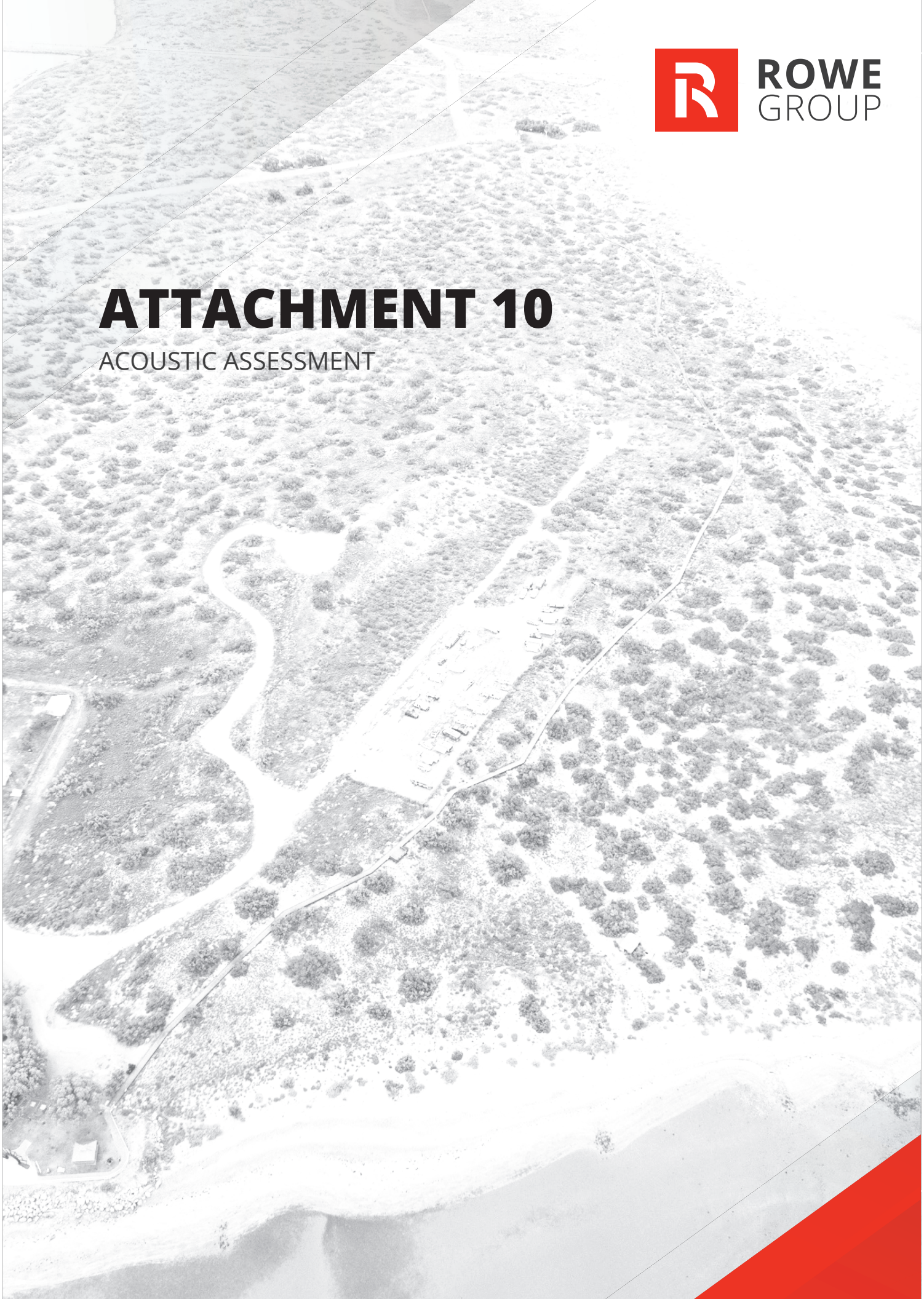
ROWE GROUP

ATTACHMENT 10

ACOUSTIC ASSESSMENT



Onslow Township Village

Acoustics Report

Development Application

Attention: Joel Fuller

Date: 25 August 2021

Prepared by: Ben Martis & Imran Khan

Ref: 301250498

Stantec Australia Pty Ltd
Ground Floor, 226 Adelaide Terrace, Perth WA 6000
Tel: +61 8 6222 7000 Web: www.stantec.com

P:\301250498\PROJECT DOCUMENTATION\ACOUSTICS\DESIGN\REPORTS\AC-RE-001-301250498_003.DOCX

Stantec

Revision

Revision	Date	Comment	Prepared By	Approved By
001	30/07/2021	Draft Acoustic DA	BEM	IK
002	05/08/2021	Acoustic DA	BEM	IK
003	25/08/2021	Updated Acoustic DA	BEM	IK

Contents

Executive Summary

Stantec has been appointed by Mineral Resources Limited (c/- Milieu Creative Design Group) to undertake acoustic assessment for the Onslow Township Village project. The project will see the development of a permanent resort style accommodation facility located in Onslow WA.

In support of the Development Application, an acoustic assessment has been carried out in order to satisfy the requirements stated in the relevant policies and guidelines applicable to the project. This includes:

- *Western Australian Environmental Protection (Noise) Regulation 1997 (EPNR);*
- *Australian and New Zealand Standard AS/NZS 2107:2016 - Acoustics – Recommended design sound levels and reverberation times for building interiors (AS 2107);*
- *National Construction Code 2016 Volume 1, Amendment 1, Building Code of Australia Class 2, 3 and 9c Buildings* (NCC 2019); and
- The project Functional Brief, Milieu Creative, *210712_ONS_Functional Brief_Rev1,* including comments from Mineral Resources Limited / Rowe Group received 15th July 2021.

This report details the relevant acoustic criteria for providing a suitable level of acoustic amenity for occupants of the proposed development, as well as for nearby receivers, including:

- Airborne sound insulation requirements for accommodation pods;
- Internal noise levels resulting from noise intrusion from mechanical services and via the façade due to external sources (including Onslow Salt noise emissions); and
- Noise emissions from the proposed development to the nearest noise sensitive receivers.

External Noise Intrusion

A noise intrusion assessment has been carried out and the minimum recommended external façade construction has been provided in the form of external glazing and wall configurations. Noise levels at the building façades were predicted, based on available data of Onlsow Salt noise emissions (TPG *Onslow Townsite Expansion Structure Plan 2016, Appendix 4 – Acoustic*).

The external facades will require the following minimum glazing configuration in order to achieve the internal noise targets stipulated in AS 2107:

- Double Glazing Unit – 6mm glass / 12mm air gap / 6mm glass.

Ambient noise levels are to be measured on the project site during design development, to confirm façade performance requirements.

Noise Emissions

Major sources of noise emissions have been identified as the tavern, restaurant, car parking, loading dock, waste collection and mechanical plant. These items (other than mechanical) have been predicted to comply with the EPNR based on predictive assessment at the DA stage, given the noise management measures provided.

Mechanical plant emissions will be assessed in detail as the design develops and information becomes available. Recommendations will be provided to ensure compliance to the EPNR where required.

1. Introduction

1.1 Overview

Stantec has been appointed by Mineral Resources Limited (c/- Milieu Creative Design Group) to undertake acoustic assessment for the Onslow Township Village project. The project will see the development of a permanent resort style accommodation facility located in Onslow WA.

This report presents the key acoustic considerations and criteria pertinent to the project. The criteria will form the basis of the acoustic design for the following areas:

- External noise impacts on the development; and
- Noise emissions from the site.

1.2 Project Location

The project site is located near Beadon Point in the township of Onslow, with residences to the south and east. The east side of Second Ave is zoned as commercial land.

Figure 1 below shows the surrounding area of the project location. Traffic and other external noise sources are expected to be minimal compared with Onslow Salt operations to the south and west of the site.

Source: NearMaps

Figure 1: Site location and surrounding area

2. Acoustic Criteria

The acoustic criteria presented in this Development Application report are derived from the following documentation;

- *Western Australian Environmental Protection (Noise) Regulation 1997 (EPNR);*
- *Australian and New Zealand Standard AS/NZS 2107:2016 - Acoustics – Recommended design sound levels and reverberation times for building interiors (AS2107);*
- *National Construction Code 2016 Volume 1, Amendment 1, Building Code of Australia Class 2, 3 and 9c Buildings (NCC 2019); and*
- The project Functional Brief, Milieu Creative, *210712_ONS_Functional Brief_Rev1,* including comments from Mineral Resources Limited / Rowe Group received 15th July 2021.

2.1 Environmental Protection (Noise) Regulation 1997

Environmental noise impacts resulting from the noise emissions from the project are addressed through the Environmental Protection Act 1986, with the regulatory requirements detailed in the Environmental Protection (Noise) Regulations 1997 (EPNR).

The EPNR establishes the maximum permissible noise emission levels (assigned levels) to be received at all adjacent noise-sensitive premises during specific periods of the day as a result of the cumulative noise emissions from all sources proposed for the project site. Compliance to relevant noise limits outlined in the EPNR is compulsory.

The EPNR states noise emissions from any premises are considered not to *significantly contribute to* the noise at a receiver if the noise emissions are 5 dB or below the assigned levels.

In brief, the assigned levels are determined by considering of the amount of commercial and industrial zones, as well as main transport corridors and sporting venues surrounding the noise sensitive premises. The assigned levels apply at premises receiving the noise (noise sensitive receiver) and not to areas within the project site or lot. In addition, the Environmental Protection (Noise) Regulations 1997 identify the following in Schedule 3, clause 2A.

"If the land within either of the circles is categorised on the land use map as land in respect of which mixed uses are permitted, the use of that land that results in the highest influencing factor is to be used in the determination of the influencing factor."

The nearest noise sensitive receivers have been considered as the residential properties along the south and east of the site, with representative addresses selected as:

- 1 First St; and
- 5 Hedditch St, Onslow WA.

For the purpose of determining the Influencing factor for these premises, the land zoning provided on the Shire of Ashburton Town Planning Scheme No. 7 plot dated 27th March 2019 has been used to ascertain land use.

Traffic data for roads surrounding the nearest noise sensitive receivers were obtained from Main Roads Western Australia (MRWA) on the 29th July 2021. It is assumed that no significant roads are present within 450m of the nearest receivers. The available traffic data for Onslow Rd, which continues into Simpson St and Second Ave, is presented in Table 1.

Table 1: Traffic count data (MRWA)

Transport Corridor	EPNR Classification [1)]	Average Daily Traffic Volumes					
		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Onslow Rd (North of Ansia Access Rd)	None	—	—	531	552	426	535

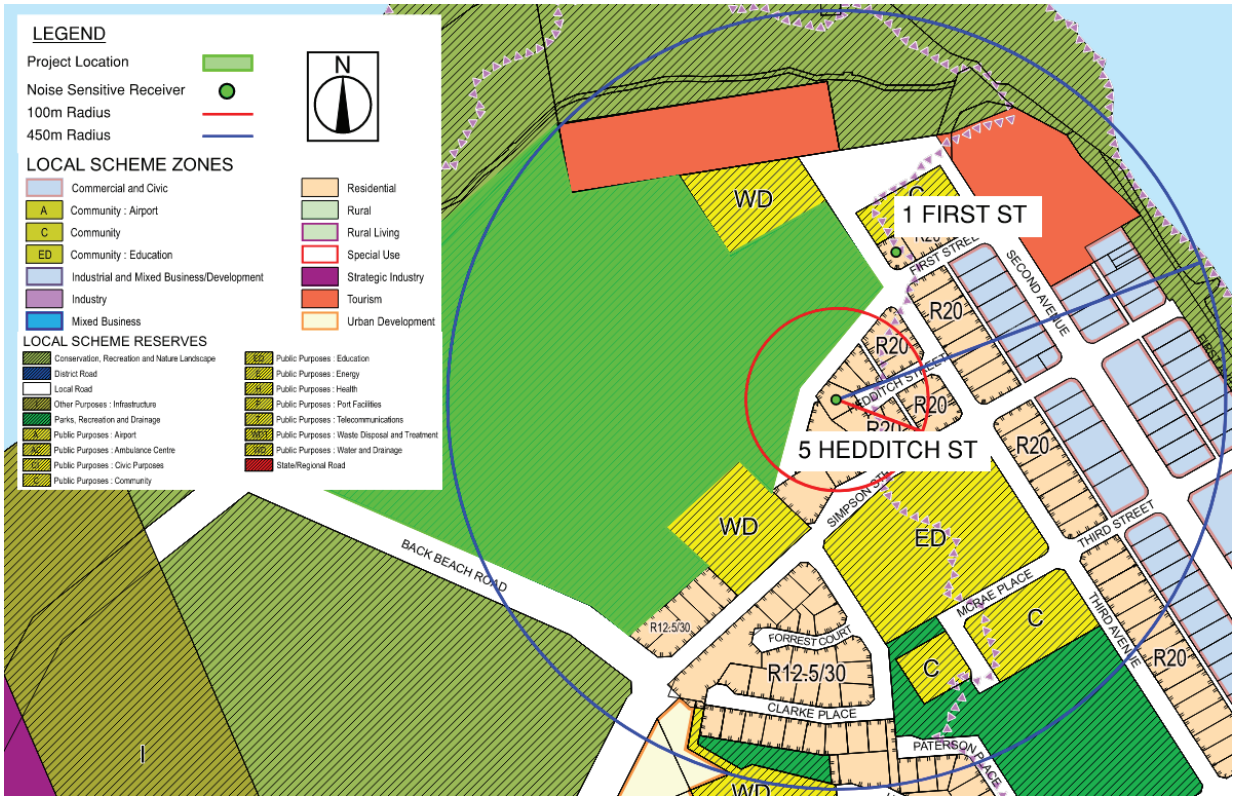
1) As defined by the EPNR. Secondary roads have between 6000-15000 vehicles per day. Major roads have greater than 15000 vehicles per day.

2.1.1 Influencing Factor

The influencing factor for the receivers identified results from identifying major roads, commercial and industrial areas for all nearest noise sensitive receivers is 0 – 1 dB, as summarised in Table 2.

Table 2: Influencing factor (IF)

Noise Sensitive Premises	Commercial Zones	Industrial Zones	Transport Corridors	Influencing Factor
1 First St	4 % within a 100 m radius 7 % within a 450 m radius	0 % within a 450 m radius	None within 450 m radius	1 dB
5 Hedditch St	0 % within a 100 m radius 7 % within a 450 m radius	0 % within a 450 m radius	None within 450 m radius	0 dB



Source: Shire of Ashburton Town Planning Scheme No. 7, Mar 2019

Figure 2: Zoning map of areas surrounding the project site

2.1.2 Assigned Noise Levels for Nearest Sensitive Receivers

Table 3 summarises the most stringent assigned levels at the nearest noise sensitive premises. It is required that all noise emissions from the development are below the assigned level for all defined periods of the day and at the lot boundary of the receiver or 15m from any associated building. It is noted that the EPNR assigned levels only apply at the premises receiving the noise only and not to noise within the site.

Table 3: Assigned levels for 5 Hedditch St

Type of premises receiving noise	Time of day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: Highly sensitive area	0700 to 1900 hours Monday to Saturday	45	55	65
	0900 to 1900 hours Sunday & public holidays	40	50	65
	1900 to 2200 hours all days	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday, and 0900 hours Sunday & public holidays	35	45	55
Noise sensitive premises: any area other than highly sensitive areas	All Hours	60	75	80
Commercial premises	All Hours	60	75	80
Industrial and utility premises	All Hours	65	80	90

2.1.3 Noise Character Adjustments

Regulation 7 states that the noise character must be "free" of annoying characteristics, namely —

- Tonality, e.g. whining, droning;
- Modulation, e.g. like a siren; and
- Impulsiveness, e.g. banging, thumping.

Regulation 9 (1) establishes the methodology for determining noise characteristics. If these characteristics cannot be reasonably and practicably removed, a series of adjustments to the measured levels are required, indicated in Table 4.

Table 4: Noise character adjustment

Adjustment where noise emission is not music these adjustments are cumulative to a maximum of 15 dB			Adjustment where noise emission is music	
Where tonality is present	Where modulation is present	Where impulsiveness is present	Where impulsiveness is not present	Where impulsiveness is present
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

2.1.4 Noise Emissions mechanical services

At this stage no information has been on mechanical equipment. Typically, projects of this type involve noise emissions from mechanical services such as air conditioning units and condensers and exhaust fans.

It is important that noise emissions from the site do not present any form of tonality, modulation or impulsiveness (as defined by the EPNR).

Given that data from mechanical plant manufacturers is generally limited to broadband data or in 1/1 octave band value, it is not possible to objectively determine tonality, as it is described in the EPNR. 1/3 octave band data is required yet is typically unavailable.

Therefore, a +5 dB correction shall be conservatively assigned when assessing noise emissions from mechanical equipment. In summary, night-time noise emissions from mechanical equipment shall comply with L_{A10} 30 dB at the nearest noise sensitive receiver (5 Hedditch St).

2.2 Internal Noise Levels and Reverberation Times

The criteria recommended in Table 5 are based on the limits presented in Australian Standard *'Acoustics – Recommended design sound levels and reverberation times for building interiors' (AS 2107:2016).* The levels stated in AS 2107:2016 apply to the combined internal noise levels from building services and external sources. The internal noise level criteria in AS2107 recommend continuous equivalent (L_{Aeq}) levels for background noise. This document is a common reference for establishing satisfactory goals for quasi-static mechanical and external noise ingress. AS2107 also provides recommended reverberation times for optimising the acoustic amenity in occupied spaces.

Table 5: Design internal noise levels and recommended reverberation time (AS2107)

Type of occupancy/activity	Recommended design sound level, L_{eq} dB(A)	Reverberation Time (Seconds)
Sleeping areas (Accommodation Pods)	30 – 35	—
Creche	40 – 45	0.4 – 0.6
Common areas (e.g. games rooms)	45 – 50	< 1.0
General office areas	40 – 45	0.4 – 0.6
Open Plan Office	40 – 45	0.4 (1)
Meeting Room (8 pax)	30 – 40	0.2 – 0.4 (Video Conferencing)
Training Rooms	30 – 40	0.2 – 0.4 (Video Conferencing)
Prayer Room, Meditation	40 – 45	< 0.6
Corridors and lobby spaces	40 – 50	< 1.0
Kitchens and service areas	45 – 55	—
Activity rooms/ Games room	45 – 50	—
Gym	< 50	< 1.0
Cafe	45 – 50	See Note 1
Restaurant	45 – 50	See Note 1
Tavern	< 50	0.6 – 1.0
Crib Room	40 – 45	0.4 – 0.6
Consult Rooms	40 – 45	0.4 – 0.6
Physio Rooms	40 – 45	0.4 – 0.6
Waiting rooms / reception areas	40 – 50	0.4 – 0.6

Note 1: Reverberation time should be minimised as far as practicable for noise control.

2.3 Sound Transmissions and Insulation — National Construction Code 2019

The acoustic requirements for inter-tenancy walls, floors etc. in residential buildings are outlined in NCC 2019. The general acoustic requirements for buildings of these classes are summarised in Table 6.

The Accommodation Pods have been considered Class 3 buildings. Building Certifier to confirm.

Table 6: Sound insulation requirements in accordance with NCC 2019

Construction	Condition	Deemed-to-Satisfy Requirements	Verification Requirements
Walls	**Airborne Sound Insulation**		
	Between sole-occupancy units	Minimum $R_w + C_{tr}$ 50	Minimum $D_{nT,w} + C_{tr}$ 45
	Between a sole-occupancy unit and a plant room, lift shaft, stairway corridor, public corridor or the like	Minimum R_w 50	Minimum $D_{nT,w}$ 45
	Impact Sound Insulation		
	Between a laundry, kitchen, bathroom or sanitary compartment in a sole-occupancy unit, and a habitable room in an adjoining unit	Discontinuous construction [1)]	As deemed to satisfy
	Between a sole-occupancy unit and a plant room or lift shaft	Discontinuous construction [1)]	As deemed to satisfy
Floors	**Airborne Sound Insulation**		
	Between sole-occupancy units and between sole occupancy unit and lift shaft, stairway or public corridor	Minimum $R_w + C_{tr}$ 50	Minimum $D_{nT,w} + C_{tr}$ 45
	Impact Sound Insulation		
	Between sole-occupancy units and between sole occupancy unit and lift shaft, stairway or public corridor	Maximum $L_{n,w}$ 62	Maximum $L_{nT,w}$ 62
Services	**Airborne Sound Insulation**		
	Between a habitable room (other than a kitchen) in a sole-occupancy unit and a duct, soil, waste or water supply pipe duct (if the duct or pipe is located in a wall or floor cavity and serves or passes through more than one sole-occupancy unit)	Minimum $R_w + C_{tr}$ 40	N/A
	Between a kitchen or non-habitable room in a sole-occupancy unit and a duct, soil, waste or water supply pipe duct (if the duct or pipe is located in a wall or floor cavity and serves or passes through more than one sole-occupancy unit	Minimum $R_w + C_{tr}$ 25	N/A
	If a storm water pipe passes through a sole-occupancy unit (habitable room other than kitchen)	Minimum $R_w + C_{tr}$ 40	N/A
	If a storm water pipe passes through a sole-occupancy unit (kitchen or non-habitable room)	Minimum $R_w + C_{tr}$ 25	N/A

1) *For the purposes of this Part, "discontinuous construction" means a wall having a minimum 20 mm cavity between two separate leaves.*

2.4 Green Building Council of Australia Green Star Rating

The Sustainability Consultant is to advise if a Green Building Council of Australia (GBCA) star rating (or equivalency) is to be targeted. If so, they should confirm the version of the GBCA submission guidelines to be used and whether any Acoustic Credits are being targeted.

Achievability of Acoustic Credits will be reviewed as the design progresses further.

2.5 Further Acoustic Considerations

Based on Stantec Acoustics discussions with the architect, the following will be factored into acoustic design of the project;

- Acoustic separation performance of party walls and bounding walls of sole occupancy units (accommodation pods) is typically addressed through NCC 2019, which provides the bare minimum requirements. Additional treatments above what is typically recommended in NCC 2019 (e.g. to achieve Green Star Acoustic Credits) could incur additional cost to the project;
- Gym floors should incorporate a floor raised by 150mm in order to accommodate a typical vibration isolating sprung floor system;
- Noise emissions from the services and plant will need consideration. At these stages of the project equipment details are typically unavailable. However, detailed reviews of mechanical plant shall be conducted during design development stages of the project.

3. Acoustic Environment

3.1 Historical Information

Understanding the existing acoustic environment of the project site is critical and based on the information available, it is apparent that the Onslow Salt operations (24hrs) drive the ambient noise levels across the township at all times of day.

At the Development Application stage, the design environmental noise levels have been predicted based on available information.

The TPG *Onslow Townsite Expansion Structure Plan 2016, Appendix 4 – Acoustic* is the report *11061853-01 Onslow Salt Draft* by Lloyd George Acoustics (LGA) dated 12th November 2011. The report includes a summary of the noise data collected by Onslow Salt over the period 2001 – 2011, stating the mean L_{A10} daytime and night-time noise levels measured at the Onslow Salt Clarke Place noise monitor during times where Onslow Salt was operational.

The reported noise levels were, to the nearest decibel:

- Daytime (0700 – 1900hr) mean L_{A10} – 54 dB(A); and
- Night-time (2200 – 0700hr) mean L_{A10} – 47 dB(A).

3.2 Design Noise Intrusion Levels

Design environmental noise levels have been selected, allowing for the predicted growth of Onslow Salt operations since 2011 and accounting for a 20-year design horizon on the project.

While no spectral content of the recorded data was made available, the frequency content has been predicted based on the weighted average of noise data provided in Table 3.2 of the LGA report.

The design environmental noise levels are provided in Table 7. The design considers daytime noise levels intruding into bedrooms, as night-shift personnel may be sleeping during the day and require adequate acoustic amenity for this.

Table 7: Design Environmental Noise Levels at the Project Site

Noise Source	L_{eq} dB(A)	1/1 Octave Band Sound Pressure Levels (dB)							
		63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**
Onslow Salt Operations (Daytime Predicted)	**60**	57	58	56	56	55	53	51	50

Ambient noise levels are to be measured on the project site during design development, to confirm façade performance requirements.

4. Noise Intrusion

Noise intrusion assessments for the proposed sensitive spaces associated with the project were conducted based on the predicted environmental noise levels. External wall and glazing have been provided according to the noise intrusion assessment results with the view of providing satisfactory internal noise levels that achieve the internal noise level criteria detailed in this report.

As the design develops, the DA stage assessment will need to be calibrated using on-site noise measurements.

Roof configuration recommendations have also been provided, based on a design rain noise rate of 15mm/hr.

Calculations were undertaken following the methodology described in British Standard BS EN 12354:2000 and by utilizing the highest predicted noise levels at each façade to determine suitable glazing to address the noise sensitive of each space. Appropriate corrections were applied to the linear spectral noise levels to compensate for potential losses due to flanking paths and façade correction.

4.1 External Envelope

4.1.1 External Walls

Based on the latest architectural layouts (received 20th August 2021), it is evident that the building envelope will consist of primarily glazed elements. The noise intrusion has been calculated for all façade elements relative to their surface area.

Where solid elements are used as the external wall, the walls are recommended to achieve $R_W + C_{tr}$ 45 as a minimum. Typically, this can be achieved with the following configuration:

- 110mm Concrete Panel; or
- Min. 250mm thick rammed earth wall (CSIRO 1987, *Bulletin No. 5 Earth-Wall Construction*).

Alternative construction material may be used to achieve the required performance. This will, however, require review and approval of the Acoustic Engineer.

Where lightweight construction is proposed, this will result in reduced acoustic performance, specifically in the lower frequencies. The following configuration ($R_W + C_{tr}$ 36) is recommended as a minimum for lightweight external walls:

- Colorbond 0.55mm or sheet steel equivalent;
- 150mm steel stud;
- 90mm glass wool insulation (density 14 kg/m^3) within the stud cavity; and
- 2 layers of 13mm standard plasterboard to the internal face.

Alternatively, where 9mm fibre cement sheet is used as the external face, 1 layer of 13mm standard plasterboard may be used for the internal face.

4.1.2 External Glazing

Glazing configurations to achieve the required internal noise levels have been provided, taking into consideration the predicted external noise levels. This configuration is to achieve acceptable internal noise levels considering the existing acoustic environment. Assessment of glazing configuration to mitigate noise intrusion from other sources (e.g. mechanical services) will be undertaken as the design progresses.

To ensure compliance to the recommended internal noise levels specified in Table 5, the treatments as detailed in Table 8 shall be applied. It is assumed that double glazed systems are required to achieve the project thermal performance criteria.

Table 8: External Glazing Recommendations

Glazing Configuration	$R_w + C_{tr}$	Spectrum Sound Transmission Loss (dB)						
		63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2kHz	4k Hz
6mm glass + 12mm air gap + 6mm glass	**30 (35, -5)**	23	25	21	35	41	37	39

Note: Glazing performance provided for glass only. Overall performance of the glazing system including the frames and seals shall not degrade by more than 3 dB as per the performance requirement stated.

4.1.3 Roof Construction

Whilst it is not a mandatory requirement of the NCC, rain noise intrusion shall be considered with a view of ensuring an adequate level of amenity for occupants. Additionally, roof construction should be adequately designed to control external noise intrusion from noise sources identified in this report. 150mm thick concrete is generally adequate for this.

It is strongly recommended to use a concrete base for any roof mounted plant to prevent mechanical services noise intrusion.

Where a lightweight roof is used (e.g. Accommodation Pods), the following construction is generally adequate to fulfil the rain noise requirements.

One layer of Colorbond sheet metal or similar (0.55 mm); and

- 75 mm thick high-density Anticon insulation hard-fixed to the underside of roof and over steel purlins;
- Minimum ceiling cavity to be 300mm;
- Suspended ceiling system; and
- Min. 50 mm thick glass wool insulation (min. 14kg/m^3) over one layer of 13 mm standard plasterboard.

5. Noise Emissions

5.1 Overview of Assessment

Noise emissions from all possible noise emitting sources proposed redevelopment are required to comply with the *Environmental Protection (Noise) Regulations 1997* (EPNR).

The following noise sources have been identified based on proposed architectural layouts;

- Tavern and Restaurant (patrons and music emissions, particularly in alfresco areas);
- Car parking (vehicle movements, audible reversing beacons and closing of doors)
- Loading dock and service vehicle deliveries;
- Waste and recycling collection and disposal;
- Children playing at the creche; and
- Mechanical plant serving the site.

To determine compliance to the assigned level criteria detailed by the EPNR (refer to Section 2.1 of this report), acoustic assessments of the above sources were undertaken, based on details provided by the design team and current architectural package (received 20th August 2021).

Noise emissions assessments have been undertaken using current noise modelling software (SoundPLAN v8.2). Design advice and recommendations have been detailed to ensure predicted compliance to the EPNR. Noise contours are presented in Appendix B.

Mechanical plant details have not been provided at this stage and will be included in the acoustic assessment once available. Appropriate treatments to ensure compliance with the EPNR (e.g. solid barriers, acoustic cowlings/louvres, low noise fans) will be recommended if required.

5.2 Noise Model Inputs

5.2.1 Topography

The topographical data for the project site and surrounding areas was sourced from Geoscience Australia 2011*, 1 Second SRTM Derived Digital Elevation Model (DEM)*.

5.2.2 Ground Absorption

A ground condition of 0 refers to flat non-porous surfaces that are highly reflective to noise and a ground condition of 1 refers to highly absorptive.

A ground factor of 0.6 was assumed in the model to account for attenuation due to ground absorption with relatively sparse vegetation cover. A ground factor of 0 (fully reflective) was used over water.

5.2.3 Meteorological Conditions

The CONCAWE algorithm has been selected for meteorological conditions, as presented Table 9, and have been factored into the model in consideration of the worst case environmental conditions for propagation of noise.

Table 9: Meteorological Conditions Incorporated into the Noise Model

Parameter	Day (0700 – 1900)	Evening / Night (1900 – 0700)
Temperature	20	15
Humidity	50	50

Parameter	Day (0700 – 1900)	Evening / Night (1900 – 0700)
Wind Speed (m/s)	4	3
Wind Direction	All	All
Pasquill Stability Class	E	F

5.3 Tavern and Restaurant Noise Emissions

The Tavern and Restaurant are located nearest to Beadon point, approximately 100m away from the nearest accommodation pod and 250m away from external noise sensitive receivers. The restaurant and tavern are designed to accommodate many patrons, both having large alfresco areas.

5.3.1 Operating Hours

The anticipated operating hours of the tavern and restaurant have been advised to be:

- Tavern – 6-9 AM and 5-9 PM;
- Restaurant – 4-8 AM and 4-8 PM.

These operating periods cater for shift workers and cover all assessment periods of the EPNR.

5.3.2 Sound Power Levels

The technical research paper '*Prediction of Noise from Small to Medium Sized Crowds'* (Hayne et al., November 2011), was used to estimate patron noise levels. L_{10} patron Sound Power Levels are approximated by the formula *15.Log(N)+67*, where N is the number of patrons.

Patron noise levels used in the noise emissions assessment have considered the following:

- Sound level associated with speech from a 50% mixture of male and female patrons;
- Corrections for elevated patron noise in the tavern, due to the consumption of alcohol (+3 dB); and
- Even distribution of patrons around the outdoor areas.

It is assumed that music will be set at an ambient or "conversational" level for the majority of the time. However, occasional live music acts are expected to perform at the venue. As such, low frequency attenuation becomes increasingly pertinent when proposing treatments for music as a source of noise compared with crowd noise at a numerically equivalent sound power level. L_{10} spectral noise data for music was sourced from measured levels on similar Stantec projects. The design does not allow for the use of sub-woofers with high low-frequency output.

An acoustic assessment was conducted for patrons and music within the tavern and restaurant alfresco areas. Noise from the alfresco areas is assumed to dominate emissions, as the architectural drawings show the indoor seating areas as being fully enclosed, with emissions thereby attenuated by the building facades (performance specified in Section 4.1). Noise management measures have been proposed to achieve compliance to external noise levels as per the EPNR.

Patron and music noise inputs to the noise model are presented in Table 10.

Table 10: Patron and Music Sound Power Levels – Tavern and Restaurant Alfresco Areas

Time of Day	Number of Patrons in Alfresco Areas	Patron SWL, dB(A)	Music SWL [(1)], dB(A)
0700 to 1900 hours Monday to Saturday;	Tavern: 80 Patrons	99	85

Time of Day	Number of Patrons in Alfresco Areas	Patron SWL, dB(A)	Music SWL [1], dB(A)
0900 to 1900 hours Sunday and Public Holidays; and 1900 to 2200 hours all days.	Restaurant: 80 Patrons	96	85
2200 hours on any day to 0700 hours Monday to Saturday; and	Tavern: 60 Patrons	97	85
0900 hours Sunday & public holidays	Restaurant: 80 Patrons	96	85

Note 1: Music levels were set for each scenario such that they would not become audible over patron noise and attract adjustments to the received level per the EPNR criteria. Refer to Section 5.3.4 for noise management measures required.

5.3.3 Results

Patron and music noise prediction results are presented in Table 11. Compliance to the EPNR is predicted at all times of day for residences around the project site, provided the management measures in Section 5.3.4 are adhered to. Noise contours are presented in Appendix B.

Noise levels at the Accommodation Pods are predicted to be up to 56 dB(A) externally, below the design level of 60 dB(A).

Table 11: Tavern and Restaurant Noise Emissions at External Receivers

Time of Day	Most Stringent EPNR L_{A10}	1 First St	2 Second Ave	9 Third Ave	1 Hedditch St	3 Back Beach Rd	29 Simpson St	Complies ? (Y/N)
0700-1900 hr Mon-Sat; 0900-1900 hr Sun & Pub Hol; and 1900-2200 hr all days.	**40 dB(A)**	34	23	36	26	36	34	**YES**
2200 hr on any day to 0700 hours Mon to Sat; and to 0900 hr Sun & Pub Hol	**35 dB(A)**	32	21	34	25	35	33	**YES**

Note: Music levels were set for each scenario such that they would not become audible over patron noise and attract adjustments to the received level per the EPNR criteria.

5.3.4 Noise Management

The tavern and restaurant amplifier systems should have known output sound levels via the controls to assist in ensuring music from the venue is inaudible at the receivers. When music becomes audible at the receiver, adjustments of 10 – 15 dB are required per the EPNR, introducing a non-compliance. Music levels should be set based on field measurements to the south and east so as not to be audible at nearby receivers and attract adjustments for music as per the EPNR. It is not recommended for external parties to bring their own speaker systems to the venue nor that music is played in the outdoor areas above what may be considered an “ambient” level (e.g. patrons remain able to converse

without raising their voices). Noise emissions from the venue should be addressed in the venue operations noise management plan.

The following is recommended for any amplifier / PA system used in the tavern and restaurant:

- Music must not become audible at nearby receivers. Note that where the noise received at a premises is music, adjustments to the received level are required when assessing compliance to the EPNR. Should music become audible and dominant, adjustments of +10 to 15 dB are required. This would likely result in non-compliance to the EPNR;
- It is critical that any music from the venue be level calibrated to a level where it is inaudible at the receiving premises and no higher than the Sound Power Levels advised in Table 10. The system should have known output sound levels indicated on the controls to assist in ensuring the amplified sound is kept within acceptable limits at nearby receivers. The limits should be set based on field measurements at nearby sensitive premises;
- The system should incorporate a frequency equalizer that is saet to control low frequency sound (bass);
- The noise from the system (within the building and/or in alfresco areas) is to be calibrated by field measurements, limited so as not to exceed the set levels and made tamper proof; and
- Allowable music noise levels for indoor speakers within the building will be dependent on design of the external facades, which will be developed during further stages of design. Further management measures such as closing all external doors and windows may be required to achieve the desired noise levels.

Given the movement of patrons between indoor and outdoor areas, noise emissions from the venue should be managed, ensuring that they do not become a dominant source of noise at the site boundaries at any time.

In addition, the following administrative controls are recommended:

- The venue amplifier / PA system should be locked away, accessible by management only; and
- Venue staff are to monitor dispersal of patrons after closing and manage any noise issues arising.

5.4 Car Park Noise Emissions

Noise emissions from vehicle movements associated with car parks are formed by a combination of successive noise events. The complexity of these noise events can be difficult to accurately simulate as individual noise sources (i.e. vehicle parking bay turnover rates, location of noise event due such as motion (acceleration, deceleration), idling points, ignition, door slams etc.).

At the time of writing this report, information car park peak turnover and expected traffic movements has not been made available. Worst-case assumptions have been made for the purpose of predicting noise emissions at the DA stage.

The following assumptions were made regarding vehicle movements;

- Car parking areas on the project site were identified from the architectural drawings. Road surface of the carparks was assumed to be “asphaltic driving lanes” (i.e. sealed car parks);
- The night-time period of the EPNR was considered for assessment, with the majority of dayshift workers predicted to leave the camp prior to 7 AM on any day, with night-shift workers also returning to camp prior to this time after a shift;
- Worst-case vehicle movements per hour were estimated to be 200. Carpark movement noise emissions are considered to be dominant over the noise of passenger vehicles on the access road and will be assessable against the EPNR L_{A10} criterion;
- Up to four audible reversing beacons may be sounding concurrently at any one time, however this will occur less than 10% of the time and will be assessable against the EPNR L_{A1} criterion; and

- Car door slamming represents the worst-case maximum noise level at the external receivers and is assessable against the EPNR L_{Amax} criterion.

5.4.1 Sound Power Levels

For a thorough assessment of car park noise emissions, reference has been made to the technical research paper *"Prediction of parking area noise in Australian conditions"* from the Australian Acoustical Society Conference (Nicol and Johnson, 2011) and parking lot study *"Parking Area Noise – Recommendations for the Calculation of Sound Emissions of Parking Areas, Motorcar Centers and Bus Stations as well as of Multi-Storey Car Parks and Underground Car Parks"* (Bavarian Landesamt für Umwelt, 2007, 6th edn), referred to as BayLfU 2007.

The BayLfU formula for car park noise was used (SWL 63 dBA per movement), being adjusted for Australian conditions (+1 dB correction, Nicol and Johnson 2011) and for the L_{A10} statistical SWL parameter (+2 dB correction, Nicol and Johnson 2011). Correction for non-sealed surfaces or car park areas were not applied. The noise source was modelled as an area source in SoundPLAN at a height of 1.5m above ground level.

In addition, maximum levels resulting from car/truck doors slamming were modelled and assessed against the EPNR L_{Amax} criterion. The Sound Power Level was based on the average maximum noise level of car/truck door shutting according to BayLfU 2007, Table 19.

Noise source Sound Power Levels and their relevant assessment criteria are presented in Table 12.

Table 12: Car Parking Activities Sound Power Levels and Assessment Criteria

EPNR Criteria Applicable	Noise Sources	Sound Power Level, dB(A)
L_{A10}	Car parking maneuvers – Peak (200 movements)	89 [1]
L_{A1}	Reversing Beacons, 4 off	101 [2] (95 per unit)
L_{Amax}	Car/truck Door Closing, Maximum Level	100 [3]

Note 1: Based on BayLfU 2007, adjustments per Nicol and Johnson 2011.
Note 2: Based on WA Noise Regulation Branch, Department of Environment and Conservation 2012: Which is Safer - Tonal or Broadband Reversing Alarms? Adjusted to Sound Power Level.
Note 3: Based on BayLfU 2007 Table 19, adjusted to Sound Power Level.

5.4.2 Results

Results of the assessments are shown in Table 13 below, with each scenario assessed against a different statistical parameter. As these are the worst-case results, compliance is inferred for all nearby sensitive receivers. Noise contours are presented in Appendix B.

Table 13: Car Parking Assessment Results

Assessment Scenario	Assigned Level – Night, dB(A)	Highest Received Noise Level, at Receiver	Complies? (Y/N)
L_{A10}	35	34 dB(A) – 10 Third Ave	**YES**
L_{A1}	45	45 dB(A) – 10 Third Ave	**YES**
L_{Amax}	55	47 dB(A) – 5B First St	**YES**

5.4.3 Management Measures

The following management measures are recommended:

- Vehicles using the site carpark should be fitted with broadband type reversing alarms (referred to as "quackers" or croakers") as opposed to "beepers". This is especially critical where reverse parking is mandated by the Client.

Tonality at the receiver locations would attract a +5 dB adjustment per the EPNR and may result in non-compliance;

- Personnel may be notified in the site induction to arrive and leave the carpark in an orderly fashion, to minimise noise (e.g. no slamming of doors) so as not to disrupt their colleagues or the community.

5.5 Loading Dock and Waste Collection

Loading of goods is assumed to be from the Restaurant/Tavern loading dock area, which is located approx. 125m from the nearest accommodation pod and 250m from the nearest external receiver. The primary bin stores for waste collection are at the tavern/restaurant bin store and the maintenance shed bin store near the site entry point. Given the ambient noise levels due to continuous Onslow Salt operations, waste collection and loading dock operations are not expected to cause a significant loss of amenity.

5.5.1 Loading Dock

At the time of writing this report, information regarding delivery schedules and anticipated truck sizes has not been made available. Worst-case assumptions have been made for the purpose of predicting emissions at DA stage.

Noise emissions from loading docks are required to be compliant to the assigned levels outlined in the EPNR. Assessment of each noise source against the EPNR criteria (L_{A10}, L_{A1}, or L_{Amax}) is proportional to the period of the day, and the combined frequency and duration of each noise event.

Noise emissions which are likely to be present for ≥ 10% of the "representative assessment period" (24 minutes in 4 hours) are to be assessed against the L_{A10} criteria. Typically, a single truck is considered present for less than 10 % of a representative measurement period, and therefore, assessment is conducted against the L_{A1} criteria. However, the cumulative number of trucks in a "representative assessment period" may result in assessment against the L_{A10} criteria. Therefore, L_{A10} criteria has been used as a worst-case scenario.

To objectively assess truck movements and additional loading dock operations, Sound Power Levels of typical activities obtained from previous Stantec measurements have been used as model inputs. The noise sources modelled are provided in Table 14. The sources considered represent worst-case concurrent loading dock activities.

Table 14: Sound Power Levels – Loading Dock Activities

Noise Sources [1]	Sound Power Level, dB(A)
19m Semi-articulated truck driving and reversing	102
19m Truck unloading activities (i.e. forklifts, pallet trucks etc.)	95

NOTE 1: The combined spectrum has been corrected based measurement conditions (i.e. distance, proximity to reflective surfaces etc.)

Prediction results are presented in Table 15. Compliance to the EPNR, based on the assumption that the loading dock will be used between 0700 – 1900 hours Monday to Saturday only. Noise contours are presented in Appendix B.

Noise levels at the Accommodation Pods are predicted to be up to 49 dB(A) externally, below the design level of 60 dB(A).

Table 15: Loading Dock Noise Emissions at External Receivers

Time of Day	Most Stringent EPNR L_{A10}	1 First St	2 Second Ave	9 Third Ave	1 Hedditch St	3 Back Beach Rd	29 Simpson St	Complies? (Y/N)
0700-1900 hr Mon-Sat	**45 dB(A)**	42	35	42	38	37	35	**YES**

5.5.2 Waste Collection

Under the EPNR Regulation 14A, the assigned noise levels of Regulation 7 do not apply to waste collection (both domestic and commercial sources), provided:

- The works are carried out in the quietest reasonable and practicable manner;
- The equipment used to carry out the works is the quietest reasonable available; and
- In the case where a noise management plan is required (e.g. works are to occur outside of 0700 – 1900 hours Monday through Saturday or 0900 – 1900 hours Sundays and public holidays), the plan is submitted and approved, with works carried out according to the plan.

However, assessment of predicted noise emissions due to waste collection has been carried out as a due diligence. The Waste Consultant has indicated that rear-lift and flat-bed trucks will be used for refuse and recycling collection. Waste will be collected daily, with recycling collected fortnightly. It is assumed that there is no waste compaction or recyclables processing is conducted on site.

Sound Power Levels of typical activities obtained from previous Stantec measurements have been used as model inputs. The noise sources modelled are provided in Table 14. The sources considered represent worst-case concurrent waste collection activities.

Table 16: Sound Power Levels – Waste Collection

Noise Sources [1]	Sound Power Level, dB(A)
12.5m rigid truck driving and reversing	99
Glass bottles being individually dumped into 240L bins [2]	91

Note 1: The combined spectrum has been corrected based measurement conditions (i.e. distance, proximity to reflective surfaces etc.)
Note 2: Based on European Directive 2000/14/EC and European Commission DG Growth: Equipment Noise by Type, 22 – Glass Recycling Containers, Measured Sound Power Levels.

Prediction results are presented in Table 17. Noise contours for collection from the restaurant/tavern bin store as well as the maintenance shed bin store are presented in Appendix B.

Compliance to the EPNR is predicted, with the recommendation that waste collection occur between 0700 – 1900 hours Monday to Saturday only. Generally, local councils cannot confirm collection times for waste collections, however they endeavour to conduct waste collection during the hours 0700 – 1900 hr Monday to Saturday in accordance with the WA Department of Environmental Regulation's Draft Guide to Management of Noise from Waste Collection and Other Works (December 2014).

Noise levels at the Accommodation Pods are predicted to be up to 46 dB(A) externally, below the design level of 60 dB(A).

Table 17: Waste Collection Noise Emissions at External Receivers

Time of Day	Most Stringent EPNR L_{A10}	1 First St	2 Second Ave	9 Third Ave	1 Hedditch St	3 Back Beach Rd	29 Simpson St	Complies? (Y/N)
0700-1900 hr Mon-Sat	**45 dB(A)**	38	31	38	35	32	30	**YES**

The following administrative measures are recommended:

- Where possible, in communication with the Shire, endeavor to have waste and recycling collected after 7 am, as this is the 'daytime' period of the EPNR and may be less of a disruption;
- An effort should be made to avoid the waste collection and recycling trucks being on site at the same time;

- If a truck is waiting in the carpark for bin access, the engine should be switched off; and
- Glass recycling trucks should not crush the bottles on premises but rather at a less noise sensitive location.

The emptying of bins, especially when filled with glass bottles, can be an occupational peak noise hazard to the operator, as well as significant source of environmental noise. The follow administrative measures are recommended:

- Venue staff should take care to reduce the drop height of glass onto glass when filling bins; and
- The handling of bins full of glass bottles should occur during daytime hours where possible to minimise disruption to the community.

5.6 Child Noise Emissions

Noise from children playing in the Creche could potentially be disruptive to nearby sensitive receivers.

The '*Guideline for Child Care Acoustic Assessment*' (Association of Australian Acoustical Consultants, 2013) provides an estimate of child Sound Power Levels. A group of 25 children playing in the outdoor area, of mixed ages from 0 – 6 years, would have a Sound Power Level of approximately 90 dBA.

As the nearest external receivers are 170m away, noise emissions are expected to comply with the EPNR.

The noise level at the nearest accommodation pods (approx. 25m) would be at least 6 dB below the predicted Onslow Salt emissions and would therefore not be considered a significant contributor.

5.7 Mechanical Services Noise Emissions

Noise generated via the mechanical services from the proposed development is required to comply with the EPNR criteria at all nearest sensitive receivers. Once details of equipment are available, appropriate recommendations will be provided as required to comply with the EPNR at all times of day.

The design should ensure that mechanical plant selected for the development is the quietest possible, is located away from noise sensitive premises and shielded and/or attenuated as required to meet the assigned levels of the EPNR.

The following equipment is likely to be included on the project site and will require acoustic review as the design develops:

- Accommodation pod and communal building condenser units and extraction fans;
- Hot water system heat pumps;
- Tavern and Restaurant cool room/ freezer room refrigeration condensers (24-hour operation);
- Tavern and Restaurant kitchen extract fans;
- Pool plant;
- Potential for recycling plant or box crushers;
- Potential for a water treatment plant (containerised);
- Potential for an on-site back-up generator (containerised); and
- Fire pumps.

Any equipment located outside an enclosed building should be of the quietest model practically available. Equipment selections shall be submitted to acoustic engineer prior to installation.

Containerised plant shall have acoustically rated enclosures and mufflers as required to ensure acceptable noise levels within the project site.

6. Conclusion

Stantec were engaged by Mineral Resources Limited (c/- Milieu Creative Design Group) to conduct acoustic assessment for the Onslow Township Village in Onslow WA.

Acoustic criteria were established based on the requirements outlined in the Regulations, Australian Standards and the Functional Brief.

Predictive noise assessment and noise management recommendations to support the Development Application have been provided, with the aim of ensuring an appropriate level of acoustic amenity for future occupants.

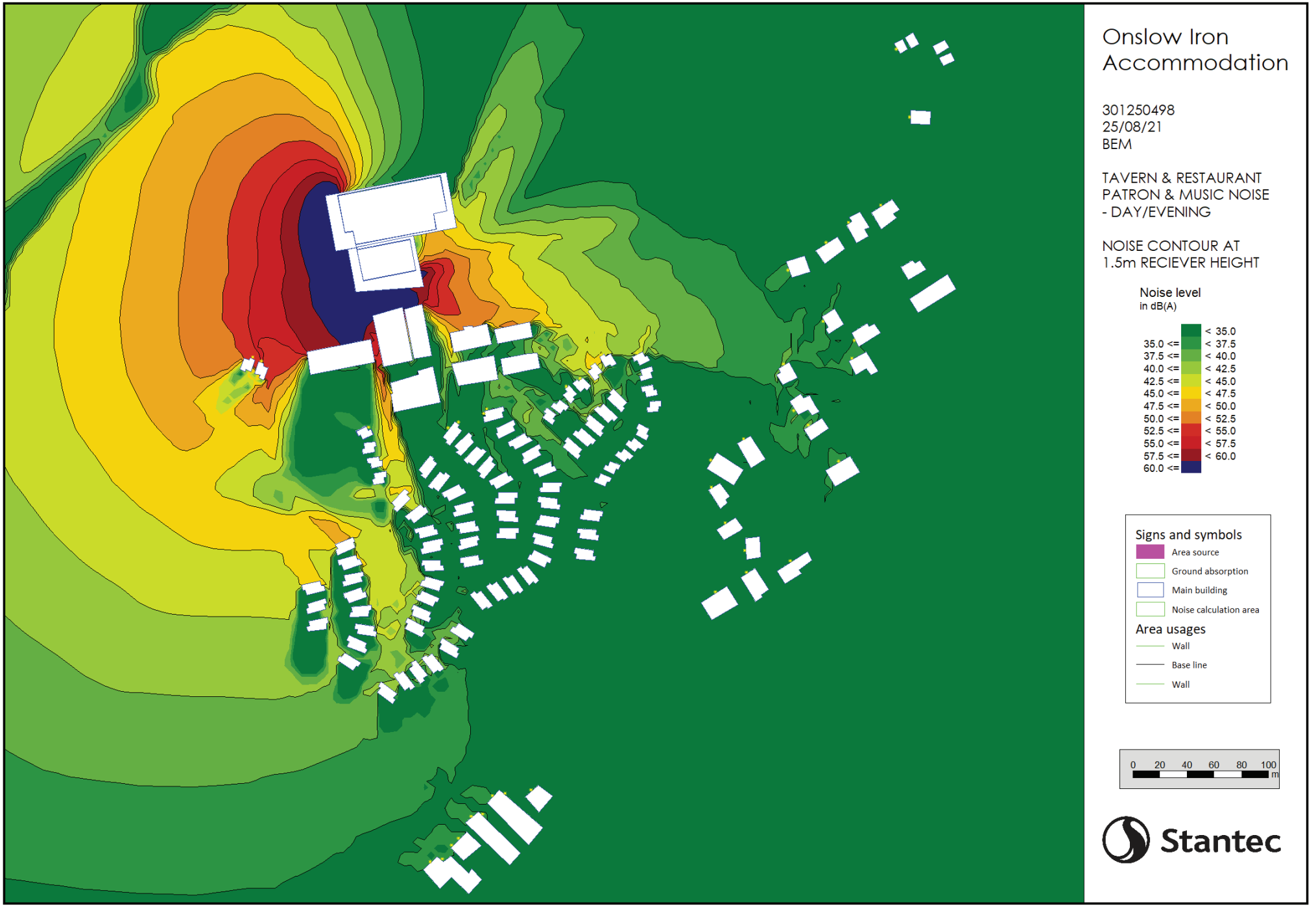
A review of the mechanical services plant will be undertaken as the design develops, with recommendations provided as necessary to satisfy the design criteria.

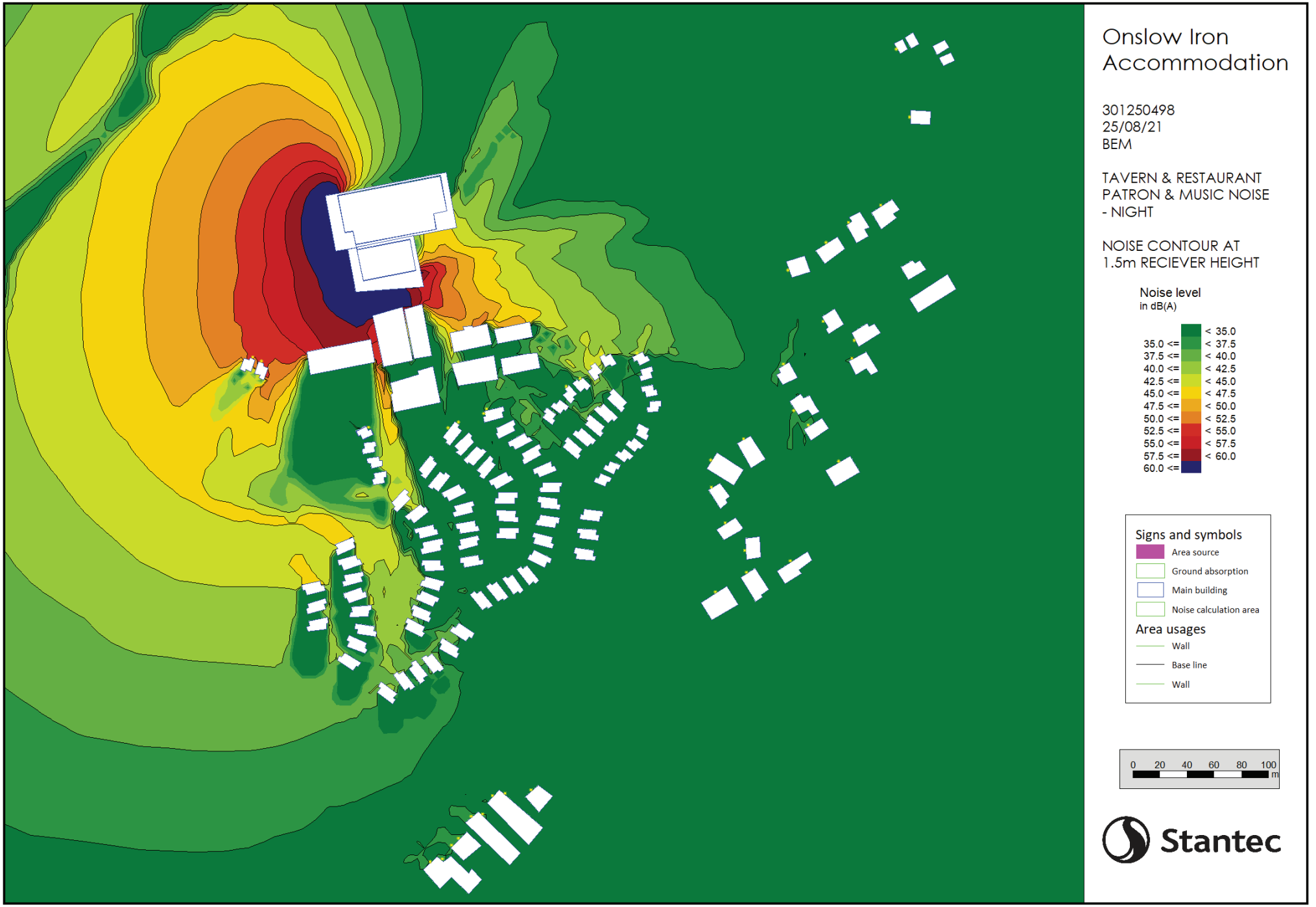
Appendix A Glossary of Acoustic Terms

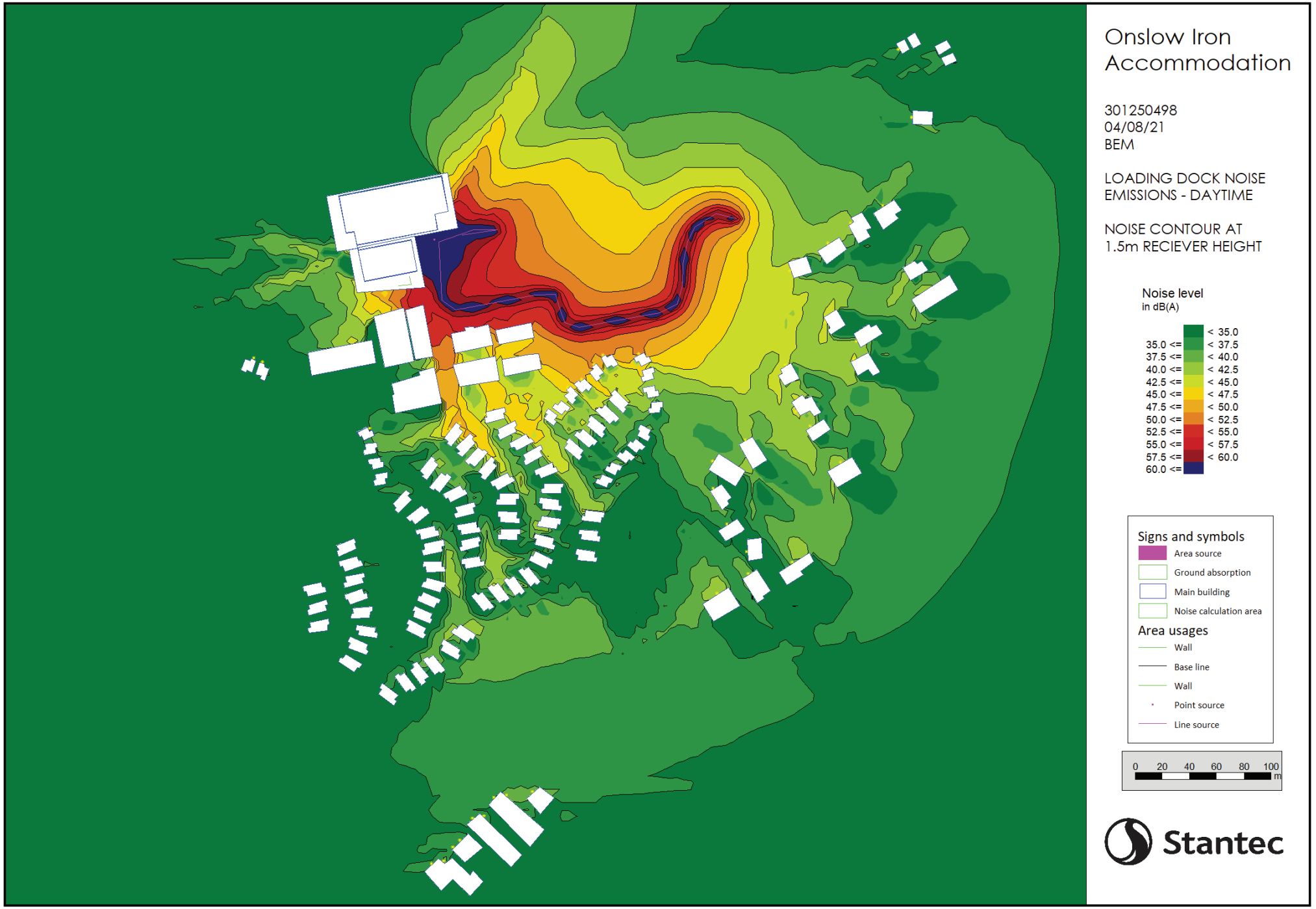
NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
LAmax	The maximum A-weighted sound pressure level measured over a period.
LAmin	The minimum A-weighted sound pressure level measured over a period.
LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.

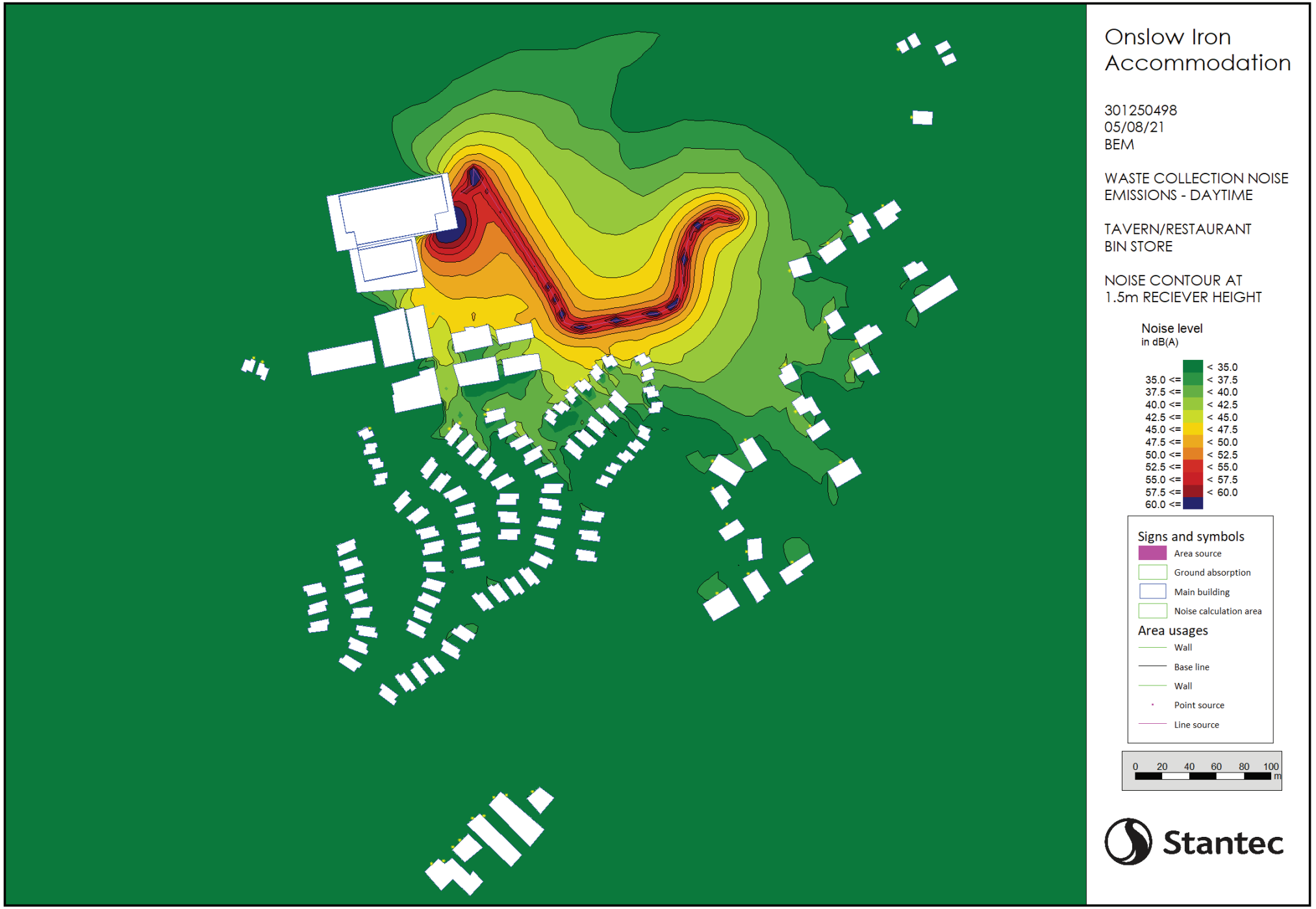
LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

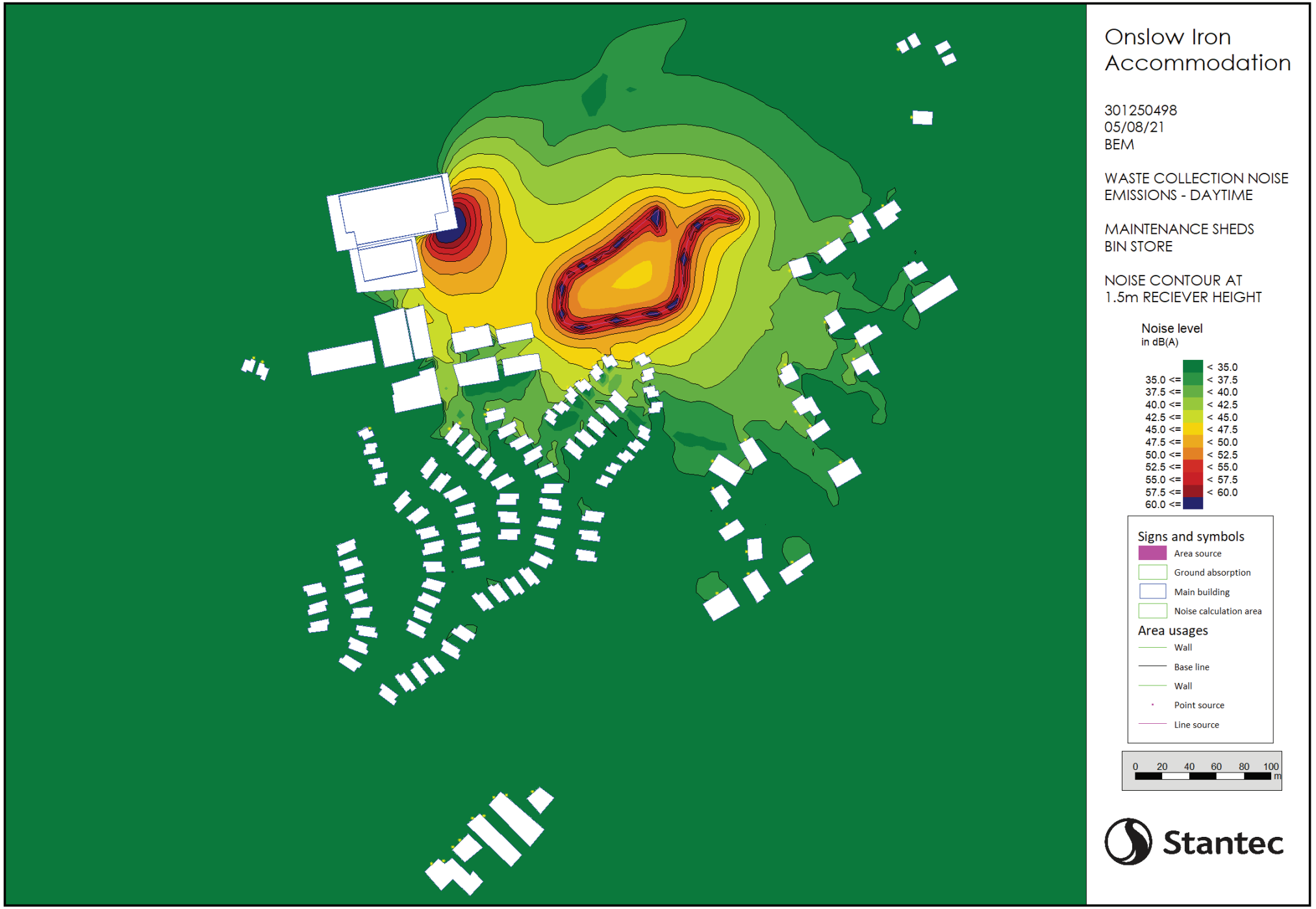
Appendix B Noise Contour Maps

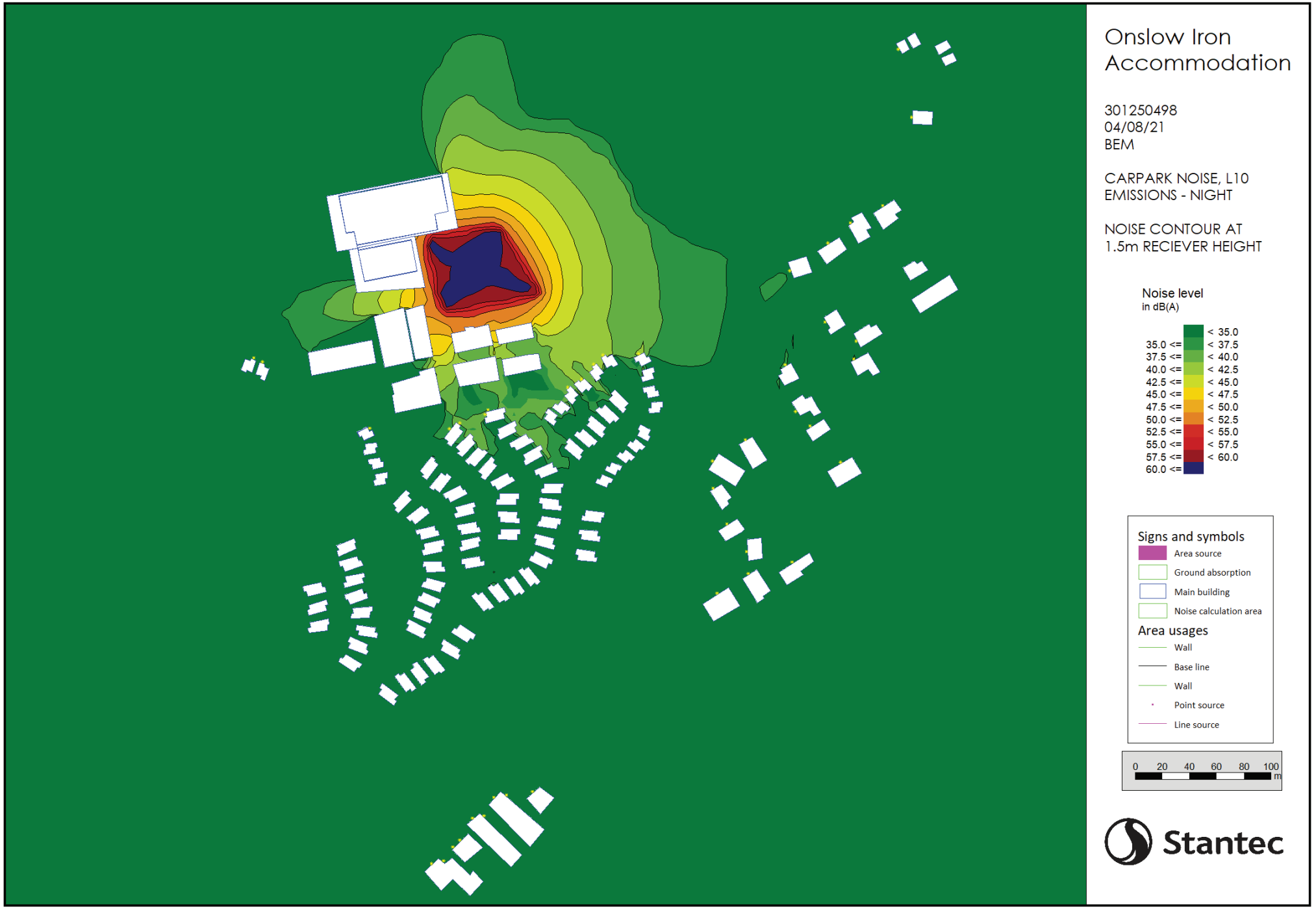

Onslow Iron
Accommodation
301250498
25/08/21
BEM
TAVERN & RESTAURANT
PATRON & MUSIC NOISE
- DAY/EVENING
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
0 20 40 60 80 100
m
Stantec

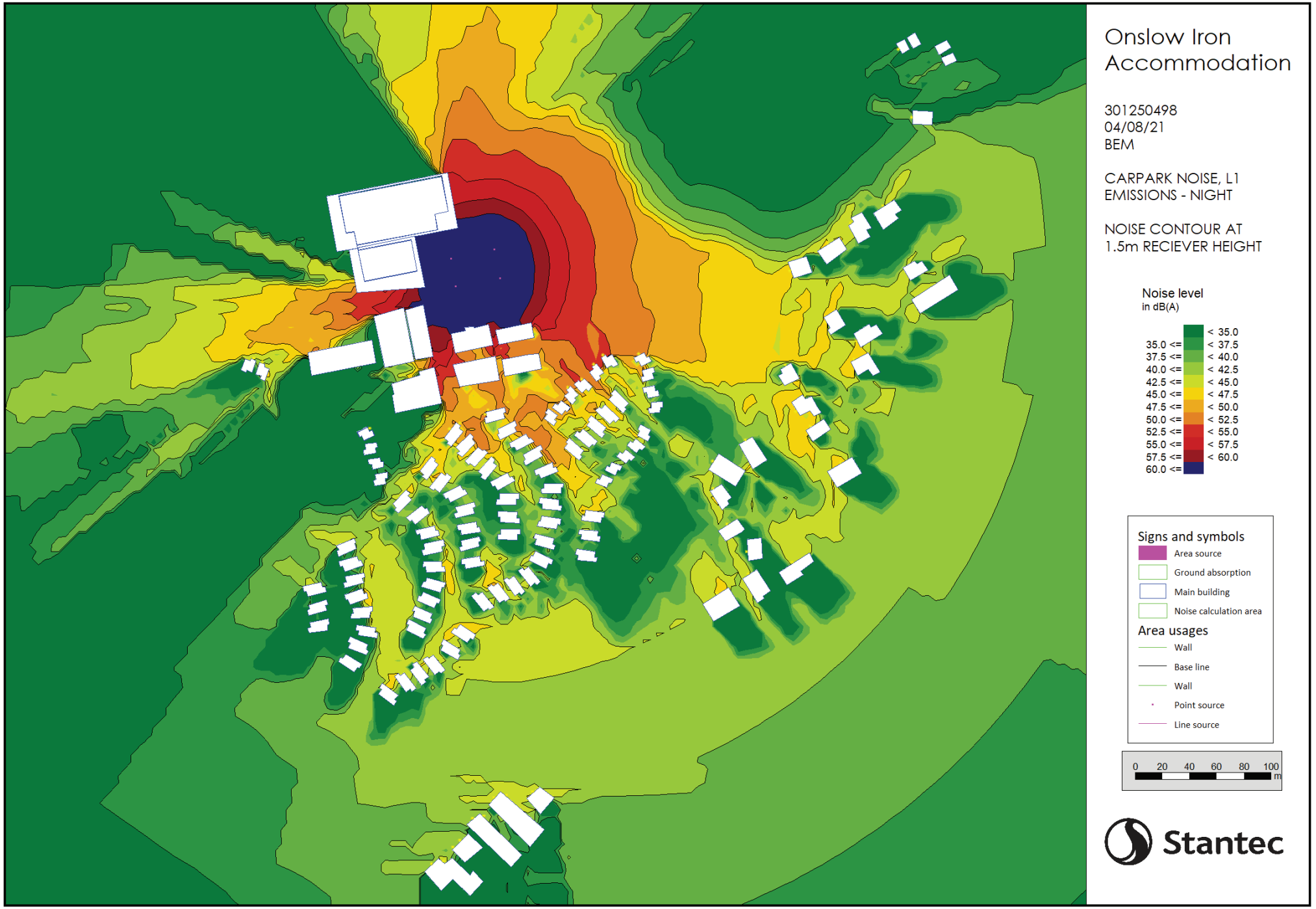

Onslow Iron
Accommodation
301250498
25/08/21
BEM
TAVERN & RESTAURANT
PATRON & MUSIC NOISE
- NIGHT
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
0 20 40 60 80 100
m
Stantec

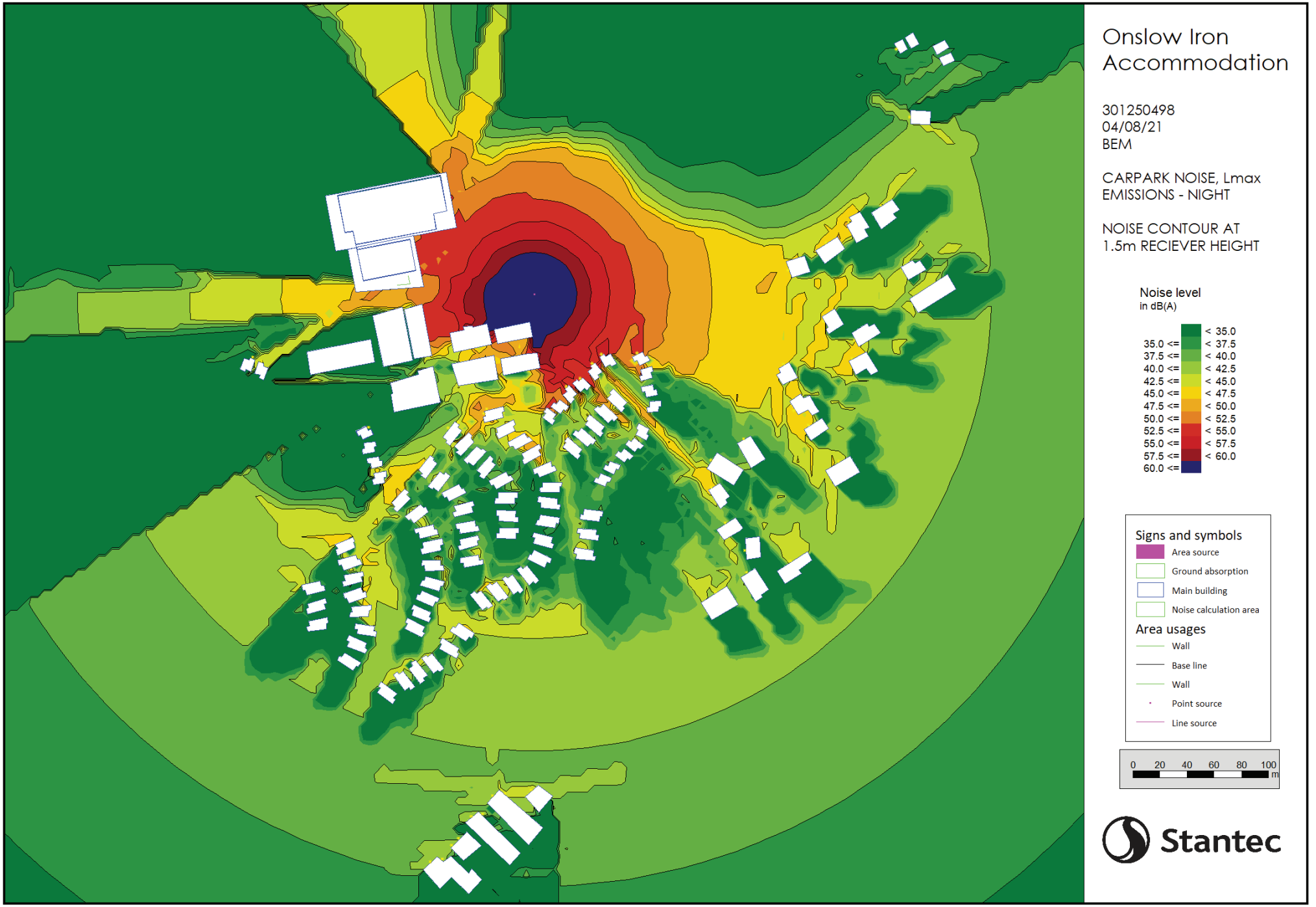

Onslow Iron
Accommodation
301250498
04/08/21
BEM
LOADING DOCK NOISE
EMISSIONS - DAYTIME
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
Point source
Line source
0 20 40 60 80 100
m
Stantec


Onslow Iron
Accommodation
301250498
05/08/21
BEM
WASTE COLLECTION NOISE
EMISSIONS - DAYTIME
TAVERN/RESTAURANT
BIN STORE
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
Point source
Line source
0 20 40 60 80 100
m
Stantec


Onslow Iron
Accommodation
301250498
05/08/21
BEM
WASTE COLLECTION NOISE
EMISSIONS - DAYTIME
MAINTENANCE SHEDS
BIN STORE
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
Point source
Line source
0 20 40 60 80 100
m
Stantec


Onslow Iron
Accommodation
301250498
04/08/21
BEM
CARPARK NOISE, L10
EMISSIONS - NIGHT
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
Point source
Line source
0 20 40 60 80 100
m
Stantec


Onslow Iron
Accommodation
301250498
04/08/21
BEM
CARPARK NOISE, L1
EMISSIONS - NIGHT
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
Point source
Line source
0 20 40 60 80 100
m
Stantec


Onslow Iron
Accommodation
301250498
04/08/21
BEM
CARPARK NOISE, Lmax
EMISSIONS - NIGHT
NOISE CONTOUR AT
1.5m RECIEVER HEIGHT
Noise level
in dB(A)
< 35.0
35.0 <= < 37.5
37.5 <= < 40.0
40.0 <= < 42.5
42.5 <= < 45.0
45.0 <= < 47.5
47.5 <= < 50.0
50.0 <= < 52.5
52.5 <= < 55.0
55.0 <= < 57.5
57.5 <= < 60.0
60.0 <=
Signs and symbols
Area source
Ground absorption
Main building
Noise calculation area
Area usages
Wall
Base line
Wall
Point source
Line source
0 20 40 60 80 100
m
Stantec

Design with
community in mind

Ground Floor
226 Adelaide Terrace
Perth WA 6000
Tel +61 +61 8 6222 7000

For more information please visit
www.stantec.com

Stantec