Melbourne Airport
M3R MDP

Chapters C1–C3

Volume 5

MELBOURNE AIRPORT

Chapter C1

Airspace - Introduction

Overview

Part C of the M3R MDP describes the potential impact of the project through associated changes in airspace and aircraft operating modalities.

This part of the MDP addresses airspace impact evaluation and assessment requirements in the following chapters:

Chapter C2: Airspace Architecture and Capacity explains the airspace architecture and operating modes associated with the current operation of Melbourne Airport. It defines the factors that influence the design of airspace architecture and the specific requirements for parallel runway operations. The chapter then presents the preliminary airspace architecture for M3R and explains the proposed day and night modes of operation when M3R is opened.

In presenting the M3R preliminary airspace architecture, the chapter documents the mitigations inherent in the design, in particular the opportunities for noise abatement in the proposed modes of operation. This discussion considers the mitigations in the context of international and Australian standards and recommended practices for the design and operation of airspace for parallel runways.

Chapter C3: Aircraft Noise Modelling Methodology details the approach to modelling predicted aircraft noise exposure associated with the changes to Melbourne Airport's operating modes and airspace that are required for M3R. To aid in understanding the assessment of aircraft noise the chapter provides an overview of the different descriptors of aircraft noise and discusses the methodology used to develop the aircraft noise modelling for M3R.

Chapter C4: Aircraft Noise and Vibration presents the outcomes of modelling for the proposed flight operations associated with M3R. Existing and forecast noise exposure results are presented for 'Build' and 'No Build' scenarios (i.e. with and without M3R). Constraints, assumptions and impact mitigations that have been incorporated in the proposed airspace design are presented.

Chapter C5: Airspace Hazards and Risks assesses the hazards and risks to aircraft, people, property and fauna (specifically birds) associated with the construction and operation of M3R. It considers applicable legislation and policy requirements, potential impacts of M3R and associated assessment methodology. Where practicable, specific measures to avoid, manage, mitigate and/or monitor these impacts are described.


ALAND

Chapter C2

Airspace Architecture and Capacity

Summary of key findings:

- Most parts of Melbourne currently experience some level of aircraft noise during the day
- To facilitate new parallel runway operations, changes to airspace architecture including new flight paths and airport operating modes are required.
- New flight paths for approaches and departures on the new runway, and changes to existing flight paths, will also be required.
- Flight paths for Melbourne Airport's Third Runway (M3R) have been developed by Melbourne Airport with assistance from Airservices Australia, considering the latest design criteria that apply to parallel runway operations.
- These flight paths consider safety, air traffic management, aircraft noise, environmental and social impacts.
- Procedures have been put in place to ensure safe and efficient airspace operations, including providing access for all airspace users.
- The airspace architecture has been designed to minimise community impacts as much as possible through the incorporation of flight path design principles intended to avoid, manage or otherwise minimise the unavoidable residual impacts.
- Opportunities exist to further reduce these residual impacts in future.


Virgin
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C2.1
INTRODUCTION

This chapter explains the factors that affect airspace operations at Melbourne Airport, and examines the airport runway operations, flight paths and airspace changes required to support M3R. This information is provided to help the reader understand the movement of aircraft in flight, and therefore the potential aircraft noise impacts, that will result from M3R. The work was undertaken for Melbourne Airport by specialist consultants including REHBEIN Airport Consulting, SoundIN, and To70 Aviation (Australia).

The airspace changes proposed in this chapter represent the flight paths and airspace operating principles that Melbourne Airport envisages will be adopted for operations on the parallel runways following completion of M3R. The flight paths presented in the preliminary airspace design in this Major Development Plan (MDP) consider prior experience with existing parallel runway systems in Australia, and incorporate current international and Australian standards and recommended practices for the design and operation of airspace for parallel runways. Airservices, Melbourne Airport and Essendon Fields Airport have worked closely together to form a collective understanding of how these standards would be applied to the future operation of the Melbourne Basin airspace.

In developing this preliminary airspace design, proposed flight paths and draft runway operating plans have been subject to multiple and iterative reviews with the objective of optimising outcomes (i.e. minimising the unavoidable residual impacts of aircraft noise on communities).

It should be noted these concepts are by necessity preliminary. Future developments in airspace design rules, aircraft technology and navigation systems, as well as the detailed design of the future Melbourne Basin air traffic management network, could result in changes to the proposed airspace architecture before opening day.

Airservices have agreed in principle with the feasibility of the proposed airspace changes and draft runway operating plan (refer to **Chapter E4: Draft Runway Operating Plan**). Before any flight path changes are implemented it is required to complete a full safety case for each element of the design and obtain approval from CASA to operate in accordance with the proposed concept. This process commenced with the preliminary airspace design but is not expected to be complete until the detailed airspace design is finalised just prior to the opening of M3R.

C2.1.1
Structure of this chapter

This chapter is structured as follows:

- **Section C2.2** provides background information on the general issues and concepts that relate to airspace operations and existing Melbourne Airport operations. This section explains the general impact of M3R on airspace and aircraft noise, thereby establishing a basis for understanding the detailed airspace architecture changes presented in the rest of the chapter.
- **Section C2.3** describes the existing flight paths and runway modes in operation at Melbourne Airport.
- **Section C2.4** outlines the methodology for developing the proposed flight paths and possible operating concepts, the key inputs and sources of data used, and applicable statutory and policy requirements.
- **Section C2.5** discusses the changes to airspace architecture envisaged as a result of M3R, including proposed flight paths and modes of operation.
- **Section C2.6** summarises the aircraft noise and emissions avoidance, mitigation and management measures that have been incorporated into the preliminary airspace architecture design.

C2.2
BACKGROUND TO AIRSPACE ARCHITECTURE

This section provides background information on the general concepts and issues relating to airspace operations, including relevant background to existing Melbourne Airport operations. It is intended to help understand the effects of M3R on airspace operations and consequent impacts (such as on aircraft noise and local air quality). Explanation of these factors will establish the basis for considering the airspace architecture changes presented in the rest of the chapter.

Airspace operations at Melbourne Airport are affected by several factors. It is important to understand how these factors influence how aircraft are required to operate. The following factors have a fundamental effect on the operation of airspace and are discussed in detail in the sections below.

- Weather conditions, including variations at different times of the day/year
- Flight paths, including origin/destination
- Volume of aircraft traffic
- Air Traffic Control (ATC) procedures
- Runway modes of operation and their capacity.

Important terms used to describe airspace architecture are defined in **Section C2.2.1**.

C2.2.1
Descriptors of airspace architecture

A number of terms are used to describe the airspace architecture associated with an airport's runway(s). The most important are described below.

- A Standard Instrument Departure (SID) is a pre-defined departure route which aircraft follow from take-off to join the 'en-route' phase of flight. The SID keeps the aircraft on a safe vertical and lateral track with respect to terrain, obstacles and other aircraft. Where possible, it balances the needs of environmental (aircraft noise and emissions) and airspace management considerations.
- A Standard Terminal Arrival Route (STAR) is a pre-defined arrival route which an aircraft follows from the en-route phase of flight to the commencement of the approach and landing phase. Each STAR keeps the aircraft on a safe vertical and lateral track with respect to avoidance of terrain, obstacle and other aircraft, and where possible balances the needs of environmental (aircraft noise and track miles required) and airspace management considerations.
- STARs and SIDs are types of 'instrument' (i.e. programmable) flight procedures that facilitate the safe and efficient flow of air traffic. The procedures manage traffic flows strategically using defined routes, speed and altitude restrictions, and enable safe flight in all weather and visibility conditions. Instrument procedures assist ATC management of safe, efficient and environmentally responsible arrival and departure sequences.
- A 'waypoint' is a specified location used to define an air navigation route. They are identified as either 'fly over' or 'fly by' to indicate whether the aircraft flies over or by the waypoint. A SID or a STAR may incorporate a string of waypoints which require an aircraft to execute actions and adjust heading or altitude.
- An Instrument Approach Procedure (IAP or instrument approach) is a series of predetermined manoeuvres that provide specific protection from obstacles and terrain. An IAP is used for the orderly transfer of an aircraft from the end of the STAR to a landing, or to a point from which a landing may be executed visually. The instrument approach itself commences at an Initial Approach Fix (IAF).
- Visual and Instrument Flight Rules (VFR/IFR) govern how aircraft are flown, and how safe separations are maintained in differing meteorological conditions:
    - When flying using VFR, pilots may navigate by sight as well as by reference to specialised instruments in the aircraft's cockpit. Flights using VFR must fly in clear weather, known as Visual Meteorological Conditions (VMC).
    - When operating IFR, pilots fly by reference to the specialised instruments in the aircraft's cockpit alone. Flights using IFR can fly in VMC as well as in poor weather known as Instrument Meteorological Conditions (IMC). Flight in IMC requires increased separation between aircraft.

- Performance-Based Navigation (PBN) requires that aircraft be capable of meeting navigation performance requirements for accuracy, integrity, continuity, availability and functionality. Australia's implementation of PBN uses the Required Navigation Performance (RNP) family of navigation specifications dependent on a Global Navigation Satellite System (GNSS) such as the Global Positioning System (GPS) and on-board navigation performance monitoring to ensure precise flight path management. PBN in Australia is not reliant on ground-based radio navigation aids.
- GNSS is a network of satellites that forms the enabling technology for RNP navigation procedures.
- An Instrument Landing System (ILS) is a highly accurate radio navigation aid which transmits signals to inbound aircraft in poor visibility conditions. Aircraft join an ILS at approximately 10 nautical miles (18 kilometres) from the target runway on extended runway centreline. An ILS enables a 'precision approach' facilitated by two main components:
    - A localiser, which provides horizontal position guidance
    - A glide path, which provides vertical position guidance
- A GBAS Landing System (GLS) is a GNSS-based alternative to an ILS that also provides precision approach capability. GLS consists of a GPS system and a Ground Based Augmentation System (GBAS) which uses a ground station to provide corrected GNSS data to suitably equipped aircraft. It offers guidance and control similar to an ILS when landing in low visibility.
- Runway Modes of Operation (RMO) consist of different combinations of runway direction and operating rules. The capacity of a runway mode (the mode capacity) is the maximum number of aircraft movements per hour that can be processed safely and consistently. The mode capacity is dependent on the number of runways in use, and the degree of interaction between aircraft movements on different runways.

C2.2.2
Weather

Weather conditions fundamentally influence airport operations by determining which runway(s) are safe and available for use, and the type of approach and departure procedures required for safe operations. These factors determine the flight paths flown by aircraft as they arrive and depart from the airport.

There are several ways in which weather affects aircraft operations:

- Wind direction and speed (which dictate what runways can be used and the direction of take-off and landing)
- Whether or not the runway is wet or dry (different operating rules apply if the runway is wet)
- Visibility and/or the height of the cloud base. These determine which aircraft operating rules and flight paths can be used. (In certain conditions, some of the airport's runways may not be available for use)
- Independent parallel approaches to parallel runways spaced by less than 1,525 metres between centrelines may be suspended under significant weather conditions. These include thunderstorms, wind shear, turbulence, crosswind and downdrafts.

C2.2.3
Wind direction

Wind at an airport is typically described in terms of 'headwind', 'crosswind' and 'tailwind' components. The vector component of the wind blowing perpendicular (at right angles) to the runway is the crosswind. The headwind or tailwind is the vector component of the wind blowing along the runway centre line.

Figure C2.1 illustrates the crosswind and tailwind components of the existing east-west runway (09/27) for a 25-knot north-easterly.

Standard runway operations (landings and take-offs) are conducted 'into the wind' (i.e. with a headwind). This tactic enables aircraft to achieve the required lift for take-off at a slower speed and reduces the distance required for decelerating upon landing. Aircraft are easier and safer to control during these critical phases of flight, and air traffic management is orderly.

Wind direction is important at Melbourne Airport for two main reasons:

1. It affects which runway(s) (east-west or north-south oriented) are operationally suitable for arrivals and departures, and the direction in which those available runways will be used.
2. It is a key factor in designing the location and orientation of any proposed runways, as they must be constructed for optimal use of the prevailing winds.

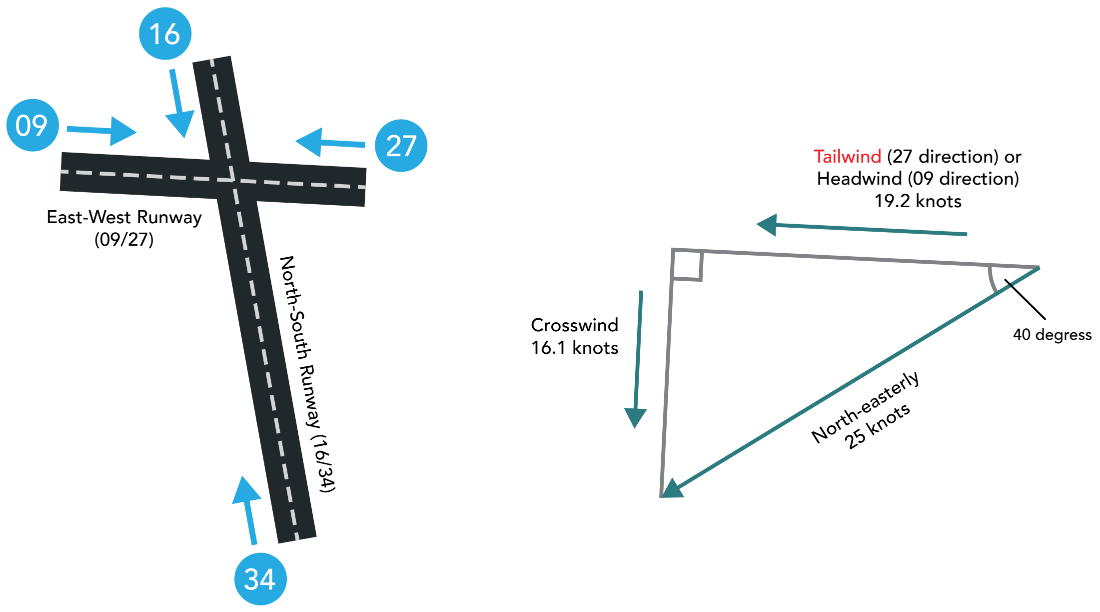
Meteorological information has been collected at Melbourne Airport for many years by the Bureau of Meteorology (BoM) and Airservices. This data allows wind speed and direction patterns to be well understood. Prevailing winds at Melbourne Airport are generally northerly for most of the year, however during summer there is a more southerly component. Winds are generally much lighter during the night (11pm to 6am) than during the day (6am to 11pm).

These wind patterns influence both the existing and anticipated future runway operating modes as described in Section C2.3 (existing runway modes of operation) and Section C2.5 (changes to airspace architecture).

C2.2.4
Wind speed

Further to wind direction, wind speed is important for ATC in deciding which runway(s) can be operated at any time. Rules defined by CASA currently stipulate that a runway cannot be nominated for use by ATC if the

Figure C2.1
Crosswind and tailwind on east-west runway (09/27) for a 25-knot north easterly



Source: APAM, 2020

crosswind for that runway exceeds 20 knots, or if the tailwind exceeds five knots (if the runway is dry) or zero knots (if the runway is wet).

If a pilot considers conditions are not appropriate to operate on the nominated runway, they may request the use of another runway. This may be because of the runway length or type of instrument approach available. However, during busy periods at a major airport like Melbourne, unless the situation is an emergency the aircraft may have to wait until the requested 'off-mode' movement can be accommodated into the ATC arrival and departure plan.

C2.2.5
Visibility

Clear weather with little or no cloud provides the optimum conditions for aircraft operations. Such conditions allow the greatest flexibility (and therefore capacity) for ATC management of traffic.

Rain, low cloud or fog conditions can reduce visibility to the extent that pilots may be unable to see the runway well enough to use visual cues (e.g. runway lighting systems) as they approach. In these situations, IAPs are used to guide the aircraft safely to a point from which the pilot can see the touchdown point on the runway or use the aircraft's auto-land capability.

ATC can use visual separation techniques to flexibly alter flight paths and improve efficiency in VMC. However, in IMC aircraft must follow strictly defined flight paths and altitudes to ensure safety. The weather conditions at Melbourne Airport are monitored continuously by ATC, and in controlled airspace (like that surrounding Melbourne Airport) ATC determines, based on the conditions, which procedures can be applied (visual or instrument). The standards for determining when VMC and IMC apply are prescribed in relevant Australian Aeronautical Information Publication (AIP) to which all aircraft operators must refer.

C2.2.6
Rain

The operating rules for aircraft are different if the runway is deemed to be wet (i.e. potentially slippery). This can occur if it is, or has recently been, raining - even very lightly.

When a runway is wet, safety considerations generally do not allow operations with any tailwind element (up to five knots of tailwind may be allowed when operating a dry runway, tailwind must be zero knots when operating a wet runway). Wet runway conditions generally also increase the runway distances required for aircraft to take-off and land. Some aircraft may be unable to use certain runways when wet.

C2.2.7
Flight paths

Flight paths are designated three-dimensional routes that guide safe flight between destinations, including manoeuvres for airport arrivals/departures. Ideally, for maximum economy and efficiency of flight operations, aircraft fly the most direct route at the optimum altitude. However, flight paths also account for airspace system considerations including safety, noise abatement rules and interaction with other airspace users.

To ensure safe and efficient separation between aircraft, they depart and arrive at Melbourne Airport according to published SIDs and STARs. The SID and STAR procedures are followed most closely in IMC but, for practical air traffic management reasons during busy periods, most aircraft will follow the designated SID or STAR.

Where arrival and departure flight paths cross, aircraft operate at specified altitudes to ensure safe vertical separation (e.g. departing aircraft may be directed to fly at lower altitudes until they have passed arriving flights operating above).

Generally, in close proximity to the airport, departing aircraft generate greater noise levels (as perceptible from the ground) than arriving aircraft. Therefore, where it is safe to do so, the climb phase for departing flights is often prioritised over arrivals. In many circumstances this can help to reduce the noise that is experienced from the ground. It also reduces the amount of fuel a departing aircraft requires to reach cruise altitude.

Airspace architecture design seeks to ensure, as far as possible, that it enables Continuous Climb Operations (CCO) and Continuous Descent Operations (CDO) with the required ATC separation between departing and arriving aircraft assured whenever they are following the respective SID and STAR procedures.

While flight paths are usually indicated as single lines on a chart, it is not possible for all aircraft to precisely follow the same track. Aircraft performance, loading, flight distance and wind strength all affect the rate at which aircraft climb and, consequently, the point at which some turns may be commenced. Aircraft may be travelling at different speeds when executing a turn, which affects the radius of the turn. Aircraft may be given specific heading instructions by ATC (known as vectoring) to ensure separation and sequencing requirements are met. This can allow the aircraft to 'shortcut' the SID or STAR to reduce unnecessary distance and/or manoeuvres, or to enable more efficient sequencing of traffic.

All of these factors result in spreading the tracks flown by individual aircraft away from the defined flight path. So, in practice, individual aircraft flight paths tend to occur within corridors varying from very narrow to several kilometres wide.

C2.2.8
Volume of aircraft traffic

The various Runway Modes of Operation (RMO) and associated air traffic management procedures generate a certain movement capacity (i.e. the number of aircraft that can safely land or take off in a certain period - normally described as an hourly rate.)

Traffic demand (i.e. the number of aircraft that wish to land or take off in a certain period) will therefore affect which available modes of operation are used.

For instance, at Melbourne Airport, the Land and Hold Short Operations (LAHSO) mode (see **Section C2.2.12**) provides a higher arrivals capacity than other modes but conversely a lower capacity to handle departures. This operating mode can therefore be useful when there are a large number of arriving aircraft and when significant airborne delays would otherwise occur.

As detailed in **Section C2.2.2**, weather will also be a limitation on when the different operating modes can be used. Using the above example of LAHSO, it may be desirable to operate the mode for capacity reasons, but weather conditions may prevent it from being adopted (e.g. when cloud base or a tailwind on runway 34 exceeds allowable limits).

Other factors also affect the implementation of certain operating modes, such as the use of Noise Abatement Procedures (NAP). Refer to **Section C2.2.14** for further details.

C2.2.9
Air Traffic Control procedures

Air Traffic Control (ATC) procedures define the specific rules that apply to every flight. These rules differ for varying operational circumstances; and are affected by such factors as weather, time of day, traffic demand, aircraft performance and pilot capability (including their familiarity with local conditions).

Whilst airports in Australia have the same fundamental consistency in design, procedure implementation and ATC management, each airport in Australia has a set of ATC procedures relevant to its operation. These are set out in the AIP, which is regularly updated and available to all aircraft operators flying to/from/within Australia. The procedures include the following:

- SID and STAR (refer to **Section C2.3.1** for the existing flight paths for Melbourne Airport)
- Visual and instrument weather criteria
- Instrument Flight Procedures
- Runway nomination rules
- The flow and priority of aircraft movements
- Noise Abatement Procedures.

Runway operations are managed by ATC using a variety of procedures to ensure safe and efficient operations of arriving and departing air traffic. While ensuring safety is the primary consideration, ATC will determine the optimal runway to be used (based on wind and weather conditions, type of aircraft, direction of the flight and traffic efficiency conditions) and will implement NAPs when weather conditions and airport capacity allow. ATC will also select the appropriate approach or departure procedures and flight paths (including any vectoring) based on traffic demand and aircraft capability.

Pilots are ultimately responsible for safety of aircraft and can require an alternative procedure.

Current ATC procedures relevant to Melbourne Airport are discussed in following sections.

C2.2.10
Instrument and visual weather criteria

The weather criteria currently used at Melbourne Airport to determine whether an instrument or visual approach will be prescribed are:

- Where the majority of cloud cover is higher than 1,600 feet above ground level (2,200 feet for LAHSO – see **Section C2.2.12**) and the visibility is eight kilometres or more – a visual approach may be nominated.
- Where the majority of cloud cover is lower than 1,600 feet above ground level or the visibility is eight kilometres or less – an instrument approach will be nominated on the Computerised Automatic Terminal Information Service (CATIS).
- Where cloud cover is lower than 600 feet above ground level or the visibility is less than 550 metres, then a Category II/III approach using the ILS will be required. Currently, there is a Category II/III ILS only on runway 16.

C2.2.11
Runway nomination rules

ATC is responsible for nominating the duty operating runways at Melbourne Airport (the duty runway indicates the operating direction of the runway). A single direction for landings and take-off on each runway is nominated (for example landings on runway 27 and take-off on runway 16). In some circumstances, more than one runway may be nominated for landings or for take-offs but only one of the two possible operating directions for each runway can be nominated at any time.

In nominating the duty runway(s) ATC will follow specific weather, operational and noise abatement provisions. **Figure C2.2** is an extract from the AIP, AIP ENR 1.5 (02 Dec 2021), which describes the conditions adhered to when nominating runways for operations at airports in Australia.

C2.2.12
Land and Hold Short Operations (LAHSO)

Melbourne Airport uses LAHSO on runway 34 during peak periods (when wind conditions allow). LAHSO is an ATC procedure used to increase airport capacity without compromising safety. During LAHSO at Melbourne Airport, aircraft may land on runway 34 and exit the runway before the intersection with runway 09/27. This allows sequenced landing and take-off operations to continue on the east-west runway with minimal disruption.

Pilots may accept a LAHSO clearance provided that the pilot-in-command is approved to use the procedure and has determined the aircraft can safely land and stop within the available landing distance. The length of the existing north-south runway (16L/34R) and the location of the intersection with the existing east-west runway (09/27) mean that aircraft at Melbourne can safely use this mode when necessary. LAHSO is only available for certain aircraft types flown by authorised domestic and New Zealand operators.

Figure C2.2
Extract from Section 9.1.2 of AIP ENR 1.5-42 (02 Dec 2021)

ENR 1.5 - 42 02 DEC 2021 AIP Australia

Where noise abatement procedures are prescribed, and ATC traffic management permits, the runway nomination provisions of DAP NAP will be applied. Not withstanding this, noise abatement will not be a determining factor in runway selection under the following circumstances (unless required by Noise Abatement legislation):

a. in conditions of low cloud, thunderstorms and/or poor visibility

b. for runway conditions that are completely dry:

(1) when the crosswind component, including gusts, exceeds 20KT;
(2) when the tailwind component, including gusts exceeds 5KT;

c. for runways that are not completely dry:

(1) when the crosswind component, including gusts, exceeds 20KT;
(2) when there is a tailwind component;

d. when wind shear has been reported;

e. when, in the opinion of the pilot in command, safety would be prejudiced by runway conditions or any other operational consideration.

Source: Airservices Australia

C2.2.13
Sequencing aircraft movements

In order to assure safe separation between aircraft and the effects of wake turbulence, flights may be 'distanced' at various phases of flight (distances between aircraft vary depending on aircraft size and weight). On-airport, the application of separation requirements and the efficiency of the on-ground infrastructure determine the capacity of the runway system.

Where wake turbulence is not a limitation, the minimum spacing for arriving aircraft in different weather conditions at Melbourne Airport are shown in **Table C2.1**.

Table C2.1 indicates how the runway approach capacity and availability of the air traffic system function is reduced due to worsening weather and visibility conditions. For example, ATC sequencing distance for arrivals in visual conditions ranges from three to five nautical miles for all specified runway directions, whereas for low cloud cover the separation distance increases to 10-15 nautical miles and only runway 16 may be used for arrivals. The maximum aircraft arrival rate per hour for a specified mode therefore reduces as weather worsens and the distance required between aircraft increases.

When the same runway is being used for both landings and take-offs, departing aircraft are typically cleared between the arriving aircraft. When one departure follows immediately behind another, the second aircraft will not be given clearance to take off until the first one has met certain criteria such as having crossed the up-wind end of the runway in use, or commenced a turn. The sequencing of departures also depends on several other factors (including wake turbulence and relative aircraft speeds) to ensure safe separations are established.

C2.2.14
Noise Abatement Procedures

The existing NAP incorporated into air traffic management for Melbourne Airport are designed to direct as much air traffic as possible away from the most densely populated areas during the most noise-sensitive part of the flight (i.e. take-offs and landings when aircraft are below 3,000 feet). The existing NAP indicate:

- The preferred runways to be used for take-offs and landings
- The preferred flight paths for arriving and departing aircraft.

The preferred runways for operations at Melbourne Airport (as detailed in the existing NAP) provide for landings and take-offs over less populated areas to the north and west of the airport whenever possible. When high arrivals demand requires the use of a LAHSO mode, or when wind conditions mean that only one runway can be used due to strong crosswinds, the arrivals and departures will fly over other areas. The preferred runway modes in the existing NAP are summarised in **Figure C2.3** (for the period 6am to 11pm) and **Figure C2.4** (for 11pm to 6am).

Table C2.1
ATC separation distance behind aircraft over threshold

Runway mode	**Distance behind aircraft over runway threshold**			
	Visual **Cloud base 1,600 ft and visibility >8km** **LAHSO** **Cloud base 2,000 ft and >8km** **09A/16D** **Cloud base 2,100ft and visibility >8km**	**Instrument A** **(CAT I)** **Cloud base 1,200 ft and visibility >8km**	**Instrument B** **(CAT I)** **Cloud <1,200 ft and >200ft and/or visibility between 550m and 8km**	**Instrument C** **(CAT II/III)** **Cloud base ≤ 200 ft and/or visibility below 550m**
27, 16 or 27A-27/34D	5 NM	5 NM	6 NM (27A-27/34D 8 NM#)	15 NM (runway 16 only)
34	5 NM	5 NM	6 NM	N/A
09	5 NM	5 NM	7 NM	N/A
27/34 LAHSO	5 NM	N/A	N/A	N/A
16A/27D	3 NM	4 NM	6 NM	10 NM
09A/16D	4 NM	N/A	N/A	N/A

Source: Airservices Australia
'Cloud base' refers to the lowest base at which scattered or more cloud is present, or where two amounts of 'FEW' cloud added together produce scattered cloud at the higher level AGL.
 # 27A-27/34D mode in instrument B conditions should only be used during low arrival demand.

Furthermore, during the period 11pm to 6am:

- Jet aircraft departing from runway 16 will use the full runway length. This allows engine thrust to be kept to the minimum, reducing aircraft noise levels
- Jet noise abatement climb procedures apply for take-offs on runway 16 and runway 09 at all times.

The existing NAP for Melbourne also specify preferred flight paths that avoid densely populated areas for the noise-sensitive parts of the flight. They also specify additional requirements for minimum heights above ground (3,000 feet for turboprops and 5,000 feet for jets) for those portions of flights over densely populated areas. In cases where it is not possible to avoid take-off or final approach over these areas, climb and descent procedures are specified to minimise noise impacts.

C2.2.15
Climb and descent procedures

Aircraft climb and descent profiles affect noise levels on the ground. In general, the higher the aircraft, the lower the noise impact at ground level. Aircraft performance during climb is affected by a number of factors including:

- Aircraft weight (which varies according to passenger, cargo and fuel loads)
- Ambient air pressure, density and temperature conditions
- Wind speed and direction
- Aircraft configuration
- Aircraft speed and bank angle of turns
- Minimum climb gradient (which may be specified in the SID to achieve obstacle clearance)
- Adjustments to climb rate and speed (to comply with ATC traffic management requirements)
- Safety considerations
- Competing demands of other airspace users.

In addition to affecting the climb rate (which can vary considerably between different aircraft) these factors may also change the point where an aircraft lifts off from the runway.

At Melbourne Airport, noise abatement climb procedures are stipulated as part of the NAPs when jet departures occur from runway 09 or runway 16. Noise abatement climb procedures refer to different combinations of power, thrust and flap settings at specific heights, which have been agreed internationally to minimise noise exposure at different points on the ground.

Throughout the later stages of descent, and on final approach to land, aircraft typically maintain a standard constant descent rate of three degrees (descending about 50 metres for every 1,000 metres travelled towards touchdown).

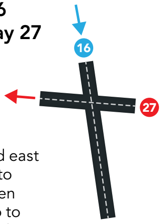
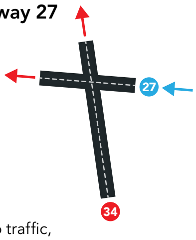
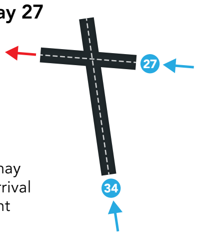
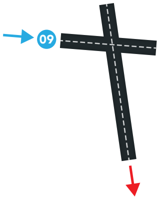
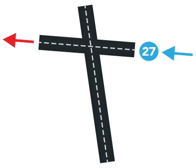
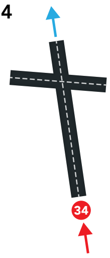
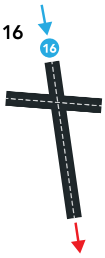
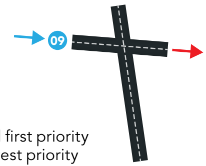
C2.2.16
Missed approach procedures

Missed approach procedures are published for each instrument approach and allow an aircraft unable to complete its landing to safely continue flight remaining clear of obstacles and other operations. Missed approaches are not uncommon and result primarily from a lack of the required visibility for a pilot to acquire the runway system, but also from an unstable approach due to weather conditions, an aircraft technical problem, or an issue on or with the runway. Missed approaches can be initiated by the Pilot or by ATC and commence at the Missed Approach Point (MAP). Missed approach procedures for a parallel runway system require a turn away from the adjoining parallel runway.

C2.2.17
Standards for parallel and near-parallel runway operations

Parallel runway standards apply where the centre lines of adjacent runways are parallel or near parallel. M3R will create a new north-south runway at Melbourne Airport that is 1,311 metres west of, and parallel to, existing runway 16/34. The runway will be designated runway 16R/34L and the existing runway redesignated as runway 16L/34R. Operations on parallel runways are subject to specific rules that ensure the safety of aircraft operations; and the distance between the runways influences the rules applied and the Communication, Navigation and Surveillance (CNS) infrastructure required to support operations. A summary of these requirements is detailed in Table C2.2.

Figure C2.3
Existing noise abatement preferred runway modes (6am to 11pm)

Priority	Day (0600 – 2300)		Day (0600 – 2300) High Capacity Landing Modes
1	**Arrivals Runway 16** **Departures Runway 27**  Runway 16 departure permitted for south and east bound routes. Subject to traffic by propeller driven aircraft or jet aircraft up to B737 / A320 size, but only when there is significant ground delay for a departure from runway 27.	**Arrivals Runway 27** **Departures Runway 27** **& Runway 34**  Runway 34 landing is permitted, subject to traffic, for arrivals from the south and south-west.	**Arrivals Runway 27** **& Runway 34** **Departures Runway 27**  High capacity modes may be used during peak arrival periods when significant airborne delays would otherwise occur.
2	**Arrivals Runway 09** **Departures Runway 16**  Not available between 2300-0600 local time.		
3	**Arrivals Runway 27** **Departures Runway 27** 		
4	**Arrivals Runway 34** **Departures Runway 34** 	**Arrivals Runway 16** **Departures Runway 16** 	
5	**Arrivals Runway 09** **Departures Runway 09**  Runway 09 is equal first priority for landing but lowest priority for take-off. Ad-hoc landings on runway 09 may be available when suitable with overall traffic management.		

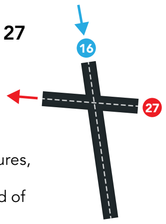
Source: Information from Airservices Australia (figure by APAM)

Figure C2.4
Existing noise abatement preferred runway modes (11pm to 6am)

Priority **Night (2300 – 0600)**

1

Arrivals Runway 16
Departures Runway 27

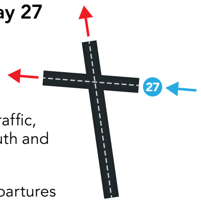


Where there are jet departures requiring the longer runway for departures, priority 2 mode may be nominated by ATC instead of priority 1.

Runway 34 landing is permitted, subject to traffic, for arrivals from the south-west.

2

Arrivals Runway 27
Departures Runway 27
& Runway 34

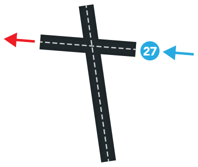


Runway 34 landing is permitted, subject to traffic, for arrivals from the south and south-west.

Where there are jet departures requiring the longer runway for departures, priority 2 mode may be nominated by ATC instead of priority 1.

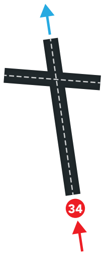
3

Arrivals Runway 27
Departures Runway 27

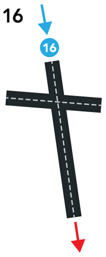


4

Arrivals Runway 34
Departures Runway 34

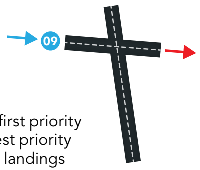


Arrivals Runway 16
Departures Runway 16



5

Arrivals Runway 09
Departures Runway 09



Runway 09 is equal first priority for landing but lowest priority for take-off. Ad-hoc landings on runway 09 may be available when suitable with overall traffic management.

Source: Information from Airservices Australia (figure by APAM)

Table C2.2
Runway separation distances

Distance between runways (m)	Operational advantage	Comment
760	Independent Parallel Departures permitted	Departure paths must diverge 15° from each other and 30° from Missed Approach Paths Wake Turbulence standard met
760	Segregated Runway Operations permitted	One runway used for departure and the other for arrivals Departure and Missed Approach Paths must diverge by 30°
915	Independent Parallel Departures and Dependent Parallel Approaches	Departure path divergence can be reduced, subject to safety assessment
1,035	Independent Parallel Arrivals and Departures	Precision Runway Monitoring (PRM) required (or similar accuracy using multilateration (MLAT) or ADS-B)
1,310	Independent Parallel Arrivals and Departures	Terminal Approach Radar or ADS-B surveillance could be used for runway monitoring if it is determined that the safety of aircraft operation would not be adversely affected
1,525	Independent Parallel Arrivals and Departures	Terminal Approach Radar can be used for runway monitoring

Source: ICAO Annex 14; ICAO Doc 9643

The new runway location was decided following a comprehensive review of many factors which are briefly described below.

C2.2.18
Instrument approaches on parallel runways

Approaches to parallel runways can be 'dependent' or 'independent'. This section provides a simplified description of the rules.

The standards for dependent approaches require that the runway centrelines be separated by at least 915 metres, and that certain ATC surveillance requirements are met. Aircraft can fly a precision approach using ILS or GLS procedures, or a RNP Approach (RNP-AR or RNP APCH). A minimum of three nautical miles lateral radar separation, or 1,000 feet vertical separation, is maintained between aircraft until both aircraft are established on their respective approach procedure, and then aircraft on adjacent approaches must be separated by a minimum distance depending on the separation between the runways.

The standards for independent (simultaneous) instrument approaches on parallel runways require runway centrelines to be separated by at least 1,035 metres and that certain ATC surveillance requirements are met. Aircraft can fly a precision approach using ILS or GLS procedures or an RNP-AR approach. A minimum of three nautical miles lateral radar separation, or 1,000 feet vertical separation, is maintained between aircraft until both aircraft are established on their respective approach procedure. Aircraft on adjacent approaches do not need to be separated.

There are also rules that require ATC to monitor the aircraft on their approaches to ensure that aircraft do not deviate from their assigned paths - if they do, ATC will issue 'breakout' instructions.

Independent parallel arrivals and departures approaches facilitate the greatest traffic flexibility, and therefore the greatest system capacity. M3R's separation of 1,311 metres allows this to occur without the need for Precision Runway Monitoring (PRM), which needs specialised equipment and additional ATC resources.

C2.2.19
Visual approaches on parallel runways

Aircraft may make independent visual approaches to parallel runways with centrelines separated by at least 760 metres provided they are making 'straight-in' approaches commencing either at the ILS outer marker or four nautical miles from the runway threshold. In addition, a minimum of three nautical miles lateral radar separation or 1,000 feet vertical separation must be maintained until certain conditions (regarding being established on an approach or having the runway in sight) are met.

C2.2.20
Parallel runway missed approach procedures

All published approach procedures incorporate instructions on how aircraft should fly in the event that a missed approach procedure needs to be initiated (e.g. if the pilot cannot see the runway at the minimum height prescribed for the procedure). Missed approaches are infrequent but considered normal operations at an airport.

For operations on parallel runways, current rules require that missed approach procedures incorporate paths that diverge by at least 30 degrees laterally, to ensure the safe separation of aircraft. The missed approach path must also diverge 30 degrees from the adjacent runway's departure path during segregated and mixed mode operations.

C2.2.21
Parallel runway use of STAR

STAR procedures may be of an 'open' or 'closed' form. In an open STAR, the flight path described does not connect directly to an instrument approach procedure. Instead, aircraft will be radar vectored from the end of the STAR to an instrument approach procedure or a visual approach.

Closed STARs connect the aircraft directly to an instrument approach procedure.

In Australia both closed and open STARs are used at airports with parallel runways (Sydney relies on open STARs - the new Brisbane parallel runway system uses closed STARs).

Closed STARs are currently used at Melbourne Airport and provide a safe, efficient and predictable manner of operation for airlines and ATC. For the purpose of this MDP, closed STARs have been developed for Melbourne's parallel runway operations, however the final arrangement will be determined during the detailed airspace and flight path design process.

C2.2.22
Parallel runway departures

The standards for independent (simultaneous) instrument departures on parallel runways require the runway centrelines to be separated by at least 760 metres and that certain ATC surveillance requirements met.

For independent departures from parallel runways, in IMC or VMC, standards require that flight paths from the two runways diverge by at least 10 degrees immediately after take-off if aircraft are using SIDs designed to RNP1 requirements. This is generally taken to mean as soon as it is safe to do so, and within two nautical miles (approximately four kilometres) of the departure end of the runway.

The introduction of the new north-south runway (16R/34L) will necessitate that the SIDs for the two runways are designed to meet the applicable standards. This will require a change to the departure procedures from the existing north-south runway (16L/34R).

C2.2.23
Weather criteria for parallel runways

The weather criteria determine whether an instrument or visual approach is used. The criteria currently used at Melbourne for existing operations are described in **Section C2.2.10** and likely to be the same for the same modes of operation with parallel runways.

C2.3
EXISTING CONDITIONS

This section provides a description of existing airspace architecture and aircraft operations at Melbourne Airport. Background information on the issues and concepts that relate to airspace operations to assist the reader in understanding the changes in flight paths and aircraft movements associated with M3R is provided in **Section C2.2**.

C2.3.1
Existing flight paths

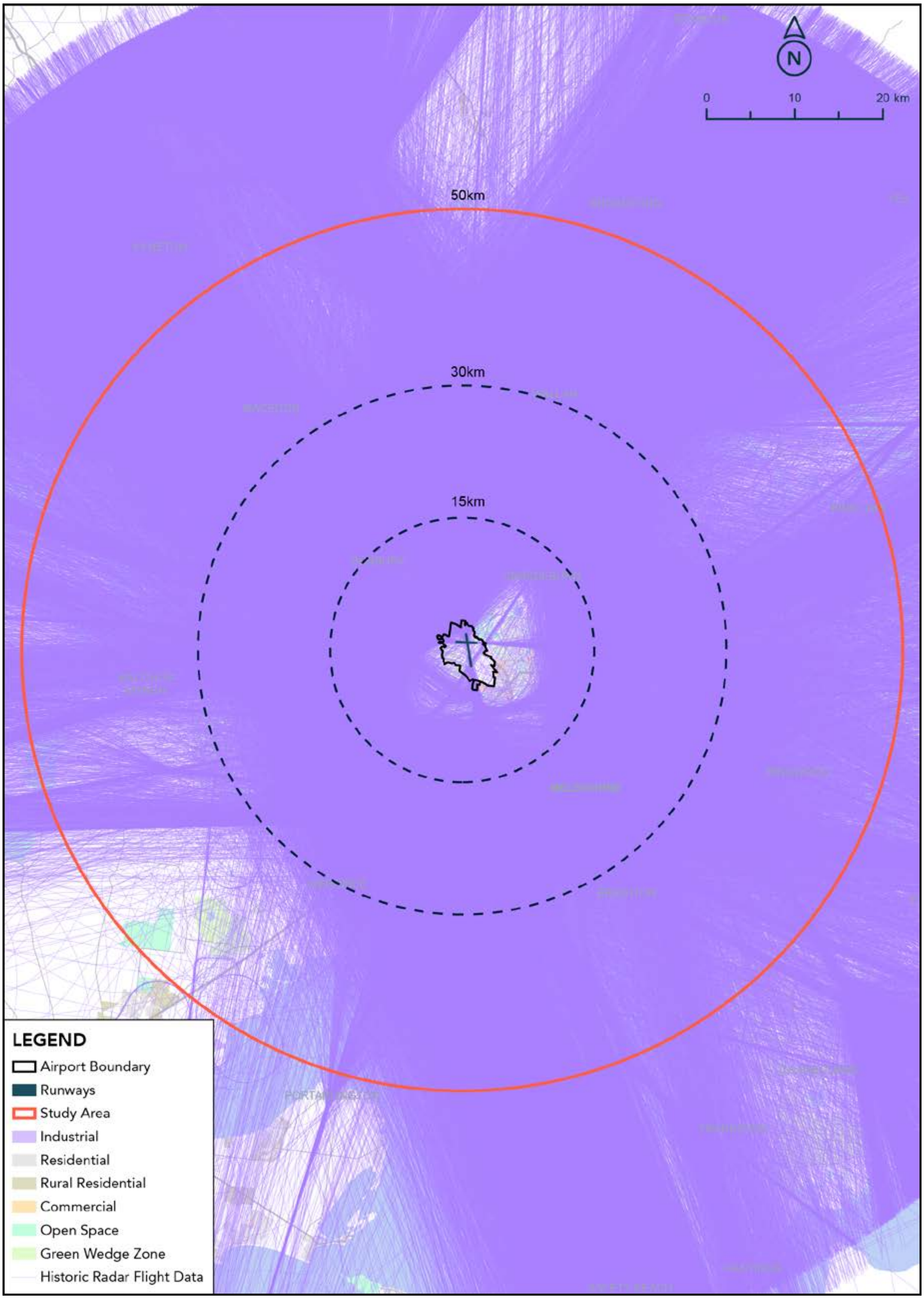
All SIDs and STARs which relate to Melbourne Airport are published as part of the Australian AIP and contained in the Airservices Departure and Approach Procedures (DAP) manual (Airservices Australia, 2020a).

At Melbourne Airport, actual flight tracks of individual aircraft are recorded by Airservices using information from ATC secondary surveillance radars. This information is available via the Airservices WebTrak portal (Airservices Australia, 2019). The tool provides an overview of where aircraft typically fly, as well as an understanding of operations and patterns over time. **Figure C2.5** shows the recorded flight track data for all aircraft operations at Melbourne Airport during 2019 (provided by Airservices).

Figure C2.6 through to **Figure C2.13** show the current flight paths for aircraft arriving and departing on each runway at Melbourne Airport. The altitude of the aircraft is represented in the figures by darker colours indicating lower altitude and lighter colours indicating higher altitude.

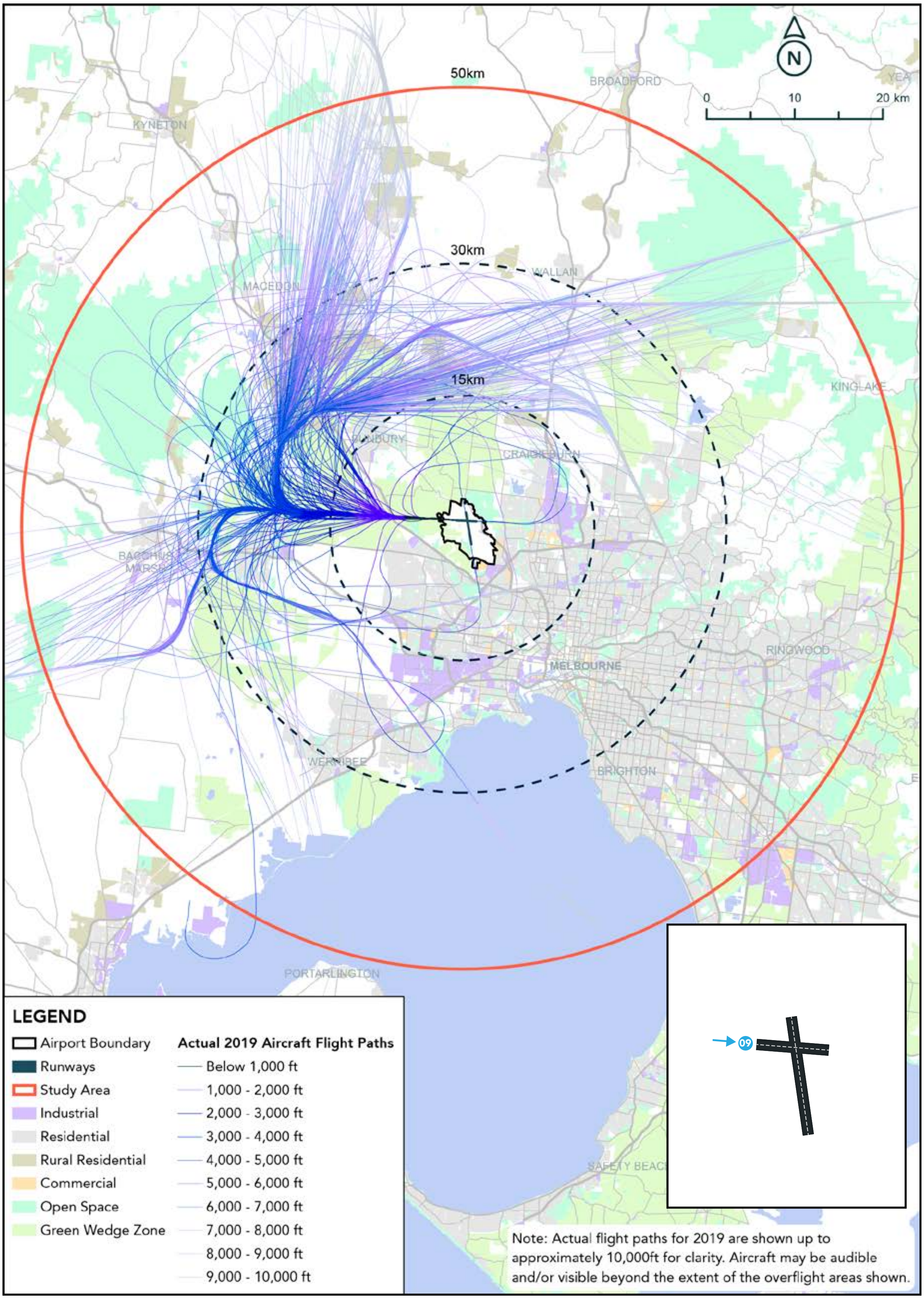
The flight-track divergence from the nominal flight paths for both arrivals and departures is evident in **Figure C2.6** through **Figure C2.13**. This spreading is due to a range of factors, as discussed in **Section C2.2.7**.

Figure C2.5
Historical annual (2019) flight radar data



Source: APAM, 2020 (data from Airservices)

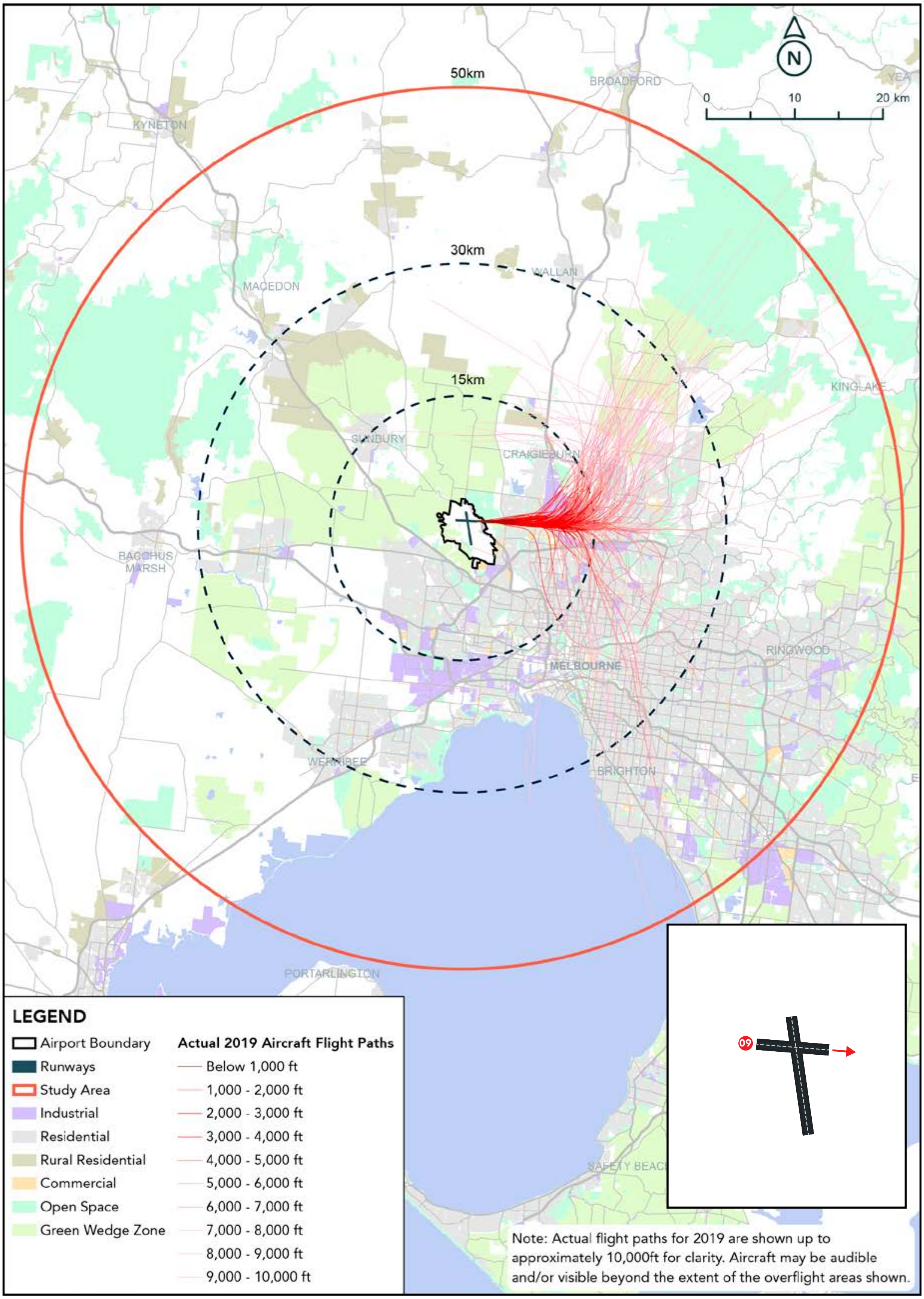
Figure C2.6
Actual 2019 aircraft flight paths – Runway 09 arrivals



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

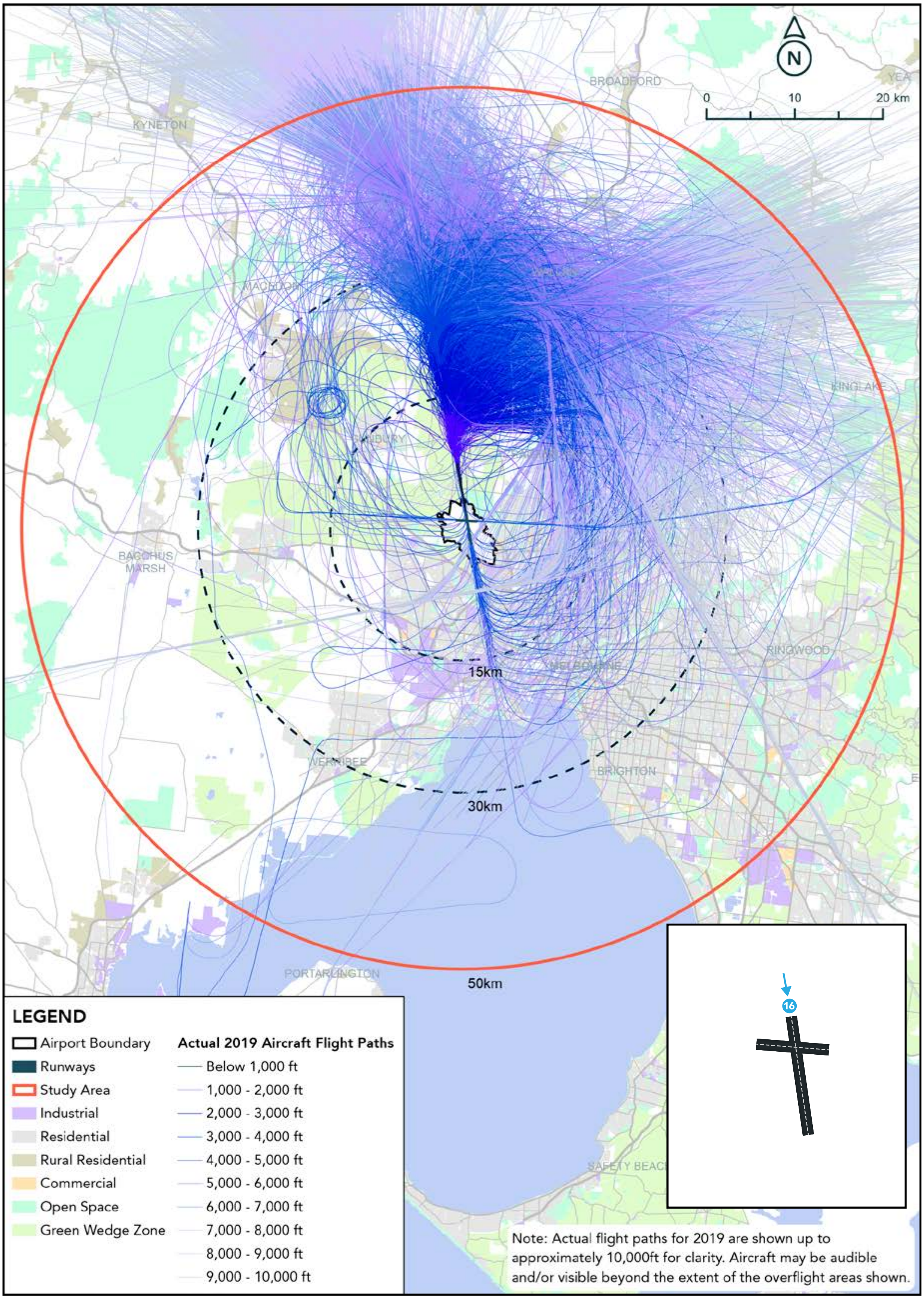
Figure C2.7
Actual 2019 aircraft flight paths – Runway 09 departures



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

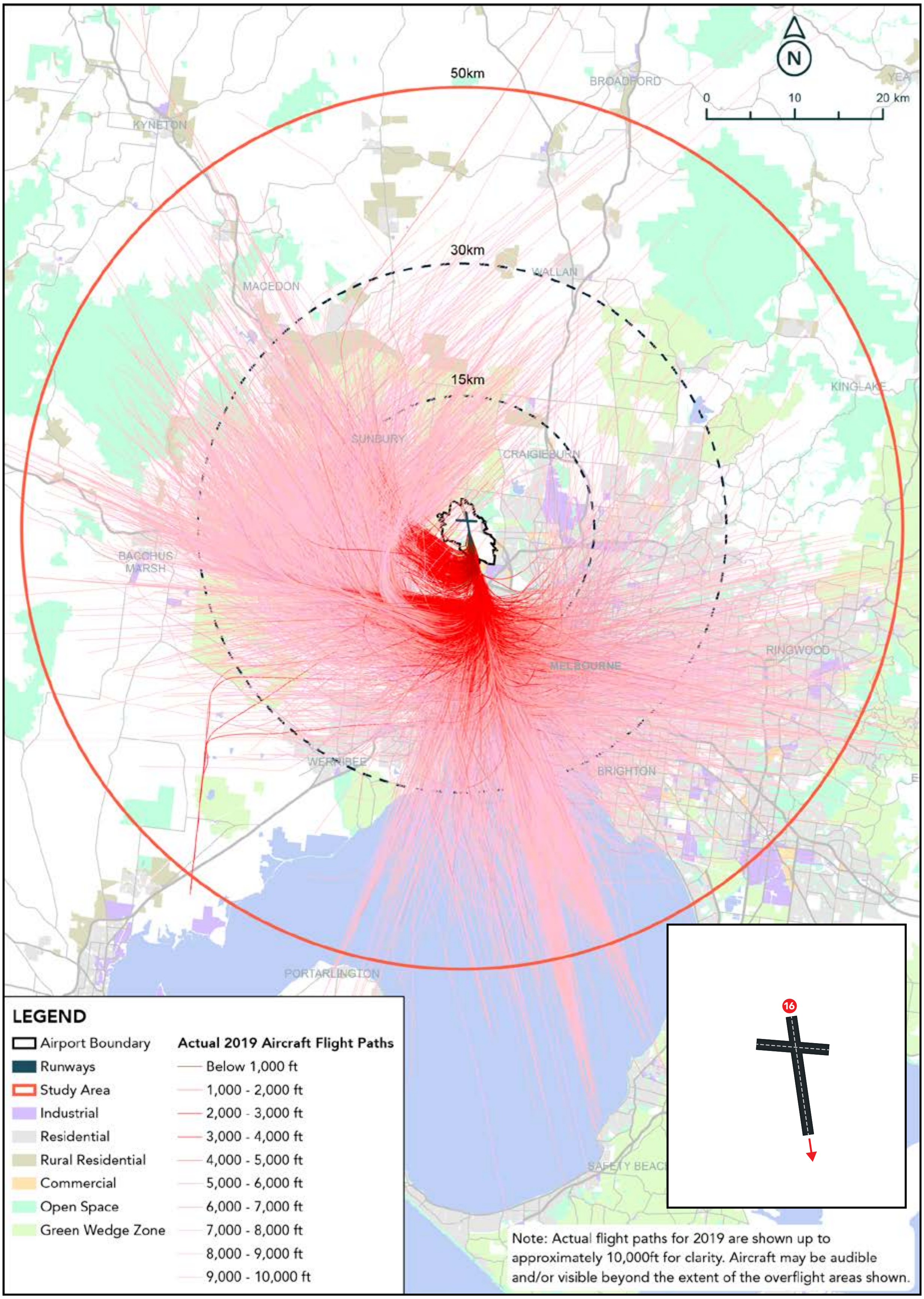
Figure C2.8
Actual 2019 aircraft flight paths – Runway 16 arrivals



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

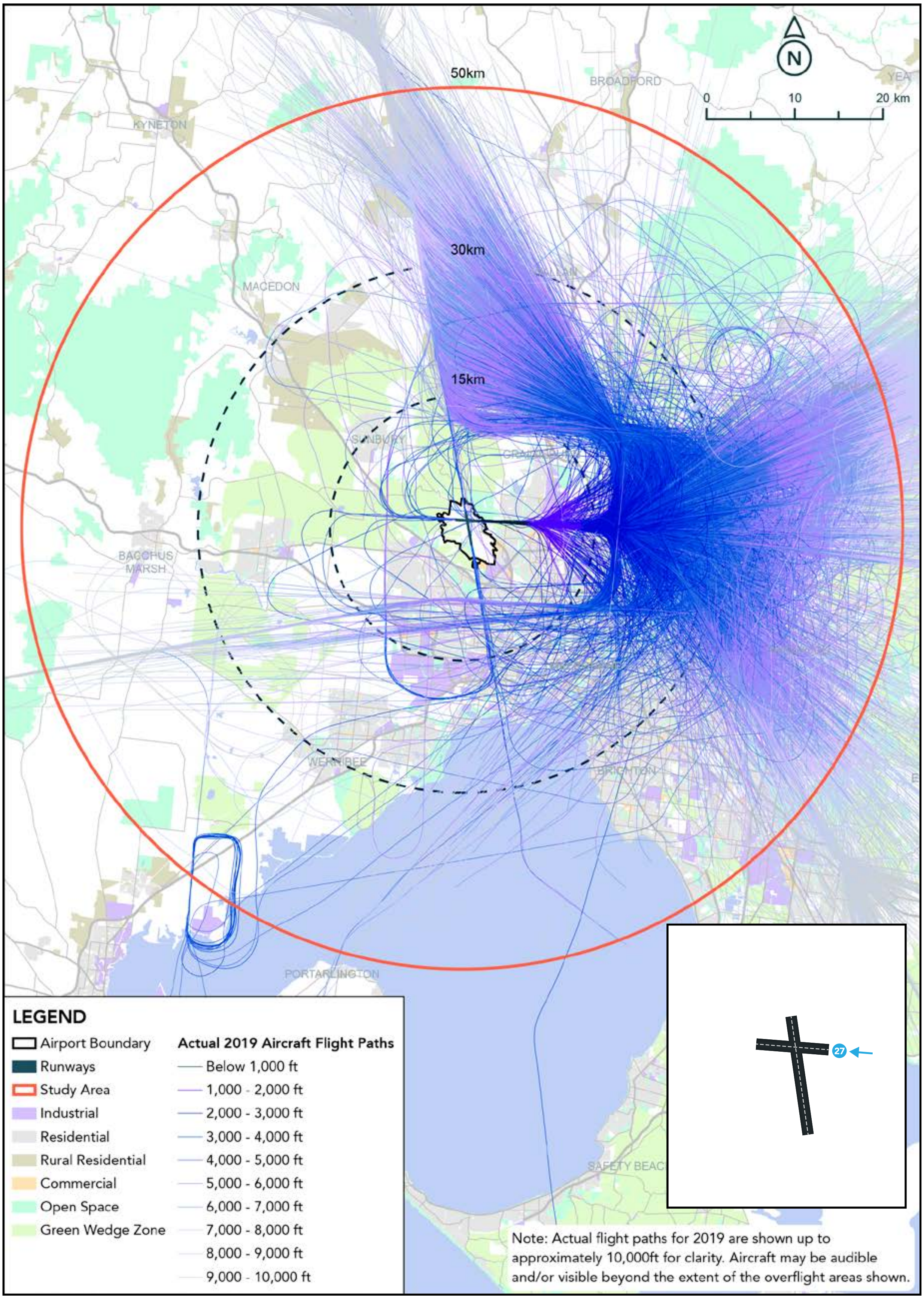
Figure C2.9
Actual 2019 aircraft flight paths – Runway 16 departures



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

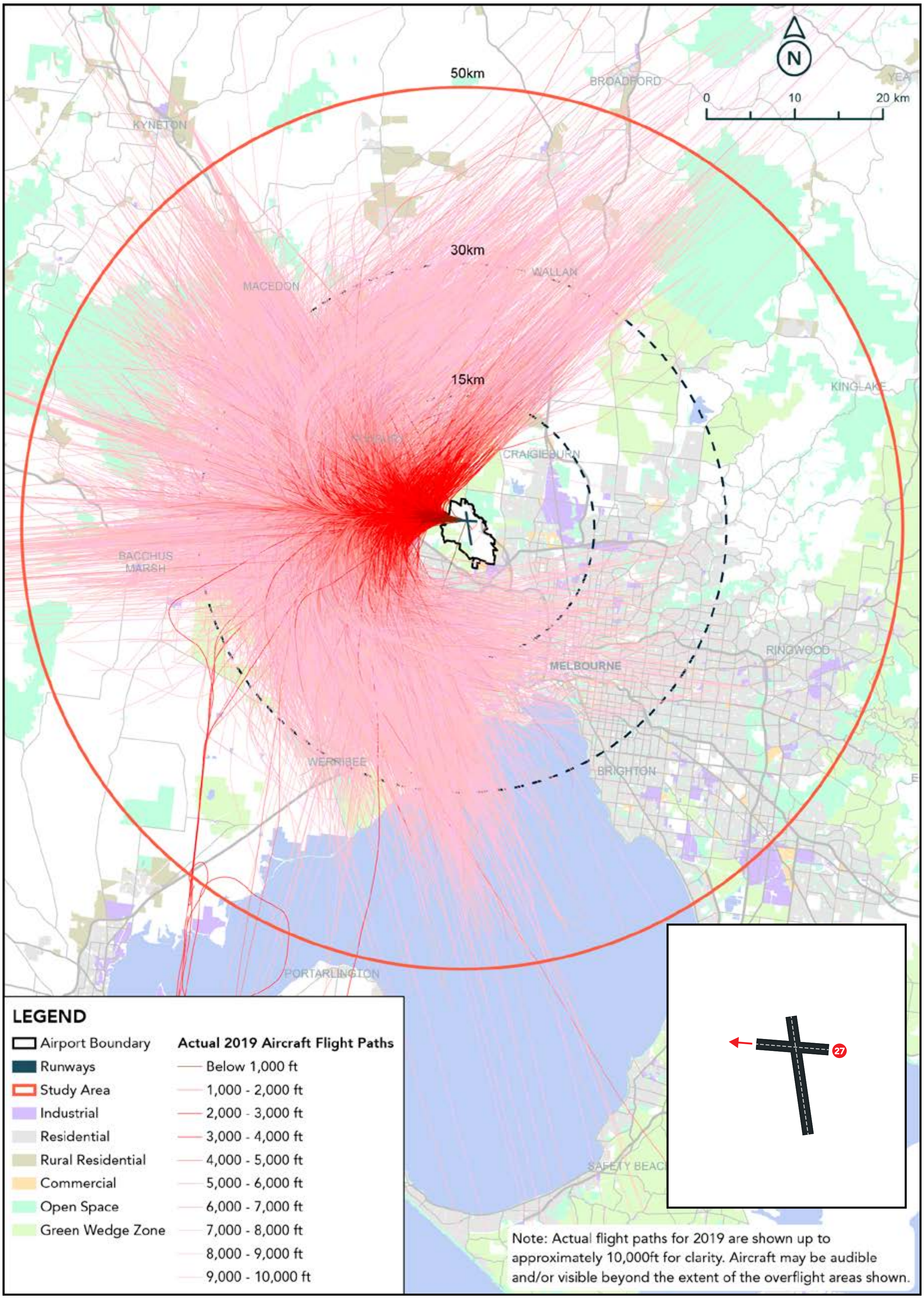
Figure C2.10
Actual 2019 aircraft flight paths – Runway 27 arrivals



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

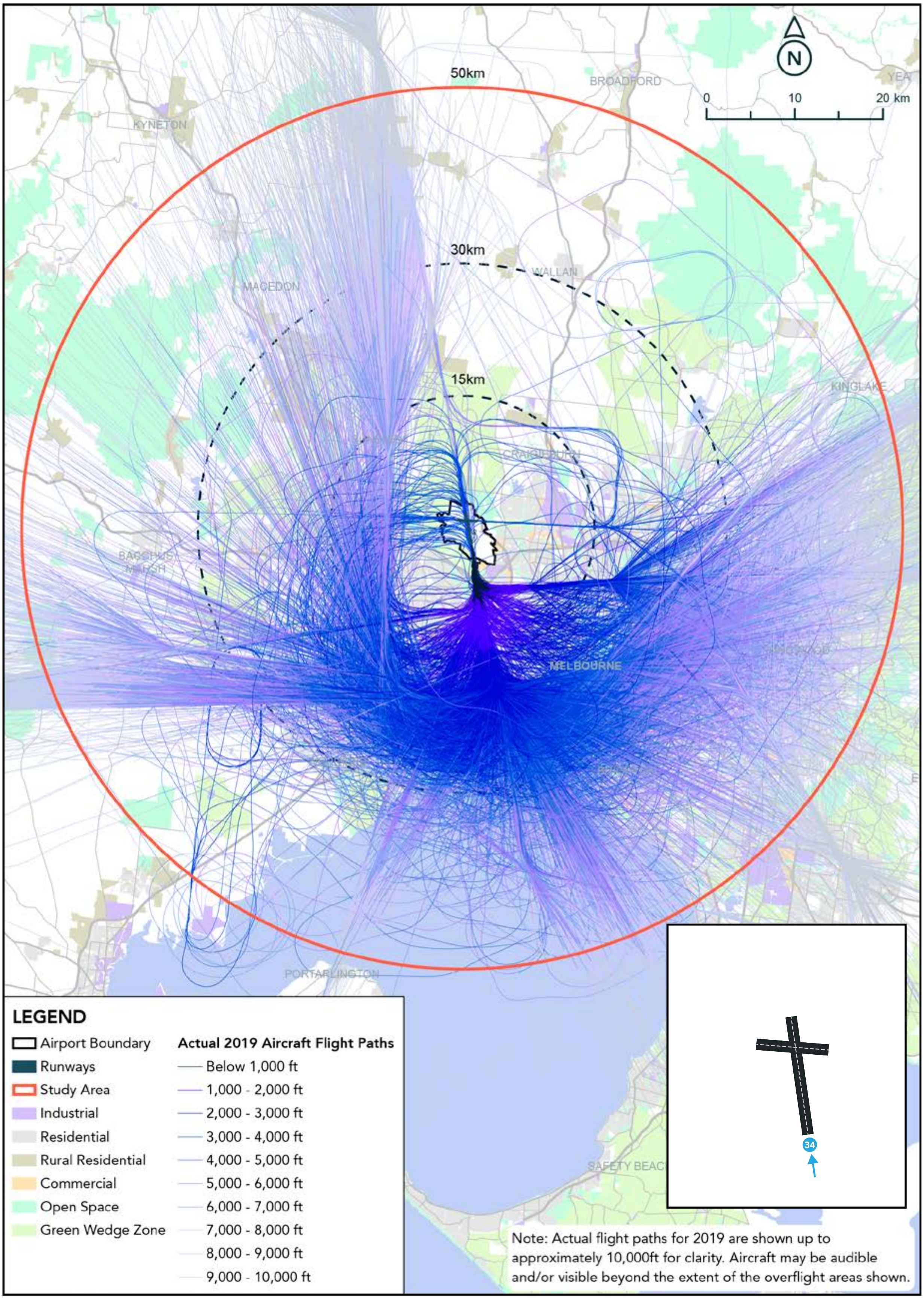
Figure C2.11
Actual 2019 aircraft flight paths – Runway 27 departures



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

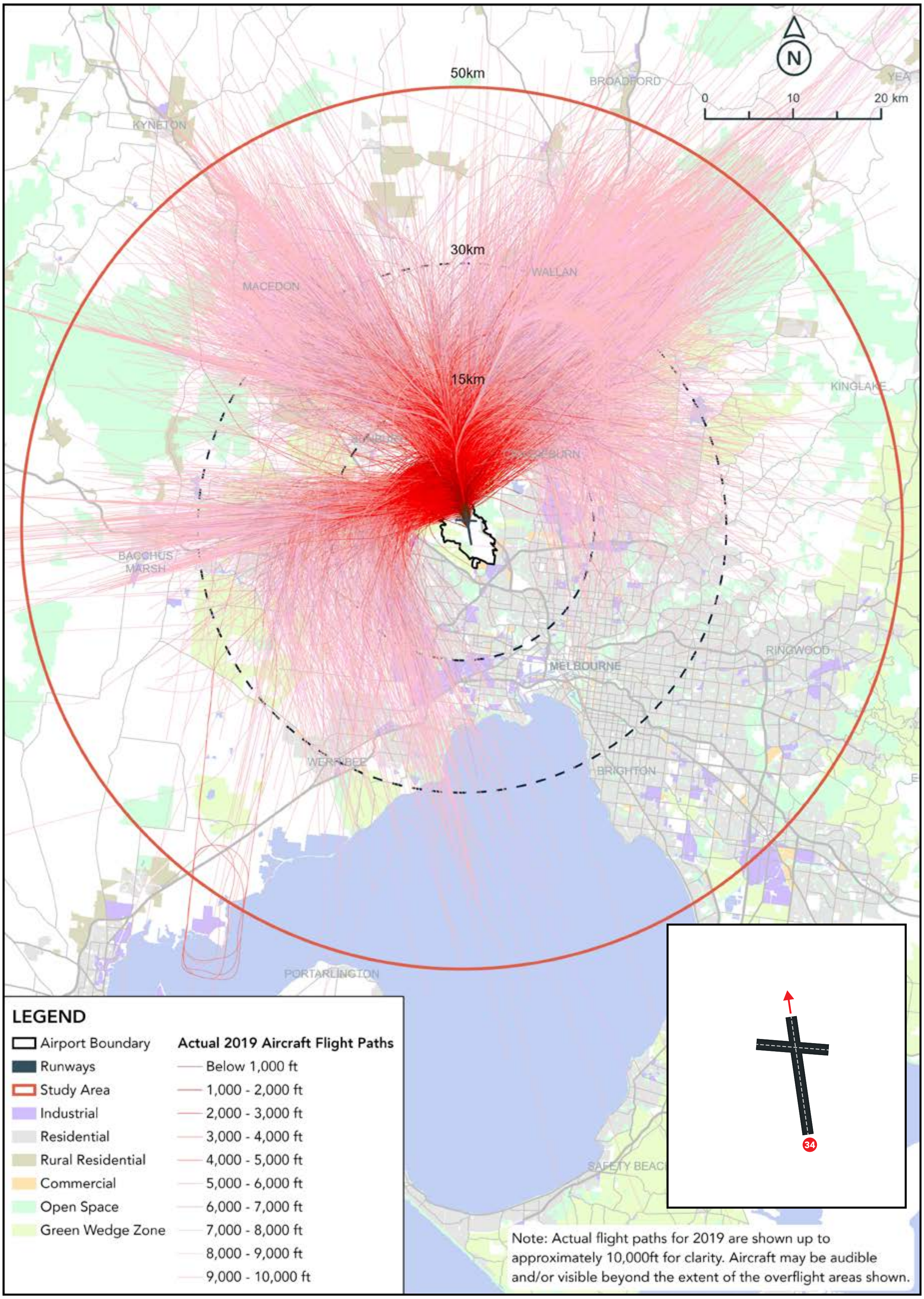
Figure C2.12
Actual 2019 aircraft flight paths – Runway 34 arrivals



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

Figure C2.13
Actual 2019 aircraft flight paths – Runway 34 departures



Note: Actual flight paths for 2019 are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020 (info from Airservices)

C2.3.2
Existing runway modes of operation

Melbourne Airport currently has two runways: the existing north-south runway (16L/34R) and an existing east-west runway (09/27). Runways operate in both directions (dependent upon weather conditions). The runway designations for the existing runways are summarised below and illustrated in **Figure C2.14**.

- Runway 09 – arrivals from the west and departures to the east
- Runway 27 – arrivals from the east and departures to the west
- Runway 16(L) – arrivals from the north and departures to the south
- Runway 34(R) – arrivals from the south and departures to the north.

Currently Melbourne Airport operates predominantly in the three mode groups described below and shown in **Figure C2.14**.

- Crossing modes (preferred):
    - Aircraft either land from the north on runway 16L and take off to the west on runway 27 (when winds are south-westerly); or
    - Arrive from the east on runway 27 and take off both to the north on runway 34R and to the west on runway 27 (when winds are north-westerly); or
    - Arrive from the west on runway 09 and take off to the south on runway 16L.
- High capacity arrivals (LAHSO) modes – in which aircraft arrive simultaneously from the east on runway 27 and from the south on runway 34R. While this mode is in operation, aircraft depart to the west on runway 27.
- Single runway modes – in which all aircraft arrive and depart on the same runway. These modes are used when winds are too strong to allow crossing runways to be used. Any of the four runway directions may be used, depending on the weather conditions.

Very occasionally, a different mode may be used to suit exceptional ATC requirements or, for example, when works are being carried out on part of a runway.

A summary of the amount of time that each mode was used in 2019 is given in **Table C2.3** with **Figure C2.15** showing monthly mode usage across the year.

C2.3.3
Mode capacities

The existing runway modes of operation have practical capacities for total aircraft movement rates of between 48 and 60 per hour in visual weather conditions. Mode capacities are lower in instrument weather conditions due to the additional separation required between arriving aircraft, as discussed in **Section C2.2.13**.

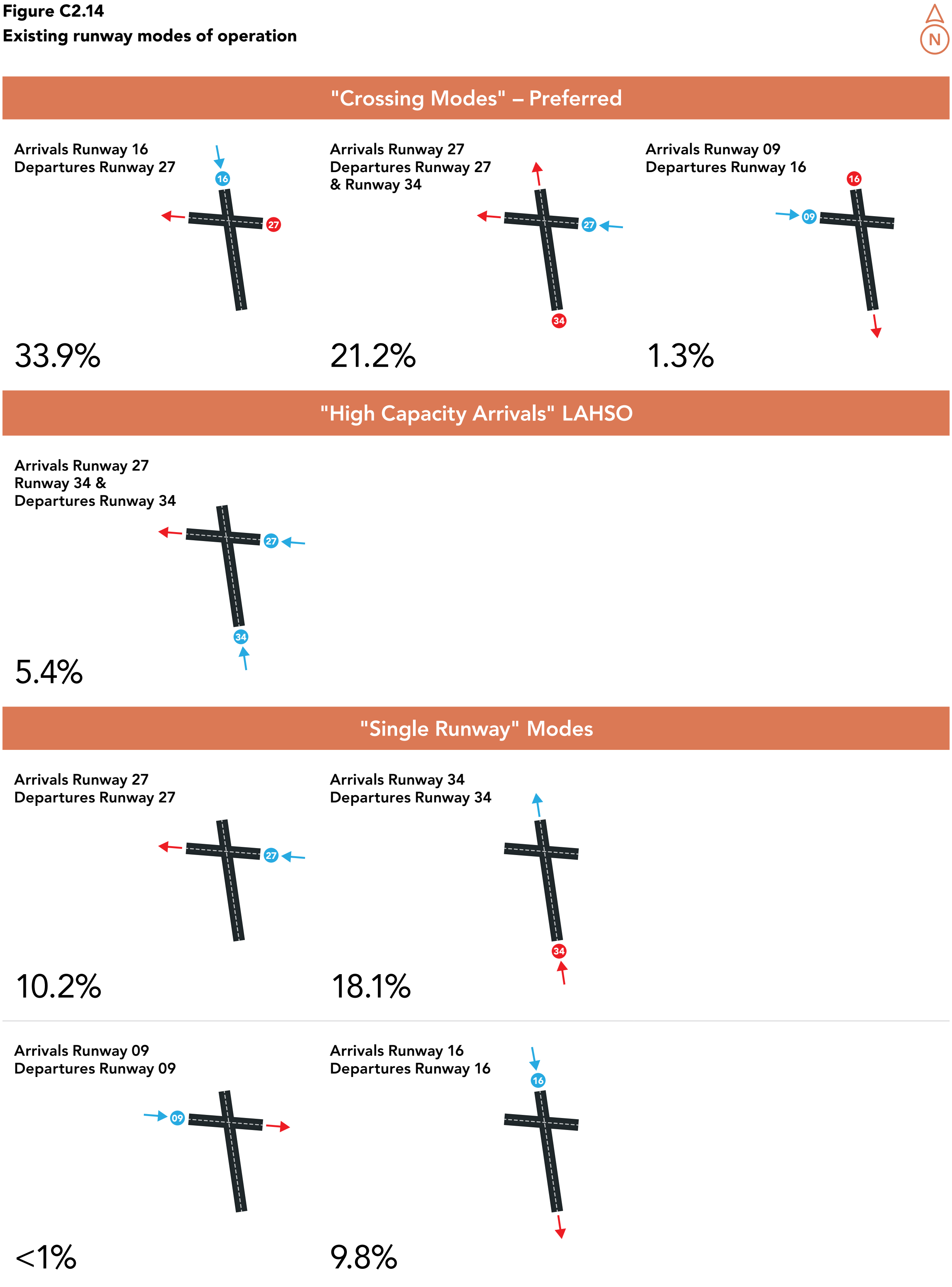
Comparatively, parallel runways operating independently in mixed mode (i.e. arrivals and departures to both runways) are expected to accommodate total aircraft movement rates of 90 to 95 per hour in all but the most restrictive weather conditions.

Table C2.3
Existing runway mode usage (2019)

Mode	Runway in use		% of time used	
	Landing	Take-off	6 am to 11pm	11pm to 6am
LAHSO	27 & 34R		7	N/A
Arrivals runway 16, departures runway 27	16	27	36	29
Arrivals runway 16, departures runway 27 and 34	16	27 & 34R	18	29
Arrivals runway 09, departures runway 16	09	16	1*	N/A
Arrivals and departures runway 27	27	27	9	13
Arrivals and departures runway 16	16	16	10	10
Arrivals and departures runway 34	34	34	18	19
Arrivals and departures runway 09	09	09	<1	<1

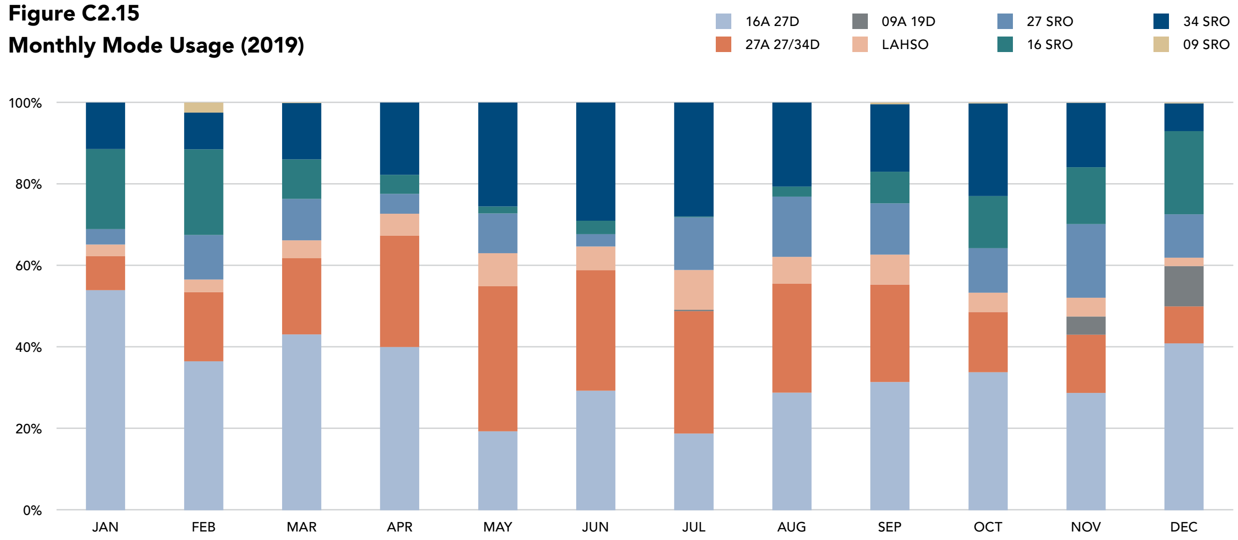
Source: APAM based on 2019 ATIS data
** Mode implemented in mid-2019*
Note: Percentages are rounded to nearest one per cent, therefore, the sum may not total exactly 100 per cent.

Figure C2.14
Existing runway modes of operation



Source: APAM based on 2019 ATIS data

Figure C2.15
Monthly Mode Usage (2019)



Source: APAM based on 2019 ATIS data

C2.3.4
Existing aircraft traffic

Melbourne Airport handled around 237,000 Regular Public Transport (RPT) aircraft movements during 2019. The vast majority of aircraft movements at the airport are commercial airline RPT services (they include both jet and non-jet passenger operations to a range of domestic and international destinations). The airport also handles some domestic and international dedicated freighter operations as described in **Chapter A2: Need for the Project**.

C2.4
METHODOLOGY AND ASSUMPTIONS

C2.4.1
Flight path development process

Flight paths for M3R have been developed by APAM with assistance from Airservices using the existing international and national parallel runway rulesets (referred to as 'standards'). A summary of the approach is provided below, with the criteria for flight path development drawn from:

- ICAO Annex 14 - Aerodromes - Volume I - Aerodromes Design and Operations
- ICAO Doc 8168 - Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS), which details technical data and requirements for the development of SIDs and STARs
- ICAO Doc 4444 - Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM), which details the actual procedures to be applied by air traffic services units in providing the various air traffic services to air traffic.
- ICAO Doc 9643 - Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways ICAO Doc 9905 Required Navigation Performance Authorization Required (RNP-AR) Procedure Design Manual
- ICAO Doc 9992 - Manual on the Use of Performance-Based Navigation (PBN) in Airspace Design
- ICAO DOC 9829 - Guidance on the Balanced Approach to Aircraft Noise Management
- Civil Aviation Safety Regulations (CASR) Manual of Standards (MoS) Part 172 - Air Traffic Services
- Considerations of the effect of airspace change to Essendon Fields Airport, Avalon Airport, RAAF Point Cook and Moorabbin Airport operations.

The following fundamental parameters are applied to flight path development:

1. Safety – paramount in all procedure development and will not be compromised
2. Air Traffic Management (ATM) requirements – procedures will be fit for purpose and based on sound air traffic management requirements to deliver the required capacity in an efficient manner
3. Environment – noise, other environmental and social impacts will be minimised to the extent practical to achieve safe and efficient operations.

Where these requirements conflict, resolution is based on the above order of priority. Safety will always take the highest priority: delivering sufficient airspace capacity is a fundamental principle underpinning the provision of runway infrastructure. However, for noise abatement at sensitive times (e.g. at night) consideration of aircraft noise impacts may take precedence over ATM efficiency requirements.

The process of developing the preliminary airspace design for this MDP involved a series of workshops between Melbourne Airport and Airservices in which the initial concepts were developed into the preliminary airspace design. This process was undertaken between late 2019 and mid 2020 and included further detailed studies on the feasible operation of the Melbourne Basin airspace. These studies involved close collaboration between Melbourne Airport, Airservices and Essendon Fields Airport. The preliminary airspace design had to ensure the operational risks and complexity of the future Melbourne Basin airspace are at an acceptable level, while also delivering sufficient capacity.

An initial high-level safety and capacity assessment has been undertaken consistent with the preliminary design status of the airspace presented in the MDP and acknowledge that complete safety validation will be part of detailed design.

Once safety and capacity requirements had been satisfied, flight paths and operating modes were then optimised to reduce unavoidable residual impacts of aircraft noise on communities to the lowest practicable level. To assist in this, the flight path development process used census data to identify populated areas and the relative density of population, as well as data on sensitive establishments drawn from the social impact assessment (see **Chapter D4: Social Impact**).

C2.4.2
Principles for development of flight paths and modes of operation

The construction of M3R will, by necessity, trigger a reconfiguration of the Melbourne Basin airspace.

Though development of M3R airspace architecture predates the development of the Airservices Flight Path Design Principles (Airservices Australia, 2020c), they have been applied as far as has been practicable at this preliminary stage of the design.

Existing SIDs and STARs paths used at Melbourne Airport have been closely followed where possible (e.g., for operations on the existing north-south runway (16L/34R) in certain modes of operation). However, as described in **Section C2.2.21**, the standards for parallel runway operations necessitate several changes to existing SIDs and STARs.

C2.4.3
Other environmental considerations

In developing the airspace architecture for this MDP, environmental impacts have been reduced as far as practical. Aircraft noise, track miles, fuel burn, carbon (and other) emissions, and vibration have all been addressed.

Comprehensive assessments of the noise exposure and emissions forecast from operations associated with M3R are detailed in **Chapter C3: Aircraft Noise Modelling Methodology** and **Chapter C4: Aircraft Noise and Vibration.** These impacts have been considered in the design of the airspace architecture and development of the draft runway operating plan. Where relevant, aspects of these assessments that have informed the preliminary airspace design are highlighted throughout the description of the proposed airspace architecture in this chapter.

C2.4.4
Inputs and sources of data

Airservices and Melbourne Airport participated in a series of workshops in which design options were evaluated and refined. Preliminary flight paths were developed collaboratively.

The main inputs and sources of data used in the development of the preliminary airspace design for M3R are those documents listed in **Section C2.4.1** and as follows.

Airservices Australia:

- Published flight paths derived with reference to the Aeronautical Information Publication – Departure and Approach Procedures (AIP-DAP) and the Designated Airspace Handbook. These provide descriptions of the published SIDs and STARs
- Existing runway modes of operations and mode priorities as stipulated in the Noise Abatement Procedures (NAP) section of AIP-DAP
- The Aeronautical Information Publication – En Route Supplement Australia (AIP-ERSA), which includes operational information
- Historical flight path data (radar tracks) provided from Airservices Australia's WebTrak and en route secondary surveillance radar transponder broadcast information
- Airservices Australia's Noise and Flight Path Monitoring System (NFPMS) records for 2019.

Civil Aviation Safety Authority:

- Civil Aviation Safety Regulations Manual of Standards Part 139 – Aerodromes
- Civil Aviation Safety Regulations Manual of Standards Part 173 – Instrument flight procedure design.

Australia Pacific Airports (Melbourne):

- Existing (2019) flight schedules
- Future flight schedules and future aircraft fleet composition
- Proposed revised airfield configuration
- The 2022 Melbourne Airport Master Plan
- Workshops to map the potential interdependencies for Melbourne Airport and Essendon Fields Airport flight paths
- Population density census data
- Sensitive establishment data.

C2.4.5
Statutory and policy requirements

The Commonwealth *Airports Act 1996* (Airports Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are the key pieces of legislation that set the regulatory framework for M3R and this assessment, as discussed in **Chapter A8: Assessment and Approvals Process**. However, further details are presented in this section. Consideration has also been given to relevant Victorian legislation including environmental planning instruments, policies and guidelines.

C2.4.6
National regulations

Melbourne Airport is a 'core regulated airport' as defined and regulated under the Airports Act and associated Regulations. Protection of airspace in the vicinity of the airport is regulated by the *Airports (Protection of Airspace) Regulations 1996* (Cth) (APARs) made under the Airports Act. Operations of the airport and airspace are also regulated by the *Civil Aviation Safety Regulations 1998* (Cth) (CASR), *Civil Aviation Regulations 1988* (Cth) (CAR), Civil Aviation Orders (CAO) and related legislative instruments.

C2.4.7
Melbourne Airport Master Plan

As discussed in **Chapter A1: Introduction**, Melbourne Airport's Master Plan (2018) required an update to reflect the changed orientation of the proposed third runway (from east-west to north-south). Master Plan 2022 contains the preliminary airspace design of M3R, honouring the principles of previous Melbourne Airport Master Plans and planning documents (consistent with the limitations associated with safe and efficient airspace operations). Central to the airspace design process is consideration of the interaction between operations at Melbourne and Essendon Fields airports. More detail on the interaction with Essendon Fields Airport is provided in **Section C2.5.11**

The assessments completed by Melbourne Airport, with input from Airservices, demonstrate that the preliminary airspace design and flights paths will achieve the following priorities:

- Ensure the risks and complexity of operation are at an acceptable level
- Minimise the overflight of populated areas to reduce noise impacts

C2.4.8
Civil Aviation Safety Regulations

International standards and recommended practices are established by ICAO under the Convention on Civil Aviation (known as the Chicago Convention). As a signatory to the Convention, Australia is obliged to enact laws that reflect these international standards.

The collective standards for the design and operations of airspace are transcribed into Australian law through two main components of the Civil Aviation Safety Regulations (the CASR). These are Part 172 which deals with air traffic services, and Part 173 which deals with the design of instrument flight procedures.

C2.4.8.1
CASR Part 172 – Air traffic service providers

Air traffic management at all airports in Australia is required to be undertaken in accordance with Part 172 (Air Traffic Service Providers) of the CASR. Part 172 of the CASR specifies the regulatory framework for the approval of air traffic service providers (including Airservices). It also includes standards for air traffic facilities, safety management and the provision of air traffic services.

These standards are set out in the *CASA Manual of Standards* (MoS) Part 172 and may be amended from time to time to reflect changes in international standards and recommended practices published by ICAO.

C2.4.8.2
CASR Part 173 – Instrument flight procedure design

The detailed design of airspace (including SIDs, STARs and IAPs) must comply with the requirements of Part 173 (Instrument Flight Procedure Design) of the CASR.

CASA Manual of Standards (MOS Part 173) is amended from time to time to reflect changes in international standards and recommended practices published by ICAO.

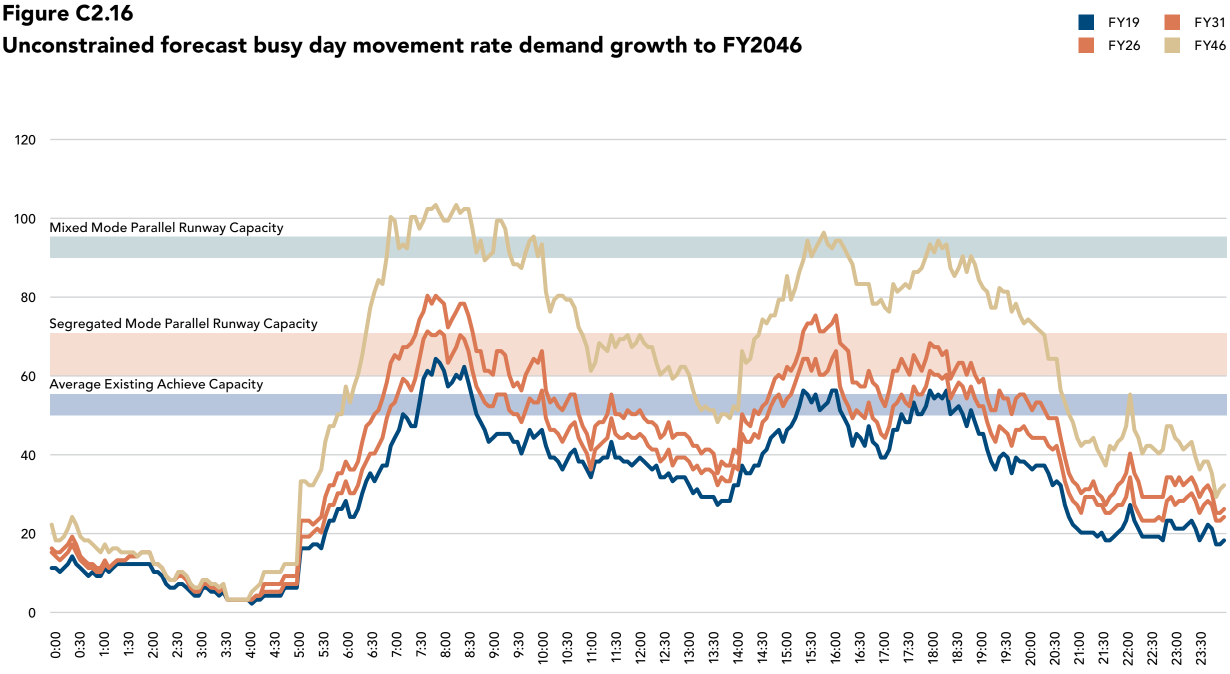
C2.4.9
Assessment of potential impacts

Completion of the new runway infrastructure will be accompanied by advance changes to the airspace architecture and flight paths around Melbourne Airport. Therefore, airspace and procedure proposals are preliminary at this stage (based on the best information available) but are suitable for assessment purposes. The preliminary airspace design incorporates Airservices and CASA requirements to the extent practicable and will be further validated during detailed design.

To complete the assessment, impacts have been estimated based on a projection (formed by Airservices working closely with Melbourne airport) of how the ruleset for parallel runway operations would most likely be applied to the specific context of the Melbourne Basin airspace.

M3R involves the introduction of new flight paths for approaches and departures on the new runway, and changes to the existing flight paths to accommodate parallel runway operations.

Figure C2.16
Unconstrained forecast busy day movement rate demand growth to FY2046



Source: L&B, 2019

Note: System capacity is shown as a range as it is dependant on the split between arrival and departure aircraft.

The dominant flow of aircraft during peak periods will become north-south/south-north to utilise the capacity afforded by the parallel runway system. The existing crossing runway modes of operation often preferred under the existing (two-runway) NAP, do not have sufficient capacity to process the expected demand. During peak periods (which by 2046 are expected to cover a large proportion of the period 6am – 11pm) independent mixed mode parallel runway operations are expected to be required. During other times different operating modes may be available. These modes and their uses are detailed in **Section C2.5.2**.

The preliminary airspace design developed for this MDP has provided, directly and indirectly, the basis for a number of impact assessments within this MDP, including:

- **Chapter C4: Aircraft Noise and Vibration**
- **Chapter C5: Airspace Hazards and Risks**
- **Chapter D3: Health Impact**
- **Chapter D4: Social Impact**

The significance assessment framework for each of these impact assessments is described within the relevant chapter.

Some interactions with existing Essendon Fields Airport procedures are likely to require further definition and clarification during the detailed airspace design. Likely airspace requirements are discussed in **Section C2.5.11**.

C2.5
M3R CHANGES TO AIRSPACE ARCHITECTURE

C2.5.1
Volume of aircraft traffic

Forecast air traffic demand is discussed in **Chapter A2: Need for the Project**. In terms of the preliminary airspace design, the important metrics are the peak hourly movement rate demand and the peak period durations. This has been estimated from the forecast schedules for an average day in the busy week at opening (2026) and at five years (2031) and 20 years (2046) post-opening, as shown in **Figure C2.16**.

The movement rate demand influences the modes of operation which are feasible at various times of the day.

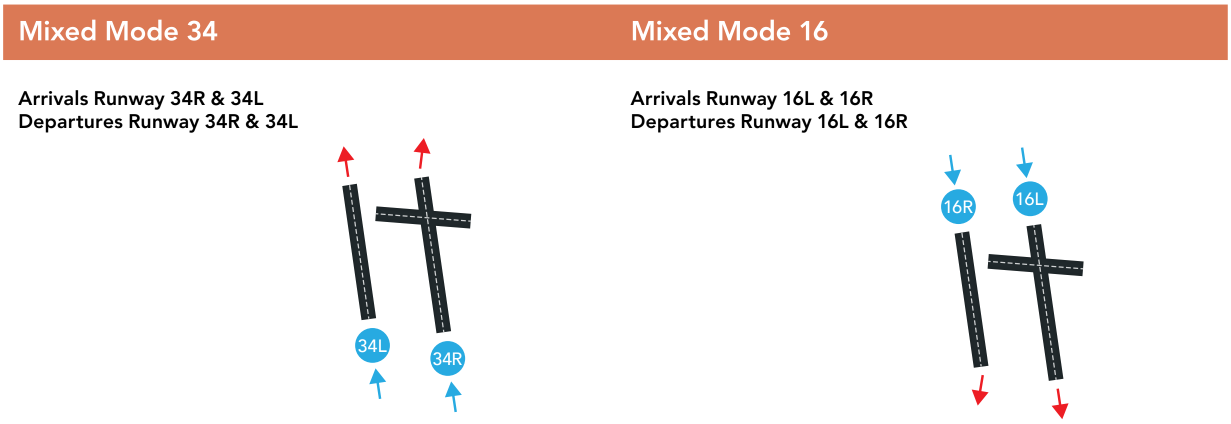
C2.5.2
Modes of operation for M3R

This section provides information on the different modes of operation available for the M3R system, and the procedures that are proposed.

The modes of operation and flight paths for M3R have been designed on the basis that most aircraft will be able to operate from the parallel north-south runways. In order to deliver the required capacity, use of the existing east-west runway will be limited to when weather conditions (primarily wind speed and direction) do not allow the use of the parallel runways.

The primary modes of operation available for the M3R system are summarised as follows and discussed in more detail in the following sections.

Figure C2.17
Mixed Mode parallel operations



Mixed Mode 34

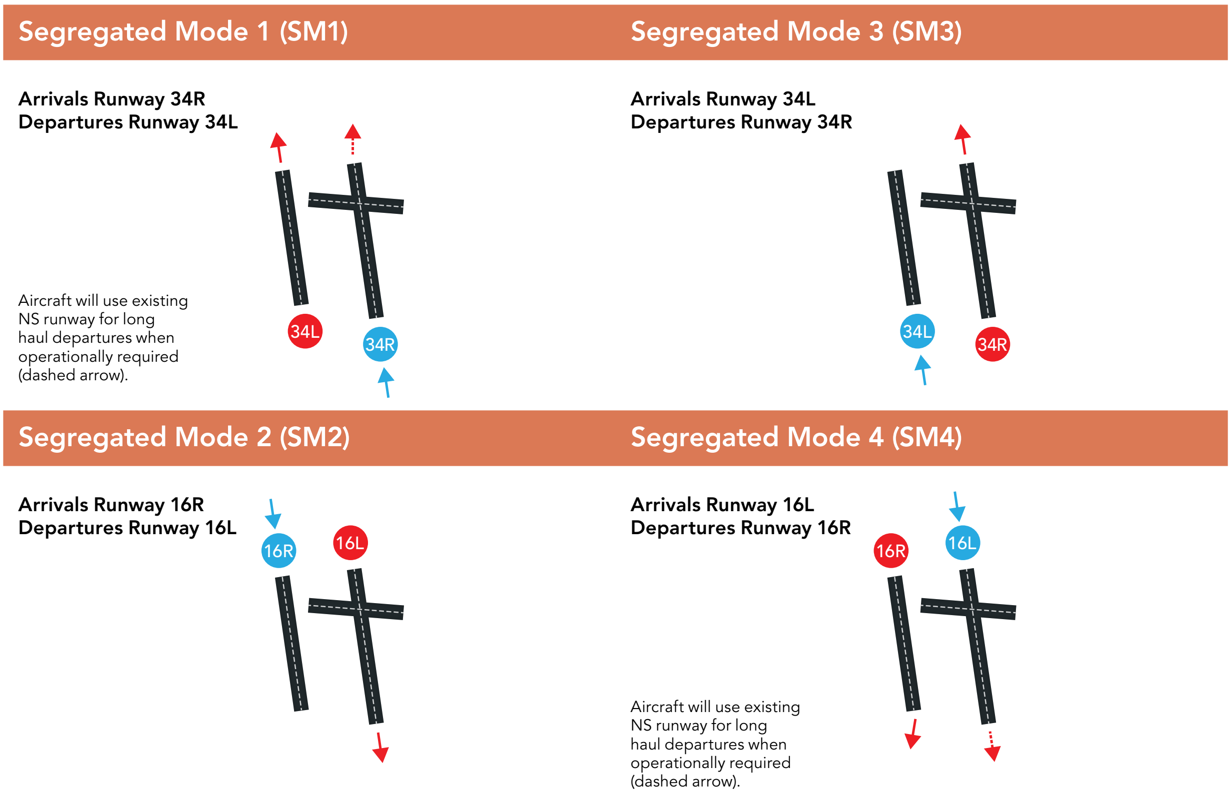
Arrivals Runway 34R & 34L
Departures Runway 34R & 34L

Mixed Mode 16

Arrivals Runway 16L & 16R
Departures Runway 16L & 16R

Source: APAM, 2020

Figure C2.18
Segregated parallel modes of operation



Source: APAM, 2020

Mixed mode parallel runway operations

- Mixed parallel operations on runways 16L and 16R
- Mixed parallel operations on runways 34L and 34R

Segregated mode parallel runway operations

- SM1 - Segregated north flow with departures on runway 34L and arrivals on 34R
- SM2 - Segregated south flow with departures on runway 16L and arrivals on 16R
- SM3 - Segregated north flow with departures on runway 34R and arrivals on 34L
- SM4 - Segregated south flow with departures on runway 16R and arrivals on 16L

Single runway operations

- Single runway operations on runway 34L or 34R
- Single runway operations on runways 16L or 16R
- Single runway operations on runway 09 or 27

SODPROPS with aircraft departing from runway 34R and arriving on 16R.

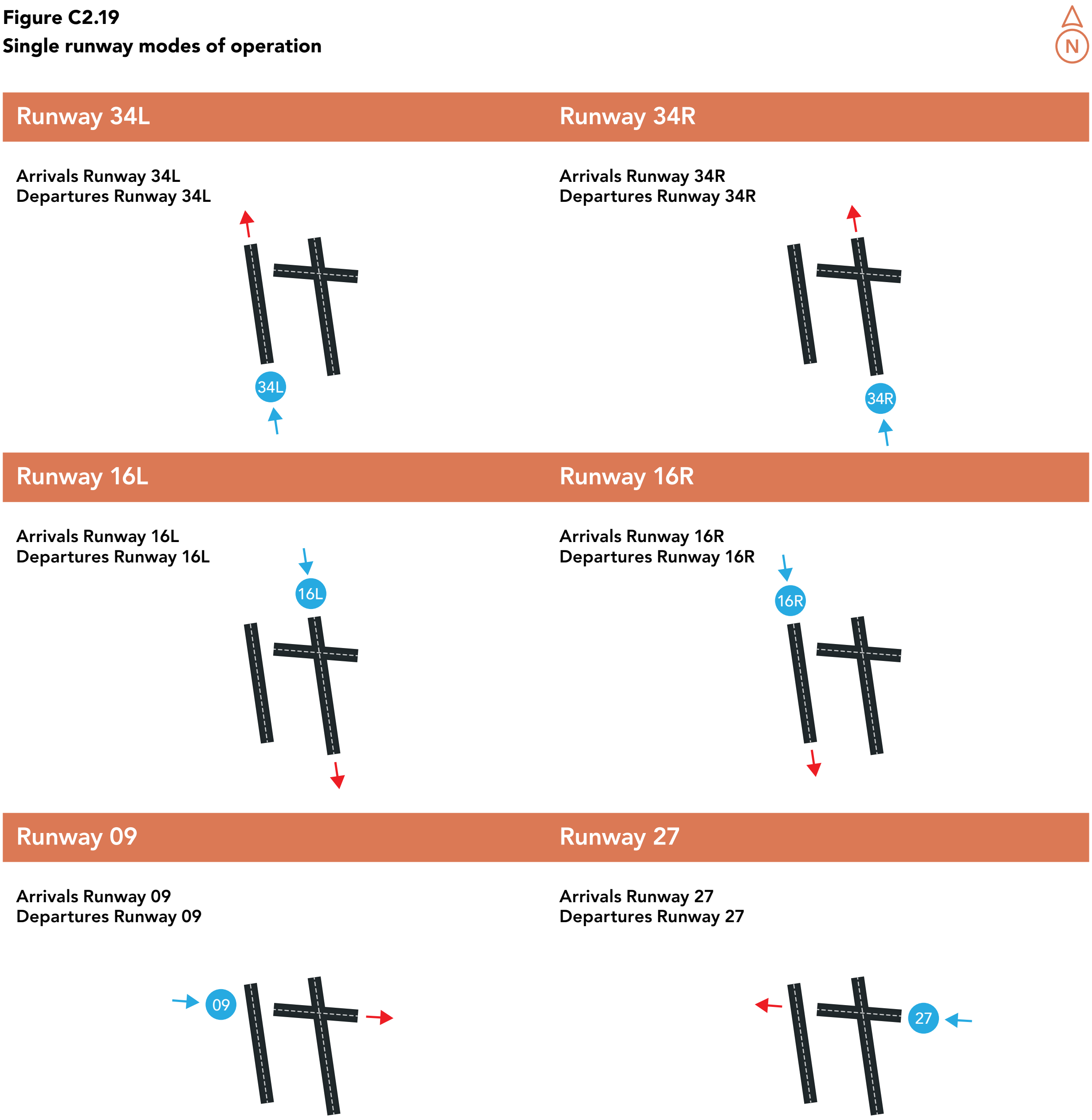
C2.5.3
Mixed Mode parallel operations

The primary mode of operation considered for arrivals and departures on the existing and proposed north-south runways is mixed mode parallel operations, as illustrated in Figure C2.17.

This mode is the standard mode for parallel runways. It provides the most capacity for air traffic management during normal operations. By having independent arrivals and departures to/from both runways, maximum use can be made of the airspace and ground infrastructure.

Aircraft would, in general, be allocated to runways based on the geographic location of their origin or destination. This allows air traffic to be processed most efficiently. In general, aircraft arriving from or departing to northern and western destinations (including Brisbane and Perth) will use the new north-south runway (16R/34L) whereas aircraft arriving from and departing to eastern destinations (including Sydney and Canberra) would use the existing north-south runway (16L/34R). However, for operational reasons and to balance capacity with demand, it will be necessary to be able to allocate aircraft to either runway.

Figure C2.19
Single runway modes of operation



Source: APAM, 2020

Figure C2.20
Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS)

Source: APAM, 2020

C2.5.4
Segregated parallel operations

In some situations, when demand is lower outside peak periods and during poor weather when low visibility procedures are in use, it may be more manageable and efficient to use segregated parallel operations (i.e. arrivals occurring on one runway and departures on the other). The various segregated parallel modes are illustrated in **Figure C2.18**.

C2.5.5
Single runway operations

Single runway modes of operation will not, during most periods of the day, offer sufficient capacity to ensure expected movement demand can be processed without significant delay to operations and resulting network congestion.

Therefore these modes will only be used when the parallel north-south runways are not available due to strong crosswinds, during periods of low demand, or when one of the north-south runways is closed for maintenance.

The single runway modes of operation are illustrated in **Figure C2.19**.

C2.5.6
Noise abatement preferred modes of operation

The preferred modes of operation for managing the impact of aircraft noise on residential areas during the night period (11pm to 6am) would be to process arriving traffic to runway 16R with departing traffic over the largely uninhabited areas to the north via runway 34R. This is the SODPROPS mode introduced in **Section C2.5.2** and presented in **Figure C2.20**. When this mode is unavailable, the next preferred mode, in terms of managing noise impacts, is to use segregated modes.

Table C2.4
Option 1 Priorities

Priority	Day (0600 – 2300)			Night (2300 – 0600)		
	Arrivals	Departures	Notes	Arrivals	Departures	Notes
1	34L	34R	SM3	16R	34R	SODPROPS
2	16R	16L	SM2	34L	34R	SM3
3	34L & 34R	34L & 34R	Mixed Mode	16R	16L	SM2
4	16L & 16R	16L & 16R	Mixed Mode	34L & 34R	34L & 34R	Mixed Mode
5	n/a	n/a	n/a	16L & 16R	16L & 16R	Mixed Mode

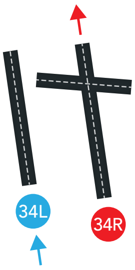
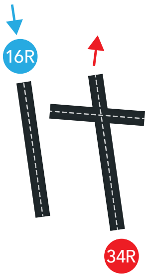
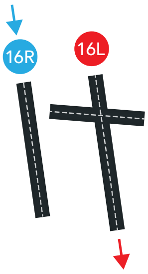
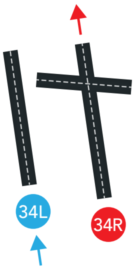
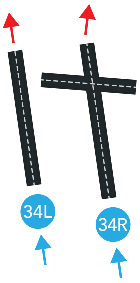
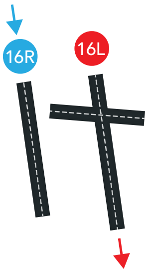
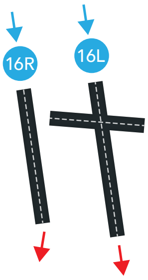
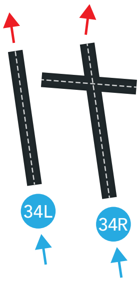
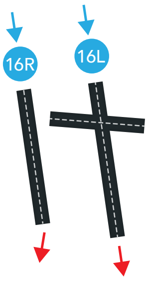
Source: APAM 2020

Table C2.5
Option 2 Priorities

Priority	Day (0600 – 2300)			Night (2300 – 0600)		
	Arrivals	Departures	Notes	Arrivals	Departures	Notes
1	34L or 34R	34L or 34R	Day 1 – SM1* Day 2 – SM3	16R	34R	SODPROPS
2	16L or 16R	16L or 16R	Day 1 – SM2 Day 2 – SM4*	34L or 34R	34L or 34R	Day 1 – SM1* Day 2 – SM3
3	34L & 34R	34L & 34R	Mixed Mode	16L or 16R	16L or 16R	Day 1 – SM2 Day 2 – SM4*
4	16L & 16R	16L & 16R	Mixed Mode	34L & 34R	34L & 34R	Mixed Mode
5	n/a	n/a	n/a	16L & 16R	16L & 16R	Mixed Mode

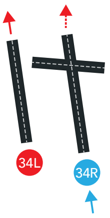
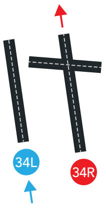
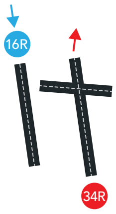
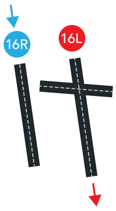
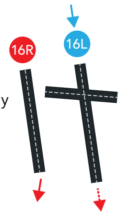
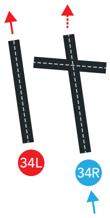
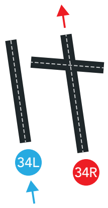
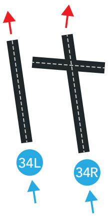
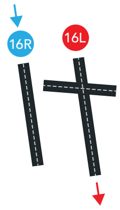
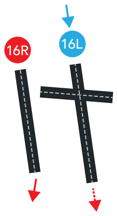
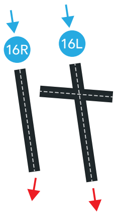
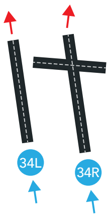
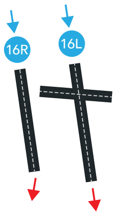
Source: APAM, 2020
**SM1 & SM4 will use existing NS runway for long haul departures when operationally required*

Figure C2.21
Option 1 Priorities

Priority	Day (0600 – 2300)	Night (2300 – 0600)
1	**Segregated Mode 3 (SM3)** Arrivals Runway 34L Departures Runway 34R 	**SODPROPS** Arrivals Runway 16R Departures Runway 34R 
2	**Segregated Mode 2 (SM2)** Arrivals Runway 16R Departures Runway 16L 	**Segregated Mode 3 (SM3)** Arrivals Runway 34L Departures Runway 34R 
3	**Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L 	**Segregated Mode 2 (SM2)** Arrivals Runway 16R Departures Runway 16L 
4	**Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R 	**Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L 
5		**Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R 

Source: APAM, 2020

Figure C2.22
Option 2 Priorities

Priority	Day (0600 – 2300)	Night (2300 – 0600)
1	**Day 1** **Segregated Mode 1 (SM1)** Arrivals Runway 34R Departures Runway 34L Aircraft will use existing NS runway for long haul departures when operationally required (dashed arrow).  **Day 2** **Segregated Mode 3 (SM3)** Arrivals Runway 34L Departures Runway 34R 	**SODPROPS** Arrivals Runway 16R Departures Runway 34R There are specific weather requirements that apply to this mode in terms of cloud base, visibility and wind strength and direction. These strict weather requirements mean that this mode is available for less than 30 per cent of the night (single-hour periods). 
2	**Day 1** **Segregated Mode 2 (SM2)** Arrivals Runway 16R Departures Runway 16L  **Day 2** **Segregated Mode 4 (SM4)** Arrivals Runway 16L Departures Runway 16R Aircraft will use existing NS runway for long haul departures when operationally required (dashed arrow). 	**Day 1** **Segregated Mode 1 (SM1)** Arrivals Runway 34R Departures Runway 34L Aircraft will use existing NS runway for long haul departures when operationally required (dashed arrow).  **Day 2** **Segregated Mode 3 (SM3)** Arrivals Runway 34L Departures Runway 34R 
3	**Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L 	**Day 1** **Segregated Mode 2 (SM2)** Arrivals Runway 16R Departures Runway 16L  **Day 2** **Segregated Mode 4 (SM4)** Arrivals Runway 16L Departures Runway 16R Aircraft will use existing NS runway for long haul departures when operationally required (dashed arrow). 
4	**Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R 	**Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L 
5		**Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R 

Source: APAM, 2020

Segregated mode grouping options are discussed in **Section C2.5.8**.

Melbourne Airport will encourage Airservices to manage operations to extend the use of NAPs in the evening and early morning as long as possible while operating conditions allow (based on safety, operational, efficiency and weather considerations). Although Airservices would plan to do this as far as practicable, the extent to which it is possible will depend on the future flight schedules as well as a number of factors which will vary day by day. However, because the use of the noise preferred modes cannot be guaranteed outside 11pm to 6am, the noise impact assessment utilises these modes only during night hours (11pm to 6am).

C2.5.7
Other modes

When weather conditions (in particular wind speed and direction) do not allow one of the above modes of operation, other modes may be required (e.g. arrivals and departures on the east-west runway). During these occasions airlines may prefer to depart and arrive using the existing north-south runway due to its greater length. These 'off-mode' flights would effectively result in a crossing mode operation that would be limited in capacity due to the high crosswind component.

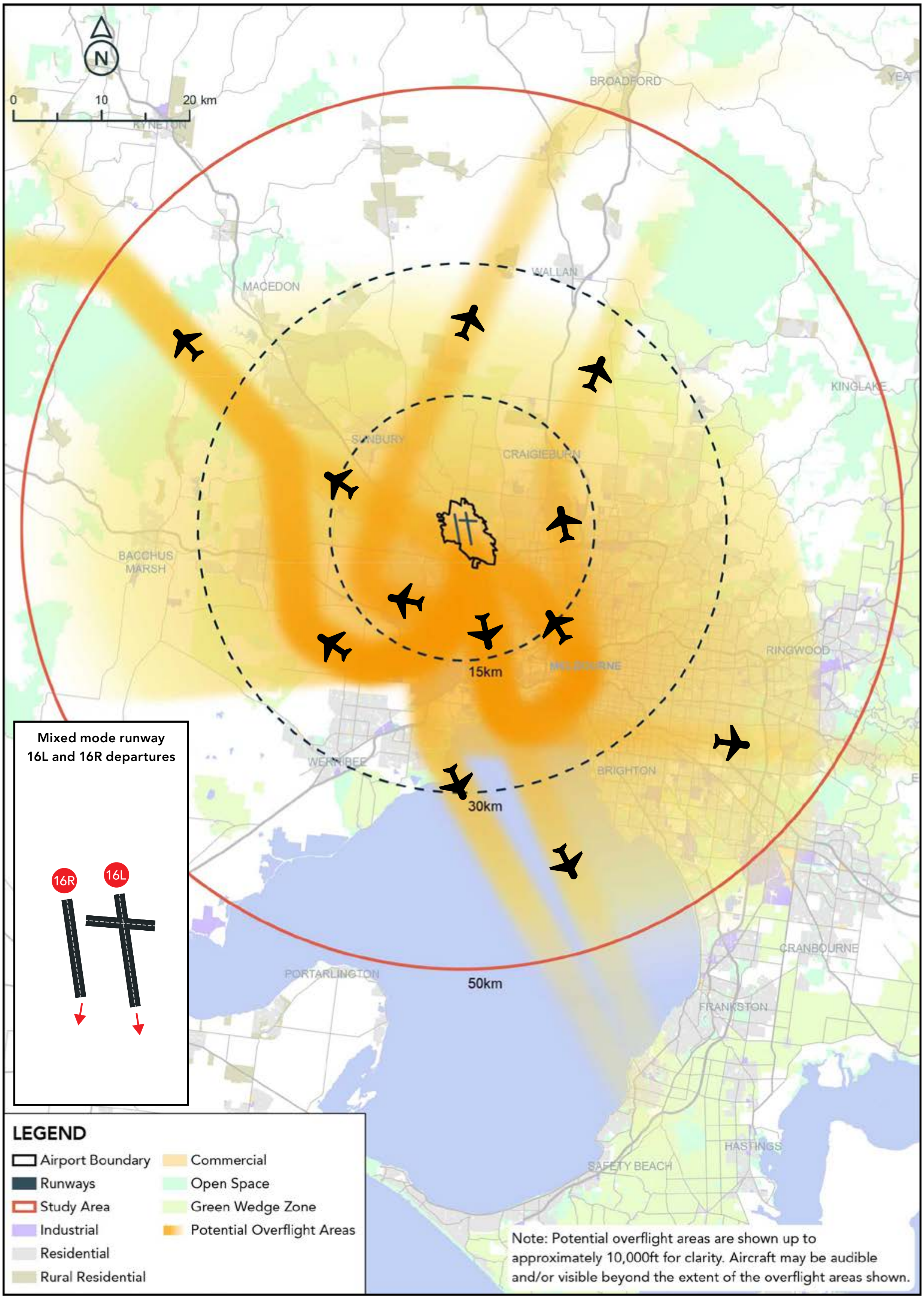
C2.5.8
Mode grouping options

During periods when demand is lower, the runway infrastructure, facilities and airspace architecture proposed under M3R will allow a range of practical operating modes:

- Option 1 – Segregated mode operations that prioritise arrivals to the new north south runway (16R/34L) and departures from the existing north south runway (16L/34R). This operating mode is the most efficient, as all aircraft (including ultra-long-haul departures) can operate from the existing runway's additional length, and all arrivals are able to land on the new runway. Departures to the north and arrivals from the south would be prioritised whenever wind conditions allowed. Modelling has shown that this mode (in combination with mixed mode when demand requires) impacts the smallest number of dwellings with significant noise impacts. This operating strategy is illustrated in **Table C2.4** and **Figure C2.21**.
- Option 2 – Segregated mode operations that alternate the runway priorities between the existing and new runways as follows, with priority for operations in a northerly direction (departures runway 34L/R). This operating strategy is illustrated in **Table C2.5** and **Figure C2.22**.
    - Day 1 – Arrivals to the new runway and departures from the existing runway (as for Option 1)
    - Day 2 – Arrivals to the existing runway and departures from the new runway, with a few ultralong-haul departures from the existing runway.
- Modelling has shown that the Option 2 operating strategy impacts a greater number of dwellings with significant noise than Option 1. However, it does distribute the noise impacts between existing and newly-affected dwellings more evenly, and with a predictable regime of respite.
- Other segregated mode operating strategies were explored but estimated to result in greater noise impacts than either of the above two options.

Chapter C4: Aircraft Noise and Vibration and **Chapter E4: Draft Runway Operating Plan** provides additional details on the proposed options, including the various mode priorities for both day and night. Additional information on individual flight paths for each segregated mode is covered in **Section C2.5.9**.

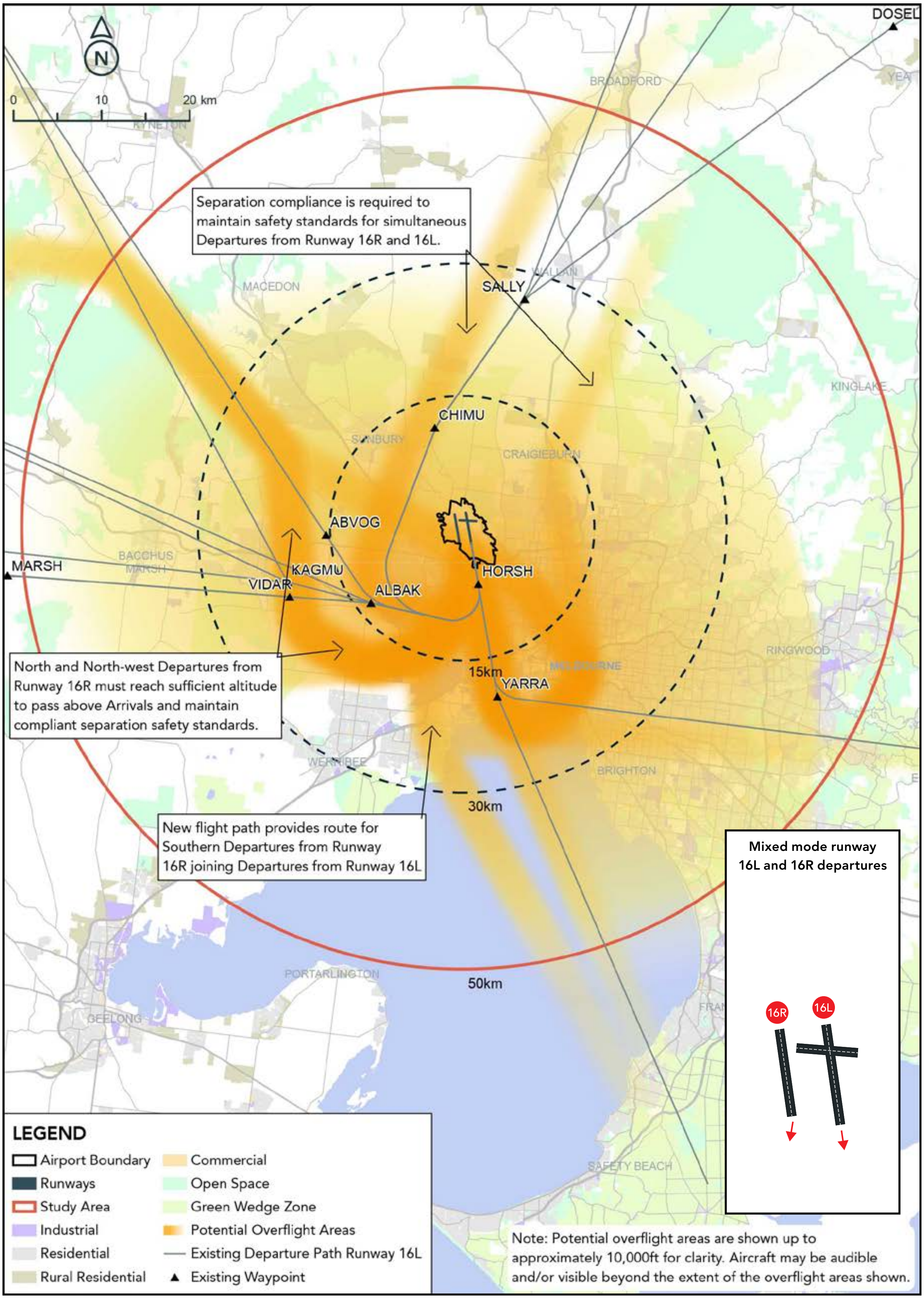
Figure C2.23
Proposed departure flight paths (SIDs) for runways 16L and 16R (mixed mode)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.24
Differences between existing and proposed departure flight paths for runways 16L and 16R (mixed mode)



Separation compliance is required to maintain safety standards for simultaneous Departures from Runway 16R and 16L.

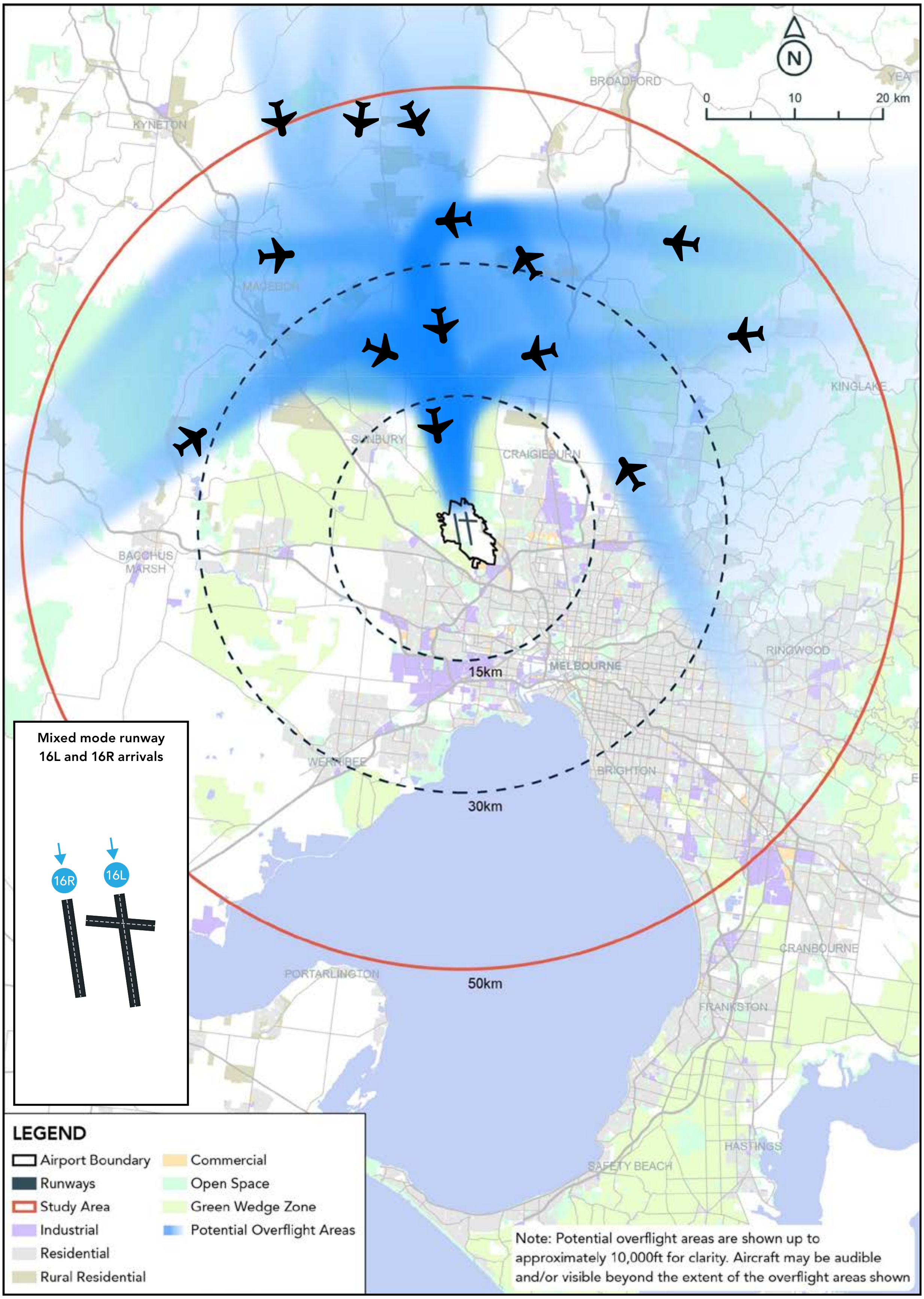
North and North-west Departures from Runway 16R must reach sufficient altitude to pass above Arrivals and maintain compliant separation safety standards.

New flight path provides route for Southern Departures from Runway 16R joining Departures from Runway 16L

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

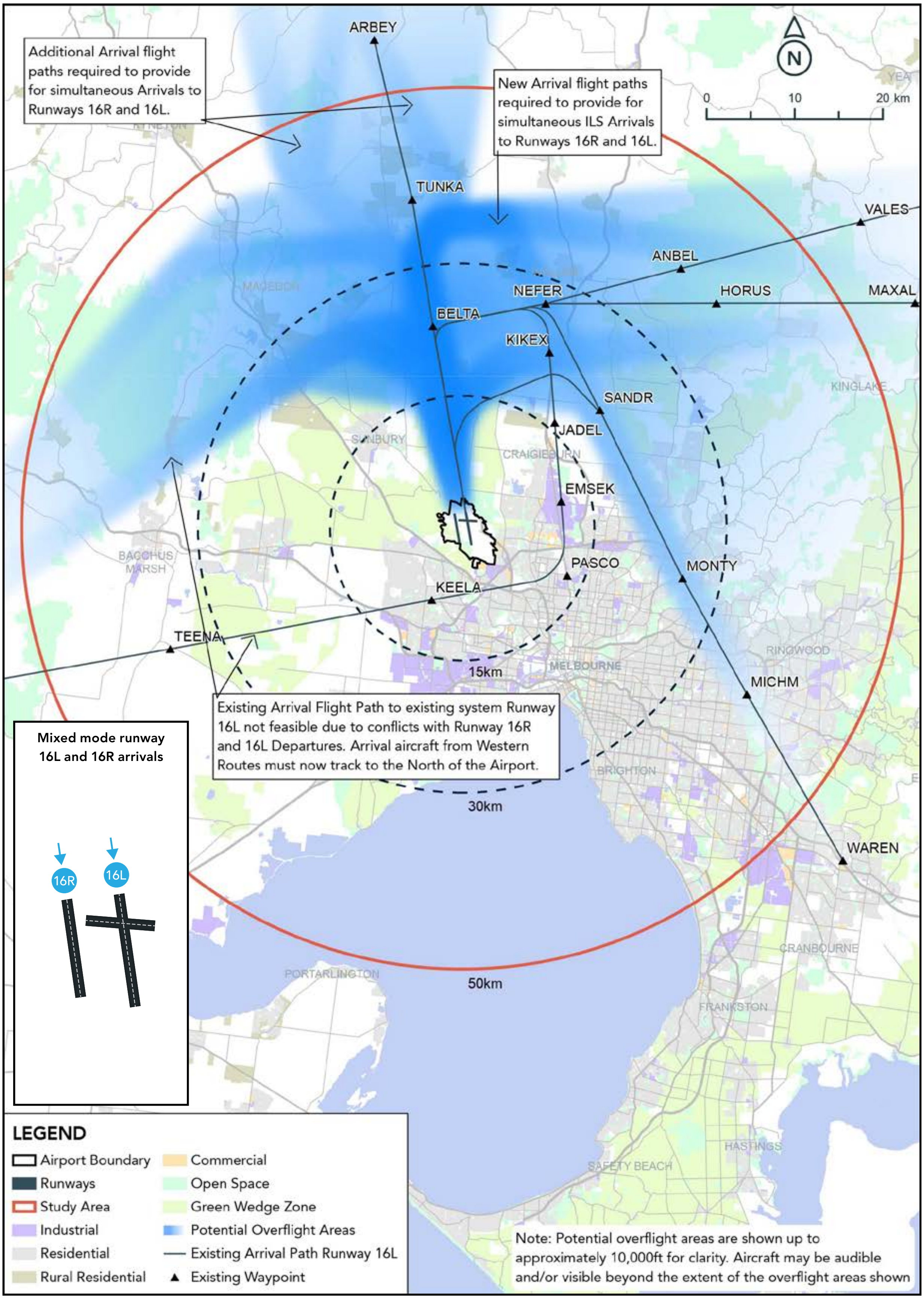
Figure C2.25
Proposed arrival flight paths (STARs) for runways 16L and 16R (mixed mode)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown

Source: APAM, 2020

Figure C2.26
Differences between existing and proposed arrival flight paths for runways 16L and 16R (mixed mode)



Additional Arrival flight paths required to provide for simultaneous Arrivals to Runways 16R and 16L.

New Arrival flight paths required to provide for simultaneous ILS Arrivals to Runways 16R and 16L.

Existing Arrival Flight Path to existing system Runway 16L not feasible due to conflicts with Runway 16R and 16L Departures. Arrival aircraft from Western Routes must now track to the North of the Airport.

Mixed mode runway 16L and 16R arrivals

LEGEND
- ☐ Airport Boundary
- ■ Runways
- ☐ Study Area
- ■ Industrial
- ■ Residential
- ■ Rural Residential
- ■ Commercial
- ■ Open Space
- ■ Green Wedge Zone
- ■ Potential Overflight Areas
- — Existing Arrival Path Runway 16L
- ▲ Existing Waypoint

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown

Source: APAM, 2020

C2.5.9
Airspace Architecture

The following sections describe the airspace architecture for the preliminary airspace design. This architecture will be used for the assessment of potential impacts.

Flight paths are depicted in Figure C2.23 to Figure C2.47 as a broad band or swathe based around a centreline track it is not possible for aircraft to track precisely along a single line due to weather influences and varying aircraft performance. The flight path construction and modelling used in developing noise metrics assumed the majority of aircraft will be on the centreline path, with a decreasing proportion of aircraft flying towards the outer edge of the swathe. Broad areas of lighter overflight shading confirm that, in general, no area of Melbourne Airport's surrounding environs will be free from a low frequency of overflights.

C2.5.9.1
Mixed mode departures from runways 16L and 16R

Figure C2.23 shows the proposed departure flight paths for runways 16L and 16R.

Departure flight paths were designed for runway 16L and runway 16R in compliance with the requirements for parallel runway departures. Continuous Climb Operations (CCO) have been prioritised over Continuous Descent Operations (CDO) wherever possible to minimise noise and fuel burn.

Departures from runway 16L continue straight (i.e. maintain runway heading) until reaching 4,000 feet, then turn left to track to the designated 'Terminal Movement Area (TMA)' exit point for the flight's destination. (The height requirement is designed to separate departures from Essendon Fields Airport's operations.)

Departures from runway 16R will maintain runway heading for approximately two nautical miles before turning right a minimum of 30 degrees in order to separate from the 'missed approach' procedure from runway 16L and runway 16L departures. The delay in the turn is because of the proximity of the Sydenham radio mast to the south west of M3R. The aircraft will then track to the designated TMA exit point for the flight's destination.

Figure C2.24 indicates differences between the existing departure flight paths for runway 16L and the proposed departure flight paths for runways 16L and 16R.

C2.5.9.2
Mixed mode arrivals to runways 16L and 16R

Figure C2.25 shows the proposed arrival flight paths for runways 16L and 16R.

Arrival flight paths have been designed for runway 16L and runway 16R in compliance with current requirements for parallel runway departures. CDO have been facilitated wherever possible.

Aircraft will fly the STAR associated with their arriving air route and enter the TMA at the designated entry point. Different intercept levels are required for the parallel runway operations to ensure vertical separation until aircraft are established on their respective approaches. The preliminary airspace design adopts the following intercept altitudes:

- Melbourne Airport proposed north-south runway (16R) - 4,500 feet AMSL
- Melbourne Airport existing north-south runway (16L) - 3,500 feet AMSL
- The intercept altitudes are relatively high due to the high terrain north of the airport, in particular Mount Macedon which is 3,300 feet AMSL.

As a result of the vertical separation requirements, the introduction of the parallel runway system will result in an increase in the 'track miles' (distance) needed to be flown by arriving aircraft - to enable them to fly the ILS/GLS approaches. Flight paths for RNP-AR approaches and independent visual approaches (shorter tracks) will be beneficial in minimising the number of track miles flown when conditions allow.

These visual and RNP-AR flight paths would intercept the runway centre line no closer than four nautical miles (approximately 7.5 kilometres) from the landing threshold of the runway. The exact intercept distance will be determined in the detailed airspace design.

Missed approaches from runway 16R will turn right 30 degrees to provide the required divergence between the missed approach track and the adjacent parallel runway departure track (straight ahead). Finalisation of missed approach procedures will consider the safe avoidance of the Sydenham Radio Mast during the airspace detailed design process. Missed approaches from runway 16L will continue straight ahead.

Figure C2.26 indicates differences between the existing arrival flight paths for runway 16L and the proposed arrival flight paths for runways 16L and 16R.

C2.5.9.3
Mixed mode departures from runways 34L and 34R

Figure C2.27 shows the proposed departure flight paths for runways 34L and 34R.

Departure flight paths were designed for runway 34L and runway 34R in compliance with the requirements for parallel runway departures. CCO have been prioritised over CDO wherever possible to minimise noise and fuel burn.

Departures from runway 34L can make a sharp left turn after departure for destinations to the south and west, similar to the turn currently flown from existing runway 34R. This turn is designed to keep aircraft south of Sunbury as far as practicable but, as described in Section C2.2.7, many factors influence the actual radius of turn. Other departures make a slight left turn to separate from the departures and missed approaches on the adjacent runway. Aircraft flying to western destinations using this departure will use the same flight path as currently used off existing runway 34R, passing north of Sunbury.

Departures from runway 34R will maintain runway heading for approximately two nautical miles (3.7 kilometres) before turning right to achieve the required separation from the departures and missed approach from runway 34L. The delay in the turn is to avoid noise sensitive areas close to the airport. The aircraft will then track to the designated TMA exit point for the flight's destination. Flight paths follow wherever practicable those currently used from existing runway 34R.

Figure C2.28 indicates differences between the existing departure flight paths for runway 34R see above and the proposed departure flight paths for runways 34R and 34L.

C2.5.9.4

Mixed mode arrivals on runways 34L and 34R

Figure C2.29 shows the proposed arrival flight paths for runways 34L and 34R.

Arrival flight paths have been designed for runway 34L and runway 34R in compliance with current requirements for parallel runway intercepts. CDO have been facilitated wherever possible.

Aircraft will fly the STAR associated with their arriving route and enter the TMA at the designated entry point.

Different intercept levels are required for the parallel runway operations to ensure vertical separation until aircraft are established on their respective approaches. The preliminary airspace design adopts the following intercept altitudes:

- Melbourne Airport proposed north-south runway (34R) - 4,000 feet AMSL
- Melbourne Airport existing north-south runway (34L) - 3,000 feet AMSL

The intercept heights from the south can be lower than from the north as there are no terrain issues to avoid. Runway 34R was selected to have the higher intercept altitude to keep aircraft flying the ILS/GLS approach higher above residential areas until crossing the east coast of Port Phillip Bay.

As a result of vertical separation requirements, the introduction of the parallel runway system will result in an increase in the track miles needed to be flown by arriving aircraft that will enable them to fly the ILS/GLS approaches. Flight paths for RNP-AR approaches and independent visual approaches (short tracks) will be beneficial in minimising the number of track miles flown, when conditions allow.

These visual and RNP-AR flight paths would intercept the runway centre line no closer than four nautical miles (7.5 kilometres) from the landing threshold of the runway. The exact intercept distance will be determined in the detailed airspace design.

Missed approaches from runway 34R will turn right 30 degrees to provide the required divergence between the missed approach track and the adjacent parallel runway departure track. Missed approaches from runway 34L will continue straight ahead.

Figure C2.30 indicates differences between the existing arrival flight paths for runway 34R and the proposed arrival flight paths for runways 34R and 34L.

C2.5.9.5

Segregated mode operations 34L departures/34R arrivals (SM1)

Figure C2.31 and Figure C2.33 show the proposed flight paths for segregated mode operations with departures from the new north-south runway 34L and arrivals to the existing north-south runway 34R (Segregated Mode SM1).

Some ultra-long-haul departures must use the existing north-south runway in this mode due to runway-length requirements.

Departures from runway 34L will use the same departure paths as those used in mixed mode except for departures to the north east. This provides the required separation from the missed approach from runway 34R.

Departures to north eastern destinations using this procedure will join a similar flight path to the mixed mode departure from runway 34R.

Figure C2.32 indicates differences between the existing departure flight paths for runway 34R and the proposed departure flight paths for runway 34L for Segregated Mode SM1.

As there are no arrivals to runway 34L, the arrival flight paths to runway 34R can be designed to be more efficient. Wherever possible, existing arrival flight paths were used.

Figure C2.34 indicates differences between the existing arrival flight paths for runway 34R and the proposed arrival flight paths for runway 34R for Segregated Mode SM1.

C2.5.9.6

Segregated mode operations 16L Departures/16R arrivals (SM2)

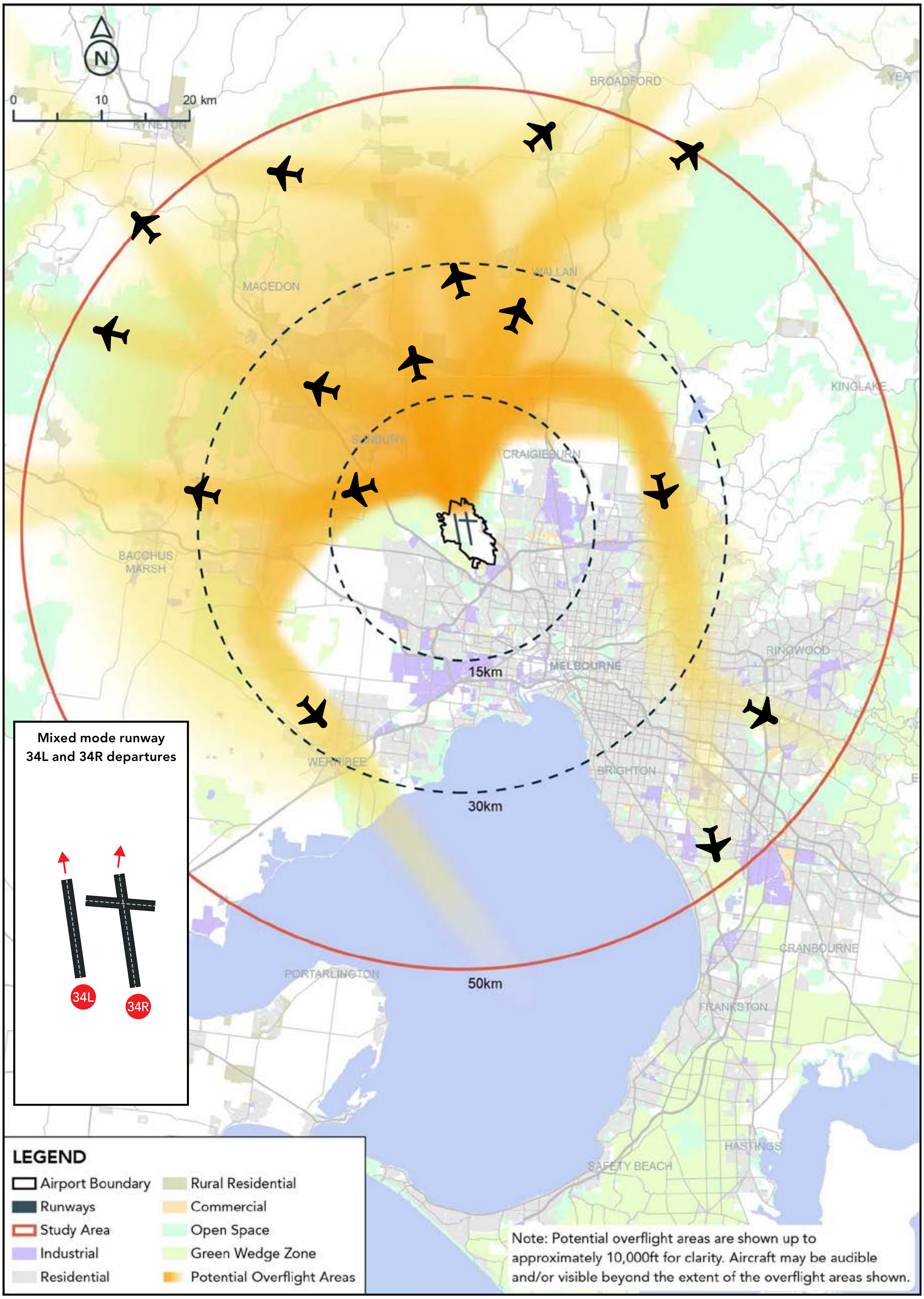
Figure C2.35 and Figure C2.37 show the proposed departure and arrival flight paths for Segregated Mode 16L Departures/16R Arrivals (Segregated Mode SM2).

Departures from 16L to the south, east and northeast are the same as those used in mixed mode due to the separation requirement with Essendon Fields.

Departures to the west and northwest must maintain runway heading to provide initial separation with the missed approach path from runway 16R, which will turn right more than 30 degrees. Finalisation of Runway 16L SID procedure will consider the safe avoidance of the Sydenham Radio Mast during the airspace detailed design process. The SIDs follow different paths than the mixed mode SIDs as there are fewer constraints on design (e.g. the long ILS/GLS approach from the south west).

Figure C2.36 indicates differences between the existing departure flight paths for runway 16L and the proposed departure flight paths for runway 16L for Segregated Mode SM2.

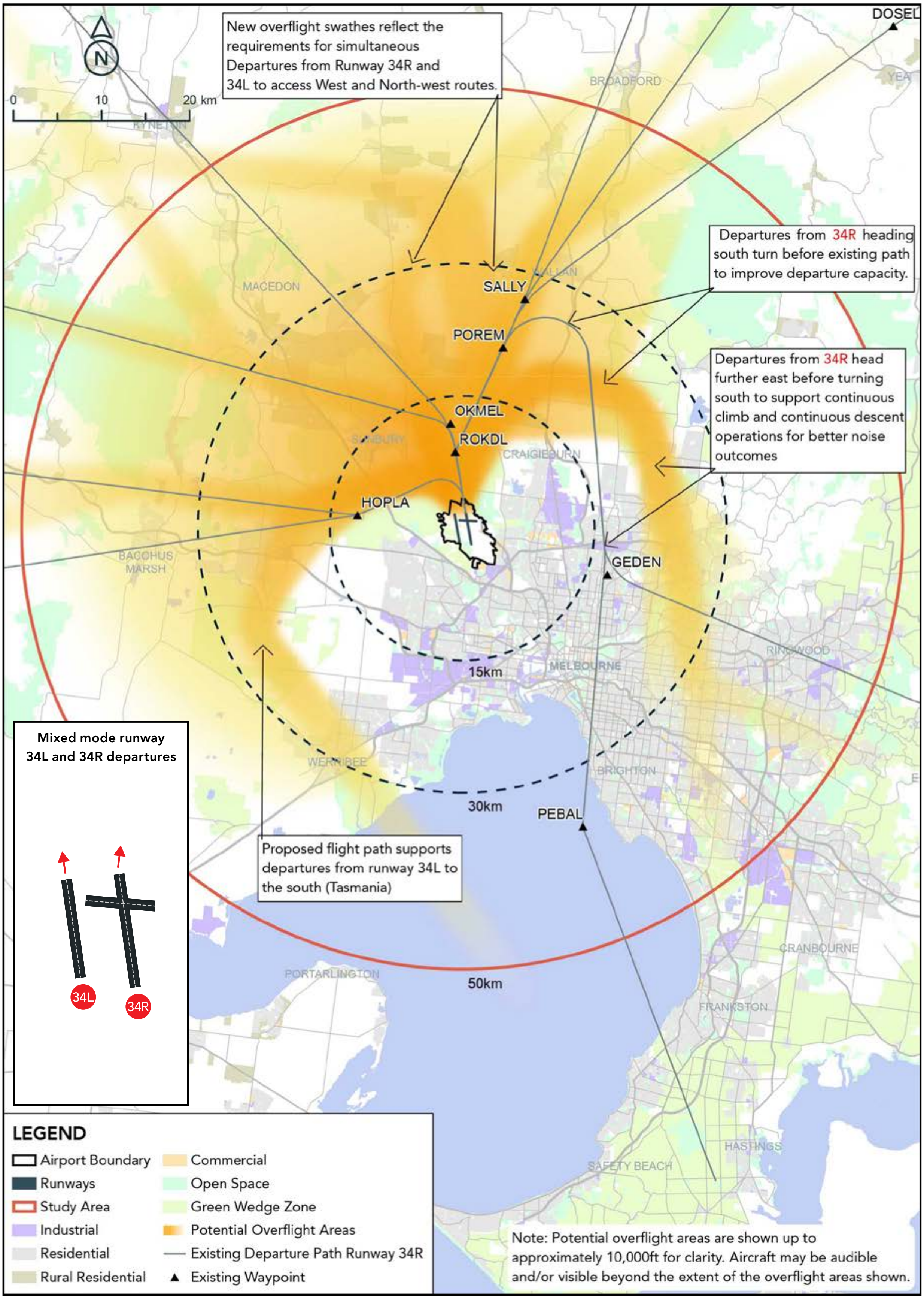
Figure C2.27
Proposed departure flight paths (SIDs) for runways 34L and 34R (mixed mode).



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.28
Differences between existing and proposed departure flight paths for runways 34R and 34L (mixed mode)



New overflight swathes reflect the requirements for simultaneous Departures from Runway 34R and 34L to access West and North-west routes.

Departures from 34R heading south turn before existing path to improve departure capacity.

Departures from 34R head further east before turning south to support continuous climb and continuous descent operations for better noise outcomes

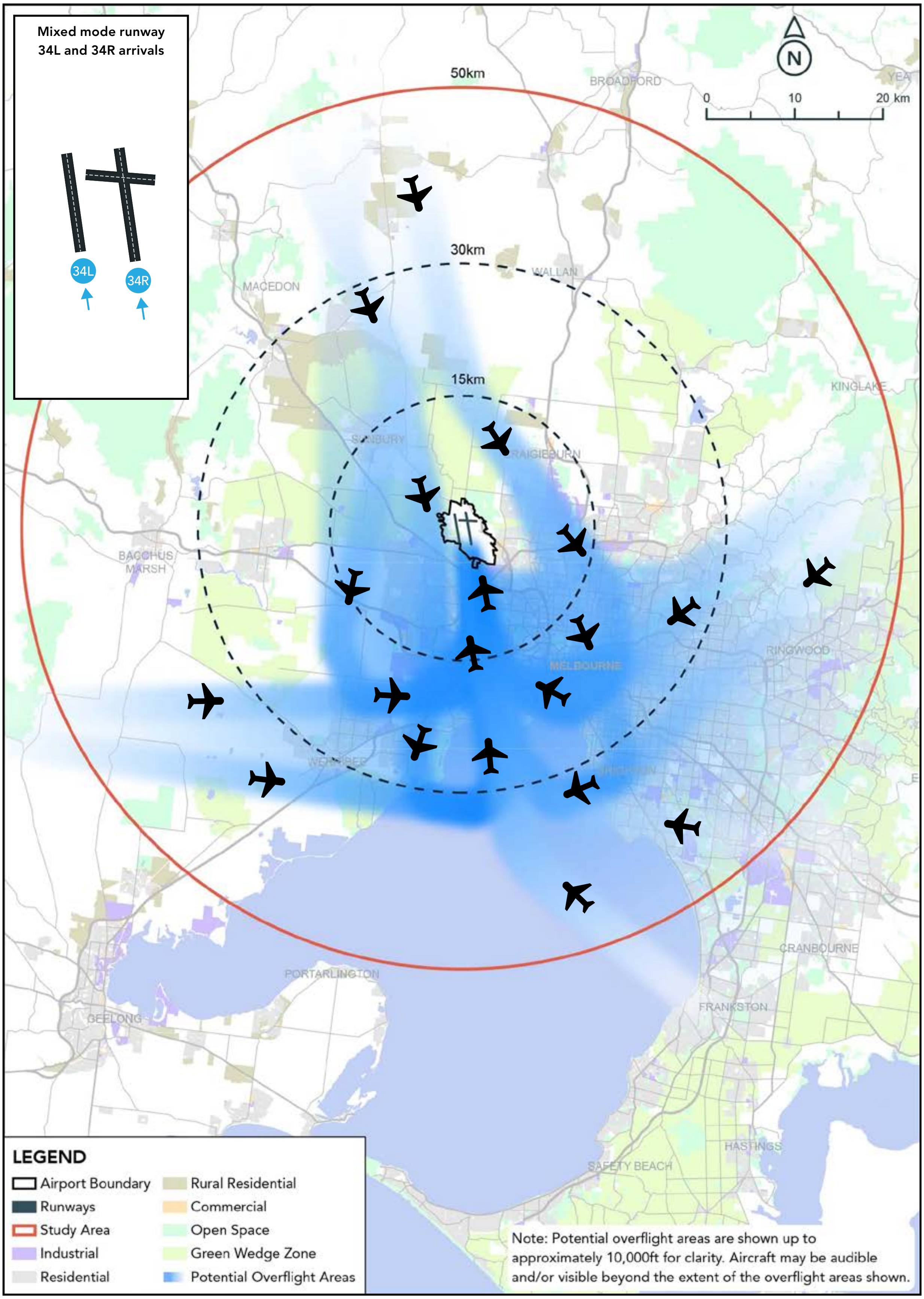
Proposed flight path supports departures from runway 34L to the south (Tasmania)

Mixed mode runway 34L and 34R departures

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

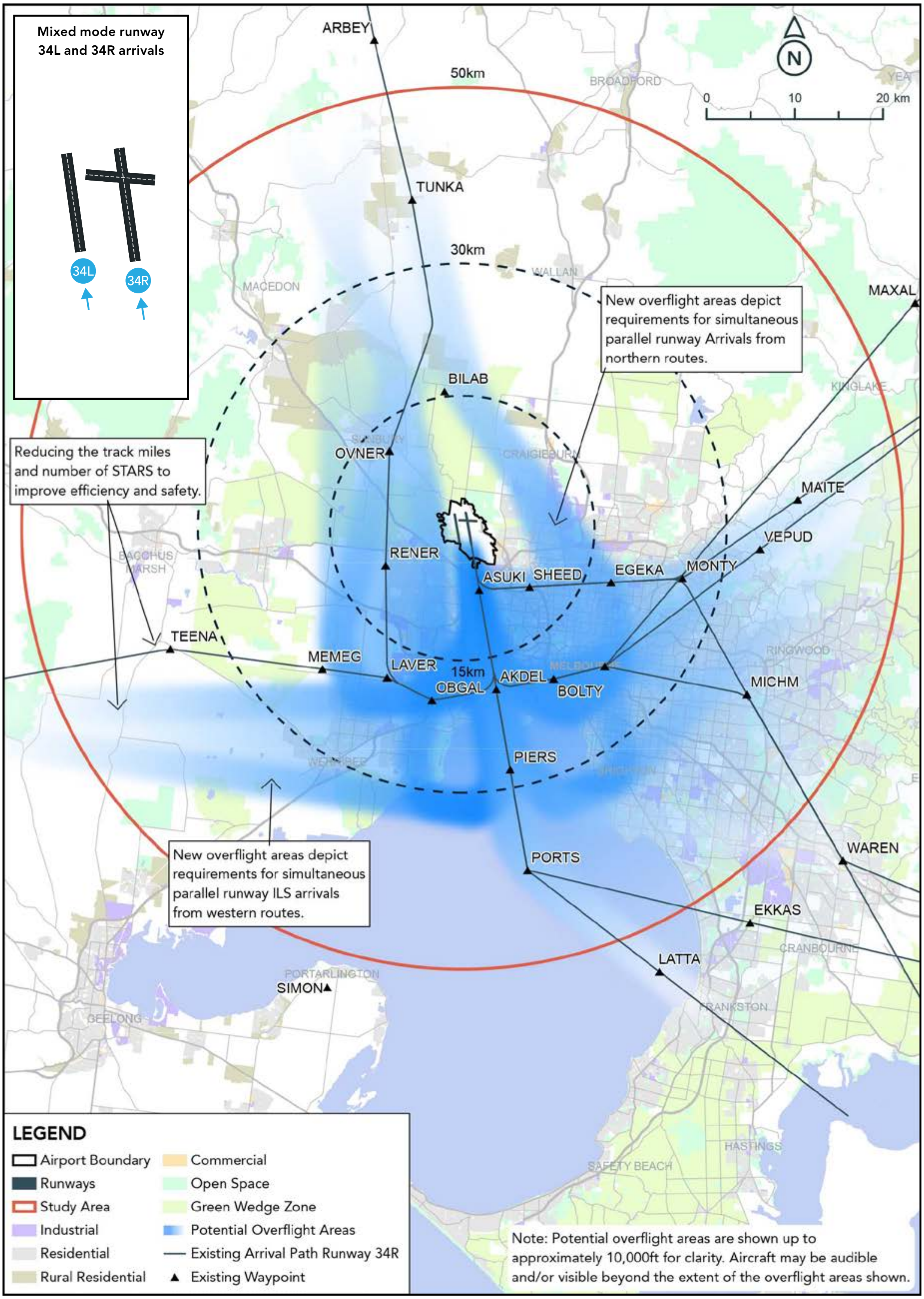
Source: APAM, 2020

Figure C2.29
Proposed arrival flight paths (STARs) for runways 34L and 34R (mixed mode)



Source: APAM, 2020

Figure C2.30
Differences between existing and proposed arrival flight paths for runways 34R and 34L (mixed mode)



New overflight areas depict requirements for simultaneous parallel runway Arrivals from northern routes.

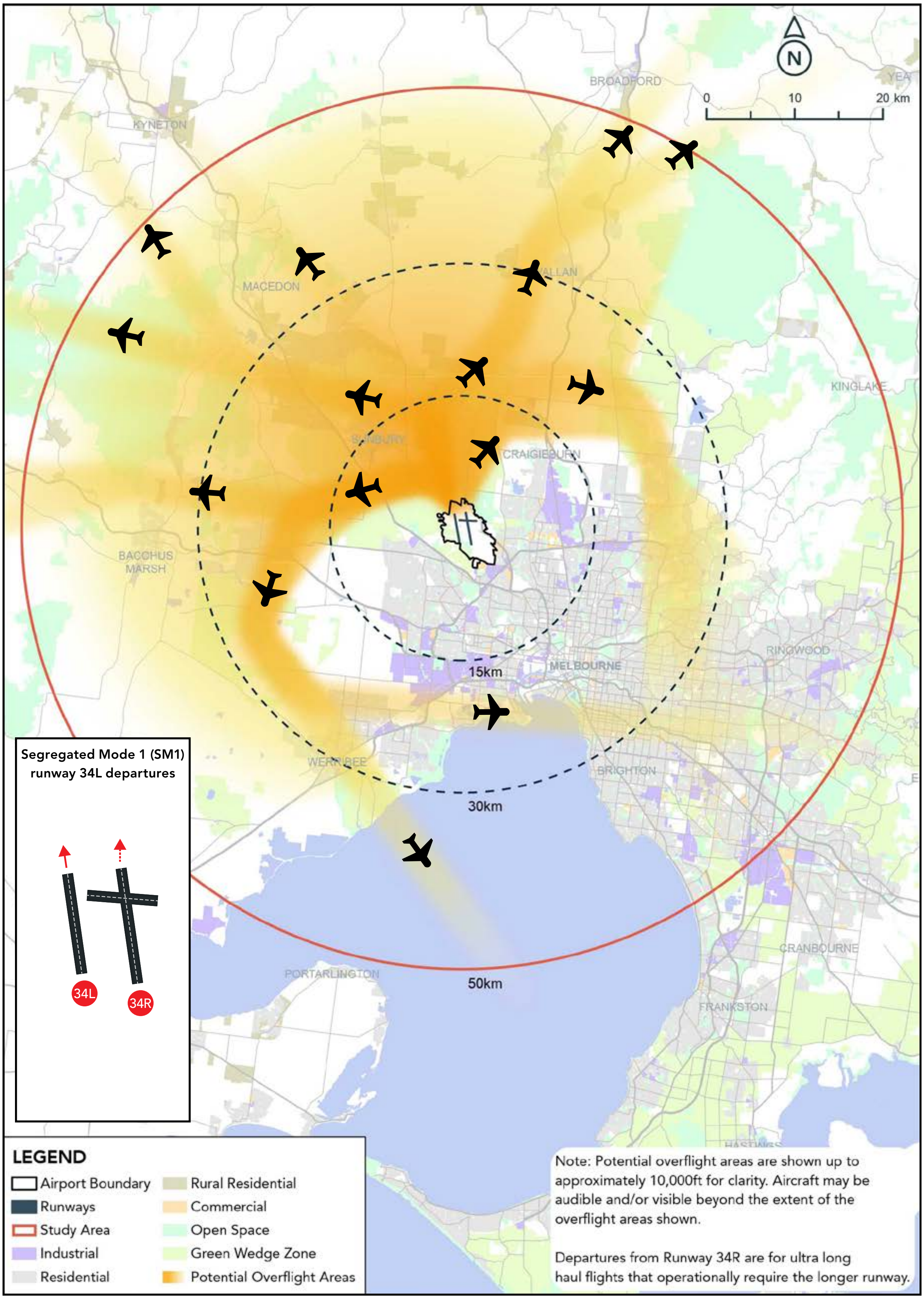
Reducing the track miles and number of STARS to improve efficiency and safety.

New overflight areas depict requirements for simultaneous parallel runway ILS arrivals from western routes.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.31
Proposed departure flight paths (SIDs) for runways 34L and 34R – segregated mode SM1

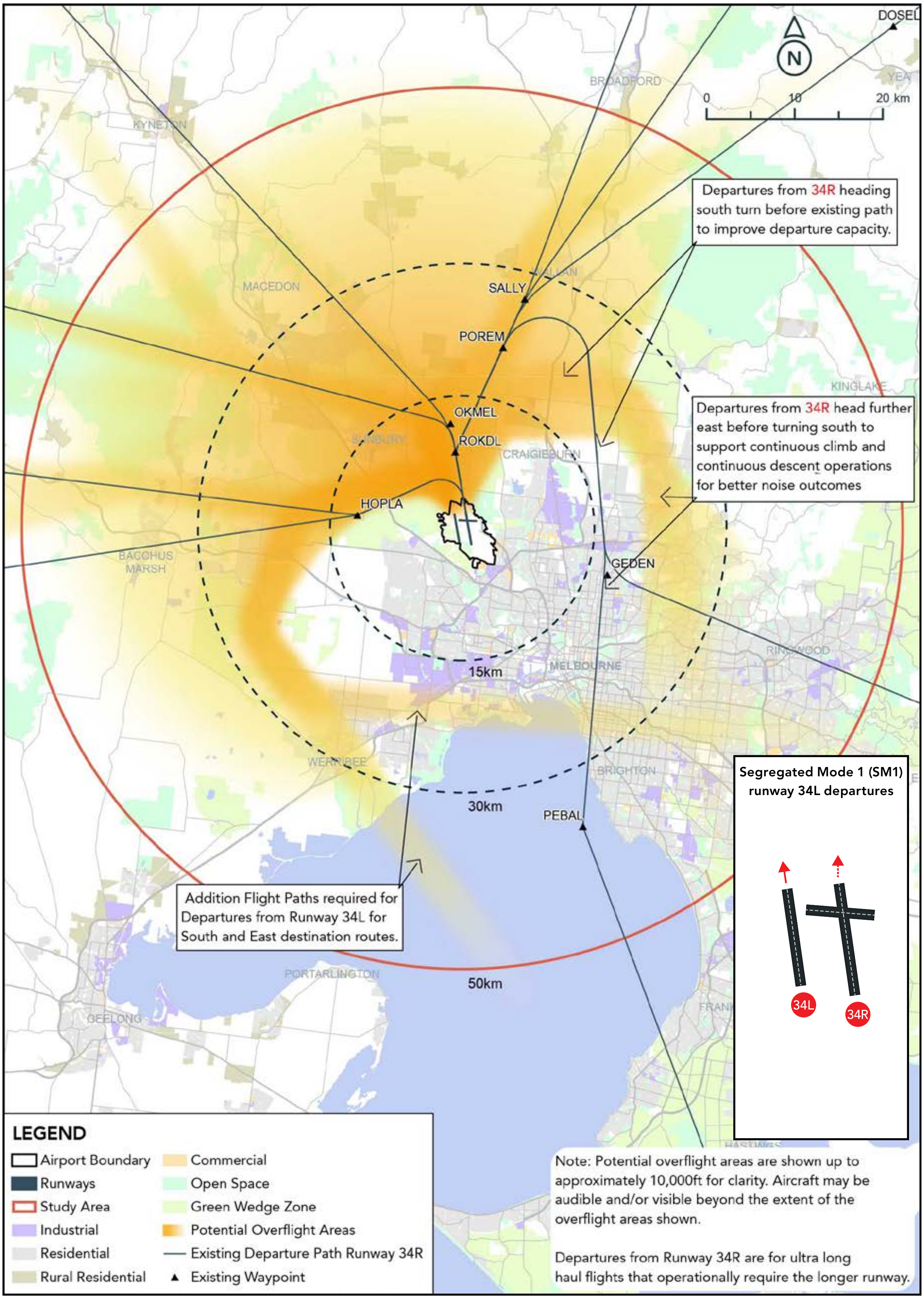


Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Departures from Runway 34R are for ultra long haul flights that operationally require the longer runway.

Source: APAM, 2020

Figure C2.32
Differences between existing and proposed departure flight paths for runways 34R and 34L (segregated mode SM1)



Departures from 34R heading south turn before existing path to improve departure capacity.

Departures from 34R head further east before turning south to support continuous climb and continuous descent operations for better noise outcomes

Segregated Mode 1 (SM1) runway 34L departures

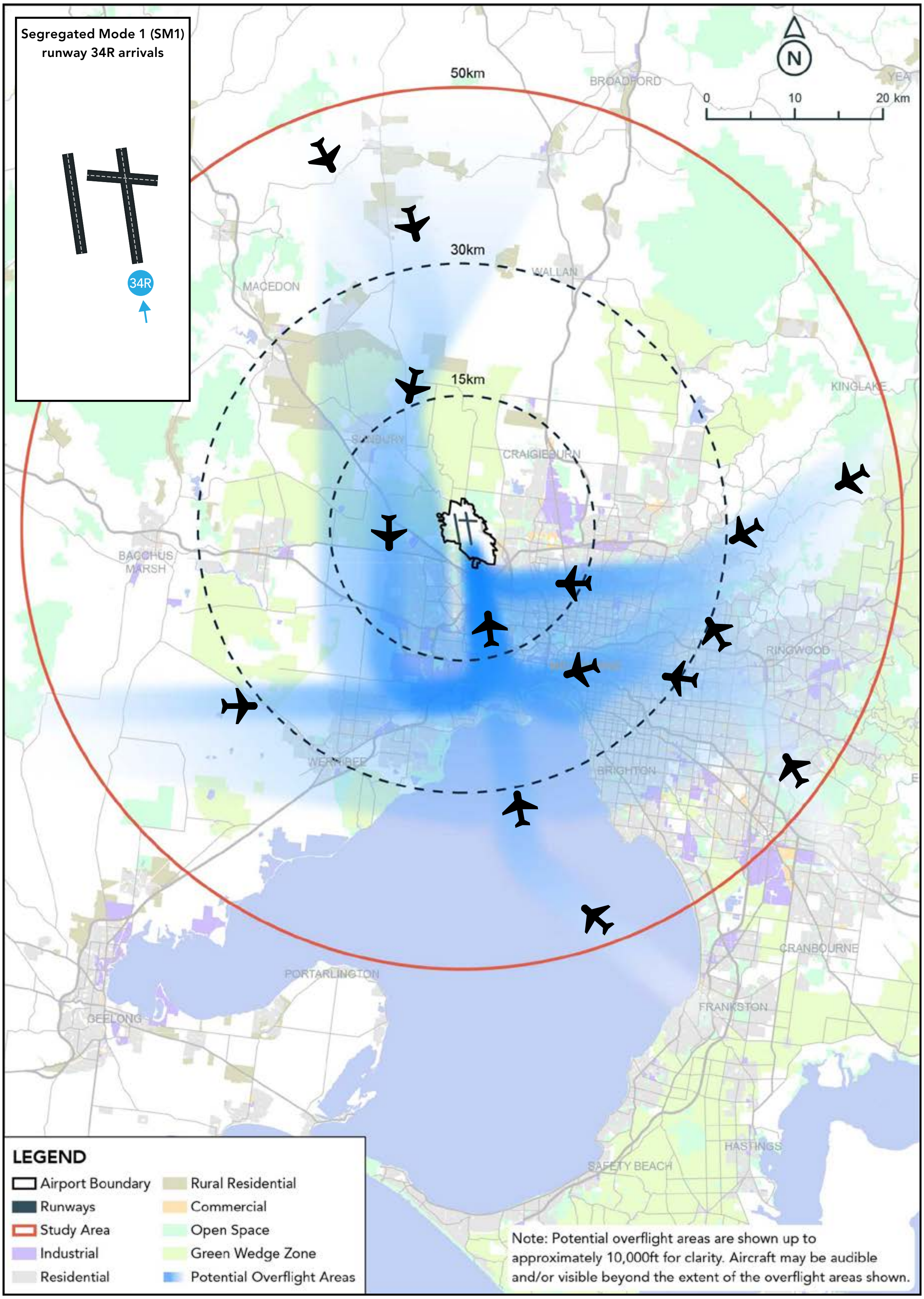
Addition Flight Paths required for Departures from Runway 34L for South and East destination routes.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Departures from Runway 34R are for ultra long haul flights that operationally require the longer runway.

Source: APAM, 2020

Figure C2.33
Proposed arrival flight paths (STARs) for runway 34R (segregated mode SM1)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.34
Differences between existing and proposed arrival flight paths for runway 34R (segregated mode SM1)

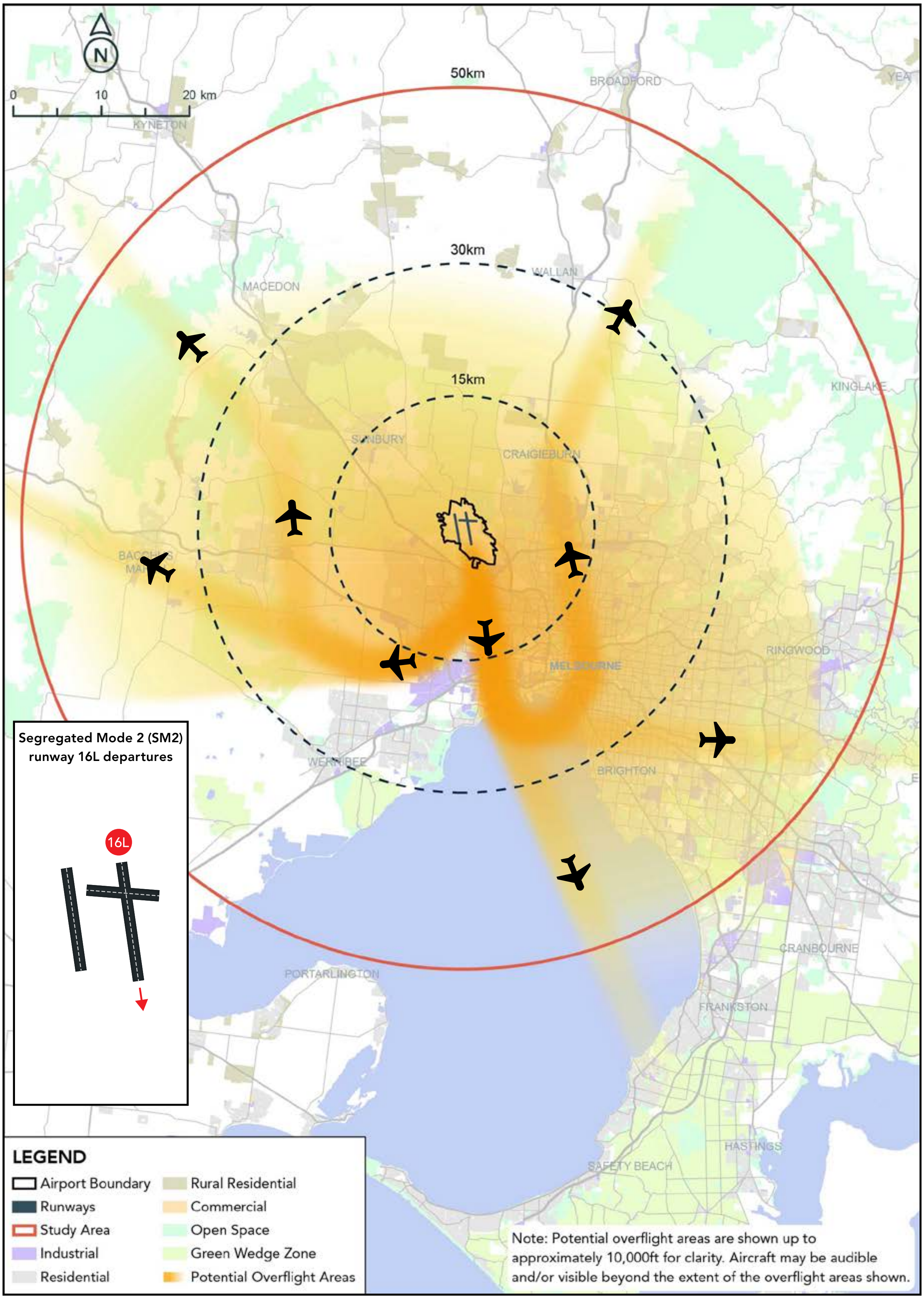
Existing flight path has not been used for the proposed M3R design. This existing track is typically used by turboprops. Turboprops will use the proposed flight paths

Arrivals from the west moved south to maintain consistency with arrival flight paths for Runway 34R & 34L Mixed Mode operations.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown

Source: APAM, 2020

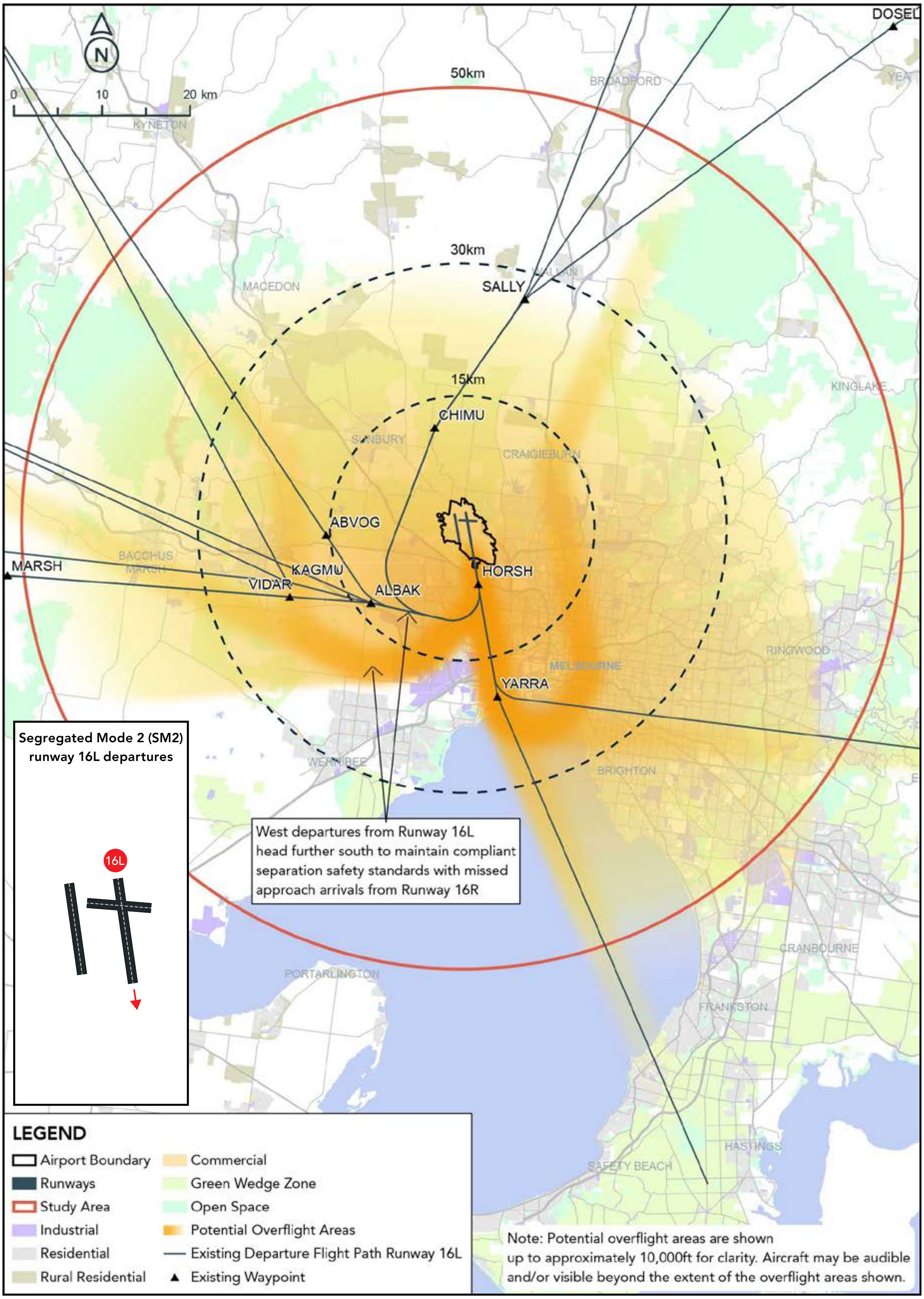
Figure C2.35
Proposed departure flight paths (SIDs) for runway 16L (segregated mode SM2)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.36
Differences between existing and proposed departure flight paths for runway 16L (segregated mode SM2)

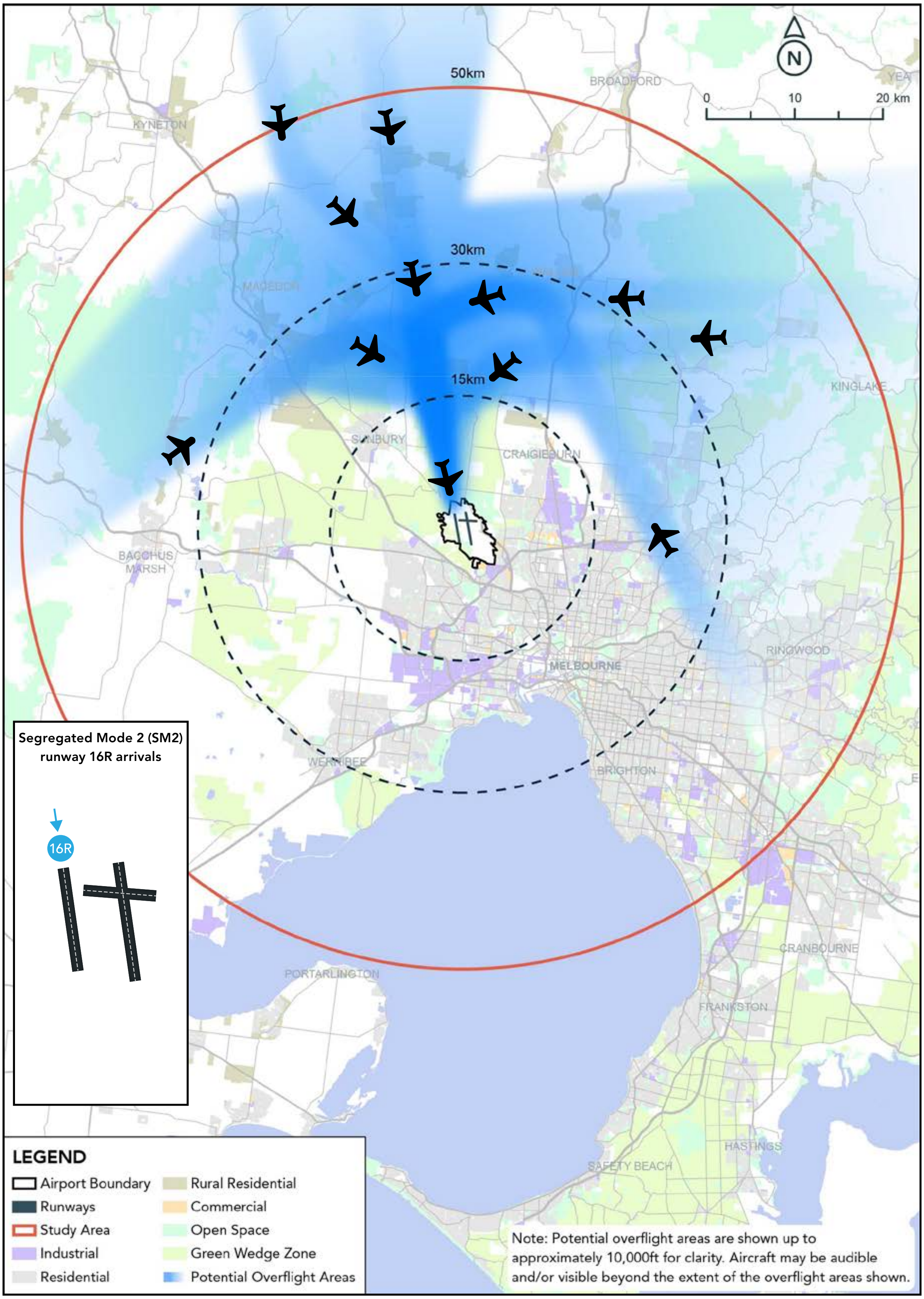


West departures from Runway 16L head further south to maintain compliant separation safety standards with missed approach arrivals from Runway 16R

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

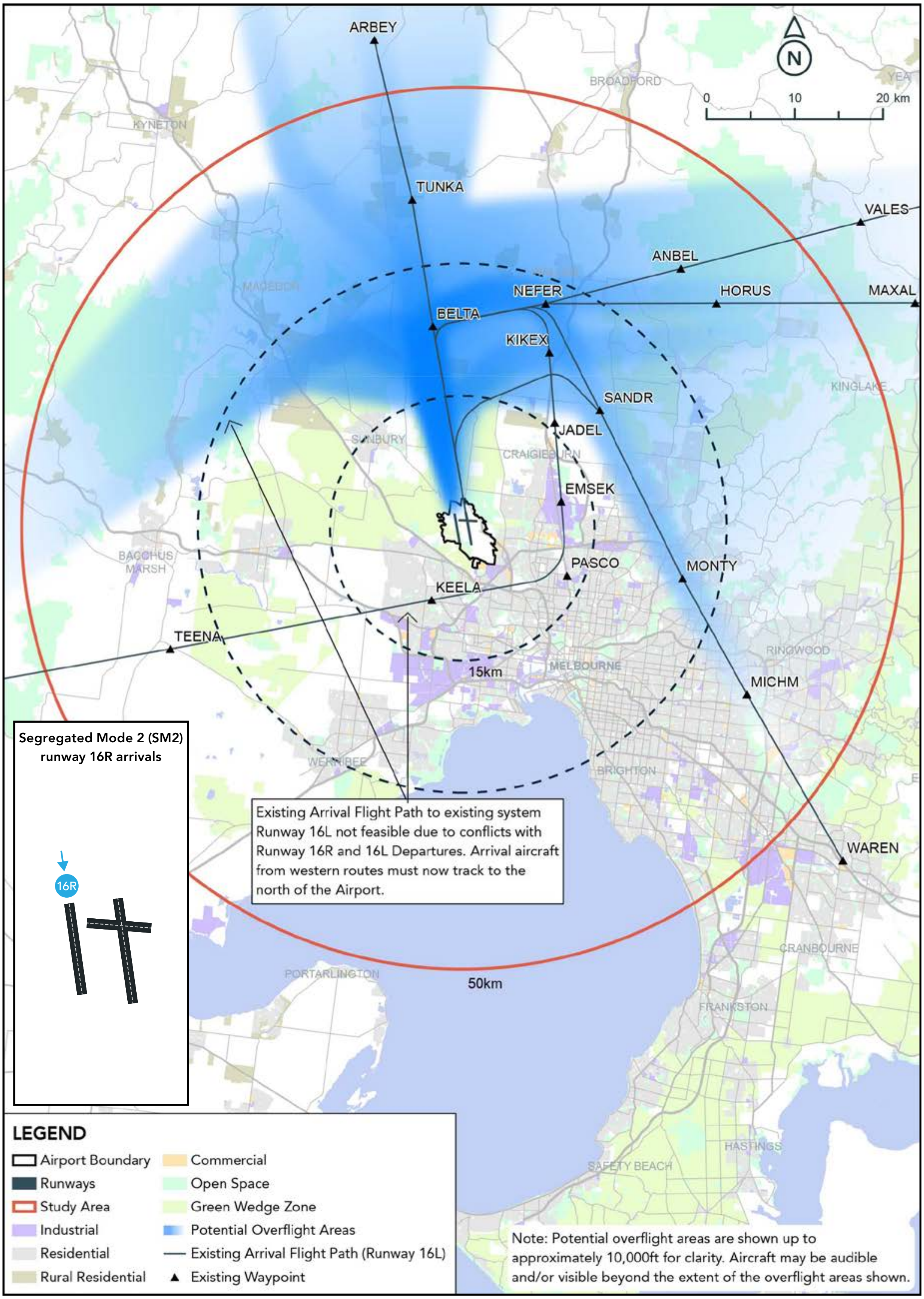
Figure C2.37
Proposed arrival flight paths (STARs) for runway 16R (segregated mode SM2)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.38
Differences between existing and proposed arrival flight paths for runway 16R (segregated mode SM2)

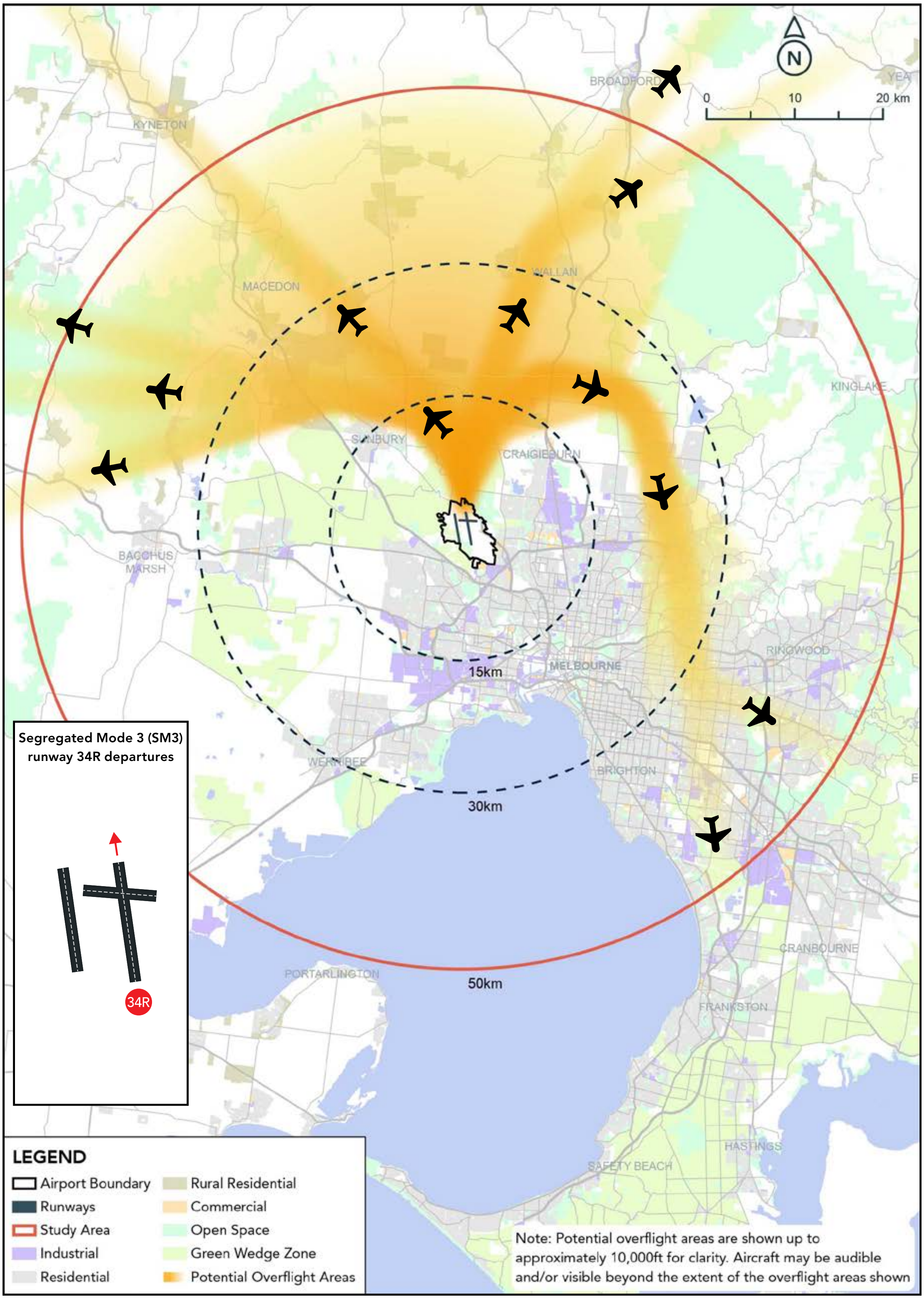


Existing Arrival Flight Path to existing system Runway 16L not feasible due to conflicts with Runway 16R and 16L Departures. Arrival aircraft from western routes must now track to the north of the Airport.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

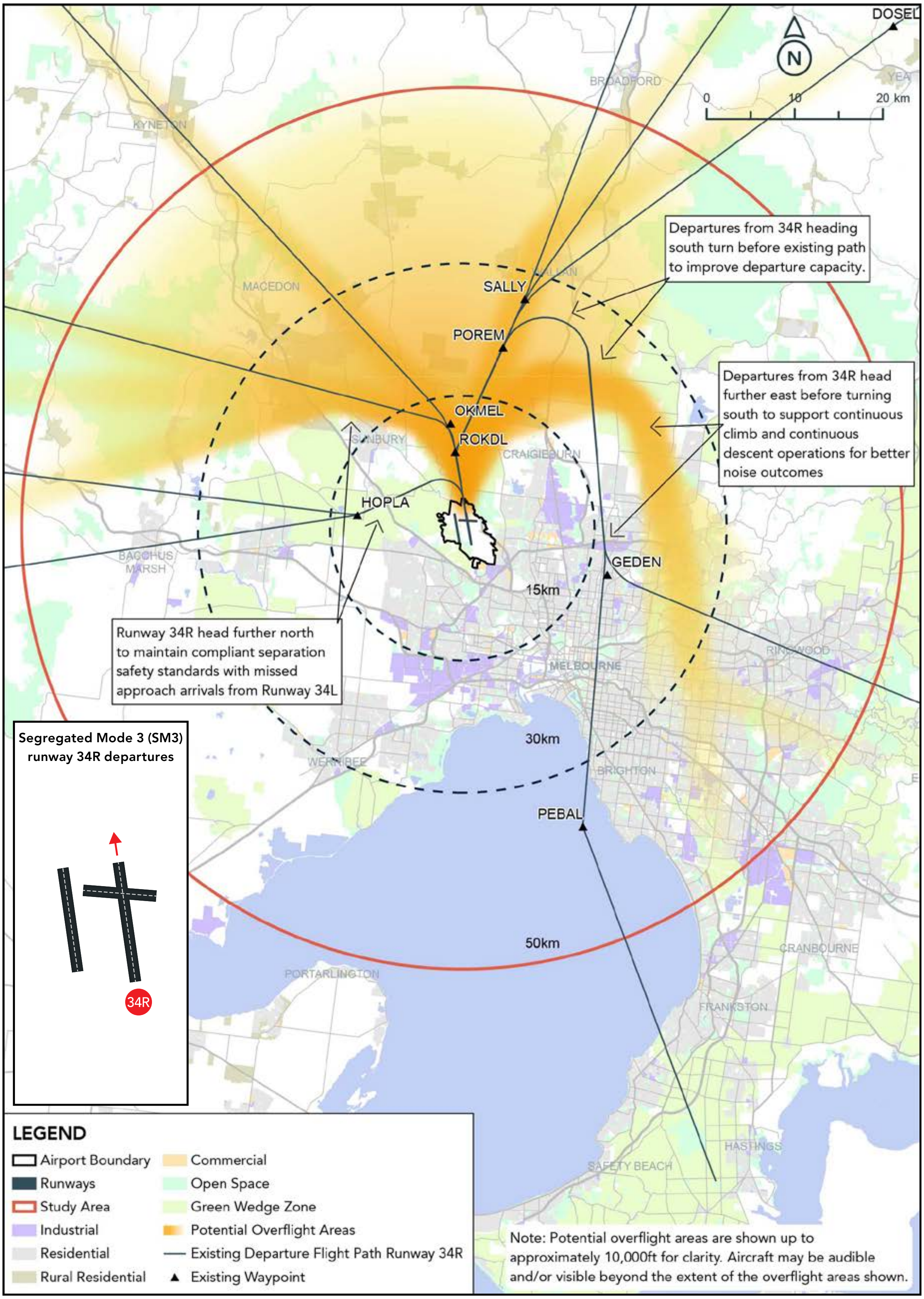
Figure C2.39
Proposed departure flight paths (SIDs) on runway 34R (segregated mode SM3)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown

Source: APAM, 2020

Figure C2.40
Differences between existing and proposed departure flight paths for runway 34R (segregated mode SM3)



Departures from 34R heading south turn before existing path to improve departure capacity.

Departures from 34R head further east before turning south to support continuous climb and continuous descent operations for better noise outcomes

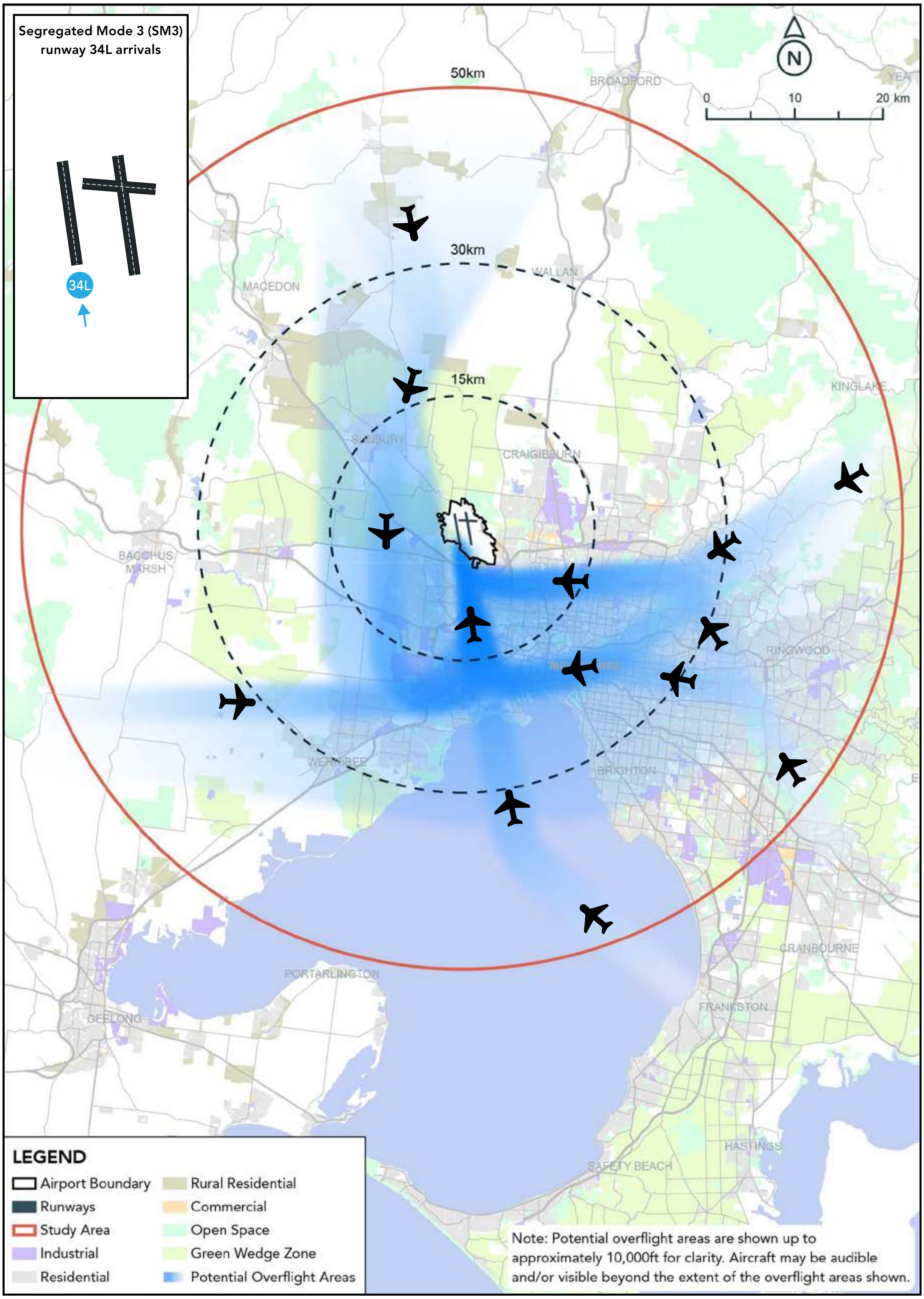
Runway 34R head further north to maintain compliant separation safety standards with missed approach arrivals from Runway 34L

Segregated Mode 3 (SM3) runway 34R departures

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

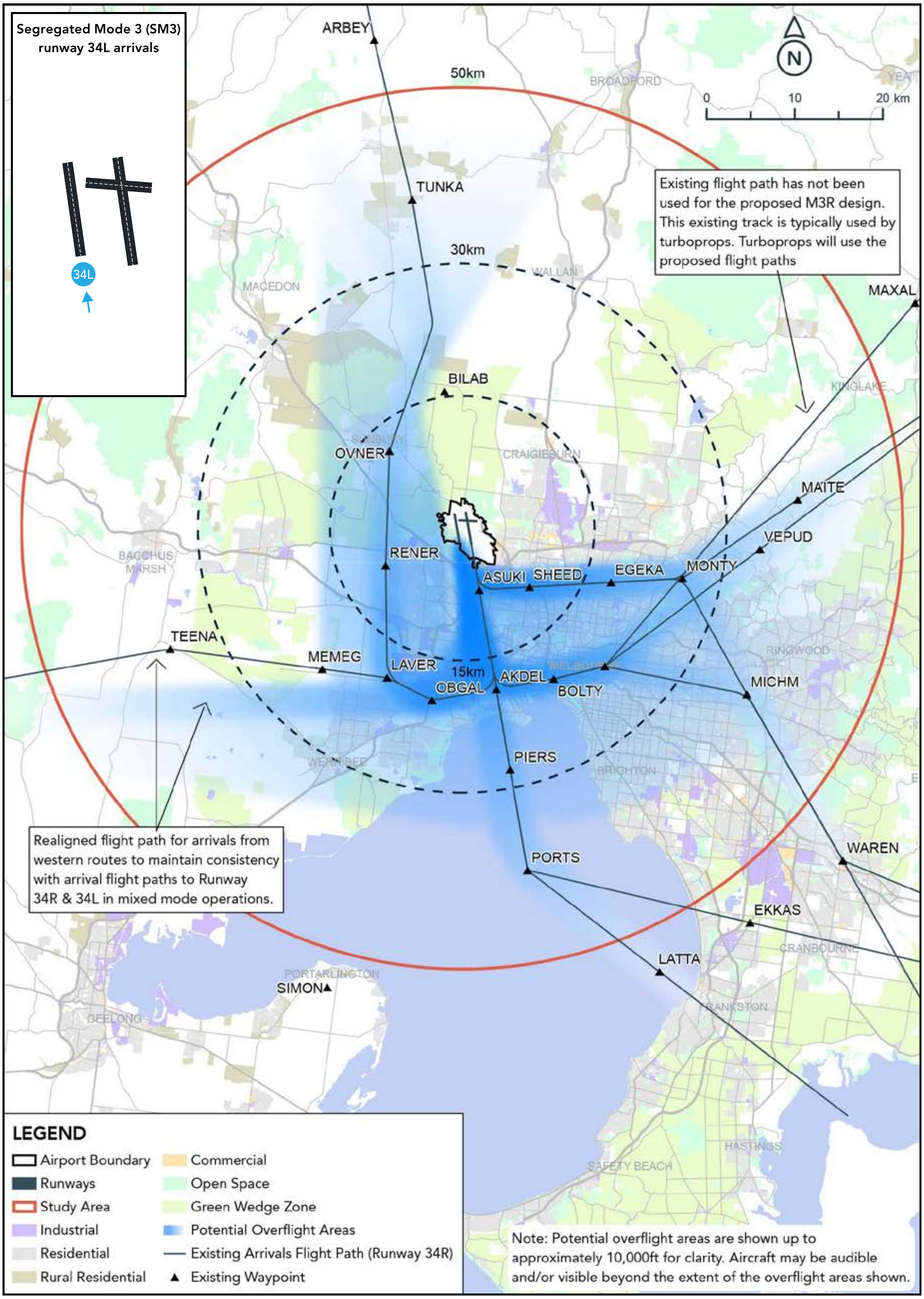
Figure C2.41
Proposed arrival flight paths (STARs) for runway 34L (segregated mode SM3)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.42
Differences between existing and proposed arrival flight paths for runway 34L (segregated mode SM3)



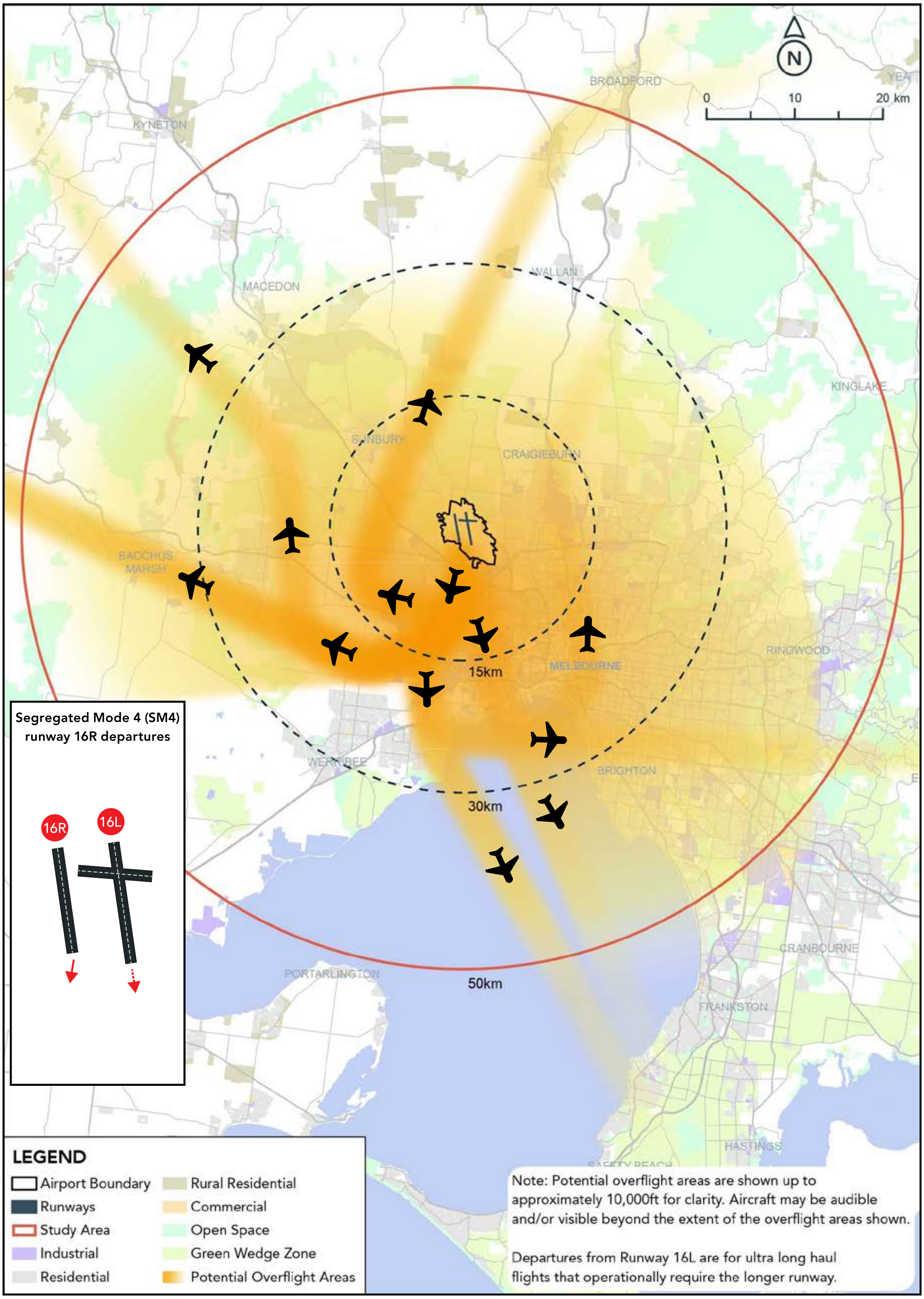
Existing flight path has not been used for the proposed M3R design. This existing track is typically used by turboprops. Turboprops will use the proposed flight paths

Realigned flight path for arrivals from western routes to maintain consistency with arrival flight paths to Runway 34R & 34L in mixed mode operations.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.43
Proposed departure flight paths (SIDs) for runway 16R and 16L (segregated mode SM4)

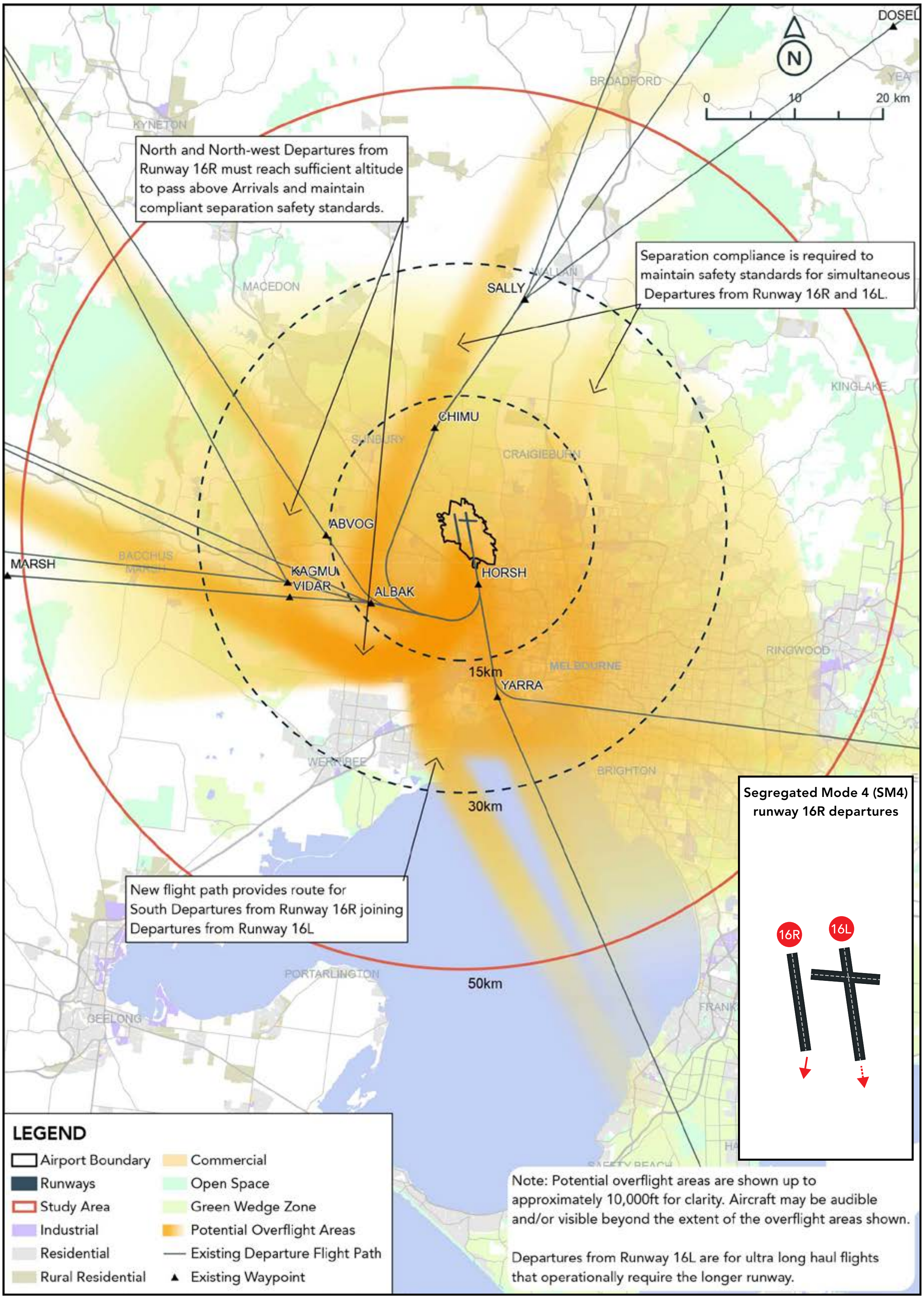


Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Departures from Runway 16L are for ultra long haul flights that operationally require the longer runway.

Source: APAM, 2020

Figure C2.44
Differences between existing and proposed departure flight paths for runway 16R (segregated mode SM4)



North and North-west Departures from Runway 16R must reach sufficient altitude to pass above Arrivals and maintain compliant separation safety standards.

Separation compliance is required to maintain safety standards for simultaneous Departures from Runway 16R and 16L.

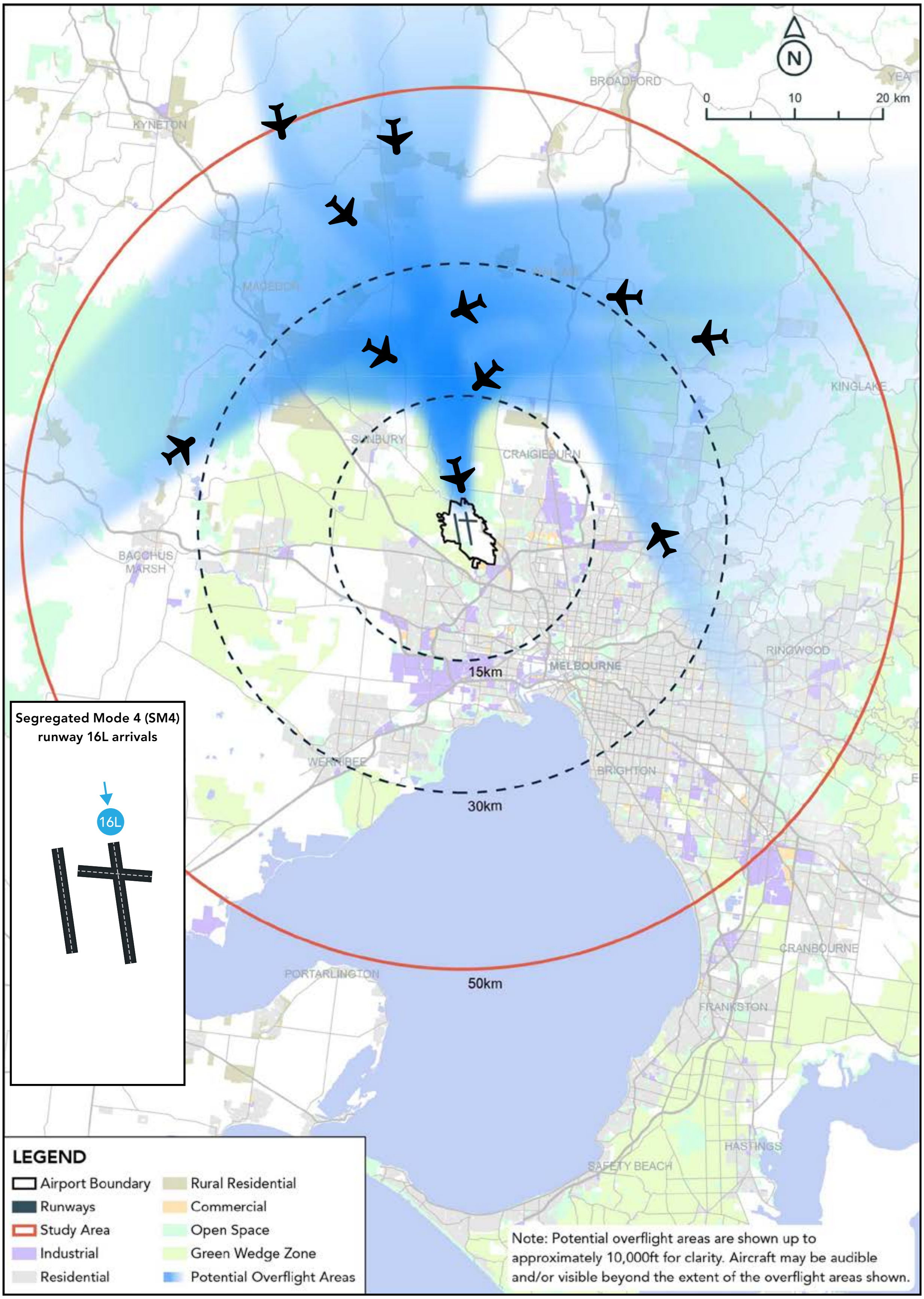
New flight path provides route for South Departures from Runway 16R joining Departures from Runway 16L

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Departures from Runway 16L are for ultra long haul flights that operationally require the longer runway.

Source: APAM, 2020

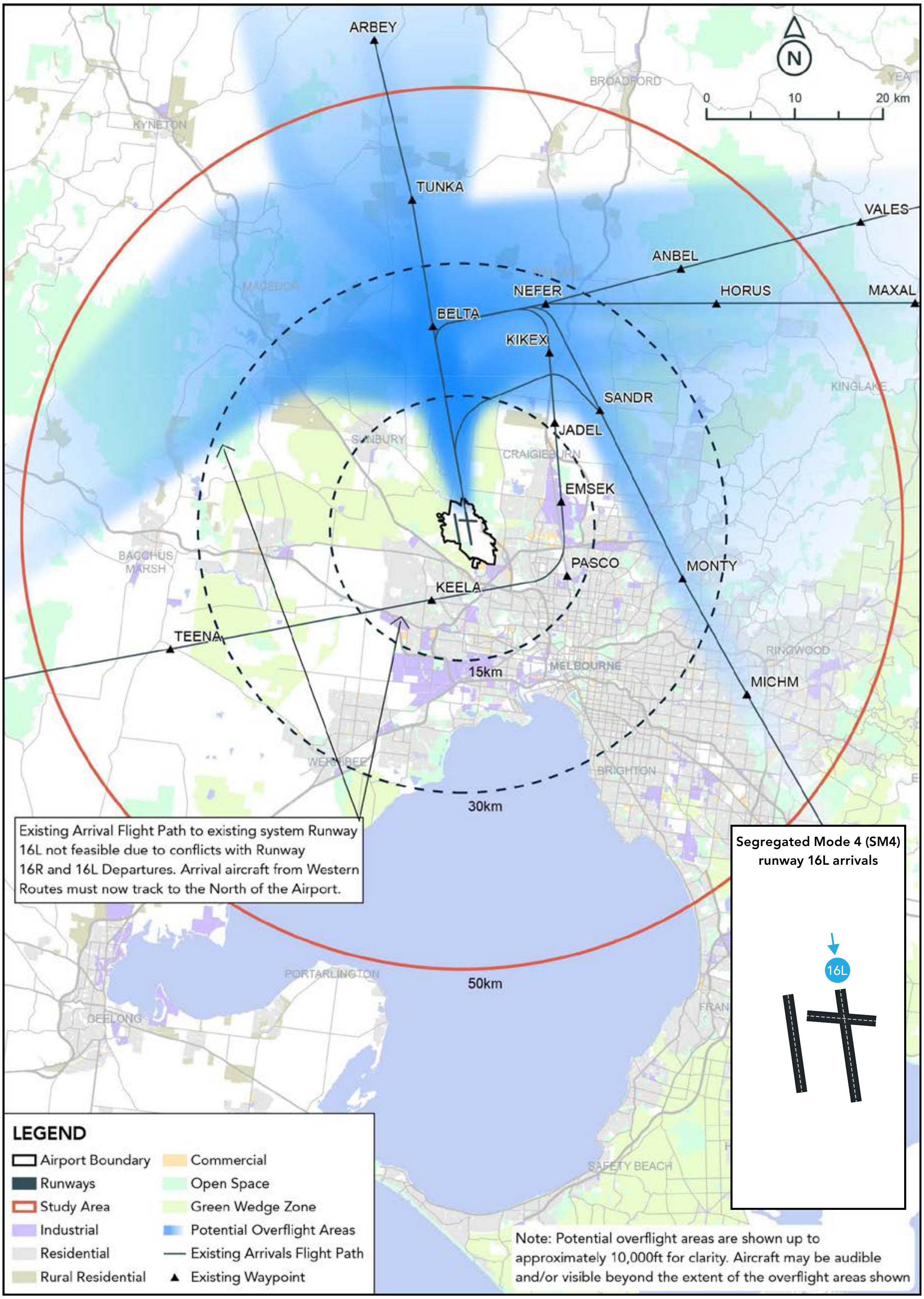
Figure C2.45
Proposed arrival flight paths (STARs) for runway 16L (segregated mode SM4)



Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

Source: APAM, 2020

Figure C2.46
Differences between existing and proposed arrival flight paths for runway 16L (segregated mode SM4)



Existing Arrival Flight Path to existing system Runway 16L not feasible due to conflicts with Runway 16R and 16L Departures. Arrival aircraft from Western Routes must now track to the North of the Airport.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown

Source: APAM, 2020

As there are no arrivals to runway 16L, the arrival flight paths to runway 16R can be designed to be more efficient. Wherever possible, existing arrival flight paths were used, the exception being those from the south west.

Figure C2.38 indicates differences between the existing arrival flight paths for runway 16L and the proposed arrival flight paths for runway 16R for Segregated Mode SM2.

C2.5.9.7
Segregated mode operations 34R departures/34L arrivals

Figure C2.39 and Figure C2.41 show the proposed departure flight paths for Segregated Mode 34R Departures/34L Arrivals (Segregated Mode SM3).

Departures from runway 34R will maintain runway heading for approximately two nautical miles (3.7 kilometres) before turning right for destinations to the north-east, east and south-east. The delay in the turn is to avoid noise sensitive areas close to the airport. Departures to the north-west and west will continue on runway heading to separate from the missed approach path from runway 34L, (which will turn left a minimum of 30 degrees) before turning west. The flight paths follow wherever practicable those used today from existing runway 34.

Figure C2.40 indicates differences between the existing departure flight paths for runway 34R and the proposed departure flight paths for runway 34R for Segregated Mode SM3.

As there are no arrivals to runway 34R, the arrival flight paths to runway 34L can be designed to be more efficient. Wherever possible, existing arrival flight paths were used. The flight paths are essentially the same as those used for arrivals to 34R in Segregated mode apart from the final approach path.

Figure C2.42 indicates differences between the existing arrival flight paths for runway 34R and the proposed departure flight paths for runway 34L for segregated Mode SM3.

C2.5.9.8
Segregated mode operations 16R departures/16L arrivals

Figure C2.43 and Figure C2.45 show the proposed departure flight paths for Segregated Mode 16R Departures/16L Arrivals (Segregated Mode SM4).

Departures from runway 16R will maintain runway heading for approximately two nautical miles (3.7 kilometres) before turning right a minimum of 30 degrees to separate from the missed approach from runway 16L. The delay in the turn is because of the proximity of the Sydenham radio mast to the south-west of M3R. Departures from 16R to the south and north-east use the same flight paths as those in mixed mode.

Departures to the south east track out on the same flight path as those heading south before turning east at the northern shore of Port Phillip Bay. This provides the required separation with Essendon Fields Airport and aligns the flight path with other south easterly departure paths.

Departures to the west and north west follow the same paths as the segregated mode departures from runway 16L.

Figure C2.44 indicates differences between the existing departure flight paths for runway 16L and the proposed departure flight paths for runway 16R for Segregated Mode SM4.

As there are no arrivals to runway 16R, the arrival flight paths to runway 16L can be designed to be more efficient. Wherever possible, existing arrival flight paths were used, the exception being those from the south-west. The flight paths are essentially the same as those used for arrivals to 16R in segregated mode, apart from the final approach path.

Figure C2.46 indicates differences between the existing arrival flight paths for runway 16L and the proposed arrival flight paths for runway 16L for Segregated Mode SM4.

C2.5.9.9
SODPROPS – 16R Arrivals/34R Departures

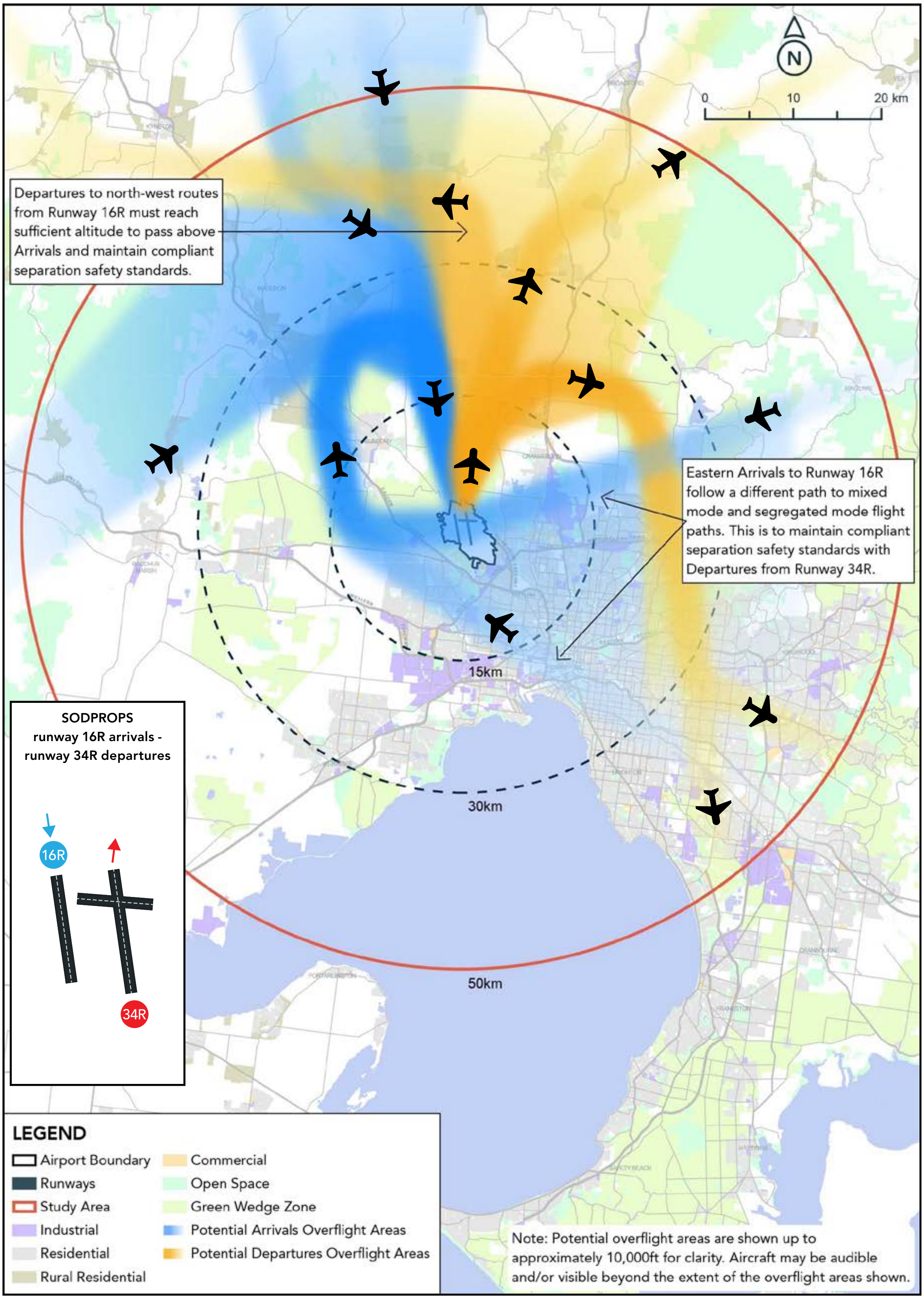
Figure C2.47 shows the proposed departure and arrival flight paths for SODPROPS.

SODPROPS is a runway mode employed at Sydney and Brisbane airports to minimise community exposure to aircraft noise during the night. SODPROPS is most logically established to the north of Melbourne Airport, as this region has the lowest population density in the vicinity of the airport. Arrivals would be flown to runway 16R and departures from runway 34R.

There are specific weather requirements applying to this mode in terms of cloud base, visibility and wind strength and direction. Departures must turn a minimum of 15 degrees away from the arrival path. These strict weather and operational requirements make SODPROPS a complex mode. It is expected that SODPROPS will only be available for less than 30 per cent of all night periods (nb. calculations are based on SODPROPS conditions for periods of at least one hour). Melbourne Airport will work closely with the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA), CASA, Airservices and airlines to explore safe changes to the criteria that may allow greater use of the mode and therefore greater concentration of aircraft noise at night to the north of the airport.

Arrivals to runway 16R for aircraft arriving from the north and west are that same as those used in segregated mode, however arrivals from the east cannot fly the same paths due to departing traffic. In this case, arrivals from the east must fly to the west of the airport to make their approach. Aircraft will be relatively high until established to the west of the airport.

Figure C2.47
Proposed arrival flight paths (STARs) for runway 16R and departure flight paths (SIDs) for runway 34R – SODPROPS Mode (Night)



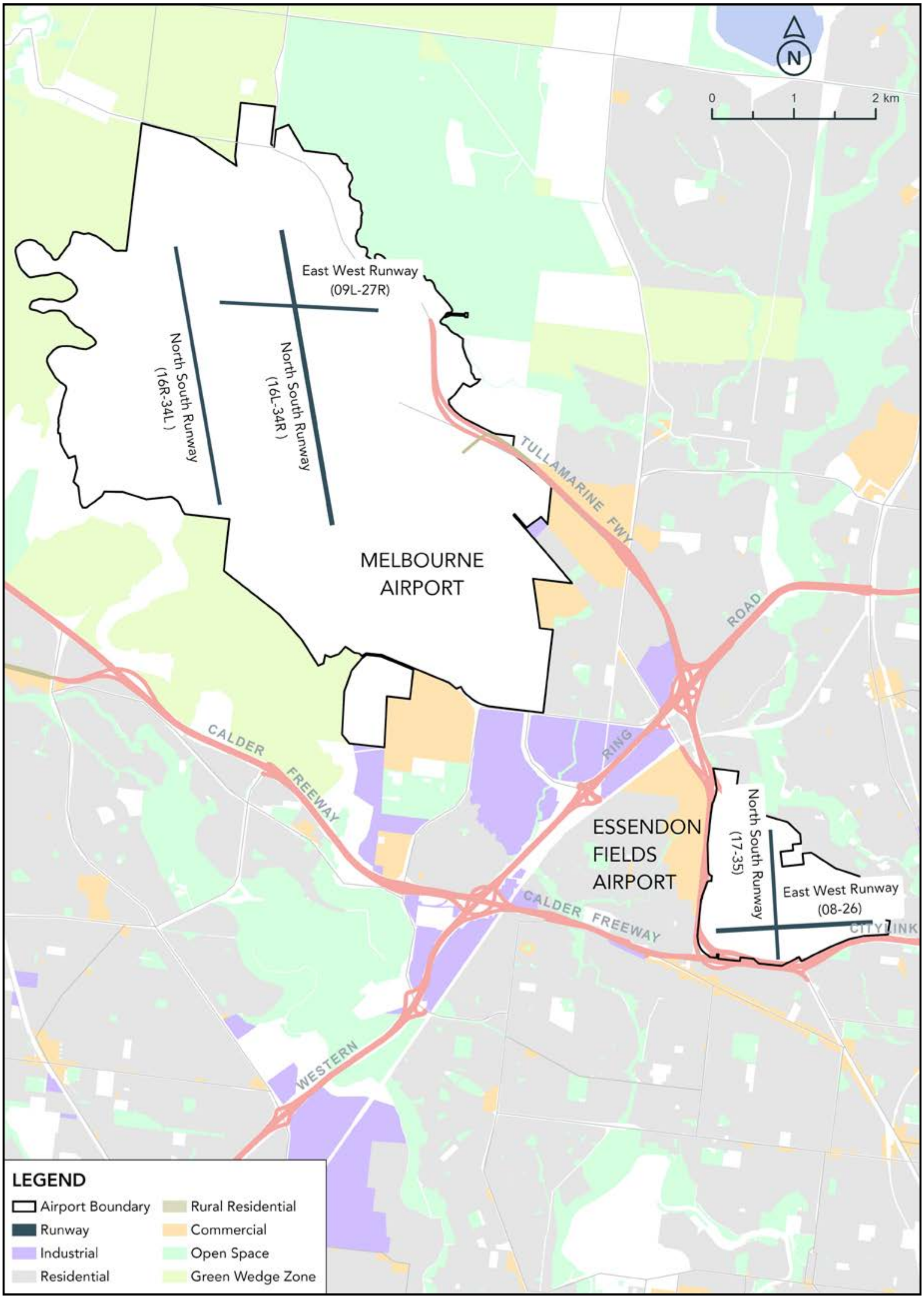
Departures to north-west routes from Runway 16R must reach sufficient altitude to pass above Arrivals and maintain compliant separation safety standards.

Eastern Arrivals to Runway 16R follow a different path to mixed mode and segregated mode flight paths. This is to maintain compliant separation safety standards with Departures from Runway 34R.

Note: Potential overflight areas are shown up to approximately 10,000ft for clarity. Aircraft may be audible and/or visible beyond the extent of the overflight areas shown.

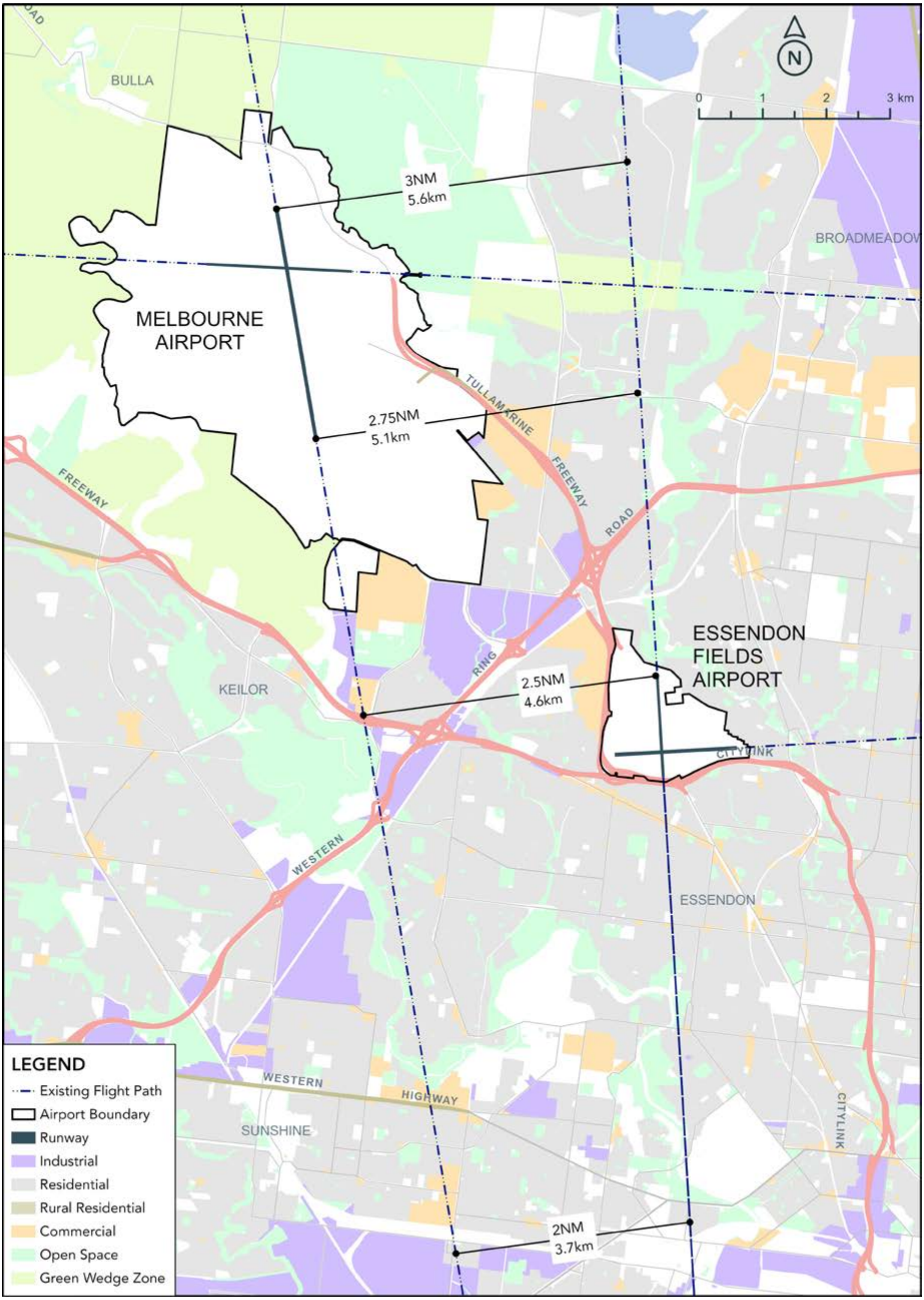
Source: APAM, 2020

Figure C2.48
Melbourne Airport and Essendon Fields Airport



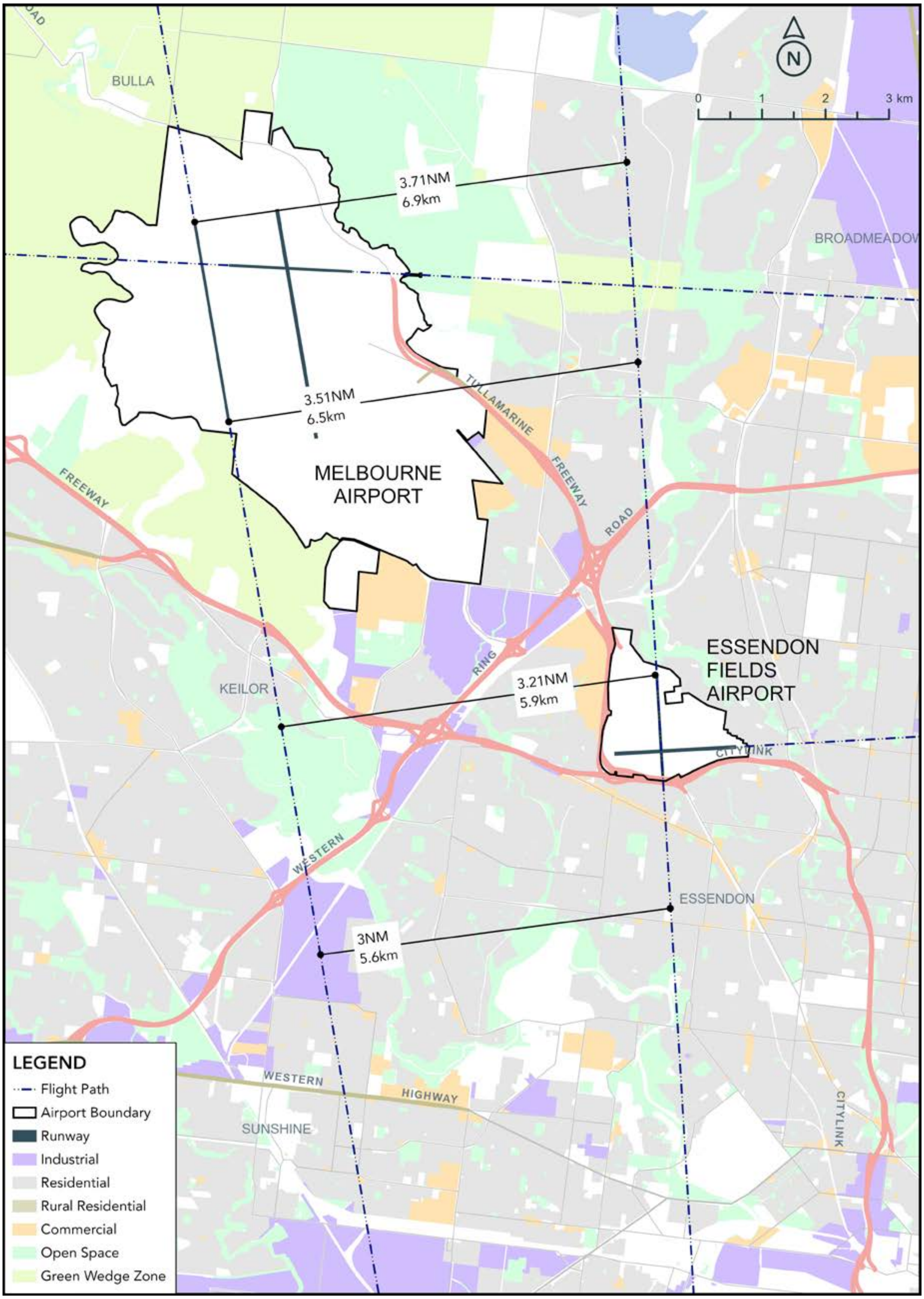
Source: APAM, 2020

Figure C2.49
Melbourne Airport and Essendon Fields Airport existing runway relationship



Source: APAM, 2020

Figure C2.50
Melbourne Airport and Essendon Fields Airport new runway relationship



Source: APAM, 2020

Departures must turn right 15 degrees immediately after take-off. For aircraft heading to the north-east, east and south, the flight paths are the same as mixed and segregated mode departures from runway 34R. SODPROPS is only operated in visual conditions and requires at least eight kilometres of visibility and a minimum cloud base of ~2,500 feet (subject to further work in the detailed airspace design).

Departures to the west must stay on a northerly track until they are high enough to cross the arriving flight paths. This results in a slightly different flight path than that used in mixed mode from runway 34R.

C2.5.10
Arrivals and departures on the existing east-west runway (09/27)

It is expected that flight paths for operations on the existing east-west runway (09/27) will remain essentially the same as today. Runway 09/27 remains an important element of Melbourne Airport's operation following M3R. Feedback during the public exhibition clearly demonstrated community desire for its ongoing use for sharing noise, especially at night.

Melbourne Airport acknowledges that there is significant opportunity to introduce operating modes that promote use of Runway 09/27 with the objective of noise sharing. The process of detailed airspace design (pending approval of the M3R MDP) shall incorporate this objective and include updated noise modelling.

C2.5.11
Interaction with Essendon Fields Airport operations

Due to the proximity of Essendon Fields Airport, the changes to airspace architecture required for M3R will alter the interaction between the airports' operations. This section outlines the key issues and resulting traffic management considerations M3R may introduce because of the airports' proximity.

Figure C2.51
Runway Mode compatibility

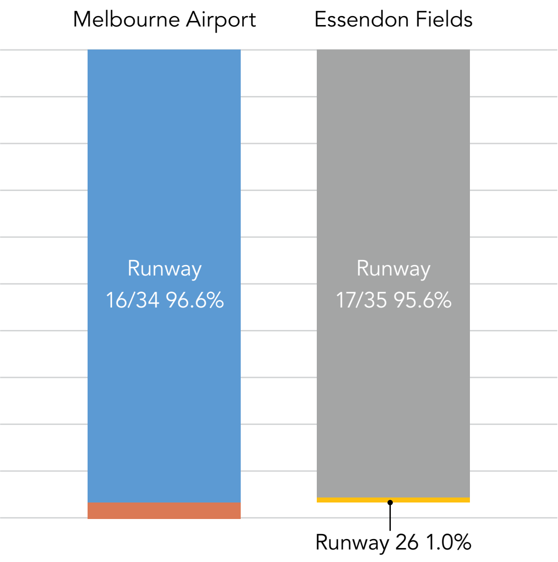


Figure C2.48, **Figure C2.49** and **Figure C2.50** show the relative locations and proximity of Essendon Fields Airport to Melbourne Airport and the runway configuration following M3R.

Melbourne Airport has been engaging with Essendon Fields Airport and Airservices to explore how the impacts of M3R should be managed to assure safe and effective operations for all parties. There exists currently a comprehensive set of air traffic control procedures (designed and maintained by Airservices) that facilitates the current safe and efficient coordination of operations between Melbourne and Essendon Fields airports.

When parallel operations are operating at Melbourne Airport, most operations at Essendon Fields Airport would also be using their north-south runway (17/35). Essendon Fields Airport would normally expect to operate runway 35 when Melbourne Airport traffic is operating runway 34, or runway 17 when Melbourne is operating runway 16.

Most of the time, complementary runway mode selections can be made that facilitate independent operations at the airports. However, in certain wind and weather conditions, dependencies arise. The impact of the dependencies has been analysed for all existing runway combinations (for example, when aircraft at Melbourne require the use of runway 16 for arrivals and departures, and aircraft at Essendon require the use of runway 26).

In good weather, the separation of aircraft is achieved using visual techniques. Good weather conditions at Essendon Fields occur approximately 92 per cent of the time, however when the weather deteriorates pilots must use instrument departure and approach procedures. All of Melbourne Airport's runways can be accessed using instrument procedures but at Essendon Fields only runways 17 and 26 have such procedures.

During periods of poor weather when non-complementary runway modes are in use, a slot scheme may be imposed on arrivals into Essendon Fields that permits only two approaches an hour to be made. These poor weather conditions exist approximately eight per cent of the year but the scheme is only implemented about four per cent of the year (~15 days). The scheme allows high capacity passenger operations into Melbourne to continue with minimal disruption, and reduces operational complexity and workload for air traffic controllers. However, mission critical operations to/from Essendon Fields (such as Air Ambulance and law enforcement flights) are still given the highest priority.

The introduction of the third runway at Melbourne will require a change to the arrival and departure paths to comply with rules for parallel runway operations. Analysis of 13 years of wind and weather data has shown that the two airports can be operating in complementary modes (runways 16/34 and 17/35) for 95.6 per cent of the time.

For one per cent of the time, due to wind, aircraft at Essendon Fields would require the use of runway 26 when Melbourne is using the north/south parallel runways. These periods of non-complementary runway operations would be typically 30-60 minutes in length. For 3.4 per cent of the time, during periods of strong westerly winds, Melbourne and Essendon Fields operate runways 27 and 26 respectively.

All arrivals and departures to/from the north of Essendon Fields (runway 17 arrivals and runway 35 departures) are more than three nautical miles away from arrivals and departures to/from the new runway (runway 16 arrivals and runway 34 departures) and therefore are separated.

All arrivals and departures to/from the south of Essendon Fields (runway 35 arrivals and runway 17 departures) gradually converge south of the aerodromes (due to the alignment of the runway headings).

Separation standards for parallel and near-parallel runways are the same. The convergence between runways 16/34 and 17/35 is six degrees (Melbourne runway heading is 160 degrees and Essendon Fields is 166 degrees) and this qualifies the runways to be classified as 'near-parallel'.

It is proposed to operate the three runways (16R/16L/17 and 34L/34R/35) as two distinct sets of parallel runways rather than as triple parallel runways (i.e. 16L/34R and 16R/34L as one set of parallels and 16L/34R and 17/35 as the other). This is because, in Australia, rules exist for the use of two parallel runways but not for triple parallel runways. Operations between the new north-south runway 16R/34L and Essendon Fields runway 17/35 are sufficiently separated so as not to be interdependent.

In visual conditions it is anticipated that aircraft operations will continue as they do today, with a similar dependence on visual separation and coordination between the various ATC positions responsible for the airspace. In marginal weather (when aircraft must use instrument procedures to arrive and depart safely) a new way of operating will be required, particularly if independent operations are to occur.

For instrument arrivals to runways 16L and 17, new rules will establish the near-parallel nature of the relationship between runway centrelines. For instrument departures and missed approaches from runway 16L and arrivals to runway 17, a new separation standard, supported by a safety case, would require agreement with CASA. If this cannot be achieved, a dependency between arrivals to runway 17, and departures/missed approaches from runway 16L, in instrument weather conditions would be necessary. The same is true for departures and missed approaches from runway 35 and arrivals to runway 34R at Melbourne.

Essendon Fields runway 35 is not equipped for instrument approach procedures. Therefore, in instrument weather conditions, when Essendon Fields is operating runway 35 and Melbourne is operating runway 34R, approach restrictions apply. In the future, when traffic conditions warrant, Melbourne Airport is committed to working with Essendon Fields Airport to support the enablement of independent parallel instrument procedures.

The parallel runway separation standards also require the missed approach paths and departure paths of parallel runways to be separated. To achieve this, the missed approach paths for runways 17 and 35 would need to track to the east of Essendon Fields and be separated by a minimum of 30 degrees from the Melbourne 16L/34R departure paths.

There are currently no STARs or procedural SIDs at Essendon Fields. In instrument weather conditions, arriving aircraft are radar vectored by ATC to the commencement points of the instrument approach procedures, and departures use a radar SID and are vectored by ATC clear of other traffic.

The parallel runway separation rules are based on aircraft executing instrument approach and departure procedures using designated navigation performance standards (RNP1). The use of procedural SIDs and STARs (designed to strategically separate the flows of arriving and departing aircraft) enhances safety, improves efficiency, and reduces complexity and workload for ATC. Therefore, where practical, procedural SIDs and STARs would be designed for Runways 08, 17, 26 and 35 at Essendon. These SIDs and STARs would be incorporated in the Melbourne Basin airspace design to ensure, wherever possible, that operations into Melbourne Airport and Essendon Fields Airport could continue independently.

Due to the parallel runway separation rules used to permit independent approaches in poor weather, more controlled airspace may be required over the northern part of Port Phillip Bay to contain the instrument approach procedures to Melbourne and Essendon Airports.

C2.5.11.1

Indicative noise impact of M3R on Essendon Fields Airport operations

As a result of M3R and the associated change to airspace operations for Melbourne Airport (i.e. increased use of north-south parallel runway operations at Melbourne Airport) there will be some effects on Essendon Fields Airport's operations. The detail of these impacts is partially dependent on the forecast mix of aircraft operations for Essendon Fields Airport.

During the preparation of this MDP, Essendon Fields Airport Pty Ltd (EAPL) advertised a preliminary version of its draft Master Plan (dMP) 2019 which was available for public consultation from 2 April 2019 to 2 July 2019. Melbourne Airport subsequently announced on 14 November 2019 it would begin preparing plans for its third runway to be built in a north-south orientation. The EAPL dMP had been prepared based on Melbourne Airport's proposed third runway being oriented east-west.

In response to EAPL community feedback and agreement from the Minister for Infrastructure, the dMP 2019 was withdrawn. EAPL were granted an extension for submission of a new dMP to 31 January 2023 (the 2013 EAPL Master Plan remains in effect). The extension allows Melbourne Airport to progress the planning approvals for M3R and share this information with EAPL. This information will enable EAPL to update all plans and forecasts in the dMP in consideration of Melbourne Airport's changed plans, consult with the community and submit a new dMP before the extension deadline.

This is considered by both organisations to be a sound outcome for the community because the two Master Plans will contain the most up-to-date information to inform community consultation.

Based on the best information currently available to Melbourne Airport, it is expected that M3R will result in an increase in the proportion of total movements at Essendon Fields Airport using the north-south runway (17/35) and a reduction in the proportion of movements using the east-west runway (08/26). This will likely result in some increase in aircraft noise impacts to the north and south of Essendon Fields Airport, and also result in a decrease of aircraft noise impacts to the east and west.

The actual impacts on operations and aircraft noise will be a function of M3R in combination with Essendon Fields Airport's forecast operations. The impacts will depend on several factors, including but not limited to:

- Availability of aircraft forecast schedules for Essendon Fields Airport
- Essendon Fields Airport requiring information on the M3R airspace and operational assumptions to be in a position to complete their own noise assessments.

A quantitative assessment of aircraft noise impacts relating to Essendon Fields Airport operations has therefore not been included in this MDP.

C2.5.12
Interaction with Avalon International Airport

Avalon International Airport is 50 kilometres south west of Melbourne airport and has a single runway, 18/36. The airport is available 24 hours and most operations are domestic and international Low-Cost Carrier (LCC) Regular Passenger Transport (RPT) operations. The airport also attracts flying training operators, who use the airspace and instrument approach procedures for training.

As Avalon is a considerable distance from Melbourne Airport there is no relationship between runway operations, and the instrument approaches do not require de-confliction. However, the introduction of the new runway and associated flightpaths will require a holistic review of all flight paths within the Melbourne Basin, including the SIDs and STARs used by aircraft operating at Avalon.

C2.5.13
Interaction with RAAF Base Point Cook Aerodrome

Point Cook aerodrome is 30 kilometres south of Melbourne Airport and has two runways (17/35 and 04/22). The base is home to the Royal Australian Air Force (RAAF) Museum and hosts regular vintage aircraft displays. The Department of Defence declares its own Restricted Airspace, activated when displays occur. There are also flying training and charter operations conducted at the aerodrome. It is anticipated that the longer ILS arrivals to Melbourne's new runway 34L will conflict with operations at Point Cook to some extent; and there is a RNAV approach to Point Cook's runway 35 that will need to be reviewed. There are no SIDs or STARs associated with Point Cook due to low volumes of traffic and types of operations. The Department of Defence has been consulted and will be included in the M3R detailed airspace design process.

C2.5.14
Interaction with Moorabbin Airport

Moorabbin airport is 40 kilometres south-east of Melbourne Airport and has two sets of parallel runways (17/35 and 13/31). It is one of Australia's busiest pilot training airports and hosts fixed wing and helicopter flying training, and some RPT and charter operations.

As Moorabbin is a considerable distance from Melbourne Airport there is no relationship between runway operations. Due to the types of flying operations there are no SIDs or STARs associated with Moorabbin. There are, however, instrument approach procedures that originate to the north and west of the airport that will require review during the detailed airspace design process of M3R.

C2.5.15
Proposed controlled airspace for M3R

Operations on the proposed parallel runways at Melbourne Airport must remain contained within controlled airspace. Some changes to the extent of the controlled airspace, specifically to the south, west and north, will be required to meet parallel runway intercept requirements (for independent operations).

Lowered Control Area (CTA) 'steps' are necessary so aircraft can approach at lower altitudes than required for single runway continuous descent approach arrivals. These will be subject to a formal airspace change proposal closer to the opening of M3R. During the detailed airspace design, efforts will be made where practicable to reduce the extent of additional controlled airspace required.

Changes to Australian airspace are made through the Office of Airspace Regulation (OAR) and are facilitated through an Airspace Change Proposal (ACP). This ACP must contain the safety case that drives the proposal and demonstrate evidence of consultation with relevant stakeholders. An ACP will be prepared once detailed airspace design is completed for M3R.

The process for protecting operational airspace from intrusions by obstacles is discussed in Chapter C5: Airspace Hazards and Risks.

C2.6
AVOIDANCE, MANAGEMENT AND MITIGATION MEASURES

Airspace design at major airports is complex. The safety of aircraft operations is paramount and, as described in preceding sections, the procedures used are governed by strict international and national standards. Additionally, flight paths and procedures must permit efficient processing of the air traffic. Because of these requirements, opportunities to mitigate aircraft noise and emissions through airspace design are limited.

The overall impact of aircraft noise from Melbourne Airport is somewhat mitigated by the presence of green wedges (particularly to the north and west of the airport) which have been enshrined in Victorian legislation and the Victoria Planning Provisions. Several additional technical measures have been incorporated into airspace design.

The preliminary airspace design incorporates a number of considerations aligned with the *Airservices Flight Path Design Principles* that seek to minimise the impacts of aircraft noise on sensitive areas. Where possible, adjustments to flight paths were made during the iterative preliminary design process to improve noise outcomes. The section below highlights several improvements incorporated through the development of the concept airspace design. These include but are not limited to improvements in the following:

- Less noise in densely populated residential areas
- Reduced fuel burn and emissions through track shortening and use of Continuous Climb Operation (CCO) and Continuous Decent Approaches (CDA)
- Introduction of new flight modes such as segregated mode which allow flight paths to remain in similar locations to existing procedures.

C2.6.1
Initial concept

The first part of the design process was to establish a team of experts drawn from Airservices' ATC, airspace and environment teams, and Melbourne Airport's M3R program. A set of functional requirements was produced incorporating international and national rules for parallel runway procedures, and social and environmental objectives.

The first airspace 'sketches' focused primarily on rule set compliance to gain a broad understanding of the boundaries within which the team needed to work and to identify where terrain may influence the design. Building on the initial basis, iterations were made that focused on improving noise and environmental outcomes. These iterations referenced potential noise and visually sensitive sites that had been identified in advance of this process through mapping and analysis of existing communities out as far as 35 nautical miles (70 kilometres) from Melbourne Airport. This analysis has considered Airservices' latest processes and internal operating procedures for airspace changes across Australia.

As and when new information became available (such as where future residential areas are being established) the preliminary design was revisited and adjustments made (where possible).

C2.6.2
Departures from runway 34L/R

As described previously, there is a relationship between departure and missed approach paths that must be applied for the runways to operate independently. The team examined how this relationship should be applied to departures from runways 34L and 34R in order to achieve a balance between operational and environmental requirements.

As can be seen in **Figure C2.52**, early projections of mixed-mode departures required aircraft to turn left from 34L and fly straight ahead and turn sharply right from 34R. The design then evolved and the outcome of the preliminary design process was for a slight left turn from runway 34L and a smaller right turn from runway 34R. This provided several benefits:

- North bound departures from 34L were moved to the east of Sunbury and away from future higher density residential areas
- West bound departures from 34L were moved to be south of Sunbury and closer to the existing departure path
- Continuous climb operations were facilitated from 34L to reduce noise on the most used paths (those going north east)
- North bound departures from 34R were moved to be west of future higher density residential areas
- The departure paths were also largely suitable for segregated mode operations and therefore fewer new flight paths had to be designed.

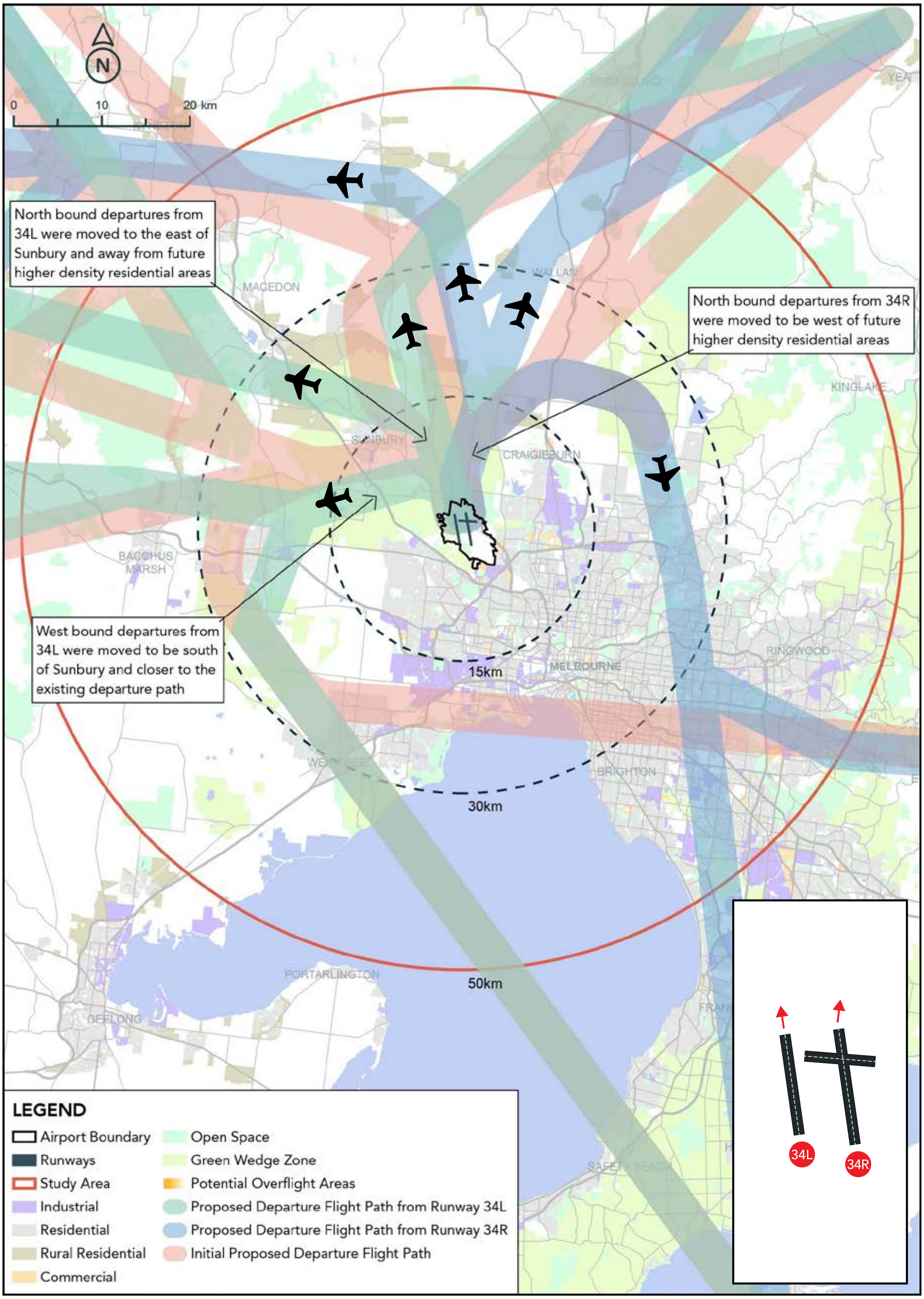
These changes made in the design process are aligned with the following Airservices design principles:

- Consider concentrating aircraft operations to avoid defined noise sensitive sites
- Design flight paths that deliver operational efficiency and predictability, and minimise the effect on the environment through reducing fuel consumption and emissions
- Consider flight paths that optimise airport capacity and meet future airport requirements. Consider current and expected future noise exposure when designing flight paths.

C2.6.3
Arrivals to runway 34L/R

During mixed mode operations, the longer ILS/GLS arrivals to runways 34L/R commence over Port Phillip Bay at 3,000 and 4,000 feet respectively. As there are no terrain concerns to the south of the airport it would have been possible to reduce the heights of the commencement points and move them closer to the airport – thus reducing the number of miles flown and therefore fuel burn and emissions. However, to do this would require aircraft to be lower over residential areas to the south-east and south-west of Melbourne. The design team worked to keep aircraft higher until they had crossed the coast to generate better noise outcomes. The cost in terms of fuel burn and emissions was tempered through the facilitation of continuous descent techniques that allow the aircraft to descend under minimum power, this also reduces aircraft noise on the ground.

Figure C2.52
Runway 34 Departure evolution

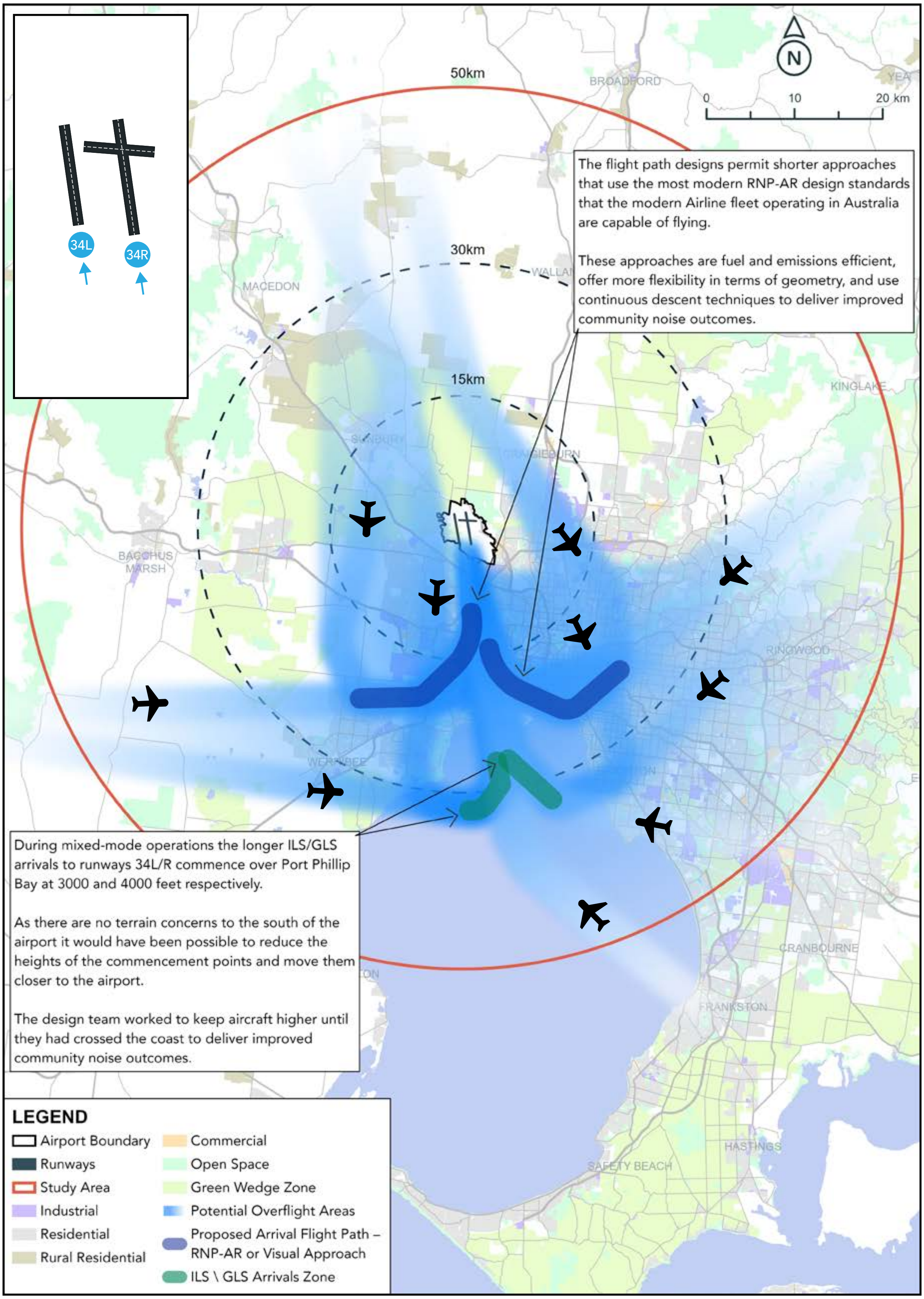

North bound departures from 34L were moved to the east of Sunbury and away from future higher density residential areas

North bound departures from 34R were moved to be west of future higher density residential areas

West bound departures from 34L were moved to be south of Sunbury and closer to the existing departure path

Source: APAM, 2020

Figure C2.53
Runway 34 Approaches



The flight path designs permit shorter approaches that use the most modern RNP-AR design standards that the modern Airline fleet operating in Australia are capable of flying.

These approaches are fuel and emissions efficient, offer more flexibility in terms of geometry, and use continuous descent techniques to deliver improved community noise outcomes.

During mixed-mode operations the longer ILS/GLS arrivals to runways 34L/R commence over Port Phillip Bay at 3000 and 4000 feet respectively.

As there are no terrain concerns to the south of the airport it would have been possible to reduce the heights of the commencement points and move them closer to the airport.

The design team worked to keep aircraft higher until they had crossed the coast to deliver improved community noise outcomes.

Source: APAM,2020

The flight path designs also permit shorter approaches that use the most modern RNP-AR design standards to be flown. These approaches are fuel and emissions efficient, offer more flexibility in terms of geometry, and use continuous descent techniques for better noise outcomes. It is anticipated that most of the domestic fleet of jet aircraft will be able to use these approaches, as well as a growing share of international aircraft. For arrivals to 34L, flightpaths have been designed to overfly, as far as practicable, industrial areas to the south-east of the airport. For arrivals to 34R, aircraft track over the water and port. These approaches are higher and wider than the approaches to 34L until they are over water. This layout alleviates access to Point Cook, and Essendon Fields runway 35, it does not impinge on the light aircraft routes around Port Phillip Bay.

To minimise the number of flight paths, the STAR tracks will be used for aircraft flying visual approaches. The aircraft will follow a similar path over ground but the pilot will comply with independent visual approach rules. It is anticipated that 80 per cent of arriving aircraft will use the shorter RNP-AR or visual approach paths. See **Figure C2.53**.

During segregated mode operations, arrival flight paths can revert to those currently in use, with minor changes to facilitate access to the new runway final approach paths. With mixed mode and segregated mode being used at different times of the day, this will share arriving aircraft across the new and existing flightpaths.

These changes are aligned with the following Airservices design principles:

- Consider concentrating aircraft operations to avoid defined noise sensitive sites
- Where high-density residential areas are exposed to noise, consider flight path designs that distribute aircraft operations, so that noise can be shared
- Design flight paths to facilitate access to all appropriate airspace users
- Design flight paths that deliver operational efficiency and predictability, and minimise the effect on the environment through reducing fuel consumption and emissions
- Consider flight paths that optimise capacity and meet future airport requirements
- Consider flight paths that optimise overall network operations including consideration of operations at adjacent airports
- Consider innovation and technology advancements in navigation and aircraft design
- Consider current and expected future noise exposure when designing flight paths.

C2.6.4
Departures from runways 16L/R

Departures from runways 16L and 16R during mixed mode operations are constrained by the Sydenham radio mast to the west and Essendon Fields Airport to the east. See **Figure C2.54**.

Departures from runway 16L will maintain runway track and climb to 4,000 feet before turning east. This is to remain separated from Essendon Fields runway 17 departures, which turn left and climb to 3,000 feet.

Due to the proximity of the Sydenham radio mast (elevation 735 metres /1029 feet AMSL) departures from runway 16R must stay on runway track for two nautical miles before they commence a turn to the right. This turn must be 30 degrees away from the departure from 16L and keep the aircraft laterally separated from the mast.

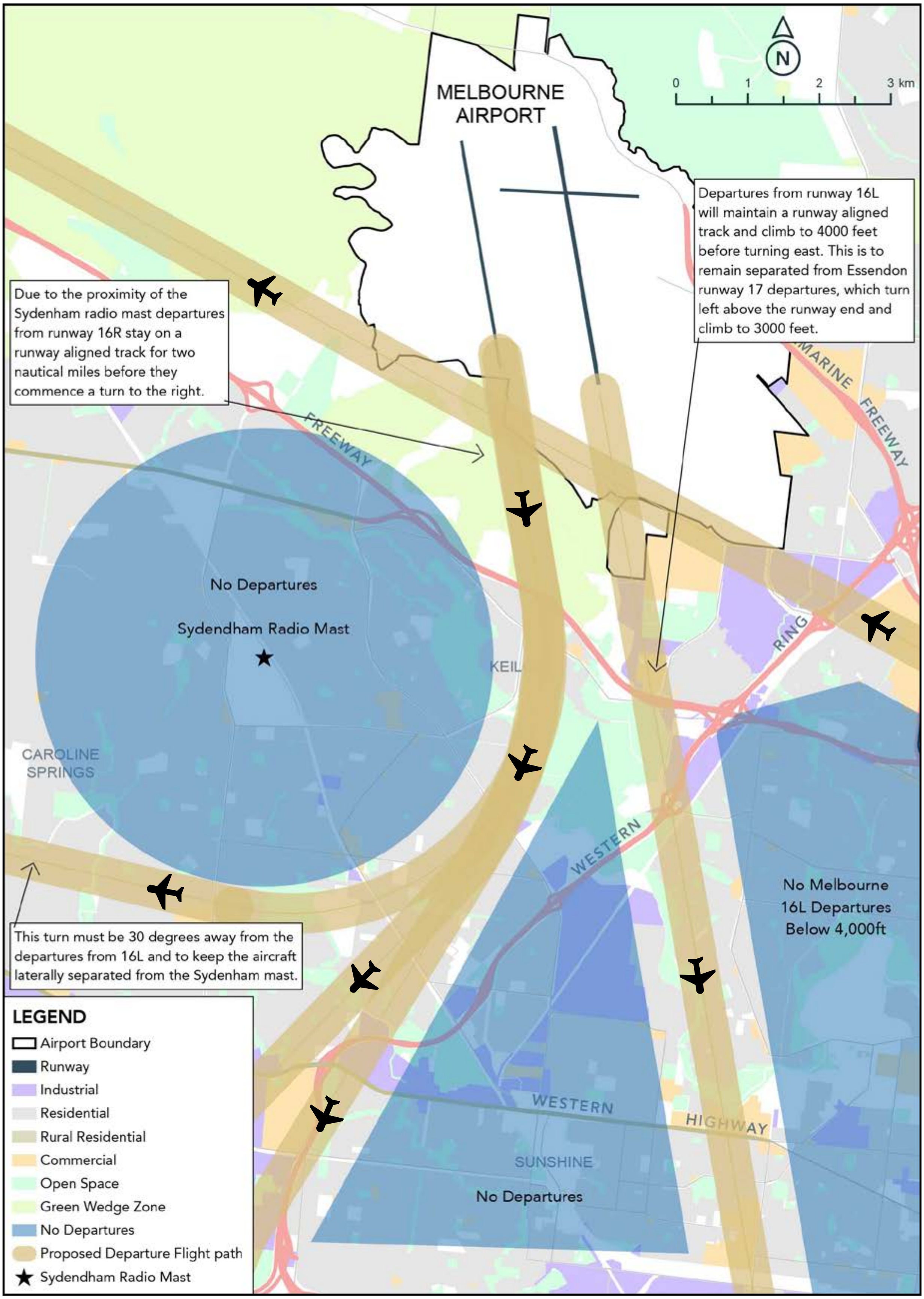
Noise Abatement Departure Procedures (NADP) will be used wherever possible to minimise noise effects caused by the departing aircraft on these constrained flight paths. The potential benefits of using noise abatement climb procedures to minimise noise effects on residential areas will be investigated in the detailed airspace design.

In segregated mode, the restrictions still exist except some departures from runway 16L can turn west once separated from the potential missed approach path from runway 16R using similar flight paths to those used today and those from 16R during mixed mode.

These changes made in the design process are aligned with the following Airservices design principles:

- Consider concentrating aircraft operations to avoid defined noise sensitive sites
- Where noise exposure is unavoidable, consider noise-abatement procedures that adjust aircraft operations to reduce noise impacts, including consideration of the time of these operations
- Design flight paths to facilitate access to all appropriate airspace users
- Design flight paths that deliver operational efficiency and predictability and minimise the effect on the environment through reducing fuel consumption and emissions
- Consider flight paths that optimise airport capacity and meet future airport requirements
- Consider flight paths that optimise overall network operations including consideration of operations at adjacent airports.

Figure C2.54
Runway 16L, Runway 16R and Essendon Fields Runway 17 departure constraints



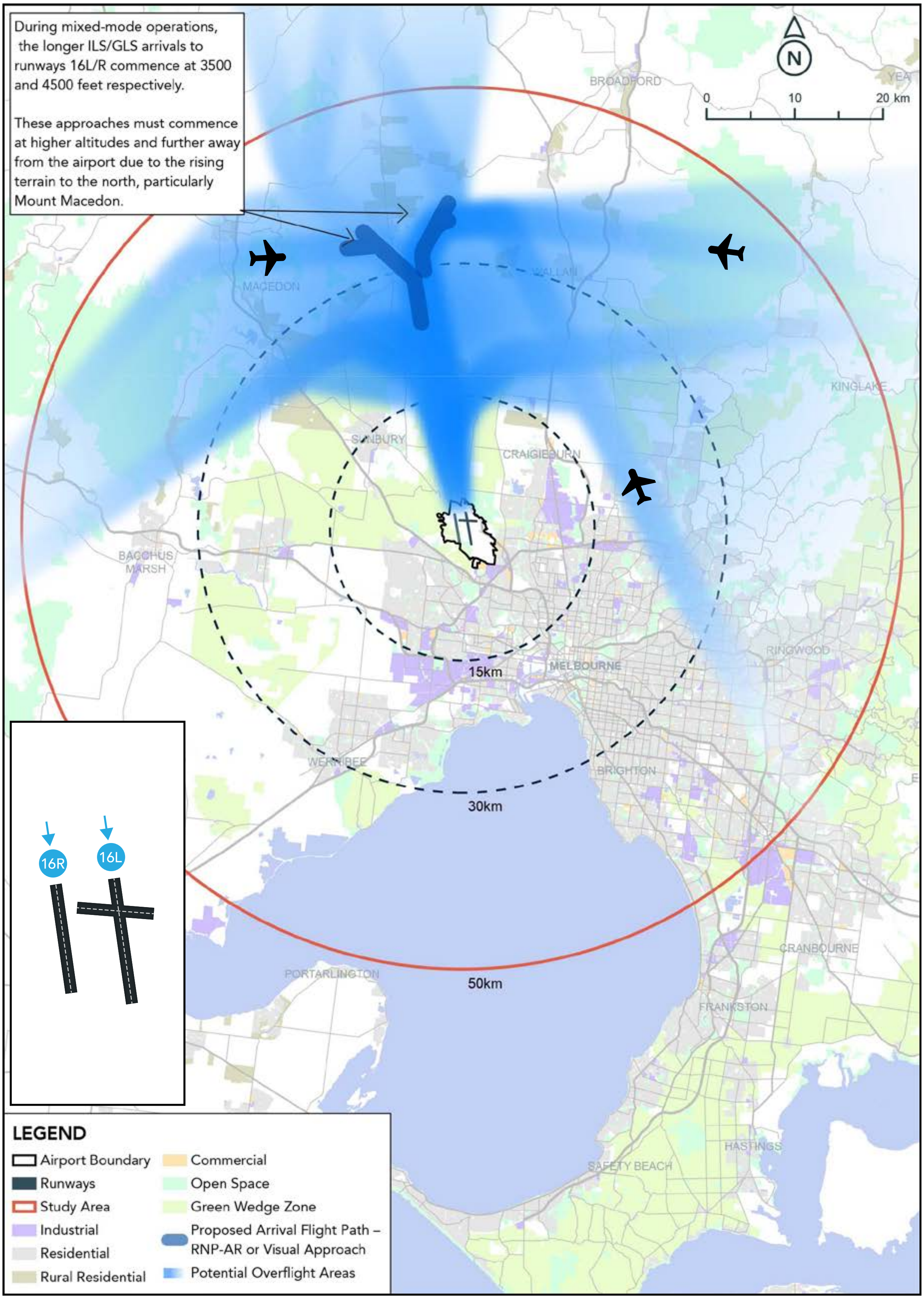
Departures from runway 16L will maintain a runway aligned track and climb to 4000 feet before turning east. This is to remain separated from Essendon runway 17 departures, which turn left above the runway end and climb to 3000 feet.

Due to the proximity of the Sydenham radio mast departures from runway 16R stay on a runway aligned track for two nautical miles before they commence a turn to the right.

This turn must be 30 degrees away from the departures from 16L and to keep the aircraft laterally separated from the Sydenham mast.

Source: APAM, 2020

Figure C2.55
Runway 16 Arrivals



During mixed-mode operations, the longer ILS/GLS arrivals to runways 16L/R commence at 3500 and 4500 feet respectively.

These approaches must commence at higher altitudes and further away from the airport due to the rising terrain to the north, particularly Mount Macedon.

Source: APAM, 2020

C2.6.5
Arrivals to runway 16L/R

One unavoidable flight path change from the existing route structure had to be made to accommodate arrivals from the south-west, which currently track south and east of the airport to arrive on runway 16L. The current procedure is designed primarily to avoid departures from runway 27, which are often used in combination with runway 16 arrivals. Arrivals from the south-west to runway 16R will now remain to the west of the airport in order to avoid conflicting with runway 16L and 16R departures. Where possible, the flight paths have been positioned over open country and areas of low population density.

During mixed-mode operations, the longer ILS/GLS arrivals to runways 16L/R commence at 3,500 and 4,500 feet respectively. These approaches must commence at higher altitudes and further away from the airport due to the rising terrain to the north, particularly Mount Macedon at 1,001 metres AMSL (3,284 feet).

The preliminary flight paths designed also permit shorter approaches to be flown that use the most modern RNP-AR design standards. These approaches are fuel and emissions efficient, offer more flexibility in terms of location, and utilise continuous descent techniques for better noise outcomes. Arrivals to 16L have been designed, as far as practicable, to be like the arrivals to the existing runway 16L. For arrivals to 16R, the aircraft track over open country and areas of low population wherever possible. See **Figure C2.55**.

During segregated mode operations, arrival flight paths can revert to those currently in use for arrivals from all directions except the south-west, with minor changes to facilitate access to the new runway final approach path. Arrivals from the south-west will use the short arrival path designed for mixed mode operations for access to both an ILS/GLS approach and a shorter RNP-AR or visual approach. The longest approach will not be used.

With mixed mode and segregated mode being used at different times of the day, this will distribute arriving aircraft across the new and existing flightpaths.

These changes made in the design process are aligned with the following Airservices design principles:

- Consider concentrating aircraft operations to avoid defined noise sensitive sites
- Where high-density residential areas are exposed to noise, consider flight path designs that distribute aircraft operations so that noise can be shared
- Design flight paths that deliver operational efficiency and predictability, and minimise the effect on the environment through reducing fuel consumption and emissions
- Consider flight paths that optimise airport capacity and meet future airport requirements
- Consider flight paths that optimise overall network operations including consideration of operations at adjacent airports
- Consider innovation and technology advancements in navigation and aircraft design
- Consider current and expected future noise exposure when designing flight paths.

C2.6.6
SODPROPS

At night, when weather conditions allow, the SODPROPS mode will be used. This mode contains all lower level arrival and departure paths to the green wedges to the north and west of the airport. See **Figure C2.47**.

C2.6.7
Runway modes of operation

In order to deliver the capacity necessary for Melbourne Airport to meet the projected demand, M3R operating modes will prioritise mixed-mode parallel runway operations during the period 6am to 11pm. However, during periods when demand is lower the improvements to runway infrastructure and facilities proposed under M3R will allow a wider range of practical operating modes. These possibilities include:

- The use of SODPROPS at night (when safe to do so and demand allows)
- A balanced use of segregated modes at night and outside the hours of highest demand
- The use of runway 27 for departures when the weather conditions require.

In combination with the mitigations incorporated within the flight path design, these possibilities present a number of opportunities to minimise the impact of M3R on aircraft noise through consideration of alternative airport operating strategies. **Chapter C3: Aircraft Noise Modelling Methodology** and **Chapter C4: Aircraft Noise and Vibration** describe how the Runway Operating Plan which is presented in **Chapter E4: Draft Runway Operating Plan** has been prepared, taking into consideration the impacts of aircraft noise.

C2.7
CONCLUSION

This chapter explains the factors that affect airspace operations at Melbourne Airport and examines the airport runway operations, flight paths and airspace changes required to support M3R.

The completion of M3R will be accompanied by changes to airspace architecture, including new flight paths and airport operating modes that facilitate parallel runway operations.

M3R involves the introduction of new flight paths for approaches and departures on the new runway, and changes to existing flight paths to accommodate these new flight paths. Flight paths for aircraft approaching or departing from the existing east-west runway (09/27) would be substantially unchanged.

Flight paths for M3R have been developed with Airservices using current design criteria (i.e. those that would apply to flight procedures being designed today). In the development of flight paths the following priorities were considered:

1. Safety – safety is paramount in the development of all procedures and will not be compromised
2. Air traffic management requirements – the procedures will be fit for purpose and based on sound air traffic management requirements to deliver the required capacity in an efficient manner
3. Environment – noise, other environmental and social impacts will be minimised to the extent practical to achieve safe and efficient operations.

The dominant flow of traffic in M3R configuration will become north-south in order to provide the required capacity to accommodate the projected aircraft movement demand. Investigations into the probable airspace requirements have been undertaken in consultation with Airservices and Essendon Fields Airport. These suggest that the impacts on capacity at Melbourne and Essendon Fields airports will be minimised through use of parallel north-south runways as the duty runways at Melbourne Airport to the greatest extent possible.

As far as possible, and within the current standards for airspace design, the flight paths have been designed to minimise aircraft noise impacts and include several features which assist this objective. In conjunction with the proposed upgrades to runway infrastructure and facilities, these introduce possibilities for new runway operating modes to be used during the night to minimise noise impacts for surrounding communities. These possibilities are discussed in **Chapter C3: Aircraft Noise Modelling Methodology** and **Chapter C4: Aircraft Noise and Vibration**.

Operations on the proposed parallel runways at Melbourne Airport will be required to remain contained within controlled airspace. As a result of the parallel runway intercept requirements for independent operations, this will require some changes to the extent of the controlled airspace. Lowered CTA steps may be required to reflect the requirement for aircraft to be lower and further from the threshold than would be the case for a single runway continuous descent approach arrival.

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E1

Chapter C3

Aircraft Noise Modelling Methodology

Summary of key findings:

- Aircraft noise is an unavoidable consequence of aircraft operations at Melbourne Airport. However, measures can be implemented to control inappropriate land use development in affected areas, or (where housing already exists) reduce the impacts of aircraft noise on the community.
- Noise emissions vary depending on the type of aircraft, whether it is taking off or landing, and how far away the aircraft is from the observer.
- The AEDT aircraft noise and emissions prediction program developed by the US Federal Aviation Administration (FAA) has been used to predict noise levels. AEDT Version 3b will be used. AEDT supersedes the Integrated Noise Model (INM).
- The assessment considered the operation modes for the airport, and the number and type of aircraft, as well as other environmental factors.


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CHAPTER C3 CONTENTS

CHAPTER C3 CONTENTS (cont.)

CHAPTER C3 FIGURES

CHAPTER C3 TABLES

C3.1
INTRODUCTION

This chapter details the methodology used to predict the aircraft noise exposure around Melbourne Airport associated with Melbourne Airport's Third Runway (M3R) project. It also summarises how aircraft noise is described, and introduces the measures of aircraft noise exposure that compare noise impacts under various operational scenarios. This work was done by specialist consultants SoundIN.

Section C3.2 to **C3.4** establish the requirements of the aircraft noise assessment and the significance criteria. **Section C3.5** outlines the aircraft noise assessment methodology, including details of the methods and metrics used for communicating and assessing aircraft noise.

Aircraft noise prediction methodology is detailed in **Section C3.6**, while the assessment's assumptions and limitations are outlined in **Section C3.7**.

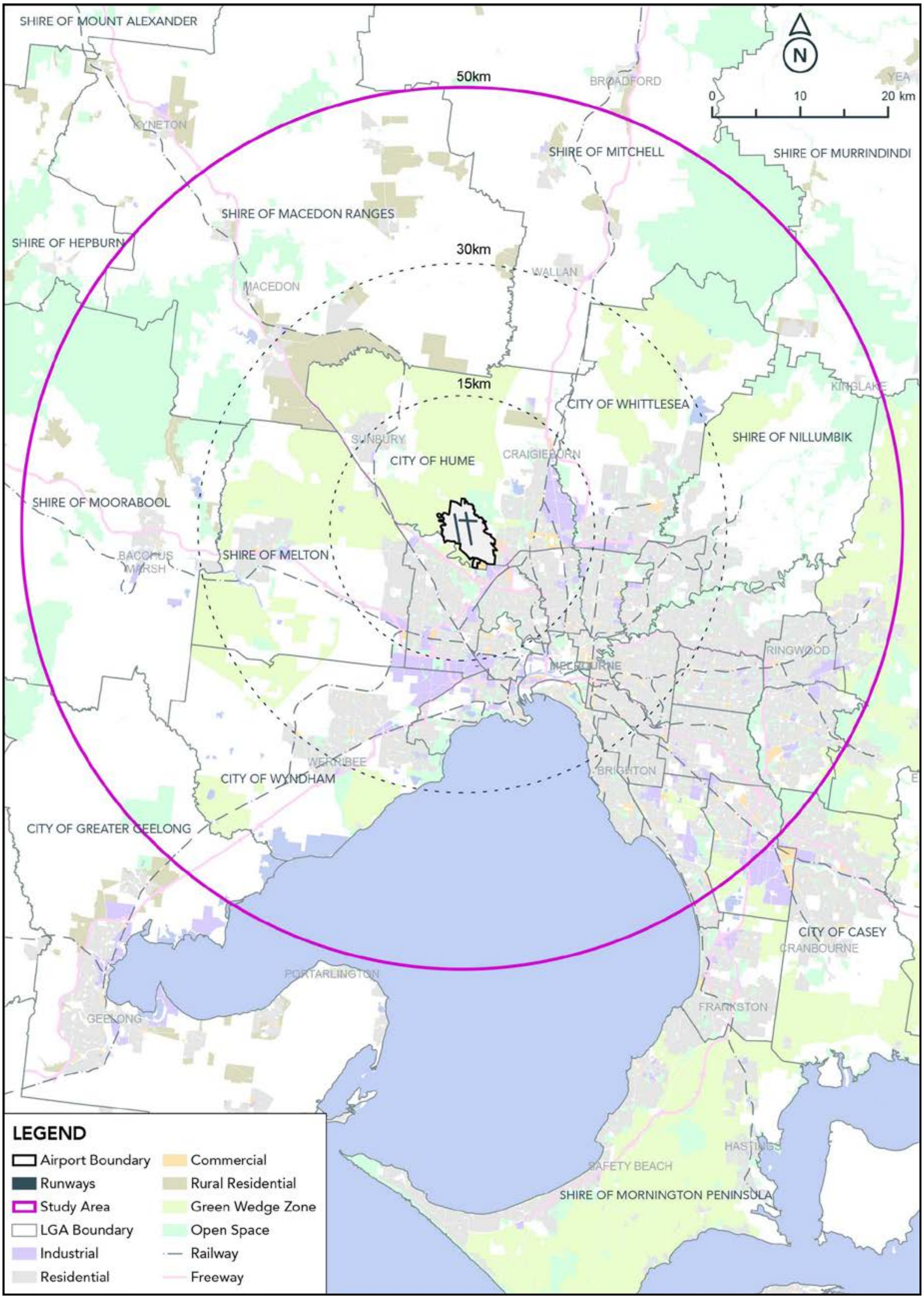
Predicted aircraft noise exposure around Melbourne Airport with M3R is presented in **Chapter C4: Aircraft Noise and Vibration**. An assessment of the potential impacts based upon the predicted noise metrics described in this chapter is given in **Chapter D4: Social Impact**.

Noise exposure calculations are based on predicted aircraft movements as detailed in **Chapter C2: Airspace Architecture and Capacity**, as well as assumptions regarding continuity of air traffic control procedures and meteorological conditions. The assessment considers noise and vibration effects within a 50 kilometre (30 nautical miles) radius from the airport.

C3.1.1
Study area

The study area is the 50 kilometres around Melbourne Airport (as shown in **Figure C3.1**) to ensure that this assessment includes the extent of the predicted noise contours.

Figure C3.1
Study area



Source: APAM, 2020
Note: Green wedges are the non-urban areas of metropolitan Melbourne outside the Urban Growth Boundary

C3.2
OVERVIEW

The M3R project centres upon construction of a new north-south runway (16R/34L) which introduces a parallel north-south runway system at Melbourne Airport. Completion of the new runway infrastructure will be accompanied by the following changes to airspace design around the airport:

- Introduction of new flight paths for approaches and departures on the new north-south runway 16R/34L
- Changes to existing flight paths to accommodate the system changes and expansion
- Consequent changes to noise exposure.

The airspace design principles adopted in this MDP's assessments for the preliminary design are consistent with existing regulatory requirements and standards, existing Airservices Australia (hereafter 'Airservices') traffic management practices, and aircraft capability. Investigations into airspace requirements were undertaken in consultation with Airservices and are addressed in **Chapter C2: Airspace Architecture and Capacity**.

The proposed changes to the runway system and airspace will be consistent with, and satisfy any conditions applied to, the approved MDP. Although detailed airspace design will not be formally undertaken until closer to the opening of M3R, it will be consistent with the aircraft noise exposure communicated through this MDP assessment.

The dominant flow of aircraft during peak periods will be north-south, because the parallel runways enable greater capacity. During other periods, there will be a variety of operating modes available. These modes and their use are detailed in **Chapter C2: Airspace Architecture and Capacity.**

Changes to aircraft noise around Melbourne Airport can be expected during the construction phase of M3R as discussed in **Chapter A5: Project Construction**.

C3.2.1
Key assessment scenarios

The key assessment scenarios for aircraft noise impacts are:

- Existing airport operations (until construction commencement) – no significant changes to airport operational procedures or aircraft flight paths are envisaged until the commencement of construction for M3R. Existing operations have been represented based on data for the year 2019
- No Build – future scenarios using only the existing runways. These scenarios incorporate only those infrastructure enhancements currently scheduled and independent of M3R, thereby enabling analysis of the variance between constrained capacity and the growth enabled by M3R
- Build (2026) – representing operations when M3R opens including redistribution of aircraft between available runways
- Build plus five years (2031) – representing aircraft noise impacts five years after the opening of the M3R infrastructure, taking account of projected growth in air traffic in this period. A corresponding No Build scenario has been prepared for the five years post-opening timeframe.
- M3R 20 years post-completion (2046) –representing aircraft noise impacts 20 years after the opening of M3R, taking account of the projected growth in air traffic in this period. A corresponding No Build scenario has been prepared for the 20 years post-opening timeframe.

C3.3
STATUTORY AND POLICY REQUIREMENTS

C3.3.1
Airports Act

The legislative framework for the M3R MDP is outlined in **Chapter A8: Assessment and Approvals Process**. Melbourne Airport is regulated under *the Airports Act 1996* (Cth) (Airports Act). Regarding environmental protection, the *Airports (Environment Protection) Regulations 1997* (Cth) (AEP Regulations) are relevant and applicable.

Because M3R is a major airport development proposal it requires preparation of an MDP in accordance with the Airports Act. One trigger for the MDP process is anticipated change to patterns or levels of aircraft noise.

Airports Act requirements related to this chapter are contained in section 91 (excerpts):

'(1) A major development plan or a draft of such a plan, must set out:

(e) if the development could affect noise exposure levels at the airport—the effect that the development would be likely to have on those levels; and

(ea) if the development could affect flight paths at the airport—the effect that the development would be likely to have on those flight paths; and

(f) the airport-lessee company's plans, developed following consultations with the airlines that use the airport, local government bodies in

(g) the vicinity of the airport and—if the airport is a joint user airport—the Defence Department, for managing aircraft noise intrusion in areas forecast to be subject to exposure above the significant ANEF levels; and

(h) the airport-lessee company's assessment of the environmental impacts that might reasonably be expected to be associated with the development; and

(j) the airport-lessee company's plans for dealing with the environmental impacts mentioned in paragraph (h) (including plans for ameliorating or preventing environmental impacts)

(6) In developing plans referred to in paragraph (l) (f), an airport-lessee company must have regard to Australian Standard AS 2021—2000 ("Acoustics—Aircraft noise intrusion—Building siting and construction") as in force or existing at that time.'

C3.3.2
Environment Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) is the Commonwealth Government's central piece of environmental legislation. It sets out requirements for the assessment and approval of actions that may have a significant environmental impact on Commonwealth land, or that is carried out by a Commonwealth agency-including a change of airspace.

C3.4
DESCRIPTION OF SIGNIFICANCE CRITERIA

Quantitatively evaluating aircraft noise exposure is complex because its significance is influenced by many factors. These include aircraft noise levels, the number of events, the duration of events, and the number of 'receivers' impacted. Also, each factor is not absolute so each one's degree of change should be considered. A description of aircraft noise and the metrics used to describe it are detailed in **Section C3.5.2**.

While there are no legislative criteria for the evaluation of aircraft noise in Australia, accepted industry practice is to consider changes within ANEC, N70 day and evening, N70 24hours, N60 night and N60 24hours. These descriptors are explained in **Sections C3.5.2** and **C3.5.3**.

Note that these descriptors are objective and may not adequately describe individuals' subjective perceptions of noise and its personal impact.

Changes in the noise environment should also be considered. A reduction of aircraft noise in one area does not offset the introduction of new aircraft noise to another community, even though the total number of receivers above a noise metric threshold may be reduced. The benefits of periods with little or no aircraft noise (known as 'respite'), or the negative impacts of reducing or removing respite, are difficult to consider in the same quantitative framework as, for example, counting dwellings within a N70 contour.

This chapter presents a set of metrics that describe aircraft noise and, to the degree possible, people's reaction to that noise. It is proposed that this suite of metrics enables all stakeholders (airlines, airports, communities, regulators, consultants) to consider the benefits and impacts of each option. These benefits and impacts can be compared against a defined impact significance framework so that the evaluation of impacts is as transparent and consistent as possible. The significance framework is qualitative and reflects the goals of the M3R project with respect to managing aircraft noise:

- To the extent permitted without compromising the operability of the airport
- To minimise impacts resulting from aircraft noise
- To consider all affected communities surrounding the airport regarding exposure to aircraft noise.

To help evaluate the significance of aircraft noise impacts, project-specific qualitative severity criteria have been developed. They are described in **Table C3.1** and applied in **Chapter D4: Social Impact**, which considers the impacts of noise emissions on the community.

To help evaluate noise impacts, the suite of noise metrics described in **Section C3.5.2** has been prepared. Wherever it is practical to do so, the number of sensitive receivers within each contour has been evaluated, along with the change in the noise metric relative to the No Build scenario.

Table C3.1
Assessment criteria

Impact categories	Description
Major	The impact is considered critical to the decision-making process. Impacts tend to be permanent or irreversible or otherwise long-term and can occur over large-scale areas. People can no longer safely live/work/learn/recreate within an area because of impacts associated with operation of the airport. The social environment is irrevocably damaged because people no longer use the impacted area.
High	The impact is considered likely to be important to decision-making. Impacts tend to be permanent or irreversible or otherwise long to medium-term. Impacts can occur over large or medium-scale areas. People can continue to live/work/learn/recreate within the area but many are severely impacted by the operation of the airport. The social environment is damaged because some people will choose to no longer use the impacted area.
Moderate	The effects of the impact are relevant to decision-making including the development of environmental mitigation measures. Impacts can range from long-term to short-term in duration. Impacts can occur over medium-scale areas or otherwise represents a significant impact at the local scale. People can continue to live/work/learn/recreate within the area but some are severely or moderately impacted by the operation of the airport.
Minor	Impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision-making process. Nevertheless, they are relevant in the consideration of standard mitigation measures. People can continue to live/work/learn/recreate within the area but are sometimes impacted by the operation of the airport.
Negligible	Minimal change to the existing situation. This could include for example impacts which are beneath levels of detection, impacts that are within the normal bounds of variation or impacts that are within the margin of forecasting error.
Beneficial	Effects of the impact are benefit to the social environment.

Source: APAM, 2020

C3.5
AIRCRAFT NOISE ASSESSMENT METHODOLOGY

This assessment has adopted an aircraft noise assessment and prediction methodology that complies with, and generally exceeds, the requirements of the Airports Act. It has been developed after reviewing contemporary assessments of similar projects both in Australia and internationally, and in consultation with Airservices.

C3.5.1
Noise levels

The volume of a sound depends on its sound pressure level, which is expressed in decibels (dB). For assessment, A-weighted decibels, referred to as dB(A), are generally used. This is because they convey the loudness of a sound by accounting for the varying sensitivity of the human ear to different sound frequencies.

Most sounds we hear in our daily lives have sound pressure levels in the range of 30 to 90 dB(A).

The sound level in a typical residential home is about 40 dB(A). The average noise level of conversation is about 60-65 dB(A). Typical levels for listening to music at home are about 85 dB(A) while a loud rock concert would produce about 110 dB(A).

Figure C3.2 provides indicative dB(A) noise levels for some familiar situations. Note that it includes reference distances for situations such as a jet departure or road traffic. It is important to consider these distances when rationalising reported noise levels because sound decays with distance.

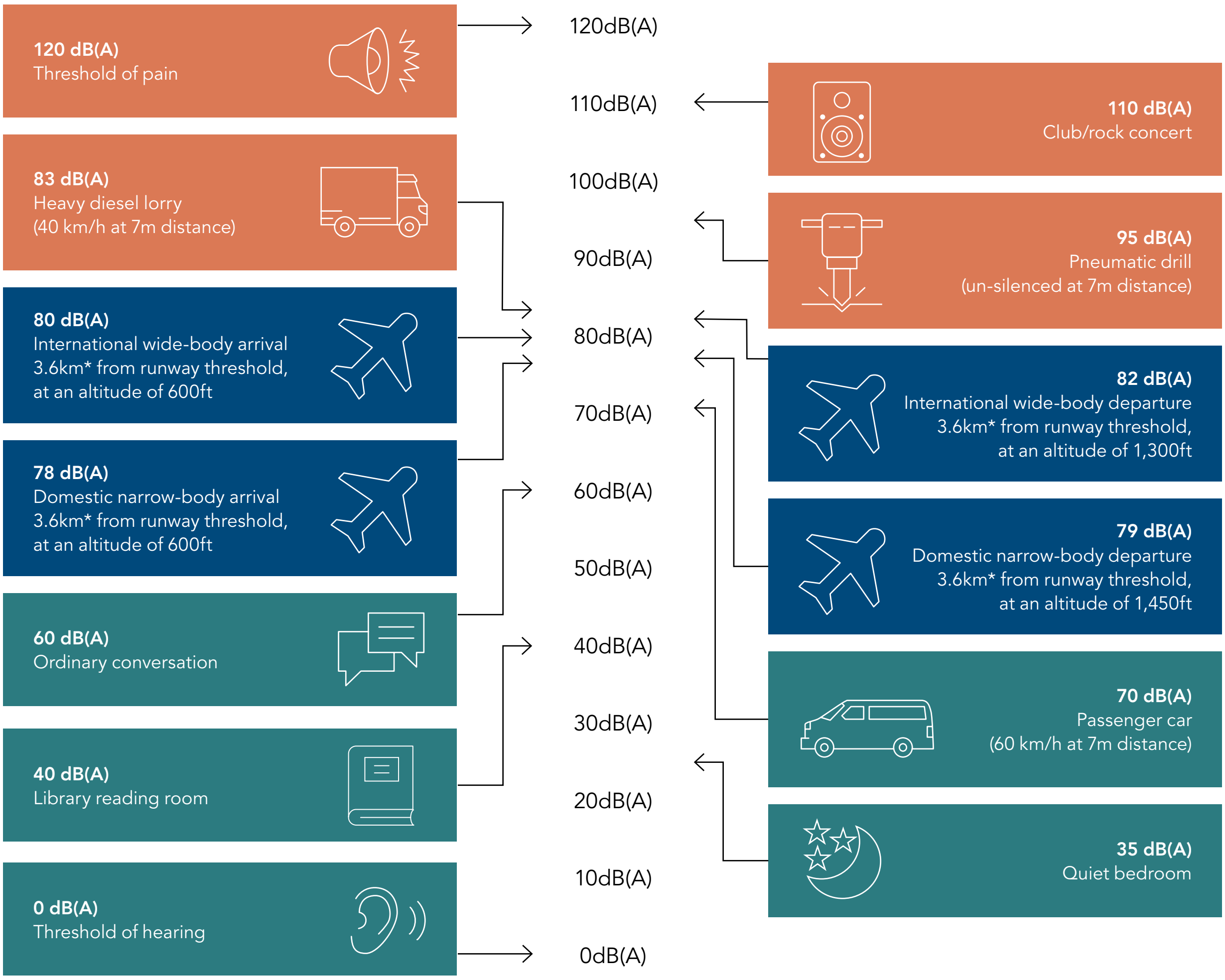
The minimum change in sound level perceived by most people is three dB(A), and every 10 dB(A) increase in sound level is generally perceived as a doubling of loudness. However, individuals may perceive the same sound differently and be more, or less, affected by a particular sound. For example, experience shows that many factors can influence someone’s response to aircraft noise.

They include:

- The specific characteristics of the noise (e.g. the frequency, intensity and duration of noise events) and the time of day when noise events occur
- Their personal circumstances and expectations about the frequency, loudness and timing of noise events
- Their personal sensitivities and lifestyle (e.g. if they spend a lot of time outdoors or sleep with a window open)

Figure C3.2
Indicative A-weighted decibel noise levels in typical situations

Noise Scale dB(A) scale



Source: APAM and NASF Guideline A: Attachment 1
**3.6km is approximately the distance from Runway 34R threshold to the Calder Freeway Aircraft noise values are based on modelling used in the M3R MDP*

- 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
- Their attitudes towards the source of the noise (e.g. general views about aviation activities and airports).

C3.5.2
Descriptors of aircraft noise impact

A number of metrics describe an area's level of aircraft noise, each used for a different purpose. The descriptors used to assess aircraft noise associated with airport infrastructure and changes to airspace are described in the following sections.

C3.5.2.1
Australian Noise Exposure Forecast (ANEF)

For land-use planning in Australia, the accepted measure of aircraft noise exposure is the Australian Noise Exposure Forecast (ANEF). This forecasts future aircraft noise exposure based on the:

- Expected aircraft movement numbers
- Types (and therefore characteristics) of aircraft
- Daily distribution by time period of arrivals and departures
- Configuration of the runways
- Arrival and departure flight paths flown.

ANEFs can be a Standard ANEF (20 year horizon), a Long Range ANEF (beyond 20 years) or an Ultimate Practical Capacity ANEF.

ANEF contours do not refer to normal decibel levels. Instead they are calculated from the Effective Perceived Noise level in decibels (EPNdB) for each operation at an airport. The EPNdB accounts for characteristics which affect the subjective noise of aircraft. ANEF contours also consider the cumulative nature of noise exposure in addition to weighting night-time operations to account for people's increased sensitivity to noise at night.

The ANEF unit was developed on the basis of social survey data and is relatively well correlated with the proportion of people who would describe themselves as 'seriously affected' by the noise. However, the ANEF was developed from a study of reactions in areas with long-established aircraft noise. Previous assessments of aircraft noise in Australia have demonstrated that the ANEF and the response function presented in **Figure C3.3** do not adequately describe people's reactions to a change in aircraft noise, such as that associated with a new runway or airspace design.

The ANEF definition is complex and, as a single-number index, it does not provide the level of information generally sought by interested members of the public.

For these reasons, the ANEF is limited in its applicability to an assessment of changing aircraft noise levels. It is therefore used primarily to assess the land-use planning implications of M3R. Alternative metrics are discussed in subsequent sections.

Guidance on an area's acceptability for various types of development regarding its ANEF level is given in Australian Standard 2021:2015 Acoustics – Aircraft noise intrusion – Building siting and construction (AS 2021) (refer to **Table C3.2**). For example, residential development is considered 'acceptable' in areas with ANEF lower than 20, 'conditionally acceptable' in areas with ANEF between 20 and 25, and 'unacceptable' in areas with ANEF greater than 25. In 'conditionally acceptable' areas, AS 2021 recommends new buildings should incorporate acoustic treatment to achieve specified internal noise levels.

The relationship between ANEF values and the proportion of people 'seriously affected' by the noise as shown in **Figure C3.3** is nevertheless instructive.

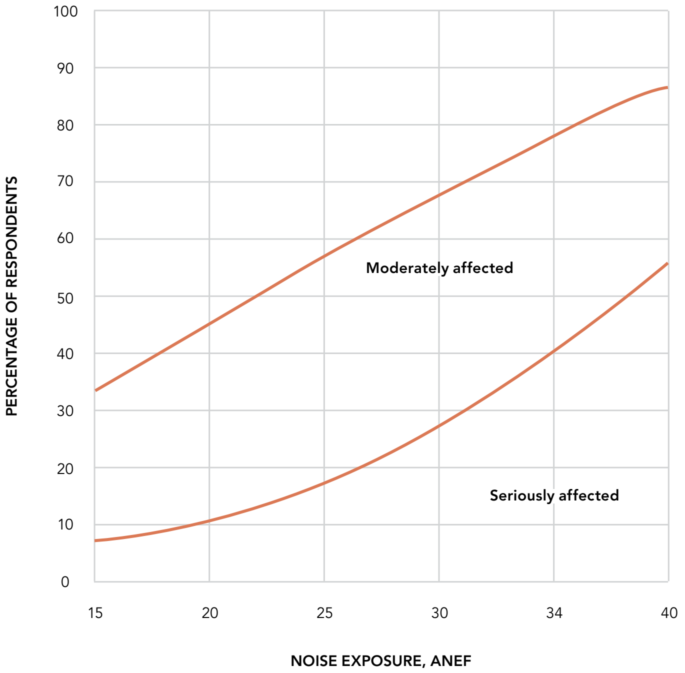
An ANEF chart is a set of land-use planning contours for a specific airport that has been formally endorsed for technical accuracy by Airservices. The production of an ANEF chart for all major airports is a requirement of the Airports Act. Victorian Planning Provisions (including the Melbourne Airport Environs Overlay) use the ANEF to regulate land-use development surrounding Melbourne Airport based on AS 2021.

Contours that have been calculated in the same way as ANEF contours, but not formally endorsed by Airservices, are known as Australian Noise Exposure Concept (ANEC) contours.

Australian Noise Exposure Index (ANEI) contours are those prepared for a previous year based on historic usage data.

This assessment uses ANEI contours for the existing situation and ANEC contours for various future airport options (as distinct from ANEF).

Figure C3.3
Relationship between ANEF and proportion of people 'seriously affected' by aircraft noise



NOTE: This graph was derived from the National Acoustic Laboratories Report No. 88

Source: AS 2021

Table C3.2
Building site acceptability based on ANEF Zones

Building Type	ANEF Zone Site		
	Acceptable	Conditional	Unacceptable
House, home, unit, flat, caravan park	Less than 20 ANEF (Note 1)	20 to 25 ANEF (Note 2)	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 35 ANEF (Note 2)	Greater than 30 ANEF
School, university	Less than 20 ANEF (Note 1)	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF (Note 1)	20 to 25 AENF	Greater than 25 ANEF
Public building	Less than 20 ANEF (Note 1)	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		

Source: AS 2021

NOTES: 1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, the procedure of Clause 2.3.2 may be followed for building sites outside but near to the 20 ANEF contour.

2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the 'incorporation of noise control features in the construction of residences or schools is appropriate (see also Figure Al of Appendix A).

C3.5.2.2
Single event maximum noise levels (L_{Amax})

L_{Amax} is the maximum A-weighted noise level that is either predicted or recorded over a period. The L_{Amax} of an aircraft overflight therefore indicates a location's maximum level of noise predicted/measured during the overflight event.

L_{Amax} noise levels are used in the calculation of N-above metrics, which are described in **Section C3.5.2.3**.

'Single event' maximum noise level contours indicate the maximum (L_{Amax}) noise level resulting from a single operation of a specific aircraft type on a specific flight track.

C3.5.2.3
N-above contours

One way to describe aircraft-noise impacts is by the number of noise events that exceed a certain level. These metrics are referred to as 'N-above' (number above) contour levels. For example, an N70 contour level shows the number of events above 70 dB(A).

The N-above system of describing aircraft noise was developed through industry and community consultation by what was then called the Department of Transport and Regional Services (DoTARS). It aims to provide information in a form that is better understood by interested members of the public. It does this by providing a comprehensive description of aircraft noise exposure at a given location and time period.

The N-above system is detailed in the discussion paper *Expanding Ways to Describe and Assess Aircraft Noise* (DoTARS, 2000). The use of N-above contours to communicate and assess aircraft-noise exposure is outlined in *The National Airports Safeguarding Framework* (NASF) *Guideline A* (National Airports Safeguarding Advisory Group (NASAG), 2016).

The most commonly used 'N-above' level is N70, which is the number of aircraft noise events a day that exceed 70 dB(A). With a noise level of 70 dB(A) outside a building, the noise inside will be approximately 60 dB(A) with the windows open. This is enough to disturb conversation because someone speaking would generally have to raise their voice to be heard. Similarly, someone watching television might not hear all the dialogue.

With windows closed and less noise coming in, the same outside noise level of 70 dB(A) would result in an internal noise level of approximately 50 dB(A).

For night-time, it is appropriate to consider lower noise levels. N60 values are most often used and would typically result in an indoor maximum noise level of 50 dB(A) with windows open and 40 dB(A) with them closed. The 50 dB(A) maximum noise level is considered close to the point at which someone sleeping may wake up. At 50 dB(A) L_{Amax} or an equivalent noise level in an alternate metric, approximately three per cent of aircraft noise events have been found to cause awakenings in field trials (R. Bullen et al, 1996; Federal Interagency Committee on Aviation Noise (FICAN), 1997). Therefore, N60 calculated for night-time is considered to reasonably describe the number of events which may, in some circumstances, cause awakening and is adopted for assessment of night-time noise from aircraft.

N-above contours can be calculated for different periods, indicating the average number of events experienced in that time. N70 and N60 contours have been calculated for the assessment of aircraft noise from M3R.

N-above values for future scenarios have been calculated based on application of a 'busy week' (90th percentile week) schedule (see Chapter C2: Airspace Architecture and Capacity).

N-above contours presented in MDP

N-above contours are presented for five or more events per period (24 hours, day/evening or night). The number of dwellings and sensitive sites within these N-above have been estimated and these contours form the basis of the MDP assessment of N-above, including the descriptions of dwellings impacted and newly affected.

These thresholds have been adopted because they represent levels above which aircraft noise would be considered a regular feature of the noise environment. N-above values of five or more are considered appropriate for describing aircraft noise in areas currently experiencing aircraft noise, as well as areas which would be newly affected. They also provide sufficient resolution to describe the change in aircraft noise for both existing and newly affected areas. The chosen thresholds for assessment generally accord with comparable contemporary assessments of aircraft noise from new runway infrastructure elsewhere in Australia.

In consultation with Airservices, additional N-above contours have been prepared to assist in more fully communicating potential aircraft noise impacts and to inform the MDP's engagement area. Those N-above contours are:

- N70 (day & evening) = 5
- N70 (24 hours) = 5
- N60 (night) = 2
- N60 (24 hours) = 10.

These N-above contours have been prepared using the 'busy week' forecast schedule as with all other standard N-above in the MDP. Typical busy day N-above ($NX_{(90)}$, see Section C3.5.2.6) for these thresholds are also presented.

It is acknowledged that the adopted thresholds are lower than those suggested for describing existing aircraft noise, particularly as it relates to land-use planning (e.g. *National Airports Safeguarding Framework Guideline A*). The purpose of this assessment differs from those guidelines and ultimately benefits from the greater resolution with which aircraft noise exposure is described.

C3.5.2.4
Flight zone diagrams

Flight zone diagrams and respite charts are supplementary metrics described in *Expanding ways to describe and assess aircraft noise* (DoTARS, 2000) for communicating aircraft noise.

Flight zone diagrams show numbers of aircraft using flight paths within a nominated zone. They can include statistics for particular time periods such as day, evening and night.

C3.5.2.5
Respite charts

Respite charts demonstrate the percentage of days when little or no aircraft noise events are expected during the nominated time. Threshold respite charts indicate the percentage of days when aircraft noise events are predicted to be below the nominated threshold.

For example, the threshold respite N70=5 expressed as a percentage for the evening period indicates the percentage of days a year when fewer than five events are predicted to exceed 70 dB(A) between 7pm and 11pm. If the threshold respite N70=5 was 90 per cent, then approximately 330 days per year would be expected to have less than five events exceeding 70 dB(A).

C3.5.2.6
Typical busy day N-above contours

A common failing of many noise metrics is that some information is obscured by the use of averages (e.g. annual or seasonal averages). This is true of N-above contours and is particularly apparent when airport infrastructure and operating modes dictate that some areas are overflown for only a portion of the utilised operating modes.

The 'typical busy day' is described from the perspective of a receiver on the ground.

The production of a 'typical busy day N-above' diagram is achieved by calculating the 90th percentile of the N-above values across the assessment period. That is, the 'typical busy day N-above' describes the N-above value exceeded on 10 per cent of days (or one in 10 days). When combined with information on respite, these metrics communicate a more complete synopsis of aircraft noise.

The percentile N-above metric is designated with the form $N_{X(90)}70$, where 90 refers to the percentile (i.e. the highest 10 per cent of days or about 36 days a year) and the 70 refers to the A-weighted decibels threshold. For this assessment 'typical busy day' N70 and N60 charts have been produced for the relevant periods.

C3.5.2.7
Difference contours

An important aspect of the current assessment is the change in aircraft noise levels. This is best represented by 'difference contours'. These describe the anticipated difference between scenarios (e.g. an N70 difference contour with a value of 10 shows areas where 10 additional N70 events are predicted). Difference contours have been produced for relevant metrics, primarily showing the difference resulting from the M3R Build scenario relative to the related No Build scenario.

Table C3.3
Aircraft noise impacts described by various metrics

Noise metric	Aircraft Noise Levels	Number of events	Duration of events	Aircraft noise character
ANEF/ANEC	Yes - ANEF is dependent on the noise level of aircraft though the noise level of aircraft cannot be deduced from the ANEF itself	Yes - ANEF is dependent on number of aircraft noise events though number of events cannot be deduced from ANEF itself	Yes - ANEF is dependent on duration of noise events though duration cannot be deduced from ANEF itself	Yes - ANEF is based on the EPNL which includes adjustments for annoying characteristics of aircraft noise
N-above	Partially - N-above charts consider events over a threshold level (e.g. 70 dB(A)) but do not consider the actual noise level of these events (i.e. the intrusion above 70 dB(A) is ignored). The inclusion of multiple thresholds (i.e. 60, 70 and 80 A-weighted decibels) makes the consideration of noise level more comprehensive	Yes - N-above charts consider the number of events over a threshold level but are averaged over a season or year	No	No
Typical busy day N-above	Partially - N-above charts consider events over a threshold level (e.g. 70 dB(A)) but do not consider the actual noise level of these events (i.e. the intrusion above 70 dB(A) is ignored)	Yes - Typical busy day N-above charts show N-above exceeded by a small percentage of days (in this assessment 10%)	No	No
L_{Aeq}	Yes - L_{Aeq} is dependent on the noise level of aircraft though the noise level of aircraft cannot be deduced from the L_{Aeq} itself	Yes - L_{Aeq} is dependent on number of noise events though number cannot be deduced from the L_{Aeq} itself	Yes - L_{Aeq} is dependent on duration of noise events though duration cannot be deduced from L_{Aeq} itself	No
Single event maximum noise level (L_{Amax})	Yes - The L_{Amax} represents the maximum noise level from a single aircraft operation	No	No	No
Flight zone diagrams	No	Yes	No	No
Respite statistics and diagrams	Partially - The absence of aircraft noise is described	Yes	N/A	N/A

Source: APAM & SoundIN, 2020

C3.5.2.8
L_{Aeq} metrics

The equivalent continuous sound level (L_{Aeq}) is the energy average of the A-weighted noise level over a sample period. It is equivalent to the level of constant noise which contains the same energy as the varying noise environment. L_{Aeq} is therefore often used to describe transportation and other noise (including aircraft, road and rail). International research into the long-term health effects of aircraft noise exposure often uses L_{Aeq} to describe the amount of noise exposure.

L_{Aeq} can be defined for different time periods (for example 9am to 3pm to describe exposure during typical school hours). Related metrics include L_{dn} and L_{den}. These are weighted versions of L_{Aeq}, with penalties applied to noise during the evening and night periods.

Chapter D3: Health Impact uses the following L_{Aeq} metrics to evaluate the potential for the M3R to impact people's health due to long-term exposure to aircraft noise:

- $L_{Aeq,16hr}$/$L_{Aeq,7am-11pm}$
- L_{night}/$L_{Aeq,11pm-7am}$
- $L_{Aeq,9am-3pm}$.

These metrics were produced using the methodology described in this chapter.

C3.5.2.9
Summary of aircraft noise metrics

The impact of aircraft noise is dependent on various factors including:

- Aircraft noise levels
- Frequency of occurrence of aircraft noise events/ number of events
- Duration of aircraft noise events
- Character of aircraft noise (e.g. low frequency noise).

Table C3.3 demonstrates which of these factors are described by the aircraft noise metrics used in this assessment. The degree to which a noise metric considers and describes each of the above factors is classified as 'Yes', 'No' or 'Partially'.

ANEF and ANEC consider each of the four factors identified and developed from social surveys of annoyance surrounding airfields. However, none of the key factors can be derived from the ANEF itself, and as such it fails to effectively communicate the real-world experience of aircraft noise.

N-above charts describe the number of events exceeding a nominated threshold. Because the threshold is a level above which noise impacts would be expected (such as interrupting a conversation) it effectively communicates the real-world impacts of aircraft noise. However, N70 and N60 metrics fail to describe the emergence above the threshold noise level and as such can fail to communicate high noise levels, such as those experienced in close proximity to airfields. The inclusion of additional thresholds, such as N80, is useful in this regard. The greatest failing of N-above contours relates to the averaging across extended periods (seasonally or annually).

'Typical busy day N-above' charts are useful in communicating the number of events above a threshold during periods of aircraft activity in an area. When combined with respite diagrams they are the best way to explain the impact of aircraft noise to the general public.

L_{Amax} is effective in communicating the noise level of aircraft events. However, it fails to communicate any other information about aircraft noise and is only useful when combined with supplementary information (e.g. N-above or 'flight zone'). Furthermore, for most airfields L_{Amax} for many operations, tracks and aircraft would be needed and the summation of all this information is difficult, thus making L_{Amax} impractical as a means of wholly describing aircraft noise.

Given the above, the assessment of impacts will consider a variety of these metrics.

All the above indicators of noise impact are included in this MDP. However, due to the number of scenarios and time periods involved some are presented for only the more important or relevant cases.

C3.5.3
Time periods

The ANEF system defines two periods: 7am to 7pm and 7pm to 7am. Noise during the latter is weighted (by a penalty of six decibels) to account for the increased sensitivity during the period referred to as 'evening/ night' by the ANEF definition. These standard time periods for the calculation of ANEF related metrics (ANEI and ANEC) have been adopted herein.

It is common practice to communicate aircraft noise using N-above and other supplementary metrics for different time periods to the ANEF system. For the purpose of this assessment N-above contours are presented for the day, evening and night (defined as 11pm to 6am) periods. These are is consistent with NASF Guideline A and the existing Melbourne Airport Noise Abatement Procedures (NAPs).

Flight path diagrams also include information for the periods 6am to 7pm (day) and 7pm to 11pm (evening) in addition to the night period.

In order to provide greater resolution of potential reactions to aircraft noise exposure at different times of day, the assessment of social impacts (see Chapter D4: Social Impact) includes N-above predictions for the day, evening and night-time periods.

C3.5.4
Potentially affected receivers and communities

Noise-sensitive receivers in the area around the airport include residences, schools and other educational facilities, hospitals and other health care facilities, libraries, nursing homes, churches and childcare centres. In this MDP assessment (including Chapter C4: Aircraft Noise and Vibration and Chapter D4: Social Impact) the potential impact is assessed in terms of a number of descriptors of noise exposure (as set out in Section C3.5.2). The benefits and impacts of the proposal are assessed in terms of changes in noise exposure at these locations, and in terms of the number of receivers experiencing a given level of noise exposure.

C3.5.4.1
Dwelling data and analysis

The locations of dwellings were obtained from the Valuer-General Victoria (registered land uses) and then associated with geometry in the form of cadastre (a digital representation of all land parcel and property boundaries) downloaded from the Victorian Government Data Directory (https://www.data.vic.gov.au/).

An analysis using GIS software was undertaken to determine the noise metric value at each dwelling for each scenario. Analysis of these values facilitated classification of dwellings within ranges of interest (e.g. dwelling counts within a contour) and also the change in noise between various scenarios for each dwelling (e.g. the number of dwellings predicted to experience a change of 10 or more N70 events). The analysis considered the centroid of each polygon representing the land use or, in the case of large lots as described above, the actual residence location. Figure C3.4 is an example of the analysis.

Figure C3.4
Example dwellings data overlaid with ANEC contours

C3.6
AIRCRAFT NOISE PREDICTION METHODOLOGY

This section provides details of the methodology used to predict aircraft noise. The noise modelling process calculates the values for the noise descriptors listed in **Section C3.5.2** for current operations as well as predicting the values for relevant future scenarios.

A wide range of factors affects the potential noise exposure from aircraft operations at Melbourne Airport. A complex modelling process is therefore required, which is shown in **Figure C3.5** and **Figure C3.6**.

For each operational scenario modelled, a set of airport operating modes is defined, together with the 'selection rules' that define the conditions under which each mode would be selected by Air Traffic Control (ATC). The rules take into account the weather conditions, the number of departures and arrivals, and the 'priority' assigned to each mode – which is generally a reflection of the effectiveness of that mode in terms of noise abatement.

A detailed schedule of predicted 'busy week' operations is used, together with historic weather data, to determine the pattern of mode usage for each assumed scenario. Aircraft operating in these modes are assigned to tracks depending on the runway in use, the type of aircraft, and the location of the airport of origin or destination.

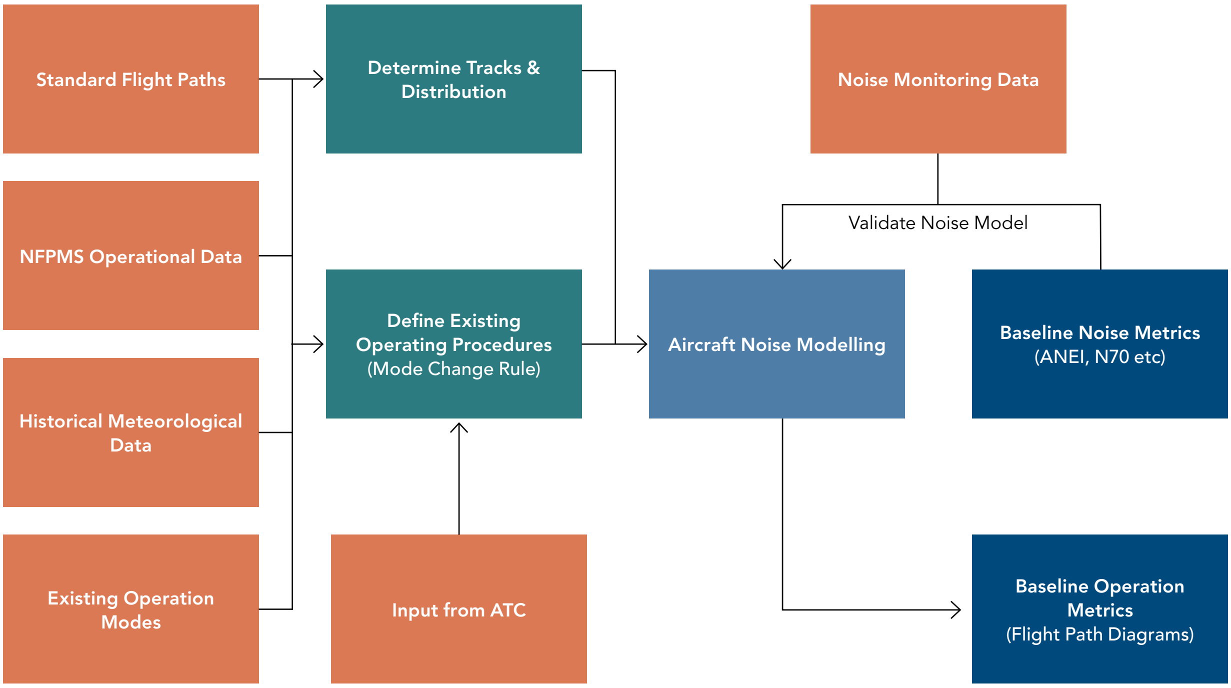
Finally, a precalculated 'noise map' shows the pattern of noise exposure for each aircraft type on each of these tracks. The noise maps for each operation are combined to produce the descriptors of overall noise exposure.

The fundamental inputs to this process are:

- Airport operating schedules (including both the numbers and times of aircraft operations, and the aircraft types which would operate in a future year)
- The selection of operating mode, which includes consideration of:
  - Meteorological data
  - Air traffic management rules
  - Aircraft flight paths, including the track followed on the ground and the height of the aircraft at various points
  - Noise levels produced by the various aircraft types performing standard arrival and departure operations.

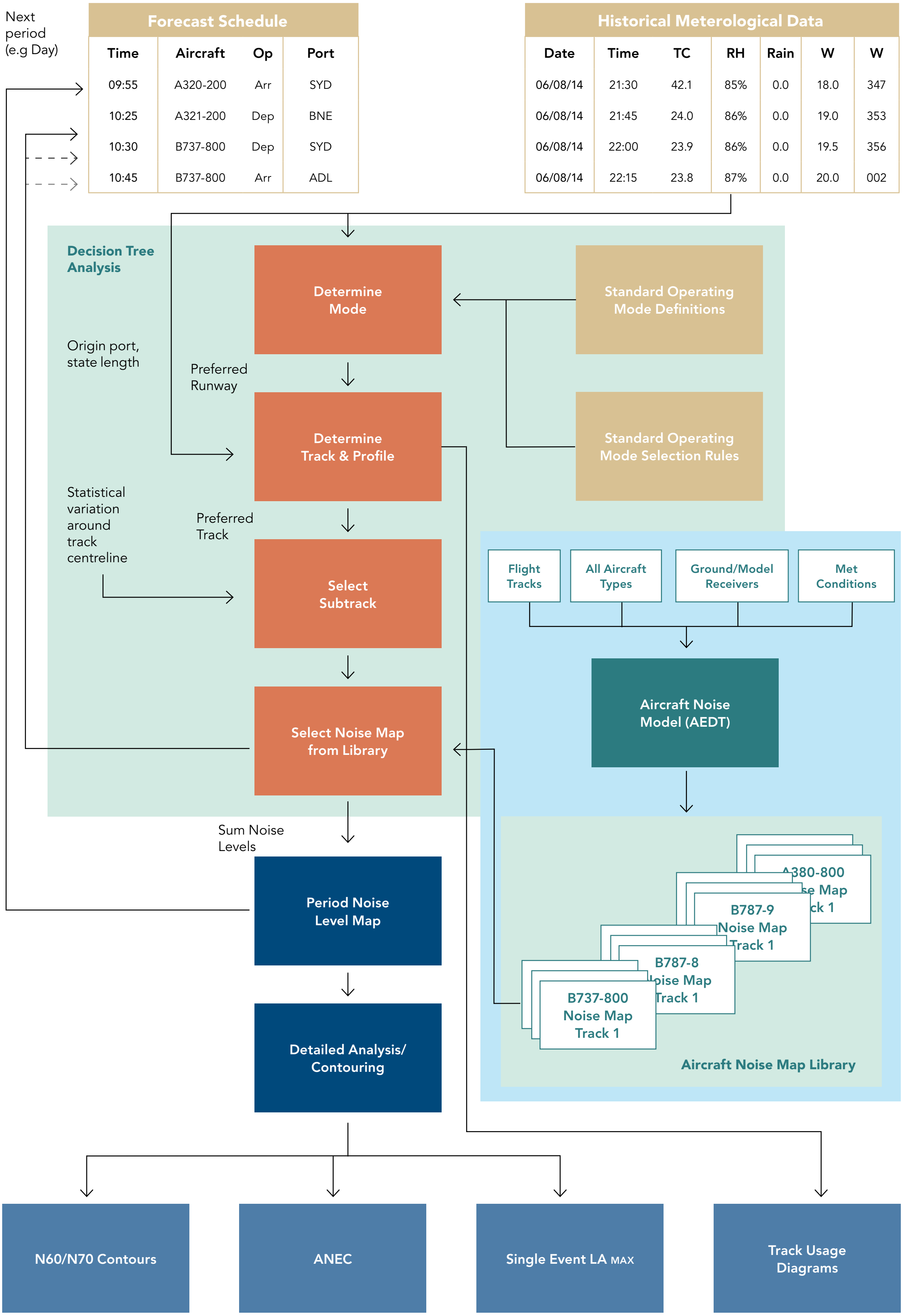
Each input is discussed in the following sections.

Figure C3.5
Aircraft noise prediction methodology overview



Source: SoundIN, 2020

Figure C3.6
Aircraft noise modelling overview



Forecast Schedule

Time	Aircraft	Op	Port
09:55	A320-200	Arr	SYD
10:25	A321-200	Dep	BNE
10:30	B737-800	Dep	SYD
10:45	B737-800	Arr	ADL

Historical Meterological Data

Date	Time	TC	RH	Rain	W	W
06/08/14	21:30	42.1	85%	0.0	18.0	347
06/08/14	21:45	24.0	86%	0.0	19.0	353
06/08/14	22:00	23.9	86%	0.0	19.5	356
06/08/14	22:15	23.8	87%	0.0	20.0	002

Source: SoundIN, 2020

C3.6.1
Aviation Environmental Design Tool (AEDT)

The AEDT aircraft noise and emissions prediction program (Version 3b) produced by the US Federal Aviation Administration (FAA) will be used to predict noise levels.

The AEDT program is a computer model that calculates aircraft noise exposure in the vicinity of airports. It was developed based on the algorithm and framework from SAE-AIR-1845 Procedure for the Calculation of Airplane Noise in the Vicinity of Airports (Society of Automotive Engineers (SAE), 1986). This used Noise-Power-Distance (NPD) data to estimate noise by accounting for specific operation modes, thrust settings, source-receiver geometry, acoustic directivity and other environmental factors. AEDT replaces the Integrated Noise Model (INM).

C3.6.2
Stage lengths

Longer flights generally require aircraft to carry more fuel on departure, increasing take-off weight and therefore requiring a higher thrust and more gradual ascent. This means longer flights typically produce higher noise levels than shorter flights.

In contrast, noise emissions of arriving aircraft are generally independent of the distance flown. This is because minimal thrust is required with much of the noise on arrival is generated by the airframe interacting with the air.

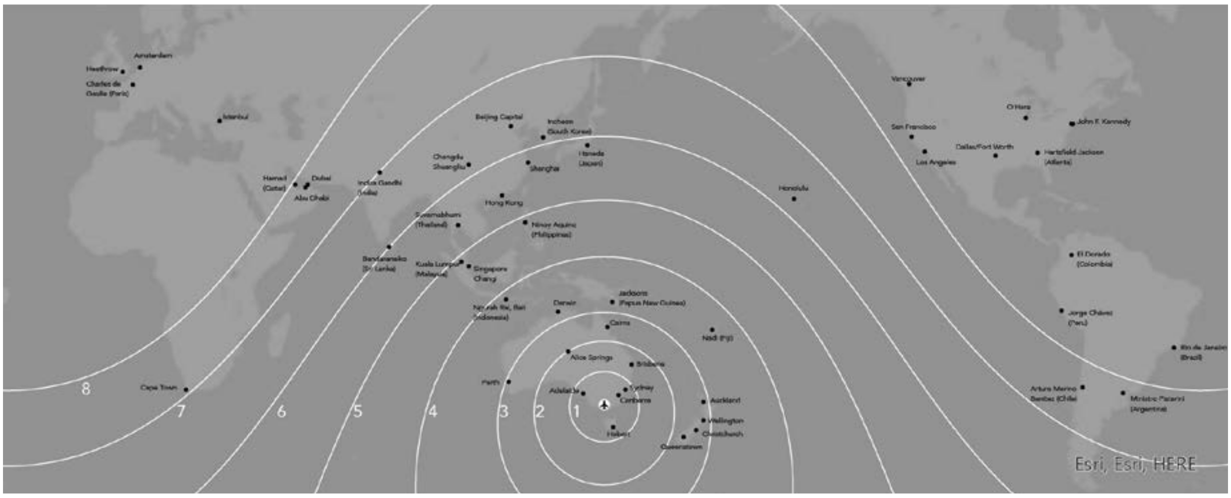
AEDT classifies departures by 'stage lengths' which represent the distance to their destination. The noise level on departure can then be calculated for by aircraft type for various stage lengths. The AEDT departure stage lengths are shown in Table C3.4.

Table C3.4
AEDT aircraft departure stage lengths

Stage length	Distance to destination airport (NM)	
	From	To
1	0	500
2	501	1,000
3	1,001	1,500
4	1,501	2,500
5	2,501	3,500
6	3,501	4,500
7	4,501	5,500
8	5,501	6,500
9	over 6,500	

Figure C3.7 indicates the airports that fall within each stage length range circle from Melbourne Airport.

Figure C3.7
Map indicating airports within various stage lengths from Melbourne Airport



Source: gcmapper

C3.6.3
Meteorological data

An airport's mode of operation depends on meteorological conditions. AEDT therefore takes meteorological parameters into account when calculating aircraft performance.

C3.6.3.1
Meteorological Conditions at Melbourne Airport

AEDT contains a database of meteorological data for airports around the world. Default annual average meteorological conditions for Melbourne Airport are:

- Temperature - 14.0 ^{0}C
- Sea level pressure - 1017.1 hectopascals
- Relative humidity – 67 per cent
- Headwind - 9.85 knots.

In addition, 10 years of meteorological data for Melbourne Airport was acquired from the Bureau of Meteorology (BoM), from 1 January 2010 to 31 December 2019. It was recorded every 10 minutes (excluding a small percentage of missing data) and includes:

- Mean wind speed
- Maximum wind gust
- Mean wind direction
- Visibility
- Cloud cover for three layers, including height and amount (oktas).

The data was used to forecast airport operating modes and runways, in the allocation of aircraft operations and in the calculation of aircraft performance, profiles and noise emissions within AEDT.

C3.6.3.2
Meteorological Conditions and Aircraft Performance in AEDT

AEDT calculates aircraft performance based on factors that include meteorological conditions (temperature, air pressure, relative humidity and headwind).

SoundIN has undertaken an analysis of the predicted aircraft performance and resulting noise levels under various conditions, covering the range of meteorological conditions present at Melbourne Airport (based on the BoM data described above). The following conditions were considered:

- Temperature - 0 to 40°C, grouped in 10°C intervals
- Station level air pressure - 990 to 1,020 hPa, in 10 hPa intervals
- Relative humidity - 25 to 100 per cent, in 25 per cent intervals
- Headwind - 0 to 25 knots, in five-knot intervals

The combination of these parameters produced 480 condition sets. Condition sets were then grouped based on those having a similar resulting aircraft trajectory (profile) and predicted noise levels on the ground. This reduced the number of permutations to 23 'met classes', each consisting of numerous condition sets and able to be represented by a single condition set for the purpose of noise modelling. The condition set selected to represent each met class was that most prevalent in the BoM data.

C3.6.4
Validation of the aircraft noise model

C3.6.4.1
Aircraft noise monitoring

Airservices' Noise and Flight Path Monitoring System (NFPMS) data was obtained for nine monitoring stations around Melbourne Airport. All aircraft noise monitoring locations are shown in **Figure C3.8** and detailed in **Table C3.5**.

Table C3.5
Noise monitoring locations

ID	Type	Suburb
2	ASA permanent noise monitoring location	Oaklands Junction
3	ASA permanent noise monitoring location	Keilor East
4	ASA permanent noise monitoring location	Essendon North
6	ASA permanent noise monitoring location	Dallas
9	ASA permanent noise monitoring location	Keilor East
10	ASA permanent noise monitoring location	Keilor East
11	ASA permanent noise monitoring location	Lalor
61	ASA permanent noise monitoring location	Lalor
364	ASA permanent noise monitoring location	Strathmore Heights

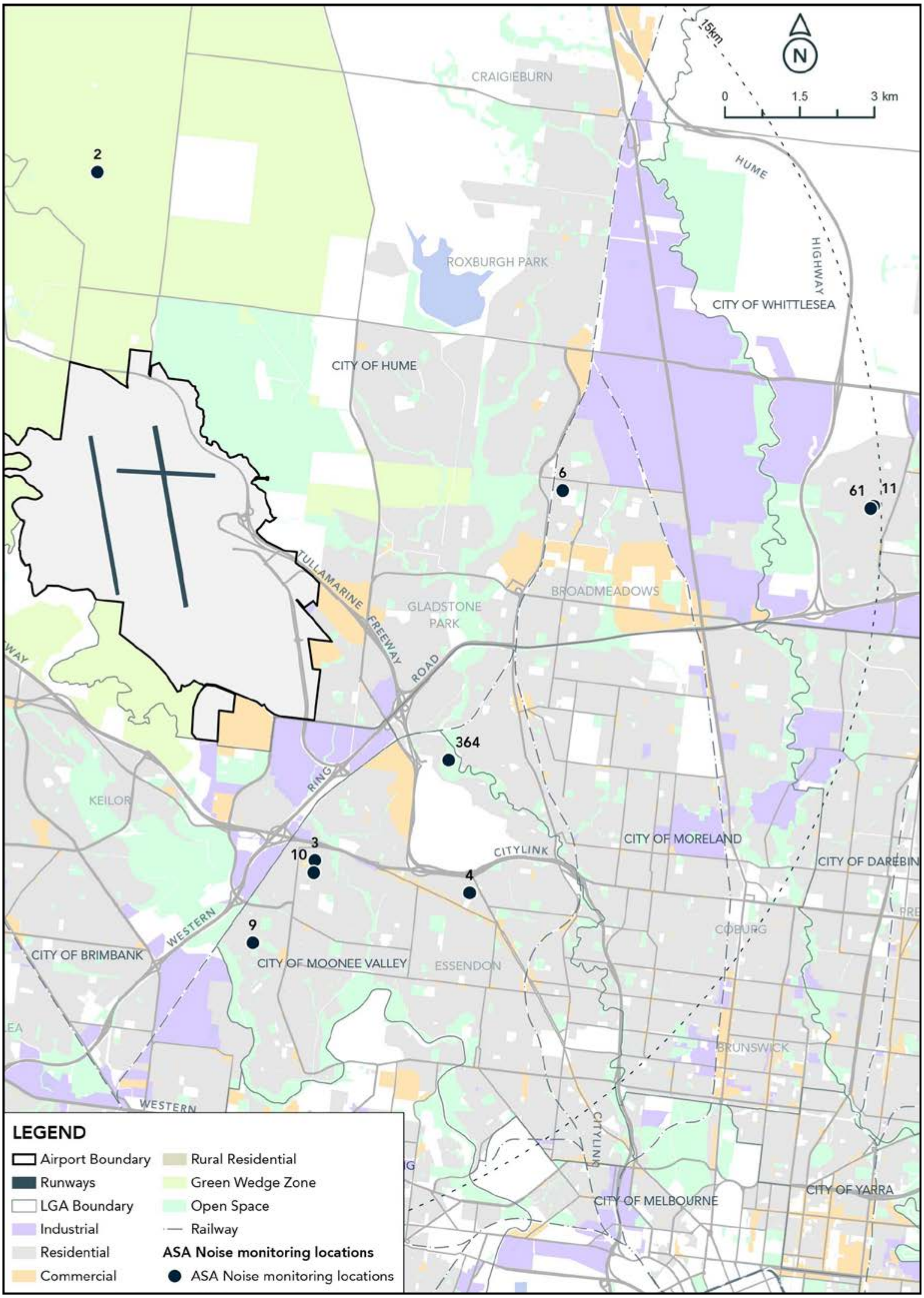
Source: APAM using Airservices NFPMS data, 2020

C3.6.4.2
Measurement of existing aircraft noise levels – NFPMS locations

Noise measurement data for calendar year 2019 was obtained from Airservices' NFPMS. The data was recorded at nine monitoring stations, including eight permanent monitoring stations and one temporary station.

The data was correlated with radar data provided from the same system. Data from 167,641 flights were correlated with noise measurement data.

Figure C3.8
Noise monitoring locations



Source: APAM using Airservices NFPMS data, 2020

Additional proposed monitoring locations

The residents of Keilor have requested placement of a noise monitor to establish baseline noise levels. Melbourne Airport supports the community's request for Airservices to install such a monitor at its earliest convenience, and also recommends installation of a monitor at the Bulla townsite. Both monitors could be placed on Council reserves and negotiations held with the local councils (Brimbank and Hume) to provide suitable land and a power connection.

C3.6.4.3
Predicted aircraft noise level verification

NFPMS data was used in the validation process described below.

Verification and subsequent calibration of the noise model used to predict L_{Amax} (being the foundation of N-above metrics) and L_{Aeq} derived noise metrics was undertaken.

The type of data required to calibrate the noise model for the ANEC/F (Effective Perceived Noise Level (EPNL) metric) was not available. Despite the unavailability of measured EPNL data, the nature of the validation process is such that it is expected to yield more accurate ANEC/F predictions (i.e. the calibration process involves adjusting modelled operations to better reflect measured data in terms of trajectory and noise level).

Predictions of Sound Exposure Level (SEL) and L_{Amax} for each of the correlated flights were conducted using AEDT. Actual radar data was used to precisely model the track flown by each operation.

AEDT includes numerous departure procedures, which are unique to each aircraft. They allow the model to determine the vertical profile and assumed aircraft settings for each stage of the operation. AEDT's in-built procedures include 'standard' procedures, noise abatement departure procedures and various de-rated take-off and reduced climb procedures.

Initially, AEDT's in-built approach and departure procedures were used for the calculations. Following these calculations, the predicted noise level for each operation was compared to the measured noise level from the NFPMS data. Similarly, the actual profiles were compared to the profiles produced by the model using the standard procedures. Many aircraft and operations (e.g. arrivals, departures and various stage lengths) demonstrated discrepancies between the measured and modelled noise levels and profiles.

In many instances these discrepancies warranted adjustment of the aircraft profile and the subsequently predicted noise levels. In the first instance, the various available stage lengths were examined to determine if any of the in-built AEDT procedures could adequately represent the operations. Additionally, user-defined aircraft profiles were developed from various AEDT in-built profiles to better reflect the measured data. These profiles included adjustments to the height of the initial climb segment for each of the various standard, de-rated take-off and reduced climb procedures. Take-off offsets, or intersection departures, were also examined for particular aircraft, remote port distances and runways.

An iterative approach was taken, whereby a change was made to the stage length and/or procedure. The measured and predicted noise levels and profiles were then compared until the model was considered to be calibrated. The verification process was separately done for each runway and noise monitoring location.

Those aircraft with insufficient data from which to draw conclusions were not calibrated.

C3.6.4.4
Mode allocation model verification process

The mode allocation model was verified against historic mode data obtained from Computerised Automated Terminal Information Service (CATIS) for the 2015 calendar year (a CATIS record is made whenever a significant change in the operating conditions of the airport is observed or made, including changes to the nominated runways.)

Noise Abatement Procedures (NAPs) are applied at Melbourne Airport (the procedure is explained in **Chapter C2: Airspace Architecture and Capacity**). The NAPs specify which operating mode will be selected based on the available modes (due to meteorological conditions, time of day and demand, and a set of mode priorities).

Air Traffic Control (ATC) at Melbourne Airport uses advanced weather forecasting and aircraft sequencing tools to sequence operations in anticipation of changing weather conditions.

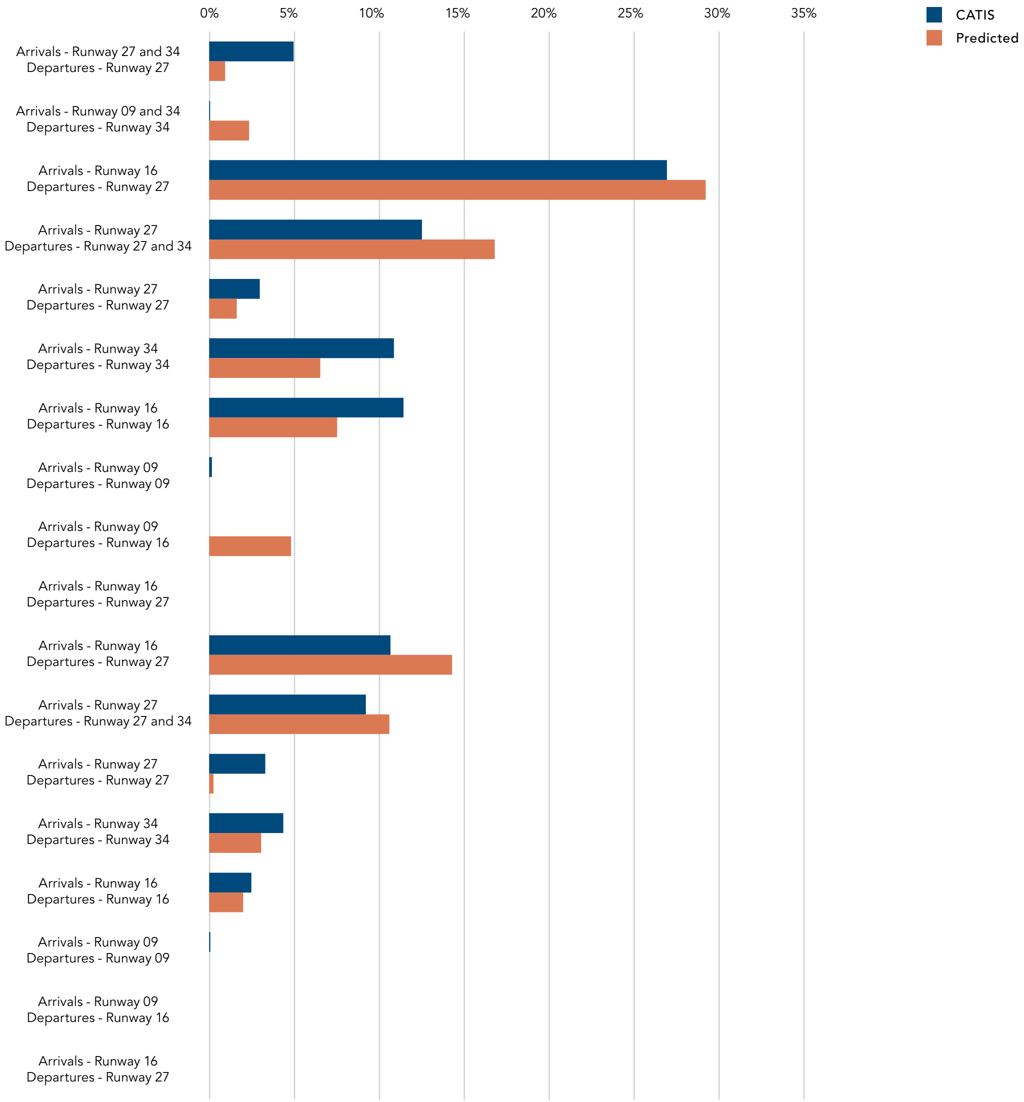
This assessment assumes that the highest priority mode, according to the NAPs, which is available based on meteorological conditions, would always be selected. The assumption was considered in consultation with Airservices. Using this assumption and a demand profile described in **C3.6.13.4**, the mode prediction model allocated modes for calendar year 2015 coinciding with the historic CATIS data.

Figure C3.9 presents a summary of the actual historic mode usage for 2015 (recorded by CATIS) and the mode usage predicted by the model by applying the mode selection assumptions detailed in the previous sections and meteorological data for 2015. **Figure C3.9** demonstrates, using 2015 as an example, how closely the operations allocation model used in this noise assessment is able to predict airport operating modes at Melbourne Airport. Similar proportions between CATIS (actual) and predicted results indicate that the operations allocation model is a good representation of reality.

The analysis shows a high correlation between the model and the historic data for the majority of modes (with some minor differences noted). Considering the above analysis and the general agreement between the mode allocation model and historic data, the mode allocation model is considered to be verified.

Figure C3.9

Comparison of actual historic and predicted mode usage (modes detailed in Figure C3.10)



Source: SoundIN, 2016

C3.6.5
Aircraft operations assumed in calculations

To facilitate noise modelling, forecast schedules for future operating scenarios were provided as an input to this assessment.

All forecast schedules were developed as accurately as possible given available data. Any foreseeable error in the schedules' generation is not considered to significantly impact the outcomes of noise modelling. The forecast schedules are therefore considered sufficient for the purpose of this assessment.

C3.6.6
Standard aircraft types used in calculations

Projections of aircraft types for future years were provided in the forecast schedules.

Table C3.6 summarises the primary aircraft types projected. They correspond to aircraft class and the standard aircraft types used to represent the aircraft noise in the AEDT program (see **Section C3.6.1**).

Figure C3.10 provides a comparison of various commercial aircraft, providing some scale for the various aircraft classes described above. The 737-800, 777-300 and 747-8 were used to produce single event maximum noise level contours in **Chapter C4: Aircraft Noise and Vibration.**

These aircraft were selected because they are prominent at Melbourne Airport.

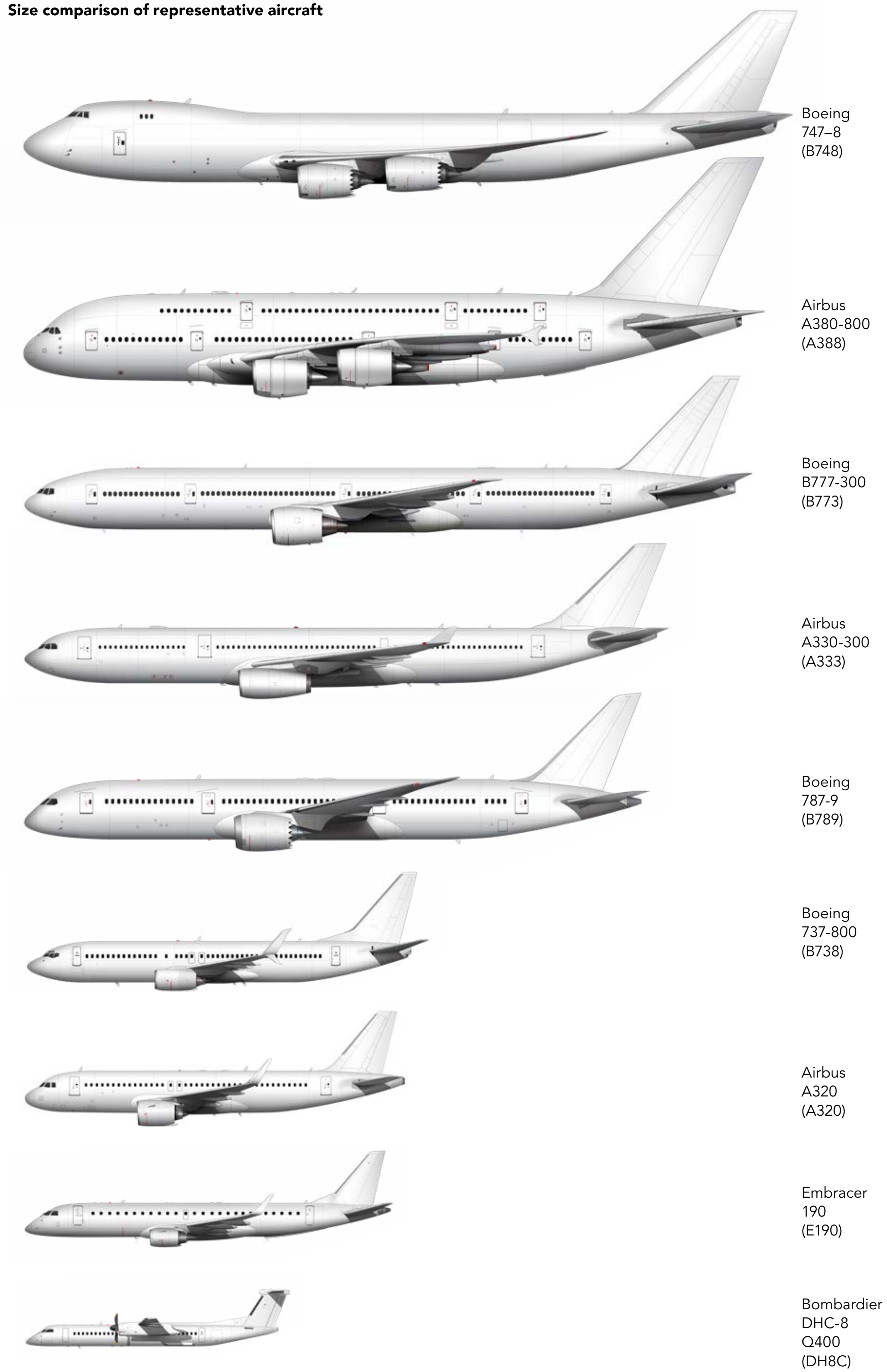
Table C3.6
Default current aircraft types modelled

Aircraft Type (scheduled)	Aircraft Class Jet /Other	AEDT ANP airframe
Antonov An-124 Ruslan	J	74720B
Airbus A319neo	J	A320-271N
Airbus A320neo	J	A320-271N
Airbus A321neo, Airbus A321LR, Airbus A321XLR	J	A320-271N
Airbus A318	J	A319-131
Airbus A319	J	A319-131
Airbus A320	J	A320-232
Airbus A321 (including freighter variant)	J	A321-232
Airbus A330 (all variants including freighters)	J	A330-301
Airbus A340-200 and Airbus A340-300	J	A340-211
Airbus A340-600 and Airbus A340-500	J	A340-642
Airbus A350-1000	J	A350-941
Airbus A350-900	J	A350-941
Airbus A380-800	J	A380-861
Boeing B737 MAX8	J	737MAX8
Boeing B737 MAX9	J	737MAX8
BAe 146-100, BAe 146-200, BAe Systems AVRO RJ 85, BAe Systems AVRO RJ-100	J	BAE146
BAe 146-300	J	BAE300
Boeing B717-200	J	717200
Boeing B737-200	J	737D17
Boeing B737-300 freighter	J	737300
Boeing B737-400 freighter	J	737400
Boeing B737-700 (all variants)	J	737700
Boeing B737 MAX10	J	737MAX8
Boeing B737-800 (all variants)	J	737800
Boeing B737-900	J	737800
Boeing B747-300	J	74720B
Boeing B747-400 (all variants)	J	747400
Boeing B747-8 (all variants)	J	7478
Boeing B757 (all variants)	J	757PW
Boeing B767 (all variants)	J	767300
Boeing 777-200 (all variants)	J	777200
Boeing B777-300 (all variants)	J	777300
Boeing B777-8	J	7773ER
Boeing B787 Dreamliner (all variants)	J	7878R
Cessna 510	J	CNA510
Cessna 525	J	CNA525C
Cessna 550	J	CNA55B
Cessna 506	J	CNA560U
Cessna 650	J	CIT3

Source: APAM, 2020

Aircraft Type (scheduled) (cont.)	Aircraft Class Jet /Other (cont.)	AEDT ANP airframe (cont.)
Cessna 680	J	CNA680
Bombardier Challenger 600	J	CL600
Embraer ERJ-135	J	EMB145
Embraer Phenom 300, Embraer EMB-550 Legacy	J	CNA55B
Embraer ERJ 170 (all variants)	J	EMB170
Embraer ERJ 190 (all variants)	J	EMB190
Fokker F100	J	F10065
Fokker F-28 Fellowship	J	F28MK2
Dassault Falcon 2000	J	CNA750
Fokker F70	J	F10062
Dassault Falcon 900	J	FAL900EX
Dassault Falcon 7X	J	GIV
Dassault Falcon 8X	J	IA1125
Bombardier Global 7000	J	BD-700-1A10
Bombardier Global Express, Bombardier Global 5000	J	BD-700-1A11
Gulfstream 4	J	GIV
Gulfstream V, Gulfstream G650	J	GV
Hawker Beechcraft 4000	J	CNA750
Learjet 35, Learjet 45	J	LEAR35
Pilatus PC-24	J	CNA55B
Piper PA-34	J	CNA55B
Raytheon 390	J	CNA55B
ATR-42 (all variants)	O	DHC8
ATR-72 (all variants)	O	HS748A
Beech 1900	O	1900D
Beech 350 Super King Air	O	DHC6
Beech 200 Super King Air	O	DHC6
Beech 36 Bonanza	O	GASEPV
Beech 58 Baron	O	BEC58P
Beech 76 Duchess	O	BEC58P
Lockheed C-130	O	C130
Cessna 172	O	CNA172
Cessna 182	O	CNA182
Alenia C-27J Spartan	O	DHC8
Cessna 441	O	CNA441
Bombardier Dash 8 Q100	O	DHC8
Bombardier Dash 8 Q200, Bombardier Dash 8 Q300, Bombardier Dash 8 Q400	O	DHC830
Embraer Brasilia (E120)	O	EMB120
Fokker F50	O	HS748A
Raytheon BAe-125 (all variants)	O	1900D
Piper PA-31	O	BEC58P
Piper PA-34	O	BEC58P
Pilatus PC-12	O	CNA208
Saab 340 (all variants)	O	SF340
Swearingen Merlin 3	O	DHC6
Swearingen Metroliner	O	DHC6

Figure C3.10
Size comparison of representative aircraft



Source: Norebbo Illustrator and Designer

C3.6.6.1
Future aircraft

Several aircraft in the forecasts are not yet included in the AEDT equipment database. They are referred to as 'future aircraft' in this report, shown in **Table C3.7** and modelled as follows:

- A320neo is included in AEDT 3b. A319neo, A321neo and A321XLR were modelled using the A320neo as it is the best representative aircraft
- A350-900 is included in AEDT 3b. A350-1000 was modelled using the A350-900
- B737-MAX8 is included in AEDT 3b and includes other 'MAX' variants
- A338 (neo) and A339 are imminent, each with ICAO type certification data. These aircraft were modelled by the most equivalent current aircraft in AEDT, with noise level adjustments based on ICAO type certification data. The selected aircraft and the respective adjustments have been determined in consultation with Airservices.

Other future aircraft types are in various stages of development. Most have suggested airframes for modelling in the AEDT database:

- A221 and A223 aircraft were modelled using the 737-700 as a basis aircraft. Adjustments of minus three and minus two decibels were applied for departures and arrivals respectively. These adjustments were based on a conservative estimate of the generational change in noise level between aircraft of similar types
- B779 and B781 were modelled using the closest equivalent without adjustment
- The B797 (Boeing New Midsize Airplane) is still a concept aircraft. Based on the information available, the 7878R was considered the best equivalent existing aircraft for noise modelling.

C3.6.7
Airport operating modes

Chapter C2: Airspace Architecture and Capacity details the existing operating modes. For convenience, the modes are shown graphically in **Figure C3.11**.

Airport operating modes for the No Build scenarios are assumed to be the same as those currently in use.

C3.6.8
Rules for mode selection

Aircraft noise metrics for the existing scenario were calculated directly from historic radar data for the 2019 calendar year. Selection of modes was therefore not necessary for this scenario. However, the rules discussed in this section are believed to approximate to current operations at Melbourne Airport.

Where more than one of these operating modes is available based on meteorological constraints, the mode to be used is selected in order of the preferences defined by the Noise Abatement Procedures (NAPs) described in **Chapter C2: Airspace Architecture and Capacity**.

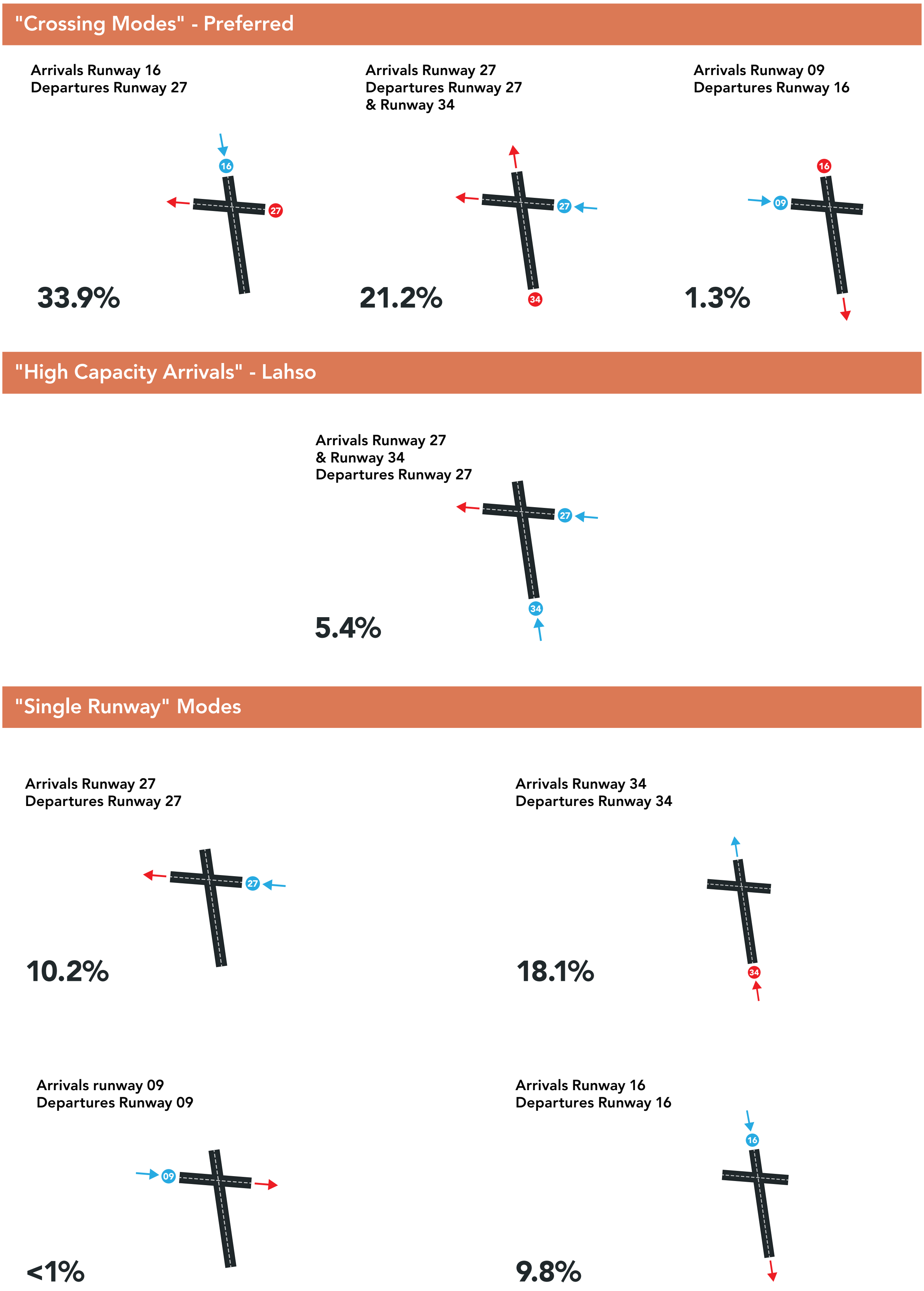
To avoid conflicts in the mode allocation model, distinct mode priorities are assigned to each mode (refer to **Table C3.8**). These were selected to mimic the existing trends of runway use that was observed in the historic radar data.

Table C3.7
Future aircraft types modelled

Aircraft type (scheduled)	Aircraft Class Jet/Other	AEDT ANP Airframe (substituted)	Adjustment Departures	Adjustment Arrivals
Airbus A220 (all variants)	J	737700	-3	-2
Airbus A319neo	J	A320-271N	0	0
Airbus A321neo, Airbus A321LR, Airbus A321XLR	J	A320-271N	0	0
A330neo (all variants)	J	A330-343	-2.2	1.4
Boeing 777X (all variants)	J	7773ER	0	0
Boeing 787-10	J	7878R	0	0
Boeing New Midsize Airplane (NMA)	J	7878R	0	0

Source: SoundIN, 2020

Figure C3.11
Existing runway modes of operation and 2019 annual usage (red = departures, blue = arrivals)



Source: APAM based on ATIS data for 2019, 2020
Note: Note mode involving arrivals on Runway 09 and departures on Runway 16 implemented mid-2019.

Table C3.8
Mode priorities

Mode	Runway use	NAPs priority	Mode allocation model priority
Day (0600-2300)			
'Crossing Modes'	Arrivals – Runway 16 Departure – Runway 27	1 (equal)	3
	Arrivals – Runway 27 Departures – Runway 27 & 34	1 (equal)	1
	Arrivals – Runway 09 Departures – Runway 16	2	4
'High-Capacity arrivals' LAHSO	Arrivals – Runway 27 & 34 Departures – Runway 27	1	2
'Single Runway modes'	Arrivals - Runway 27 Departures – Runway 27	3	5
	Arrivals - Runway 34 Departures – Runway 34	4 (equal)	7
	Arrivals - Runway 16 Departures – Runway 16	4 (equal)	6
	Arrivals - Runway 09 Departures – Runway 09	5	8
Night (2300-0600)			
'Crossing Modes'	Arrivals – Runway 16 Departure – Runway 27	1	1
	Arrivals – Runway 27 Departures – Runway 27 & 34	2	2
'Single Runway modes'	Arrivals - Runway 27 Departures – Runway 27	3	3
	Arrivals - Runway 34 Departures – Runway 34	4 (equal)	5
	Arrivals - Runway 16 Departures – Runway 16	4 (equal)	4
	Arrivals - Runway 09 Departures – Runway 09	5	6

Source: APAM, 2020

In addition to the mode priorities, the following rules relating to changes between these modes have been applied.

Changes to a higher priority mode occur if:

- The new mode is forecast to remain available (based on meteorological conditions) for two hours
- The new mode meets currently scheduled demand
- The new mode is available at the time in question (i.e. day or night).

Changes to a lower priority mode occur if:

- The current mode is unavailable at the current time
- The new mode is available with regard to meteorological conditions
- The new mode meets the currently scheduled demand
- The new mode is available at the time in question (i.e. day or night).

C3.6.9
Flight tracks

In this MDP, established convention is applied in distinguishing between an aircraft's 'flight path' (representing a three-dimensional trace of an aircraft's position) and a 'flight track' (representing a two-dimensional projection of the flight path onto the ground surface). This section considers flight tracks (the height-vs-distance profile of aircraft performing these operations is considered separately).

Chapter C2: Airspace Architecture and Capacity explains how aircraft operate around airports. Aircraft arriving at and departing from an airport nominally follow one of a number of Standard Arrival Routes (STARs) or Standard Instrument Departure Routes (SIDs). However, the actual tracks can diverge from these nominal tracks due to meteorological conditions, requirements for aircraft separation, and other variable factors. The approach outlined in this section has been developed to model, as accurately as possible, anticipated future movements of aircraft based on the current spread of tracks around the nominal STARs and SIDs. SIDs and STARs for the existing airspace along with proposed SIDs and STARs for M3R are described in **Chapter C2: Airspace Architecture and Capacity**.

It is important to note this is only a 'best-fit' approximation for future movements. While this is considered reasonable and is current best practice, actual distribution of aircraft around a nominal track will vary from day to day, week to week and month to month.

Aircraft noise metrics for the existing scenario were calculated directly from historic radar data for calendar year 2019. Each operation was therefore individually modelled on the track described by the radar data.

Existing aircraft flight tracks were analysed to determine the tracks for the No Build scenario. The dispersion of existing tracks determined by this analysis was also used to inform the dispersions applied to new tracks. Representative existing tracks were determined by analysis of all the flight tracks recorded by Airservices over the 2019 calendar year.

The data contained approximately 242,000 flights that had been matched to flight plans by Airservices. It contained information such as the port of origin/ destination, aircraft type, operation and runway. The data was checked for consistency, and geometric filters used to confirm the operation and runway.

The purpose of this flight track analysis was to identify the tracks associated with specific types of aircraft operations. This will allow the noise emissions to be predicted for future years.

Aircraft operations were classified by:

- Aircraft category (jet or non-jet)
- Operation (arrival or departure)
- Visual Meteorological Conditions (VMC) or Instrument Meteorological Conditions (IMC). These were determined from the meteorological data visibility and cloud records at the time.

Figure C3.12 and **Figure C3.13** demonstrate the analysis of all arrival and departure flight densities and permits the identification of typical flight tracks surrounding the airport. The density is expressed as a percentage of the total operations in the dataset.

Prominent concentrations of tracks are later represented as 'track groups' to facilitate further analysis.

For each group, a set of nominal tracks was then determined, representing the centre of each group and the dispersion of tracks within the group. Generally, between five and 15 sub-tracks were assigned for each group. The locations of these nominal tracks were determined directly from the recorded tracks using custom-developed software. These tracks could then be modelled. Unlike standard sub-track distributions in AEDT, sub-tracks determined this way may be asymmetric (i.e. if there is a bias for aircraft to fly farther to one side of the median than the other, this is reflected by the sub-tracks).

In this way, if aircraft operations are categorised as described above, they can be assigned on a proportional basis first to a group (using the proportion of actual operations in each group) and then to nominal tracks.

C3.6.10
Height-vs-distance profiles

All departure operations were modelled with height-vs-distance profiles, as determined by the verification and calibration process described in **Section C3.6.4**.

Vertical Navigation (VNAV) requirements are included on some procedures in the preliminary airspace design. The proposed height-vs-distance profile for each operation was evaluated against VNAV requirements to confirm that the selected profile complied. For those operations that exceeded VNAV restrictions, an alternate climb profile was adopted (e.g. a reduced climb profile was adopted to remain below a maximum VNAV requirement).

All arrival operations for future infrastructure scenarios were modelled with user-defined profiles in order to capture the altitude restrictions that would be required for the airspace (e.g. ILS intercept altitudes and distances). All arrival profiles were based upon standard AEDT height-vs-distance profiles, with the altitude and distance of level flight sections amended appropriately.

C3.6.11
Intersection departures

Intersection departures may occur for aircraft and operations that do not require a runway's full length, and if such a departure is requested by the pilot and will assist traffic flow.

An analysis of the radar data for 2019 indicated that intersection departures are desirable for various aircraft, runway and remote port combinations. However for the purpose of noise modelling, intersection departures and de-rated takeoffs are related (often one or the other may occur, but be difficult to distinguish in the available data). The verification process described in **Section C3.6.4** considered, among other variables, numerous combinations of intersection departures and derated take-offs.

Similar to other settings determined in the verification process, the intersection departures determined to provide appropriate calibration of the noise model were applied to existing and future scenarios alike.

C3.6.12
Runway starter departures

The new north-south runway includes a 200 metre starter extension at the beginning of Runway 34L. The starter extension increases effective runway length for northerly departures in hot weather, which is necessary to counteract the effect of the runway's uphill slope (see Section A4.5.5.1 for more information). It is expected that the starter extension will only be used when requested by pilots, based upon aircraft performance and conditions.

Aircraft and destination pairings that are anticipated to require the starter extension during hot weather conditions have been identified from the forecast schedules. Conservatively, modelling has assumed starter extension use for these pairings in all conditions. Use of the runway starter extension will be further refined during the detailed airspace design process.

C3.6.13
Calculation of aircraft noise impact descriptors

C3.6.13.1
Noise levels from individual aircraft operations

The AEDT aircraft noise prediction program developed by the United States Federal Aviation Administration (FAA) was used to predict noise levels from each flight track. Version 3b was used because it was the latest available version when performing the calculations.

A variety of meteorological conditions were modelled as described in Section C3.6.3. Terrain was also considered in the noise model, obtained from NASA's Shuttle Radar Topography Mission (SRTM) 3 arc second global dataset.

AEDT was used to compute three distinct noise descriptors for each operation: Effective Perceived Noise Level (EPNL), maximum A-weighted noise levels (L_{Amax}) and A-weighted Sound Exposure Level (SEL or L_{AE}).

ANEC and ANEI values are calculated from the EPNL. N-above values are calculated from maximum A-weighted noise levels. L_{Aeq} metrics are calculated from A-weighted sound exposure levels.

Noise levels were calculated for every actual or predicted combination of:

- Aircraft type
- Operation type (arrival or departure)
- Runway
- Stage length (for departures)
- Height-vs-distance profile/procedure
- Track and sub-track
- Meteorological 'class'.

C3.6.13.2
AEDT calculations for 2019

AEDT was used to compute historic noise metrics using the 2019 radar data described in Section C3.6.4.2. In total, 242,001 operations were modelled, based on radar data for each.

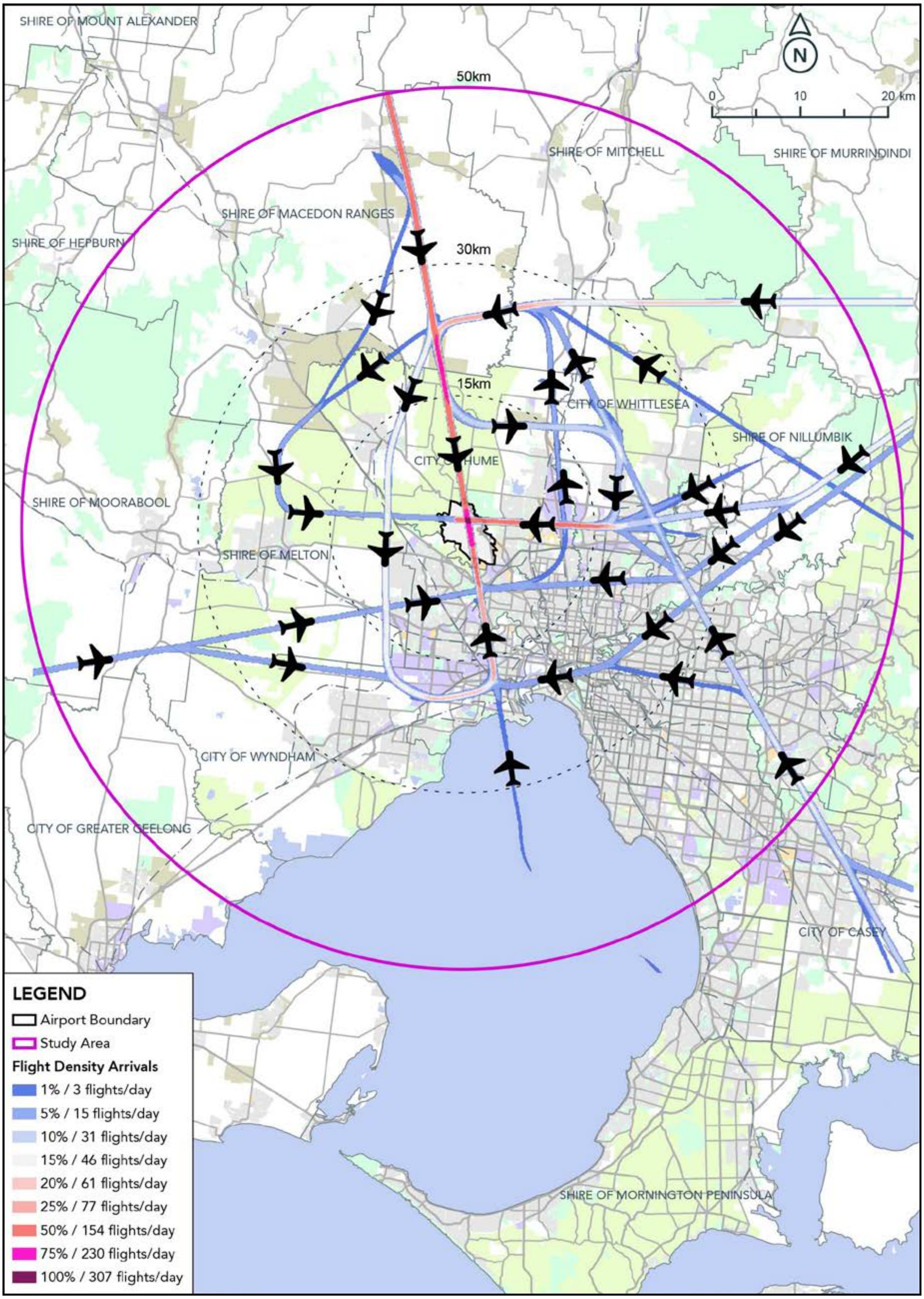
L_{Amax} and EPNL for each operation were calculated across a grid of points at 185 metre intervals. Post-processing of this data permitted the calculation of N-above metrics and an ANEI.

C3.6.13.3
AEDT calculations for future scenarios

AEDT was used to calculate maximum noise levels at each point on a grid measuring 185 metres by 185 metres, covering the area of interest.

Noise levels for each distinct operation were calculated and stored to allow calculation of N-above values for a range of airport operating scenarios using the custom-developed post-processing software.

Figure C3.12
Analysis of flight density for all jet arrivals for 2019*



**The 2019 dataset analysed 242,462 operations. The total number of operations involving jet aircraft was 220,974. On average, 303 jet departures and 303 jet arrivals per day were included in the density analysis.*
Source: APAM, 2020

Figure C3.13
Analysis of flight density for all jet departures for 2019*

*The 2019 dataset analysed 242,462 operations. The total number of operations involving jet aircraft was 220,974. On average, 303 jet departures and 303 jet arrivals per day were included in the density analysis

Source: APAM, 2020

C3.6.13.4
Predicted numbers of aircraft operations for future scenarios

Predicted future numbers of aircraft movements are based on modelling produced by Melbourne Airport (refer to **Chapter A2: Need for the Project**).

Forecast schedules detailing a list of aircraft operations for a typical 'busy week' were provided. Schedules were supplied for each MDP assessment year for both the Build and No Build scenarios. The forecast schedules included future aircraft type, operation type (arrival or departure), time of operation, and port of origin or destination for each operation. They are the basis of all modelling described below.

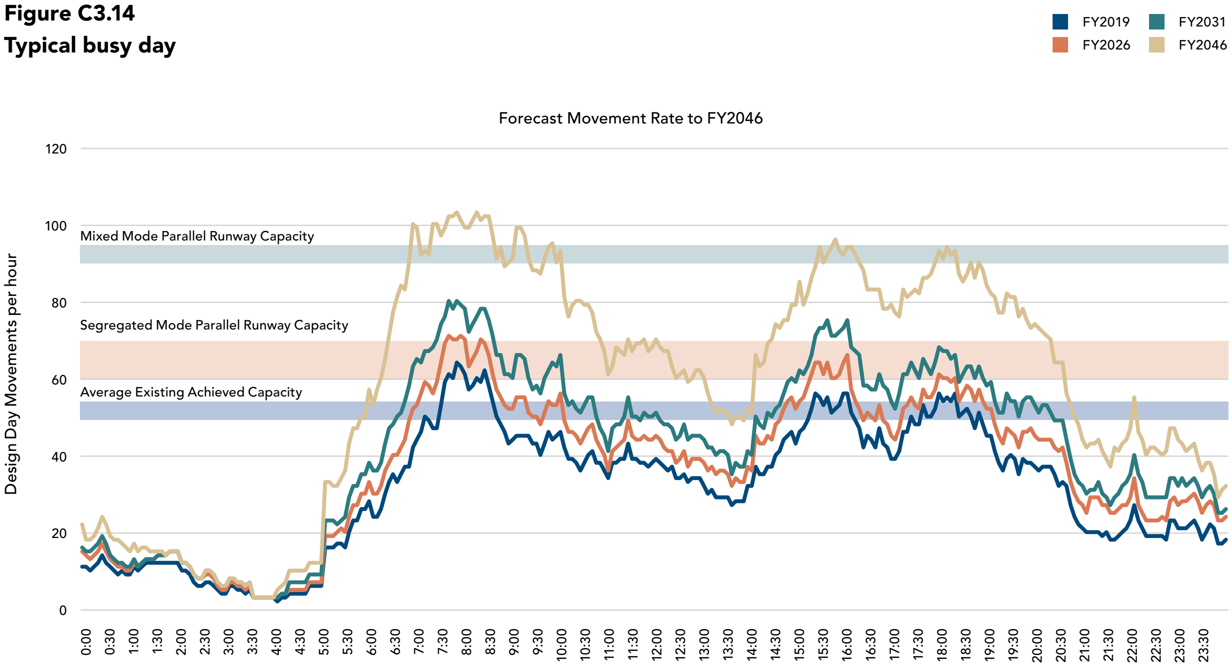
In addition to the 'busy week' schedules, annual forecasts were also supplied. Because the 'busy week' schedules represent activity greater than an average week, annualising these schedules results in more annual movements than are actually predicted. N-above and related metrics (typical busy day N-above and threshold respite) were based on the busy week schedules. They are therefore considered to be slightly conservative but consistent in communicating aircraft noise effectively without obscuring impacts through the use of averages.

The annual forecasts were used to scale results for annualised noise metrics (e.g. ANEC).

Table C3.9 shows predicted annual total fixed wing aircraft movements for each MDP assessment year. The No Build scenarios become constrained beyond 2026, resulting in fewer movements than the corresponding Build scenario. By 2046, ~42 per cent more operations are forecast to be accommodated with M3R. **Figure C3.14** presents the forecasts operations in a typical busy day for the build scenario. The typical morning and evening peaks are evident, as is the distinctly lower number of flights during the night period (11pm to 6am) especially in the period from 2am to 6am.

The variability between weekday and weekend days is consistent with the variability between weekdays. Noting this, and in the interest of reducing the number of presented noise metrics, no distinction is made between weekdays and weekends in the current assessment.

Figure C3.14
Typical busy day



Source: APAM, 2020

Table C3.9
Total predicted aircraft movements by scenario and year

Assessment year	Annual Movements* (RPT, Freight & General Aviation)	
	No Build	Build
2026	288,650	288,650
2031	315,300	333,800
2046	328,770	465,270

**excludes rotary wing movements*
Source: APAM, 2020

Table C3.10 shows a breakdown by aircraft family for financial year 2019 and 2046. Narrow-bodied jets account for most operations (approximately 70 per cent). Forecasting indicates that there is a greater proportion of larger aircraft predicted in future (see **Chapter A2: Need for the Project**).

Table C3.10
Predicted aircraft movements by aircraft family

Mode	Aircraft	FY2019	FY2046
Cargo	B747-8F	<0.1%	<0.1%
	B747-400F	0.2%	0.2%
	B777-200F	-	<0.1%
	A330F	-	<0.1%
	A321P2F	-	0.4%
	B738BCF	-	1.4%
	B737-400F	0.7%	0.3%
	B737-300F	0.9%	0.3%
	BAe 146-300F	0.5%	-
	BAe 146-200F	0.3%	-
	ATR 42-300F	0.2%	-
	Swearingen Merlin 3	0.3%	-
Passenger aircraft - International	A380-800	2.0%	-
	B777-9	-	2.1%
	B777-8	-	<0.1%
	B777-300ER	1.1%	-
	B777-300	0.2%	-
	B777-200LR	0.0%	-
	B777-200	0.5%	-
	A340-300	0.3%	-
	A350-1000	-	3.2%
	A350-900	1.8%	6.8%
	B787-10	-	1.7%
	B787-9	1.6%	5.0%
	B787-8	2.2%	2.2%
	A330neo	-	0.6%

Source: APAM, 2020

Mode (cont.)	Aircraft (cont.)	FY2019 (cont.)	FY2046 (cont.)
	A330-300	3.9%	-
	A330-200	2.1%	-
	B797	-	0.8%
	A321XLR	-	0.6%
	A321neo	-	0.2%
	A320neo	-	2.0%
	A320	2.2%	-
	B737 MAX10	-	0.1%
	B737 MAX9	-	0.8%
	B737 MAX8	-	3.0%
	B737-800w	2.6%	-
	B737-800	0.3%	-
Passenger aircraft - domestic	B787-9	-	0.5%
	B787-8	-	0.8%
	A330-300	0.7%	-
	A330-200	2.6%	-
	B797	-	2.1%
	A321XLR	-	8.1%
	A320neo	-	13.6%
	A321	5.0%	-
	A320	15.5%	-
	B737 MAX10	-	13.0%
	B737 MAX8	-	26.8%
	B737-800w	43.0%	-
	B737-700	0.5%	-
	B717-200	<0.1%	-
	Embraer 170	0.3%	<0.1%
	A220	-	0.9%
	ART 72-500	0.4%	0.2%
	ATR 42-600	-	2.0%
	Dash-8 Q400	3.4%	-
	Saab 340	4.4%	-

C3.6.13.5
Overall calculation procedures for future scenarios

For each airport operating scenario that was considered, an airport operating mode was assigned for every 10 minutes over a 10-year period taking into account:

- The set of possible operating modes and their priority
- Whether each mode is available under the current meteorological conditions (using the meteorological data set described in **Section C3.6.3**)
- Whether a change to a higher-priority mode would be undertaken under the assumed rules for mode selection (described in **Section C3.6.7**).

Aircraft operations occurring in that 10-minute period were then assigned to tracks according to the direction of the port of origin or destination. The meteorological conditions in that period determine the 'met class'. Each operation can then be used to determine measures of overall noise exposure (using the noise levels calculated in the manner described in **Section C3.6.13.3**.)

C3.7
ASSUMPTIONS

All care has been taken to reduce the influence of variables which would compromise the validity of assessment outcomes. The assessment therefore considers the following assumptions:

- Aircraft operations forecasts
- Aircraft schedule forecasts
- Flight tracks and airspace design
- Flight profiles
- Meteorological conditions
- Aircraft fleet
- Continuity of current ATC procedures
- Adoption of future procedures by ATC
- Runway nomination/availability rules.

The assumption with the greatest potential to make the actual noise exposure differ from the predicted exposure in this assessment is that regarding flight tracks and airspace design. The sensitivity of the predictions to each of the above assumptions is considered in the following sections.

C3.7.1
Assessment scenarios rationale

The assessment of aircraft noise for M3R considers numerous aircraft noise metrics (refer to **Section C3.5.2**) and scenarios. The resulting permutations are vast, and presenting all of them would require many figures and an overwhelming amount of information. The following sections discuss the similarities between several scenarios and the rationale for limiting the number of scenarios ultimately presented in the MDP.

C3.7.1.1
Seasonal variations

Seasonal variations in meteorological conditions and schedules can result in significant changes in noise exposure. Schedule changes are commonly associated with varying schedules at associated airports, such as those due to daylight saving. For the current assessment, the seasonal variation in the schedule was not considered significant enough to warrant production of two different schedules. The assessment has therefore been based on a single busy week schedule.

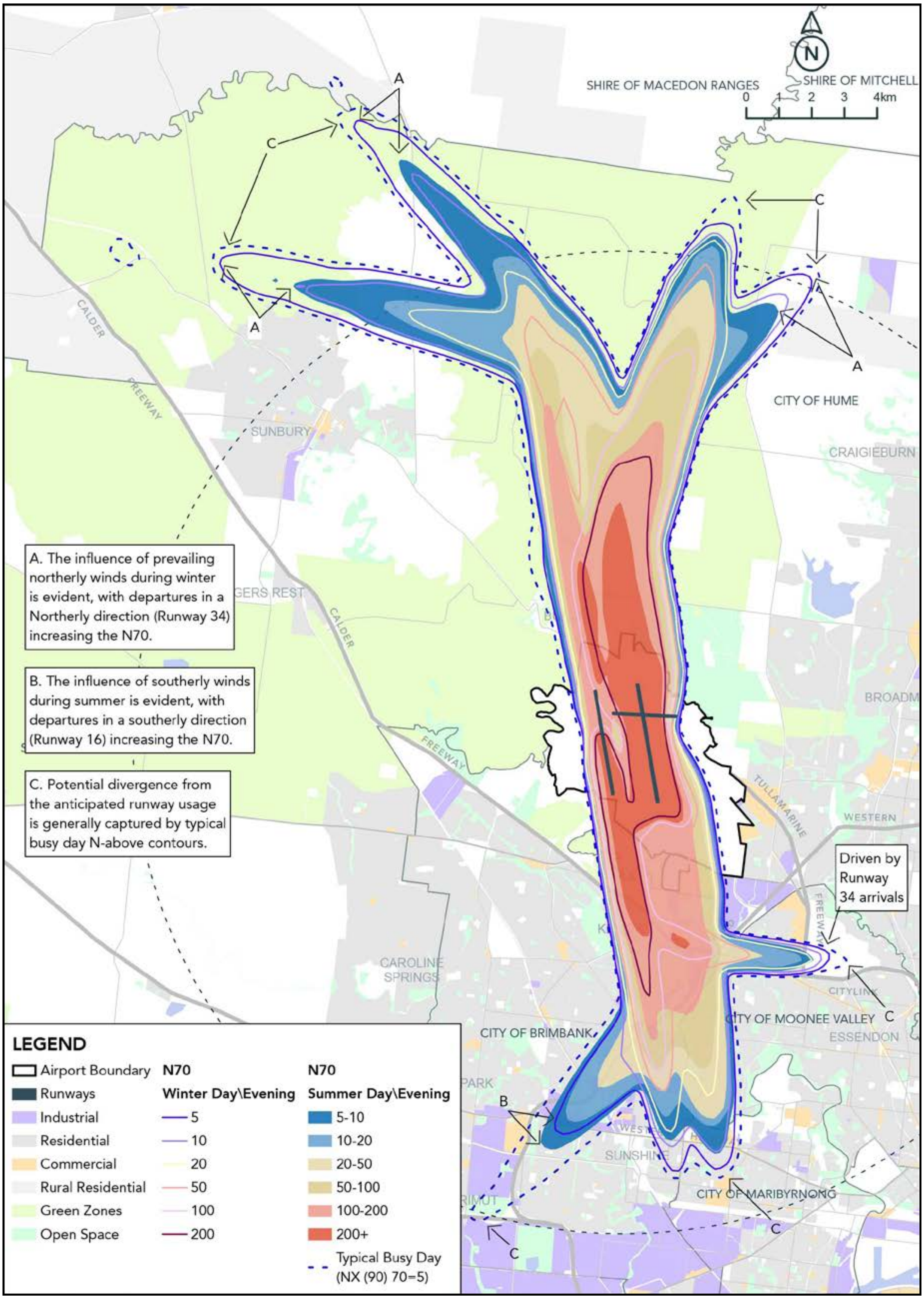
Seasonal variations due to meteorological conditions with reference to the prevailing winds for each season are considered in this section. An analysis of winds at Melbourne Airport was done as part of this assessment and N-above contours produced for summer and winter. For N-above charts, summer is defined as October to March and winter as April to September – these periods were selected because historically they represent the most distinct shift in prevailing winds.

Figure C3.15 to **Figure C3.18** present summer and winter N-above contours for M3R Option 1 and Option 2 at 2026 (opening day). The N-above contours were calculated by considering realistic runway availability limitations dictated by seasonal winds. The following observations have been made:

- The influence of prevailing northerly winds during winter is evident, with departures in a northerly direction (runway 34) increasing the N70 and N60 contours.
- The influence of southerly winds during summer is evident, with departures in a southerly direction (runway 16) increasing the N70 and N60.
- It is noted that the N60 night equals five contour for Option 1 is larger in winter compared to summer, northwest of the airport. This is related to departures toward the northwest off runway 34R. The N60 night equals five is particularly sensitive to a change of very few movements – even a single movement. It is noted that this area is within the typical busy day N60 contour for Option 1. Option 2 does not exhibit this same difference, because the operations are split between runways 34R and 34L, which have substantially different tracks.
- Potential divergence from the anticipated runway usage is generally captured by the 90th percentile (or typical busy day) N-above contours.

Noting that seasonal variations generally have a limited impact on the resulting operations and, consequently, aircraft noise metrics, presentation of separate summer and winter contours for each scenario is not warranted. The 90th percentile (typical busy day) N-above contours and other noise metrics adequately communicate potential variation in aircraft noise exposure.

Figure C3.15
Season variation M3R Option 1 2026 – N70 day and evening



A. The influence of prevailing northerly winds during winter is evident, with departures in a Northerly direction (Runway 34) increasing the N70.

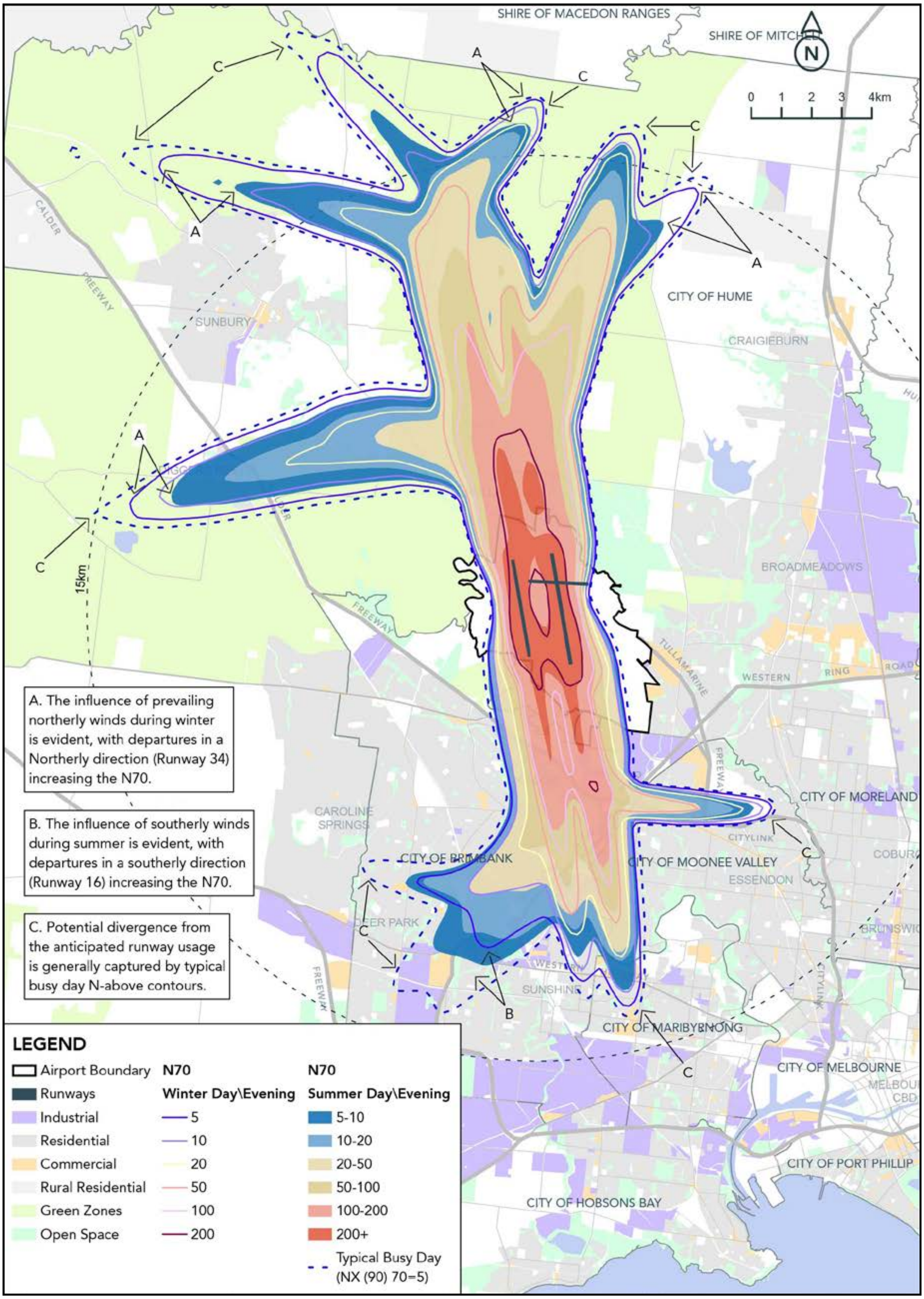
B. The influence of southerly winds during summer is evident, with departures in a southerly direction (Runway 16) increasing the N70.

C. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Driven by Runway 34 arrivals

Source: SoundIN, 2020

Figure C3.16
Season variation M3R Option 2 2026 – N70 day and evening



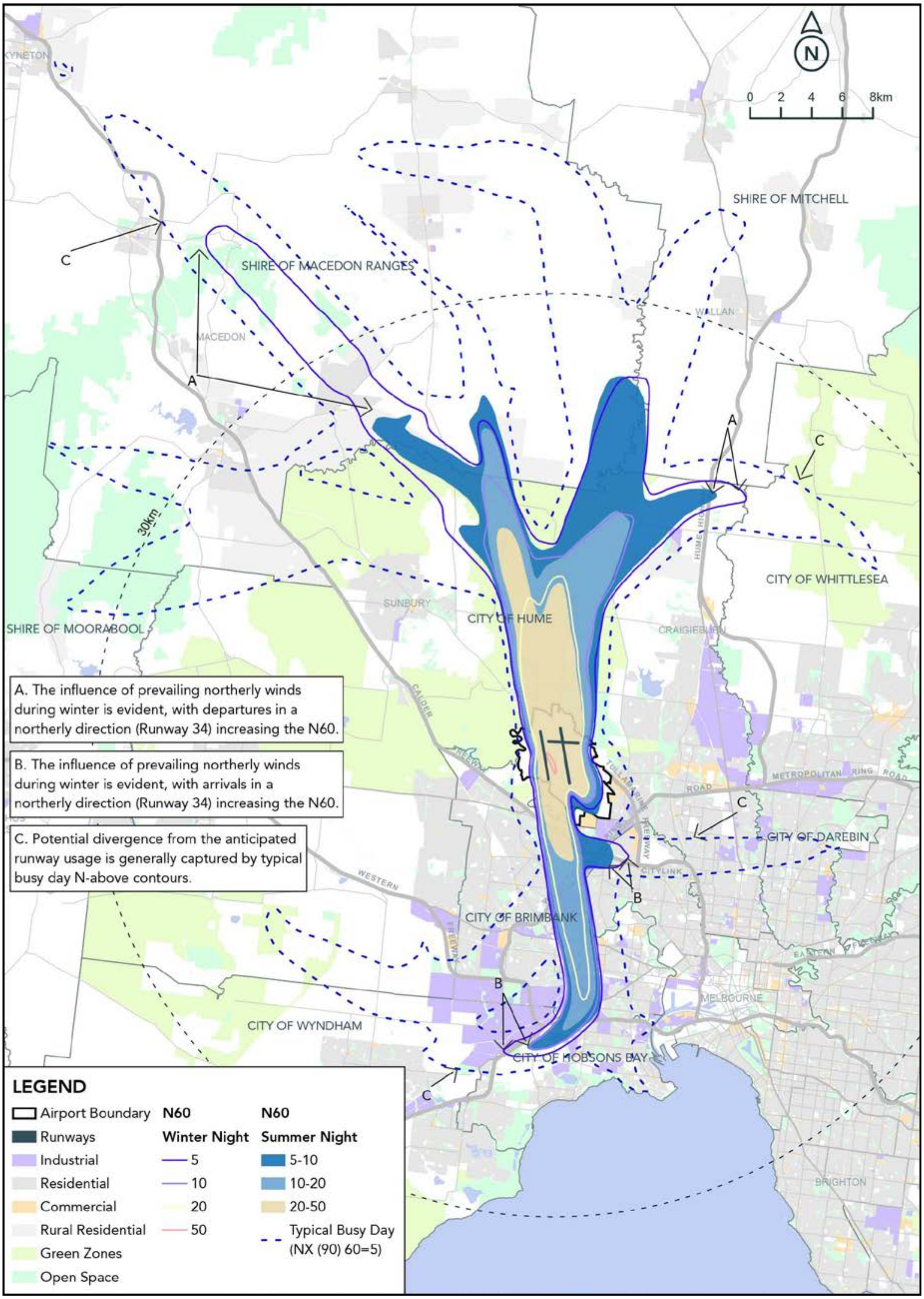
A. The influence of prevailing northerly winds during winter is evident, with departures in a Northerly direction (Runway 34) increasing the N70.

B. The influence of southerly winds during summer is evident, with departures in a southerly direction (Runway 16) increasing the N70.

C. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

Figure C3.17
Season variation M3R Option 1 2026 – N60 night



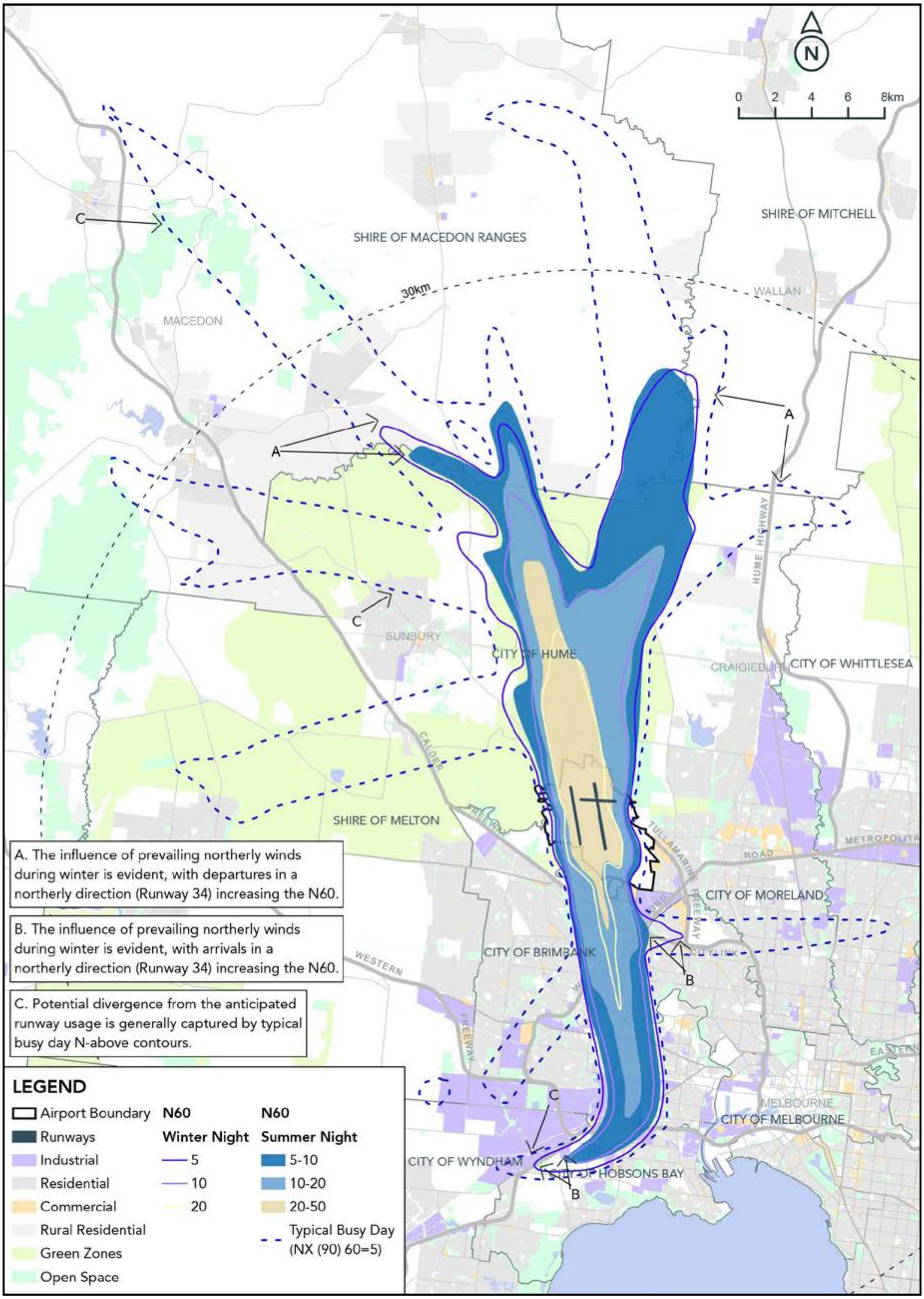
A. The influence of prevailing northerly winds during winter is evident, with departures in a northerly direction (Runway 34) increasing the N60.

B. The influence of prevailing northerly winds during winter is evident, with arrivals in a northerly direction (Runway 34) increasing the N60.

C. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

Figure C3.18
Season variation M3R Option 2 2026 – N60 night



A. The influence of prevailing northerly winds during winter is evident, with departures in a northerly direction (Runway 34) increasing the N60.

B. The influence of prevailing northerly winds during winter is evident, with arrivals in a northerly direction (Runway 34) increasing the N60.

C. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

C3.7.1.2
Weekday vs weekend

Some airports often have substantially different numbers of operations on weekends compared to weekdays. **Section C3.6.13.4** discusses the predicted operations in the future, including a comparison of weekday and weekend days. The variability between weekday and weekend days is consistent with the variability between weekdays.

Figure C3.19 to **Figure C3.22** present weekday and weekend N-above contours for the M3R Build proposed 2046 scenario.

There are some differences in the N60 night, related to flights to and from the north and north-east. These include ports such as Sydney and Brisbane, which have more night-time operations during the week.

There are some differences in the N60 night, related to flights to and from the north and northwest. These include international ports such as Singapore and Hong Kong, which have more night-time operations forecast during the weekend.

Given that variations between weekday and weekend days generally have a limited impact on operations, and consequently aircraft noise metrics, the presentation of separate weekday and weekend contours for each scenario is not warranted. The 90th percentile (or typical busy day) N-above contours and other noise metrics adequately communicate the potential variation in aircraft noise exposure.

C3.7.1.3
2026 vs 2031

Forecast growth in airport operations through the five years post-opening is minimal. Some increase in operations is anticipated. However, the effect of this on the overall noise emissions is largely negated by forecast fleet renewal, and subsequently a larger proportion of operations using newer, quieter aircraft.

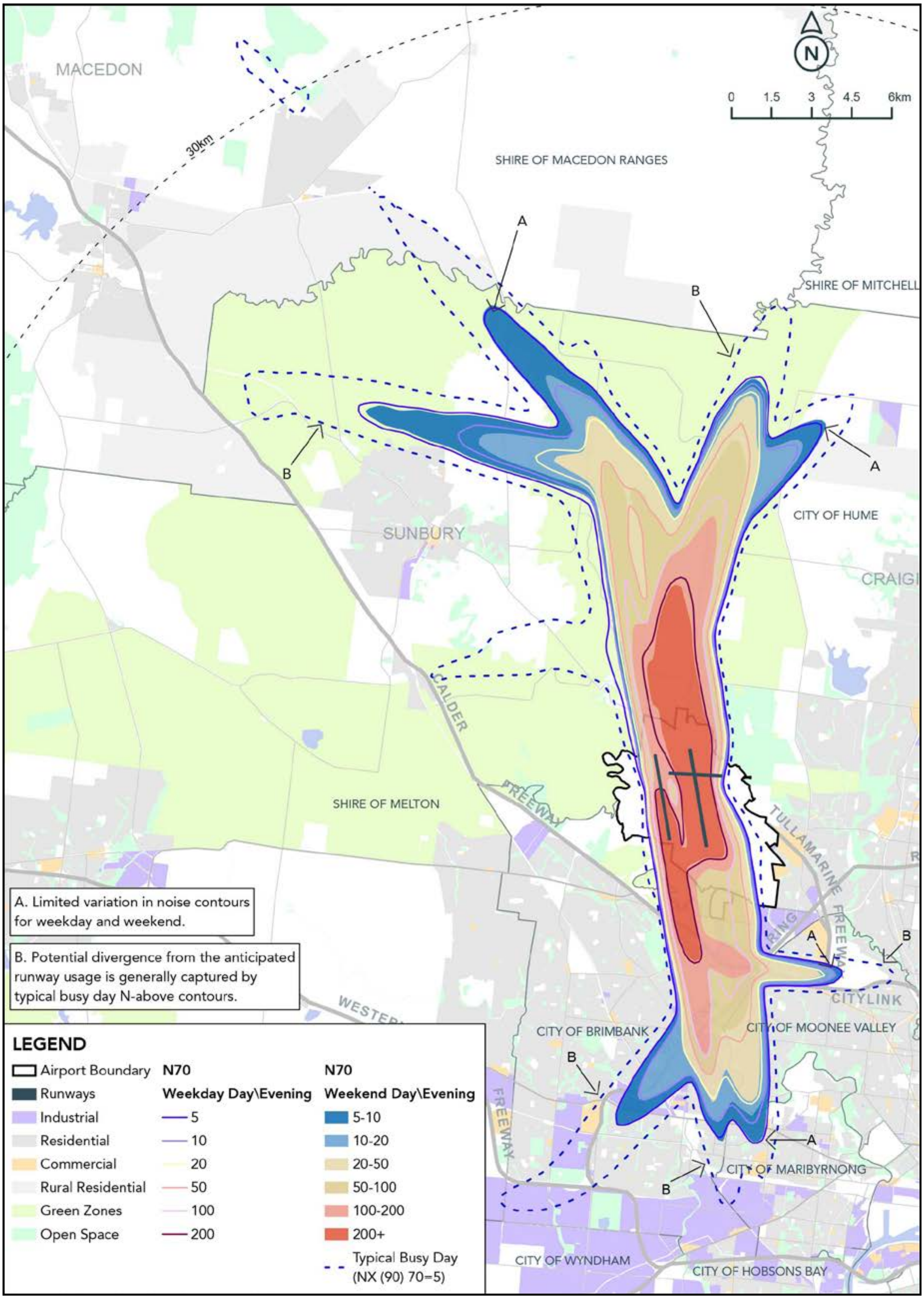
Figure C3.23 to**Figure C3.26** present N-above contours for the M3R Build scenario in 2026 and 2031.

There are very minimal differences between the two reference years. Reduction in contour extents between 2026 and 2031 reflect the forecasted introduction of quieter aircraft into the airlines fleet (A320neos, B737 MAX).

It is noted that the N60 night equals five contour for Option 1 is larger in 2031 compared to 2026, northwest of the airport. This is related to departures toward the northwest off runway 34R. The N60 night equals five is particularly sensitive to a change of very few movements; even a single movement. It is noted that this area is within the typical busy day N60 contour for Option 1. Option 2 does not exhibit this same difference, because the operations are split between runways 34R and 34L, which have substantially different tracks.

Therefore, noting that there are generally few differences between forecast noise for 2026 and 2031, presentation of separate contours for each scenario is not warranted.

Figure C3.19
Weekday and Weekend variation M3R Option 1 2026 – N70 day and evening

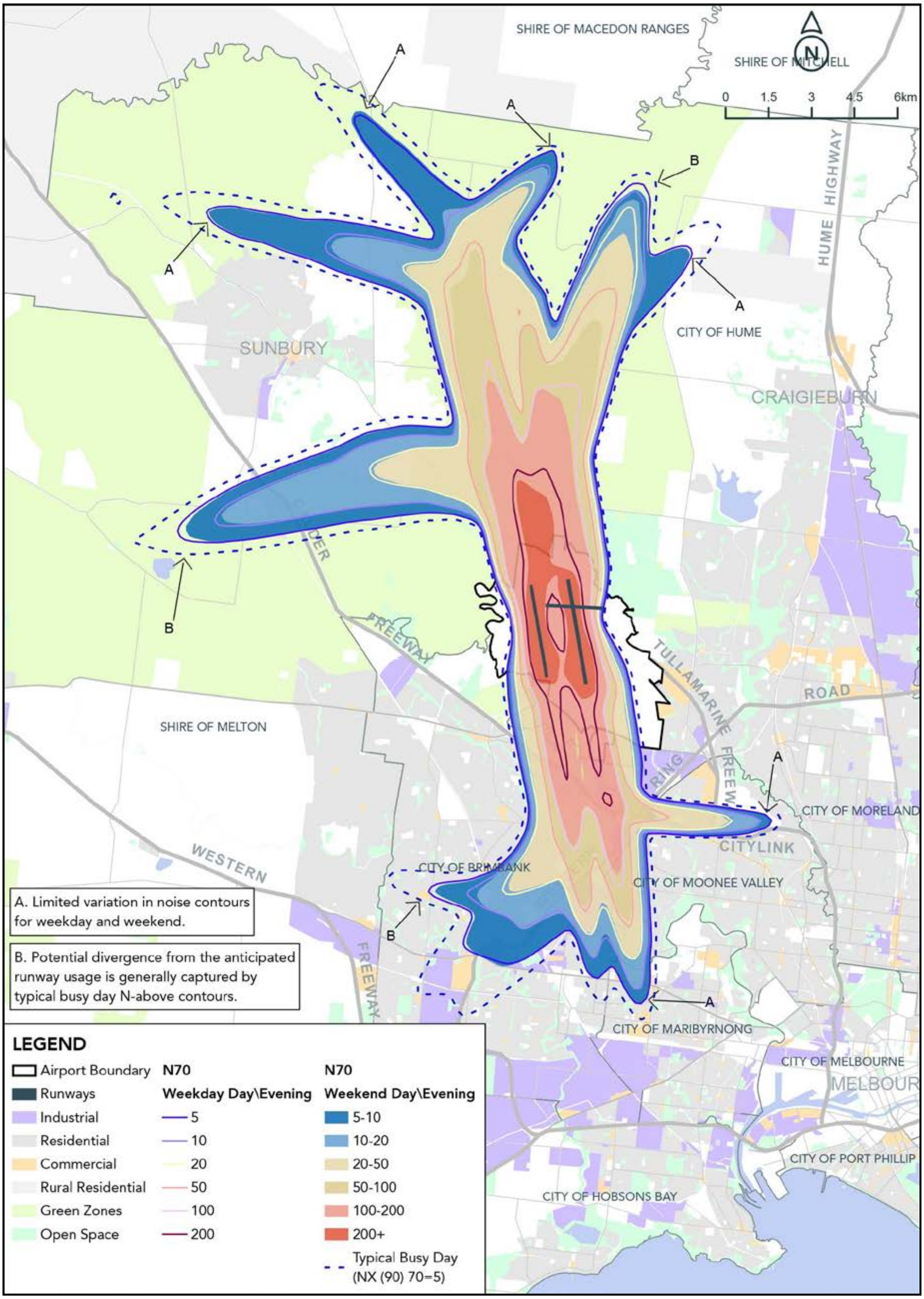


A. Limited variation in noise contours for weekday and weekend.

B. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

Figure C3.20
Weekday and Weekend variation M3R Option 2 2026 – N70 day and evening

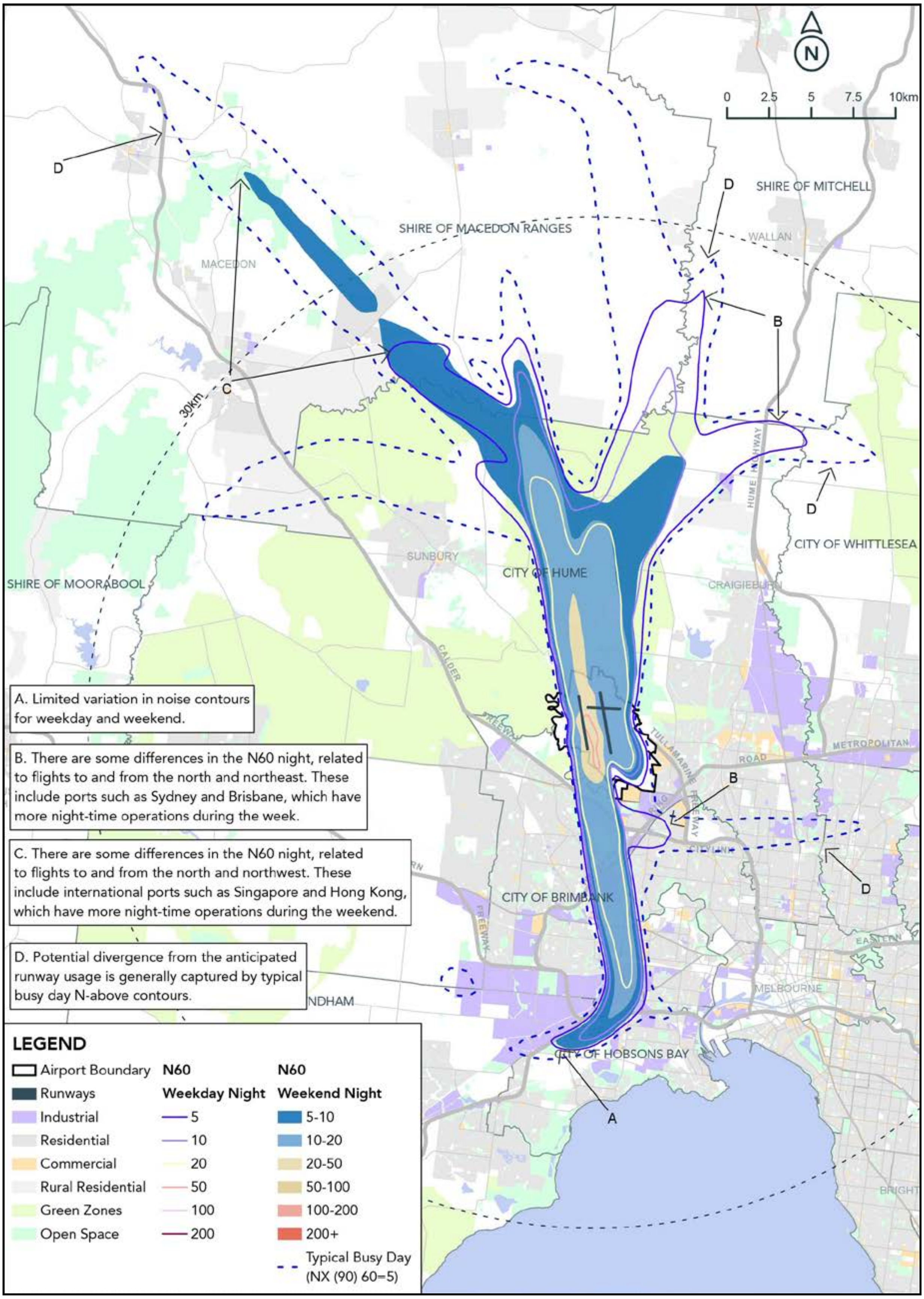


A. Limited variation in noise contours for weekday and weekend.

B. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

Figure C3.21
Weekday and Weekend variation M3R Option 1 2026 – N60 night



A. Limited variation in noise contours for weekday and weekend.

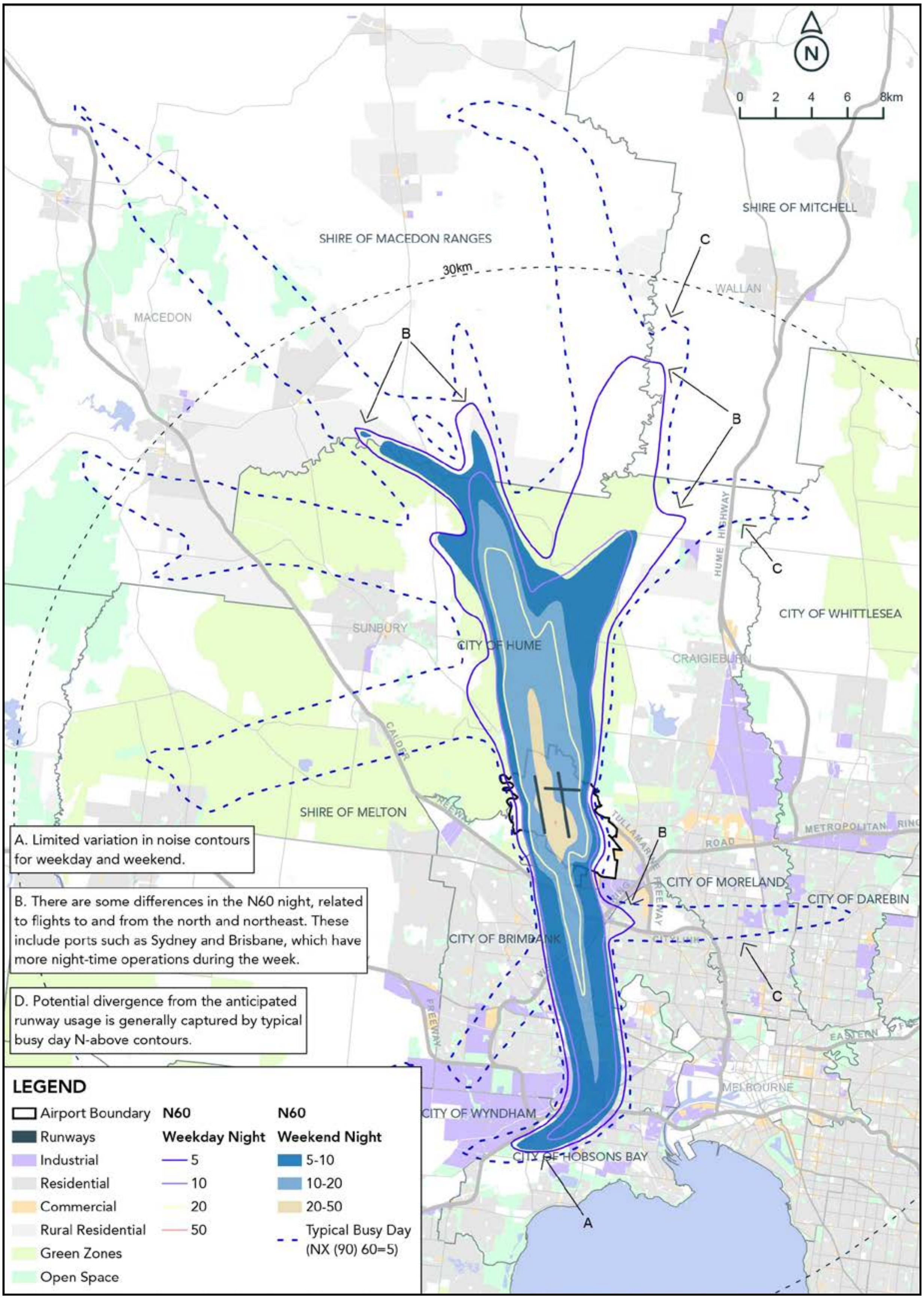
B. There are some differences in the N60 night, related to flights to and from the north and northeast. These include ports such as Sydney and Brisbane, which have more night-time operations during the week.

C. There are some differences in the N60 night, related to flights to and from the north and northwest. These include international ports such as Singapore and Hong Kong, which have more night-time operations during the weekend.

D. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

Figure C3.22
Weekday and Weekend variation M3R Option 2 2026 – N60 night



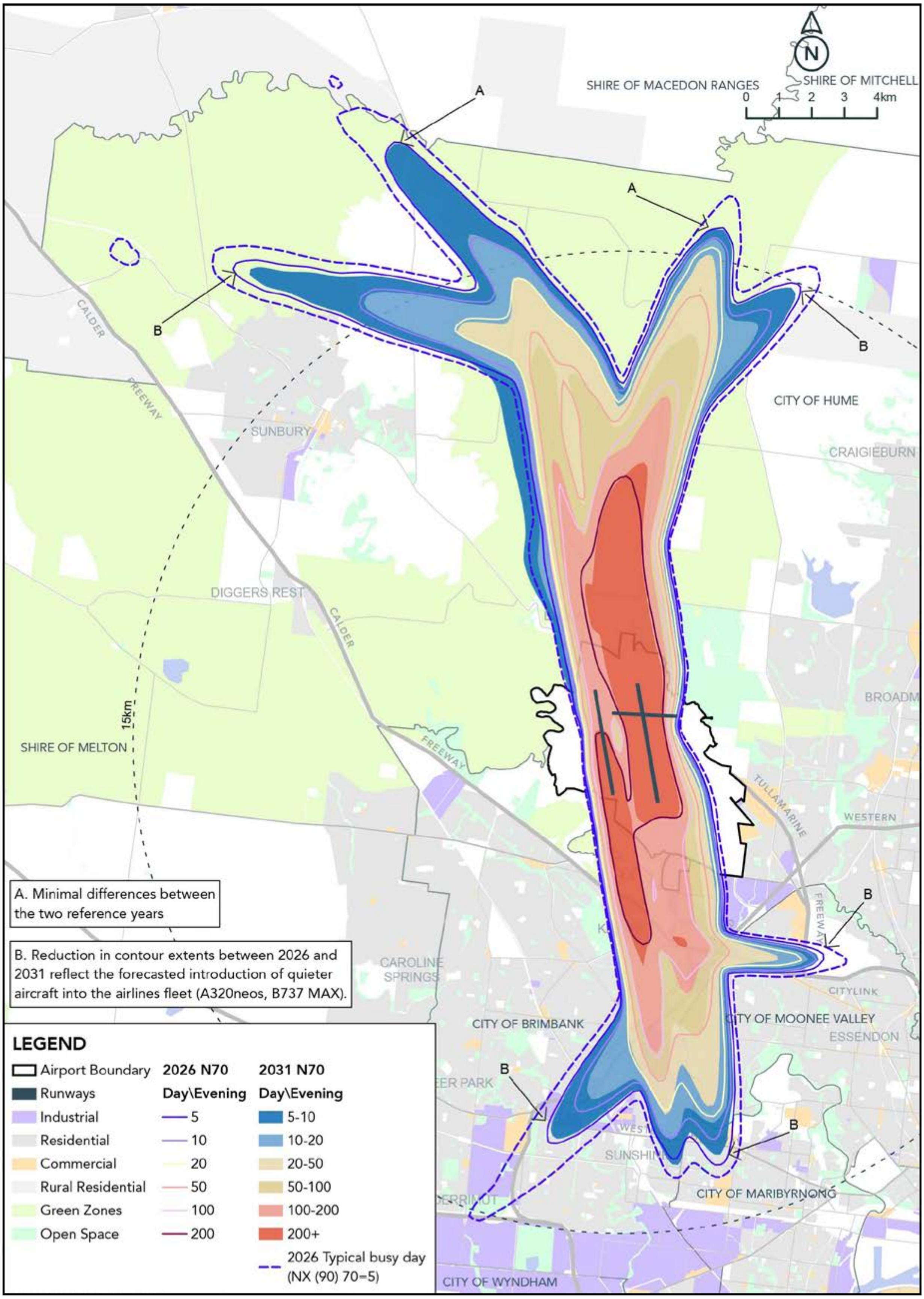
A. Limited variation in noise contours for weekday and weekend.

B. There are some differences in the N60 night, related to flights to and from the north and northeast. These include ports such as Sydney and Brisbane, which have more night-time operations during the week.

D. Potential divergence from the anticipated runway usage is generally captured by typical busy day N-above contours.

Source: SoundIN, 2020

Figure C3.23
2026 v 2031 M3R Option 1 – N70 day and evening

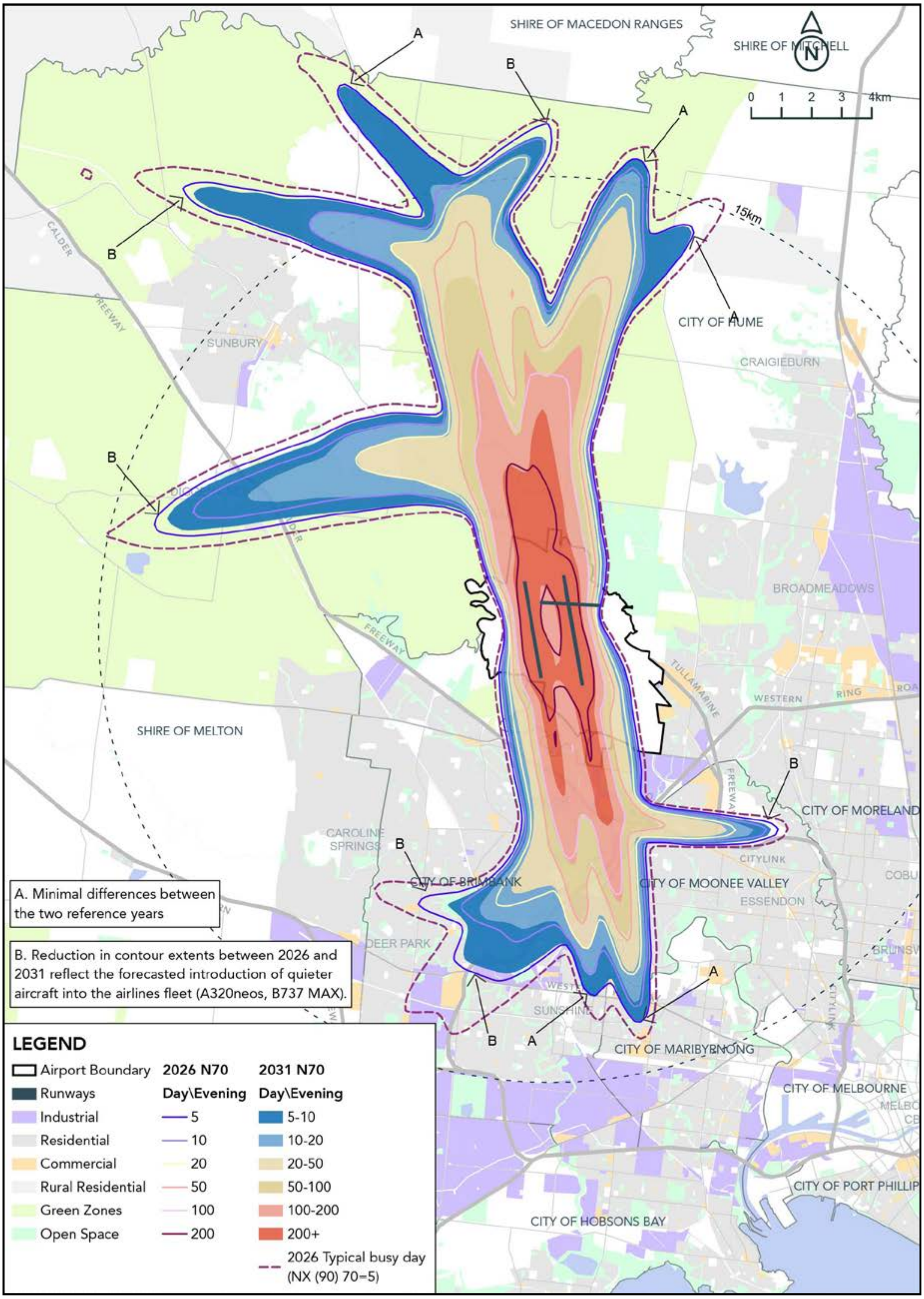


A. Minimal differences between the two reference years

B. Reduction in contour extents between 2026 and 2031 reflect the forecasted introduction of quieter aircraft into the airlines fleet (A320neos, B737 MAX).

Source: SoundIN, 2020

Figure C3.24
2026 v 2031 M3R Option 2 – N70 day and evening

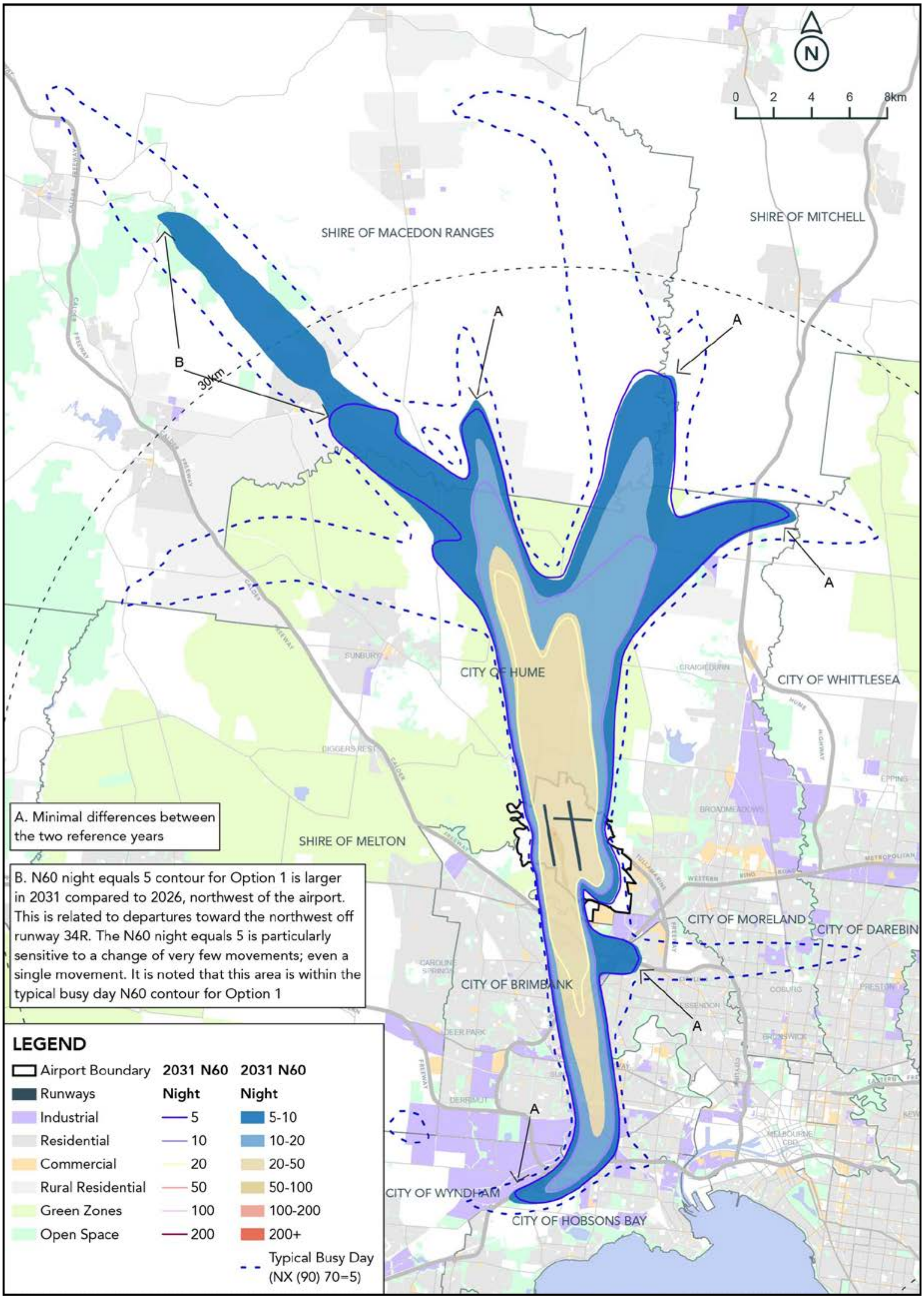


A. Minimal differences between the two reference years

B. Reduction in contour extents between 2026 and 2031 reflect the forecasted introduction of quieter aircraft into the airlines fleet (A320neos, B737 MAX).

Source: SoundIN, 2020

Figure C3.25
2026 v 2031 M3R Option 1 – N60 night

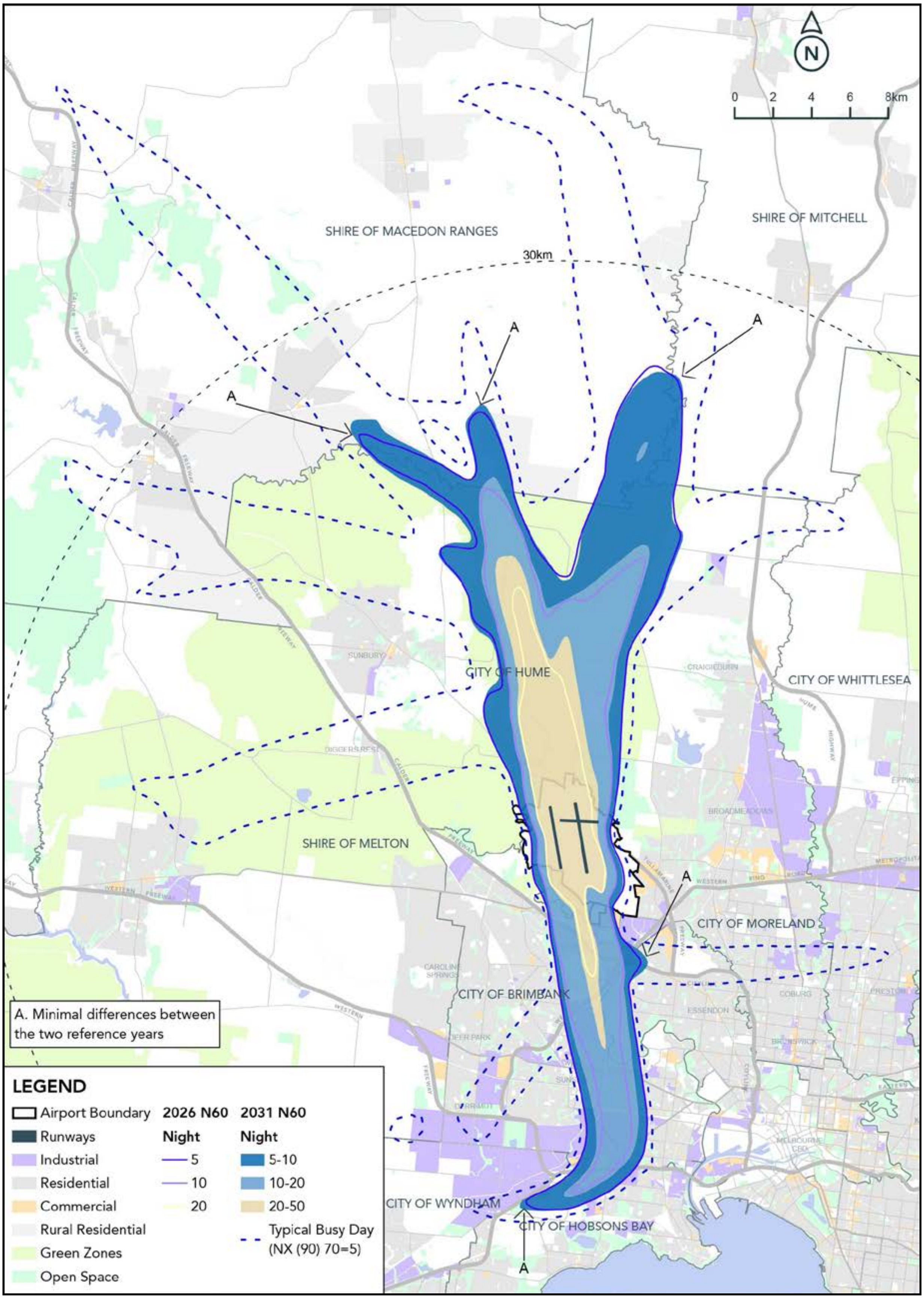


A. Minimal differences between the two reference years

B. N60 night equals 5 contour for Option 1 is larger in 2031 compared to 2026, northwest of the airport. This is related to departures toward the northwest off runway 34R. The N60 night equals 5 is particularly sensitive to a change of very few movements; even a single movement. It is noted that this area is within the typical busy day N60 contour for Option 1

Source: SoundIN, 2020

Figure C3.26
2026 v 2031 M3R Option 2 – N60 night



Source: SoundIN, 2020

C3.7.1.4
2046

The proposed parallel runway system offers a variety of ways to operate the airport. These operating modes and strategies are discussed in **Chapter C2: Airspace Architecture and Capacity** and **Chapter C4: Aircraft Noise and Vibration**. In this assessment, three main operating strategies are presented for the day and evening period, and two strategy options are presented for the night period.

By 2046, forecast operations are predicted to require high-capacity operating modes for a significant portion of the day and evening periods. This is reflected in the noise contours for each of the above scenarios becoming similar.

Figure C3.27 presents the N70 day and evening for the three operating strategies. It is clear that each strategy is forecast to result in similar operations and noise emissions during the day and evening.

During the night, the two operating strategies are predicted to remain distinct, with lower demand providing more opportunity to use the various operating modes.

Where it is appropriate to do so in the assessment of aircraft noise for 2046 (including in **Chapter D4: Social Impact** and **Chapter D3: Health Impact**) a composite of the forecast noise metrics for each scenario has been used. The composite contours represent the worst-case noise prediction of the scenarios (i.e. an envelope capturing the three scenarios).

C3.7.2
Sensitivity of the assessment to assumptions and inputs

C3.7.2.1
Aircraft operations forecasts

Noise predictions are sensitive to the forecast operations. Because the ANEC is an energy-dose metric, the extent of each contour will either grow or shrink proportional to a change in aircraft numbers.

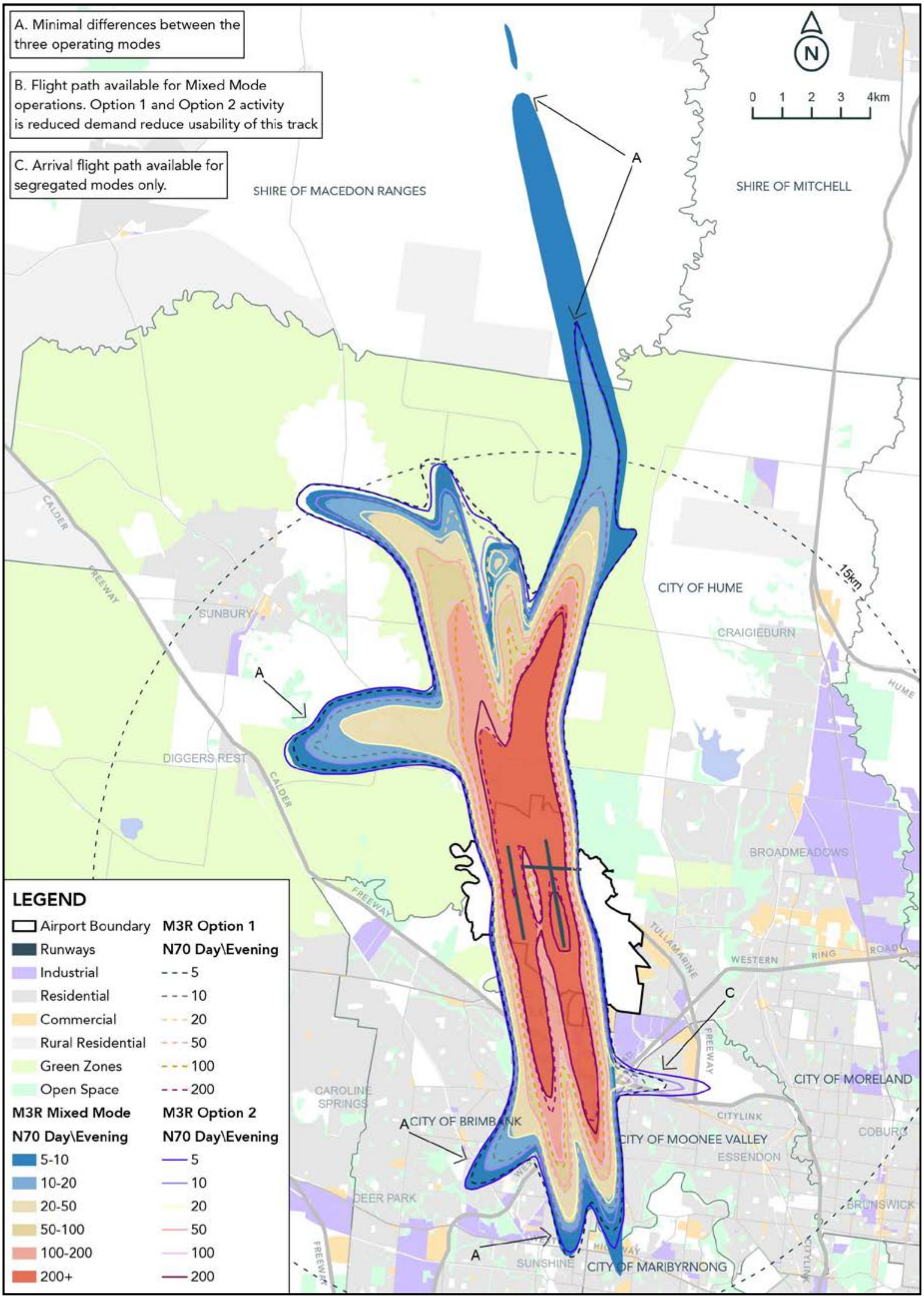
The following example (**Table C3.11**) is provided to help understand the impact that changing the forecast operations would have on the ANEC. If the total number of operations at the airport were to increase or decrease from the predicted value (while retaining the same aircraft types, tracks and other features) the impact would be as detailed in the table.

Table C3.11
Impacts on the ANEC by changes to forecast operations

Change in aircraft movements	Impact at a point on the ground			Impact on contour extents	
	Change in ANEC value	Change in N-above value	Perception	ANEC	N-above
Double	Plus 3 ANEC	N-above value at any point would double	Double the number of overflights would be observed and the noise environment would be noticeably greater	Noticeably larger; the area within the ANEC 20 or above contours would increase significantly (approx. double)	N-above contours would expand slightly. For low values of N-above, such as N70=5, the extent of the contours is limited by the loudest aircraft type so this may not extend greatly
Increase by 10%	Plus less than 0.5 ANEC		10% more operations may be noticed if sudden; the long-term impact of such change is negligible	Minor increase; noticeable on a community-scale map, but negligible on a larger-scale map	N-above contours are unlikely to expand greatly
Decrease by 10%	Minus less than 0.5 ANEC		10% fewer operations may be noticed if sudden; the long-term impact of such a change is negligible	Minor decrease; noticeable on a community-scale map, but negligible on a larger-scale map	N-above contours are unlikely to contract greatly
Half	Minus 3 ANEC	N-above value at any point would halve	Half the number of overflights would be observed and the noise environment would be noticeably less	Noticeable smaller; the area within the ANEC 20 or above contours would decrease significantly (approx. halve)	N-above contours would decrease slightly. For low values of N-above, such as N70=5, the extent of the contours is limited by the loudest aircraft type so this may not contract greatly

Source: SoundIN, 2020

Figure C3.27
M3R 2046 N70 day and evening for various operating strategies (includes Options 1 & 2 and Mixed Mode)


A. Minimal differences between the three operating modes

B. Flight path available for Mixed Mode operations. Option 1 and Option 2 activity is reduced demand reduce usability of this track

C. Arrival flight path available for segregated modes only.

Source: SoundIN, 2020

C3.7.2.2
Aircraft schedule forecasts

The N-above and ANEC metrics are related to the time period that flights are allocated to: day (6am to 7pm), evening (7pm to 11pm) or night (11pm to 6am).

Changing flight scheduling within these time periods would therefore not significantly alter noise predictions. However, a greater or lesser proportion of flights during the evening and night would significantly alter the noise predictions for those periods. For example, changing a flight from 8am to 9am would have minimal effect because it is still in the day period – on the other hand, moving a flight from 11am to 11pm would have a far greater effect because it involves a change to the number of flights in the day and night periods.

C3.7.2.3
Flight tracks and airspace design

The assessment is sensitive to the location of flight tracks and the distribution of operations to these tracks.

Flight track design for M3R’s airspace architecture is discussed in **Chapter C2: Airspace Architecture and Capacity**. A key design principle when developing tracks is to minimise noise impacts by avoiding the overflight of populous areas, where possible.

Tracks used in the existing and No Build scenarios were determined from existing operations. Significant analysis was done to accurately determine, and consequently model, the distribution of operations across currently flown tracks for these scenarios.

Considering the normal deviation of individual aircraft from standard tracks (both instrument and visual), modelling includes a number of sub-tracks that are distributed either side of the median track (middle or main track). The locations of these for tracks not currently flown are based on existing dispersions of similar tracks. Operations are assigned to the median and sub-tracks by using a distribution profile, which may vary along a track’s length and may be asymmetrical (e.g. about altitude turns). This ensures that noise modelling is more aligned with reality.

If tracks are altered, then the noise footprint would alter accordingly. Therefore, although the predictions are sensitive to flight tracks, care has been taken to ensure that the model closely represents reality, and significant variation from modelling assumptions in this regard is therefore considered unlikely.

As discussed in **Chapter C2: Airspace Architecture and Capacity**, following an approved MDP the final flight paths will be determined in partnership with Airservices during the detailed airspace and flight path design process.

A significant change to the airspace surrounding Melbourne Airport (such as the introduction of new air traffic management procedures) would alter the noise footprint.

C3.7.2.4
Flight profiles

Departure procedures are typically specific to both aircraft and airlines. Different procedures may dictate different climb rates and thrusts used. These will alter the noise level on the ground. Aircraft performance, and therefore departure profile, is affected by many factors including temperature, pressure, humidity and headwind.

Ascent profiles also depend on wind and other meteorological conditions that influence aircraft performance (for example, departures with a stronger headwind will follow a steeper profile than those with less headwind).

A variety of temperatures, pressures, humidity and headwinds were used in the assessment, across each of the ‘met classes’ discussed in **Section C3.6.3**.

A significant verification and calibration process was used to determine the flight profiles that best represent existing operations (in terms of trajectory and noise levels on the ground) for each of the met classes. The assessment assumes that similar ascent and descent profiles will continue in the future (except where a specific profile is a feature of the airspace design e.g. VNAV requirements, ILS intercepts).

Departures considered the forecast destination, and consequently determined an ascent profile based on the AEDT stage length (and consequent fuel load).

See **Section C3.6.4** for further details of the calibration of profiles and noise emissions based on historic data.

It is possible that some operations could adopt alternate profiles and/or procedures, if appropriate procedures are developed, which may alter the noise footprint for these operations.

C3.7.2.5
Meteorological conditions

The assessment is sensitive to the influence of prevailing meteorological conditions on the airport operating mode and aircraft performance characteristics.

The impact of these conditions was accounted for by analysing 10-years of meteorological data and incorporating this data into the modelling methodology. Consequently, over time, actual conditions are unlikely to dictate significantly different operations from those determined by the assessment. It is however recognised that there may be periods when different meteorological conditions prevail, and for these periods that there may be more or fewer operations of a particular type.

Variations in meteorological conditions affecting airport operating modes are adequately captured by the ‘typical busy day N-above’ contours that capture peak usage of the various available modes and runways.

C3.7.2.6
Aircraft fleet

The assessment has considered the realistic adoption of new generation aircraft. In general, these aircraft characteristically have reduced noise emissions. The earlier adoption of these aircraft would reduce the noise footprint of Melbourne Airport. Similarly, delayed adoption or the introduction of additional older/current generation aircraft would increase this footprint.

The International Civil Aviation Organisation (ICAO) sets aircraft noise standards (known by the 'ICAO Chapter' which defines each standard). In Australia, these standards are administered through the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA). The majority of the current fleet at Melbourne Airport comply with the ICAO Chapter 4 Standard, which is mandatory for all aircraft manufactured since 2006.

Though many aircraft in the fleet were certified prior to ICAO Chapter 4, they meet the requirements of the newer standard. The ICAO Chapter 14 Standard has now been adopted by ICAO and is applicable to new aeroplane types submitted for certification on or after 31 December 2017 (the implementation for aircraft under 55 tonnes is extended to 2021, however the 31 December 2017 date would apply to most RPT aircraft).

The introduction of new technologies has resulted in a significant reduction in the amount of noise that individual aircraft of a similar size make when compared to their predecessors. This has, to some limited degree, balanced the very substantial growth in the number of aircraft flying today, and the growth in the average size of passenger jets.

The continuation of this trend is anticipated in the future. The degree and speed of renewal of the fleet at Melbourne Airport could impact the noise predictions (see also **Section C3.6.6**).

C3.7.2.7
Continuity of current ATC procedures

Noise Abatement Procedures (NAPs) are applied at Melbourne Airport. They provide a number of measures aimed at minimising aircraft noise impacts around the airport – including a hierarchy of airport operating modes that inform the runways to be nominated for arrivals and departures.

The availability of operating modes is typically dictated by weather conditions and the capacity of each mode relative to the number of movements required to be processed (i.e. demand). Occasionally, other factors (such as runway or infrastructure maintenance) will influence which modes are available.

No Build scenarios have assumed the continuation of current ATC procedures (including current Melbourne Airport NAPs) regarding operating mode selection. Significant deviation from these procedures would alter the noise footprint.

Notwithstanding the anticipated continuation of current NAPs regarding airport operating mode and runway selection, technological developments may alter the way that aircraft fly into and out of Melbourne Airport. Such technological advancements may include precision navigation protocols, which could impact the sequencing and concentration of aircraft along flight paths.

C3.7.2.8
Adoption of future procedures by ATC

The noise-exposure assessment for future scenarios has been done using an iterative process to minimise noise exposure while maximising airport operability. Operating modes and procedures are therefore an integral control measure, so the presented noise exposure is correlated with the assumed procedures.

Small changes to the operating procedures (which may be necessary for practical reasons that are not currently not identified) would have minimal impact on the assessment outcomes. On the other hand, significant deviation from the proposed procedures would alter the noise footprint, and potentially the outcomes and conclusions of this assessment.

It is possible that new technologies will permit the detailed airspace design to deviate from the modelling assumptions. New technologies often present opportunities to reduce aircraft noise emissions. Regardless, airspace changes are subject to assessment and aircraft noise will be considered at the detailed airspace design stage.

C3.7.2.9
Runway nomination/availability rules

Rules for the selection of runway in use were taken from *Manual of Standards Part 172 – Air Traffic Services* (Commonwealth of Australia, 2020). Their application to the meteorological data was determined to match, as much as possible, the historic data describing runway selection at Melbourne Airport. See **Section C3.6.8** for further details of these rules and their application. **Chapter C2: Airspace Architecture and Capacity** includes further detail about runway nomination procedures.

Should these rules or their application be altered in the future, this has the potential to alter the availability of runways and consequently the noise footprint.

However, the current assessment does include 'typical busy day N-above' contours that capture impacts from peak usage of available modes and runways. Therefore, the risk of alternative rules affecting runway usage and significantly altering the noise footprint examined in this assessment is mitigated.

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Sources of key information

Table C3.12 summarises the sources of all key data discussed in this chapter and used in the calculation of noise descriptors for this report.

Table C3.12
Sources of key information used

Information	Source
Forecast future annual aircraft movements and synthetic flight schedule	APAM
Current aircraft types used to represent future types	APAM
Selection of representative AEDT aircraft types	SoundIN
Indicative aircraft flight tracks	Rehbein in consultation with APAM and Airservices
Rules for availability of runways by meteorology	Rehbein in consultation with Melbourne Airport and Airservices
Historical meteorological records at Melbourne Airport	Bureau of Meteorology (BoM)
Allocation of operations on a runway to flight tracks	Rehbein in consultation with Melbourne Airport and Airservices
Coordinates of runway ends and runway thresholds	APAM
Heights of runway ends	APAM
Meteorological conditions used in noise modelling	SoundIN, based on BoM and NFPMS data
Dwelling information	State of Victoria's Valuer-General


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