B15 AIRPORT AND SURROUNDS NOISE AND VIBRATION

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APPENDICES (REFER SEPARATE APPENDICES DISK)

B15:A Wind roses
B15:B Noise measurement results

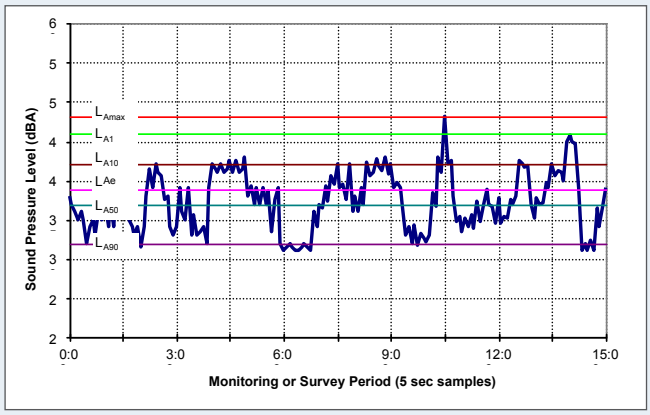
GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed, which involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors are defined and demonstrated in the graph on the next page.

Maximum Noise Level (L_{Amax})	Is the maximum level, measured on fast response, during the sample period.
L_{A1}	Is the noise level which is exceeded for 1% 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}	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}	Is the noise level which is exceeded for 90% 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.

NCA	A Noise Catchment Area is a group of receivers with similar ambient noise environments and exposure to sources of interest. For assessment purposes these receivers are grouped to streamline the amount of information that needs to be produced.
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.
Ambient Noise	Is generally considered to be all the noise that exists in an environment. It is commonly used to describe the noise environment in the absence of 'foreign' noise sources, such as an introduced industrial noise source. The ambient noise is most commonly expressed in terms of the L_{Aeq} noise descriptor.
Background Noise	Describes the underlying baseline noise within a given noise environment. This noise is usually the result of one or several steady noise sources, such as distant traffic noise or general 'urban hum'. The background noise is typically described by the L_{A90}. The ABL and RBL are specific descriptors used to define the background noise from measured L_{A90} noise levels.
Background Creep	Is the progressive addition of noise sources to an environment, which causes background noise levels to steadily increase. Background creep is a "long-term" noise consideration.

Typical graph of sound pressure level vs time



15.1 INTRODUCTION

This chapter addresses changes to terrestrial (on-ground) noise as a consequence of the construction and operation of the Sunshine Coast Airport (SCA) Expansion Project (the Project). The following have been considered:

- Ground running of aircraft (engine testing etc.)
- Aircraft whilst stationary at the terminal (i.e. whilst emissions are dominated by the aircraft's Auxiliary Power Unit [APU])
- Helicopter engine run-up/run-down and low-level hover training
- General plant noise from the terminal and other facilities within the airport
- Traffic noise on the public road network from the operation of the airport
- Noise generated during the construction of the Project
- Traffic noise on the public road network during the construction of the Project.

In-air aircraft (both fixed-wing and rotary-wing) are addressed separately in Chapter D3 – Aircraft Noise. The proposed airfield layout at project completion is shown in **Figure 15.1a**.

15.2 MEASUREMENT OF AMBIENT 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. Each of these locations is either a residence, or is representative of residences which are nearby. The noise monitoring locations are shown in **Figure 15.2a** and described in **Table 15.2a**.

Monitoring was conducted for two weeks at each location between 29 August and 12 October 2012. The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response, continuously monitoring over 60 minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for subsequent detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1 per cent, 10 per cent and 90 per cent of the sample time respectively (see Glossary for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period.

Detailed results for each monitoring location are shown in graphical form in **Appendix B15:B**. The graphs show measured values of L_{Aeq}, L_{A90}, L_{A10} and L_{A1} for each sampling period.

Table 15.2b summarises the results, for "Day", "Evening" and "Night" periods as defined in the Queensland Department of Environment and Heritage Protection's (DEHP) document "Planning for Noise Control" (PNC). The summary values are:

- $L_{Aeq,Period}$ – the overall L_{Aeq} noise level measured over the assessment period.
- $minL_{A90,1hr}$ – a measure of typical background noise levels which is used in determining noise criteria under the PNC.

All noise measurements were undertaken in general accordance with DEHP's "Noise Measurement Manual".

15.2.1 Noise monitoring locations

Figure 15.2a shows the noise monitoring locations and their proximity to the SCA. Monitoring locations were selected such that the existing noise environment could be captured at noise sensitive residential receivers around the airport, and locations likely to experience noise impacts from the Project.

Attended monitoring was also conducted for one 15 min interval at each of the locations listed in **Table 15.2a**, excluding Location L, which is alongside the existing Runway (RWY) 18/36. The purpose of attended monitoring was to identify the relevant noise sources affecting each location.

The values shown in **Table 15.2b** are considered typical for the relevant areas, which range from urban to rural environments.

Of the monitoring locations representing residences, the lowest background noise levels were recorded at sites B, G and H. Location B is a quiet residential area on the northern side of the Maroochy River to the south of the airport. Location G is a secluded rural block adjacent to the Maroochy River to the north-west of the airport. Location H is within rural farmland to the west of the airport.

The highest night time background levels are at sites D and E, in Maroochydore and Marcoola respectively. Elevated noise levels at Location D, a commercial premises within Maroochydore, are largely due to traffic noise along The Esplanade. Site inspections indicate that noise levels at Location E are largely due to noise from the ocean, which is directly behind the premises. This is reflected by consistent background levels during the day, evening and night periods.

15.3 SURROUNDING NOISE-SENSITIVE RECEIVERS

Residences account for the majority of noise-sensitive receivers surrounding the airport, consequently, this assessment focuses on residential receivers. Some other noise-sensitive receivers are present, however appropriately managing noise at the numerous residential receivers will ensure that noise levels are appropriately managed at other noise-sensitive receivers. Non-residential noise-sensitive receivers are identified in Chapter D3 – Aircraft Noise.

Figure 15.1a: Proposed airfield layout

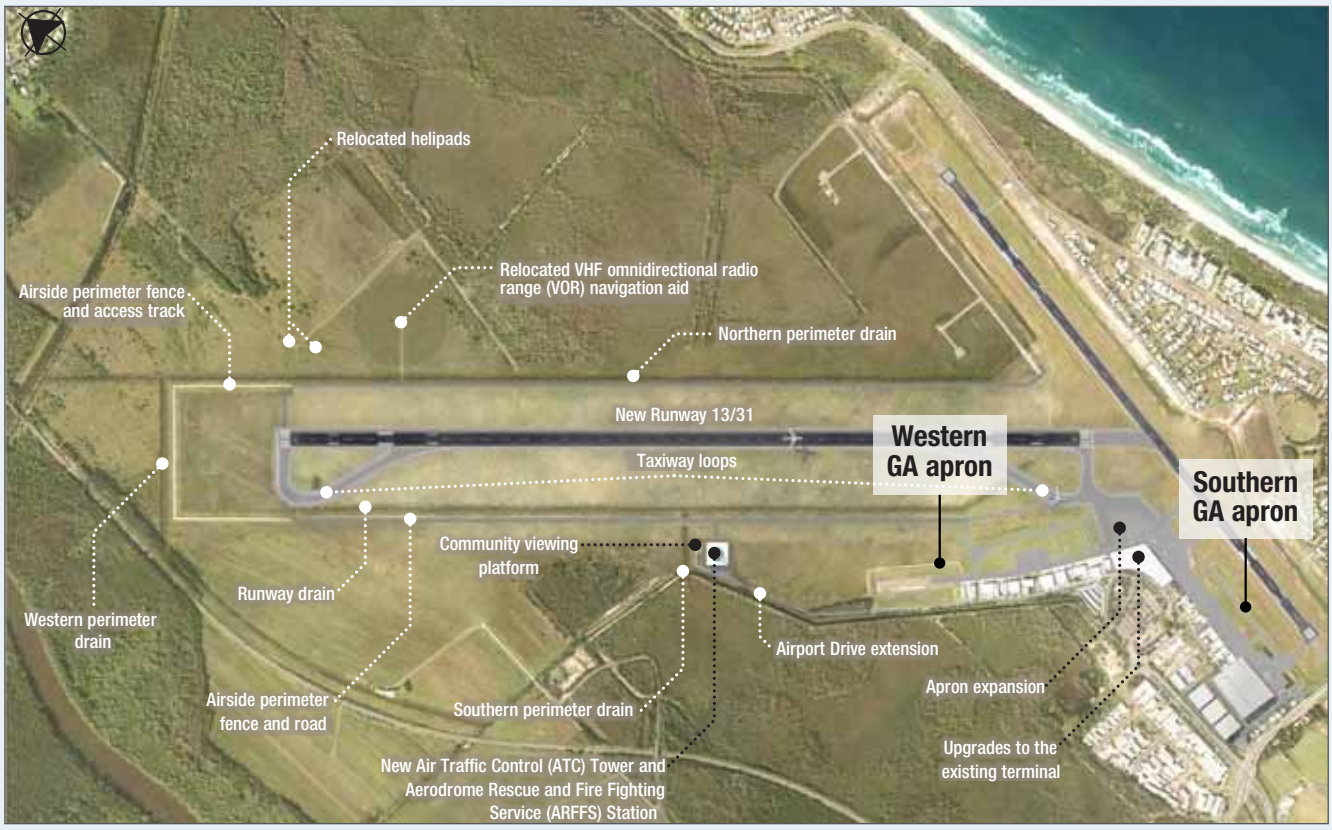


Figure 15.2a: Unattended and attended noise monitoring locations

Table 15.2a: Unattended and attended noise monitoring locations

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

Table 15.2b: 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	342	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. Based on noise level trends at Location J, which has similar exposure to the Sunshine Motorway, the daytime level has been assumed for the evening period at Location G.

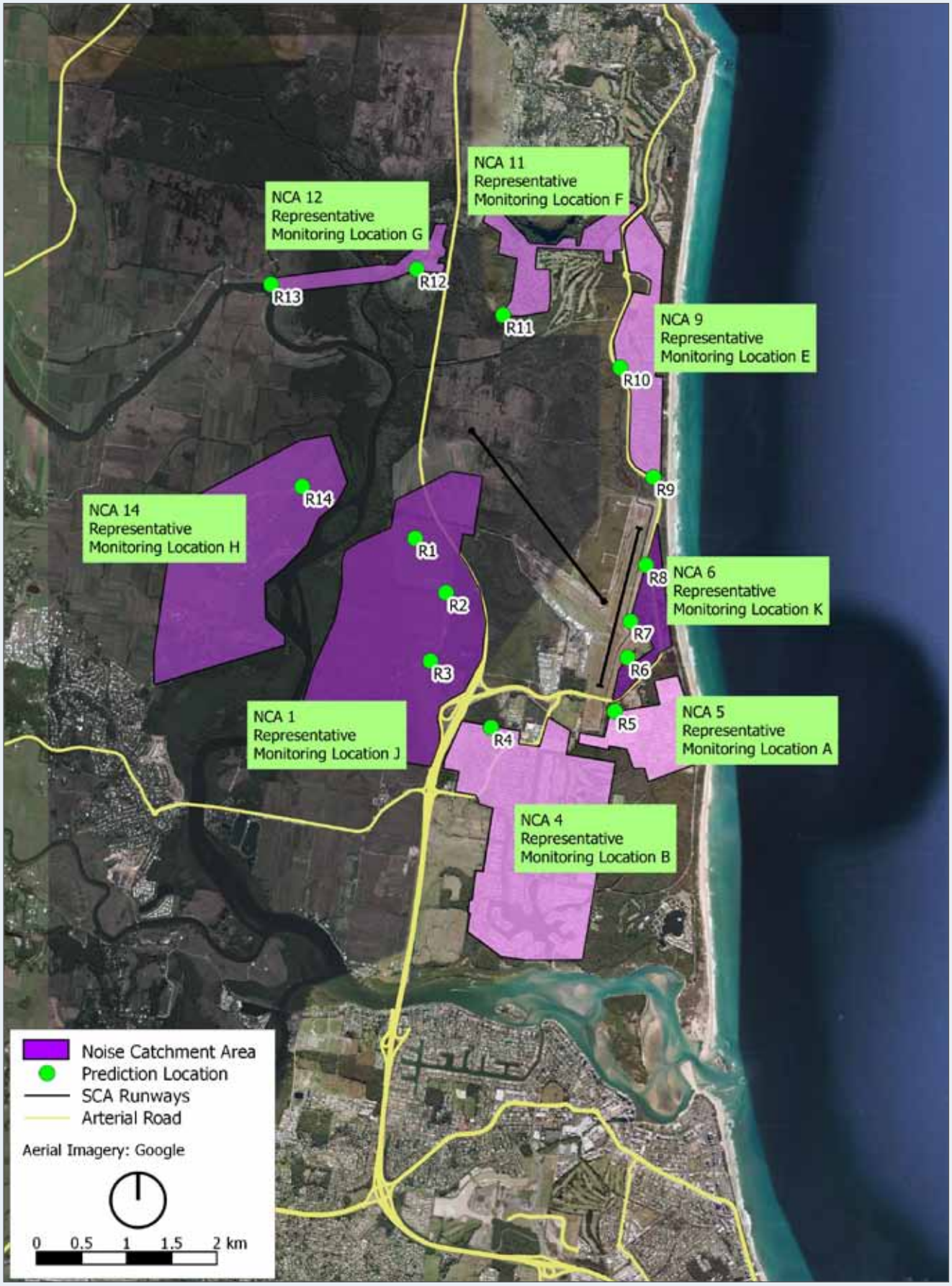
For ease of assessment the residential areas surrounding the airport have been classified into noise catchment areas (NCAs). The NCAs are shown in **Figure 15.3a**.

The extents of these NCAs have been identified such that their inhabitants have similar exposures to ambient and background noise sources. Hence each of the NCAs has been assigned a representative noise monitoring location and criteria can be derived for the entire NCA based upon measured levels at this location.

The NCAs also have similar exposure to noise emissions from SCA. A minimum of one prediction location (R) has been allocated to each NCA. Note that where noise received from SCA is expected to vary significantly within an NCA, predictions have been made for multiple locations (e.g. NCA 6). Prediction locations are presented in **Figure 15.3a**.

In addition to residences, the other sensitive receiver in this location is the Ground Parrot habitat located north of the existing RWY 12/30 and west of RWY 18/36 in an area called the Wallum Heath Management Area (WHMA). The impacts of terrestrial noise on the Ground Parrot population are discussed in more detail in Chapter B8 – Terrestrial Fauna.

Figure 15.3a: Noise catchment areas and noise prediction locations



15.4 ASSUMPTIONS AND TECHNICAL LIMITATIONS

15.4.1 Terrestrial operational noise

For assessment purposes helicopter flights not elevating above 10 feet were considered as part of the terrestrial noise assessment. This delineation was made on the basis that flights below this level would not be perceived as 'overflights' by neighbouring receivers.

15.4.2 Construction noise

The construction noise assessment is contingent on similar equipment and operations to those detailed in this report.

Noise goals determined for construction noise are equivalent to those for industrial noise sources. In this regard they represent noise levels that provide good protection of surrounding receivers' amenity, and are conservative given the finite duration of works. For this reason, the construction noise assessment considers noise goals rather than compliance criteria.

15.5 CONSTRUCTION NOISE

15.5.1 Construction noise requirements

In the case of construction activities, criteria for assessment of this noise are typically less stringent than for permanent sources, because of their temporary nature.

Noise from building construction activities is addressed in the Queensland *Environmental Protection Act 1994* at Part 3B Division 3 Default Noise Standards Clause 440R Building Work. This clause places specific constraints on the permitted hours for building construction activity, but does not impose noise level limits, viz:

> *"(1) A person must not carry out building work in a way that causes an audible noise –*
>
> *(a) on a business day or Saturday, before 6.30am or after 6.30pm; or*
>
> *(b) on any other day, at any time."*

The Project would involve some instances where construction activity would be required to be undertaken on a 24 hour basis and that would likely be audible outside of the regulated construction hours. Approval is therefore sought to undertake these activities, with the noise goals detailed herein believed to adequately protect surrounding receivers' amenity.

Noise-producing construction activities are proposed to take place over a period of approximately 4 years. Given this time scale and the nature of construction activities it is considered appropriate that associated noise levels also be assessed against goals for permanent industrial sources. These goals are applied to developments such as quarries, mines and ports, which produce noise emissions that are characterised by heavy machinery and their diesel engines. In this regard the long-term construction proposed as part of the Project is consistent with an industrial source.

Therefore, noise objectives defined in The Environmental Protection (Noise) Policy 2008 (EPP [Noise] 2008) and the PNC document for general industrial noise sources were considered for assessment of construction noise. These goals are far more stringent and offer protection of surrounding receivers' acoustic amenity above and beyond that required for normal construction activities.

The noise levels derived from these documents constitute goals only, and their application is subject to reasonableness and feasibility during construction. It is expected that whilst works are close to sensitive receivers, exceedances of the noise goals may be unavoidable. The character, level and duration of works regularly exceeding the goals would be consistent with ordinary construction activities and as such would only be subject to the requirements of the Act detailed above, i.e. limiting work to regulated construction hours.

15.5.1.1 Noise goals from planning for noise control

The PNC sets out three objectives to be considered in noise assessment. These are discussed separately below.

Control and prevention of background noise creep

This objective is intended to control noise from continuous sources such as fans, which produce a relatively constant noise level. Noise goals for the control of background creep are unduly stringent in the context of construction noise and therefore have not been applied.

Containment of variable noise levels and short-term noise events

This objective applies to intermittent noise events, as well as quasi-continuous noise, such as that from dozer and truck operations during construction. The relevant noise goals depend on the existing background noise level, the type of area, and the presence of nearby roads. It sets a limit on the $L_{Aeq,1hour}$ noise level from such sources.

In practice, for the areas and types of noise in question, the criterion is the higher of:

- min$L_{A90,1hour}$ plus 3 dBA or
- the minimum $L_{Aeq,1hour}$ in the relevant time period due to traffic noise.

For Locations A, B, F, G, H and J, given the observed noise trends, it is reasonable to conclude that the lowest recorded $L_{Aeq,1hour}$ noise level in any time period would be due to road traffic, as traffic noise is relatively constant on an hour-to-hour basis. At other sites sources such as surf noise are likely to have contributed to minimum L_{Aeq} noise levels.

Table 15.5a shows derived noise goals for $L_{Aeq,1hour}$ from new intermittent and quasi-continuous noise sources. In general, daytime goals are determined by the level of traffic noise in the area, whereas evening and night criteria are determined by the background noise level (in the absence of significant traffic noise).

Avoidance of sleep disturbance

Sleep disturbance criteria are considered in addition to the above noise goals. They protect against short duration noise events (i.e. seconds to minutes) at night that might cause sleep disturbance but would otherwise not be captured by regular noise metrics, which are typically measured over a minimum period of 15 minutes.

In the construction scenarios being considered the noise would be quasi-continuous in nature and therefore the sleep disturbance criterion would be less stringent than the night time noise goals described above. Consequently it is not considered in the present assessment.

15.5.1.2 Noise goals from EPP (Noise) 2008

EPP (Noise) 2008 presents a table of acoustic quality objectives which are "prescribed for enhancing or protecting the environmental value(s)...It is intended that the acoustic quality objectives be progressively achieved as part of achieving the purpose of this policy over the long term."

For residential dwellings the acoustic quality objectives (measured using the most stringent noise level parameter, i.e. $L_{Aeq,adj,1hr}$) for satisfactory internal noise levels (together with equivalent external noise levels) would be as follows:

- Day and evening (7.00am – 10.00pm): 35 dBA internally (i.e. 45d BA free field externally with windows open)
- Night (10.00pm – 7.00am): 30 dBA internally (i.e. 40 dBA free field externally with windows open).

Numerically, these noise goals are similar to the goals determined in accordance with the PNC. Given their stated purpose is to achieve satisfactory noise environments in the long-term, they are considered the least relevant of the goals considered and are not adopted as noise goals for the Project.

EPP (Noise) 2008 also includes noise goals for the control of background creep. These goals are unduly stringent in the context of construction noise and hence have not been applied.

15.5.2 Project construction noise goals

Noise from construction work associated with the Project is considered to be an important issue. In particular the operation of the dredge vessel and associated plant during the night time requires careful consideration.

For assessment of construction noise associated with the Project, the following were adopted:

- Standard work hours are derived from the *Environmental Protection Act 1994*:
  - Construction should be limited, where practical, to 6.30am – 6:30pm on a business day or Saturday
- DEHP's "Planning for Noise Control" document noise goals are adopted, requiring that feasible and reasonable mitigation measures be applied to attempt to achieve these levels.

In practice the above hierarchy sets standard work hours that should be adhered to. The more stringent noise goals provide guidance in the application of feasible and reasonable mitigation and management measures.

Table 15.5b presents a summary of the project specific construction noise goals for each NCA.

15.5.3 Construction methodology

The construction of the Project is proposed to be carried out over approximately four years. A description of likely construction processes, activities and equipment to be used is presented in Chapter A5 – Project Construction. The construction procedures and equipment detailed in that chapter represent the likely works to be conducted to meet the construction works requirements and program. The exact details of each construction stage will be established by the successful construction contractor. A summary of the proposed construction staging is presented in **Table 15.5c**. Details of works predicted during each stage are included in the subsequent sections.

Table 15.5a: PNC noise goals for $L_{Aeq,1hr}$ from new intermittent and quasi-continuous noise sources (dBA) [Bolded value shows noise goal to be adopted]

NCA (Figure)	Monitoring Location	$minL_{A90,1hour}$ + 3	$L_{Aeq,1hr}$ from traffic	$minL_{A90,1hour}$ + 3	$L_{Aeq,1hr}$ from traffic	$minL_{A90,1hour}$ + 3	$L_{Aeq,1hr}$ from traffic
1	J	39	**46**	38	**41**	34	**36**
4	B	37	**45**	35	**38**	32	**33**
5	A	39	**48**	41	**43**	37	**38**
6	K	**43**	N/A	42	N/A	**40**	N/A
9	E	**45**	N/A	46	N/A	**45**	N/A
11	F	42	**47**	39	**39**	**36**	35
12	G	37	**44**	37	**44**	**32**	31
14	H	39	**45**	36	**38**	**34**	**34**

Note: 1. Only monitoring locations representing NCAs are presented. Other monitoring locations are more distant from the airport and are not relevant to the assessment of construction noise.

2. The higher of the "$minL_{A90,1hour}$ + 3" and "L_{Aeq},1hr from traffic" is adopted as the noise goal for each period.

15.5.4 Construction noise sources

Typical Sound Power Levels (SWL) of the plant likely to be used at various stages of the works are identified in **Table 15.5d**. These SWLs have recently been measured at other similar construction sites and are representative of modern, well-maintained plant. The successful contractor, in preparing noise control measures for their Environmental Management Plan (EMP) will need to confirm noise levels of actual equipment to be used.

15.5.5 Construction scenarios

Following a review of the proposed construction packages, and the various stages within each package, three scenarios have been selected for noise modelling.

These represent typical locations during the relevant construction period.

To represent the progression of material placement and paving activities across the runway length, three snapshots were represented for each of these packages.

Although exact equipment locations would vary from day to day and month to month, this variation would not have a significant impact on noise levels at relevant receivers.

15.5.5.1 Package 1: Construction compound and upgrade of Finland Road

Package 1 noise modelling represented a typical snapshot of this package whereby general site clearing and compounds are being established/used.

15.5.5.2 Package 2: Dredging and reclamation

Package 2 noise modelling represented three typical snapshots of this package where dredging and fill placement are being undertaken. The three modelled scenarios represent the progression of fill placement starting at the south-eastern end of the runway and progressing north-west.

Preliminary noise predictions identified the need to attenuate the dredge booster pump. The predicted levels in the following sections assume that attenuation is applied to limit the SWL of this pump to 106 dBA.

In this scenario, both the dredging and the sand distribution on site would occur on a 24 hour basis. The anticipated dredge cycle near the airport is shown in **Table 15.5e** (transit and times at the remote sand extraction areas are not shown – refer to Chapter A5 – Project Construction). The "Lower" and "Higher" estimates represent the range of dredge vessel sizes that may be selected.

Table 15.5b: Noise goals for $L_{Aeq,1hr}$ from construction (dBA)

NCA (Figure)	Monitoring Location	Daytime (7.00am-6.00pm)	Evening (6.00pm-10.00pm)	Night (10.00pm-7.00am)
1	J	46	41	36
4	B	45	38	33
5	A	48	43	38
6	K	43	42	40
9	E	45	46	45
11	F	47	39	36
12	G	44	44	32
14	H	45	38	34

Table 15.5c: Proposed construction packages

Package	Works	Proposed hours	Commencement	Completion
1	Construction compound and upgrade of Finland Road	6 days per week, 6.30am 6.30pm	2nd Quarter 2016	2nd Quarter 2017
2	Dredging and reclamation	6 days per week, 6.30am 6.30pm with dredging and placement occurring 7 days, 24 hours per day for a dredge campaign of approximately 14 weeks in the 2nd and 3rd quarter of 2017	1st Quarter 2017	3rd Quarter 2018
3	Runway, taxiways and apron	6 days per week, 6.30am 6.30pm (night works will be required where construction infringes upon either the RWY 18/36 flight strip or the OLS side transitional surfaces for RWY 18/36) - probably at the end of 2019	3rd Quarter 2018	1st Quarter 2020
4	Building works	6 days per week, 6.30am 6.30pm	1st Quarter 2018	1st Quarter 2019

Table 15.5d: Typical construction plant sound power levels (SWL)

Plant	SWL (dBA)
30t Excavator	107
10t Excavator	101
Front end loader	107
Articulated dump trucks	107
Smooth drum roller	105
Padfoot roller	101
Marco roller	107
Scrapers	111
Graders	108
Dozer	111
Bobcat	105
Backhoe	101
Concrete trucks	109
Water truck	107
Vibratory rollers	110
Franna crane	107
Pug mill	105
Concrete plant	103
Asphalt plant	114
Paving machine asphalt	104
Paving machine concrete	104
Generators	95
Light towers	95
Dredge booster pump	120-123 unattenuated; 106 attenuated
Trailing suction hopper dredger (TSHD)*	105

*Note: * Noise levels of the dredge are based on measurements conducted for the Melbourne Ports Authority "Trial Dredging Program". Measurements are based on noise emissions from the dredge "Queen of the Netherlands" which is significantly larger than the dredger likely to be used for the Project during pump out.*

From the cycle it should be noted that the dredge vessel would be at the pump-out site for 95-175 minutes. This would occur two to three times daily.

During the construction of the sand delivery pipeline work will be undertaken near the northern end of RWY 18/36, outside the airport. These work areas will consist of a construction compound, a pipe assembly area on the beach and an access area from David Low Way (refer **Figure 15.5a**).

This work is likely to be undertaken during standard construction hours and would last only 3 to 4 weeks for installation and a further two to three weeks for removal. Given the short timeframe this work has not been quantitatively assessed.

For safety reasons, the work may be restricted by operations on RWY 18/36. In this event, it would be necessary to undertake some work outside standard hours. This will not be known until a 'method of working plan' has been developed. If work is required outside standard construction hours a full and detailed noise assessment would be required as part of the contractor's EMP.

15.5.5.3 Package 3: Runway, taxiways and apron

This scenario involves the progressive construction of the new runway and taxiway pavements.

Table 15.5f presents the mix of equipment which has been modelled for each of the construction packages. These scenarios are considered to represent a likely "busy" scenario for each package. Not all equipment that is anticipated to be on site has been modelled concurrently; however the majority of significant noise emitting equipment has been included.

15.5.5.4 Package 4: Building works

Package 4 involves terminal upgrades and will include internal renovations and staged extensions.

The internal renovations will consist of basic building work, undertaken by building contractors.

Table 15.5e: Typical dredging and pump-out cycle times

Activity	Estimated duration (minutes)	
	Lower	Higher
At SCA		
Mooring and pipe coupling	15	15
Pumping to sand placement site	55	125
Cleaning pipeline of sand	15	25
Pipe uncoupling and unmooring	10	10
Total cycle duration at SCA	**95**	**175**

Figure 15.5a: Indicative areas for the dredge pipe assembly

The extensions will require the demolition of existing structures, including the existing baggage handling area, and construction of the new buildings. The building construction will include new foundations, building framework and internal fit out.

15.5.6 Noise mitigation

15.5.6.1 Construction noise mitigation measures – Package 2

Preliminary investigations into the noise emissions from this package dictated that mitigation measures be included in the design. The following measures have been included in the predictions and assessment as they are considered to represent feasible and reasonable mitigation measures. These measures are not intended to be prescriptive, and ultimately the mitigation measures adopted will be decided by the construction contractor.

Unmitigated, the booster pump, which is anticipated to be located near the south-eastern end of the site, is predicted to be a significant source of noise emissions during this package. Based upon measurements of similarly attenuated equipment, it has been estimated that an equivalent sound

Table 15.5f: Construction equipment by package

Package	Description	Equipment	Number
1	Construction compound and upgrade of Finland Road	30t Excavator	3
		Articulated dump truck	3
		Front end loader	1
		Scraper	2
		Dozer	2
		Grader	2
		Pad foot roller	1
		Smooth drum roller	1
		Water truck	1
2	Dredging and reclamation – standard construction hours	Dozer	4
		Front end loader	2
		Scraper	2
		Grader	1
		Water Truck	1
		30t Excavator	1
		Dredge Booster Pump	1
		TSHD	1
	Dredging and reclamation – outside standard construction hours (sand delivery)	Dozer	2
		Light Towers	5
		Dredge Booster Pump	1
		TSHD	1
3	Runway, taxiways and apron	Paver	2
		Pugmill	1
		Smooth drum roller	2
		Trucks	3
		Marco roller	1
		Asphalt plant	1
		Asphalt paver	1
		Water truck	1
4	Building works	Excavator (during demolition)	Multiple

power level of 106 dBA would be achieved by a combination of the following:

- Enclosing the engine with an acoustically robust enclosure including internal acoustic absorption
- Fitting residential class mufflers
- Selection of the quietest available plant or perhaps over specified equipment (allowing lower operating speeds for the same throughput)
- Enclosing the pump.

The noise emissions from this pump will need to be reviewed once the actual plant has been selected.

This item will need to be specifically addressed in the contractor's EMP.

Works outside standard construction hours would be limited to essential mobile plant only. This assessment has assumed that one near-new, well maintained dozer fitted with modern sound attenuation will be used at night to support hydraulic sand placement.

Modelling for the EIS assumed a 7 m high bund along the eastern extent of the reclamation area and another 5 m high bund along the northern boundary adjoining the WHMA. The final noise mitigation will be chosen by the contractor to suit their construction program and methodology. The contractor will be required to demonstrate that the target noise levels can be achieved before construction commences.

The locations of the modelled barriers are shown in **Figure 15.5b**.

Figure 15.5b: Noise bund locations

15.5.7 Noise modelling

Noise level calculations were performed using the ENM computer noise model, which has been shown to produce reliable predictions of noise levels from construction and similar developments. The model takes account of the topography of the area, as well as prevailing wind and temperature inversion conditions. Each of the scenarios detailed in the preceding section was modelled separately for day, evening and night time conditions.

At relatively large distance from a source, the received noise levels will be influenced by meteorological conditions, particularly wind and temperature gradients, and hence can vary from hour to hour and day to day.

The DEHP's PNC specifies that, where meteorological effects are significant, noise criteria should be achieved under adverse meteorological conditions, which are defined in terms of specific parameters to be used in the assessment. Separate procedures are defined for assessment of temperature inversions and gradient wind effects.

The procedures described in the PNC are directed toward finding a single set of meteorological conditions, representing generally adverse conditions for noise propagation, to be used in noise assessment. Whilst this is considered adequate, it is considered that it is more appropriate to assess noise impacts under the entire range of meteorological conditions applying at the location. This is important, for example, where meteorological conditions which result in enhanced noise levels at one receiver may result in reduced noise levels at another.

In the present assessment, meteorological effects on noise propagation are taken into account generally in accordance with the procedures of the PNC. However, the noise level used in comparison with the stated criteria (whether derived from the PNC or the Regulations) is defined more precisely as the level which is exceeded for 10 per cent of the time during the relevant periods (day, evening and night), under the range of meteorological conditions prevailing at the site. This interpretation is believed to be consistent with the intent of both the PNC and the Regulations and is a more scientifically valid interpretation of the physical environment.

The joint probability distribution of wind speed, wind direction and stability class for the site was obtained from historical Bureau of Meteorology meteorological observations during the period November 2008 to August 2012. Wind roses for SCA are presented in **Appendix B15:A**.

A temperature inversion is generally assumed to exist when the atmospheric Pasquill Stability Class is F or G. Inversion strengths of 3ºC per 100 m and 4ºC per 100 m were assumed for F and G stability classes respectively.

Construction noise levels at each receiver location were calculated under 144 different meteorological conditions (eight wind directions, six wind speeds, three temperature inversions), using the probability of occurrence for each of these conditions.

15.5.8 Predicted noise levels

This section summarises predicted construction noise levels with respect to relevant noise goals detailed in **Table 15.5b**.

In all tables the maximum predicted noise level for all seasons is shown. Indicative noise contours are also presented. It should be noted that these have been produced from a single meteorological condition and, as such, do not reflect the 10 per cent exceedance level in all cases (the 10 per cent exceedance level is compared against the noise goals in the tables and annotated next to the prediction location in the figures). Nonetheless, these contours are useful in demonstrating the general propagation of noise from each scenario.

15.5.8.1 Package 1

Table 15.5g presents the noise levels predicted to be exceeded for 10 per cent of the time during Package 1 construction.

The predictions show that Package 1 works are expected to be compliant with the noise goals.

Note that the modelled scenario assumes a dispersion of plant across the site. When works are concentrated about the south-eastern end of the site, higher noise levels can be expected. For construction noise during standard construction hours, and noting that the worst-case noise levels would occur for limited periods, the predicted noise levels are considered acceptable. Refer **Figure 15.5c**, for example noise contours.

15.5.8.2 Package 2

Table 15.5h presents the noise levels predicted to be exceeded for 10 per cent of the time during Package 2 daytime construction.

The predictions show that Package 2 works, with the mitigation discussed in **Section 15.5.6**, are expected to be generally compliant with the noise goals. Whilst works are concentrated about the south-eastern end of the site, very minor exceedances (1dB) of the noise goals are predicted along Keith Royal Drive

For construction noise during standard construction hours, and noting that the worst-case noise levels would occur for only limited periods, the predicted noise levels are considered acceptable. Refer **Figure 15.5d**, **Figure 15.5e** and **Figure 15.5f**, for example noise contours.

Table 15.5i and **Table 15.5j** present the noise levels predicted to be exceeded for 10 per cent of the time for package 2 construction during the evening and night time periods respectively. Note that these prediction scenarios assume only essential activities associated with sand delivery.

The predictions show that, with the inherent noise mitigation applied, noise emissions are expected to be generally within the project goals. A very minor exceedance (1dB) of the noise goals is predicted at and surrounding Receiver 8 in Keith Royal Drive in the night period.

Therefore the predictions indicate that acceptable noise levels would be expected from the proposed evening and night-time works. Refer **Figure 15.5g**, **Figure 15.5h** and **Figure 15.5i**, for example noise contours.

Table 15.5g: Package 1 – predicted construction noise levels exceeded for 10% of time – $L_{Aeq,1hr}$ (dBA)

		Daytime		
Prediction location	**NCA**	**Noise goal**	**Predicted**	**Exceedance**
R1	1	**46**	30	0
R2		**46**	31	0
R3		**46**	26	0
R4	4	**45**	25	0
R5	5	**48**	29	0
R6	6	**43**	35	0
R7		**43**	43	0
R8		**43**	41	0
R9	9	**45**	33	0
R10		**45**	28	0
R11	11	**47**	26	0
R12	12	**44**	21	0
R10		**44**	18	0
R14	14	**45**	23	0

Figure 15.5c: Package 1 – predicted construction noise levels – daytime

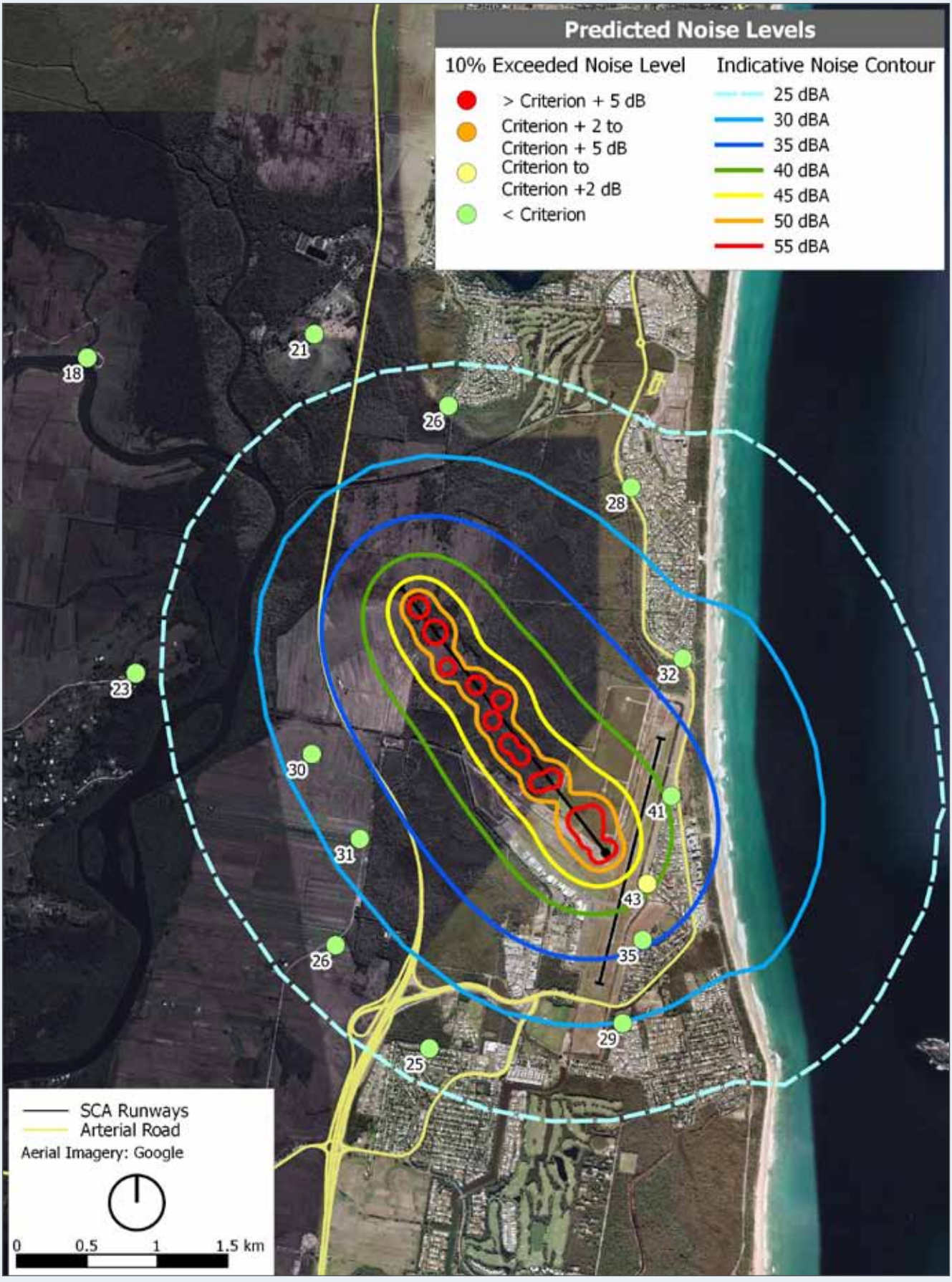


Figure 15.5d: Package 2 south-east – predicted construction noise levels – daytime

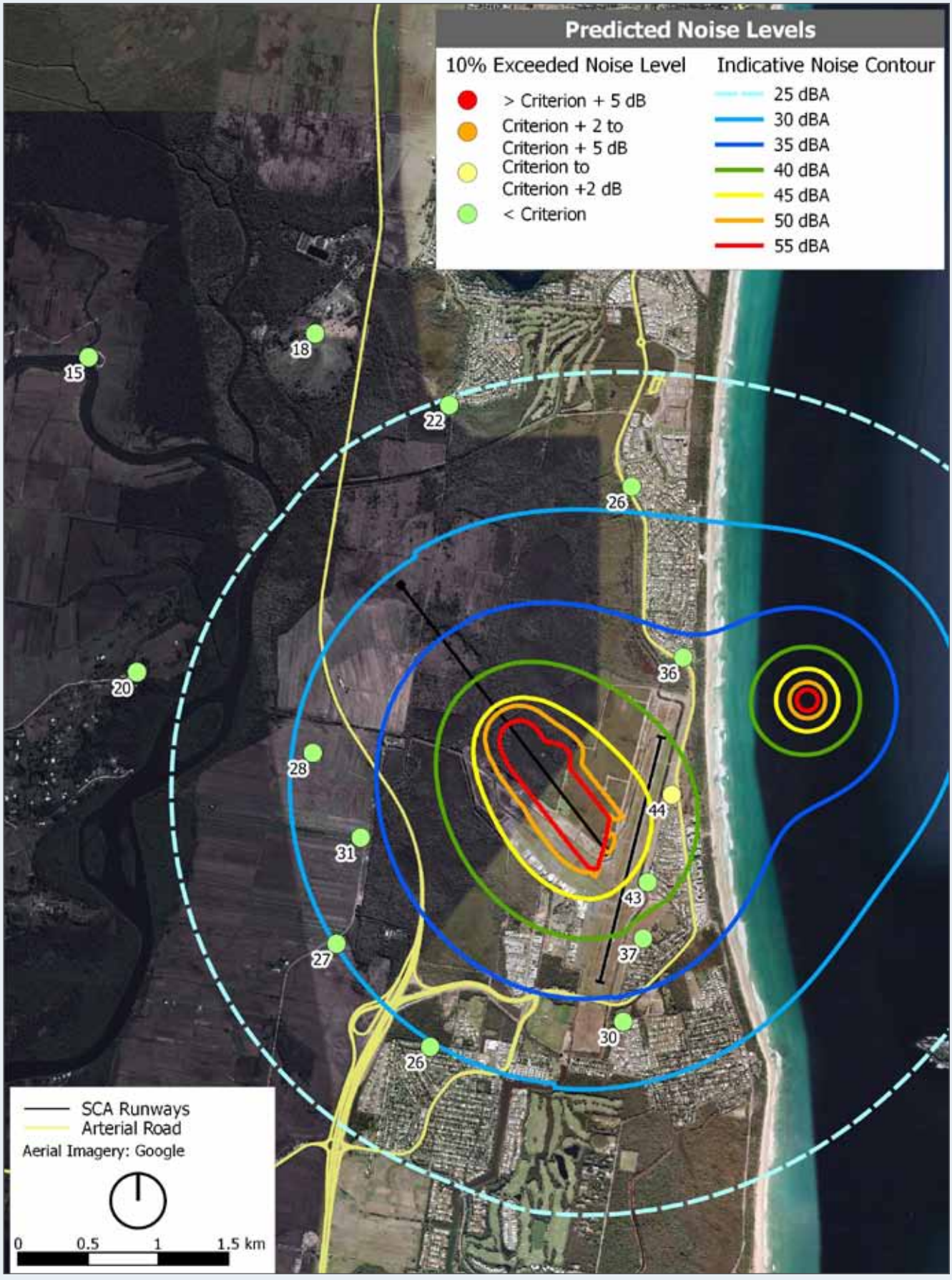


Figure 15.5e: Package 2 middle – predicted construction noise levels – daytime

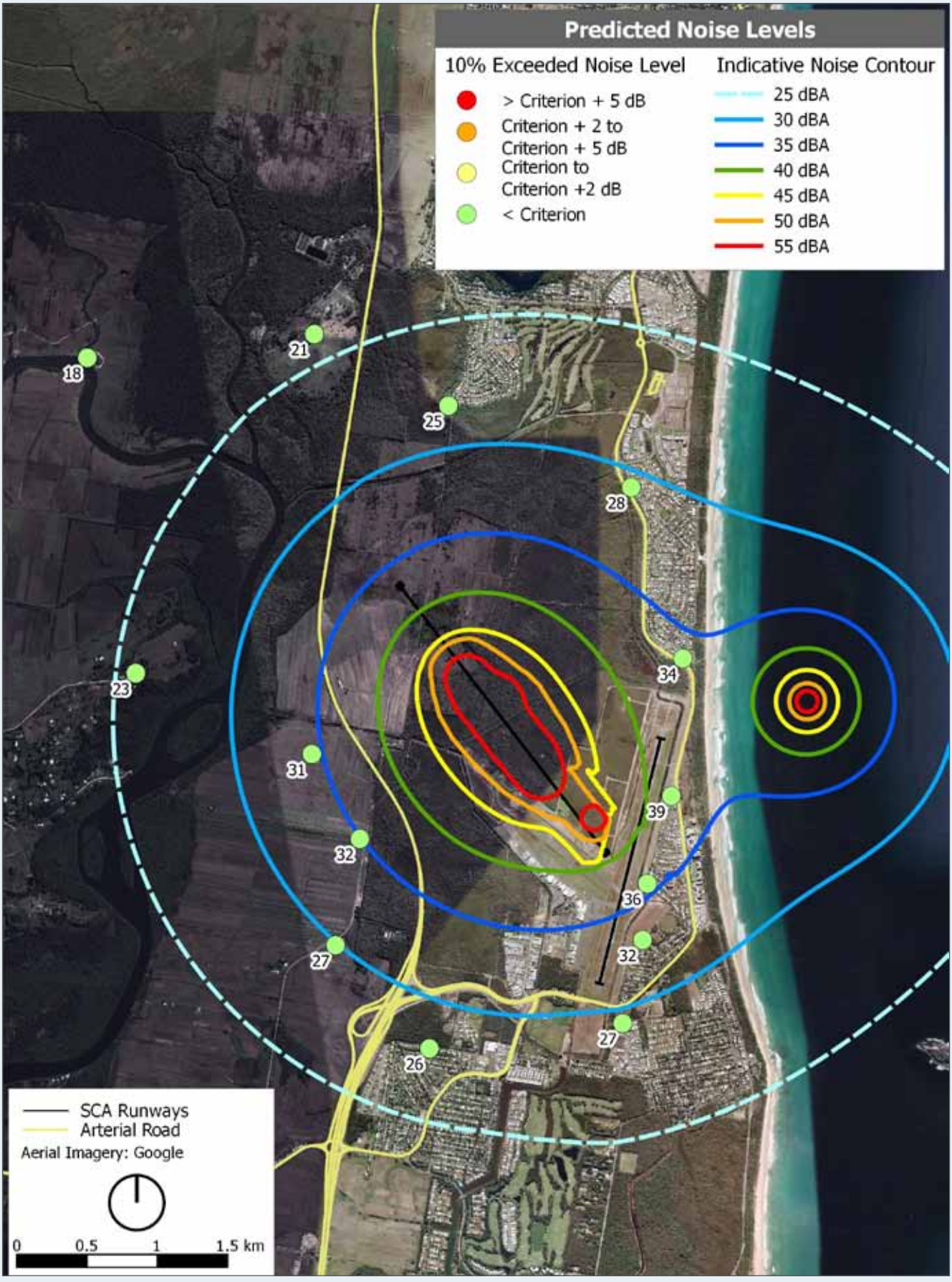


Figure 15.5f: Package 2 north-west – predicted construction noise levels – daytime

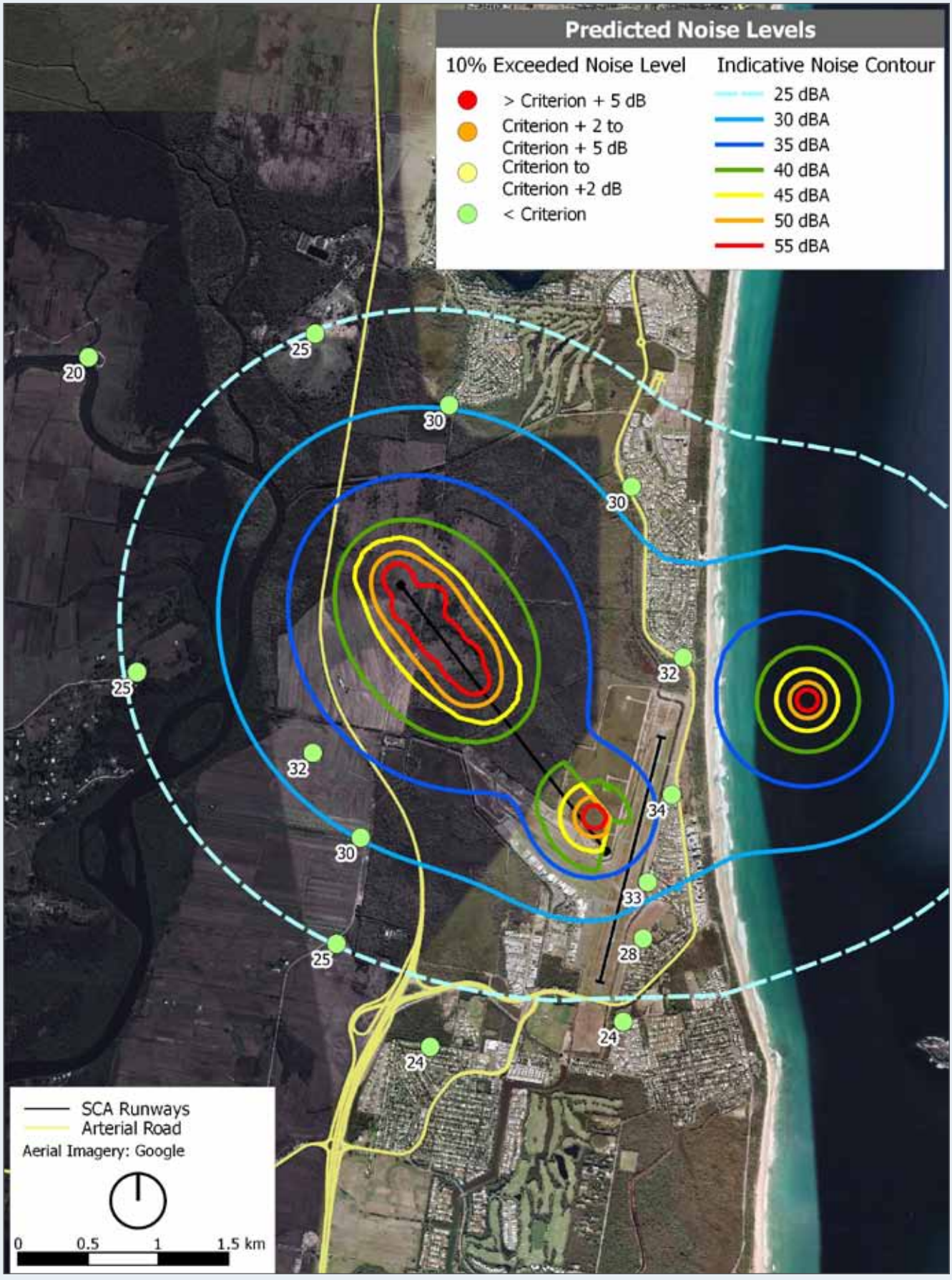


Table 15.5h: Package 2 daytime – predicted construction noise levels exceeded for 10% of time – $L_{Aeq,1hr}$ (dBA)

Prediction location	NCA	Noise goal	South-east		Middle		North-west	
			Predict.	Exceed.	Predict.	Exceed.	Predict.	Exceed.
R1	1	**46**	28	0	31	0	32	0
R2		**46**	31	0	32	0	30	0
R3		**46**	27	0	27	0	25	0
R4	4	**45**	26	0	26	0	24	0
R5	5	**48**	30	0	27	0	24	0
R6	6	**43**	37	0	32	0	29	0
R7		**43**	43	0	36	0	33	0
R8		**43**	44	1	39	0	34	0
R9	9	**45**	36	0	34	0	32	0
R10		**45**	26	0	28	0	30	0
R11	11	**47**	22	0	25	0	30	0
R12	12	**44**	18	0	21	0	25	0
R10		**44**	15	0	18	0	20	0
R14	14	**45**	20	0	23	0	25	0

Table 15.5i Package 2 evening – predicted construction noise levels exceeded for 10% of time – $L_{Aeq,1hr}$ (dBA)

Prediction location	NCA	Noise goal	South-east		Middle		North-west	
			Predict.	Exceed.	Predict.	Exceed.	Predict.	Exceed.
R1	1	**41**	18	0	23	0	24	0
R2		**41**	20	0	25	0	25	0
R3		**41**	18	0	22	0	22	0
R4	4	**38**	19	0	22	0	22	0
R5	5	**43**	23	0	27	0	27	0
R6	6	**42**	34	0	34	0	34	0
R7		**42**	38	0	37	0	36	0
R8		**42**	41	0	38	0	37	0
R9	9	**46**	31	0	32	0	32	0
R10		**46**	21	0	24	0	25	0
R11	11	**39**	16	0	19	0	21	0
R12	12	**44**	12	0	16	0	17	0
R10		**44**	9	0	12	0	13	0
R14	14	**38**	12	0	17	0	18	0

15.5.8.3 Package 3

Table 15.5k presents the noise levels predicted to be exceeded for 10 per cent of the time for Package 3 construction during the daytime.

Predictions show that whilst works are concentrated about the south-eastern end of the site, minor exceedances (4 dB) of the noise goals are expected at the nearest receivers. This is due to exposed mobile plant operating near the eastern end of the site (the noise bunds described in **Section 15.5.6** will have been removed by this stage).

As works progress north-west, the noise levels are predicted to comply with the noise goals.

For construction noise during standard construction hours, and noting that the worst-case noise levels presented would occur only for limited periods, the predicted noise levels are considered acceptable.

Though the majority of work will be done during standard construction hours, night works will be required where construction infringes upon either the RWY18/36 flight strip or the OLS side transitional surfaces for RWY 18/36. Considering the noise levels presented in **Table 15.5k** and the night time noise goals presented in **Table 15.5b**, exceedances of approximately 7 dB would be expected. The need for limited night works in large infrastructure projects is typical.

The distance to the nearest receivers in this case is relatively large (270 m) and consequently noise levels are reasonable. The attenuation from outside to inside with an open window is typically between 5 and 15 dB, whilst a building with closed windows provides in excess of 20 dB attenuation. Therefore the construction noise level from inside a bedroom would be expected to be in the range 27-42 dBA. This is similar to Australian Standard 2107 "Acoustics – Recommended Design Sound Levels and Reverberation

Table 15.5j: Package 2 night – predicted construction noise levels exceeded for 10% of time – $L_{Aeq,1hr}$ (dBA)

Prediction location	NCA	Noise goal	South-east		Middle		North-west	
			Predict.	Exceed.	Predict.	Exceed.	Predict.	Exceed.
R1	1	**36**	18	0	23	0	24	0
R2		**36**	20	0	25	0	25	0
R3		**36**	18	0	22	0	22	0
R4	4	**33**	19	0	22	0	22	0
R5	5	**38**	23	0	27	0	27	0
R6	6	**40**	34	0	34	0	34	0
R7		**40**	38	0	37	0	36	0
R8		**40**	41	1	38	0	37	0
R9	9	**45**	31	0	32	0	32	0
R10		**45**	21	0	24	0	25	0
R11	11	**36**	16	0	19	0	21	0
R12	12	**32**	12	0	16	0	17	0
R10		**32**	9	0	12	0	13	0
R14	14	**34**	12	0	17	0	18	0

Table 15.5k: Package 3 daytime – predicted construction noise levels exceeded for 10% of time – $L_{Aeq,1hr}$ (dBA)

Prediction location	NCA	Noise goal	South-east		Middle		North-west	
			Predict.	Exceed.	Predict.	Exceed.	Predict.	Exceed.
R1	1	**46**	23	0	25	0	26	0
R2		**46**	24	0	26	0	24	0
R3		**46**	20	0	20	0	19	0
R4	4	**45**	20	0	18	0	16	0
R5	5	**48**	25	0	20	0	17	0
R6	6	**43**	35	0	23	0	20	0
R7		**43**	47	4	26	0	23	0
R8		**43**	37	0	29	0	26	0
R9	9	**45**	27	0	28	0	26	0
R10		**45**	20	0	23	0	24	0
R11	11	**47**	17	0	19	0	24	0
R12	12	**44**	12	0	14	0	19	0
R10		**44**	9	0	10	0	14	0
R14	14	**45**	14	0	16	0	19	0

Times for Building Interiors", which recommends noise levels inside bedrooms up to 40 dBA. Therefore noise from limited night works in Package 3 are predicted to be acceptable for limited durations.

Nevertheless these emissions would need to be considered by the contractor and some management measures may be appropriate (i.e. limiting the number of consecutive nights). Refer **Figure 15.5j**, **Figure 15.5k** and **Figure 15.5l**, for example noise contours.

15.5.8.4 Package 4

Terminal upgrades undertaken as part of Package 4 will include internal renovations and staged extensions.

The noise emissions will vary greatly across the various stages of these upgrades. Package 4 will be completed concurrently with parts of Packages 2 and 3.

In general the noise emissions from Package 4 works will be insignificant in comparison to the concurrent works of other packages. The noise predictions in the preceding sections will remain representative of overall noise levels at receivers during the concurrent works.

Figure 15.5g: Package 2 south-east – predicted construction noise levels – night

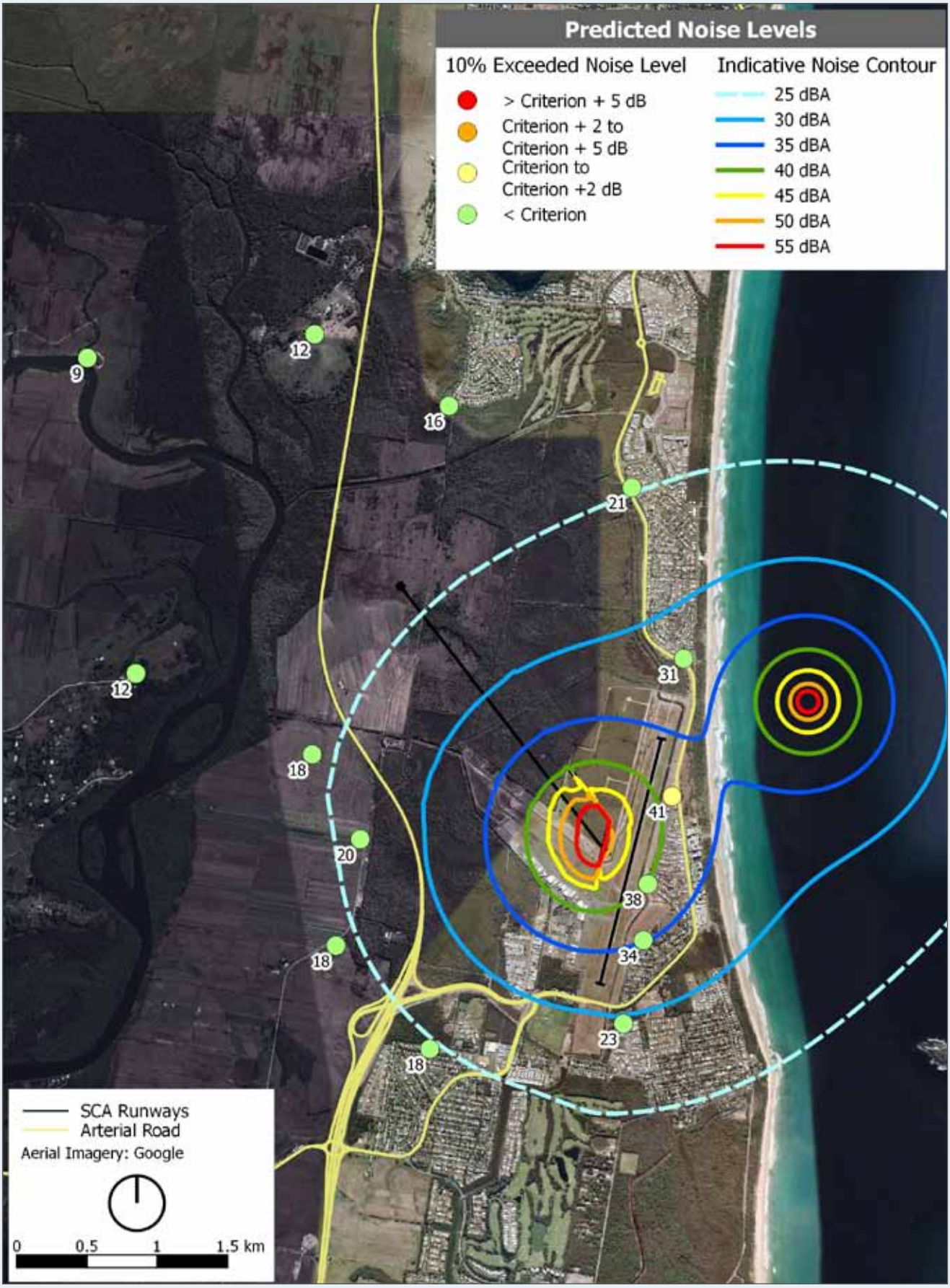


Figure 15.5h: Package 2 middle – predicted construction noise levels – night

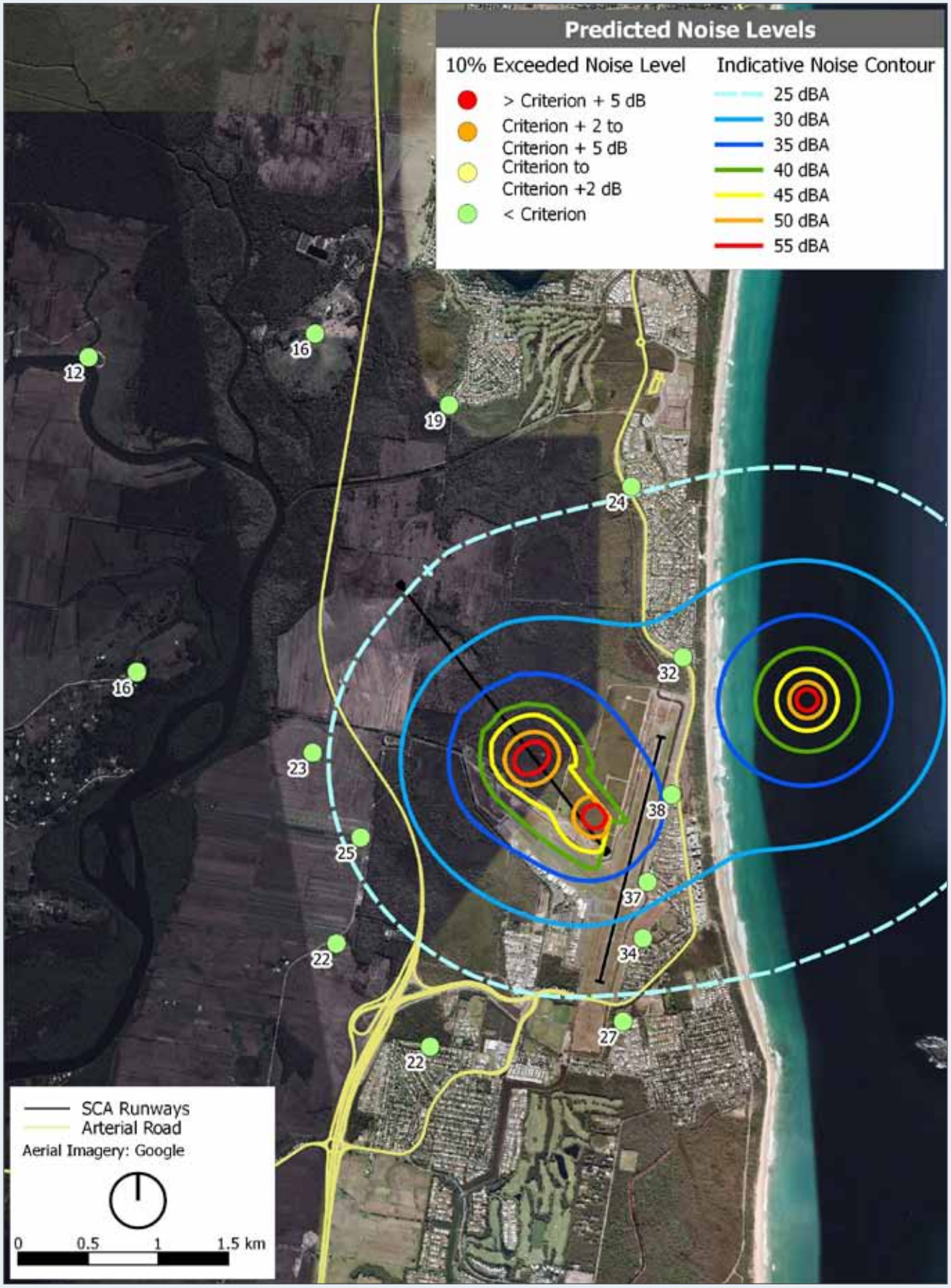


Figure 15.5i: Package 2 north-west – predicted construction noise levels – night

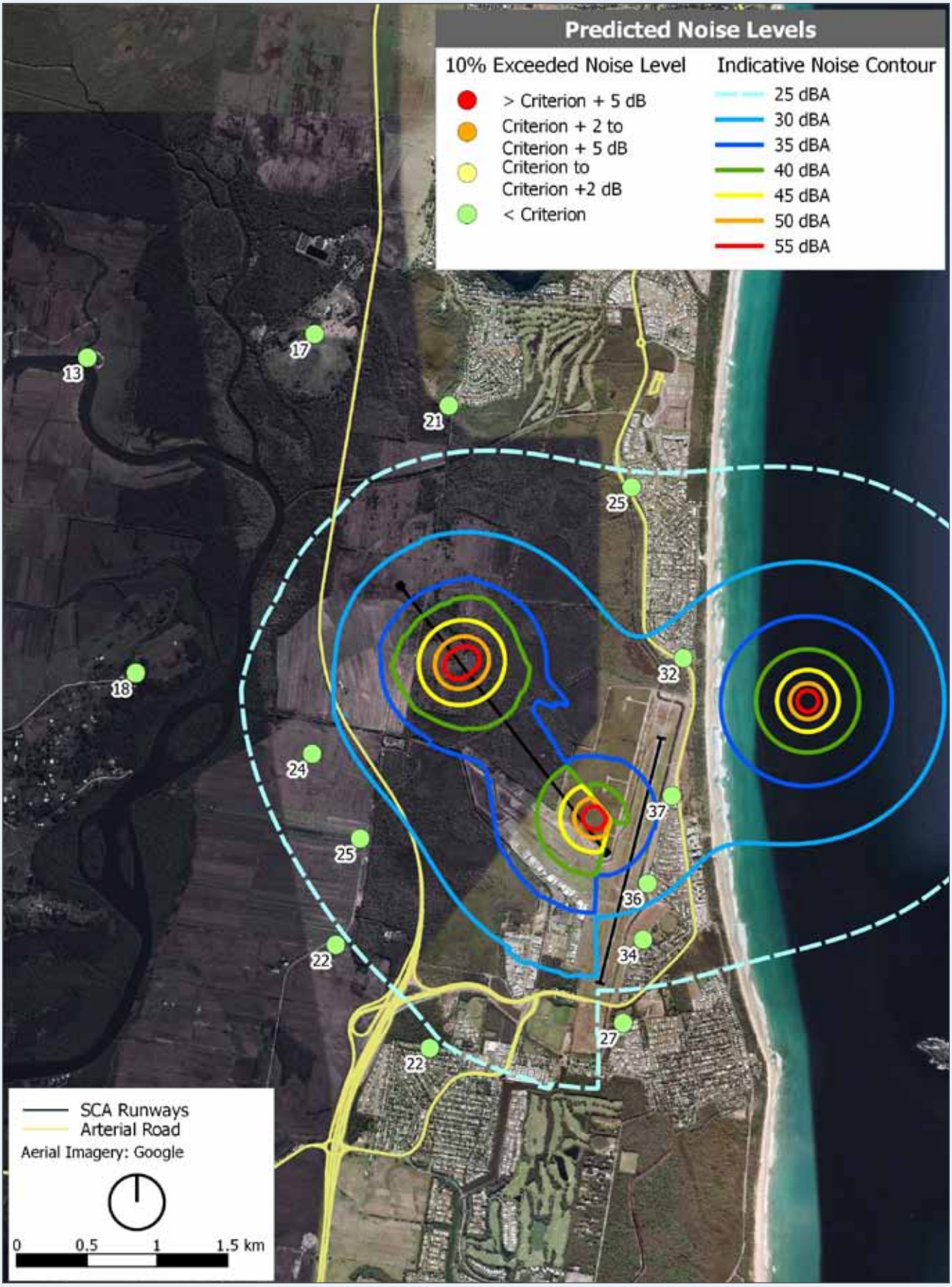


Figure 15.5j: Package 3 south-east – predicted construction noise levels – daytime

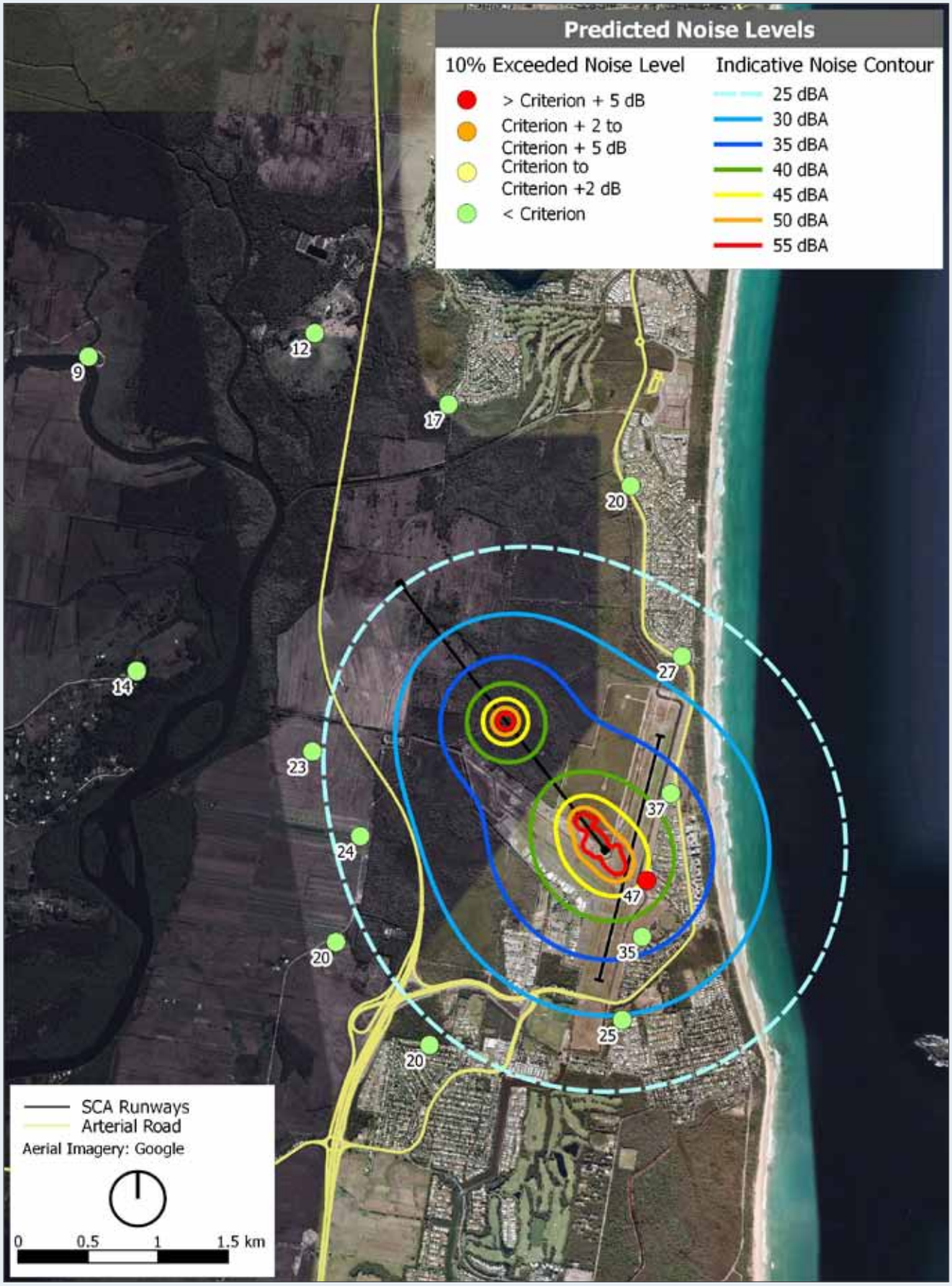


Figure 15.5k: Package 3 middle – predicted construction noise levels – daytime

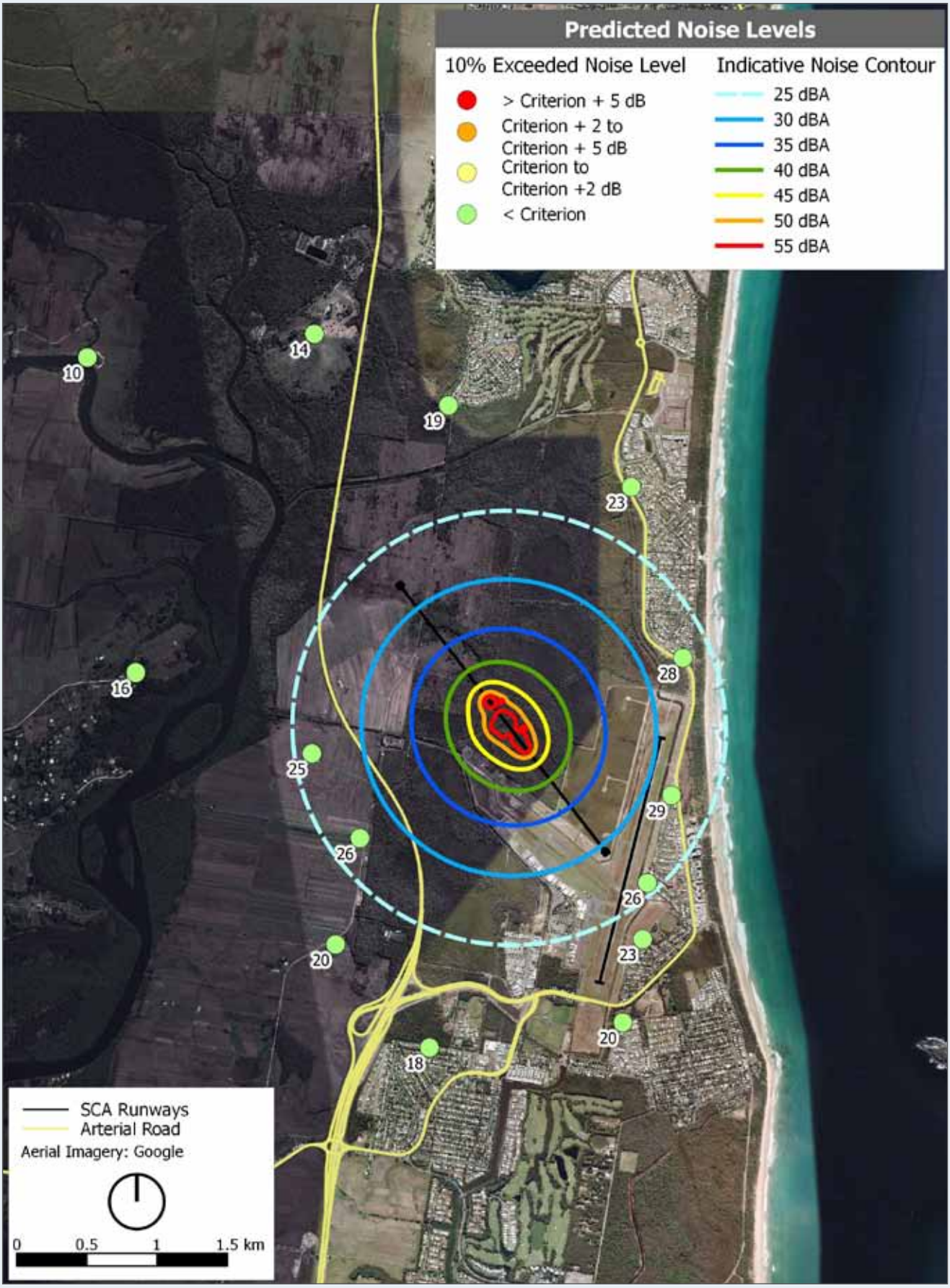
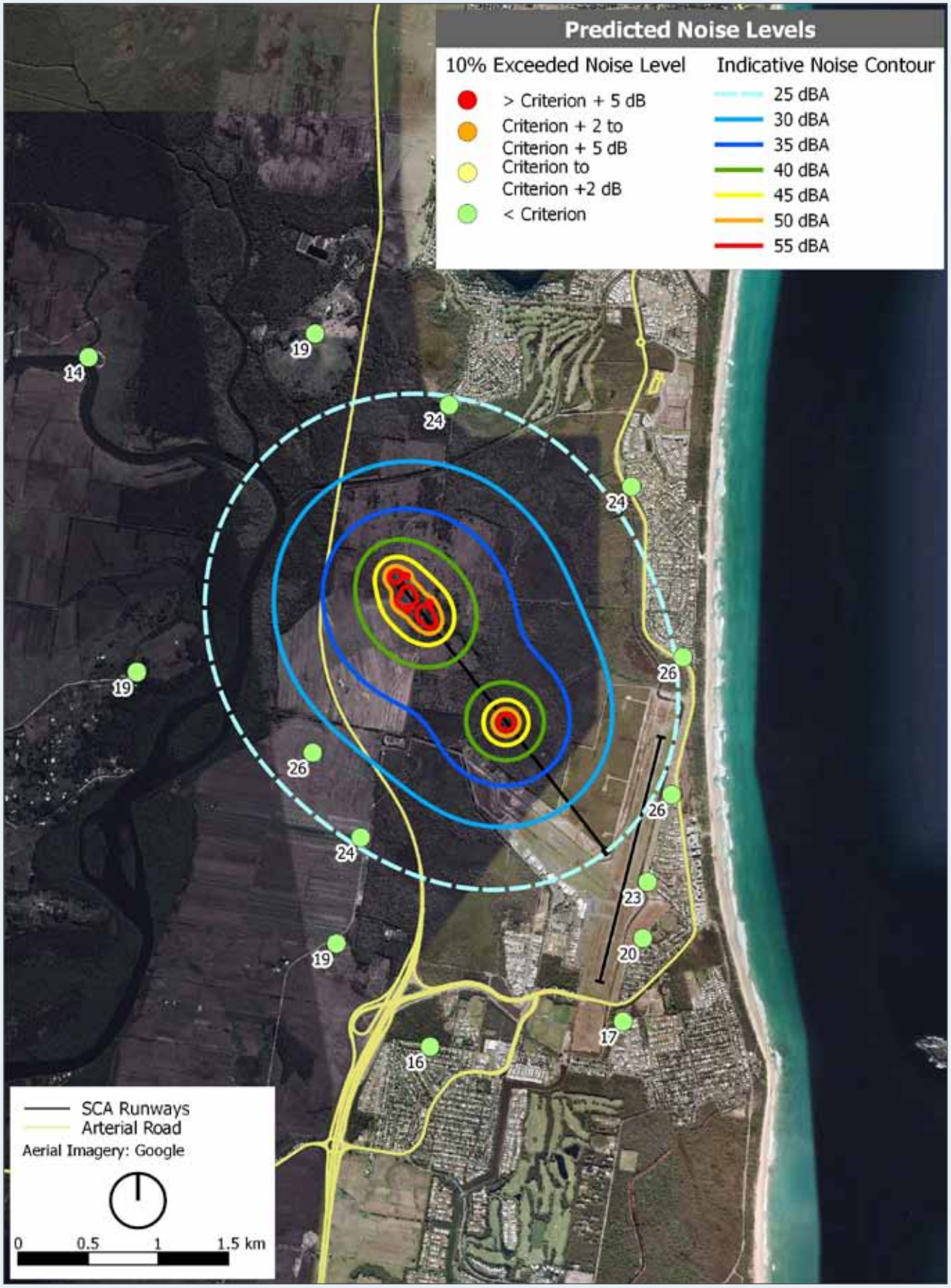


Figure 15.5l: Package 3 north-west – predicted construction noise levels – daytime



15.6 TERRESTRIAL OPERATIONAL NOISE

This section considers operational noise from terrestrial sources within SCA and includes:

- Ground running of aircraft (engine testing etc.)
- Aircraft whilst stationary at the terminal (i.e. whilst emissions are dominated by the aircraft's APU
- Helicopter engine run-up/run-down and low-level hover training
- General plant noise from the terminal and other facilities within the airport.

Noise generated by an aircraft in flight or when landing, taking off or taxiing is addressed in Chapter D3 – Aircraft Noise.

Helicopter noise during low-level[1] operations has been included in this assessment because of the nature of these activities at SCA, given the prevalence of training operations. These operations are not adequately described by the assessment procedures undertaken for in-flight noise emissions in Chapter D3 – Aircraft Noise.

15.6.1 Terrestrial operational noise criteria

The following sections detail derived noise criteria based on State guidelines. The following publications are relevant to the Project:

- *Queensland Environmental Protection (Noise) Policy 2008*
- DEHP's guideline Planning for Noise Control.

15.6.1.1 Noise from terrestrial aircraft operations

Noise from terrestrial aircraft operations is assessable under EPP (Noise) 2008.

EPP (Noise) 2008 presents a table of acoustic quality objectives which are "prescribed for enhancing or protecting the environmental value(s) ... It is intended that the acoustic quality objectives be progressively achieved as part of achieving the purpose of this policy over the long term."

The relevant acoustic quality objectives are reproduced in **Table 15.6a**.

It is convenient to consider external noise objectives. To derive external noise objectives it is appropriate to apply a 5-10[2] dB correction to account for the attenuation from outside to inside.

EPP (Noise) 2008 also presents noise criteria for the control of background creep, stating that "to the extent that it is reasonable to do so" these criteria should not be exceeded. In practice these criteria are not well suited to the assessment of terrestrial aircraft operations, nor to the assessment of intermittent operations in the context of the ambient noise environment surrounding the airport, i.e. one characterised by high noise level events resulting from aircraft overflights. Therefore background creep criteria have not been considered in the assessment of noise from terrestrial aircraft operations.

15.6.2 Noise from general mechanical plant

Noise criteria can be derived from the EPP (Noise) 2008 and PNC, which provide criteria for general industrial noise sources, such as manufacturing facilities, distribution centres, warehouses and car parks.

Ultimately, these publications yield similar noise criteria. For convenience, discussion of criteria for these sources is limited to those promulgated by EPP (Noise) 2008.

The acoustic quality objectives presented in **Table 15.6a** are appropriate for the assessment of general mechanical plant noise. Due to the nature of noise emissions from mechanical plant, it is appropriate to apply the L_{Aeq} objectives.

Objectives to control background creep must also be considered in the assessment of mechanical plant noise. At Clause 10 "Controlling background creep", EPP (Noise) 2008 states:

"To the extent that it is reasonable to do so, noise from an activity must not be:

(a) for noise that is continuous noise measured by $L_{A90,T}$ – more than nil dBA greater than the existing acoustic environment measured by $L_{A90,T}$; or

(b) for noise that varies over time measured by $L_{Aeq\ adj,T}$ – more than 5 dBA greater than the existing acoustic environment measured by $L_{A90,T}$.

Table 15.6a: EPP (Noise) 2008 acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objective (dBA)		
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$
Dwelling (for outdoors)	Daytime and evening	50	55	65
Dwelling (for indoors)	Daytime and evening	35	40	45
	Night-time	30	35	40

1 *For assessment purposes, helicopter flights not elevating above 10 feet were considered as part of the terrestrial noise assessment. This delineation was made on the basis that flights below this level would not be perceived as 'over flights' by neighbouring receivers.*

2 *The level of attenuation provided by a façade with an open window has been the focus of numerous investigations. 10 dB is commonly adopted as a conservative estimate. Notably a reduction of 10 dBA is ascribed by AS3671 – 1989 Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction for a facade with openings, including open windows and doors.*

The EPP (Noise) 2008 objectives for the control of background creep have been applied to the component noise level (i.e. from the industrial source only) for the Project

Due to the relatively consistent operation of general mechanical plant, producing a continuous or quasi-continuous noise character, it is appropriate to apply the L_{A90} objective of background plus zero.

Table 15.6b shows "acoustic quality" and "background creep" objectives at locations around the airport, representing the range of locations which are potentially affected by terrestrial noise. The lesser of the two objectives was adopted (bolded figures in **Table 15.6b**). To the extent that it is reasonable to do so, mechanical plant should be designed so that these noise criteria are not exceeded at the surrounding sensitive receivers.

The background creep objectives are generally more stringent than the acoustic quality objectives. It is most convenient to consider a single noise descriptor for the objectives. Thus the most stringent objectives have been defined in terms of the L_{A90} and are presented in **Table 15.6c**.

15.6.3 Terrestrial operational noise levels

The following sections examine the potential for the Project to affect noise emissions to surrounding sensitive receivers from terrestrial noise sources at SCA.

15.6.3.1 Noise from terrestrial aircraft operations (including APUs)

The Project is not predicted to significantly alter the terrestrial operations of fixed-wing or rotary-wing aircraft. The existing terminal would receive an extension, though the locations of parked aircraft relative to residences would not change significantly.

Table 15.6b: Criteria for plant and machinery (dBA)

		Daytime 7.00am-6.00pm		Evening 6.00pm-10.00pm		Night 10.00pm-7.00am	
NCA (Figure)	Monitoring location	Background creep objective L_{A90}	Acoustic quality objective L_{Aeq}	Background creep objective L_{A90}	Acoustic quality objective L_{Aeq}	Background creep objective L_{A90}	Acoustic quality objective L_{Aeq}
1	J	**36**	45	**35**	45	**31**	40
4	B	**34**	45	**32**	45	**29**	40
5	A	**36**	45	**38**	45	**34**	40
6	K	**40**	45	**39**	45	**37**	**40**
9	E	**42**	**45**	43	**45**	42	**40**
11	F	**39**	45	**36**	45	**33**	40
12	G	**34**	45	**34**	45	**29**	40
14	H	**36**	45	**33**	45	**31**	40

Note: 1. Only monitoring locations representing NCAs are presented. Other monitoring locations are more distant from the airport and are not relevant to the assessment of construction noise.

2. The most stringent objective is bolded. An adjustment of 3 dB was applied in comparing L_{A90} and L_{Aeq} objectives. (When dealing with continuously operating mechanical plant, L_{Aeq} noise levels are typically 2-3 dB greater than L_{A90} noise levels.)

3. Acoustic quality objectives are derived by applying a 10 dB correction to internal objectives promulgated by EPP (Noise) 2008.

Table 15.6c: Project specific noise objectives for plant and machinery – L_{A90} (dBA)

NCA (Figure)	Monitoring location	Daytime 7.00am-6.00pm	Evening 6.00pm-10.00pm	Night 10.00pm-7.00am
1	J	36	35	31
4	B	34	32	29
5	A	36	38	34
6	K	40	39	37
9	E	42	42	37
11	F	39	36	33
12	G	34	34	29
14	H	36	33	31

Existing hangars would remain in service beyond the scope of the Project. There is presently no non-emergency maintenance performed on jets at SCA, and no additional ground-running (i.e. testing of an engine whilst it is fitted to an aircraft) is proposed.

Given that there is predicted to be minimal impact on the noise emissions from terrestrial aircraft operations as a result of the Project and that the acoustic quality objectives are intended to be "progressively achieved … over the long term", the impact of the Project on noise emissions from these sources is expected to be negligible.

In this regard, it is considered that terrestrial aircraft operations with the Project should be evaluated in terms of potential reasonable and practicable measures to limit emissions.

We note that the operation of helicopters, particularly in the southern General Aviation (GA) area (refer **Figure 15.1a**), is a large emitter of noise from terrestrial operations at the airport. Mitigation of this source through physical barriers and the like is impractical. Consistent with the intent of EPP (Noise) 2008, the most significant long-term reduction would be achieved by relocating these operations to the western GA area. In 2012 helicopters operated from the southern GA area at the airport and as of 2013 operations after 4.00pm were moved to the newly opened western GA area. It is expected that the southern GA area will continue to be used for daytime helicopter operations until 2027, when existing hangar leases expire. These actions, which have begun and are independent of the Project, are considered to be consistent with EPP (Noise) 2008.

15.6.3.2 Noise from general mechanical plant

Mechanical plant noise at airports is generally associated with buildings. The terminal upgrade would require some new mechanical plant. Details of this plant were not known in the preparation of the EIS. Given the significant distance to the nearest receivers, noise emissions from any mechanical plant will be controlled to within the noise criteria detailed in **Table 15.6b** with minimal acoustic mitigation.

A new joint Air Traffic Control (ATC) tower and Aviation Rescue and Fire Fighting Service (ARRFS) facility is proposed as part of the Project. The tower and station will be located west of the western GA area away from residential areas.

15.7 PROPOSED CONSTRUCTION NOISE MANAGEMENT MEASURES

Construction noise is predicted to comply with daytime noise goals at the majority of receivers for the majority of the time. Some exceedances are predicted; however, in the context of construction and noting the magnitude of predicted noise levels in the context of the ambient levels, these noise levels do not warrant further assessment.

Works during the evening and night time periods are predicted to again generally be compliant with the noise goals. Notwithstanding this, reasonable and practicable mitigation and management measures should be considered to reduce the noise emissions as much as practicable during these sensitive periods. The following sections describe possible noise mitigation measures that may be implemented to manage construction noise.

15.7.1 Construction noise mitigation measures – general approach

A range of possible approaches to reducing the impact of construction noise is described below. It is proposed that these strategies be applied to areas of exceedance identified in the preceding section.

- *Noise monitoring programme* – A well-planned noise monitoring programme will assist in identifying the site-specific potential for disturbance at particularly sensitive localities as the works progress. Reasonable and feasible mitigation measures, such as time restrictions, changes in work sequences or selection of smaller items of equipment can then be put in place before significant disturbance occurs

The programme would include the ongoing monitoring of emissions from work sites and would assist in planning of ongoing works

- *Equipment selection* – All plant at the work sites should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures in order to ensure that the total noise emission from each work site is minimised
- *Plant noise audit* – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items *prior to the eq*uipment going into regular service. Periodic noise monitoring should be conducted to ensure that items of plant continue to be well maintained in compliance with the noise emission limits for that class of equipment

  To this end, a regular equipment testing programme should be established with the contractor
- *Operator instruction* – Operators should be trained to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission
- *Site noise planning* – Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels
- *Permissible times of work* – Where engineering, safety, access or programming constraints permit, the hours of use of noisy equipment may be limited at the work sites where residential areas could otherwise be adversely affected. However, the implications of this in terms of possible extension of the period of noise exposure should be considered.

15.7.2 Community liaison and general approaches to mitigation

An effective community relations programme should be put in place to keep the potentially affected community appraised of progress of the works, and to forewarn of potentially affected groups (e.g. by letterbox drop, meetings with community groups, etc.) of any anticipated changes in noise emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms.

Close liaison should be maintained between the local communities and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

15.7.3 Construction noise management plan

A comprehensive construction noise management measures should be included in the EMP for the Project. The plan should be prepared during the project planning process, including components relating to noise. This plan should detail the mitigation, monitoring, complaint response and community liaison measures outlined in the previous section. The plan should be updated to incorporate any additional measures that emerge as the Project design evolves and work methodologies become better defined.

A key element of the construction noise management measures will be the need to conduct progressive noise impact assessments prior to each stage of the works commencing. In this manner, the work activities having particular potential for noise impact can be identified (as proposed work methodologies become clearer).

Further control and monitoring methodologies can be refined to suit those activities, and assurance can be given that emissions will be managed to an acceptable level wherever practical.

15.8 CONSTRUCTION VIBRATION

15.8.1 Construction vibration criteria

When assessing vibration there are two components that require consideration:

- human exposure to vibration
- the potential for building damage from vibration.

15.8.1.1 Human exposure to vibration

Guidance in relation to assessing the potential human disturbance from ground-borne vibration inside buildings and structures is contained in Australian Standard AS 2670.2-1990 “Evaluation of Human Exposure to whole-body vibration Part 2: Continuous and shock induced vibrations in buildings (1 Hz to 80 Hz)”.

AS 2670.2 gives guidance regarding satisfactory vibration velocity levels based on root mean squared” (RMS) vibration levels. The RMS vibration level can be converted to peak vibration level by applying the appropriate “crest” factor (i.e. ratio of the peak level to RMS level) to obtain a “peak” vibration level. Crest factors will vary from 1.4 for construction activities of a sinusoidal nature (e.g. continuous vibratory rolling and rotating plant) up to four or more for intermittent activities such as rockbreaking.

From AS 2670.2, satisfactory magnitudes of peak vibration velocity (i.e. values below which the probability of “adverse comment” is low) are shown in **Table 15.8a** for generally sinusoidal vibration. For reference the “continuous or intermittent vibration” goals for residences correspond to a level that would be slightly perceptible to most people.

With close cooperation and liaison with the occupants of the potentially affected properties, significantly higher levels of short-term vibration could be tolerated by many people for construction projects. In many instances there is a trade-off between the magnitude and duration of construction related vibration.

Table 15.8a: Satisfactory level of peak vibration velocity

		Satisfactory peak vibration levels (mm/s)	
Type of space	**Time of day**	**Continuous or intermittent vibration**	**Transient vibration**
Critical working areas (e.g. some hospital operating theatres, some precision laboratories)	Day Night	0.4	0.4
Residential	Day Night	0.3 to 0.6 0.2	4 to 13 0.2 to 3
Offices	Day	0.26	0.51

Note: 1. Objectives for vertical vibration are shown. Greater levels of horizontal vibration may be tolerated depending on the occupants' orientation.
2. Objectives are presented fro the frequency range 8 Hz to 80 Hz. The majority of significant vibration generated by construction would be in this range.

15.8.1.2 Building damage from vibration

There are currently no Australian Standards or guidelines to provide guidance on assessing the potential for building damage from vibration. It is common practice to derive goal levels from international standards. British Standard BS7385:1993 and German Standard DIN4150:1999 both provide goal levels, below which vibration is considered insufficient to cause building damage. Of these DIN4150 is the more stringent. **Table 15.8b** summarises the goal levels specified in DIN4150.

With regard to these levels DIN4150 states:

> *"Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Exceeding [these] values does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary."*

For construction activities the vibration is typically in the frequency range 31.5 – 80 Hz. Because the dominant frequency of vibration cannot be determined with certainty, our assessment has adopted a goal level peak particle velocity (PPV) 5 mm/s for the nearest residences. This is considered to introduce an element of conservatism to the assessment.

15.8.2 Construction vibration assessment

Vibration from construction activities is typically limited to a small selection of plant. Items of plant that are likely to produce significant vibration in this project are:

- Vibratory roller
- Alternative compaction methods (e.g. dynamic compaction or vibratory compaction).

Details of the compaction method are not known. Vibration from this source, and others, may need to be investigated by the contractor in the preparation of the EMP. A preliminary assessment is undertaken here to provide guidance on the likelihood of impacts.

Rockbreakers are not anticipated to be extensively used, however they may be necessary for small durations in the removal of existing concrete, etc. This source has been included in this assessment for the purposes of building damage only.

The highest vibration levels are expected to be produced by vibratory rollers and rockbreakers (if required). The PPV vibration level of each of these at varying distances from the source is presented in **Table 15.8c** for consideration against building damage criteria.

The nearest residences to vibration emitting works are approximately 270 m away. Vibration from the construction plant at this distance is predicted to be well within guidelines for the assessment of building damage (5 mm/s) and human comfort (0.3 mm/s for continuous vibration during the day) and is unlikely to be perceptible. Therefore, no impacts are expected to result from vibration generated by vibratory rolling, rockbreaking or other typical construction processes.

Greater vibration emissions are possible from some compaction methods, such as dynamic compaction, and if applicable should be assessed by the contractor in the preparation of the EMP.

Table 15.8b: Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

	Guideline Values for Velocity – PPV (mm/s)		
Type of Structure	**1 Hz to 10 Hz**	**10 Hz to 50 Hz**	**50 Hz to 100 Hz**
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/ or occupancy	5	5 to 15	15 to 20
intrinsic value	3	3 to 8	8 to 10

[Source: Table 1, DIN4150-3:1999]

Table 15.8c: Vibration with distance – PPV

	Guideline Values for Velocity – PPV (mm/s)				
	Distance				
Equipment	**10 m**	**20 m**	**30 m**	**40 m**	**50 m**
Vibratory Roller (12 t)	1.3	0.9	0.6	0.5	0.35
Rockbreaker 30 t	1.5	1.0	0.7	0.5	0.35

15.9 NOISE FROM ROAD TRAFFIC

15.9.1 Noise level criteria

The proposed development has the potential to create additional traffic on roads surrounding the airport, both during construction and during operation. This in turn has the potential to result in additional noise impacts at residences adjacent to those roads.

The Queensland Department of Transport and Main Roads sets out criteria for assessment of traffic noise in a number of circumstances. The most relevant of these is assessment of noise from "Existing Roads – No Roadworks":

- $L_{10(18hr)}$ noise level 10 years after the date of the assessment of 68 dBA or greater.

This criterion defines noise levels at which "measures for noise attenuation will be considered within the road reserve".

This criterion can be used to assess the impact of growth in traffic noise associated with the airport as a whole, as well as the additional impact from the Project.

It is also readily accepted that a 2 dB increase in existing noise levels due to the proposal is noticeable. This can be used to guide the evaluation of traffic noise from a development. Where practical, it is generally good practice to ensure that increases due to a development do not exceed 2 dB.

15.9.2 Calculated noise levels

Existing and projected traffic volumes are discussed in Chapter B14 – Surface Transport. Volumes relevant to this assessment are reproduced in **Table 15.9a**. The annual average daily traffic (AADT) has been adopted for assessment.

Projections of operational traffic volumes are available for the year 2020 (representing the year of opening) and 2030. For simplicity, only 2030 is considered quantitatively in this assessment.

Projections for the construction phase have been made for 2018, which represents the peak construction traffic generation for the Project, coinciding with the import of terrestrial fill for the runway and taxiway pavement construction. Impacts on traffic volumes due to construction are primarily related to Finland Road and David Low Way (west of Finland Road).

Traffic noise is only considered as far back as the Sunshine Motorway. Impacts beyond this will be negligible in the context of organic traffic volumes on the road network.

For each road section, the $L_{A10,18hr}$ noise level was calculated at the nearest residence using the standard CoRTN methodology, with the following standard assumptions:

- Traffic volumes in the period 6.00am-midnight are 95 per cent of the average daily volume
- Traffic speeds on all roads considered are 60 km/h
- Ground between road and residence is 50 per cent acoustically soft
- A façade correction of 2.5 dBA is included
- The nearest residential setback from the near traffic lane is 20 m.

Table 15.9b shows traffic noise levels at the nearest residence, calculated in this way.

From **Table 15.9b** the following points are clear:

- At all locations except Finland Road, calculated $L_{A10,18hr}$ noise levels exceed the level of 68dBA nominated in **Section 15.9.1**, without the Project
- At all locations except Finland Road, the projected increase in traffic noise due to the Project is well below 2 dB
- Noise levels in Finland Road during construction are predicted to be noticeably increased (i.e. > 2dB) and above the nominated goal of 68 dBA.

The predicted increases in traffic noise along Finland Road during construction are to be expected. Finland Road is a very quiet road with currently infrequent traffic, presumably by residents of Finland Road (i.e. little or no regular through traffic). During construction this would be utilised by the majority of construction traffic to the Project site. Fourteen residences are located on Finland Road and would be affected by this traffic noise.

We recommend that anticipated traffic noise be communicated to residents adjoining Finland Road ahead of significant heavy vehicle traffic on this road. These residents should be notified ahead of peak terrestrial fill imports and regularly updated about the progress and anticipated duration of works which are anticipated to generate significant traffic volumes. Terrestrial fill importation should be limited to standard construction hours. Traffic noise in Finland Road should be addressed in the DMP.

Table 15.9a: Projected traffic volumes

Road	2018 – construction phase				2030 – operational phase			
	Without AEP		With AEP		Without AEP		With AEP	
	AADT	%HV	AADT	%HV	AADT	%HV	AADT	%HV
David Low Way (east of Airport Drive)	15064	2.8%	15137	2.8%	18933	2.7%	19203	2.7%
David Low Way (south of Airport Drive, east of Sunshine Motorway)	15280	3.4%	15287	3.4%	22360	3.3%	22629	3.3%
David Low Way (west of Sunshine Motorway, east of Finland Road)	10421	4.9%	10561	5.1%	15419	4.7%	15689	4.6%
Finland Road	44	9.1%	232	22%	44	9.1%	44	9.1%
(west of Finland Road)	10416	4.9%	10464	5.0%	15415	4.7%	15684	4.6%

Table 15.9b: Calculated $L_{A10,18hr}$ noise levels (dBA)

Road	2018 – construction phase			2030 – operational phase		
	Without AEP	With AEP	Increase	Without AEP	With AEP	Increase
David Low Way (east of Airport Drive)	69.2	69.2	0.0	70.2	70.2	0.0
David Low Way (south of Airport Drive, east of Sunshine Motorway)	69.4	69.4	0.0	71.1	71.1	0.0
David Low Way (west of Sunshine Motorway, east of Finland Road)	68.2	68.3	0.1	69.8	69.9	0.1
Finland Road [1]	45.4	71.3	>2	45.4	45.4	0.0
(west of Finland Road)	68.2	68.2	0.0	69.8	69.9	0.1

Note: 1. Calculated noise levels are for traffic generated on Finland Road. The proximity to the Sunshine Motorway means that far greater noise levels would be expected in the absence of the Project. Nonetheless noise levels with the Project would be negligibly or only slightly increased by the addition of traffic noise from the Sunshine Motorway. In this regard the noise level predictions appropriately describe the impact of the Project.

15.10 IMPACT SIGNIFICANCE ASSESSMENT

This section presents an assessment of the potential impacts identified in this chapter (refer **Table 15.10a** and **Table 15.10b**.

Table 15.10a: Impact significance criteria adopted in this chapter

Impact significance / consequence	Description of significance
Very high	The impact is considered critical to the decision-making process. Impacts tend to be permanent or irreversible or otherwise long term and can occur over large scale areas. Very high sensitivity of environmental receptors to impact (e.g. significant direct risk to receptors health or property – i.e. regular noise events approaching or exceeding hearing loss thresholds).
High	The impact is considered likely to be important to decision-making Impacts tend to be permanent or irreversible or otherwise long to medium term. Impacts can occur over large or medium scale areas High to moderate sensitivity of environmental receptors to impact (e.g. moderate direct risk to receptors health and/or significant indirect risk to receptors health or well being – i.e. regular noise events that would cause significant annoyance and could not be readily mitigated by the receptor by closing windows etc.)
Moderate	The effects of the impact are relevant to decision-making including the development of environmental mitigation measures Impacts can range from long term to short term in duration Impacts can occur over medium scale areas or otherwise represents a significant impact at the local scale Moderate sensitivity of environmental receptors to impact (e.g. negligible direct risk to receptors health and/or moderate indirect risk to receptors health or well being – i.e. regular noise events that would cause moderate annoyance and could be readily mitigated by the receptor by closing windows etc. to achieve only minor annoyance.)
Minor	Impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision making process. Nevertheless, they are relevant in the consideration of standard mitigation measures. Impacts tend to be short term or temporary and/or occur at local scale. (e.g. regular noise events that would cause minor annoyance)
Negligible	Minimal change to the existing situation. This could include for example impacts which are beneath levels of detection, impacts that are within the normal bounds of variation or impacts that are within the margin of forecasting error.

15.11 CONCLUSIONS

An assessment of changes to terrestrial (on-ground) noise as a consequence of the Project has been undertaken. The following have been considered:

- Ground running of aircraft (engine testing etc.)
- Aircraft whilst stationary at the terminal (i.e. whilst emissions are dominated by the aircraft's APU
- Helicopter engine run-up/run-down and low-level hover training
- General plant noise from the terminal and other facilities within the airport
- Traffic noise on the public road network from the operation of SCA
- Noise generated during the construction of the Project
- Traffic noise on the public road network during the construction of the Project.

Assessment was undertaken with regard to the following publications relevant to the Project:

- *Environmental Protection Act 1994*
- *Queensland Environmental Protection (Noise) Policy 2008*
- Queensland Government Department of Environment and Heritage Protection's guideline *Planning for Noise Control.*

Table 15.10b: Impact significance assessment

		Significance of impact				Significance of impact (with mitigation)		
Element	**Impact description**	**Significance assessment**	**Likelihood**	**Risk rating**	**Additional mitigation measures**	**Significance assessment**	**Likelihood**	**Risk rating**
Daytime construction noise	Excessive environmental noise has been shown to cause annoyance. Construction noise is by nature temporary is generally tolerated at higher noise levels than permanent noise sources.	Minor	Likely	Medium	Undertake noisy activities within standard construction hours wherever possible	Minor	Possible	Low
Evening construction noise	Excessive environmental noise has been shown to cause annoyance. Receptors are generally more sensitive to noise during the evening.	Minor	Likely	Medium	Undertake only necessary works outside standard construction hours and incorporate mitigation that has been identified in this assessment	Minor	Unlikely	Low
Night time construction noise	Excessive environmental noise has been shown to cause annoyance and excessive night time noise can cause sleep disturbance. Receptors are generally more sensitive to noise during the evening.	Moderate	Likely	Medium	Undertake only necessary works outside standard construction hours and incorporate mitigation that has been identified in this assessment	Moderate	Unlikely	Low
Ground running of aircraft	Excessive environmental noise has been shown to cause annoyance.	Minor	Unlikely	Low	None	Minor	Unlikely	Low
Mechanical plant noise	Excessive environmental noise has been shown to cause annoyance.	Negligible	Unlikely	Negligible	None	Negligible	Unlikely	Negligible
Construction vibration causing annoyance	Excessive vibration has been shown to cause annoyance.	Minor	Highly unlikely	Negligible	None	Minor	Highly unlikely	Negligible

		Significance of impact				Significance of impact (with mitigation)		
Element	Impact description	Significance assessment	Likelihood	Risk rating	Additional mitigation measures	Significance assessment	Likelihood	Risk rating
Construction vibration causing building damage	High level vibration (greatly exceeding the threshold of perceptibility) can cause damage to buildings and structures. This damage is usually cosmetic.	Moderate	Highly unlikely	Low	None	Moderate	Highly unlikely	Low
Construction traffic noise	Noise from construction related traffic could cause annoyance to receptors along the traffic routes.	Minor	Possible	Low	Avoid construction traffic outside standard construction hours whenever practical	Minor	Possible	Low
Operational traffic noise	Noise from traffic generated by the operation of the Project could cause annoyance to receptors along the traffic routes.	Negligible	Highly unlikely	Negligible	None	Minor	Highly unlikely	Negligible

The only criteria relating to construction noise are those contained in the Act. Due to the nature and duration of construction on the Project, noise objectives for industrial noise sources were adopted for assessment. This informs the process of applying feasible and reasonable mitigation measures to control nose emissions to within these objectives wherever possible. The approach also allows for the assessment of construction noise outside standard construction hours, by appropriately managing noise emissions during all time periods.

Noise modelling of three construction packages was undertaken. Preliminary investigations into construction noise highlighted the need for noise mitigation to be inherent in the design. The following mitigation was assumed in modelling.

- Attenuating the dredge booster pump through a variety of measures to achieve an equivalent sound power level of 106 dBA
- Constructing bunds on selected boundaries of the reclamation area.

These mitigation measures have been assumed for the purpose of this assessment only. It is necessary to afford flexibility in the mitigation measures. Ultimately mitigation measures will be determined by the successful contractor, however the objective will remain to minimise noise emissions through reasonable and feasible measures.

Noise predictions indicate that the noise goals are expected to be complied with during the majority of construction. Some small exceedances are predicted when mobile plant is concentrated in areas near to sensitive receivers.

This is typical for construction of this scale and is considered acceptable given that reasonable and feasible mitigation is incorporated in the design and impacts would be finite.

Work outside standard construction hours is expected to be limited to 24 hour operations associated with dredge pump-out and fill placement. Typically 2-3 dredge cycles will occur daily. The dredge would be at the pump-out site for 90-175 minutes during each of these cycles, with the remainder of the time spent in transit or at the sand extraction area. Outside standard construction hours the equipment would be limited to only that which is critical to the sand delivery. With the above mitigation measures incorporated, noise criteria for out of hours works associated with the sand delivery are predicted to comply with the noise goals at the majority of receivers. During the worst-case scenario a 1 dB exceedance is predicted in Keith Royal Drive. This level of exceedance is considered to be negligible.

Notwithstanding the predicted noise levels during construction being acceptable, noise management of these activities would be required, and modifications to the construction methodology would need to be implemented, where feasible and reasonable, should actual noise impacts occur.

Construction noise management measures would be required in the DMP to specifically address these areas and to nominate the physical and operational measures which will be used to minimise both the noise emission and any resultant impact. Such a plan should describe:

- Noise monitoring procedures to validate noise level predictions, and better identify the extent of any criterion exceedances
- On-site noise controls, including physical and operational controls which can feasibly be implemented
- A complaints procedure
- A community consultation process to ensure that residents are fully informed of the works being undertaken, their potential noise impacts, and the measures being taken to control them.

Noise from terrestrial sources associated with the operation of the airport is predicted to be negligibly impacted by the Project.

With respect to noise from road traffic, the Project is predicted to have negligible impact once the runway is operational. The major part of the surrounding road network is predicted to experience negligible increases in traffic noise during the construction phase, with the exception of Finland Road. Residents along Finland Road will need to be consulted with and impacts managed during peak terrestrial fill import periods. The mechanism for this should be detailed in the EMP.