respectively.

Table 2. Local wind speed and direction deviation at potential site options at 10 m height from local ground level

Wind Speed (m/s)

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Option1	3.5	4.7	4.0	3.5	3.2	3.3	3.1	3.7	3.9	3.5	3.2	2.7	2.1	2.4	3.1	3.2
Option2	3.1	3.9	3.3	3.4	3.8	3.9	4.1	3.7	3.1	3.0	2.9	2.9	2.9	2.9	3.2	2.7
Option3	3.5	3.8	4.0	3.8	4.0	3.7	3.9	3.4	3.4	3.5	3.3	3.0	3.0	2.7	3.5	3.5
Option4	2.4	3.4	4.1	3.5	3.3	2.6	2.0	1.5	2.0	3.4	3.4	2.9	2.5	2.2	0.3	1.0

Wind direction deviation (°)

	N 0	NNE 22.5	NE 45	ENE 67.5	E 90	ESE 112.5	SE 135	SSE 157.5	S 180	SSW 202.5	SW 225	WSW 247.5	W 270	WNW 292.5	NW 315	NNW 337.5
Option1	6	2	-2	2	2	1	2	1	-4	-8	-9	-10	-13	0	2	3
Option2	1	1	6	5	0	-3	1	-4	-9	-9	-2	5	5	5	1	0
Option3	2	8	3	5	5	1	2	3	5	3	-2	-6	-9	-10	-11	-8
Option4	33	20	6	4	15	31	34	50	23	21	5	21	25	50	31	39

Option 1:

Deviation of the local wind direction is in the range of -13° to +6°. For prevalent winds from the west quadrant, this deviation is about -13°. This means that based on a single data point result, the optimized orientation of the runway would be 13° counter-clockwise from WNW. For prevalent winds from the south-east, the local wind direction deviation is negligible; hence, the runway would be oriented correctly based on the global wind rose.

It should be noted that the wind direction deviation diminishes at higher elevations for almost all wind directions. This is an indicator of local topographical features, including surrounding local hills, causing these deviations and at the higher elevations the impact reduces. If these deviations are minor, then they would not impact on aircraft operations.

Option 2:

In general, Option 2 has lower deviation of local wind directions compared with Option 1, since there are fewer hills and less varying topography. Maximum devotion is about -9 degree for winds from the south which is an infrequent wind direction. For prevalent winds, the local wind direction is rotated within the range of ±5° to the incident wind direction. Hence, the runway orientation assumed for this option based on Jindabyne wind rose is valid.

Option 3:

The range of deviation of wind direction and the far-field direction that are getting deviated are similar to Option 1. For prevalent winds from the west quadrant, the deviation is about -10° which means the optimal runway orientation based on the prevalent winds from west should be rotated °10 counter-clockwise from WNW.

Option 4:

Option 4 shows considerable wind flow deviation from the incident wind direction as the flow is channelled up the valley. Due to the valley topography, the runway would need to be orientated at about 90° to the prevailing wind directions from the west. Approaching aircraft would therefore be susceptible to a cross-flight wind at elevation, which then changed to a headwind closer to ground level. The switch in wind direction would be associated with an area of high turbulence. This option is not considered viable from a prevailing wind perspective; hence it would not be considered in Step 2.

2.3.3 Step 2. Runway alignment with multiple points data

Contour plots of local wind speed and direction in an area with a radius of 3 km around the centre of the runway for each of the four site options at height of 10, 30, 60, 100, 150 and 200 m above the local ground are presented in Appendix A3.1 and for horizontal surfaces above the centre of runway at the selected heights in Appendix A3.2. The contour plots for prevalent wind directions for winds from WNW and SE are shown in Figure 16. It is evident the general wind speed is similar across the height plane for all Options except for Option 4 where there is considerable variability in wind speed and direction.

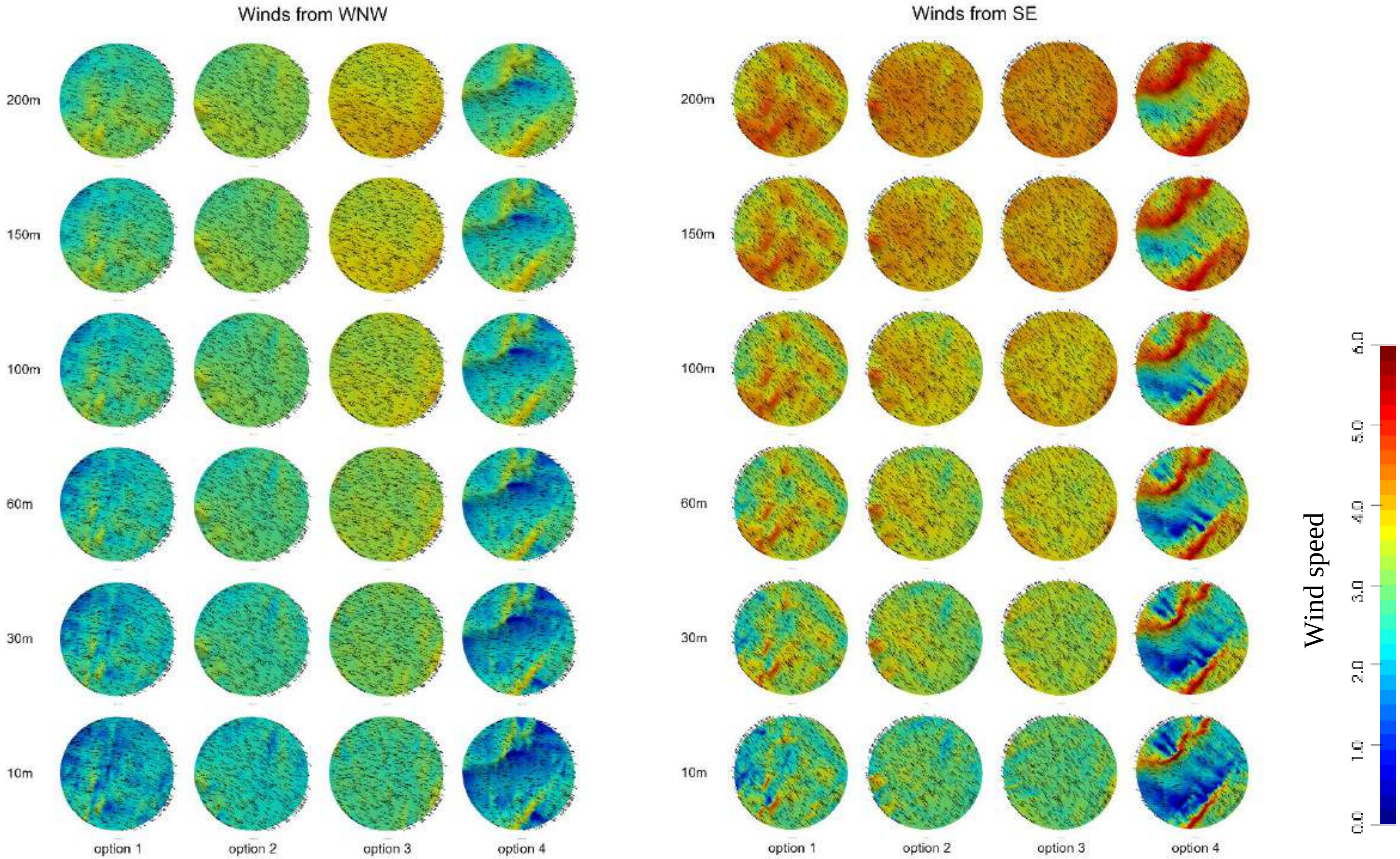


Figure 16. Wind speed and direction plots at various heights for the four configurations for prevailing wind directions

The variability of wind direction across Surfaces A and B as defined in Figure 15 for Options 1 to 3 at various heights is presented in Figure 17, with the average deviation presented in Table 3. The spread of data in Figure 17 indicates the level of variability in the flow field across the approach volume. The narrower the bands the less variability in local wind direction. Unsurprisingly, there is greater directional variability closer to the ground.

Generally, the wind conditions in all these areas are similar, with Option 1 being slightly more varied due to the local topography. It is evident from Table 3 that the average deviation from the incident wind direction is less than 10° for all height and locations.

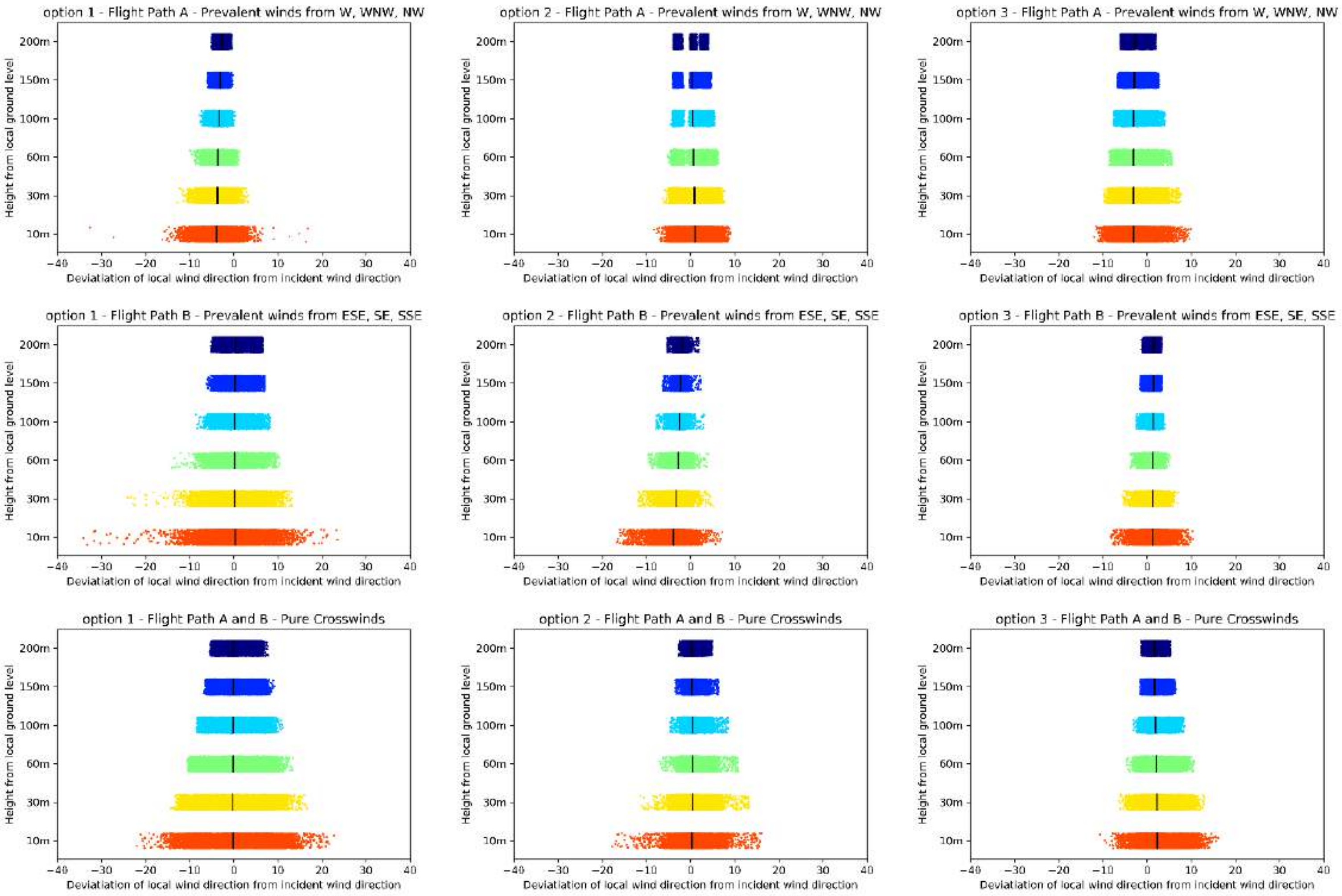


Figure 17. Variability in local wind direction across assessment surfaces for Options 1 to 3 at various heights

Table 3. Area averaged wind direction deviation

Option 1		Cross-wind				Flight Path A				Cross-wind			Flight Path B			
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10m	2	4	3	2	-2	-3	-1	5	3	-4	-7	-6	-2	-3	5	1
30m	2	3	2	2	-2	-2	-1	4	2	-4	-7	-5	-3	-3	4	1
60m	2	3	2	2	-2	-2	-1	4	2	-3	-6	-5	-3	-3	4	2
100m	2	3	2	1	-2	-2	-1	4	2	-3	-6	-4	-2	-3	4	2
150m	2	2	2	1	-2	-2	0	4	2	-3	-5	-4	-2	-3	4	2
200m	1	2	2	0	-2	-2	0	4	2	-2	-5	-4	-2	-2	4	2

Option 2	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10m	3	2	5	2	-1	-4	-3	-5	-2	-1	-1	-3	2	5	7	4
30m	3	2	4	1	-1	-3	-2	-4	-1	-1	-1	-3	2	4	7	4
60m	3	1	4	1	-1	-3	-2	-3	-1	-1	-1	-3	1	4	7	4
100m	3	1	3	0	-2	-3	-2	-2	0	0	0	-3	1	4	7	4
150m	3	1	2	0	-2	-2	-2	-2	1	0	0	-3	1	3	6	3
200m	3	1	1	0	-2	-2	-2	-1	1	0	0	-3	1	3	6	3

Option 3	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10m	-1	4	6	4	2	1	2	1	5	0	0	1	-4	-6	-8	-7
30m	0	4	6	3	2	1	2	1	4	0	0	1	-4	-6	-8	-6
60m	0	4	5	3	2	1	2	2	4	0	0	0	-4	-6	-7	-6
100m	0	3	4	3	1	1	2	2	3	1	0	0	-4	-5	-6	-5
150m	0	3	3	2	1	0	1	2	3	1	0	0	-4	-5	-5	-4
200m	1	2	3	2	1	0	1	3	3	1	0	0	-3	-5	-4	-3

3 Discussion and Conclusions

Based on the presented information, the wind conditions across the Snowy Mountains are complex due to the local topography. In general, the available meteorological data are strongly affected by the local topography close to the anemometer. Wind speed corrections can be made to the data, but directional shifts cannot be made with confidence without knowledge of the global incident wind direction. Combined with the CFD analysis at the anemometer locations, it is evident that the Jindabyne Airport anemometer data is the most appropriate to assess the general global wind conditions.

The high-level analysis indicates that Option 4 would be unsuitable for the Runway as the local wind direction is considerably different to the incident wind direction for the prevailing wind directions. A more detailed assessment indicates that the wind conditions at Options 2 and 3 would be marginally better than Option 1. For all Options 1 to 3, the recommended runway alignment would be best orientated along ESE/WNW (relative to true north). To minimise the impact of cross-flight wind conditions, whilst allowing flexibility for ground works and infrastructure, the Runway could be orientated between 90°/270° and 120°/300° true north or (78°/258° and 108°/288° magnetic north)

Appendix A |

Detailed Analysis of CFD Results

A1 Wind conditions at weather stations

Table 4. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Jindabyne Airport anemometer.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	3.0	3.9	3.4	3.5	3.8	4.5	3.8	3.9	3.5	3.1	2.8	2.3	3.1	2.5	3.5	3.2
30 m	3.7	4.6	4.0	4.1	4.4	5.2	4.4	4.5	4.1	3.9	3.4	2.9	3.6	2.8	4.0	3.8
60 m	4.1	5.2	4.4	4.4	4.9	5.6	4.7	4.9	4.6	4.4	4.1	3.6	3.9	3.0	4.3	4.3
100 m	4.5	5.6	4.9	4.8	5.4	5.8	5.1	5.3	5.0	4.8	4.6	4.2	4.1	3.3	4.6	4.8
150 m	4.8	6.0	5.4	5.1	5.8	6.1	5.4	5.8	5.4	5.2	5.1	4.6	4.4	3.6	4.9	5.4
200 m	5.0	6.3	5.7	5.4	6.0	6.4	5.7	6.1	5.7	5.5	5.5	5.0	4.6	3.8	5.0	5.8

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	2	24	50	77	97	111	131	150	168	186	218	243	269	286	314	334
30 m	2	24	49	77	97	112	132	152	169	189	218	243	268	287	316	335
60 m	3	25	48	76	96	113	133	153	171	191	218	243	267	287	318	336
100 m	3	25	47	74	95	114	133	155	173	193	218	243	266	288	320	338
150 m	2	25	46	72	94	115	134	156	175	195	219	243	266	289	321	339
200 m	2	25	46	70	93	116	135	157	176	197	219	243	266	290	321	339

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	2	2	5	10	7	-2	-4	-8	-12	-16	-7	-5	-1	-6	-1	-3
30 m	2	2	4	9	7	-1	-3	-6	-11	-14	-7	-5	-2	-6	1	-2
60 m	3	2	3	8	6	1	-2	-4	-9	-12	-7	-5	-3	-6	3	-1
100 m	3	2	2	6	5	2	-2	-3	-7	-10	-7	-5	-4	-5	5	0
150 m	2	3	1	4	4	3	-1	-2	-6	-8	-7	-5	-4	-4	6	1
200 m	2	3	1	2	3	3	0	-1	-4	-6	-6	-4	-4	-3	6	2

Table 5. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Perisher Valley anemometer.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	3.5	4.6	4.7	3.2	2.4	1.8	1.6	2.2	3.3	3.4	2.9	3.2	1.8	1.7	2.8	3.2
30 m	4.2	5.6	5.5	3.6	2.7	2.3	2.2	2.6	3.6	3.9	3.3	3.7	2.1	2.2	3.3	3.8
60 m	4.7	6.0	6.1	4.0	3.1	3.4	3.3	3.3	4.0	4.4	3.9	4.1	2.5	2.7	3.6	4.2
100 m	5.1	6.3	6.4	4.5	3.6	4.6	4.5	4.4	4.6	5.0	4.6	4.4	3.0	3.3	3.9	4.5
150 m	5.4	6.5	6.6	4.9	4.3	5.4	5.5	5.3	5.1	5.5	5.1	4.6	3.5	3.7	4.1	4.8
200 m	5.6	6.7	6.8	5.3	4.9	5.7	6.3	5.9	5.5	5.9	5.5	4.8	3.8	4.1	4.2	5.1

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	14	31	38	53	72	86	162	198	209	207	214	240	259	287	332	355
30 m	13	29	40	55	74	99	152	189	204	205	214	239	261	291	332	355
60 m	12	28	43	58	78	111	142	176	194	203	215	239	264	294	330	354
100 m	11	27	45	61	83	114	138	165	185	201	216	239	267	295	329	352
150 m	10	27	47	63	86	114	136	159	180	200	218	239	268	296	327	350
200 m	9	26	48	65	89	113	135	156	177	200	219	240	268	296	326	348

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	14	8	-7	-14	-19	-26	27	41	29	4	-11	-8	-11	-5	17	18
30 m	13	7	-5	-13	-16	-13	17	32	24	3	-11	-8	-9	-2	17	18
60 m	12	6	-2	-10	-12	-2	7	18	14	0	-10	-9	-6	1	15	17
100 m	11	5	0	-7	-7	1	3	8	5	-2	-9	-9	-4	3	14	15
150 m	10	4	2	-4	-4	1	1	2	0	-2	-7	-8	-2	3	12	12
200 m	9	4	3	-2	-1	1	0	-1	-3	-2	-6	-8	-2	3	11	10

Table 6. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Thredbo anemometer.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	2.8	3.1	2.6	3.4	4.2	4.7	5.4	3.8	4.2	3.6	3.2	2.0	3.0	2.5	2.6	2.8
30 m	3.1	3.5	2.9	3.7	4.6	4.9	5.6	4.2	4.8	4.0	3.8	2.3	3.6	2.9	3.0	3.1
60 m	3.6	4.2	3.3	4.0	4.9	4.8	5.3	4.5	5.2	4.5	4.3	2.7	4.3	3.6	3.4	3.6
100 m	4.2	4.9	3.8	4.3	5.2	4.7	5.0	4.8	5.6	4.9	4.7	3.2	4.7	4.3	3.8	4.1
150 m	4.7	5.5	4.3	4.7	5.5	4.8	4.8	5.1	5.9	5.3	5.2	3.8	5.0	5.0	4.2	4.6
200 m	5.2	6.0	4.8	5.0	5.8	4.9	4.7	5.5	6.3	5.7	5.5	4.3	5.2	5.5	4.5	4.9

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	9	31	47	72	93	119	148	148	175	202	222	239	265	289	310	346
30 m	8	30	46	71	92	118	146	149	175	202	224	240	266	288	311	345
60 m	6	29	46	72	91	115	144	149	176	202	225	243	267	287	312	344
100 m	4	29	45	72	90	112	140	149	177	202	226	245	268	289	313	344
150 m	3	28	45	72	89	110	136	150	177	202	226	246	269	291	314	343
200 m	2	28	45	73	89	110	133	151	178	202	226	247	270	293	314	343

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	9	8	2	4	3	7	13	-9	-5	0	-3	-9	-5	-4	-5	9
30 m	8	8	1	4	2	6	11	-9	-5	-1	-2	-7	-4	-5	-4	8
60 m	6	7	1	4	1	2	9	-9	-4	-1	0	-5	-3	-5	-3	7
100 m	4	6	0	5	0	-1	5	-8	-3	0	1	-3	-2	-4	-2	6
150 m	3	6	0	5	-1	-2	1	-7	-3	0	1	-1	-1	-2	-1	6
200 m	2	5	0	5	-1	-3	-2	-6	-3	0	1	-1	0	0	-1	5

Table 7. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Khancoban anemometer.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	3.8	4.4	2.3	4.3	3.3	2.3	3.1	3.4	4.1	4.8	4.3	3.3	2.6	2.0	2.3	2.8
30 m	4.0	4.6	2.4	4.6	3.7	2.3	3.3	3.7	4.3	5.0	4.4	3.6	2.9	2.3	2.6	3.1
60 m	4.4	4.8	2.4	4.9	4.2	2.3	3.6	4.1	4.6	5.2	4.6	3.9	3.4	2.8	3.1	3.5
100 m	4.7	5.0	2.5	5.2	4.7	2.3	3.9	4.5	4.9	5.4	4.9	4.3	3.8	3.3	3.5	4.0
150 m	5.0	5.2	2.6	5.6	5.2	2.4	4.2	4.9	5.2	5.6	5.2	4.7	4.3	3.8	4.0	4.5
200 m	5.3	5.4	2.9	5.8	5.6	2.7	4.4	5.2	5.4	5.8	5.4	5.0	4.6	4.1	4.3	4.8

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	12	25	62	75	89	145	166	162	173	199	211	226	259	290	328	356
30 m	10	25	60	74	89	142	164	162	174	199	212	228	260	290	326	354
60 m	8	25	57	73	90	137	162	162	175	199	214	231	261	291	325	351
100 m	7	25	53	73	90	132	160	162	175	199	215	234	262	291	323	348
150 m	6	24	49	72	91	126	158	161	176	199	217	236	263	291	322	346
200 m	5	24	45	72	92	123	157	161	176	199	218	238	263	292	321	345

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	12	3	17	7	-1	32	31	4	-7	-3	-15	-22	-12	-3	13	19
30 m	10	2	15	7	-1	29	29	5	-6	-4	-13	-20	-11	-2	11	16
60 m	8	2	12	6	-1	24	27	5	-5	-4	-11	-17	-9	-2	10	13
100 m	7	2	8	5	0	19	25	5	-5	-4	-10	-14	-8	-1	8	10
150 m	6	2	4	5	1	14	23	4	-4	-3	-8	-11	-8	-1	7	9
200 m	5	2	0	4	2	10	22	3	-4	-3	-7	-9	-7	-1	6	7

A2 Wind conditions at single point for potential site options

Table 8. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Option 1.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	3.5	4.7	4.0	3.5	3.2	3.3	3.1	3.7	3.9	3.5	3.2	2.7	2.1	2.4	3.1	3.2
30 m	3.9	5.1	4.5	4.1	3.9	4.4	4.3	4.3	4.3	3.9	3.6	3.0	2.6	2.7	3.4	3.6
60 m	4.2	5.4	5.0	4.5	4.5	5.0	4.7	4.8	4.8	4.3	4.1	3.4	3.3	2.8	3.8	4.0
100 m	4.4	5.7	5.4	4.9	4.9	5.5	5.0	5.3	5.1	4.7	4.7	4.0	3.8	2.8	4.2	4.6
150 m	4.6	5.9	5.7	5.3	5.3	5.8	5.2	5.7	5.5	5.1	5.2	4.6	4.1	3.0	4.5	5.1
200 m	4.8	6.1	6.0	5.7	5.7	6.0	5.3	6.0	5.7	5.3	5.5	5.1	4.3	3.1	4.7	5.6

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	6	24	43	69	92	114	137	158	176	194	216	238	257	292	317	341
30 m	6	25	45	71	93	113	135	158	176	194	216	238	260	290	317	341
60 m	6	25	46	72	93	113	135	158	176	193	216	238	262	288	319	340
100 m	5	26	47	71	93	113	134	158	176	194	216	239	263	286	320	340
150 m	4	26	46	70	93	114	134	158	176	195	217	240	264	285	321	340
200 m	3	26	46	69	92	115	134	158	177	197	219	241	264	286	321	340

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	6	2	-2	2	2	1	2	1	-4	-8	-9	-10	-13	0	2	3
30 m	6	2	0	3	3	1	0	0	-4	-9	-9	-10	-10	-2	2	3
60 m	6	3	1	4	3	1	-1	0	-4	-9	-9	-9	-8	-5	4	3
100 m	5	3	2	4	3	1	-1	0	-4	-9	-9	-9	-7	-6	5	3
150 m	4	4	1	3	3	2	-1	0	-4	-7	-8	-7	-6	-7	6	3
200 m	3	3	1	2	2	2	-1	0	-3	-6	-7	-6	-6	-7	6	3

Table 9. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Option 2.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	3.1	3.9	3.3	3.4	3.8	3.9	4.1	3.7	3.1	3.0	2.9	2.9	2.9	2.9	3.2	2.7
30 m	3.7	4.6	3.8	3.9	4.3	4.4	4.6	4.5	3.8	3.6	3.5	3.4	3.6	3.5	3.7	3.2
60 m	4.2	5.2	4.3	4.3	4.7	4.6	5.0	4.9	4.2	4.1	4.0	4.0	4.0	3.7	4.0	3.7
100 m	4.8	5.7	4.9	4.8	5.1	4.8	5.5	5.2	4.4	4.5	4.5	4.5	4.3	3.8	4.3	4.2
150 m	5.3	6.1	5.4	5.2	5.5	5.1	5.9	5.5	4.7	4.9	4.9	4.9	4.6	3.9	4.5	4.6
200 m	5.7	6.4	5.8	5.6	5.8	5.6	6.2	5.7	4.9	5.2	5.2	5.2	4.8	4.0	4.7	5.0

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	1	24	51	72	90	110	136	153	171	194	223	253	275	298	316	338
30 m	2	24	50	71	90	110	136	153	173	195	223	250	274	299	317	339
60 m	3	24	50	70	90	110	135	154	174	197	223	248	273	299	319	341
100 m	4	24	49	69	90	111	135	154	176	199	223	246	272	299	322	341
150 m	4	24	48	68	89	112	135	155	178	201	224	245	271	298	324	341
200 m	4	25	47	67	89	113	135	156	179	202	224	244	271	298	325	341

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	1	1	6	5	0	-3	1	-4	-9	-9	-2	5	5	5	1	0
30 m	2	1	5	4	0	-3	1	-4	-7	-8	-2	3	4	6	2	2
60 m	3	1	5	3	0	-2	0	-4	-6	-6	-2	0	3	6	4	3
100 m	4	1	4	2	-1	-2	0	-3	-4	-4	-2	-2	2	6	7	4
150 m	4	2	3	1	-1	-1	0	-2	-2	-2	-1	-3	1	6	9	4
200 m	4	2	2	0	-1	0	0	-1	-1	-1	-1	-3	1	5	10	3

Table 10. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Option 3.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	3.5	3.8	4.0	3.8	4.0	3.7	3.9	3.4	3.4	3.5	3.3	3.0	3.0	2.7	3.5	3.5
30 m	3.9	4.1	4.4	4.3	4.6	4.6	4.5	3.8	3.9	3.9	3.7	3.5	3.3	3.2	4.0	4.1
60 m	4.2	4.4	4.8	4.7	5.0	5.1	4.9	4.3	4.2	4.3	4.1	4.1	3.8	3.6	4.4	4.4
100 m	4.5	4.6	5.1	5.0	5.3	5.5	5.4	4.9	4.7	4.8	4.5	4.7	4.3	4.0	4.8	4.6
150 m	4.8	5.0	5.4	5.3	5.5	5.7	5.8	5.5	5.1	5.3	5.0	5.3	4.7	4.4	5.1	4.9
200 m	5.2	5.3	5.6	5.6	5.7	5.9	5.9	6.0	5.5	5.8	5.4	5.7	5.0	4.8	5.4	5.2

B. Local wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	2	30	48	73	95	113	137	160	185	206	223	241	261	283	304	330
30 m	2	30	48	71	94	113	136	159	184	205	224	243	261	283	305	331
60 m	2	29	48	71	93	113	136	158	183	204	224	244	261	283	305	331
100 m	2	28	47	70	92	113	136	158	183	203	225	245	261	283	306	332
150 m	2	27	46	69	91	112	136	158	182	201	224	245	262	284	308	334
200 m	2	26	46	68	91	112	135	159	181	201	224	245	262	284	309	335

C. Deviation of local wind direction from undisturbed wind direction

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	2	8	3	5	5	1	2	3	5	3	-2	-6	-9	-10	-11	-8
30 m	2	7	3	4	4	1	1	1	4	3	-1	-5	-9	-10	-10	-7
60 m	2	6	3	3	3	1	1	0	3	2	-1	-4	-9	-10	-10	-6
100 m	2	5	2	2	2	0	1	0	3	0	-1	-3	-9	-9	-9	-5
150 m	2	4	1	2	1	0	1	1	2	-1	-1	-3	-8	-9	-7	-4
200 m	2	3	1	1	1	-1	0	1	1	-2	-1	-3	-8	-8	-6	-3

Table 11. Wind speed, local wind direction, and deviation of local wind direction from undisturbed wind direction for Option 4.

A. Wind Speed

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	2.4	3.4	4.1	3.5	3.3	2.6	2.0	1.5	2.0	3.4	3.4	2.9	2.5	2.2	0.3	1.0
30 m	2.8	3.9	4.7	4.0	3.8	2.9	2.3	1.6	2.3	3.6	3.9	3.3	2.8	2.3	0.5	1.2
60 m	3.3	4.5	5.2	4.5	4.2	3.3	2.8	1.9	2.6	3.8	4.3	3.7	3.0	2.3	1.0	1.6
100 m	3.8	5.2	5.7	5.0	4.7	3.8	3.4	2.3	3.1	4.0	4.6	4.0	3.3	2.3	1.3	2.5
150 m	4.3	5.7	6.1	5.6	5.2	4.5	4.1	2.9	3.7	4.3	5.0	4.4	3.6	2.4	1.5	3.5
200 m	4.7	6.1	6.4	5.9	5.7	5.1	4.6	3.6	4.2	4.7	5.3	4.7	3.9	2.5	1.4	4.3

B. Local wind direction

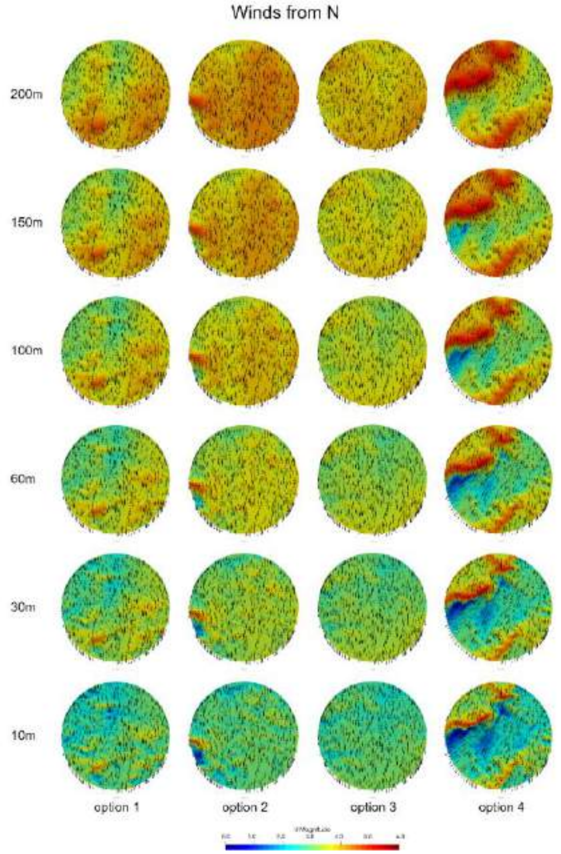
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	33	42	51	63	75	82	101	207	203	223	220	227	245	243	346	39
30 m	31	40	49	64	76	83	106	198	199	221	221	229	247	245	345	29
60 m	27	38	49	66	78	86	113	185	194	217	221	231	248	250	348	14
100 m	22	36	48	68	80	90	120	173	189	213	222	234	251	256	348	3
150 m	17	34	49	69	82	95	125	165	185	209	223	236	253	264	346	357
200 m	14	33	50	69	84	99	129	160	183	207	223	238	255	271	341	354

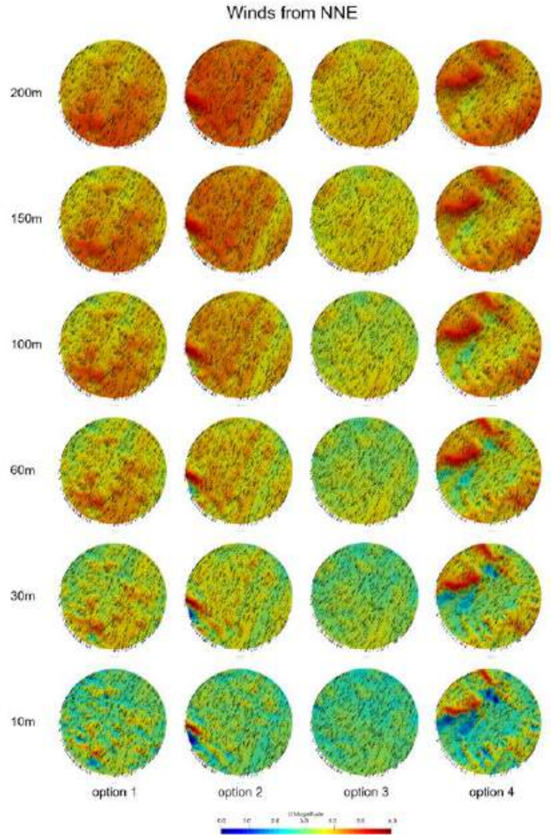
C. Deviation of local wind direction from undisturbed wind direction

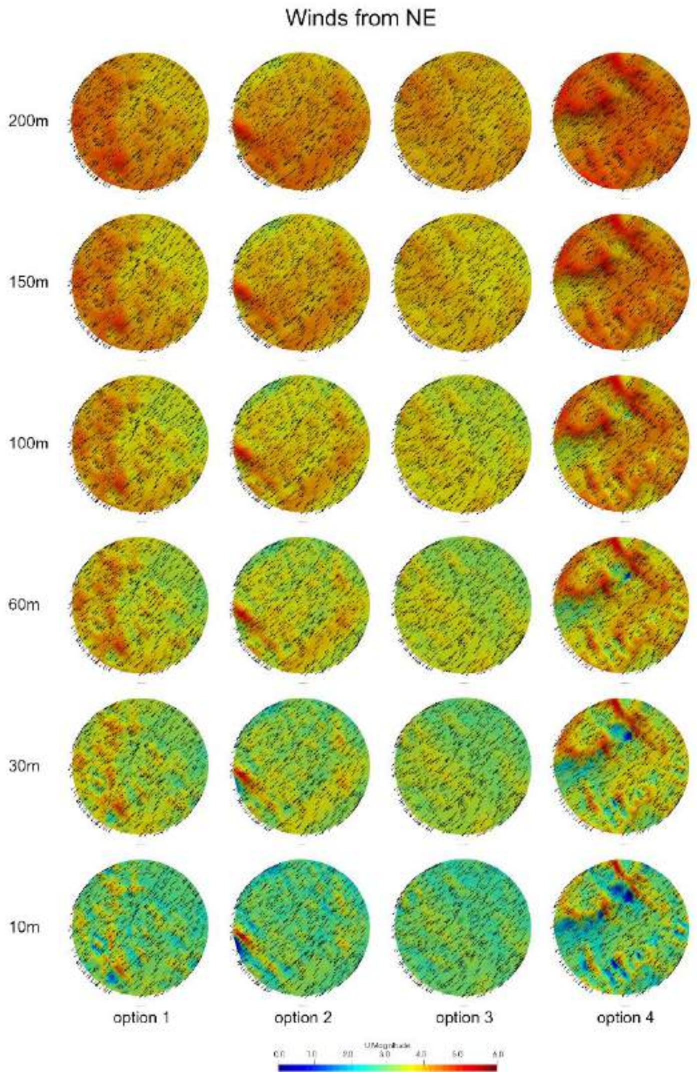
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10 m	33	20	6	4	15	31	34	50	23	21	5	21	25	50	31	39
30 m	31	18	4	4	14	29	29	41	19	18	4	19	23	48	30	29
60 m	27	15	4	2	13	27	22	28	14	15	4	17	22	43	33	14
100 m	22	13	3	0	10	23	16	16	9	11	3	14	19	37	33	17
150 m	17	11	4	2	8	18	10	7	5	7	3	12	17	29	31	19
200 m	14	10	5	2	6	14	7	2	3	4	2	10	15	22	26	16

A3 Contour plots of wind speed and direction

A3.1 For area of 3 km around potential options at selected heights above local ground level (offset surfaces)



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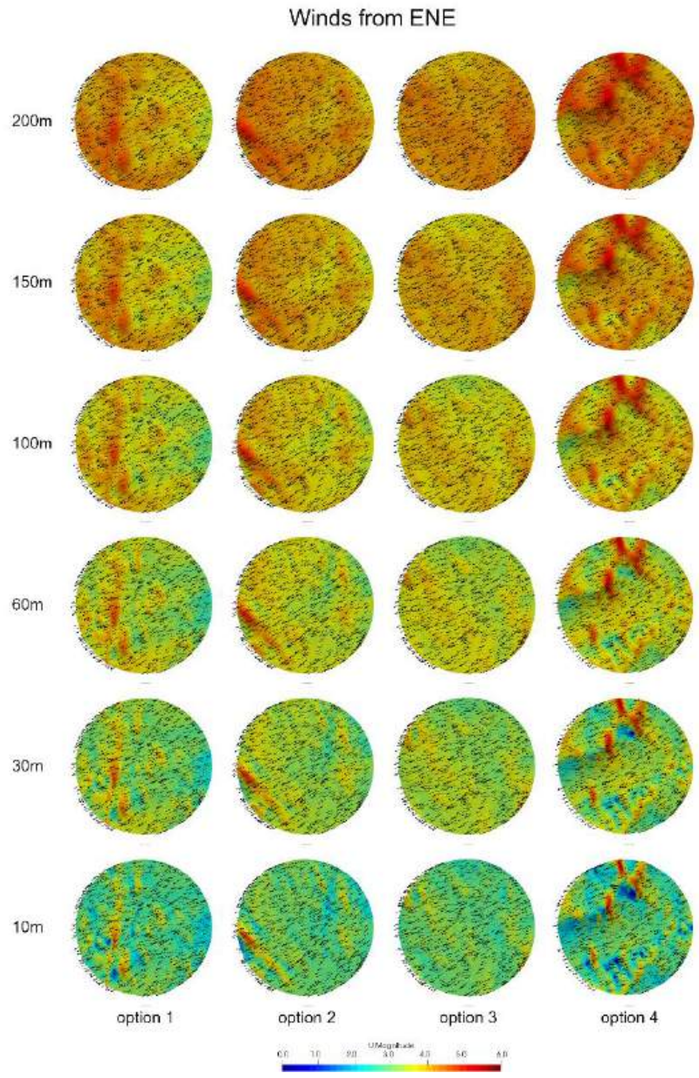
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4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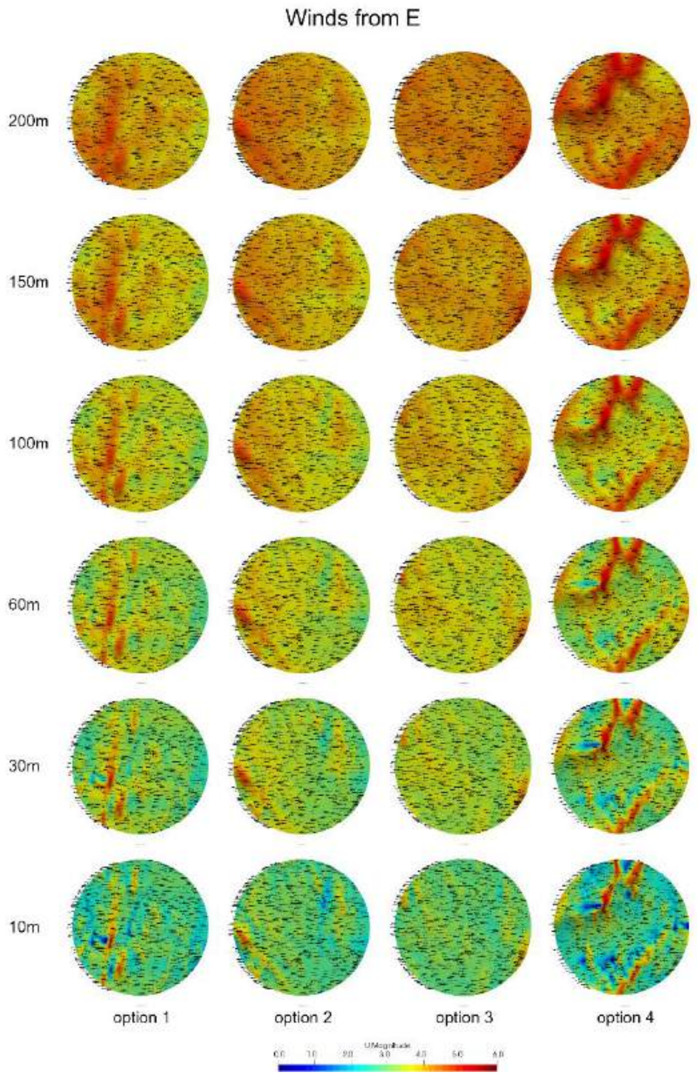
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4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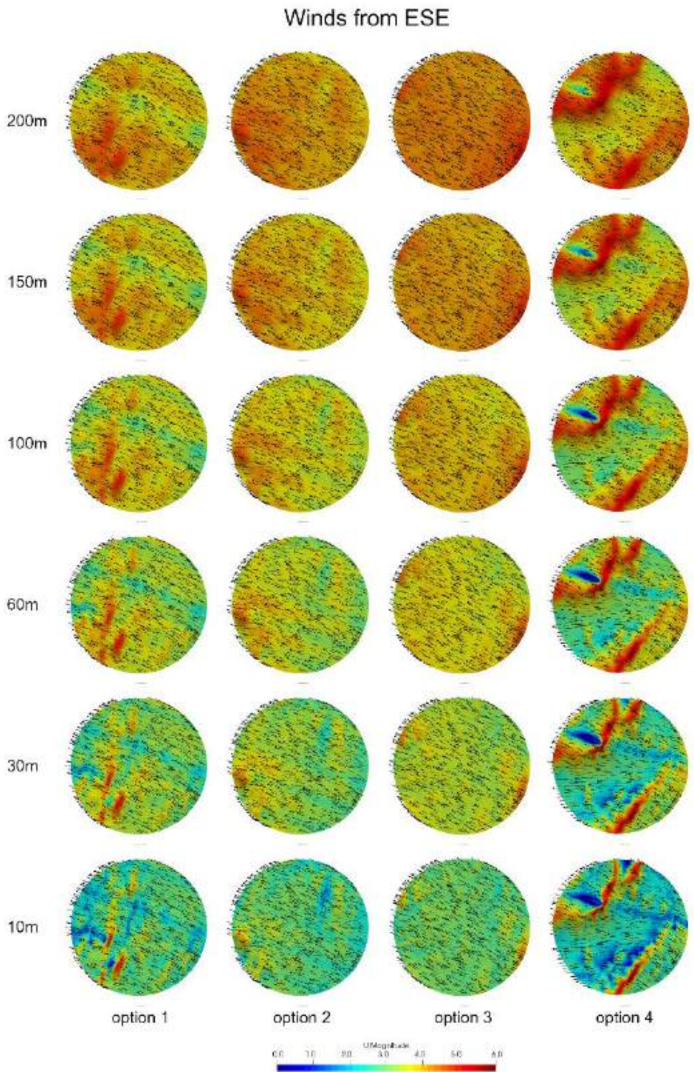
100m
60m
30m
10m
option 1
option 2
option 3
option 4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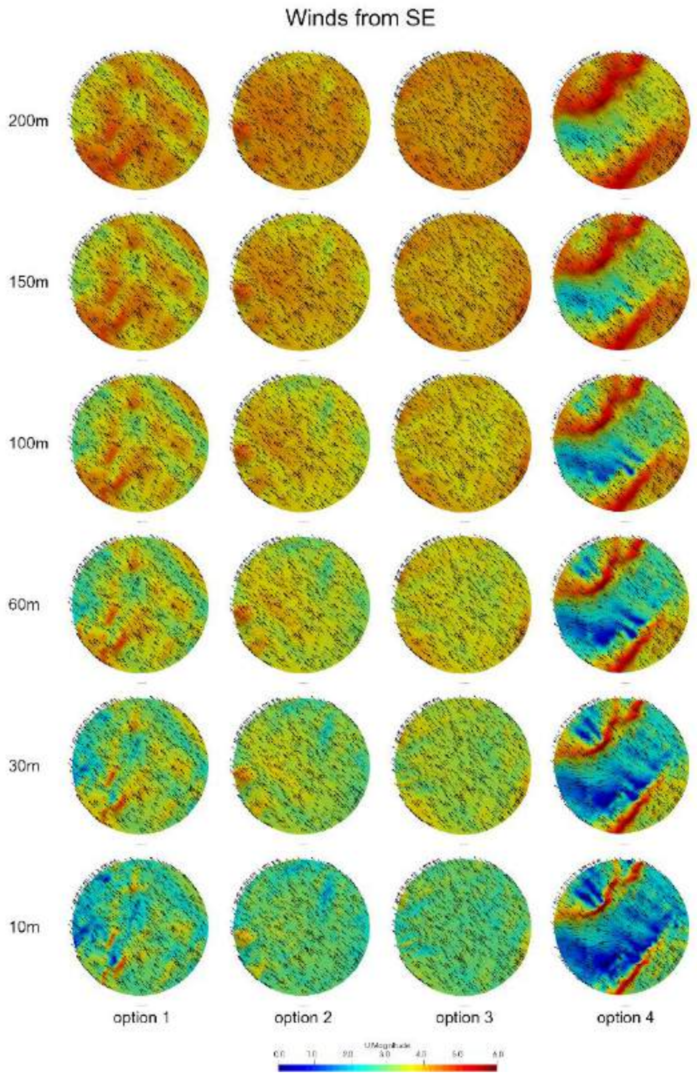
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4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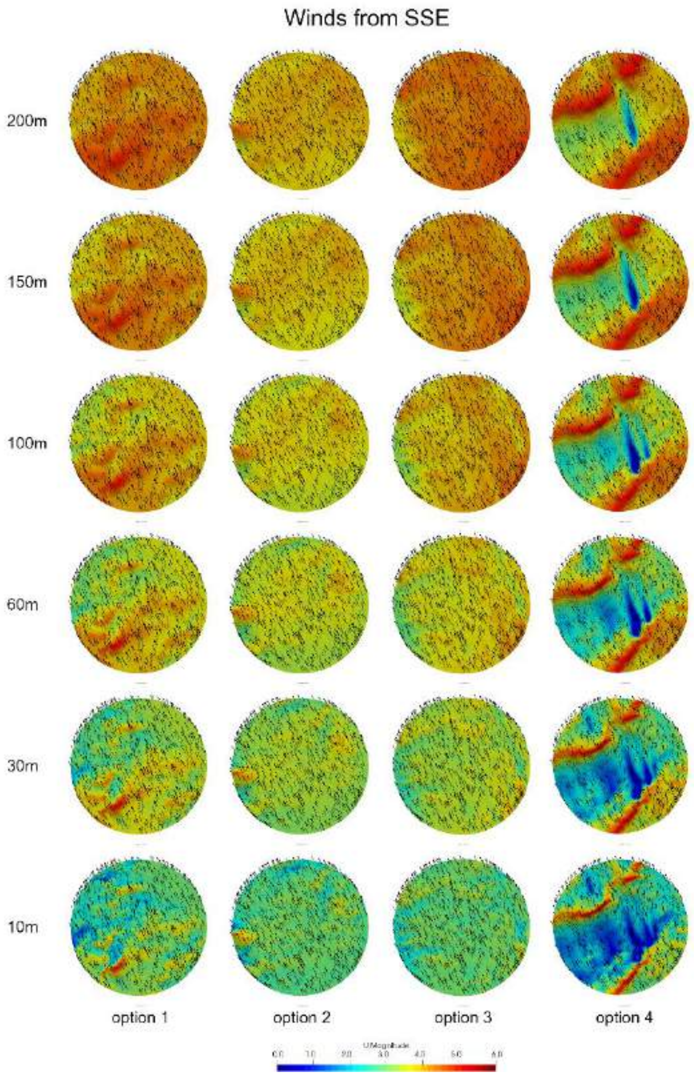
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4
UMagnitude


Winds from SSE
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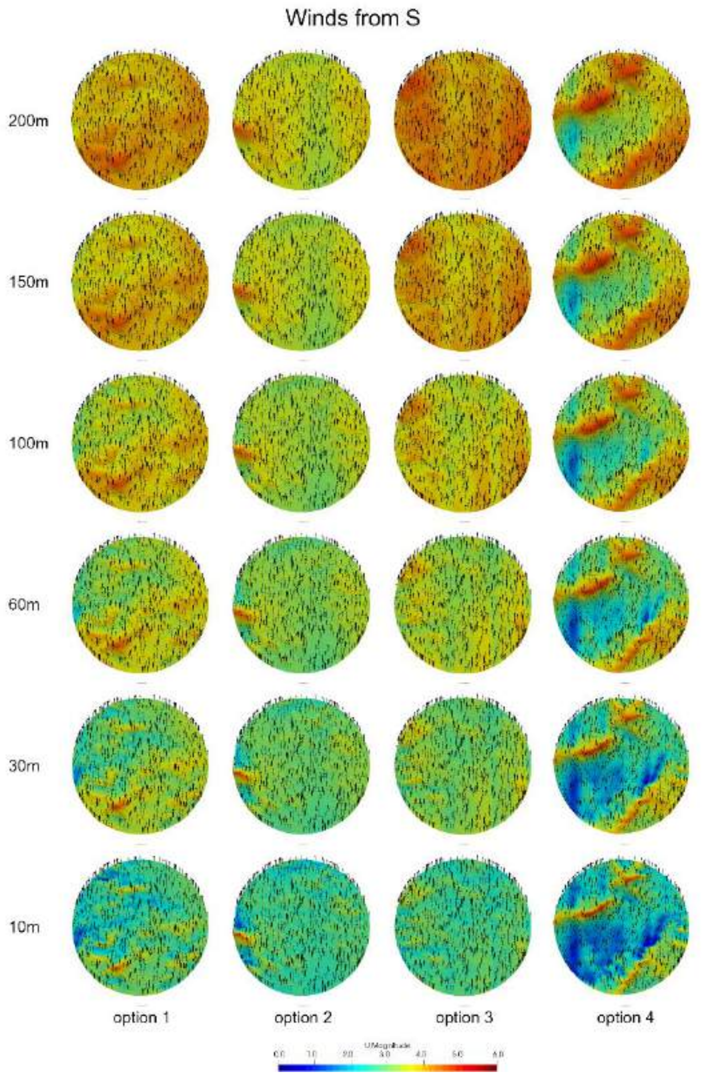
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4
UMagnitude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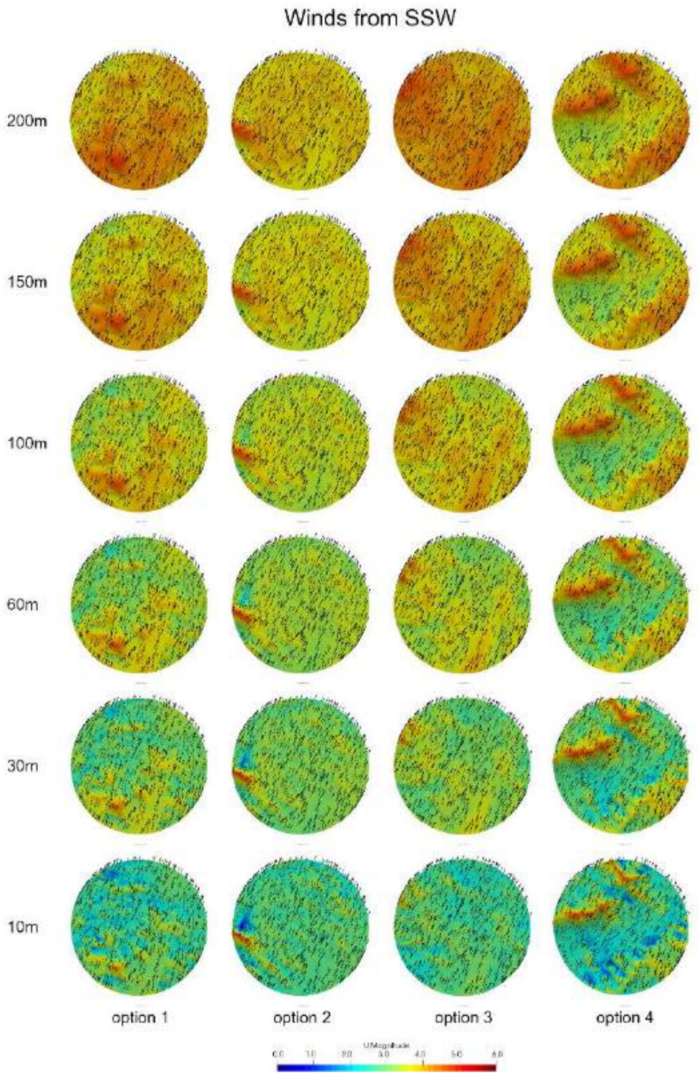
100m
60m
30m
10m
option 1
option 2
option 3
option 4
UMagnitude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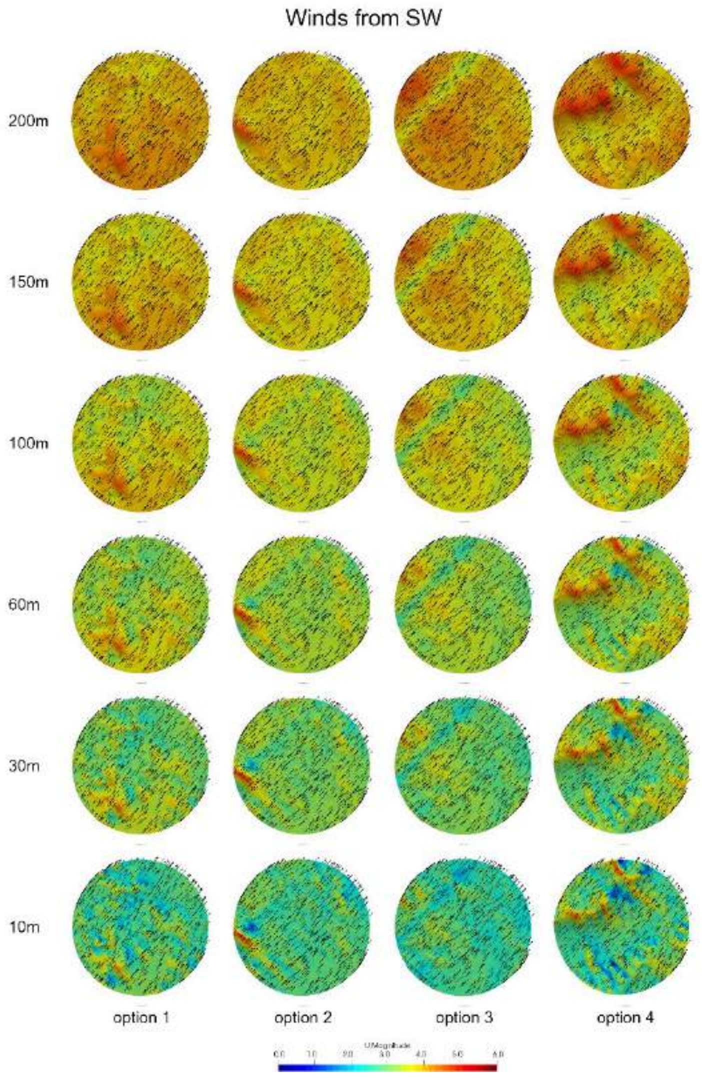
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4
UMagnitude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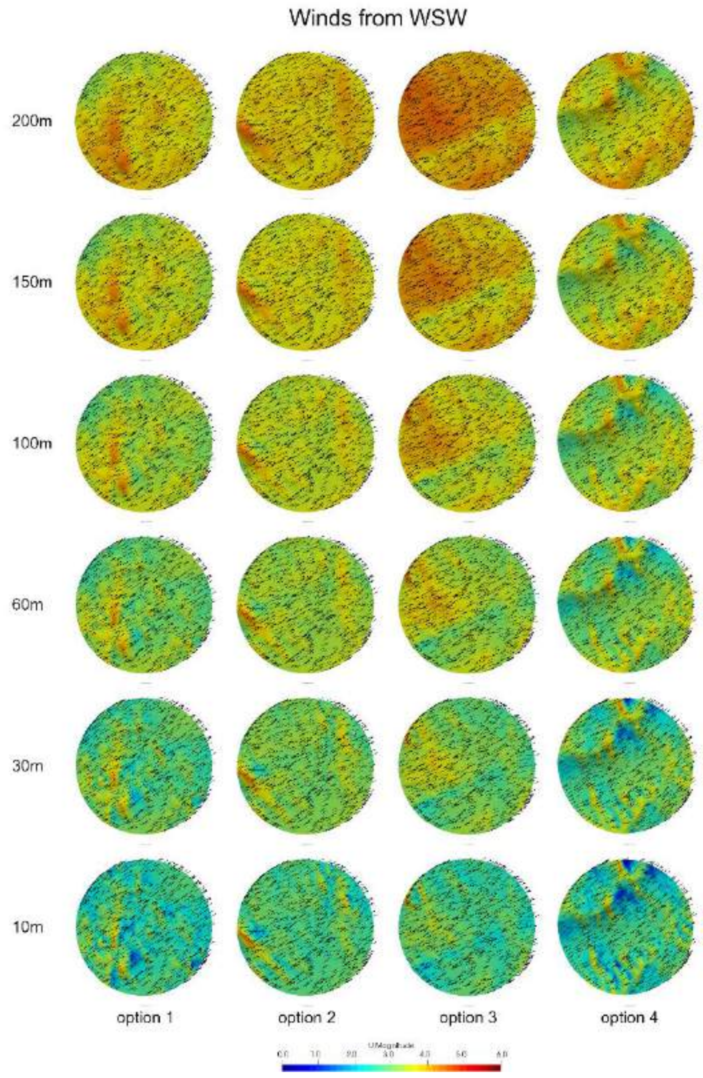
150m
100m
60m
30m
10m
option 1
option 2
option 3
option 4


Winds from WSW
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100m
60m
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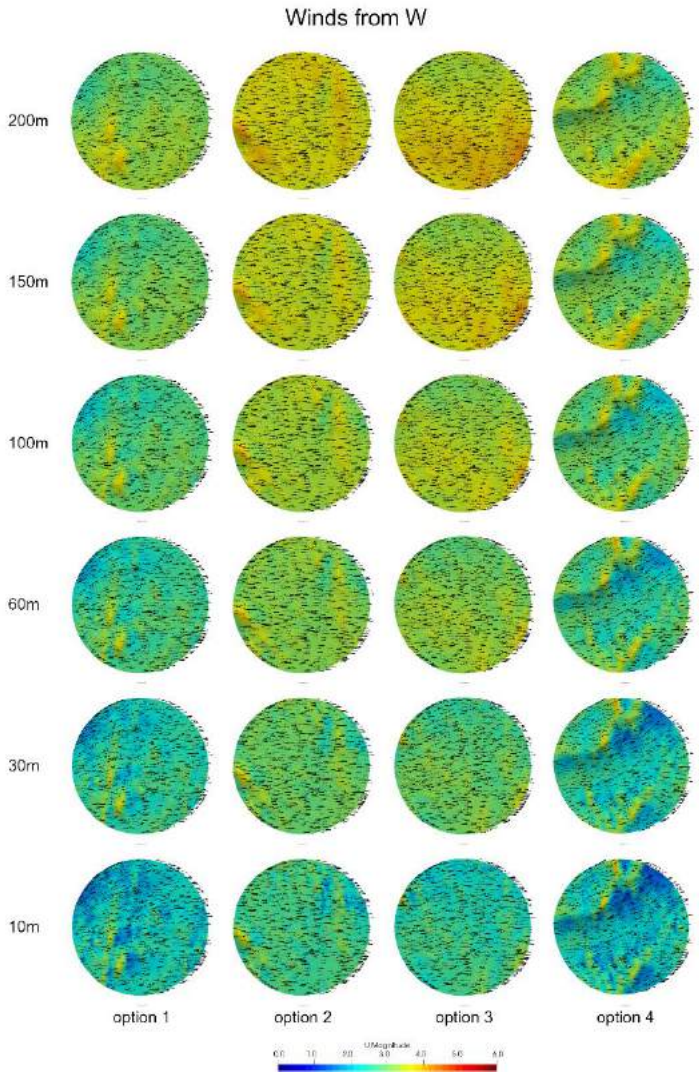
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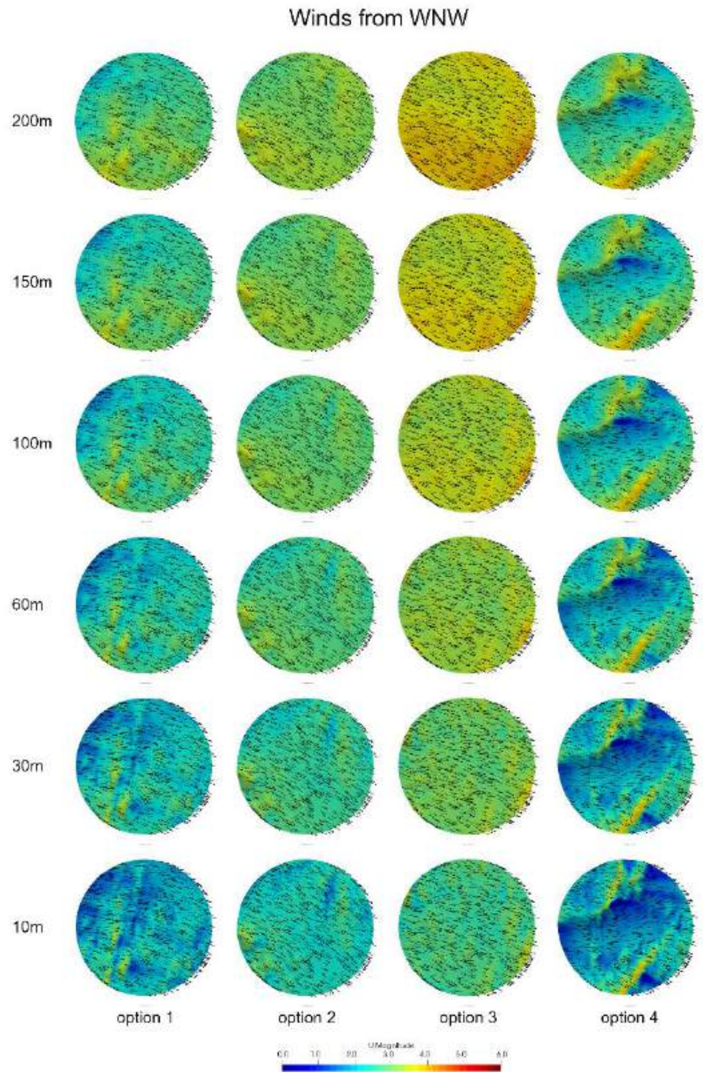
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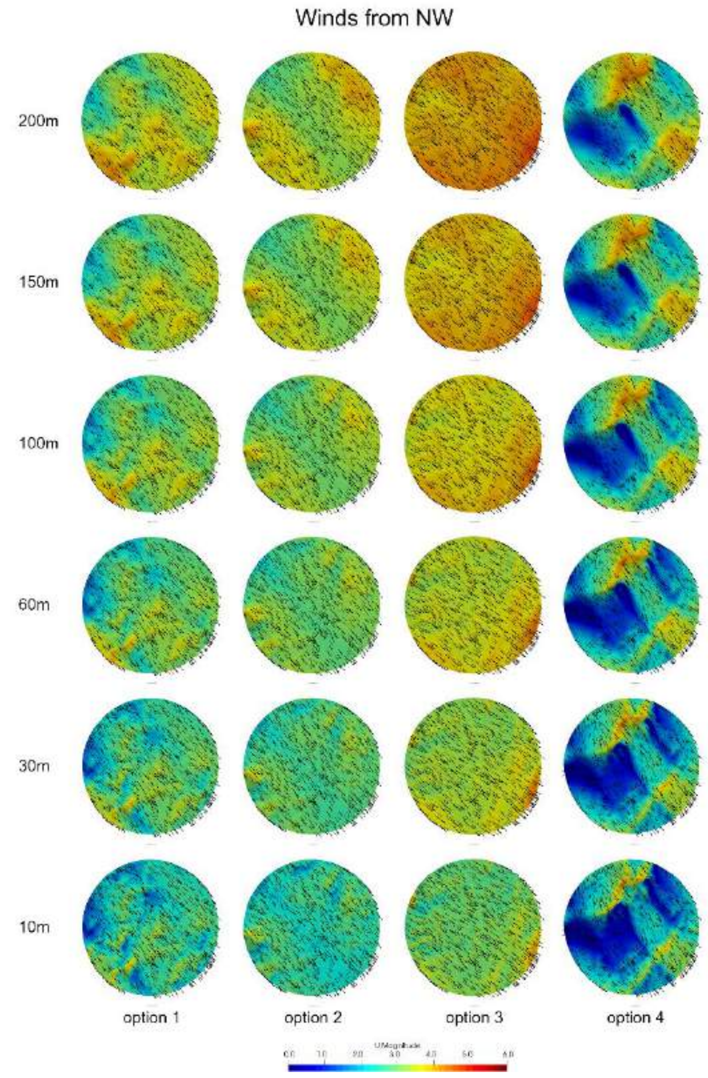
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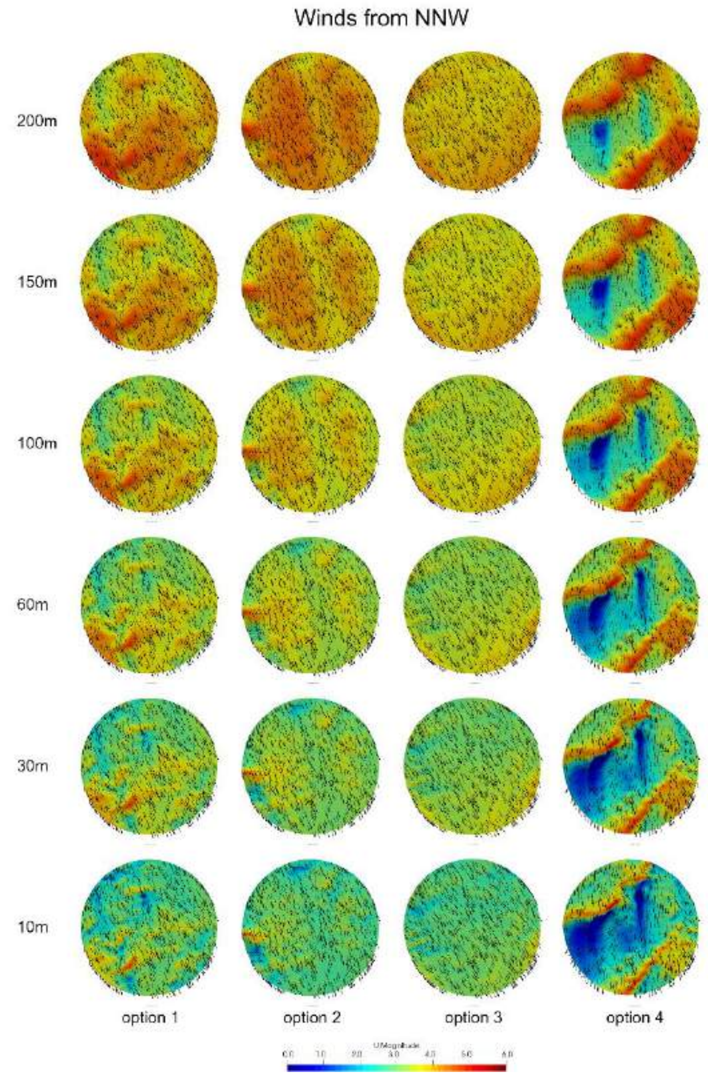
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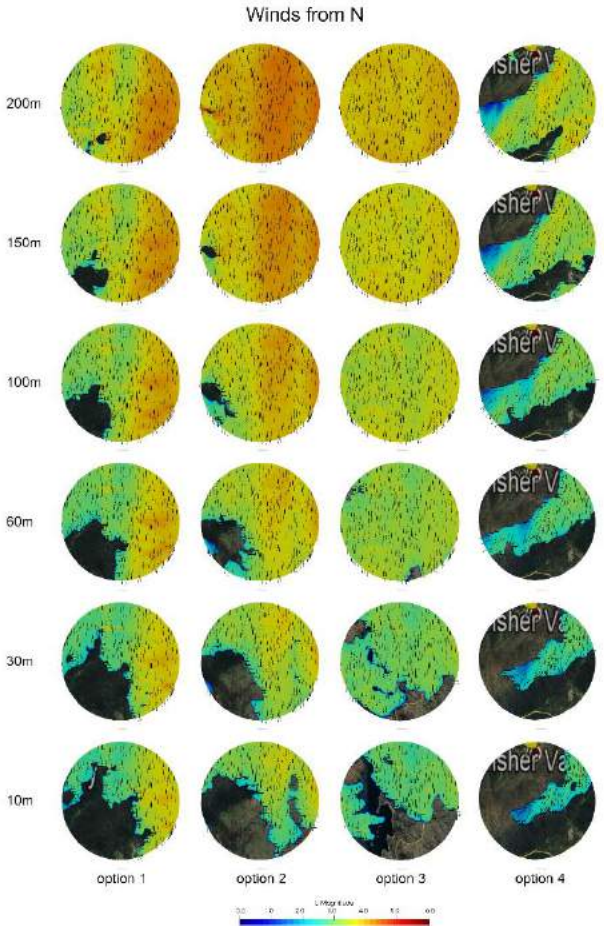
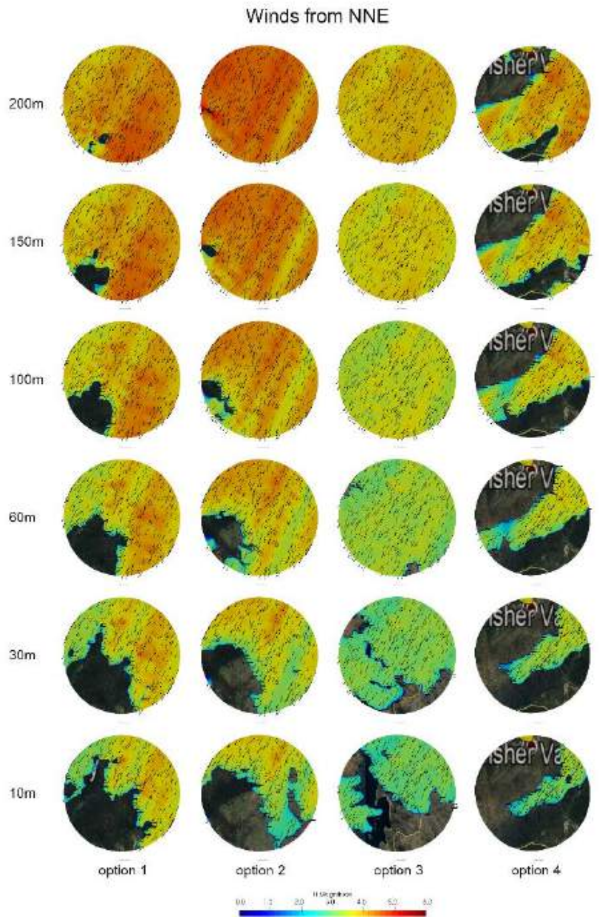
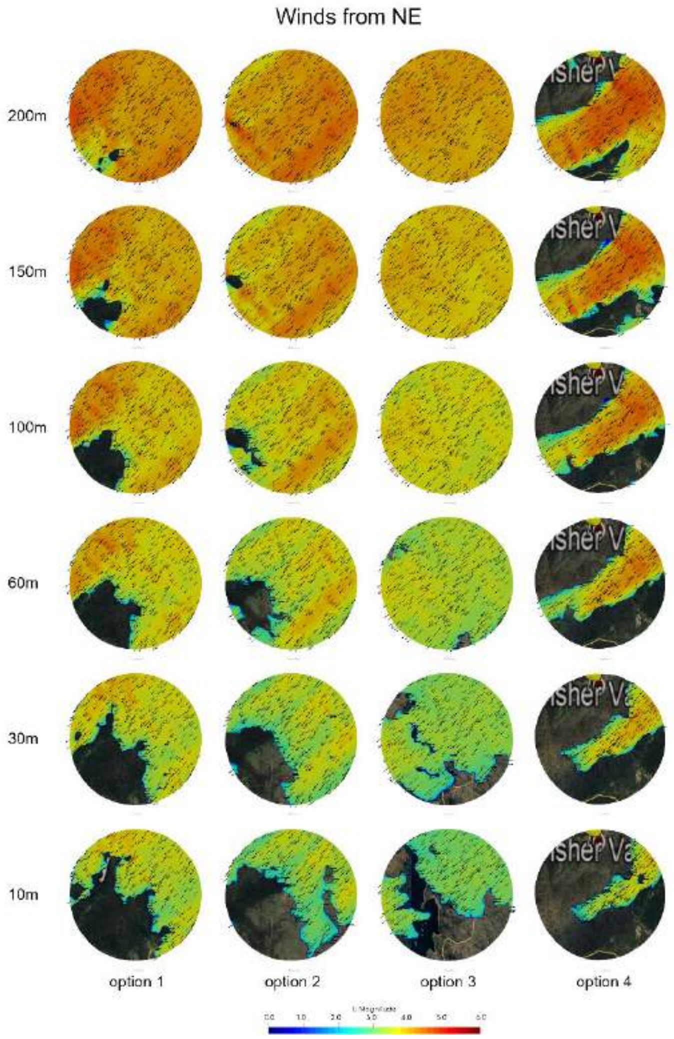
A3.2 For area of 3 km around potential options at selected heights above centre of runway (horizontal surfaces)



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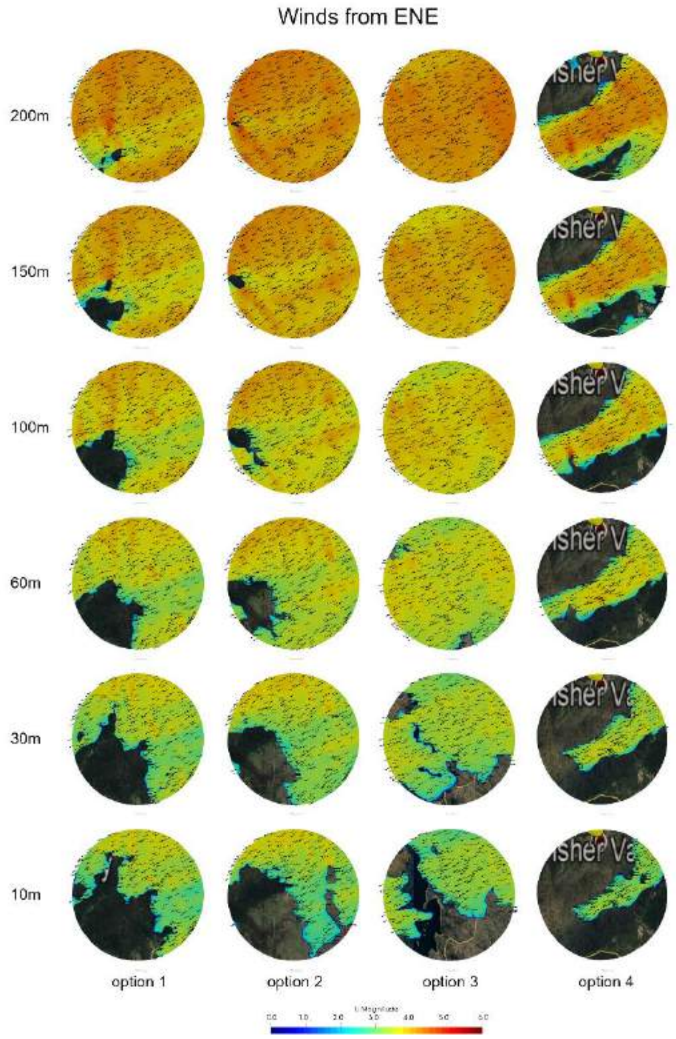
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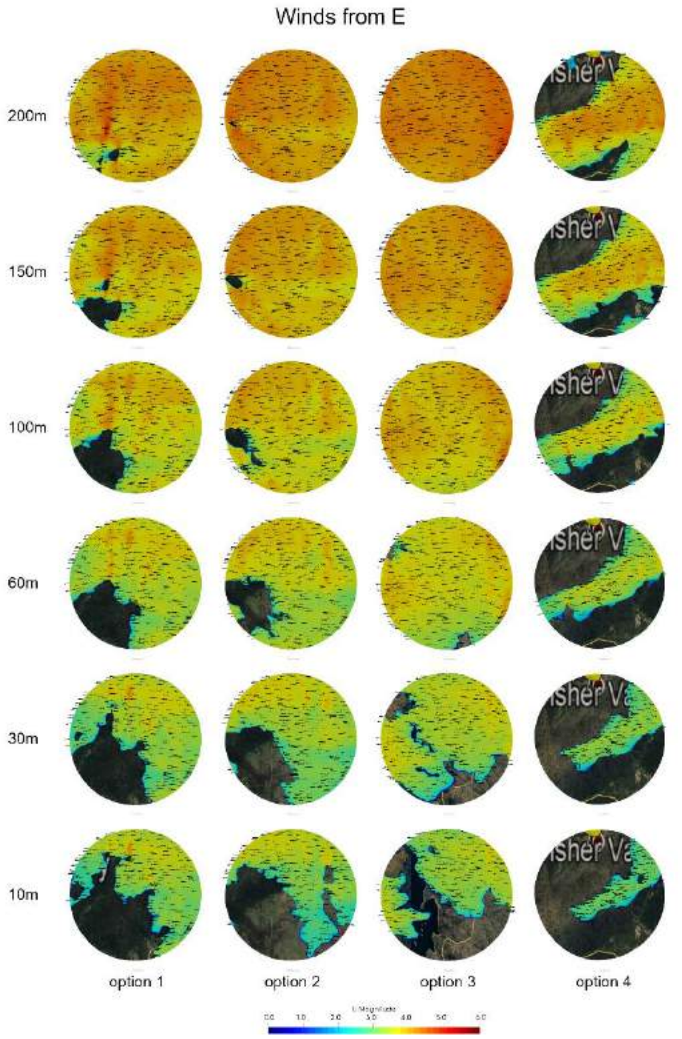
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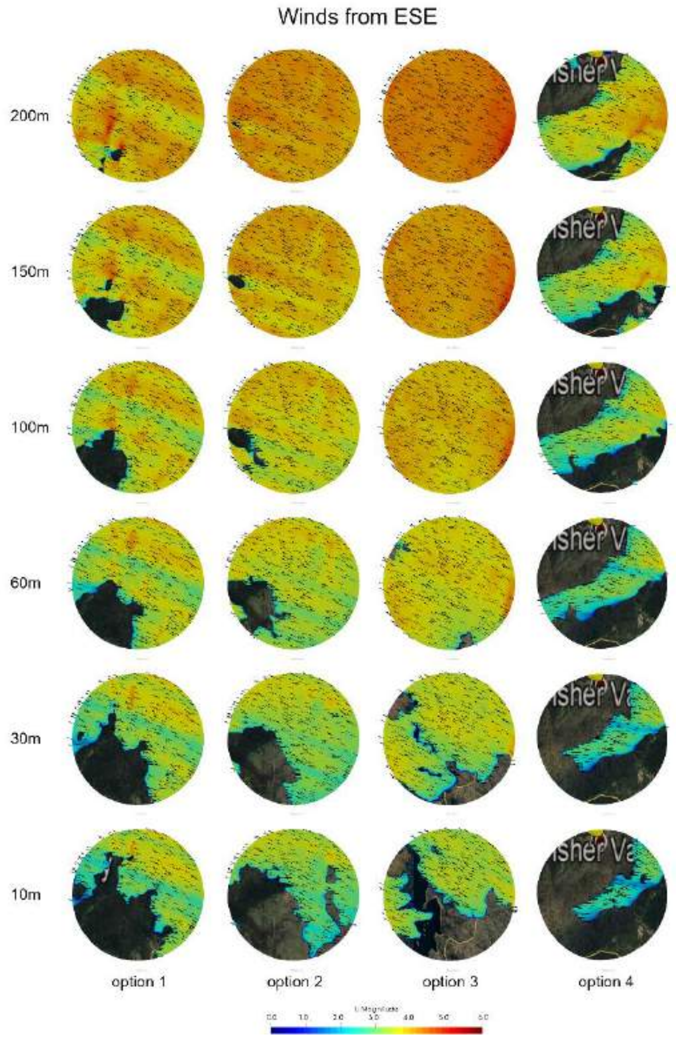
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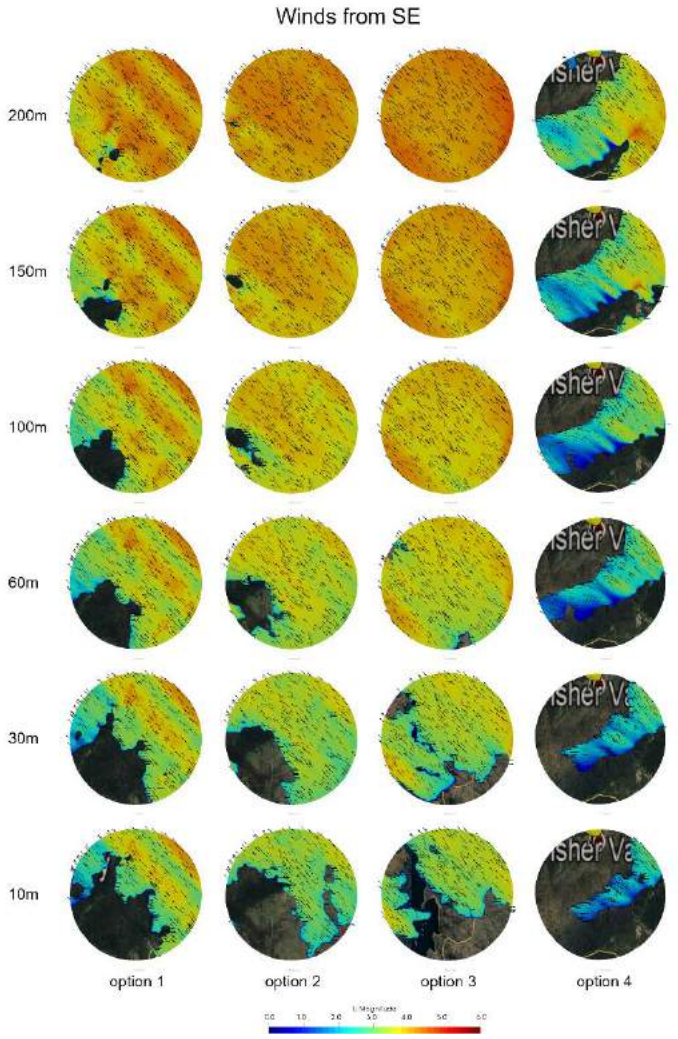
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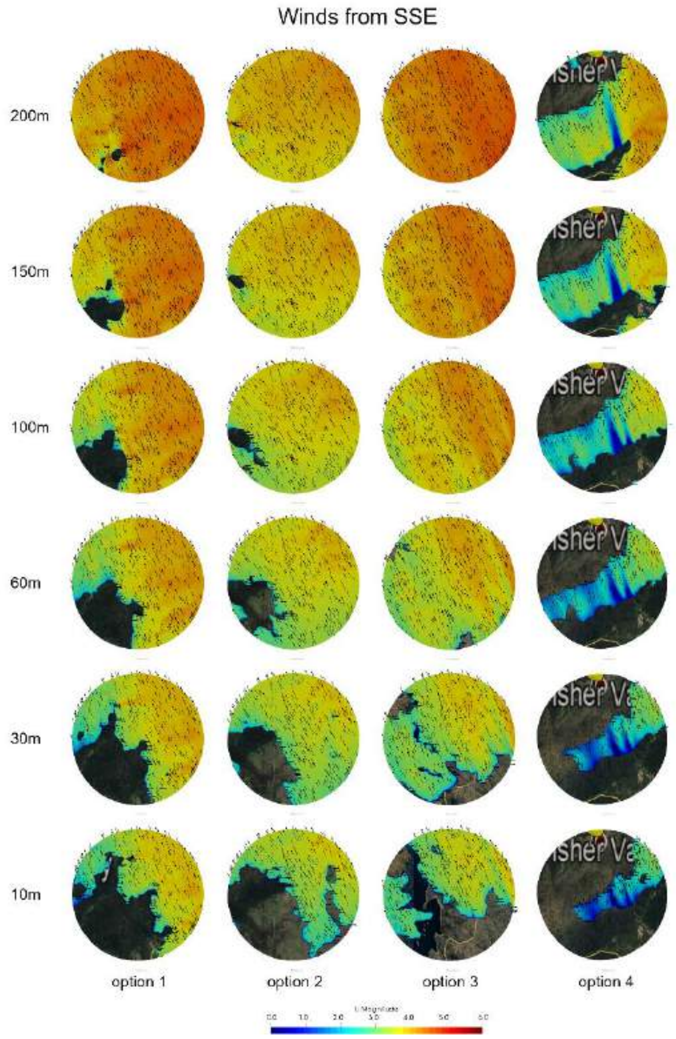
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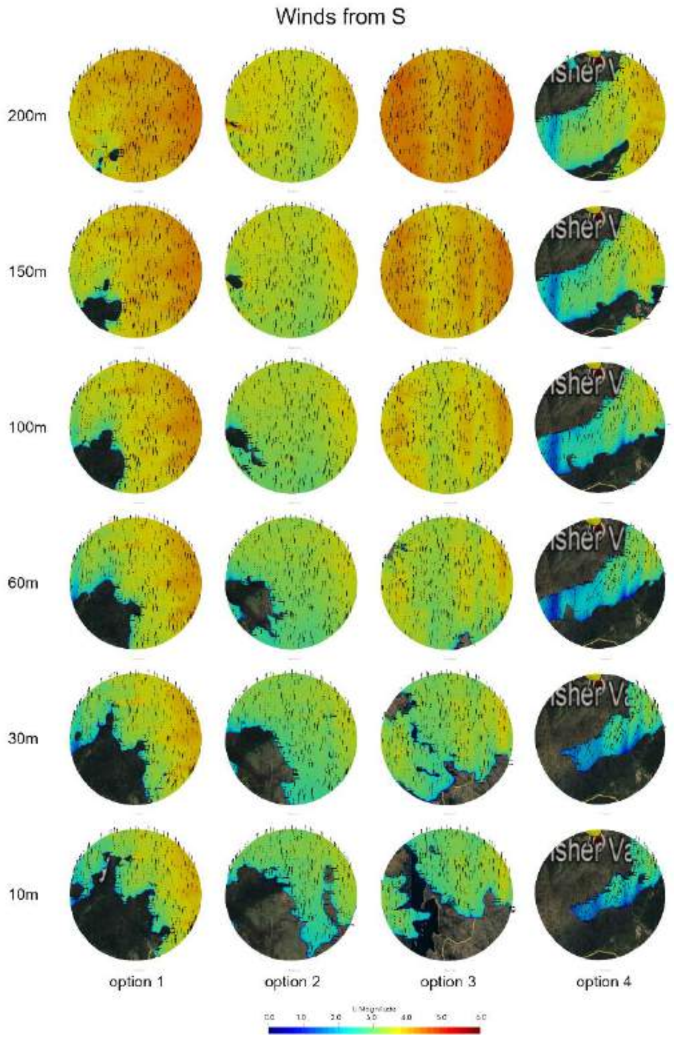
Winds from S
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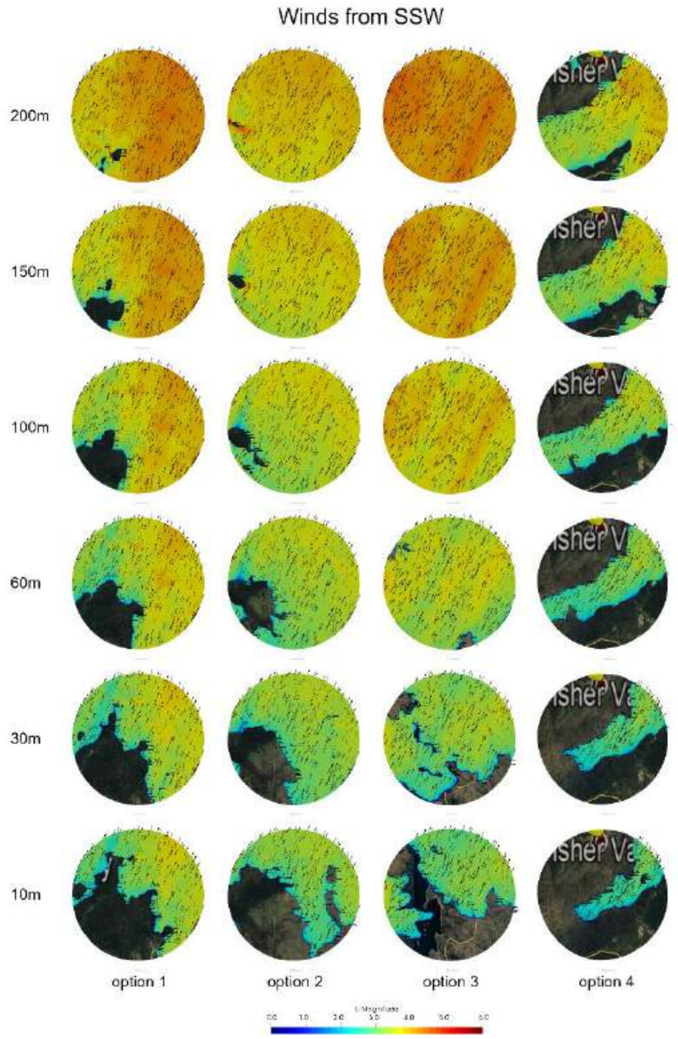
Winds from SSW
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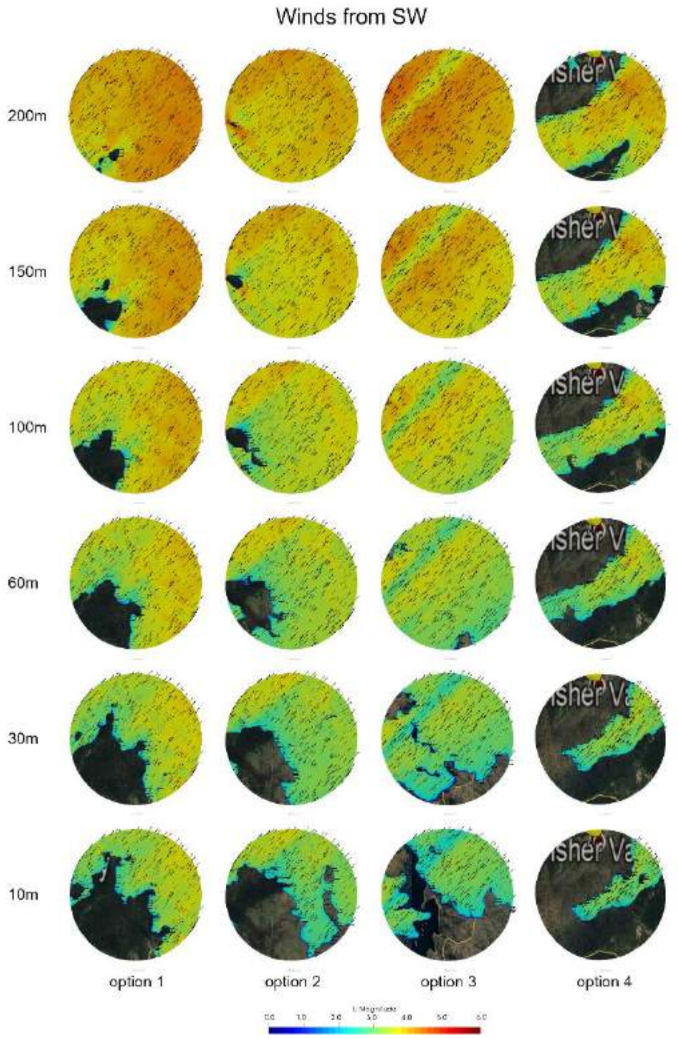
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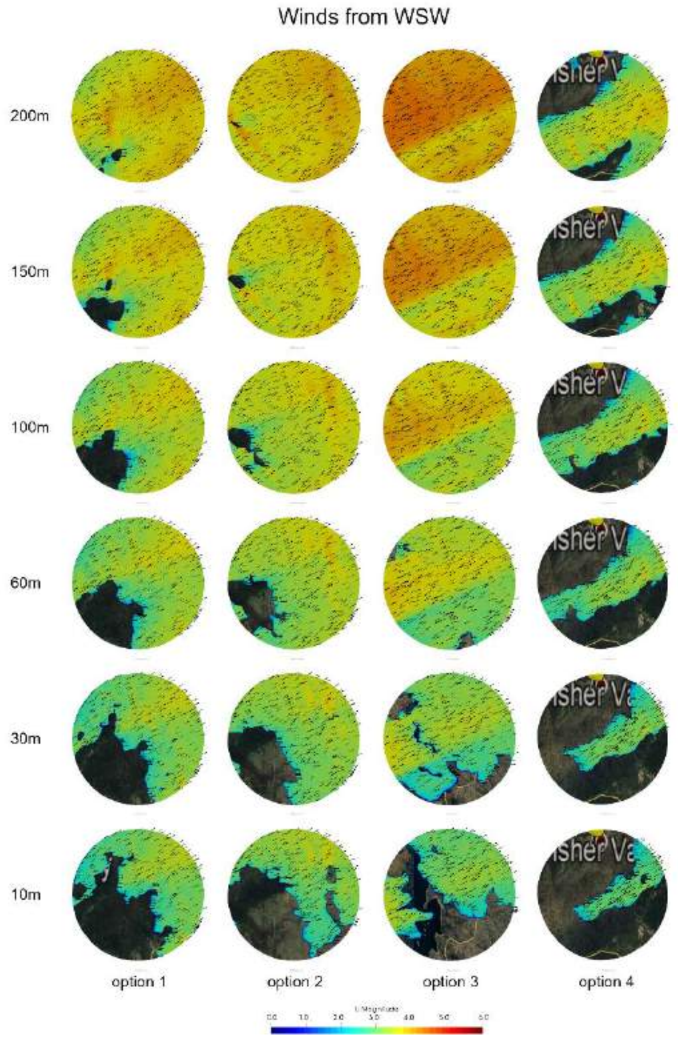
Winds from WSW
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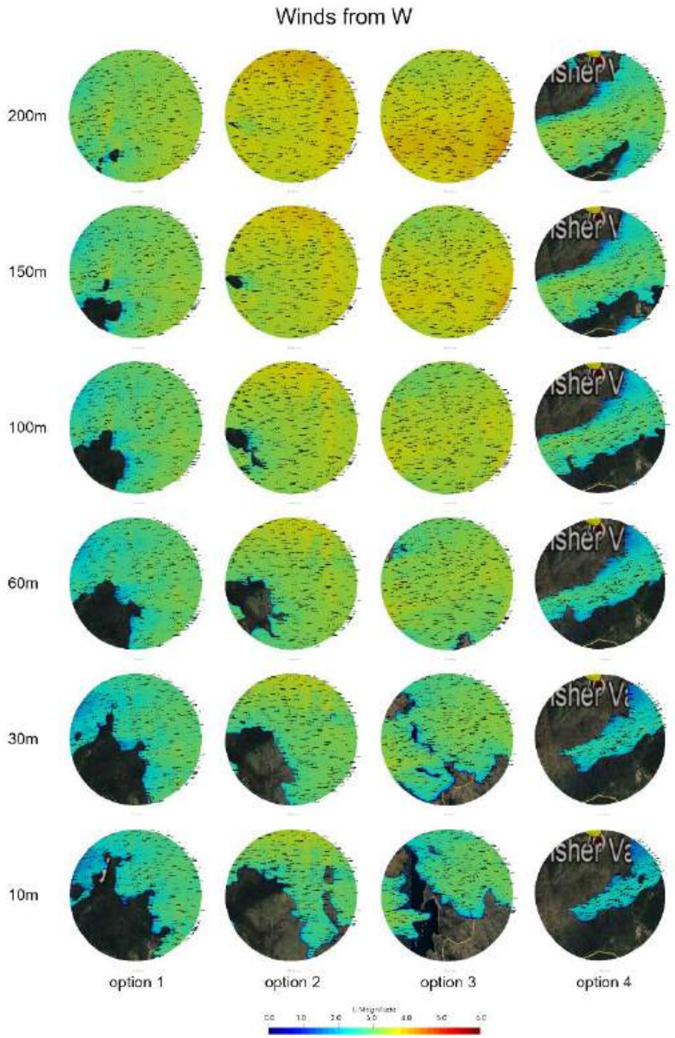
Winds from W
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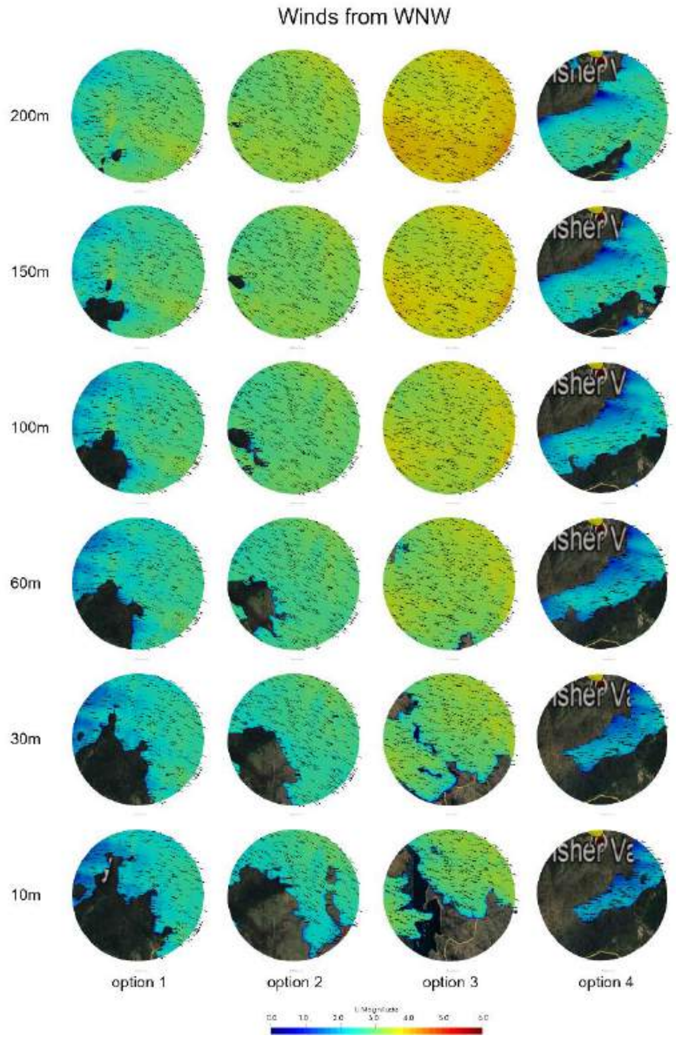
Winds from WNW
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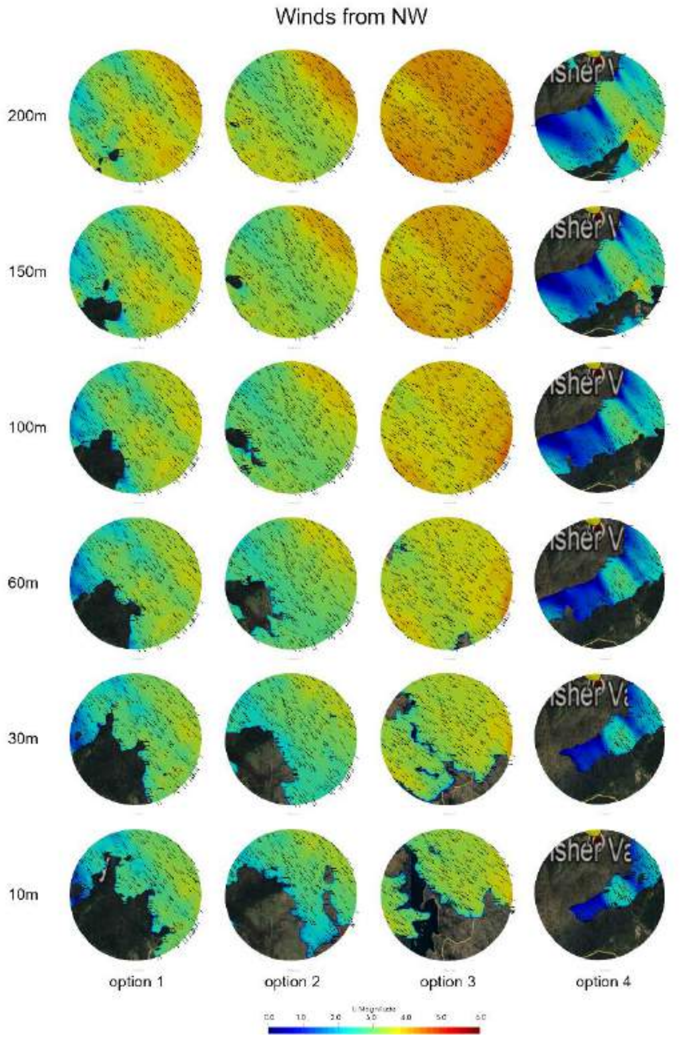
Winds from NW
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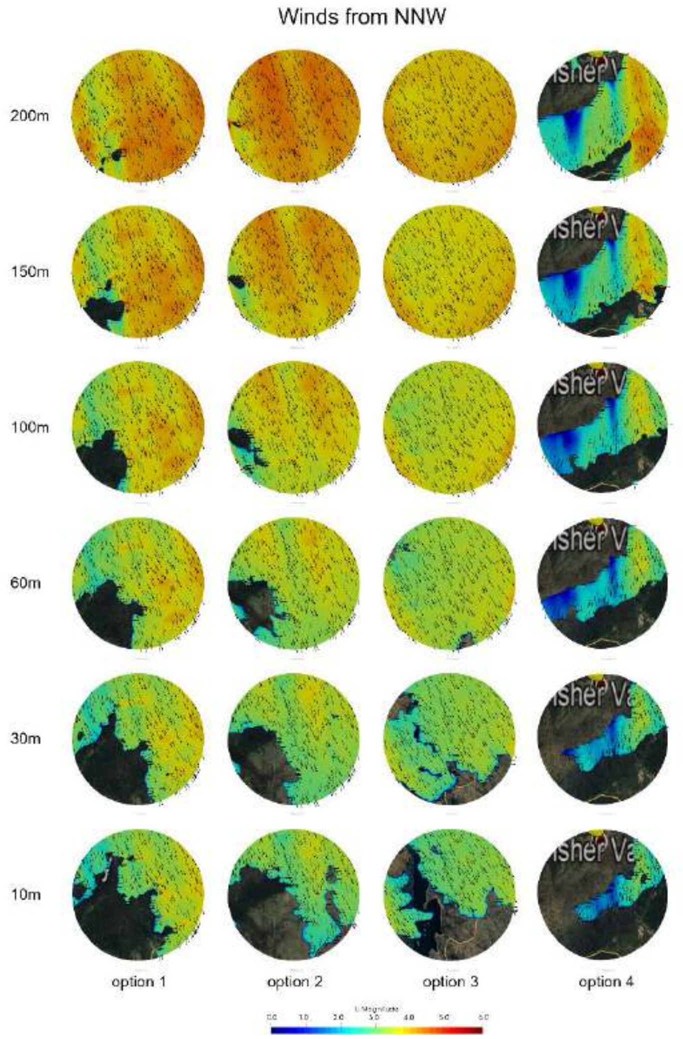
Winds from NNW
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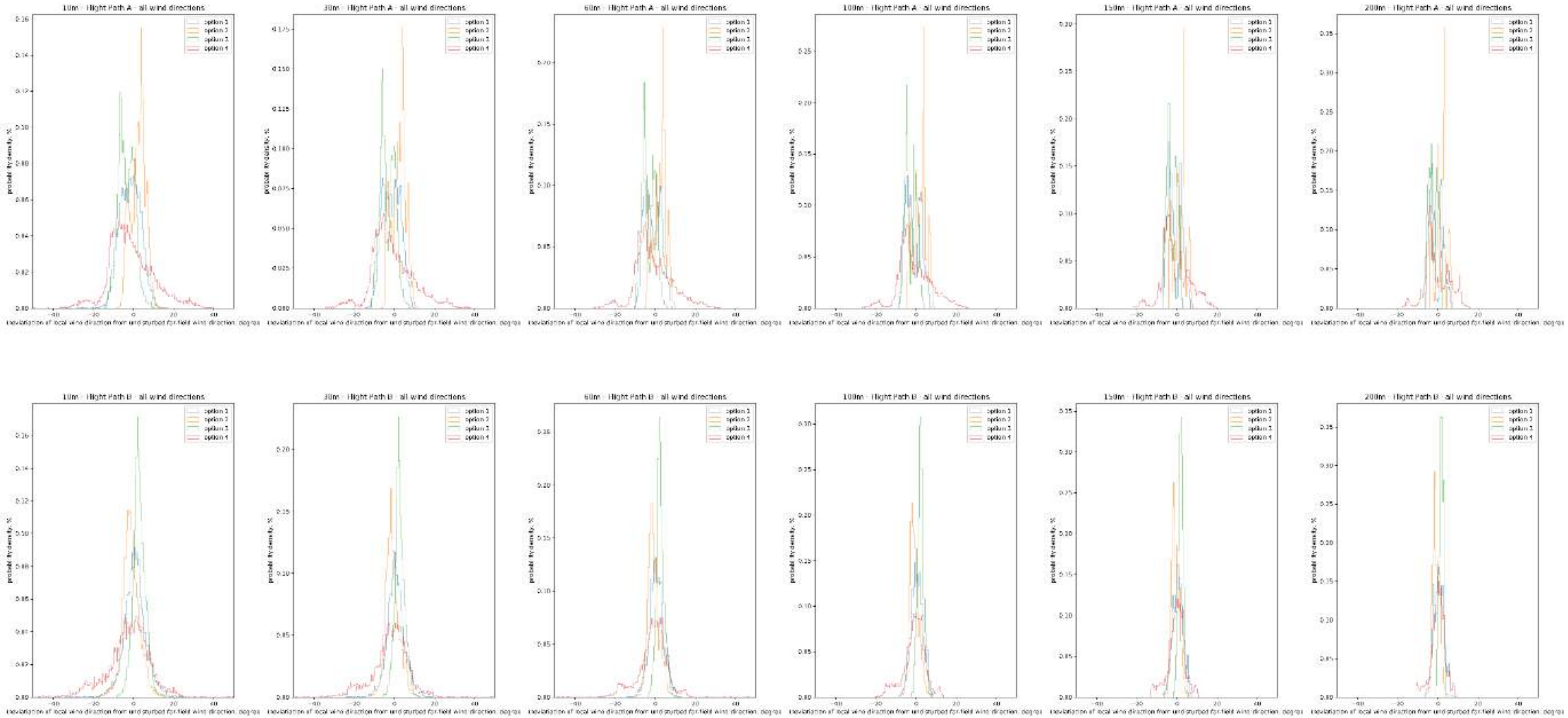
A4 Probability Distribution of local wind deviation at Flight Paths



Appendix G

Commercial Report

Snowy Mountains SAP – Airport Commercial Workstream

Final Report (Version 1)
8th October 2020

ARUP

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Executive Summary

Executive Summary

New Jindabyne airport presents a viable market for airline operations

A commercial analysis was undertaken of the Snowy SAP/Jindabyne market to determine the viability of air travel in the region.

From an airline perspective, the forecast visitation by air in 2031 to the Snowy SAP region is considered sufficient to justify air services from the three key markets: Sydney, Melbourne and Brisbane. With services per week at greater than 3 turnarounds and a minimum load factor of 65%, each market demonstrates sufficient demand to provide an attractive opportunity to airline operators. The aircraft of choice may differ between the routes however the demand is considered sufficient to justify jet and larger turboprop aircraft (e.g. A320, Boeing 737 and Q400). Unless the visitation from other areas of Australia changes significantly from the CIE forecasts, these visitors were assumed to connect via the three key markets mentioned above. International traffic associated with the Snowy SAP region was assumed to come through Sydney.

From an airline profitability perspective an operating cost and yield analysis was conducted to identify that viable ticket prices needed to justify each of the key markets, delivering an average profit margin that is in line with those achieved by operators on similar destinations. During the early years, conservative fares are expected to encourage the growth in demand. As the demand materialises there is the opportunity to increase the fares on particular routes and generate greater yields.

The financial performance of the airport is outlined within this report and provides an additional insight to the investment required and the expected returns over the forecast horizon. The current iteration of the financial model is predicated on high level and preliminary inputs. It is sensitive to its assumptions, in particular any changes to traffic and capex are highly material. The current outputs suggest there are challenges with the investability of the airport. Arup would like to work with the Government to develop some structural, commercial and financial options that would prove the market viability of the airport.

Study Approach

Study Approach (1)

Overall approach

Our commercial assessment of the viability of a new airport at Jindabyne has given consideration to:

- The attractiveness of the market from an airline perspective – both the operating schedule feasibility and the required financial return:
  - The schedule feasibility assessment utilised the air demand forecasts (provided by CIE) and the known characteristics of leisure markets in terms of the weekly and daily schedules (derived from Arup case studies), to derive a frequency of flights, including with different sized aircraft. A minimum frequency and load factor were set as the floors (Arup airline experience sets this criteria) above which the market was determined to be viable from a scheduling perspective.
  - The financial feasibility was assessed by identifying the commercial profit derived by airlines on other similar leisure markets. This profit was assigned to the break even fare value for an airline operating into the Jindabyne Airport to derive a new fare value, that would need to be achieved in the Jindabyne market for the airline to consider the market financially attractive. It was this new fare value that was subsequently used by CIE in their cost model, to quantify the level of air visitor demand.
- The attractiveness of the Jindabyne airport from an investors perspective:
  - A high level profit and loss for the airport was developed, utilizing benchmark data of other relevant Australian regional airports.
  - A high level capital cost programme to build the airport was assumed.
  - A Net Present Value (NPV) cash flow model was utilised to identify key investment metric results from a bottom up perspective.
  - Sensitivities were utilised to frame the business case requirements from a top down perspective.

Integration with CIE Demand Model

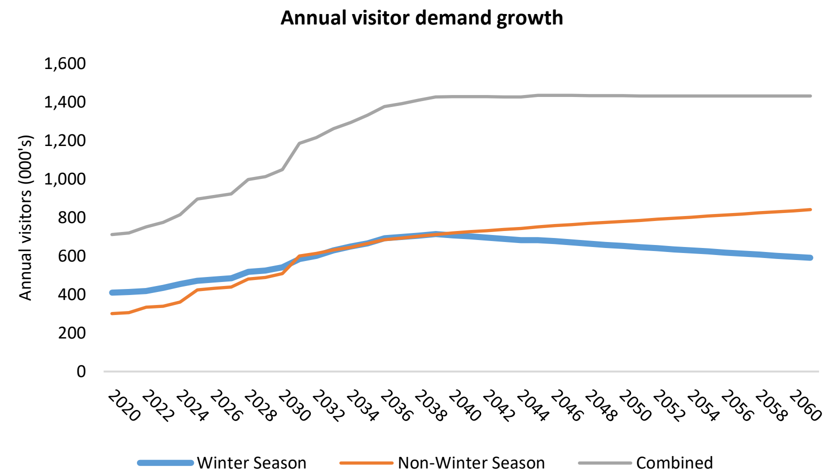
- We have worked in an integrated manner with other consultants engaged on the project. In particular, our key integration has been with CIE who were responsible for quantifying the overall visitor demand, including air visitor demand. Our models each required inputs and outputs from each other.
- We provided the following inputs for the CIE model:
  - The average one-way fare value for each origin market; and
  - The average schedule frequency for each origin market (by season).

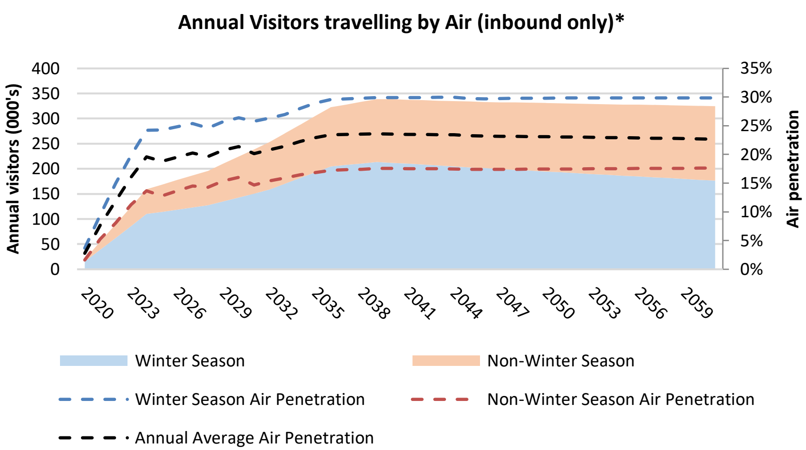
Both of these inputs fed into the CIE total cost model, which ultimately provided the quantified output of visitor demand by air for each origin market (by season, annually).

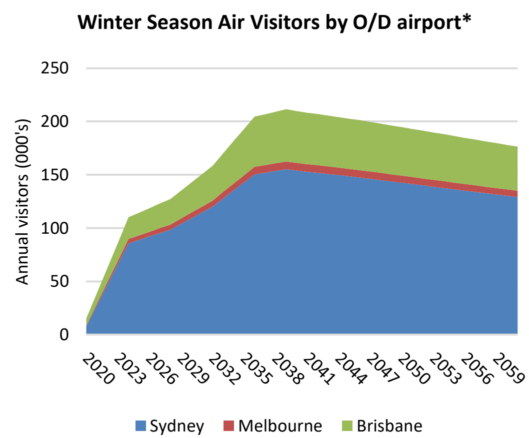
Study Approach (2)

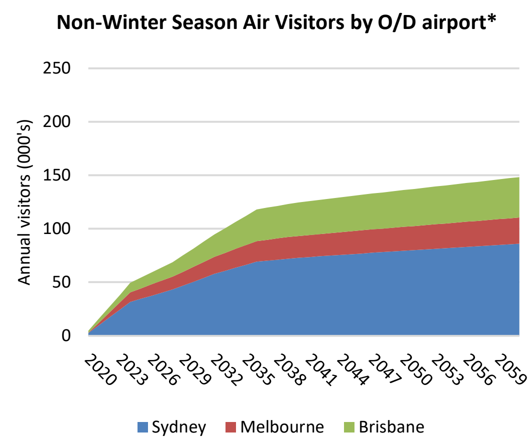
CIE Outputs – Air visitation

- Visitation forecasts for the Snowy SAP region were prepared by CIE for the planning horizon until 2061. As part of this forecast, CIE used a cost-based approach to determine the assumed a split of transport modes used to access the region; of which air travel was one. Prior to New Jindabyne airport opening, the air demand is expected to be served through a combination of the existing Snowy Mountains airport and alternate transport modes.
- Beyond 2031, the air visitation is expected to be served solely from the New Jindabyne airport. The forecast demand is not considered sufficient to support the operation of two airports in the region.
- The CIE forecasts took into consideration the broad range of investment initiatives that are expected to boost visitation to the region. Of particular note to the airport commercial study, the initiatives are intended to generate increased visitation in the non-winter season, balancing out the demand to provide a more stable economy across the year.
- In addition, it is expected that visitation through the winter season will peak around 2039, with growth in the non-winter season broadly retaining the annual visitation by air up to 2061.
- The visitation by air was prepared as annual totals and by season. The graphs below and adjacent demonstrate the gradual shift in visitation between the winter and non-winter seasons.









* Note that these charts present annual visitors travelling by air. For airport passenger volumes, these numbers are doubled to reflect an arrival and departure movement for each visitor.

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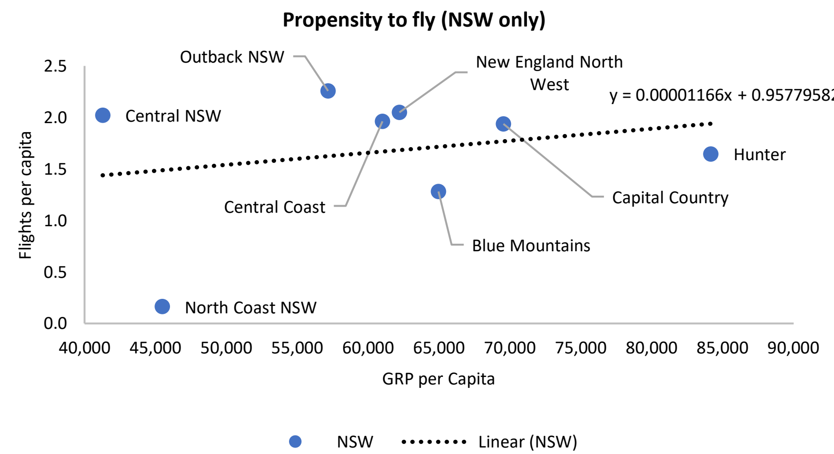
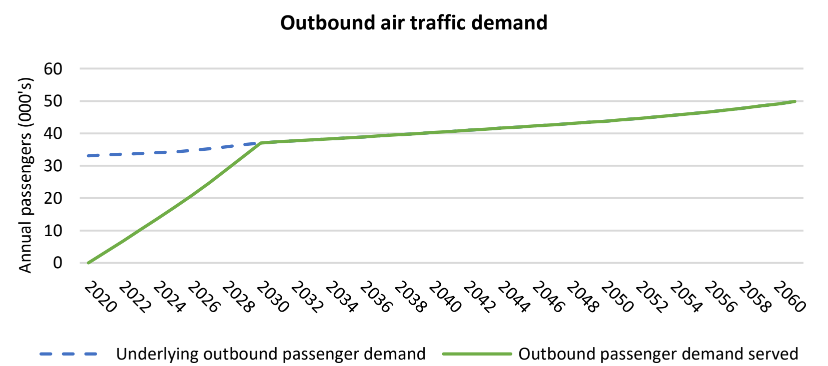
Study Approach (3)

Arup Outputs – Resident Air demand

- The CIE demand model provided the demand for air visitors to Jindabyne. This accounted for the inbound passenger traffic assumed for the new airport. There is also outbound demand generated from the population residing within the airport catchment.
- The Snowy Monaro Region resident outbound demand was derived through a propensity to fly analysis, that considered that flights per capita grows in relation to Gross Regional Product (GRP). The outbound demand growth is therefore driven by both increases in Jindabyne's population and GRP.
- The propensity to fly was determined through a regression analysis of domestic flights per capita against GRP per capita. The underlying population and regional GRP data was sourced from Tourism Research Australia (TRA), whilst the domestic passenger numbers were sourced from BITRE. Only the NSW region was considered as it comprised a comprehensive dataset.
- For the Snowy Monaro Region, the SAP resident forecasts were provided by CIE. GRP was sourced from .idcommunity, whilst GRP growth with estimated against the NSW Budget GSP growth projections at 1.08% annual growth per capita.
- Finally, it was assumed that it would take approximately 10 years for the air modal share for outbound traffic develop.





- The outbound air demand was allocated between Sydney (60%), Melbourne (20%) and Brisbane (20%) airports.

Airline - Commercial Assessment (Schedule Viability)

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Airline Schedule – Viable or not?

Conclusions

- The forecast visitation by air in 2031 to the Snowy SAP region is considered sufficient to justify air services from the three key markets: Sydney, Melbourne and Brisbane.
- 3 weekly services were considered the minimum viable demand that an airline would consider to justify opening the new route to New Jindabyne airport.
- For now the airline operators Qantas and Jetstar have been included within the data sets to reflect the potential aircraft types and seat capacities that could serve the airport. Further engagement would be required with the airlines to gauge the market appetite, with this report providing a useful demonstration of the viability.
- There is a notable difference in the frequencies between Sydney, Melbourne and Brisbane. For the Brisbane, the route is thinner and therefore required smaller aircraft to serve the demand.
- Visitation from other areas of Australia were assumed to connect via the three key markets mentioned above. International traffic associated with the Snowy SAP region was assumed to come through Sydney.

Airline Schedule – Viable or not? (1)

Key assumptions derived from case studies

- In order to assess the viability of the airline schedule, key assumptions need to be made that turn annual seasonal demand into a weekly schedule. The following key assumptions, derived from an assessment of relevant case studies, were utilised in the schedule development.
- Aircraft types reflect those in the current fleet of potential operators. Smaller aircraft types were not considered as demand from day 1 of airport operations justify larger aircraft.
- Case studies of other leisure markets, in particular the previous Mt Hotham schedule, helped inform our view on the optimal schedule for winter period.
- Non-winter schedules were assumed to follow a similar schedule to winter but with a greater distribution across the week.
- The profiles across both seasons considered a flattening across the week relative to the case studies, as added attractions prior to 2031 would cater for a broader visitor profile (e.g. conference and conventions).
- For the purposes of assessing viable airline operations for each direct market (SYD, MEL, BNE) we considered the two different winter and non-winter schedules. The results of which follow on the subsequent pages.
- For airport planning purposes, a combination of weekly schedules were considered to establish a range of requirements across the forecast horizon. These are detailed further within the Air Demand for Planning section of this report.
- Load factor was the final input assumption, below which a frequency was considered non-viable from an airline perspective.

Aircraft Types by Potential Airline Operators:

Airline	Aircraft Type	Assumed Seats
Qantas	Q400	74
Qantas / Jetstar	A320	180

Proportion of passengers served by Day of Week:

For Commercial Viability Purposes	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
2031							
Winter	19%	8%	5%	11%	25%	7%	25%
Non-Winter	16%	15%	8%	16%	20%	5%	20%

Minimum load factors:

Winter	Non-Winter
65%	65%

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Airline Schedule – Viable or not? (2)

Sydney Market Viability in 2031

A viable schedule for an airline is generally one that justifies a minimum 3 weekly services with a minimum average load factor of 65%.

- The Sydney market

Winter Schedule *

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Weekly Ops
SYD	Qantas/Jetstar A320-200	180	153	11	5	2	6	14	5	14	**57**

Non-Winter Schedule *

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Weekly Ops
SYD	Qantas/Jetstar A320-200	180	153	1	2	1	1	1	2	1	**9**

* Note that due to the high number of daily frequencies, these schedules assume a higher load factor of 85%.

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Airline Schedule – Viable or not? (3)

Melbourne Market Viability in 2031

A viable schedule for an airline is generally one that justifies a minimum 3 weekly services with a minimum average load factor of 65%.

- The Melbourne market

Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
MEL	Qantas Q400	74	48	1	1	-	1	-	5	-	8

Non-Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
MEL	Qantas Q400	74	48	1	1	-	1	-	3	-	**6**

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Airline Schedule – Viable or not? (4)

Brisbane Market Viability in 2031

A viable schedule for an airline is generally one that justifies a minimum 3 weekly services with a minimum average load factor of 65%.

- The Brisbane market

Winter Schedule *

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
BNE	Qantas/Jetstar A320-200	180	153	2	2	1	1	3	2	3	**14**

* Note that due to the high number of daily frequencies, the winter schedule assumes a higher load factor of 85%.

Non-Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
BNE	Qantas/Jetstar A320-200	180	153	-	1	1	-	-	1	-	**3**

Airline - Commercial Assessment (Financial Viability)

Airline Financials – Viable or not?

Conclusions

- The three key markets Sydney, Melbourne and Brisbane are all viable markets from a fares perspective.
- The fare values generated as part of this assessment provide an average profit margin that is expected by the operators on similar destinations.
- The fares during the opening years are considered to be conservative to encourage the growth in demand. As the demand materialises there is the opportunity to increase the fares on particular routes.

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Airline Financials – Viable or Not? (1)

Approach

Arup conducted a fares analysis for the Jindabyne market. This was utilised for 2 purposes:

- To identify the average cost of air travel per passenger to feed into the CIE cost model. By identify considering total journey costs the CIE model calculated air visitor demand by year and market; and
- To identify the revenue per passenger required to deliver a profit margin return to airlines that was reflective of the same average profit margin achieved from similar sector length leisure markets. And thus represent a viable market from an airline perspective.

Methodology

RDC Apex Fares is a database of fares obtained from airline website scraping. It is the most accurate capture of airfares in the market. This same software tool also provides airline operating cost analysis, by aircraft type by distance. Together the fares and cost analysis enables a view on airline profitability.

Step 1

Identify the specific sector length operating costs per passenger, based on an assumed averaged load factor, for each carrier option (Qantas, Jetstar) by each aircraft type (737, A320, Q400) to establish an equivalent break-even fare per passenger.

+

Step 2

Establish the additional revenue per passenger expected from ancillary charges to achieve break-even.

+

Step 3

Identify the average profit margin currently achieved on similar sector length leisure markets, by carrier, by season.

=

Step 4

The revenue per passenger that would deliver a competitive profit return value to the respective airlines by aircraft type, by season.

Step 5

Conversion of analysis to passenger cost scenarios for CIE cost model.

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Airline Financials – Viable or Not? (2)

Average Fares Analysis – Step 1

- A fares software product called 'Apex Fares' calculates the operating cost of airlines by aircraft type, by market, to display what is called a 'break even' fare.

		Route	SYD-OOM	MEL-OOM	BNE-OOM
Airline	Aircraft	Load Factor	Break-even Fare (AUD)		
Qantas	Q400	65%	102	106	172
		75%	90	93	151
		85%	80	84	135
Qantas	738	65%	80	82	119
		75%	72	74	106
		85%	65	67	96
JetStar	A320	65%	63	64	98
		75%	55	57	87
		85%	50	51	78

- The table above reflects the break-even fare for each of the markets we anticipate airlines to operate direct services.

Average Fares Analysis – Step 2

- The break even revenue calculations are the product of two streams: fares and ancillary revenue (e.g. offerings such as purchasing seat selection or additional baggage).

		Route	SYD-OOM	MEL-OOM	BNE-OOM
Airline	Aircraft	Load Factor	Break-even revenue per passenger (AUD)		
Qantas	Q400	65%	106	110	184
		75%	93	98	164
		85%	84	88	148
Qantas	738	65%	84	87	131
		75%	76	78	118
		85%	69	72	108
JetStar	A320	65%	66	69	111
		75%	59	62	99
		85%	53	56	90

- The table above shows the total revenue required from each passenger (fare and ancillary) to break-even.

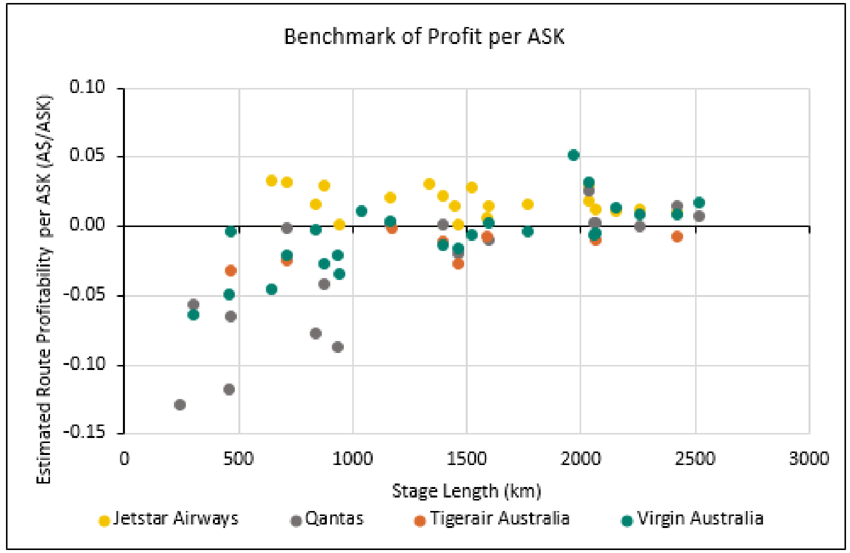
Airline Financials – Viable or Not? (3)

Average Fares Analysis – Step 3

- A fares software product called 'Apex Fares' calculates the average profit margin achieved on similar leisure markets by sector length.

- The markets reflected in the adjacent scatter gram include:
  - Ballina Byron, Bundaberg, Cairns, Coffs Harbour, Gladstone, Gold Coast, Hamilton Island, Mackay, Whitsunday Coast, Queenstown, Mackay and Townsville.
  - And reflect the average of all fare types available on these markets.

- We made two further assumptions on these results:
  - We used the Jetstar profit margin as the expected profit margin for all carriers operating this sector length during the winter season - $**0.03 per ASK**.
  - We assumed a lower profit margin of **$0.01 per ASK** for the non-winter revenue, as fares would need to be discounted to attract and compete for demand in the market.



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Airline Financials – Viable or Not? (4)

Average Fares Analysis – Step 4

- The tables below reflect the revenue per passenger that would be targeted by the airlines, considering the addition of the breakeven fares, ancillary revenue plus the average profit margin by season.
- The table further highlights that passengers originating in other capital city markets would need to hub over one of the main gateways (SYD, MEL, BNE) to connect onto direct flights into Jindabyne. The average economy fare value for this originating sector has been added to the gateway-Jindabyne fare to derive a total fare value for these connecting markets.

Peak Season Revenue Per Passenger		Route	SYD-OOM	MEL-OOM	BNE-OOM	ADL-MEL-OOM	PER-MEL-OOM	DRW--SYD-OOM	HBA-MEL-OOM
		Origin	Sydney	Melbourne	Brisbane	Adelaide	Perth	Darwin	Hobart
Airline	Aircraft	Load Factor	Revenue per passenger (AUD)						
Qantas	Q400	65%	116	123	218	248	377	459	249
		75%	104	110	197	235	364	447	236
		85%	94	101	181	226	355	437	227
Qantas	738	65%	94	99	164	224	353	437	225
		75%	86	91	152	216	345	429	217
		85%	80	84	142	209	338	423	210
JetStar	A320	65%	77	81	144	206	335	420	207
		75%	69	74	133	199	328	412	200
		85%	64	68	124	193	322	407	194

Off-Peak Season Revenue Per Passenger		Route	SYD-OOM	MEL-OOM	BNE-OOM	ADL-MEL-OOM	PER-MEL-OOM	DRW--SYD-OOM	HBA-MEL-OOM
		Origin	Sydney	Melbourne	Brisbane	Adelaide	Perth	Darwin	Hobart
Airline	Aircraft	Load Factor	Revenue per passenger (AUD)						
Qantas	Q400	65%	109	115	196	232	365	351	244
		75%	97	102	175	219	352	339	231
		85%	87	93	159	210	343	329	222
Qantas	738	65%	87	91	142	208	341	329	220
		75%	79	82	129	199	332	321	211
		85%	73	76	120	193	326	315	205
JetStar	A320	65%	70	73	122	190	323	312	202
		75%	62	66	110	183	316	304	195
		85%	57	60	102	177	310	299	189

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Airline Financials – Viable or Not? (5)

Average Fares Analysis – Step 5

- The scenarios outlined in the table below were provided to CIE to utilise in their cost based modelling.
- The table below reflects an averaging of the load factor revenue values (for the direct Jindabyne market sectors), to derive an average fare value for each aircraft type for each market, including connecting flights.
- Three scenarios were generated to consider different aircraft types operating the market.

Scenario	Q400 only	Jet only	Jets (SYD/BNE), Q400 MEL
Airport inputs	One way cost to the passenger $ (AUD)	One way cost to the passenger $ (AUD)	One way cost to the passenger $ (AUD)
Peak Season			
Sydney	105	78	78
Melbourne	111	83	111
Brisbane	199	143	143
Adelaide	236	208	236
Perth	365	337	365
Darwin	448	421	421
Hobart	237	209	237
Off-Peak Season			
Sydney	98	71	71
Melbourne	103	75	103
Brisbane	176	121	121
Adelaide	220	192	220
Perth	353	325	353
Darwin	340	313	313
Hobart	232	204	232

Airline Financials – Viable or Not? (6)

Average Fares Analysis

- For completeness we show the derived fare values for the Jindabyne market within the context of other fare values on other similar leisure markets across Australia.
- All fare values are an average of the fares sold across all categories available on these markets (business, full economy, discount economy, 6,3,1,month in advance, 1 week in advance, for the period 2018/2019).

Sydney

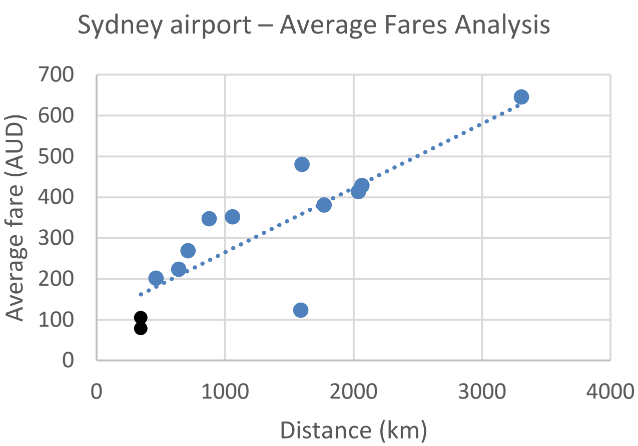
- The peak fares for Sydney considering both the Q400 and Jet aircraft variants are both within the expected range.
- The selected fares are slightly below the trend line however this was considered acceptable for Sydney given the market is a new entrant of weekly services directly into the Snowy SAP region.

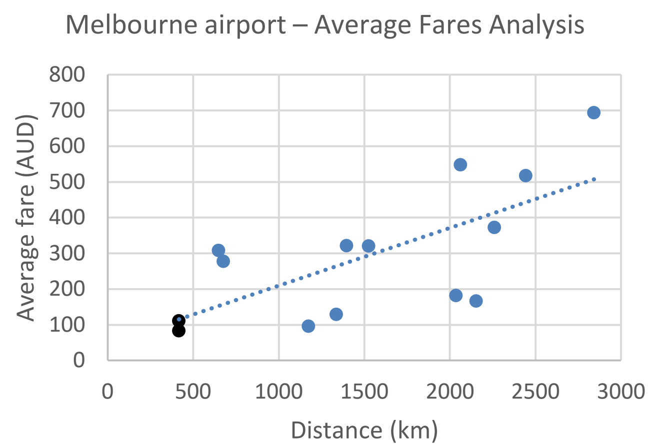
Melbourne

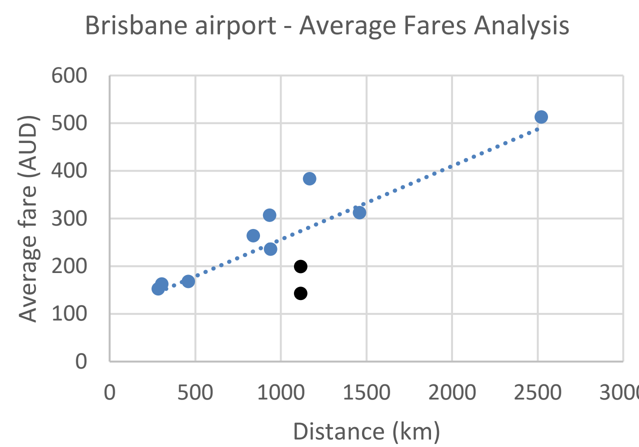
- The peak fares for Melbourne considering both the Q400 and Jet aircraft variants are both within the expected range.

Brisbane

- The peak fares for Brisbane considering both the Q400 and Jet aircraft variants are both within the expected range.
- The selected fares are slightly below the trend line however this market will be a key new entrant to the Brisbane. For this reason competitive price in the early years will be expected to generate demand.







● Fares to and from New Jindabyne

Airport – Financial Assessment

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Airport Financials (1)

- Arup has prepared a financial model for the SAP airport scheme, supporting the ongoing assessment and optioneering exercises. As the SAP airport project progresses, the model can be revised to reflect decision making and refined/revised inputs.

- The primary purpose of the model is to provide a preliminary view of the airport's financial performance across a range of scenarios. This helps to inform the commercial viability of the schemes.

- The model is a high level assessment of basic parameters and assumptions. Findings and outputs are provided on an indicative basis, and its analysis is highly sensitive to changes in inputs.

- Arup does not provide any reliance on the model or its outputs.

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Airport Financials (2)

The model is comprised of the following components and logic:

Passenger numbers

- Annual passenger numbers are derived from AIR visitation numbers provided by CIE, supplemented by resident outbound demand estimated by Arup
- The traffic volumes are considered once the airport upgrade /construction is complete. As an initial assumption, this is 2031 for a new Jindabyne airport.

P&L – Operating costs and revenues

- The specific assumptions are described in the following slides
- The assumptions are modelled as revenues / cost per passenger. Estimated in 100,000 pax increments, the model interpolates the values and multiplies through the annual passenger numbers

Capex

- The model considers expansionary capex only. No allowance is made for ongoing maintenance and replacement works
- As an initial estimate this is $250m for a new Jindabyne airport.
- The capex cashflow is equally distributed across the construction period. In this instance, the construction period is assumed to be five years, so $250m is allocated as $50m spend per year from 2026 to 2030.

Cashflow

- Cashflow is expressed in real terms, calculated as EBITDA less capex.
- The NPV is calculated against the cashflow using a WACC of 6%.
- ‘Breakeven’ is defined as cumulative cashflow = 0

Sensitivity Testing

- A flat subsidy per passenger can be input to the model to test the level of subsidy required to achieve a target IRR (bottom up assessment)
- Similarly, all airport value drivers can be solved to estimate the quantum of traffic to reach a target IRR (top down assessment)

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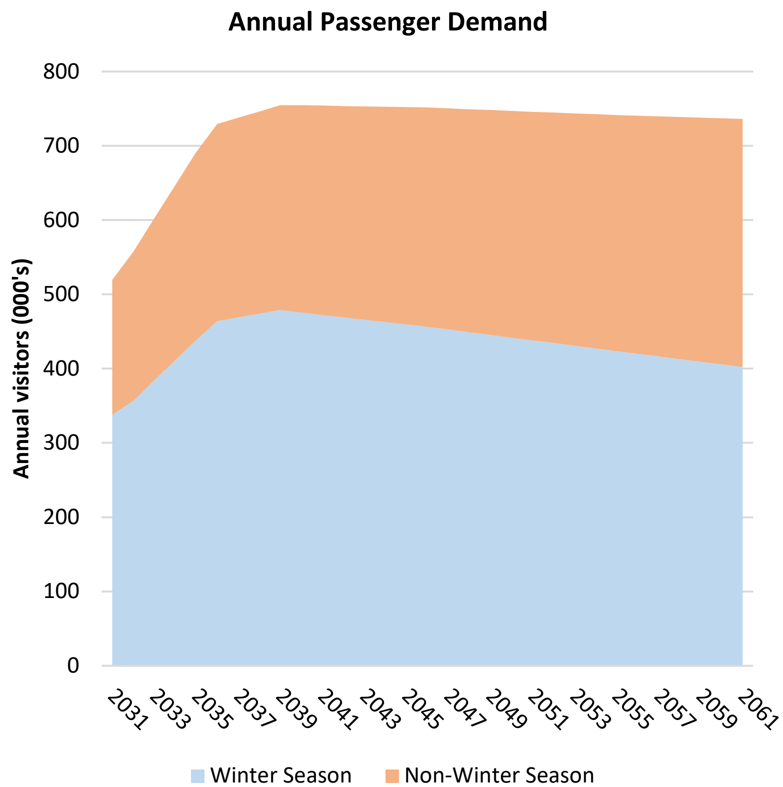
Airport Financials (3)

Traffic Demand

- The total annual traffic volumes for the airport peak at 754k passengers in 2039, declining marginally to 736k passengers by 2061
- This is driven by a gradual decline in winter season demand, discussed above in this report.



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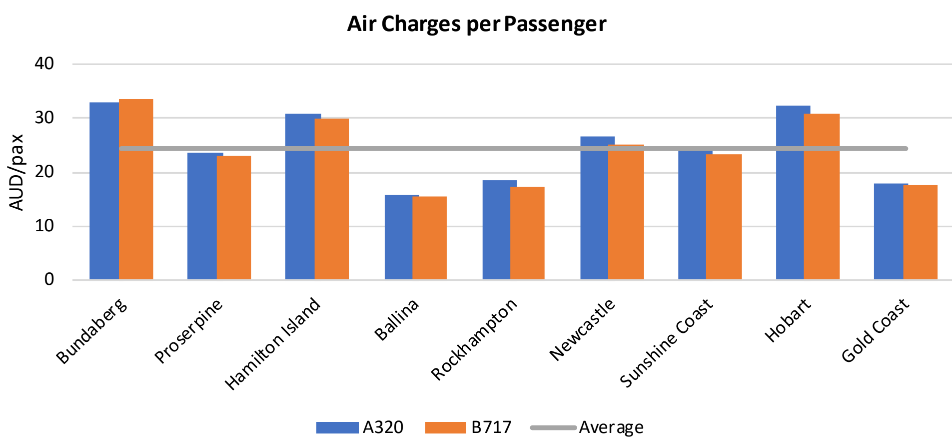
Airport Financials (4)

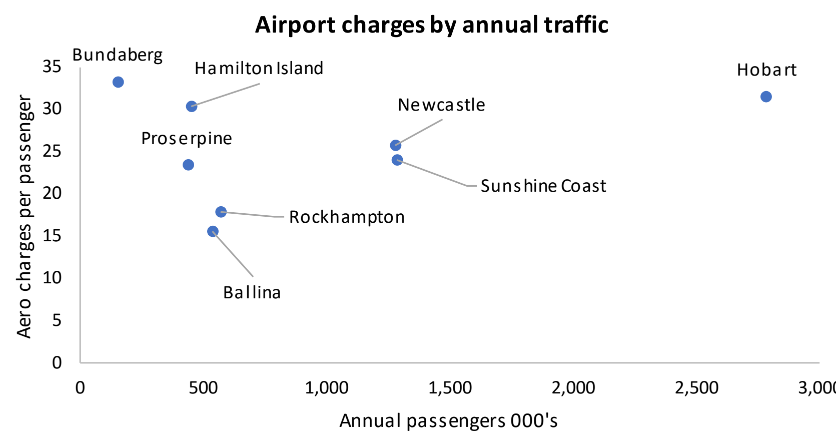
Approach to aeronautical revenue airport charges

A benchmarking exercise of air charges per passenger has been undertaken for comparable airports. This is built up on the full turnaround charges for both an A320-200 and B717-200 – common jets in Qantas' fleet.

There is high variability in air charges per passenger amongst the peer airports, with an average around $25 AUD/pax.
For high level financial model analysis, the difference between the A320 and B717 is negligible at this stage.

There is no clear correlation between the scale of these airports and the charges – likely due to the unregulated and ad-hoc approach adopted by smaller airports in Australia in setting landing charges. For the purposes of the model they are therefore assumed flat.





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Airport Financials (5)

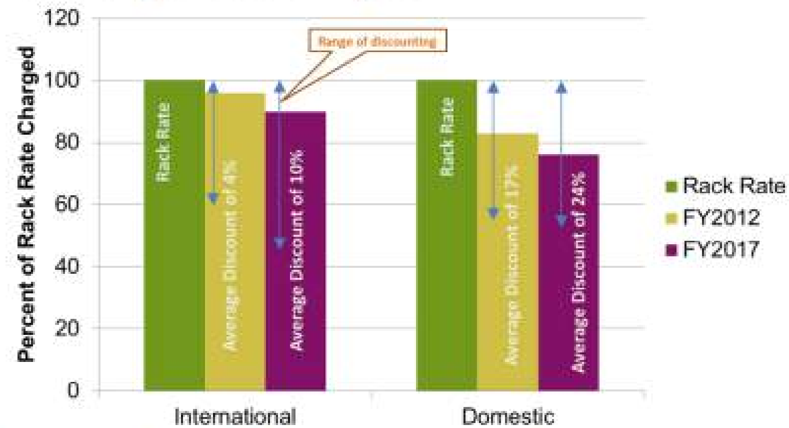
Approach to aeronautical revenue discounting

Airports offer a range of discounts and incentives to the published rack rates through their commercial negotiations with airlines.

In their 2018 report to Australian Airports Association on 'The Impact of Airport Charges on Airfares', InterVISTAS Consulting estimated the average discount to domestic carriers at around 24%.

For the purposes of this model, a 24% competitive discount is applied to the assumed rack rates. This discounts the $25 AUD/pax charge down to an average aeronautical revenue of $19 AUD/pax.

Figure E-1
Discounting at Australian Airports



Source: Data received from Australian Airports Association

Airport Financials (6)

Airline Subsidies

There is likely going to be several types of airline subsidies needed to support and grow Jet services into the Cooma/Jindabyne market.

a. Load Factor Subsidy:

- We have identified a commercial schedule that is viable based the forecast levels of visitor demand. A viable schedule is one that has a minimum frequency of 3 services per week. Below this level of frequency the airlines are unlikely to be interested in switching capacity into this market.
- The average load factors across this viable commercial schedule average above 65% - a schedule is not considered viable unless this minimum load factor is achieved.
- In practice however, if load factors were to fall below 65% airlines would look for a load factor subsidy to continue to support the service.
- Indeed, the airline would probably look to negotiate a certain load factor guarantee to trial the market, stay in the market, and build base demand. This will be a negotiation but could be as high as 50% load factor.
- The period of support will likely be to the point at which consistent load factors averaging well above 65% are achieved.

b. Profit Support Subsidy:

- For the Jindabyne market to be appealing to the leisure sector, airfares into the market will need to compete with average airfares into other leisure destinations. Indeed for a period of time, airlines will likely discount fares for a new market, to stimulate demand and create awareness.

b. Profit Support Subsidy Continued ….

- If we start with the assumption that average fares into competing destinations return a reasonable profit to airlines, then the level of support needed to retain that equivalent profit is the value of the fare discount.

c. Marketing Support

- For new markets there needs to be considerable effort in promoting the new service. The funds required to advertise and market the route/destination will usually be shared between the local /State/Federal tourism organizations, the airport and the airline.

d. Set Up Costs

- Airlines servicing an airport for the first time, will ask for compensation of operational set up costs.

e. Landing Charges Discounts

- Discounts to landing charges usually structured as Year 1- 100% discount, Year 2 - 75%, Year 3 - 50% Year 4 - 25%, Year 5 - 0%. However, if load factor support is provided and profit support this should not be additional.

f. Growth Rebates:

- Once the service is achieving consistent load factors, the airline will transition onto an ongoing growth rebate, that rewards the airline for new/incremental growth each year

Note: none of these subsidies have been modelled into the airport financials at this stage

Airport Financials (7)

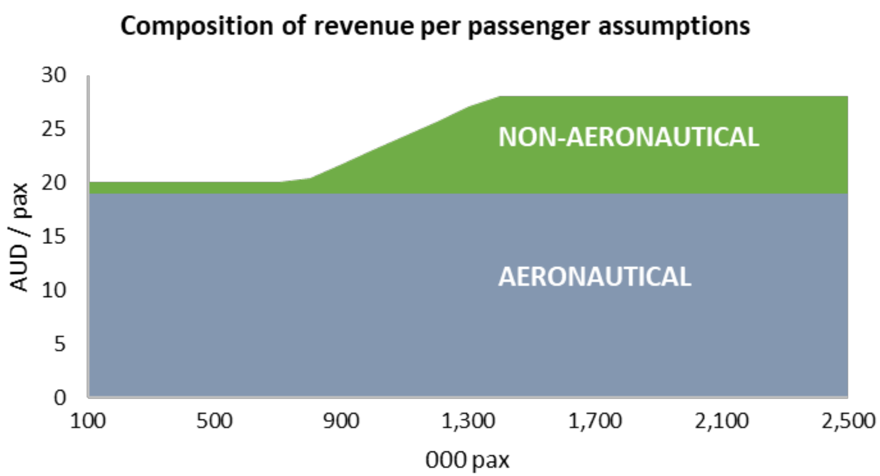
Approach to Non-Aeronautical Revenue / Benchmarking

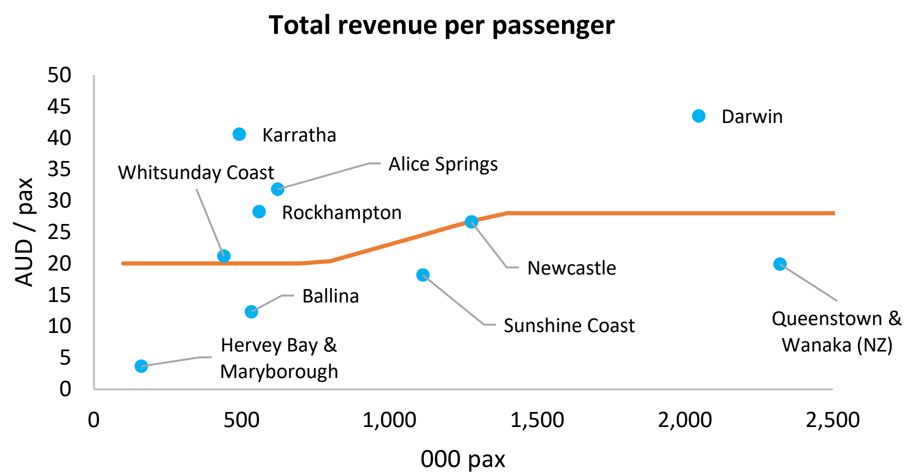
Benchmarking the public domain financial performance of other small Australian airports demonstrates that operating revenues increase with scale. This growth is attributed to non-aeronautical revenues; where a greater scale of passenger demand underpins the business case for developing commercial products to attract higher yields.

The assumed non-aeronautical yields are derived from the total revenue benchmarking chart trendline, subtracting off the aeronautical revenues.

Upper and lower values of $1 AUD/pax and $9 AUD/pax respectively are assumed as limits for non-aeronautical yields.

The resulting total revenue per passenger (aeronautical + non-aeronautical) are displayed as the orange line in the benchmarking chart below.





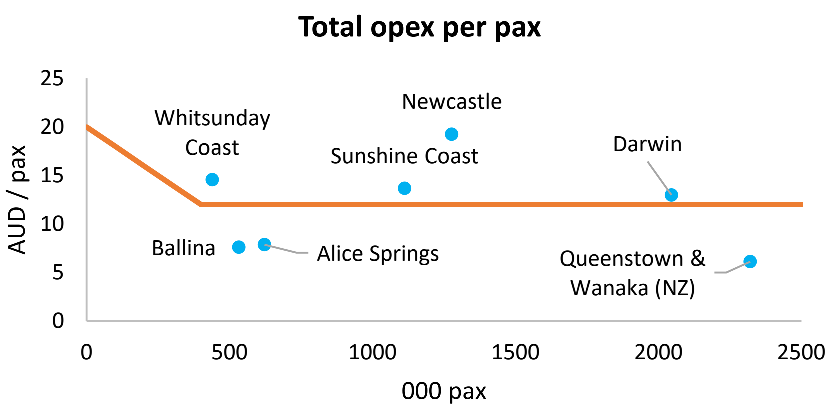
Airport Financials (8)

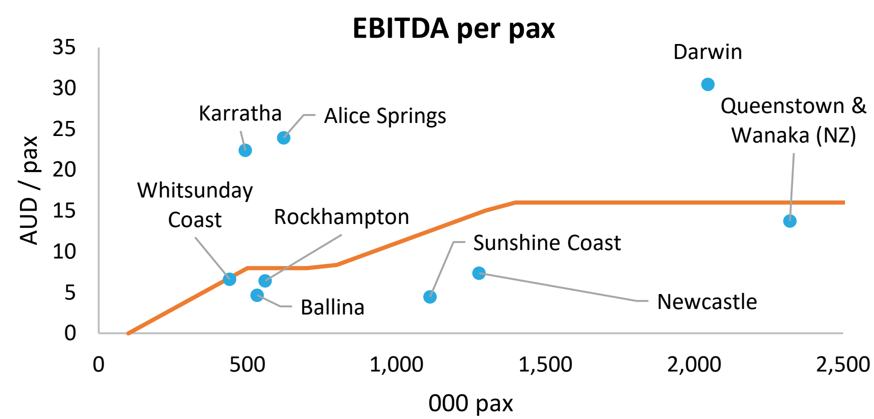
Approach to Operating Costs –Benchmarking

Airport operating costs generally experience a declining trend against demand, as costs decrease through the realisation of economies of scale.

However for small regional airports, the datapoints are sporadic due to a cost base that is very specific to each location. Reflecting the strong economy of scale for small airports the model assumes that opex begins at $20 AUD/pax and drops significantly until it reaches a conservative flat rate of $12 AUD/pax.

To validate the assumed operating costs and revenues, the EBITDA per passenger model results are compared vs the benchmark. Model results shown as the orange line below sit within the anticipated range.





Airport Financials (9)

Summary of Airport Value Drivers by Annual Demand

Passenger range	Aero revenue *(AUD / pax)*	Non-aero revenue *(AUD / pax)*	Operating Costs *(AUD / pax)*	EBITDA *(AUD / pax)*
0-99,999	19.00	1.00	20.00	0.00
100,000-199,999	19.00	1.00	18.00	2.00
200,000-299,999	19.00	1.00	16.00	4.00
300,000-399,999	19.00	1.00	14.00	6.00
400,000-499,999	19.00	1.00	12.00	8.00
500,000-599,999	19.00	1.00	12.00	8.00
600,000-699,999	19.00	1.00	12.00	8.00
700,000-799,999	19.00	1.39	12.00	8.39
800,000-899,999	19.00	2.72	12.00	9.72
900,000-999,999	19.00	4.05	12.00	11.05
1,000,000-1,099,999	19.00	5.38	12.00	12.38
1,100,000-1,199,999	19.00	6.71	12.00	13.71
1,200,000-1,299,999	19.00	8.03	12.00	15.03
1,300,000-1,399,999	19.00	9.00	12.00	16.00
1,400,000-1,499,999	19.00	9.00	12.00	16.00
1,500,000 +	19.00	9.00	12.00	16.00

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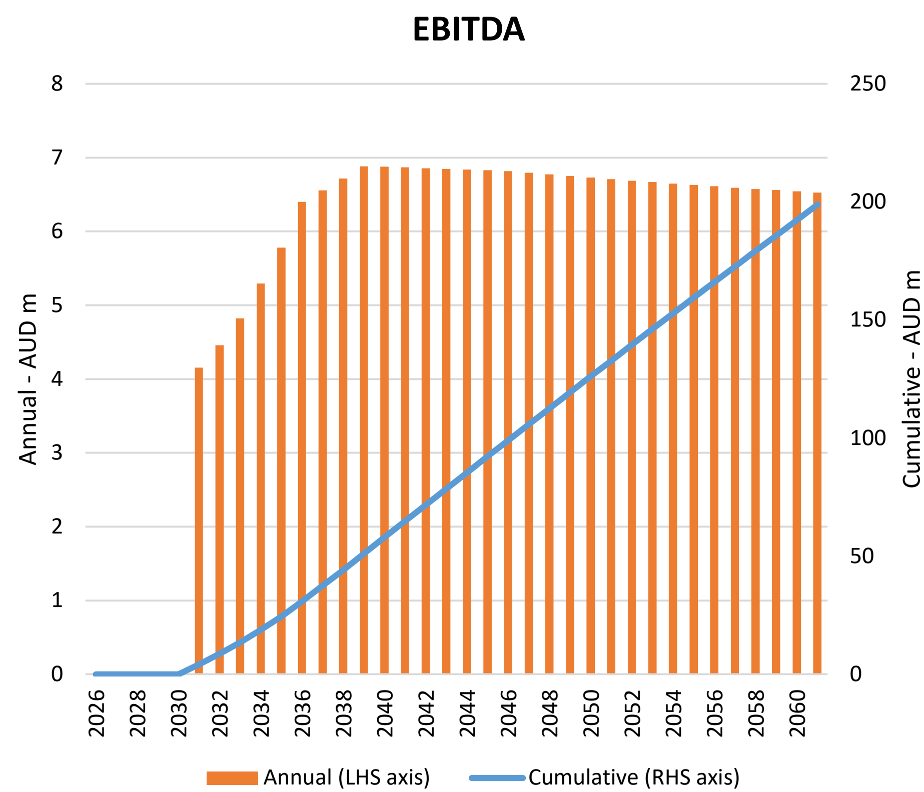
Airport Financials (10)

Airport Profitability Profile

- Using the stated underlying assumptions for costs and revenues per passengers at this stage, the EBITDA is only influenced by the passenger volumes.
- Annual EBITDA ramps up in the initial years to 2039 as traffic volumes grow, before gradually declining to 2061

Scenario Name	Cumulative 2061 EBITDA (AUD m)
New Jindabyne	198.8



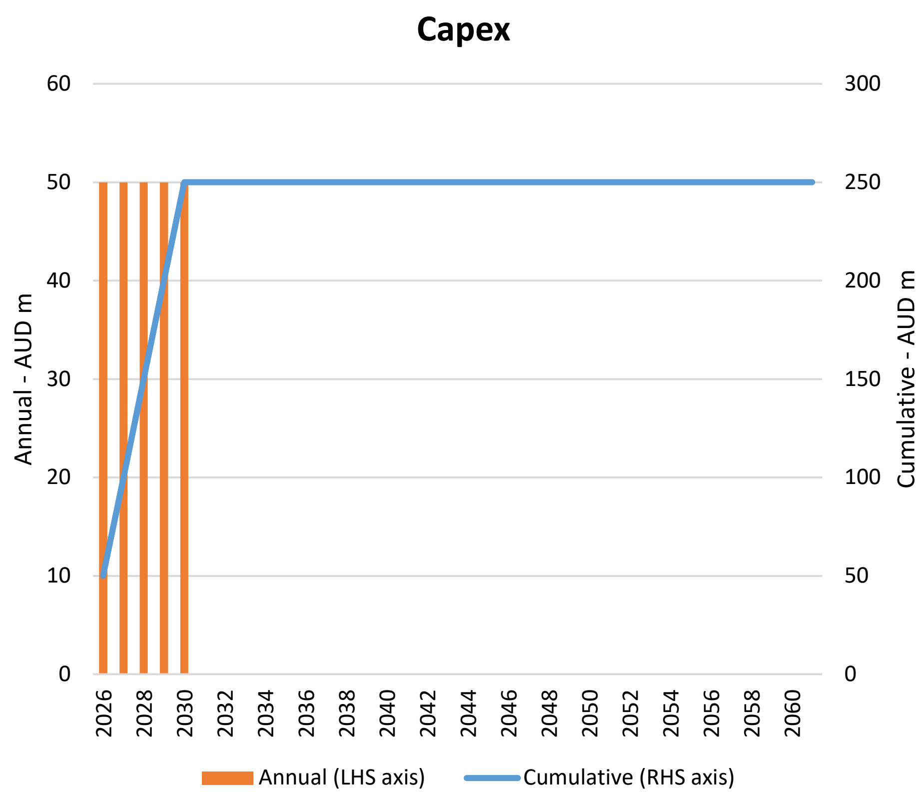
Airport Financials (11)

Capital Costing

The Financial Model assumes some very indicative capex costings which can be refined as design work is completed.

At this stage, the new Jindabyne airport has an estimated $250m AUD capex

Scenario Name	Capex
New Jindabyne	$250m AUD

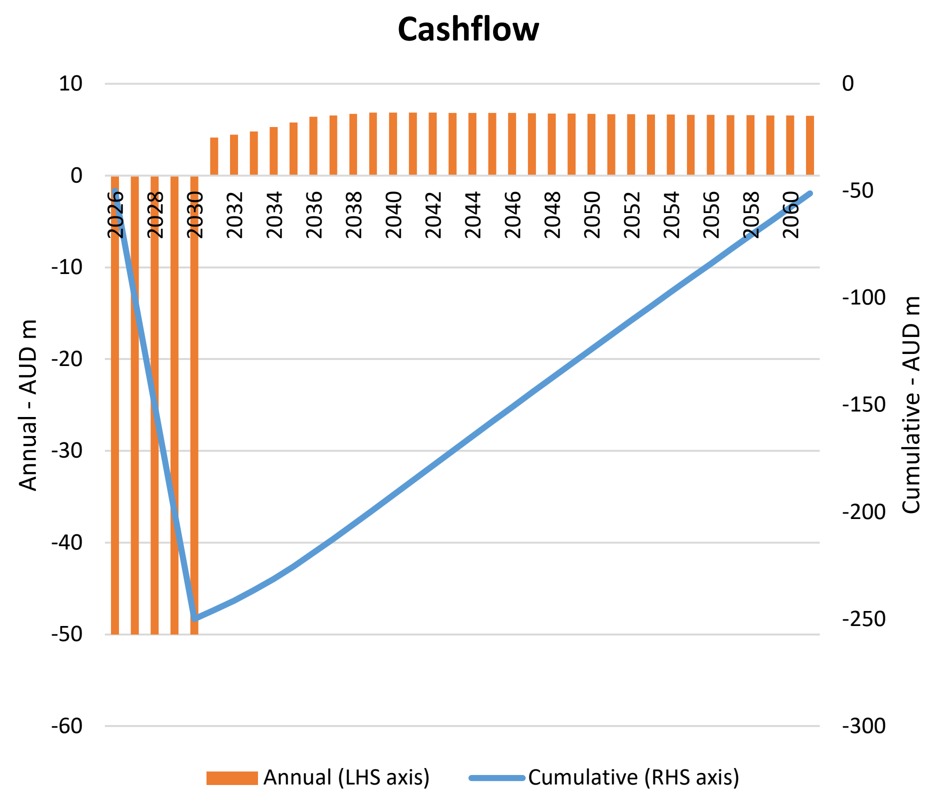


Airport Financials (12)

Break Even Result

The New Jindabyne scenario does not achieve breakeven by 2061.

Scenario Name	Cumulative 2061 Cashflow (AUD m)	Breakeven year
New Jindabyne	-51.2	-



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Airport Financials (13)

NPV Result:

By 2061, the airport project has an NPV of -103.3m, and an IRR of -1.2%

To achieve a 10% IRR, a cumulative subsidy of 856.1m AUD is required, or 38.22 AUD per passenger

Scenario Name	Cumulative Cashflow (AUD m)	Breakeven Year*	NPV @ 6% WACC (AUD m)	IRR
New Jindabyne	-51.59	n/a	-103.3	-1.2%

Subsidy to Achieve 10% IRR (AUD/pax)	Cumulative Subsidy (AUD m)	Breakeven Year* with Subsidy
38.22	856.1	2039

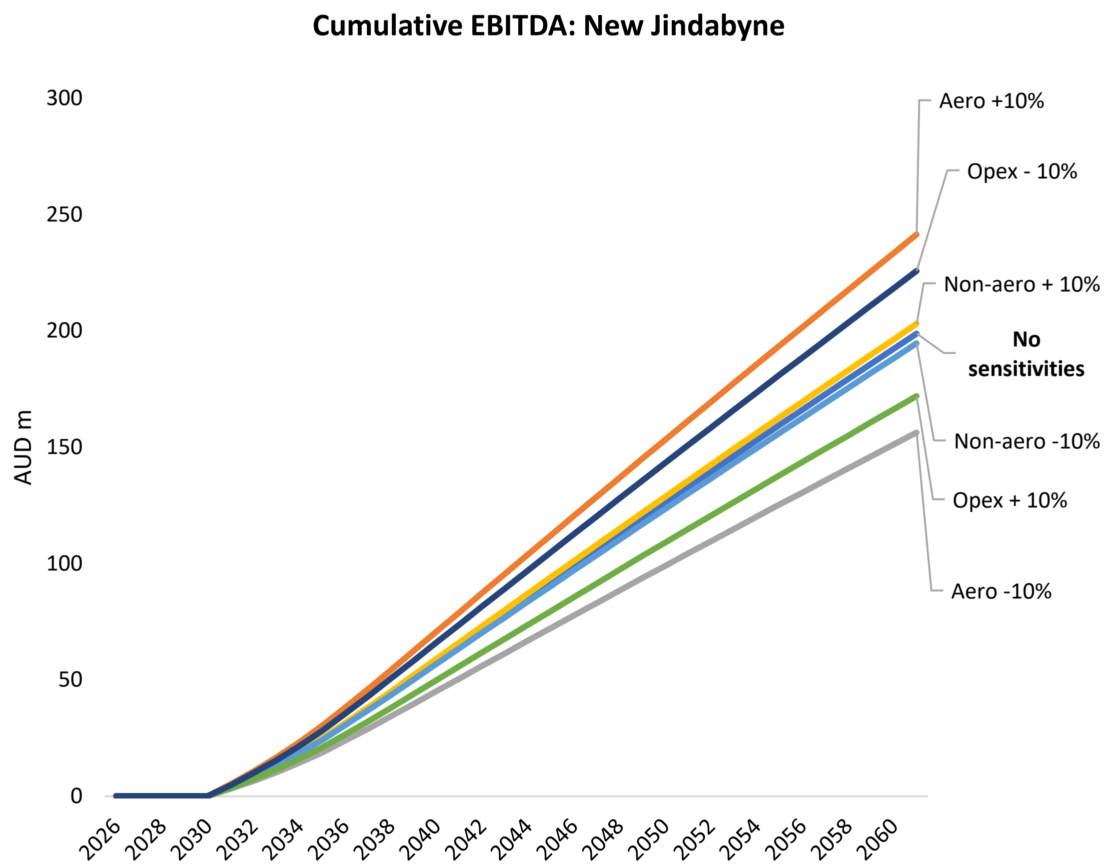
** Breakeven defined when undiscounted cumulative cashflow reaches 0*

Airport Financials (14)

Sensitivity Analysis

- The adjacent chart shows the results of sensitivity analysis for the New Jindabyne Airport
- These sensitivities are:
  - Aero yields +/- 10%
  - Non-aero yields +/- 10%
  - Opex +/- 10%
- The EBITDA is most sensitive to the aero revenue assumptions, followed by opex and non-aero.

2061 Cumulative EBITDA		
	AUD m	***Impact***
No sensitivities	198.8	
Aero +10%	241.4	*+21%*
Aero -10%	156.3	*-21%*
Non-aero + 10%	203.0	*+2%*
Non-aero -10%	194.6	*-2%*
Opex + 10%	171.9	*-14%*
Opex - 10%	225.7	*+14%*



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Airport Financials (15)

How sensitive is the subsidy value (IRR 10%) to key operating metrics?

The subsidy required to achieve the target IRR is highly sensitive to passenger volumes, aeronautical yields and quantum of capex

Subsidy required for 10% IRR (New Jindabyne)		
	Subsidy (AUD / pax)	***Impact***
No sensitivities	38.22	
Aero +10%	36.35	*-4.9%*
Aero -10%	40.15	*+5.0%*
Non-aero + 10%	38.06	*-0.4%*
Non-aero -10%	38.44	*+0.6%*
Opex + 10%	39.45	*+3.2%*
Opex - 10%	37.02	*-3.1%*
Capex + 10%	42.95	*+12.4%*
Capex -10%	33.56	*-12.4%*
Passenger volumes +10%	33.21	*-13.1%*
Passenger volumes -10%	43.95	*+15.0%*

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Airport Financials (16)

How sensitive is the IRR @ 10% to traffic uplift ?

For New Jindabyne Airport, without a subsidy a 193% uplift in traffic is required to achieve a target IRR of 10%. This represents a 2061 demand of 2.16m passengers.

Is this uplift is unrealistically large, for sensitivity testing we have combined the traffic uplift with a $20/pax subsidy to derive an IRR of 10%.

In the base case the traffic uplift required is 45%. Other sensitivities tested, shows this traffic variance could be within a range of +34% to +55%.

Traffic uplift required to achieve 10% IRR		
	New Jindabyne – High Air Case ($20/pax subsidy assumed)	
	2061 demand (000 pax)	*Uplift applied*
No sensitivities	1,064	*45%*
Aero +10%	1,021	*39%*
Aero -10%	1,110	*51%*
Non-aero + 10%	1,052	*43%*
Non-aero -10%	1,077	*46%*
Opex + 10%	1,093	*48%*
Opex - 10%	1,037	*41%*
Capex + 10%	1,138	*55%*
Capex -10%	987	*34%*

Next Steps

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Next Steps

Next Steps

- The current iteration of the financial model is predicated on high level and preliminary inputs. It is sensitive to its assumptions, in particular any changes to traffic and capex are highly material.
- The current outputs suggest there are challenges with the investability of the airport. Arup would like to work with the Government to develop some structural, commercial and financial options that would prove the market viability of the airport.
- We would like to assist in holding market soundings and testing market appetite for an agreed scheme.

Supporting Information

Air Demand for Planning

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Air Demand for Planning

Summary

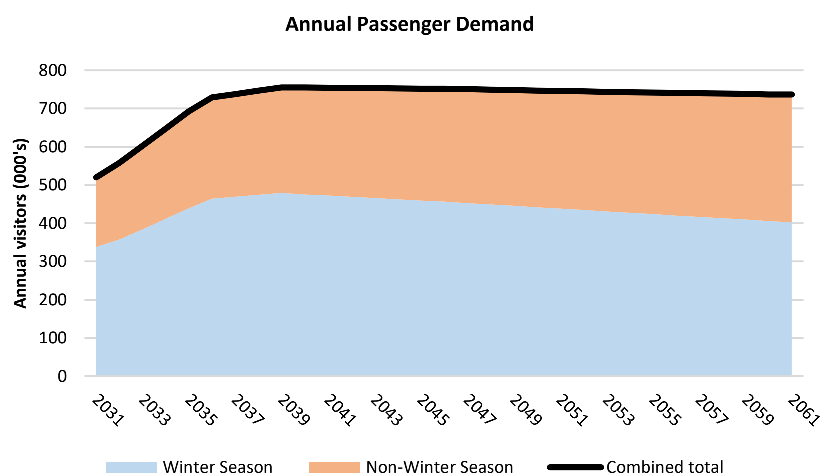
An output of this commercial workstream is to provide annual and daily demand for consideration in the airport planning studies. The demand is convert from the CIE annual visitation forecasts into the appropriate metrics using benchmarking case studies.

The following information was used to determine the airport infrastructure requirements at the New Jindabyne airport.

Annual Passenger Demand

Expected to begin operations in 2031, demand at the New Jindabyne airport is forecast to grow significantly in the opening years. In particular, the winter season (approximately 91 days) is expected to be the main area of growth until 2039.

Beyond 2039, the non-winter season is forecast to represent an increasing share of the annual visitation, with the local investments stimulating a better distribution of visitors across the year.



Air Demand for Planning

Daily Frequencies - **Opening Year - 2031**

Drawing from the existing operations at regional airports, the weekly distribution during the 2031 winter season reflects a concentration of operations on the weekend to align with the expected ski visitation. Despite the increased attractions during the week and across seasons, the weekend during the winter is still the critical period for planning purposes in this initial opening phase.

The non-winter period reflects a greater distribution of flights across the week to capture the assumed visitation from new initiatives in the area, including the business trips related to the conference facilities.

Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	11	5	2	6	14	5	14	**57**
BNE	Qantas/Jetstar A320-200	180	153	2	2	1	1	3	2	3	**14**
MEL	Qantas Q400	74	48	1	1	-	1	-	5	-	**8**
			Total Turnarounds	14	8	3	8	17	12	17	79

Non-winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	1	2	1	1	1	2	1	**9**
BNE	Qantas/Jetstar A320-200	180	153	-	1	1	-	-	1	-	**3**
MEL	Qantas Q400	74	48	1	1	-	1	-	3	-	**6**
			Total Turnarounds	2	4	2	2	1	6	1	**18**

Daily Frequencies - **Ultimate Design Year – 2039 (Winter) and 2061 (Non-Winter)**

The peak periods for each season were identified to determine the safeguarding requirements for the airport infrastructure. As a result of the changing balance across the forecast horizon, the weekly schedules for two different years were selected.

The most onerous period for the airport infrastructure is forecast to occur in 2039 during the winter season. The non-winter season is expected to grow up to 2061 but at no point is it expected to exceed the Winter season with regards to infrastructure requirements.

The 2039 winter weekly schedule considers a conservative approach, assuming a high concentration of flights during the weekends. This schedule provides a suitable upper bound for the planning of infrastructure requirements.

There is a notable growth in the Non-winter season from the opening year with the Snowy SAP initiatives generating greater visitation over this period. However, the weekly frequencies are much lower than the winter season and therefore fall within the capacity provided for the 2039 winter season.

Winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	4	3	2	4	31	3	31	**78**
BNE	Qantas/Jetstar A320-200	180	153	1	1	1	1	10	-	10	**24**
MEL	Qantas/Jetstar A320-200	180	153	-	-	-	-	1	-	1	**2**
MEL	Qantas Q400	74	63	-	1	-	-	-	3	-	**4**
			Total Turnarounds	5	5	3	5	42	6	42	**108**

Non-winter Schedule

To / From	Potential Operating Aircraft	Seats per AC	Passengers per AC	Frequency of services (turnarounds) by day of week							Weekly Ops
				Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
SYD	Qantas/Jetstar A320-200	180	153	2	3	1	2	3	1	3	**15**
BNE	Qantas/Jetstar A320-200	180	153	1	1	-	1	1	1	1	**6**
MEL	Qantas Q400	74	63	1	3	1	1	-	5	-	**11**
			Total Turnarounds	4	7	2	4	4	7	4	**32**

Case Studies

Case Studies

Schedule Analysis

Drawing upon historic OAG flight data, an analysis of weekly flights was completed for 3 case study airports; Mount Hotham, Snowy Mountains (Cooma) and Queenstown. Each of the selected airports are heavily influenced by the winter ski season and therefore provide a good indication of the operations that could develop at the New Jindabyne airport when its opens in 2031.

Mount Hotham (MHU) – the smallest of the three airports provides an example of the winter dedicated operations only, with no scheduled flights outside of the skiing season. With the very low demand it demonstrates how the frequencies offered by the airlines are condensed to the high demand days only, minimising operations to achieve the required load factors.

Snowy Mountains – Cooma (OOM) – currently providing air access to the Snowy Mountains, this airport provides a indication of the current demand into the region and a basis for the schedule development at the New Jindabyne airport.

Queenstown (ZQM) – As a world renowned ski destination in the southern hemisphere this case studies provides an insight into the type of schedule that can be achieve if significant growth is achieved. The change in weekly operations provides an indication of the likely changes that would occur as the demand increases.

In addition the impact of traffic volumes, the case studies also take into account the likely impact of the Snowy SAP initiatives and how that could spread demand across the week.

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Case Studies

Weekly Schedule - Seasonal Airports

Winter Season

The case studies opposite show a distinct pattern of airlines operating dense schedules on a Friday and a Sunday for domestic market primarily associated with skiing.

This is consistent with the package arrangement for skiing and accommodation in Australia, where lodges accept weekend bookings to include inbound on a Friday and outbound on a Sunday. And then week bookings, inbound on a Sunday and outbound on a Friday.

The Queenstown market has a flatter schedule, a consequence of this market being the predominant destination for International travel to New Zealand. It is unlikely, Jindabyne would ever be considered a major International attraction or play this same role for Australia or scale to the same degree as the Queenstown market.

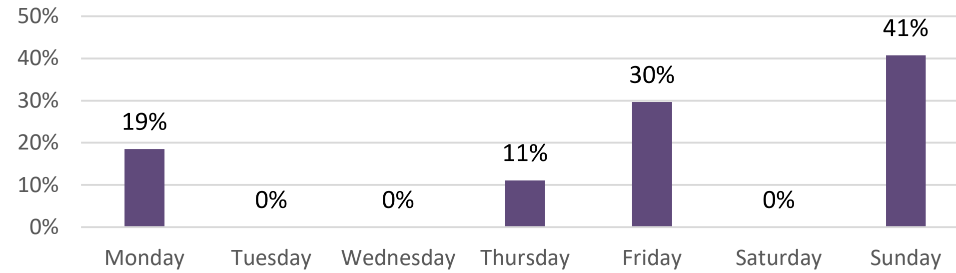
However, the proposed local investment of attractions and conference facilities may result in a flatter profile across the week as inbound business visitors fly in during the week and either return immediately or extend their stay over the weekend.

We do not anticipate the resident population generating significant outbound demand at differing times to the visitor demand.

Thus, whilst the airport remains small in scale we anticipate the airline schedule to remain quite peaky across a weekend profile.

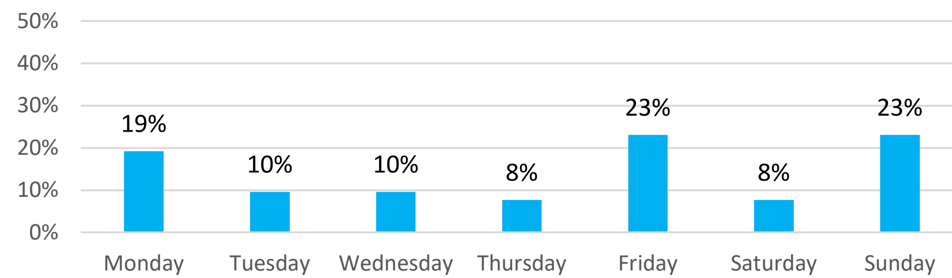
Mount Hotham (MHU)

- *Year: 2011*
- *54 ATMs in August*
- *July – September Service only*
- *Other peak months reduced a weekend service only.*



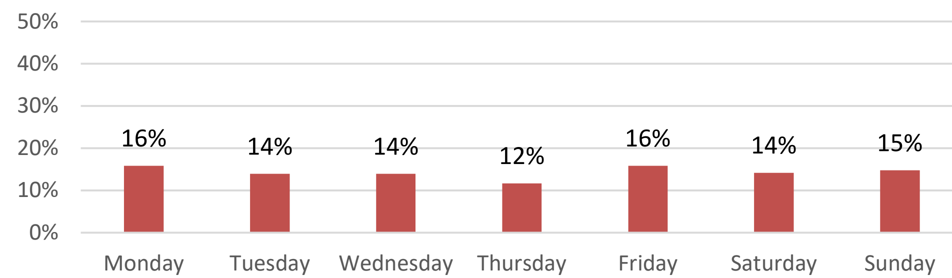
Snowy Mountains Airport (OOM)

- *Year: 2019*
- *104 ATMs in July*
- *January – December Services*



Queenstown (ZQM) to Auckland

- *Year: 2019*
- *720 ATMs in July*
- *January – December Services*



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Case Studies

Weekly Schedule - Seasonal Airports

Non-Winter Season

Focussing on scheduled operations during the quieter months, the case studies opposite show how the demand profile can change completely to serve a different market.

In the case of Mount Hotham, there was not sufficient demand outside of winter to justify scheduled flights.

For the Snowy Mountains airport, there is a noticeable shift towards the working week, with reduced operations over the weekends. Recognising that the Snowy SAP initiatives will likely grow demand during the non-winter season, we would anticipate New Jindabyne Non-winter season continue to be predominantly weekend demand (for the summer activities), with a similar schedule to the winter season.

With the significant demand across the week between Queenstown and Auckland the differences between the winter season and non-winter season is less notable.

Considering the forecast demand for the New Jindabyne airport, it is highly likely that the non-winter profile will continue to focus around the weekend, with some additional growth either side of the weekend to capture the additional conference demand.

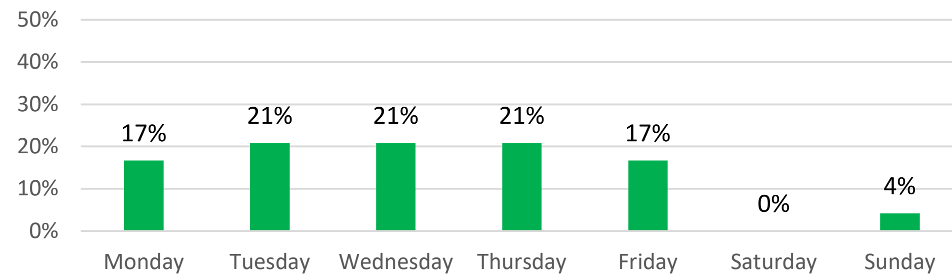
Mount Hotham (MHU)

- *Year: 2011*
- *Closed between October and the following June*

No Services

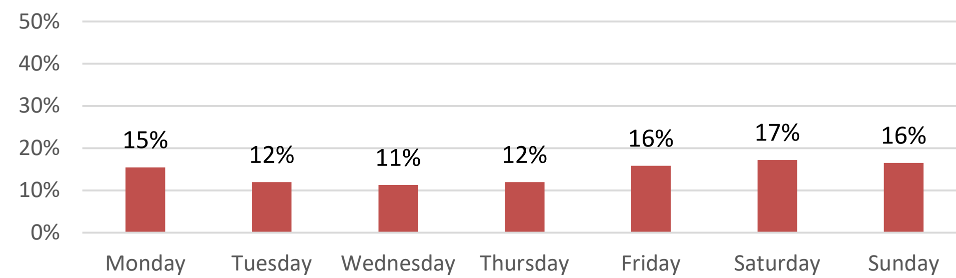
Snowy Mountains Airport (OOM)

- *Year: 2019*
- *48 ATMs in January*
- *January – December Services*
- *A transition to midweek focus but with only half the ATMs of Peak season (July).*



Queenstown (ZQM) to Auckland

- *Year: 2019*
- *570 ATMs in June*
- *January – December Services*



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Appendix H

Cost Estimate

WT PARTNERSHIP

ORDER OF MAGNITUDE - NEW JINDABYNE AIRPORT

SNOWY MOUNTAINS SAP

ORDER OF MAGNITUDE - NEW JINDABYNE AIRPORT
OOM - NEW JINDABYNE AIRPORT

WT PARTNERSHIP

Estimate Summary

Code	Description	Quantity	Unit	Rate	Total
	ORDER OF MAGNITUDE - NEW AIRPORT				
	ENABLING WORKS & SITE PREPARATION				32,440,260
	BULK EARTHWORKS				69,572,973
	LANDSIDE ROADS AND CAR PARKS				12,470,000
	NEW TERMINAL BUILDING				17,500,000
	ANCILLARY BUILDINGS				9,000,000
	AIRSIDE PAVEMENTS				28,721,038
	UTILITIES & SERVICES				6,835,000
	NAVAIDS & AGL				2,246,000
1/A	ENVIRONMENTAL MANAGEMENT	1.0	%	178,785,271	1,787,853
	SUBTOTAL - DIRECT COSTS				*180,573,124*
1/B	PRELIMINARIES	20	%	180,573,124	36,114,625
1/C	DESIGN	10	%	216,687,749	21,668,775
1/D	CONTRACTOR'S OVERHEADS & MARGIN	6	%	238,356,524	14,301,391
	SUBTOTAL - INDIRECT COSTS				72,084,791
	SUBTOTAL - CONSTRUCTION COSTS				**252,657,915**
	LAND ACQUISITION				300,000
1/E	OTHER CLIENT COSTS	6	%	252,657,915	*15,159,475*
	SUBTOTAL - CLIENT COSTS				**15,459,475**
	TOTAL PROJECT COSTS				**268,117,390**
1/F	RISK - DETERMINISTIC	20	%	268,117,390	*53,623,478*
1/G	ESCALATION - 3 years @ 3.5%	11	%	321,740,868	*33,782,791*
	TOTAL OUTTURN PROJECT COSTS				**355,523,660**
	ASSUMPTIONS & EXCLUSIONS				0
	TOTAL COST				**355,523,660**

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	ENABLING WORKS & SITE PREPARATION				
	Security Fencing				
2/A	Security Perimeter Fencing 2.4m high mesh with barbed wire inc. CCTV	5,087	m	1,500.00	7,630,260
2/B	Prov. Sum for Manned Entrance Gates	2	no	30,000.00	60,000
	Clearing / Demolition				
2/C	Clearing and Grubbing (300x2500m) - including tree removal	750,000	m2	5.00	3,750,000
	Environmental Offsets				
2/D	Snow Gum Woodland	1	sum	21,000,000.00	21,000,000
	Total - ENABLING WORKS & SITE PREPARATION				**32,440,260**

WT PARTNERSHIP

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	BULK EARTHWORKS				
	Topsoil Management				
3/A	Strip Topsoil and stockpile on site (150mm)	112,500	m3	9.00	1,012,500
3/B	Stockpiled topsoil to batters	750,000	m2	3.00	2,250,000
	Bulk Earthworks				
	Runway & Taxiway				
3/C	Cut to fill - Rippable 50%	460,000	m3	11.00	5,060,000
3/D	Cut to fill - Blasting (granite) - 50%	460,000	m3	30.00	13,800,000
3/E	Balanced Net Volume (Imported Fill)	30,000	m3	40.00	1,200,000
	Terminal - Subject to further review				
3/F	Cut to fill - Rippable 50%	50,000	m3	11.00	550,000
3/G	Cut to fill - Blasting (granite) - 50%	50,000	m3	30.00	1,500,000
3/H	Balanced Net Volume (Imported Fill)	1,070,000	m3	40.00	42,800,000
	Foundation Treatment				
3/J	Loosen and Recompact to non-landscaped areas	204,482	m2	1.50	306,723
	Landscaping				
3/K	Revegetation (250x2500m) Hydroseeding	625,000	m2	1.75	1,093,750
	Total - BULK EARTHWORKS				**69,572,973**

WT PARTNERSHIP

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	<u>LANDSIDE ROADS AND CAR PARKS</u>				
	<u>Car Park</u>				
	Rate for car park benchmarked, incl. boom gates, drainge, lighting, CCTV. $12,000 per space				
4/A	Car Park (15,000sqm - 500 spaces) 400mm DGB 40mm Asphalt	15,000	m2	410.00	6,150,000
	<u>Internal and Access Roads</u>				
4/B	Allowance for access and internal roads (say 2000x8m) 650mm pavement kerbs drainage services trench	1	sum	5,120,000	5,120,000
4/C	Allowance for street lighting to above	100	no	12,000.00	1,200,000
	Total - LANDSIDE ROADS AND CAR PARKS				**12,470,000**

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	NEW TERMINAL BUILDING				
5/A	Passenger Terminal Building	3,500	m2	5,000.00	17,500,000
	Total - NEW TERMINAL BUILDING				**17,500,000**

WT PARTNERSHIP

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	ANCILLARY BUILDINGS				
6/A	Air Rescue & Fire Fighting Station (ARFF)	1,000	m2	3,500.00	3,500,000
6/B	Maintenance Building / Workshop	200	m2	2,500.00	500,000
6/C	Ancillary Building	2,000	m2	2,500.00	5,000,000
	Total - ANCILLARY BUILDINGS				**9,000,000**

WT PARTNERSHIP

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	AIRSIDE PAVEMENTS				
	Airside Pavements				
7/A	Runway Pavement (45x2000m) 400mm SMZ, 300mm DGB, 300mm DGS, 50mm AC	90,000	m2	166.00	14,940,000
7/B	RESA (90x90m; 2No.) Grassed; allowance	16,200	m2	22.00	356,400
7/C	Taxiway (135x30m) 400mm SMZ, 300mm DGB, 300mm DGS, 50mm AC	4,050	m2	166.00	672,300
7/D	Aircraft Apron 100mm DGB, Concrete Pavement 450mm	30,258	m2	335.00	10,136,433
7/E	Taxilane 400mm SMZ, 300mm DGB, 300mm DGS, 50mm AC	8,050	m2	166.00	1,336,244
7/F	Helipad (30x50m) 100mm DGB, Concrete Pavement 450mm	1,500	m2	335.00	502,500
7/G	Perimeter Internal Road, Unsealed (4m wide) 100mm subbase	17,960	m2	15.00	269,400
	Linemarking				
7/H	Runway centre line dash [say 1200m]	1,200	m	20.00	24,000
7/J	Runway threshold lines (say 30x1.6m - no.24)	24	no	900.00	21,600
7/K	Runway side strip lines	4,000	m	25.00	100,000
7/L	Runway numbering [say no. 4 digits]	4	no	1,500.00	6,000
7/M	Runway touchdown zone marking (say 22x.3m - no.24)	24	no	900.00	21,600
7/N	Runway aiming points	4	no	5,000.00	20,000
7/P	Taxiway centre line inc. line-up rwy	180	m	15.00	2,700
7/Q	Taxiway side strip lines	270	m	20.00	5,400
7/R	Allowance for Taxilane and Apron line-marking including center and side lines, intersections and stop markings, gates IDs, pedestrian and light vehicles markings	38,308	m2	8.00	306,461
	Total - AIRSIDE PAVEMENTS				**28,721,038**

WT PARTNERSHIP

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	UTILITIES & SERVICES				
	Sewer				
8/A	Allowance for sewer reticulation from main at site boundary into terminal and ancillary buildings [say 2000m]	2,000	m	400.00	800,000
	Water				
8/B	Allowance for water reticulation from main at site boundary into terminal and ancillary buildings [say 2000m]	2,000	m	300.00	600,000
8/C	Prov. Sum for external Water Tank - say 500,000L	1	sum	120,000.00	120,000
	Drainage				
8/D	Runway drainage, bio-swales to both sides including slotted carrier pipes	4,000	m	180.00	720,000
8/E	Allowance for 4 No. 600mm dia x 300m runway crossings	1,200	m	800.00	960,000
8/F	Prov. Sum for OSD Basin [say 3,000sqm]	3,000	m2	115.00	345,000
8/G	Apron drainage, Heavy Duty ACO channel with locking grate [say 700m]	700	m	800.00	560,000
8/H	Oil-Water Separators at discharge [say no.4]	4	no	40,000.00	160,000
	Communications				
8/J	Allowance for reticulation of comms cables and conduits from mains at boundary into terminal, ancillary buildings and NAVAIDS	3,000	m	250.00	750,000
	Electrical				
	Aeronatical Ground Lighting (AGL) accounted under NAVAIDS section				
8/K	Primary electrical reticulation [say 6,000m]	6,000	m	200.00	1,200,000
8/L	Prov. Sum for Apron flood lights [6 poles]	6	no	70,000	420,000
	Fuel				
8/M	Supply and install 20,000L external fuel tank	1	no	200,000.00	200,000
	Total - UTILITIES & SERVICES				**6,835,000**

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	NAVAIDS & AGL				
	Navigational Aids				
9/A	Prov. Sum for GBAS (LNAV/VNAV)	1	sum	100,000	100,000
9/B	PAPIs	2	no	60,000	120,000
	Movement Signs				
9/C	Prov. Sum for vertical information signs [say no.5]	4	no	20,000	80,000
	AGL - Aeronautical Ground Lighting				
9/D	Runway centre-line and edge lighting [say no.160]	160	no	2,000	320,000
9/E	Threshold lighting [say no. 36]	36	no	2,000	72,000
9/F	Taxiway lighting [say no.27]	27	no	2,000	54,000
	ALER - Airfield Lighting Equipment Room				
9/G	Prov. Sum for ALER	1	sum	1,500,000	1,500,000
	Total - NAVAIDS & AGL				**2,246,000**

WT PARTNERSHIP

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	ASSUMPTIONS & EXCLUSIONS				
	ASSUMPTIONS				
	ENABLING WORKS & SITE PREPARATION				
	Security Fence - perimeter measured on plan, benchmarked rate including CCTV				
	Clearing & Grubbing rate benchmarked, based on visual inspection of aerial images				
	Environmental Offsets included at $21m as instructed by Arup				
	BULK EARTHWORKS				
	All excavated material to remain on-site, stockpiled and spread over/benched on perimeter batters				
	Bulk Earthworks quantities provided by Arup				
	50% of excavated material assumed to be rippable - blended rate				
	50% of excavated material assumed to be blasted				
	LANDSIDE ROADS AND CAR PARKS				
	All-in benchmarked rate used for car park, approximately $12,000 per sqm includes pavements, footpaths, CCTV, boom gates and fencing				
	Allowance for access road including street lighting, assumed 2000x8m corridor, including kerbs, drainage, pavements and services trench				
	NEW TERMINAL BUILDING				
	New terminal building assumed 3,500sqm GFA - no details, benchmark rate				
	ANCILLARY BUILDINGS				
	ARFF station assumed 1,000sqm GFA				
	Maitenance / Workshop assumed 200sqm				
	Ancillary Building assumed 2,000sqm				
	AIRSIDE PAVEMENTS				
	Pavement profiles as per Arup's specification				
	Line-marking pricing detailed for runway and taxilane. Line-marking for Apron is an allowance per sqm				
	UTILITIES & SERVICES				
	Sewer reticulation, assumed 1,000m - benchmarked rate per l/m				
	Water reticulation, assumed 1,000m - benchmarked rate per l/m + allowance for 1x 500,000L external tank				
	Runway drainage - assumed bio-swales both sides with subsoil pipe				
	Apron drainage - assumed ACO heavy duty, 700m				
	Comms reticulation, assumed 3,000m - benchmarked rate per l/m				
	Electrical reticulation, assumed 6,000m - benchmarked rate per l/m				
	Apron floodlights - assumed 6 poles for 3 gates				
	NAVAIDS & AGL				
	Number of AGL lighting based on runway and taxiway lenght				
	ENVIRONMENTAL MANAGEMENT				
	Environmental management costs assumed at 1% of Direct Costs				
	INDIRECT COSTS				

Estimate Details

Code	Description	Quantity	Unit	Rate	Total
	Contractor's Preliminaries set at 20% of Direct Cost				
	Design - assumed full D&C - 10% of DC+Preliminaries				
	Contractor's Overheads & Margin at 6%				
	EXCLUSIONS				
	Disposal of any surplus material off-site				
	Management, remediation and/or disposal of any contaminted or hazardous material				
	Any other latent conditions, such as heritage findings				
	Any works outside of boundary is excluded - it is assumed that services infrastructure required will be provided at site boundary by others				
	Land Acquisition costs as per North Projects estimate				
	Other client costs (reference design, delivery team, PM, QS) assumed 6%				
	Escalation assumed 3 years at 3.5% per year				
	Risk and Contingency is deterministic allowance at 20%				
	GST is excluded				