

10 Noise (aircraft)

Operation of the proposed airport would result in changes to the pattern of aircraft movements above Western Sydney through the introduction of new aircraft operations. Communities in Western Sydney and the Blue Mountains would be impacted by noise from aircraft during take-off, landing and when in flight. The greatest impacts are predicted to be experienced in those locations closer to the airport under or near the aircraft departure and arrival routes. The geographic extent and level of aircraft noise exposure that would result from operation of the proposed airport is complex, and depends on approved final flight paths and aircraft operating procedures, time of day, season, weather conditions as well as other factors.

This noise assessment of the proposed Stage 1 development is based on indicative flight paths prepared by Airservices Australia to cater for a demand of approximately 10 million annual passengers and about 63,000 aircraft movements a year (total passenger and freight movements). The flight paths for the proposed airport will be formalised as part of a separate process closer to the commencement of airport operations. While the Australian Government has stated that one element of the indicative flight paths, a single merge point over Blaxland will not be implemented, the indicative flight paths presented in the EIS continue to provide a reasonable and contemporary basis for assessing the potential extent and intensity of noise impacts associated with aircraft operations at the proposed airport.

The noise impact assessment undertaken for this EIS has adopted a conservative approach by assuming an aircraft fleet based on current day aircraft types, without taking account of any future reductions in aircraft noise emissions which may occur over time as a result of technological advancements. The assessment assumes the use of continuous descent approaches, which minimise the use of engine thrust by pilots. Continuous descent approaches are used at a variety of other airports and are embodied in the preliminary airspace design provided by Airservices Australia.

Individuals show varying sensitivity to noise. Experience at existing airports in Australia has shown that, while aircraft noise contours based on cumulative noise exposure measures such as the Australian Noise Exposure Forecast (ANEF) are useful for land use planning purposes near airports, they are not necessarily an indicator of the full extent of community reaction to, or individual annoyance from, aircraft noise or the total spread of noise impacts. The EIS assessment of aircraft noise is based on measures outlined in Australian Standard 2021:2015 and the National Airports Safeguarding Framework. These guidelines emphasise the challenge of communicating the complex nature and extent of aircraft noise and advocate using a number of different measures to aid interpretation of predicted noise exposure levels. While this EIS has used a range of measures for describing noise exposure, it is important to note that aircraft noise impacts would be experienced outside the areas depicted by the various noise exposure contours. Individuals and communities newly exposed to aircraft noise are likely to show an enhanced sensitivity to changes in the noise environment.

For the loudest aircraft operations (long-range departures by Boeing 747 aircraft or equivalent), maximum noise levels over 85 dBA are predicted at a small number of rural residential locations in Badgerys Creek close to the airport site. Noise levels of 70–75 dBA would be experienced over a greater area and could be expected within built-up areas in St Marys and Erskine Park. The Boeing 747 is, however, being phased out of passenger services by most airlines. Maximum noise levels due to more common aircraft types such as Airbus A320 or equivalent are predicted to be lower at 60–70 dBA in built-up areas around St Marys and Erskine Park, and over 70 dBA in some adjacent areas to the south-west of the airport site, such as Greendale.

Over a 24-hour period, between 1,500 and 1,600 residents are predicted to experience five or more aircraft noise events above 70 dBA. The number of residents affected by different levels of aircraft noise depends on the runway operating strategy adopted. Comparison of the two key strategies indicates that while there is limited variability of noise exposure levels in close proximity to the proposed airport, the choice of runway operating strategy has a more pronounced effect on communities further away.

On an average night, aircraft approaching and departing the proposed airport in a south-west to north-east direction are predicted to result in an estimated 48,000 people experiencing more than five events above 60 dBA. With an operating strategy in the opposite direction, approximately 6,000 people are predicted to experience on average more than five events above 60 dBA per night. This number would reduce to 4,000 if a head-to-head operating mode was implemented, in which aircraft would both approach and depart at the south-west end of the runway.

Most recreational areas in the vicinity of the airport site would not be subject to aircraft overflight noise events with maximum levels exceeding 70 dBA. In recreational areas where this level of noise exposure is predicted, the average number of events above 70 dBA would be less than one event per day. The noise impact associated with take-offs in both directions and aircraft reverse thrust during landing would primarily affect Luddenham and Greendale. The potential impacts of aircraft noise on community health and social factors such as amenity and annoyance are discussed in Chapter 13 and Chapter 23 respectively. Approaches to mitigating aircraft noise generally focus on reducing noise emissions from the aircraft themselves, planning flight paths and airport operating modes in a way that minimises potential noise and environmental impacts, and implementing land use planning or other controls to ensure that future noise-sensitive uses are not located in noise-affected areas. Land use planning controls have largely protected the airport site from incompatible development for nearly three decades. It is expected that future land use planning around the proposed airport would be influenced by final long term ANEF contours, once flight paths and operating modes are finalised and approved. Subject to relevant considerations such as aircraft safety, all practicable opportunities for mitigating noise impacts will be considered in finalising the flight paths and aircraft operating procedures for the proposed airport.


10.1 Introduction

This chapter provides an assessment of potential aircraft overflight noise associated with the operation of the proposed airport. The chapter draws on a comprehensive aircraft noise assessment which is included as Appendix E1 (Volume 4). In considering anticipated aircraft overflight noise impacts, the assessment takes into account the projected air traffic volumes, indicative aircraft flight paths and airport operating modes, noise emissions from different aircraft types, and future population densities in areas surrounding the airport site.

As discussed in Chapter 7 (Volume 1), the Australian Government has stated that the airspace design to be implemented for the proposed airport will not converge arriving aircraft at a single point over the community of Blaxland. While this aspect of the airspace design will not be realised, the indicative flight paths presented in the EIS provide a reasonable and contemporary basis for assessing the potential extent and intensity of impacts associated with aircraft operations at the proposed airport. The indicative flight paths have been used to calculate the potential extent of noise exposure associated with aircraft overflights. The use of preliminary flight paths for noise assessment in an EIS is consistent with other environmental assessments of new runway infrastructure, including the 1997-1999 Second Sydney Airport Proposal EIS and more recent proposals such as the Brisbane Airport New Parallel Runway. Final flight paths can only be implemented following further analysis, including detailed consideration of potential noise abatement opportunities and additional community consultation.

The assessment addresses the requirements of the EIS Guidelines, which specifically require consideration of aircraft noise and vibration impacts on everyday activities and on sensitive receptors. For the purposes of assessment, aircraft noise has been divided into two main categories generally in line with the regulation of aircraft and airport noise, and having regard to the noise characteristics of different operations and the modelling approaches adopted for this EIS. These categories are:

- aircraft overflight noise (including noise generated during flight, take-off and landing); and
- ground-based noise (including noise generated from aircraft taxiing, aircraft engine ground running and airport construction).



This chapter assesses noise associated with aircraft overflights which are defined as being from the start of roll for departures and until an aircraft exits the runway on arrival. This includes noise generated by operations when the aircraft is on the ground such as elevated thrust during take-off and reverse thrust during landing.

Ground-based noise from sources such as fixed-wing engine runs, aircraft taxiing and other on-airport operations (e.g. road traffic, plant and equipment) is considered separately in Chapter 11.

10.2 Understanding aircraft noise

10.2.1 Nature of noise

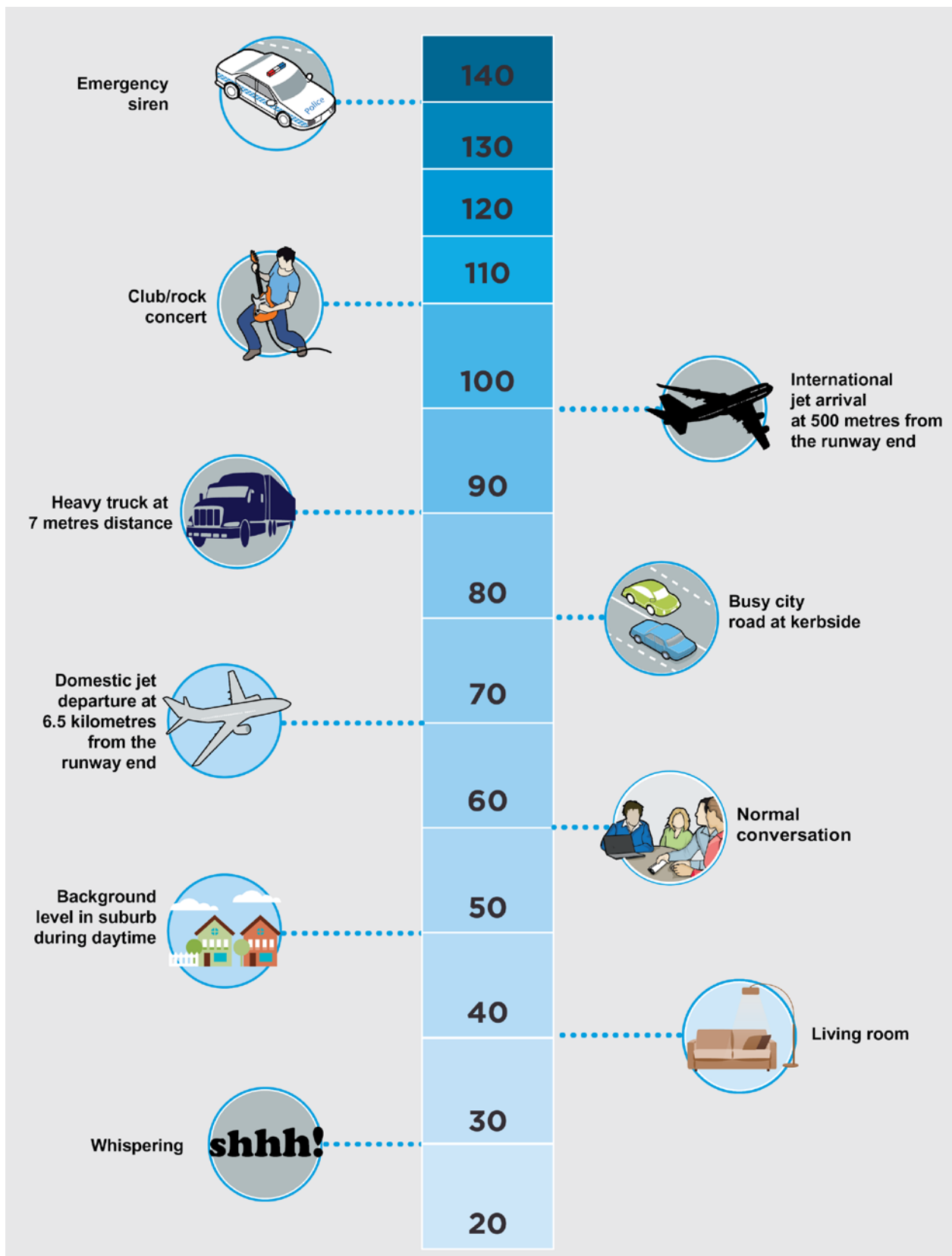
Sound is a vibration travelling as a wave of pressure through the air from a source to a receiver, such as the human ear. The frequency of a sound is what gives it a distinctive pitch or tone – the rumble of distant thunder is an example of a low frequency sound and a whistle is an example of a high frequency sound. The human ear is more sensitive to high frequency sounds.

The loudness of a sound depends on its sound pressure level, which is expressed in decibels (dB). Most sounds we hear in our daily lives have sound pressure levels in the range of 30-90 decibels. A-weighted decibels (dBA) are generally used for the purposes of assessment and have been adjusted to account for the varying sensitivity of the human ear to different frequencies of sound. The main effect of the adjustment is that low and very high frequencies are given less weight.

The sound level in a typical residential home is about 40 dBA. The average noise level of conversation is about 60-65 dBA. Typical levels for listening to music at home are about 85 dBA, while a loud rock concert would produce about 110 dBA. Figure 10–1 illustrates indicative sound levels measured in dBA for these and other typical situations.

In terms of sound perception, 3 dBA is the minimum change in sound level that most people can detect and every 10 dBA increase in sound level is perceived as a doubling of loudness. However, individuals may perceive the same sound differently and may be more or less affected by a particular sound. For example, experience has shown that many factors can influence an individual's response to aircraft noise, including:

- the specific characteristics of the noise (e.g. the frequency, intensity and duration of noise events) and the time of day noise events occur;
- their personal circumstances and expectations about the number, frequency, loudness and timing of noise events;
- their individual sensitivities and lifestyle (e.g. whether they spend a lot of time outdoors or sleep with a window open);
- their reaction to a new noise source (in the case of a new airport or new runway infrastructure) or to changed airport operational procedures;
- their understanding of whether the noise is avoidable and their notions of fairness; and
- their attitudes towards the source of the noise (e.g. general views about aviation activities and airports).



Note: Noise levels adapted from Melbourne Airport website

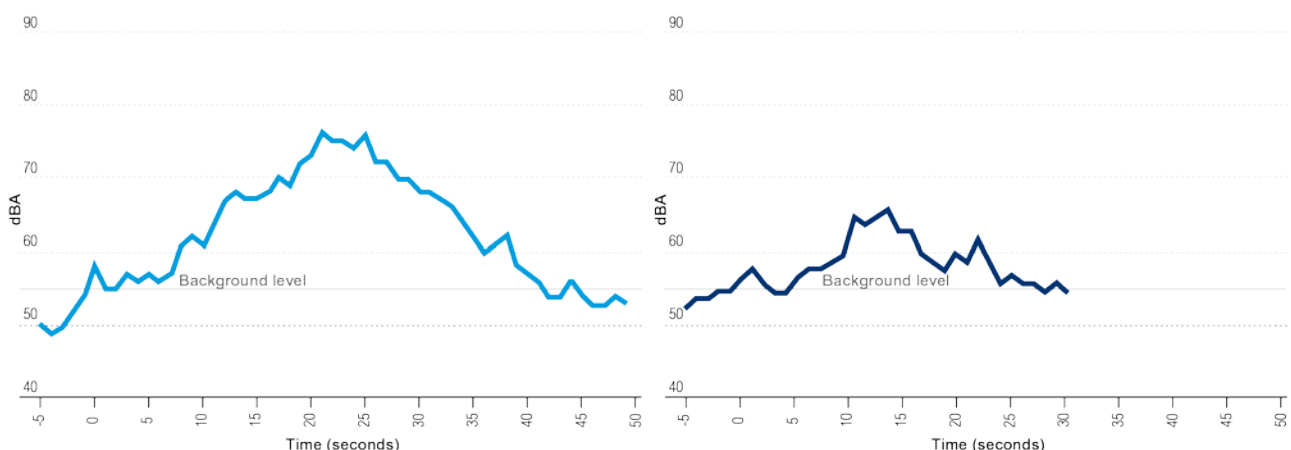
Figure 10–1 Indicative dBA noise levels in typical situations

10.2.2 Typical profile of aircraft noise

Figure 10–2 shows the measured duration and noise level from an overflight of a jet aircraft. The figure on the left shows the noise profile for a flight passing directly overhead of a noise monitor while the figure on the right shows the noise profile measured at a horizontal distance of approximately three kilometres from the flight path.

While the two figures are broadly comparable, there are some notable differences. The noise profile for a jet aircraft flying directly overhead shows that aircraft noise levels rise above the background noise level for approximately 45 seconds and the peak noise level, about 76 dBA, is more than 20 dBA above the background level. In the figure on the right, where the aircraft is further away from the receiver, the duration of the aircraft noise event is approximately 30 seconds or about two-thirds of that measured from the overhead flight. The peak noise level of about 65 dBA is about 10 dBA above the background level.

As indicated above, these key differences in measured noise level and duration from typical aircraft overflights would be perceived differently by individuals in different locations, potentially leading to a different reaction to the measured noise level.



Source: Burgess and McCarty, Acoustics Australia Vol 38 August 2010 No 2

Figure 10–2 Noise profile for a typical jet aircraft overflight

10.2.3 Sources of aircraft noise

Operation of the proposed airport would result in changes to the pattern of aircraft movements in the airspace above Western Sydney due to the introduction of new aircraft flight paths.

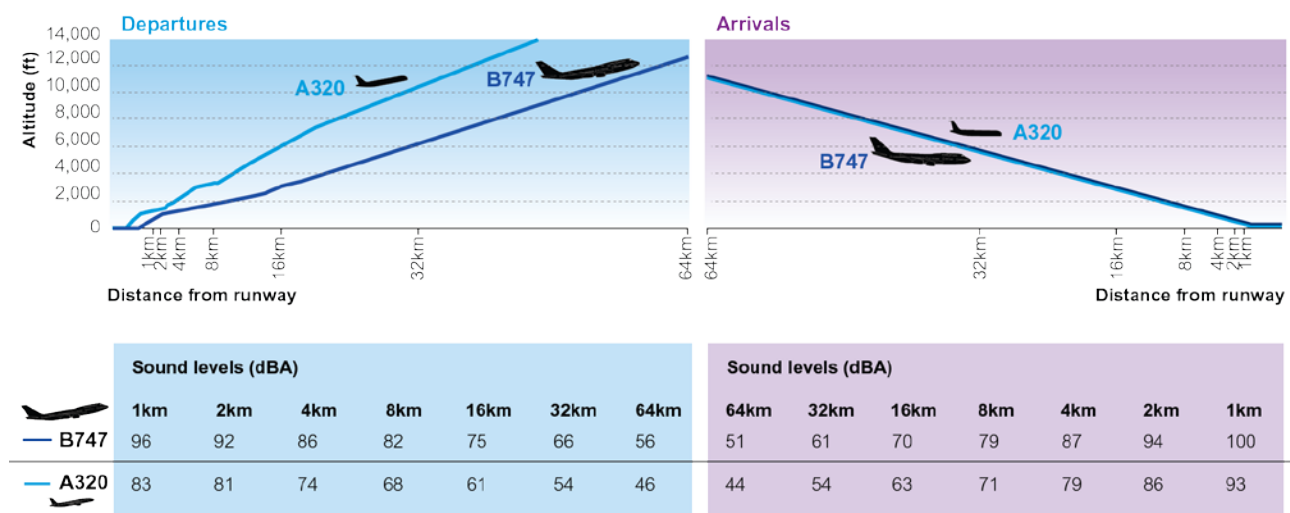
The characteristics of sound from aircraft can vary depending on a range of factors, including the type of engine, the stage of flight, the height of the aircraft and the prevailing meteorological conditions. While there are many sources of noise from an aircraft, including noise generated by the airframe, engines are the dominant source of noise for the majority of the flight cycle.

Engine noise can be particularly pronounced when aircraft are operating on the ground as a result of elevated thrust during take-off and reverse thrust during landing. Reverse thrust noise levels are typically higher than take-off noise levels as a result of the diversion of the engine exhaust to assist with deceleration, which results in a characteristic noise contour bulge surrounding a runway.

The pattern of noise exposure that would result from operation of the proposed airport is complex, and depends on final flight paths and airport operating procedures, time of day, season, weather conditions and other factors.

The Government's primary objectives for the proposed airport are to improve access to aviation services for Western Sydney and solve the long term regular transport capacity constraints in the Sydney basin. Bankstown Airport remains the principal general aviation aerodrome in the Sydney basin. Planning for the proposed airport does not include specific provisions for general aviation facilities, such as helicopters and tourist flight facilities. The potential noise impacts of general aviation operations are therefore not assessed in this EIS. Should such facilities be proposed in the future, they (and any associated aviation activities) would be subject to any relevant requirements of the *Airports Act 1996*.

Generally speaking, aircraft noise levels would decrease with distance from the proposed airport primarily as a result of the higher altitude of aircraft operations. Indicative departure and arrival profiles and associated sound levels for a Boeing 747 and an Airbus A320 aircraft at specified distances from the runway are shown in Figure 10–3.



This figure provides information on indicative noise levels at certain distances from the end of the runway for A320 and B747 aircraft. The estimates present the height of the aircraft relative to the runway and do not account for local terrain. The indicative noise levels were calculated at the runway height.

Figure 10–3 Indicative sound levels for B747 and A320 aircraft – departures and arrivals

10.2.4 Responsibilities for aircraft noise

A number of organisations have a role in managing aircraft noise. A summary of relevant organisations and their role in managing aircraft noise is provided in Table 10–1. These include the Airport Lessee Company (ALC), the Australian, State and local governments, airlines, aircraft and engine manufacturers, and regulators.

Table 10–1 Responsibilities for managing airport related noise at civilian airports

Organisation	Summary of responsibilities concerning the management of civil aircraft noise
<p>International Civil Aviation Organization</p> <p>ICAO is a United Nations specialised agency established under the Convention on International Civil Aviation (Chicago Convention) that works with member states and global aviation organisations to develop international standards and recommended practices for adoption in national civil aviation regulations.</p>	<ul style="list-style-type: none"> • Aircraft built today are required to meet ICAO's strict aircraft noise standards. • As an ICAO member state, Australia has adopted laws and regulations to reflect these international standards, for example through the Air Navigation (Aircraft Noise) Regulations 1984.
<p>Airservices Australia</p> <p>Airservices Australia would be responsible for managing aircraft movements at the proposed airport.</p>	<p>Under the <i>Air Services Act 1995</i>, Airservices Australia must exercise its powers and perform its functions in a manner that ensures that, as far as is practicable, the environment is protected from the effects of, and the effects associated with, the operation and use of aircraft.</p> <p>In meeting its responsibilities, Airservices Australia:</p> <ul style="list-style-type: none"> • provides air traffic control management and related airside services to the aviation industry; • prepares and publishes noise abatement procedures; • determines aircraft flight paths and airport operating procedures; • publishes information on aircraft movements, runway and track usage and noise impacts using a range of noise descriptors; • handles aircraft noise complaints and inquiries (other than ground-based noise complaints which would be handled by the ALC); • operates flight and noise monitoring equipment in the vicinity of major airports and publishes results; and • reviews and endorses for technical accuracy the ANEF noise contours for airports.
<p>Australian Government: Aircraft Noise Ombudsman</p> <p>Conducts independent administrative reviews of Airservices Australia's management of aircraft noise-related activities.</p>	<p>The Aircraft Noise Ombudsman:</p> <ul style="list-style-type: none"> • reviews the handling of complaints or enquiries made to Airservices Australia and the Department of Defence (Defence); • reviews community consultation processes related to aircraft noise for Airservices Australia and Defence; and • reviews the presentation and distribution of aircraft noise-related information for Airservices Australia and Defence.
<p>Airport Lessee Company (ALC)</p> <p>This is the airport lessee and the operator of an airport.</p>	<p>The Airport Lessee Company's responsibilities include:</p> <ul style="list-style-type: none"> • managing operations at the airport and ensuring the effective delivery and coordination of airport-related services and facilities; • preparing an airport master plan, including publication of an ANEF and an environment strategy that identifies measures to manage noise impacts; • establishing procedures to control noise generated by engine ground running; • engaging with the community; and • managing ground-based noise complaints.

Organisation

Summary of responsibilities concerning the management of civil aircraft noise

Civil Aviation Safety Authority (CASA)

Under the *Civil Aviation Act 1988*, and subject to its primary responsibilities being to maintain, enhance and promote the safety of civil aviation, CASA must exercise its powers and perform its functions in a manner that ensures that, as far as is practicable, the environment is protected from the effects of, and the effects associated with, the operation and use of aircraft.

Through the Office of Airspace Regulation, CASA ensures that proposed changes to airspace adequately consider environmental implications.

Infrastructure Minister

The Minister and his or her Department are responsible for administering airports and aviation legislation and developing and implementing national aviation policy. Specific responsibilities relating to the management of aircraft overflight noise include:

- approving airport master plans in accordance with the *Airports Act 1996*;
- promoting policies and guidance material, such as the National Airports Safeguarding Framework, to support the implementation of best practice land use assessment and planning in the vicinity of airports (e.g. by ensuring due recognition is given to aircraft noise impacts in land use and related planning decisions);
- regulation of airport curfews at Sydney, Adelaide, Coolangatta and Essendon airports; and
- development of national airspace and air traffic management policies.

Airlines and aircraft operators

Airlines and aircraft operators are responsible for:

- maintaining aircraft fleets and engines that meet the ICAO and Australian standards; and
- implementing noise abatement principles for flight operations, where applicable.

Aircraft and engine manufacturers

Aircraft and engine manufacturers need to design and manufacture new aircraft that comply with ICAO certification standards.

State government and local councils

State governments and local councils regulate land use planning and development in the vicinity of airports.

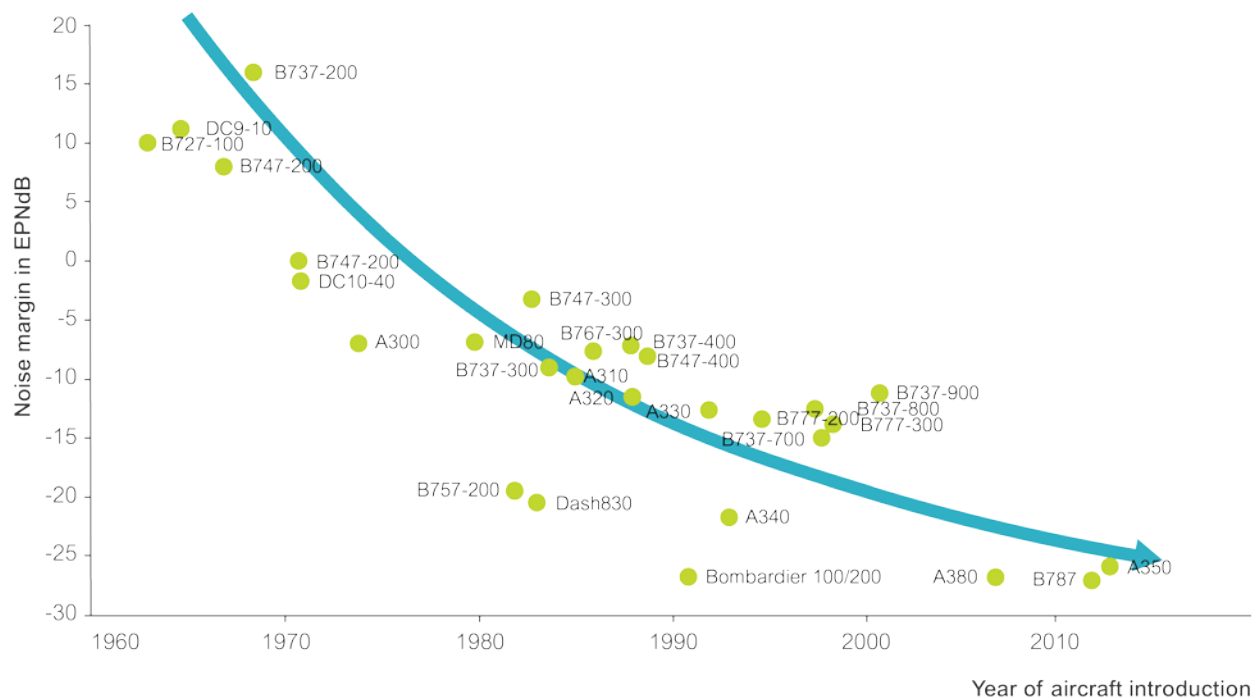
10.2.5 Aircraft noise emissions control

The International Civil Aviation Organization (ICAO) has responsibility for setting noise emissions standards for aircraft globally. The standards are contained in Annex 16, Volume 1 – Procedures for the Noise Certification of Aircraft which underpins the global effort by aircraft manufacturers to design quieter aircraft.

Aircraft operating in Australia must meet noise standards specified in the Air Navigation (Aircraft Noise) Regulations 1984. These regulations require aircraft to be verified as complying with noise standards established by ICAO. The regulations carry strict penalties for operating an aircraft without a noise certificate issued under ICAO standards. The regulations also provide for exceptional circumstances where dispensations may be applied for to enable limited operation of non-compliant aircraft. Dispensations will include conditions that are intended to mitigate the impact of aircraft noise on the community. These regulations ensure that aircraft using airports in Australia—including the proposed airport—whether in flight or on the ground are compliant with internationally accepted noise standards and practices.

Figure 10–4 shows how aircraft have become progressively quieter over the past several decades through the incorporation of new airframe technologies and engine innovations. In 2013, ICAO agreed that more stringent noise standards would apply to all new aircraft types over 55 tonnes in weight submitted for certification on or after 31 December 2017. The amendments include a new noise standard for jet and turboprop aircraft, which represents a reduction of 7 EPNdB¹ relative to the current Chapter 4 cumulative levels.

Despite the likely introduction of these next-generation aircraft in the future, the assessment of noise impacts in this EIS has been based on aircraft types that are commonplace today, including the louder Boeing 747 and the Airbus A320. The Boeing 747 is the loudest aircraft anticipated to operate at the proposed airport and airlines are already beginning to retire it from regular passenger services. The Airbus A320 is an example of a more common type of aircraft expected to operate at the proposed airport.



Source: Brisbane New Parallel Runway EIS, 2007, CANSO and ACI 2015. Composited by GHD 2016.

Note: Noise levels are relative to ICAO Chapter 3 which took effect in 1978.

Figure 10–4 Reduction in commercial aircraft noise over time

¹ EPNdB, or Effective Perceived Noise level in decibels, is used for the certification of aircraft according to ICAO procedures. It is a measure of human annoyance to aircraft noise that takes into account the special spectral characteristics, intensity, tonal content and duration of noise from an aircraft pass-by event. EPNdB values cannot be directly measured. They are calculated using noise monitoring data recorded at certification points that account for different phases of an aircraft movement (e.g. approach and flyover on departure) and the lateral spread of noise.

10.3 Airport operations

10.3.1 Indicative flight paths

Airservices Australia undertook a preliminary assessment of airspace implications and air traffic management arrangements for Sydney region airspace associated with the potential commencement of operations at the proposed airport (see Chapter 7 (Volume 1)). This assessment of aircraft overflight noise is based on indicative flight paths prepared by Airservices Australia. As discussed in Chapter 7 (Volume 1) of this EIS, it is expected that a detailed airspace design process will be undertaken closer to the commencement of operations at the proposed airport.

The principal objective of Airservices Australia's preliminary assessment was to establish whether safe and efficient operations could be introduced at the proposed airport through developing indicative proof-of-concept flight paths. The assessment confirms the basic viability of the proposed airport for both single and parallel runway operations, and shows that the proposed Stage 1 development and Sydney (Kingsford Smith) Airport could safely operate independently as high capacity airports. This ensures the selection of runways or operating modes at one airport can be made to suit local conditions without considering the operating mode at the other. While the indicative flight paths provide a reasonable and contemporary basis for assessing the potential extent and intensity of impacts associated with aircraft operations at the proposed airport, the conceptual and preliminary airspace design illustrated in this EIS has not been developed to a level of detail necessary for implementation. New flight paths can only be implemented following further analysis, including detailed consideration of potential noise abatement opportunities and extensive community consultation, and final approval by CASA. The process for developing final flight paths, which would commence after determination of the Airport Plan by the Infrastructure Minister, is explained in Chapter 7 (Volume 1).

10.3.2 Operating strategies

Assessment of aircraft overflight noise for the proposed Stage 1 development focuses on the point at which passenger demand reaches approximately 10 million annual passenger movements and related freight movements (referred to as 'Stage 1 operations'). This level of demand is expected to occur around five years after the proposed airport commences operations. At this stage, the airport would comprise a single (northern) runway.

The approximate north-east/south-west or 050/230 degree runway orientation resulted in three primary operating modes being considered:

- Mode 05 – aircraft arrive from the south-west and depart to the north-east;
- Mode 23 – aircraft arrive from the north-east and depart to the south-west; and
- Head-to-head² – all landings and take-off movements occur in opposing directions, to and from the south-west.

² The feasibility of head-to-head operations would be established as part of the detailed design of air traffic procedures for the proposed airport. The conditions applying to this mode of operation assumed in the noise modelling are based on similar conditions adopted at other airports where head-to-head operations are used.

The availability of each operating mode (described in greater detail in Chapter 7 (Volume 1)) at any given time would depend on meteorological conditions, particularly wind direction and speed, the number of presenting aircraft and the time of day. Due to the relatively low and consistent wind speeds at the airport site, it is likely that either the 05 operating mode or 23 operating mode could be used over 80 per cent of the time based solely on these factors. However, the selection of a preferred or priority operating mode, or a preferred combination of operating modes (i.e. preferred operating strategy), for noise management or other operational purposes has a notable effect on the overall noise impact of the airport. In this context, the preferred operating strategies that were considered as part of the noise impact assessment are as follows:

- Prefer 05 strategy – all aircraft would be directed to approach and land from the south-west and take-off to the north-east. If this is not possible for meteorological or operating policy reasons, then second priority would be given to operations in the opposite direction (i.e. the 23 direction).
- Prefer 23 strategy – all aircraft would be directed to approach and land from the north-east and take-off to the south-west. If this is not possible for meteorological or operating policy reasons, then second priority would be given to operations in the opposite direction (i.e. the 05 direction).
- Prefer 05 strategy with head-to-head – as per Prefer 05, except that during the night time period between 10.00 pm and 7.00 am, the head-to-head operating mode to the south-west would be used when:
 - there are no more than a total of 20 aircraft movements expected in the hour following the relevant time; and
 - wind conditions allow the use of both runway directions.
- Prefer 23 strategy with head-to-head – as per Prefer 05 with head-to-head, except that when the head-to-head operating mode is not in use, Prefer 23 applies rather than Prefer 05.
- If either the Prefer 05 or Prefer 23 operating strategy is in use during the night time period, the operating mode would revert to head-to-head under the following conditions:
 - the use of head-to-head has been allowed for at least two hours before the change time; and
 - the use of head-to-head would be allowed for at least two hours after the change time.

10.3.3 Hours of operation

As the airport is proposed to operate on a curfew-free basis, the assessment of overflight noise considers the operation of the proposed airport over a range of timeframes, including a full operating day (24-hours) and night time hours (10.00 pm–7.00 am). This range of timeframes has been adopted to capture the range of potential noise impacts at sensitive receivers and on particular activities (including the potential for sleep disturbance).

These timeframes are considered in conjunction with the various operating modes discussed in Section 10.3.2 to capture a wide range of potential conditions. The effect of seasonality is also considered as part of the technical paper presented in Appendix E1 (Volume 4). Minimal variation in noise impacts between summer and winter seasons was evident from this analysis.

10.4 Methodology

10.4.1 Assessing aircraft overflight noise

The impact of aircraft noise is dependent on a number of factors, of which four key variables are:

- aircraft noise levels;
- frequency of occurrence;
- duration of each event; and
- the character of aircraft noise (i.e. low frequency rumble, etc.).

A number of different noise measures referenced in Australian Standard 2021:2015 – *Acoustics—Aircraft noise intrusion—Building siting and construction* (AS 2021) and the *National Airports Safeguarding Framework* (NASF) have been used in this EIS. Each measure has different purposes and may include some or all of the above factors. Consistent with best practice communication of aircraft noise impacts, it is important to describe noise using a range of descriptors and to understand the differences in the outputs produced. Table 10–2 summarises each of the measures used in this EIS and how they combine each of the four key aircraft noise variables listed above. A more detailed explanation of each measure is provided below the table.

Table 10–2 Key attributes of noise measures used in this EIS

Noise measure	Aircraft noise levels	Number of events	Duration of events	Aircraft noise character
ANEF/ANEC	Yes, this variable is included in calculating ANEF/ANEC values but this information is not discernible from the output.	Yes, this variable is included within the calculations but this information is not discernible from the output.	Yes, this is included within the calculations but this information is not discernible from the output.	Yes, ANEF/ANEC is based on the Effective Perceived Noise Level (EPNL), which includes modification for noise tonal characteristics.
N70/60	Partially – this is included in the calculations but noise level information is grouped within bands and areas exposed to higher noise levels are not readily discernible.	Yes this information is illustrated in contours of equal numbers of noise events.	No	No
Single event or maximum noise level (L_{Amax})	Yes, the output indicates the maximum noise level from a single (chosen) aircraft type.	No	No	No

10.4.1.1 ANEF and ANEC

For land use planning around airports, Australia has adopted the Australian Noise Exposure Forecast (ANEF) system, which describes cumulative aircraft noise for an ‘average annual day’. The ANEF system was developed on the basis of social survey data which aimed to correlate aircraft noise exposure with community reaction in residential areas. The ANEF system is useful for controlling new noise sensitive developments near airports. It is not intended to present information about the nature or potential impact of aircraft noise the community may experience on a day-to-day basis.

An “ANEF chart” is a set of noise exposure contours for an airport that has been formally endorsed for technical accuracy by Airservices Australia. The Airports Act requires all major airports to produce an ANEF chart for inclusion in their airport master plan.

An Australian Noise Exposure Concept (ANEC) is a noise exposure chart produced for a hypothetical future airport usage pattern, and is useful for considering the land use planning consequences of alternative operating strategies. ANEC noise exposure contours are calculated using the same methods as the ANEF; however, they use indicative data on aircraft types, aircraft operations and flight paths. They are generally used in environmental assessments to depict and compare noise exposure levels for different flight path options.

AS2021 contains advice on the acceptability of building sites based on ANEF zones. The acceptability criteria vary depending on the type of land use as shown in Table 10–3. An aircraft noise exposure level of less than 20 ANEF is considered acceptable for the building of new residential dwellings.

Table 10–3 Building site acceptability based on ANEF zone (AS 2021)

Building Type	ANEF zone of site		
	Acceptable	Conditionally acceptable	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
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	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		

This EIS has calculated ANECs to describe specific elements of aircraft noise and to allow comparison with ANECs produced for previous environmental assessments for an airport at Badgerys Creek. It is important to note that areas within the 20 ANEF/ANEC contours do not represent the only areas in which aircraft noise may be experienced or that residents outside of these contours will not be annoyed by aircraft noise. Some individuals may be relatively unaffected by noise within the highest ANEF/ANEC contour zones, while others may be seriously affected by relatively low levels of noise in areas outside the lowest depicted contours.

A series of ANECs³ was developed for the 1985 *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* (1985 Draft EIS) (Kinhill Stearns 1985). These contours have guided subsequent planning controls implemented by the NSW Government and relevant local councils in the vicinity of the airport site.

Planning controls that are implemented based on an ANEF typically serve to limit the types of development permitted to occur within particular noise exposure zones.

The key planning decision made subsequent to the 1985 Draft EIS is the ministerial direction under section 117(2) of the *Environmental Planning and Assessment Act 1979* (NSW). The direction applies to all land within the 20 ANEF contour in the local government areas of Fairfield, Liverpool, Penrith and Wollondilly and requires that planning instruments do not contain provisions enabling development that could hinder the potential for development of a second Sydney Airport. The direction has subsequently been given effect through the *Penrith Local Environmental Plan 2010* and *Liverpool Local Environmental Plan 2008*, with the inclusion of provisions aimed at preserving noise related buffers around the airport site (see Chapter 21). This has resulted in limited noise sensitive development around the airport site.

It is expected that a formal ANEF would be produced and endorsed by Airservices Australia prior to the commencement of operations at the proposed airport, as described in Chapter 7 (Volume 1).

While useful for land use planning purposes, there are limitations in using the ANEF system as an accurate or reliable predictor of community reaction to aircraft noise or of impacts on people as individuals. Data produced by the ANEF system have also been shown to be difficult for people to interpret. This is largely because these data represent cumulative noise exposure levels for an 'average annual day' and do not reflect how people experience noise events in their day to day lives. Also, this approach does not generally portray variations in patterns of noise exposure (e.g. from day to day, season to season or at different times of the day).

In isolation, ANEF/ANEC data do not enable people potentially exposed to aircraft noise to make a reasoned judgement on whether the predicted level of noise would be acceptable to them, particularly in an environment of changing noise exposure (DASETT 1991) or where the number of aircraft movements changes substantially over a period. Accordingly, this EIS presents updated and long term ANEC contours for the purpose of showing those areas around the airport site potentially subject to future aircraft noise-related planning controls, which are currently based on 30-year old predictions of aircraft noise exposure.

10.4.1.2 'Number Above' measures

Noise measures based on the intensity and frequency of individual aircraft noise events provide a more realistic and effective way of conveying information to the public about aircraft noise impacts. These measures potentially offer a more easily interpreted measure of noise impact compared to cumulative measures such as the ANEC/ANEF, for example, as indicators of disturbance to communication, sleep and every-day activities such as listening to the television or the radio. Interruption to these types of activities represents some of the most common causes of annoyance from aircraft noise (Environment Australia 1999). Measures that more explicitly portray the number of aircraft movements may also be more effective for communicating aircraft noise impact as over time individual aircraft events have become quieter but the frequency of movements has increased.

³ The 1985 EIS included a scenario-based noise exposure chart in the form of an "ANEF", which we would today term an "ANEC".

‘Number Above’ (NXX) measures indicate the average number of aircraft overflights per day (or other nominated time period) exceeding a specified noise level (XX dBA). The N70 and N60 measures are commonly used in environmental impact assessments to better inform strategic planning and provide more comprehensive and understandable information on aircraft noise for communities.

- N70 – this is the average number of aircraft noise events per day with maximum noise levels exceeding 70 dBA. A noise level of 70 dBA outside a building would generally result in an internal noise level of approximately 60 dBA, i.e. a reduction of 10 dBA if windows are partly open. This noise level is sufficient to disturb conversation, such that a speaker would generally need to raise their voice to be understood or some words may be missed in speech from a television or radio. If windows are closed, an external noise of 70 dBA would result in an internal noise level of approximately 50 dBA; and
- N60 – this is the average number of aircraft noise events with maximum noise levels exceeding 60 dBA during the night-time period 10:00 pm – 7:00 am. An external noise level of 60 dBA approximates an internal level of 50 dBA if windows are partly open or 40 dBA if windows are closed. An internal noise level of 50 dBA is commonly used as a design criterion for noise in a bedroom, to protect against sleep disturbance. An outdoor noise criterion of 60 dBA is also considered appropriate for recreation areas, both passive and active, on the basis that at this level, a person may need to raise their voice to be properly heard in conversations.

Standard calculations of N70 and N60 represent an average over all days (or all days in a specified season or period), and may not provide a representative measure if the number of events above 70 dBA or 60 dBA varies significantly between days. To overcome this potential shortcoming, this EIS has also calculated modified N70 and N60 values (known as 90th percentile N70s and N60s) to identify the upper range of aircraft movements likely to be experienced. The 90th percentile is a statistical category representing noise values that would be exceeded on only 10 per cent of days. Accordingly, the 90th percentile N70 and N60 values represent days where there would be a particularly high number of aircraft movements and may therefore be likened to a near worst case scenario compared to the standard ‘average’ N70 or N60.

While ‘Number Above’ data show the number of events that are predicted to exceed a certain noise level at a given location, they do not show the intensity of noise to be experienced at that location from individual flyovers. That is, two different locations having the same N70 value may be exposed to different noise exposure levels (e.g. one location may generally experience noise levels in the 70 dBA to 75 dBA range, while another location closer to an airport may generally experience the same number of events but at a noise level of between 80 dBA to 85 dBA). Also, experience at other airports has shown that a large number or concentration of low noise events may result in similar levels of annoyance as a small number of high noise events.

10.4.1.3 Single event or maximum noise level

L_{Amax} is the maximum A-weighted noise level predicted or recorded over a period. In this assessment, L_{Amax} denotes the maximum level of noise predicted at a location during a single overflight from a particular aircraft occurring at any time.

10.4.1.4 *Population exposure estimates*

An estimate of the population likely to be exposed to particular levels of noise—based on the N70 and N60 measures—has also been calculated to show differences resulting from the use of different runway operating strategies, e.g. Prefer 05 and Prefer 23. These estimates show the number of noise events that a proportion of the total future forecast population are predicted to experience.

Existing and forecast population estimates were developed based on the September 2014 release of the NSW Bureau of Transport Statistics population forecasts. These forecasts take into account metropolitan planning development forecasts for future land use in Sydney as well as NSW Department of Planning and Environment population forecasts. The limit of these forecasts is currently 2041; therefore, in order to project to 2063 and beyond, Series B population growth rate estimates used by the Australian Bureau of Statistics in their long term population forecasts were applied.

GIS databases based on the above population forecasts and address point data provided by NSW Land and Property Information were assembled and used to estimate the future population location and distribution. The address point dataset provided a set of GIS coordinates for each registered address point within the data area and was used to represent the spatial distribution of the existing population. The address point data were then divided into subareas based on statistical local area (SLA) boundaries developed for the Census. By matching the population estimates and address points to a common SLA, an estimated population per SLA and average population per address point were calculated.

The noise contours generated by the noise studies were then overlaid with the address point dataset for each forecast year to enable a count of future population potentially affected by each airport operational scenario.

10.4.2 *Aircraft overflight noise modelling*

The modelling of aircraft overflight noise uses information and projections from a number of sources, including projected air traffic volumes, aircraft flight paths, airport operating modes, assumed fleet mix and scheduling, noise emissions from representative aircraft types, and predicted future population densities in areas around the airport. A summary of the modelling process is described below and shown in Figure 10–5. Full details of the noise assessment methodology are included in Chapter 2 of Appendix E1 (Volume 4).

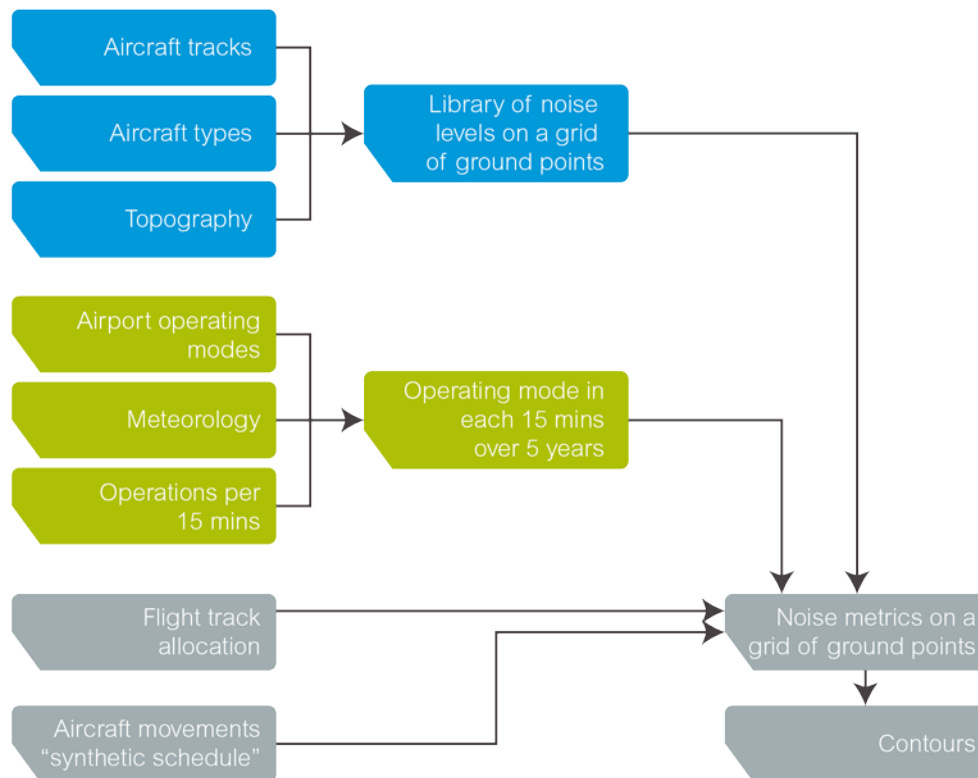


Figure 10–5 Noise modelling process

The Integrated Noise Model (INM) aircraft noise prediction software, produced by the US Federal Aviation Administration, was used to predict noise levels from each of the 22 aircraft types on the 245 indicative flight paths for Stage 1 operations. The model includes aircraft overflight noise together with departure noise, landing and reverse thrust noise when the aircraft is on the runway.

Predicted future numbers of aircraft movements (one movement consists of an aircraft either taking off or landing) were in the form of ‘synthetic schedules’ which detail a list of aircraft operations for a typical busy day⁴, including aircraft family, operation type (arrival or departure), time of operation and port of origin or destination for each operation.

Predicted total daily aircraft movements for Stage 1 operations (see Section 2.5 in Appendix E1 (Volume 4)) are summarised in Table 10–4 and the predicted number of movements for each hour of the day is shown in Figure 10–6.

⁴ The proposed Stage 1 airport development assumes 63,000 aircraft movements per year, which equates to about 173 aircraft movements per day. The synthetic schedule used as a basis for all noise modelling assumes that 198 aircraft movements would occur at the proposed airport each day. The aircraft traffic levels used in the noise modelling are therefore representative of those expected on a ‘typical busy day’. This provides some conservatism in estimates of noise exposure. For simplicity, these ‘conservative’ noise exposure outcomes are referred to as ‘average’ outcomes throughout this assessment.

Table 10–4 Predicted daily aircraft movements for Stage 1 operations by aircraft family

Aircraft	Daily movements
<i>Passenger Movements</i>	
Airbus A320	100
Airbus A330	18
Airbus A380	–
Boeing 737	28
Boeing wide-body general	–
Boeing 777	4
DeHaviland DHC8	8
Saab 340	12
<i>Freight Movements</i>	
Airbus A330	2
Boeing 737	2
Boeing 747	10
Boeing 767	4
Boeing 777-300	–
Small Freight	10

The aircraft types shown in Table 10–4 were used to calculate noise exposure levels in the noise modelling software. The use of these representative aircraft types is considered to be a conservative assumption as aircraft are predicted to become progressively quieter with the introduction of new models into service over time.

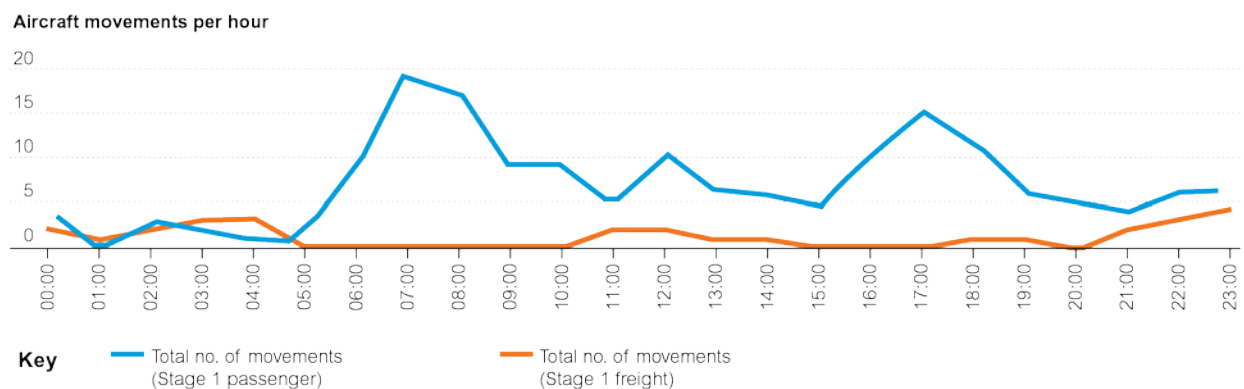


Figure 10–6 Predicted aircraft movements per hour for Stage 1 operations

An airport operating mode was assigned for each 15-minute period over the five years covered by the meteorological data, using the rules for operating mode selection described in Section 10.3.2. Aircraft operations occurring in that 15-minute period (taken from the synthetic schedule) were then assigned to flight paths according to meteorological conditions, visual or instrument landing conditions (for arrivals), aircraft type (e.g. assignment of only turboprop aircraft to certain flight paths) and the direction of the destination airport (for departures).

Arrival flight paths were assumed to follow a 'point merge' configuration where all aircraft approaching the airport pass over a single point to the north of the airport then move to a final approach in either of the two runway directions (see Chapter 7 (Volume 1)).

The Point Merge system is a way of synchronising arriving aircraft and directing them to the runway in a structured manner. By directing aircraft through a series of predictable routes, the vertical and lateral path taken on approach is more accurate and can result in a reduction of the number of level flight segments required during descent. The system may help to reduce fuel consumption, emissions and noise impacts, as it allows for a continuous descent profile and therefore limits use of engine power settings above idle. Figure 10–7 illustrates the zone of potential noise benefit from a continuous descent approach. The concept of a continuous descent approach and Point Merge system is explained in further detail in Chapter 7 (Volume 1).

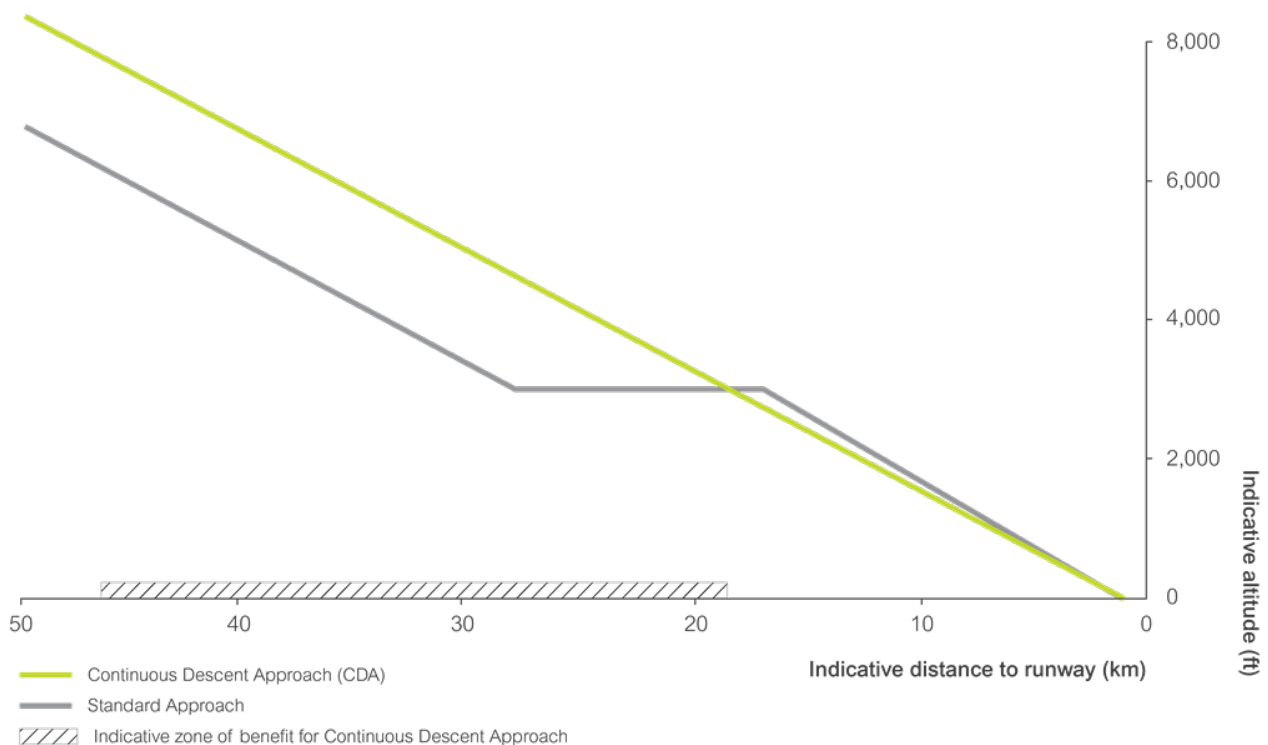


Figure 10–7 Concept diagram of continuous descent approach showing zone of noise benefit

For each aircraft type, flight path and possible stage length (a measure of distance to destination for departing aircraft), specialist software was used to calculate noise levels at each point on a 185 x 185 metre grid, covering the assessment area. Maximum noise levels for every aircraft movement within this assessment area were used to form the 'library of noise levels' shown in Figure 10–5.

For N70 and similar units, this library was used to determine the number of events at each grid point exceeding the relevant L_{Amax} threshold, and the results used to produce contours.

10.5 Assessment of aircraft noise impacts

10.5.1 Sensitive receivers

Aircraft noise would be experienced across a broad area of Western Sydney as a result of aircraft arrival and departures at the proposed airport. Noise contour maps have been produced at a range of scales which represent the geographic extent of exposure for each noise assessment measure adopted as part of the analysis. For example, maximum noise levels during a single overflight from a particular aircraft have the widest potential geographic exposure and have therefore been mapped at a relatively small scale. “Number above” measures affect a comparatively smaller geographic area and therefore the noise contours have been presented on maps with a larger scale and show more detailed information.

Sensitive receivers located in proximity to the airport would generally be exposed to higher levels of aircraft noise. Maximum single event noise contours have therefore also been produced at a meso scale (zoomed in) to provide higher resolution mapping of noise exposure near to the airport site.

Noise-sensitive receivers in the area surrounding the proposed airport are represented in Figure 10–8. Noise sensitive receivers include residences, recreational areas, schools and other educational facilities, hospitals and other health care facilities. The noise assessment has primarily focussed upon the size of the affected population for each noise assessment measure and the impact upon surrounding recreational areas. More detailed consideration of impacts on individuals and to other potentially affected sensitive receivers such as schools and hospitals is provided in the community health and social assessments (Chapter 13 and Chapter 23 respectively) of this EIS. Consideration of potential impacts on the Greater Blue Mountains World Heritage Area is presented in Chapter 26.

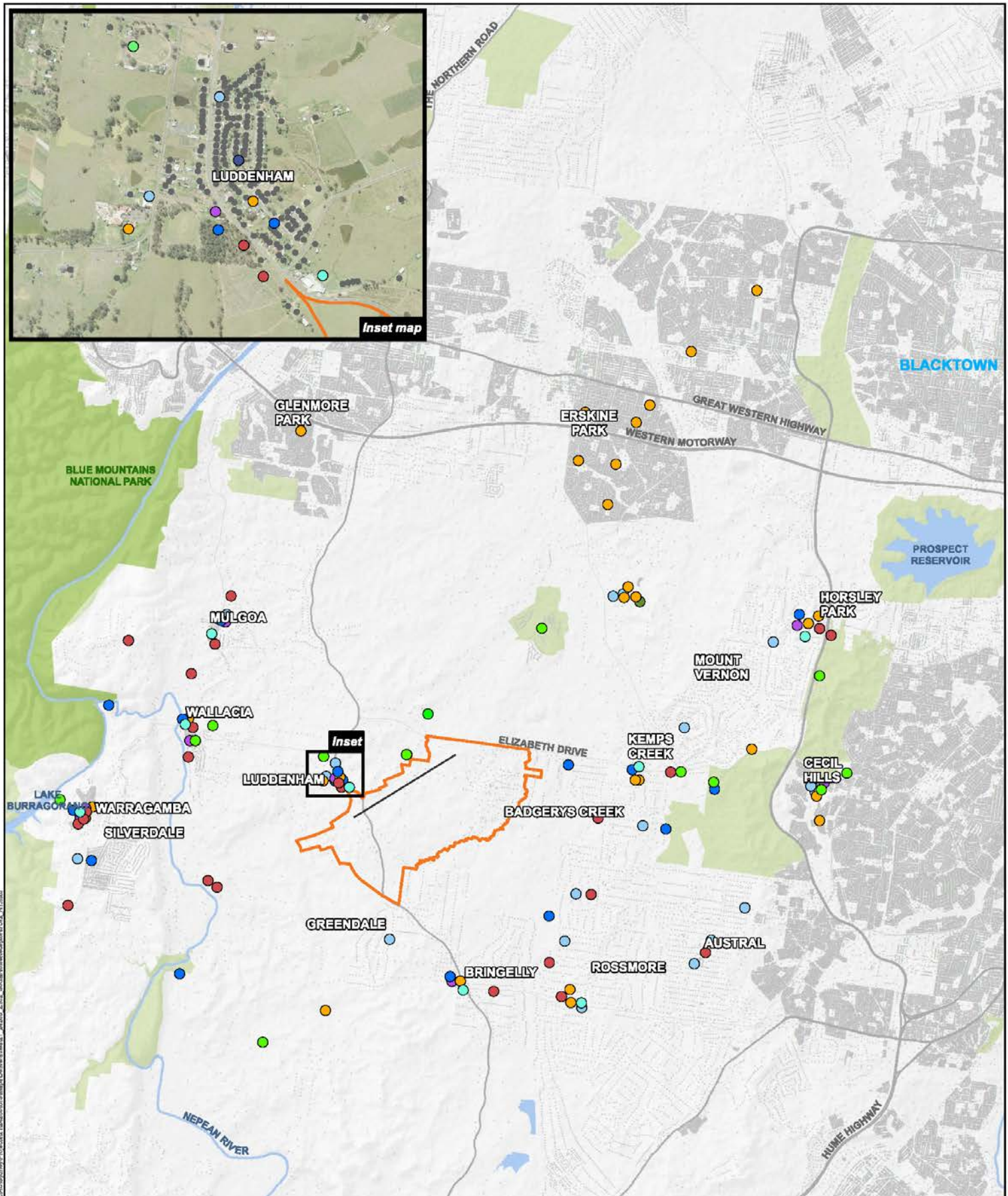


Figure 10-8 - Sensitive Receivers surrounding the airport site

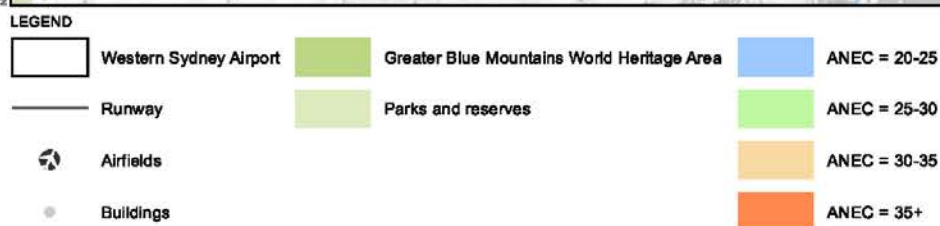
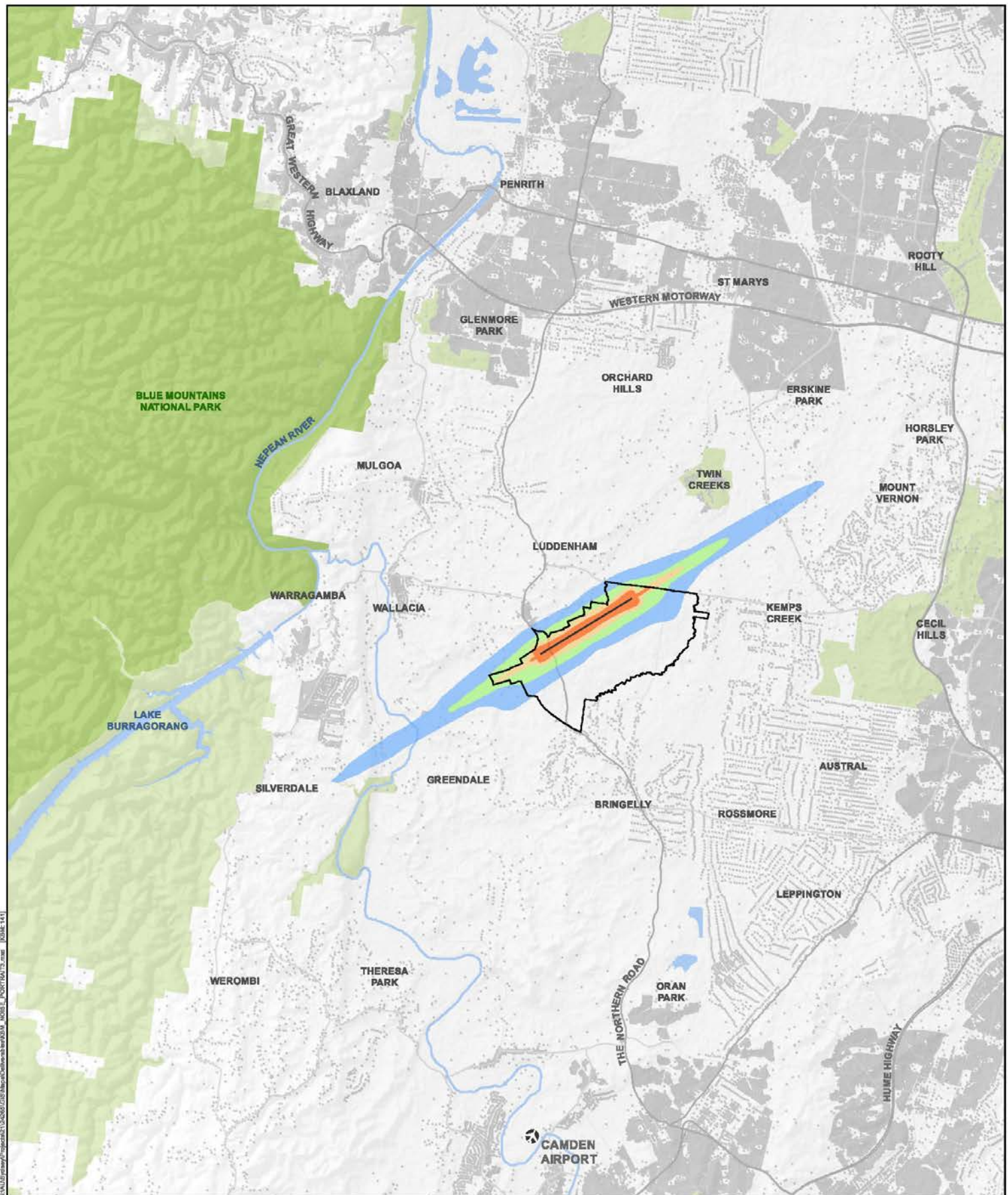
10.5.2 Land use planning implications

ANEC contours have been developed based on indicative flight paths and operating strategies to provide an indication of the likely acceptability of building types based upon AS 2021. An endorsed ANEF noise exposure chart would be produced prior to commencement of operations at the proposed airport. Figure 10–9 shows the Stage 1 operations ANEC contours for the combined Prefer 05 and Prefer 23 operating strategies.

Figure 10–10 shows the combined ANEC 20 contour for Stage 1 operations compared to the ANEC 20 contour presented in the 1985 Draft EIS (Kinhill Stearns 1985). The 1985 ANECs were prepared for a dual runway airport and have been used for land use planning purposes to date.

These figures show that the new 2030 ANEC contour is generally less extensive than that developed for the 1985 Draft EIS (Kinhill Stearns 1985). It is important to note that the ANEC contours for the proposed Stage 1 development are not intended to guide future land use planning and are provided primarily for comparative purposes and to provide information about predicted noise exposure. It is intended that any change to current land use planning instruments would be based on longer term forecasts of noise exposure and the final airspace design.

While there are differences between the Prefer 05 and Prefer 23 operating strategies, the introduction of head-to-head operations at night does not greatly influence the contours (see Section 3.6 of Appendix E1 (Volume 4)). This is because even with the additional 6 dBA weighting for night time noise events included in the ANEF formula, overall noise exposure is still dominated by daytime events.



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 10-9 - Stage 1 combined ANEC contours – Prefer 05 and Prefer 23 operating strategies



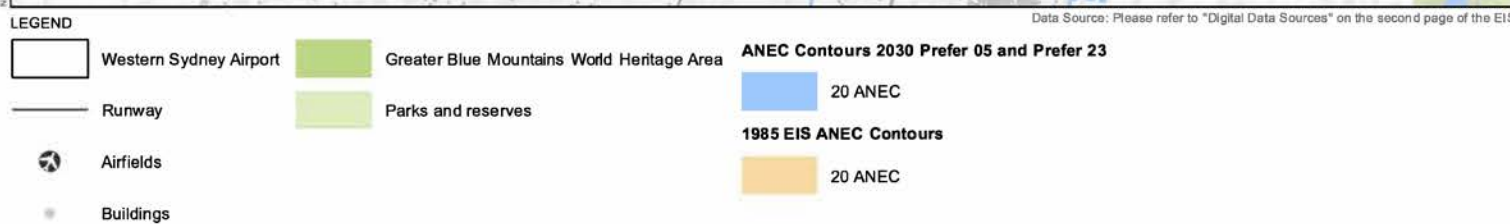
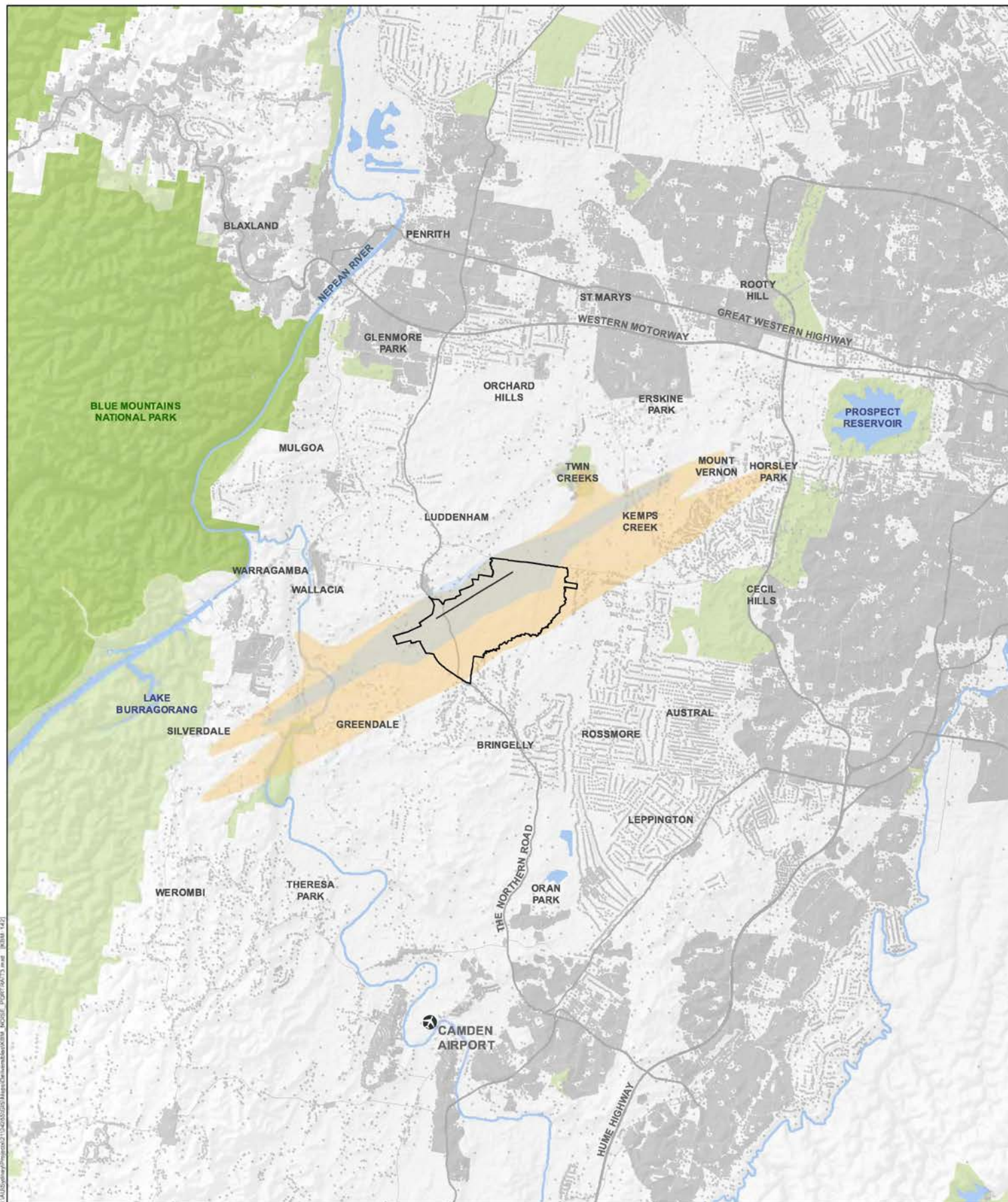


Figure 10-10 1985 ANEC 20 contour compared to Stage 1 operations combined Prefer 05 and 23 ANEC 20 contour

10.5.3 Single event or maximum noise levels

Single-event noise contours depict the maximum (L_{Amax}) noise levels resulting from a single operation of a specific aircraft type on all applicable arrival or departure flight paths.

In the Integrated Noise Model, each aircraft departure is assigned a 'stage length', which represents the distance to the aircraft's destination. Stage 1 is the shortest stage with a destination distance of at least 1,500 nautical miles, while stage 9 is the longest with a destination distance of over 6,500 nautical miles. Aircraft flying greater distances require higher fuel loads and this additional weight at take-off, and its effect on aircraft performance, is taken into account in calculating noise exposure levels.

Figure 10–11 shows single-event L_{Amax} noise level contours for the loudest noise event predicted to occur at the proposed airport under this assessment scenario – a B747 departure with stage length 5, corresponding to a departure for Singapore. These events are predicted to occur once per day on average, on any of a number of flight paths. Although contours are shown for these events on paths heading south from the airport, it is very unlikely that a stage 5 departure would occur on these paths.

At the most-affected locations close to the airport, L_{Amax} noise levels from these events would be in the range of 80 to 90 dBA. This is clearly demonstrated in Figure 10–12, a meso scale (zoomed in) version of the single-event L_{Amax} noise level contours for a B747 departure with stage length 5. There are less than 10 existing residences within the 85 dBA L_{Amax} contour for these events, located to the south-west of the proposed airport. When these events occur on the flight path leading north in the 05 operating mode (i.e. departures to the north-east), L_{Amax} noise levels exceeding 70 dBA are predicted over more densely-populated areas around St Marys, with levels above 75 dBA predicted in some parts of Erskine Park.

Figure 10–13 shows L_{Amax} noise levels from a B747 arrival on any flight path. In this case, noise levels of 60 to 70 dBA could be expected over sections of Erskine Park and St Marys, extending to parts of Blacktown as shown at a meso scale in Figure 10–14. Noise levels from this event would also reach 60 dBA in parts of the lower Blue Mountains. In 2030, there are predicted to be five such arrivals per day.

Figure 10–15 to Figure 10–17 show L_{Amax} noise levels for much more common events – departures (stage 4 and stage 1) and arrivals by A320 and similar aircraft types. Stage 3 or 4 departures by A320 aircraft (on any flight path) are predicted to occur 12 times per day for Stage 1 operations. When these events occur to the north in the 05 operating mode, maximum noise levels in parts of St Marys would be up to 64 dBA. For stage 1 or 2 departures (for example, to Brisbane or Melbourne), the maximum noise level over built-up areas is not predicted to exceed 60 dBA.

Arrivals by A320 aircraft, when they occur in the 23 operating mode—from the north-east—are predicted to produce L_{Amax} noise levels exceeding 60 dBA over areas between Erskine Park, St Marys and Blacktown. A320 arrivals in the 05 operating mode—from the south-west—would produce L_{Amax} levels exceeding 60 dBA over limited areas in the Blue Mountains National Park and Greater Blue Mountains World Heritage Area.

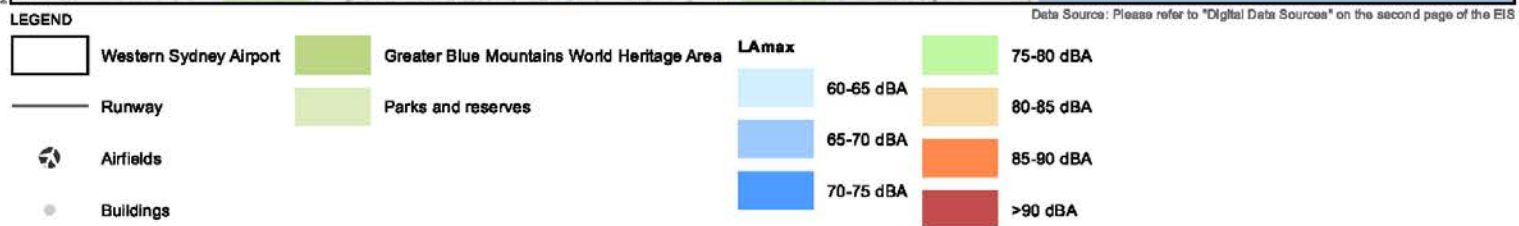
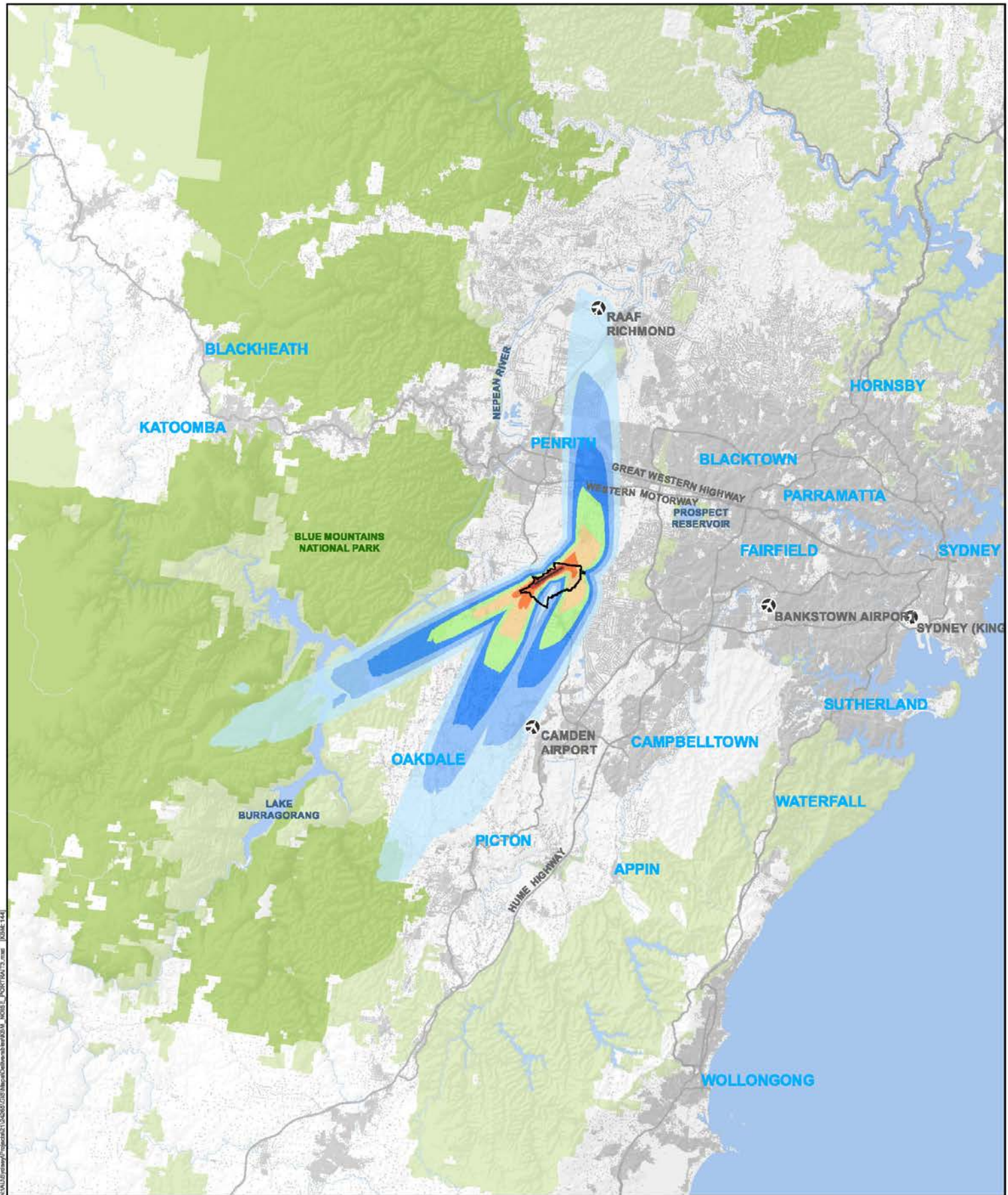
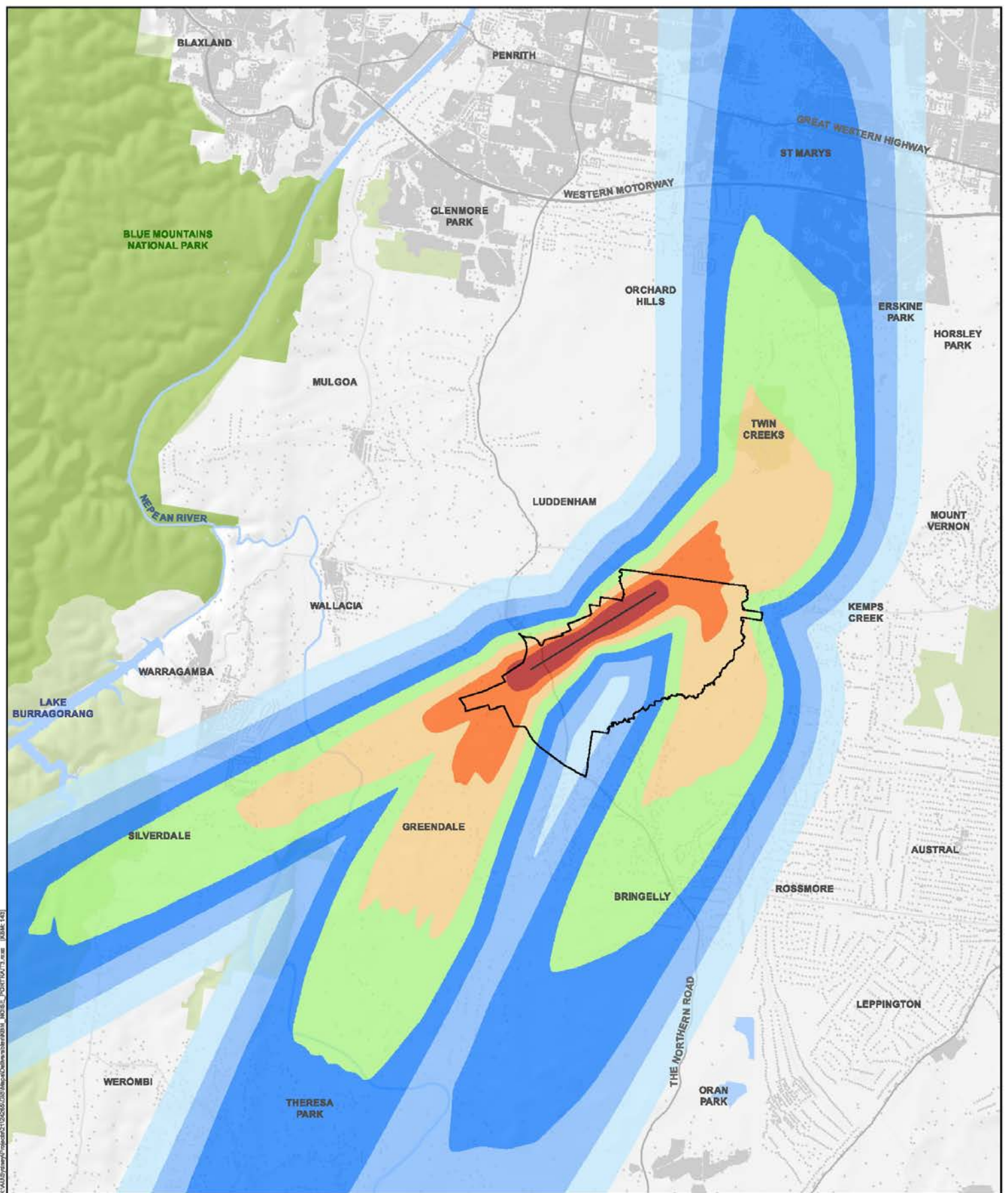


Figure 10-11 - Single event B747 departure - stage 5 - on all flight paths





Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 10-12 - Single event B747 departure - stage 5 - on all flight paths (meso scale)

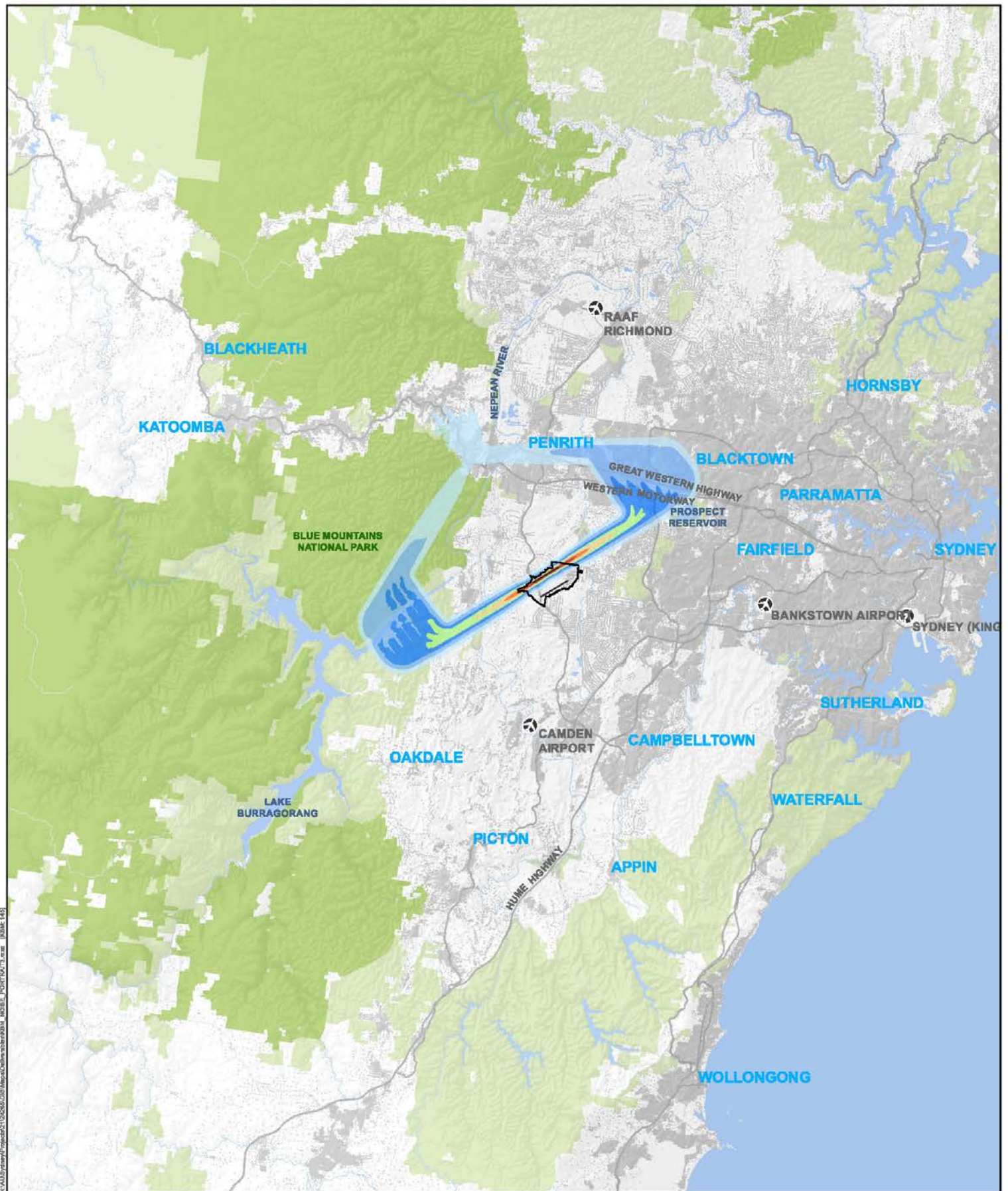


Figure 10-13 Single event B747 arrival on all flight paths

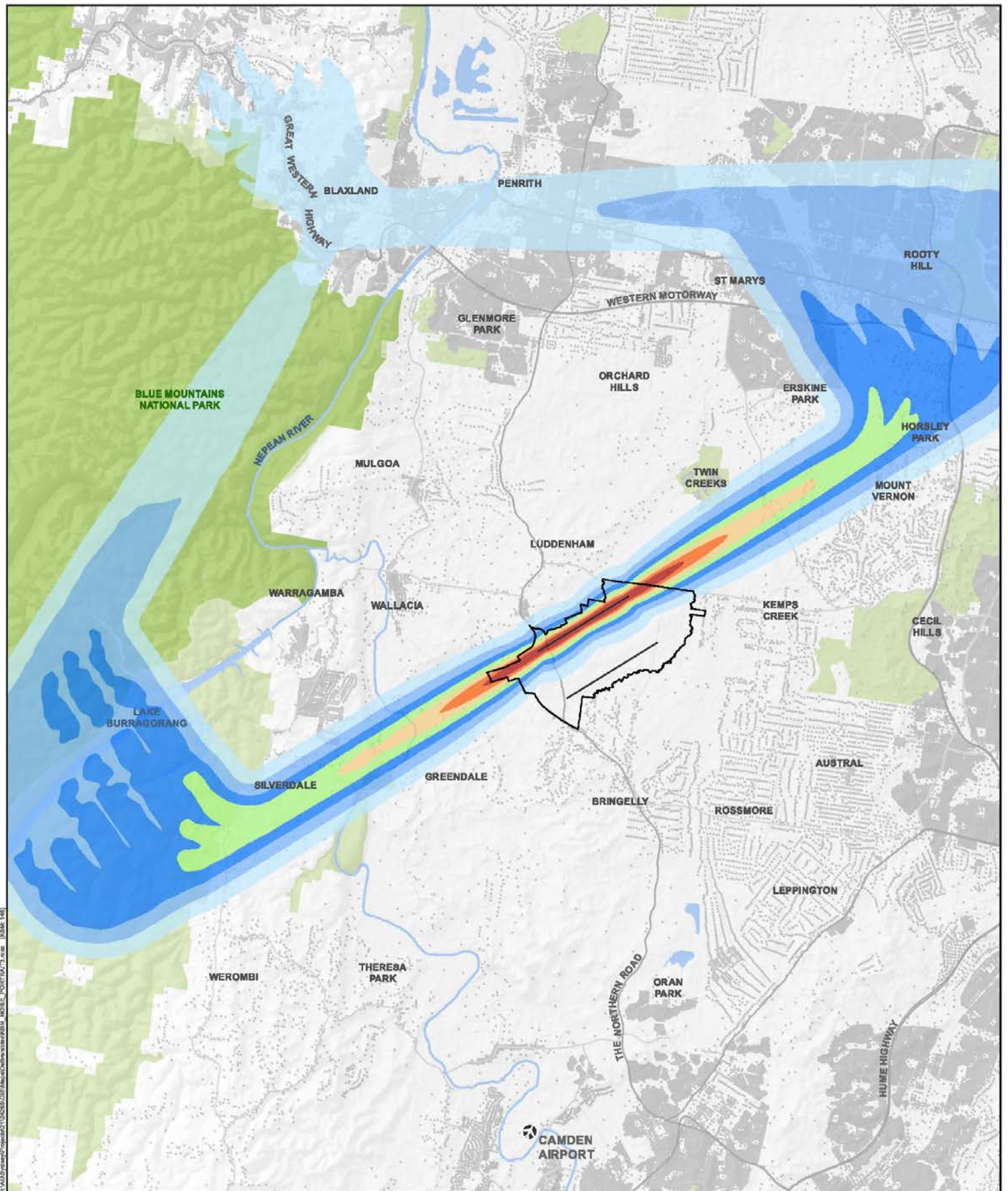


Figure 10-14 Single event B747 arrival on all flight paths (meso scale)



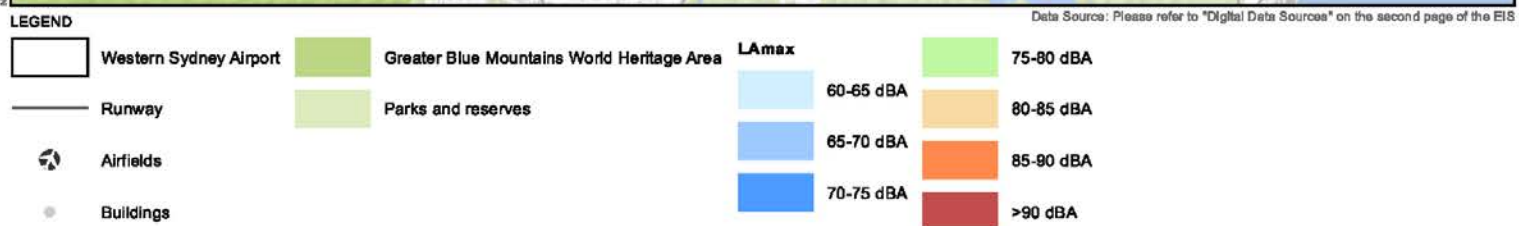
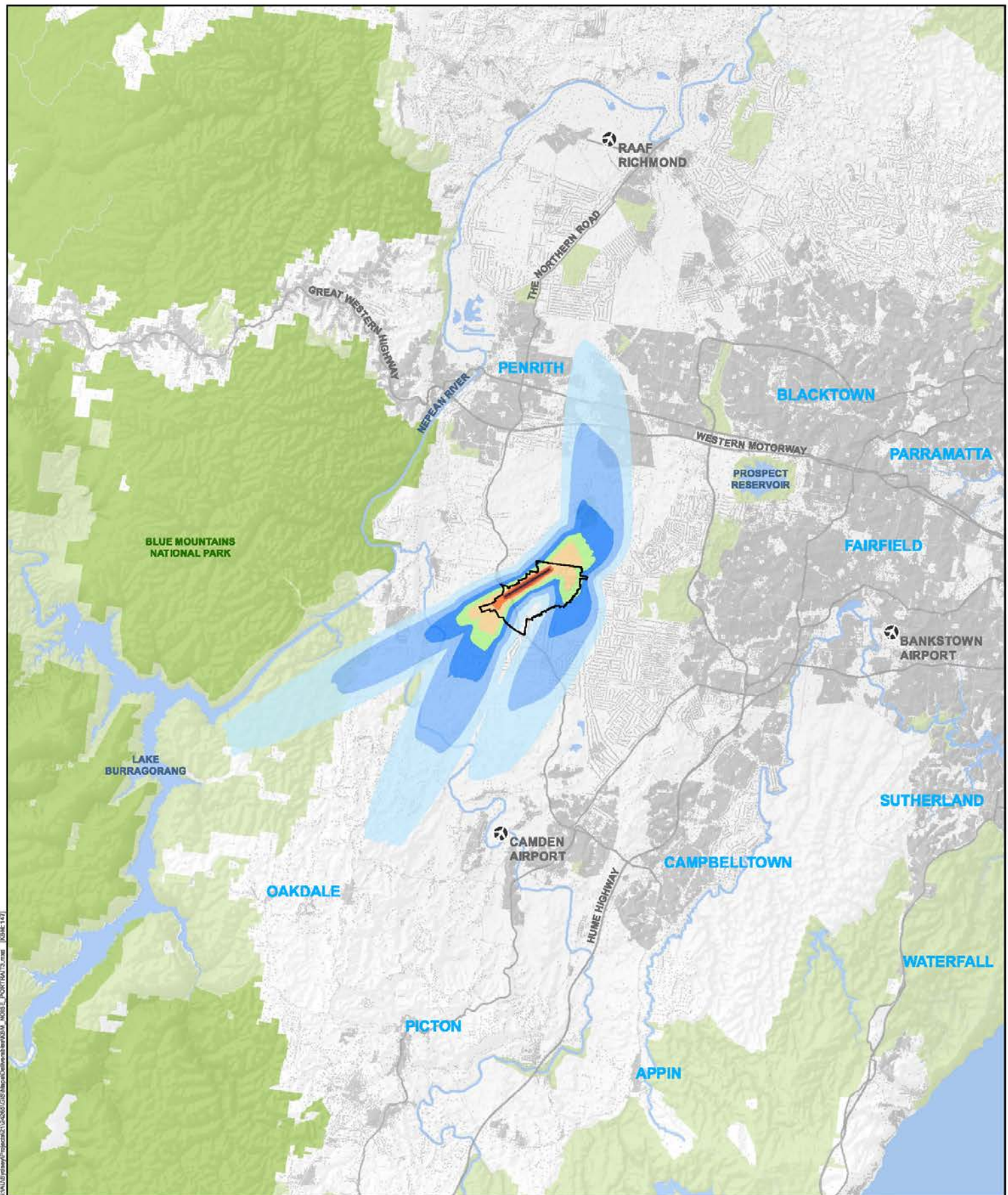


Figure 10-15 - Single event A320 departure - stage 4 - on all flight paths

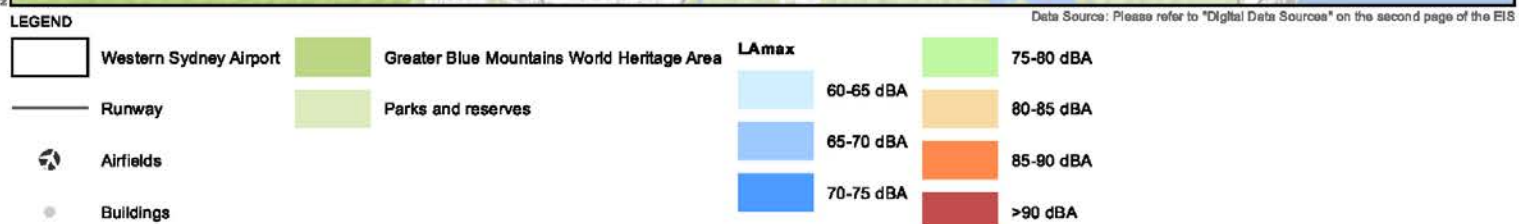
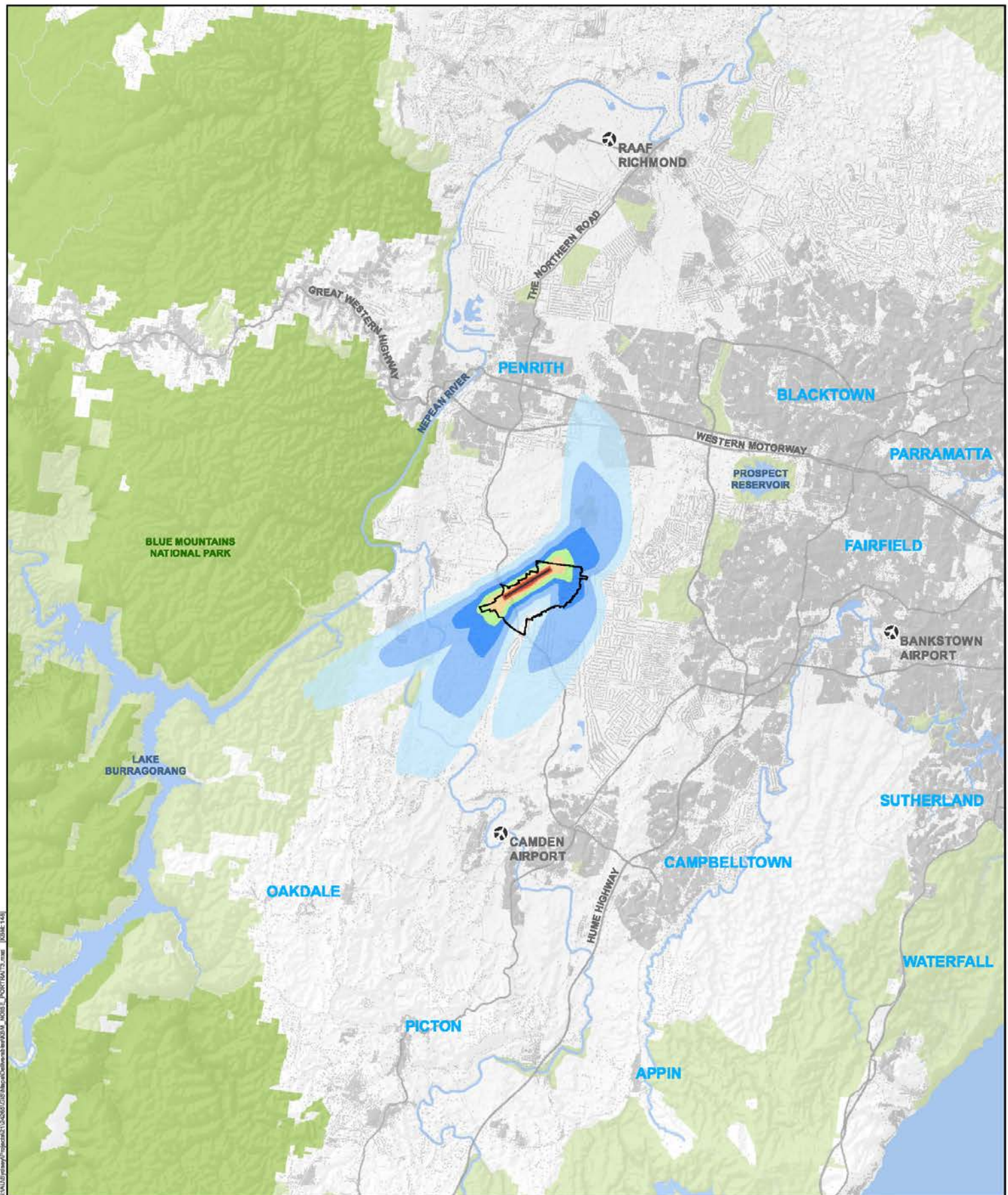


Figure 10-16 - Single event A320 departure - stage 1 - on all flight paths

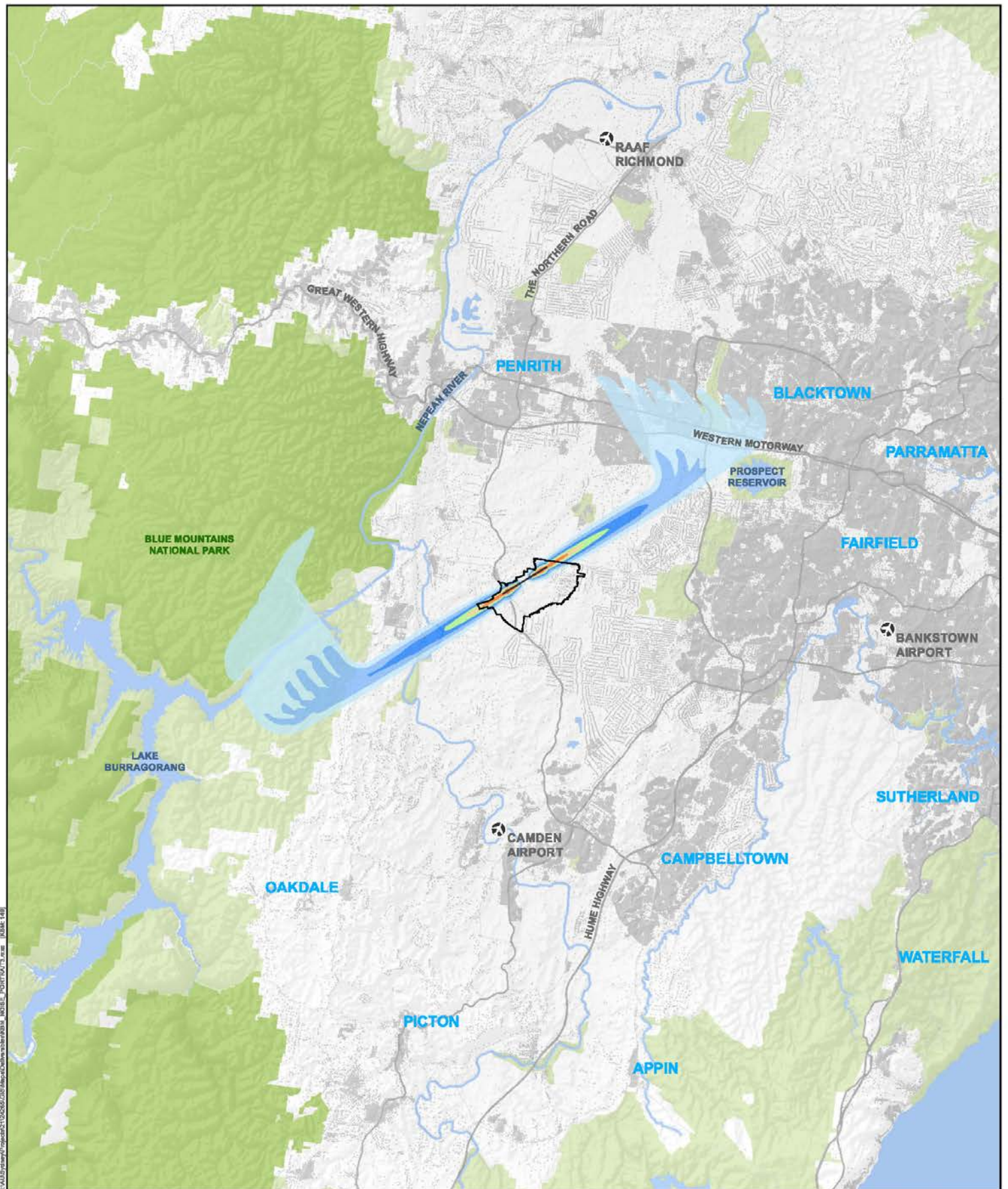


Figure 10-17 - Single event noise level for an A320 arrival (left) and departure (right)

10.5.4 Noise over 24 hours

10.5.4.1 N70 contours

Aircraft noise exposure over a full day can be described by the number of noise events exceeding 70 dBA, or N70 (see Section 10.4.1).

Calculated N70 noise contours for each of the four airport operating strategies described in Section 10.3.2 are shown on Figure 10–18 to Figure 10–21. These represent the predicted annual average number of movements per day with L_{Amax} noise levels exceeding 70 dBA.

10.5.4.2 90th percentile N70 results

Figure 10–22 and Figure 10–23 show 90th percentile values of N70 calculated over all days. These figures show the number of daily aircraft noise events over 70 dBA that would be exceeded on only 10 per cent of days. This can be thought of as a typical worst case day. Head-to-head operations are not shown as this operating strategy makes very little difference to the results for the 90th percentile N70 values.

The most noticeable aspect of these figures is that generally the difference between noise impact on average and typical worst case days is not large. This is due to the relatively low and consistent wind speeds at the airport site, which means that the proposed airport's preferred operating strategy could be selected over 80 per cent of the time.

10.5.4.3 N70 population exposure estimates

Table 10–5 shows the population estimated to be affected by noise above 70 dBA from Stage 1 operations on an average day for each operating strategy. The number of people experiencing five or more aircraft noise events per day above 70 dBA would be roughly 1,500–1,600 and would depend very little on which operating strategy is adopted. The Prefer 23 operating strategy results in fewer people being affected at lower noise levels (generally to the north of the proposed airport), but this is offset by more people being affected at higher noise levels, generally located in rural residential areas to the south and west of the airport site. Head-to-head operations are expected to only occur in favourable meteorological conditions during the night hours of 10.00 pm to 7.00 am. Because night-time movements would represent a relatively small component of the overall daily number of aircraft operations for Stage 1 operations, the inclusion of a head-to-head operating mode does not substantially affect the number of residents predicted to experience noise levels above 70 dBA.

There are differences in the number of residents affected by the different operating strategies. The Prefer 05 operating strategy results in greater impacts on residents in areas north-east of the proposed airport. However, no densely populated residential areas are predicted to experience more than five events per day above 70 dBA (Figure 10–18).

Table 10–5 Estimated population within N70 contours for Stage 1 operations (based on predicted 2030 population levels)

N70	Operating strategy			
	Prefer 05	Prefer 23	Prefer 05 with head-to-head	Prefer 23 with head-to-head
5–10	563	399	852	405
10–20	581	450	326	439
20–50	192	426	258	431
50–100	152	192	167	178
100–200	5	0	10	10
>200	0	0	0	0
Total	1,493	1,468	1,614	1,464

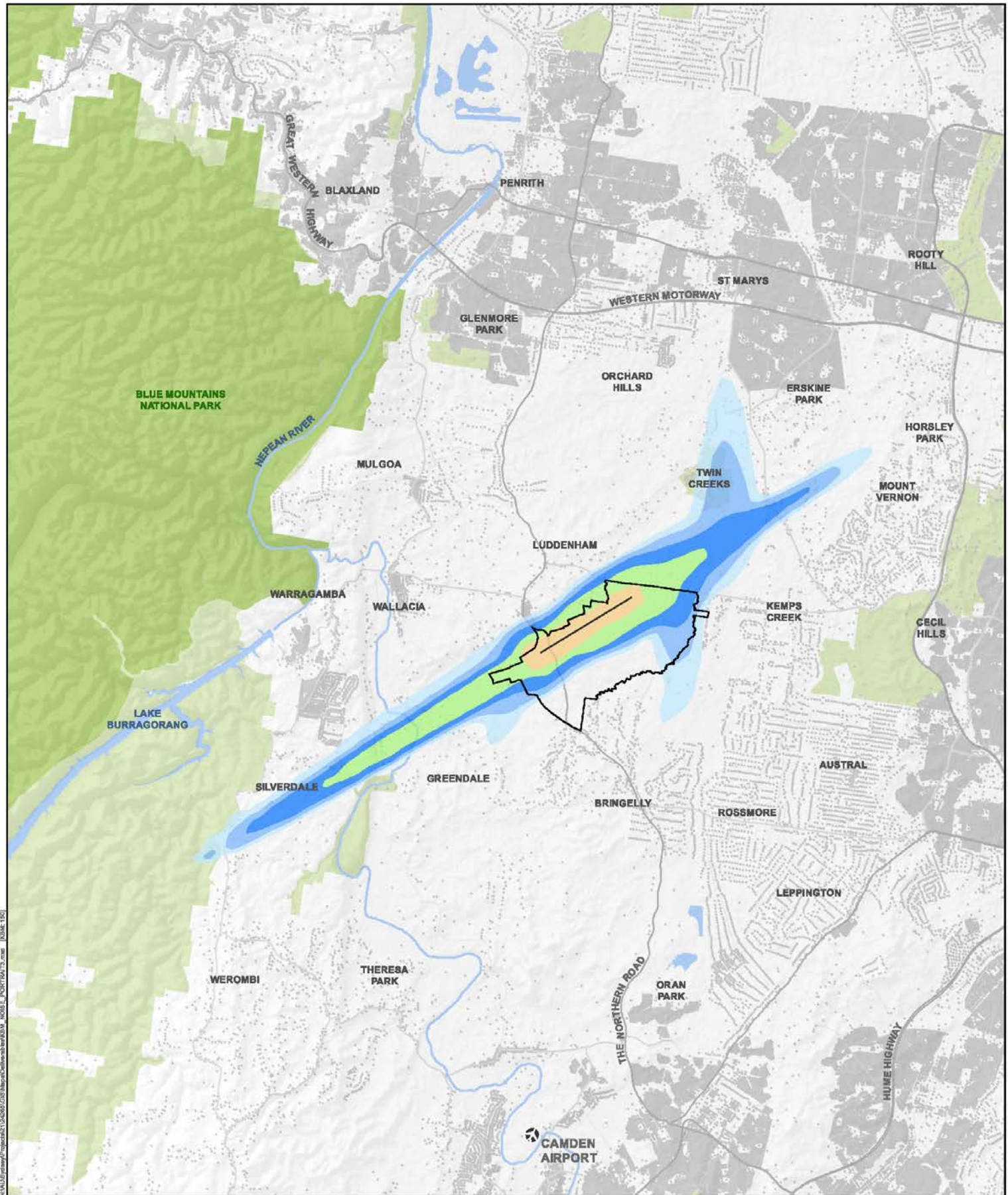


Figure 10-18 - N70 contours - Stage 1 operations - Prefer 05



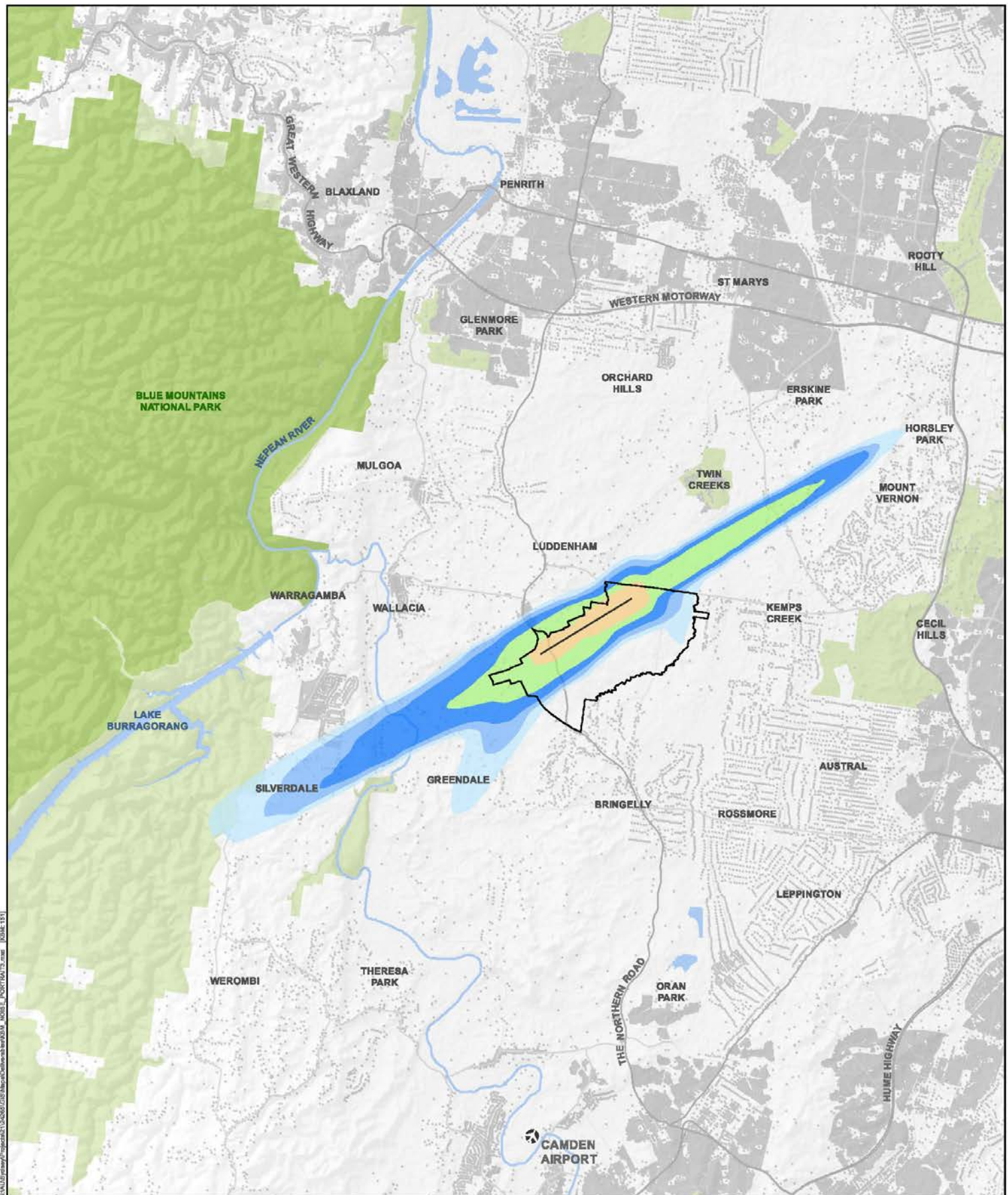


Figure 10-19 - N70 contours - Stage 1 operations - Prefer 23

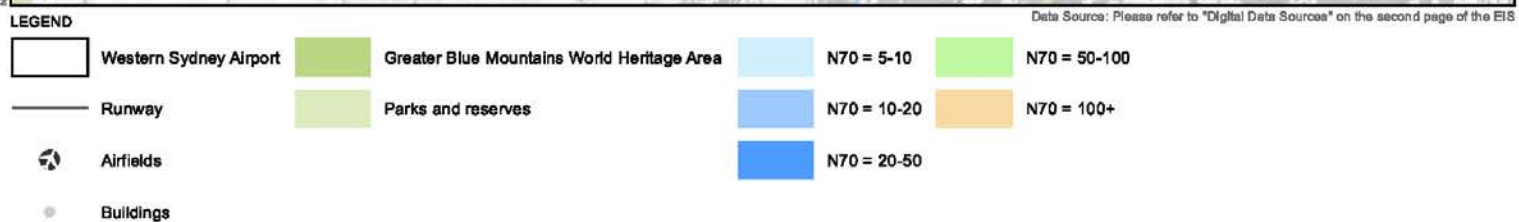
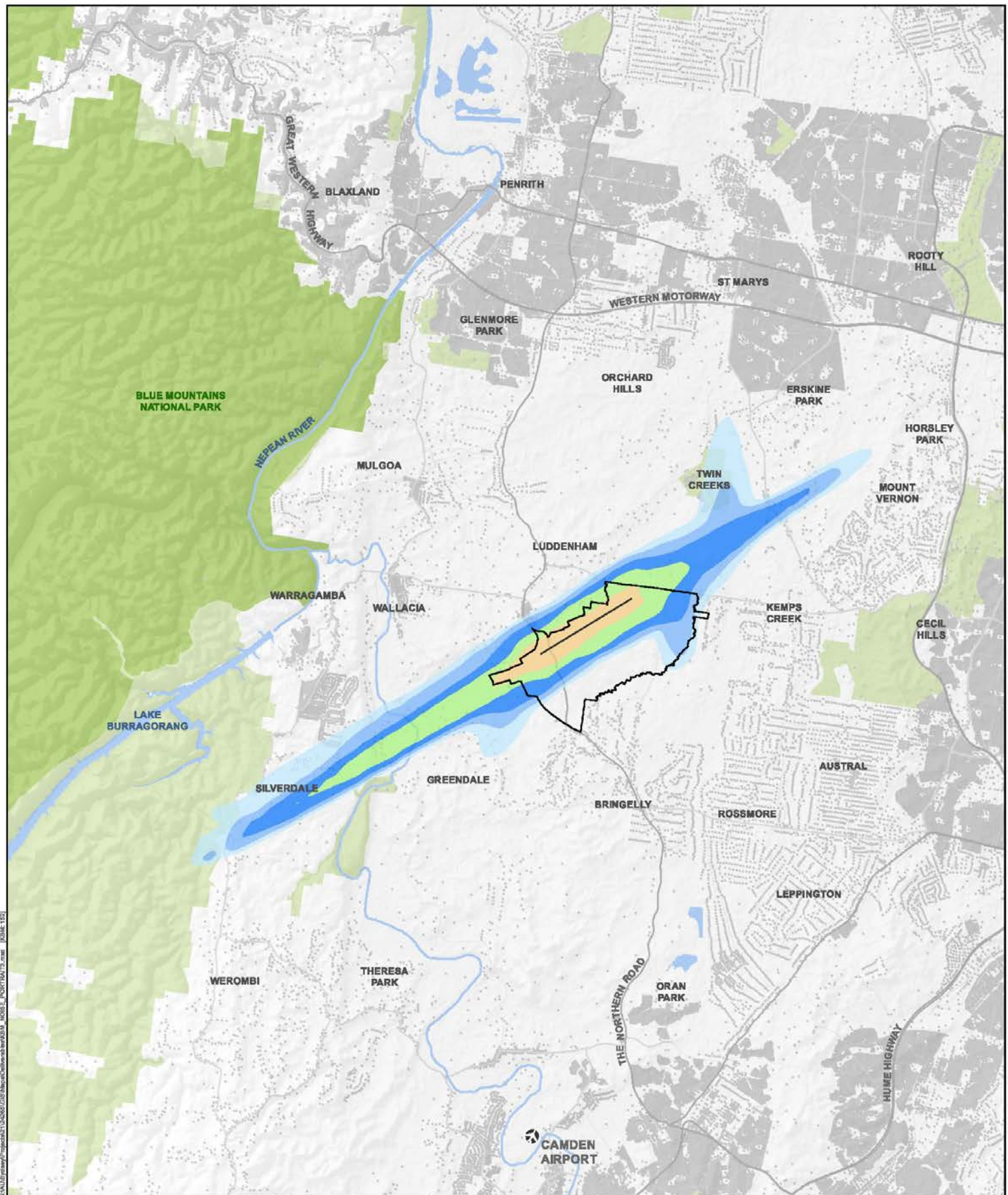


Figure 10-20 - N70 contours - Stage 1 operations - Prefer 05 with head-to-head



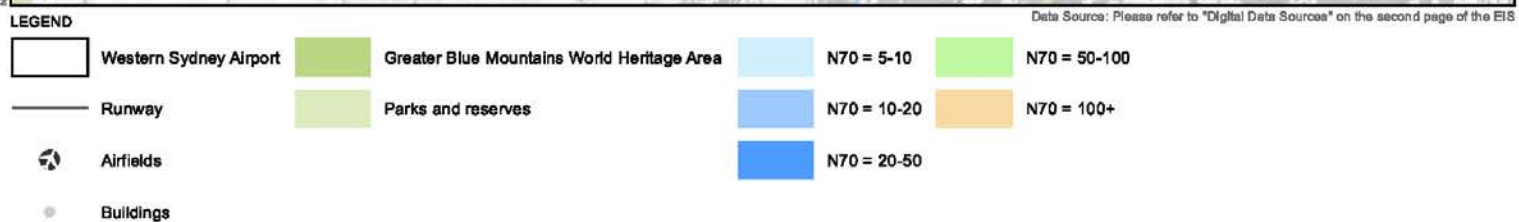
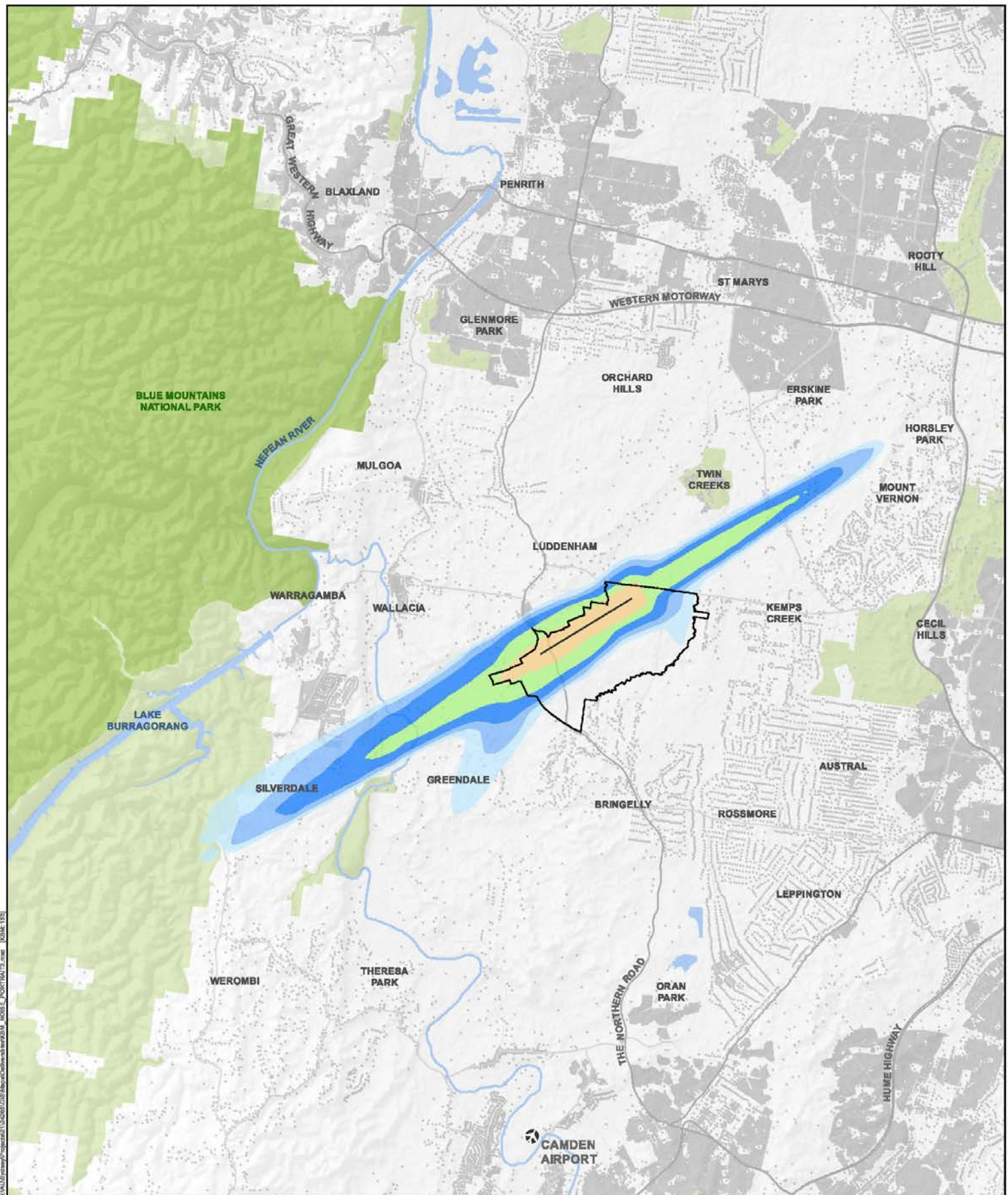


Figure 10-21 - N70 contours - Stage 1 operations - Prefer 23 with head-to-head

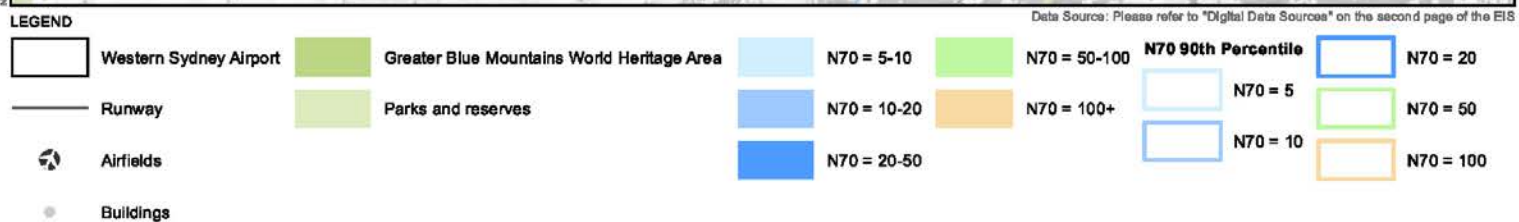
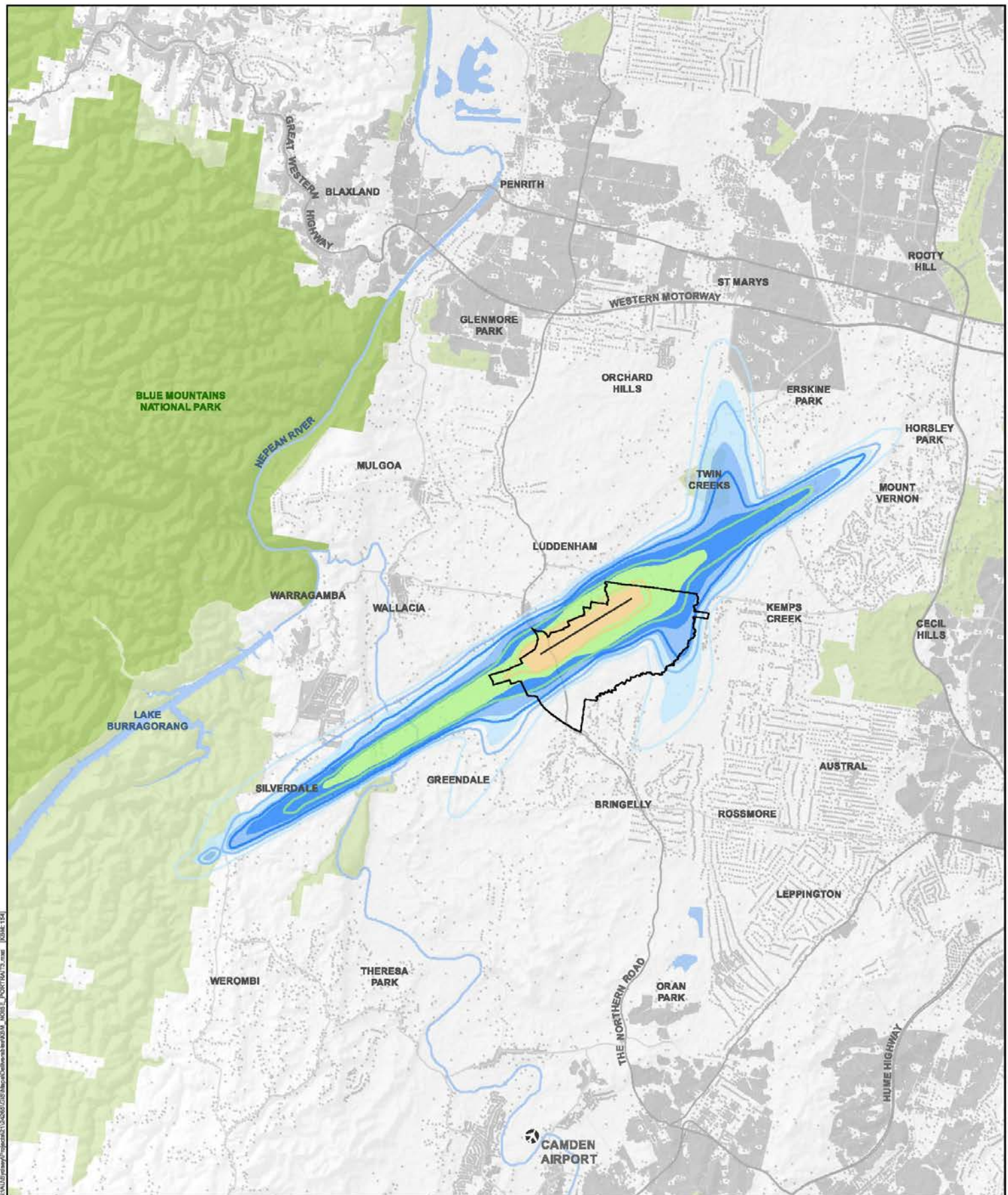


Figure 10-22 - 90th percentile N70 contours - Stage 1 operations Prefer 05



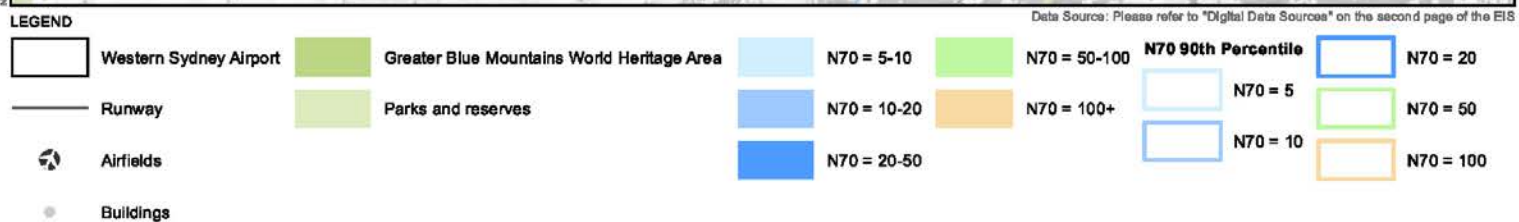
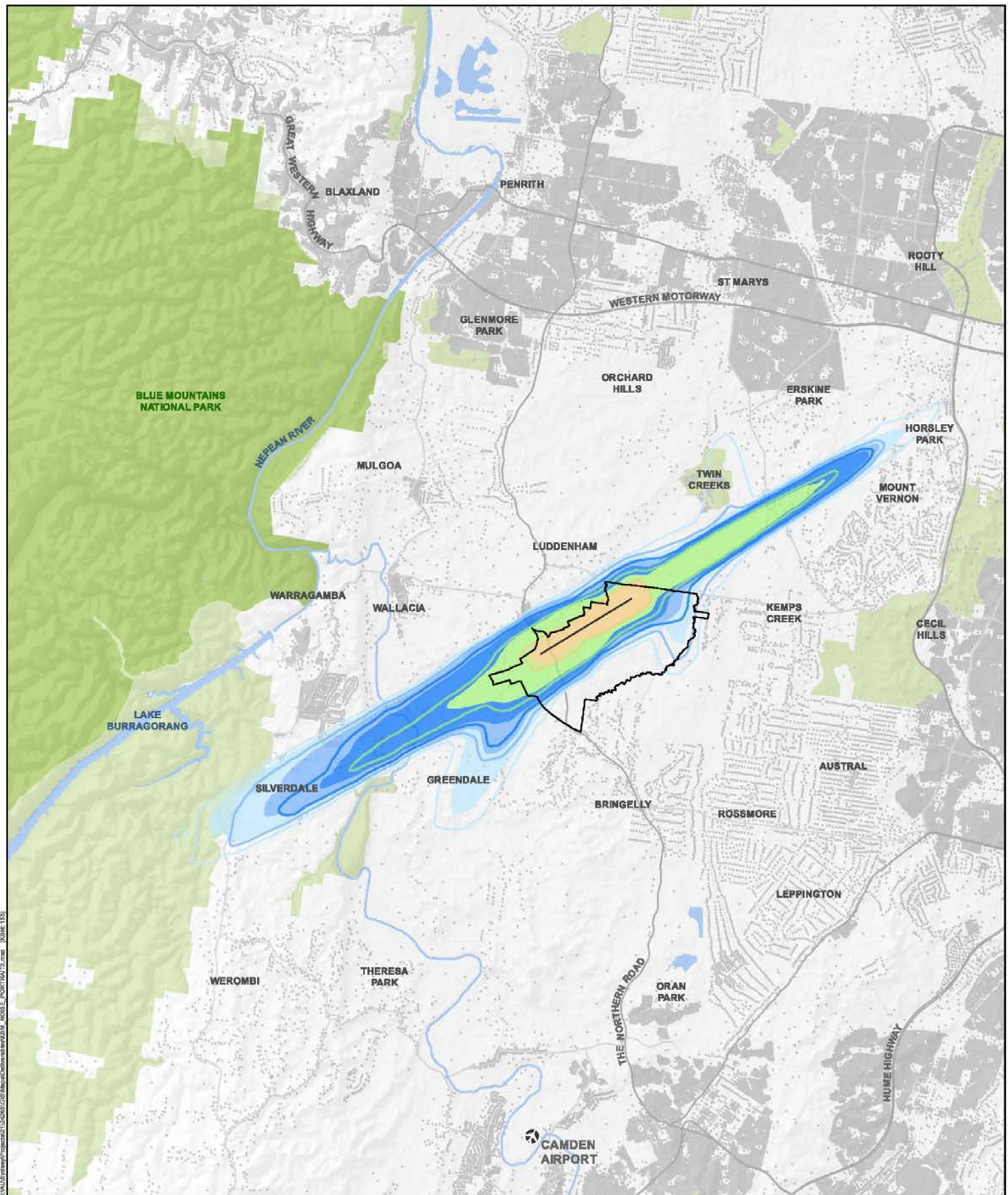


Figure 10-23 - 90th percentile N70 contours - Stage 1 operations Prefer 23



10.5.5 Night time noise

10.5.5.1 N60 contours

The number of noise events exceeding 60 dBA (N60) has been used to describe the impact of noise at night.

N60 values have been predicted for the standard night time period 10.00 pm – 7.00 am.

Figure 10–24 to Figure 10–27 show contours for the four operating strategies considered for the Stage 1 development.

The difference between Prefer 05 and Prefer 23 operating strategies is notable. The Prefer 05 strategy is predicted to have a greater impact on built-up areas around St Marys, while the Prefer 23 strategy is predicted to have a greater impact on rural residential areas around Greendale and Silverdale. A small area to the south of Blacktown would experience up to 20 noise events per night above 60 dBA under the Prefer 23 strategy. Both strategies would impact areas of Luddenham to the north of the runway; however, the Prefer 23 strategy is predicted to affect a larger area of Luddenham village.

The number of night time noise events in densely populated areas could be reduced by use of head-to-head operations where available. As demonstrated in Figure 10–26 and Figure 10–27, this would result in no built-up residential areas being exposed on average to more than five events per night above 60 dBA.

10.5.5.2 90th percentile N60 results

Figure 10–28 to Figure 10–31 show predicted 90th percentile night-time N60 values for Stage 1 operations. These figures give an indication of the number of events per night predicted to exceed 60 dBA on a typical worst case night compared to an average night. As for the N70 90th percentile results, differences between ‘average’ and ‘typical worst case’ days are generally not large.

10.5.5.3 N60 population exposure estimates

Table 10–6 shows the population estimated to be affected by night time noise above 60 dBA from Stage 1 operations. A Prefer 05 operating strategy is predicted to result in an estimated 48,000 people experiencing more than five events above 60 dBA on an average night. This is predicted to reduce to approximately 6,000 with a Prefer 23 operating strategy, or about 4,000 if head-to-head operations are combined with either the Prefer 05 or Prefer 23 operating strategies. However, compared to the Prefer 05 strategy, a Prefer 23 strategy or either of the head-to-head strategies would result in more people experiencing a higher number of night time noise events in rural residential areas to the south and west of the airport site.

Table 10–6 Estimated population within N60 contours (for Stage 1 operations (based on predicted 2030 populations)

N60	Operating strategy			
	Prefer 05	Prefer 23	Prefer 05 with head-to-head	Prefer 23 with head-to-head
5-10	46,731	3,436	2,245	2,287
10-20	1,065	1,474	841	844
20-50	609	1,269	1,200	1,200
50-100	0	0	0	0
>100	0	0	0	0
Total	48,405	6,179	4,286	4,331

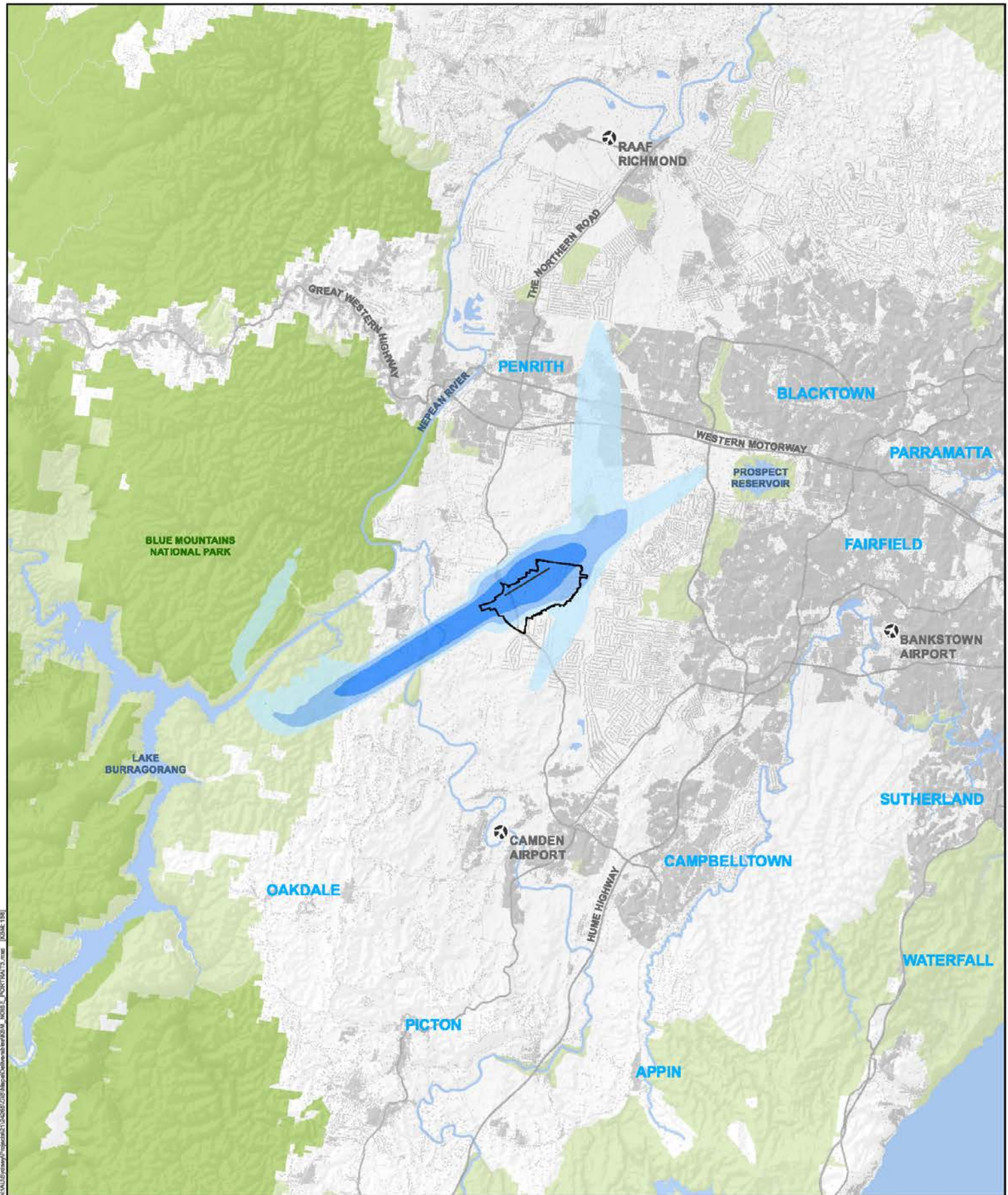


Figure 10-24 - N60 contours - Stage 1 operations Prefer 05



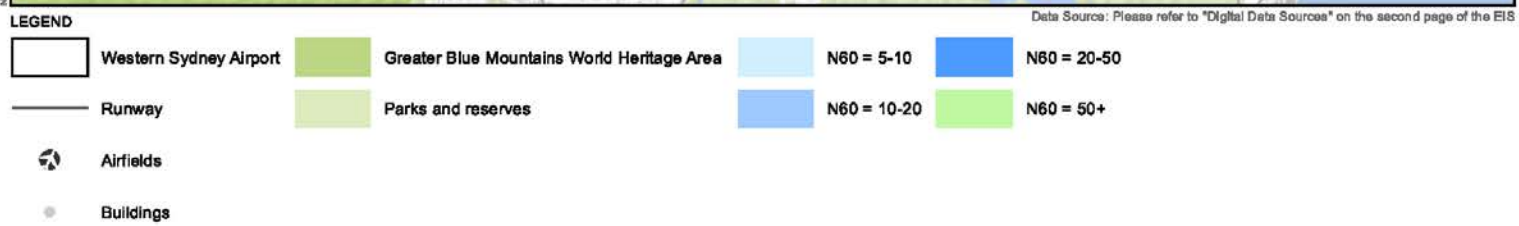
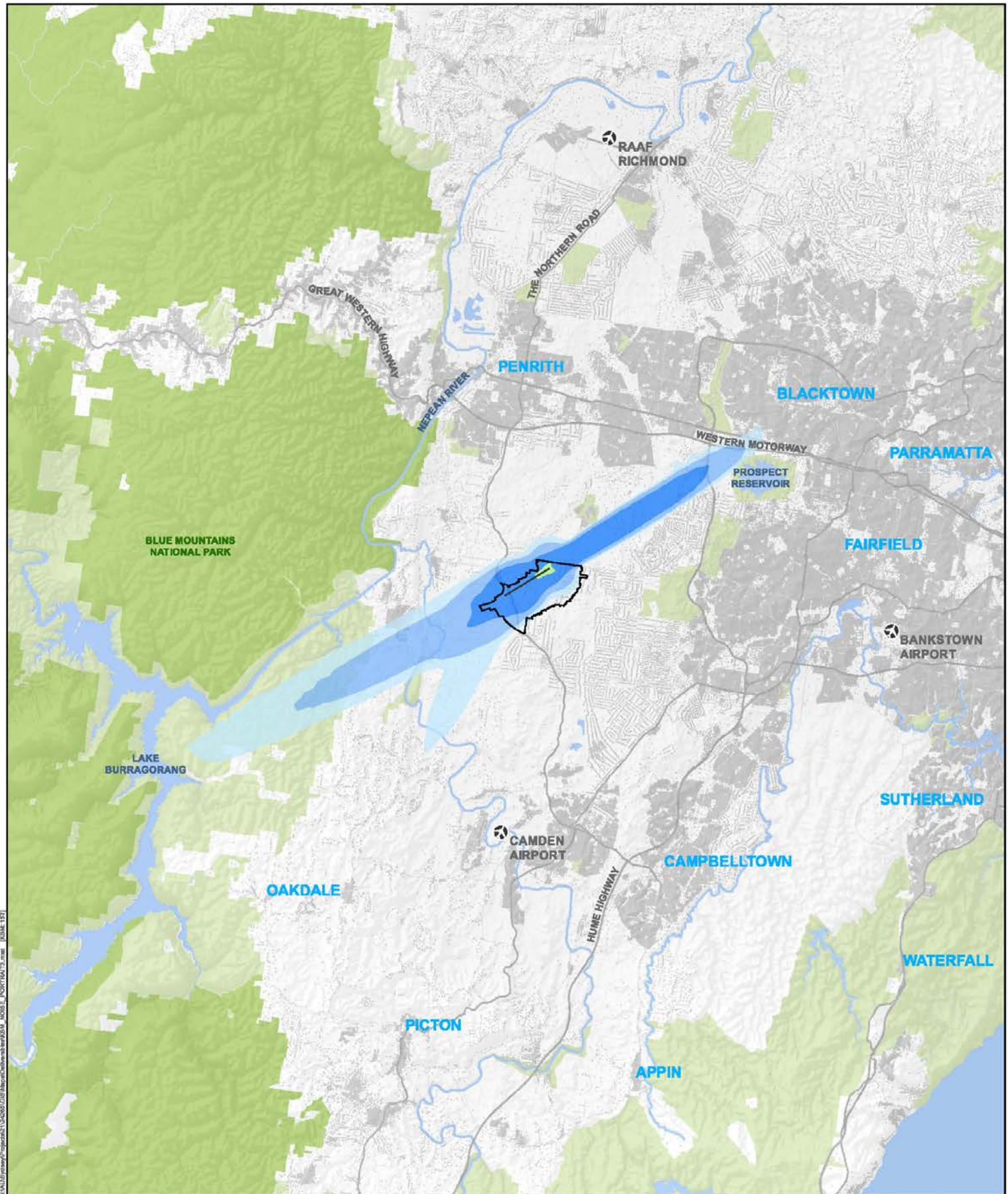
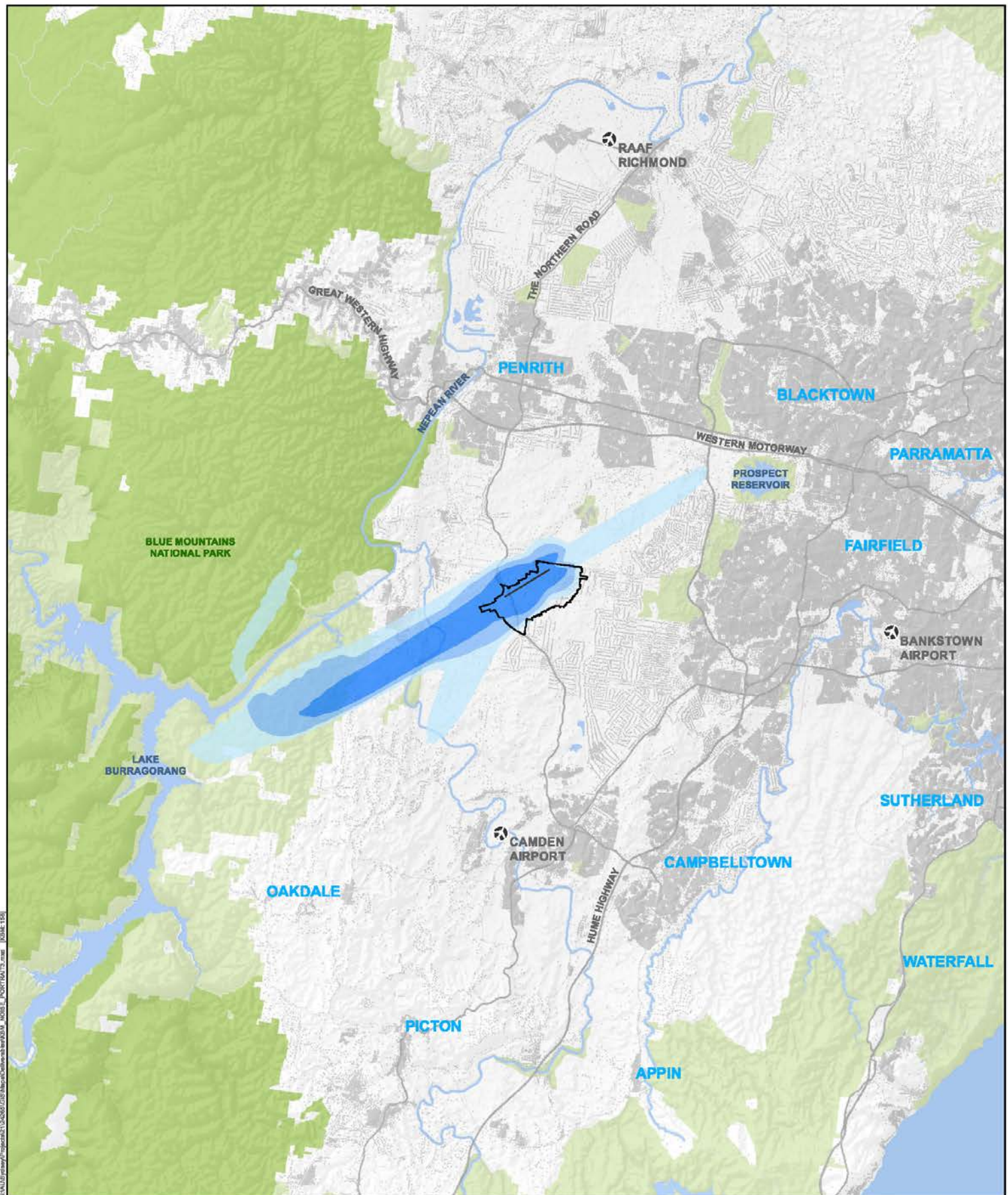


Figure 10-25 - N60 contours - Stage 1 operations Prefer 23



LEGEND

	Western Sydney Airport		Greater Blue Mountains World Heritage Area		N60 = 5-10		N60 = 20+
	Runway		Parks and reserves		N60 = 10-20		
	Airfields						
	Buildings						

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 10-26 - N60 contours - Stage 1 operations Prefer 05 with head-to-head



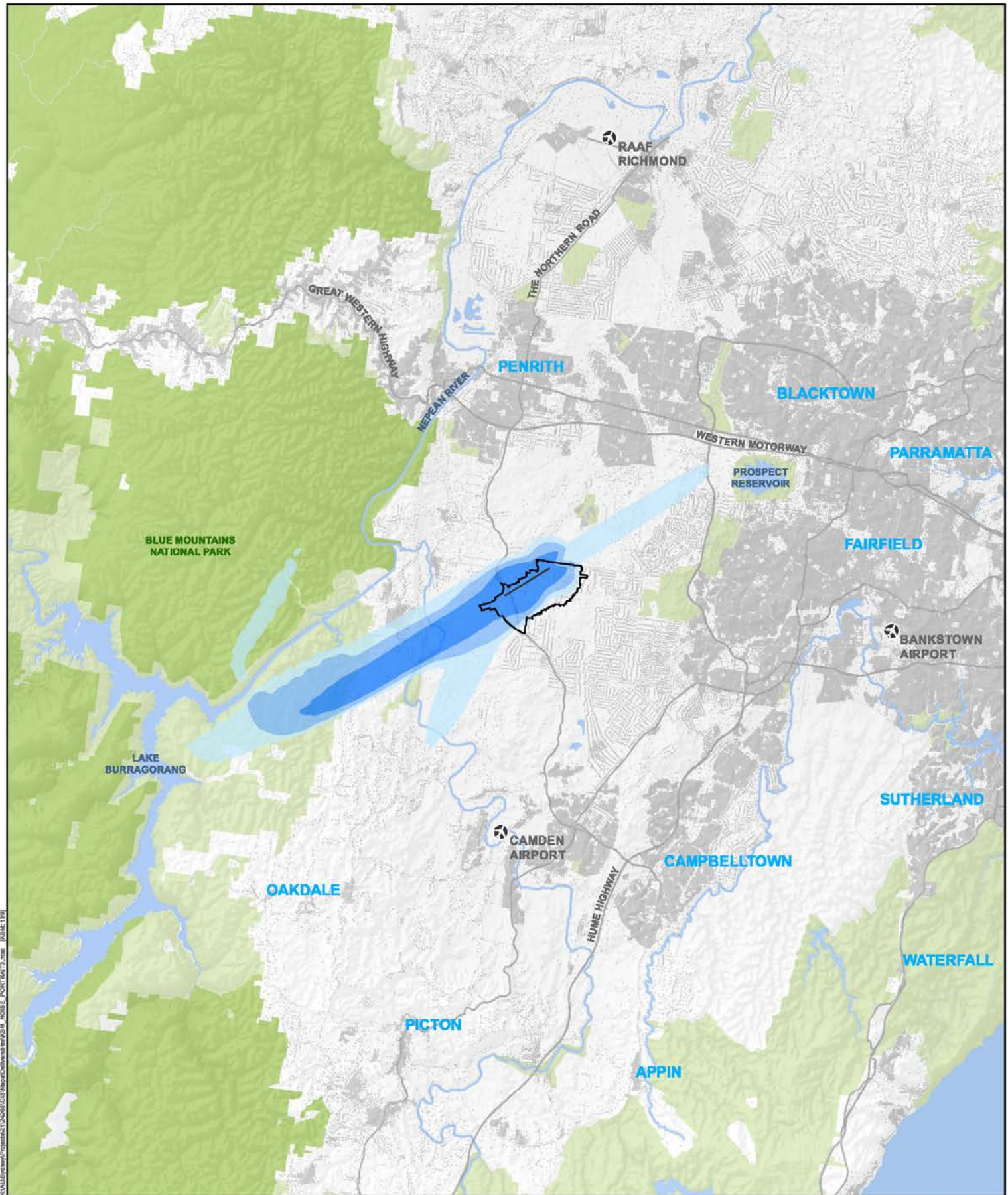


Figure 10-27 - N60 contours - Stage 1 operations Prefer 23 with head-to-head



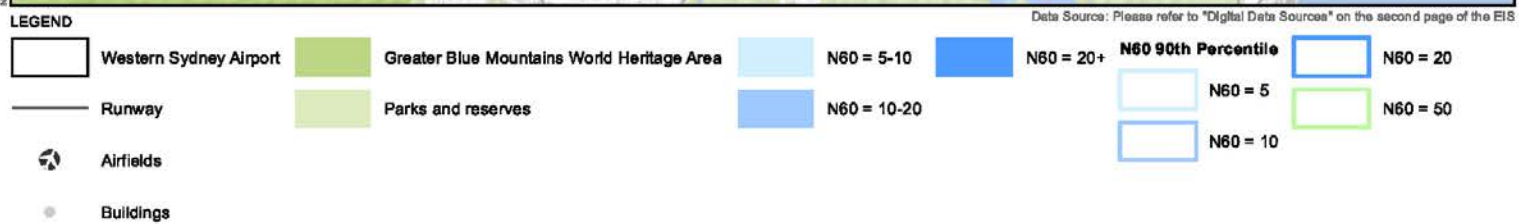
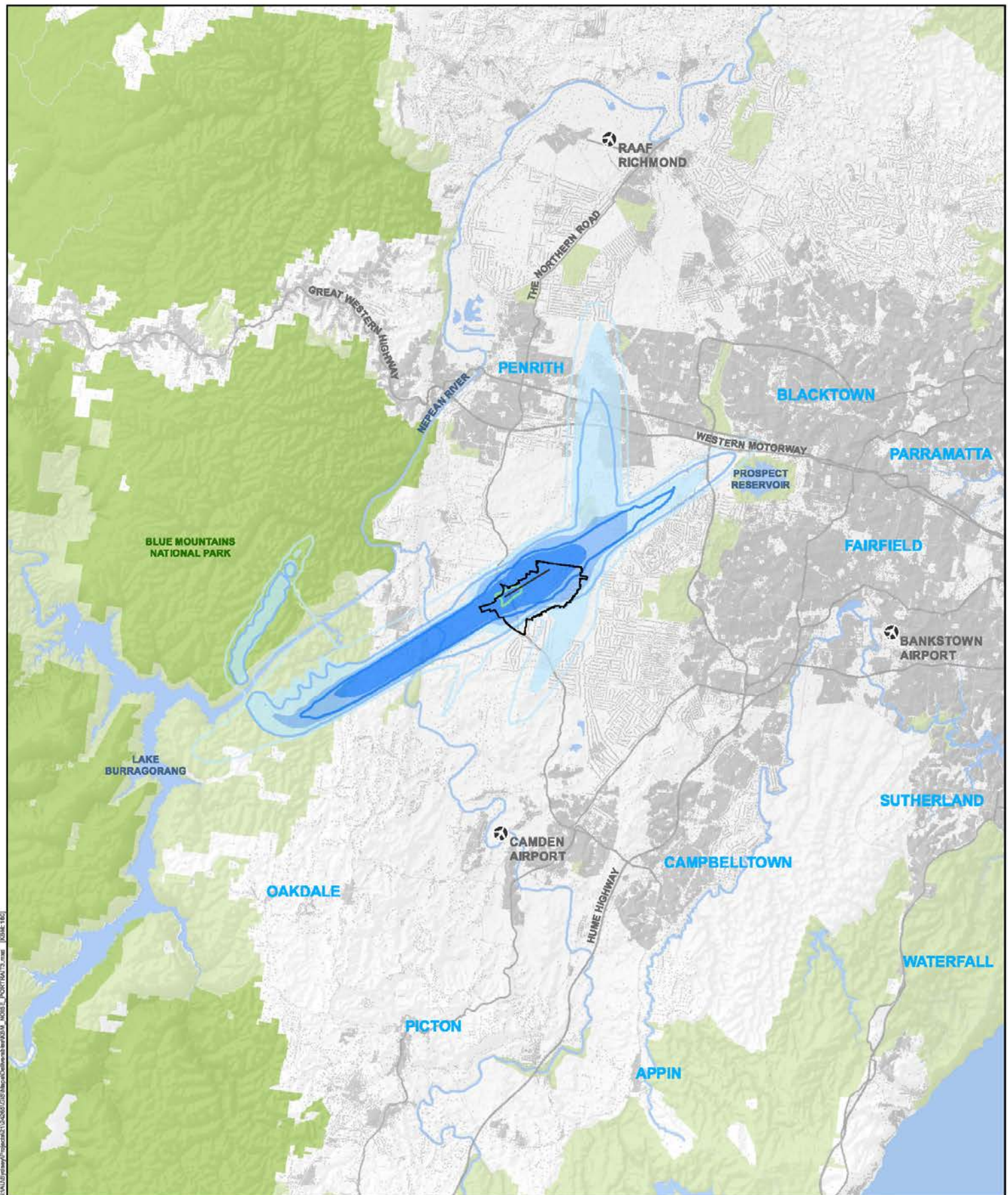


Figure 10-28 - 90th percentile N60 contours - Stage 1 operations - Prefer 05

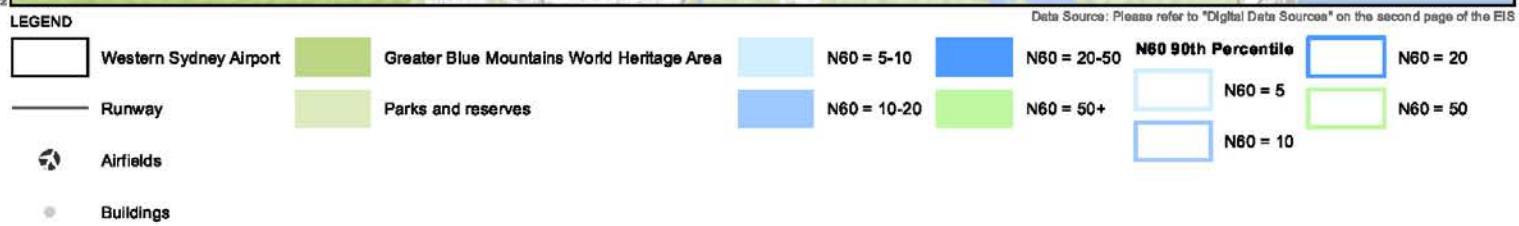
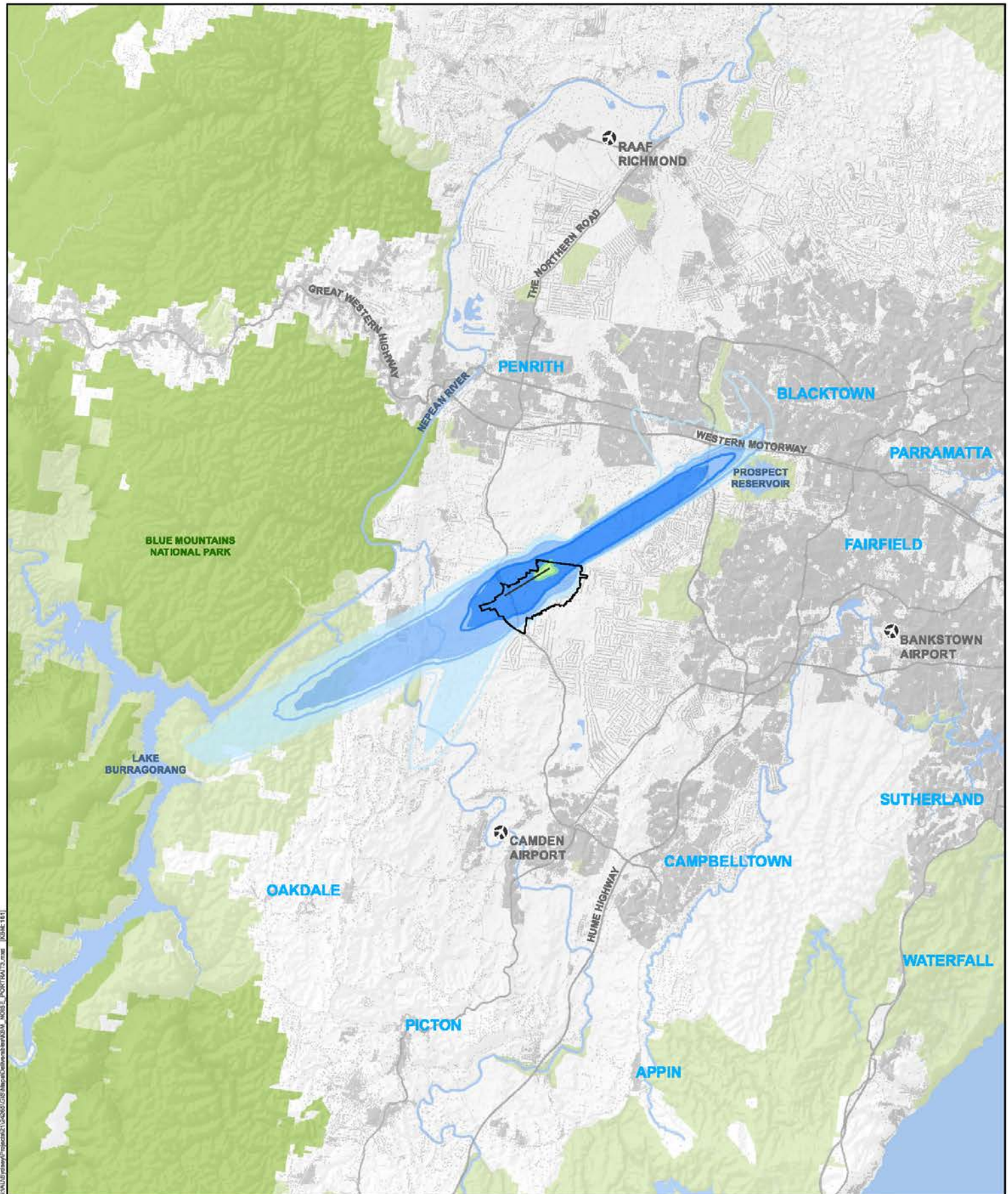


Figure 10-29 - 90th percentile N60 contours - Stage 1 operations - Prefer 23

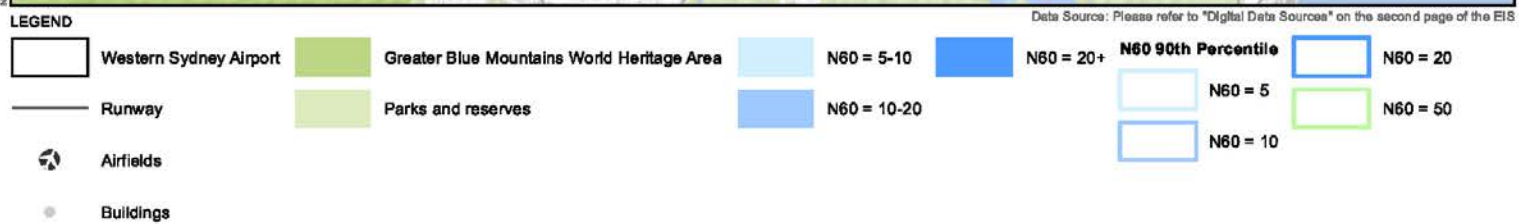
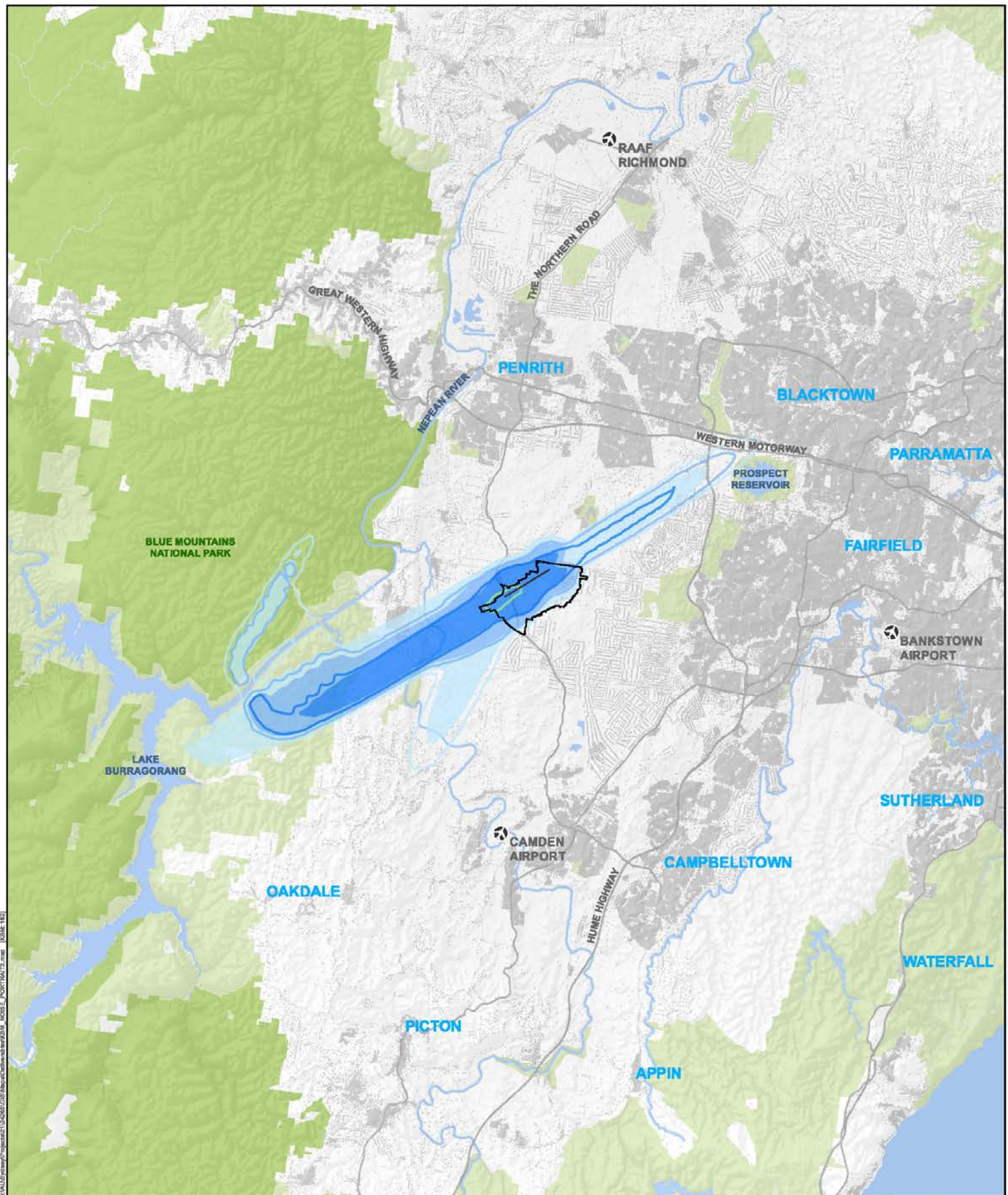


Figure 10-30 - 90th percentile N60 contours - Stage 1 operations - Prefer 05 with head-to-head

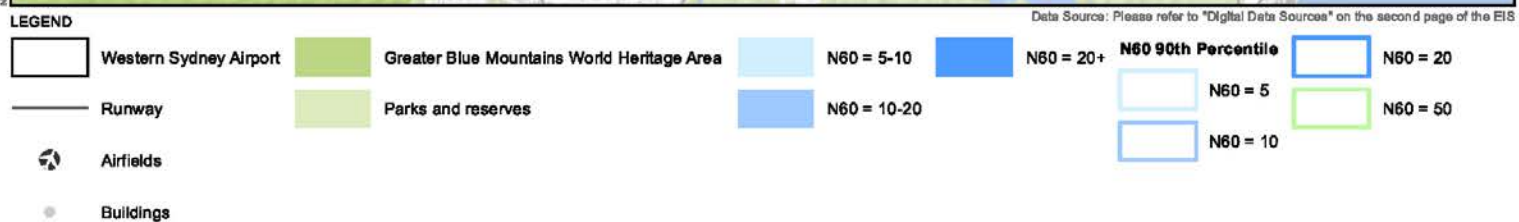
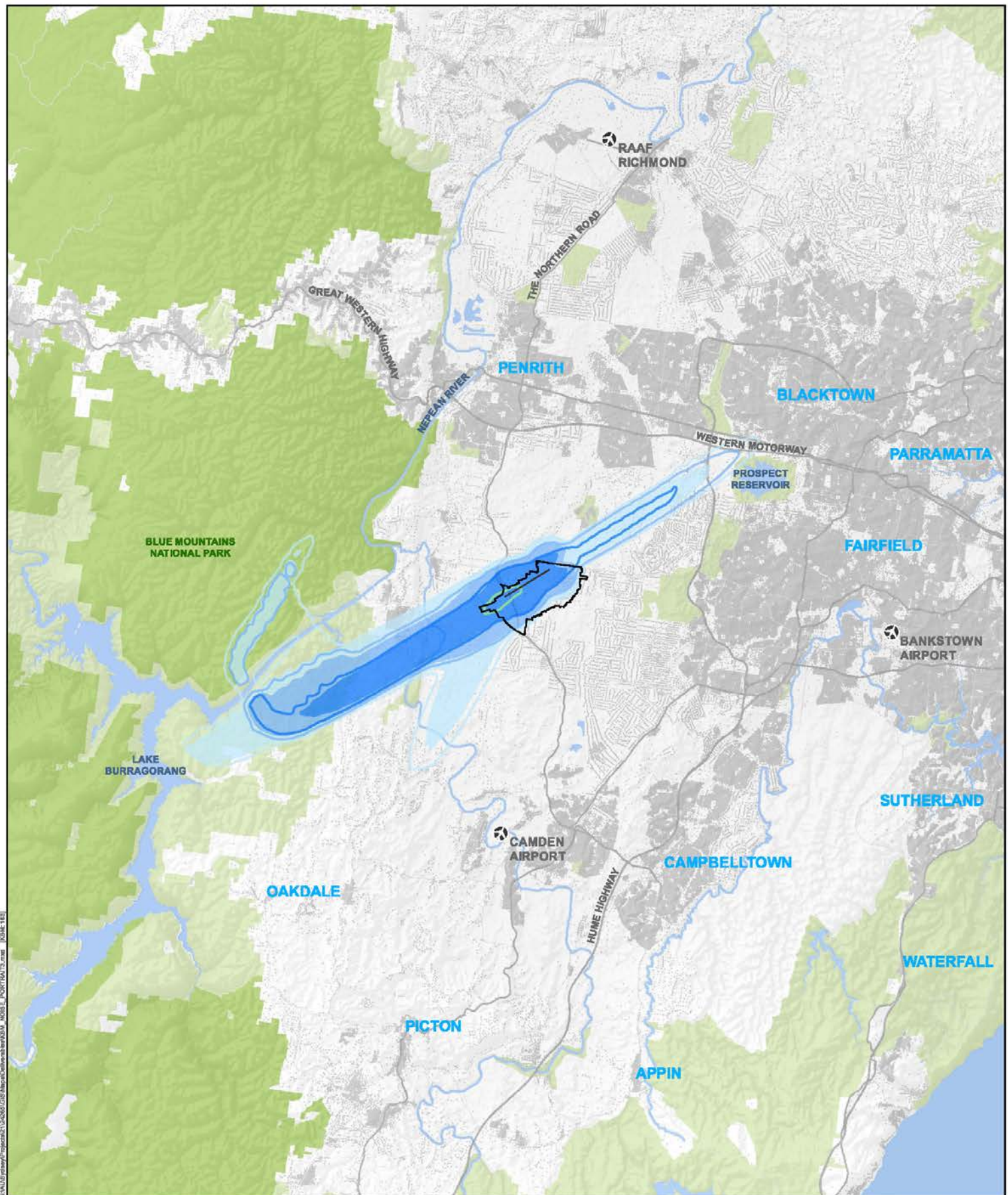


Figure 10-31 - 90th percentile N60 contours - Stage 1 operations - Prefer 23 with head-to-head

10.5.6 Recreational areas

Several recreational areas have been identified within the area potentially affected by the threshold levels of aircraft overflight noise exposure used in this assessment (see Figure 10–8). These range from sports areas used for active pursuits such as horse riding, bowling or golf to nature reserves which may be used for more passive activities.

The impact of aircraft noise in recreational areas can be quantified by calculating the number of events per day exceeding maximum noise levels of 60 dBA and 70 dBA. Where a noise level exceeds 60 dBA, a person may need to raise their voice to be properly heard in conversation but this level would be unlikely to cause disruption to active sporting pursuits. However, the noise would be noticeable and could impact on the acoustic amenity of areas used for passive recreation for the duration of the aircraft overflight. Noise levels above 70 dBA would require increased voice effort (although not shouting), for conversation to be understood and would likely be considered to be acoustically intrusive in passive recreation areas for the duration of the aircraft overflight.

Table 10–7 and Table 10–8 show the identified recreation areas and the predicted values of N60 and N70 for the Prefer 05 and Prefer 23 operating strategies. The values shown are for the period 7.00 am – 6.00 pm, representing the times when these areas would most likely be used.

Table 10–7 Average number of daily noise events with L_{Amax} exceeding 60 dBA (N60) at recreational areas

Recreational area	Stage 1 noise events	
	Prefer 05	Prefer 23
Bents Basin State Conservation Area & Gulguer Nature Reserve	7	13
Kemps Creek Nature Reserve	0	0
Rossmore Grange	3	1
Horsley Park Reserve	0	0
Twin Creeks Golf & Country Club	23	6
Sydney International Equestrian Centre	0	0
Whalan Reserve, St Marys	1	2

Table 10–8 Average number of daily noise events with L_{Amax} exceeding 70 dBA (N70) at recreational areas

Recreational area	Stage 1 noise events	
	Prefer 05	Prefer 23
Bents Basin State Conservation Area & Gulguer Nature Reserve	0	0
Kemps Creek Nature Reserve	0	0
Rossmore Grange	0	0
Horsley Park Reserve	0	0
Twin Creeks Golf & Country Club	5	1
Sydney International Equestrian Centre	0	0

Recreational area

Stage 1 noise events

	Prefer 05	Prefer 23
Whalan Reserve, St Marys	0	0

The results indicate that most of the identified recreational areas would not be subject to aircraft overflight noise events with maximum levels exceeding 70 dBA, or their exposure would be less than one event per day on average.

Aircraft noise levels at Twin Creeks Golf and Country Club would be noticeable and at times a raised voice would be required for effective communication outdoors. At this location, predicted noise exposure would be significantly reduced under a Prefer 23 operating strategy.

Bents Basin State Conservation Area and Gulguer Nature Reserve would be subject to a number of flyovers with noise levels exceeding 60 dBA, which would be noticeable to passive users of these areas. Bents Basin State Conservation Area is used for camping, and would on average be subject to less than five night time noise events exceeding 60 dBA each day. At this location, noise exposure would be lower under a Prefer 05 operating strategy.

10.5.7 Noise induced vibration

At high noise levels, the low frequency components of aircraft noise can result in vibration of loose elements in buildings, notably windows.

Even at the highest expected noise levels, the levels of vibration due to low frequency noise would be well below those which may cause structural damage to buildings. With typical light building structures, noise induced vibration may begin to occur where the maximum external noise level reaches approximately 90 dBA. The effect is more common on take-offs than for landings because the noise spectrum for a take-off close to the airport has stronger low frequency components.

Figure 10–32 shows 85 dBA and 90 dBA noise level contours for a B747 aircraft departure (stage length 5). Only areas within the 90 dBA contour could expect to experience any noise-induced vibration of building structures, and even then only during a departure of a B747 aircraft with maximum stage length 5. For Stage 1 operations, there are no existing residences within the 90 dBA contour.

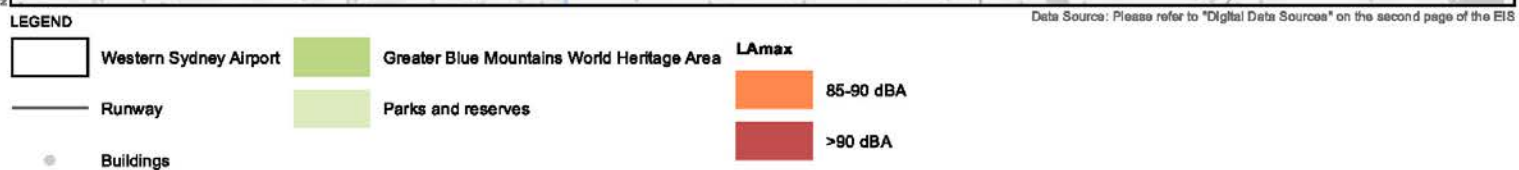
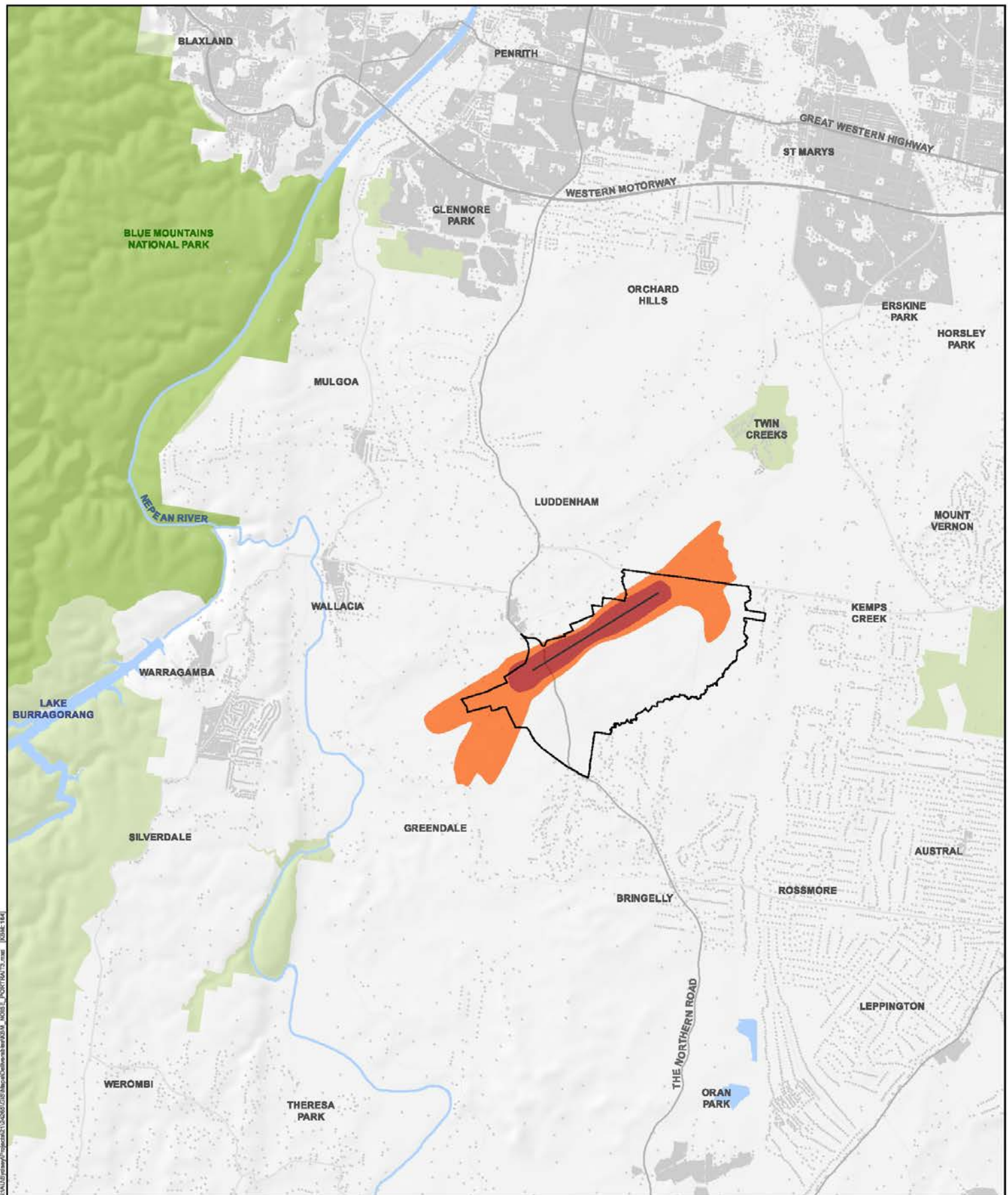


Figure 10-32 - 85 dBA and 90 dBA L_{max} contours - stage 5 B747 departure - Stage 1 development

10.6 Mitigation and management measures

This section describes potential noise mitigation and management approaches having regard to the elements of the ICAO Balanced Approach and potential operations at the proposed airport. Consideration of feasible noise abatement operational procedures would be a key component of the future airspace and flight path design process (see Chapter 7 (Volume 1)).

10.6.1 ICAO Balanced Approach

In 2008, the International Civil Aviation Organization (ICAO) developed an internationally agreed approach to managing aircraft noise at international airports. The *Guidance on the Balanced Approach to Aircraft Noise Management* (ICAO 2008) provides advice for managing noise in a transparent and consultative manner that is tailored to the individual airport situation. It supports airport authorities addressing aircraft noise problems in an environmentally responsive and economically responsible way. The four principal elements of the ICAO Balanced Approach are:

- reduction of noise at source (i.e. reducing noise emissions from aircraft through improved engine and airframe design and performance);
- land use planning and management (i.e. using land use planning or other controls to ensure that future noise-sensitive uses are not located in noise-affected areas, and ensuring new airspace procedures take into account local and regional land uses and sensitivities);
- noise abatement operational procedures (e.g. developing flight paths and operational procedures that avoid or reduce noise over populated or otherwise sensitive areas); and
- operating restrictions on aircraft – to be used only after potential benefits from the preceding three options have been exhausted.

The ability and responsibility for implementing each of these elements lie with different aviation stakeholders. The third element, implementation of noise abatement operational procedures, is the typical path for airport operators to work with regulators and the community to implement procedures for local noise management.

10.6.1.1 Improvements in aircraft technology

Aircraft engine and airframe manufacturers continually improve low noise technology and aircraft operators continually modernise their fleets by buying new, quieter aircraft. While significant reductions in aircraft noise emissions have been achieved over the previous four decades, it is difficult to predict future reductions in aircraft noise emission levels. Even without further technological advances, it is reasonable to assume that average aircraft noise emissions from individual aircraft would decrease over time as quieter new generation aircraft make up a greater share of the commercial fleet mix. For example, Singapore Airlines has already removed the louder Boeing 747 aircraft from passenger services. Qantas has also reduced the size of its Boeing 747 fleet and is expected to retire its remaining Boeing 747s by the time operations commence at the proposed airport.

As noted earlier, ICAO has agreed to introduce more stringent standards that will require further reductions in engine noise emission levels for all new aircraft types over 55 tonnes in weight submitted for certification on or after 31 December 2017.

10.6.1.2 Land use planning

Land use planning around airports in Australia is based on the ANEF system for predicting noise exposure and the recommendations of AS 2021. Commonwealth, State and local government agencies implement planning controls having regard to AS 2021 and national policies for protecting airport operations, in particular the National Airports Safeguarding Framework (NASF).

As noted in Section 10.4.1.1, noise exposure forecasts developed for the 1985 Draft EIS (Kinhill Stearns 1985) have guided current planning controls implemented by the NSW Government and relevant local councils in the vicinity of the airport site. These earlier ANECs are broadly consistent with the ANECs presented in this EIS, in particular those prepared for the long term assessment scenario (see Chapter 31 (Volume 3)). Consistent with these planning controls, land to the north of the airport site has been earmarked for employment generating land uses. Development in accordance with this strategic planning will continue to provide a buffer between the airport site and residential areas. It is expected that future land use planning around the proposed airport would be based on formal long term ANEF contours endorsed by Airservices Australia prior to the commencement of airport operations (see Chapter 7 (Volume 1)).

The NASF is a further initiative that addresses land use planning and aircraft noise. NASF is a national land use planning framework, agreed to by Commonwealth, State and Territory ministers in 2012 that establishes planning principles and guidelines in order to:

- improve community amenity by minimising aircraft noise-sensitive developments near airports including through the use of additional noise metrics and improved noise-disclosure mechanisms; and
- improve safety outcomes by ensuring aviation safety requirements are recognised in land use planning decisions through guidelines being adopted by jurisdictions on various safety-related issues.

Further detail on the NASF is included in Chapter 21.

10.6.1.3 Noise abatement operational strategies

The location of flight paths and the selection of airport operating modes and strategies are key factors affecting the pattern of noise exposure presented in this EIS. Flight path alteration and the selective use of different operating modes can help reduce the impacts of airport operations on surrounding communities. For example, subject to safety and operational requirements, alternating operating modes (i.e. the direction in which landings and departures occur) can be an effective way of sharing aircraft noise impacts more equitably at airports with an identified noise problem. As the proposed airport is planned to operate 24-hours a day, the determination of preferred operating modes and other possible noise abatement operational procedures would be particularly important for managing night time noise impact on surrounding communities.

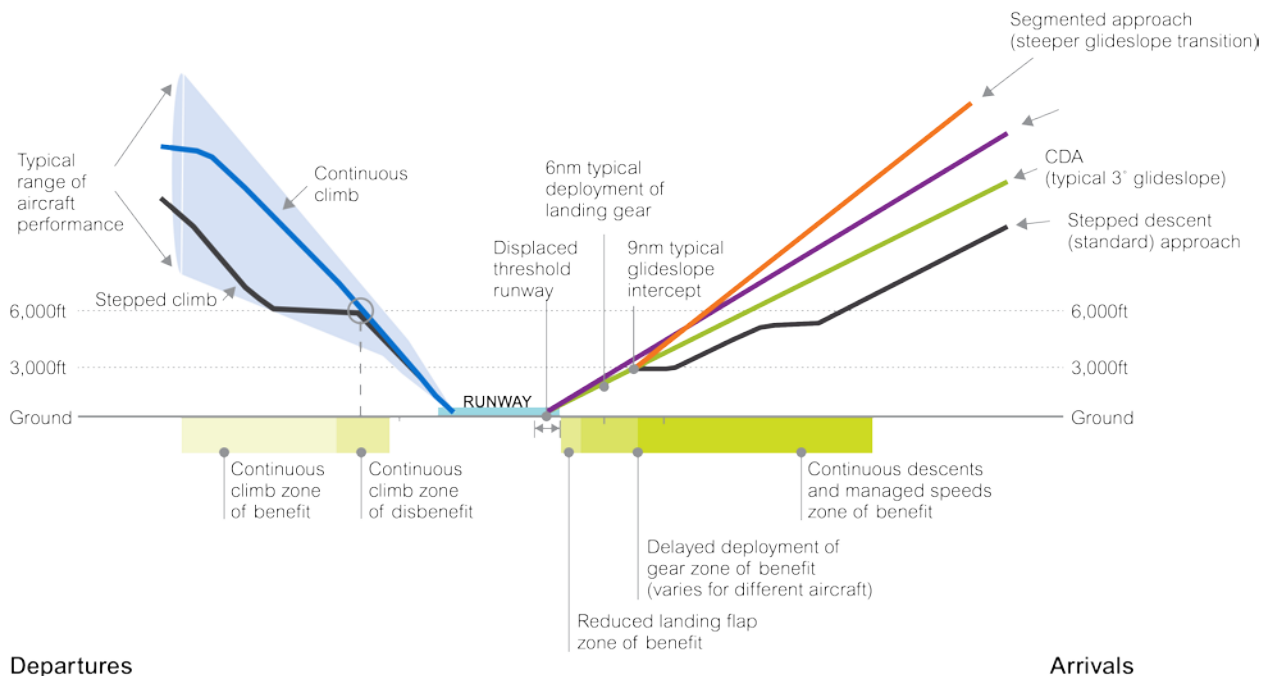
Table 10–9 lists a number of methods that have been developed to reduce or redistribute aircraft noise. The potential applicability of any particular measure to operations at the proposed airport would require detailed consideration during the airspace and flight path design process and ongoing review after the commencement of operations. Collaboration between stakeholders including airport operators, airlines, the community and regulators would be needed to implement some of these measures, noting that the operational efficacy and environmental benefits of newer measures are still being researched. All measures would be subject to overriding safety considerations.

Table 10–9 Potential methods for mitigating airport operational noise

Initiative or procedure	Overview
Departure and arrival management collaboration	This procedure enhances continuous descent and continuous climb operations that can minimise controller vectoring of aircraft and local noise during arrival and departures.
Thrust-managed climb	A noise abatement procedure that requires departing aircraft to reduce engine thrust after a safe altitude is reached.
Area navigation (RNAV) and Required Navigational Performance (RNP) arrivals and departures	RNAV/RNP are precision-based navigation procedures that take advantage of improving aircraft technology to provide precise adherence to a defined flight path. Such flight paths can be designed to reduce community noise, e.g. by directing aircraft over waterways or low sensitivity areas, where possible. By integrating with ground-based augmentation systems (GBAS), RNAV/RNP procedures can facilitate the definition of multiple departure/ approach profiles from different ends of the runway.
Continuous descent approaches	Continuous descent approaches facilitate more fuel-efficient and quieter arrivals by enabling aircraft to employ minimum engine thrust and by reducing the need for level flight segments during approach (see Figure 10–33).
Continuous climb operations	Similar to continuous descent operations but for departure traffic where an aircraft climbs without levelling off at intermediate levels. While very efficient at reducing fuel and emissions if performed with normal engine thrust, this procedure may lead to more noise over nearby communities than a thrust-managed departure.
Arrival and departure path alternation	These procedures incorporate local rules to dictate which arrival routes or departure paths may be used at certain times. This may support the use of respite periods.
Low power, low drag arrivals	This is a technique for making landing approaches less noisy. By delaying landing gear and flap deployment these operations keep the aircraft aerodynamically ‘cleaner’ and reduce noise generated by air passing over the airframe, which can be a significant source of aircraft noise close to an airport. Reducing drag also enables engine thrust to be reduced. The employment of these procedures may be dependent on air traffic levels, prevailing weather conditions and other safety considerations.
Increased angle approaches and displaced runway threshold	Increased angle final approaches keep the aircraft higher for as long as feasible (i.e. until the ILS glideslope is intercepted) to reduce the perceived noise levels on the ground. Displacing the runway threshold is another method for keeping arriving aircraft higher over nearby communities. This procedure permits an aircraft to land at a point further down the runway than the normal runway threshold.
Thrust reversal limitations at night	Limiting the use of thrust reversal for landings at certain times (e.g. at night or when arrivals are not closely spaced) may reduce noise impacts on nearby communities.

Source: Managing the Impacts of Aviation Noise, CANSO and ACI, 2015

Figure 10–33 illustrates a number of these methods and shows where the potential zone of noise benefit is provided.



Source: The Sustainable Aviation Noise Road Map: A Blueprint for Managing Noise from Aviation Sources to 2050

Figure 10–33 Aircraft overflight noise mitigation opportunities


10.6.1.4 Operating restrictions on aircraft

An operating restriction is any noise-related action that limits or reduces an aircraft's access to an airport. Restrictions may include limits on total movements, noise quotas, night time restrictions and curfews. Restrictions might be applied to specific runways or flight paths, specific aircraft types, aircraft arrivals or departures and/or to specific time periods.

Restricting aircraft operations at night by imposing a curfew or other measures can impact the efficiency and economic activity of an airport. Noise quotas or limits allow some minimum level of activity while placing a limit on total noise exposure levels. The economic consequences of a curfew are outlined in Chapter 2 (Volume 1). For these and other reasons, ICAO considers that operating restrictions should be considered only as a last resort.

10.6.2 Communication and coordination

It is important that both existing and potential residents in areas likely to be affected by aircraft noise have access to information about expected noise exposure levels and patterns. This includes ensuring that information about aircraft noise is presented in a way that is understandable to a non-expert and addresses issues such as the frequency and loudness of noise events and the variability in aircraft noise exposure throughout the day and when the airport is operating in different modes of operation (i.e. 05 versus 23 direction). By providing this type of information, communities are able to actively and meaningfully participate in any public consultation process and potential buyers are better placed to make informed decisions about whether or not to move into an area predicted to experience aircraft noise.



The Australian Government recognises the importance of engaging meaningfully with communities to understand their concerns about aircraft noise and to raise awareness of the constraints and restrictions that govern safe and efficient aircraft operations.

As discussed in Chapter 7 (Volume 1), further detailed technical work would be undertaken to optimise the design of flight paths and noise abatement procedures for the proposed airport so that noise and environmental impacts are reduced as far as practicable. This airspace planning and design process would involve extensive community and stakeholder consultation and would ensure alignment with international best practice, aviation industry expectations and Australia's obligations under international aviation agreements.

Any proposal to introduce a new airspace regime for the proposed airport would also comply with national environmental law. Accordingly, the proposed airspace design arrangements, including nominated flight paths, would be formally referred for consideration under the EPBC Act.

A community and stakeholder reference group would be convened by the Department of Infrastructure and Regional Development to ensure community views are taken into account in the airspace design process. The reference group would provide a forum for stakeholder representatives to exchange information on issues relating to the proposed airspace design and flight path options and their impacts.

The Australian Government also expects federally-leased airports to operate Community Aviation Consultation Groups (CACGs). Consistent with arrangements at other major Australian airports, the ALC for the proposed airport would establish a CACG before airport operations commence. There are guidelines for CACGs which specify that they should be independently chaired and should engage broad community representation. While they are not decision-making bodies, CACGs provide for effective and open discussion of airport operations and their impacts on nearby communities.

Major capital city airports are also required to establish Planning Coordination Forums. The purpose of Planning Coordination Forums is to support a strategic dialogue between the airport operator and local, State and Australian government agencies responsible for town planning and infrastructure investment. Effective discussions in Planning Coordination Forums support better integration of planning for an airport and for the surrounding urban and regional community.

10.6.2.1 Managing aircraft noise enquiries and complaints

Airservices Australia is responsible for managing complaints and enquiries about aircraft noise and operations through its Noise Complaints and Information Service (NCIS). This service is the Australian aviation industry's main interface on aircraft noise and related issues for the community. Complaints and enquiries about aircraft noise relating to operations at the proposed airport will be managed through the NCIS.

An airport's CACG provides another mechanism for aircraft noise enquiries and complaints to be registered and addressed.

Further information about the management of noise enquiries and complaints is provided in Chapter 28 (Volume 2b).

10.6.3 Monitoring noise

Noise associated with the proposed airport is expected to be monitored using the Noise and Flight Path Monitoring System operated by Airservices Australia.

The objectives of noise monitoring are to:

- determine the contribution aircraft noise makes to the overall noise to which a community is exposed;
- provide information to the community;
- help local authorities make informed land use planning decisions;
- inform impact estimates resulting from changes in air traffic control procedures – including changes to reduce aircraft noise impacts;
- validate noise modelling;
- inform the determination of aviation policy by government; and
- assist the government in implementing legislation.


Consistent with the practice at other major airports, a number of permanent monitors would be installed at locations that are representative of noise impacts at surrounding communities. The design and installation of a noise monitoring network at the proposed airport will be undertaken in consultation with the community and stakeholder reference group established for the detailed airspace and flight path design process. This network will be integrated into the noise and flight path monitoring system. In line with existing practice, the noise monitoring network and locations around the proposed airport will be regularly reviewed to ensure they meet contemporary needs.

Airservices Australia produces quarterly Noise Information Reports for major urban areas which include information and analysis on aircraft movements, noise monitoring and complaint issues. The reports are available online at Airservices Australia's website. Real time noise and aircraft operations information is also available for major airports in Australia through the agency's online WebTrak flight tracking tool. The tracking of aircraft operations at the proposed airport and measurement of their associated noise levels would be integrated into these existing monitoring programmes and reporting tools.

Further details about aircraft noise monitoring and reporting at the proposed airport are provided in Section 28.5 (Volume 2b).

10.6.4 Property acquisition and acoustical treatment for aircraft noise

In line with the 1985 recommendations of the Commonwealth House of Representatives Select Committee on Aircraft Noise, the Commonwealth acquired land within the 35 ANEF contour established in the 1985 EIS to provide a noise buffer for the proposed airport. Between 1990 and 1993, the Commonwealth acquired 12 properties within the 35 ANEF. A further eight properties were identified at the time as eligible for acquisition but the land owners did not take up the Government's offer of acquisition. No residential dwellings or other buildings have been insulated for aircraft noise through a Commonwealth programme, although new residential dwellings in some predicted noise-affected zones have been required by local planning regulation to comply with the internal noise criteria stipulated in AS 2021.



The Commonwealth would be responsible for any noise amelioration programme required for the proposed airport that aims to mitigate the impact of aircraft overflight noise for areas surrounding the airport site. Funding arrangements for any programme of this type would be considered at the time.

Government policy relating to any aircraft noise acquisition and insulation programme at the proposed airport would be established as part of the detailed airspace and flight path design process.


The establishment of eligibility criteria and other relevant parameters for such a programme will require consideration of several matters including:

- the calculation and endorsement of an appropriate ANEF chart to inform the identification of residential dwellings and other noise sensitive facilities within respective noise exposure zones, noting that delivery of a noise amelioration programme may be staged;
- the eligibility criteria for acquisition and insulation treatment with reference to the appropriate ANEF chart(s), noise exposure acceptability advice contained in AS 2021 and any other noise measures that may be deemed applicable;
- the timeframe for implementation, taking into account issues such as the date of commencement of operations, air traffic movement and noise exposure forecasts;
- staging priorities;
- for any voluntary acquisition scheme, the achievement of appropriate land use planning outcomes;
- funding arrangements; and
- compliance with the internal noise design criteria contained in AS 2021, having regard to the practicality and costs of achieving compliance for certain residences and other buildings.

10.6.5 Approach to managing aircraft overflight noise

Noise impacts from aircraft operations are inherently linked to the flight paths and operating procedures implemented at an airport. Aircraft in-flight or when landing, taking off or taxiing at an airport and their associated impacts are regulated by laws and regulations such as the *Air Services Act 1995*, the *Airspace Act 2007*, *Air Navigation Act 1920*, Air Navigation (Aircraft Engine Emissions) Regulations and the Air Navigation (Aircraft Noise) Regulations. These laws and regulations are administered through the Department of Infrastructure and Regional Development, CASA or Airservices Australia. The ALC would be responsible for managing the impacts of ground-based operations noise generated on the airport site from sources such as aircraft engine ground running, road traffic and construction activities in accordance with the airport's environment strategy and the Airports (Environment Protection) Regulations.

The Commonwealth is responsible for delivering the airspace and flight path design for single runway operations at the proposed airport prior to the commencement of operations. The Department of Infrastructure and Regional Development, in collaboration with Airservices Australia, CASA and the ALC (once appointed), will oversee a detailed airspace and flight path design process prior to the commencement of operations at the proposed airport. The process will include further analysis of flight path options and extensive community consultation.



The consideration of flight path options and airport operating procedures and their consequent noise impacts as part of the detailed airspace and flight path design for the proposed airport is consistent with the delineation of responsibilities described above. Airport operating procedures include measures to control the loudness of noise events, such as noise abatement departure and arrival procedures, and the use of reverse thrust during landings.

The detailed airspace design will consider the safety of all aircraft and airspace users across the Sydney basin, aircraft operation efficiency and opportunities to minimise noise and amenity impacts on all potentially affected communities, sensitive receivers and the environment. All feasible noise abatement and noise respite opportunities will be assessed throughout the design process. This will include:

- during the initial planning phase – the iterative design and assessment of conceptual air traffic management options, including consideration of predicted noise exposure levels and population and effectiveness of noise abatement procedures;
- during the preliminary design and environmental assessment phase – the development, evaluation and validation testing of the preferred preliminary airspace concept and referral of the preferred concept for consideration under the EPBC Act. Government policy on the voluntary acquisition and insulation of properties affected by aircraft overflight noise at the proposed airport would be announced in this phase of work; and
- during the detailed design phase – final development and testing of the proposed airspace design and flight paths based on the EPBC Act process, including comments received during community consultation, and input from all stakeholders to ensure the operating procedures, including noise abatement procedures, are fit for purpose and suitable for implementation.

Identifying flight paths and procedures that minimise aircraft noise impacts at night will be a critical component of this work. The change in air traffic complexity at night enables greater flexibility in designing arrival and departure routes for night time operations and improved scope to minimise aircraft overflight noise impacts from these particularly sensitive operations.

The future airspace design and associated noise abatement procedures will be planned in accordance with *Airservices commitment to aircraft noise management* (Airservices Australia 2013) which aligns with the strategies developed by ICAO in its *Balanced Approach to Aircraft Noise Management*. The design of flight paths for the proposed airport will also be guided by the principles provided in Table 7–1 (see Chapter 7 (Volume 1)). These principles closely align with the above national and international benchmarks for managing aircraft noise.

An ANEF chart based on long term parallel runway operations at the proposed airport will be prepared during the detailed design phase of the future airspace and flight path design process to inform land use planning in the vicinity of the airport site.

The specific noise abatement procedures and noise management measures developed through the airspace and flight path design process will be recorded in the ALC's Noise Operational Environmental Management Plan (see Chapter 11). This record will serve as a baseline for any future proposed amendments to the aircraft overflight noise abatement procedures and noise management measures developed for the proposed airport.

10.7 Conclusion

This chapter provides an assessment of potential aircraft noise impacts associated with Stage 1 operations at the point at which passenger demand reaches approximately 10 million annual passenger movements, which is anticipated to occur around five years after operations commence.

The noise assessment is based on indicative flight paths prepared by Airservices Australia as part of a preliminary proof-of-concept assessment of the air traffic management implications of introducing operations at the proposed airport. A future airspace design process will be undertaken closer to the commencement of operations at the proposed airport and further noise impact assessment would be carried out at that time. This would include further analysis of flight path options, detailed consideration of potential noise abatement opportunities and extensive community consultation.

The specific noise abatement procedures and noise management measures developed through the airspace design process will be recorded in the ALC's Noise Operational Environmental Management Plan. This record will serve as a baseline for any future proposed amendments to the aircraft overflight noise abatement procedures and noise management measures developed for the proposed airport.

The current assessment indicates that for the loudest aircraft operations, long-range departures by Boeing 747 aircraft or equivalent, maximum noise levels above 85 dBA would be experienced at a small number of residential locations close to the airport site. Maximum noise levels of 70–75 dBA could be expected within built-up areas in St Marys and Erskine Park as a result of worst case operations. Maximum noise levels due to more common aircraft types such as Airbus A320 or equivalent are predicted to be lower at 60–70 dBA in built-up areas around St Marys and Erskine Park, and over 70 dBA in some adjacent areas to the south-west of the airport site, notably in Greendale.

On an average day, about 1,500 residents are expected to experience five or more aircraft noise events above 70 dBA.

At night, the Prefer 05 operating strategy is predicted to result in an estimated 48,000 people experiencing more than five events above 60 dBA during the night time period. With a Prefer 23 operating strategy, approximately 6,000 people are predicted to experience on average more than five events above 60 dBA each night (i.e. between 10.00 pm and 7.00 am). This number is predicted to reduce to about 4,000 residents if a head-to-head strategy (both approaches and departures to the south-west) is used when weather conditions and traffic levels permit.

Most recreational areas would not be subject to aircraft overflight noise events with maximum levels exceeding 70 dBA, or their exposure would on average be less than one event per day. Aircraft noise levels at Twin Creeks Golf and Country Club would be noticeable—potentially exceeding 80 dBA from departures by the loudest modelled aircraft type—and at times a raised voice would be required for effective communication outdoors. At this location, predicted noise exposure would be significantly reduced under a Prefer 23 operating strategy.

Approaches to mitigating aircraft noise generally focus on reducing noise emissions from the aircraft themselves, planning flight paths and airport operating modes in a way that minimises potential noise and environmental impacts, and implementing land use planning or other controls to ensure that future noise-sensitive uses are not located in noise-affected areas.