D3

AIRSPACE AND AIRCRAFT RELATED NOISE

AIRCRAFT NOISE

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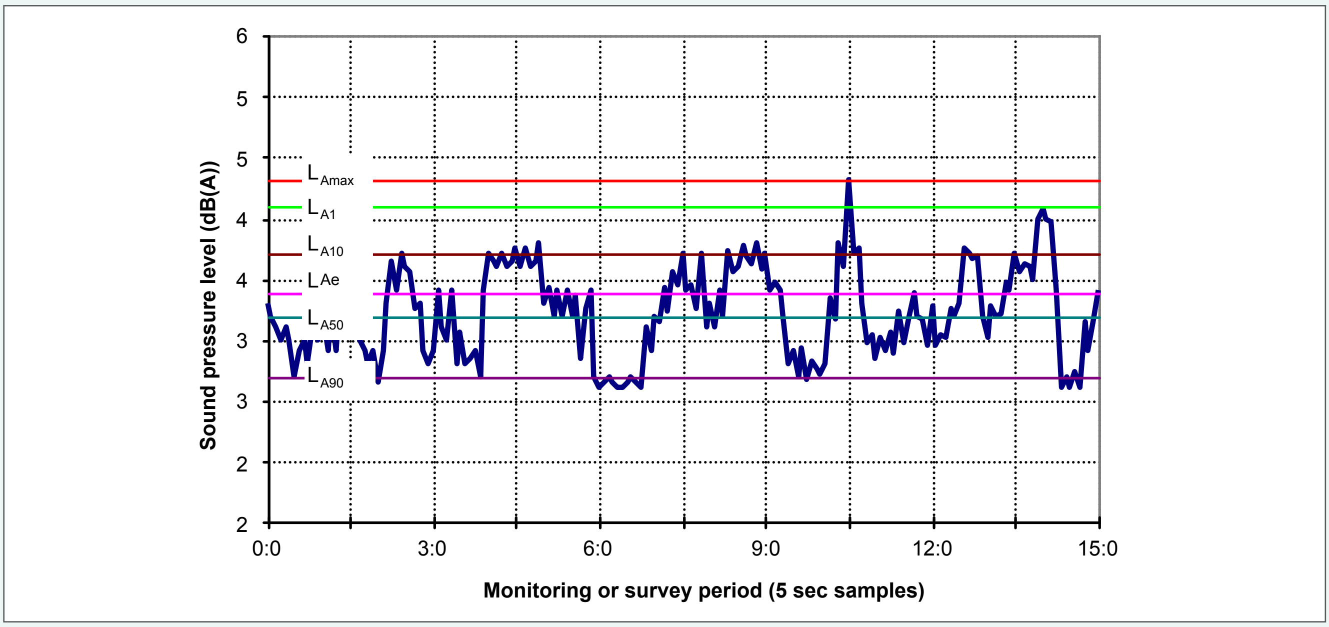
GLOSSARY OF ACOUSTIC TERMS

To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically being 15 minutes. These descriptors, which are demonstrated in the graph below, are defined here.

Maximum noise level (L_{Amax})	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
L_{A1}	The L_{A1} level is the noise level which is exceeded for 1 per cent of the sample period. During the sample period, the noise level is below the L_{A1} level for 99 per cent of the time.
L_{A10}	The L_{A10} level is the noise level which is exceeded for 10 per cent of the sample period. During the sample period, the noise level is below the L_{A10} level for 90 per cent of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A90}	The L_{A90} level is the noise level which is exceeded for 90 per cent of the sample period. During the sample period, the noise level is below the L_{A90} level for 10 per cent of the time. This measure is commonly referred to as the background noise level.
L_{Aeq}	The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th per cent) background level (L_{A90}) for each period.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.



AIRCRAFT NOISE

3.1 INTRODUCTION

This chapter provides details of predicted aircraft noise exposure around Sunshine Coast Airport (SCA) with the Airport Expansion Project (the Project). The following scenarios have been considered.

- Current operations
- Proposed closure of the existing Runway 12/30 in 2016 – 2017 to allow construction of the new Runway 13/31
- Operations in 2020 immediately after new Runway 13/31 becomes operational
- Operations in 2040 with the Project
- Operations in 2020 and 2040 without the Project.

In each case, noise exposure is predicted for the day period (7am to 6pm), the evening period (6pm to 10pm) and night period (10pm to 7am).

Noise exposure calculations are based on predicted aircraft movements, as well as assumptions regarding continuity of air traffic control procedures and meteorological conditions.

Due to the volume of helicopter traffic at SCA, noise exposure predictions have considered the influences of fixed-wing and rotary-wing (helicopter) operations separately, as well as cumulatively.

This chapter first describes the noise prediction and assessment methodology (**Section 3.2**). Helicopter and fixed-wing noise exposures are then discussed separately using this methodology. Cumulative aircraft noise exposure is then discussed in detail (**Section 3.7**). In each case, existing noise exposure is presented initially, with predicted noise exposure following. An assessment of impacts, based upon the predicted metrics described in this chapter, is undertaken in Chapter D5 (Social Impact Assessment).

3.1.1 Impacts of the Project on noise exposure

SCA currently has two runways; the primary Runway 18/36 and the secondary Runway 12/30. The Project proposes to close Runway 12/30 and construct a new Runway 13/31 which would become the primary runway. The proposed airfield layout is shown in **Figure 3.1a**.

The opening of the Project would be accompanied by changes to the airspace design around SCA, with consequent changes to noise exposure. Investigations into the probable airspace requirements have been undertaken in consultation with Airservices Australia (Airservices), and their conclusions are taken into account in this chapter. These changes would not be formally approved until a time much closer to the opening of the Project, and hence details of the procedures to be adopted cannot be guaranteed at this point. However, it is understood that the airspace design principles outlined by Airservices would need to be adopted for safety and operational reasons.

Figure 3.1a: Proposed airfield layout

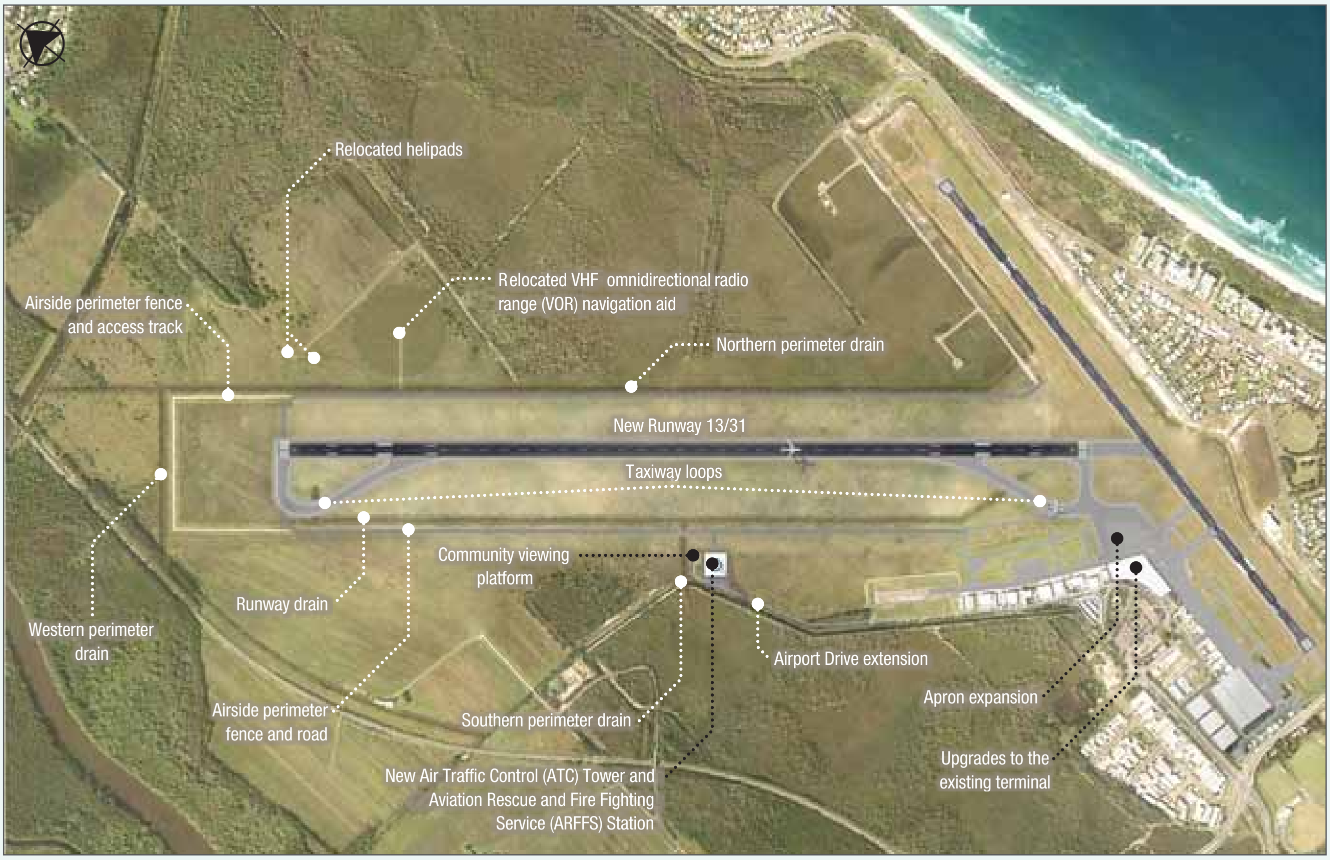
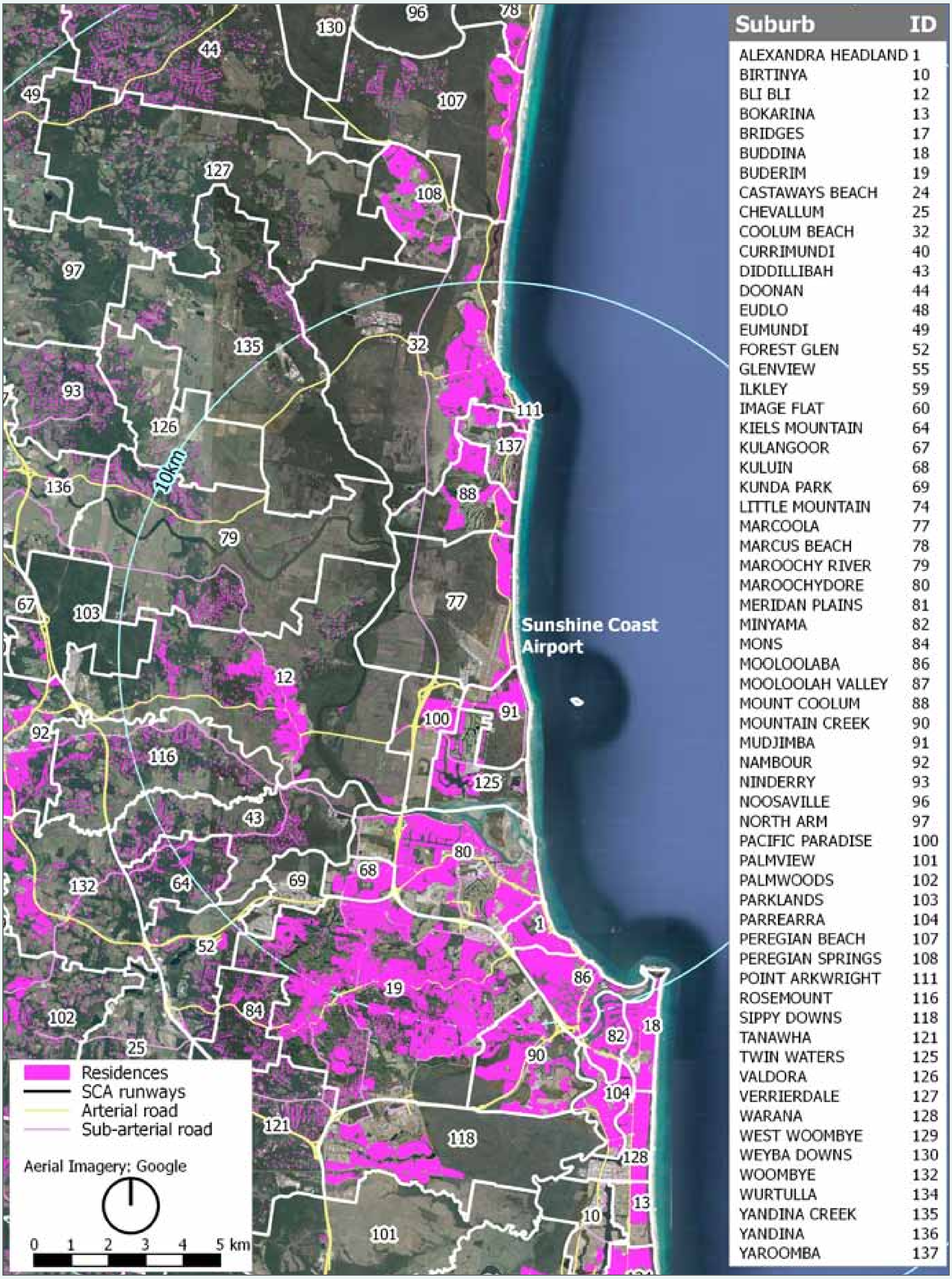


Figure 3.1b: Residences surrounding SCA with suburb [Source: SCC]



Hence the broad airspace design assumptions which underpin this noise assessment are considered to be appropriate.

During the construction process, aircraft flight tracks and operating procedures at the airport would change due to the closure of the existing cross runway (Runway 12/30). These changes would only affect General Aviation (GA) aircraft, which can currently utilise Runway 12/30. Regular Public Transport (RPT) aircraft would be unaffected by the Runway 12/30 closure.

With the opening of the new Runway 13/31, aircraft flight tracks and patterns of usage would need to change. The required changes are documented in Chapter D2.

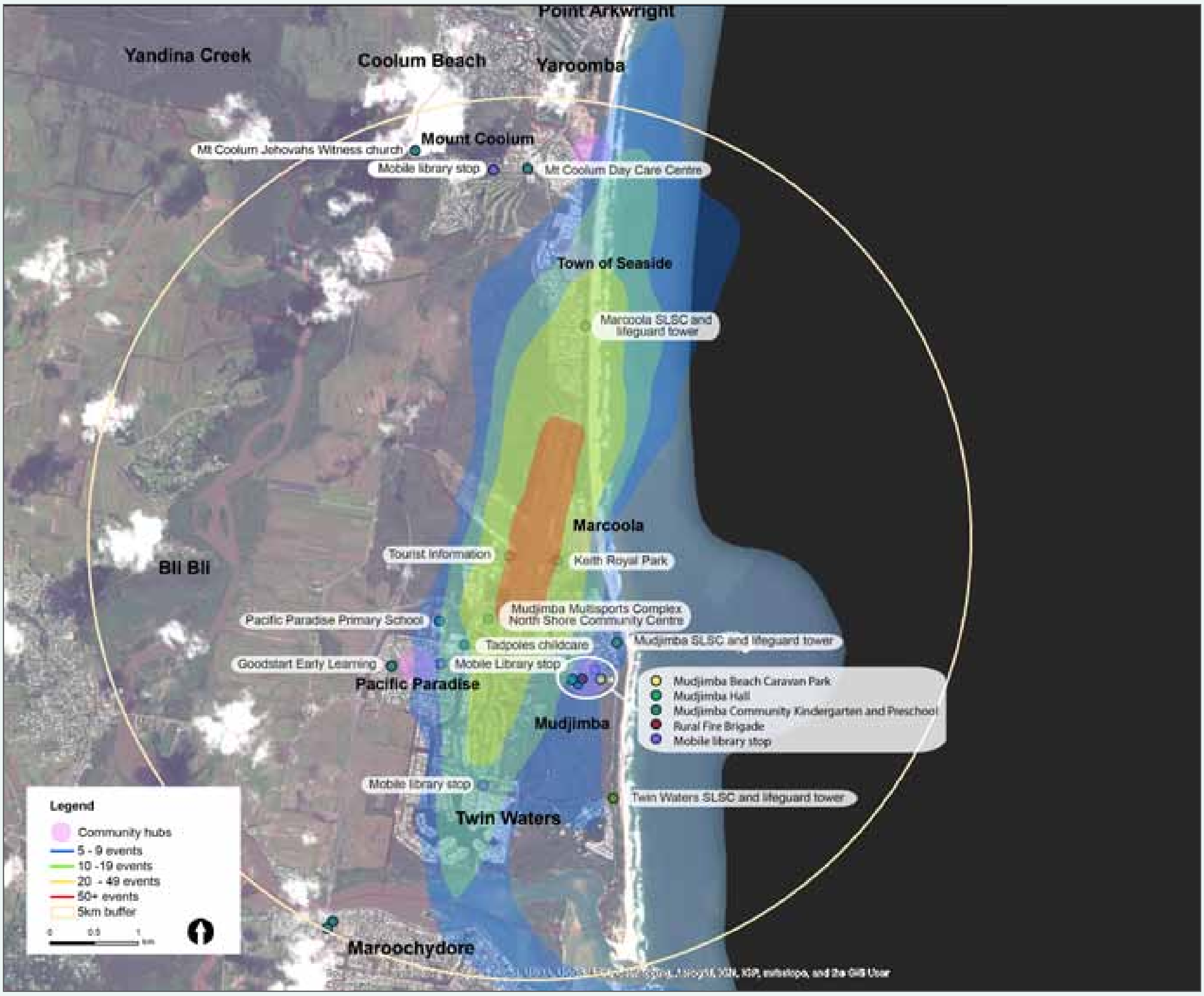
Broadly, the changes would involve the introduction of new flight paths for approaches and departures on the new runway, which would become the primary runway for SCA. Flight paths for aircraft approaching or departing from the existing main Runway 18/36 would be substantially unchanged, however Runway 18/36 would see a significant reduction in usage. This will be particularly so for RPT aircraft operations, which will solely occur on the new Runway 13/31.

In the longer term, increased usage of the airport as a result of the Project would result in alterations to the pattern of road traffic around the airport. Noise impacts from this change, while relatively minor, are considered in a separate report addressing on-ground noise (Chapter B15). Noise associated with construction works is also assessed in that separate report.

3.1.2 Potentially-affected receivers

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 report, the potential impact of the proposal on these receivers is assessed in terms of a number of descriptors of noise exposure, as set out in **Section 3.2**. Benefits and disbenefits 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.

Figure 3.1c: Noise sensitive receivers (apart from residences) surrounding SCA [Source: SCC]



Locations of noise-sensitive receivers were obtained from Sunshine Coast Council (SCC) in the form of geographical information system (GIS) layers. **Figure 3.1b** presents the residences surrounding SCA (see **Section 3.2.4** for details of this data) and suburbs. The boundaries of suburbs shown in **Figure 3.1b** were provided by SCC and are referred to throughout this chapter. **Figure 3.1c** presents the locations of other noise-sensitive receivers surrounding the airport.

3.1.3 Historical noise complaints at SCA

Complaints represent one mechanism for quantifying community response toward existing aircraft noise exposure at SCA.

Noise complaint data for the period January 2010 to March 2012 was analysed. In total 249 complaints were received in this period.

These complaints were categorised by suburb and subject matter. **Figure 3.1d** presents a breakdown of the complaints by subject.

Helicopters accounted for 52 per cent of the noise complaints. The distribution of helicopter complaints was widespread, though the majority of these complaints were generated within suburbs immediately surrounding SCA.

Jet aircraft were responsible for 13 per cent of the complaints received. In addition to Marcoola, these were concentrated south of the airport; Twin Waters, Maroochydore, Buderim, Minyama and Buddina.

Approximately 50 per cent of the complaints relating to jet aircraft were generated in Buderim.

18 per cent of the complaints received related to propeller aircraft. Like helicopters, these complaints were generated across the Sunshine Coast region with the greatest concentration around SCA. The data showed a bias toward the south of the airport.

Figure 3.1e presents complaints data geographcially. Suburbs are colour-coded based on the total number of complaints for that suburb. The number of complaints for each of the subject categories is indicated by the bars (length indicates the number of complaints) and also by the number annotated to the left of these bars. Complaints which were not associated with a location, or the location was omitted from the complaint record, have been excluded from **Figure 3.1e**.

A noise complaint has historically been represented as the number of complaints. It is now more generally accepted that a complaint refers to an issue raised by a person. Once the issue is raised it becomes one complaint regardless of the amount of reports associated with the one complaint.

Figure 3.1d: Noise complaints by subject – January 2010 to March 2012

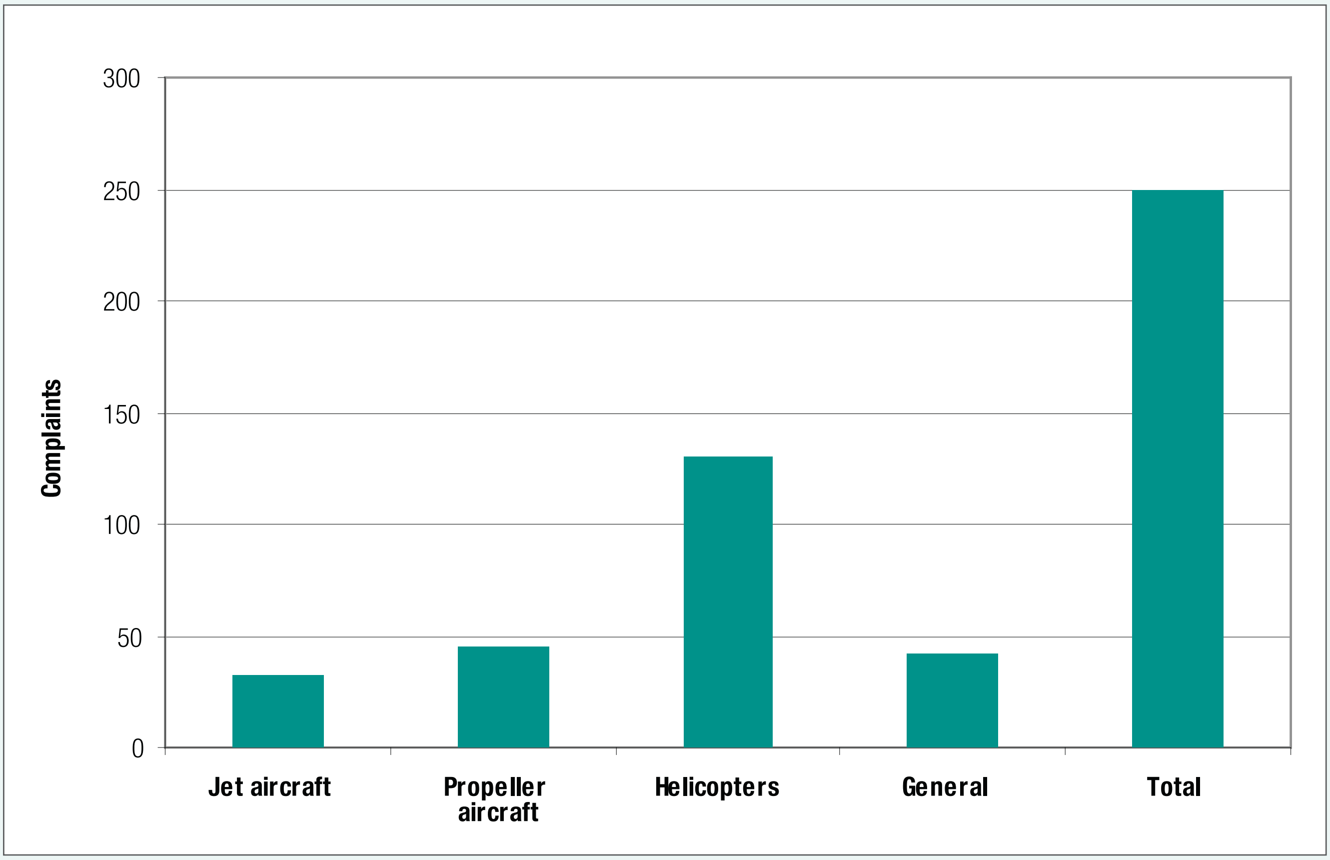
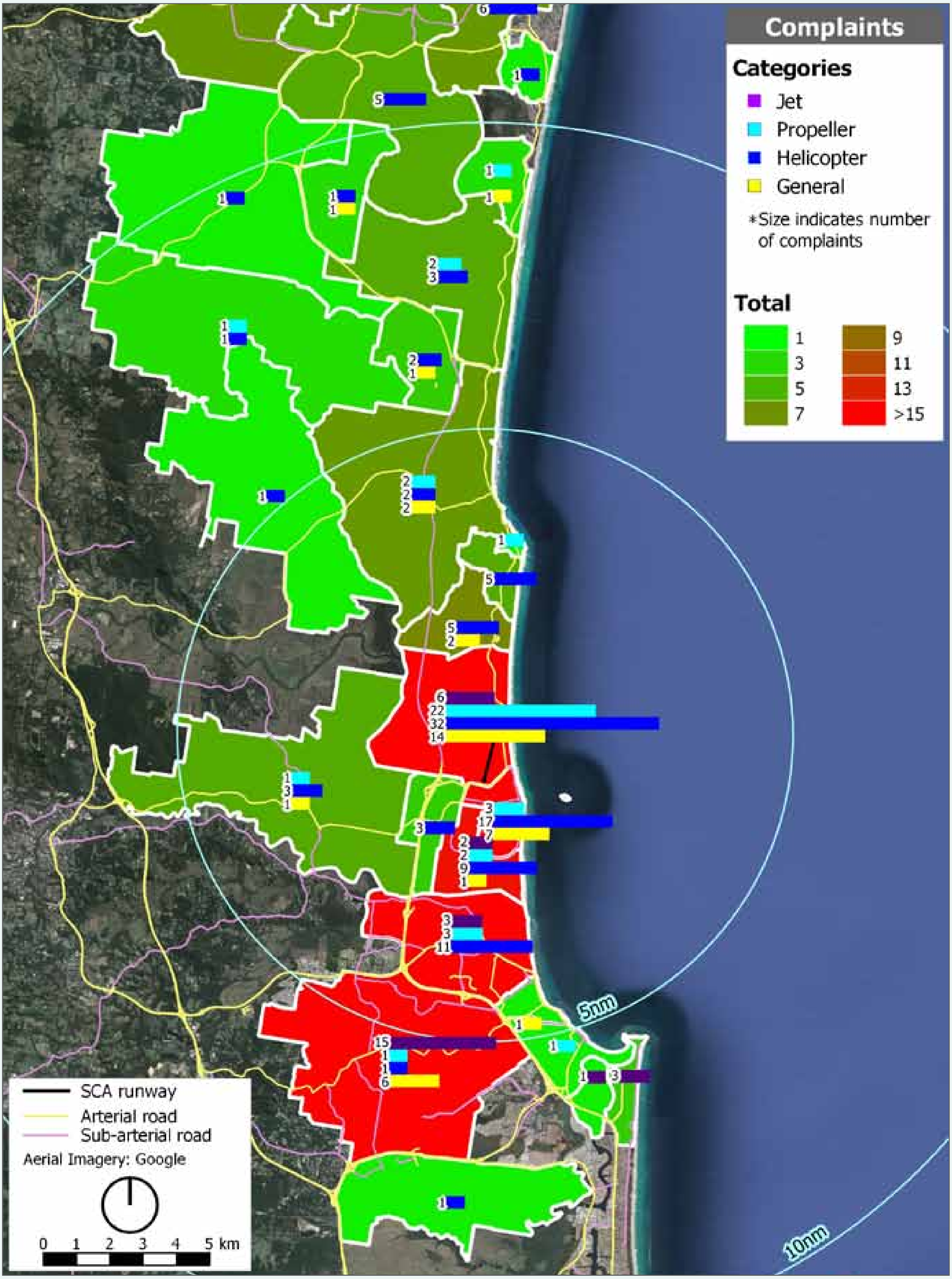


Figure 3.1e: Noise complaints by location – SCA January 2010 to March 2012



3.1.4 Measurement of ambient noise levels

The measurement of ambient noise levels is detailed in Chapter B15. Pertinent details are reproduced for correlation with predicted noise levels.

Ambient noise levels were monitored at 12 locations around the Airport, selected to cover the range of environments in the potentially-affected area. The locations are shown in **Figure 3.1f** and described in **Table 3.1a**.

Table 3.1b summarises the results, for "Day", "Evening" and "Night" periods as defined in the Queensland Environmental Protection Agency's document "Planning for Noise Control" (PNC). The summary values are:

- $L_{Aeq,Period}$ – the overall LAeq noise level measured over the assessment period
- $minL_{A90,1hr}$ – a measure of typical background noise levels.

The values shown in **Table 3.1b** are considered typical for the relevant areas.

Table 3.1a: Unattended and attended noise monitoring locations

Location	Description of Location
A	East of existing Runway 12/30 at 31 Sassifras Street, Mudjimba
B	South of existing Runway 18/36 at 20 Moorings Circuit, Twin Waters
C	South of existing Runway 18/36 across the river at 70 Broadwater Avenue, Maroochydore
D	South-east of existing Runway 18/36 across the Maroochy River on Level 1, 29 The Esplanade, Maroochydore
E	North of existing Runway 18/36 at 9 Joanne Street, Marcoola
F	North of existing Runway 18/36 at Palmer Coolum Resort, Coolum Beach
G	North-west of SCA, near the new Runway 13/31 centreline extension at 200 West Coolum Road, Coolum Beach
H	North-west of SCA, near the new Runway 13/31 centreline extension at 34 Twin Peaks Road, Bli Bli
I	Measured existing noise-sensitive fauna habitats in the Mount Coolum National Park, north of existing Runway 12/30
J	Measured existing noise-sensitive fauna habitats in the Mount Coolum National Park, south of existing Runway 12/30
K	On the side of existing Runway 18/36.
L	Measure existing noise-sensitive fauna habitats in the north-western area of current SCA

Table 3.1b: Noise measurement results

	$minL_{A90,1hr}$ (dBA)			$L_{Aeq,period}$ (dBA)		
Location	Day	Evening	Night	Day	Evening	Night
A	36	38	34	53	46	48
B	34	32	29	53	45	44
C	36	33	32	59	53	46
D	50	44	42	62	56	53
E	42	43	42	60	54	49
F	39	36	33	54	42	45
G	34	34[2]	29	49	45	44
H	36	33	31	52	41	46
I	36	33	32	59	53	46
J	36	35	31	57	60	46
K	40	39	37	63	57	46
L	35	38	35	58	53	47

Note:
1. *Day (7:00am – 6:00pm), Evening (6:00pm – 10:00pm), Night (10:00pm – 7:00am)*
2. *Evening background level at this location was influenced on all nights by the use of a generator. The daytime level has been assumed.*

Figure 3.1f: Unattended and attended noise monitoring locations

3.2
AIRCRAFT NOISE PREDICTION AND ASSESSMENT METHODOLOGY

3.2.1 Descriptors of aircraft noise impact

A number of units are available to describe the level of aircraft noise in an area, each being useful for a different purpose. The most important are described in the sections below.

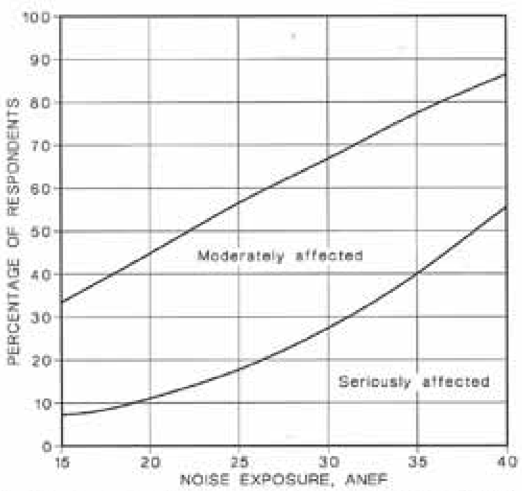
3.2.1.1 Australian Noise Exposure Forecast (ANEF)

For land use planning in Australia, the accepted measure of aircraft noise exposure is the ANEF. Australian Standard 2021 (the Standard) provides guidance on the acceptability of various areas for certain types of development, in terms of the ANEF level in the area. 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 the Standard recommends that new buildings should incorporate acoustic treatment to achieve specified internal noise levels.)

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, its 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. In addition, it is not used outside Australia, and is therefore not generally used in describing the findings of overseas research.

The relationship between ANEF values and the proportion of people "seriously affected" by the noise, as shown in **Figure 3.2a**, is nevertheless instructive.

Figure 3.2a: Relationship between ANEF and proportion of people "seriously affected" by aircraft noise (from Australian Standard 2021)



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

An "ANEF chart" is a set of land use planning contours for a specific airport which has been formally endorsed for technical accuracy by Airservices, after a period of public consultation. The production of an ANEF chart for all major airports is a requirement of the *Airports Act 1996* (the Act), although the Act does not apply to SCA. Queensland State Planning Policy December 2013 uses the ANEF to determine land use development surrounding strategic airports. The policy lists SCA as a strategic airport to which the policy is applicable. Furthermore, the current Sunshine Coast Planning Scheme 2014 also relies upon ANEF contours, through the specification of Australian Standards AS2021, to identify and establish land use controls over land deemed to be affected by aircraft noise.

Contours which are calculated using the same methods as ANEF contours, but which have not been formally endorsed, are known as Australian Noise Exposure Concept (ANEC) contours. This assessment presents ANEC contours (as distinct from ANEF) for various future airport options.

3.2.1.2 N70 and related units

A system of describing aircraft noise was developed by the Department of Transport and Regional Services (now known as the Department of Infrastructure and Regional Development or DIRD) through industry and community consultation. This system is oriented toward providing information in a form that can be understood by interested members of the public, and provides a comprehensive description of the nature of aircraft noise exposure at any point. The information is presented in terms of a number of descriptors, and is intended to provide sufficient detail to allow members of the public to understand for themselves the likely impact of the noise.

This system is described in the discussion paper "Expanding Ways to Describe and Assess Aircraft Noise" published in 2000 by DIRD. The most commonly-used noise descriptor in this system is N70 – the number of aircraft noise events per day exceeding 70 dB(A). (A-weighted decibels (dB(A)) are an expression of the relative loudness of sounds in air as perceived by the human ear.)

A noise level of 70 dB(A) outside a building would generally result in an internal noise level of approximately 60 dB(A), if windows are open to a normal extent. This noise level is sufficient to disturb conversation, in that a speaker would generally be forced to raise their voice to be understood. An internal aircraft noise level of 60 dB(A) is likely to also cause some words to be missed in speech from a television or radio. N70 values indicate the number of times per day when such events would occur.

If external windows are closed, thus providing greater noise attenuation through the façade, an internal noise level of 60 dBA would be experienced when the external noise level is approximately 80 dB(A). For a listener outside, thus receiving no noise attenuation from a building, the described effects would be experienced with an external aircraft noise level of approximately 60 dB(A).

Recently, the N60 descriptor has emerged as a useful metric for describing night time impacts from aircraft noise. The N60 describes the number of events exceeding 60 dB(A) external to a building, which would typically result in a maximum noise level of 50 dB(A) within a building having windows open to a normal extent. If this were the case in a room where a person is sleeping, a 50 dB(A) maximum noise level is considered to be close to the point at which noise may cause awakening. (At 50 dB(A) L_{Amax}, or an equivalent noise level in an alternate metric, approximately 3 per cent of aircraft noise events have been found to cause awakenings in field trials.) Hence N60, calculated for the night-time period, is considered to reasonably describe the number of events which may in some circumstances cause awakenings, and is adopted for assessment of night time noise from aircraft.

N70 and N60 contours can be calculated for different periods, indicating the average number of events experienced per day in that period. In this project, N70 contours are calculated for eight separate periods, representing combinations of:

- Day (7am-6pm) or Evening (6pm-10pm)
- Weekday or Weekend
- Summer or Winter.

N60 contours have been calculated for the "night" (10pm-7am) period with the above combinations.

N70 and N60 values have been calculated for a "busy day" scenario based on the available forecasts.

N70 contours are presented for 5 or more events per day. Recognising the greater sensitivity of the night period, N60 contours are presented for 2 or more events.

"Flight zone" diagrams, showing numbers of aircraft using flight paths within a nominated zone, have also proved to be useful in understanding and assessing noise impact and changes in noise impact.

3.2.1.3 Summary of aircraft noise metrics

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

- Aircraft noise levels
- Frequency of occurrence of aircraft noise events / number of events
- Duration of aircraft noise events
- The character of aircraft noise (eg. low frequency noise).

Table 3.2a demonstrates which of these factors are described by the aircraft noise metrics used in this assessment.

ANEF/ANEC considers each of the four factors identified and was 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.

Table 3.2a: 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 the number of aircraft noise events though the number of events cannot be deduced from the ANEF itself.	**Yes** ANEF is dependent on the duration of aircraft noise events though the duration of events cannot be deduced from the ANEF itself.	**Yes** ANEF is based on the EPNL which includes adjustments for annoying characteristics of aircraft noise.
N70/N60	**Partially** N70 and N60 consider events over a threshold level (eg. 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** N70 and N60 consider the number of events over a threshold level.	**No**	**No**
L_{Amax}	**Yes**	**No**	**No**	**No**
"Flight zone" diagrams	**No**	**Yes**	**No**	**No**

N70 and N60 can be readily understood as describing the number of events exceeding the nominated threshold. This threshold represents a level above which impacts would be expected (eg. conversation interrupted) and as such is an effective means of communicating 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.

L_{Amax} is effective in communicating the noise level of aircraft events. It fails to communicate any other information about aircraft noise and so is only useful when combined with supplementary information (eg. N70s 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.

It is clear that the assessment of impacts should consider each of these metrics.

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

3.2.2 Descriptors of aircraft noise impact required by Terms of Reference (TOR)

This section discusses the key requirements of the Project's TOR regarding the assessment of aircraft noise impacts and details how each is addressed in this assessment.

TOR Requirement:

> *Clearly show the land use planning implications for each of the nominated alternative runway operating configurations through the use of an Australian Noise Exposure Forecast (ANEF) analysis.*

ANEC contours have been produced, representing the impact on SCA's ANEF and hence land-use planning surrounding the airport.

TOR Requirement:

> *The public must be able to easily access:*
>
> - *where the flight paths for the new runway are likely to be, and the likely height of aircraft using those flight paths;*
> - *at what times aircraft are likely to use a flight path and in particular, usage during sensitive times–night, early morning, evening and weekends;*
> - *how often aircraft are likely to use each flight path; and*
> - *variations in activity levels from hour to hour, day to day, week to week, month to month and long-term trends.*

Flight path diagrams are presented for each scenario. These diagrams are annotated with the number of flights predicted to occur on each path for day, evening and night periods. Typical heights of aircraft are indicated in these diagrams also.

Flight path diagrams indicate the range of daily flights forecast to occur on each path. They also present the percentage of days that a flight path is not predicted to be used.

The consideration of operations and noise emissions for summer and winter seasons indicates the operational variation between seasons given the prevailing meteorological conditions.

The assessment considers an ultimate assessment year of 2040, as well as intermediate years 2016 and 2020 in order to demonstrate the long term trends of airport operations.

Forecast schedules are also presented showing the distribution of flights throughout the day, including during sensitive time periods.

TOR Requirement:

> *The public must be able to easily access noise levels from individual flights to indicate the extent to which the noise decays with distance from the airport and height above ground level.*
>
> *Single event decibel dB(A) levels for all aircraft types on all flight paths, including an assessment of the impact of variations in flight paths on maximum dB(A).*

Single-event maximum noise level contours are presented for typical operations of each scenario. Maximum noise level contours are presented for each aircraft and scenario. These plots are presented by operation (arrival and departure) to clearly demonstrate the noise levels that are predicted for distinct operations. Typical heights of aircraft are presented in the flight path diagrams.

TOR Requirement:

> *N70s–the number of noise events per unit time above 70 dB(A); this information must include scenarios showing variations in noise patterns due to seasonal and meteorological factors.*

N70s are presented for all scenarios, summer and winter, for day and evening time periods. To aid in the understanding of aircraft noise events exceeding 70 dB(A), N70s are presented separately for fixed-wing and helicopter as well as combined operations.

TOR Requirement:

> *N60–the number of noise events per unit time above 60 dB(A) for night-time operations as this is relevant to the indoor sound levels for sleeping areas as per AS2021.*

N60s are presented for all scenarios, summer and winter, for the night time period. To aid in the understanding of aircraft noise events exceeding 60 dB(A) at night, N60s are presented separately for fixed-wing and helicopter as well as combined operations.

TOR Requirement:

> *[Single-event maximum noise level contours, N70s and N60s] must be provided for the current situation and also for 20 years from the operational date, to present a clear picture of the potential changes that may be brought about in the acoustic environment.*

and

> *Generation of Australian Noise Exposure Concept (ANEC) for each of the alternatives with a planning horizon of 20 years.*

ANEC, single-event maximum noise level, N70 and N60 contours are presented for both the "New Runway" and "Do Minimum" (see **Section 3.2.3**) alternatives at the anticipated year of opening (2020) and also a 20 year planning horizon (2040). Contours presenting the existing (2012) noise exposure and exposure during construction (2016-2020) are also presented.

TOR Requirement:

> *Estimation of the number of people, houses, schools, hospitals, community facilities and other land use types in each [ANEC] contour.*

Estimation of the number of dwellings, schools, hospitals, community facilities and other land use types in each ANEC contour has been undertaken.

Estimation of the number of dwellings within N70 and N60 contours has also been undertaken.

3.2.3 Project stages

From the point of view of aircraft noise impacts, four project stages can be identified, as follows.

- **Existing operations (2012-2016[1]).** No significant changes to airport operational procedures or aircraft flight paths are envisaged until 2016. Subject to funding and approvals, construction could commence in 2016 and would begin with site preparation and fill placement. Existing operations would continue in this stage until commencement of sand pumping works, nominally in 2016, which would require the closure of existing Runway 12/30. Existing operations have been represented based on historical data for the year 2012 – referred as scenario "**Existing 2012**".
- **New Runway 13/31 construction (2016-2020).** In this period existing Runway 12/30 will be closed, resulting in increased operations on the existing main Runway 18/36. Post-2012 Required Navigation Performance-Authorisation Required (RNP-AR)[2] procedures have been developed for Runway 18/36 and are expected to be progressively adopted by RPT jets on arrival to SCA. By 2017 all RPT jets are expected to have adopted these procedures. This scenario (representing 2016-2020) has assumed all RPT jet arrivals will use the developed RNP-AR procedures. This scenario is referred to as "**New Runway Construction 2016**" (though the new runway is not yet built, this scenario will only eventuate if the new runway is to be built – hence it is considered a "New Runway" scenario as it is a consequence of the Project). During the 4 year construction period General Aviation will need to use RWY 18/36. There will be a small percentage of time when General Aviation will not be able to land on RWY 18/36 due to weather conditions. This situation would either delay their landing/take off or would mean they may choose to utilise other local aerodromes.
- **2020[1].** This stage represents aircraft operations immediately after the opening of the new Runway 13/31, which would become the main runway. Consequently, a significant redistribution of operations to the new Runway 13/31 is predicted.
- **2040.** This stage represents aircraft noise impacts 20 years after the opening of the new Runway 13/31, taking account of projected growth in air traffic in this period.

In this chapter, the descriptors of aircraft noise impact, which are outlined in **Section 3.2.1**, are considered for each of these four project stages.

For comparison, noise impacts in 2020 and 2040 are calculated for both "New Runway" and the "Do Minimum" cases.

The "Do Minimum" case assumes the existing runways and operating procedures, and a forecast of future aircraft movements at the airport. This case assumes that necessary actions will be taken to permit the continued use of Runway 18/36 for classes of aircraft that currently operate on this runway.

3.2.4 Dwellings data and analysis

Dwellings data were obtained from SCC via land-use records. The data contained one entity for each land-use (i.e. apartment blocks were represented by multiple entities within the data). The data was compared with dwellings counts from Australian Bureau of Statistics (ABS) 2011 Census data and found to provide reasonable agreement. **Figure 3.1b** presents the dwelling data.

The data was verified against aerial photography in the area of interest (i.e. within ANEC, N70 and N60 contours). In rural-residential areas large parcels of land were identified as having a residential land use. To permit greater accuracy in the identification of dwellings within each noise contour, the locations of dwellings upon these large lots were identified from aerial photography and the dwellings data was amended to reflect these locations (i.e. impacts were determined on the dwelling, not the land).

An analysis using GIS software was undertaken to determine the number of dwellings within each noise contour. 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 3.2b presents an example of the analysis.

1 *Timing subject to funding and approvals.*
2 *RNP is a type of navigation that allows aircraft to fly a specific path between two 3D-defined points in space.*

Figure 3.2b: Example dwellings data overlaid with ANEC contours

3.2.5 Aircraft noise prediction overview

This section provides details of the aircraft noise prediction methodology.

The object of the noise modelling process is to calculate values of the noise descriptors listed in **Section 3.2.1** for current SCA operations, and to predict values for all relevant future scenarios.

A wide range of factors affect the potential noise impact from operations at SCA, and hence a complex modelling process is required to take all these factors into account. **Figure 3.2c** shows the process in diagramatic form.

For each operational scenario modelled, a set of airport operating modes is defined, together with 'selection rules' defining the conditions under which each mode would be selected by Air Traffic Control (ATC).

The rules take account of weather conditions, the number of departures and arrivals occurring at the time, and the 'priority' assigned to each mode – generally a reflection of the desirability of that mode in terms of noise abatement.

A detailed schedule of predicted 'busy day' operations is used, together with historical weather data, to determine the pattern of mode usage which would result for a typical busy day in the assumed scenario. Aircraft operating in these modes are then assigned to tracks according to the runway in use, the type of aircraft and the location of the airport of origin or destination. Finally, a pre-calculated 'noise map' gives the pattern of noise exposure for each aircraft type on each of these tracks.

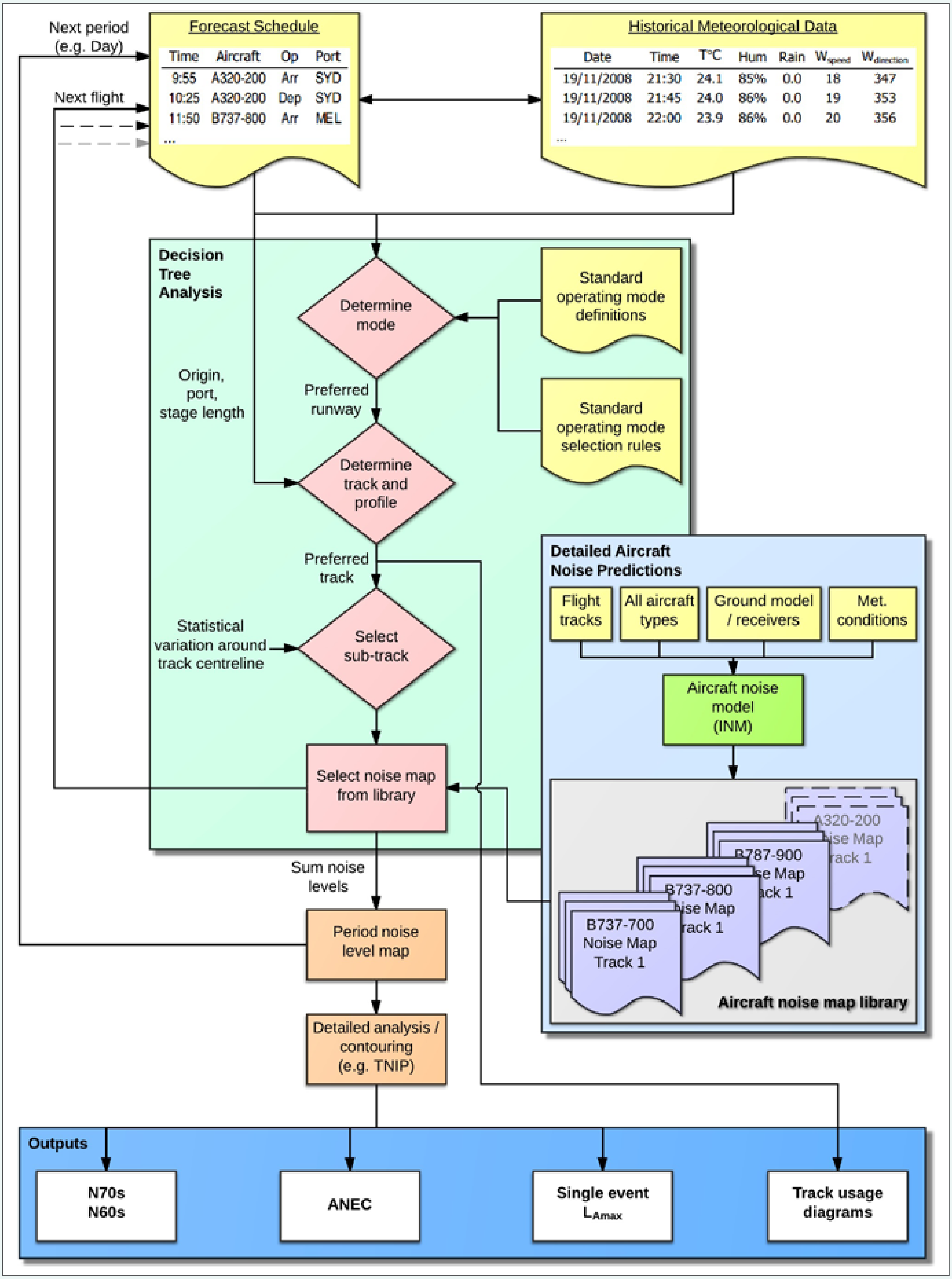
The 'noise maps' for each operation are summed or combined in various ways to produce the descriptors of overall noise exposure.

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 of these inputs is discussed in the following sections.

Figure 3.2c: Aircraft noise prediction methodology overview



3.2.6 Validation of the aircraft noise model

The Integrated Noise Model (INM) was used to calculate noise levels for each operation considered in the assessment. INM is produced by the US Federal Aviation Administration and has been validated in numerous studies.

The overall aircraft noise modelling process for this assessment was validated by comparing L_{Amax} and L_{Aeq} noise metrics with measured noise level data. Given their proximity to the airport and runways, the following assumptions are appropriate for noise monitoring locations A, E, K and L (refer to **Figure 3.1f**):

- The majority of regular maximum noise levels (L_{Amax}) at these locations are likely due to aircraft operations.
- The L_{Aeq} noise level is likely dominated by aircraft noise.

A comparison between measured and modelled L_{Amax} noise levels is possible and generally supports the noise prediction model (INM). A comparison of measured and modelled L_{Aeq} noise levels is useful in validating the modelling as a whole; i.e. assuming predicted noise levels for each operation are valid, then validating L_{Aeq} noise levels confirms the appropriateness of operations which have been modelled. (Refer **Table 3.2b**.)

The modelled levels are consistent with the measured levels[3] and as such validate the noise modelling process.

3.3 FIXED-WING PREDICTION METHODOLOGY

3.3.1 Aircraft operations assumed in calculations

Projections of aircraft movements for future years are provided in Chapter A2 and comprise forecast schedules of RPT for future operating scenarios.

GA movement numbers were also forecast by LEAPP. To facilitate noise modelling, forecast schedules were extrapolated from existing Airservices data (see **Section 3.3.3.3**), using the forecast movements provided by LEAPP.

All forecast schedules, whether developed by Wilkinson Murray or by external consultants, were developed as accurately as possible given the available data. However, these schedules were developed solely to facilitate noise modelling and may not precisely represent future operations. Any foreseeable error in the schedules' generation is not considered to significantly impact the outcomes of noise modelling. Hence they are considered sufficient for the purpose of this assessment.

3.3.2 Aircraft types used in calculations

Projections of RPT aircraft types for future years were provided by LEAPP. **Table 3.3a** summarises the aircraft types projected, their corresponding aircraft class and the standard aircraft types used to represent the aircraft noise in INM (see **Section 3.3.6**).

The aircraft types shown in **Table 3.3a** and **Table 3.3b** were used for noise level calculations in all scenarios. They were selected to be representative of the aircraft currently using the airport, and can also be used to represent future aircraft types. Of course, the noise emission characteristics of future aircraft types are not known, but it can be reasonably assumed that they will not be higher than those of current equivalent types, and in general they are expected to be lower. Hence, the present procedure of representing future aircraft types by current aircraft types is considered conservative.

Within the current aircraft fleet, it can be expected that older-generation aircraft will be phased out over time and replaced by newer-generation aircraft from within the list shown in **Table 3.3a**. The assumed schedule for this replacement is shown in **Table 3.3d**.

3 Modelled levels represent a yearly average whereas the majority of measurements were undertaken during a two week period. There exists potential for operations in a short period such as two weeks to be inconsistent with average operations over the entire year and as such some variation is expected.

Table 3.2b: Comparison of modelled and measured noise levels

Location	L_{Amax} dB(A)			$L_{Aeq,Day}$ dB(A)	
		Modelled			
	Typically measured	B737800 departure	B737800 arrival	Typically measured	Modelled
A	80-90	85-90	62	53	52
E	85-95	90-92	95	54	57
K	90-100	95	85	57	60
L	85-95	84	70	53	55

Table 3.3a: Fixed-wing RPT aircraft types modelled

Aircraft type	Aircraft class	INM model type
A320-200	Large narrow-body	A320-232
A350-800	Medium wide-body	A330-343
A350-900	Medium wide-body	A330-343
ATR-72	Large turbo-prop	DHC830
ATR72-500	Large turbo-prop	DHC830
B737-600	Large narrow-body	737700
B737-700	Large narrow-body	737700
B737-800	Large narrow-body	737800
B737-900	Large narrow-body	737800
B787-800	Medium wide-body	B7878R
B787-900	Medium wide-body	B7878R
DHC-8	Medium turbo-prop	DHC830
Q400	Medium turbo-prop	DHC830

Table 3.3b: Fixed-wing GA aircraft types modelled

Aircraft type	Aircraft class	INM model type
C510	Small jet	CNA510
C550	Small jet	CNA55B
C560	Small jet	MU3001
AT76	Small turbo-prop	DO328
BE20	Small turbo-prop	CNA441
BE30	Small turbo-prop	CNA441
BE76	Twin-engined prop	BEC58P
C172	Single-engined prop	CNA172
C182	Single-engined prop	CNA182
C208	Small turbo-prop	CNA208
C303	Twin-engined prop	BEC58P
C310	Twin-engined prop	BEC58P
C414	Twin-engined prop	BEC58P
DH8A	Medium turbo-prop	DHC830
DH8C	Medium turbo-prop	DHC830
P68	Twin-engined prop	CNA441
PA31	Twin-engined prop	PA31
PA46	Single-engined prop	GASEPV
PC12	Small turbo-prop	CNA208
SR22	Single-engined prop	GASEPV

Table 3.3c: Distribution of RPT fixed-wing aircraft types within classes

		Year					
				2020		2040	
Aircraft class	**Aircraft type**	**2012**	**2016**	**Do minimum**	**New runway**	**Do minimum**	**New runway**
Medium wide-body	B7878R	0%	0%	0%	13%	0%	9%
	A340-642	0%	0%	0%	0%	0%	9%
Large narrow-body	737700	0%	9%	7%	6%	10%	9%
	737800	21%	26%	29%	25%	36%	30%
	A320-232	79%	51%	45%	37%	39%	30%
Large turbo prop	DHC830	0%	14%	19%	19%	15%	13%

3.3.3 Existing airport operations – fixed-wing aircraft

3.3.3.1 Existing airport operating modes

Currently SCA operates in one of two modes:

- "18" mode, in which jet aircraft arrive from the north and depart to the south on the main runway, with a very small number of operations, by GA, on the cross runway in the south-easterly ("12") direction
- "36" mode, in which jet aircraft arrive from the south and depart to the north on the main runway, with a very small number of operations, by GA, on the cross runway in the north-westerly ("30") direction.

These modes are only available under certain weather conditions. For "18" and "36" modes, the meteorological restrictions are:

- With a dry runway, all aircraft operations are restricted to a maximum downwind component of 5 knots, and a maximum crosswind component of 20 knots
- With a wet runway, no downwind component is allowed. (In modelling this was replaced with a maximum component of 1 knot, to avoid anomalous behaviour when the wind is almost at right angles to the runway.)

Both modes have operational capacity limits exceeding the current number of presenting aircraft in any time period. This is also true for all future scenarios addressed in this study. That is, all airport modes can in principle be used at any time, provided they are allowed by the meteorological conditions.

To facilitate noise modelling, these two "base" modes – which are based on RPT – have been expanded to six modes, comprising all combinations of GA operations on the main and cross runways. These modes are presented in **Figure 3.3a**.

3.3.3.2 Existing rules for mode selection

At all times, where more than one of the above operating modes is available on the basis of meteorological constraints, the mode to be used is selected in order of preference from Mode 1 to Mode 6.

The current procedure for changing modes at SCA is best described as "passive". That is, if the airport is currently operating in one mode and a higher-priority mode becomes available, a change to the higher-priority mode is not necessarily implemented immediately. In general, a change to a higher-priority mode is implemented only if the current mode becomes unavailable, or will clearly become unavailable in a short time.

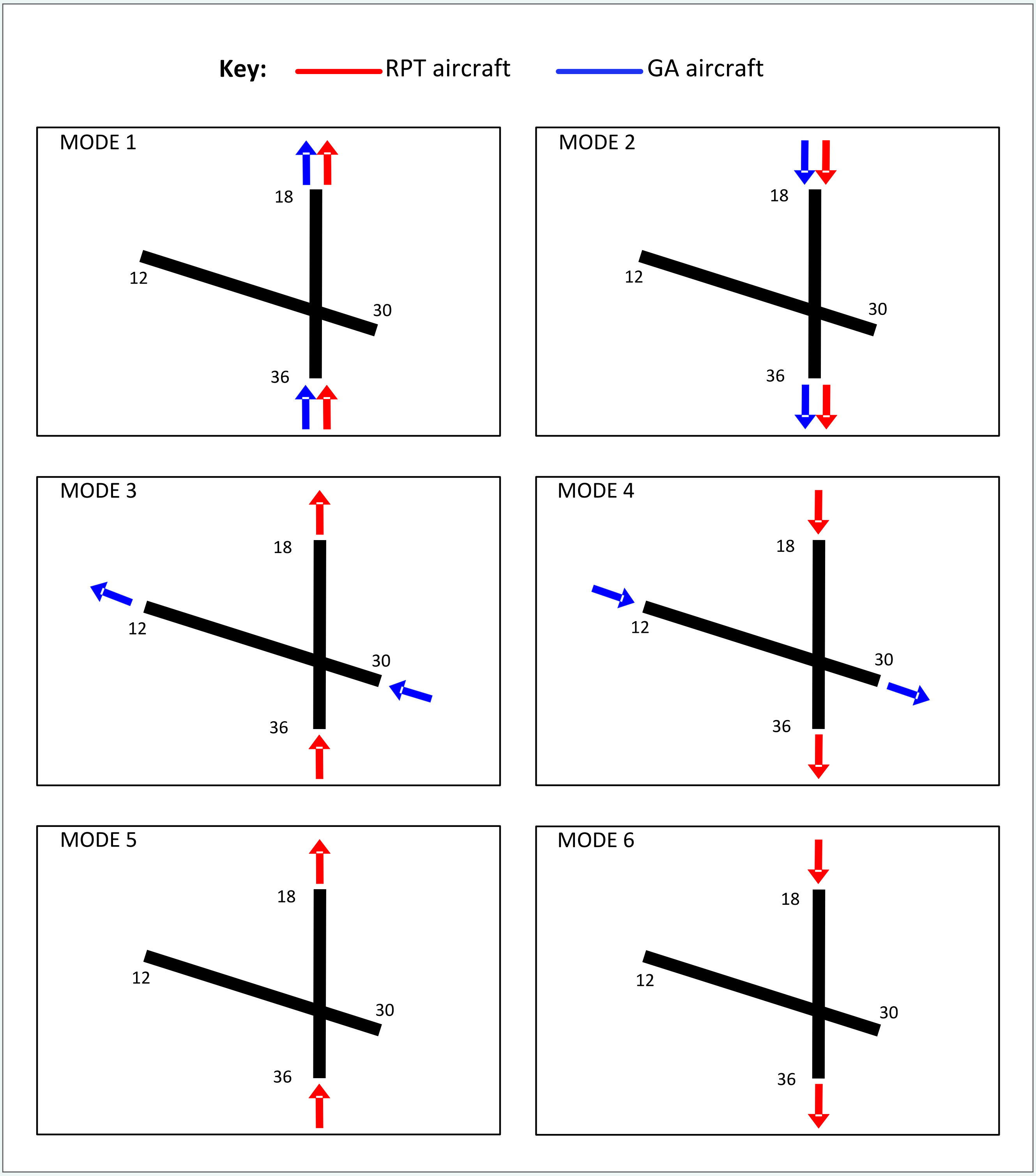
This is understood to approximately represent current practice by ATC.

3.3.3.3 Existing fixed-wing flight tracks

In this report the usual convention is applied in distinguishing between an aircraft "flight path", which represents a three-dimensional trace of an aircraft's position while performing an operation, and a "flight track", which represents 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 below.

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, actual tracks 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 the anticipated future movements of aircraft, based on the current spread of tracks around the nominal STARs and SIDs. It is important to note, however, that this is a "best-fit" approximation only for future movements. While this approach is considered reasonable and current best-practice, the actual distribution of aircraft around a nominal track will vary from day to day, week to week and month to month.

Figure 3.3a: Sunshine Coast Airport modes – Existing scenario



Existing aircraft flight tracks were determined by analysis of all flight tracks recorded by Airservices over two separate six month periods – November 2011 through April 2012; and June 2012 through December 2012. These were chosen to allow comparison of tracks used in different seasons. However, preliminary analysis indicated no systematic differences between the tracks flown by aircraft in these two periods and hence in the analysis presented below data from all months are aggregated.

The data contained 12,768 flights which had been matched to flight plans by Airservices. Additionally 103,268 flights were unable to be matched to flight plans (noting that some of these flights through SCA airspace were not related to SCA – e.g. overflights at high altitudes).

"Matched" flights contain information such as the port of origin/destination, aircraft type and operation. The majority of forecast RPT jet flights were contained within the "matched" dataset (87 per cent). This dataset was used in the derivation of jet tracks.

"Unmatched" flight data was filtered by proximity, speed and altitude to eliminate those flights which were not believed to have been related to SCA. Further filters divided the "unmatched" data into fixed-wing and helicopters. The filtered "unmatched fixed-wing" data was combined with the "matched" data for propeller aircraft in the derivation of flight tracks for propeller aircraft. The filtered "unmatched helicopter" data was combined with the "matched" data for helicopters in the derivation of flight tracks for these aircraft.

The purpose of this analysis is to identify tracks that are associated with specific types of aircraft operations, allowing the total number of operations on the various tracks to be predicted for future years. Aircraft operations were classified by:

- Aircraft category (jet or non-jet)
- Operation (arrival or departure).

The analysis process is illustrated in **Figure 3.3b** to **Figure 3.3h**. As an example, the track analysis is shown for jet departures.

- **Figure 3.3b** demonstrates the analysis of flight densities from all flights in the dataset. This analysis permits the identification of typical flight tracks surrounding the airport. The density is expressed as a percentage of the total operations in the dataset.
- **Figure 3.3c** shows the above analysis with the dataset filtered to include only jet arrivals. Prominent jet arrival tracks become evident, and these are later represented as track groups.
- **Figure 3.3d** presents the allocation of flight records into groups corresponding with the concentration of flight tracks in one area. (Different track groups are represented by different colours.)

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 five nominal tracks were assigned for each group:

- A central track, representing 30 per cent of all tracks
- Tracks on either side of the centre, each representing 22 per cent of all tracks
- Outlying tracks on either side, each representing 13 per cent of all tracks.

(In some cases where there were very few recorded tracks, only three or, rarely, only one nominal track was identified.)

The locations of these nominal tracks were determined directly from the recorded tracks, using custom-developed software. **Figure 3.3e** demonstrates the construction of discrete flight tracks to represent the spread of tracks in the existing dataset. These tracks can then be modelled.

Figure 3.3f to **Figure 3.3h** demonstrate this process for departures.

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.

The process described above was repeated for all combinations of aircraft type, operation and runway. This results in a total of 535 and 66 nominal tracks describing existing fixed-wing and helicopter operations respectively.

3.3.3.4 Existing fixed-wing height-vs-distance profiles

The INM program which is used for calculation of aircraft noise levels has "standard" height-vs-distance profiles for all aircraft types on approach and departure. On departure, different profiles are assigned for different "stage lengths", representing the distance to the port of destination. All fixed-wing operations were modelled with "standard" INM height-vs-distance profiles.

Figure 3.3b: Analysis of flight density for all fixed-wing 2012-2013

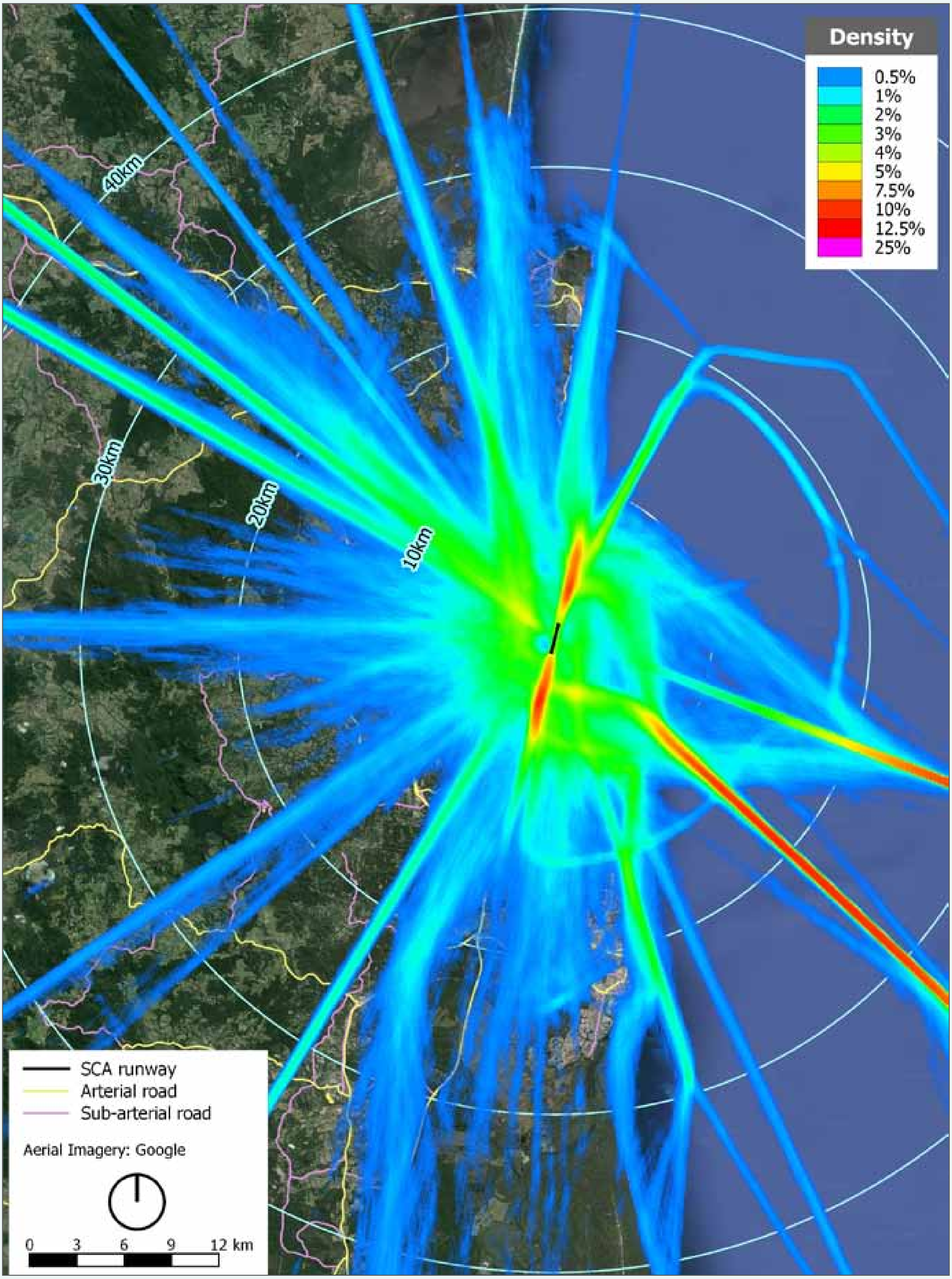


Figure 3.3c: Analysis of flight density for jet arrivals 2012-2013

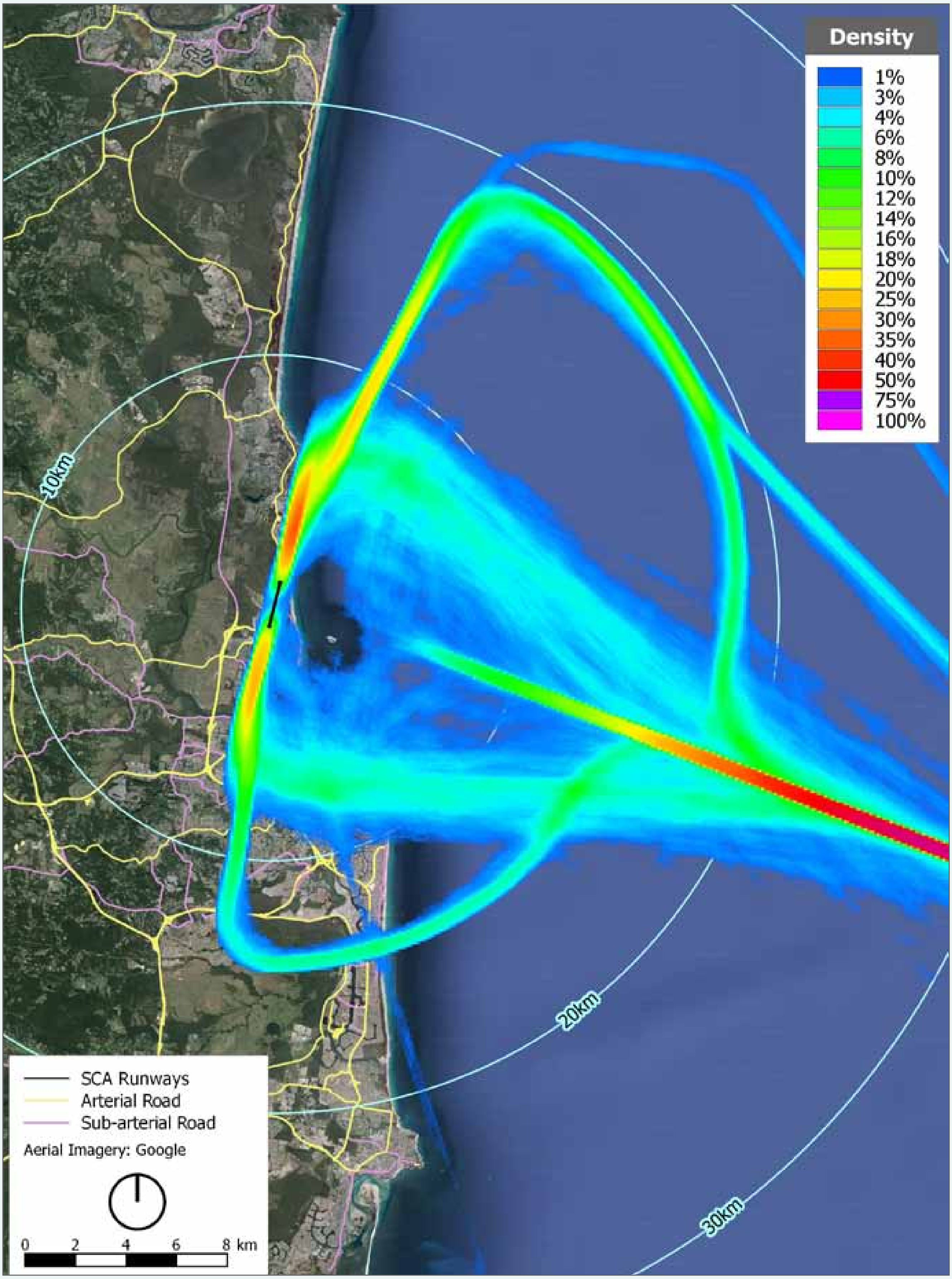


Figure 3:3d: Classification of tracks into groups – jet arrivals – existing

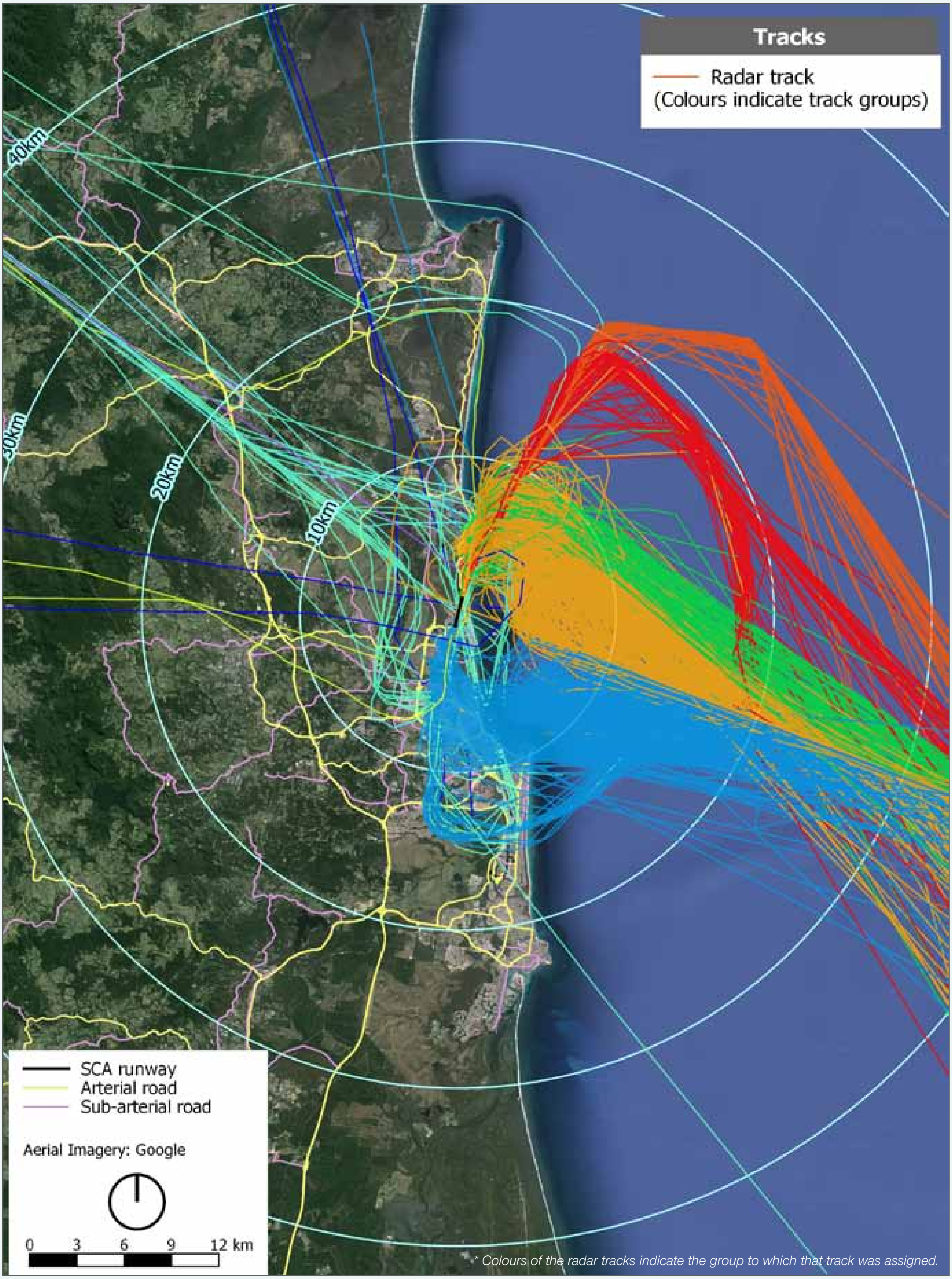
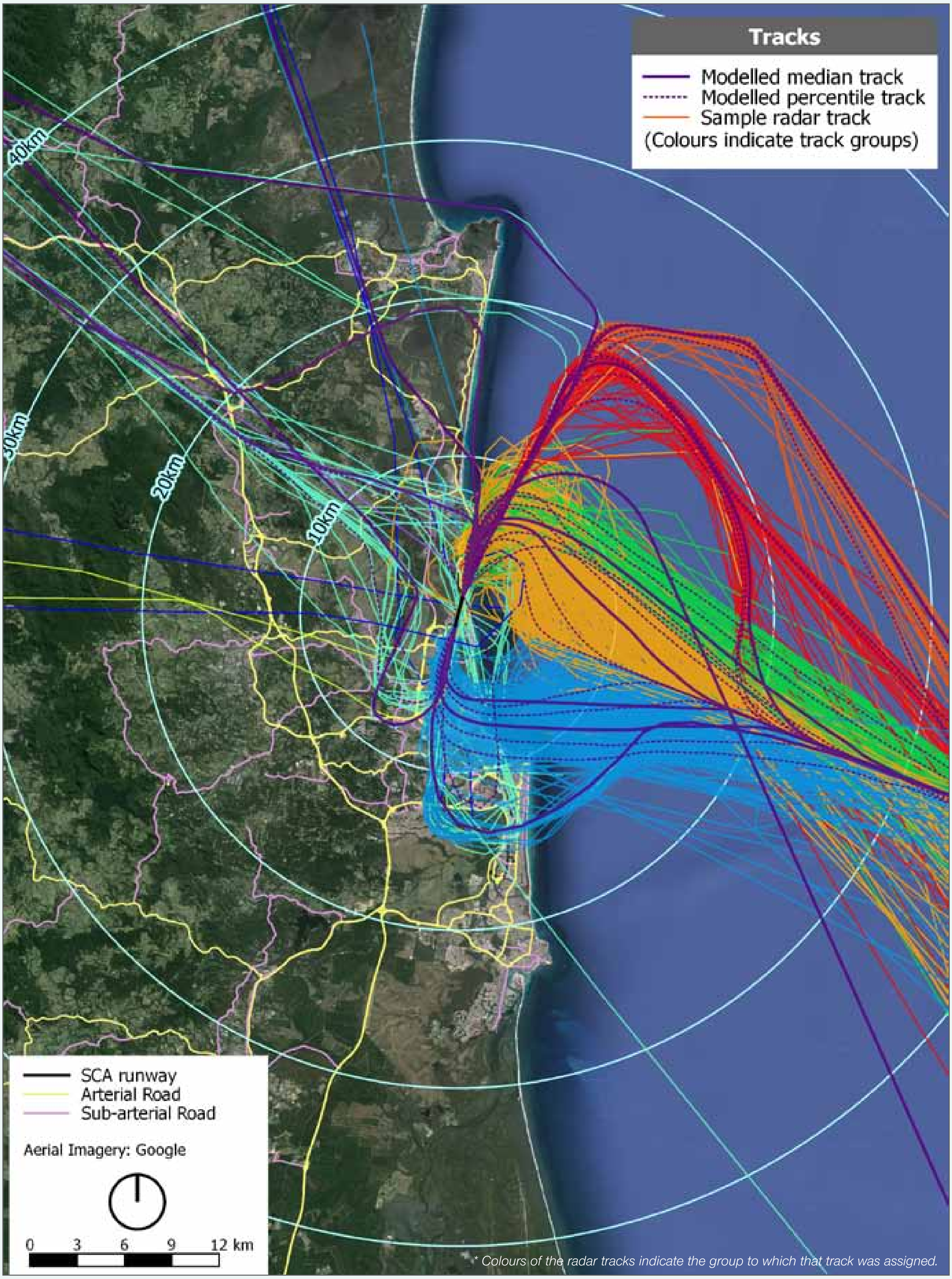


Figure 3.3e: Construction of tracks to represent the spread of tracks in each group – jet arrivals – existing and modelled



* Colours of the radar tracks indicate the group to which that track was assigned.

Figure 3.3f: Analysis of flight density for jet departures 2012 – 2013

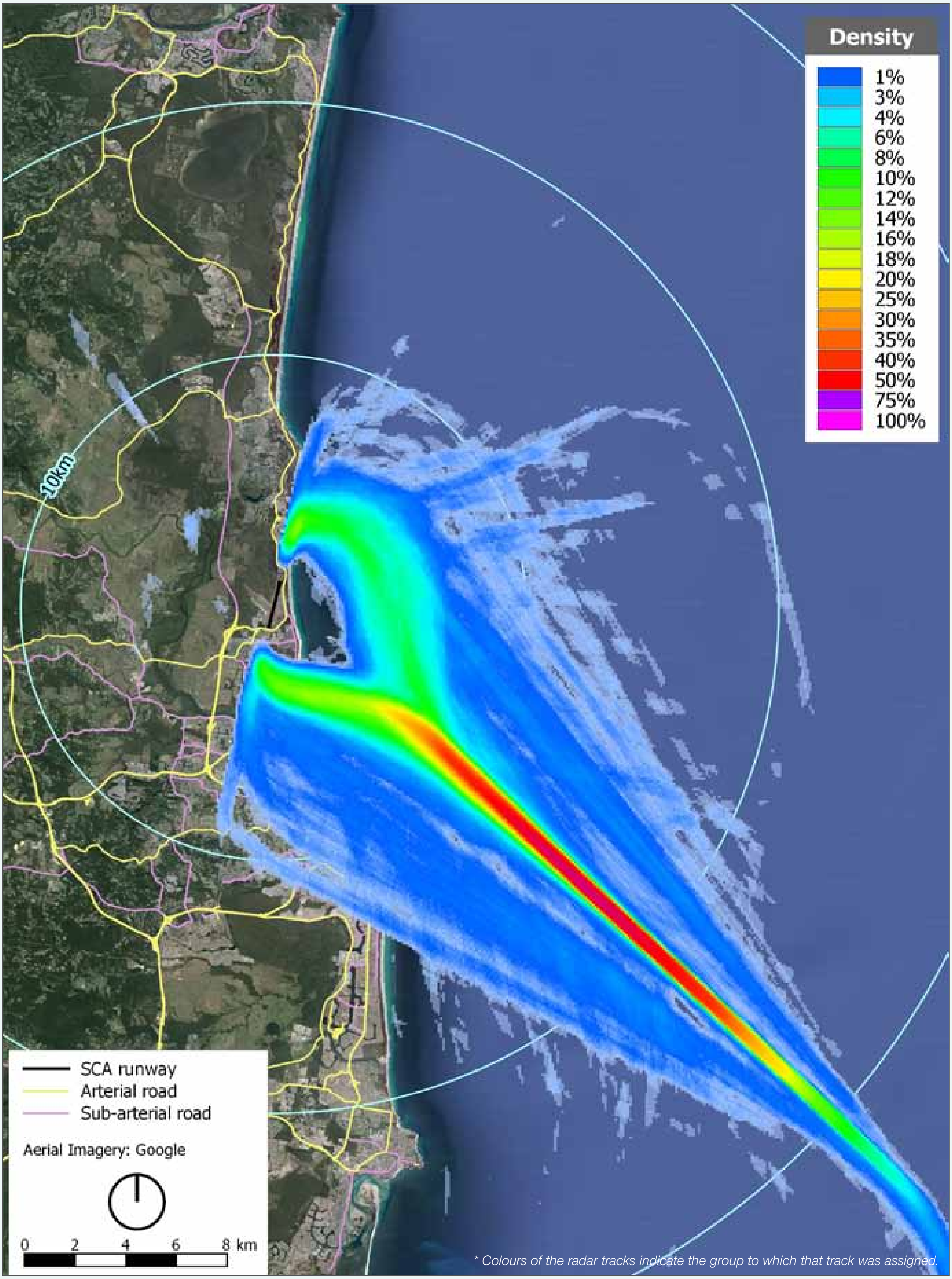


Figure 3.3g: Classification of tracks into groups – jet departures – existing

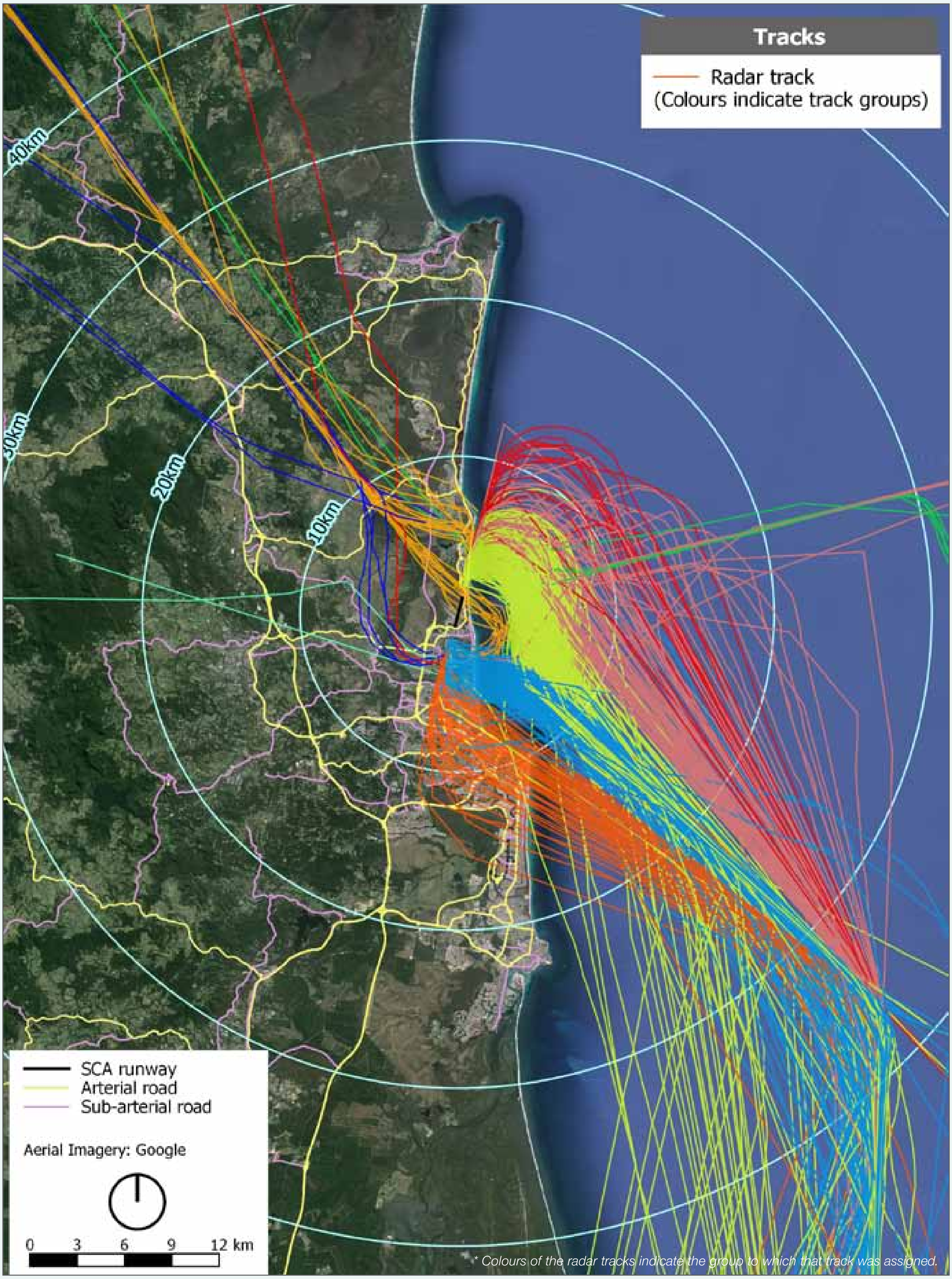
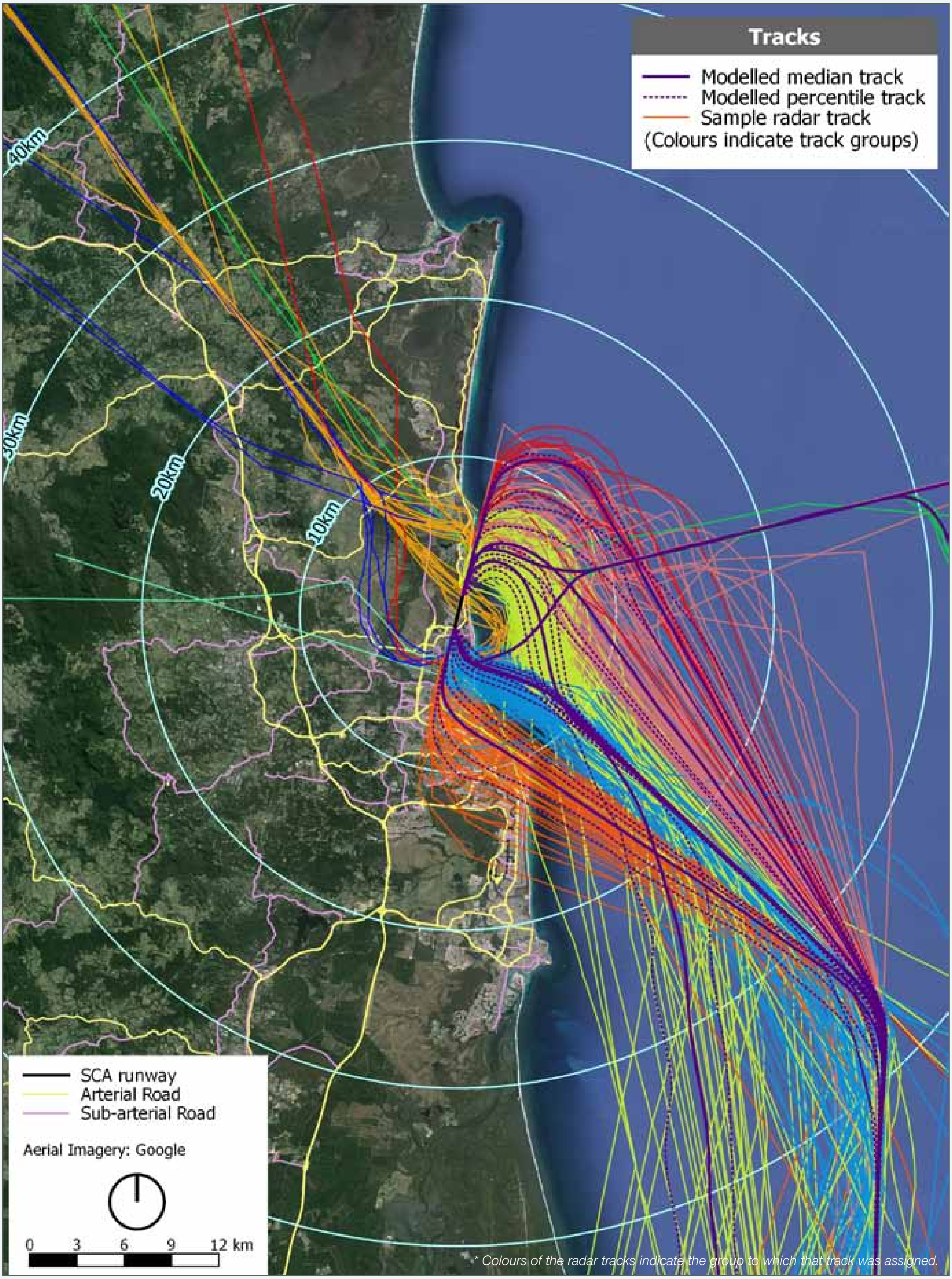


Figure 3.3h: Construction of tracks to represent the spread of tracks in each group – jet departures – existing and modelled



3.3.4 Operations in the period 2016-2020 – fixed-wing aircraft

Airport operational procedures in the period 2016-2020, when the cross Runway 12/30 would be closed, would be similar to existing operations. In modelling, the following differences were incorporated.

- In 2016-2020, no operations are allowed on the cross Runway 12/30. Aircraft currently using this runway are assigned to Runway 18 or 36, using existing tracks for aircraft in that category.

With the above exception, operational modes, and mode selection rules, are the same as for existing operations.

Figure 3.3i presents these operating modes.

3.3.5 Operations with the Project – fixed-wing

Proposed operational procedures with the Project in place are described in LEAPP's "Airspace Design Concepts" (Chapter D2). This section provides a summary of those procedures, with emphasis on changes which are relevant for assessment of noise impacts. Where information necessary for the noise assessment is not detailed in LEAPP's report, this has been determined through consultation with SCA and LEAPP and is detailed below.

Significantly, the new runway will permit wide-bodied jets which are currently prohibited by the existing runway.

3.3.5.1 Future airport operating modes

With the Project, standard airport operating modes will differ from current operating modes (refer **Figure 3.3j**). All narrow bodied and wide bodied jet aircraft will utilise the new 13/31 runway. GA aircraft will also predominantly utilise 13/31, except where restricted due to meteorological conditions, whereby they will utilise the existing 18/36 runway. Theoretical modes available for airport operations, which have been considered in modelling, are:

Mode 1: In this mode, arrivals of RPT and GA aircraft occur on the new Runway 13 with approach from the north-west of the airport. Departures of RPT and GA aircraft occur on new Runway 13 over the coast.

Mode 2: This mode is similar to mode 1, however GA aircraft are forced to use existing Runway 18 due to wind limitations. Arrivals and departures of RPT aircraft are as per mode 1, occurring on Runway 13.

Mode 3: This mode is similar to mode 2, however wind restrictions require arrivals and departures of GA aircraft to occur on existing Runway 36 rather than Runway 18. Arrivals and departures of RPT aircraft occur on new Runway 13.

Figure 3.3i: Sunshine Coast Airport modes – 2016 scenario with Runway 12/30 closure

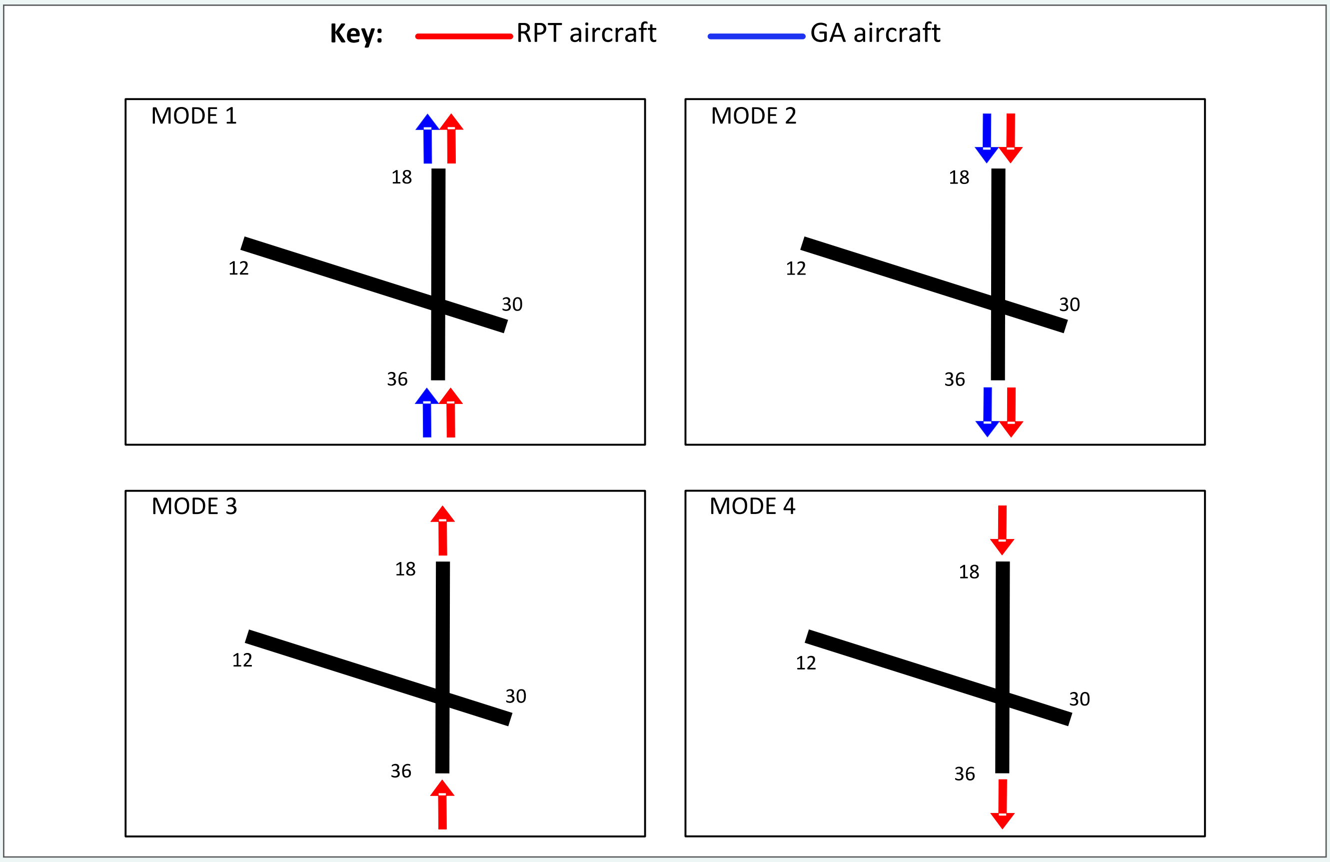
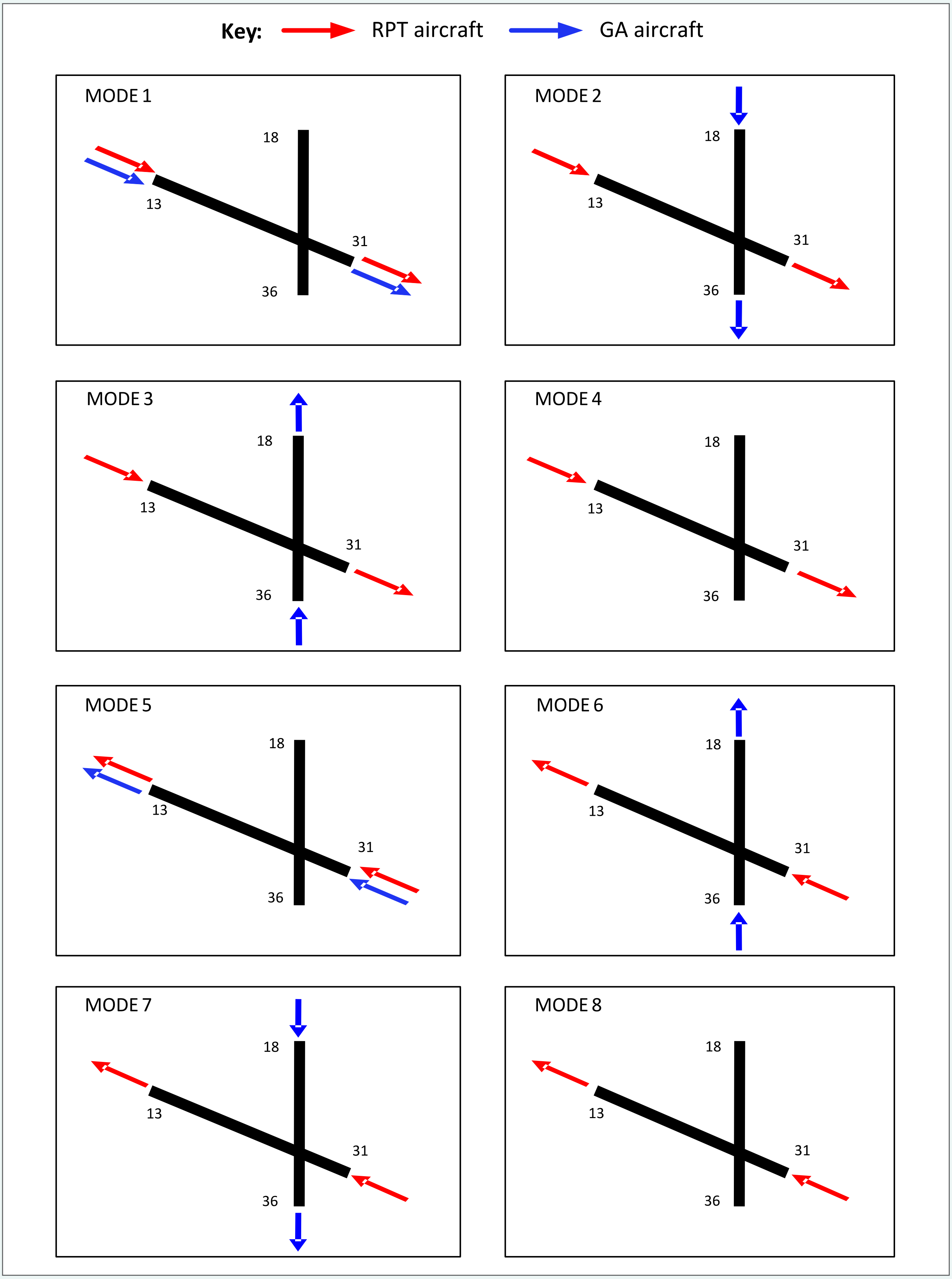


Figure 3.3j: Sunshine Coast Airport modes – New Runway scenario



Mode 4: In this mode arrivals and departures of RPT aircraft occur along new Runway 13. No operations of GA aircraft are allowed for due to weather restrictions.

Mode 5: In this mode, arrivals of RPT and GA aircraft occur on the new Runway 31 with approach from the south-east of the airport. Departures of RPT and GA aircraft occur on new Runway 31 to the north-west of the airport.

Mode 6: This mode is similar to mode 5, however GA aircraft are forced to use existing Runway 36 due to wind limitations. Arrivals and departures of RPT aircraft occur on new Runway 31.

Mode 7: This mode is similar to mode 6, however wind restrictions require arrivals and departures of GA aircraft to occur on existing Runway 18 rather than Runway 36. Arrivals and departures of RPT aircraft occur on new Runway 31.

Mode 8: In this mode arrivals and departures of RPT aircraft occur along new Runway 31. No operations of GA aircraft are allowed for due to weather restrictions.

Reciprocal modes (departures in the opposite direction to arrivals) are theoretically available and would not be prohibited due to capacity restrictions. However, the only time they would be available would be at night and consequently they would not be relevant in the near future (no night flights are forecast in 2020 and only 2 departures are forecast in 2040). These are not desired by ATC or SCA due to increased difficulties associated with the management of air traffic and the requirement to maintain appropriate aircraft separations. Therefore, at this stage reciprocal modes have not been considered further.

3.3.5.2 Future rules for mode selection

Rules for determining the availability of each of the modes presented in **Section 3.3.5.1** are similar to those for the corresponding existing modes. Differences in the mode allocation from existing runway operations include the following:

- Jet aircraft are allocated to new Runway 13/31 only
- GA aircraft are prioritised to new Runway 13/31, except where weather conditions dictate moving these aircraft to existing Runway 18/36.

Allocation of modes is based on a priority system. The priorities of each mode have been determined through consultation with SCA and LEAPP. By convention in this report the modes have been labelled in order of priority; i.e. Mode 1 is the highest priority mode and Mode 8 is the lowest.

Runway 13 is given arrival and departure priority. This allows arriving aircraft to approach at low altitudes over the farmland to the north-west, where there are fewer noise-sensitive receivers. It also facilitates departure over the coast. This results in a residential area at the end of Runway 13 (south-east of the runway; Marcoola and Mudjimba) being directly overflown by the majority of departures. From a noise perspective, departures are preferred to arrivals because the noise footprint is smaller, largely because departing aircraft typically climb at a steeper rate than they descend on approach.

3.3.5.3 Future aircraft flight tracks

Aircraft tracks will be significantly changed as a result of the new runway. All RPT and jet operations will use Runway 13/31, with only a small proportion of GA aircraft using Runway 18/36 when weather does not permit their operation on Runway 13/31.

Figure 3.3k and **Figure 3.3l** present the design flight tracks for the new Runway 13/31. Minimising noise impacts was an integral design goal in the development of these tracks. This has been achieved by, wherever possible, avoiding overflights of residential areas. As noted above, a residential area is overflown at the end of Runway 13 (south-east of the runway; departures on 13 toward the south-east, arrivals on 31 toward the north-west).

Tracks have been developed to allow the design aircraft – a Boeing 787 (wide-bodied jet) – to use them. These aircraft require greater distances to bank and join in the northern approach routes when arriving from southern destinations.

Shorter tracks, which present fuel and emissions savings are generally preferred over longer ones. Narrow-bodied jets are capable of flying shorter radius turns than larger wide-bodied jets. In the case of narrow-bodied aircraft from the south approaching SCA on Runway 13 (i.e. having to track north of the airport and loop back), it is forecast that an RNP-AR track would be developed. This track would involve short radius turns and a shortened final approach, meaning that wide-bodied jets are unlikely to be permitted to use it. A second RNP-AR track may be developed for arrivals from ports north of SCA on Runway 31, however as this is over water it has no bearing on this noise assessment and has thus been ignored. An in-principle design for the Runway 13 RNP-AR track has been identified in consultation with SCA and Airservices (see Chapter D2). The design minimises residential areas which are overflown (the track centreline overflies few residences and avoids densely populated areas). This Runway 13 RNP-AR track has been included in this assessment. Note that the detailed design of RNP-AR tracks would be done at a later stage, though the in-principle design adopted in this assessment represents the most likely track given the available information at this stage.

The design tracks for Runway 13 and Runway 31 are presented in **Figure 3.3k** and **Figure 3.3l** respectively. It is evident that residential areas have been avoided in the new runway track design wherever practical.

Figure 3.3k: New Runway 13 design flight tracks

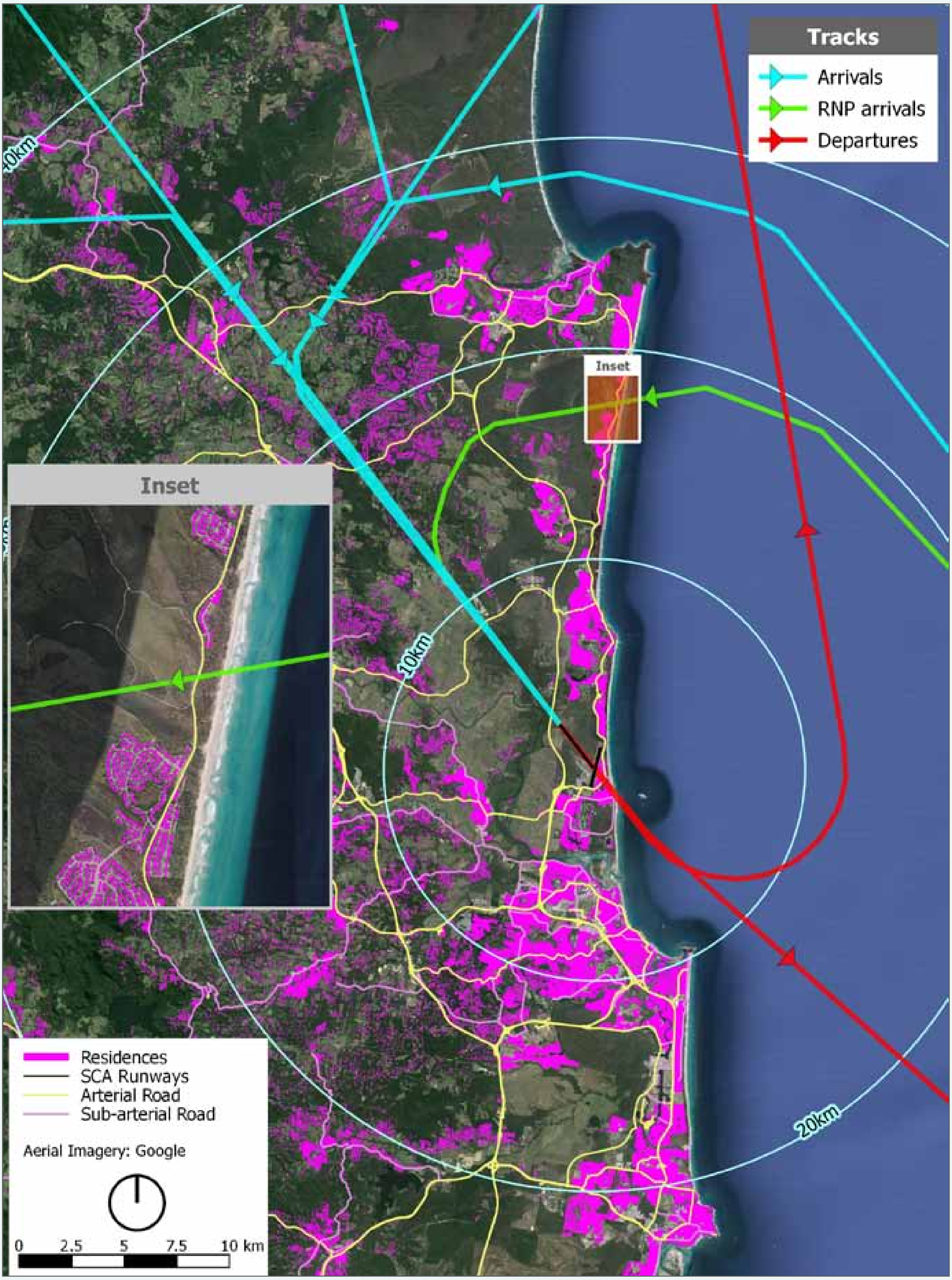
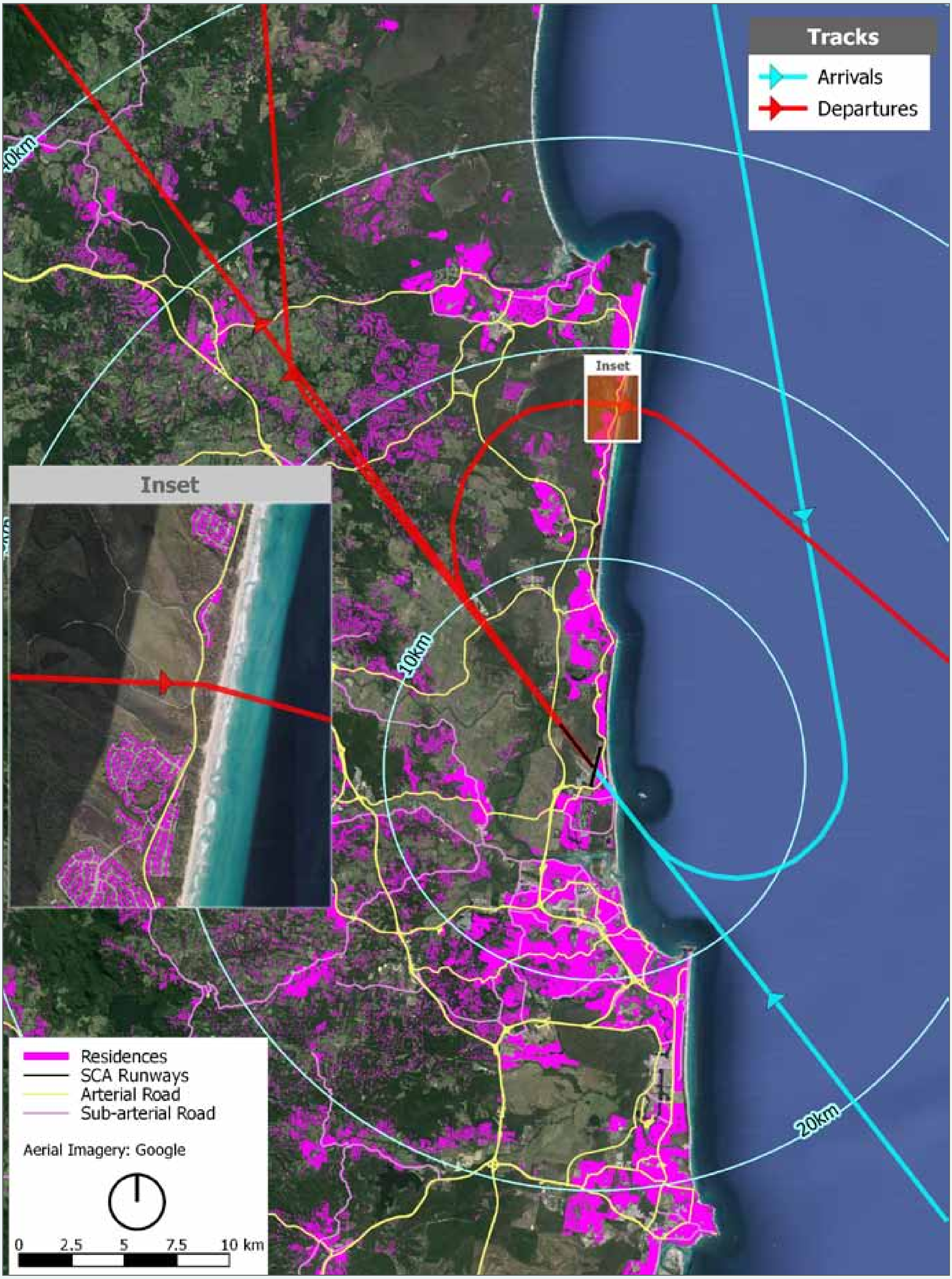


Figure 3.3l: New runway 31 design flight tracks



3.3.5.4 Fixed-wing height-vs-distance profiles

All fixed-wing operations were modelled with "standard" INM height-vs-distance profiles with the exception of RNP-AR procedures.

RNP-AR procedures are forecast to be developed for arrivals on Runway 13/31, and have already been developed for Runway 18/36. These procedures are assumed to implement a "Continuous Descent Approach" (referred to as CD, CDO or CDA). This differs from a conventional stepped approach in that the aircraft approaches the runway at a constant rate of descent (typically 3°). The benefits of this type of approach in low traffic environments are reported to include reduced emissions and fuel consumption, through reduced thrust, and reduced noise impacts through maintaining higher altitudes for a greater proportion of the approach. **Figure 3.3m** presents a comparison of a CDA (CD) and a conventional stepped approach.

3.3.6 Calculation of aircraft noise impact descriptors

3.3.6.1 Noise levels from individual aircraft operations

The INM aircraft noise prediction program, produced by the U.S. Federal Aviation Administration, was used to predict noise levels from each of the 15 fixed-wing and 5 helicopter aircraft types on each of the 601 flight tracks (including training circuits). INM Version 7.0d was used, as this was the latest available version at the time of performing the calculations.

Parameters used in the calculations are:

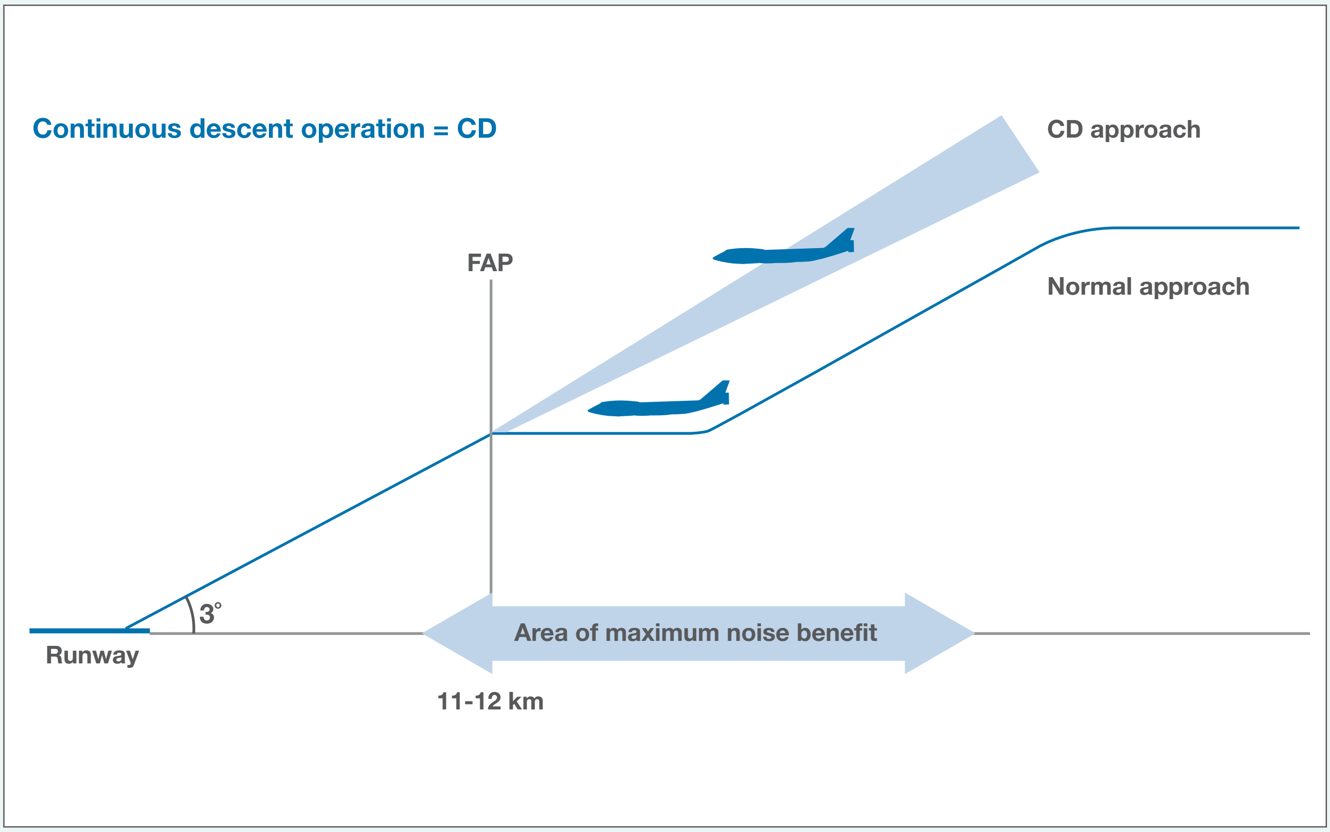
- Temperature 20° C
- Atmospheric pressure 760 mmHg
- Average headwind 8 kts.

Predicted noise levels are not very sensitive to any of the above parameters – for example, changing the temperature by 5°C would change the noise level by less than 1dB.

As described above, INM's "standard" height-vs-distance profiles were used in all calculations except RNP-AR tracks where specific profiles were entered. Departures by most aircraft types are defined for several "stage lengths", representing different distances to the destination, and hence different assumed fuel loads. Noise levels on departure were calculated for all possible stage lengths for each aircraft type and were allocated to operations based on the port of destination assigned to each departure in the synthetic schedule for the relevant scenario.

INM was used to compute two distinct noise descriptors – ANECs and maximum noise levels for each operation. ANECs are computed from the Effective Perceived Noise Level (EPNL) and were calculated entirely within INM (i.e. without further post-processing).

Figure 3.3m: Normal and continuous descent approach profiles



** Final Approach Point (FAP) is the point along the approach track that the final descent grade is obtained. Beyond this point conventional stepped approach and continuous descent approach profiles converge.*

N70 values are calculated from maximum noise levels. INM was used to calculate maximum noise levels at each point on a grid of size 185 m x 185 m, covering the area of interest. This grid size was selected because results were shown to be grid independent at this resolution (i.e. refining the grid further did not appreciably alter the calculation results).

Noise levels for each operation on each track were stored to allow calculation of N70 values for a range of airport operating scenarios using the Department of Infrastructure and Regional Development's Transparent Noise Information Package (TNIP).

3.3.6.2 Predicted numbers of aircraft operations

Predicted numbers of aircraft operations in future years were provided by LEAPP. For each year, separate predictions for weekday and weekend operations were provided.

For each of these scenarios, the predictions provide a detailed schedule of aircraft arrivals and departures, by aircraft type (**Table 3.3a**) and origin or destination. **Figure 3.3n** and **Figure 3.3o** show predicted scheduled (RPT) aircraft movements per hour for 2020 and 2040 respectively. Weekday forecasts are shown; between 1 and 6 fewer operations are scheduled on weekends.

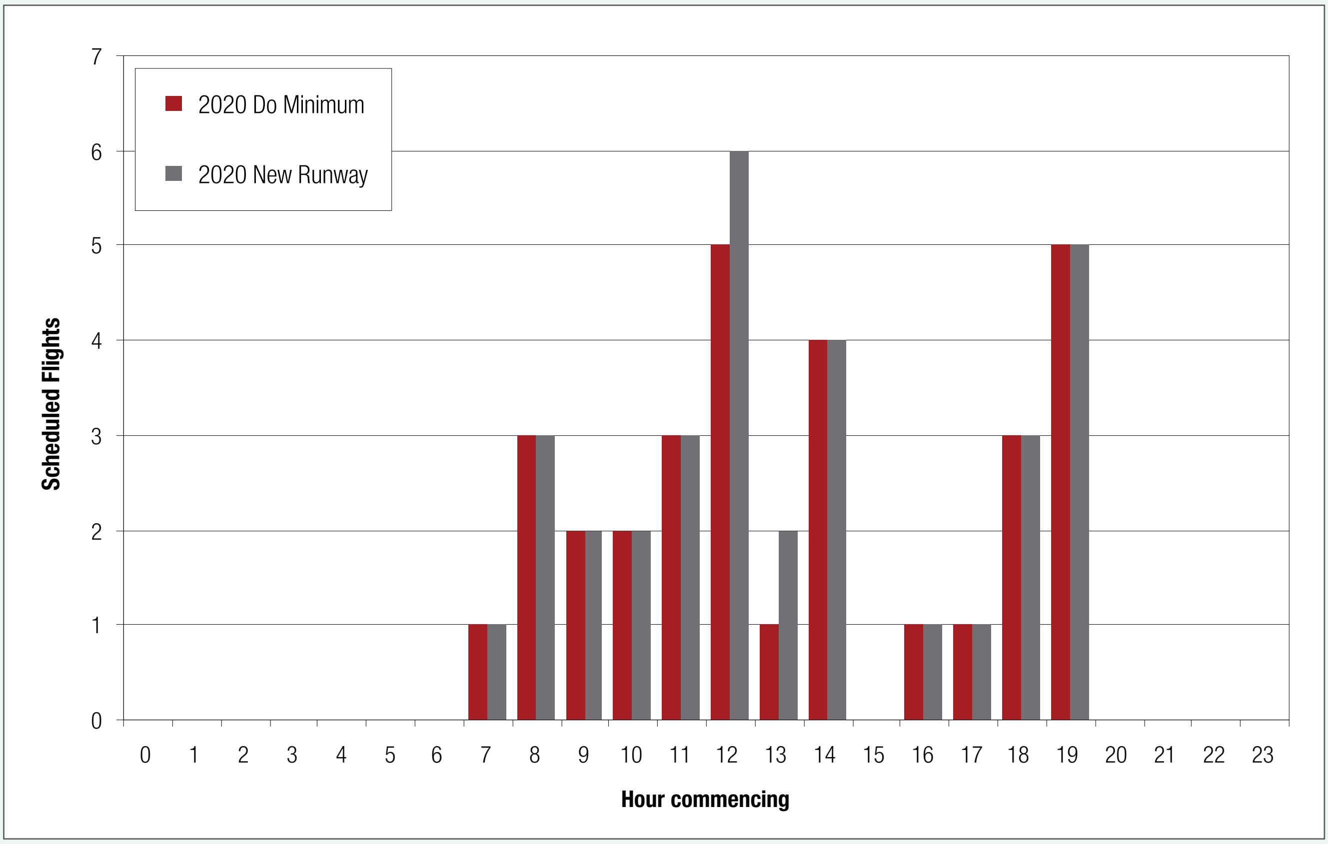
It is noteworthy that few operations are forecast during the night time period (10.00pm-7.00am). Night time operations are not forecast until 2040 and only two operations are forecast, in the early morning period between 6.00am and 7.00am. No night time operations are forecast on weekends in any year. Therefore night time N60 charts for fixed-wing operations are only shown for 2040 weekday scenarios.

3.3.6.3 Meteorological data

The mode of operation of the airport depends strongly on meteorological conditions.

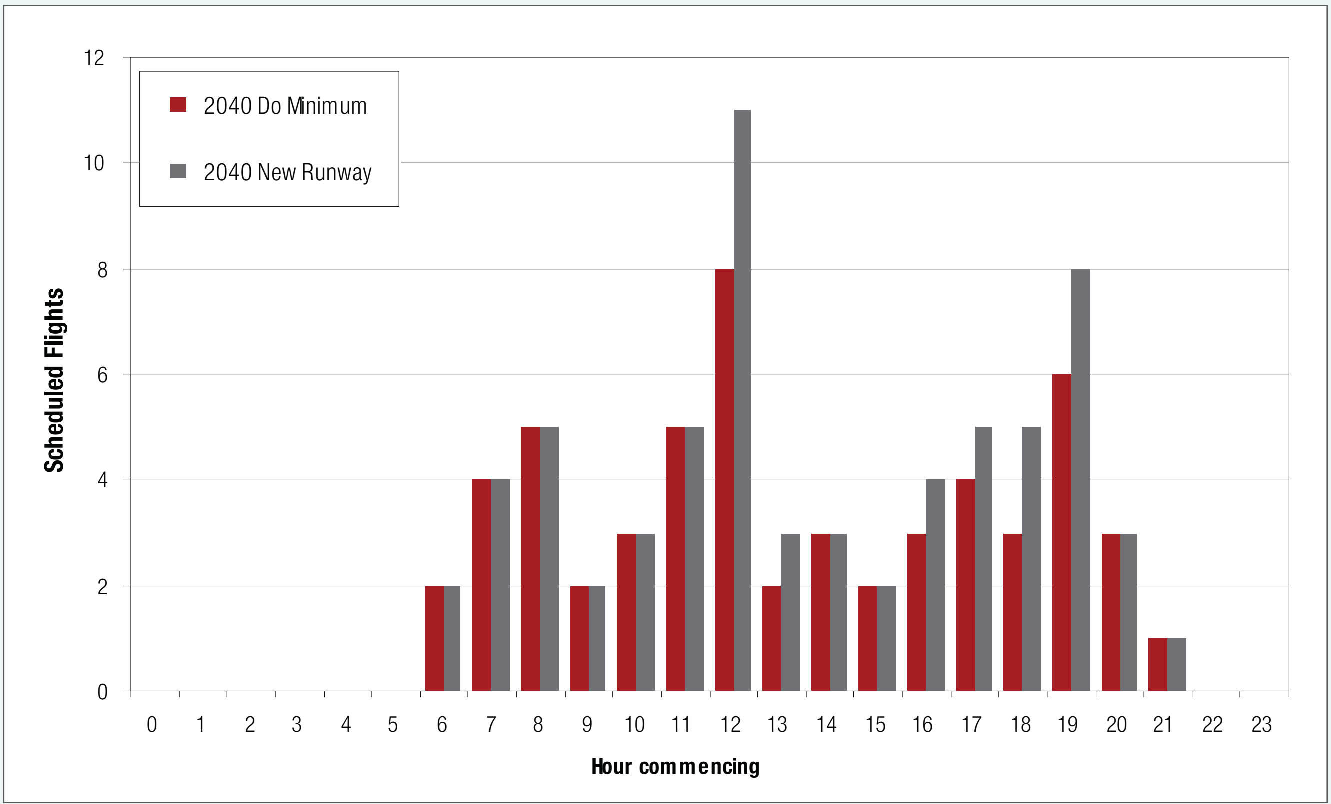
Meteorological data for SCA was available, from the Bureau of Meteorology (BOM) for the period 1 January 2002 to 29 August 2012 (approximately 10 years, 8 months of data). This data gives mean wind speed, maximum wind gust and mean wind direction over the 10 minutes before the time of the reading. Data is generally recorded every 30 minutes, but is sometimes recorded more often, and sometimes less. For analysis, the data were regularised to give values every 30 minutes, corresponding to the nearest actual recorded data point. Gaps in data are 0.9 per cent, with the maximum gap being 3 days, 4 hrs. There appears to be some concentration of data gaps around the months of September and October (representing approximately 40 per cent of all data gaps). However, given the small prevalence of gaps compared to the overall data set, this does not influence the analysis in any significant manner.

Figure 3.3n: Scheduled[4] aircraft movements per hour – 2020



4 GA aircraft are not scheduled but will be distributed throughout the day. This distibution is not anticipated to be affected by the Project.

Figure 3.3o: Scheduled[4] aircraft movements per hour – 2040



4 GA aircraft are not scheduled but will be distributed throughout the day. This distibution is not anticipated to be affected by the Project.

3.3.6.4 Overall calculation procedures

For each airport operating scenario considered, an airport operating mode was assigned for each 30 minutes over a 10-year period, taking account of:

- 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 3.3.6.3**.
- whether a change to a higher-priority mode would be undertaken under the assumed rules for mode selection, as described in **Sections 3.3.3.1** and **3.3.5.1**.

Aircraft operations occurring in that 30-minute period are then assigned to tracks according to the direction of the port of origin or destination. Operations on each track can then be used to determine measures of overall noise exposure, using the calculated noise levels described in **Section 3.3.6.1**.

3.4 EXISTING FIXED-WING NOISE MODELLING RESULTS

The following sections present the noise modelling results for existing fixed-wing operations.

3.4.1 Flight track movement charts

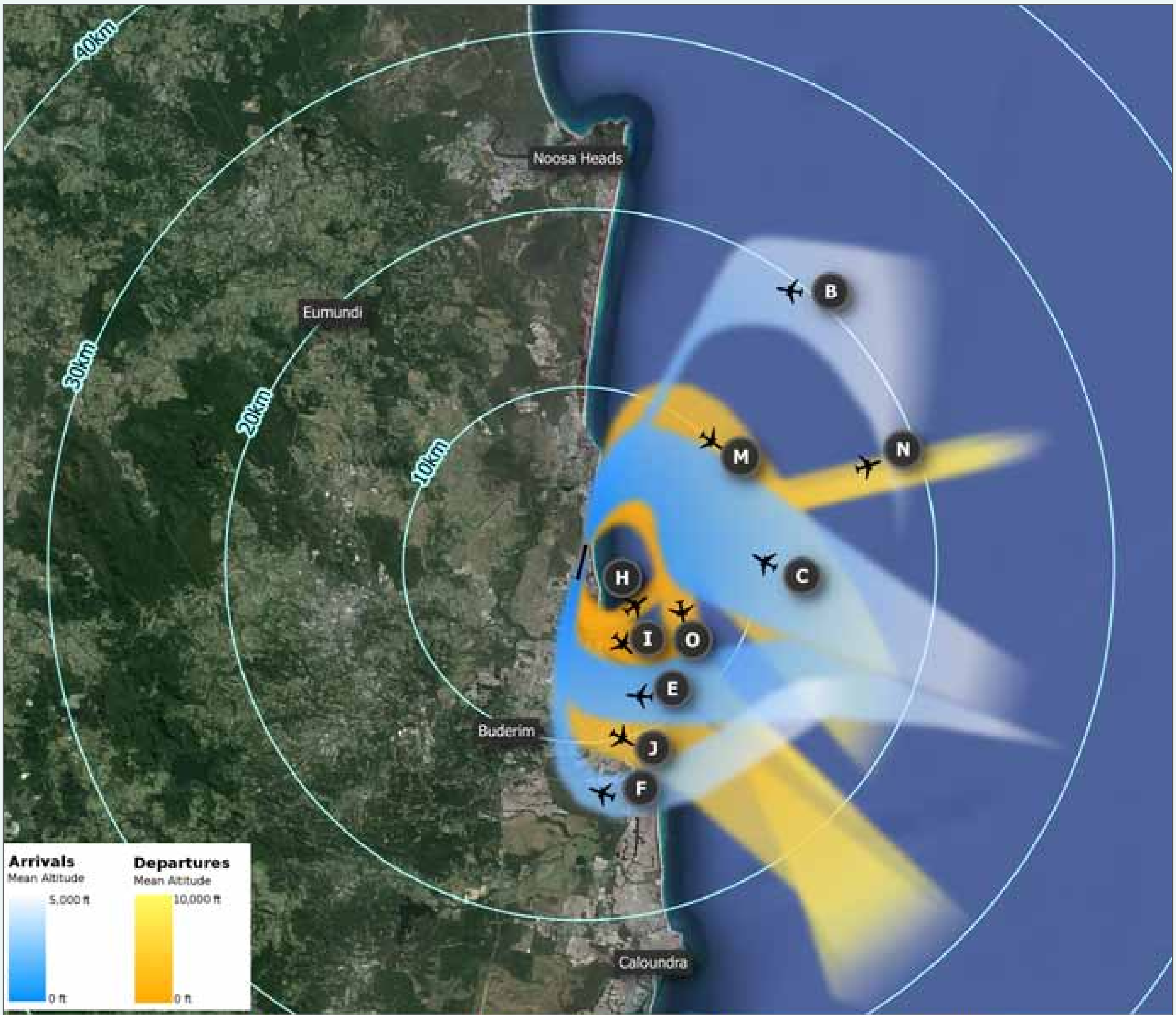
Figure 3.4a shows historical (2012) movements of RPT jets within each track group.

Operations are presented as the weighted average across weekday/weekend and summer/winter.

Flight paths are presented as coloured swathes overlaid on a map of the Sunshine Coast. Each path, denoted by a capital letter, shows three pieces of information:

- Whether aircraft are using the flight path for arrival or departure, illustrated by the direction of the aircraft icon and the colour scheme of the path
- The approximate altitude of aircraft as it comes into or out of Sunshine Coast airport shown through a colour gradient that can be interpreted by using the altitude legend on each chart
- The potential width of the flight path.

Figure 3.4a: RPT flight track movements – Existing 2012 Runway 18



Flight path	Flight path type	Runway	Day: Average number of RPT flights	Day: Expected minimum and maximum number of RPT flights	Day: Percentage of SCA's total RPT flights	Day: Percentage of days with no RPT flights	Evening: Average number of RPT flights	Evening: Expected minimum and maximum number of RPT flights	Evening: Percentage of SCA's total RPT flights	Evening: Percentage of days with no RPT flights
B	Arrival	18	1.5	0-8	10%	6%	0.2	0-2	5%	52%
C	Arrival	18	2.2	0-8	14%	3%	0.3	0-2	8%	36%
E	Arrival	36	3.9	0-8	26%	63%	1	0-2	23%	87%
F	Arrival	36	0.5	0-8	3%	93%	0.1	0-2	3%	98%
H	Departure	18	0.2	0-7	1%	73%	0.1	0-3	1%	89%
I	Departure	18	2.3	0-7	15%	3%	0.7	0-3	15%	15%
J	Departure	18	0.8	0-7	5%	19%	0.2	0-3	5%	52%
M	Departure	36	1.5	0-7	10%	79%	0.7	0-3	15%	91%
N	Departure	36	0.2	0-7	2%	96%	0.1	0-3	3%	98%
O	Departure	36	2.1	0-7	14%	75%	1	0-3	22%	88%

Data tables are presented at the bottom of each flight path chart. These tables present, for day, evening and night periods:

- The average number of RPT flights per day for each path in the periods described by day (7.00am – 6.00pm), evening (6.00pm – 10.00pm) and night (10.00pm – 7.00am). These are calculated as an annual average (i.e. the total flights expected on the path for the year divided by 365 days)
- The minimum and maximum number of flights to use the flight path per day
- The proportion of all SCA RPT flights to use the path for each period, expressed as a percentage of the total number of RPT flights in that period
- The percentage of days when the flight path experienced no RPT flights during the period being reported on.

The altitude legend shows the typical altitudes for arriving and departing paths with respect to the distance from the runway. This graph also shows indicative noise levels on the ground corresponding to the aircraft's altitude.

RPT aircraft regularly fly over residential areas north and south of SCA about the extended runway centreline and east of this line, as tracks depart or arrive over the ocean.

3.4.2 N70 and N60 noise contours for fixed wing aircraft

N70 and N60 noise level contours represent the number of noise events per day which exceed 70 dB(A) and 60 dB(A) respectively during specific time periods, and are described in detail in **Section 3.2.1.2**. They combine information on the noise level from individual events and the number of such events per day, and have been found to be useful in understanding the extent and nature of aircraft noise exposure.

This section presents N70 contours for the daytime (7am – 6pm) and evening (6pm – 10pm) periods.

3.4.2.1 Existing fixed-wing daytime and evening periods

Appendix D3:B shows calculated N70 contours for all periods – summer and winter, weekday and weekend, day, and evening, for all assessment scenarios.

Figure 3.4b presents a comparison of the weekday and weekend modelling results. In 2012, weekends were scheduled to have only two fewer aircraft than weekdays (both RPT). Hence the differences in N70 for the two periods are small. For this reason, and to streamline the information presented in this chapter, only weekday results are presented.

Figure 3.4c and **Figure 3.4d** present the calculated Existing 2012 Weekday Day Fixed-wing N70 contours for both summer and winter. To aid in comparing the two, **Figure 3.4e** presents a composite of these figures.

The N70 contours are concentrated about the Runway 18/36 centreline; extending north and south over residential areas along the coast.

Comparing summer and winter it is evident that little difference exists (**Figure 3.4e**). Winter meteorological conditions favour Runway 18 (arriving and departing in a north-to-south direction) slightly more than summer. Hence, with more arrivals from the north, the N70 contour for winter extends further north than summer. Similarly, fewer arrivals from the south during winter means that the contours extend less to the south. The N70 contour extends further to the south-west, in winter as a consequence of more departures occurring on Runway 18 in this season.

Areas which currently experience more than 5 events per day above 70 dB(A) from fixed-wing aircraft are:

- Pacific Paradise
- Twin Waters
- Mudjimba
- Marcoola
- Maroochydore
- Mount Coolum.

Figure 3.4f presents the Existing 2012 Weekday Evening Fixed-wing N70 for summer. The evening N70 contours are more localised to SCA than daytime N70 contours. This is due to fewer flights being scheduled in the evening time period.

As analysis of the forecast operations revealed little seasonal variation, and in the context of this assessment and its' outcomes, this seasonal variation is considered insignificant, the presentation of both summer and winter seasons in the EIS body is unwarranted. The summer period was selected for presentation herein because noise contours for this period generally have a slightly larger footprint over existing residential areas, thus providing slightly better resolution of the predicted impacts.

N70 contours for winter are included in **Appendix D3:B**.

Figure 3.4b: N70 fixed-wing contours – Existing 2012 day summer, comparison of weekday and weekend

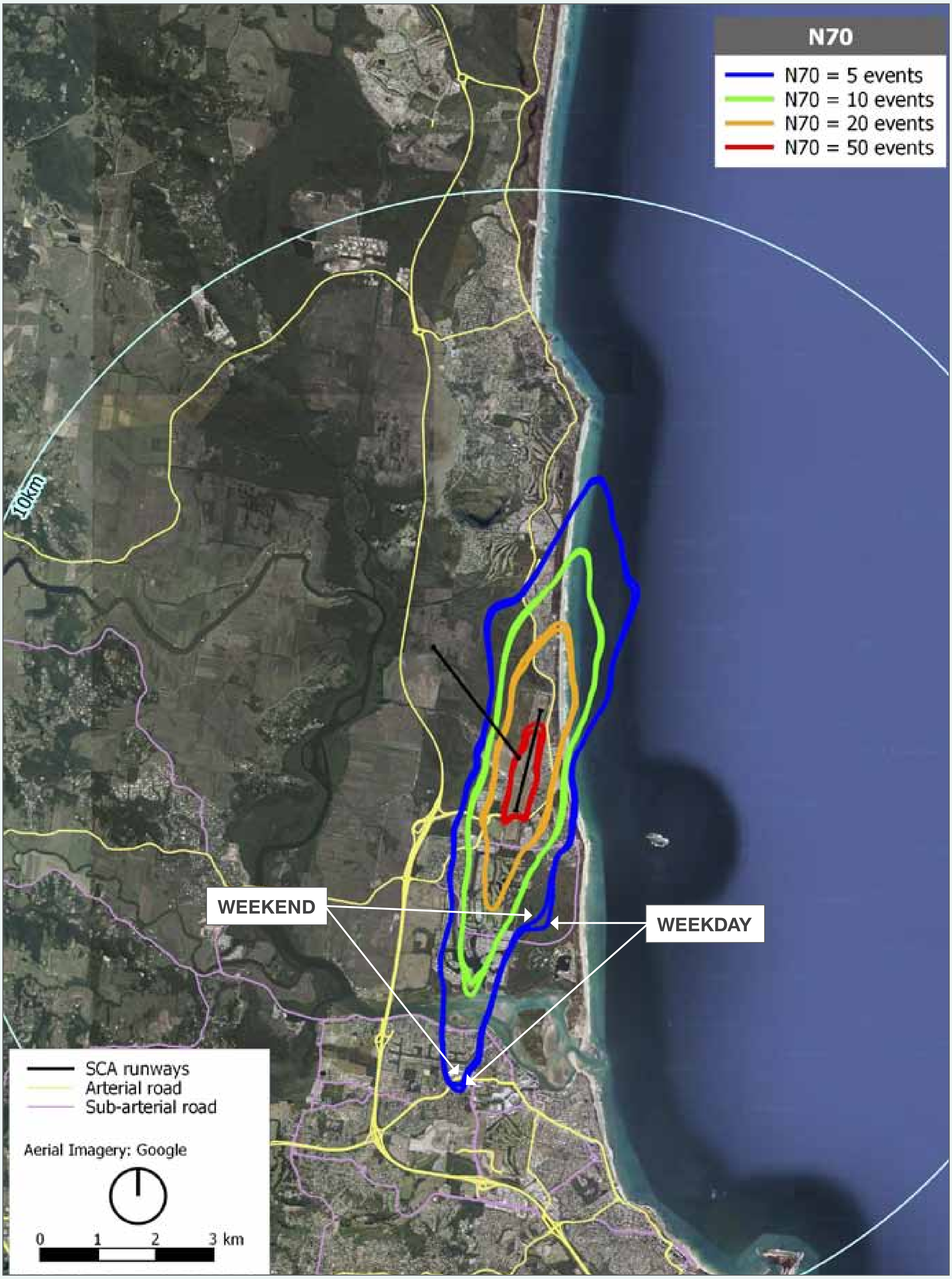


Figure 3.4c: N70 fixed-wing contours – Existing 2012 day, summer weekday

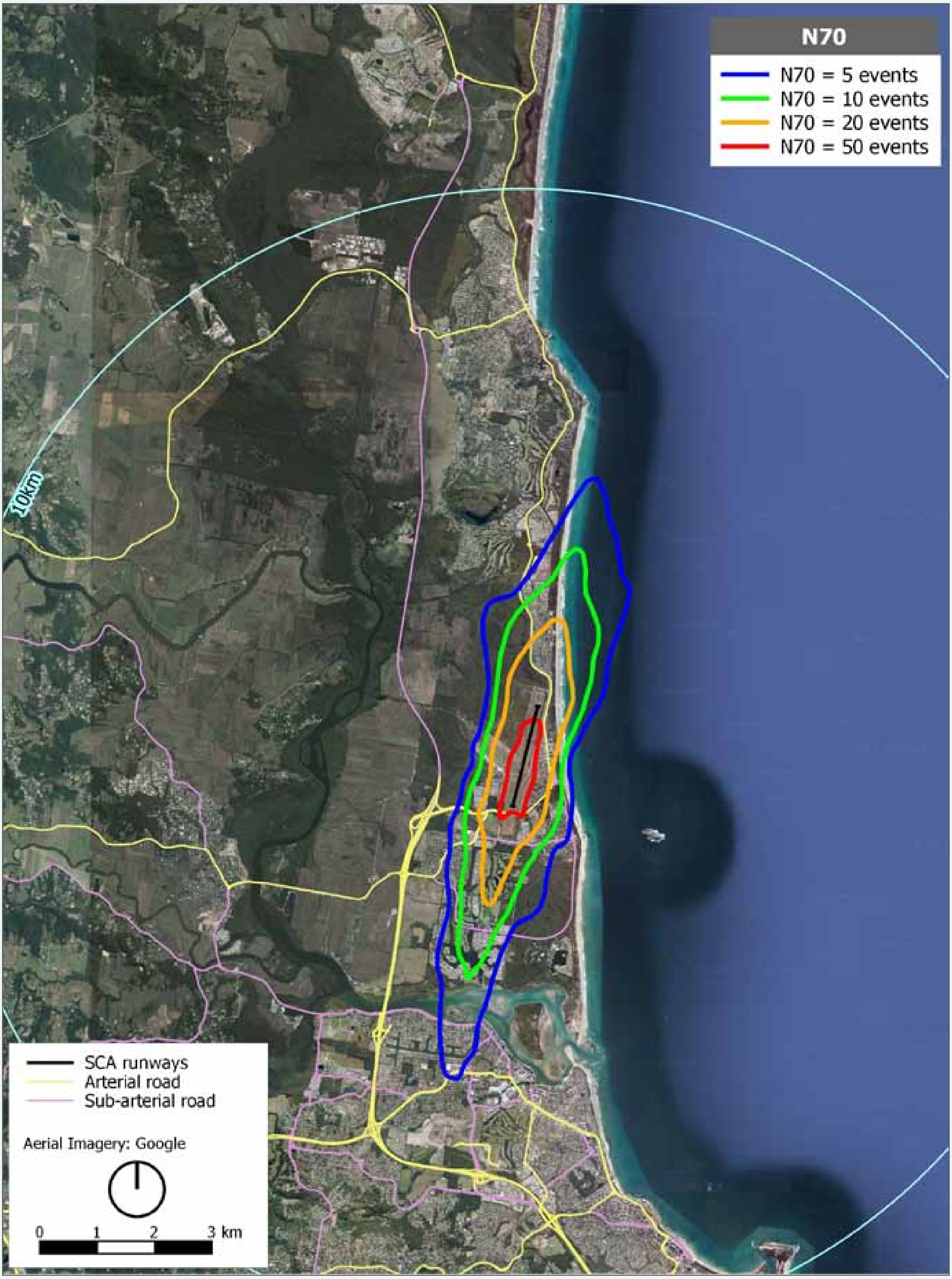


Figure 3.4d: N70 fixed-wing contours – Existing 2012 day, winter weekday

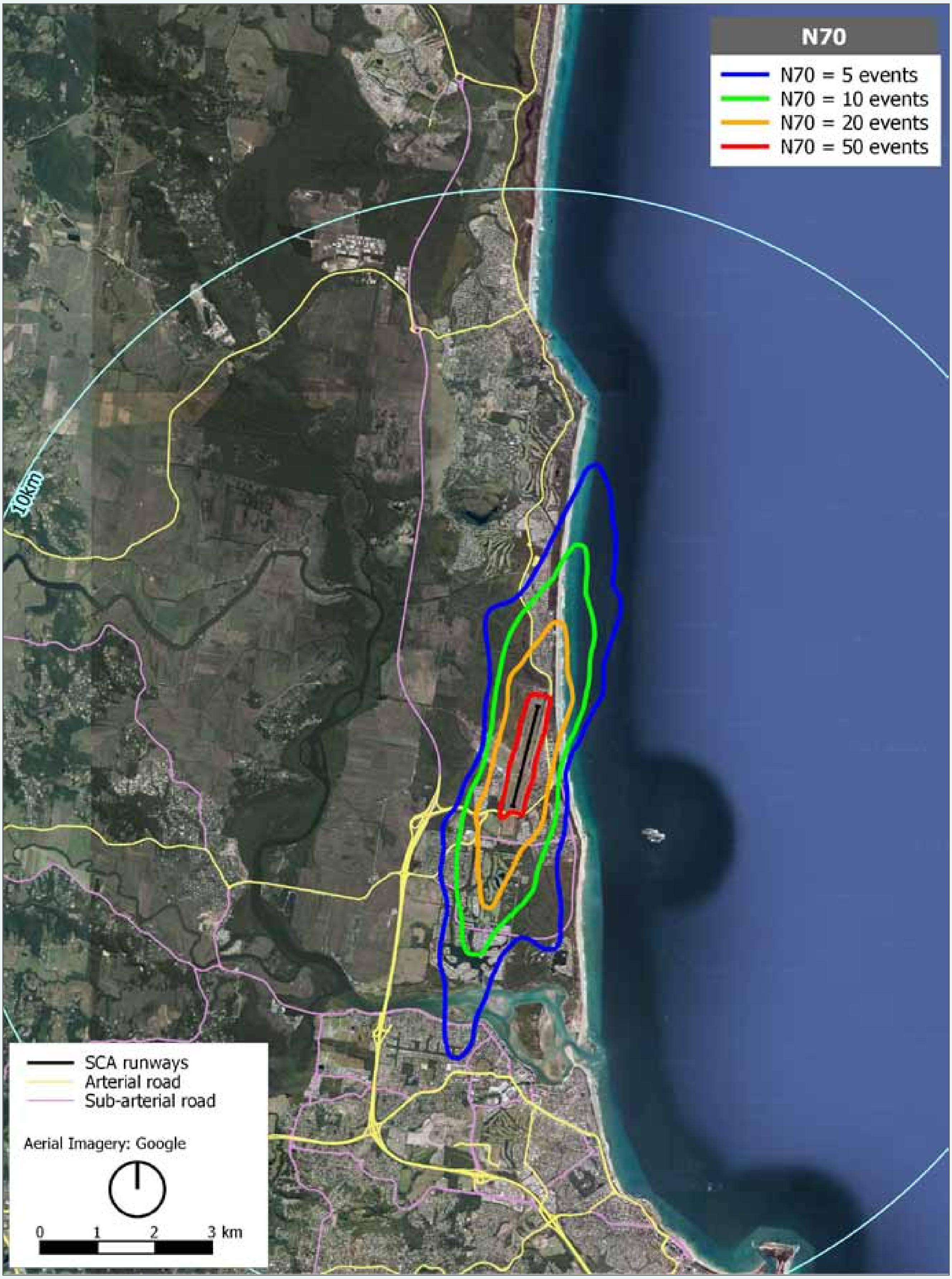


Figure 3.4e: N70 fixed-wing contours – Existing 2012 day weekday, comparison of summer and winter

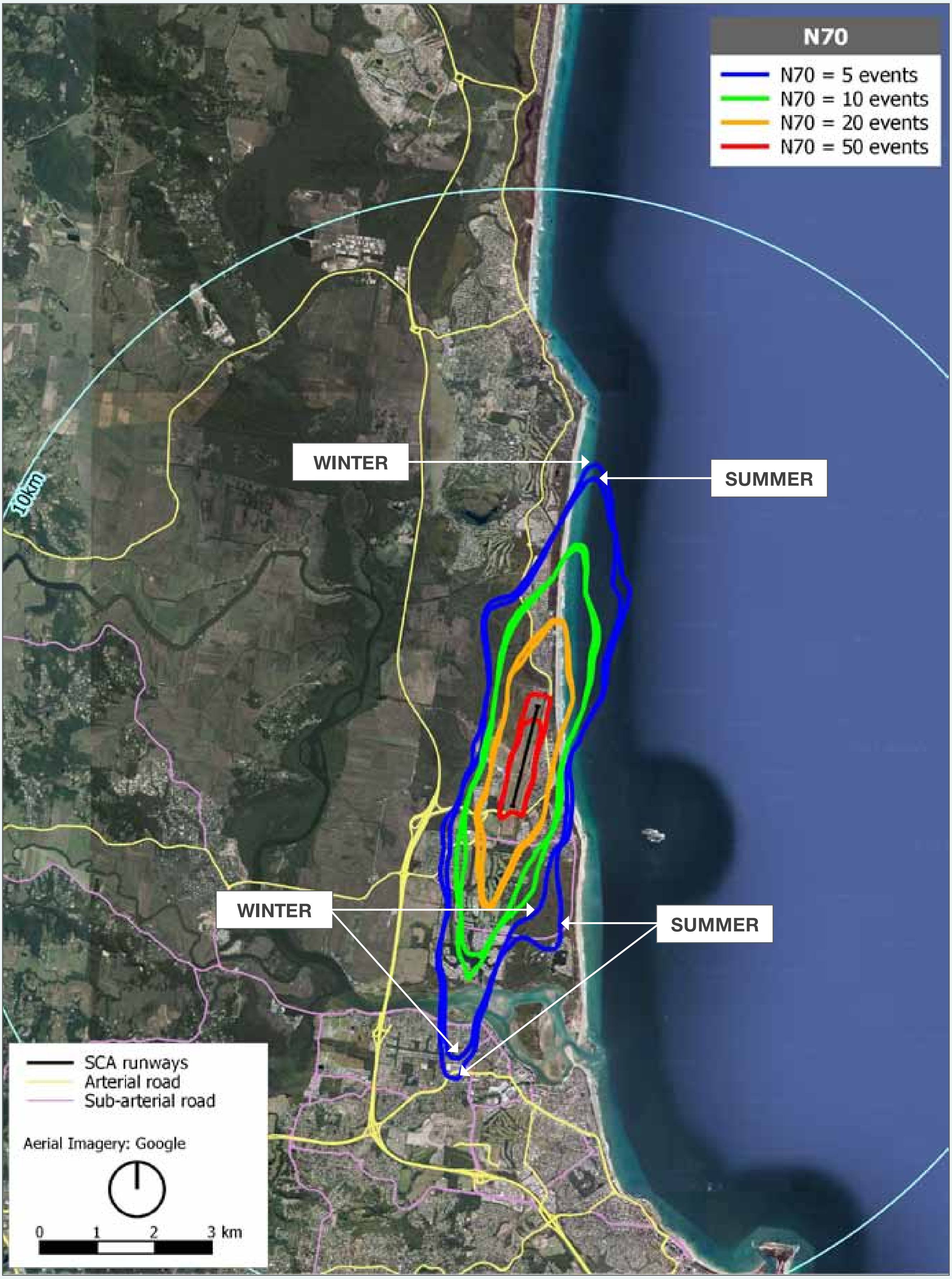
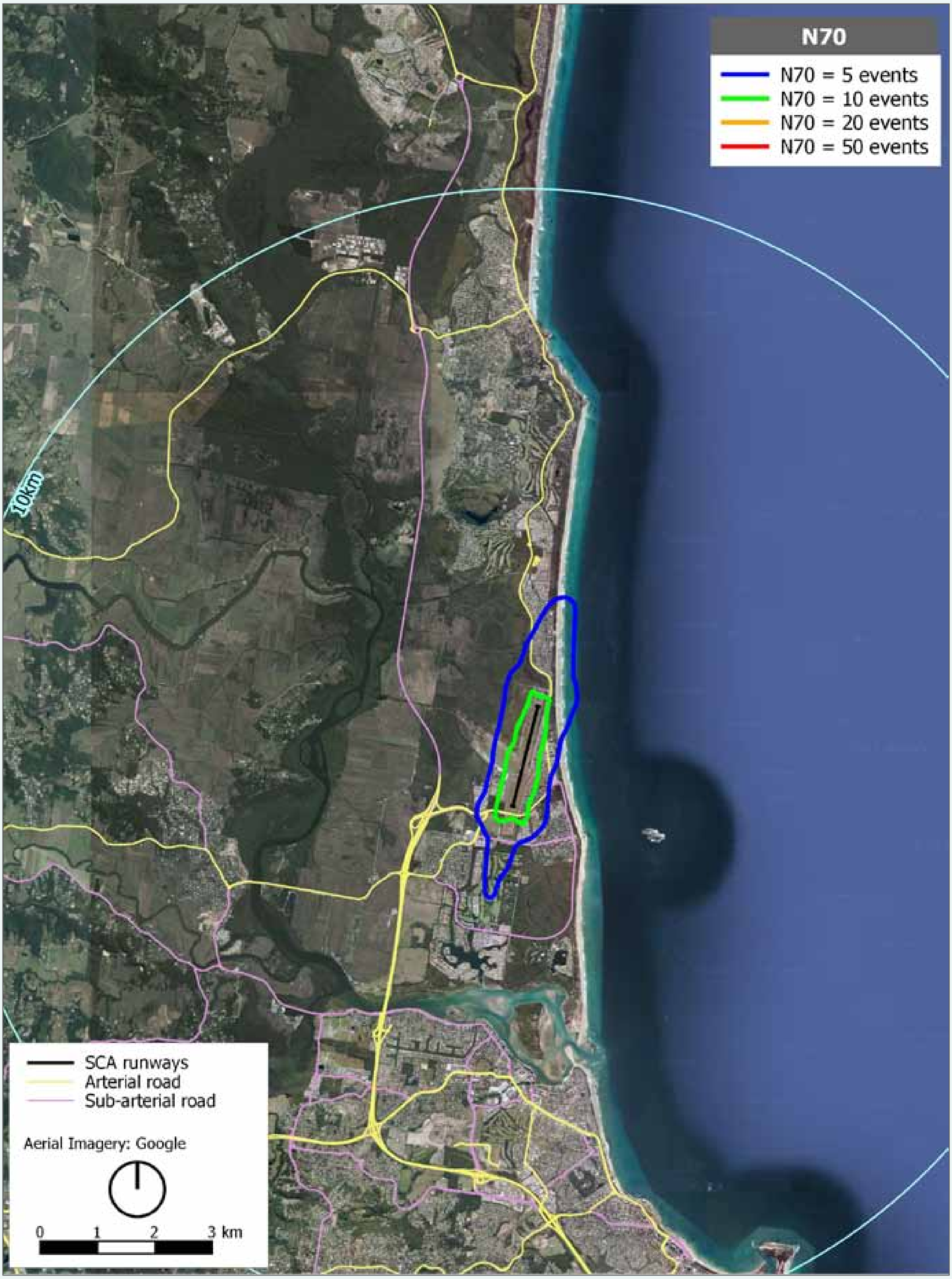


Figure 3.4f: N70 fixed-wing contours – Existing 2012 evening, summer weekday



3.5 FUTURE FIXED-WING NOISE PREDICTIONS AND ASSESSMENT

The following sections present the noise modelling results for future operations.

In the following results, the "Do Minimum" scenario refers to a scenario whereby measures are undertaken to permit narrow-bodied jets to continue operating on Runway 18/36. This effectively equates to an extension of the existing scenario.

Assessment of the impacts associated with the Project can be made by comparing the "Do Minimum" scenario with the corresponding "New Runway" scenario.

3.5.1 Flight track movement charts

Figure 3.5a to **Figure 3.5d** show forecast movements of RPT aircraft within each track group.

Operations are presented as the weighted average across weekday/weekend and summer/winter.

(Refer to **Section 3.4.1** for an explanation of these charts.)

The scenarios using Runway 18/36 clearly overfly residential areas north and south of SCA about the extended runway centreline and east of this line, as tracks depart or arrive over the ocean. The concentration of arrivals onto RNP-AR tracks for these scenarios beyond 2016 is also evident.

The scenarios using Runway 13/31 overfly Marcoola and Mudjimba and sparsely populated areas north-west of SCA about the extended runway centreline. Runway 13 is heavily favoured by prevailing meteorological conditions and is therefore used for 77 per cent of RPT operations. In this operating mode departures overfly Marcoola and Mudjimba, and arrivals overfly the greenfield and sparsely populated regions north-west of SCA. This scenario is preferable to Runway 31 from a noise perspective because departing aircraft ascend more quickly than arriving aircraft descend, meaning that departing aircraft will be more elevated beyond the runway end than an equivalent arriving aircraft. Consequently reduced noise levels are expected from departures (refer to **Section 3.5.2** for figures demonstrating the difference between arrival and departure noise footprints).

The diagram below shows typical altitudes for arrivals and departures of narrow-body jets. This should be read in conjunction with **Figures 3.5a** to **3.5d**. Note that the additional length of the new runway (2,450 m), conpared with the existing runway (1,800 m), means that departing aircraft will be higher as they leave the airport.

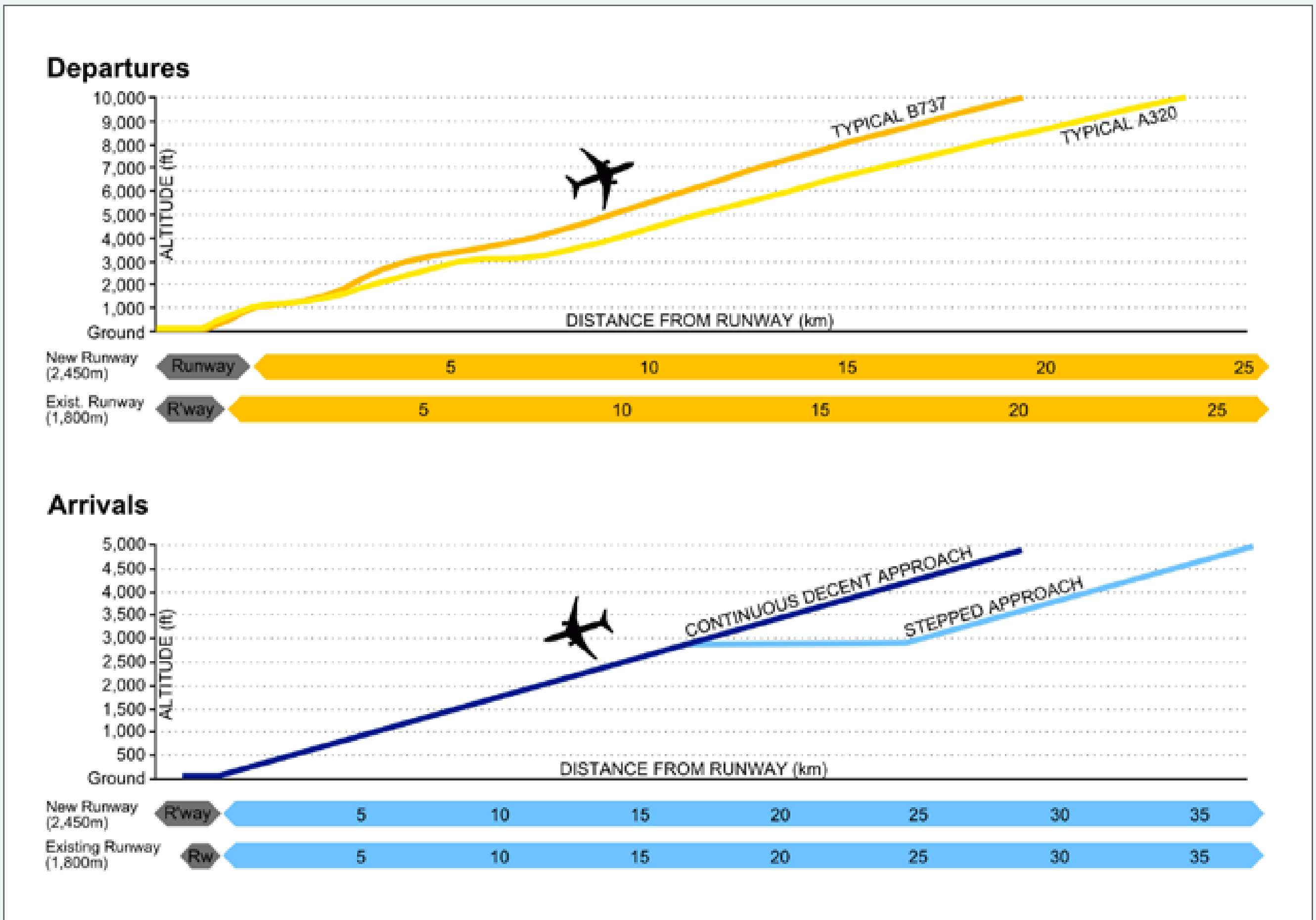
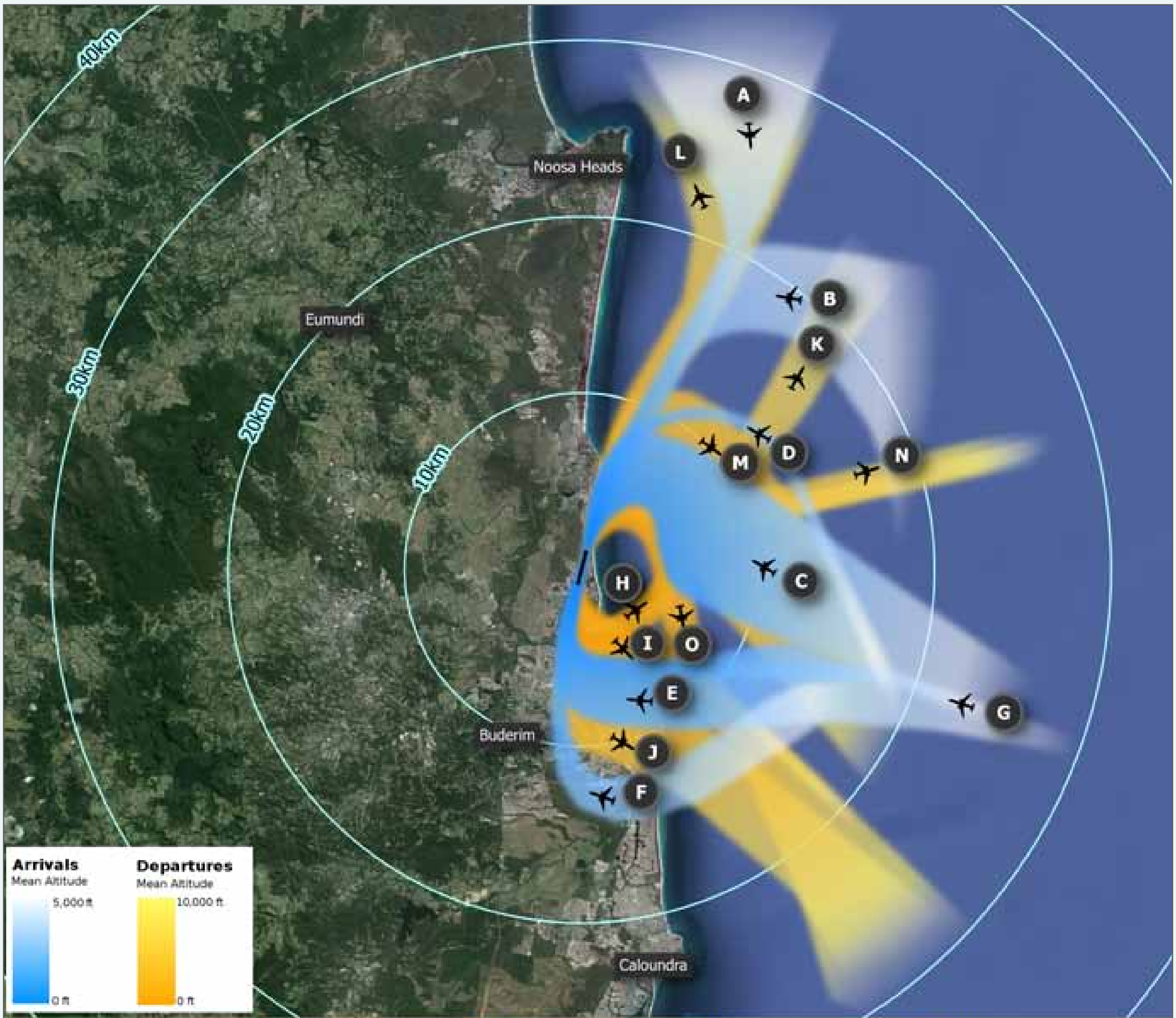
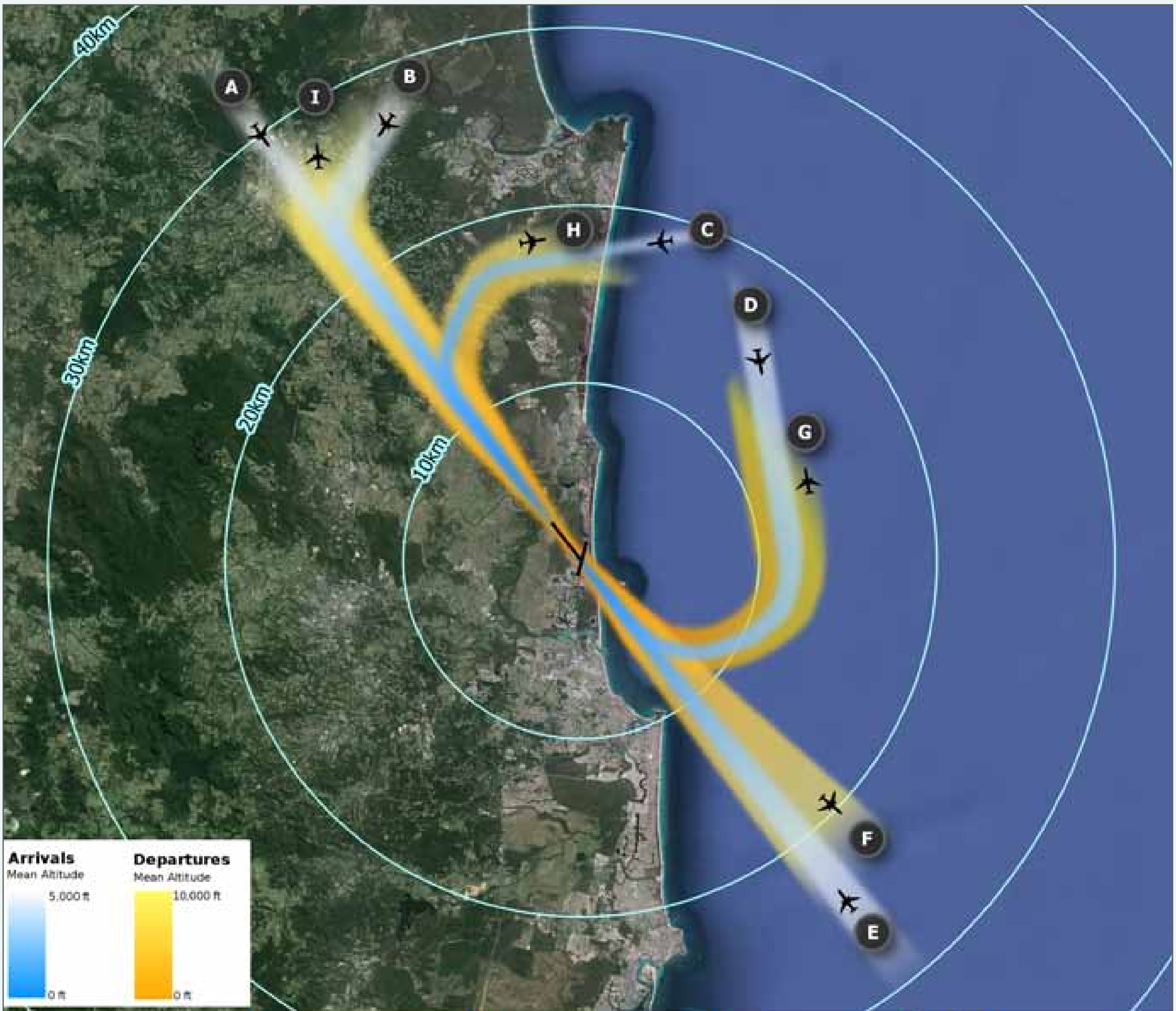


Figure 3.5a: RPT flight track movements – Do Minimum 2020



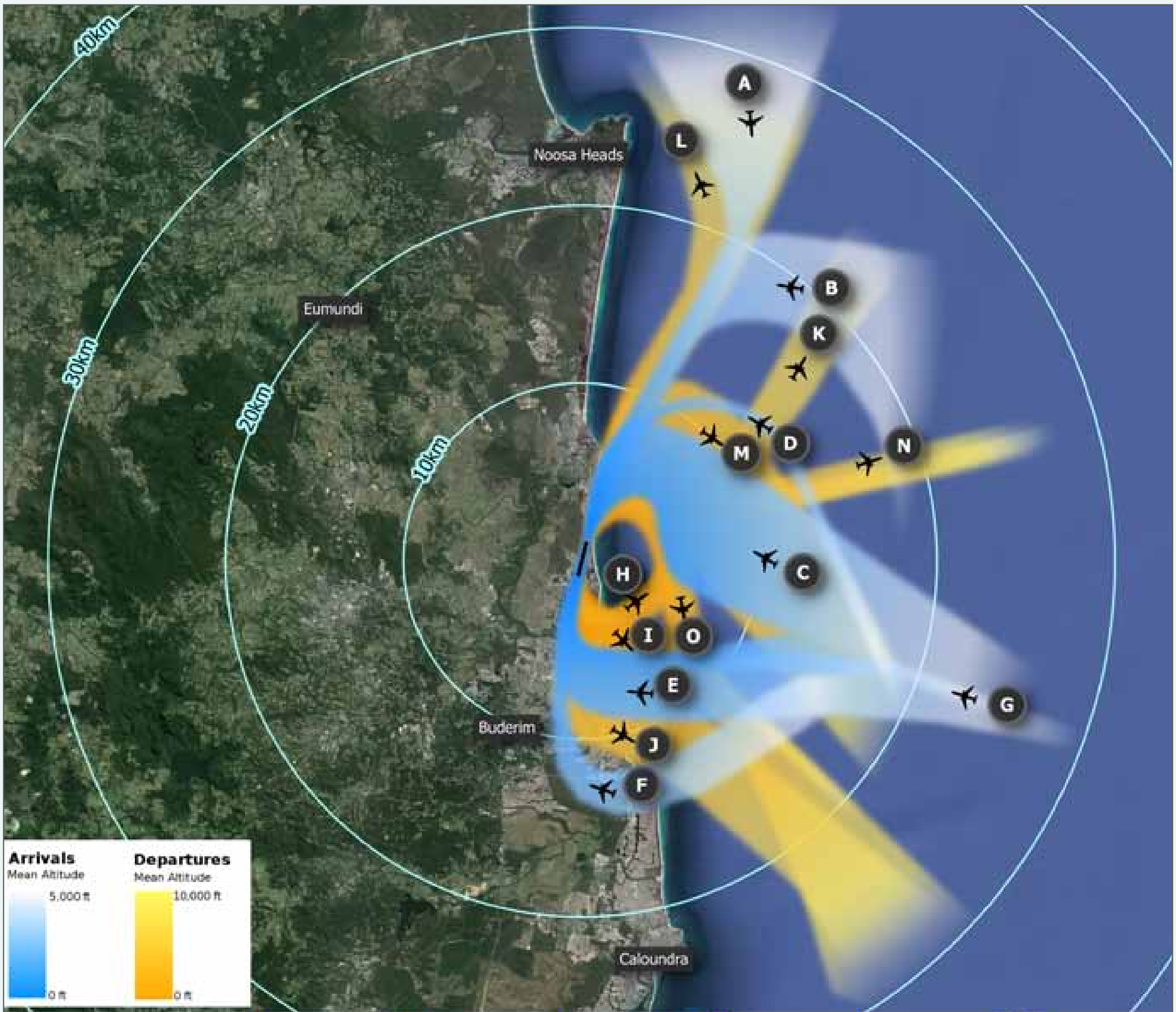
Flight path	Flight path type	Runway	Day: Average number of RPT flights	Day: Expected minimum and maximum number of RPT flights	Day: Percentage of SCA's total RPT flights	Day: Percentage of days with no RPT flights	Evening: Average number of RPT flights	Evening: Expected minimum and maximum number of RPT flights	Evening: Percentage of SCA's total RPT flights	Evening: Percentage of days with no RPT flights
A	Arrival	18	0.8	0-2	4%	6%	0.2	0-1	3%	21%
B	Arrival	18	0	0-0	0%	100%	0	0-0	0%	100%
C	Arrival	18	0.3	0-2	1%	95%	0	0-0	0%	100%
D	Arrival*	18	3.9	0-9	17%	2%	1.3	0-4	18%	3%
E	Arrival	36	1	0-2	4%	93%	0.3	0-1	4%	96%
F	Arrival	36	0.4	0-2	2%	93%	0.1	0-0	1%	100%
G	Arrival*	36	4.5	0-9	19%	60%	2.4	0-4	34%	74%
H	Departure	18	0.3	0-11	1%	65%	0.1	0-2	1%	90%
I	Departure	18	3.2	0-13	14%	2%	0.5	0-3	8%	18%
J	Departure	18	1.1	0-11	5%	11%	0.2	0-2	3%	57%
K	Departure	18	0.9	0-2	4%	13%	0.2	0-1	2%	34%
L	Departure	36	1	0-2	4%	83%	0.4	0-1	5%	91%
M	Departure	36	2.1	0-11	9%	74%	0.6	0-2	8%	92%
N	Departure	36	0.6	0-11	3%	95%	0.1	0-2	1%	99%
O	Departure	36	3.2	0-11	14%	69%	0.8	0-2	12%	90%

Figure 3.5b: RPT flight track movements – New Runway 2020



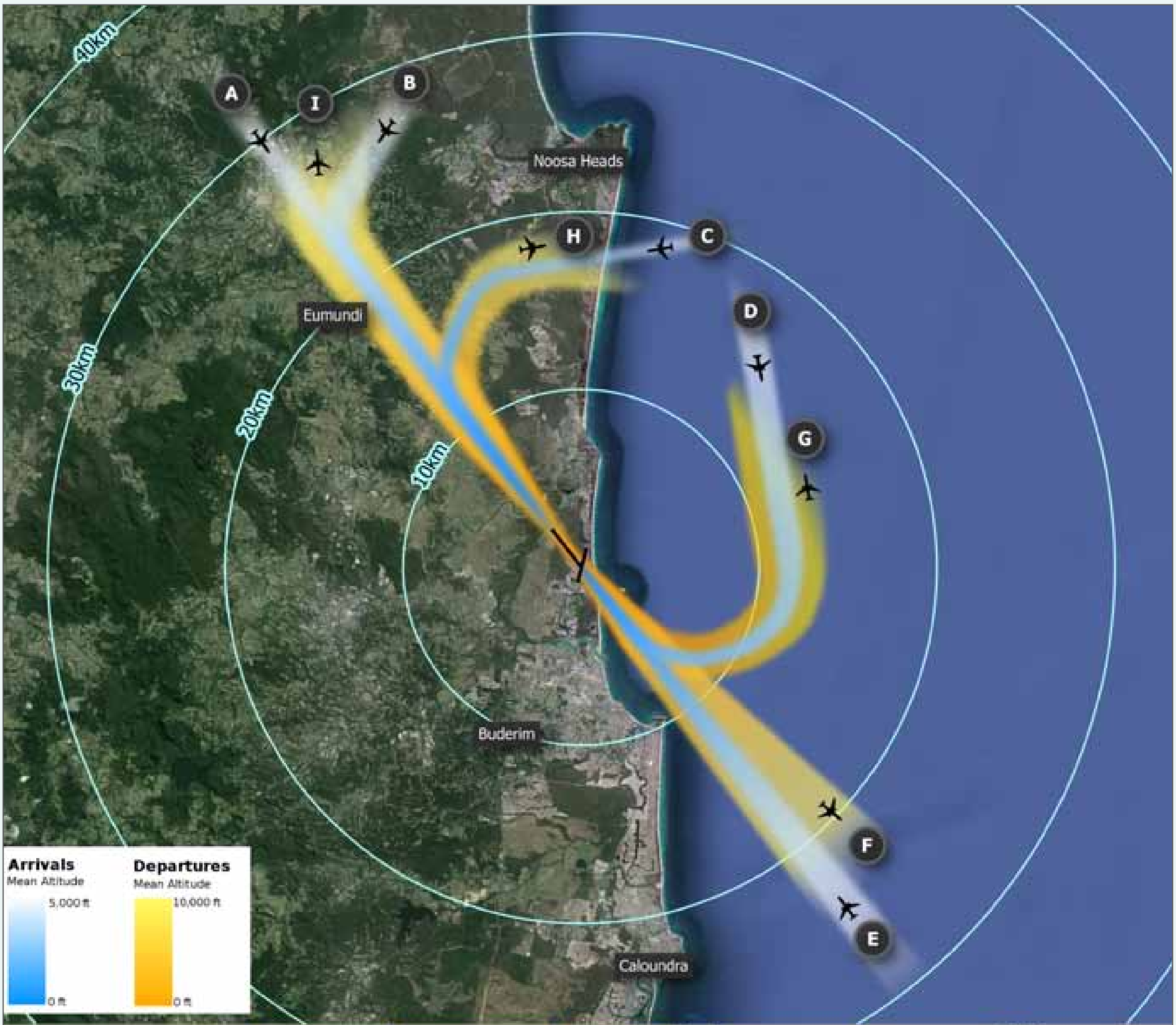
Flight path	Flight path type	Runway	Day: Average number of RPT flights	Day: Expected minimum and maximum number of RPT flights	Day: Percentage of SCA's total RPT flights	Day: Percentage of days with no RPT flights	Evening: Average number of RPT flights	Evening: Expected minimum and maximum number of RPT flights	Evening: Percentage of SCA's total RPT flights	Evening: Percentage of days with no RPT flights
A	Arrival	13	0.8	0-3	4%	1%	0.4	0-1	6%	18%
B	Arrival	13	0.6	0-1	3%	18%	0	0-0	0%	100%
C	Arrival*	13	6.4	0-8	30%	1%	2.9	0-4	41%	1%
D	Arrival	31	0.4	0-2	2%	86%	0.1	0-1	2%	92%
E	Arrival	31	1.8	0-10	8%	63%	0.8	0-4	12%	78%
F	Departure	13	7.4	0-11	35%	1%	1.8	0-2	25%	3%
G	Departure	13	1.5	0-3	7%	1%	0.4	0-1	6%	18%
H	Departure	31	2.1	0-11	10%	63%	0.5	0-2	7%	85%
I	Departure	31	0.4	0-3	2%	81%	0.1	0-1	2%	92%

Figure 3.5c: RPT flight track movements – Do Minimum 2040



Flight path	Flight path type	Runway	Day: Average number of RPT flights	Day: Expected minimum and maximum number of RPT flights	Day: Percentage of SCA's total RPT flights	Day: Percentage of days with no RPT flights	Evening: Average number of RPT flights	Evening: Expected minimum and maximum number of RPT flights	Evening: Percentage of SCA's total RPT flights	Evening: Percentage of days with no RPT flights	Night: Average number of RPT flights	Night: Expected minimum and maximum number of RPT flights	Night: Percentage of SCA's total RPT flights	Night: Percentage of days with no RPT flights
A	Arrival	18	2.8	0-7	7%	2%	0.2	0-1	1%	21%	0	0-0	0%	100%
B	Arrival	18	0	0-0	0%	100%	0	0-0	0%	100%	0	0-0	0%	100%
C	Arrival	18	0.2	0-3	1%	95%	0.1	0-1	1%	95%	0	0-0	0%	100%
D	Arrival*	18	6.3	0-14	15%	2%	1.8	0-6	15%	2%	0	0-0	0%	100%
E	Arrival	36	1.3	0-3	3%	90%	0.4	0-1	3%	96%	0	0-0	0%	100%
F	Arrival	36	0.4	0-3	1%	85%	0.2	0-1	2%	95%	0	0-0	0%	100%
G	Arrival*	36	9.7	0-18	24%	54%	3.6	0-6	30%	68%	0	0-0	0%	100%
H	Departure	18	2	0-14	5%	54%	0.1	0-4	1%	83%	0	0-2	2%	94%
I	Departure	18	4.4	0-20	11%	2%	1	0-6	9%	5%	0.4	0-2	27%	45%
J	Departure	18	1.5	0-14	4%	5%	0.4	0-4	3%	36%	0.1	0-2	9%	72%
K	Departure	18	0.9	0-6	2%	2%	0.4	0-2	3%	13%	0	0-0	0%	100%
L	Departure	36	1.1	0-6	3%	66%	0.7	0-2	6%	83%	0	0-0	0%	100%
M	Departure	36	4.9	0-14	12%	68%	1.1	0-4	9%	86%	0.3	0-2	24%	95%
N	Departure	36	0.7	0-14	2%	93%	0.3	0-4	3%	98%	0.1	0-2	4%	99%
O	Departure	36	4.3	0-14	11%	63%	1.7	0-4	14%	82%	0.5	0-2	34%	93%

Figure 3.5d: RPT flight track movements – New Runway 2040



Flight path	Flight path type	Runway	Day: Average number of RPT flights	Day: Expected minimum and maximum number of RPT flights	Day: Percentage of SCA's total RPT flights	Day: Percentage of days with no RPT flights	Evening: Average number of RPT flights	Evening: Expected minimum and maximum number of RPT flights	Evening: Percentage of SCA's total RPT flights	Evening: Percentage of days with no RPT flights	Night: Average number of RPT flights	Night: Expected minimum and maximum number of RPT flights	Night: Percentage of SCA's total RPT flights	Night: Percentage of days with no RPT flights
A	Arrival	13	2.8	0-10	7%	1%	1.2	0-2	7%	4%	0	0-0	0%	100%
B	Arrival	13	2.8	0-1	7%	18%	0.8	0-1	5%	18%	0	0-0	0%	100%
C	Arrival*	13	10.6	0-13	26%	1%	4.5	0-6	28%	1%	0	0-0	0%	100%
D	Arrival	31	1.4	0-7	3%	68%	0.1	0-1	1%	92%	0	0-0	0%	100%
E	Arrival	31	3.3	0-17	8%	57%	1.8	0-8	11%	67%	0	0-0	0%	100%
F	Departure	13	10.3	0-14	25%	1%	3.6	0-4	22%	1%	1.1	0-2	75%	31%
G	Departure	13	5.2	0-9	13%	1%	2.4	0-4	15%	1%	0	0-0	0%	100%
H	Departure	31	3	0-14	7%	59%	1.1	0-4	7%	75%	0.4	0-2	25%	90%
I	Departure	31	1.5	0-9	4%	64%	0.7	0-4	4%	76%	0	0-0	0%	100%

3.5.2 Single-event noise contours

Single-event noise contours are useful in demonstrating the difference that can be expected from individual flights. The number of combinations of aircraft and tracks flown at SCA makes it impractical to compare contours for each of these. Instead the typical operation of a 737-700 has been examined in detail, for both arrival and departure operations. This aircraft was selected because it is present in both "Do Minimum" and "New Runway" scenarios and is typical of the most common RPT jets in the forecast schedules. The difference in noise level from these operations would be typical of other aircraft on similar typical approach or departure tracks.

Figure 3.5e and **Figure 3.5f** present a composite of maximum noise levels. It is clear that localities north and south of the airport are predicted to experience reduced noise levels from equivalent typical operations as a result of the AEP. Twin Waters, Maroochydore, Buderim, Alexandra Headland, Yaroomba, Point Arkwright and part of Marcoola and Mount Coolum are all expected to benefit. Noise levels from these typical operations are predicted to be 10-20+ dB quieter in these areas.

Marcoola (south-east of SCA) and Mudjimba are the most densely populated areas predicted to experience an increase in aircraft noise levels from typical RPT operations. Noise levels in these areas are predicted to be 5-10 dB louder during departures and 10-20 dB louder during arrivals. These impacts are examined in more detail in Chapter D5. Less populated parts of Bli Bli, Maroochy River, Coolum (inland parts) and Yandina Creek are predicted to receive increased noise levels from overflights.

In addition to the analysis of typical arrival and departure operations, **Figure 3.5g** to **Figure 3.5v** present maximum noise contours for each of the RPT jets at SCA, on all tracks predicted to be flown by those aircraft. Contours show the maximum noise level, from all tracks flown by that aircraft, for that scenario ("Do Minimum" or "New Runway") and stage length (see below).

Contours are shown for departures and arrivals in the year 2040. (Hence the contours include some operations which currently do not occur for these aircraft). No "Do Minimum" scenario is presented for B787 and A330 because wide-bodied jets are not permitted in this scenario.

The majority of figures clearly demonstrate the different noise exposures from equivalent arriving and departing aircraft. Departing aircraft ascend more quickly than arriving aircraft descend. Furthermore, departing aircraft will not use the entire length of the runway, meaning that they will have gained altitude before passing over the end of the runway (threshold). In contrast, arriving aircraft descend the final approach at a steady descent of approximately 3°, and aim to touch down approximately 300 m from the runway threshold. Therefore departing aircraft will be more elevated beyond the runway end than an equivalent arriving aircraft. This increased altitude results in lower noise levels on the ground for most aircraft (e.g. A320, B787).

Very near to the runway end, departures can actually produce greater noise levels primarily due to greater thrust required during take-offs. Departing aircraft noise levels are also dependent on the stage-length (i.e. how far the departing aircraft will travel), which dictates how much fuel is carried. The increased weight of large fuel loads can cause departing aircraft to ascend more slowly, remaining at a relatively low altitude, and also to require greater thrust. This combination of reduced altitude and increased thrust can result in greater departure noise footprints, and in some cases departures can be louder than arrivals near the runway end (e.g. see B737-800).

The wide-bodied jets (B787 and A330) are predicted to produce the greatest noise levels. Narrow-bodied jets are predicted to produce slightly lesser noise levels, with the A320, B737-700 and B737-800 footprints being similar.

Figure 3.5e: Typical single-event maximum noise contours – B737-700 arrivals comparison of New Runway and Do Minimum

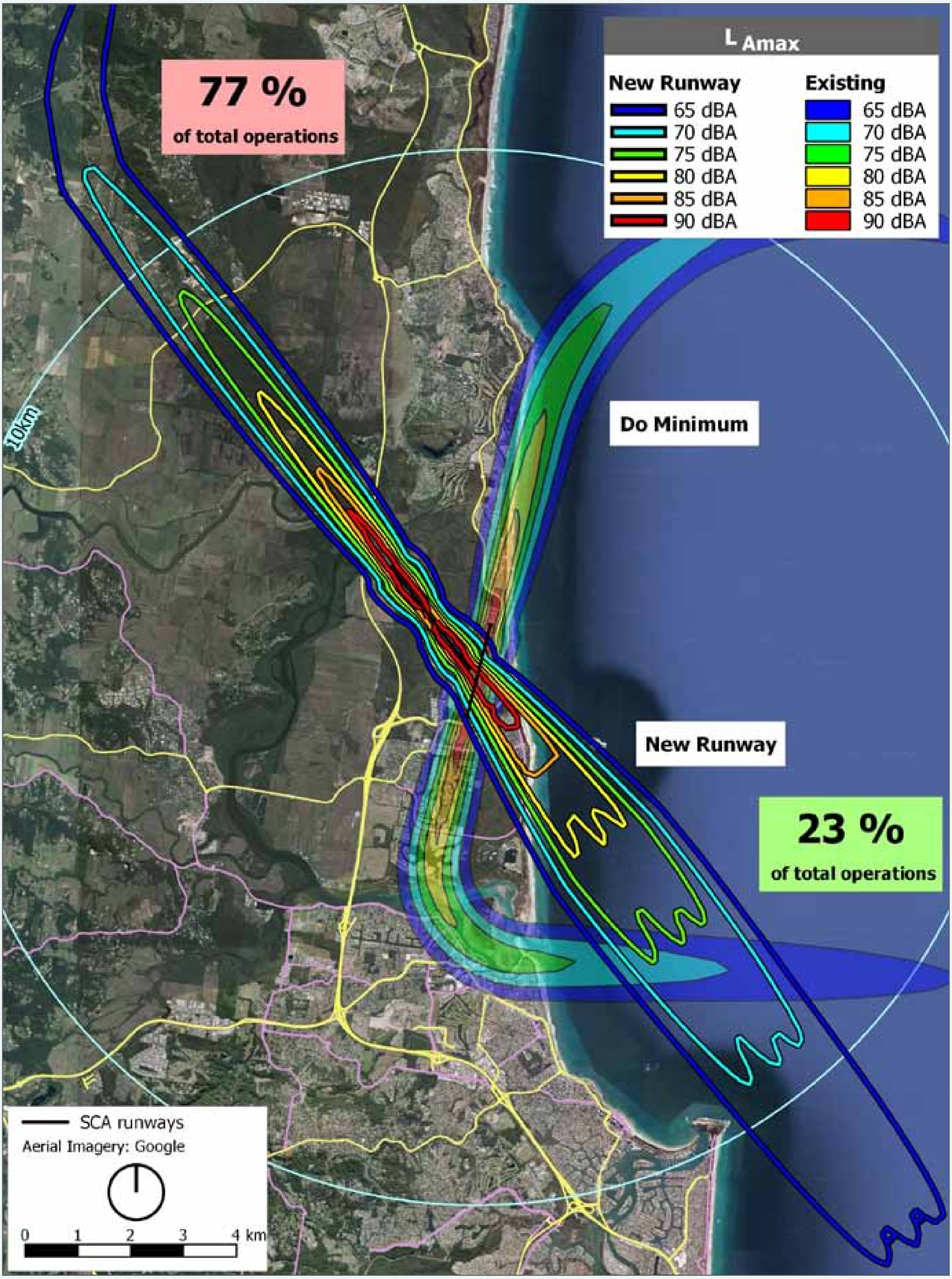


Figure 3.5f: Typical single-event maximum noise contours – B737-700 departures comparison of New Runway and Do Minimum

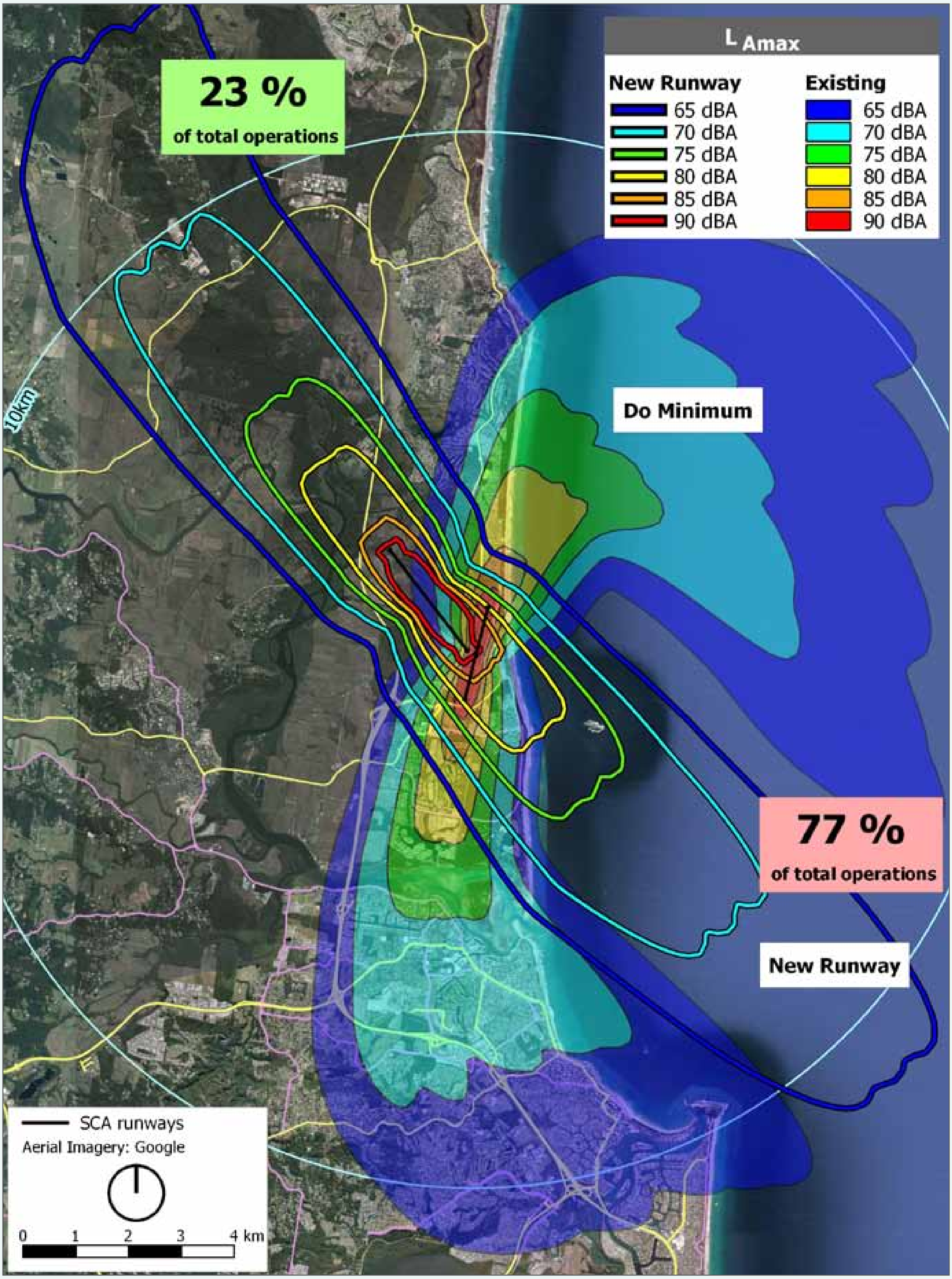
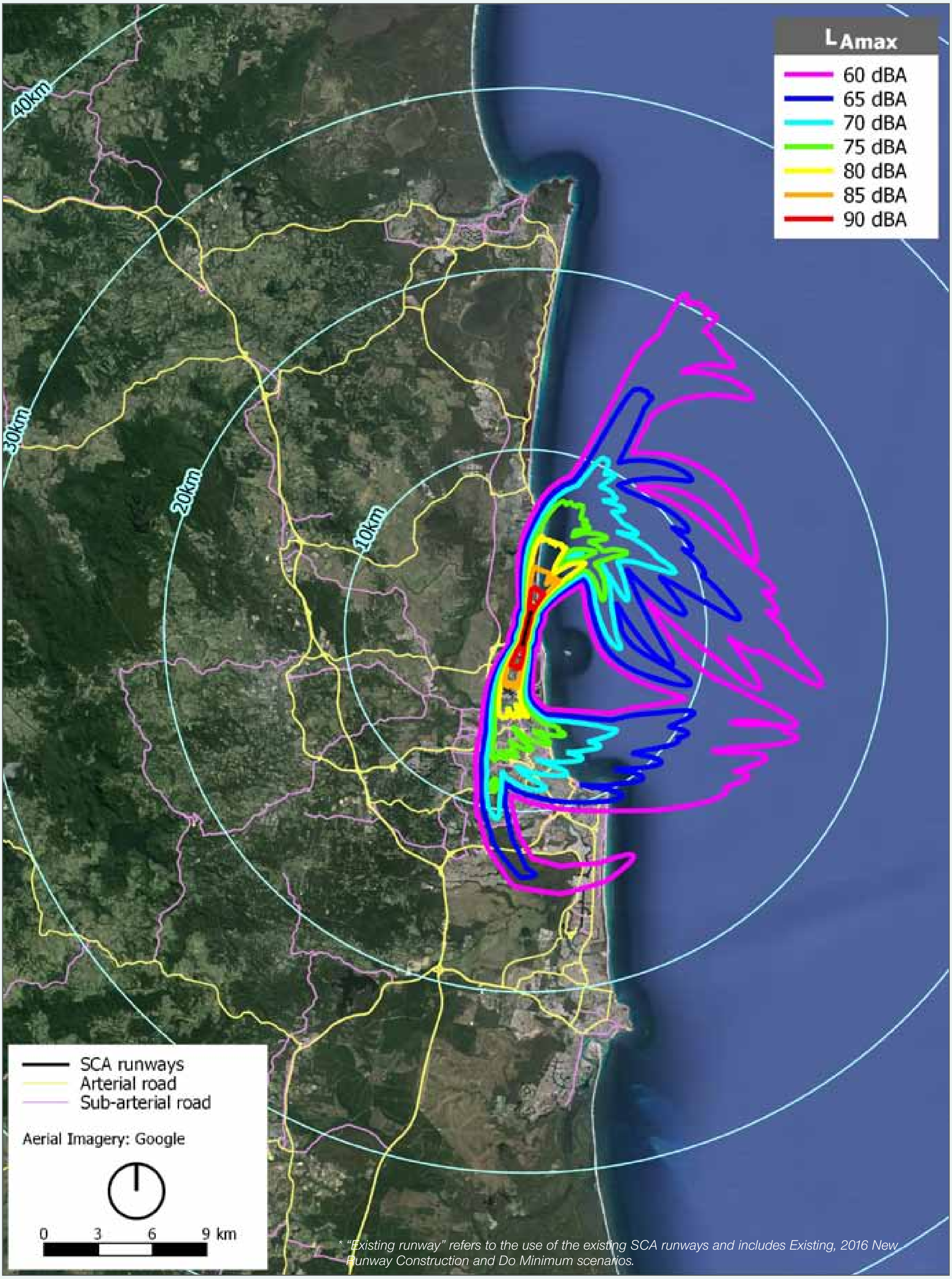


Figure 3.5g: Maximum noise contours – B737-700 arrivals, Existing runway*



* "Existing runway" refers to the use of the existing SCA runways and includes Existing, 2016 New Runway Construction and Do Minimum scenarios.

Figure 3.5h: Maximum noise contours – B737-700 arrivals, New Runway

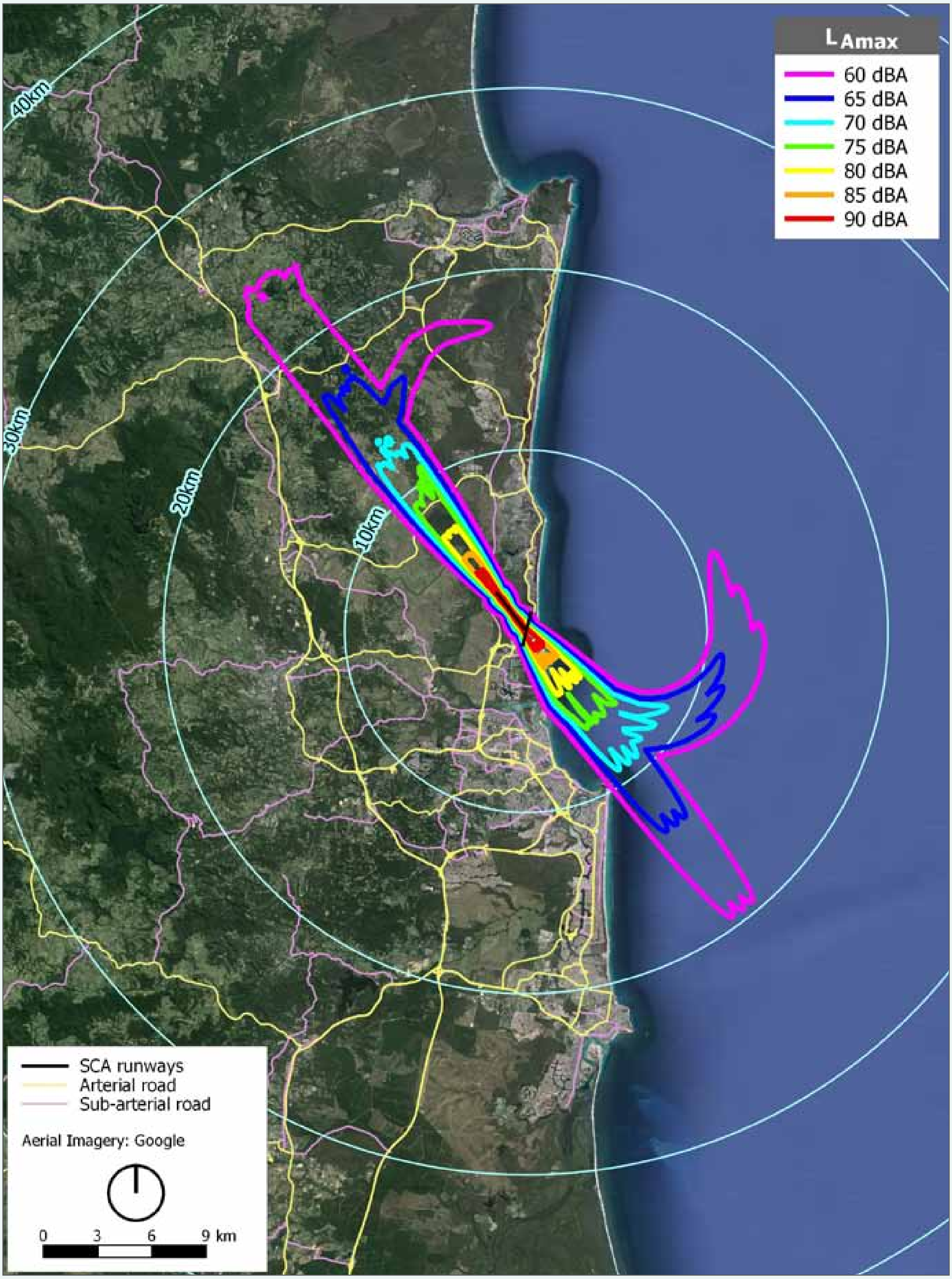
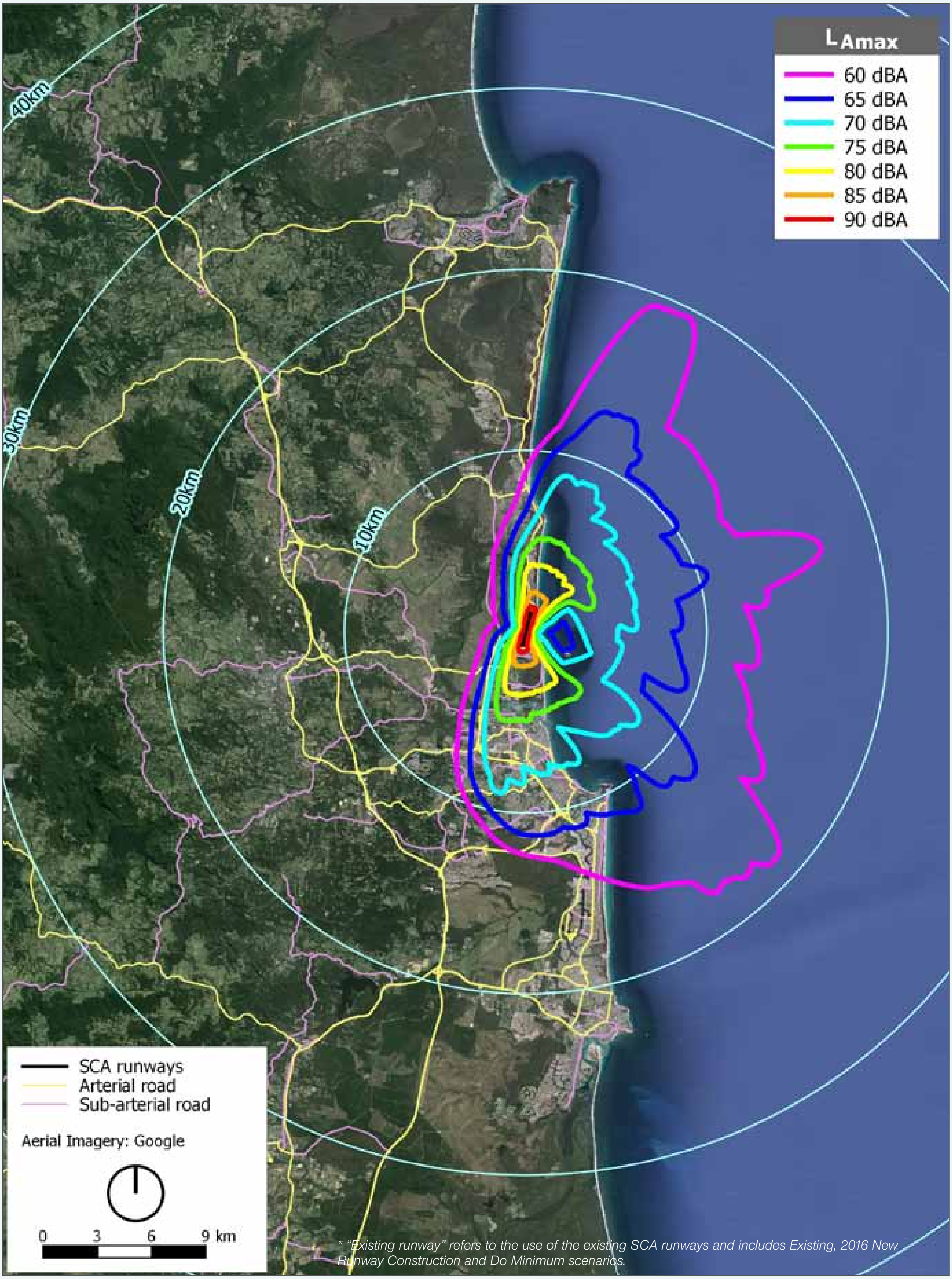


Figure 3.5i: Maximum noise contours – B737-700 departures, Existing runway*



* "Existing runway" refers to the use of the existing SCA runways and includes Existing, 2016 New Runway Construction and Do Minimum scenarios.

Figure 3.5j: Maximum noise contours – B737-700 departures, New Runway

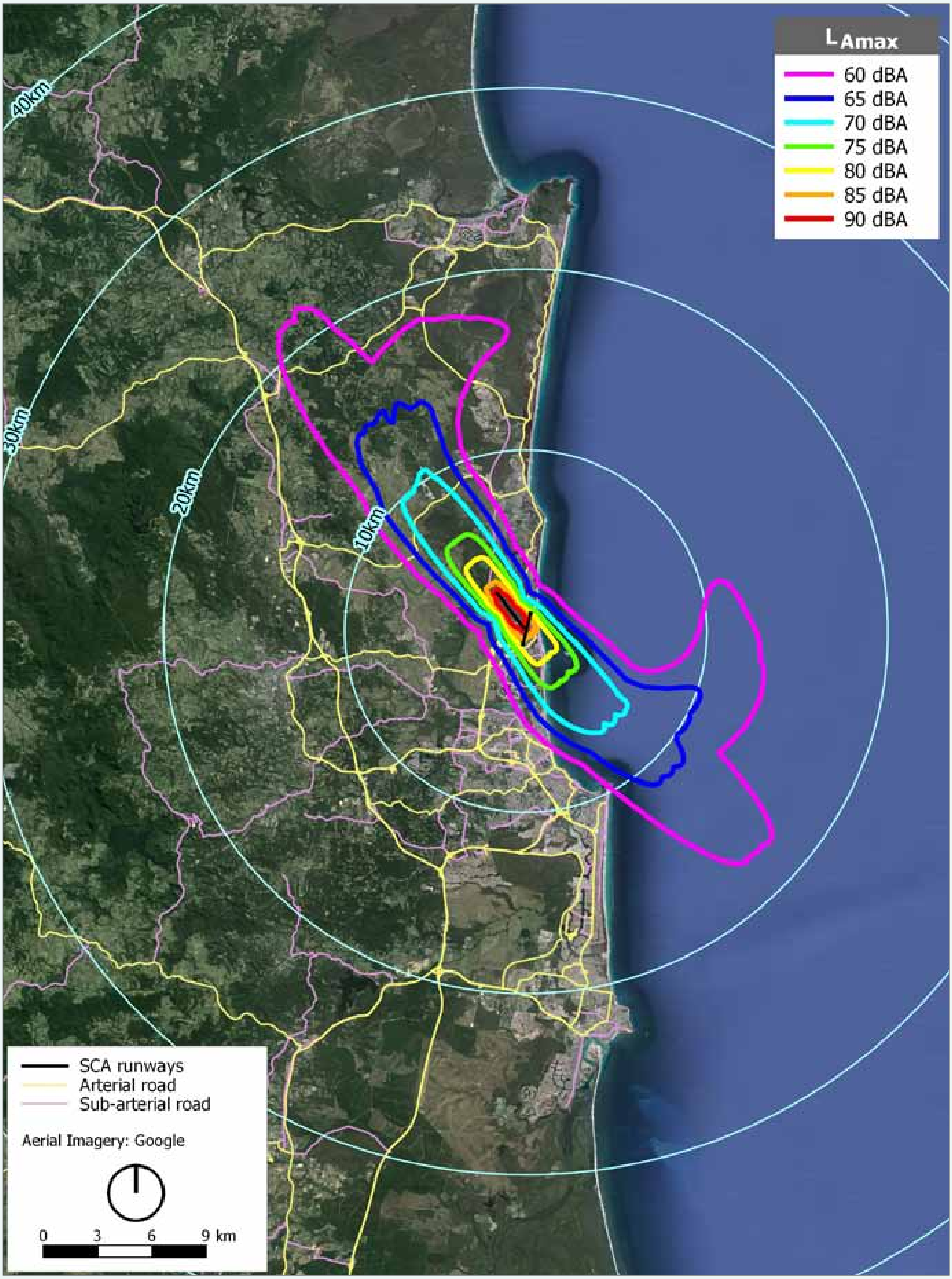
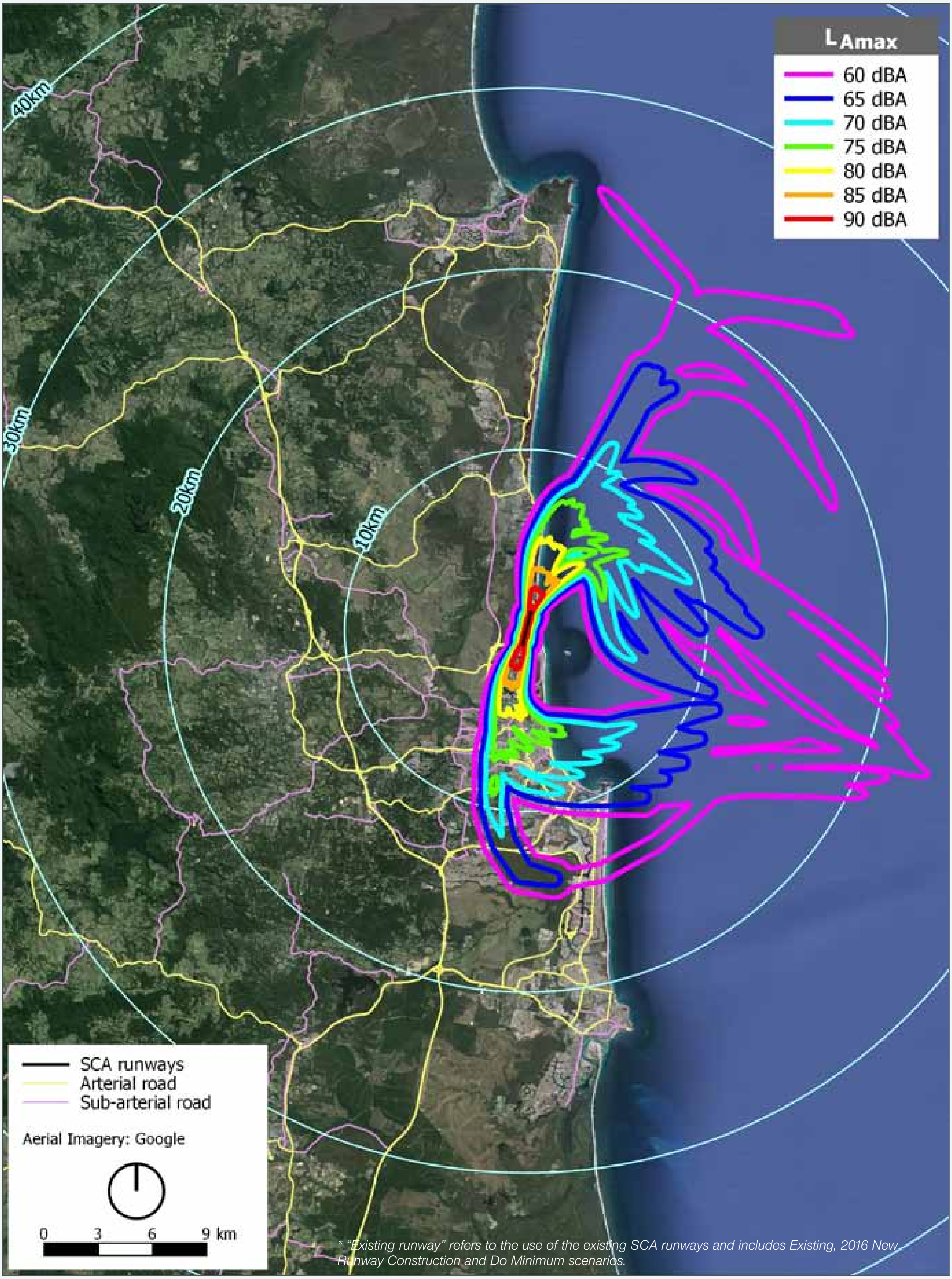


Figure 3.5k: Maximum noise contours – B737-800 arrivals, Existing runway*



* "Existing runway" refers to the use of the existing SCA runways and includes Existing, 2016 New Runway Construction and Do Minimum scenarios.

Figure 3.5l: Maximum noise contours – B737-800 arrivals, New Runway

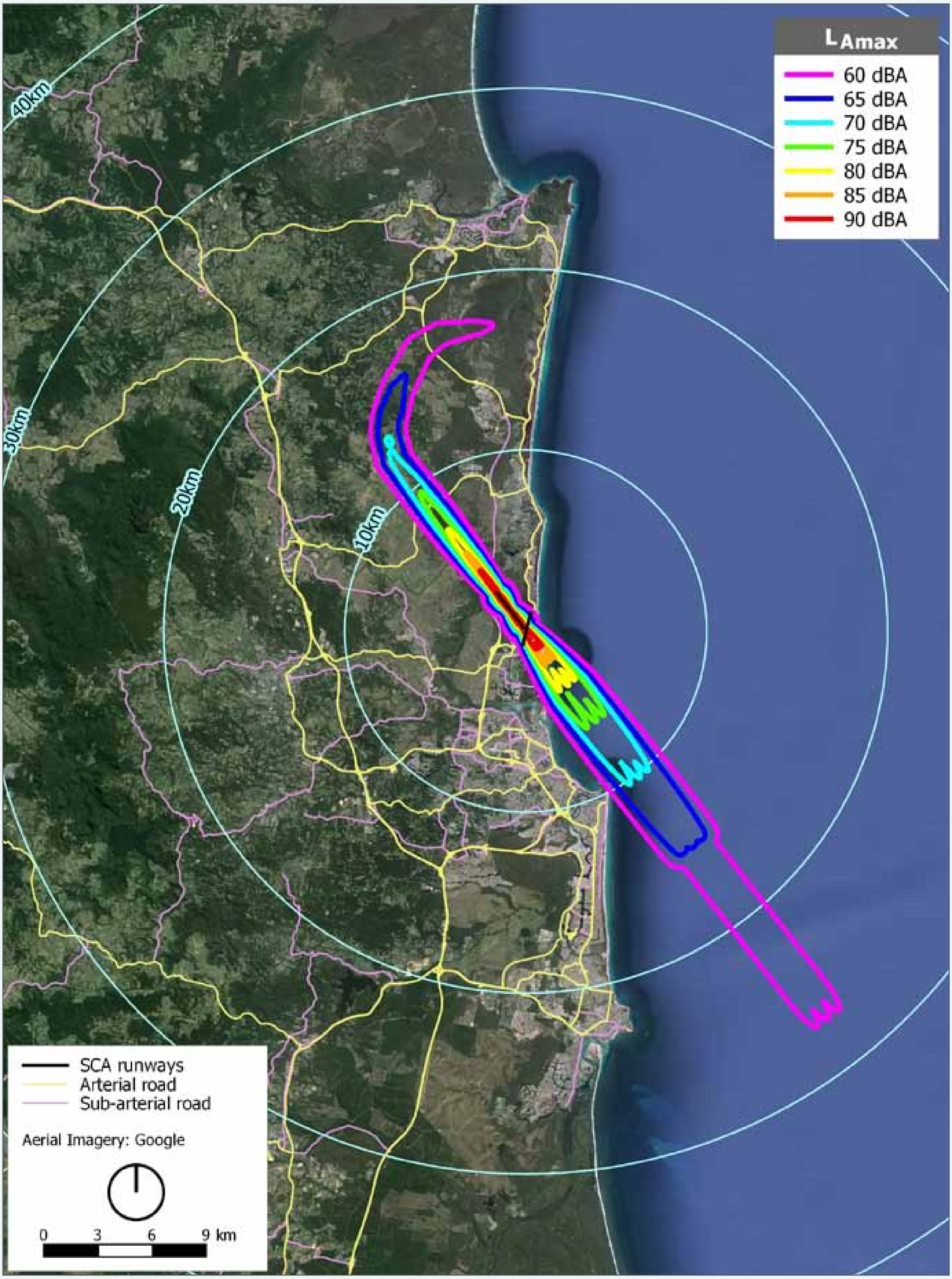
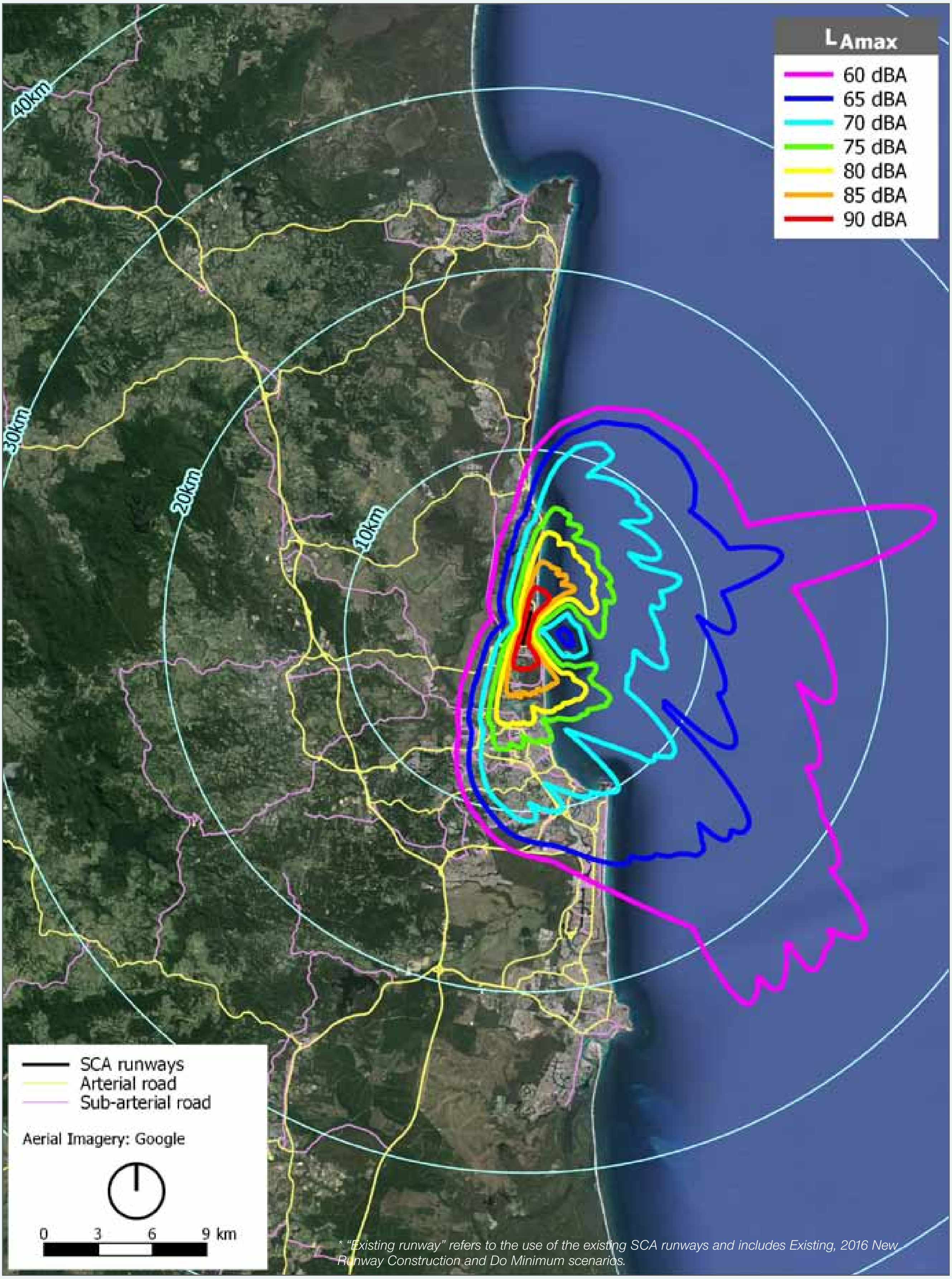


Figure 3.5m: Maximum noise contours – B737-800 departures, Existing runway*



* "Existing runway" refers to the use of the existing SCA runways and includes Existing, 2016 New Runway Construction and Do Minimum scenarios.

Figure 3.5n: Maximum noise contours – B737-800 departures, New Runway

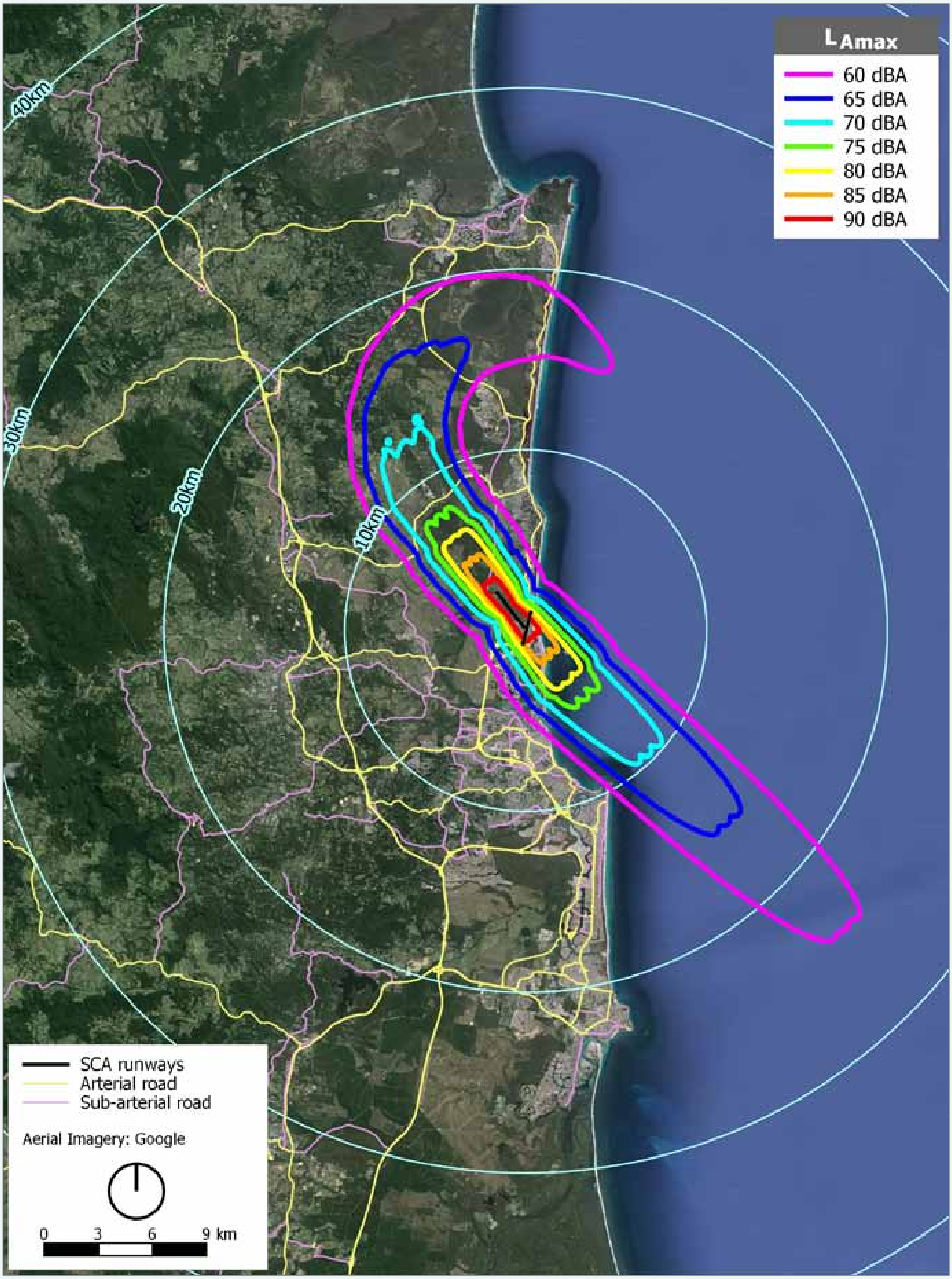
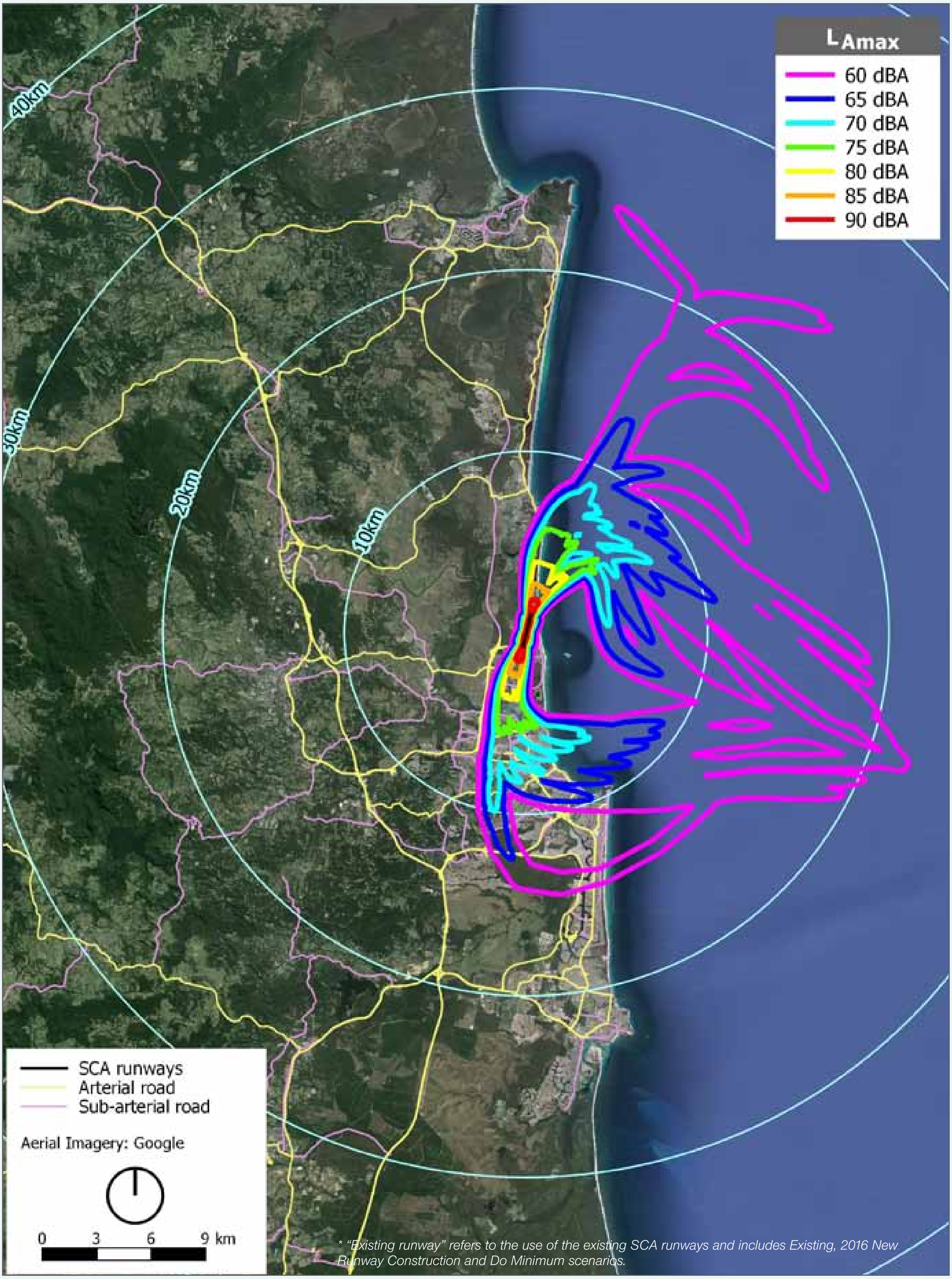


Figure 3.5o: Maximum noise contours – A320 arrivals, Existing runway*



* "Existing runway" refers to the use of the existing SCA runways and includes Existing, 2016 New Runway Construction and Do Minimum scenarios.

Figure 3.5p: Maximum noise contours – A320 arrivals, New Runway

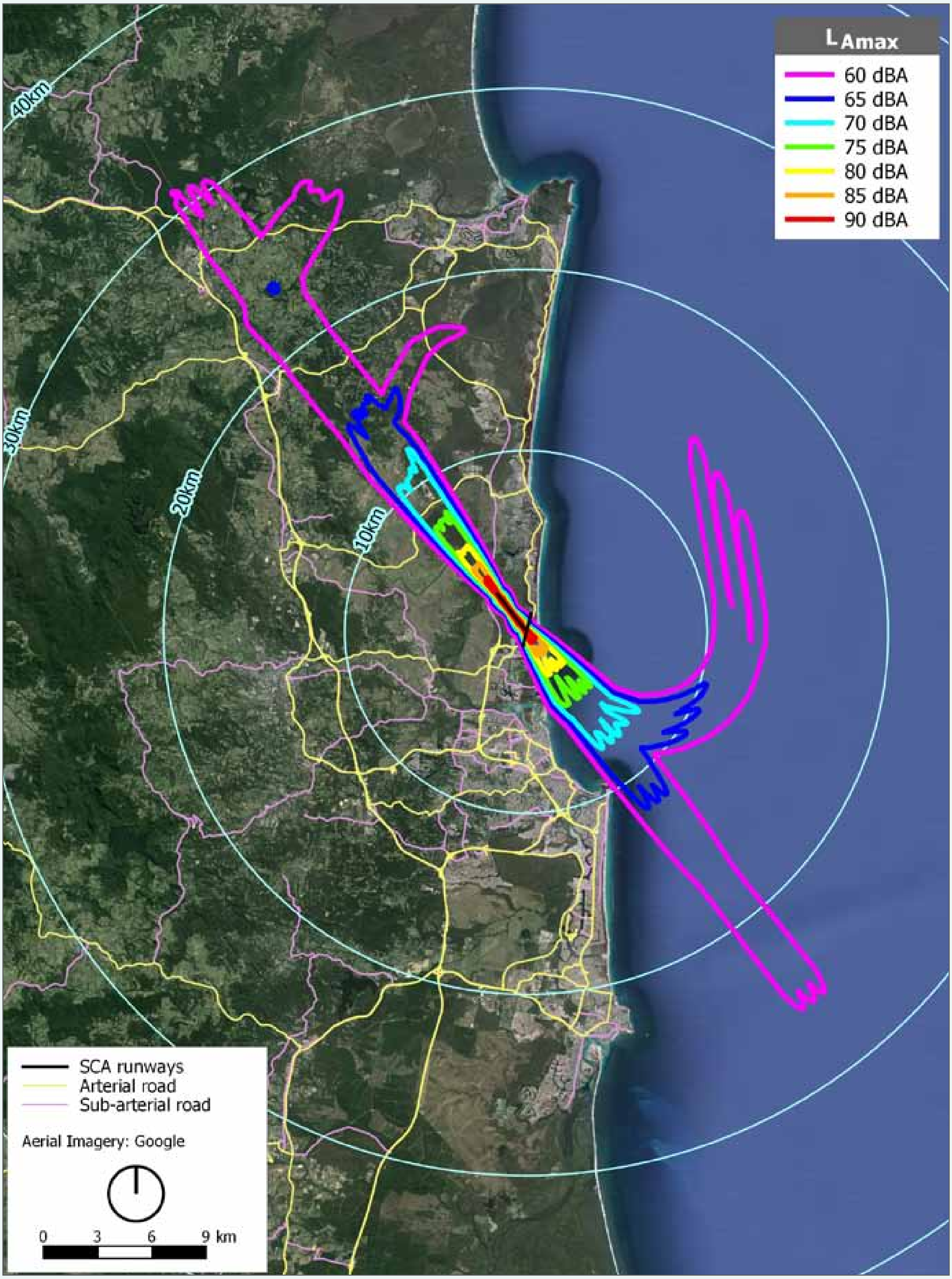
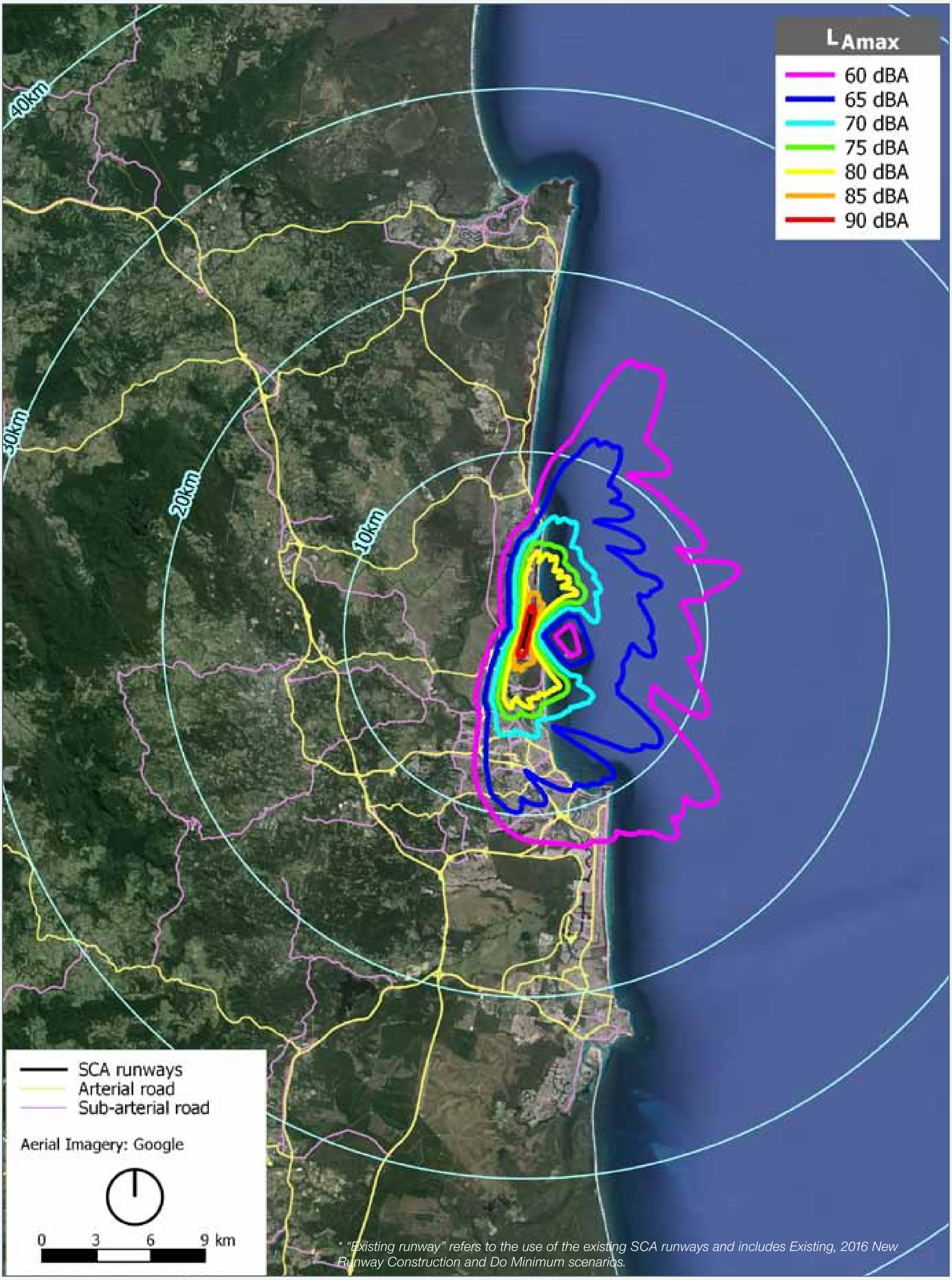


Figure 3.5q: Maximum noise contours – A320 departures, Existing runway*



* "Existing runway" refers to the use of the existing SCA runways and includes Existing, 2016 New Runway Construction and Do Minimum scenarios.

Figure 3.5r: Maximum noise contours – A320 departures, New Runway

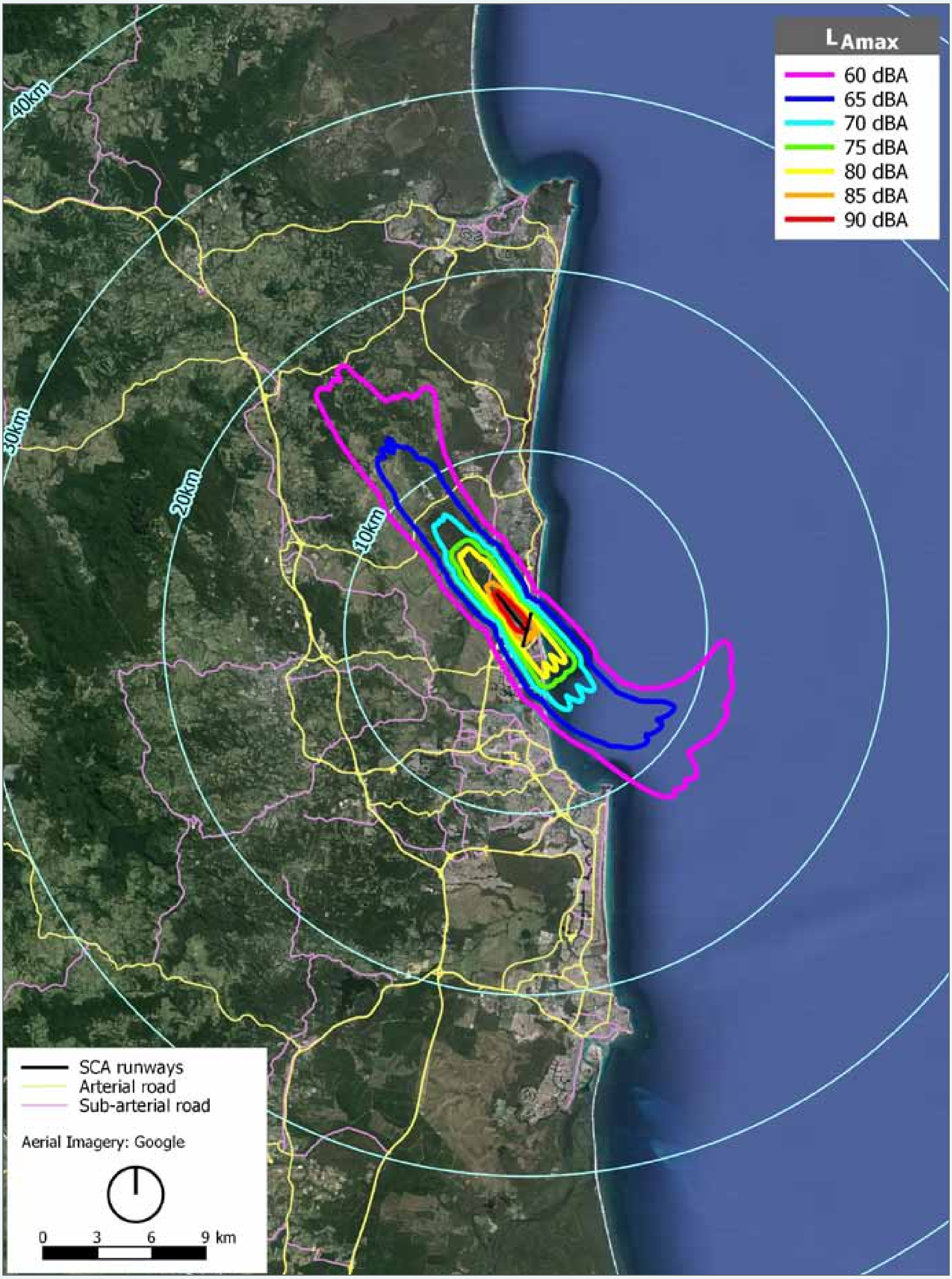


Figure 3.5s: Maximum noise contours – B7878R arrivals, New Runway

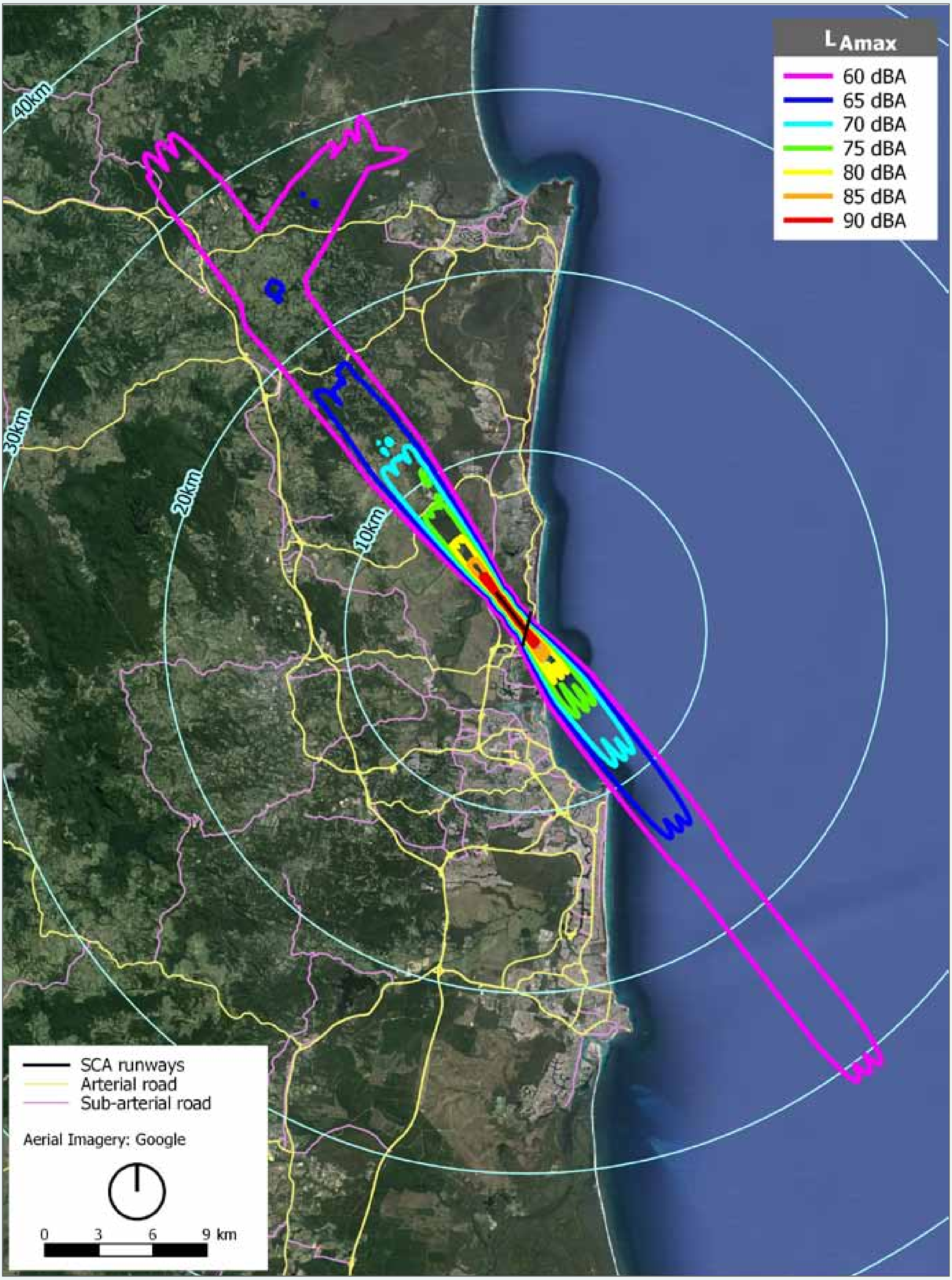


Figure 3.5t: Maximum noise contours – B7878R departures, New Runway

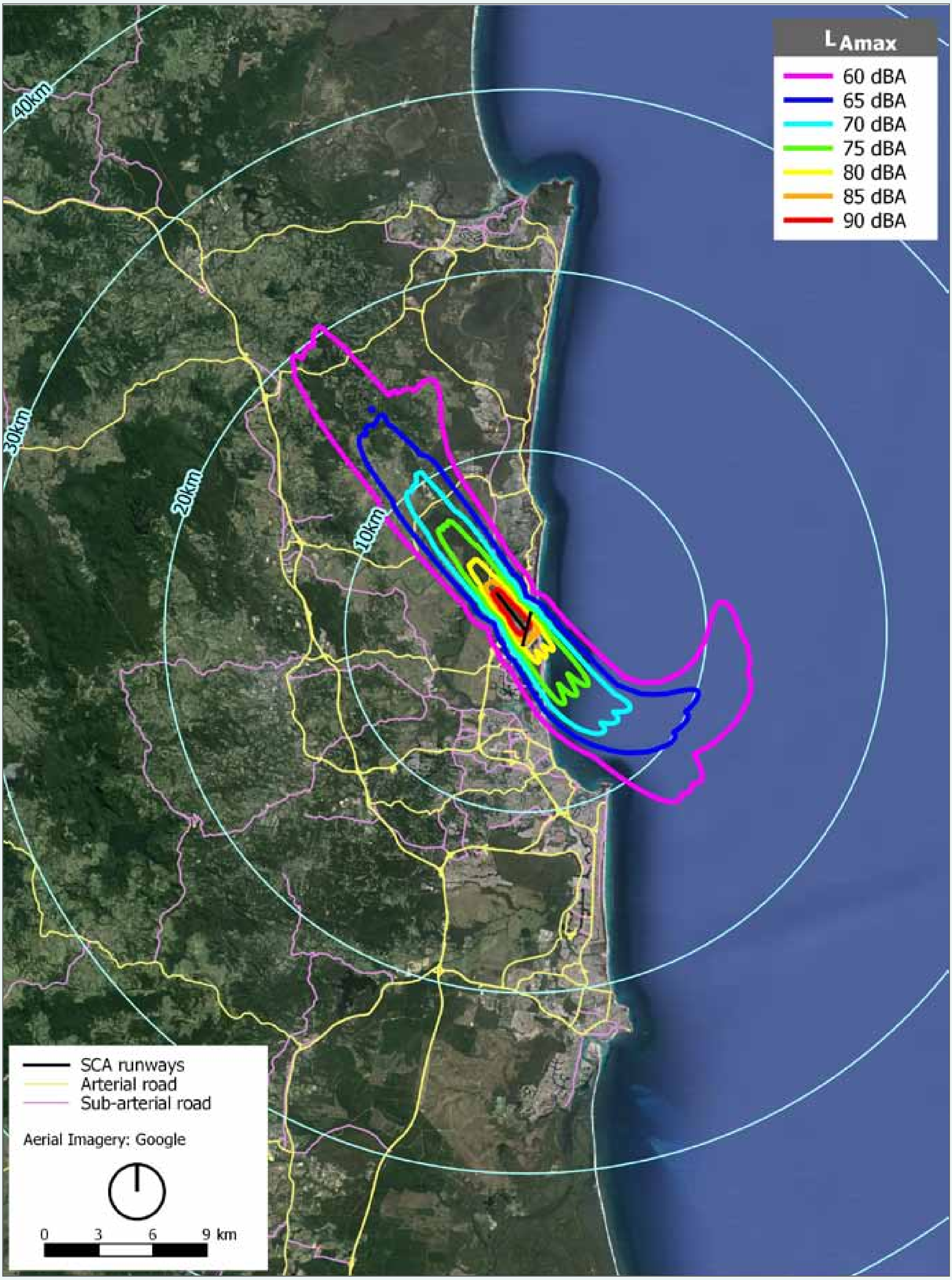


Figure 3.5u: Maximum noise contours – A330 arrivals, New Runway

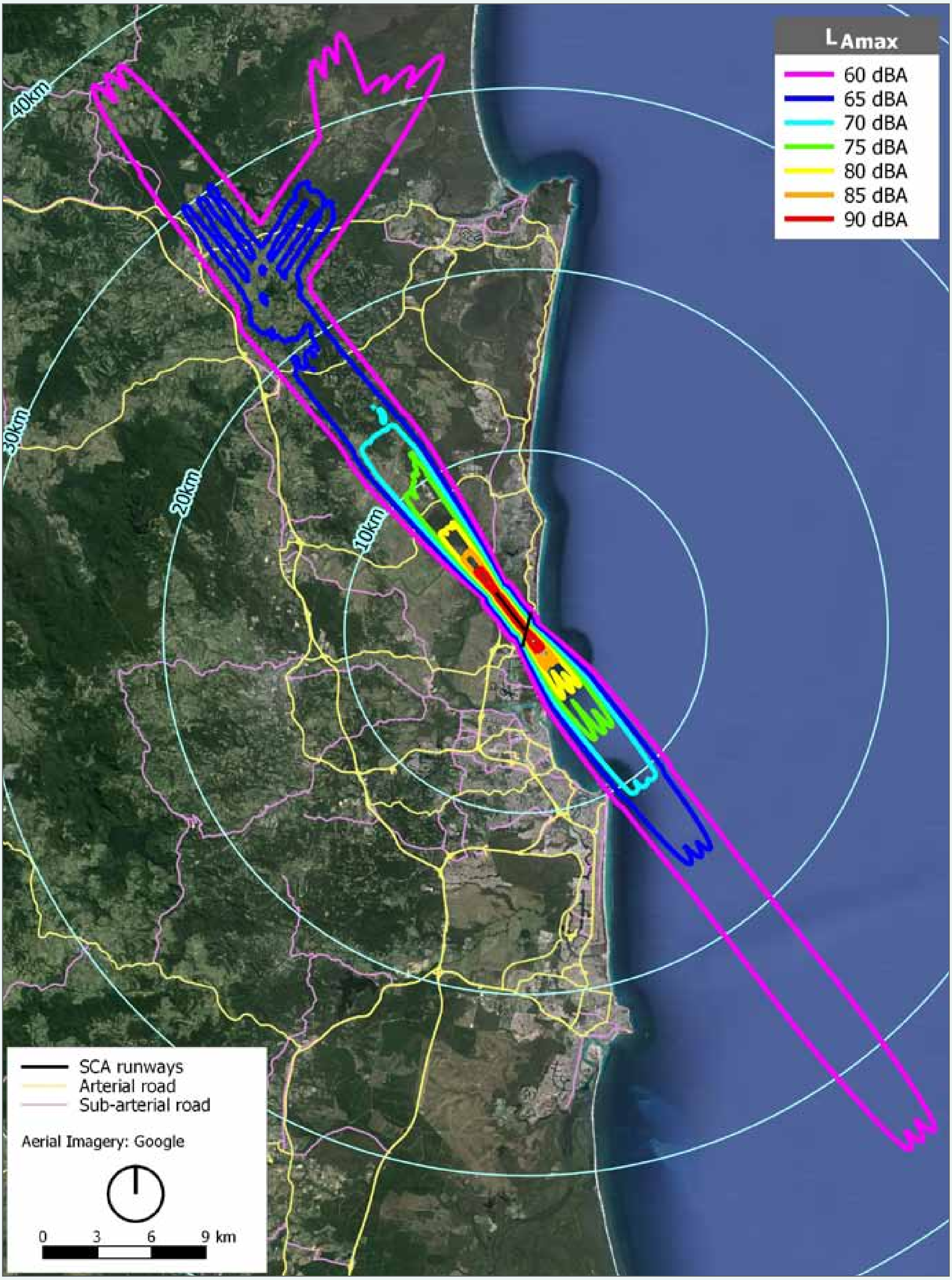
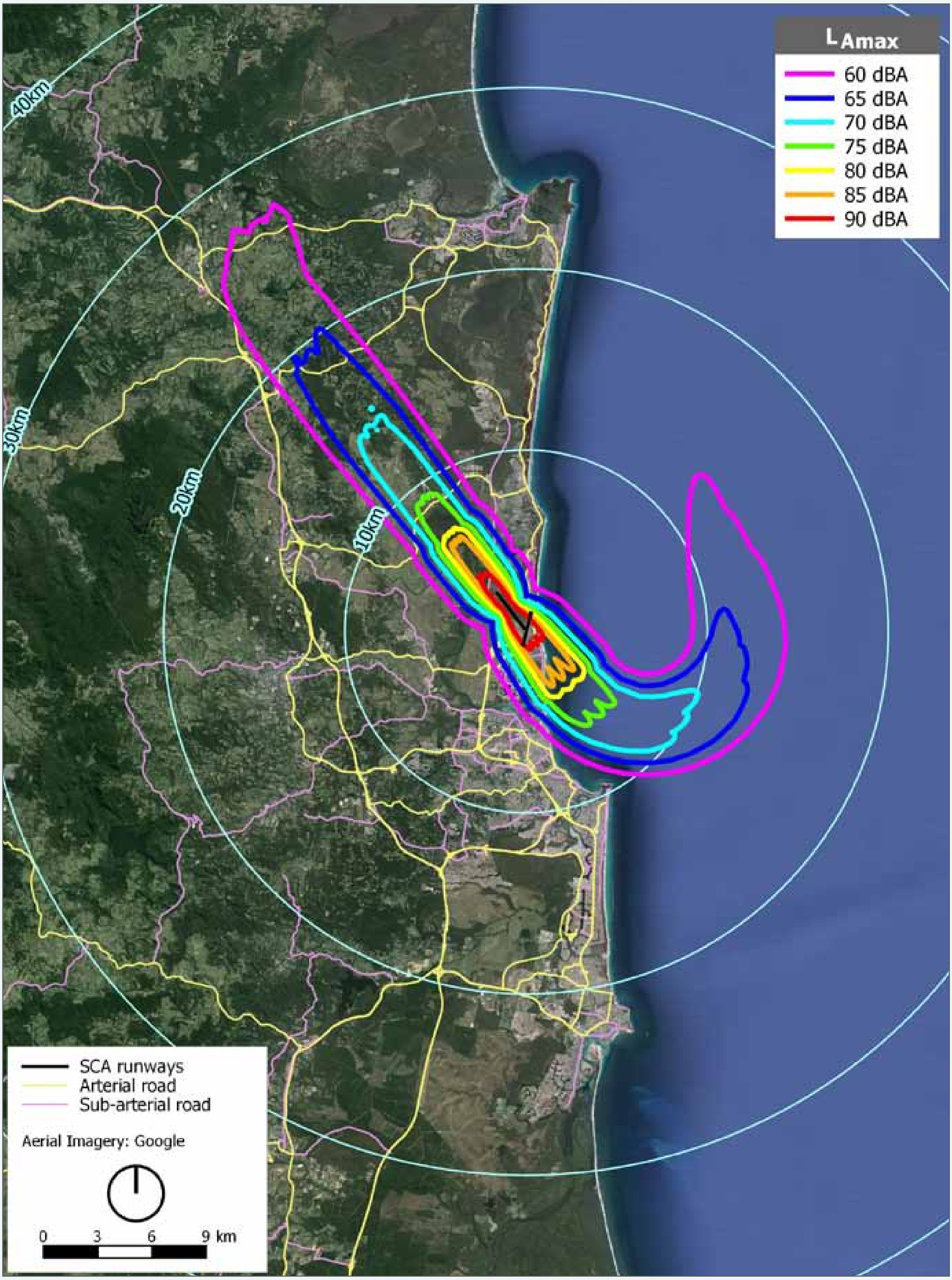


Figure 3.5v: Maximum noise contours – A330 departures, New Runway



3.5.3 N70 and N60 noise contours – future fixed wing

This section first presents N70 contours for the daytime (7am – 6pm) and evening (6pm – 10pm) periods, and N60 contours for the night period (10pm – 7am).

3.5.3.1 Fixed-wing daytime and evening periods

Figure 3.5w and **Figure 3.5x** present N70 contours for summer and winter.

They show that there is little difference between the summer and winter seasons for the New Runway scenario – during summer meteorology (e.g. wind and rain; predominantly cross winds) more frequently prohibits GA from using Runway 13/31, hence more GA operations occur on Runway 18/36, producing slightly greater N70 values at its runway ends.

As with the Existing scenario, in the Do Minimum scenario, meteorological conditions dictate that Runway 18 is used more often in winter. This is characterised by the N70 contour being biased toward the north during winter, and the south during summer (corresponding to the direction which is overflown by more arriving aircraft). This is most notable in the "N70 equals 5" contour, largely because the number of operations with the loudest jets slightly exceeds 20 (10+ arrivals, 10+ departures). Hence the imbalance between Runway 18 and runway 36 means that the loudest operations (i.e. arrivals) slightly exceed or are slightly below the threshold of 5 events (i.e. "N70 equals 5"). This difference is far less pronounced in other N70 contours, and indeed other Existing or Do Minimum scenarios. In order to streamline the information presented in this chapter, figures are presented only for the summer season.

Weekend periods have only slightly fewer scheduled flights than weekday and this is reflected in the N70 contours for each scenario. Hence only weekday figures are presented in the body of this chapter.

Figure 3.5y to **Figure 3.5ah** present the predicted fixed wing N70 contours for all future scenarios for the summer weekday day and evening periods. **Appendix D3:B** shows calculated N70 contours for all periods – summer and winter, weekday and weekend, day, and evening, for all assessment scenarios.

Noise exposure is seen to grow gradually from 2012 to 2040 as a result of increasing numbers of events. This progression is evident in the "2012 Existing", "2016 New Runway Construction", "2020 Do Minimum" and "2040 Do Minimum" scenarios.

The impact of the new runway is clearly evident in comparing the New Runway and Do Minimum scenarios. The New Runway contours are concentrated about the new runway centreline; extending north-west over greenfield areas and south-east over the ocean. This contrasts the Do Minimum contours which are concentrated about the Runway 18/36 centreline; extending north and south over residential areas along the coast.

The New Runway scenarios have a greater concentration of operations on the preferred runway (Runway 13) than Do Minimum scenarios (Runway 18). This is due to the orientation of Runway 13/31 relative to prevailing meteorological conditions. As a consequence of this more consistent usage, the majority of arriving aircraft do so from the north-west. This is reflected in the N70 contours for the New Runway scenario, which extend much farther north-west than south-east. This is most evident in the "N70 equals 5" contour of the "2040 New Runway" scenario; the contour extends 10 km north-west of the near runway threshold, and less than 8 km south-east. Contrastingly the corresponding Do Minimum "N70 equals 5" contour extends 8.3 km north, and 9.1 km south.

The differences in N70 values between New Runway and Do Minimum scenarios are presented graphically in **Figure 3.5ai** to **Figure 3.5al**.

The addition of wide-bodied jets as a consequence of the new runway has a moderate impact, and is evident in the greater extents of the "N70 equals 5" contour. However, these increased extents are largely confined to non-urban areas and so the impact is predicted to be minimal.

3.5.3.2 Fixed-wing night time periods

Appendix D3:B shows calculated N60 contours for all periods – summer and winter, weekday and weekend night, for all assessment scenarios.

There are very few fixed-wing flights scheduled during the night time period. Forecasts for 2016 and 2020 have no night time flights, whilst 2040 has two flights at night (between 6am and 7am).

Figure 3.5am and **Figure 3.5an** present only the summer weekday variant (which generally has the largest footprint). Note that as there are only two flights scheduled for the night period, the "N60 equals 1" is shown.

The change in noise as a result of the new runway is clearly evident in comparing the "New Runway" and "Do Minimum" scenarios. The "New Runway" contours are concentrated about the new runway centreline, and extend almost exclusively south-east over the ocean. This contrasts the "Do Minimum" contours which are concentrated about the Runway 18/36 centreline; extending north and south over residential areas along the coast.

The addition of wide-bodied jets as a consequence of the new runway has no impact on night time noise as operations involving these aircraft are not forecast at night.

Figure 3.5w: N70 fixed-wing contours – Do Minimum 2020 day, comparison of summer and winter

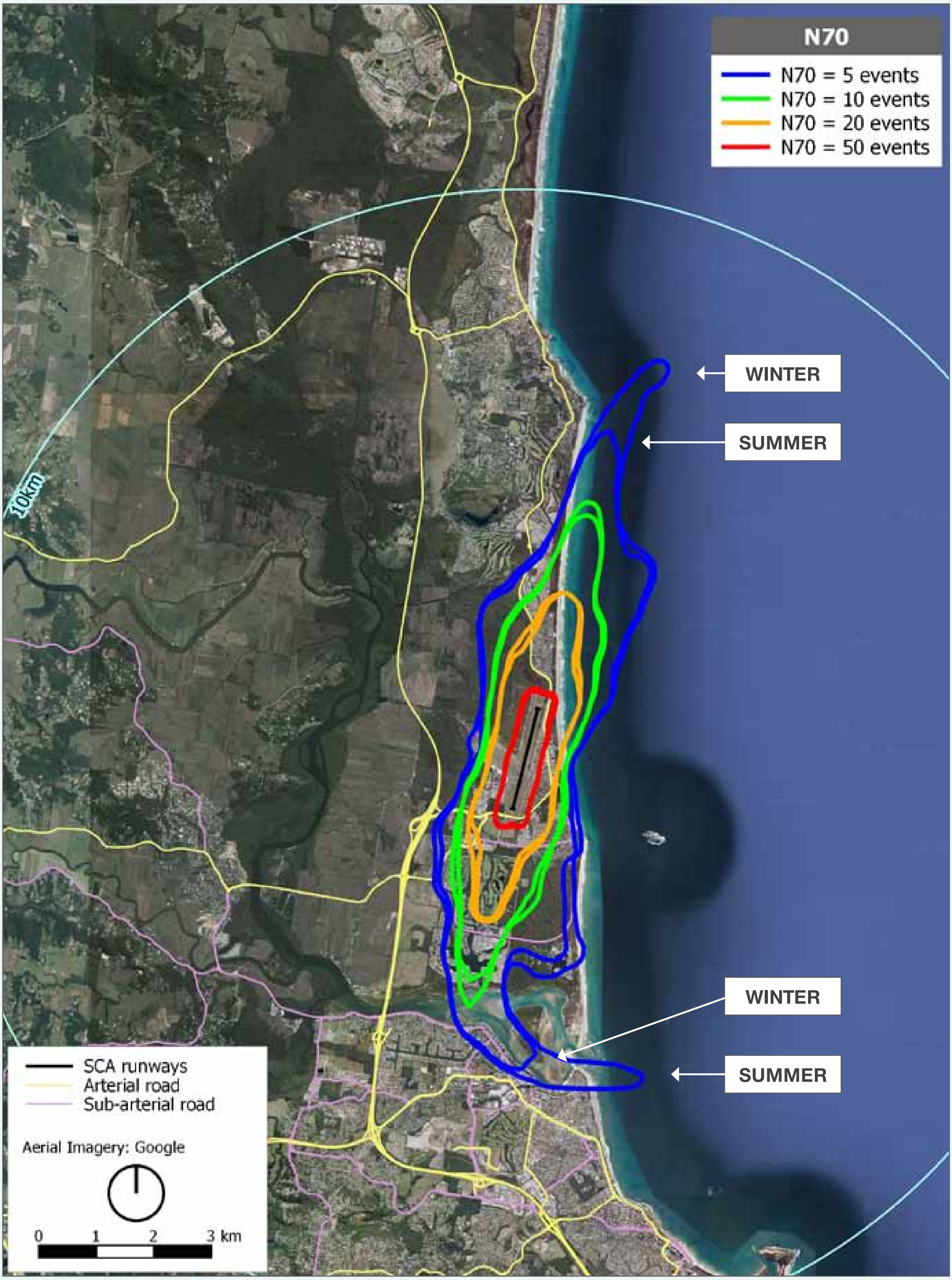


Figure 3.5x: N70 fixed-wing contours – New Runway 2020 day, comparison of summer and winter

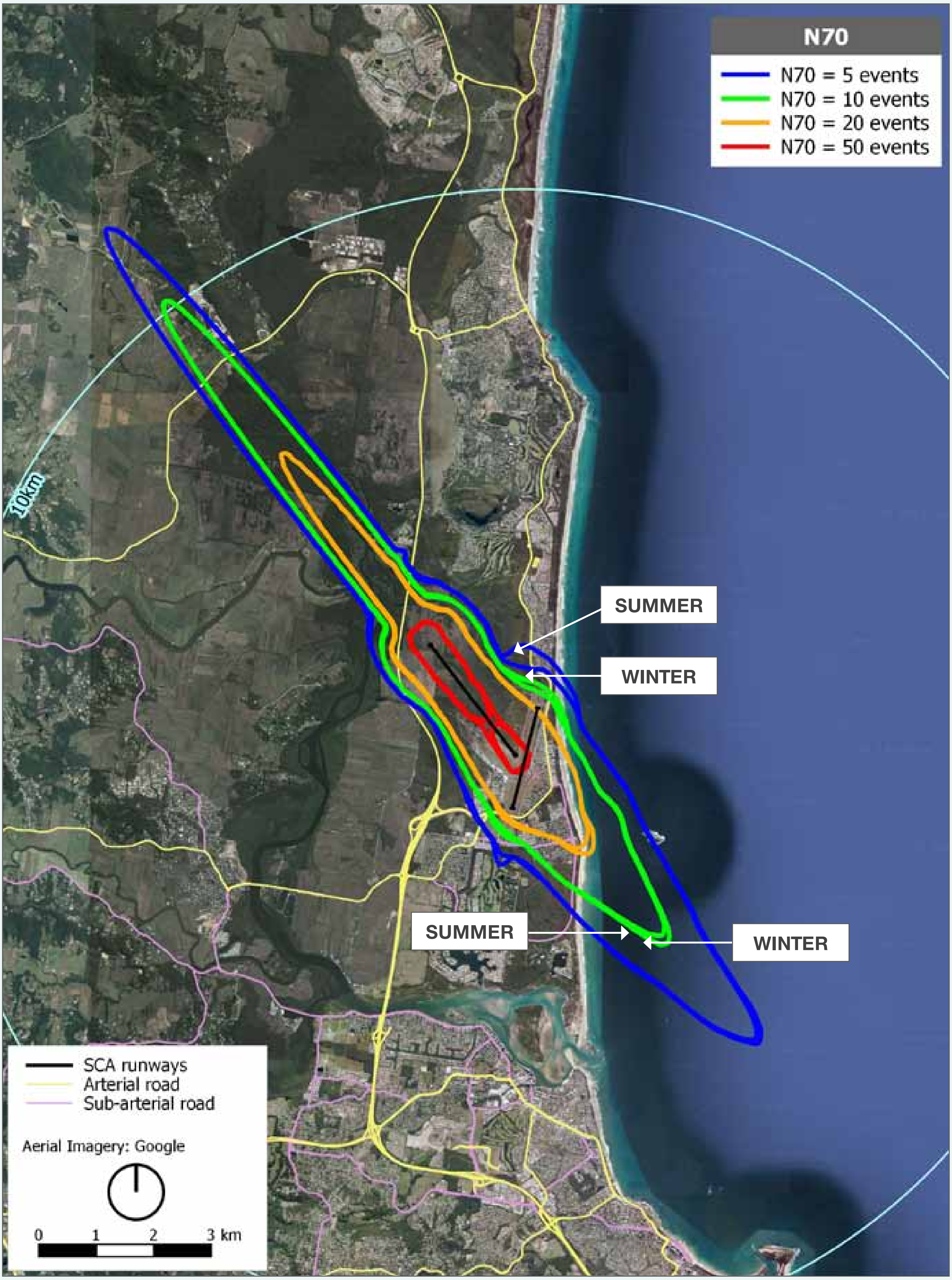


Figure 3.5y: N70 fixed-wing contours – New Runway Construction 2016 day, summer weekday

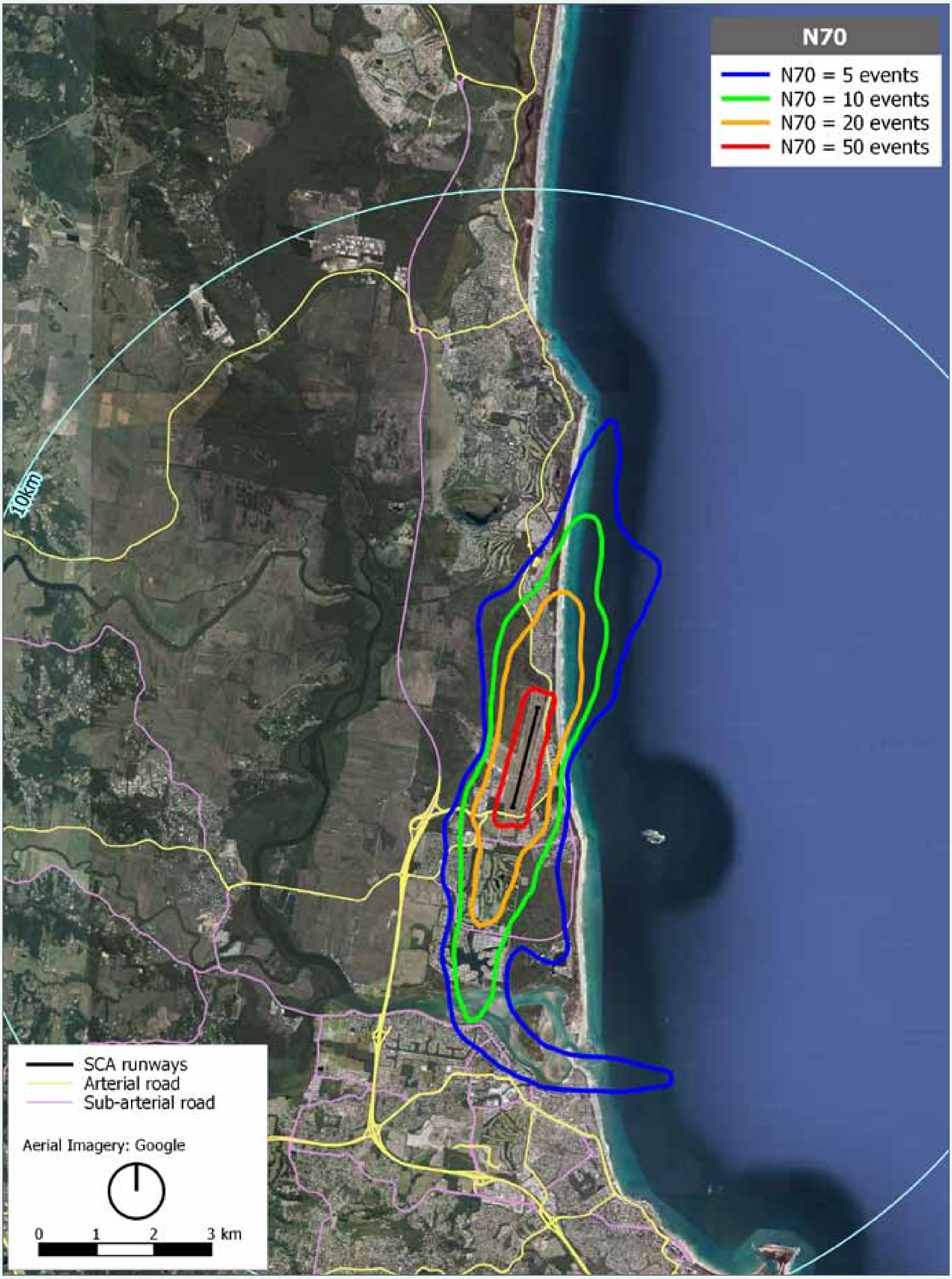


Figure 3.5z: N70 fixed-wing contours – New Runway Construction 2016 evening, summer weekday

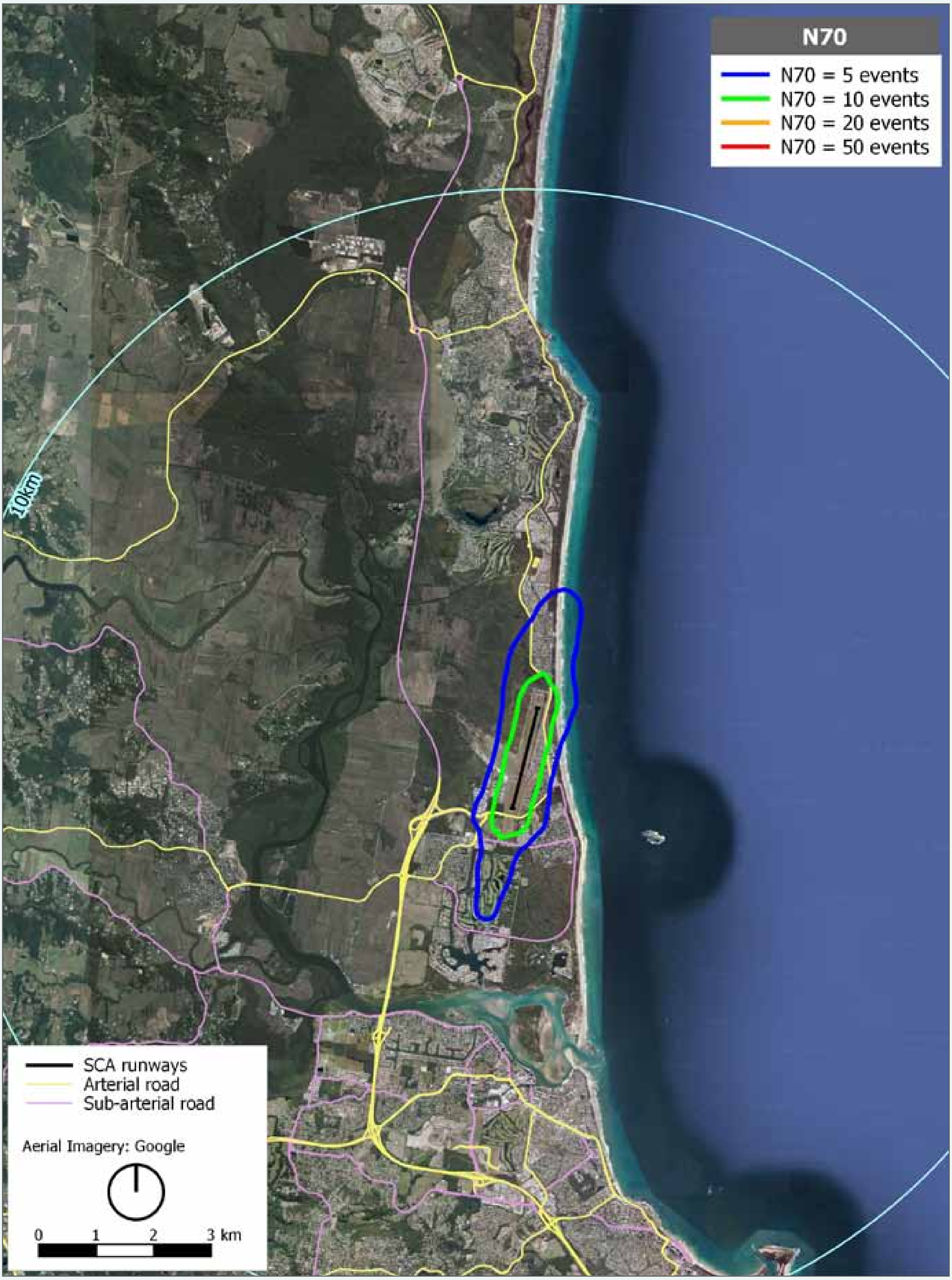


Figure 3.5aa: N70 fixed-wing contours – Do Minimum 2020 day, summer weekday

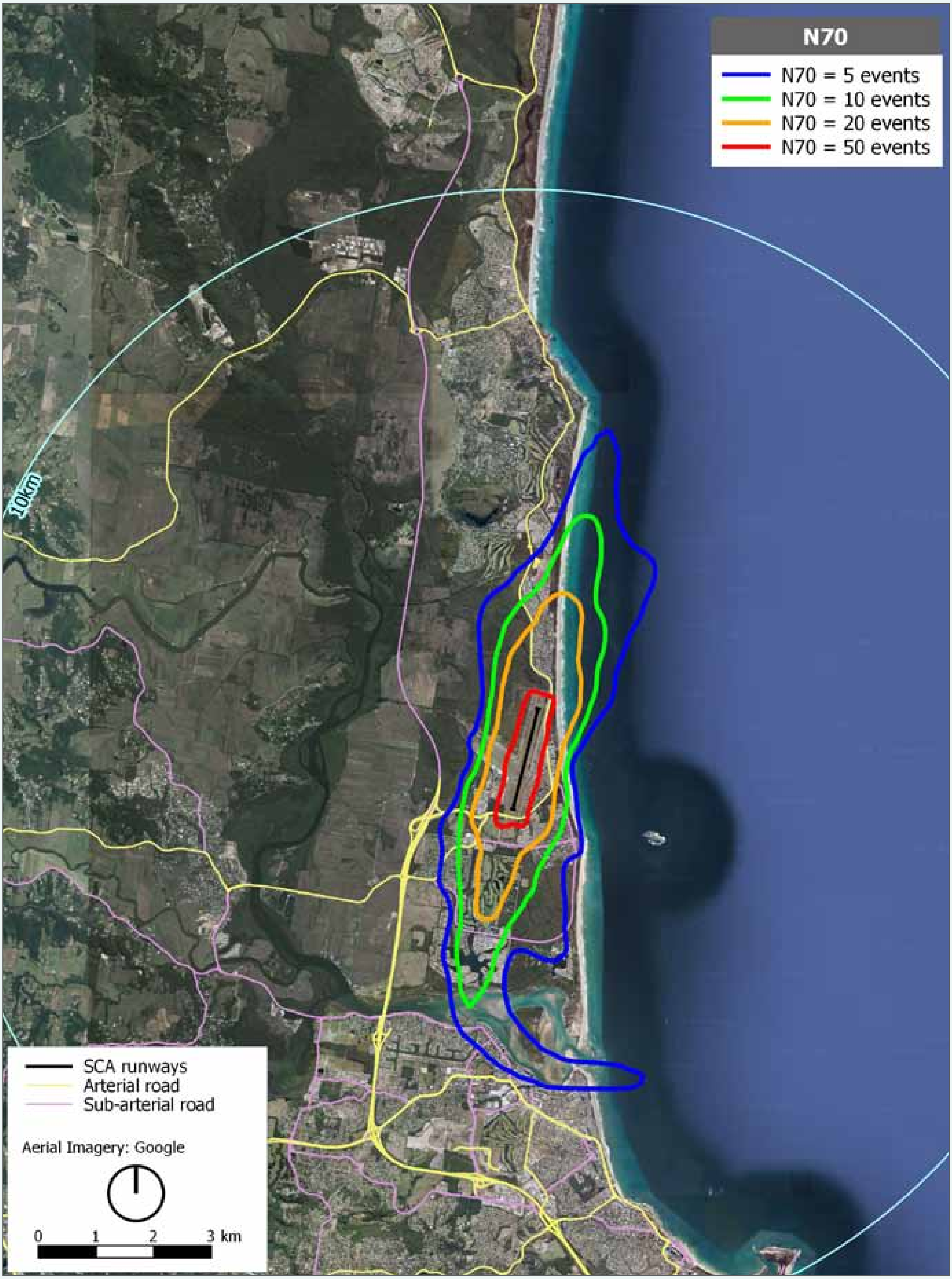


Figure 3.5ab: N70 fixed-wing contours – New Runway 2020 Day, summer weekday

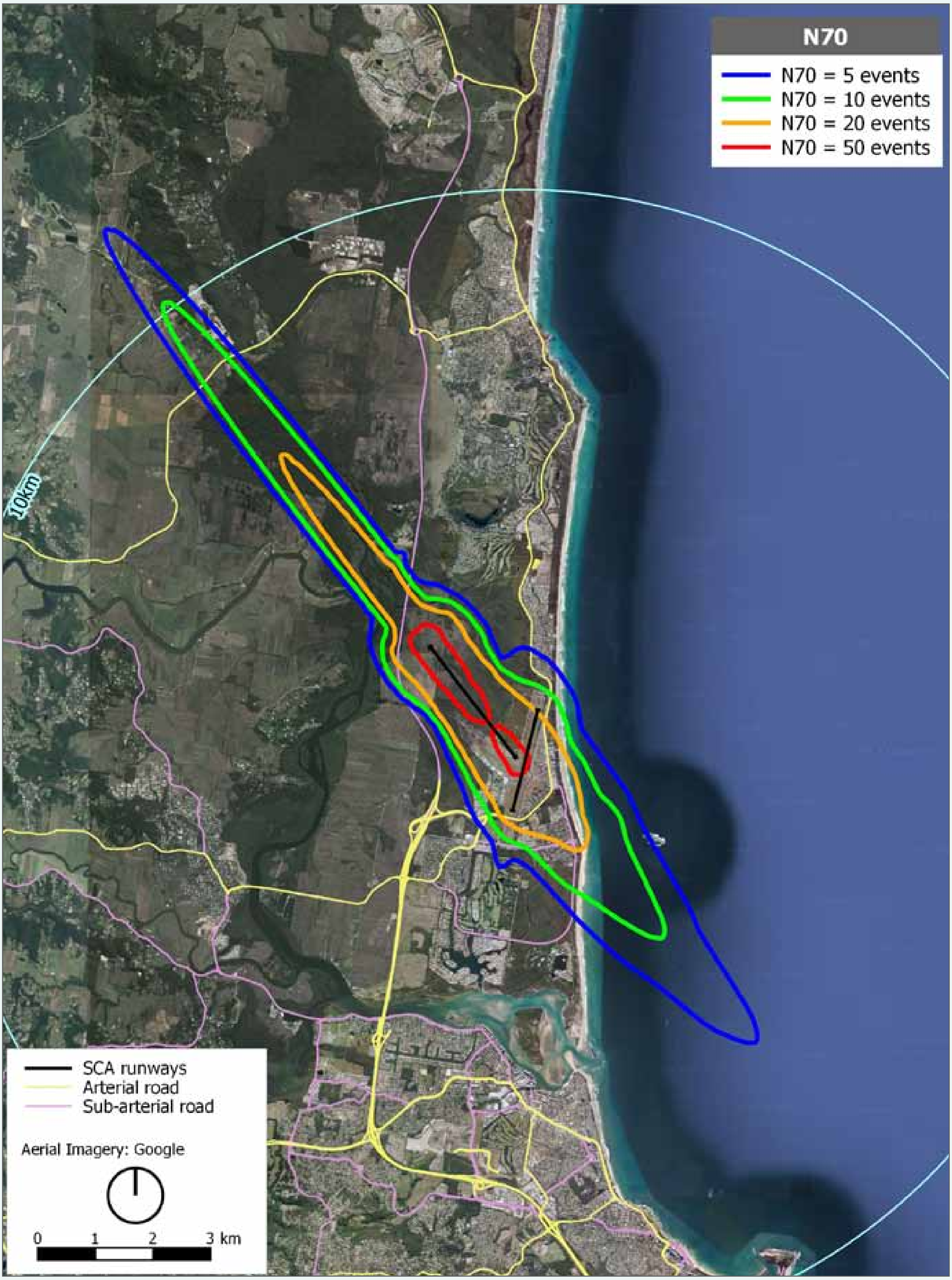


Figure 3.5ac: N70 fixed-wing contours – Do Minimum 2020 evening, summer weekday

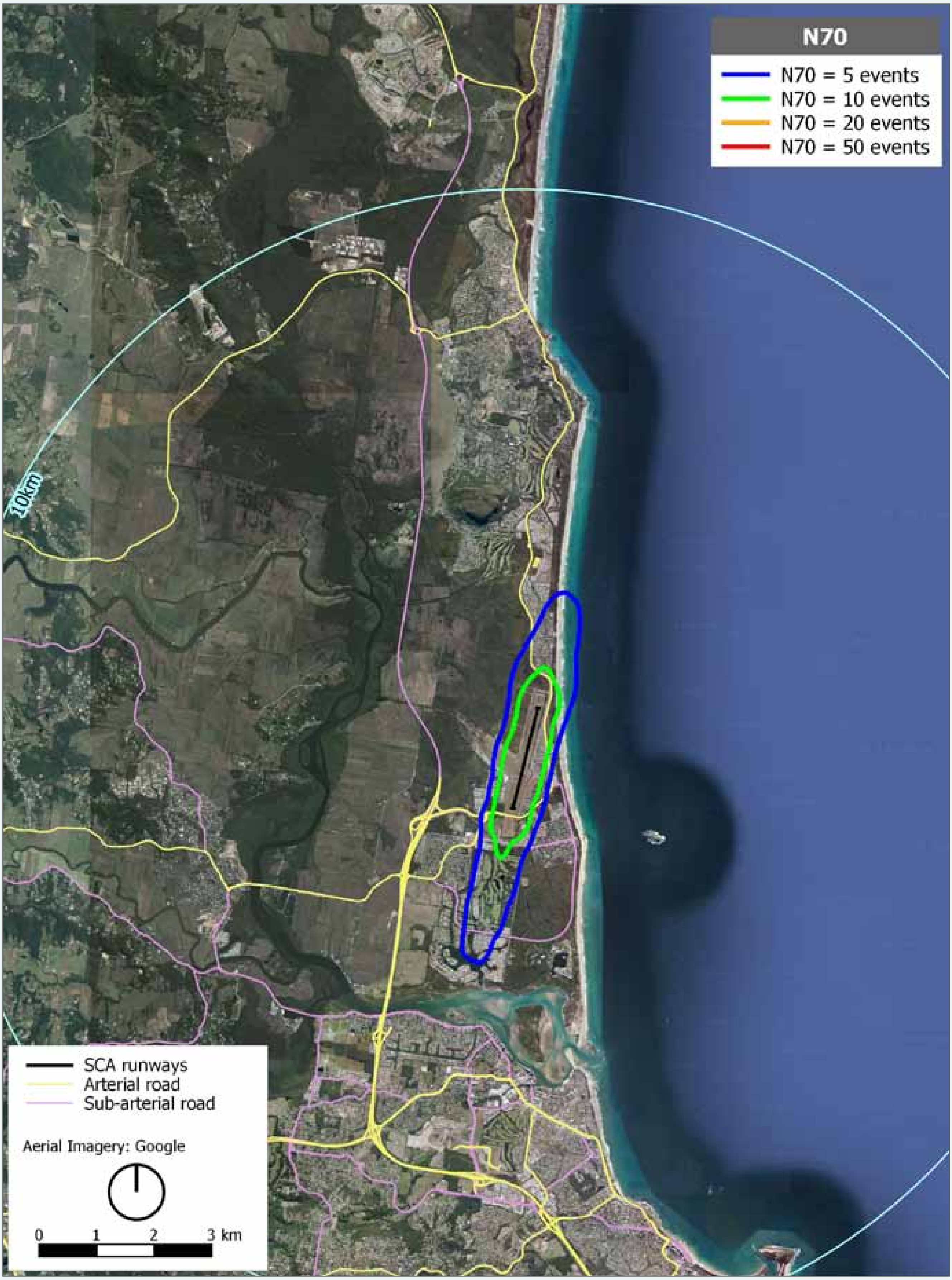


Figure 3.5ad: N70 fixed-wing contours – New Runway 2020 evening, summer weekday

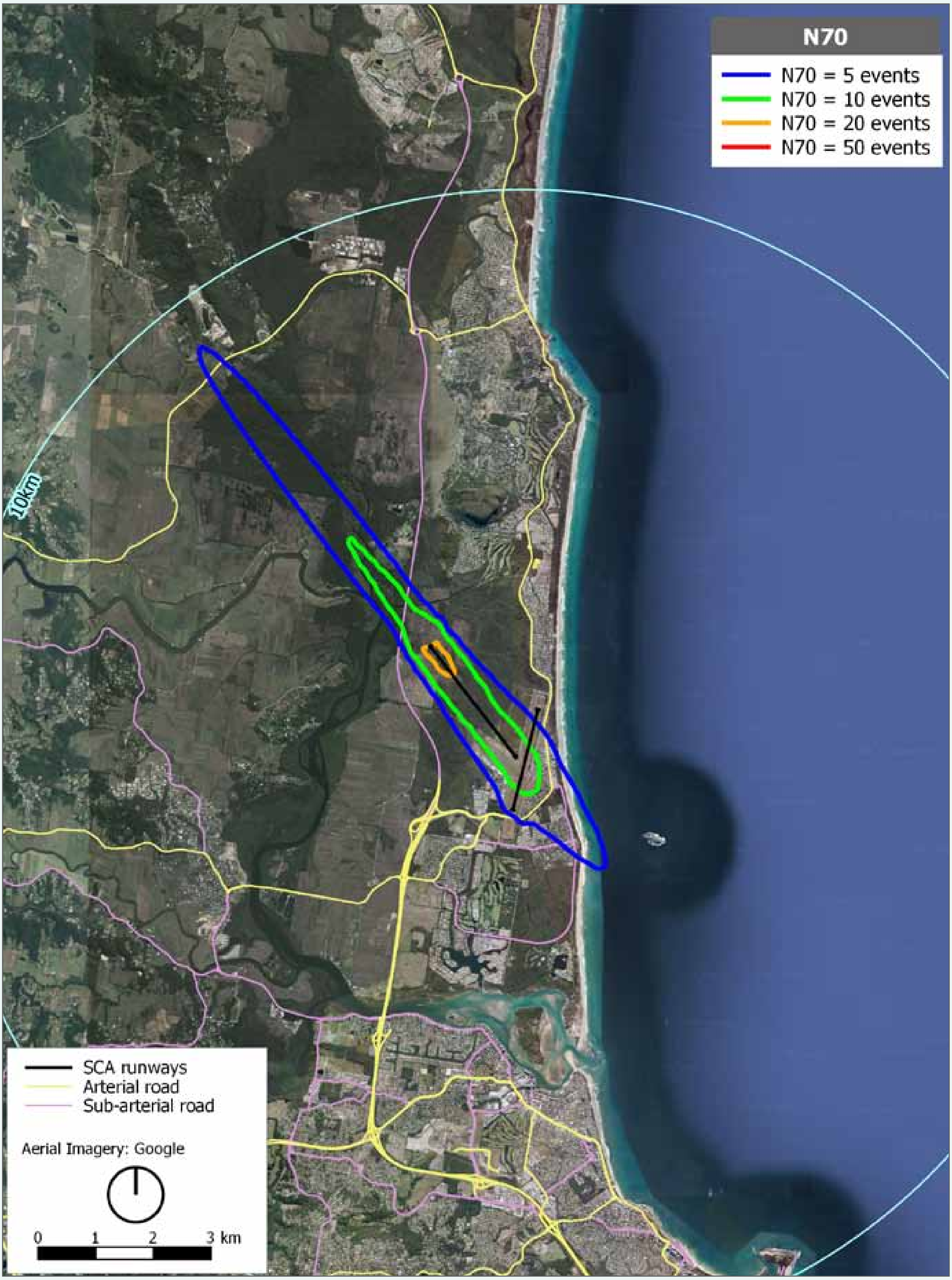


Figure 3.5ae: N70 fixed-wing contours – Do Minimum 2040 day, summer weekday

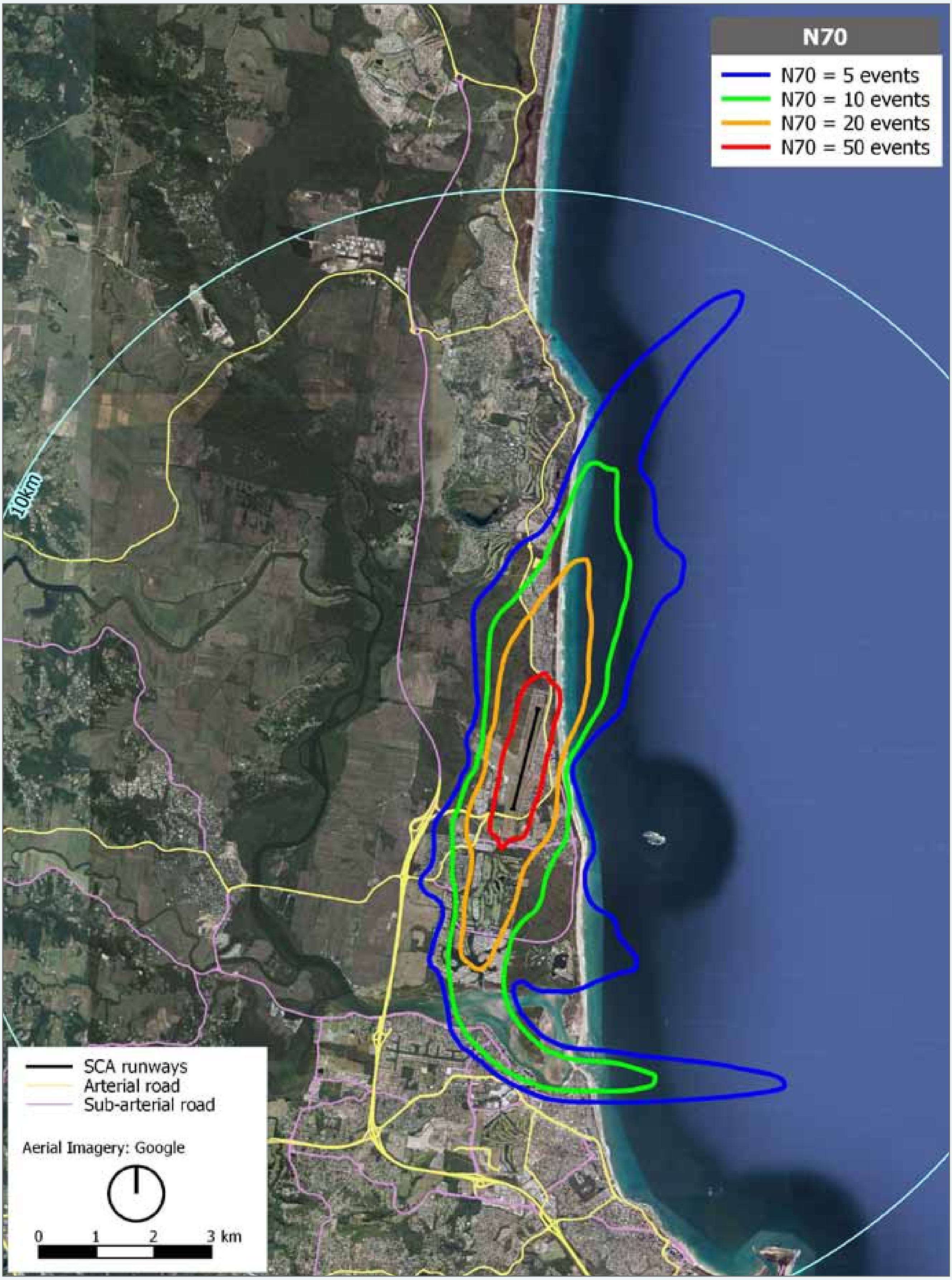


Figure 3.5af: N70 fixed-wing contours – New Runway 2040 day, summer weekday

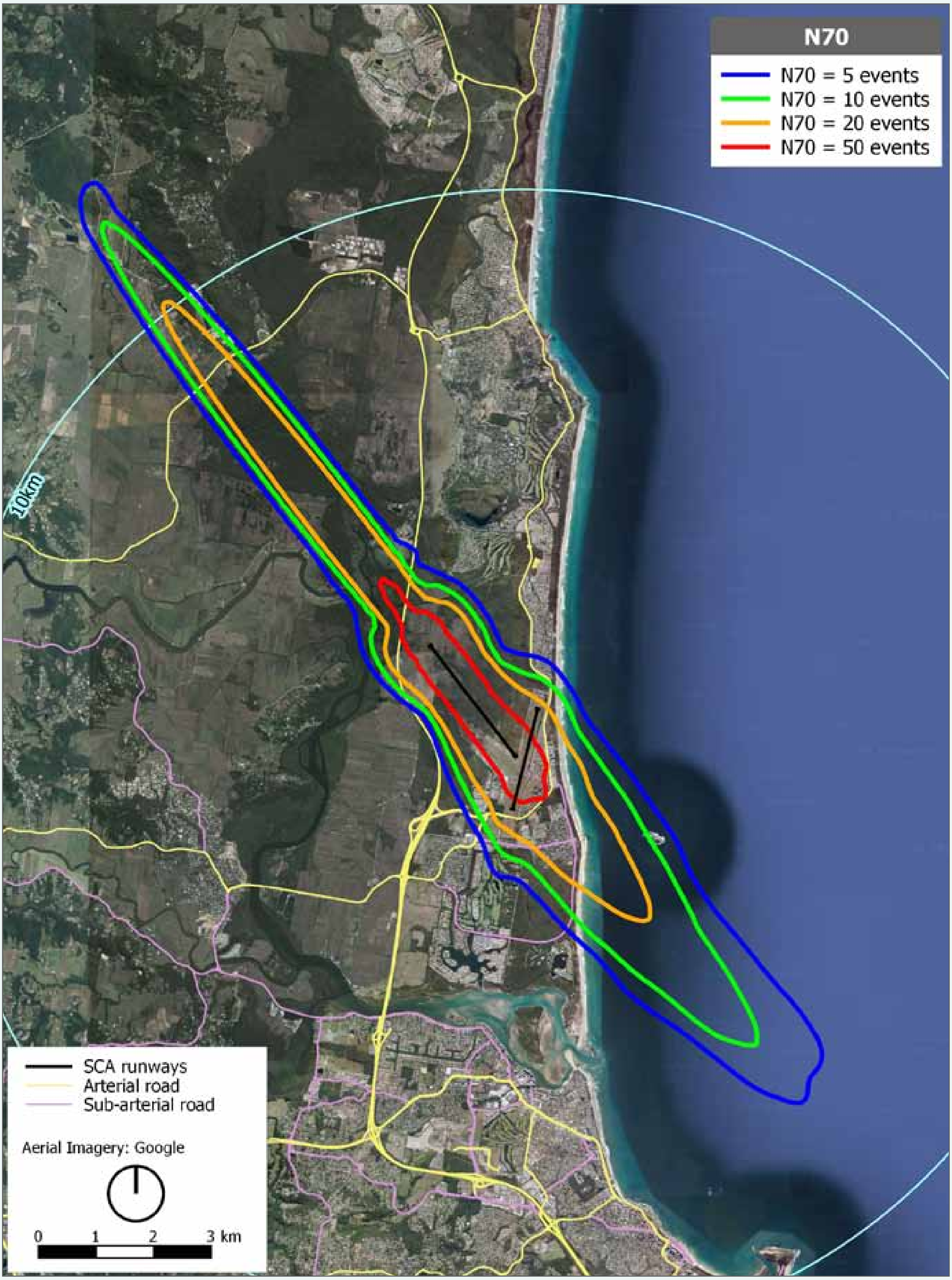


Figure 3.5ag: N70 fixed-wing contours – Do Minimum 2040 evening, summer weekday

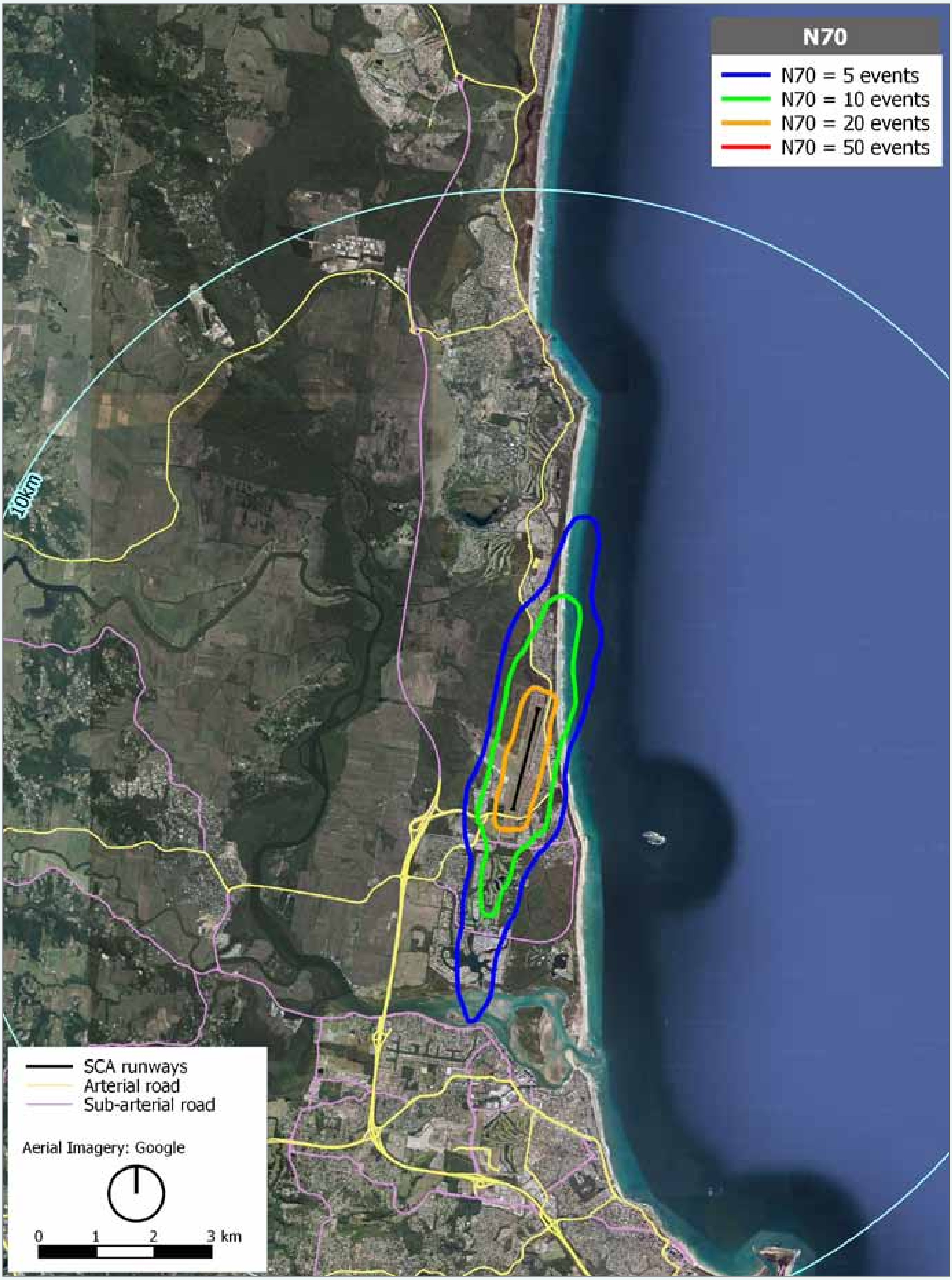


Figure 3.5ah: N70 fixed-wing contours – New Runway 2040 evening, summer weekday

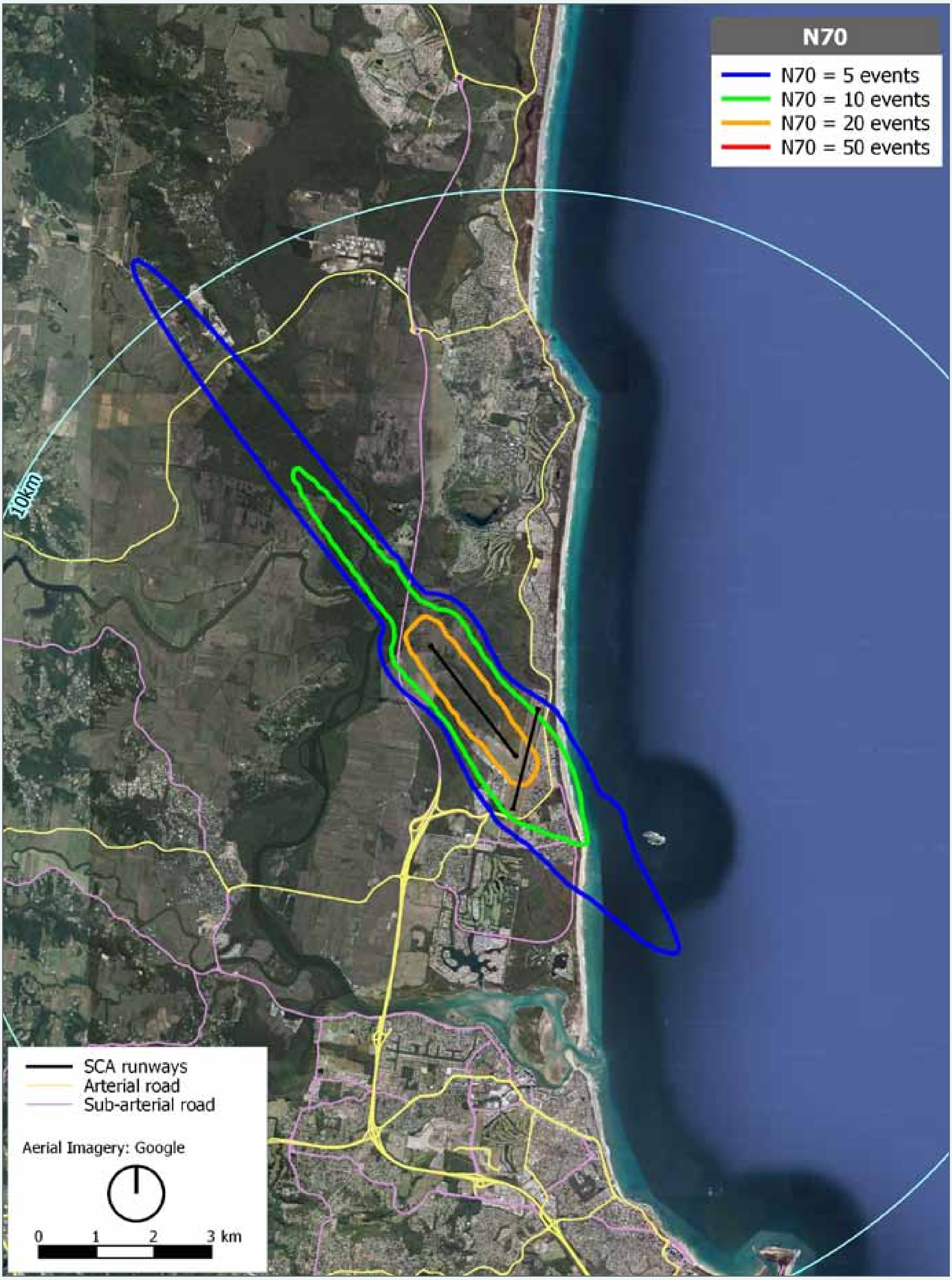


Figure 3.5ai: N70 fixed-wing difference contours – 2020 day, summer weekday, New Runway minus Do Minimum

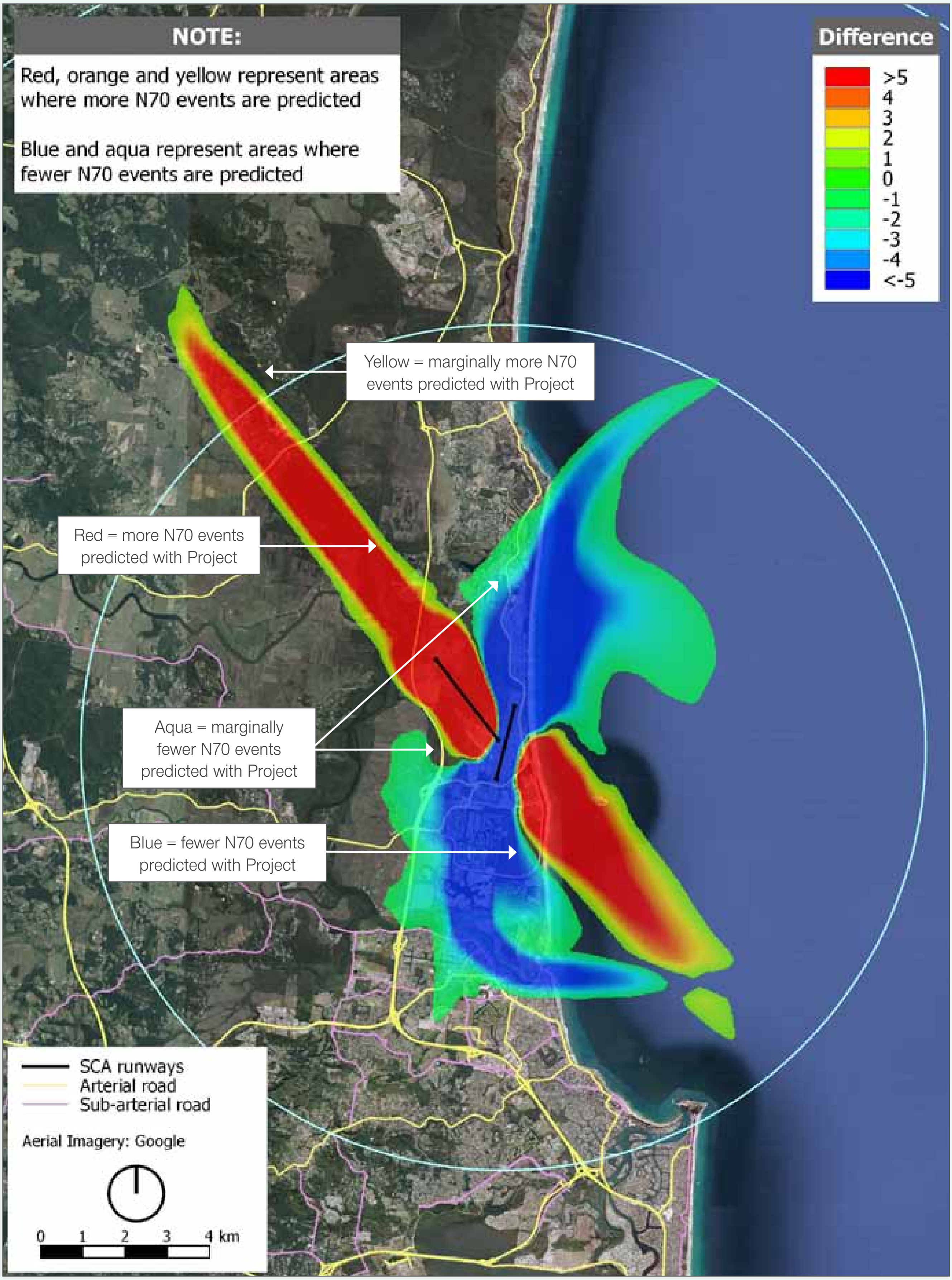


Figure 3.5aj: N70 fixed-wing difference contours – 2040 day, summer weekday, New Runway minus Do Minimum

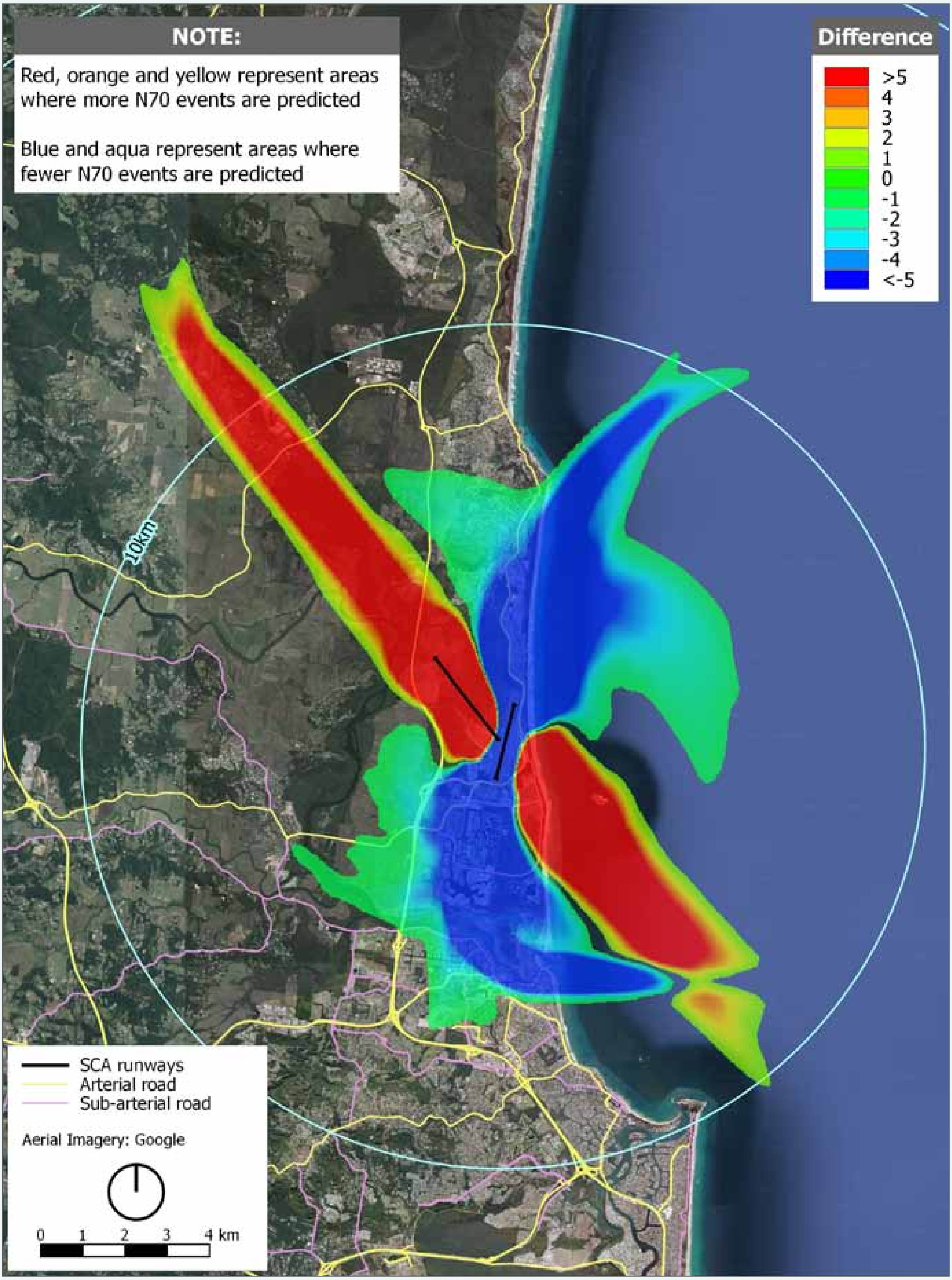


Figure 3.5ak: N70 fixed-wing difference contours – 2020 evening, summer weekday, New Runway minus Do Minimum

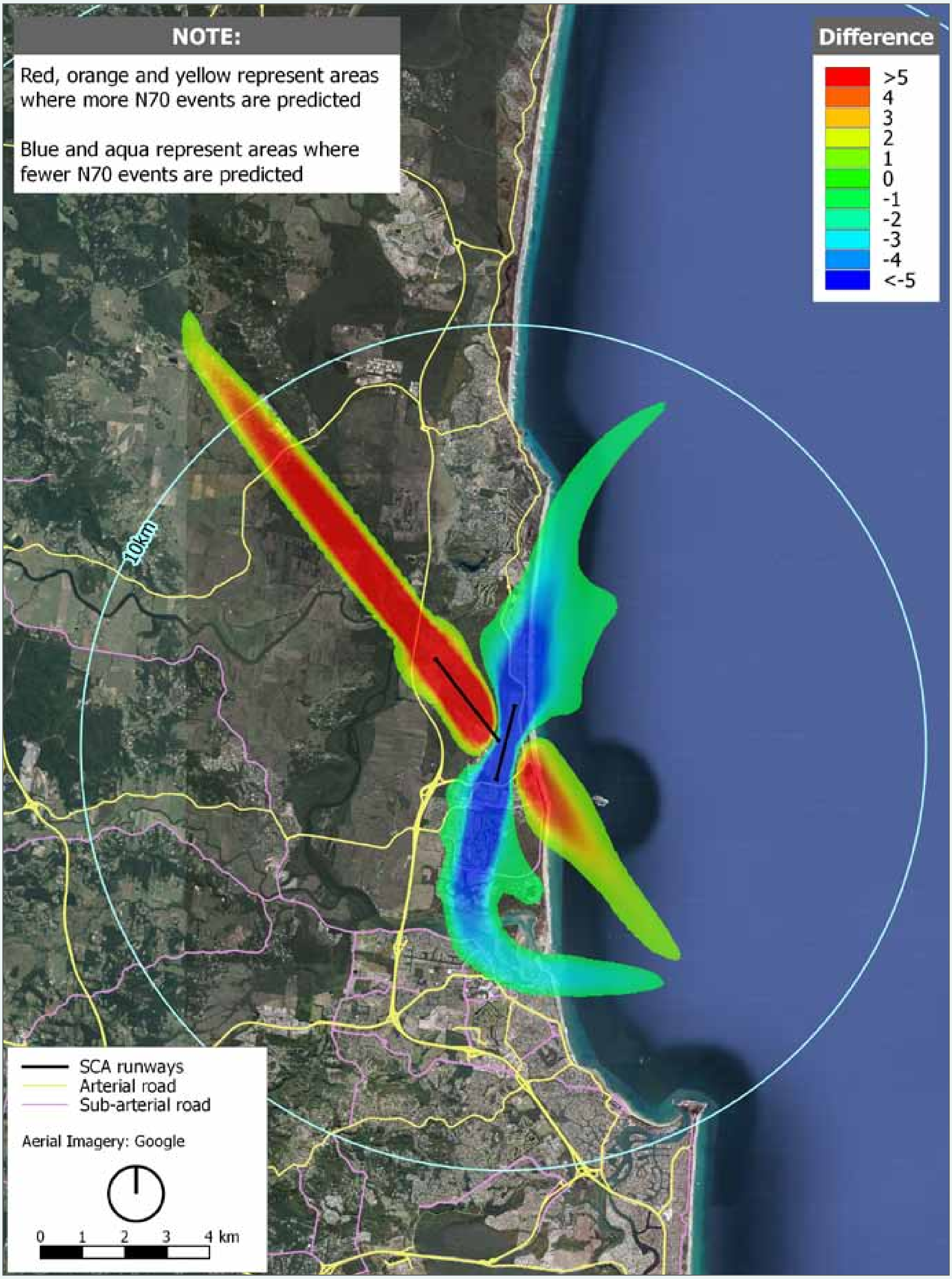


Figure 3.5al: N70 fixed-wing difference contours – 2040 evening, summer weekday, New Runway minus Do Minimum

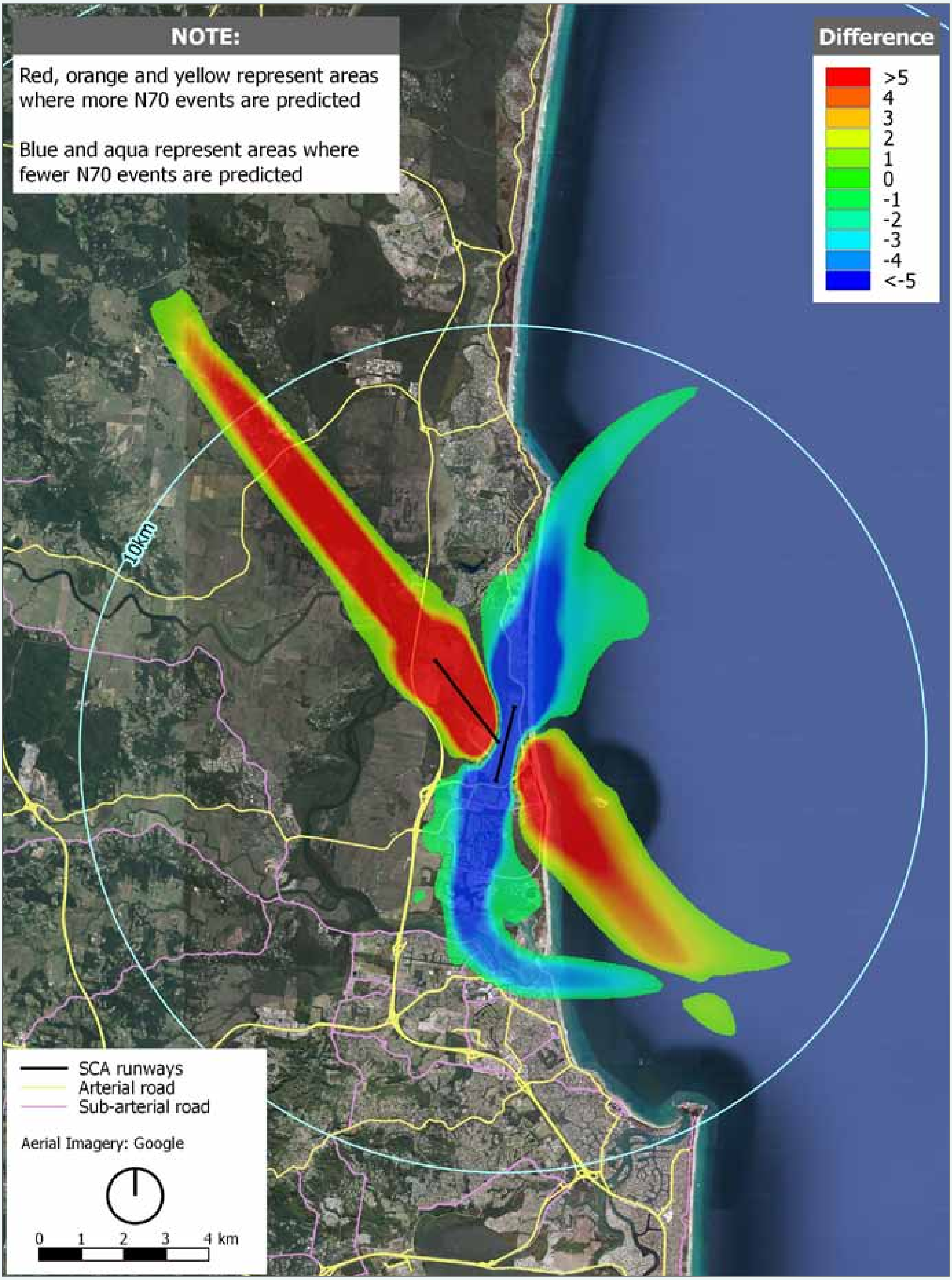


Figure 3.5am: N60 fixed-wing contours – Do Minimum 2040 night, summer weekday

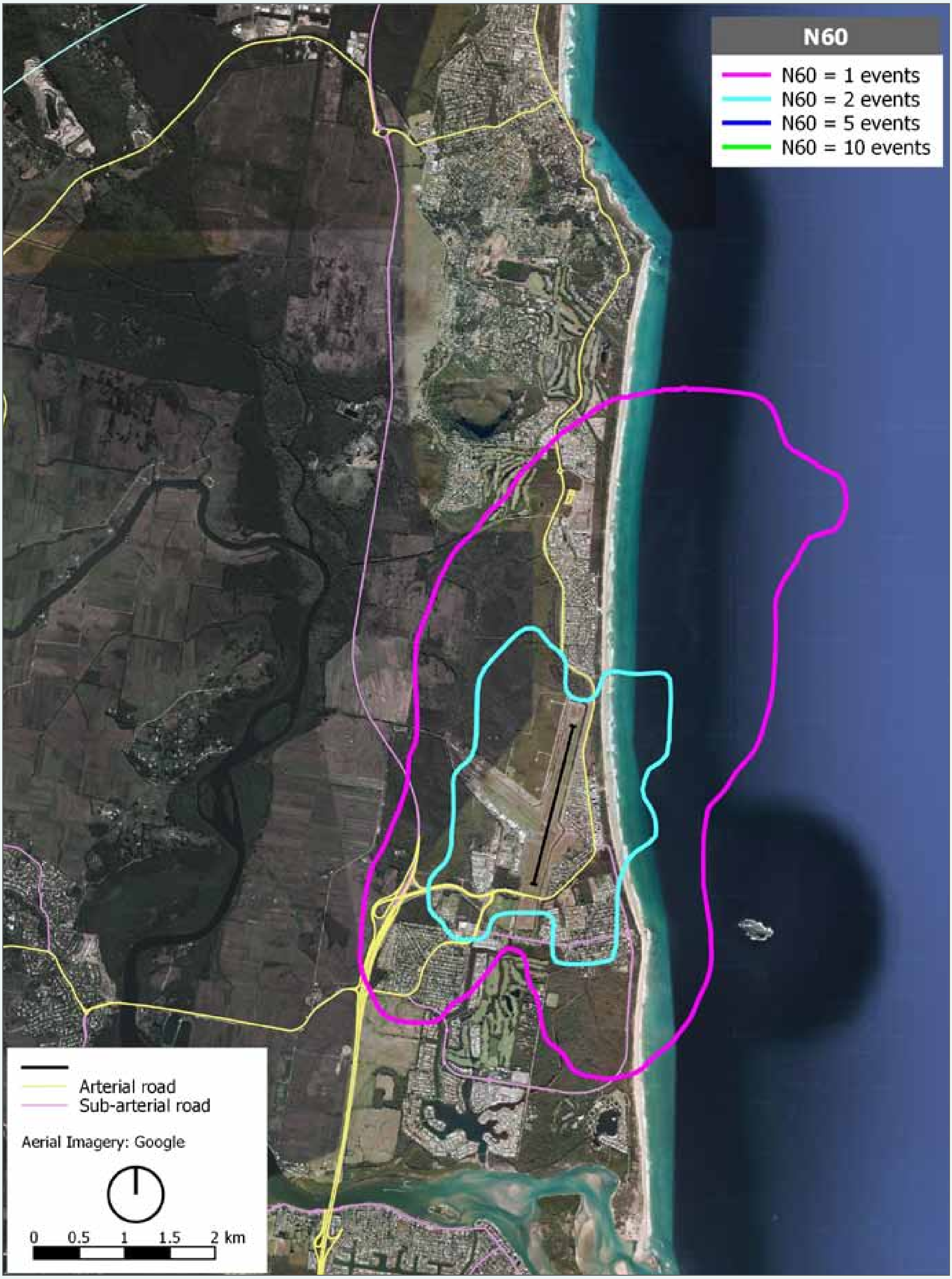
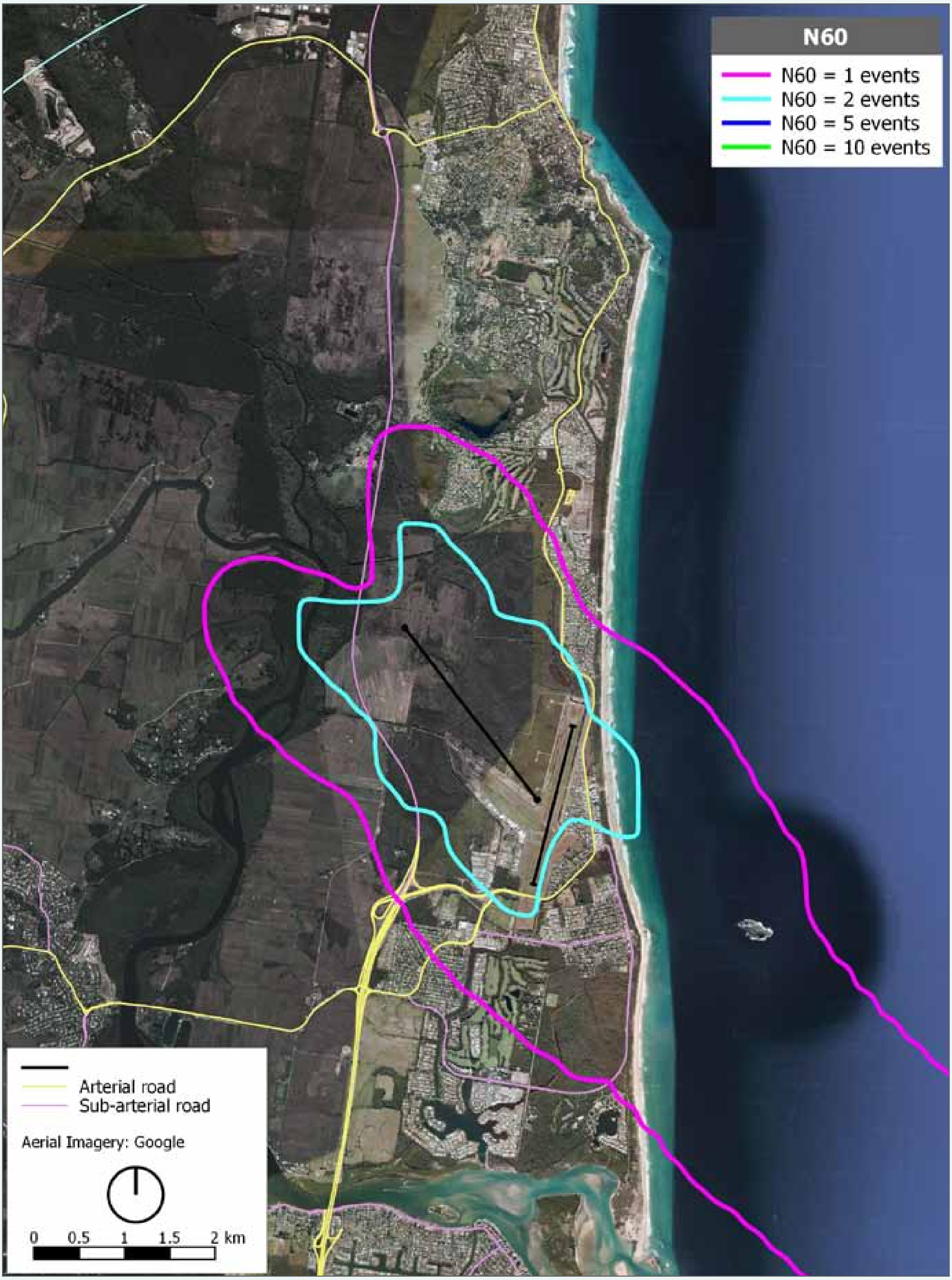


Figure 3.5an: N60 fixed-wing contours – New Runway 2040 night, summer weekday



3.6 HELICOPTER NOISE

While helicopters are modelled for completeness of the noise assessment, there is little relationship between their operations and the Project. The Project is predicted to have minimal impact on the majority of helicopter operations.

Currently helicopters operate from the southern GA area at the airport. Some training circuits are currently flown in the area north of Runway 12/30 and north-east of Runway 18/36. These areas are shown in **Figure 3.6a**.

As of 2013 operations after 4pm were moved to the newly opened western GA area. The southern GA area will continue to be used for daytime helicopter operations until 2027, when existing hangar leases expire.

The impact of the Project on helicopter operations would be limited to the closure of the training circuit area described above. Consequently a small (11 per cent) increase in transit flights would result as these training circuits would be flown at satellite training areas.

Noise exposure from helicopter operations is discussed separately in this section. Due to the limited relationship between these operations and the Project, a specific assessment of impacts has not been undertaken. However, the impact of helicopters on noise exposure is considered in the cumulative noise metrics presented in **Section 3.7**.

3.6.1 Aircraft operations assumed in calculations

Helicopter movement numbers were forecast by LEAPP. Forecast schedules for helicopters were developed using LEAPP's forecast numbers and by extrapolating Airservices data and surveying helicopter operators at SCA.

Figure 3.6a: Helicopter operations at SCA

3.6.2 Aircraft types used in calculations

Projections of aircraft types for future years were assumed to be similar to the current mix. **Table 3.6a** summarises the aircraft types projected, their corresponding aircraft class and the standard aircraft types used to represent the aircraft in the INM modelling program (see **Section 3.3.6**).

3.6.3 Existing airport operations – helicopters

Modelling assumed 165 movements per day for 2012 (including training circuits). This was determined from LEAPP data, Airservices data and discussions with operators. For the purpose of this report a movement was defined as occurring when the projected location of a helicopter left or entered SCA's boundary, i.e. as distinct from taxiing and hover training. Training circuits, which depart and return to SCA but remain relatively near to the airport, such that a receiver would likely perceive it to be only one event, were counted as only one movement (and not two events; one for the departure and another for the arrival). Differences in the definition of a movement are believed to have led to some discrepancy between the various sources of helicopter movement numbers available to the assessment. The assumed movement numbers are believed to reflect actual operations as accurately as could be achieved with the available data. Notwithstanding this discrepancy the analysis provides a reasonable representation of noise likely to be≈experienced.

3.6.3.1 Helicopter operating modes

Currently helicopter movements at SCA consist predominantly of training flights, with a small number of other commercial operations. Aircraft arriving and departing from SCA are generally directed by ATC, but are not necessarily limited to paths as dictated by the current operating mode for fixed-wing runway allocation. (Helicopter paths may not change in phase with fixed-wing operating modes, which are dictated primarily by meteorological conditions.)

3.6.3.2 Helicopter flight tracks

The nature of helicopters enables them to approach and leave landing pads in a much more flexible and multidirectional fashion than fixed-wing aircraft. Despite this, helicopters arriving and departing from SCA nominally follow a number of flight tracks.

Existing aircraft tracks were determined by analysis of the Airservices data discussed above and through close consultation with the primary helicopter operators from SCA. The Airservices data was filtered to eliminate fixed-wing aircraft through a process considering minimum speed, as well as altitude and proximity to known helicopter training areas. **Figure 3.6b** shows the flight density (expressed as a percentage of total helicopter operations in the data) which was determined through analysis of the Airservices data. Typical arrival and departure tracks were selected for the common destinations frequented. **Figure 3.6c** shows the modelled tracks overlaid on the flight density chart; the prevailing flight tracks are evident in the Airservices data. Divergence from these flight tracks can be expected for rescue helicopters, whose flight tracks necessarily deviate greatly from those of typical flight training aircraft.

3.6.3.3 Height-vs-distance profiles

These were determined through consultation with the main helicopter operators. A number of limitations are imposed on the allowable altitudes of helicopter operations around the airport and surrounding residential areas. In the interest of reducing annoyance, ATC where possible directs helicopters away from built up areas. Generally, transiting helicopters are encouraged to remain above 1,500ft. Modelling assumed helicopters transit at 2,000ft. Training circuits around the airport were assumed to reach an altitude of 500ft during level flight. Ascent and descent profiles to these altitudes were developed based on rates described by SCA helicopter operators.

Table 3.6a: Rotary-wing aircraft types modelled (helicopters)

		INM model type	
Helicopter type	**Helicopter class**	**L_{Amax} (N70)**	**ANEC 1**
AS350	Light utility	SA350D	B206B3
R22	Light utility	R22	R22
R44	Light utility	R44	R44
A109	Light utility	A109	B206B3
B206L	Multipurpose utility	B206L	B206B3

Note:
1. Only selected helicopters have Effective Perceived Noise Level (EPNL) data required to calculate ANECs in INM. Therefore substitution of some aircraft for this calculation is necessary.

Figure 3.6b: Analysis of flight density for helicopters 2012 – 2013

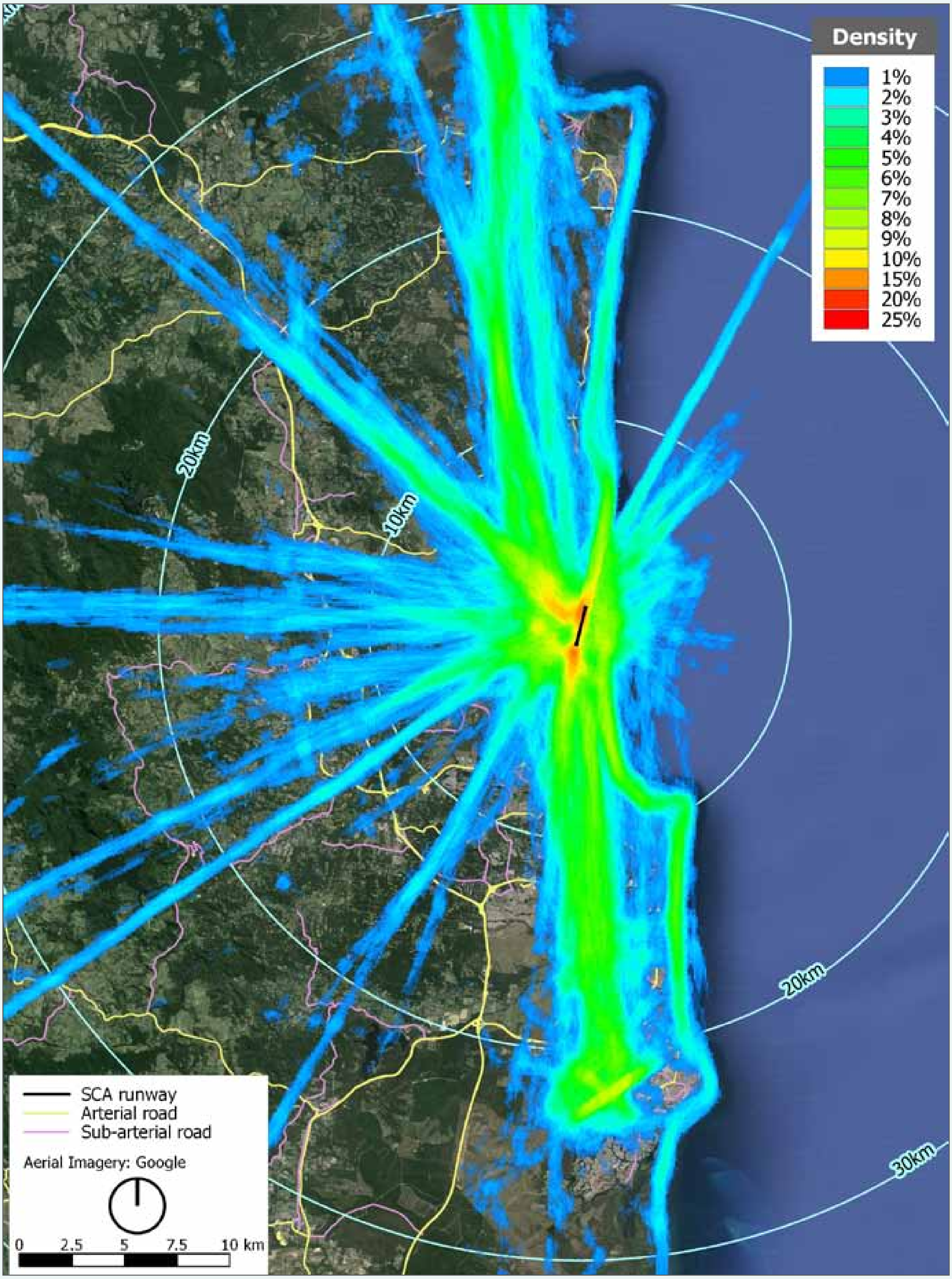
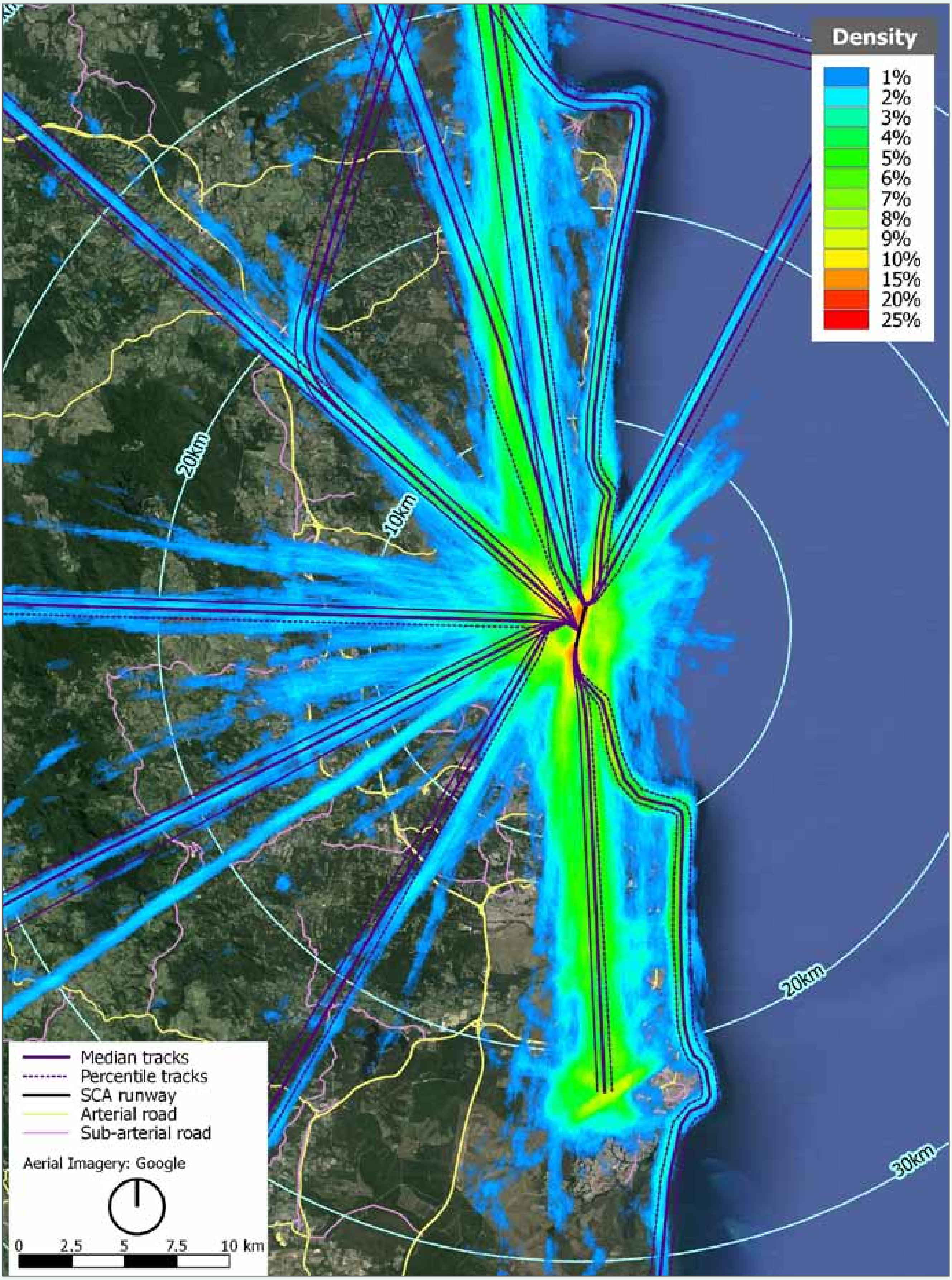


Figure 3.6c: Modelled flight tracks determined through analysis of historical data 2012 – 2013



3.6.4 Future airport operations – helicopters

3.6.4.1 Helicopter operations with the new runway

The Project is predicted to have minimal impact on the majority of helicopter operations.

Greenfield land west of the existing Runway 18/36 is currently used for training circuits (the area contained approximately by the Sunshine Motorway, Mount Coolum residences, Pacific Paradise residences and Runway 18/36). These training cirbuits account for approximately 10 per cent of helicopter operations currently.

The construction of Runway 13/31 may exclude the use of this land for training circuits. As a result these training circuits may need to be undertaken at alternative training sites. The locations of these alternative training sites were not known at the time of preparing this assessment, though it was clear that no land exists within SCA's boundary and so these sites will need to be remote. To account for the potential additional flights that would be required to transit to and from the remote future training sites, flights have been allocated proportionally to the existing transiting flight tracks (i.e. assuming that the current training areas will absorb the surplus).

3.6.4.2 Helicopter operating modes

The current procedures, whereby helicopters are generally directed by ATC are not anticipated to change as a result of the Project.

3.6.4.3 Helicopter flight tracks

Helicopter flight tracks are predicted to remain consistent with existing flight tracks, regardless of the Project.

3.6.4.4 Height-vs-distance profiles

Height-vs-distance profiles are not expected to change as a result of the Project.

3.6.5 Existing helicopter noise modelling results

The following sections present the noise modelling results for existing operations.

3.6.5.1 Flight track movement charts

Figure 3.6d and **Figure 3.6e** show historical (2012) movements of helicopters within each track group. Each chart represents a particular operation (departure or arrival).

Operations are presented as the weighted average across weekday/weekend and summer/winter.

The annotations adjacent to each track group detail the number of operations historically for the day (7am – 6pm), evening (6pm – 10pm) and night time (10pm – 7am) periods. The total average operations per 24 hour period are also presented.

Residences are shown on the base image for context. On some tracks, helicopters regularly fly over residential areas north and south of SCA.

3.6.5.2 Existing N70 and N60 noise contours – helicopters

This section presents N70 contours for the daytime (7am – 6pm) and evening (6pm – 10pm) periods, and N60 contours for the night period (10pm – 7am).

Figure 3.6f and **Figure 3.6g** present the calculated Existing 2012 Helicopter N70 contours for day and evening respectively.

The N70 contours are concentrated about the helicopter tracks presented in **Figure 3.6d** and **Figure 3.6e**.

Areas which are affected by helicopter noise from existing operations, as indicated by the "N70 equals 5" contour (i.e. 5 events exceeding 70 dB(A)) are:

- Twin Waters
- Mudjimba
- Marcoola.

The evening N70 contours are far more localised to SCA than daytime N70 contours. This is due to fewer flights being scheduled in the evening time period. **Figure 3.6h** presents the Existing Night Helicopter N70.

3.6.6 Future helicopter noise modelling predictions and assessment

The following sections present the noise modelling results for future helicopter operations.

3.6.6.1 Future helicopter flight track movement charts

Figure 3.6i to **Figure 3.6l** show forecast movements of helicopters within each track group. For simplicity only 2040 is shown, representing the maximum operations in the assessable period. Years 2016 and 2020 are included in **Appendix D3:B** and are effectively scaled down versions of 2040.

Numbers of operations are a weighted average across weekday/weekend and summer/winter.

All tracks are the same as those presented for the existing scenario.

Note that the numbers of operations for "New Runway" scenarios are 11 per cent greater than equivalent "Do Minimum" scenarios during the day and evening periods due to the redistribution of training circuit operations currently undertaken at SCA.

Figure 3.6d: Helicopter flight track movements – Existing 2012 arrivals

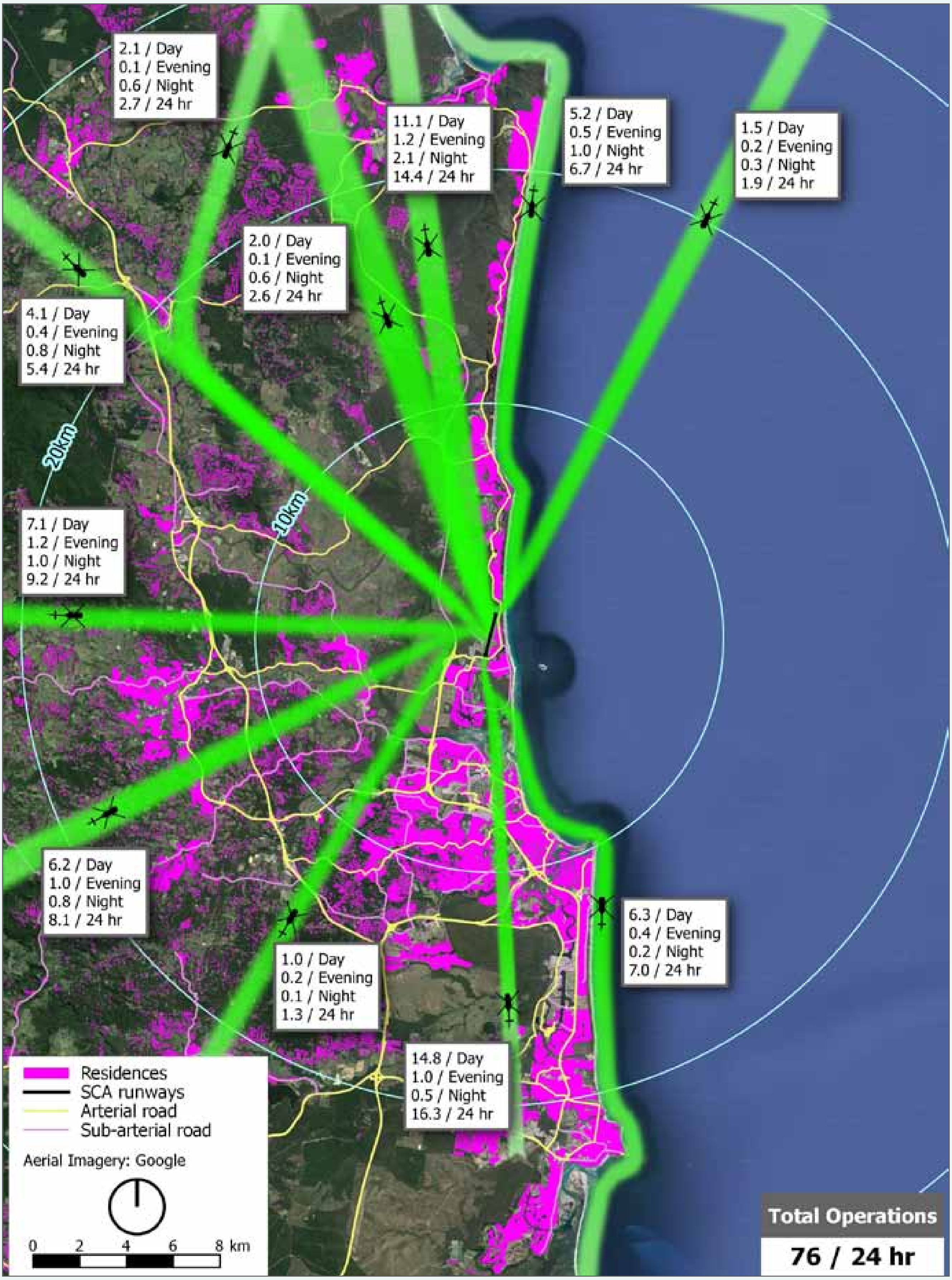


Figure 3.6e: Helicopter flight track movements – Existing 2012 departures

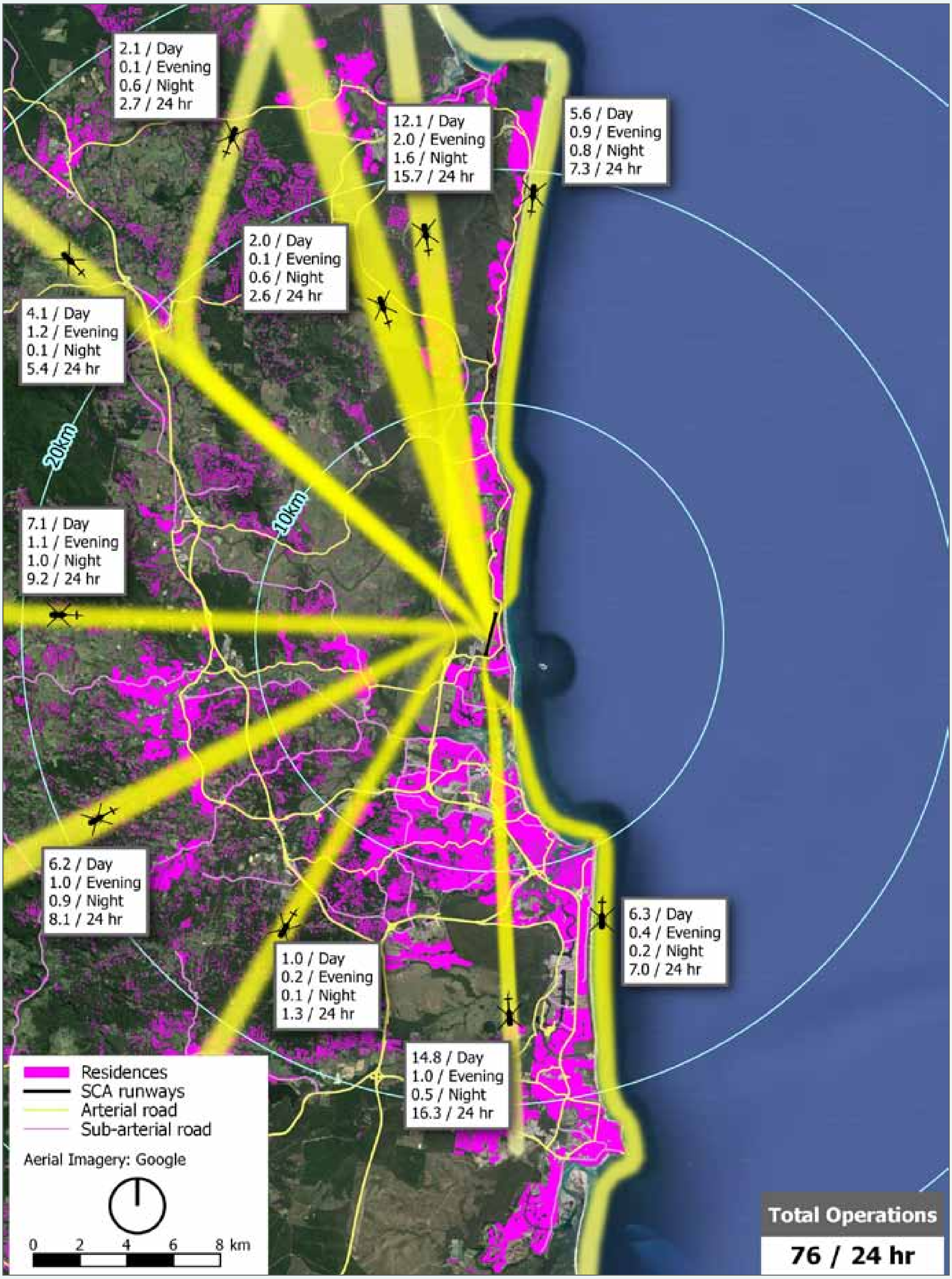


Figure 3.6f: N70 helicopter contours – Existing 2012 day

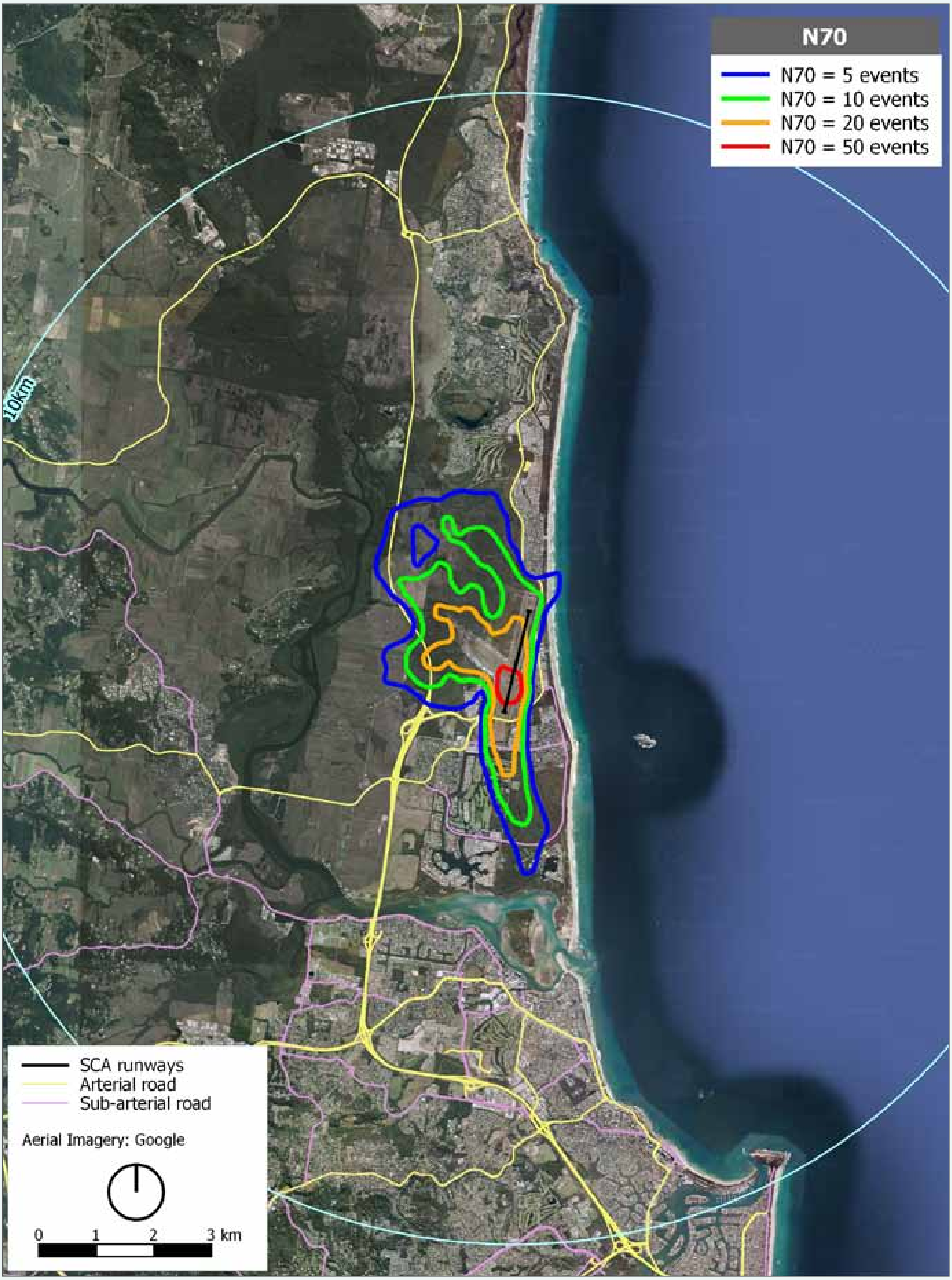


Figure 3.6g: N70 Helicopter Contours – Existing 2012 Evening

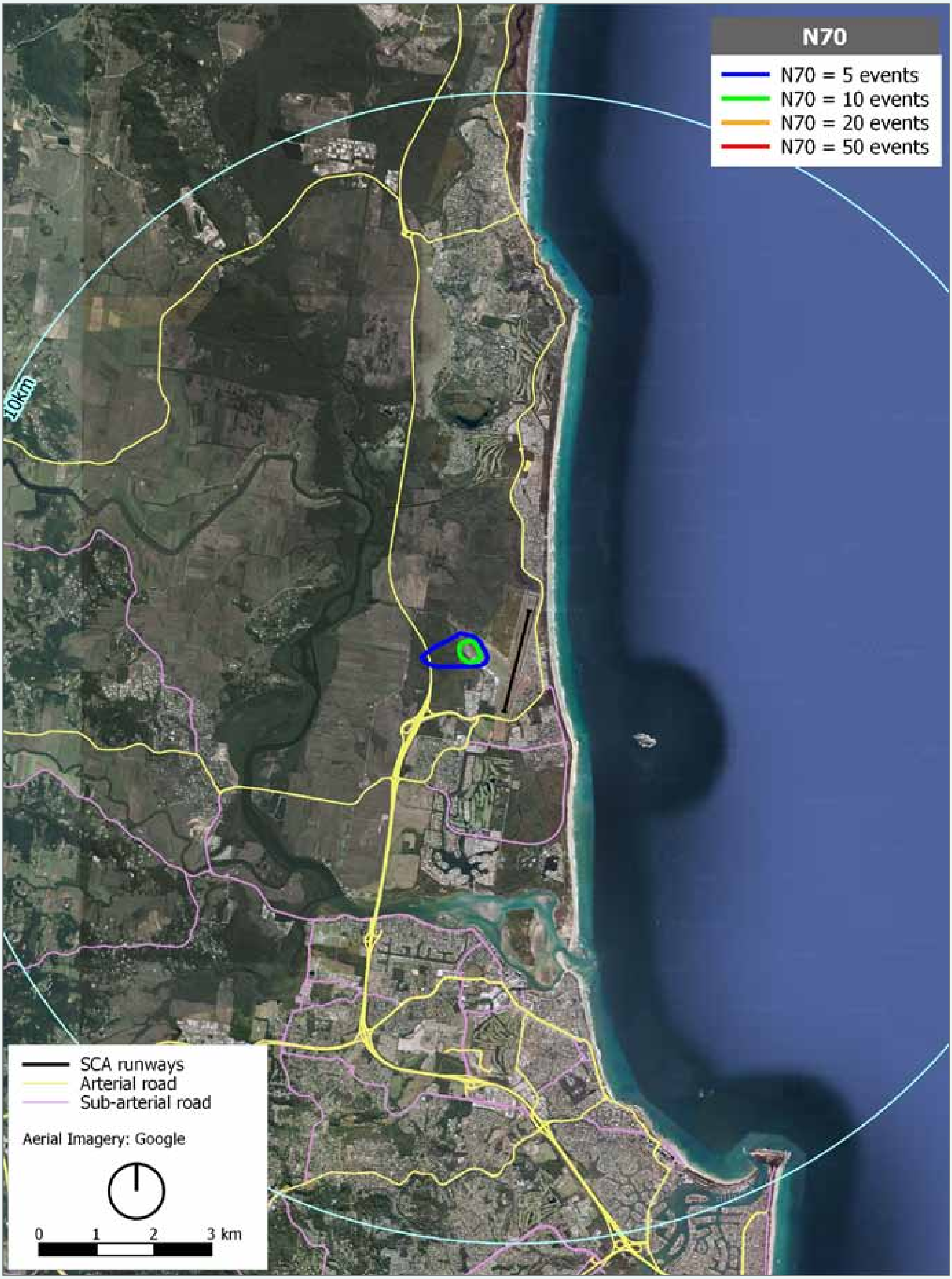


Figure 3.6h: N60 Helicopter Contours – Existing 2012 Night

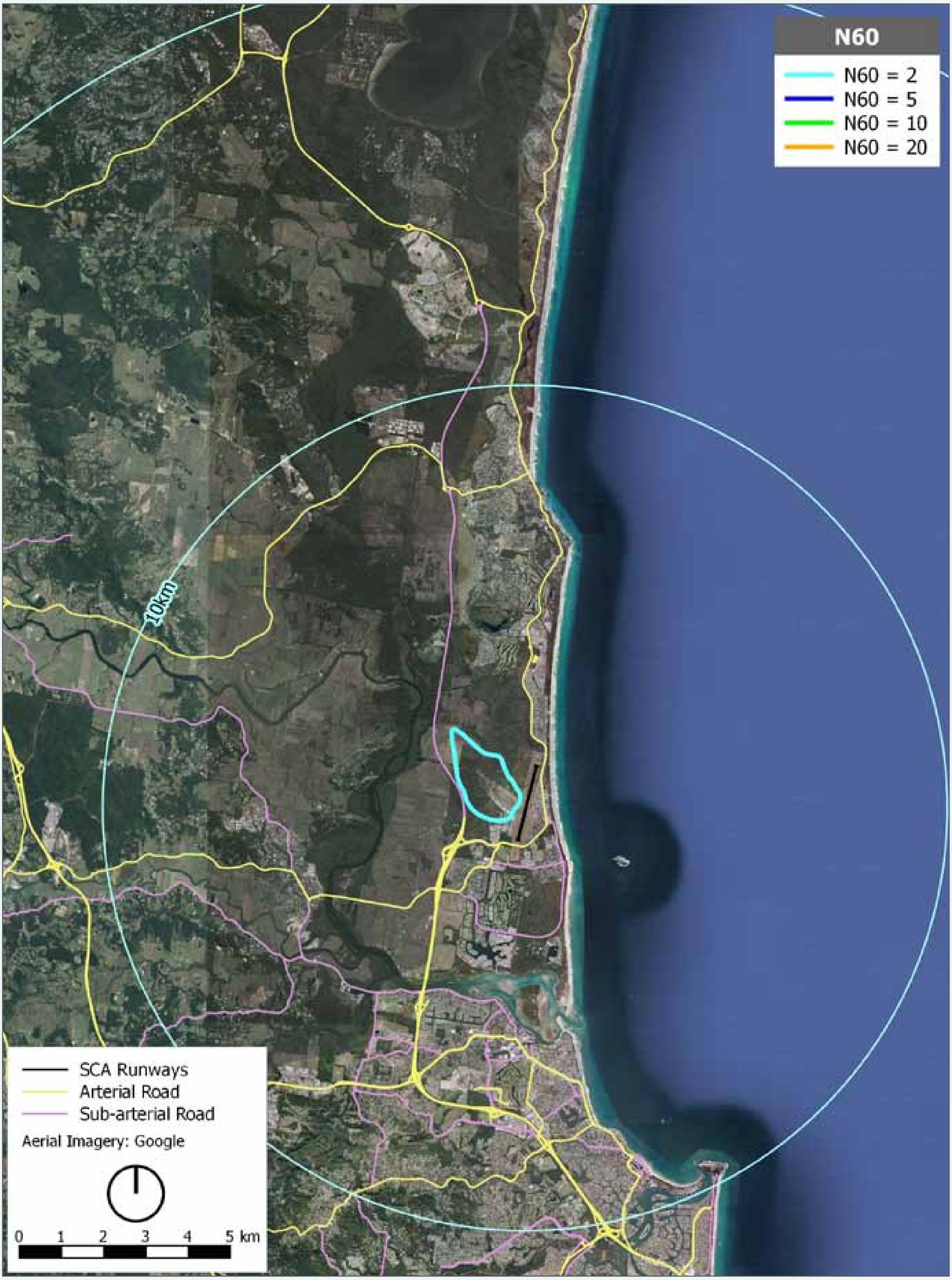


Figure 3.6i: Helicopter flight track movements – Do Minimum 2040 arrivals

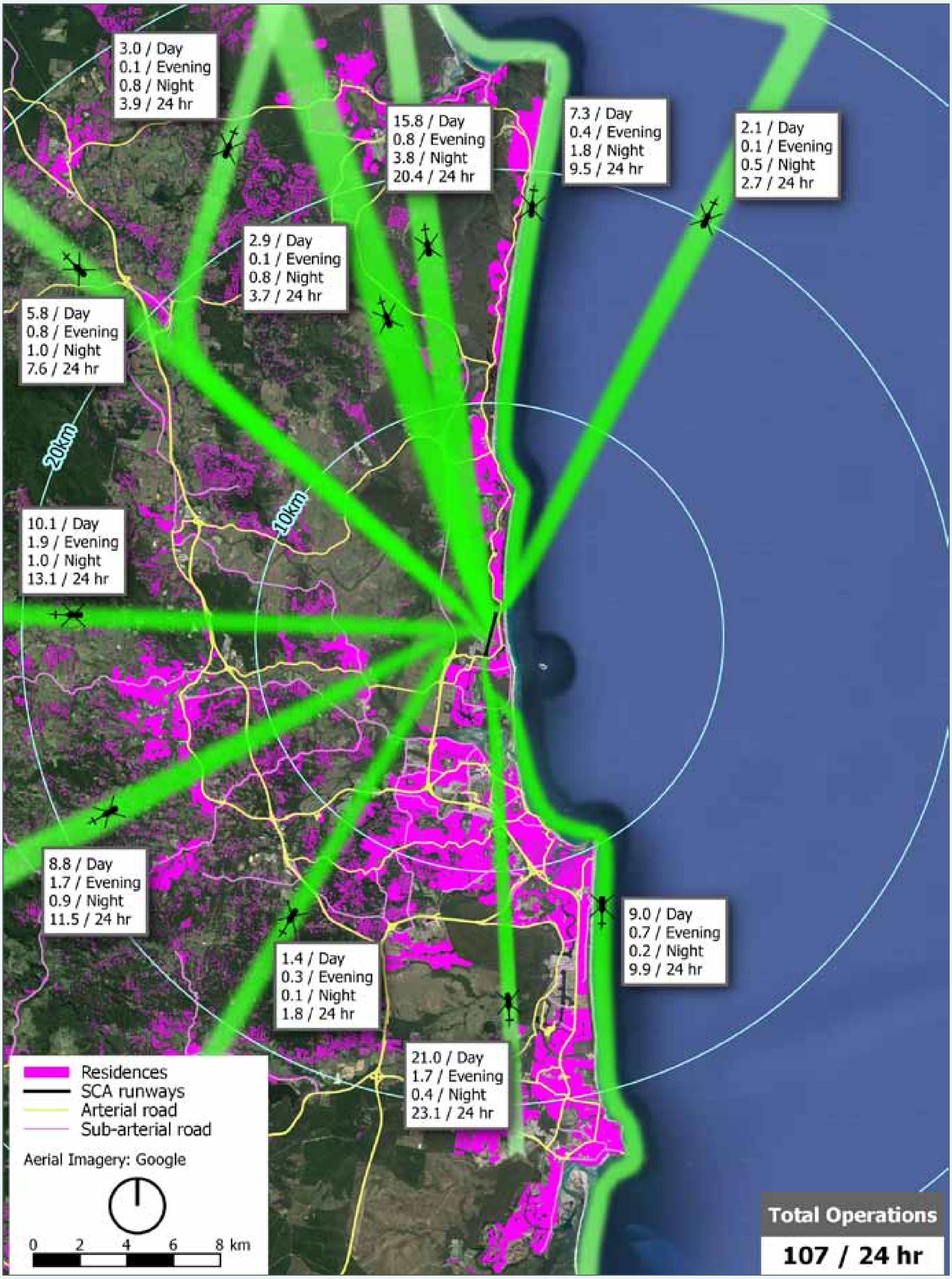


Figure 3.6j: Helicopter flight track movements – Do Minimum 2040 departures

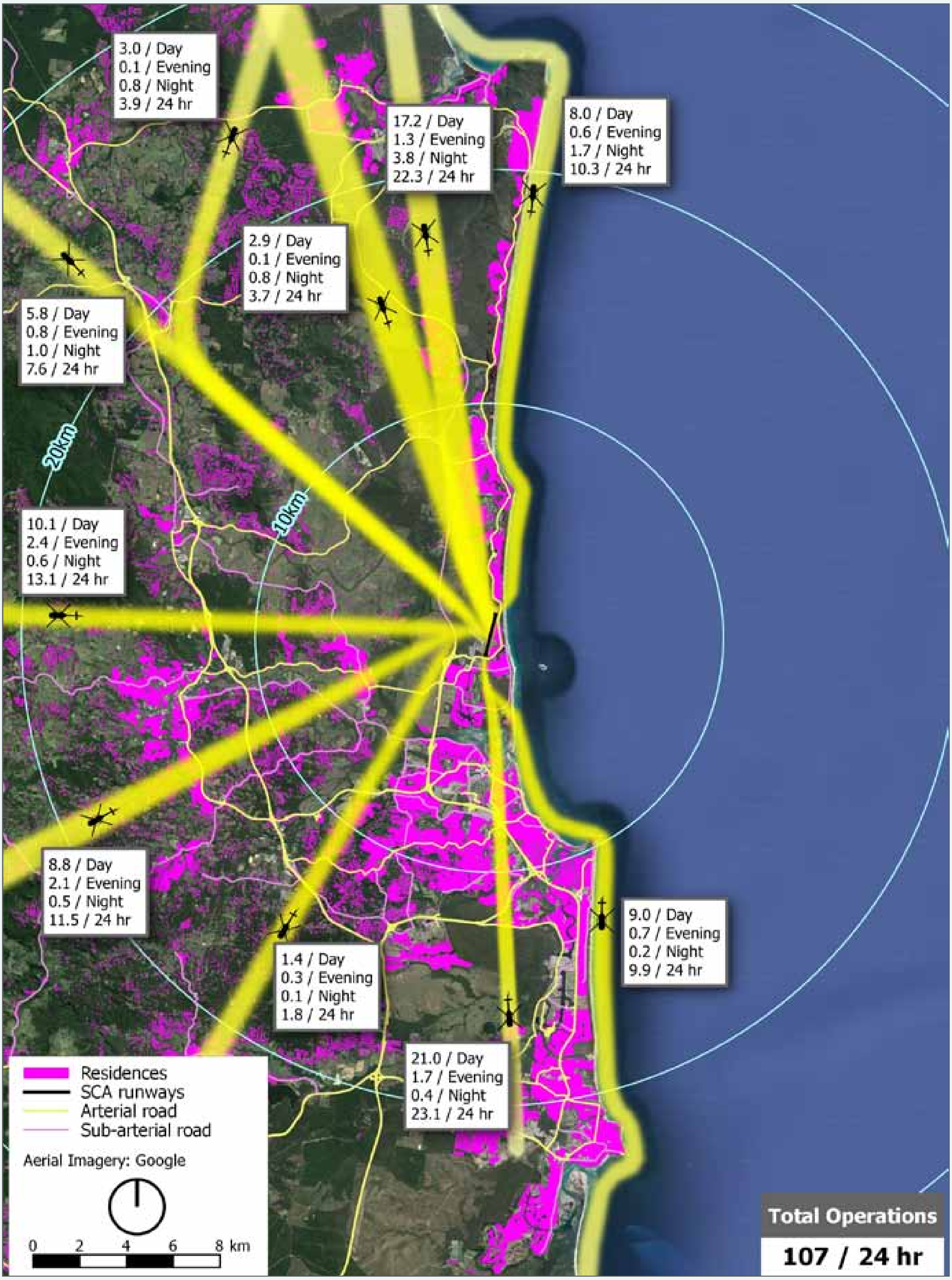


Figure 3.6k: Helicopter flight track movements – New Runway 2040 arrivals

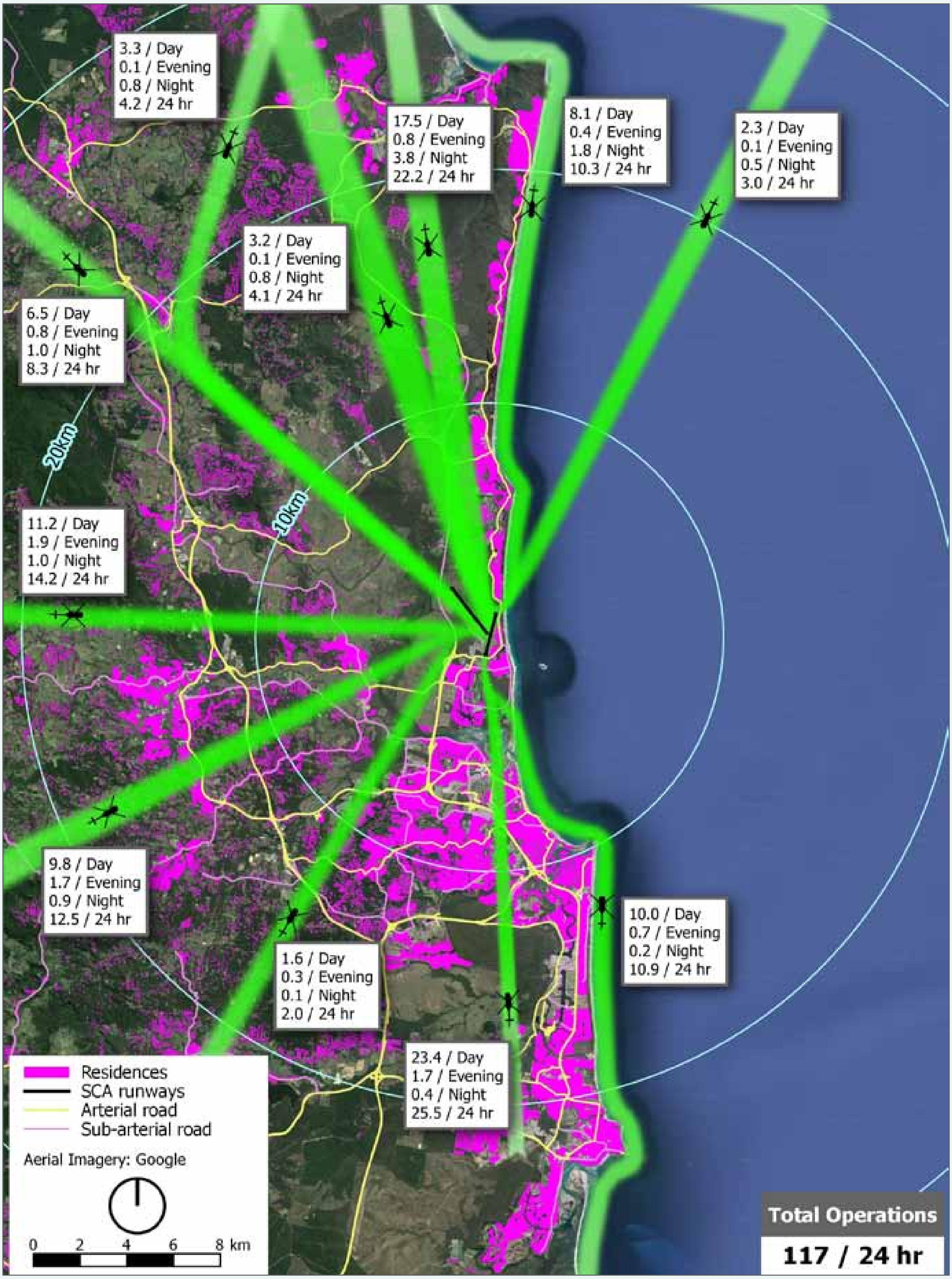
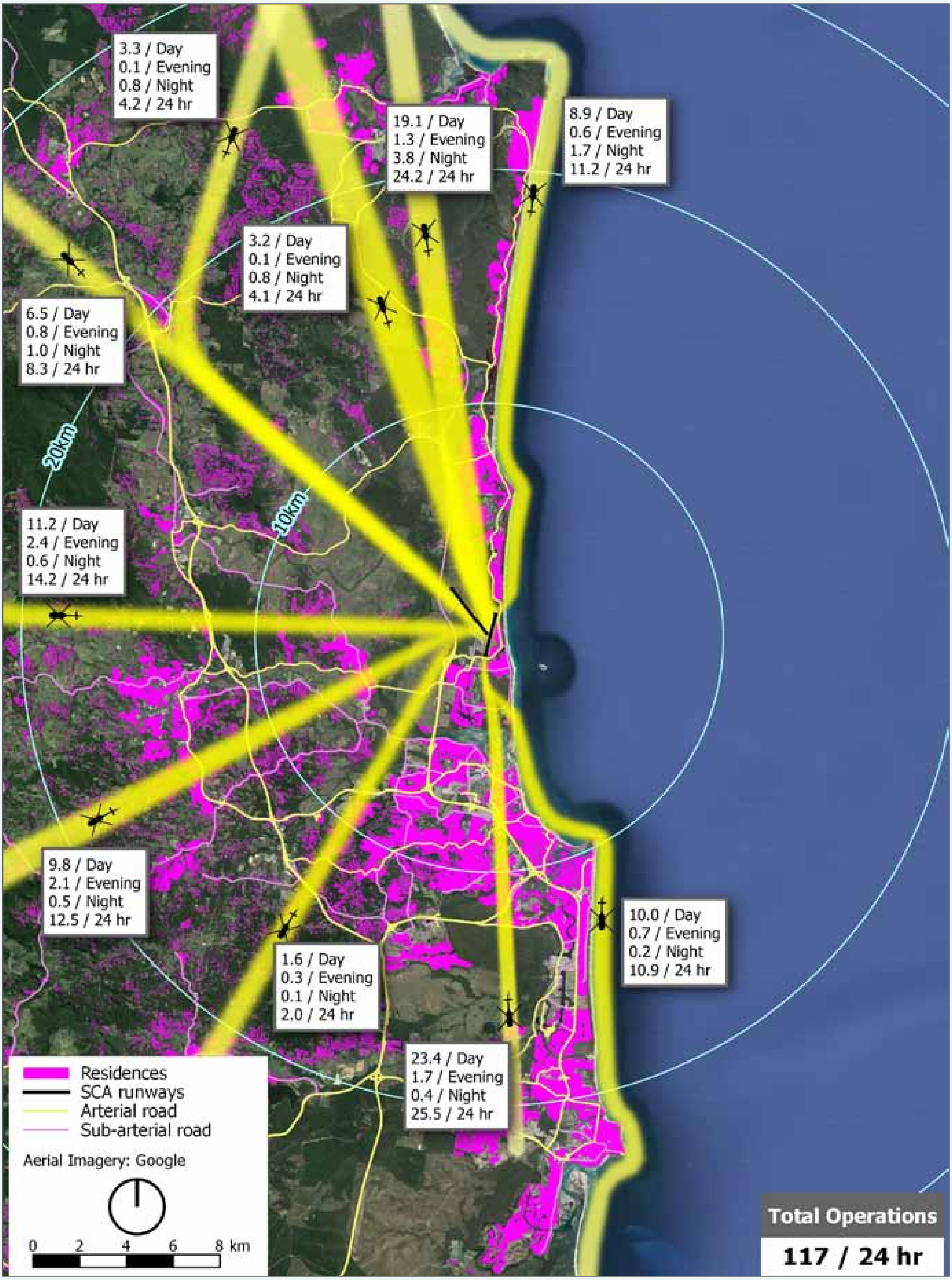


Figure 3.6l: Helicopter flight track movements – New Runway 2040 departures



3.6.6.2 Future N70 and N60 noise contours – helicopters

This section first presents N70 contours for the daytime (7am – 6pm) and evening (6pm – 10pm) periods, and N60 contours for the night period (10pm – 7am).

Figure 3.6m to **Figure 3.6q** present the predicted N70 contours for all future scenarios for the day period. Note that evening contours are not presented because these are constrained almost entirely to the airport and no appreciable change is demonstrated be these.

Noise exposure is seen to grow gradually from 2012 to 2040 as a result of increasing numbers of events. This progression is evident in the "2012 Existing", "2016 New Runway Construction", "2020 Do Minimum" and "2040 Do Minimum" scenarios.

The impact of the new runway is minimal. Operations are expected to remain on the same tracks as existing helicopter operations. The only difference that is expected as a result of the Project is the redistribution of 10 per cent of the operations to compensate for the closure of the training area at SCA. This is best demonstrated by **Figure 3.6r** and **Figure 3.6s**.

The following areas, which are currently partially within the "N70 equals 5" contour are predicted to be affected by an additional 11 per cent of operations.

- Twin Waters
- Mudjimba
- Marcoola.

Figure 3.6t and **Figure 3.6u** present the helicopter N60 contours for the night time period.

It is estimated that on average 14 helicopter flights occurred each night in 2012. With the organic growth of helicopter activity at SCA this is forecast to increase to 21 flights by 2040. It is noted that this growth is independent of the Project. There are currently no training circuits undertaken at SCA during the night period and this would remain unchanged with the Project.

The Project is not expected to impact helicopter night operations at all. Hence the "Do Minimum" and "New Runway" predictions are identical for the night time period.

Figure 3.6m: N70 helicopter contours – New Runway Construction 2016 day

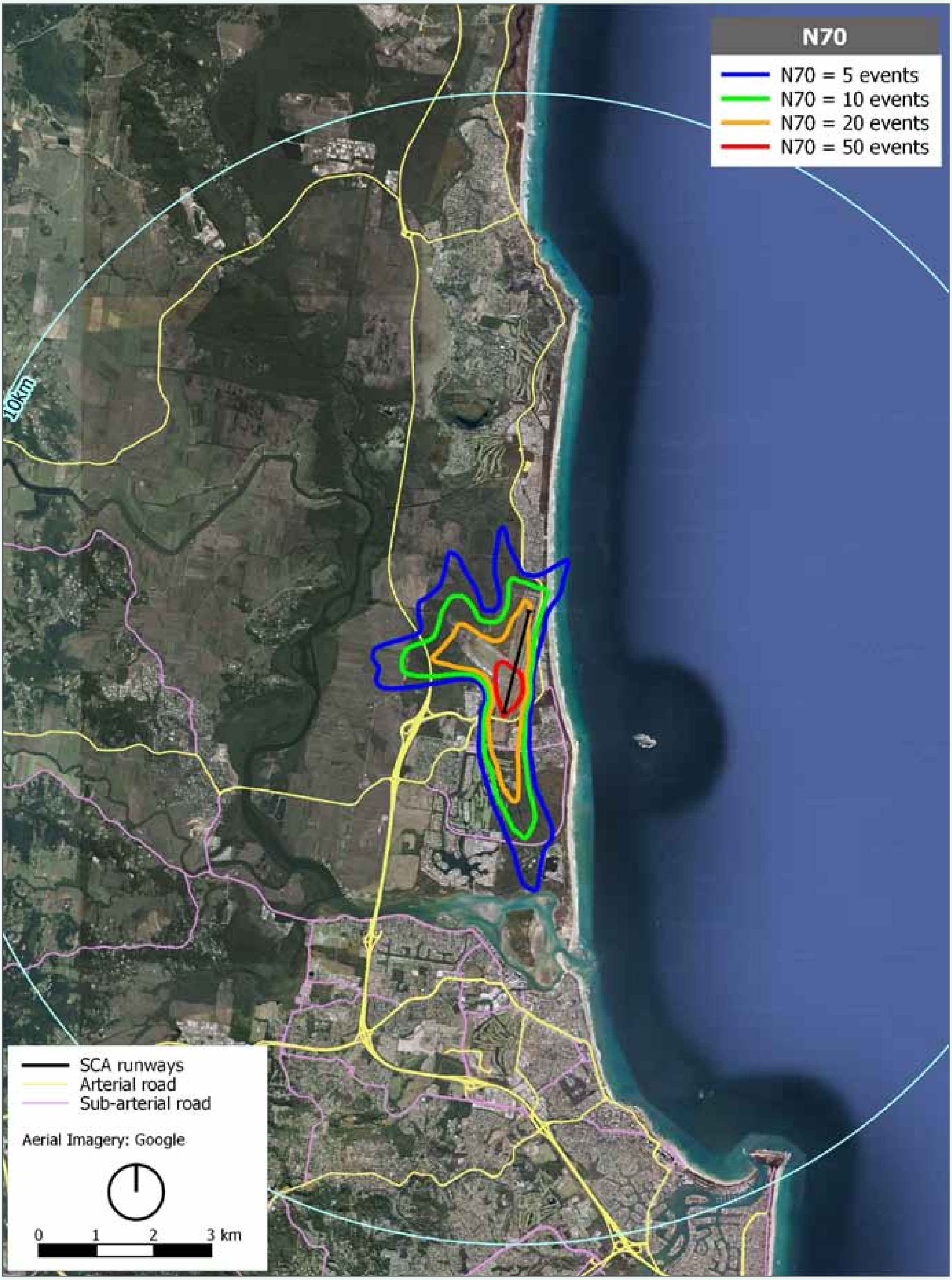


Figure 3.6n: N70 helicopter contours – Do Minimum 2020 day

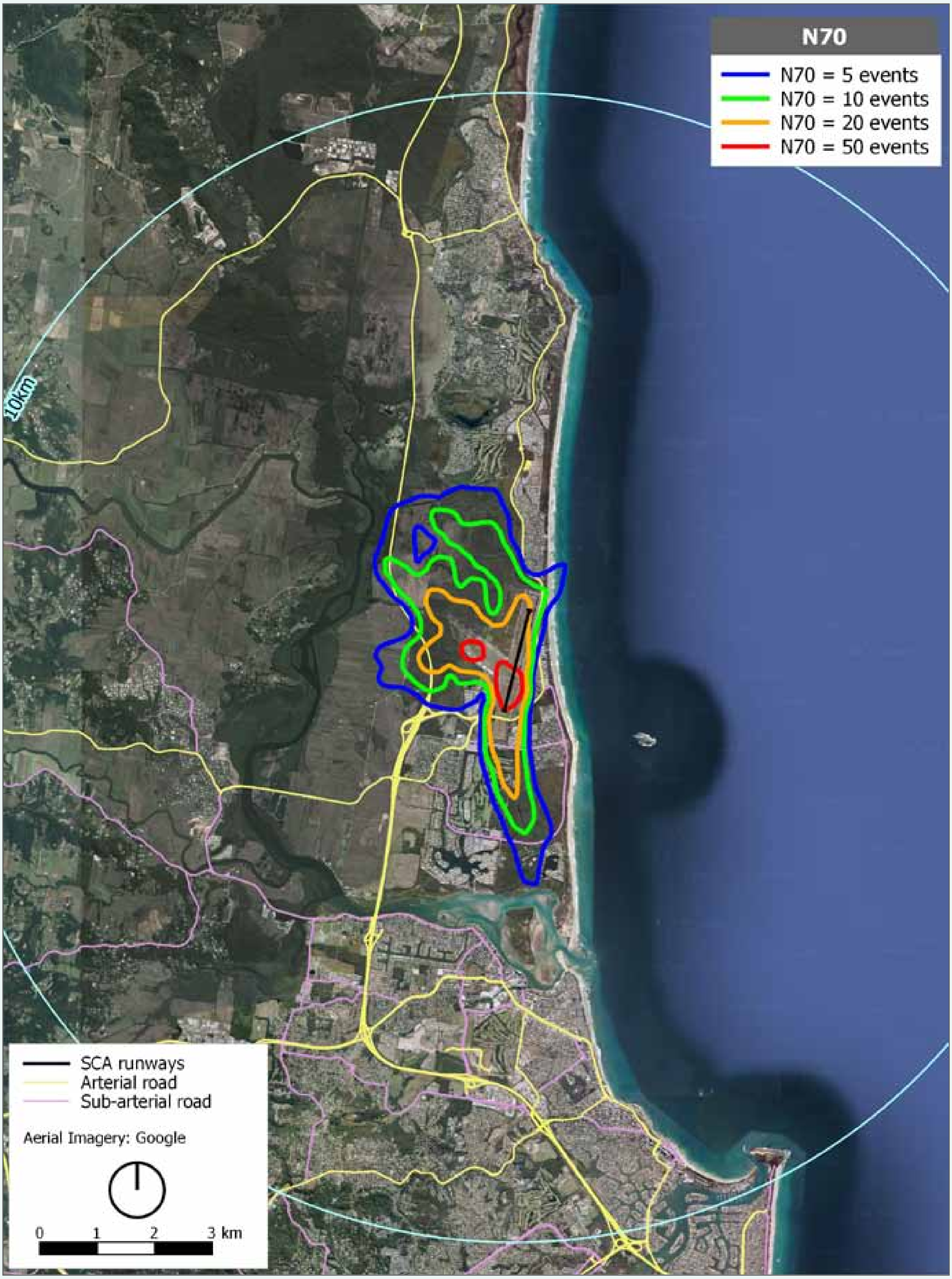


Figure 3.6o: N70 helicopter contours – New Runway 2020 day

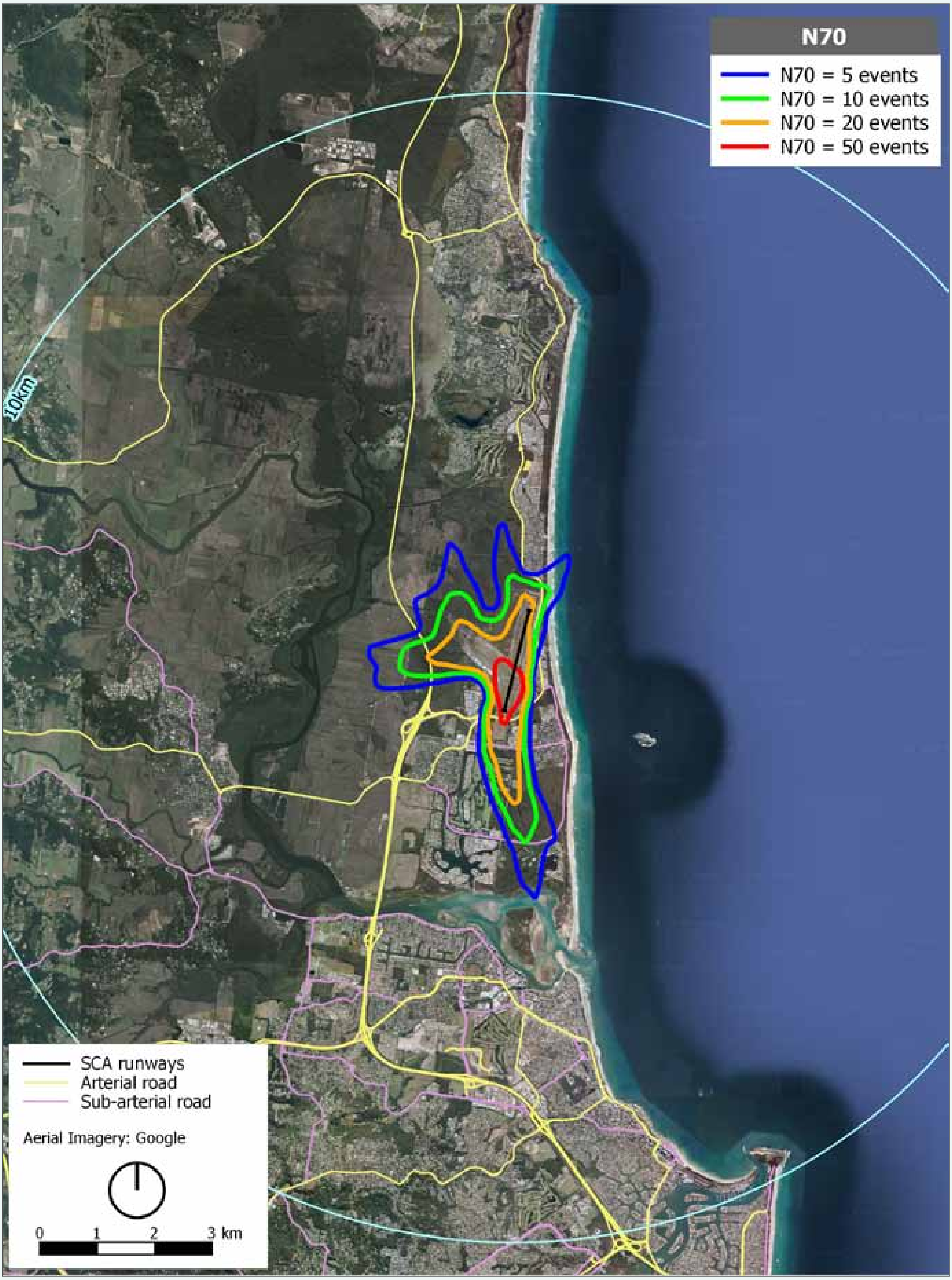


Figure 3.6p: N70 helicopter contours – Do Minimum 2040 day

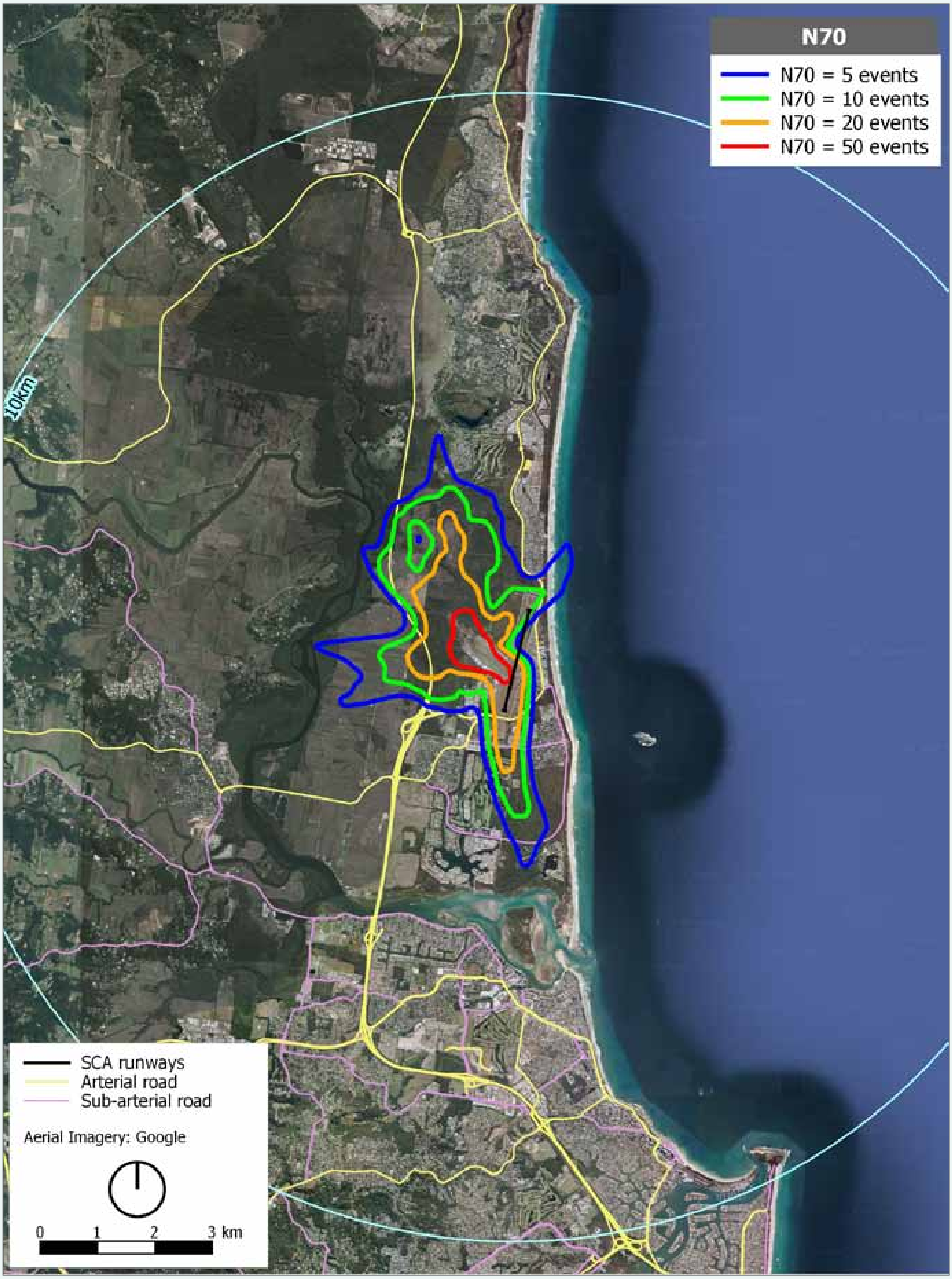


Figure 3.6q: N70 helicopter contours – New Runway 2040 day

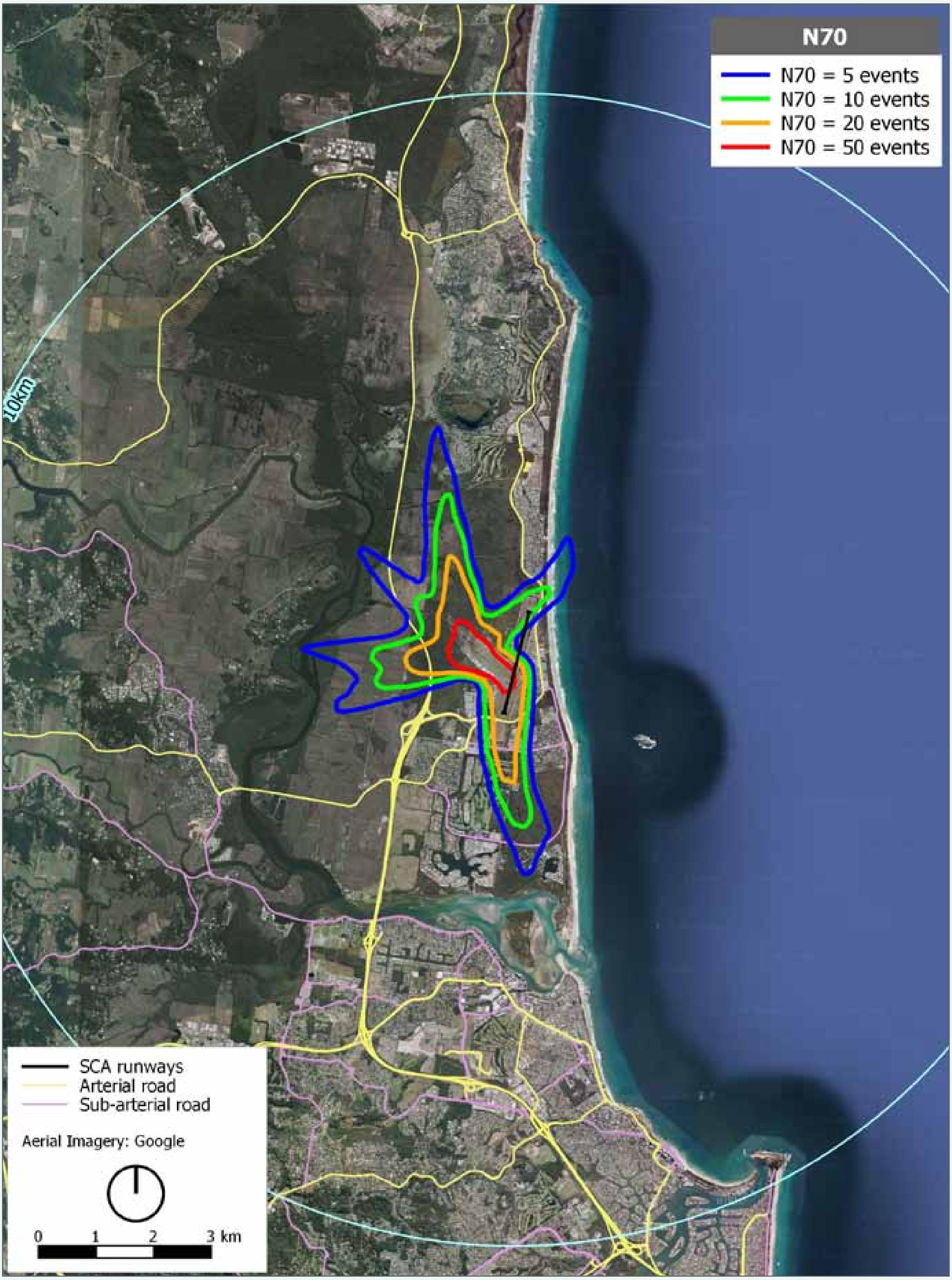


Figure 3.6r: N70 helicopter difference contours – 2020 day, "New Runway" minus "Do Minimum"

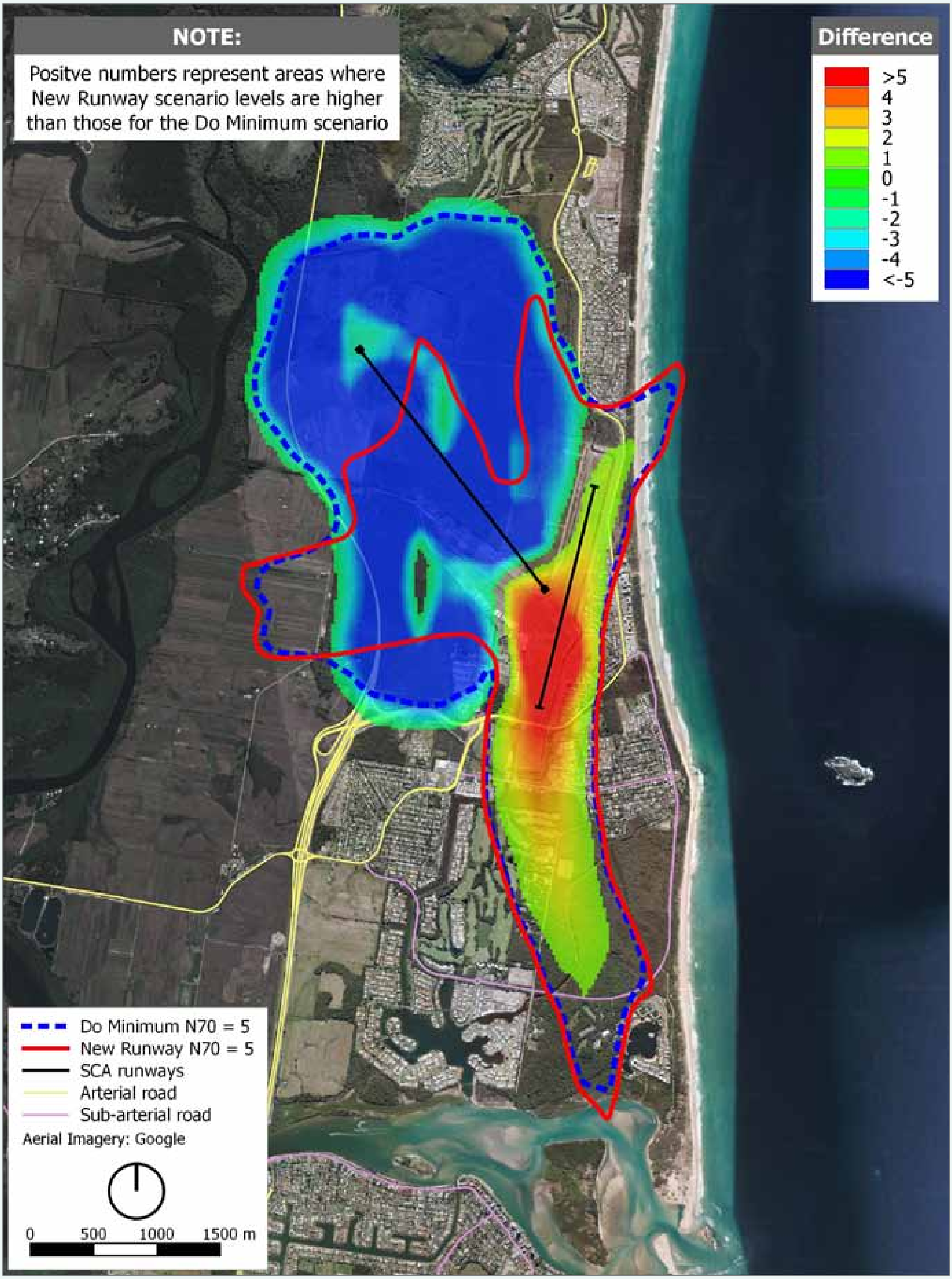


Figure 3.6s: N70 helicopter difference contours – 2040 day, "New Runway" minus "Do Minimum"

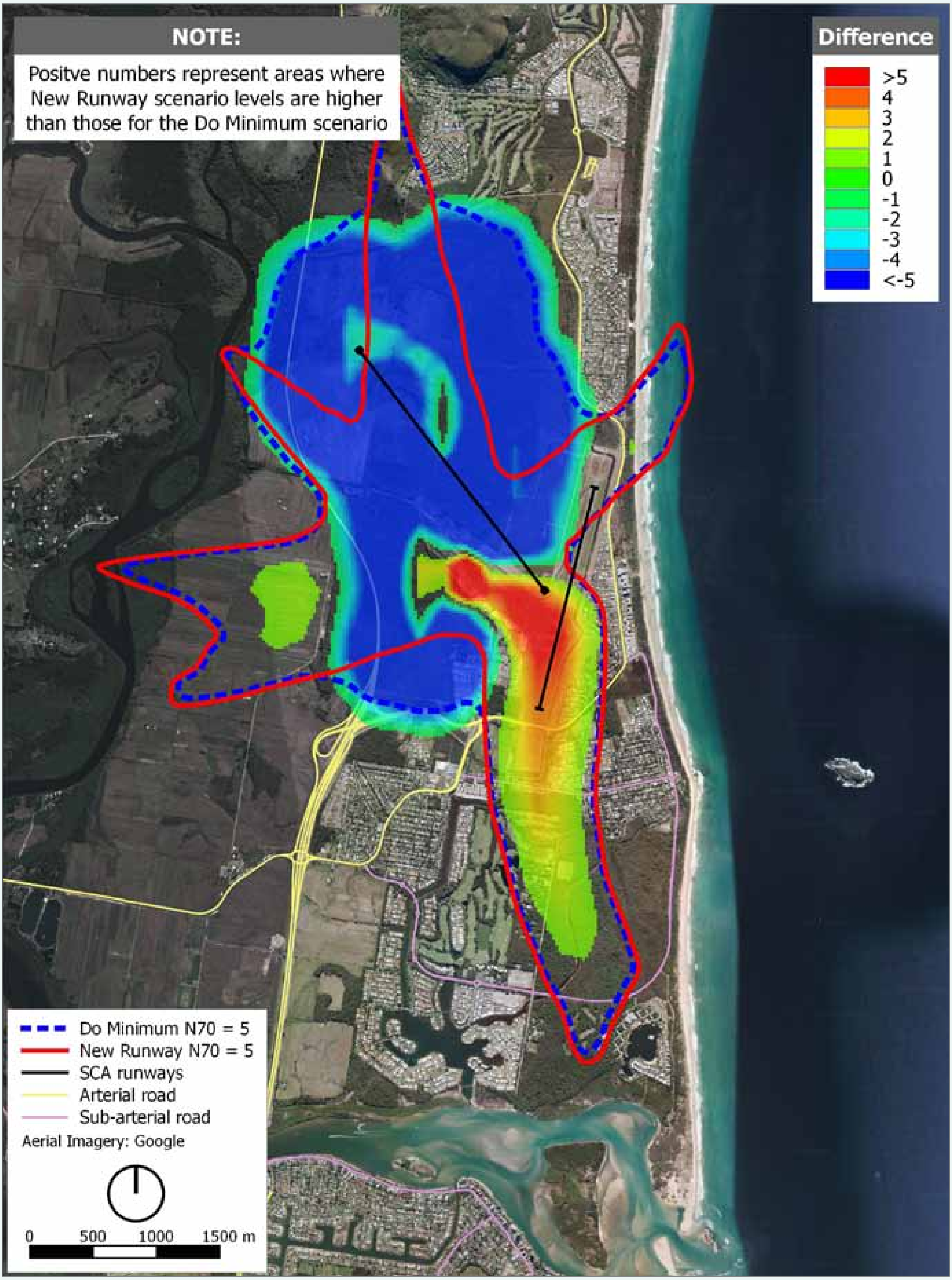


Figure 3.6t: N60 helicopter contours – New Runway / Do Minimum 2020 night

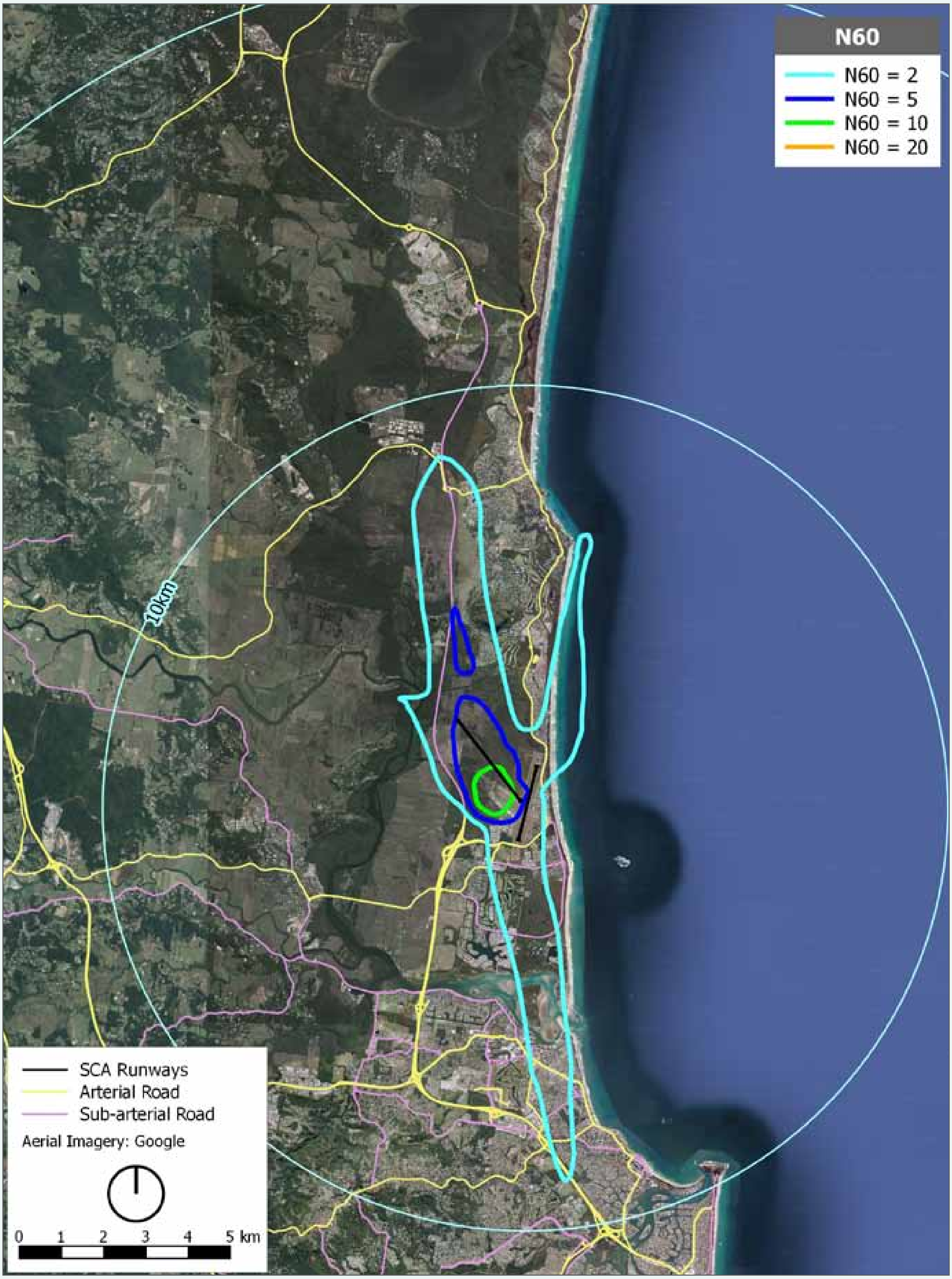
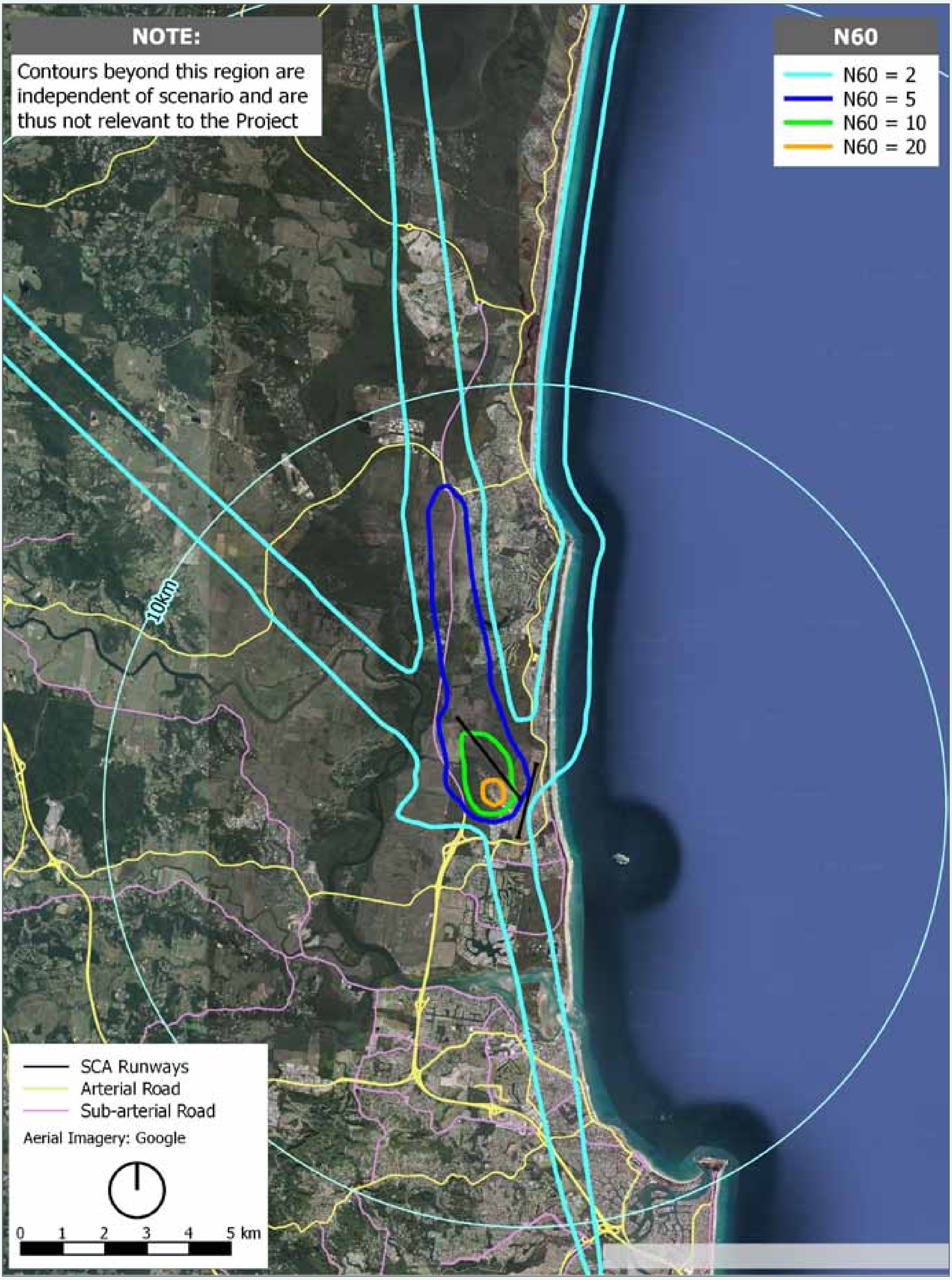


Figure 3.6u: N60 helicopter contours – New Runway / Do Minimum 2040 night



3.7 CUMULATIVE NOISE PREDICTIONS

This section presents the cumulative (fixed-wing and helicopter) aircraft noise predictions. For the relative contributions of fixed-wing aircraft and helicopters refer to the preceding sections.

3.7.1 N70 and N60 noise contours

This section first presents N70 contours for the daytime (7am – 6pm) and evening (6pm – 10pm) periods, and N60 contours for the night period (10pm – 7am).

3.7.1.1 Daytime and evening periods

Figure 3.7a to **Figure 3.7l** present the predicted cumulative N70 contours for all future scenarios for the summer weekday day and evening periods.

Appendix D3:B shows calculated N70 contours for all periods – summer and winter, weekday and weekend, day, and evening, for all assessment scenarios.

Noise exposure is seen to grow gradually from 2012 to 2040 as a result of increasing numbers of events. This progression is evident in the "2012 Existing", "2016 New Runway Construction", "2020 Do Minimum" and "2040 Do Minimum" scenarios.

The impact of the new runway is clearly evident in comparing the "New Runway" and "Do Minimum" scenarios. The New Runway contours are concentrated about the new runway centreline; extending north-west over greenfield areas and south-east over the ocean. This contrasts the Do Minimum contours which are concentrated about the Runway 18/36 centreline; extending north and south over residential areas along the coast.

The New Runway scenarios have a greater concentration of operations on the preferred runway (Runway 13) than "Do Minimum" scenarios (Runway 18). This is due to the orientation of Runway 13/31 relative to prevailing meteorological conditions. As a consequence of this more consistent usage, the majority of arriving aircraft do so from the north-west. This is reflected in the N70 contours for the New Runway scenario, which extend much farther north-west than south-east. This is most evident in the "N70 equals 5" contour of the "2040 New Runway" scenario; the contour extends 10 km north-west of the near runway threshold, and less than 8 km south-east. Contrastingly the corresponding Do Minimum "N70 equals 5" contour extends 8.3 km north, and 9.1 km south.

The differences in N70 values between New Runway and Do Minimum scenarios are presented graphically in **Figure 3.7m** to **Figure 3.6p**.

The New Runway scenarios used in modelling assume a much more organised airspace than that which currently exists. This is reflected in the contours, which clearly follow the few tracks modelled off each runway. The organisation of the airspace is expected to be a consequence of the AEP and is thus not an erroneous consequence of the modelling assumptions.

The addition of wide-bodied jets as a consequence of the new runway has a moderate impact, and is evident in the greater extents of the "N70 equals 5" contour. However, these increased extents are largely confined to non-residential areas and so the impact is predicted to be minimal.

Figure 3.7a: N70 contours – Existing 2012 day, summer weekday

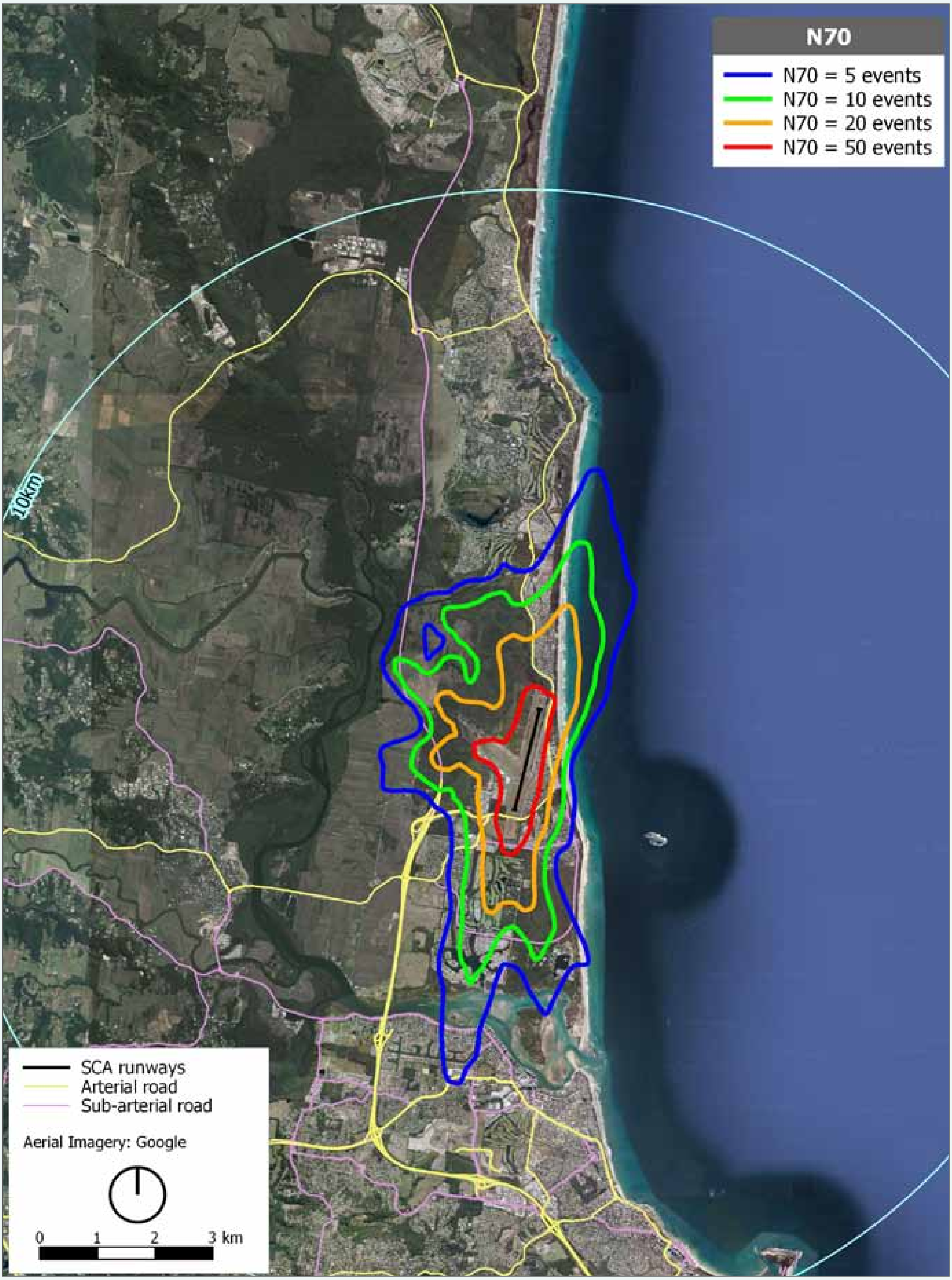


Figure 3.7b: N70 contours – Existing 2012 evening, summer weekday

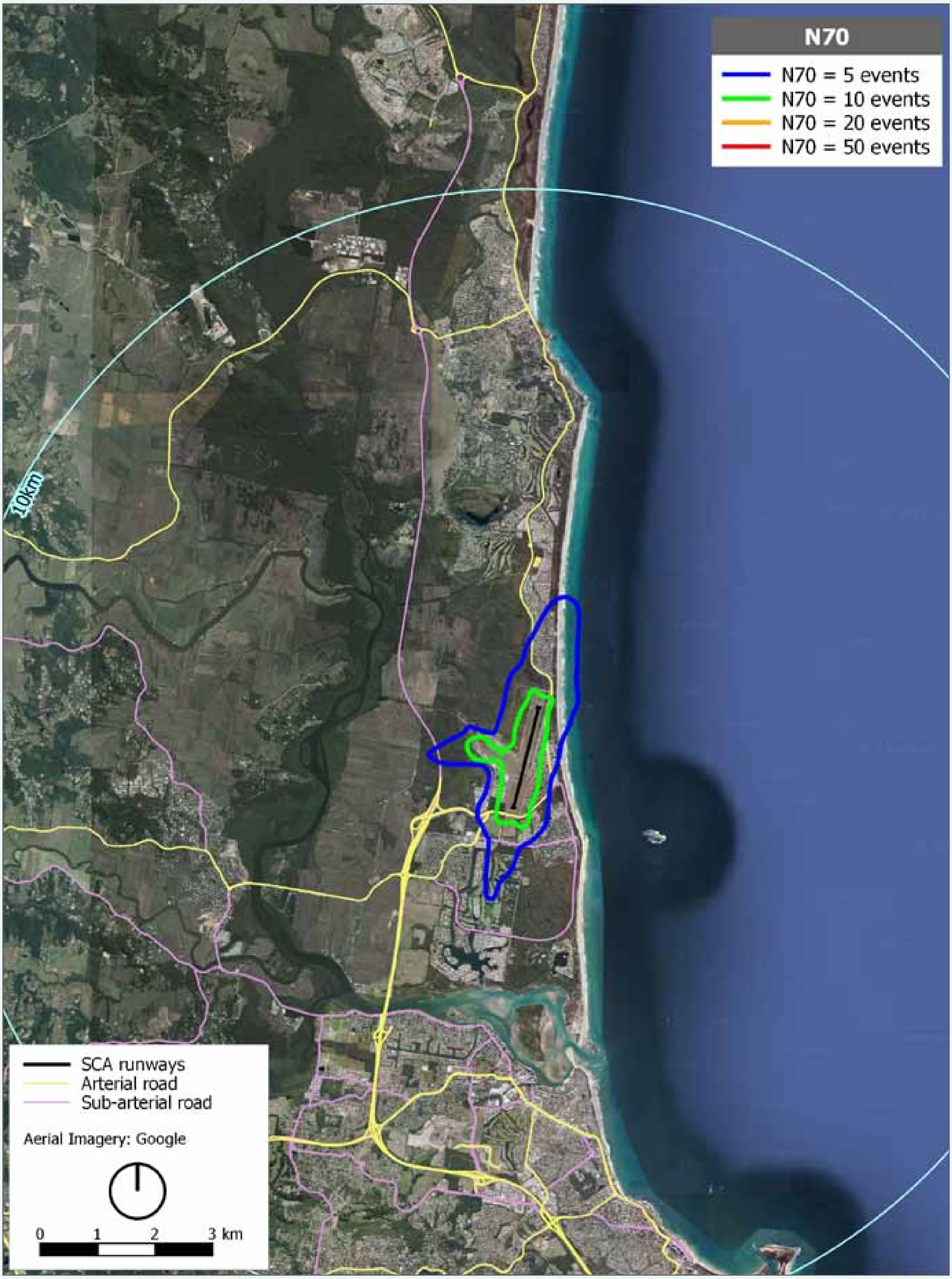


Figure 3.7c: N70 contours – New Runway Construction 2016 day, summer weekday

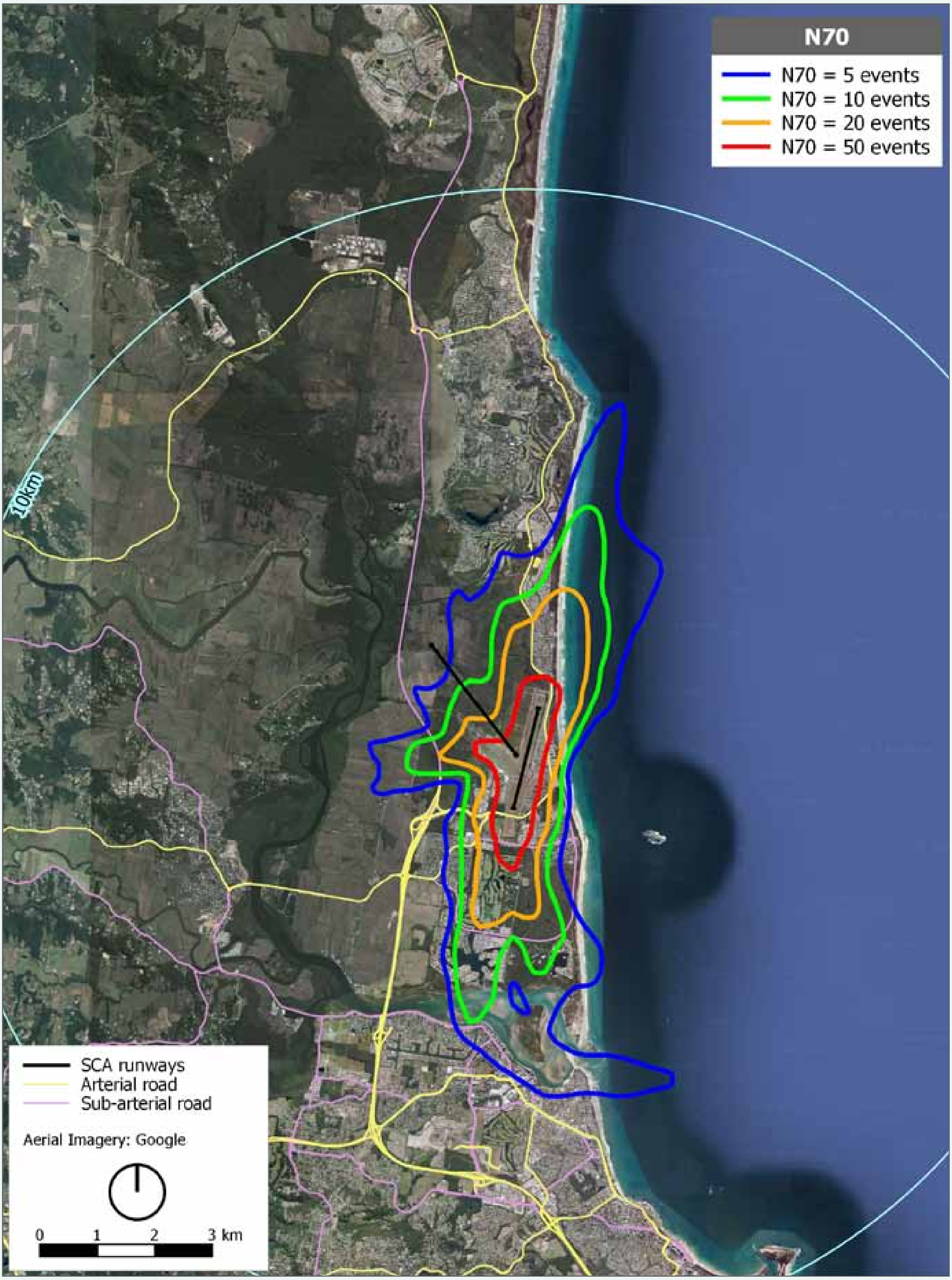


Figure 3.7d: N70 contours – New Runway Construction 2016 evening, summer weekday

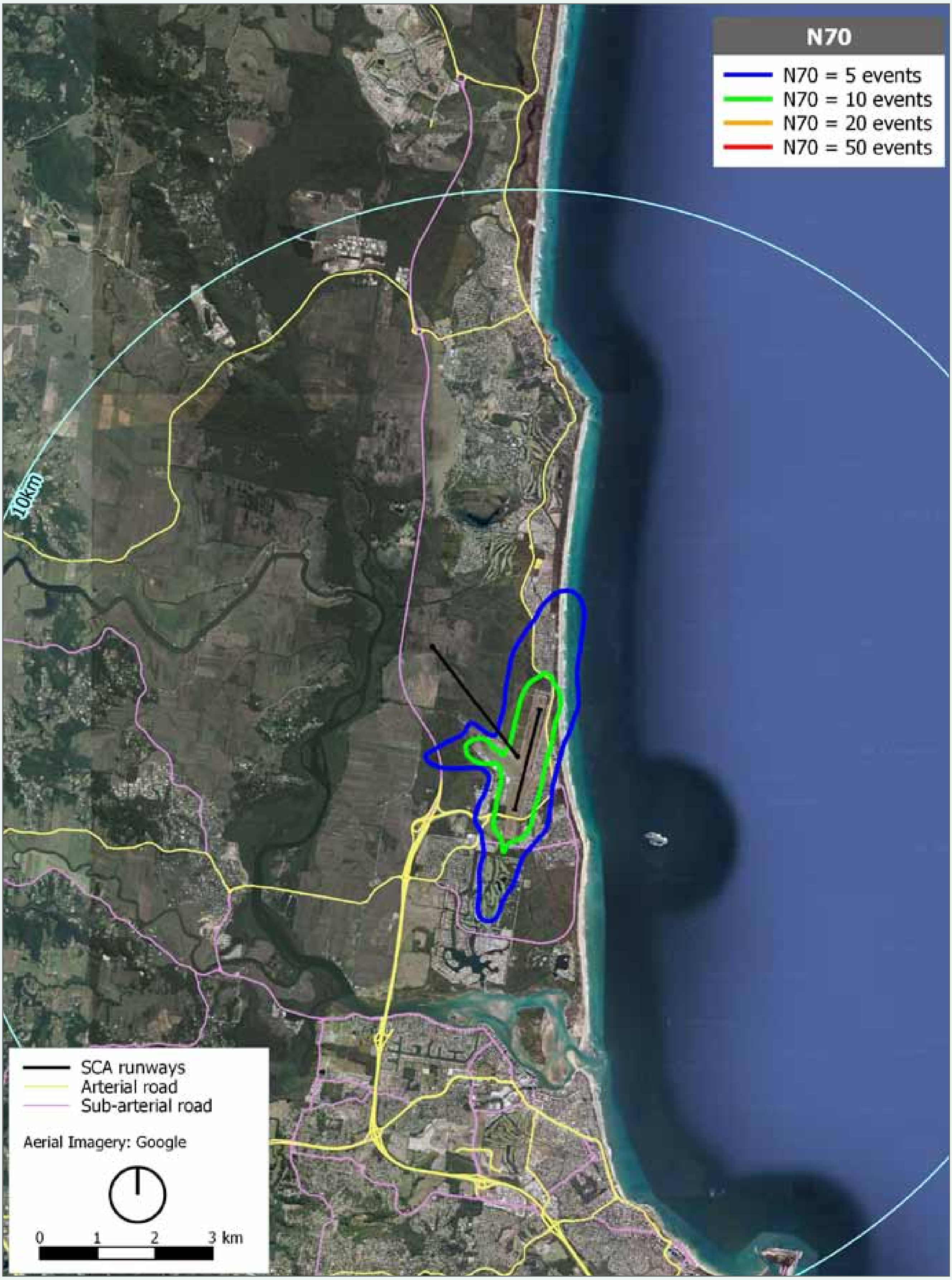


Figure 3.7e: N70 contours – Do Minimum 2020 day, summer weekday

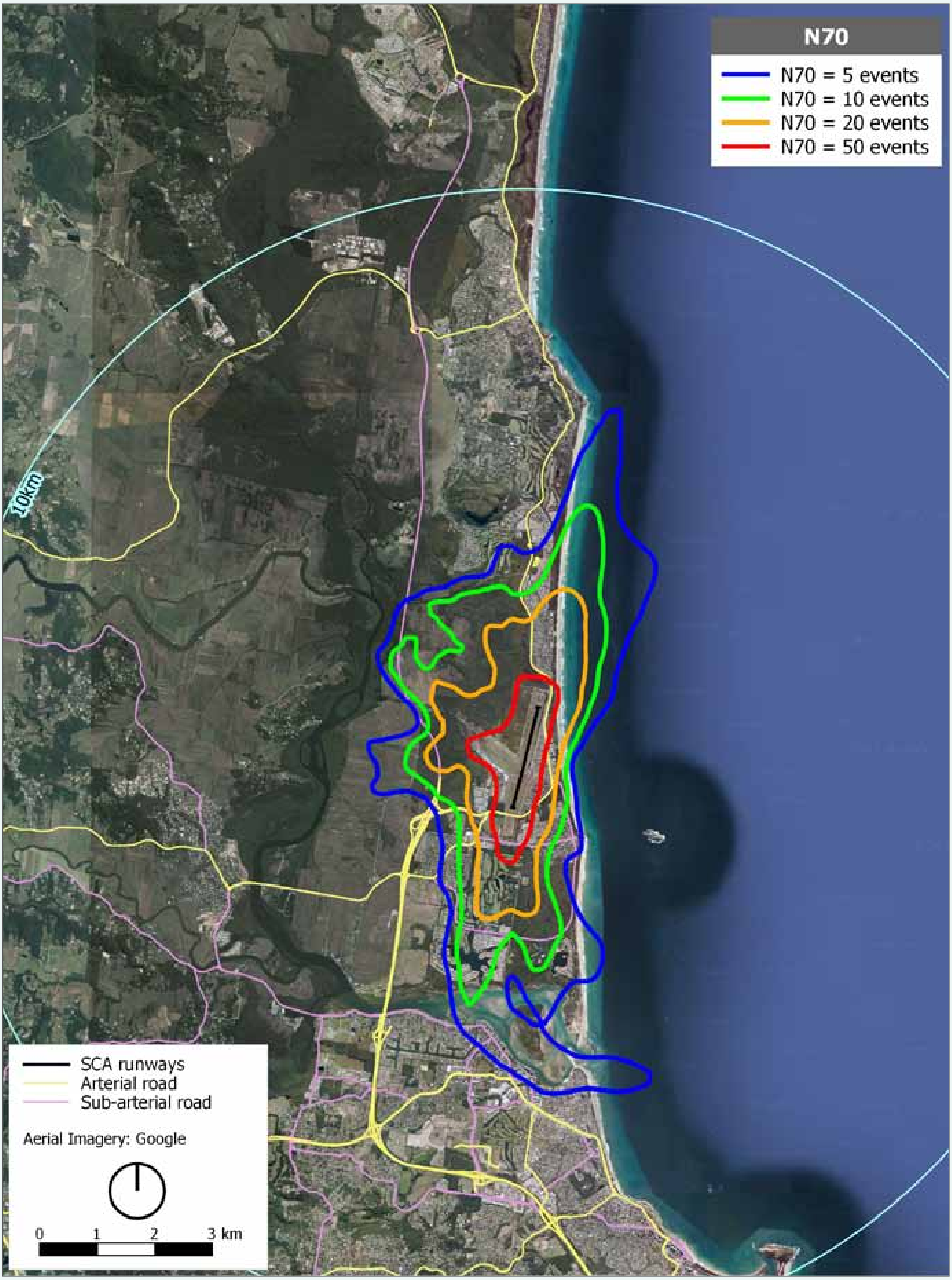


Figure 3.7f: N70 contours – New Runway 2020 day, summer weekday

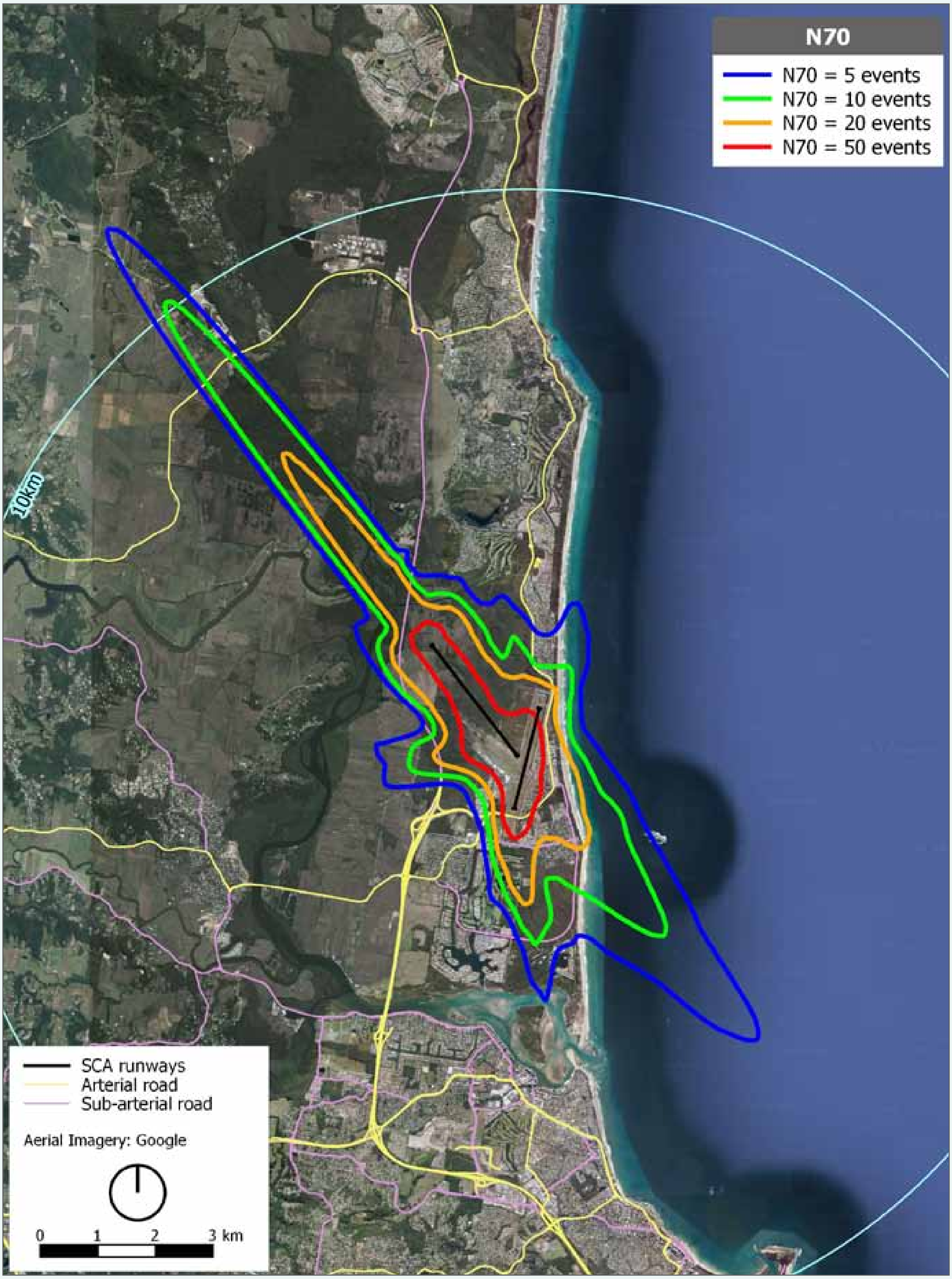


Figure 3.7g: N70 contours – Do Minimum 2020 evening, summer weekday

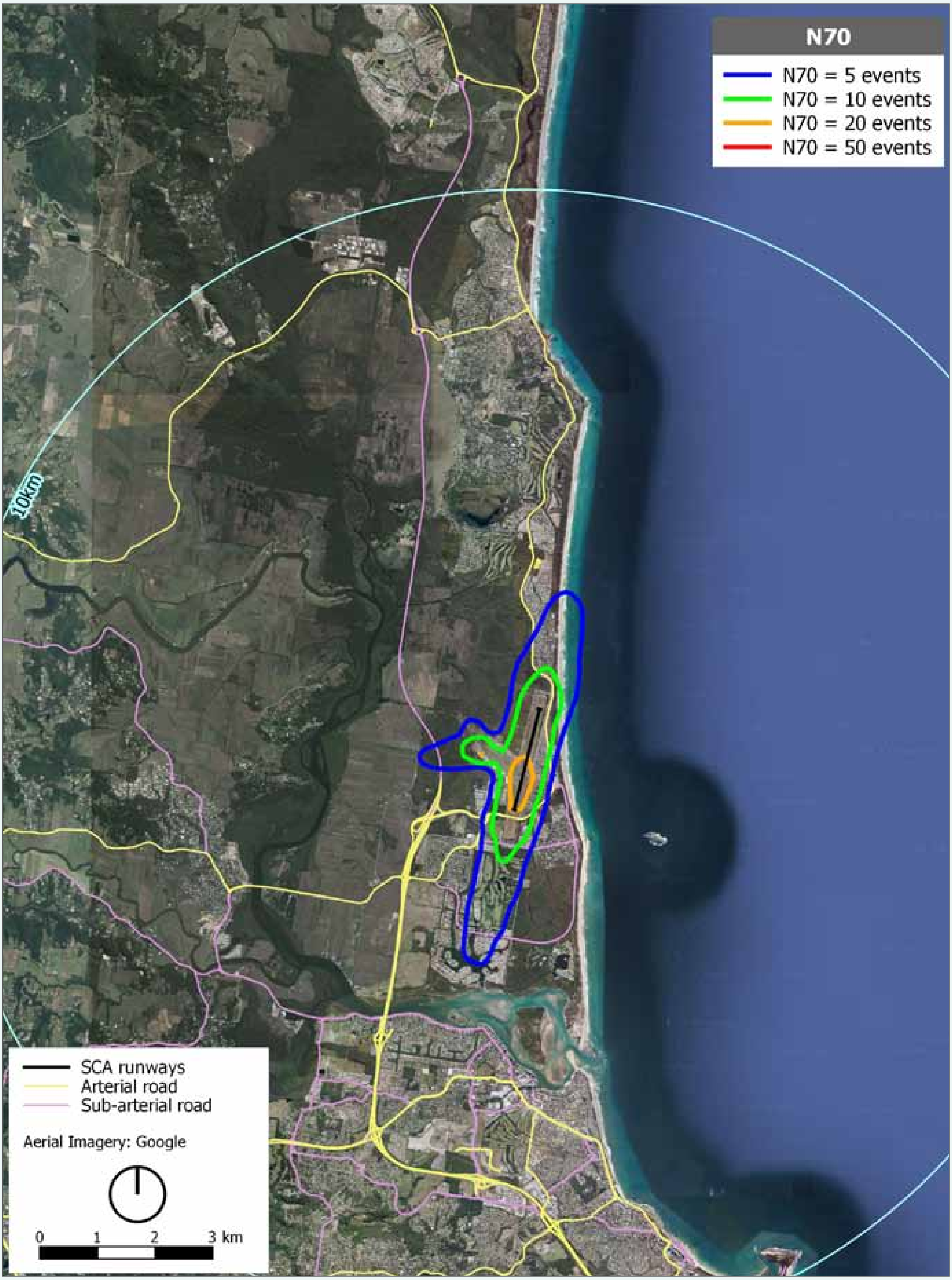


Figure 3.7h: N70 contours – New Runway 2020 evening, summer weekday

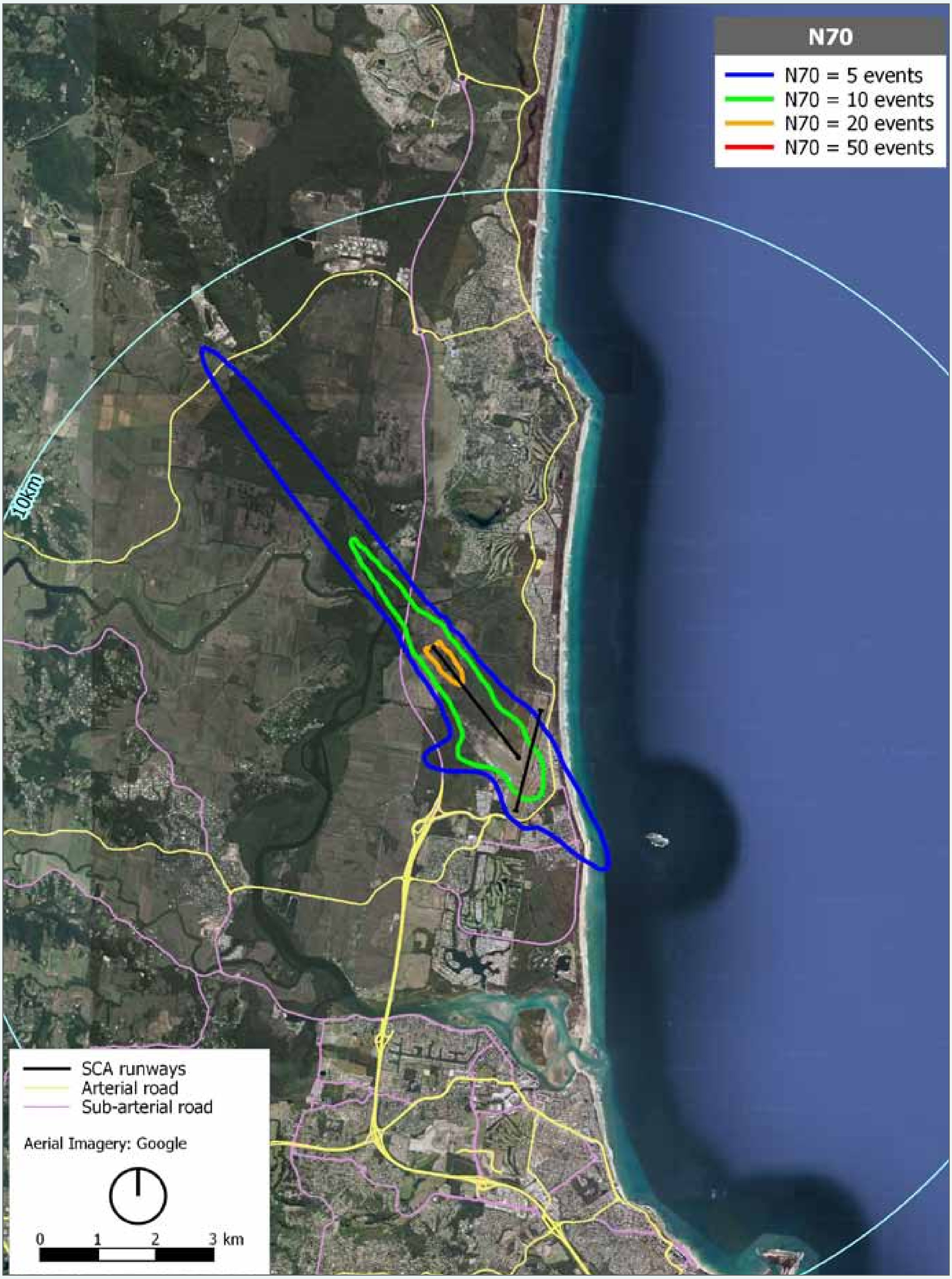


Figure 3.7i: N70 contours – Do Minimum 2040 day, summer weekday

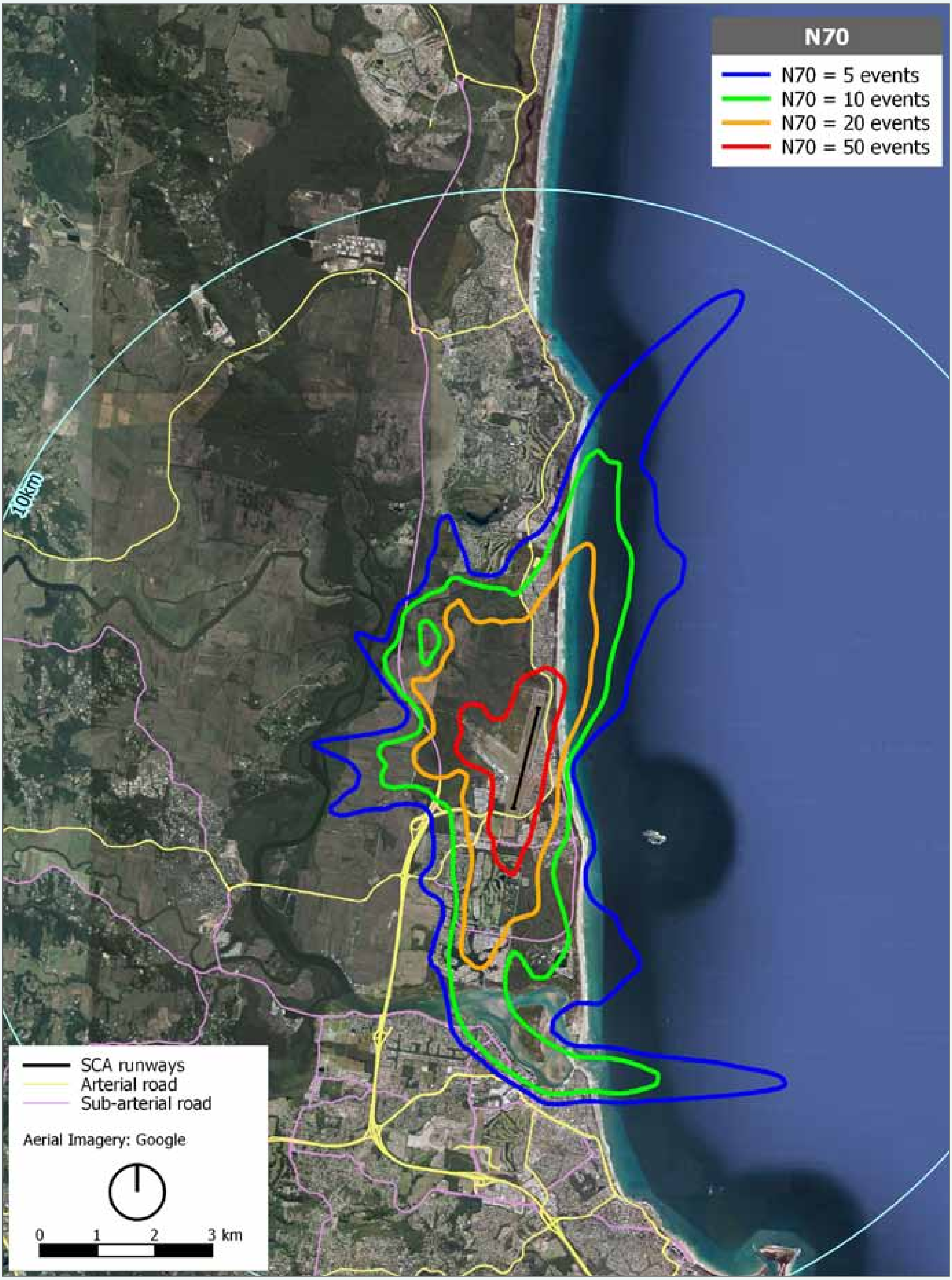


Figure 3.7j: N70 contours – New Runway 2040 day, summer weekday

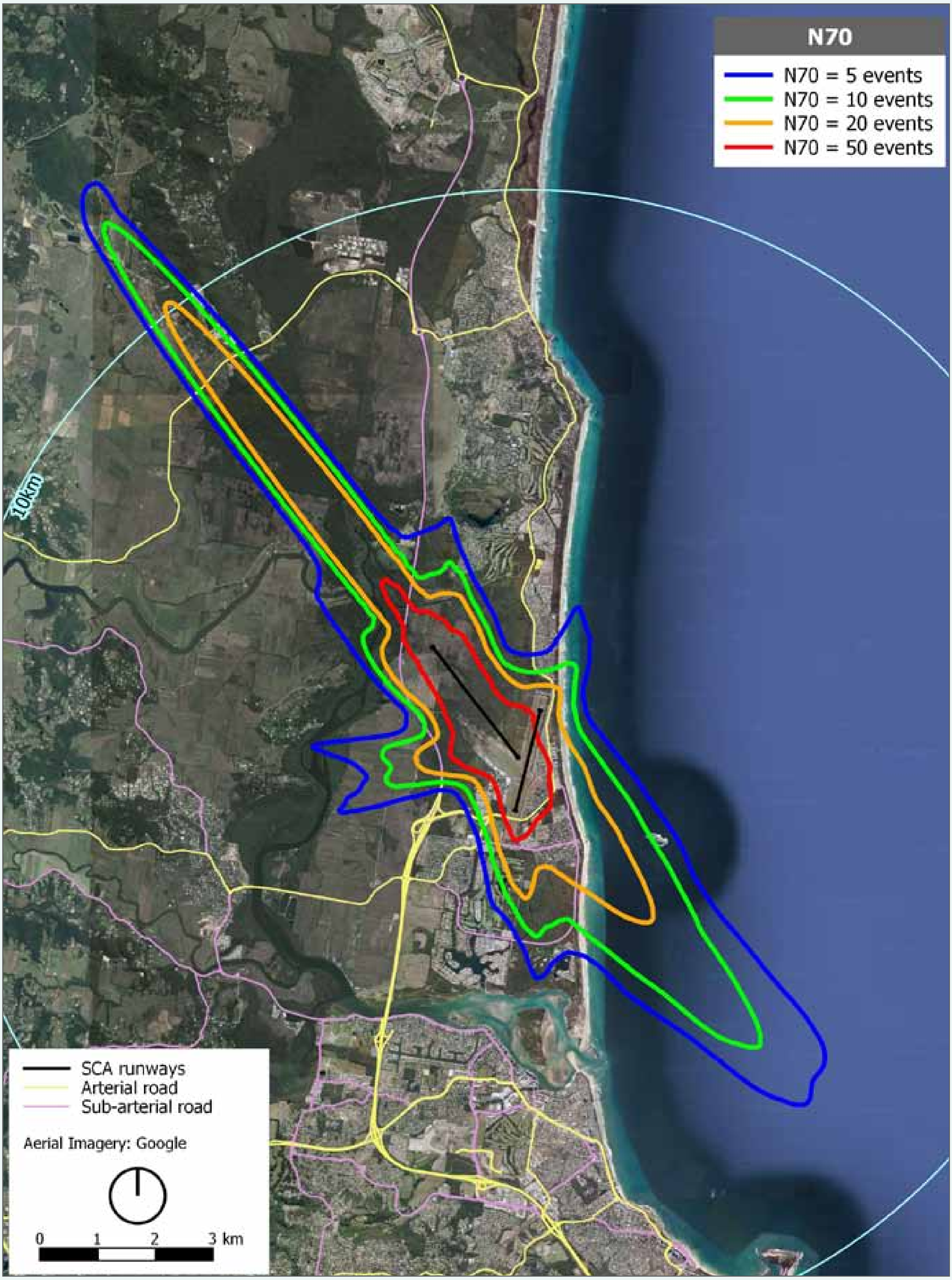


Figure 3.7k: N70 contours – Do Minimum 2040 evening, summer weekday

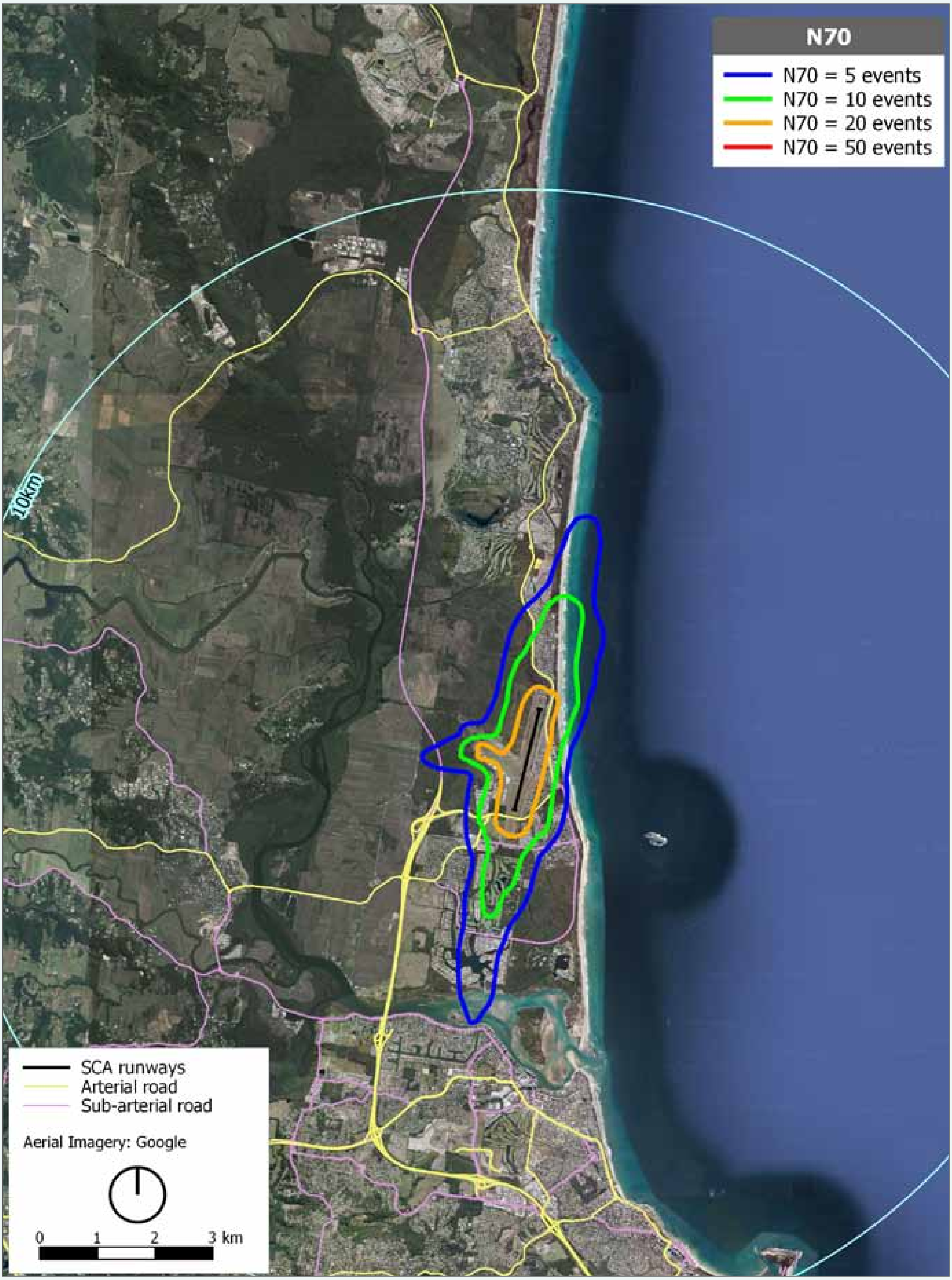


Figure 3.7l: N70 contours – New Runway 2040 evening, summer weekday

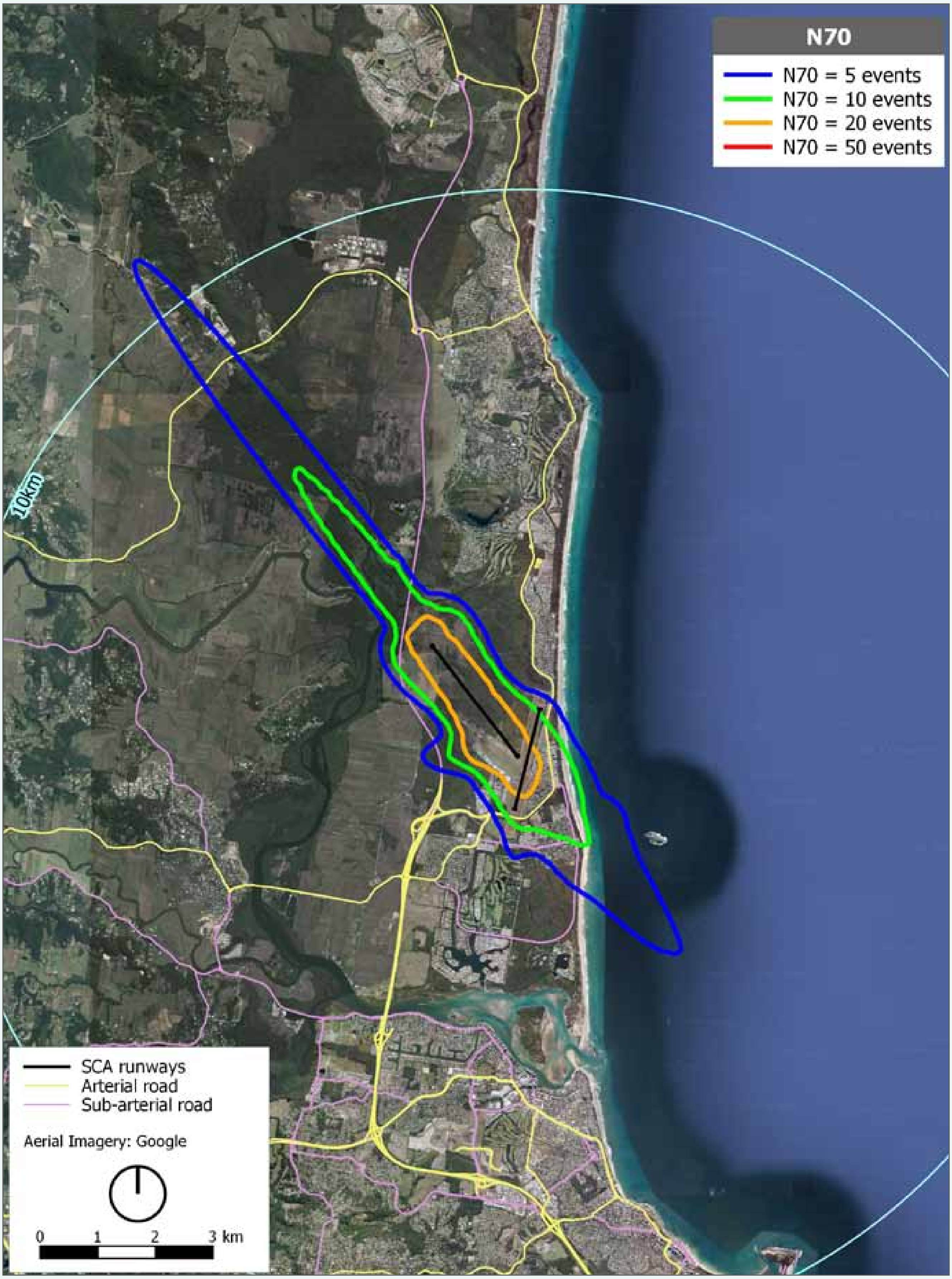


Figure 3.7m: N70 difference contours – 2020 day, summer weekday, New Runway minus Do Minimum

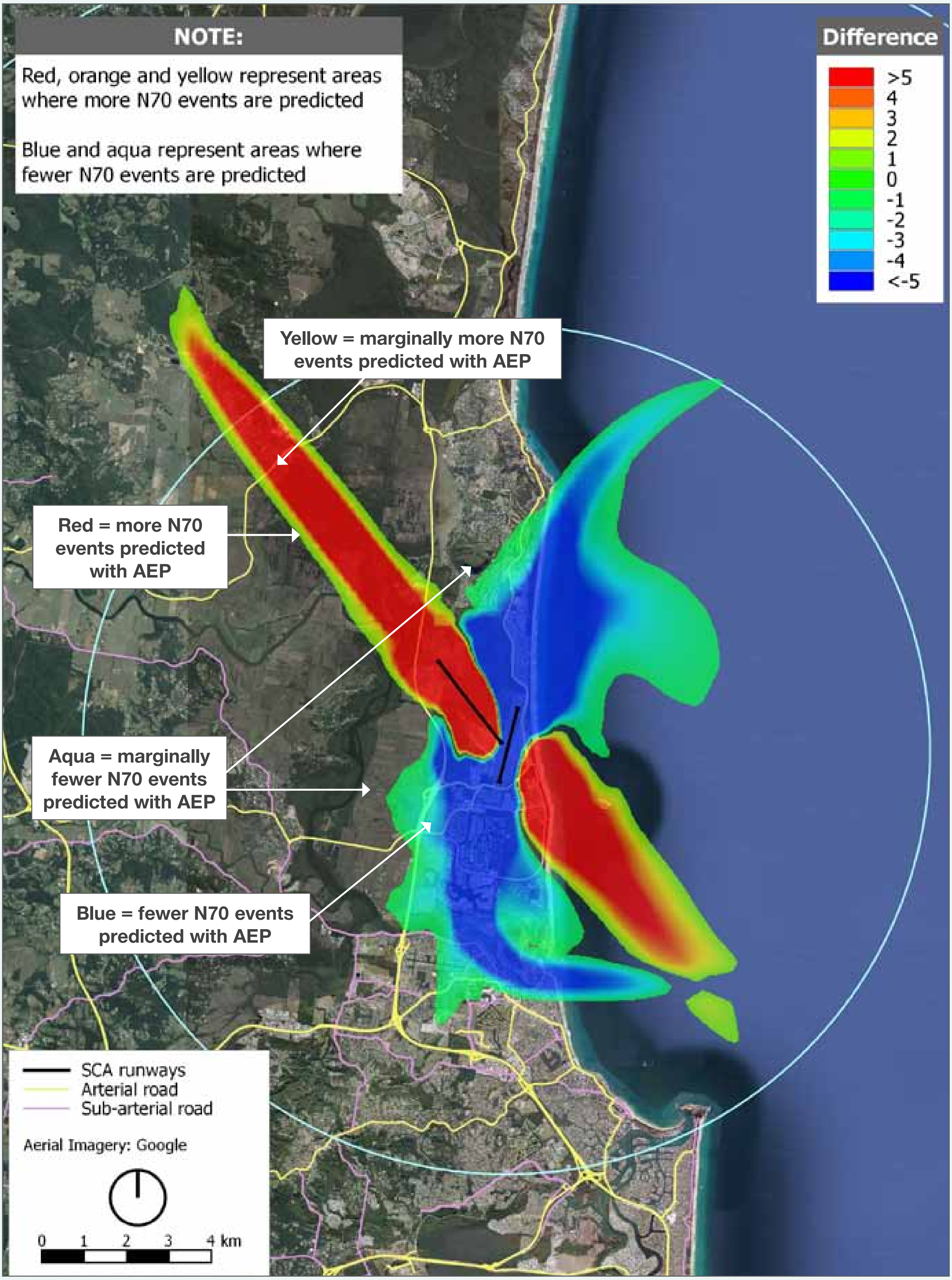


Figure 3.7n: N70 difference contours – 2040 day, summer weekday, New Runway minus Do Minimum

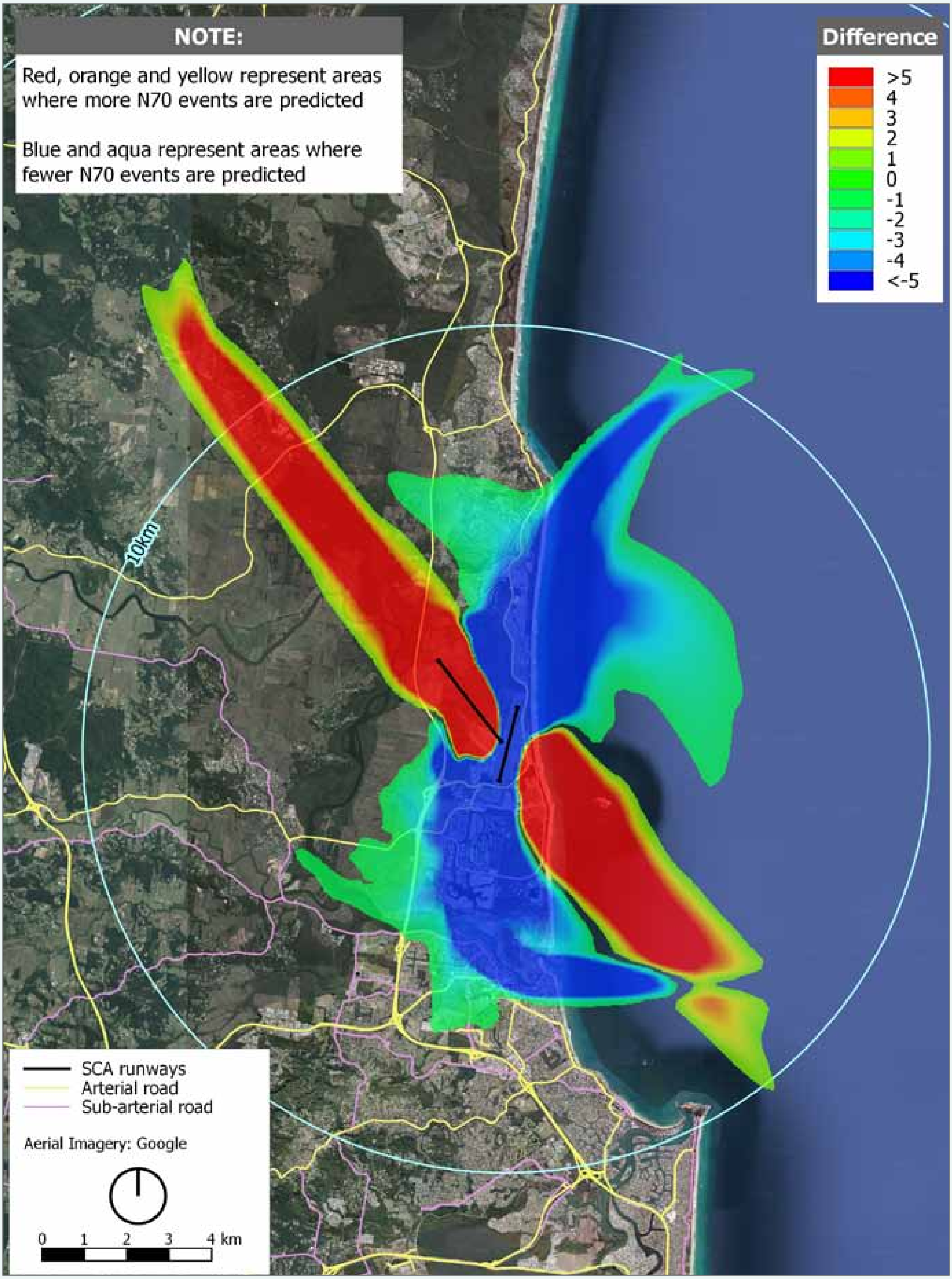


Figure 3.7o: N70 difference contours – 2020 evening, summer weekday, New Runway minus Do Minimum

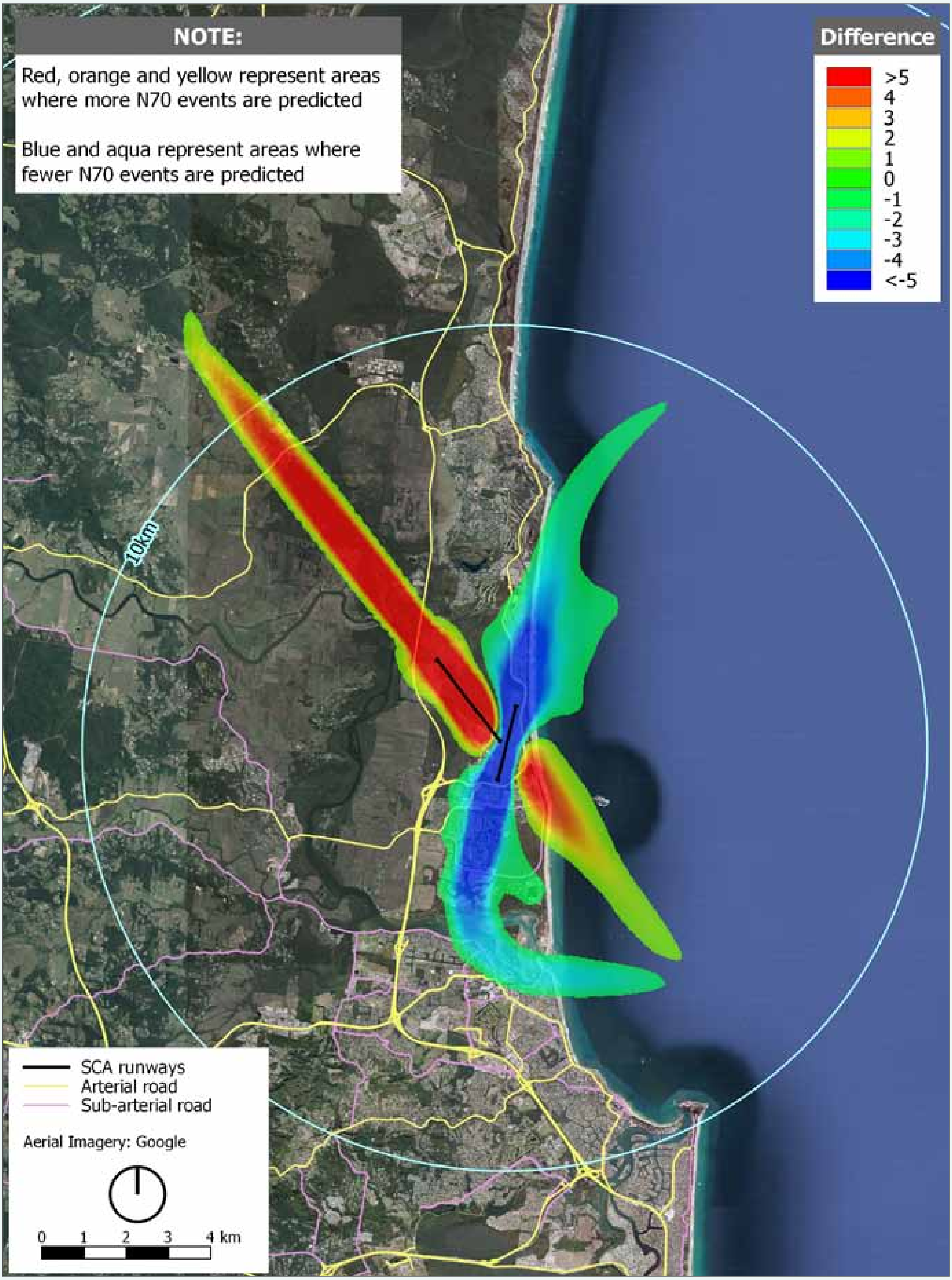
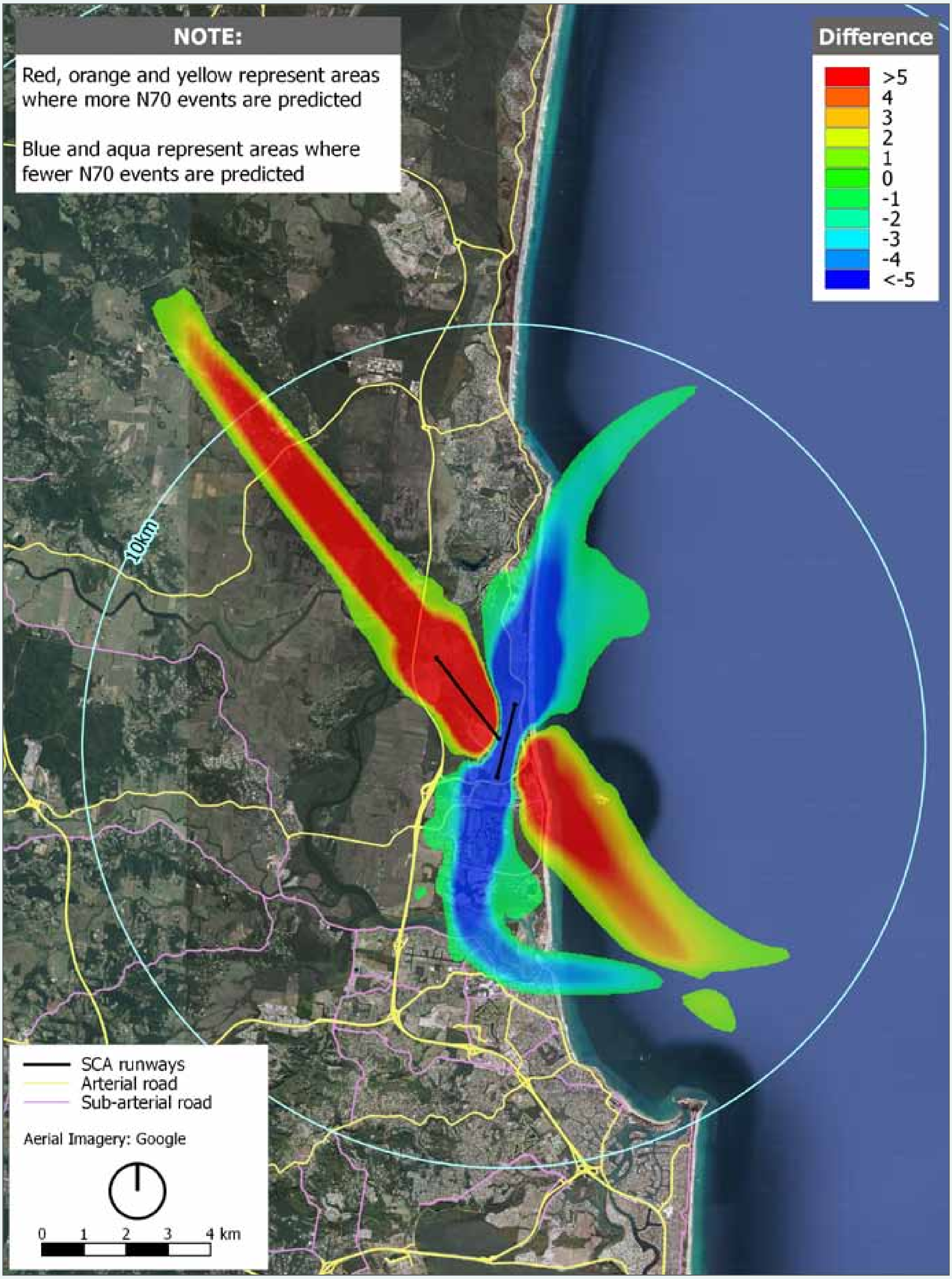


Figure 3.7p: N70 difference contours – 2040 evening, summer weekday, New Runway minus Do Minimum



3.7.1.2 N60 night time periods

Appendix D3:B shows calculated N60 contours for all periods – summer and winter, weekday and weekend night, for all assessment scenarios.

There are very few fixed-wing flights scheduled during the night time period. Forecasts for 2016 and 2020 have no fixed-wing night time flights, whilst 2040 has two fixed-wing flights at night (between 6am and 7am).

Figure 3.7q and **Figure 3.7r** present only the summer weekday variant (which generally has the largest footprint). Helicopters are the dominant source of night time N60 events.

The impact of the new runway on overall N60 contours is marginal, helicopters being unchanged as a result of the Project and dominating the N60 contours.

The addition of wide-bodied jets as a consequence of the new runway has no impact on night time noise as operations involving these aircraft are not forecast at night.

3.7.2 ANEC noise levels

As outlined in **Section 3.2.1.1**, the most important use of ANEF contours is in land use planning around airports, using the principles set out in the Standard. ANEF is a measure of total aircraft noise exposure at a point, and ANEF charts are prepared by all major airports in Australia to indicate projected future noise exposure in surrounding areas. An ANEF chart is an ANEC chart produced for a specific future year which has been endorsed for technical accuracy by Airservices and has undergone a consultation process, thereby becoming the officially-recognised forecast of noise exposure for that airport (until it is superseded by a later chart).

Land use planning advice in the Standard is expressed in terms of ANEF zones, as described in **Section 3.2.1.1**.

The ANEC represents all aircraft noise; i.e. both fixed-wing and helicopter operations are included.

3.7.2.1 Existing ANEF chart

The current ANEF chart for the Airport is presented in **Figure 3.7s**. This ANEF chart was produced as part of the Sunshine Coast Planning Scheme 2014 (the Planning Scheme) and features a composite of ANEF contours for the existing and proposed runways. The ANEF was produced for the year 2025.

Since preparation of the Planning Scheme the following has occurred.

- The proposed location and alignment of the new runway has changed slightly. The runway proposed as part of the Project is now proposed approximately 310 m south-east of the location considered by the Planning Scheme and approximately 4° clockwise.
- INM 7.0 has been developed which incorporates modelling of helicopters very differently to previous versions.
- Forecasts of future operations at SCA have been updated.

In addition to the above items, several particulars of the current assessment differ from the noise predictions used in developing the Planning Scheme. The following are worthy of distinction here.

- Significant analysis of historical data has been undertaken to determine the tracks flown for Existing and Do Minimum scenarios. Particular attention has been paid to accurately representing helicopter operations.
- Analysis of 10 years of meteorological data and consideration of ATC procedures has been used to better predict future operations, including the proportional split of operations between runways.
- Key inputs to the current modelling differ from the Planning Scheme;

  <u>Do Minimum</u>

  – All fixed-wing aircraft use Runway 18/36 unless it is unavailable due to meteorological conditions (35 per cent in the Planning Scheme)

  <u>New Runway</u>

  – 100 per cent of RPT aircraft are forecast to use Runway 13/31 (90 per cent in the Planning Scheme)

  – GA would use Runway 13/31 when available (10 per cent in the Planning Scheme)

Comparing the existing ANEF chart (2025) with the 2020 and 2040 ANEC contours prepared in this assessment, the impact of the above is evident. The most notable difference is the influence of helicopters about the helipad locations and training area, which cannot be seen in the existing ANEF chart.

Figure 3.7q: N60 contours – Do Minimum 2040 night, summer weekday

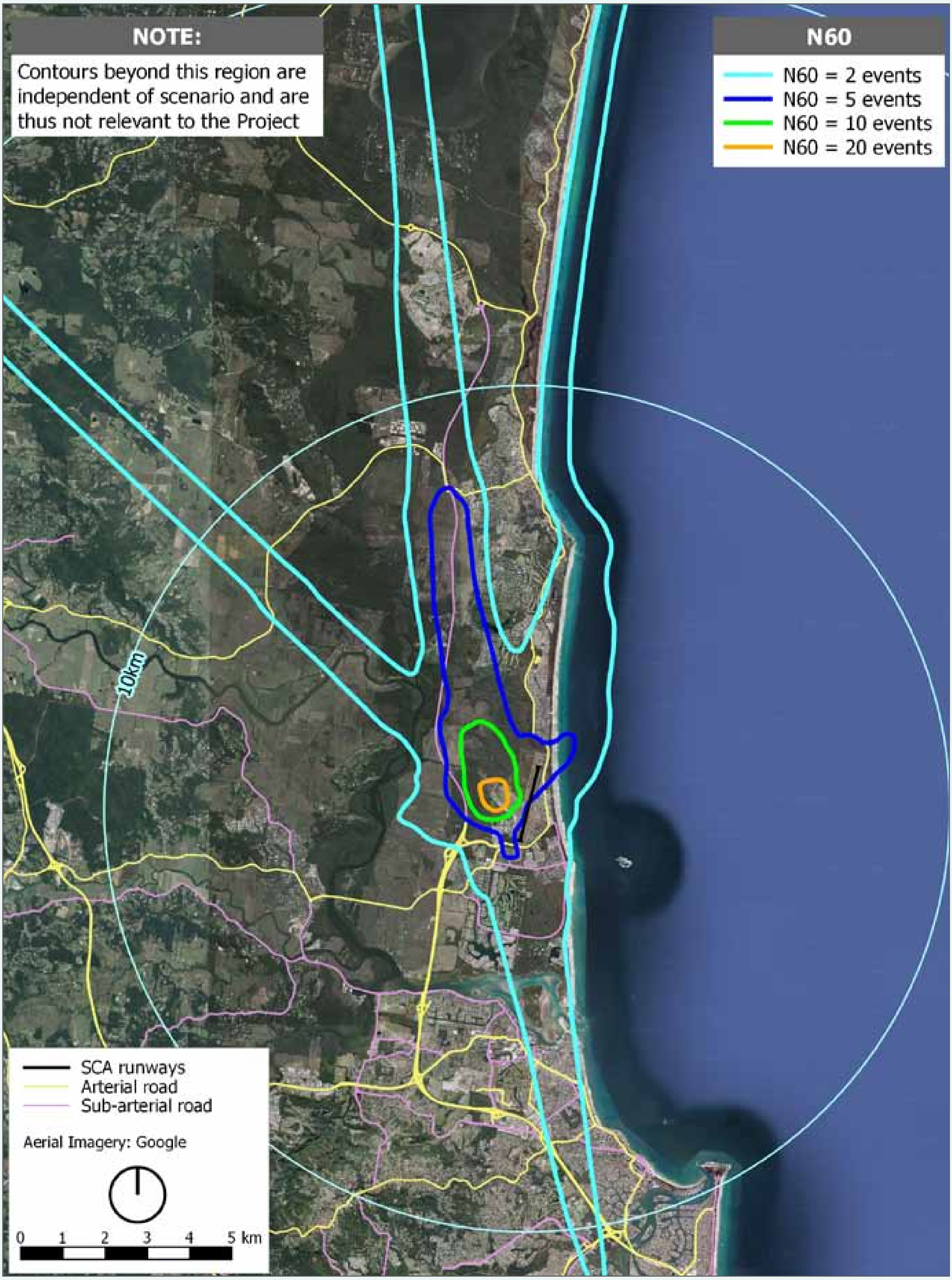


Figure 3.7r: N60 contours – New Runway 2040 night, summer weekday

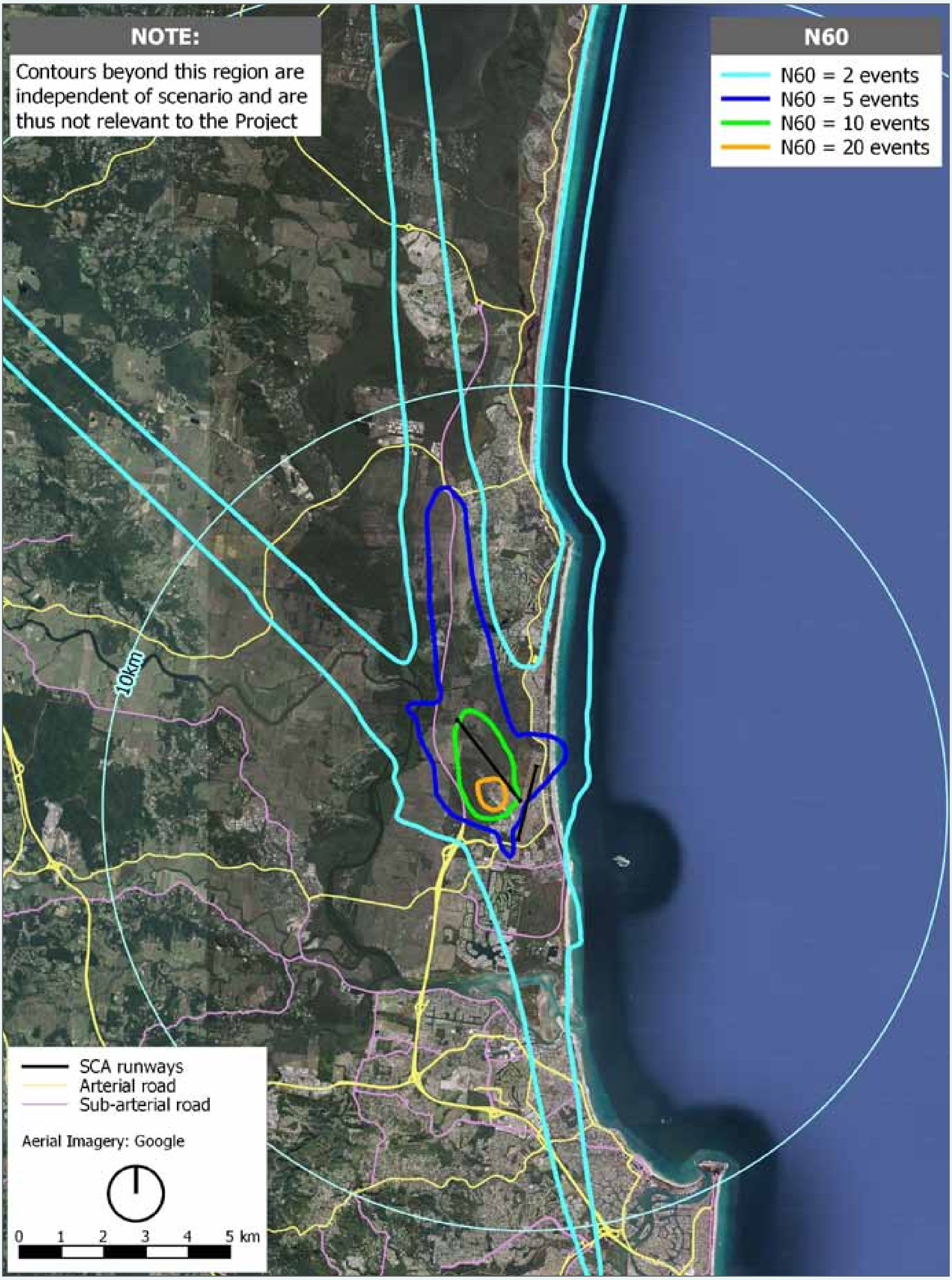


Figure 3.7s: Existing ANEF – 2025 composite of existing and proposed runways (Source: Sunshine Coast Planning Scheme 2014)

3.7.2.2 Predicted ANEC contours

Figure 3.7t to **Figure 3.7y** present the predicted ANEC noise levels for 2012 to 2040 Existing, Do Minimum and New Runway scenarios.

The change in noise as a result of the new runway is evident in comparing the New Runway and Do Minimum scenarios. The New Runway contours are concentrated about the new runway centreline; extending north-west over greenfield areas and south-east over the Mudjimba and the ocean. This contrasts the Do Minimum contours which are concentrated about the Runway 18/36 centreline; extending north and south over residential areas along the coast.

Areas that are within the Do Minimum ANEC 20 are:

- Twin Waters
- Marcoola
- Mudjimba
- Small areas of Pacific Paradise (no residential areas)

Areas that are within the New Runway ANEC 20 are:

- Marcoola
- Mudjimba
- Small areas of:
  - Coolum Beach[4]
  - Yandina Creek
  - Maroochy River (no residential areas)
  - Mount Coolum (no residential areas)
  - Pacific Paradise (no residential areas)

The addition of wide-bodied jets as a consequence of the new runway is not clearly evident in the ANEC contours. However, the extents of New Runway scenario ANECs can partially be attributed to the inclusion of these aircraft. Regardless, the ANECs for these scenarios are generally over greenfield areas north-west of the airport, with minimal encroachment on urban areas.

The residential areas of Mudjimba and Marcoola (east of the Runway 18/36 centreline) are the only densely populated areas encompassed by the ANEC 20 contour with the Project. These areas are also within the ANEC 20 contour for the corresponding Do Minimum scenario. Additional residential areas north and south of Runway 18/36 are also within the Do Minimum ANEC 20 contour. These areas include parts of Marcoola, Mudjimba and Twin Waters.

4 The Coolum Beach locality extends west to Yandina Creek, with one residence identified near this border. Refer to ***Figure 3.1b***

3.8 MODELLING SENSITIVITY TO ASSUMPTIONS

In order to undertake noise predictions for the various scenarios a number of assumptions were made. This section examines the sensitivity of the predictions to these assumptions.

3.8.1 Aircraft operations forecasts

Noise predictions are sensitive to the forecast operations. The ANEC is an energy-dose-like metric and thus the extent of each contour would extend or retract proportionally to a change in aircraft numbers.

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 follows.

- A change of 50 per cent would result in a change of 3 in the ANEC value at any point. This would definitely be noticeable by residents.
- A change of 10 per cent would result in a change of less than 0.5 in the ANEC value at any point. While this may be noticed by some residents if it occurred suddenly, the long-term impact of such a change is considered negligible.

N70 and N60 contours would be expanded slightly by a doubling in aircraft numbers, and the N70/N60 value at any point would double. For low values of N70/N60, such as N70 = 5, the extent of the contours is limited by the loudest aircraft type, and so this may not extend greatly.

Subjectively, for a listener on the ground, a change in the number of operations would be perceived by the frequency of overflights or the duration between them. A change of 10 per cent may or may not be noted, but a doubling or halving of the number of flights is likely to be very noticeable.

It is unlikely that the Project will significantly impact the number of operations. The only significant impact that the Project is likely to have on forecasts is through the introduction of wide-bodied jets, and allowing farther ports to be accessed by narrow-bodied jets. Hence for this project, the outcomes of the noise modelling do not depend critically on the forecast total number of flights at the airport.

3.8.2 Aircraft schedule forecasts

With regard to scheduling, N70, N60 and ANEC metrics are related to the allocation of flights to the time periods day, evening and night.

Altering the scheduling within these time periods would not significantly alter the noise predictions. However, having a greater or lesser proportion of flights during the evening and night would significantly alter the noise predictions for those periods. (I.e. moving a flight from 8am to 9am would have minimal effect on the noise predictions because the flight remains in the 'day' period; moving a flight from 8am to 8pm would have a far greater effect on the predictions because this involves changing the number of flights in the 'day' and 'evening' periods.)

Forecasting suggests that scheduling of operations is largely independent of the Project (i.e. Do Minimum and New Runway forecast schedules are similar). Therefore the sensitivity of this assessment to scheduling is diminished.

3.8.3 Flight tracks

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

The design of flight tracks for the new runway is discussed in **Chapter D2**. Minimising noise impacts by avoiding overflying urban areas was a key design principle in the development of proposed tracks. Because of this acknowledged sensitivity, it is important that modelled tracks closely resemble the actual tracks flown.

Tracks used in the Existing and Do Minimum scenarios were determined from existing operations. Significant analysis was undertaken to accurately determine and consequently model the distribution of operations across currently flown tracks for the Existing and Do Minimum scenarios.

Considering the normal deviation of individual aircraft from standard tracks (both instrument and visual), modelling includes a number of subtracks which are distributed either side of the median track (middle or main track). Operations are assigned to the median and subtracks using a normal distribution profile. This ensures that the noise modelling is more aligned with reality.

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

3.8.4 Flight profiles

The assessment generally assumed standard ascent and descent profiles, with the exception of constant descent approach (CDA) on RNP-AR tracks.

Departures considered the forecast destination and consequently determined an ascent profile based on the stage length (and consequent fuel load). These are considered likely to closely align with actual flight profiles as significantly greater or lesser ascents require more fuel and/or are not permitted.

Ascent profiles depend on wind conditions – departures with a stronger headwind will follow a steeper profile than those with less headwind. Modelling used a headwind of 8 kts which was determined through analysis of 10 years of historical meteorological data.

It is possible that more arrivals could adopt a CDA profile if appropriate procedures are developed. This would reduce the noise footprint for all arrival tracks except RNP-AR, which have been assumed to implement a CDA regardless.

3.8.5 Meteorological conditions

The assessment is sensitive to the prevailing meteorological conditions, the impact of which would be to alter the airport operating mode (essentially reverse the direction of arrivals and departures). The impact of these conditions was accounted for by the analysis of over 10 years of meteorological data and consequently actual conditions are unlikely to dictate significantly different operations from those determined by the assessment, in the long term. Of course there may be periods of time when different meteorological conditions prevail, and in that case for these periods there may be more or fewer operations of a particular type.

3.8.6 Aircraft fleet

The assessment has considered the realistic adoption of new generation aircraft. In general these aircraft have reduced noise emissions. The assumed schedule for this replacement is shown in **Table 3.3d**.

The adoption of these aircraft sooner would reduce the noise footprint of SCA. Similarly, the delayed adoption or introduction of additional older/current generation aircraft would increase this footprint.

3.8.6.1 Implications of Aircraft Technology Improvements

The first civil subsonic aircraft, such as the B707 and DC-8, came into service in the 1960s and were powered by noisy turbojet engines. Aircraft noise was dominated by the engine's high velocity jet exhaust. When civil aviation started to grow, aircraft noise became an issue and alternative engines were looked for. The replacement of the turbojet engine by the turbofan engine was the first step in the process of aircraft noise reduction.

The first turbofan engine had a low bypass ratio. To reduce its engine noise, high bypass ratios were introduced and as a direct result, airframe noise became a dominant noise source during landing. For this reason, both engine noise and airframe noise have to be considered when reducing aircraft noise.

Significant research has been and continues to be undertaken to reduce aircraft noise. NASA (National Aeronautics and Space Administration), in cooperation with the aerospace industry, is researching all possible solutions to aircraft noise reduction. NASA initiated a noise reduction program in 1992 and started in 1994 with its first program, Advanced Subsonic Technology (AST). AST was divided into three parts: engine, nacelle (the covered housing of the engine) and airframe noise reduction. After eight years the program was finished and an 8 dB noise reduction was obtained relative to 1992 technology.

A subsequent noise reduction program started in 2001, the Quiet Aircraft Technology (QAT), with the intention to reduce aircraft noise by 10 dB within 10 years and by 20 dB within 25 years relative to 1997 technology.

Figure 3.7t: ANEC contours – Existing 2012

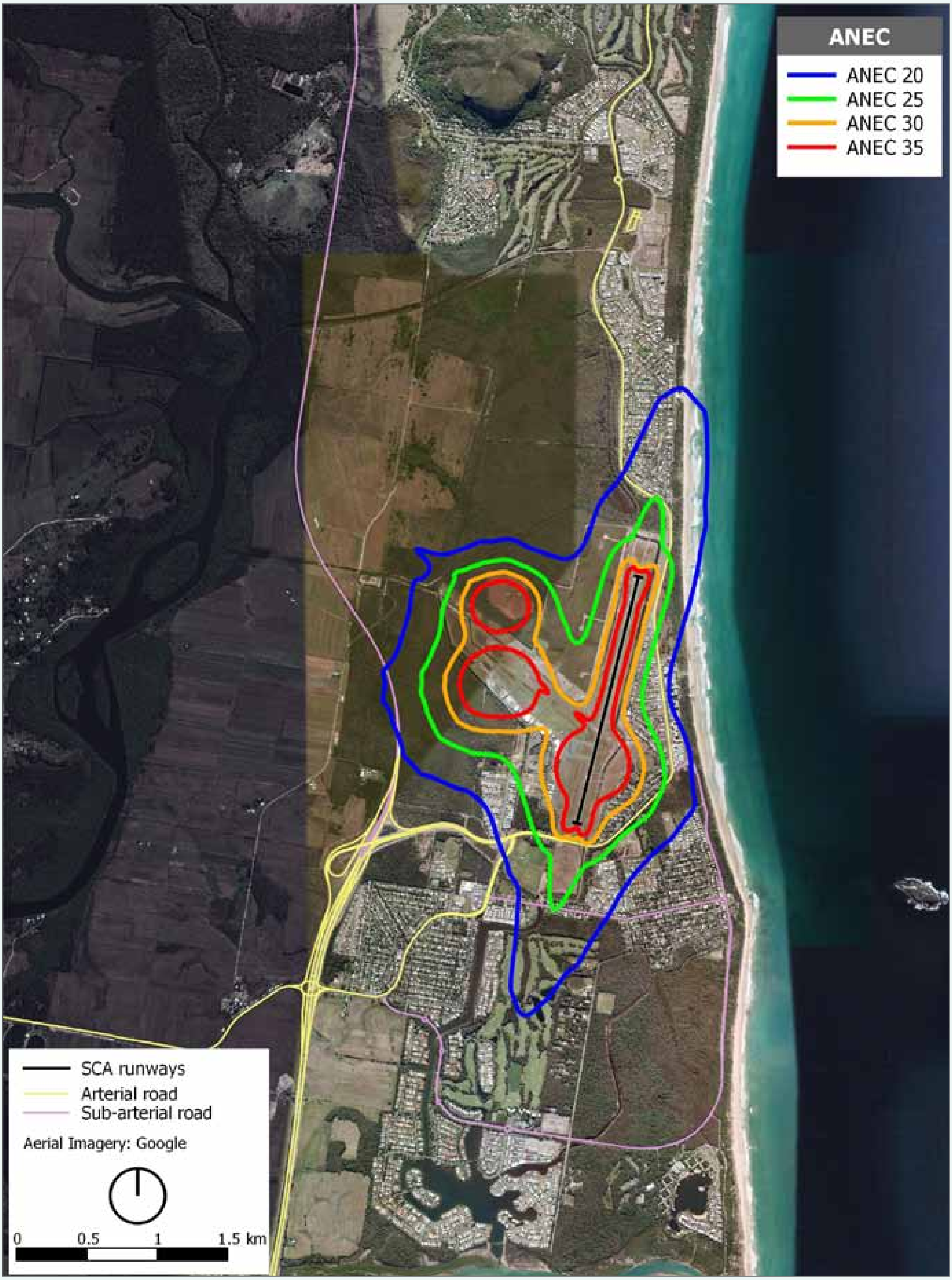


Figure 3.7u: ANEC contours – New Runway Construction 2016

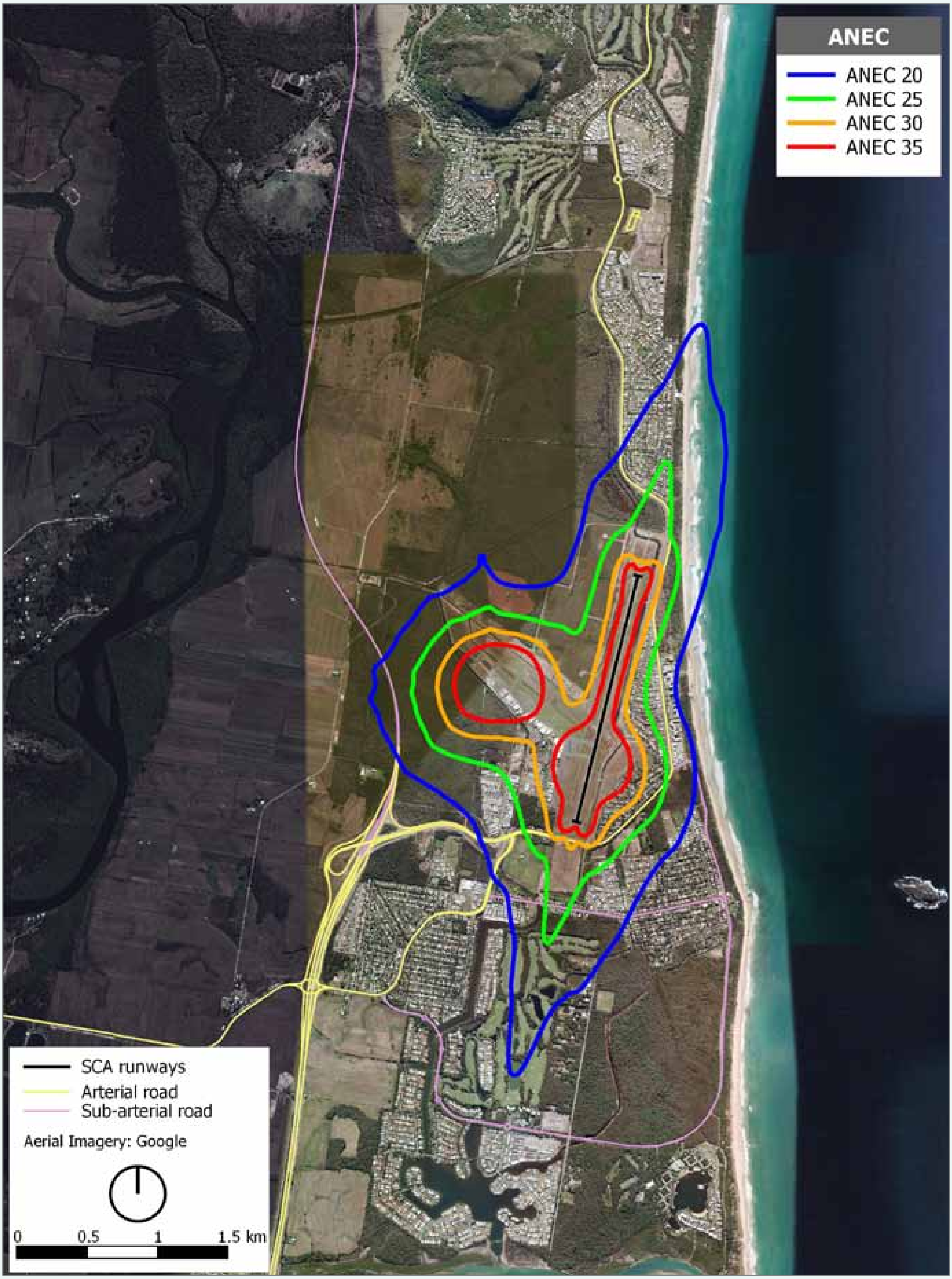


Figure 3.7v: ANEC contours – Do Minimum 2020

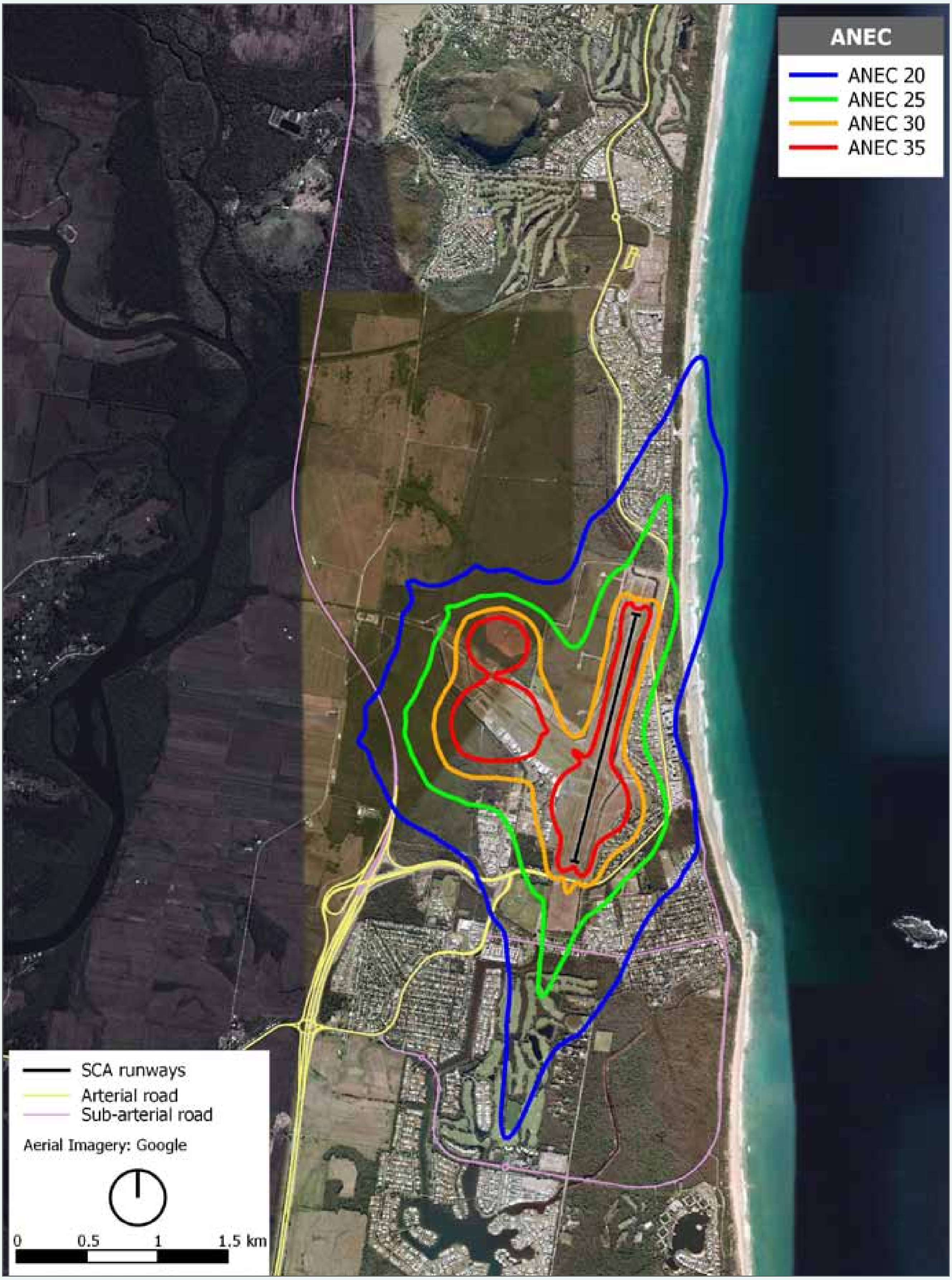


Figure 3.7w: ANEC contours – New Runway 2020

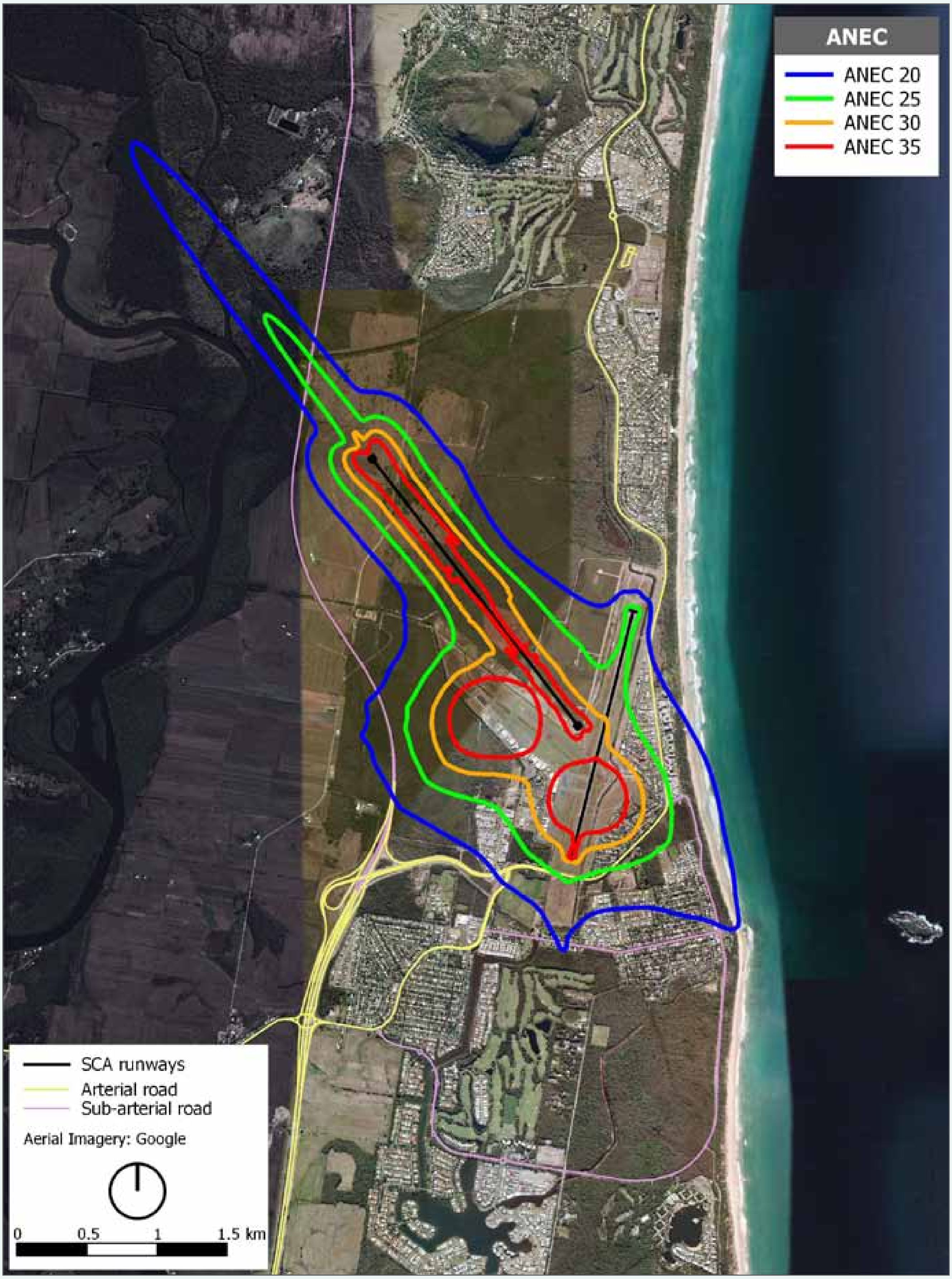


Figure 3.7x: ANEC contours – Do Minimum 2040

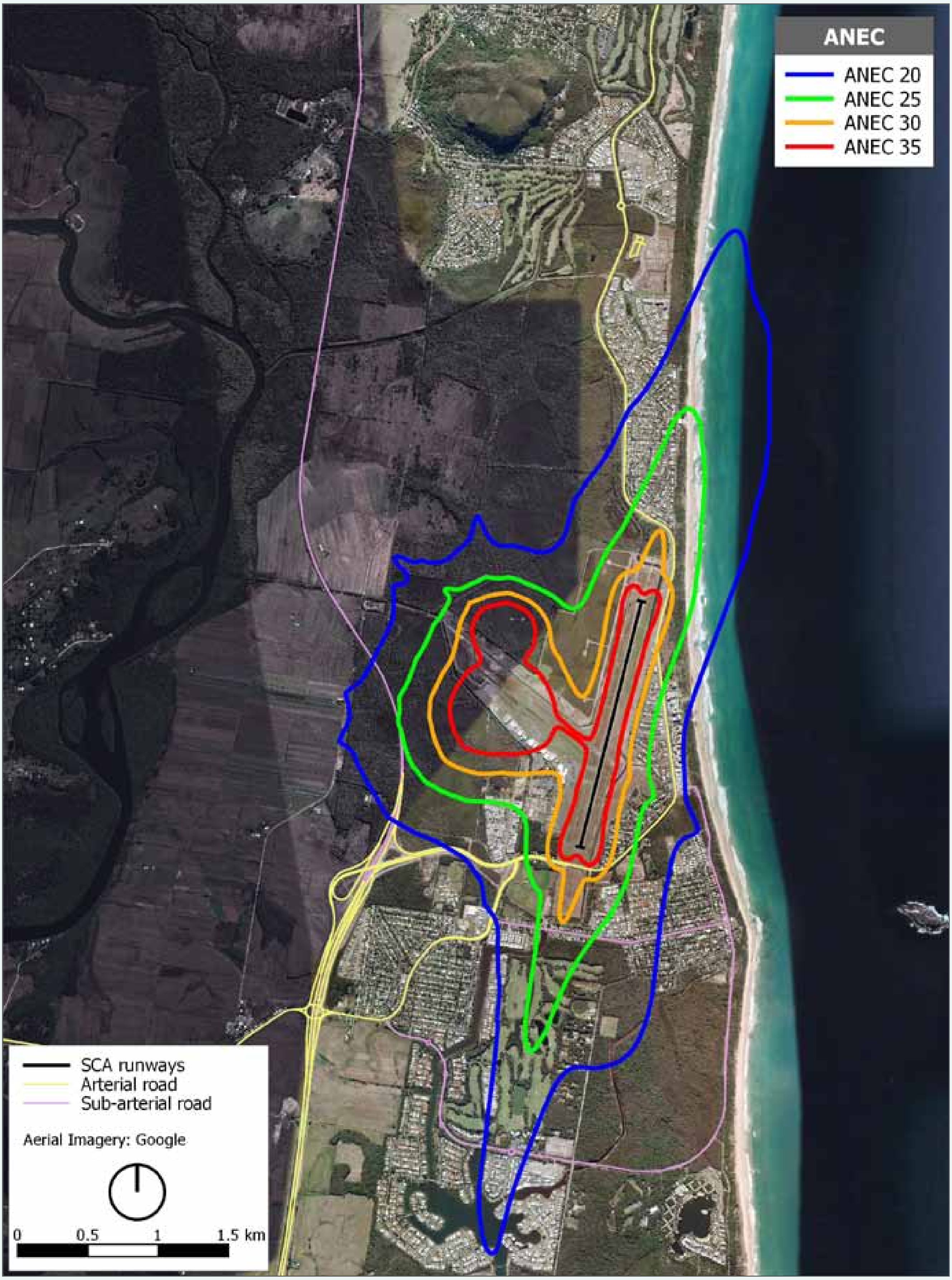
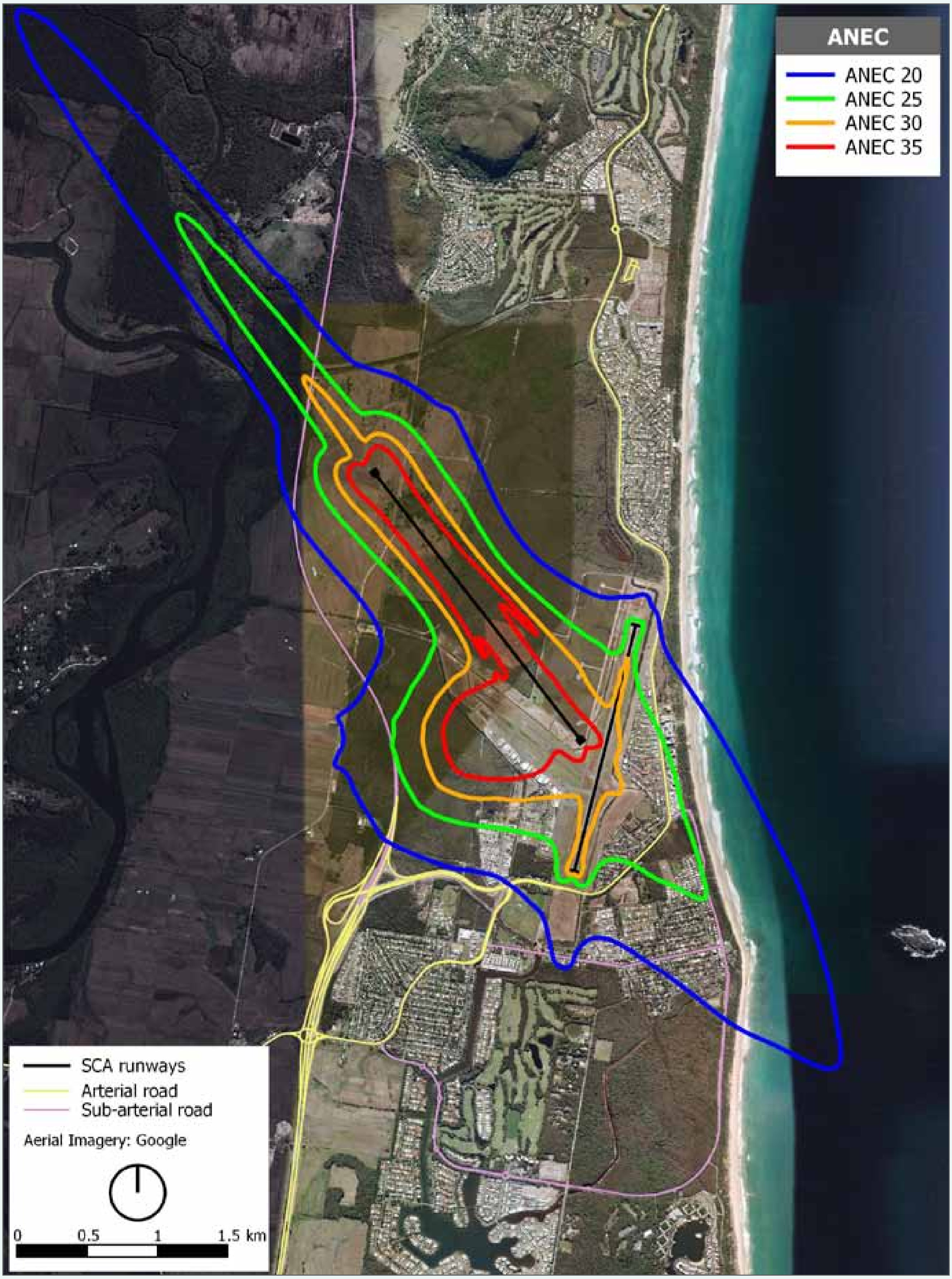


Figure 3.7y: ANEC contours – New Runway 2040



The Advisory Council for Aeronautics Research in Europe (ACARE) goal for EU research, established in 2000, was to develop the technology to reduce the Effective Perceived Noise in Decibels (EPNdB) of new aircraft by 10dB (decibels) over 20 years.

The aircraft noise technology trend is supported by regulations for new aircraft. Noise regulations for civil aircraft are described in ICAO Annex 16 Volume I Chapter 2-4. Chapter 2 aircraft are phased-out in Australia because they are too noisy. All current aircraft operating in Australia are Chapter 3 and Chapter 4 aircraft. All aircraft certified from 1 January 2006 are Chapter 4 aircraft.

Current noise reduction research is being undertaken on engine and airframe noise. Engine noise reduction techniques include reducing jet exhaust noise by applying high bypass ratios and using modified engine nozzles.

Airframe noise is dominated by deployed high-lift devices and landing gear. The principle in reducing airframe noise is to make the wing as smooth as possible, with high-lift devices deployed. Reducing the gaps between slats and main wing, and main wing and flaps, and moving small rods of the landing gear behind larger parts, make the flow around the wing and landing gear more laminar, reducing airframe noise.

New aircraft such as the A380 and the B787 incorporate new technologies to lower the aircraft noise. The B787 is Boeing's replacement for the B767. Half of the aircraft is made out of composites, making it much lighter than an aluminium aircraft. Some engine improvements include a high bypass ratio, chevrons at the nozzle and laminar flow nacelles. Airframe noise reduction is obtained by applying quiet flaps and slats and a low-noise landing gear.

The major Australian airlines flying at Sunshine Coast Airport are Virgin and Jetstar. These airlines started their operations in August 2000 and May 2004 respectively, and have a new aircraft fleet. Virgin fleet consists of B737-700 and B737-800 aircraft, and are new generation Boeing aircraft. Jetstar has A320-200 in their fleet flying to SCA. All RPT aircraft currently operating at SCA comply with the Chapter 4 Standard. This is forecast to continue in the future.

3.8.7 GA operations

SCA has a significant number of GA operations relative to the number of RPT operations. In particular there are a significant number of helicopter operations at SCA.

The assessment has assumed a gradual increase in the number of fixed wing and helicopter GA operations. This approach is considered conservative. At some larger airports across Australia, GA operations have trended downward with the increase in RPT operations, due to more difficult access (greater airspace restrictions, less runway availability and typically increased landing fees).

The impact of GA is most evident in the ANECs, which exhibit large 'bulges' around aprons utilised by helicopters. A decrease in helicopter activity in particular would decrease the extent of these 'bulges'.

The extent of N70/N60 and ANEC contours along the flight tracks frequented by heavy jets is dictated by these aircraft and is largely independent of GA.

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