Western Sydney Airport EIS Submission

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22 January 2024

Recommendations:

Recommendation 1: Integration of Flexible Use of Airspace (FUA) with protection of heritage and population areas will maximise community and air safety outcomes. An **Integrated Risk Review** of FUA in the Sydney basin can be done to optimise and minimise aviation risks in the Sydney basin for Jets and turbo jets using both KSA and WSA by incorporating the consequences for 5.3 million local stakeholders, heritage effects and animal, insect and flora changes from noise pollution and aircraft crash risks.

The Federal Government has recently introduced changes to the way aircraft use airspace to fly between airports to produce a more flexible approach for airspace use and to integrate civilian and military use of airspace, allowing the use of common designated flightpaths and communication systems.

There is a Federal Ministerial directive to design a flightpath system for Western Sydney Airport (WSA) that does not affect the current flight paths into Kingsford Smith Airport (KSA). Key changes that can be included in the study would be based on assessments of flightpaths into WSA that do not overfly the Blue Mountains World Heritage Area and surrounding National Parks.

Recommendation 2: That overflight of the Greater Blue Mountains World heritage Area by jets and turbojet aircraft be restricted to flights above 31000ft in line with international practice.

The risk assessments that were undertaken as part of the EIS have not been directed at the broader Sydney and Blue Mountains public or consider domestic, economic and business benefits of an integrated approach to meet these large population needs and to meet international environmental protection standards for protected heritage areas.

The risk on non-compliance with Australian air regulations and safety of the flying public are an essential component of the risk assessment. Catastrophic risks from aviation also need to be included - the consequences of terrorist (deliberate) acts, and the impact on the communities of a crash, or environmental consequences. As an example, aviation risks focus on what is acceptable in terms of frequency of an event and the number likely to be killed and fail to take into account the complex environment around a major urban city such as Sydney with protected heritage areas. These wider stakeholders in the Sydney and Western Sydney airports number 5.3 million people. In some parts of the world aviation risks have to consider terrorism threats, consequences of aircraft crashes on dense urban areas and critical infrastructure risks from a crash.

It can be an objective of a risk assessment to identify the residual risks which are the result of changes such as those proposed for aviation and then to assess the costs of reducing some of these risks either by removing or protecting vulnerable impact areas or changing the air traffic plans. The latter can be stress tested against long term risks over the lifetime of the airport facilities and considered in 5,10, 20 year airport and surrounding infrastructure and residential planning.

The EIS has not at this stage covered residual risks and has not considered known risks in the detail required for this level of professional risk assessment. A cogent example is bird and bat strikes that may be considered in causing crashes but there is not the reverse analysis of flight paths and eradication of bird risks on mitigation strategies on bird and bat populations. This does not preclude a final assessment that is in accord with some of the existing findings but ensures the residual risks and cost are quantified and transparent in government and aviation policy.

Noise is an important issue around flightpaths. The current land use planning regulations for noise at airports are not suitable for protecting populations away from the airfield where noise levels drop below 60dBA. While this might be suitable in urban environments where the background noise over a 24hr period is about 55-60 dBA, it has a different effect when introduced into regions where background 24hr levels are 20-25dBA. This level occurs in Western Sydney on the Cumberland plain and in the Greater Blus Mountains World heritage Area (GBMWHA) and buffer zones. The World Health Organisation admits that there is a dearth of information on human health hazards in the published literature below 33dBA. The Sydney populations have two problems- the new noise in the background environment and the continuity of that noise across activities of daytime and nighttime living. This applies both to residential and trade interests. The WHO recommendations concentrate on assessed health risks. It is a similar story with published data on noise exposure of animals and plants and issues of harm in life cycle or movements and depletion of propagation. There is no data for the majority of species found on the Cumberland plain or in the BMWHA and surrounding parkland. Overflights of these areas by commercial jets range from 55dBA to 65 dBA depending on aircraft type and which departure route they use. The effect of increasing land height over the Blue Mountains effectively keeps the level of noise constant at and above urban background noise levels. This understanding of the physics of noise at different altitudes should be integrated within risk assessments.

Finding: An initial assessment is that there would be a level of noise in the BMWHA and surrounding National Park areas with long term impacts on native species.

An aspect of the BMWHA is the aesthetic value that it brings to people that live there, visitors from across the world and the cultural significance. Most of this cannot be appreciated in purely economic terms but can be assessed for residual risk to the heritage value of a world heritage listing.

Finding: An initial assessment indicates that the Aesthetic values that produce long term wellbeing for the benefit of the NSW population and other visitors have only been assessed on economic grounds and not on the long term sustainability of aesthetic values.

Recommendation 3: The Federal Government should consider developing a high speed train network across the Eastern States of Australia with future development to the Northern Territory and Western Australia.

There is a further existential risk that threatens the BMWHA and Sydney. Climate change is a major factor in the sustainability of the BMWHA as well the threat to the general population in Sydney. The submission that was made to the Federal Government on policy for the Aviation White paper demonstrated that in order to get to zero emissions in aviation by 2050, there needed to be a reassessment across all transport modes of moving to more efficient energy use in transport. Ultra-High Speed Rail (300-350km/hr) has been shown to be the most efficient form of transport.

Developing a network across the Eastern States has the potential to produce large economic benefits to the regional areas of Australia. Australia is in a position to develop large scale use of hydrogen and electric aircraft that have ranges up to 1500km. Such aircraft are more suited to moving people and freight between regional areas of Australia. By using population hubs on the High speed rail network integrated with this type of aircraft, introduces aviation transport options in the regions that is not easily achievable at present.

Ultra -High speed rail also reduces the need to service the East Coast cities by aircraft freeing up the airspace into KSA for international flights while reducing the overall crash risk into and around the Sydney basin and significantly reduces the crash risk to heritage sites and the ecosystem of flora and fauna.

Contents

Introduction:

The Environmental Impact Statement (EIS) was released to the General Public in late October for comment with a closing date of 31 Jan 2024. This EIS focuses on the risks that Western Sydney Airport (WSA) poses for Western Sydney and the Greater Blue Mountains World Heritage area (GBMWHA).

This submission will discuss risks from aviation in the Sydney basin and Greater Blue Mountains World Heritage area. To put this in context, this discussion will discuss basic risk concepts before discussing the risk technical papers in the EIS.[1] A discussion will then focus on processes that have been used in this EIS, what can be improved and how an integrated risk assessment based on all stakeholders and the environmental factors can produce outputs of value to aviation and the government.

Basic Risk Concepts for a sustainable future

ISO31000, commonly called the risk management standard, is the Internationally accepted rules based approach to managing Government's or organisation's risks. In this standard, the risk is defined *as* ***the effect of uncertainty on objectives*****.**

The EIS requires the Airport and the Aviation space associated with it to operate with consequences that are acceptable to the general public. As this is a joint Government development, it is an obligation to ensure the public is informed with the knowledge of the true nature of likely impacts from the building and use of WSA in order that they can critically respond to their future. This should occur before any business plan and proposed flight paths are accepted by Governments.

The risk management standard provides the principles and guidance as to how to manage risks within an organisation and Government. A flow diagram of these principles is shown in Figure 1.

The risk is multidimensional, and safety is just one of these dimensions. The other stakeholder areas within Government and organisations involved with this project include; Legal, Personal, Health, Economic, Contractual, Professional, Operational, Environmental, Civil, Political, Geopolitical, Technological, Security and Corruption.

In addition, there are external factors beyond the immediate control of the Federal or State Government that will also change the risk. There are also connections across these different areas within the Federal Government, the State Government and other organisations that can provide positive and negative feedback loops affecting the level of risk.

Risk can therefore be considered in two ways:

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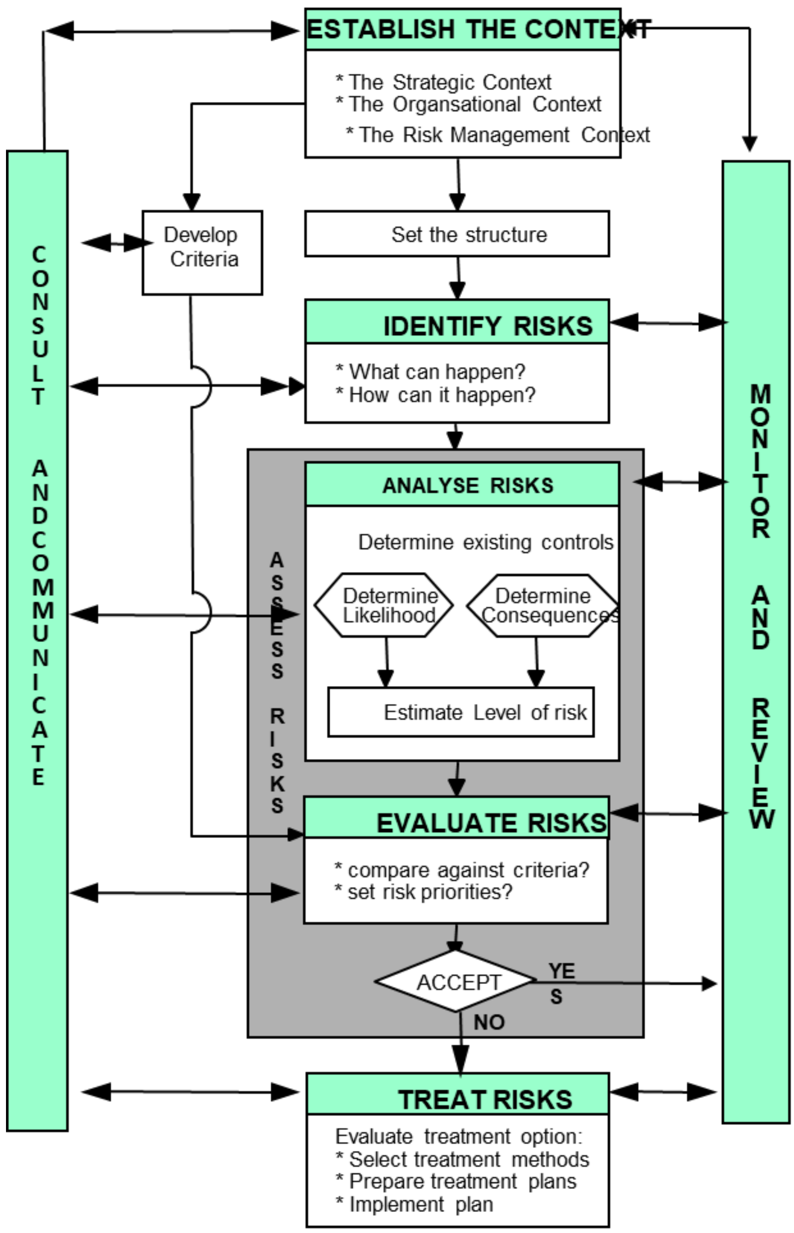
[1] EIS technical Papers 4, 5 and 14. While technical papers 6-12 all have aspects of risk management in their discussions, they will be highlighted if need arises from discussion the these three technical papers.

- Tame Risks (Independent Risks) where the basic assumption is that the system being analysed is independent of other systems and there is no feedback from other systems into the system being analysed; and
- Wicked Risks (Complex and Complicated Risks) where substantial feedback mechanisms lead to long “tail risks” (low probability, high impact events) that arise if the system is inappropriately analysed as a tame risk. This can also occur from high impact events when certain conditions are met that lead to failure of the system.

1)



2)

Figure 1 The process of Risk Management taken from ISO31000.

The EIS should reflect that this project has wicked risks. A consequence of this is that the risks cannot be analysed in isolation. Safety of the operation and airspace cannot be isolated separately without considering the full economic and social impact of unwanted events. This problem will be discussed below.

ISO31010 provides guidance on how to estimate risks using over 30 different assessment techniques. These include quantitative and qualitative assessment methods. In may risk assessments, both qualitative and quantitative methods are used.

The *uncertainty on objectives* in risk arises from a deficiency of information related to understanding or knowledge of given circumstances, its consequence, or likelihood both at the present time and how this might change in the future.

Risk is generally characterized by reference to potential events and consequences, or a combination of these. Risk is commonly expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence.

Assessment of risk is often based on empirical historical data of a threat or hazard occurring (Figure 2). There usually is plenty of data on common risks but as risks become rarer there is decreasing data and much larger uncertainties in its interpretation. At some point there are examples around the world of events but no local data. At this point assessment of risk must rely on foreseeable *credible* mechanisms for the threat or hazard to occur that are assessed by modelling the system. Beyond this thought experiments and imagination can lead to incredible mechanisms of failure, often in the realm of science fiction. A problem is that with the passage of time there are changes in the risk that occur through disruptive technology, changes to society, the natural world and community, that bring future scenarios of threat from fantasy to being credible.

These changes, often called black swan events, are thought of as unforeseen events. Similarly, people say they have never experienced such an event, such as the severity of floods or bushfires. In both cases the magnitudes of the consequences are foreseeable, but the political action needed to ensure there are adequate controls for mitigation is lacking because the frequency has been underestimated. These types of problems occur in this EIS and will be discussed below.

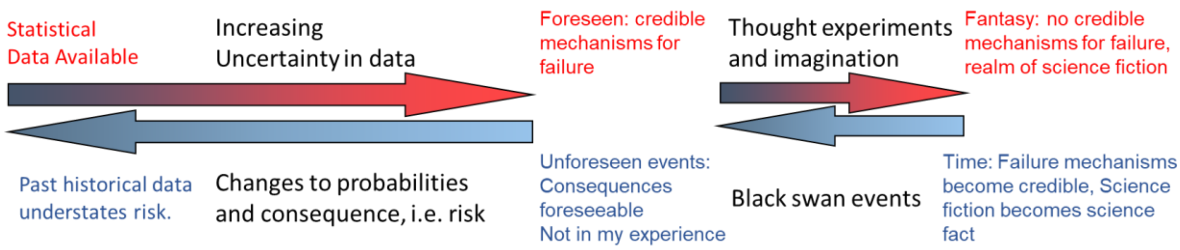


Figure 2 Risk Assessment with Increasing Uncertainty

Another complication is that at some point control of the system is lost due to external vectors out of the control of the designers or operators of the systems. It can also occur because of the complexity of the system itself. Figure 3 is a schematic of risk as a function of likelihood. There are three regions the expected risk, the expected and unexpected risk and the catastrophic risk. All are related to the ability to mitigate the risk. The term SFAISRP (So far as is reasonably practical)[2] is about how the control system is designed and is usually a mixture of human protocols and regulations and engineering controls. There is always a tail risk (or residual risk) that also needs to be considered in complex problems. The tail risk can be sufficiently large to upend all the assumptions that have been made to control the risk.

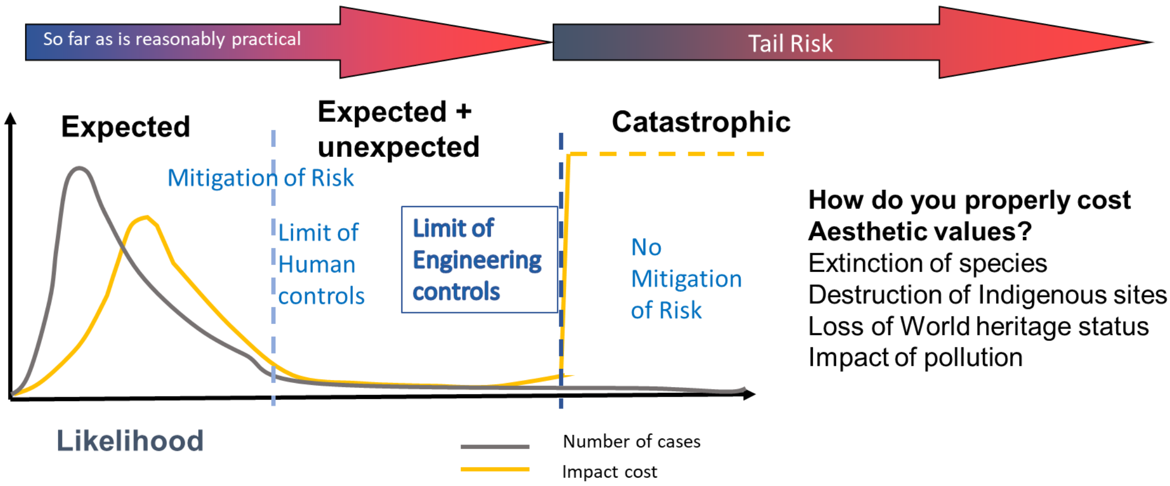


Figure 3 risk profiles with likelihood.

One of the reasons for this failure is that control of the system is considered in isolation from the damage that can occur. There are examples of this in the EIS.

When it comes to the control of threats and hazards, the treatment options should take account of the Hierarchy of controls:

1. Eliminate the risk – in many cases, the risk can be avoided by consideration of other options;
2. Substitute for the risk – alternative processes can be used;
3. Re -Engineer – add additional controls that react to engineering failures or behavioural failures;
4. Review Procedures – alter procedures to limit Human behaviour; and

[2] In the EIS, the two terms So Far As Is reasonably Practical (SFAISRP) and Ad Low As Reasonably Practical (ALARP) are used as being interchangeable. They are different. ALARP is used as a target level of risk that is needed to be achieved. This can set by Government as regulations or by organisations where an internal target is required to achieve their objectives. SFAISRP is the controlled level of risk that arises from the mitigation or control of the risk. SFAISRP risks can be above or below the ALARP level. .

5. Provide personal protection – this can be in the form of protective equipment for physical hazards or insurance.

Generally, the higher the control is in the hierarchy the greater the reduction in risk.

As stated above, risk is a measure of uncertainty and this uncertainty increase as information becomes sparse. Part of the risk management assessment should be to model or otherwise estimate the change in the risks for the aviation industry and place some bounds on the risks in the future. While individual risk types such as a crash risk might seem to be easily calculated, from historical data, the vagaries of slightly different circumstances of the crash can alter the consequences (examples of this will be discussed below). Quantitative risk assessments should be explained with the 95% uncertainties. Qualitative risk assessments should be explained with the expected and high and low level of risks.

EIS Risk Processes

Strategic risk Context- Recommendation for inclusion

The strategic risk context of this project can be included in an integrated risk assessment that has the objective to ensure that airspace in the Sydney basin *"is administered and used safely, taking into account the protection of the environment, efficient use of that airspace, equitable access to the air space for all users of that air space, and national security."* [3] Furthermore, the environmental impact statement needs to include risks associated with matters of national environmental significance. These include World Heritage areas, places of national heritage, wetlands of international importance under the RAMSAR convention, threatened species and ecological communities, migratory species protected under international agreements and Commonwealth marine areas.[4]

The Sydney basin has a complex airspace. To develop a risk context that takes account of the strategic context, assumptions about the nature of available airspace and whether the current technology for airspace use is fit for purpose are required. Due to recent advances in aviation communication and manoeuvrability, in consultation with ICOA and Defence, the Federal Government has recently moved to a Flexible Use of Airspace (FUA) to make more efficient use of airspace around Sydney. This has required changes to the communication systems and Air Traffic Control systems for amalgamation of Defence and Civilian aircraft. The purpose is that for civil and military use of airspace FUA integrates common routes with the same communications technology leading to more efficient use of airspace especially when the airspace becomes dense with traffic as is the case around the Sydney basin.

Considering the topology of the Sydney basin and international agreements and movement to a FUA regime, an opportunity exists for alternative and more optimal system of flight paths into both airports. This more optimal airspace architecture is not reflected in either the 2016 Airport EIS or the 2023 Flight Paths EIS. Figure 4 shows the current use of airspace for Kingsford

[3] EIS Chapter 5, 5.2.1.2 Airspace Act 2007.

[4] EIS Chapter 5. 5.2.1.4 Environmental Protection and Biodiversity Conservation Act 1999

Smith Airport (KSA). The complexity for some 930 movements per day is also complicated by general aviation flights at Camden and Bankstown airports and military flights at Richmond and Holsworthy Airports.[5]

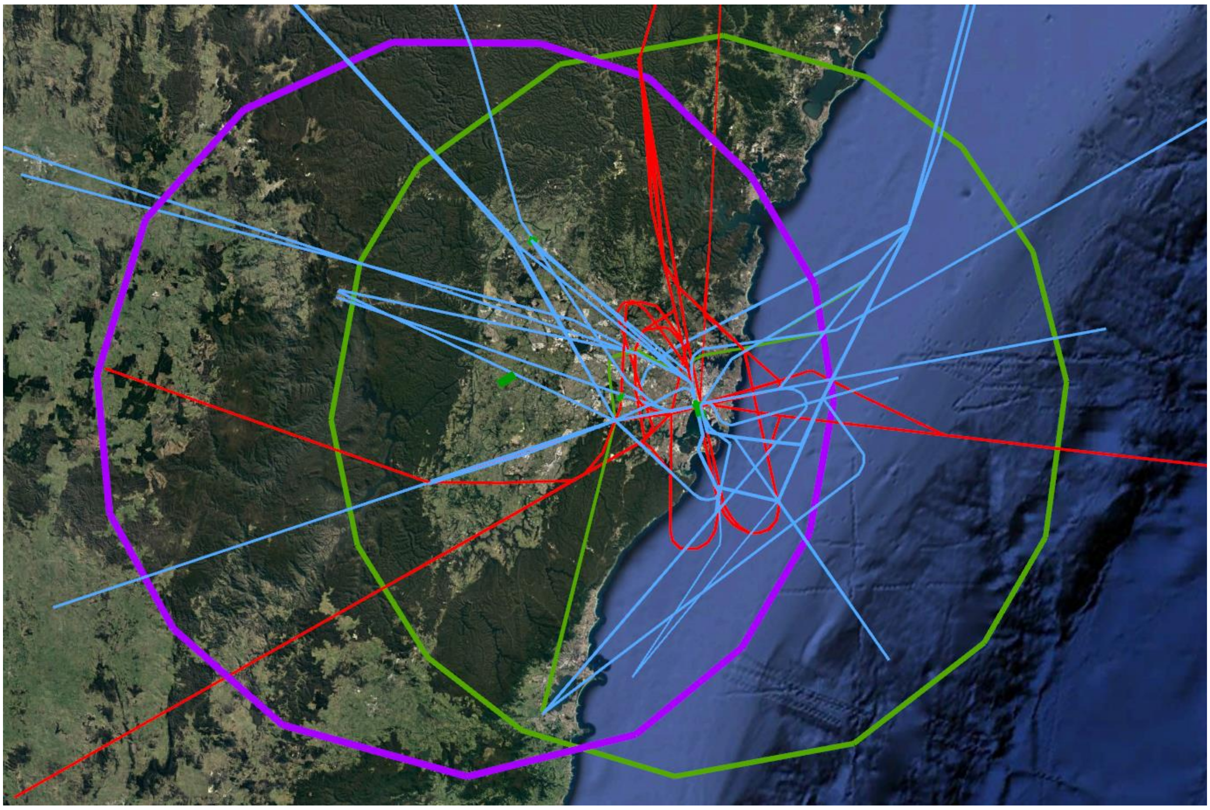


Figure 4 Current jet and Turbojet flight paths (2023) into KSA together this the 45 NM control space for KSA (Green) and WSA (purple). Red lines indicate Standard Instrument Arrival (STAR) flightpaths and light blue paths represent Standard Instrument Departure (SID) flightpaths. (The map was prepared using Google Earth).

A letter was tabled at a Sydney Airport Community Forum (SACF) meeting from then Federal Minister Paul Fletcher which outlined the Government's view that Flight Paths for KSA would not change to accommodate flight paths for WSA. This is reflected in both the 2016 Airport EIS and the 2023 Flight Paths EIS. The Minister's statement goes against the objective embedded in FUA. It means that the flight paths for jets and turbo-jets operating into and out of the Sydney basin, are not optimal for either WSA or KSA.

[5] The arrival and departure routes were taken from observation of flight paths in September 2023 and correlation with the published STAR and SID routes at KSA. This should be compared with the patterns in Figure 4.2 of Chapter 4 of the EIS which shows the dispersions of planes in the 2016 business plan and is mainly due to noise abatement programs in addition to the SID and Star Routes.

Recommendation 1: Integration of Flexible Use of Airspace (FUA) with protection of heritage and population areas will maximise community and air safety outcomes. An **Integrated Risk Review** of FUA in the Sydney basin can be done to optimise and minimise aviation risks in the Sydney basin for Jets and turbo jets using both KSA and WSA by incorporating the consequences for 5.3 million local stakeholders, heritage effects and animal, insect and flora changes from noise pollution and aircraft crash risks.

The problem of optimal use of airspace for both WSA and KSA will be discussed below in regard to assessing the validity of controls proposed in the EIS. This approach can mitigate serious residual risk that is apparent through assessing the technical papers on risk within the EIS. And provide a sustainable future.

In the EIS, the result of this sub-optimal process is overly complex flightpaths that have to avoid the designated jet and turbo jet paths into KSA as shown in in Figure 5. All new flight paths are pushed to the west and overfly the Greater Blue Mountains World heritage area. Furthermore, the departure modes are more complicated than they need be.

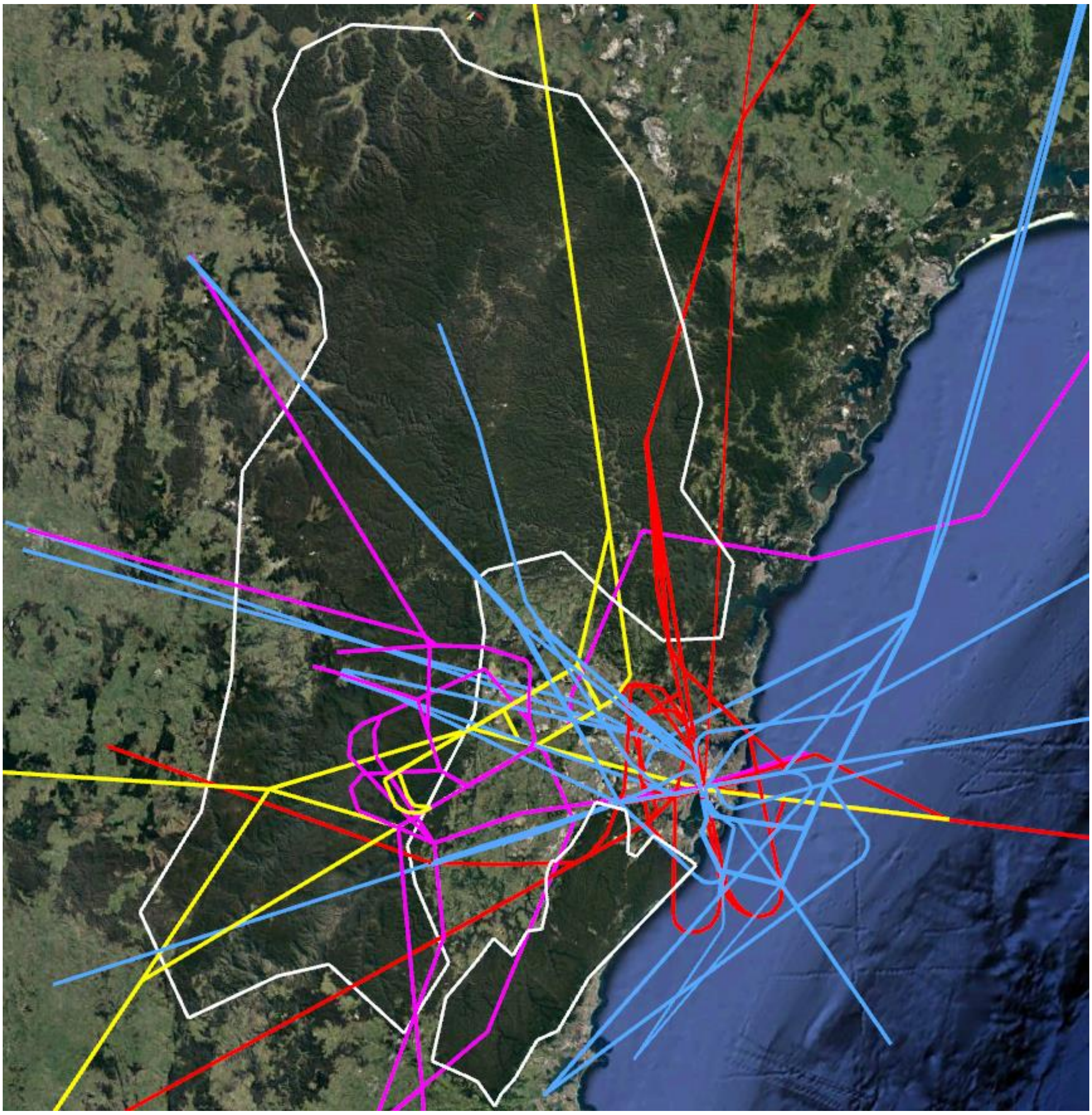


Figure 5 Flight paths for Arrivals and Departures for KSA and WSA. STAR arrivals to KSA are shown in red, SID departures from KSA are shown in blue, STAR arrivals to WSA are shown in yellow, SID departures from WSA are shown in purple (The map was prepared using Google Earth).

Risk in Airspace within the EIS-Technical paper 4 : Hazard and risk

The technical paper considers that SFAISRP is the basis of meeting regulatory acceptance on air safety. The implicit assumption is that courts operate on precedence and hence any mitigation has to be both practical and reasonable in terms of other factors.

Another assumption is that as long as the control system is in line with regulation and can be shown it is in line with regulation then there is nothing further that needs to be done to mitigate risk. It relies on the fact that it meets legal acceptance of the problem regarding risk rather than demonstrating that the residual risk can never cause severe and unacceptable consequences through unanticipated ways.

ALARP is a target level of risk that is often given in government guidance material rather than statute. The assumption being made here is that this target level of risk is acceptable to the people that will experience the impact if the risk eventuates. While this assumption may be true for Government and Aviation operators and the flying public, it is unlikely to be true for the general public where overflight occurs.

While the crash rate per million movements is the current value quoted in the EIS according to IATA[6], data should be assessed in terms of all airports operating Jet and Turbo jet services which contribute to the crash risk - in this case within the Sydney basin. Currently Controlled flight into terrain, loss of control in flight and midair collisions amount to 61% of turboprop crashes and to 39% of Jet crashes. If the amount of air traffic into KSA is maintained constant, the traffic into WSA represents approximately 19% of the crash risk in the Sydney basin in 2033 and 41% of the crash risk in 2055 if the growth at WSA projected in the EIS is accepted.

The risks being assessed in the EIS are shown in Table 1. The first column indicates the topics that were assessed in the EIS. The columns to the right of this first column indicate the risks that need to be analysed for an integrated risk assessment to produce sustainable outcomes. Those assessed in the EIS are shown in column 2. Risks that were assessed and analysed to SFAIRP indicating that they are likely to have met regulatory requirements are shown in the green squares. Risks that were not or inadequately analysed but which are impacted by the EIS risks are shown in red.

In column 2 of Table 1 there were two areas that were inadequately analysed in the EIS. The first is noise because the standards, as discussed earlier in this document, are not inclusive of all effects on stakeholders and the environment, and the second was terrorism which was excluded from discussion even though internationally recognised as having significant larger consequences compared with normal aircraft crashes. Apart from terrorism, Australia has also in recent years been subject to statements relating to conflict.

Noise

Noise is an environmental pollutant which causes harm in the environment and is an increasing problem in all urban and rural areas. While the technical papers on this in the EIS only dealt with the effects on humans, the effects on wildlife such as on communication can be properly assessed in a wider integrated risk report as recommended.

The technical paper on noise was required to assess noise impacts on residential and noise sensitive regions such as the Greater Blue Mountains World Heritage Area (GBMWHA). and other wilderness areas. The assessments rely on the airspace design put forward in the 2016 business case.

[6] https://www.iata.org/en/publications/safety-report/interactive-safety-report/

Table 1 Sustainable Outcomes by Integrating risk over the operation of WSA and KSA

Risks in the EIS	**Risks that need to be Considered for Sustainable Outcomes**						
	SFAIRP (meets regulatory requirements)	**Blue Mountains World Heritage Area**	**Sydney Water Supply**	**Climate Change**	**UAVs and pilotless aircraft**	**Hydrogen Fueled Aircraft**	**Future building in Sydney basin**
Noise	X	X					
Bird and bat strike	√	X		X	X	X	
Drone model aircraft strike	√				X	X	
Airspace obstruction	√						X
Mid-air collision with other aircraft	√	X			X	X	
Military and emergency service operations;	√	X					
high velocity air /gas discharge;	√				X	X	
Adverse meteorology	√			X			
Aircraft crashes into critical infrastructure	√	X	X				
Objects Falling from aircraft	√				X	X	
Terrorism incidents	X	X	X	X	X	X	
Aircraft fuel jettisoning	√	X			X		
Objects falling from aircraft	√				X		
Aircraft wake vortex strikes	√					X	

Note: Green Squares with a tick indicate that they are currently broadly adequate to SFAISP. Red Squares with a cross indicate that there is a requirement for further analysis and integration of mitigation strategies with the operations of KSA and WSA that will address issues with residual risk.

Noise standards which apply to land use near the airport are inadequate for flights for rural areas and the Greater Blue Mountains World Heritage areas. The standards that are used are predicated on background noise being around the 55-57dBA[7] level of noise during the day and night typical of urban areas in Eastern and inner Western Sydney[8]. Areas of Western Sydney and the GBMWHA and National Parks, however, have much lower background noise. The background noise during the day in the Blue Mountains, for example, has been measured at two places and is between 19 and 24dBA.[9]

Aircraft flying over an escarpment will have enhanced noise due to the effect of rising ground level height against the height of the aircraft, normally taken as above sea level. For example, an aircraft flying over waypoint, KADOM, at Katoomba on departure from KSA would normally be between 14000ft and 22000ft and have a noise range of between 47-53 L_{Amax} dBA.[10] Because the elevation of land at waypoint, KADOM, is approximately 3000ft, the noise is increased to an approximate range of 48-56dBA. The new airport would produce noise levels of between 50-60 L_{Amax} dBA.

While the range change does not seem significant, an increase in 3dBA is a doubling of the energy in the noise and an increase 10dBA represents a doubling in loudness. The aircraft overflying Katoomba (waypoint KADOM) can be heard above an urban background noise (56dBA) and is some 35 dBA above the background noise levels in the Blue Mountains. This represents at least a 10 fold increase in loudness.

Freight aircraft are generally older than those used for passenger service and hence are noisier. One stated purpose for WSA is to increase freight to and from Sydney. This automatically causes an increased in loudness observed over rural and Blue Mountains areas.

Noise represents an environmental risk to both humans and animals. A review by the World Health Organisation (WHO) of worldwide studies on human health risk recommended that noise levels be below 45dBA for day and night aircraft exposure and 40dBA for nighttime exposure.[11] This roughly corresponds to 3 aircraft per hour, overnight. These recommended levels are not without controversy. The reason, according to the WHO, is that there is a paucity of data on low background noise level areas. The lowest cause of annoyance that they could

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[7] dBA is a measure of noise in decibels on an A weighted scale that corresponds approximately to the human ear response.

[8] Measurement taken by Eric Ancich and Don Carter in 2016 at Avondale and Mayshill gave readings in this range.

[9] Marshal Day report for Blue Mountains Council in 2019 measured along the causeway at Blackheath and at Glenbrook in the National Park.

[10] L_{Amax} is defined as the maximum A-weighted sound level (in dBA) measured during an aircraft fly-by.

[11] WHO Environmental Noise Guidelines for the European Region, 2018, ISBN 978 92 890 5356 3, 9789289053563-eng.pdf. The WHO uses a different measurement L_{eq}, which is the energy averaged noise in dBA of each aircraft noise averaged over a given time period The periods commonly used are Day, Evening and Night exposure to noise.

find was 33dBA in the studies they reviewed. Although the WHO recommended penalty additions for such low background noise levels (none for day flights, 5dBA for evening flights and 10dBA for night flights) it does not assuage annoyance in people. The noise protests around airports in Australia are evidence of public dissatisfaction with this noise pollution and the responsibility of government to correct the annoyance.

The technical papers on noise and biodiversity hazard[12] show that very few studies have been about to the impact of noise on animals. The research indicates that noise levels above 40dBA can trigger a response by animals. There is no threshold on noise levels that determines impact mainly because noise studies are limited to around Airfields rather than areas of low ambient noise. The choice of 60dBA as a threshold is arbitrary given the lack of studies particularly at low ambient noise levels. Some 40% of animals are affected below this value and there has been large variation in individuals within a species (very similar to humans).

Terrorism

The risk of terrorism is again escalating worldwide. Australia has already intercepted threats against its aircraft from terrorists carrying improvised devices and there is a risk of aircraft hijacking. There are recognised emerging threats onto airports by use of drones and unmanned aircraft. There is also the development by some countries of long range drones assisted by AI.

While the EIS assessed some of the risks on Infrastructure from crashes, it did not include terrorism events. Significant infrastructure and defence facilities within any threat assessment are Warragamba Dam, Prospect Dam and Orchard Hill defence establishment. Warragamba Dam reservoir when full has an amount of water that would cause an inundation along either side of the Nepean River through Penrith to Windsor should the dam wall fail. It would affect 100000 people and the cost will be over $5 trillion and leave 80% of Sydney without water for at least 5 years.[13]

Impact of new technology over the next 30 years

New technology for the aviation industry is already being developed and is likely to be in service about 2030. One driver is the requirement of Governments to move to net zero by 2050 due to climate change. Another is the development and likely increased use of drone technology and the move to pilotless aircraft and remote aircraft control.

[12] EIS technical papers 1 and 8.

[13] The 5 years is taken as the minimum time that it would take to rebuild the dam and restore the water level. The GDP of Sydney is currently estimated as $443000 per capita per annum With a population of 5.32 Million this represents a potential loss of $2.36 Trillion per annum. Amounting to $11.8 trillion over the 5 years. While there will be some recovery in GDP due to the work generated by rebuilding the dam, the figure does not include long term life and health costs of the population affected.

Net Zero and Hydrogen Fuelled Aircraft

Boeing and Airbus are both investing in designing aircraft fuelled by Hydrogen[14]. The UK has recently flown a Dornier aircraft capable of seating 20 passengers.[15] Similarly, it is intended to fly a hydrogen fuel cell box aircraft in Australia next year for the emergency service industry.[16] These advances are being driven by the need to have zero emission technology in place by 2050. These aircraft use either fuel cell technology or liquid hydrogen. While the flammability properties of Hydrogen in air are well known and led to the Hindenburg airship disaster in 1937, cryogen hydrogen has different properties to hydrogen gas while in liquid state and the technology in its handling and use has developed from the space industry.

Hydrogen cells being considered for aircraft represent less of a hazard as they generate what is needed in flight and storage levels are minimal. Hydrogen being carried as liquid hydrogen in tanks poses a different threat. While liquid hydrogen is less easily ignited, it still poses a detonation hazard if the liquid does not catch fire immediately on rupture of the tank. A fuel air explosion can occur which may then detonate. This will cause a larger radius of impact than a non-detonating fuel-air explosion (about three times on a volume basis). Tanks caught in a fire can also cause a Boiling liquid expanding vapour explosion (BLEVE) similar to the LPG BLEVE at St Peters in Sydney in 1990.

If such an event were to occur, whether with jet fuel or other mixes, over the Blue Mountains World Heritage Area, it can cause a rapidly expanding bushfire that would be difficult to stop. The costs of bushfires that are published are usually direct costs and do not include the long term cost of rehabilitation, of health from smoke and of death trauma and of revenue loss to businesses or on loss of tax.

In the US, "Analysis of the literature suggests nearly half of all wildfire costs are paid at the local community level by government agencies, non-governmental organizations, businesses, and homeowners. Almost all wildfire costs accrued at the local level are the result of long-term damages such as landscape rehabilitation, lost business and tax revenues, degraded ecosystem services, depreciated property values, and impacts to tourism and recreation."[17] It would be expected that this also applies in Australia. A bushfire stated by an explosion from an aircraft that destroys a township because of the initial intensity and area and the reaction

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[14] Boeing acknowledges hydrogen's potential, while Airbus plans a hydrogen-fuelled airliner by 2035, Thom Patterson, 5 July 2022, https://www.flyingmag.com/boeing-and-airbus-a-stark-contrast-on-hydrogen/

[15] https://zeroavia.com/about-us/. https://zeroavia.com/flight-testing/.

[16] https://www.vertiia.com/. https://newatlas.com/aircraft/vertiia-australia-most-efficient-evtol/.

[17] The full community cost of Wildfires, Headwater Research, May 2018, full-wildfire-costs-report.pdf

time required to fight the fire can produce a loss event approaching a trillion dollars when the long-term costs to the community affected are considered.[18]

Drones and Unmanned Aerial Vehicles (UAVs)

The next 30 years will see increased demand for use of drone UAVs around the urban area that has an impact on the design of the airspace because of an increase in density of use of the airspace. Generally, such aircraft fly under 3000ft. Consequently, the risk is mainly around the two airports where jets and turbo-jets are approaching or departing the airport. While air traffic control rules are currently acceptable, the availability of drones and public interest creates an ever-present risk of such rules being deliberately flouted by the public. Access to sophisticated drones and the ability of these drones to defeat airport countermeasures remains a constant threat in relation to terrorism or criminal acts.

In the future, UAVs will go from small drones that are used for mapping, freight delivery and other local tasks through to major freight aircraft. These need different flight requirements for airspace and have autonomous control systems including in the future the use of neural networks.[19] Furthermore, large UAV freight aircraft may be controlled from outside of Australia and this causes problems with managing the safety of airspace within Australia and may present a Sovereign risk to the Nation and the Nation's economy.

Mitigation has to occur from appropriate design of the operating system of drones and UAVs taking account of how they interface with human factors and the capacity to control internal and international overflights of the airspace. Without this approach to mitigation, developments in Drone and UAV technology represent a sovereign risk particularly flying into WSA with the proximity of Warragamba dam.

Greater Blue mountains World Heritage Area

The Greater Blue Mountains World Heritage Area and its surrounding National parks is a place that has many attributes that require preserving for future generations. The overflight of the area is a major risk that relies solely on the current regulations for airspace and aircraft operations. The dismissal of potential impacts as acceptable cannot be accepted unless there is a quantified analysis of the uncontrolled residual consequences of such impacts. This is a major gap in an Environment Impact Statement that the Government published.

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[18] US studies indicate the long term costs can be approximately 40 times that of the direct costs. Estimates of Australian fires which have been smaller than the American has been indicated at between $100-200 billion for the 2019 bushfires. A disaster that affects a larger township can easily reach long term costs of $1 Triilion.

[19] Safety Implications of Autonomous Vehicles – System Theoretic Process Analysis Applied To A Neural Network-Controlled Aircraft, Ryan Bowers, John Thomas, 54th Annual fires International Symposium, Society of Flight Engineers, 16-19 Oct 2023, Patuxent River, MD.

Finding: The Government's EIS only relies on the current crash rate on deaths and injury of humans. It did not consider any of the impacts that arise from such an event and the loss that occurs from extinction of rare and local species or the oncosts that such events have on the local population or the local tourist economy and working opportunities.

The GBMWHA contains unique species which if lost would become another extinct species.[20] It also contains indigenous artifacts and cave paintings that are of significant cultural and archaeological value. Destruction of these would not be unique according to the Parliamentary inquiry into the destruction of the Juukan Gorge cave system.[21] It was one of "countless instances where cultural heritage has been the victim of the drive for development and commercial gain" While this inquiry was looking in particular at the mining culture, it also applies to the GBMWHA where overflights can end in a crash causing direct loss of heritage as well as initiating a bushfire that can result in indirect loss such as the destruction of cave paintings and loss of flora and fauna, and pollution of Sydney's water supply.

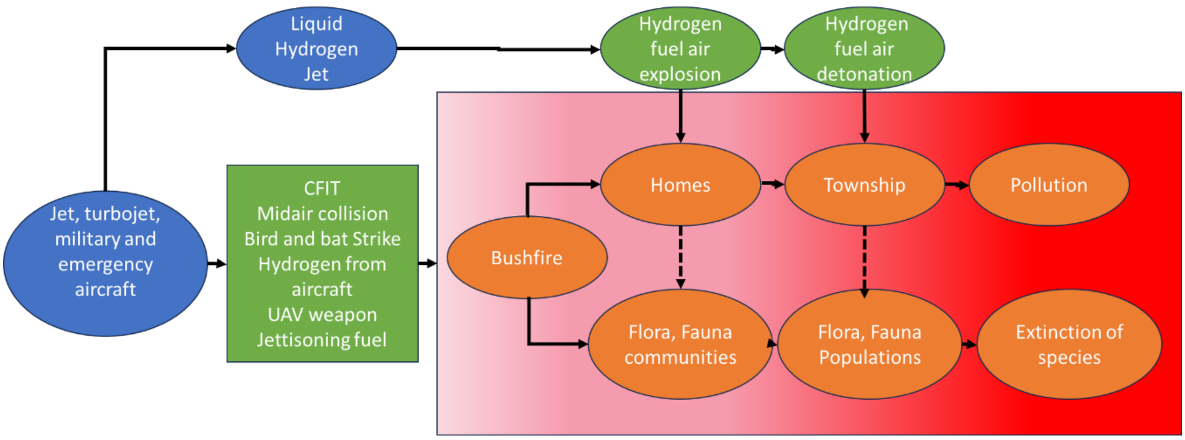

Figure 6 The mechanism by which destruction of town ships and extinction of species can occur. The blue ovals are the aircraft type involved, green ovals and boxes are the vectors of destruction, orange are the consequential loss with severity increasing to the right of the box.

The mechanism that can lead to a crash and subsequent bushfire and consequential damage is shown in Figure 6. The crash can result in a bushfire. The rapidity with which the bushfire

[20] Technical paper 14, section 5.2.1 World Heritage properties, indicates that the GBMHA supports10% of Australia's endangered flora, comprising some 152 plant families, 484 genera of fauna and 1500 species particularly adapted to the dry and wet sclerophyll temperate rainforests of the area. These plant communities and habitats support more than 400 vertebrate taxa (40 are threatened), comprising some 52 mammal, 63 reptile, over 30 frog and about one third of Australian bird species, invertebrates of 120 butterfly and 4000 moth species and rich cave invertebrates (67 taxa),

[21] 'Failures at every level': changes needed to stop destruction of Aboriginal heritage after Juukan Gorge, Lorena Allam, the Guardian, 19 October 2021.

escalates is determined by the area of spread of the crash, the angle with which it impacts and the wind conditions at the time.

Bird and Bat strikes were not adequately quantified as to their impact on crashes. According to the EIS, 93% of bird and bat strikes occur below 3500ft (1150m) with the 93% of flying fox strikes occurring below 1000ft (330m). The other 7% of bird and bat strikes occur above 3500ft (1150m) up to 10000ft (3300m).

Figure 7 shows the elevation of flight departures from KSA and WSA through waypoint, KADOM, at Katoomba. The graph indicates that there is a risk along the flight path up to 50-55km along the flight path. It is not just around the immediate departure or arrival zone of the airport as indicated in the EIS but is a risk more generally while over the Cumberland Plain and about 50% of its climb up the escarpment. The birds that impact at heights greater than 3500ft (1150m) are more likely to be larger species that have a larger impact on a strike with a larger risk than the background risk would suggest.

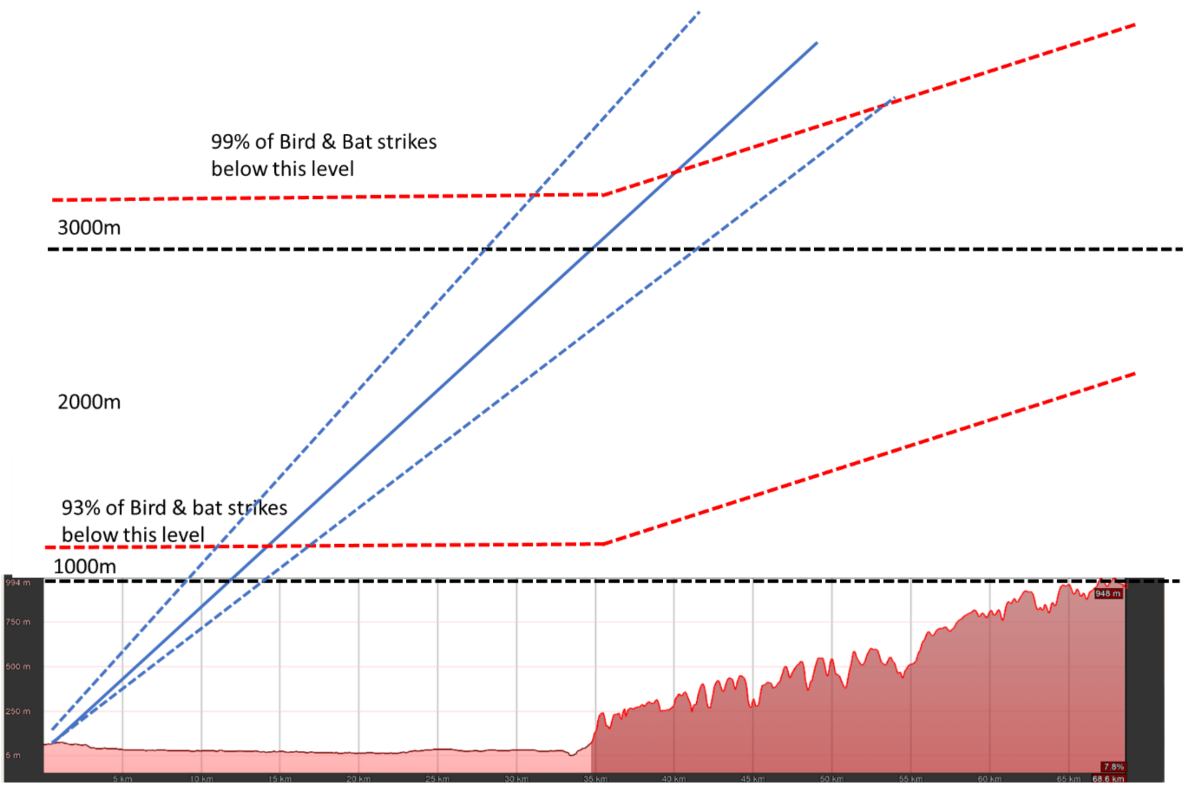

Figure7 Effect of aircraft height on the risk of Bird and Bat strike. The average aircraft height is the solid blue line and the 95% percentiles are shown as dotted blue lines. The elevation is from Google earth for flights to waypoint KADOM from WSA.

The BMWHA has been listed by UNESCO as a place of outstanding natural beauty and it is visited by people from all over the world. Some of the impacts of overflights have been rated as medium to high on many aesthetic qualities of the mountain area.

Overflights cause visual and noise pollution of pristine wilderness and from many of the tourist vantage points. This undermines the reason for having a world heritage area. People visit to bush walk, to experience the peacefulness and beauty of the bush and contemplate the universe. Others visit to explore the indigenous heritage in the cave art for similar reasons. All these aesthetic reasons cannot be easily translated into transactional risk but are an aesthetic component of the wellbeing of the people of Sydney and Western Sydney.

The proposed airport changes without an integrated risk assessment will cause an inevitable degradation of the basis for the classification of the area as World Heritage; the biodiversity and natural balance within extensive areas of the National Park and threatening endangered species such as the Wollemi pine and resident Koala population amongst others.

A limited study of overflights using flightradar24 of world heritage sites in the USA and Europe using flightradar24 found that the only aircraft on commercial routes overflying the World Heritage Areas were well in excess of 28000ft in height and most were over 35000ft. All other flights including nearby airports for tourism were routed around the Parks. [22]

By contrast, flights in the Sydney basin such as departures from Kingsford Smith Airport routinely fly on three routes, to the Katomba and Kandos waypoints with aircraft crossing the World Heritage Area of the Blue Mountains and over Wollemi National Park towards Cassilis. Aircraft heights can be as little as 11000ft (L_{Amax} approximately 62dBA) to 20,000ft (L_{Amax} approximately 54dBA). The terrain needs to be taken into account for aircraft noise as the height at Katoomba waypoint is 3200ft making the noise more like 56 L_{Amax} dBA than 54 L_{Amax} dBA.

Before the Covid -19 lockdown in 2020, the number of overflights across the Mountains varied on a daily basis; between 11 and 68 noise events per day in the upper mountains and 42 to 115 noise events per day in the lower mountains.[23]

[22] AR Green, unpublished research, 2019. The parks in the USA assessed were Olympic National Park, Washington State, Redwood National Park, Six Rivers National Park, Yosemite National Park, Yellowstone National Park, Waterton Glacier National Park, Grand Mesa National Park, Chacko Culture National Historic Park, Grand Canyon National Park, Carlsbad Caverns national Park, Pueblo Historic Remains that is a world Heritage Centre, San Antonio missions National Park, Poverty Point World Heritage site, Cahokia Mounds State Park, Mammoth Cave National Park. Parks in Europe were Wakau Valley Austria, Salts Gamma Got Austria, Swabian,, Jura Germany, Wadden Sea National Park Denmark, Schotland Island Netherlands, Neolithic Orkney, UK, St. Kilda; UK, Giants Causeway Northern Ireland, UK, Boyne valley Neolithic tombs, Ireland, Skellig Michael Ireland, Stonehenge and Amesbury, UK, Jurassic Coast Dorset and East Devon, UK. Cornwall mining sites, UK and Studley Royal Park and Fountains Abbey, UK.

[23] Greater Blue Mountains Aircraft Noise Monitoring, Marshall Day Acoustics, Prepared for Blue Mountains City Council, Rp 002 20170310, 1 December 2017.

Clearly, many of the risk problems associated with the BMWHA can be significantly reduced if an integrated risk assessment is made to ensure all known risks are considered, quantified and mitigated or accepted transparently as residual risks.

Mitigation

Recommendation 2: That overflight of the Greater Blue Mountains World Heritage Area by jets and turbojet aircraft be restricted to flights above 31000ft in line with international practice.

This recommendation is in line with practice in the USA, Canada and Europe over World Heritage Park Areas. In those countries jet aircraft using nearby airports are pathed around the World Heritage Areas. Only jet aircraft enroute (usually longhaul above 31000ft are allowed by Air Traffic Control to overfly along designated flightpaths. Currently such longhaul overflights of the GBMHA that are not landing in Sydney are above 28000ft and use Sydney NDB (Waypoint TESAT).

Imposing a restriction on the GBMWHA has an immediate and beneficial impact on the GBMWHA as it removes the possibility of aircraft crashes being the cause of extinction of flora and fauna, loss of cave art and associated cultural areas. It allows for preservation of koala populations and other threatened species that exist in the GBMWHA together with the removal of jet aircraft noise and visual pollution that has an effect on the health of the population and animals. There is still a risk, however, from other forms of aircraft but consequences of these is unlikely to be as great as the quantity of fuel and crash area are likely to be smaller with much reduced short and long term impacts.

Figure 8 shows all the flightpaths obtained from integrating FUA with KSA and WSA airports. It ensures that the flightpaths take full advantage of the FUA airspace changes and the associated capability in aircraft performance. A more detailed examination of the flight paths through a series of *use cases*[24] is given in Appendix A to this submission.

Comparison of Figures 5 and 8 show that these changes result in more aircraft arriving and departing over the ocean and less flights over the greater Sydney area . Those that remain are mainly due to the landlocked airport at Badgerys Creek. Currently, aircraft using STAR and SID routes into KSA from international flights arrive to the south of the Blue Mountains between Goulbourn and to the north in the hunter valley region near Singleton. These two areas also integrate southern city and northern city routes into the SID and STAR routes in these two areas respectively.

[24] Use cases are examples that can be used as a starting point to further analysis that would be required to be undertaken before changes to the flight paths can occur.

Figure 9 shows the proposed flightpaths to and from KSA for a typical day. The STAR and SID routes are clearly visible, but the dispersion indicates that the existential risk of a crash for arrivals is mainly over the Inner west of Sydney with less dense tracks over the Eastern Suburbs and North Shore. Departures show a different pattern with aircraft not flying over land to the East but once jets get above a certain height are dispersed on a great circle route to their destination. Departures to the south either continue south or turn west over the Royal National Park. The dispersion that occurs over land is due to noise abatement over the suburbs affected by the STAR and SID flightpaths.

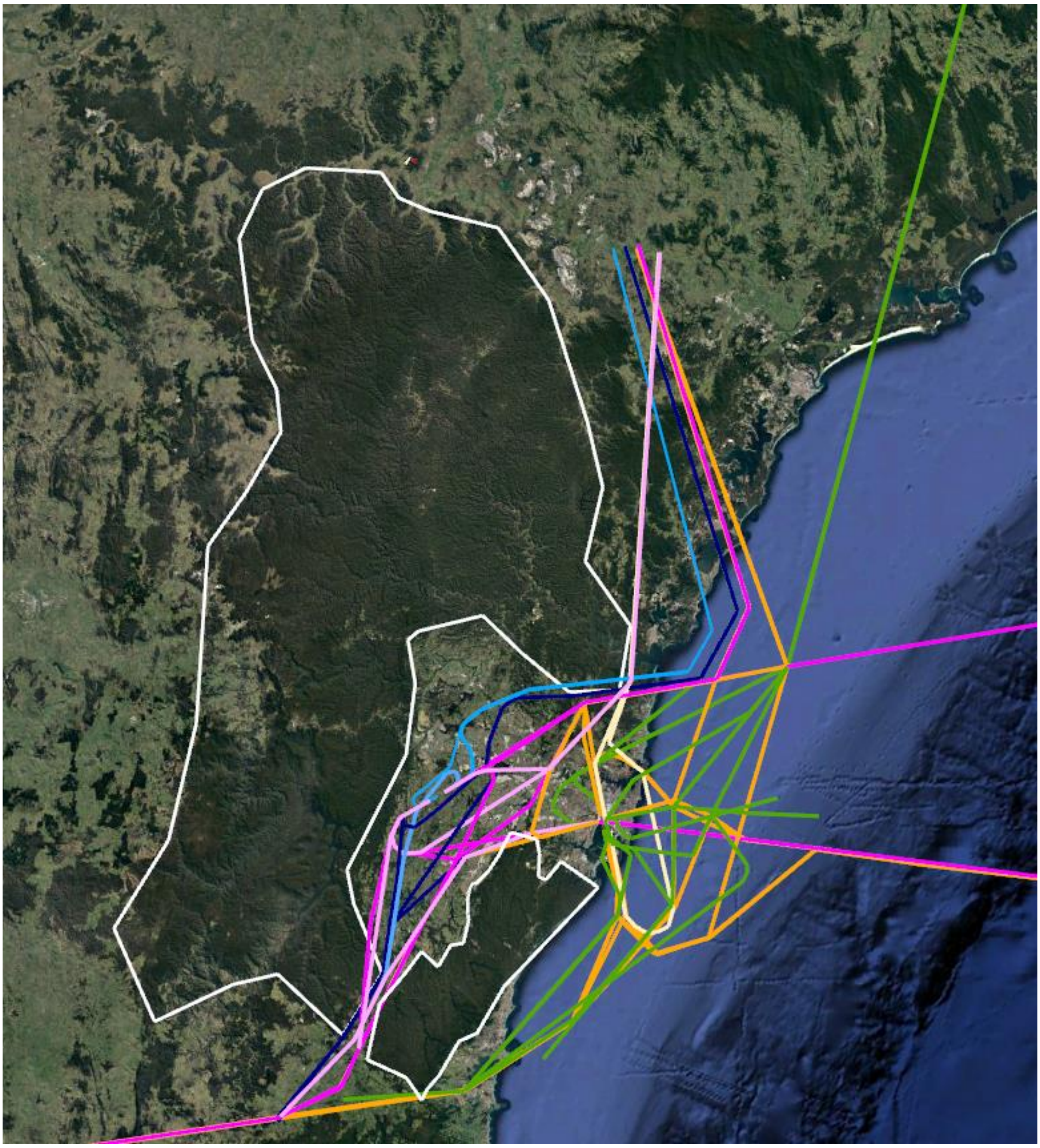

Figure 8 Proposed Sydney basin flightpaths taking account of recommendations 1 and 2. The white areas are the Greater Blue Mountains World heritage Area and surrounding buffer zones (NSW Parks) and the Royal National Park. Jet Arrivals to KSA are shown in yellow. Jet arrivals to WSA are in purple.

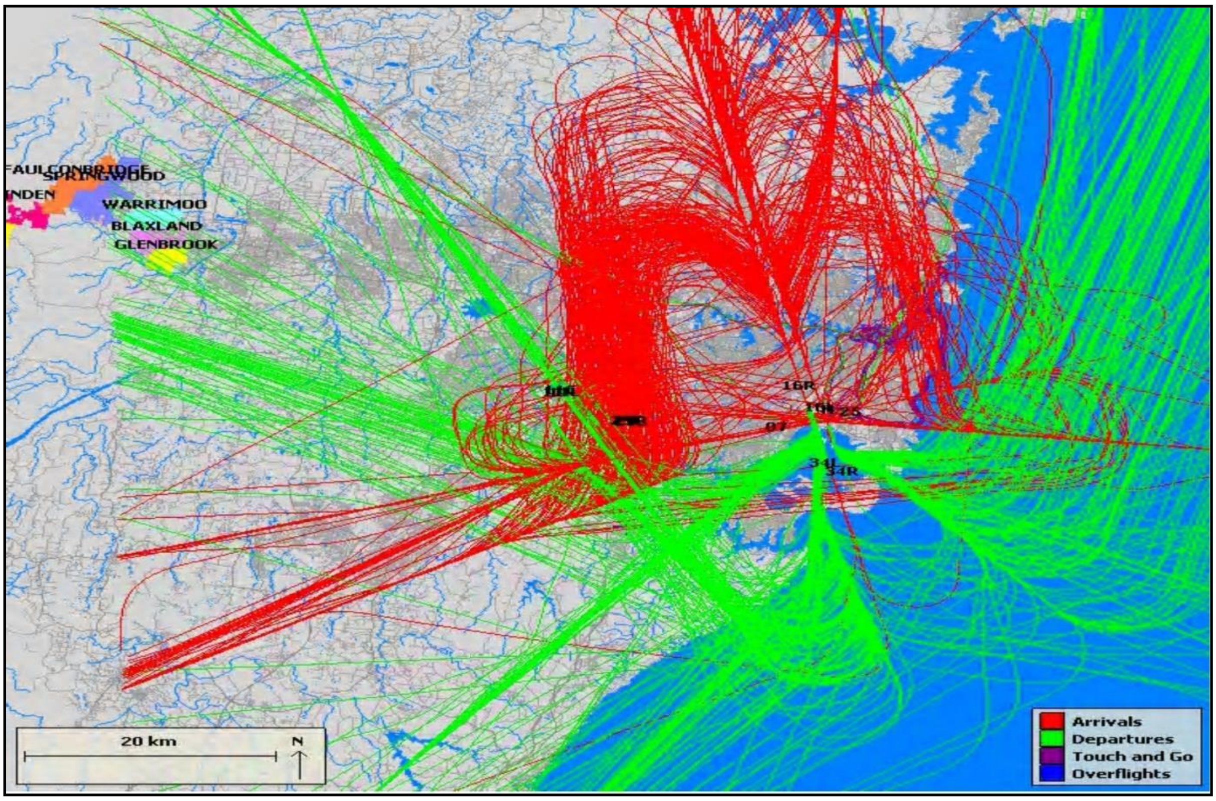

Figure 9 Radar Flight paths of aircraft into KSA . In this AsA provided image aircraft tracks in red are arrivals and those in green are departures.

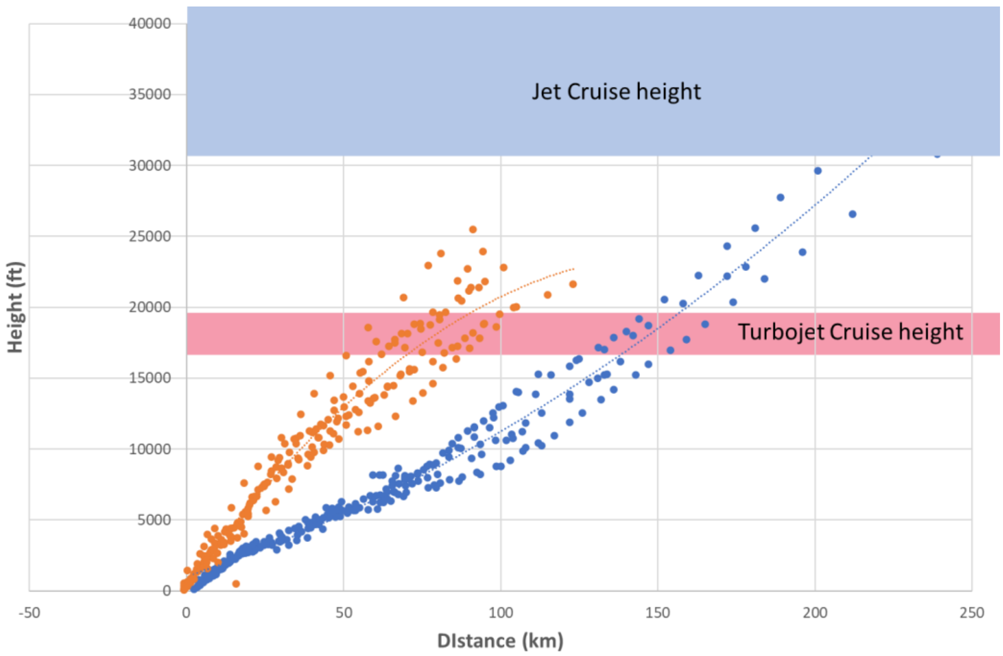

Figure 10 Typical KSA departure and arrival heights with distance. Orange points – Departures, Blue points - Arrivals. Data obtained from flightradar24 during October 2023.

Because of the collection points for arrivals north and south of the Sydney basin, they have been utilised in developing common routes into both KSA and WSA, aircraft separation depends on ensuring the aircraft can be separated at least 2000ft in all directions around an aircraft and the separation along a flight path does not risk being in the vortex wake of preceding jets.

Typical flight heights are shown in Figure 10. Jet at cruise heights are typically above 30000 ft. Turbojet and similar aircraft flying between Sydney and regional airports typical have a cruise height of between 14000 and 20000ft. Because these aircraft are slower and fly at lower altitudes, separate routes are required from the jets and only integrate with jet paths near the airport runways where the flightpaths are of similar height. As a consequence, points to the north and south can act as collection areas for the STAR and SID routes for both KSA and WSA avoiding overflight of the GBMWHA and surrounding national parklands. Flights from over the Pacific Ocean come in from the East and can be integrated into this network.

Controlled airspace for an airfield occurs 45nm out from the airport. Arriving jets start their descent some 200km from the airport. These are in the area just north of Goulburn or in the Hunter Valley. Turbojets on the other hand start their descent about 130-150 km from the airport. Departing jets do not reach cruise height for 110-140km depending on the type of aircraft. Departing turboprops reach cruise height between 50and 80 kms.

Figure 5 shows the current routes proposed in the EIS for WSA and those from KSA. Many of the routes fly at levels of below 5000ft on arrival at KSA and will be similar for the published route for WSA. Departures are higher between 13000ft and 22000 depending on the aircraft as they pass from the 45nm controlled space. This is below the proposed flight level of 31000 ft that would allow them to proceed over the GBMWH and surrounding National Parks. The dispersal of jets on departure towards their destination, as shown in Figure 9, and could not occur until they had reached 31000ft. The aircraft are beyond the Blue Mountain range to the north or south similar to arrivals.

Figure 8 shows the proposed flightpaths taking account of both recommendation 1 and recommendation 2. These flight paths have been determined based on safe airspace principles and the availability of height for similar paths. The flight paths do not overlap when operational modes are considered (see Appendix). Jet departures to KSA are in green and for WSA in dark blue. The white and light blue routes correspond to turbojet for arrivals and departures respectively. The difference between the two highlights the greater use of the ocean to approach both airports compared to imposing flightpaths for WSA on the GBMWHA and surrounds.

The advantage is that it lessens the time over land on both Arrivals and Departures and represents a real reduction in residual risk to the population of Sydney. Table 2 shows the reduction in risk for Arrivals and Departures. The percentages shown are based on the average distance of the flight paths over land for each of the runways used and then corrected for the total number of aircraft for the years shown. The contribution of approach or departure that is over the ocean is taken as zero contribution to the path.

Year	Arrivals	Departures
2024	46%	37%
2033	41%	31%
2055	36%	26%

Table 2 Percentage reduction in residual risk due to using FUA principles.

The largest reduction of risk is for arrivals rather than departures. This is due to the many ocean flights that occur from departure from KSA at the current time. The main reduction therefore occurs from arrivals. While the paths shown in Figure 8 seem too close, they are in fact separated by the required 1000ft around the aircraft. Another fact is that analysis of the typical flight paths into KSA as indicated in Figure 9 show a difference in height between Departures and Arrivals. Arrivals descend from cruise altitudes at a greater distance than departures. Departures on the other hand initially climb at a faster rate than descending aircraft, hence departures tend to overfly arrivals to the controlled airspace around the airport until they achieve cruise heights for the aircraft.

Recommendation 3: The Federal Government should consider developing a high speed train network across the Eastern States of Australia with future development to the Northern Territory and Western Australia.

In September 2023 the Federal Government asked for submissions on aviation policy. In researching the requirements for the aviation white paper, it was apparent that in order to meet net zero emissions by 2050, transport policy (and aviation policy) had to change.[25] Australia is in a good position to develop hydrogen fuelled aircraft as a means of achieving this target. Unfortunately, the feasibility of hydrogen use, while being researched across the world is still in the first stages of development. The development of hydrogen power trains for powering aircraft is at least a decade away from scaled up manufacture of current development, even though there are plans for proving flights this and next year across the world.

The airports at both KSA and WSA (as well as other Australian airports) contribute to CO2 emissions from the aviation. Aviation and road transport have been shown to be the largest emitters of CO2 equivalent in transport. While Australia's contribution might be considered small compared with Europe, Asia or North America, it still is significant and poses an existential risk to the survival of humanity and species across the globe.

25 White Paper on Aviation Submission: The Future of Aviation in Australia, AR Green, Submitted 28/11/2023, Aviation White Paper Submission.pdf

Research and practice in Europe, China and Japan has shown that Ultra-high speed electric rail (>300km/hr) produces the least emissions when the electricity that is used for powering the trains is generated from renewable energy sources including as part of the route design.

France has now banned flights of under 2.5hr duration or 250km where rail travel is available affecting 12% of domestic flights.[26] As Dr Papa states, in The Conversation "*it marks one of the first times that politicians in a wealthy country have endorsed something that most, if not all, have been reluctant even to consider. That high-carbon conveniences aren't always necessary, or even desirable, and that curbs on the most polluting aspects of consumption are necessary to tackle climate change".*

While there are different challenges in Australia, the domestic short haul aviation market, between cities, fly an average of 1120km per flight. These flights carried 36.8 million passengers in the 2018/2019 financial year, and this compares with 42.1 million passengers on international flights.[27] Producing an alternative transport mode to replace short haul flights between Capital cities would benefit Australia by eliminating the highest form of pollution from different modes of transport. There are three ways in which this can be done and enhance Australian society: Changes in Aviation technology; Introduction of ultra-high speed rail or; a combination of the two.

Figure 11 is an example of a proposed Ultra-High Speed rail network across Eastern Australia linking the major cities and many regional towns. Other routes could be chosen if they serve the same purpose. Ultra-High speed freight transport is underrated as a means to develop passenger rail services. It is freight that can return the capital investment that can, if necessary, subsidise passenger services initially. As long as the network is built to carry both freight and passengers (separate trains) at speeds in excess of 300km/hr, 5600km of track including 20% tunnelling would cost in the order of $B173.[28] According to Bitre[29], Australian Infrastructure construction cost on road, highways, bridges and subdivisions over the last 15 financial years has been $B225 while similar construction on railways has been $B96.

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[26] Short-haul flight ban is a good start – now we need to reimagine the modern airport, Enrica Papa, The Conversation, Published: April 29, 2021 12.15am AEST.

[27] Domestic Aviation Activity – Cities and Regions, https://www.bitre.gov.au/publications/ongoing/domestic-aviation-activity-cities-and-regions. International scheduled traffic to/from Australia, https://www.bitre.gov.au/publications/ongoing/international_airline_activity-time_series.

[28] Based on rail track, catenary and tunnelling requirements using data from UIC High Speed Rail: Fast track to sustainable mobility, 2018, International Union of Railways, https://uic.org/IMG/pdf/uic_high_speed_2018_ph08_web.pdf, p59. Note this does not include construction of stations and freight handling facilities at the hub.

[29] bitre-yearbook-2022-2-infrastructure-construction.xlsx, Tables 2.3b and c, Value of transport infrastructure engineering construction work done by the private sector and public sector for the public sector. Tables are adjusted for Chain Volume.

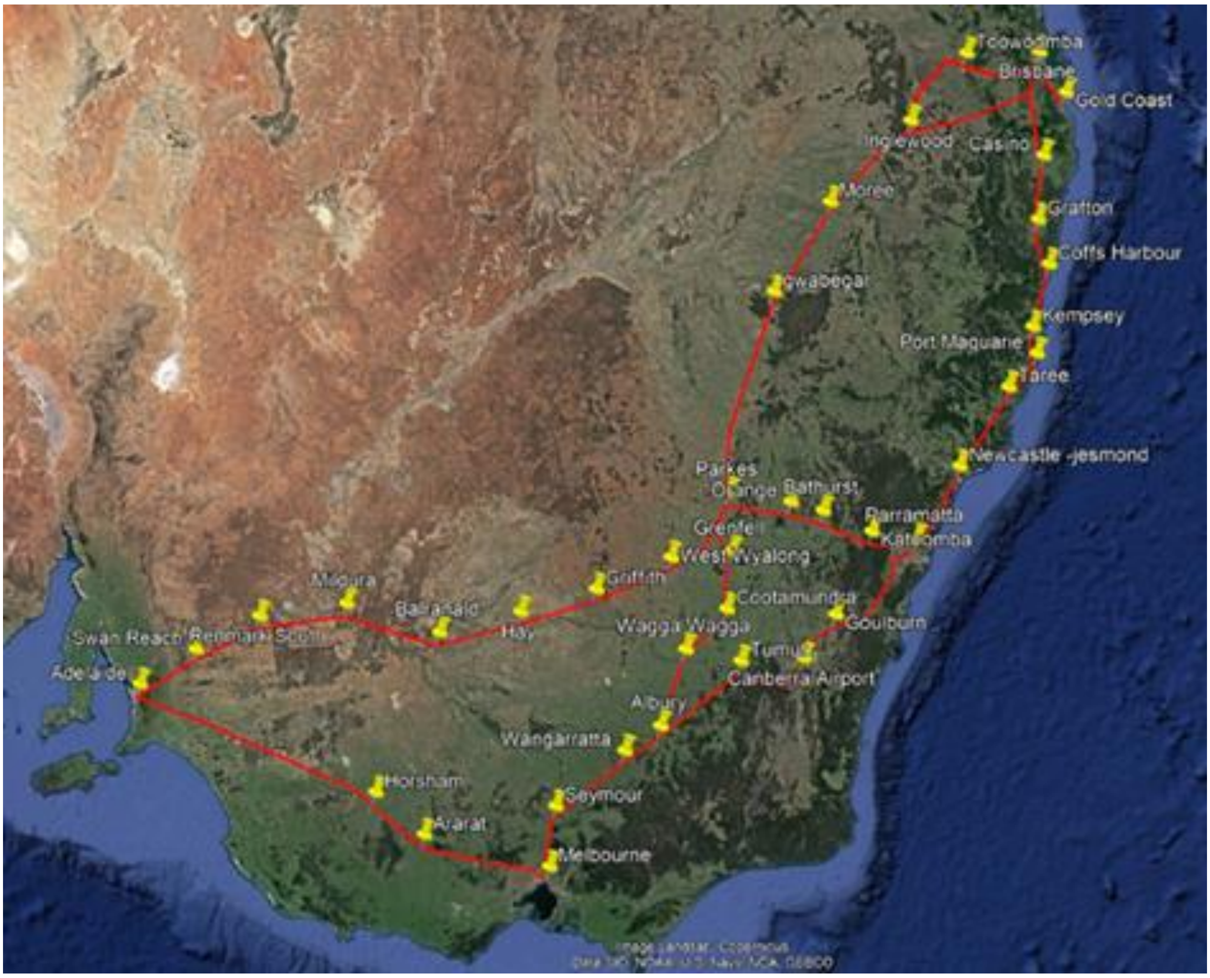


Figure 11 An example of a High Speed rail network in Australia linking three states and one territory.

Clearly Expenditure of $B173 over 15 years is well within the Federal Infrastructure construction budget as indicated above. It provides an alternative transport network for moving across the Eastern States and has advantages in providing short and longer term employment and encouraging tourism into the regions, as well as revitalising regional hubs for retail, offices, hotel accommodation, residential growth and entertainment to four states and the ACT. In addition, it allows for transfer of goods between ports and regional areas without relying on road transport – reducing another high emission source of emissions. Furthermore, this network reduces road maintenance costs that are principally funded by the States and Local Councils.

Future aviation has the potential to alter the way air transport occurs. While developing better fuel options and more efficient power trains for jet aircraft is already taking place, it is in the 0 to 1000km flight range of aircraft that Australia is in a good position to take advantage of recent developments, eVTOL designs and the use of Hydrogen as a fuel.

This range of aircraft is more suitable for servicing regional requirements for aviation than servicing major urban airports. Regional hubs can be associated with Freight and Passenger hubs on a high speed rail network. This has an advantage not only of improving travel times in many regional areas of Australia, including the regional hubs but can further reduce the crash risk in the major cities. Currently Sydney to Melbourne was the fifth busiest domestic route in the world with 9.3 million passengers.[30]

By building a high speed rail network and mandating its use as the French have done would eliminate most of the flights between Sydney and Melbourne, Sydney and Brisbane and between Sydney and Adeliade. This has the benefit of freeing up airspace at KSA allowing more international aircraft while producing real economic benefits to the interior of Australia.

ETHICS STATEMENT

The author has received no funds or benefits from any organisation in relation to this paper.

AUTHOR: Dr Anthony Green

DR Green is a scientist with four decades experience in risk assessments across many Australian industries and with experience in laboratory analysis for forensic investigations. He has published widely, presented at international conferences and taught risk in academic institutions over three decades. In aviation he commenced work in risk assessments in 1995 and has regularly been involved in meetings, consultations and commissioned work by government and non-government organisations and industry sectors.

Dr Green holds a PhD in Chemistry from the University of Edinburgh.

[30] The world's busiest flight routes and airports revealed, Sydney Morning Herald, December 28, 2023 — 5.00am.

Appendix A: Suggested Amalgamated Flightpaths

Use Cases

Use cases in the context of this submission are intended to act as a preliminary assessment of an integrated approach to the use of airspace into both WSA and KSA. A series of *use cases* are presented below that are intended to act as a starting point for further analysis by the Federal Government. Any changes to airspace use have to be approved by CASA before alteration to existing flightpaths can be altered.

Airspace Requirements

General airspace use requires at least 1000ft separation laterally in width or vertically in height from another aircraft. If aircraft are flying the same flight path under the enroute controller at the same altitude, then they need to be separated by 5 NM (9 km) but can be reduced to 3 NM (5.56 km) in the airport control zone.[31] The maximum number of air movements on one runway is limited by this longitudinal separation. As the landing speed is about 150knots with similar take off speeds, then this is equivalent to a maximum of 50 per hour or 1200 per day.

In the following Use Cases, the current waypoints have been used where possible for the alternative flightpaths. New waypoints had to be defined for many of the turning points required. The waypoints are not shown in the figures below.

WSA Runway Operation

There are three operational modes into WSA: runway 05, runway 23 and Reciprocal runway operation (RRO) of runway 23 during the night. These three modes are shown in Figures A3 to A5. In each of these figures, the green circle represents the 45 Nautical Mile (NM) control space for Sydney Airport (KSA). This has been shown because the airspace being discussed is wholly within the control space of KSA. The red Lines represent the GBMWHA and its surrounding national parks including the Royal National Park. The filled red objects are military sites with no overflying requirements by civil aviation. Arrivals for Jets are indicated by the dark pink lines and turbojets by the light pink lines. The dark blue lines represent the jet departure flightpaths and the light blue the Turbojet flightpaths.

The integrated airspace also has to take account of runways 16 R & L, 34 R &L, 07 and 25 that operate at KSA. The published landing and take-off requirements for wind conditions have been used as a guide for operation at both airports. Generally, it is assumed that the wind conditions at KSA dictate the wind conditions at Badgerys Creek. While this may not be true 100% of the time, it is likely to be true for at least 80% of the time.

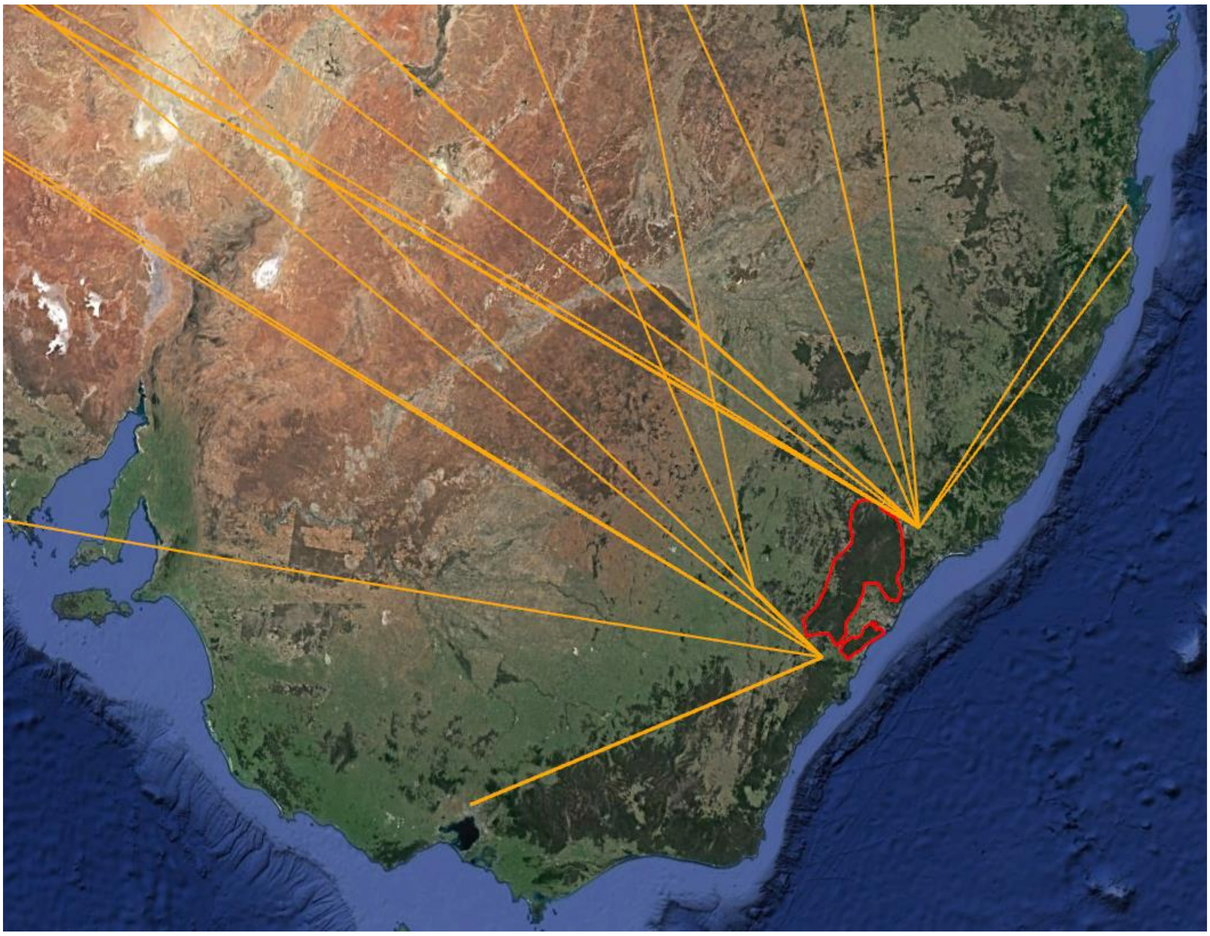
[31] EIS chapter 3, Introduction to Airspace, 3.3.4.2 IFR Separation, page 3-19

Use Case 1: Enroute Jet Arrival and Departures

Jets arriving from overseas or from interstate are under the guidance of an enroute controller to a designated waypoint where control is passed to the local control. In order to take account of recommendations 1 and 2 above, these waypoints need to be north and south of the Sydney basin as shown in Figure A1. The Arrival routes shown are basically the great circle routes to two waypoints: north of the Sydney in the Hunter Valley and south of the Sydney basin between Marulan and Moss Vale.[32] These points are some 150-200 km form KSA and WSA and arriving aircraft would be between 24000 ft and 31000ft based on Figure 10 above. Similarly, a waypoint can be designated for flights arriving from the Pacific Ocean to the East of the Sydney Basin. From these waypoints the aircraft would follow STAR routes into the two airports.

Similar waypoints can be defined in the same regions for departing jet aircraft clear of the GBMWHA. At 150 to 200km most aircraft would have reached their cruise height above 30000ft. When above 31000ft these aircraft would be able to turn to the enroute tracks across Australia.

[32] While the great circle routes from overseas airports are depicted in Figure A1, the actual routes follow designated flight routes across Australia. These routes all coalesce north or south of Sydney in the areas shown in Figure A1.



Figures A1 Proposed Jet arrival paths from Interstate and Overseas. The red lines surround the GBMWHA and surrounding national park and the Royal National Park.

Use Case 2: Enroute Turbo jet Arrivals

The same process can define waypoints North South and East of the Sydney basin for Arrivals as shown in Figure A2. The departures would be similar to the arrivals but using different waypoints. Cruise heights for Turbojets are normally between 14000 ft and 20000 ft and are generally lower than the cruise heights of jets (above 30000 ft).

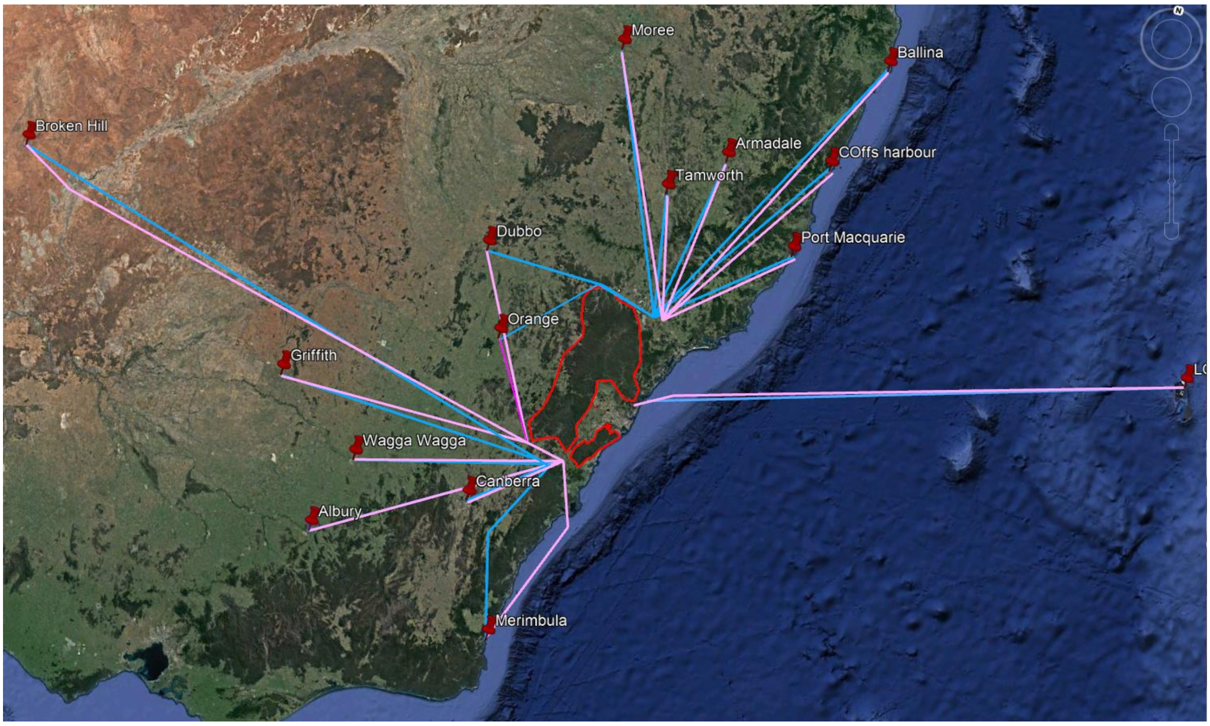


Figure A2 Proposed regional Turbojet Arrivals and Departures into the Sydney basin.

Use Case 3: Proposed operation of runway 23

Runway 23 operates from NE to SW. The proposed flightpaths are shown in Figure A3. The point A indicated on Figure A3 corresponds to where the arrival paths for both jet and turbojet flightpath is overflown by departing jet aircraft that are going north after a SW take off on runway 23. Point A is 21 km from the runway 23 eastern threshold. Consequently, the aircraft height for Arrivals will be approximately 3000ft. Jet aircraft departing north from the SW threshold will have travelled approximately 43 km and would be 12500ft in height some 9500ft above arriving aircraft. If arriving aircraft need to fly around due to a missed approach, then they can use the departing jet or turbojet flightpath from the SW end of the runway.

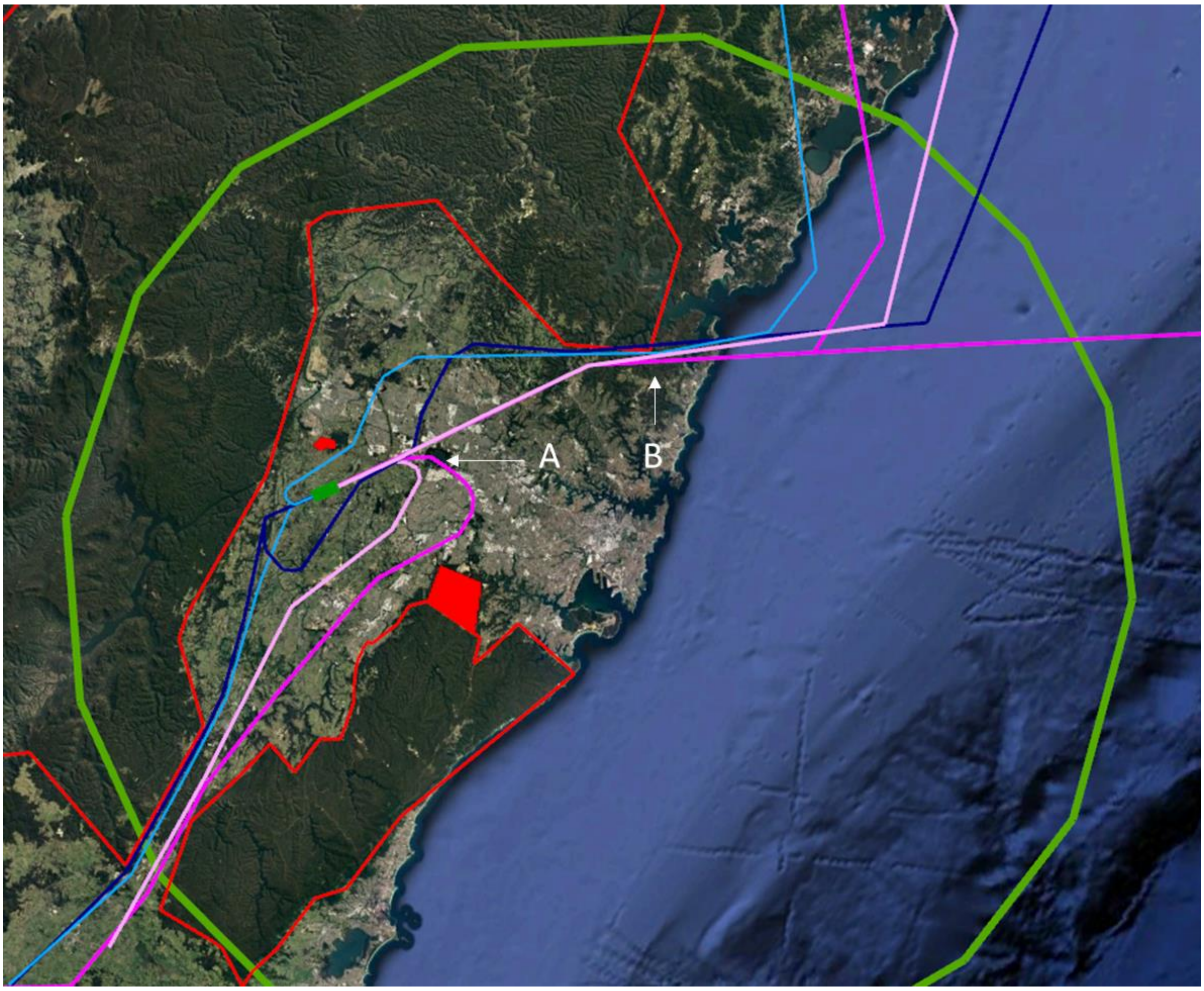


Figure A3 Proposed operation of runway 23 at WSA. Arrivals are from the Northeast and Departures are to the Southwest.

Point B represents another location where height is important. Incoming jets and turbojets are at 53 km from runway 23 threshold at a height of 10000ft. Jet departing to the SW to go north are about 90 km along the flightpath at a height of 20000ft. SW departing turbojets going north would be 73km along the flightpaths at a height of 16700 ft.

The last place of interaction between incoming and outgoing aircraft is near the 45NM area to the SW. Departing jets to the south are approximately 61km from the SW runway 23 threshold and at a height of 14700ft. Turbojets will be slightly lower than this at about 13000ft. Jets arriving from the south will be at about between 101 and 96 km from the runway threshold at 17000ft dropping to 16300 ft. Turbojets would be 15300ft dropping to 14000ft. There is potential conflict here, but the gap is 8km wide (24000ft) and aircraft can be separated safely.

Use Case 4: Proposed operation of runway 05.

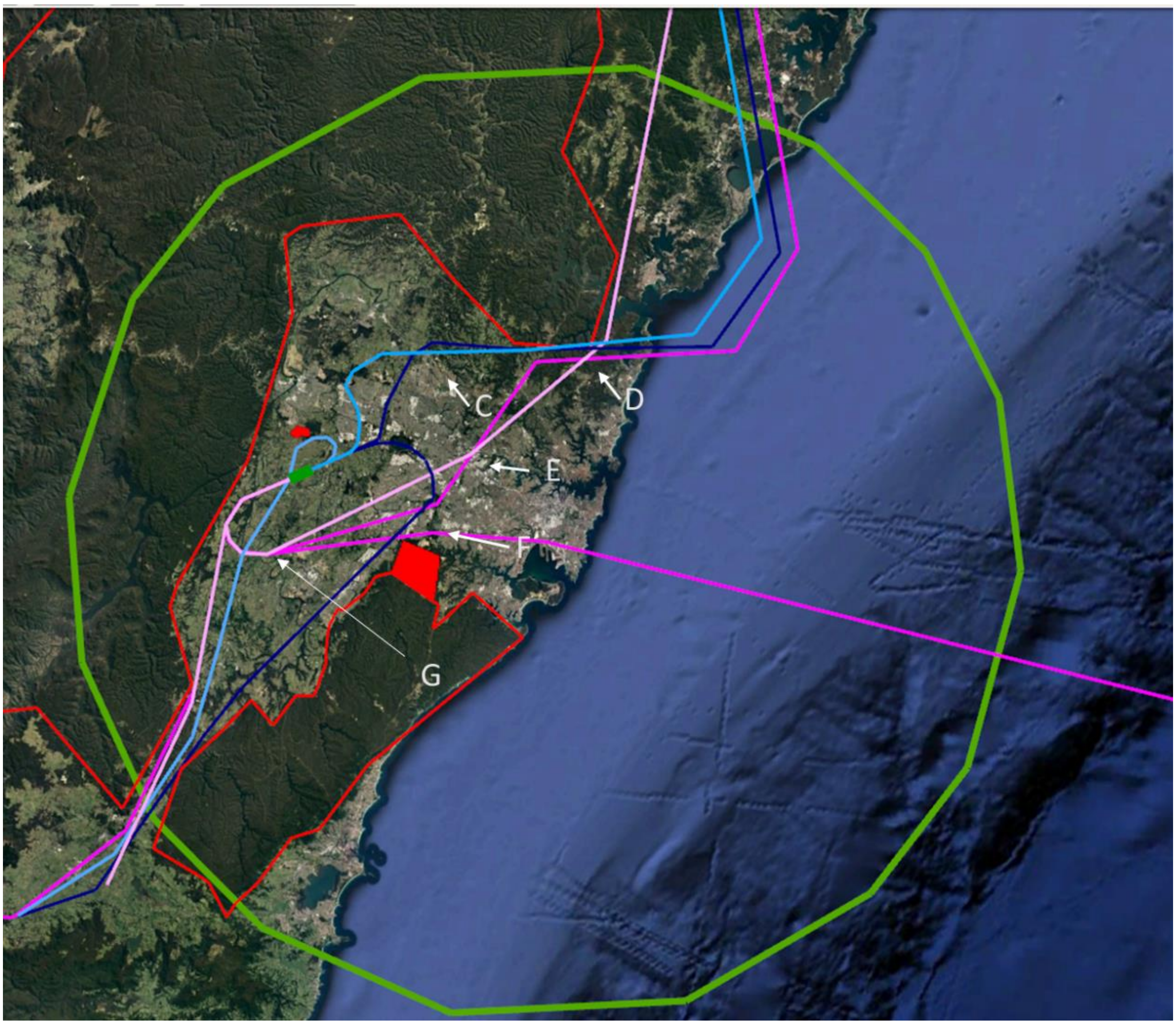


Figure A4 Proposed operation of runway 05 at WSA. Arrivals are from the SW and Departures are to the NE.

The operation of runway 05 is from the SW to NE. Figure A4 shows the proposed flightpaths for operation of runway 05. In this mode of operation arrivals land from the SW and take off to the Northeast. Again, there are several areas where height between aircraft is important. Point C is 34km along the turbojet departures and would be at about 9900ft. It is about 29 km along the jet departure track and these aircraft would about 8500ft. The separation can be increased from the scheduling of aircraft departures on runway 05 to ensure safe separation once airborne.

Point D is an area where incoming flights can intersect with departing flights. Point D is about 61-65 km from the 05 runway threshold for departing aircraft and would be between 14700ft and 15400ft. Arrivals are about 93 km from the SW 05 runway threshold and would be 15900 ft. The jet departure flightpath is separated from the Arrival jet flightpath laterally by some 5000ft. The main problem is the incoming Turbojet flight path which crosses the outgoing jet and turbo jet flightpaths. This can be solved by having a waypoint on the turbojet route before this intersection with the turbojets having to be below 13000ft.

Point E is similar to point C but this time on the arrival routes. Safe distances can be controlled by suitable scheduling.

Point F is jet departure route that intersects the Turbojet arrival route 24 km from the NE 05 runway threshold. Turbojet Arrivals are 56km from the SW 05 runway threshold. At this point, the respective heights for jet departures and turbojet arrivals are 7000ft and 10000 ft respectively which has sufficient clearance. The other two jet arrival flightpaths cross the jet flightpaths 53 km and 47km at heights of 10200 ft and 9300ft respectively. The jet departure is 34km and 39 km at a height of 9400ft and 11400ft respectively.

Point G is 34 km from take-off for turbojets to the intersection with Arrivals who are 20km from landing. The heights are 10000ft for departing turbojets and 3000ft for the Arrival aircraft. This should not present a problem with airspace use.

Use Case 5: Proposed reciprocal runway operations (RRO)

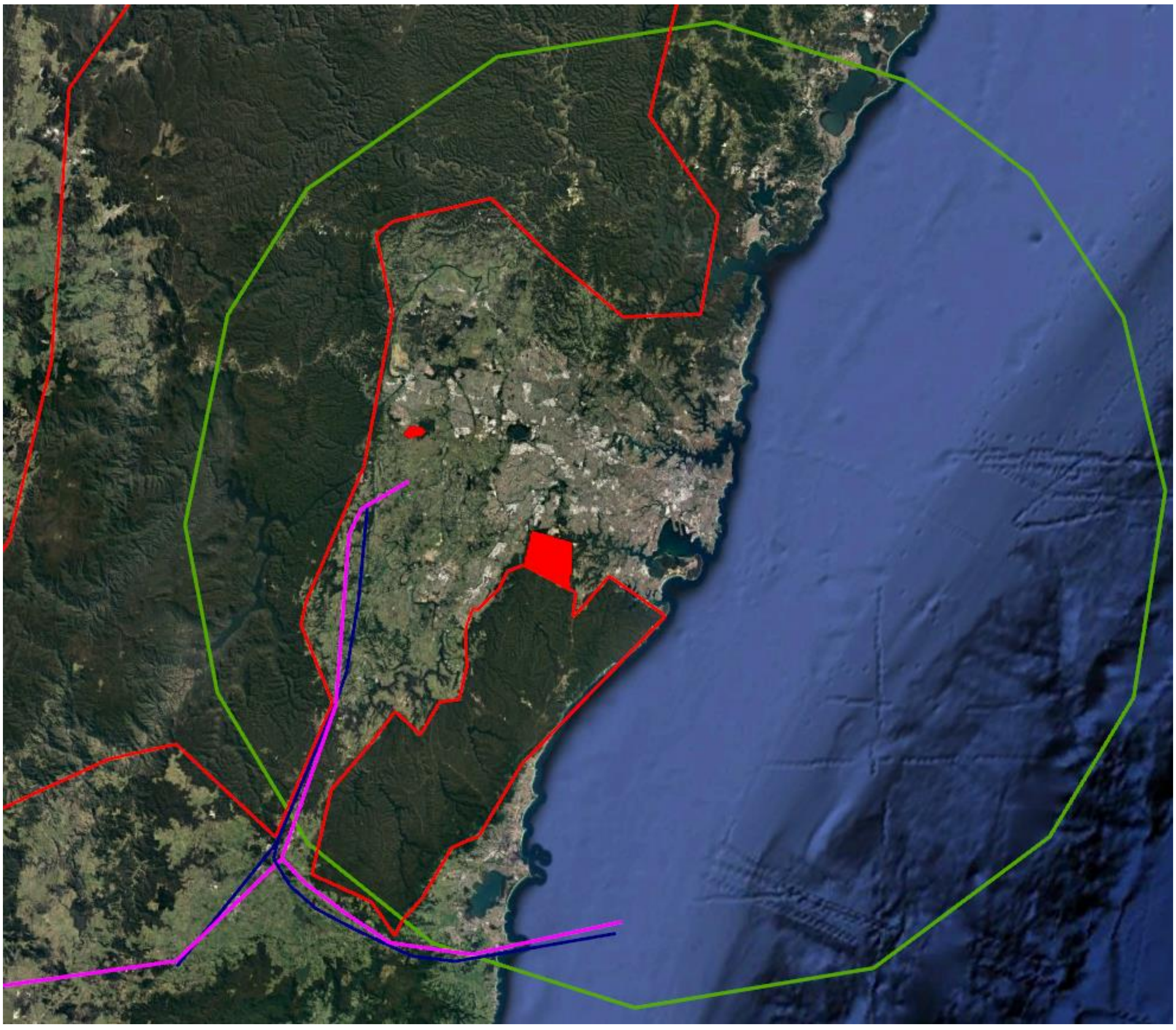


Figure A5 Proposed operation of runway 23 overnight (RRO). All arrivals are on 05 and Departures are on 23 to the SW.

In this proposed mode of operation arrivals and departures are to the SW. The use of the runway in this proposed RRO mode is at night as shown in Figure A5. Arrivals from the north or east fly to a waypoint east of Wollongong and fly over relatively unpopulated terrain to merge with the flightpath from the south to approach WSA from the SW on runway 05. Departures use the RRO mode and use runway 23 for departure. Again aircraft to the North and East continue around to the coast at Wollongong. The RRO operation restricts flights because of the counter use of the runway.

Use Case 6: Proposed runway 5 operation at WSA with runway 07/25 operations at KSA

As WSA has to operate in conjunction with KSA, the flight paths into KSA have been altered to take advantage of the use of the Ocean and limiting overflights of the populated areas of Sydney as much as possible.

The main conflict with flights into WSA is from the use of runway 25 for Arrivals at KSA and runway 07 for Departures from KSA. The arrival path operating for Arrivals is shown in Figure A6. The main conflict is at Point H where the KSA arrival crosses the jet departure from WSA. This point is 26 km from runway 07 at KSA. Arrival aircraft will be at approximately 3800 ft. Jets departing WSA are 40km from 23 eastern runway threshold at a height of 8300ft. There is no conflict in the use of airspace for arrivals on 07.

Point J is the intersection of turbojet arrivals on 07 to KSA and arrivals from the north and east for jet and turbojet into WSA on runway 05. Point J is 47km from KSA and 25km from WSA. Aircraft arriving on 07 at KSA will be at 9300 ft and aircraft landing on 05 will be at 3700 ft.

There appears to be no conflict in airspace use between use of KSA and 07 arrivals at KSA.

Departures on runway 25 from KSA intersect arrivals of both jets and turbojets using runway 05 at WSA as shown in Figure A7.

Departing jets also cross the arriving turbojet to WSA 53km from 25 runway threshold. The nominal height is 13400 ft. Arriving jets on 23 runway at WSA are 52km at a height of 10200 ft indicating good height separation.

Departing turbojets on runway 25 intersect arriving jets on runway 23 some 30 km from the runway threshold. Aircraft are at a height of 8800 ft. Arriving jets at runway 23 are at a height of 10200 ft 53 km from the 23 threshold. The departing aircraft also intersect the turbojet flightpath into WSA 39km from runway 25. Aircraft are at 11400ft. Arriving aircraft are 36 km from runway 23 at a height of 5200 ft.

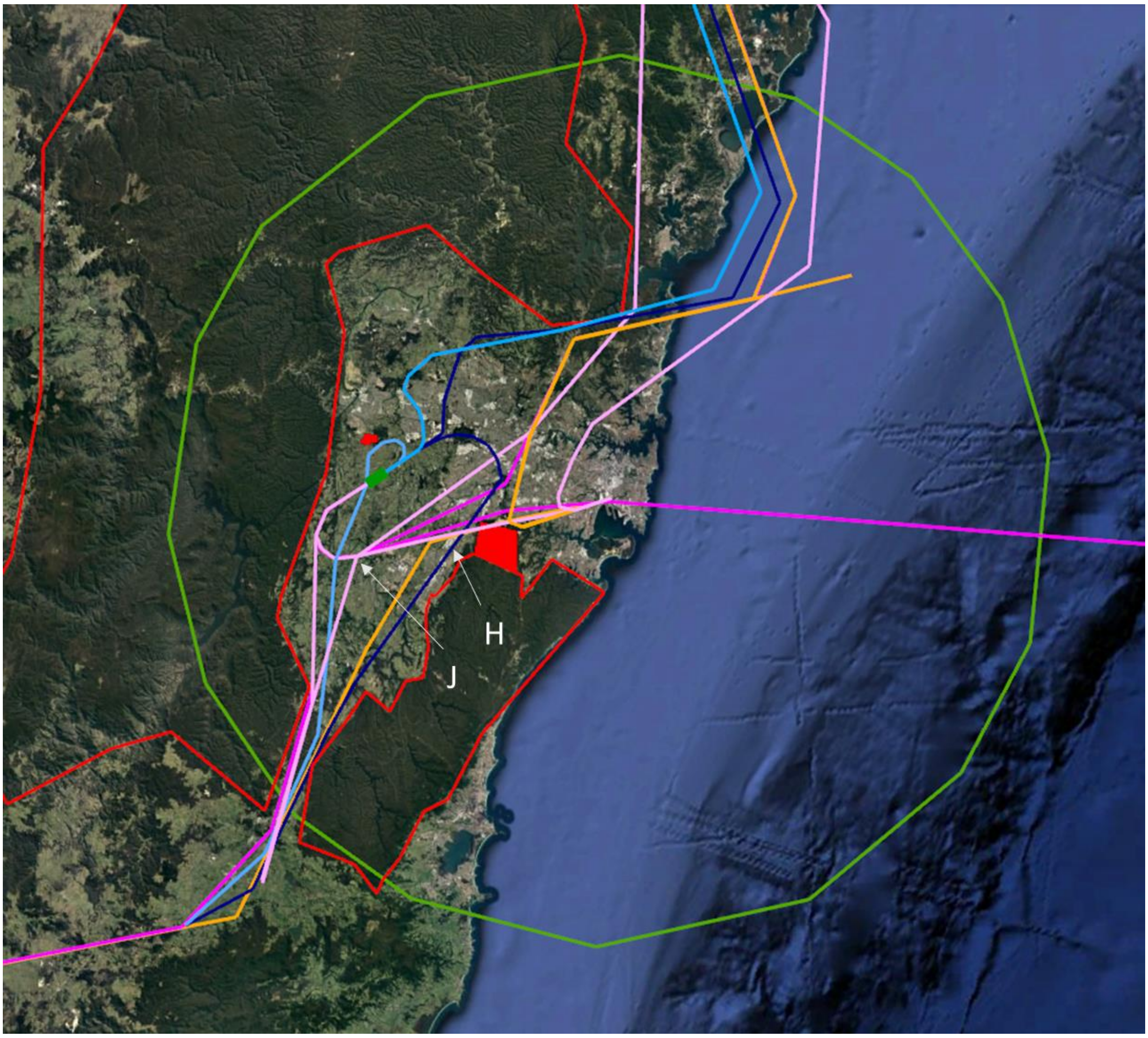


Figure A6 Proposed operation of runway 05 for Arrivals and Departures and Runway 07 for Arrivals at KSA

Jet departures from runway 25 at KSA intersect jet arrivals at runway 23 WSA at point H as shown in Figure A7. This point is 35 km from runway 25 at KSA and 43km from WSA runway 23. Departing jet Aircraft are at a height of 10200 ft. Arriving jet aircraft are 8700 ft. The nominal height separation is about 1500 ft which can be increased by the scheduling of aircraft between the two airports.

There appears to be no conflict for departures from KSA 35 runway with WSA Arrivals or Departures.

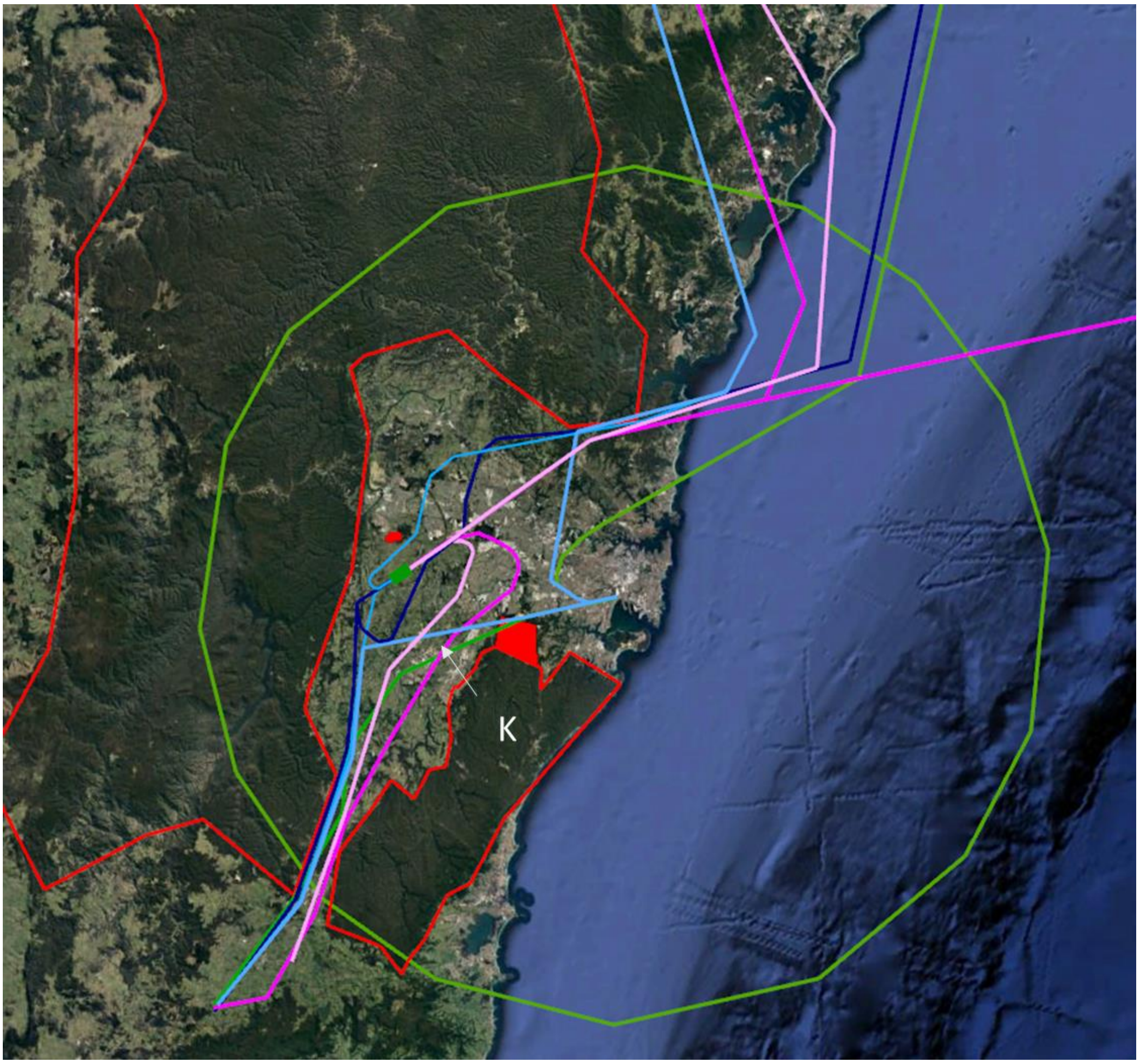


Figure A7 Proposed operation of runway 23 at WSA and runway 25 at KSA

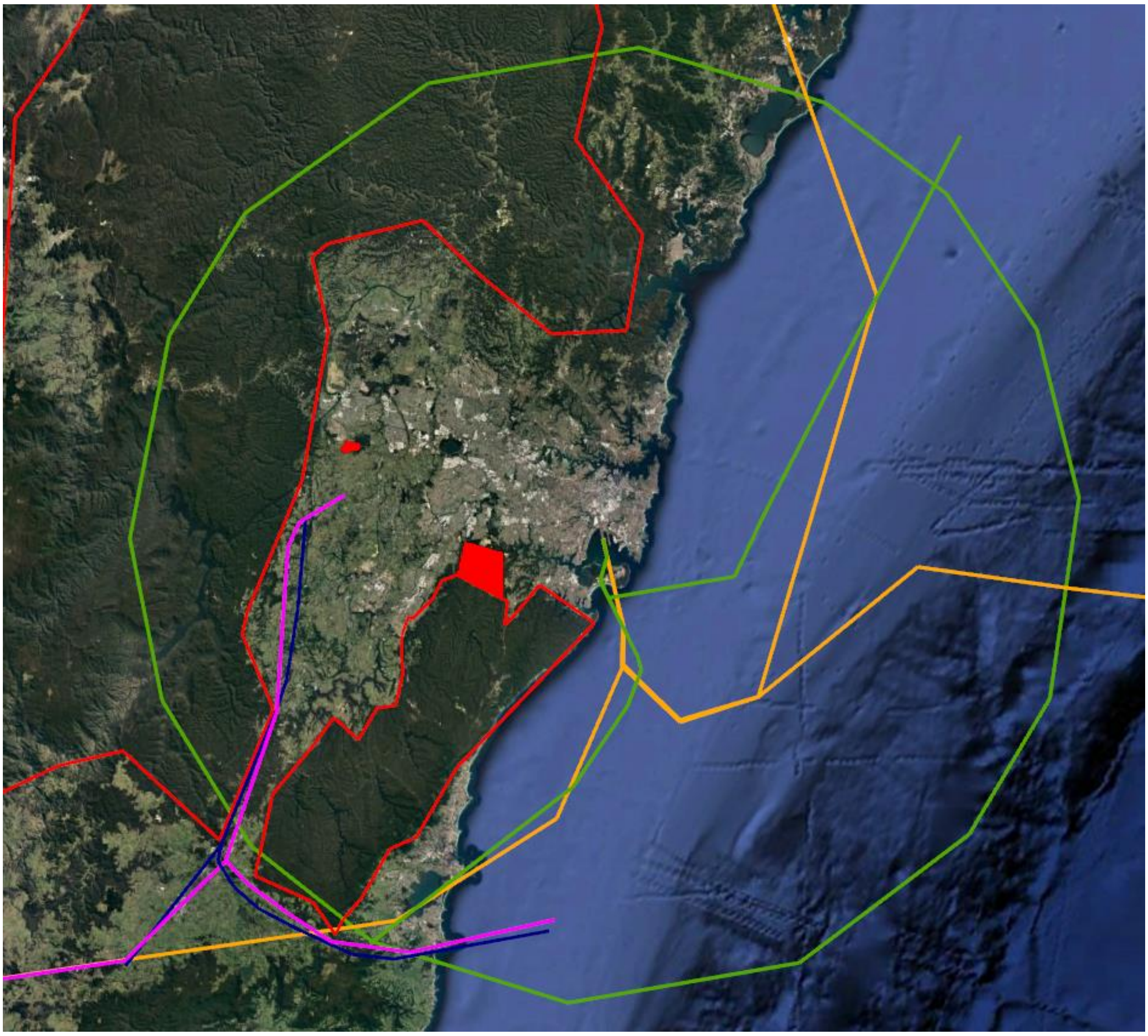


Figure A8 Proposed operational Mode 1 at KSA and RRO operation at WSA.

Use Case 7: Proposed operation of WSA with KSA modes of operation

The proposed operational modes for both airports are shown in Figures A8 to A16. Arrivals to KSA are shown in yellow, Departures from KSA are shown in green, Arrivals to WSA are shown in pink and Departures from WSA in dark blue. Light blue are paths involving turbojets rather than jets.

The wind conditions determine the mode of operation at KSA. It is assumed that WSA operates in the same wind conditions as the operational mode. Where this is not the case in practice then some additional considerations as to appropriate flightpaths might be needed.

Figure A8 shows the proposed operational Mode 1 at KSA and RRO operation for WSA. This mode of operation is operated overnight to limit noise impacts on the population as a whole. At KSA, runway 34L is used for all arrivals and runway 16R is used for all departures. At WSA, runway 05 is used for all arrivals and runway 23 is used for all departures. Departures to the North and East from WSA are above the arrival and departure flightpaths into KSA.

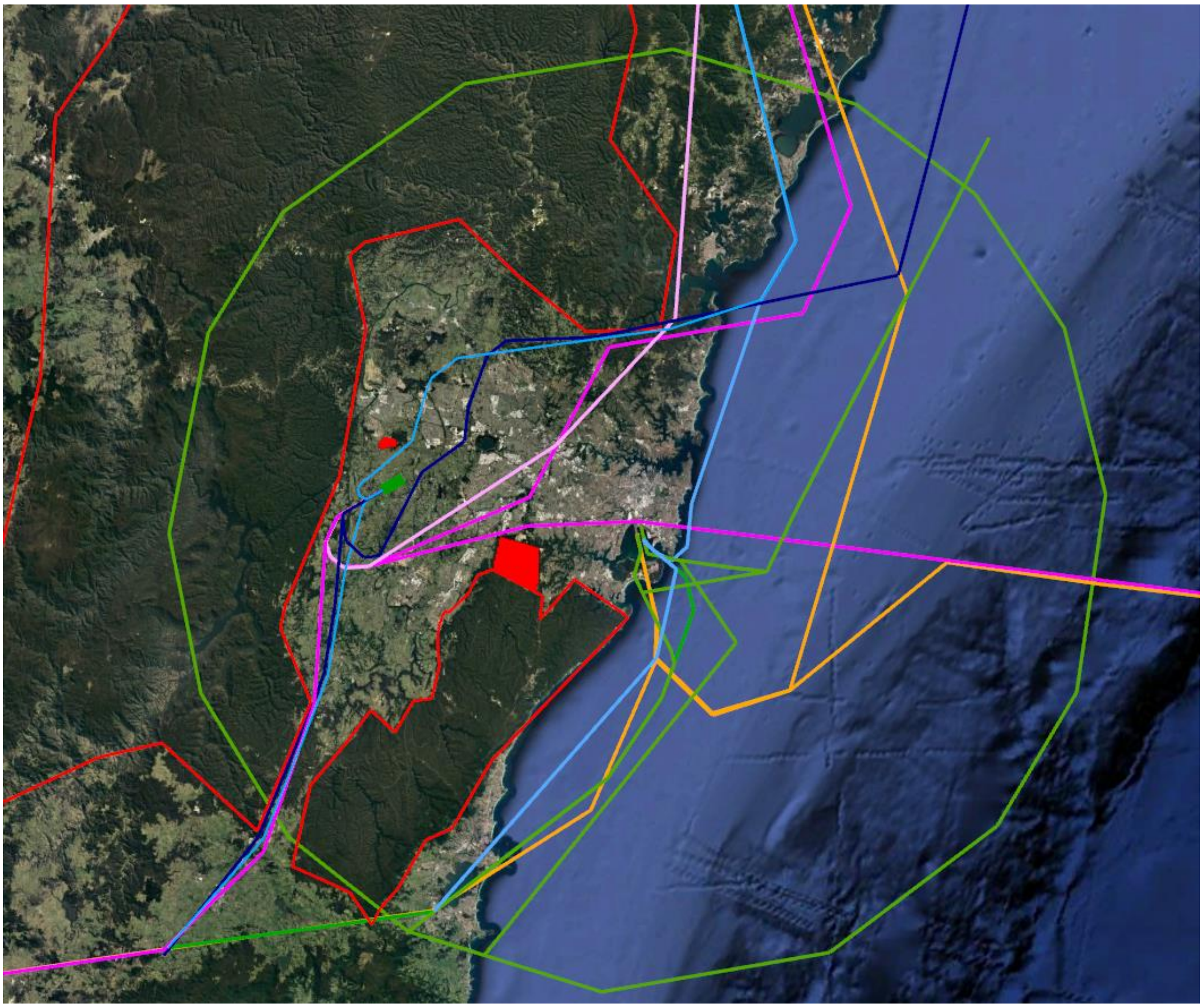


Figure A9 Proposed operational Mode 4 at KSA and RRO operation as a shoulder period.

Figure A9 shows the proposed arrivals and departures for mode 4. This is mainly used in the shoulder periods that occur between 10pm and 11pm or 6am to 8am. At KSA arrivals are still on runway 34L but departures are now on 16R. Longhaul jets would still use 16R when the longer runway is required for take-off. It is assumed that at WSA the wind will still allow use of runway 23 for a SW departure and 05 for arrivals. During this period There are no conflicts between paths for the two airports. The turbojets from KSA are more than 2000ft above the flightpaths for arrivals into WSA.

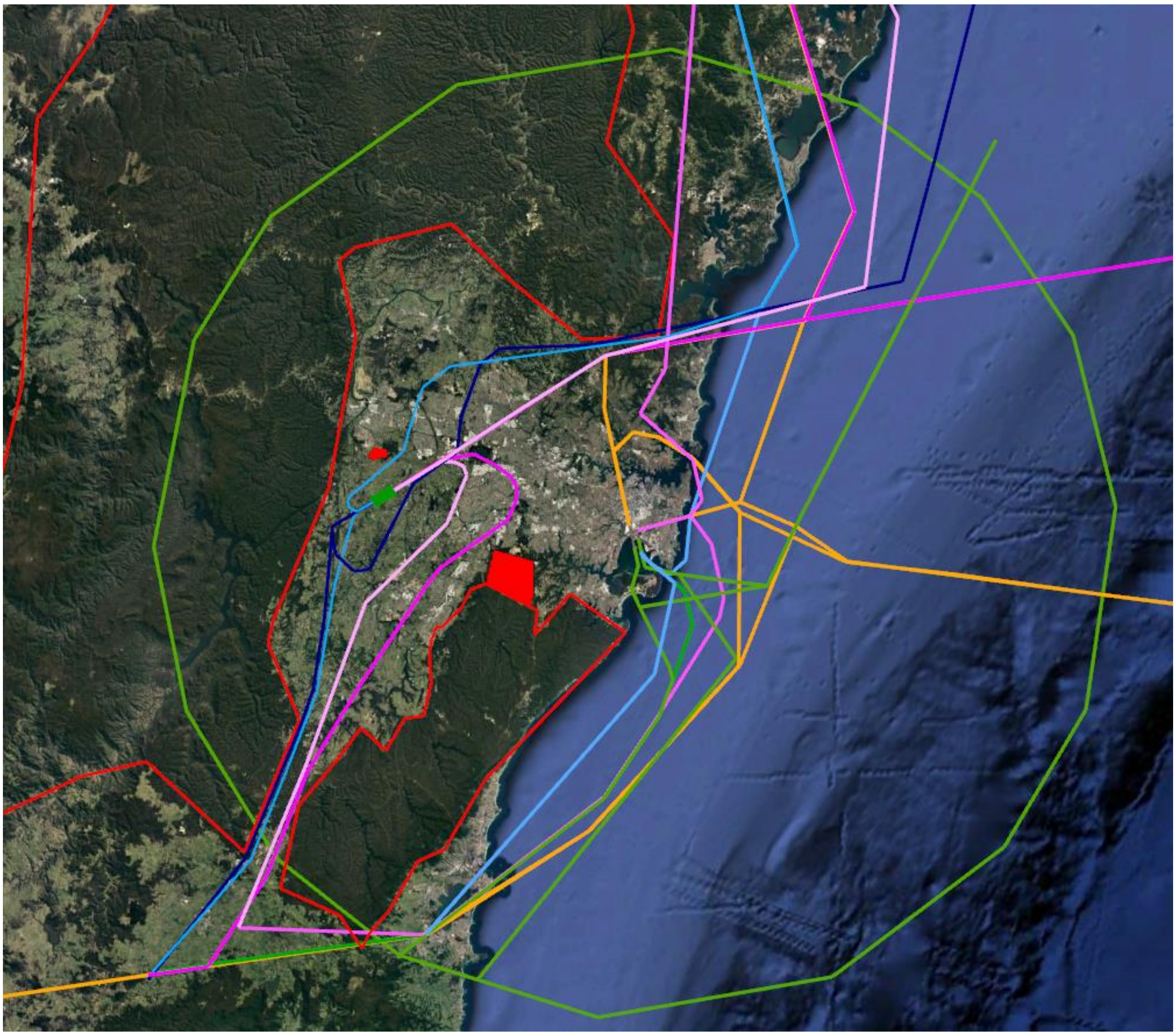


Figure A10 Proposed operational Mode 5 at KSA and runway 23 operation at WSA.

Proposed operational Mode 5 is shown in Figure A10. Arrivals are on runway 25 with only those long haul aircraft requiring the long runway on 16R. Departures are from 16L and 16R. This operates when the wind is between the SSE to W. It is assumed that the wind at Badgerys Creek is similar and arrivals at WSA will be on runway 23 and departures will be on runway 23. The 16R arrival pathway has a common space some30 km from KSA and are on similar arrival paths to WSA. The respective heights are 4300 ft for 16R and 9000ft for runway 23 at WSA. As most arrivals for KSA land on runway 25, the number of flights using 16R can be integrated with jets using a similar path but going to WSA runway 23. Departures do not cause any interference problems.

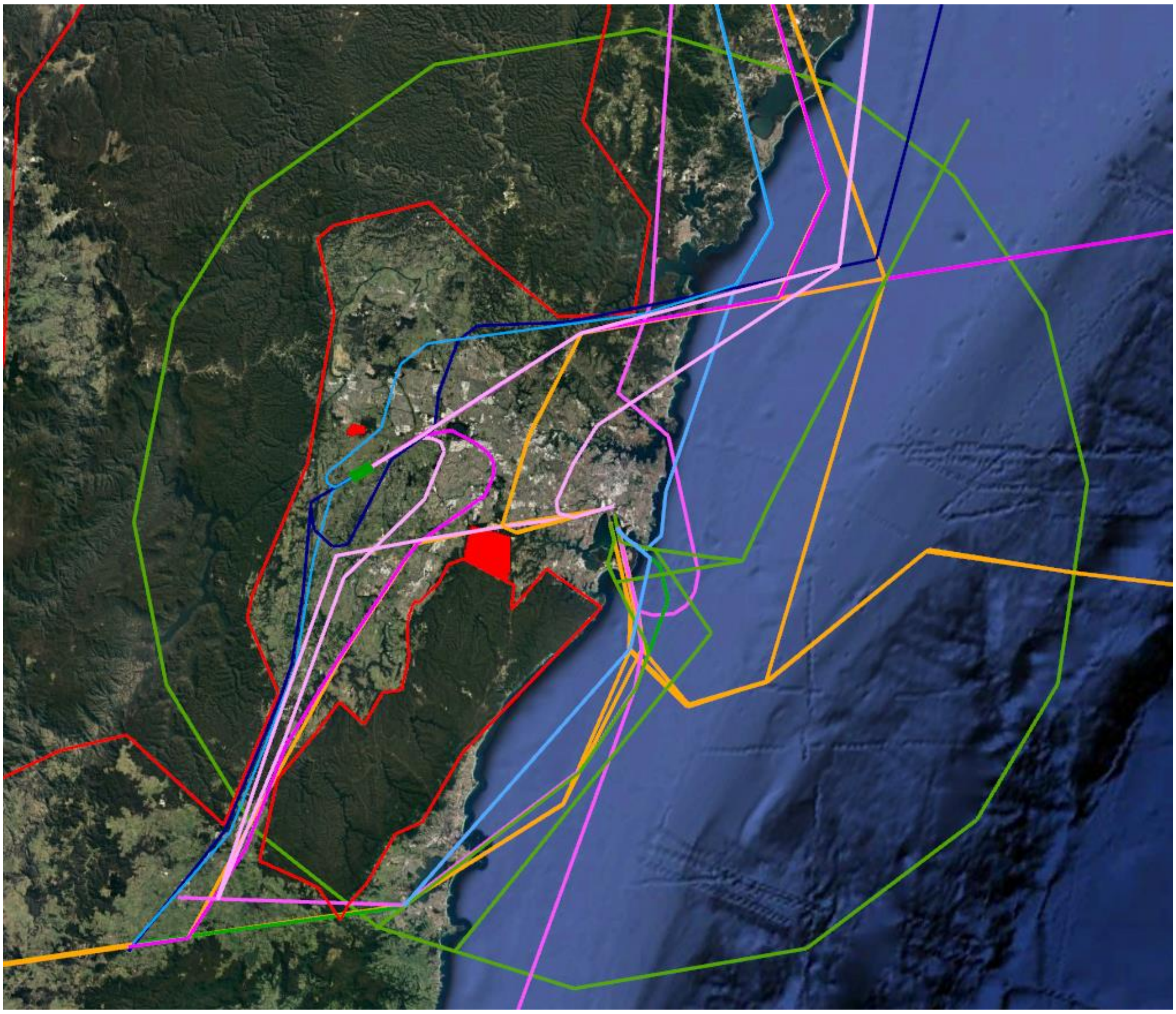


Figure A11 Proposed operational Mode 7 at KSA with runway 23 operation at WSA.

Proposed operational Mode 7 is shown in Figure A11. Arrivals are on runways 34R and 34L with departures on runway 25 and 34L. This mode operates in winds from the SW to N. Again, assuming wind conditions are similar at Badgerys Creek, arrivals at WSA would be on runway 23 and departures on runway 23.

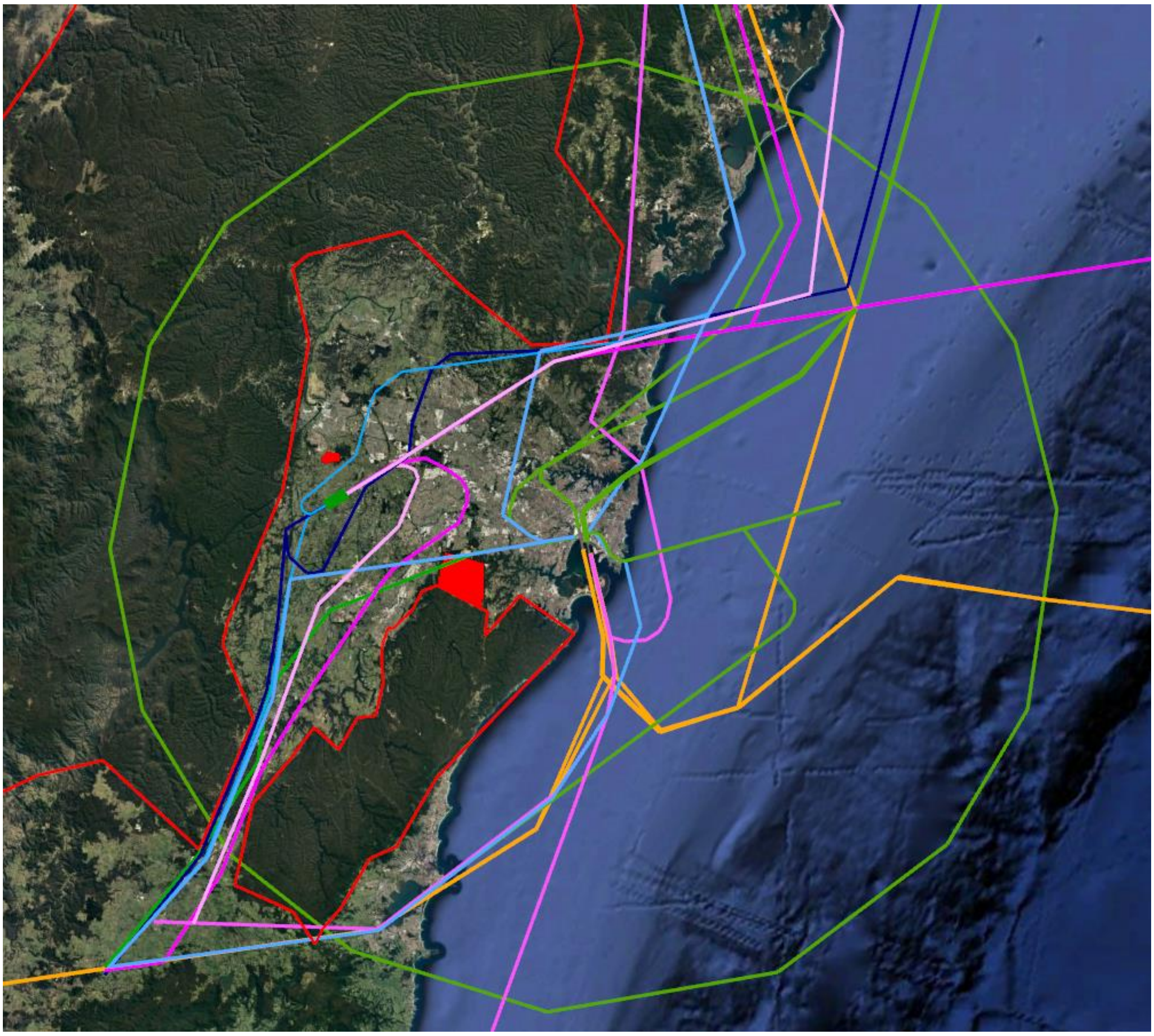


Figure A12 Proposed operational Mode 8 at KSA and runway operation 23 at WSA.

Figure A12 is proposed operational mode 8. At KSA arrivals occur from the south on runways 34L and 34R. Departures are from runway 25 and 34R with long haul aircraft using the long runway, 34L. This mode is use when the wind is from WSW to N. The arrivals at WSA are on runway 05 with departures on the same runway. This assumes that the wind at Badgerys Creek is more northerly than from the west.

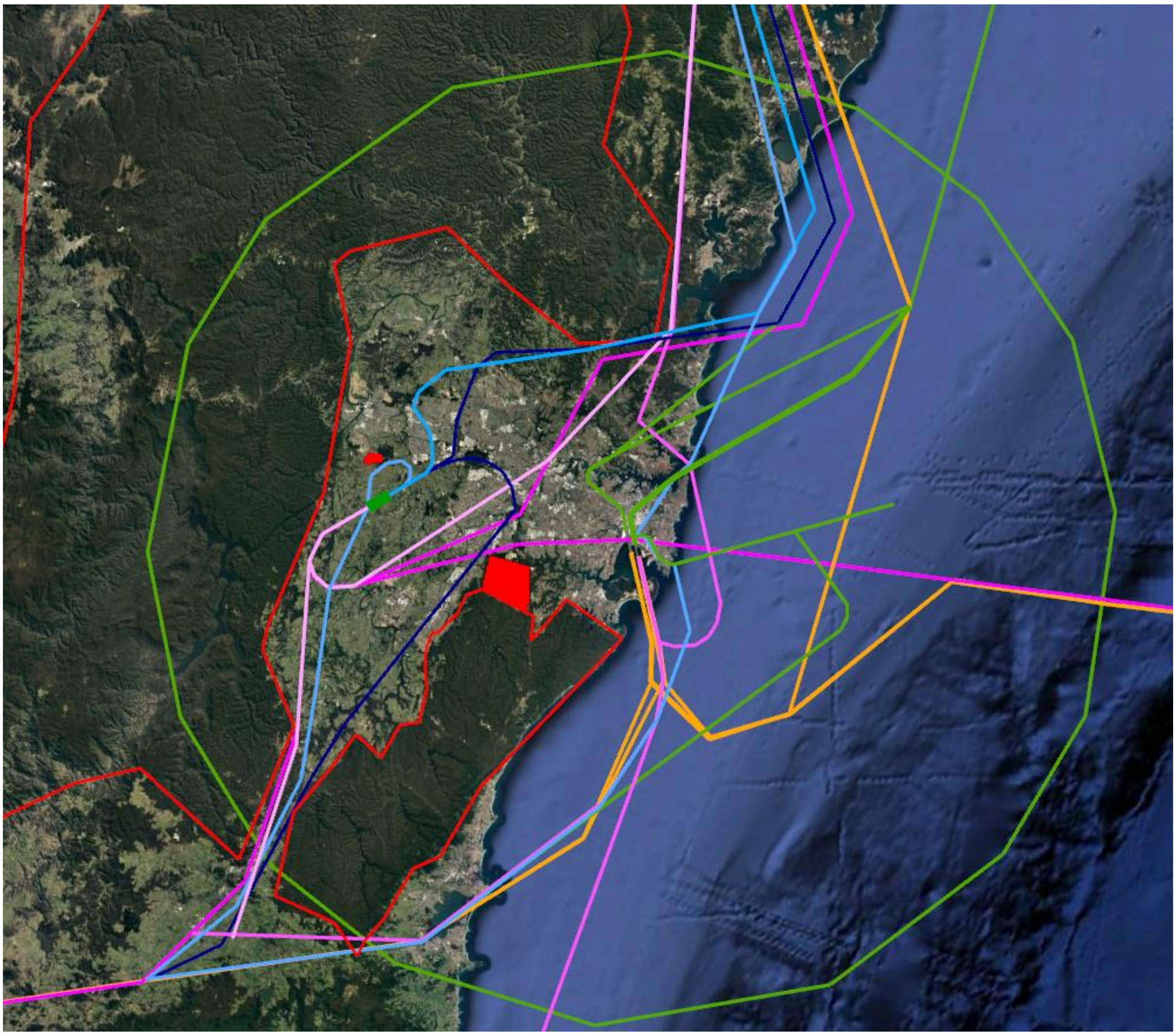
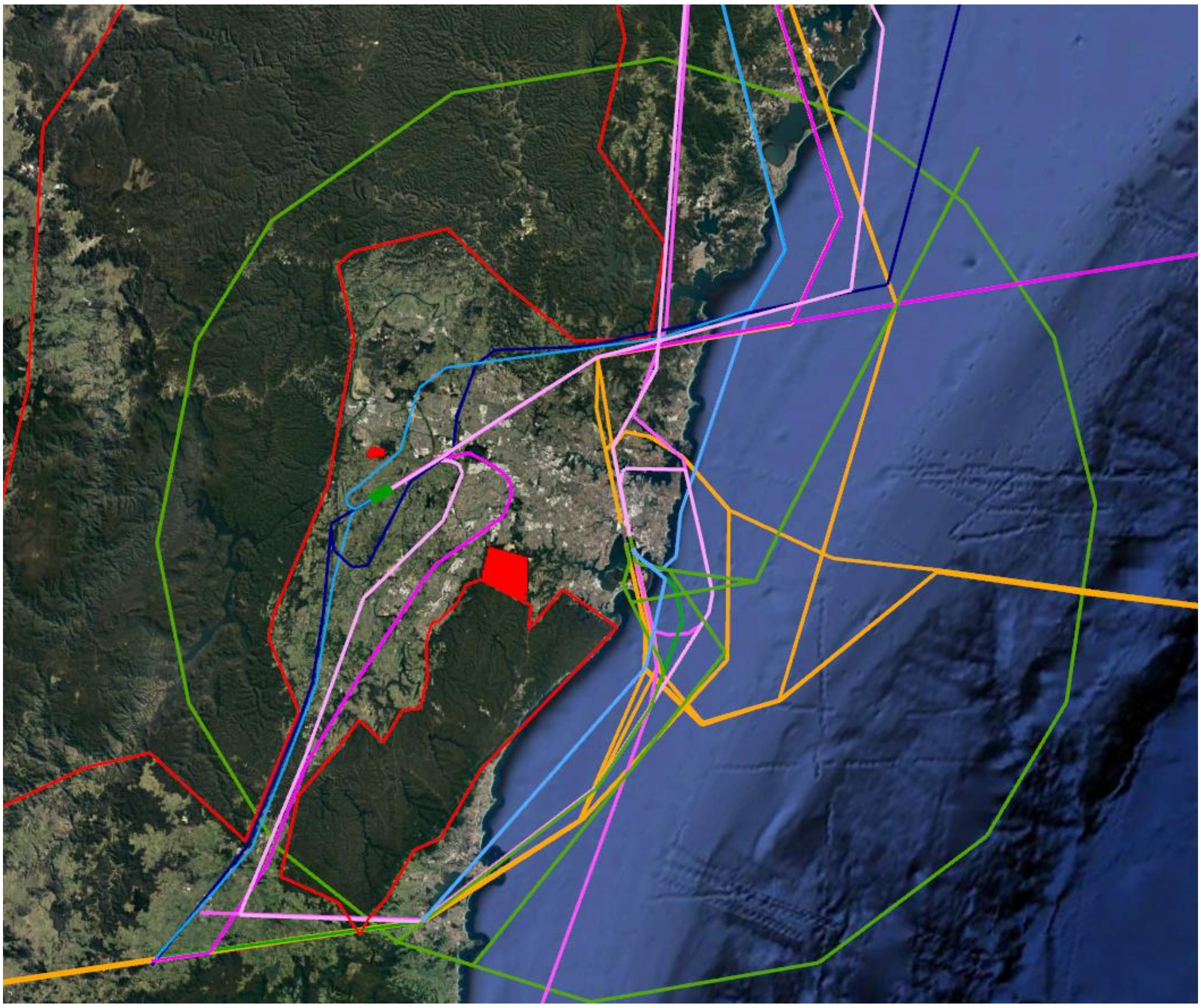


Figure A13 Proposed operational Mode 9 at KSA and runway 05 operating at WSA.

Figure A13 is proposed operational mode 9. Arrivals at KSA are from the south on runways 34R and 34L. Departures are also from 34R and 34L. It is operational when the wind is from the west through the North to East. Assuming the wind is from the north rather than the south at Badgerys Creek, arrivals at WSA would be on runway 05 and departures from the same runway.



FigureA14 Proposed operational Mode 10 at KSA and runway 23 operation at WSA.

Figure A14 is proposed operational mode 10. At KSA arrivals are on 16L and 16R from the north and departures are on 16L and 16R to the south. This mode operates when there is a southerly component of the wind of less than 5 knots. The arrivals at WSA are shown as being on runway 23 with departures on runway 23 but this is highly dependent on the wind strength at Badgerys Creek. If the wind strength from the North-East is too strong, then the arrivals and departures would be on 05.

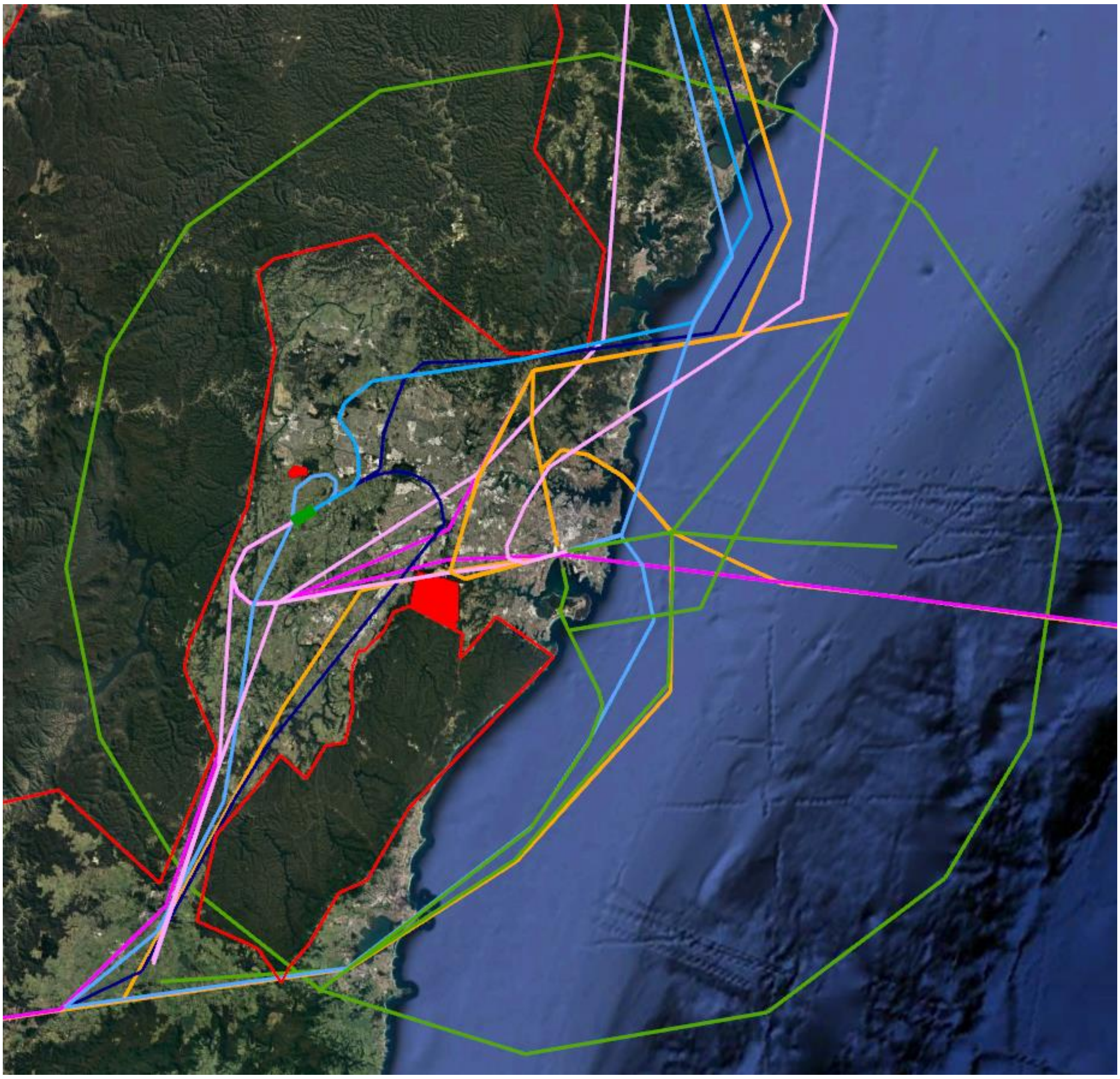


Figure A15 Proposed operational Mode 12 at KSA and runway 05 operation at WSA.

Proposed operational mode 12 is shown in Figure 24. The arrivals at KSA occur on runway 07 from the west and depart on runway 07 to the east. Departures requiring the longer runway depart on 34L to the north or 16L to the south. It is used when there is an easterly component to the wind. Arrivals and departures are on runway 05 assuming there is a strong easterly component to the wind.

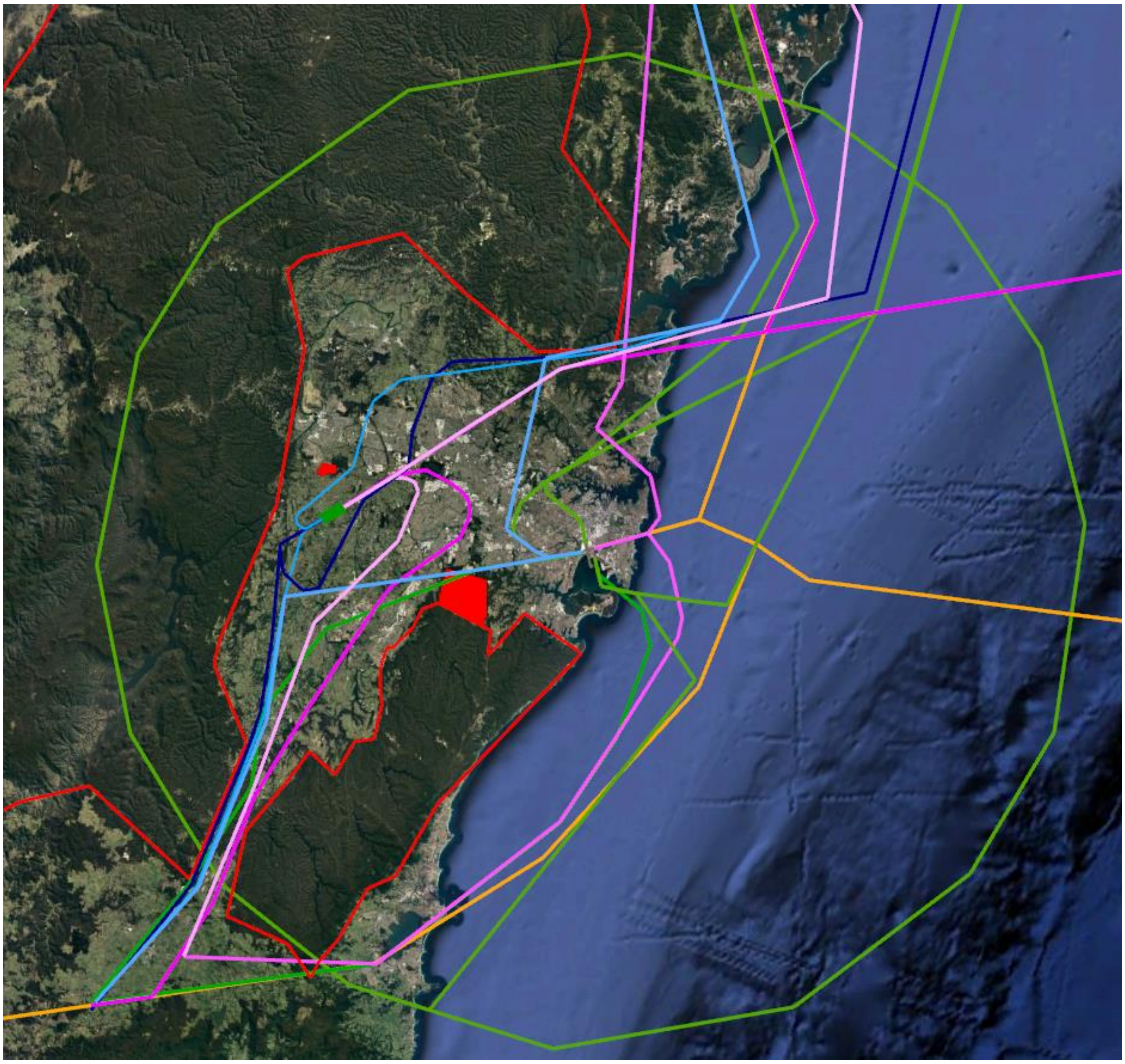


Figure A16 Proposed operational Mode 13 at KSA and runway 23 operation at WSA.

Proposed operational mode 13 is shown in Figure A16 Arrivals at KSA are from the east on runway 25. Departures are mainly on runway 25 to the west with the long runway being used for long haul aircraft on 16L or 34L. This mode is used when the wind is from the S through west to North. Runaway 23 is used at WSA.

Conclusion

The use cases demonstrate a viable alternative to what has been proposed in the EIS for Western Sydney Airport. It has a number of advantages in creating a safe airspace that reduces the consequences of any air crash on the population of Greater Sydney by approximately 50% and ensures that the environment of the Greater Blue Mountains World Heritage Area, its surrounding national parklands including the Royal National Park remain a sustainable aesthetic asset for Sydney and Australia.