Appendix F
Noise and Vibration Assessment

Oxley Hwy Interchange

Noise and Vibration Impact Assessment

Transport for NSW

22 July 2025

→ The Power of Commitment

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1. Noise and Vibration

1.1 Existing environment

An ambient noise survey was conducted to characterise and quantify the existing acoustical environment in the area surrounding the proposal site. Long term noise monitoring was undertaken at one (1) location (M1) and short term noise monitoring was undertaken at three (3) locations (M1, M2 and M3) which were considered representative of the nearest potentially-affected noise-sensitive receivers to the proposal site.

The ambient noise monitoring consisted of continuous, unattended noise logging and operator attended noise surveys. The operator attended noise surveys help to define noise sources and the character of noise in the area and are, therefore, used to qualify unattended noise logging results. Monitoring was undertaken on Tuesday 3 September 2024 and Wednesday 23 October 2024 to Tuesday 12 November 2024 at the location presented in Figure 1.1 and Table 1.1.

Unattended noise measurements were undertaken using a SVAN 977 Type 1 sound level meter (serial number 97530). Attended noise measurements were undertaken using a SVAN 977 Type 1 sound level meter (serial number 97528). These instruments are capable of measuring continuous A-weighted 1/3 octave sound pressure levels and able to record L_{Amin}, L_{A90}, L_{A10}, L_{A1}, L_{Amax} and L_{Aeq} noise descriptors.

Field calibrations were checked by GHD immediately before and after each set of measurements using a SVAN SV 36 sound level calibrator (serial number 106878). In all cases, pre and post calibration checks were within the acceptable range of 94 dB +/- 0.5 dB.

All instrumentation used during noise measurements comply with the requirements of AS IEC 61672.1-2019 Electroacoustics - Sound Level Meters – Specifications, AS IEC 61672.2-2019, AS IEC 61672.3-2019 and carry current NATA or manufacturer calibration certificates. Calibration Certificates for the sound level meters during the monitoring have been attached in Appendix A.

Table 1.1 Noise monitoring locations

Monitoring Location	Equipment Type / Serial No.	Location		Photo
		Easting	Northing	
M1 – 1179 Oxley Highway	SVAN 977 (97530) (unattended) SVAN 977 (97528) (attended)	482232	6519060	
M2 – 77 Capital Drive	SVAN 977 (97528)	483352	6519305	

Monitoring Location	Equipment Type / Serial No.	Location		Photo
		Easting	Northing	
M3 – Gillman Way	SVAN 977 (97528)	483127	6518877	

Paper Size ISO A4

0 60 120 180 240

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

Noise monitoring locations

Project No. **12548230**
Revision No. **0**
Date **17/08/2021**

FIGURE 1-1

N:\AU\PortMacquarie\Projects\22\12548230\GIS\Maps\Noise_0.aprx
Print date: 17 Aug 2021 - 11:24

Data source: TfNSW: The proposal, 2021; LPI: DTDB / DCDB, 2017;public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

1.2 Noise monitoring results

1.2.1 Attended noise monitoring

Operator attended noise measurements were conducted during the day period at the noise monitoring locations M1, M2 and M3. Details of the monitoring location are provided in Table 1.1 and Figure 1.1.

The purpose of these surveys was twofold; to qualify the unattended noise logging results and to determine the contribution of existing noise sources (including those from the proposal site) to the total ambient noise environment.

Operator attended noise measurements were conducted during the day on Tuesday 3 September 2024. Each operator attended noise survey was 15 minutes in duration.

The results of the operator attended noise measurements are given in Table 1.2. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and any other industrial operations.

The tables provide the following information:

– Monitoring location
– Date and start time
– Typical maximum (LAF) and contributed noise levels

Table 1.2 Operator attended noise survey results

Location Date/start time Operator SLM Details	Primary noise descriptor (dBA re 20 µPa)					Description of noise emission and typical maximum levels L_{Amax} (dBA)
	L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
M1 03/09/2024 12:15 SVAN 977 SN 97528	69	64	60	51	57	Traffic 49 to 65 dBA Plane 50 to 61 dBA Birds 56 to 62 dBA Car on Driveway 53 to 68 dBA
M2 03/09/2024 12:55 SVAN 977 SN 97528	84	74	68	52	64.7	Traffic 49 to 75 dBA Distant construction 52 to 55 dBA Ambulance siren 53 to 77 dBA Wind in trees 51 to 60 dBA
M3 03/09/2024 13:30 SVAN 977 SN 97528	67	55	53	50	52	Traffic 52 to 54 dBA Truck Idle 50 to 52 dBA Wind in trees 49 to 56 dBA Lawn mower 51 to 55 dBA

Results of operator-attended noise surveys indicate that road traffic is the main contributor to the ambient noise environment during the day time period.

1.2.2 Unattended noise monitoring

Noise levels were monitored from Wednesday 23 October 2024 to Tuesday 12 November 2024. The noise logger was programmed to record statistical noise level indices continuously in 15-minute intervals, including L_{Amax}, L_{A1}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. Precautions were taken to minimise influences from extraneous noise sources and unwanted reflections from adjacent buildings.

Weather data for the survey period was obtained from the Bureau of Meteorology (BOM) weather station located at Port Macquarie Airport (approximately 5.4 km north east of the Site). Noise data corresponding to periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded in accordance with NPI data exclusion methodology.

Rating background levels and ambient noise levels recorded at Location M1 are summarised in Table 1.3.

Daily noise monitoring charts for the entire monitoring period at Location M1 are presented in Appendix B.

Table 1.3 Summary of noise monitoring results – M1 (97530) dBA

Date	Rating background level 90th percentile $L_{A90(15min)}$			Ambient noise levels, $L_{Aeq(period)}$		
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
Wednesday-23-Oct-24	50	46	35	61	59	57
Thursday-24-Oct-24	52	-	37	61	-	58
Friday-25-Oct-24	54	44	32	62	58	55
Saturday-26-Oct-24	49	41	29	60	58	54
Sunday-27-Oct-24	48	44	31	60	58	57
Monday-28-Oct-24	50	40	36	63	58	57
Tuesday-29-Oct-24	52	40	35	61	58	57
Wednesday-30-Oct-24	52	44	37	61	58	57
Thursday-31-Oct-24	50	45	35	60	60	57
Friday-01-Nov-24	52	42	36	61	58	54
Saturday-02-Nov-24	48	-	34	60	-	53
Sunday-03-Nov-24	-	40	35	-	57	56
Monday-04-Nov-24	51	45	41	62	58	57
Tuesday-05-Nov-24	53	40	34	62	58	57
Wednesday-06-Nov-24	51	46	40	62	59	57
Thursday-07-Nov-24	49	-	41	66	-	56
Friday-08-Nov-24	51	44	36	61	62	54
Saturday-09-Nov-24	51	46	36	59	58	54
Sunday-10-Nov-24	48	43	38	60	58	56
Monday-11-Nov-24	52	-	43	63	-	56
Tuesday-12-Nov-24	53	-	-	62	-	-
RBL and Overall Leq	**51**	**44**	**36**	**62**	**59**	**56**

Note:

1. Daytime 7.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm, Night-time 10.00 pm to 7.00 am; On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm, Night-time 10.00 pm to 8.00 am.

1.3 Criteria

1.3.1 Construction noise criteria

Construction noise criteria were developed in accordance with the ICNG (DECC, 2009) for each work area. Construction hours for standard and out of hours work periods are defined in Table 1.4.

Table 1.4 Construction hours

Period	Monday – Friday	Saturday	Sunday & Public Holidays
Standard Hours	7:00 am to 6:00 pm	8:00 am to 1:00 pm	No work
Out of hours work Period 1	6:00 pm to 10:00 pm	7:00 am to 8:00 am 1:00 pm to 10:00 pm	8:00 am to 6:00 pm
Out of hours work Period 2	10:00 pm to 7:00 am	10:00 pm to 8:00 am	10:00 pm to 8:00 am

Proposed construction activities are expected to occur during standard construction hours with out of hours work required for activities adjacent to traffic or reducing the capacity of lanes to meet road occupancy licence requirements.

The ICNG acknowledges that the following activities can be justified to be conducted outside the recommended construction hours:

– The delivery of oversized plant or structure.
– Emergency work.
– Works for which it can be demonstrated that there is a need to operate outside the recommended standard hours.
– Works which maintain noise levels at receivers below the night time noise affected construction noise management levels.

For standard construction hours, the following terms are used in relation to establishment of construction noise criteria:

– The 'noise affected level' represents the point above which there may be some community reaction to noise. For standard construction hours this level is established with reference to the measured rating background level (RBL) plus 10 dB(A). Outside standard construction hours this level is the RBL plus 5 dB(A).
– The 'highly noise affected level' represents the point above-which there may be strong community reaction to noise. This level is set at $L_{Aeq(15min)}$ 75 dB(A).

The construction noise management levels (CNMLs) that apply to sensitive receivers near the proposal are presented in Table 1.5.

Table 1.5 ICNG CNMLs at Identified receivers, dB(A)

Receiver Type	Construction noise management levels, $L_{Aeq\ (15min)}$				
	Standard construction hours		Outside standard construction hours		
	Noise affected	Highly noise affected	Day	Evening	Night
Residential	61	75	56	49	41
Commercial	70 (external)				
Industrial	75 (external)				
Educational Facility	55 (external)[1] or 45 (internal)				
Place of worship	55 (external)[1] or 45 (internal)				

Notes:
1. External noise management level is based on a 10 dB noise reduction through an open window.

1.3.2 Sleep disturbance criteria

In lieu of any specific sleep disturbance criteria in the ICNG, the NPI (EPA 2017) recommends the following screening criteria when assessed externally at the nearest residential location:

– $L_{Aeq(15min)}$ 40 dBA or the prevailing RBL + 5 dBA (whichever is greater); and/or
– L_{AFmax} 52 dBA or the prevailing RBL + 15 dBA (whichever is greater).

1.3.3 Road traffic criteria

The *Road Noise Policy* (RNP) (DECCW, 2011) provides traffic noise criteria for residential receivers in the vicinity of existing roads (Table 1.6). The criteria is applied to operational and construction traffic on public roads to identify potential road traffic impacts and the requirement for feasible and reasonable mitigation measures.

The RNP application notes state that *"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."*

If road traffic noise increases due to construction or operation are within 2 dB(A) of current levels then the objectives of the RNP are met and no specific mitigation measures are required.

Table 1.6 Road traffic noise criteria, $L_{Aeq(period)}$, dB(A)

Type of development	Day 7:00 am to 10:00 pm	Night 10:00 pm to 7:00 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{eq(15\ hour)}$	55 $L_{eq(9\ hour)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{eq(1\ hour)}$	50 $L_{eq(1\ hour)}$

1.3.4 Vibration criteria

Human comfort

Vibration criteria for human comfort have been established with consideration to the *Assessing Vibration: A Technical Guideline* (AVTG) (DECC 2006) for guidance on human exposure to vibration.

The AVTG separates sources of vibration into continuous, impulsive and intermittent and explains that each category should be assessed differently. Vibration from construction work, passing heavy vehicles, and piling is provided as an example of an intermittent source of vibration which is to be assessed using the vibration dose value (VDV) method.

While the AVTG recommends that for intermittent vibration VDV is used as the primary indicator for human comfort, the British Standard BS 5228-2:2009 *Code of practice for noise and vibration on construction and open sites – Part 2: Vibration* guidance can be used as an additional indicator of perceptibility. BS 5228-2 recommends the guidance values presented in Table 1.7. These values are often more suitable for construction works as available information for construction activities and equipment is typically in the form of a peak particle velocity value rather than a dose value.

Table 1.7 Guidance on effects of vibration levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.30 mm/s	Vibration might be just perceptible in residential environments.
1.00 mm/s	It is likely that vibration of this level in residential environments would cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Cosmetic damage

Vibration criteria for cosmetic damage have been established with consideration to:

– British Standard BS 7385:1993 *Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground Borne Vibration* for guidance on cosmetic damage to residential buildings.

– German Standard DIN 4150-3: 2016 *Vibrations in buildings – Part 3: Effects on structures* for guidance on cosmetic damage to heritage buildings.

BS 7385:1993 provides guidance on vibration level likely to cause cosmetic damage to residential buildings or reinforced structures and is reproduced in Table 1.8.

Table 1.8 Transient vibration guide for cosmetic damage (BS 7385:1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	

The German Standard states values where cosmetic damage is not likely and is reproduced in Table 1.9.

Table 1.9 Guideline values for short term vibration on structures (DIN 4150-3)

Type of structure	Guideline values for velocity, vi(t)[1] (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[2]
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
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings)	3	3 to 8	8 to 10

Notes:

1. The term v_i refers to vibration levels in any of the x, y or z axes.
2. At frequencies above 100 Hz the values given in this column may be used as minimum values.

Guidelines for buried pipework and services

The British Standard *BS 7385-2:1993 Evaluation and measurement for vibration in buildings* notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition.

Guideline values for vibration to evaluate the effects of vibration on buried pipework is provided in *DIN 4150-3*. These values are reproduced in Table 1.10.

Table 1.10 Guideline values for vibration effects on buried pipework

Line	Pipe material	Guideline values for vibration velocity measured on the pipe
1	Steel (including welded pipes)	100 mm/s
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s
3	Masonry, plastic	50 mm/s

Notes:

In general, compliance with the guideline values for structural damage would result in compliance with the guideline values buried pipework.

1.4 Assessment of potential noise and vibration impacts

1.4.1 Construction noise impact assessment

A qualitative construction noise assessment method was applied to the construction of the proposal.

Construction equipment sound power levels

Major noise generating plant and their corresponding sound power levels that have been assumed to be used during construction are presented in Table 1.11.

Although it is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time, the assessment of the proposed works assumes that all equipment associated to an activity/scenario is operating simultaneously. This approach has been adopted to identify worst case impacts and any associated mitigation measures.

Table 1.11 Construction equipment sound power levels

Scenario ID	Activity	Equipment	Qty	Sound Power Level dB(A)[1]	Equivalent Sound Power Level dBA
S1	Mobilisation & Site Establishment	Truck (medium rigid)	4	103	115
		Road truck	4	108	
		Scissor Lift	1	98	
		Franna crane	1	98	
S2	Compounds	Front end loader	1	91	119
		Excavator (tracked) 35t	1	110	
		Road truck	4	108	
		Compressor	1	109	
		Welding equipment	1	105	
		Light vehicles	12	103	
		Power generator	1	103	
S3	Corridor Clearing	Excavator (tracked) 35t	1	110	121
		Chainsaw 4-5hp	1	114	
		Tub grinder/ mulcher 40-50hp	1	116	
		Dump truck	4	110	
S4	Bulk Earthworks	Scraper 651	1	110	121
		Excavator (tracked) 35t	1	110	
		Grader	1	113	
		Dump truck	8	110	
		Compactor	1	106	
		Roller (large pad foot)	1	109	
		Water cart	1	107	
S5	Drainage Infrastructure	Backhoe	1	110	119
		Franna crane	1	98	
		Excavator (tracked) 35t	1	110	

Scenario ID	Activity	Equipment	Qty	Sound Power Level dB(A)[1]	Equivalent Sound Power Level dBA
		Concrete truck	4	109	
		Truck compressor	1	75	
		Vibratory Roller	1	109	
		Road truck	4	108	
S6	Paving / Asphalting	Pavement laying machine	1	104	121
		Dump truck	4	110	
		Asphalt truck & sprayer	1	104	
		Concrete truck	1	109	
		Smooth drum roller	1	107	
		Concrete saw	1	118	
S7	Road Furniture Installation	Road truck	4	108	115
		Scissor Lift	1	98	
		Franna crane	1	98	
		Line marking truck	1	108	
S8	De-mobilisation and site clean up	Truck (medium rigid)	4	103	115
		Road truck	4	108	
		Scissor Lift	1	98	
		Franna crane	1	98	

Notes:

1. Equipment sound power levels are sourced from Transport for New South Wales construction and maintenance noise estimator (March 2017) and BS5228-2009.

Noise Impact

Prediction of the construction noise impacts on nearby noise sensitive receptors has been performed using the Transport for New South Wales construction and maintenance noise estimator tool (March 2017). Table 1.12 summarises the distance from the construction activity, where sensitive receivers located within that distance are expected to exceed the corresponding management level. The predicted values presented in Table 1.12 are based on the assumptions that:

– There is no line of site between the proposal site and the nearest noise sensitive premises and -5 dB has been applied to calculations.
– The construction equipment would be operating continuously at full capacity for the full 15-minute evaluation period which is very unlikely in the actual construction site.
– All the construction equipment would be operating simultaneously to estimate the worst-case condition, which is unlikely to occur during actual construction.
– The construction equipment would not generate any annoying characteristics (low frequency, tonality, impulsiveness, etc).

Table 1.12 Construction noise impact distances

ID	Activities	Equivalent SWL	Residential Receivers					Commercial Receivers (70 dB(A))	Industrial Receivers (75 dB(A))
			Construction Noise Management Level (61 dB(A))	Highly Affected Level (75 dB(A))	Outside of standard hours (day) (56 dB(A))	Outside of standard hours (evening) (49 dB(A))	Outside of standard hours (night) (41 dB(A))		
S1	Mobilisation & Site Establishment	115	< 75 m	< 13 m	< 124 m	< 215 m	< 394 m	< 23 m	< 13 m
S2	Compounds	119	< 107 m	< 21 m	< 161 m	< 276 m	< 504 m	< 32 m	< 21 m
S3	Corridor Clearing	121	< 127 m	< 23 m	< 188 m	< 322 m	< 585 m	< 44 m	< 23 m
S4	Bulk Earthworks	121	< 134 m	< 23 m	< 199 m	< 339 m	< 616 m	< 49 m	< 23 m
S5	Drainage Infrastructure	119	< 114 m	< 23 m	< 170 m	< 291 m	< 531 m	< 36 m	< 23 m
S6	Paving / Asphalting	121	< 129 m	< 23 m	< 191 m	< 326 m	< 594 m	< 46 m	< 23 m
S7	Road Furniture Installation	115	< 72 m	< 13 m	< 121 m	< 210 m	< 385 m	< 23 m	< 13 m
S8	De-mobilisation and site clean up	115	< 72 m	< 13 m	< 121 m	< 210 m	< 385 m	< 23 m	< 13 m

Contours illustrating the construction noise impact zones are presented graphically in Appendix C.

Predicted results indicate that noise associated with the construction of the proposal is expected to impact on nearby sensitive receivers when work is undertaken outside of standard hours.

The predicted noise exceedances are due to the nature of the proposed activities and their proximity of the nearest sensitive receptors. The fact that exceedances have been identified does not indicate that the proposed activities cannot be undertaken, but that care needs to be taken to identify feasible and reasonable mitigation and management measures that can be implemented to minimise the potential impacts. Proposed noise mitigation and management recommendations have been provided in Section 1.5.

As per the requirements of the ICNG, predictions are based on a “worst case” assessment and, in most cases, the measured levels during construction of the proposal are likely to be lower than predicted in this assessment. The modelling assumes that all equipment is operating at the same time, which is rarely the case in practice.

Construction traffic noise

A significant increase in traffic volumes would be required to increase road traffic noise by 2 dB(A). The Roads and Maritime *Noise Criteria Guideline* applies existing road criteria where the works increase noise levels by more than 2 dB(A) relative to the existing noise levels at the most affected receiver.

Given the low volume of construction traffic associated with the proposed works it is expected that construction road traffic noise levels associated with the works would result in a relative increase in road traffic noise levels of less than 2 dB(A) at the most affected sensitive receivers.

Traffic on local roads would be managed in accordance with a traffic management plan which would be prepared by the contractor and would detail specific routes that construction traffic and local traffic would follow throughout the construction phase.

1.4.2 Vibration impact assessment

Construction

Exact details of the equipment sizing and type would be confirmed by the Contractor during construction planning. For reference, an extract of the safe working buffer distances to comply with human comfort and cosmetic damage for standard dwellings were sourced from the *Construction Noise and Vibration Strategy* (Transport for NSW, 2018) and provided in Table 1.13. Note that construction would require use of other plant and equipment, but excavators and vibratory rollers are some of the typical equipment that generate the most vibration.

Table 1.13 Vibration safe working distances

Activity	Approx. size/weight/model	Human comfort (OE&H Vibration Guideline)	Cosmetic damage in Standard dwelling (BS 7385)
Vibratory roller	1-2 tonne	15 m to 20 m	5 m
	2-4 tonne	20 m	6 m
	4-6 tonne	40 m	12 m
	7-13 tonne	100 m	15 m
	13-18 tonne	100 m	20 m
	> 18 tonne	100 m	25 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	7 m	2 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	23 m	7 m
Large Hydraulic Hammer	1600 kg (18 to 34 t excavator)	73 m	22 m
Pile Driver - Vibratory	Sheet piles	20 m	2 m to 20 m
Jackhammer	Handheld	Avoid contact with structure	1 m

The above safe working distances are indicative only and may vary depending on the specific equipment used and the ground conditions.

Aerial imagery shows that portions of the works would be in close proximity to a commercial receiver (approximately 20 metres). Vibration from construction activities may be perceptible at sensitive receiver locations within 50 metres of the works and may cause complaint at sensitive receivers within 10 metres of the works, however these vibration levels can generally be tolerated if prior warning and explanation is provided. Vibration levels are expected to be within guideline values for structural damage at dwellings and buildings of similar design or construction.

1.4.3 Operational noise impact assessment

The upgraded interchange would improve traffic flow and driver safety. Predicted traffic volumes are predicted to only increase slightly and are presented in Table 1.14.

Table 1.14 Operational traffic volumes

Scenario	Volume	
	AM Peak	PM Peak
Base case	4035	3683
With upgrades	4431	4177
Traffic noise increase	**0.4**	**0.5**

Traffic volumes were provided to GHD by TfNSW. The relative increase in operational road traffic noise levels associated with the interchange due to the upgrade are predicted to be less than 1 dB which is a negligible increase.

1.5 Mitigation measures and management recommendations

1.5.1 In-principle noise and vibration control

In principle, there are three approaches to controlling construction noise and vibration:

– Control at the source.
– Control on the source-to-receptor pathway.
– Control at the receptor.

Control at the source

Control at the source is considered to be the most cost-effective in the reduction of noise and vibration levels and as such should be given highest priority when considering mitigation options. The solutions available include:

– Substitution of equipment:
  - Substitution involves where reasonably practicable the use of less noisy or vibration-generating equipment. This should be considered at the beginning of the construction phase, prior to any work being carried out. Equipment should be selected to meet the needs of the proposal or process it is required for and not be excessive.
– Modification of existing equipment:
  - Modification of equipment involves the addition of acoustic treatments to parts of the machinery. These include but are not limited to improved mufflers, stiffening of panels and surface coating of resonance dampening material. These options would often require discussion with the supplier and manufacturer of the equipment.

– Use and siting of equipment:
  - Plant should always be used in accordance with the manufacturer's instructions. Where possible the location of equipment should be away from noise-sensitive areas. This includes taking into consideration the emission direction of equipment and directing this away from noise sensitive receptors. Plant used intermittently should be shut down during the intervening periods or throttled down to a minimum. Dropping of material from height should be limited where possible, particularly the loading and unloading of scaffolding.
– Regular and effective maintenance.
  - Maintenance should be carried out to ensure equipment is running at optimal conditions.

Control along the path

There are two ways of mitigating noise along the transmission path:

– Increasing the distance between the source and receptor.
– Where distance is limited, screening of noise may be considered. In some circumstances it may also be possible to enclose the equipment during the operation.

Table 1.15 provides typical noise attenuation provided by noise control methods.

Table 1.15 Typical attenuations for source to receptor noise control methods

Control by	Nominal noise reduction possible, in total A-weighted sound pressure level LpA dB
Distance	Approximately 6 for each doubling of distance
Screening	Normally 5 to 10, maximum of 15
Enclosure	Normally 15 to 25, maximum of 50

Control of noise at the receptor

Reasonable and feasible mitigation measures at the receptors for this proposal are limited to effective community consultation. This is further outlined in Section 1.5.2.

1.5.2 Construction mitigation measures

The noise mitigation measures detailed in Table 1.16 would be implemented to reduce the impact of noise on the surrounding receptors and sensitive land uses.

Table 1.16 Standard mitigation measures for construction noise and vibration

Action required	Details
Management measures	
Implement community consultation measures	Nearby receptors would be notified of the works prior to commencement. Notification would include expected noise levels, duration of the works and a method of contact.
Site inductions	All employees, contractors and subcontractors would receive an environmental induction. The induction would include: – All relevant proposal specific and standard noise and vibration mitigation measures – Relevant license and approval conditions – Permissible hours of work – Any limitations on high noise generating activities – Location of nearest sensitive receptors – Employee parking areas – Designated loading/unloading areas and procedures – Construction works traffic routes – Site opening/closing times (including deliveries) – Environmental incident procedures

Action required	Details
Behavioural practices	No unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Out of hours work (OOHW)	In accordance with Transport's Construction noise and vibration guideline (CVNG).
Source controls	
Construction hours and scheduling	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods. – Standard daytime construction hours: – Monday to Friday: 7.00 am to 6.00 pm – Saturday: 8.00 am to 1.00 pm – Sundays and public holidays: no work
Construction respite period during normal hours (RO) and out-of-hours work (R1)	As a guide high noise and vibration generating activities near receivers should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The duration of each block of work and respite should be flexible to accommodate the usage and amenity at nearby receivers. Unless negotiated with the community with consultation documented and approved by Council's project manager or permitted under the license there should be no more than: – Two consecutive evenings or nights per week – Three evenings or nights per week – Six evenings or nights per month For night work these periods of work should be separated by not less than one week.
Equipment selection	Use quieter and less noise and vibration emitting removal methods where feasible and reasonable.
Use and siting of plant	Plant used intermittently would be throttled down or shut down. Noise-emitting plant would be directed away from sensitive receptors.
Plan worksites and activities to minimise noise and vibration	Traffic flow, parking and loading/ unloading areas would be planned to minimise reversing movements within the site.
Non-tonal reversing alarms	Where feasible and reasonable, non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all vehicles and mobile plant regularly used on site and for any out of hours work.
Minimise disturbance arising from delivery of goods to construction sites	Loading of materials would occur as far as practical from sensitive receptors. Site access points and roads would be located as far as possible away from sensitive receptors. Dedicated loading/unloading areas would be shielded if close to sensitive receptors. Delivery vehicles would be fitted with straps rather than chains for unloading, wherever possible.
Path controls	
Shield stationary noise sources such as pumps, compressors, generators, fans etc.	Stationary noise sources would be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receptors from noisy activities	Structures would be used to shield residential receptors from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable)
Highly noise affected receivers	
Communicate with impacted residences.	Noise levels are predicted to exceed OOHW noise limits during construction works at a number of receptors, most notably residences to the east of the proposal. As such, the proponent would communicate with the impacted residents clearly explaining the duration and noise level of the works and inform the residents of any respite periods.

1.5.3 Additional mitigation measures - construction noise and vibration guideline

The Transport for New South Wales CNVG provides practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from noise and vibration generated during the construction of transportation projects (and related infrastructure) through the application of all feasible and reasonable mitigation measures.

The guideline includes a standard suite of noise and vibration management measures that are to be applied on all projects, together with additional mitigation measures which are applicable when construction noise or vibration is predicted to exceed the proposal's construction noise and vibration objectives.

The standard suite of mitigation measures includes management measures such as community consultation, site inductions (with guidance on how to minimise noise and vibration) and the preparation of site specific Construction Noise and Vibration Management Plans. The guideline also includes several recommendations for reducing the source noise levels of construction equipment via good planning and equipment selection.

In many instances, impacts from construction noise are unavoidable and it is not feasible to achieve the construction noise objectives. Therefore, the CNVG includes a list of additional noise mitigation measures which aim to minimise the potential noise impacts. These include measures ranging from letter box drops and phone calls to offers of alternative accommodation (should noise intensive night-time works be required). A summary of the additional noise mitigation measures matrix is provided in Table 1.17.

Table 1.17 Triggers for additional mitigation measures – Airborne noise (from Construction Noise and Vibration Guideline)

Predicted airborne $L_{Aeq(15minute)}$ noise level at receiver			Additional mitigation measures type[1]	Mitigation levels[2]
Perception	**dBA above RBL**	**dBA above NML**		
All hours				
75 dB(A) or greater			N, V, PC, RO	HA
Standard Hours: **Mon - Fri (7:00 am – 6:00 pm), Sat (8:00 am – 1:00 pm), Sun/Pub Hol (Nil)**				
Noticeable	5 to 10	0	-	NML
Clearly Audible	10 to 20	< 10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML+ 10
Highly intrusive	> 30	> 20	N, V	NML+ 20
OOHW Period 1: **Mon - Fri (6:00 pm – 10:00 pm), Sat (7:00 am – 8:00 am & 1:00 pm – 10:00 pm), Sun/Pub Hol (8:00 am – 6:00 pm)**				
Noticeable	5 to 10	< 5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1, DR	NML + 5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+ 15
Highly intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN	NML+ 25

Predicted airborne $L_{Aeq(15minute)}$ noise level at receiver			Additional mitigation measures type[1]	Mitigation levels[2]
Perception	**dBA above RBL**	**dBA above NML**		
OOHW Period 2: **Mon - Fri (10:00 pm – 7:00 am), Sat (10:00 pm – 8:00 am), Sun/Pub Hol (6:00 pm – 7:00 am)**				
Noticeable	5 to 10	< 5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML + 5
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+ 15
Highly intrusive	> 30	> 25	AA, V, IB, N, PC, SN, R2, DR	NML+ 25

Note:

1. The following abbreviations are used: AA = Alternative Accommodation, V = Verification, IB = Individual briefings, N = Notification, R2 = Respite Period 2, DR = Duration Respite, R1 = Respite Period 1, PC = Phone calls, SN = Specific notifications, Perception = relates to level above RBL
2. NML = Noise Management Level, HA = Highly Affected (>75 dB(A) – applies to residences only)

Predicted construction noise is expected to impact on nearby sensitive receivers during outside of hours work, most notably on receivers located to the east of the proposal. In accordance with the Transport for New South Wales CNVG the exceedances would require additional mitigation measures. Sensitive receivers within the outside of hours impact distances for each construction activity presented in Appendix C would be given notification 7 days prior to commencement of any works associated with the activity

Appendices

Appendix A

Calibration Certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM37488

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Svantek		
Type No:	SVAN 977C	**Serial No:**	97530
Mic. Type:	MK255	**Serial No:**	21346
Pre-Amp. Type:	SV12L	**Serial No:**	108451
Filter Type:	1/3 Octave	**Test No:**	F037489

Owner: GHD Pty Ltd
Level 3, 24 Honeysuckle Drive
Newcastle, NSW 2300

Tests Performed: IEC 61672-3:2013 & IEC 61260-3:2016

Comments: All Test passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1005	hPa ±1 hPa	**Date of Receipt :**	19/09/2023
Temperature	24	°C ±1° C	**Date of Calibration :**	25/09/2023
Relative Humidity	41	% ±5%	**Date of Issue :**	04/10/2023

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Hein Soe

Accredited for compliance with ISO/IEC 17025 - Calibration
Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

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www.acu-vib.com.au

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	*Clause*	*Result*
Absolute Calibration	10	Pass
Acoustical Frequency Weighting	12	Pass
Self-Generated Noise	11.1	Observed
Electrical Noise	11.2	Observed
Long Term Stability	15	Pass
Electrical Frequency Weightings	13	Pass
Frequency and Time Weightings	14	Pass
Reference Level Linearity	16	Pass
Range Level Linearity	17	Pass
Toneburst	18	Pass
Peak C Sound Level	19	Pass
Overload Indicator	20	Pass
High Level Stability	21	Pass

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013.

This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 61260-3:2016 and were conducted to test the following performance characteristics:

Tests performed	*Clause*	*Result*
Test of relative attenuation at filter midband frequency	10	Pass
Linear operating range including range control if fitted	11	Pass
Test of lower limit of linear operating range	12	Pass
Measurement of relative attenuation (filter shape)	13	Pass

The filter submitted for testing successfully completed the tests listed above for the environmental conditions under which the tests were performed. If the filter type has successfully completed the pattern-evaluation tests of IEC 61260-2 then it can be stated that the filter set continues to conform to the specifications of IEC 61260-1.

A full technical report is available on request.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM37222

EQUIPMENT TESTED: Sound Level Meter

Manufacturer:	Svantek		
Type No:	SVAN 977C	**Serial No:**	97528
Mic. Type:	MK255	**Serial No:**	21348
Pre-Amp. Type:	SV12L	**Serial No:**	108473
Filter Type:	1/1 Octave	**Test No:**	F037225

Owner: GHD Pty Ltd
Level 3, 24 Honeysuckle Drive
Newcastle, NSW 2300

Tests Performed: IEC 61672-3:2013 & IEC 61260-3:2016

Comments: All Test passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	996	hPa ±1 hPa	**Date of Receipt :**	25/08/2023
Temperature	23	°C ±1° C	**Date of Calibration :**	31/08/2023
Relative Humidity	46	% ±5%	**Date of Issue :**	31/08/2023

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Hein Soe

Accredited for compliance with ISO/IEC 17025 - Calibration
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The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	*Clause*	*Result*
Absolute Calibration	10	Pass
Acoustical Frequency Weighting	12	Pass
Self-Generated Noise	11.1	Observed
Electrical Noise	11.2	Observed
Long Term Stability	15	Pass
Electrical Frequency Weightings	13	Pass
Frequency and Time Weightings	14	Pass
Reference Level Linearity	16	Pass
Range Level Linearity	17	Pass
Toneburst	18	Pass
Peak C Sound Level	19	Pass
Overload Indicator	20	Pass
High Level Stability	21	Pass

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013.

This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 61260-3:2016 and were conducted to test the following performance characteristics:

Tests performed	*Clause*	*Result*
Test of relative attenuation at filter midband frequency	10	Pass
Linear operating range including range control if fitted	11	Pass
Test of lower limit of linear operating range	12	Pass
Measurement of relative attenuation (filter shape)	13	Pass

The filter submitted for testing successfully completed the tests listed above for the environmental conditions under which the tests were performed. If the filter type has successfully completed the pattern-evaluation tests of IEC 61260-2 then it can be stated that the filter set continues to conform to the specifications of IEC 61260-1.

A full technical report is available on request.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: C52835

EQUIPMENT TESTED : Acoustic Calibrator

Manufacturer:	Svantek
Type No:	SV 36 **Serial No:** 106878
Class:	1
Owner:	GHD Pty Ltd Level 3, 24 Honeysuckle Drive Newcastle, NSW 2300
Tests Performed:	Measured Output Pressure level, Frequency & Distortion
Comments:	See Details and Class Tolerance overleaf.

CONDITION OF TEST:

Ambient Pressure	1000	hPa ±1 hPa	**Date of Receipt :**	17/02/2025
Temperature	23	°C ±1° C	**Date of Calibration :**	18/02/2025
Relative Humidity	48	% ±5%	**Date of Issue :**	19/02/2025

Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2017

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Hein Soe

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Acoustic and Vibration Measurements

CERTIFICATE NO: C52835

The Calibrator described in this report has been tested to the requirements of the standard IEC 60942-[Ed 4]:2017-11.
The tests described in Annex B of the standard (Periodic tests) were carried out under the environmental conditions listed above to the following clauses:

Clause	Test description
B4.6	Sound Pressure Level (By comparison with a reference calibrator).
B4.7	Frequency (By measurement with a calibrated frequency meter).
B4.8	Total distortion and noise. (By measurement with a calibrated Noise and Distortion meter).

Notes:

1. The calibrator was calibrated with the main axis vertical and facing down.
2. No corrections have been made for atmospheric pressure, temperature, or humidity.

Parameter	Pre-Adj	Adj Y/N	Output: **(dB re 20 µPa)**	Frequency **(Hz)**	THD&N **(%)**
Level1:	NA	N	94.03 dB	1000.00 Hz	0.63 %
Level2:	NA	N	114.02 dB	1000.01 Hz	0.18 %
Uncertainty			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

Parameter	Class 1		Class 2	
Nominal Frequency	250 Hz	1 kHz	250 Hz	1 kHz
Output dB SPL	0.25 dB	0.25 dB	0.40 dB	0.40 dB
Frequency Hz	0.7 % (1.75 Hz)	0.7 % (7 Hz)	1.7 % (4.25 Hz)	1.7 % (17 Hz)
THD&N	2.5 %	2.5 %	3.0 %	3.0 %

Tolerance limits from AS/IEC60942 (edition 4)

Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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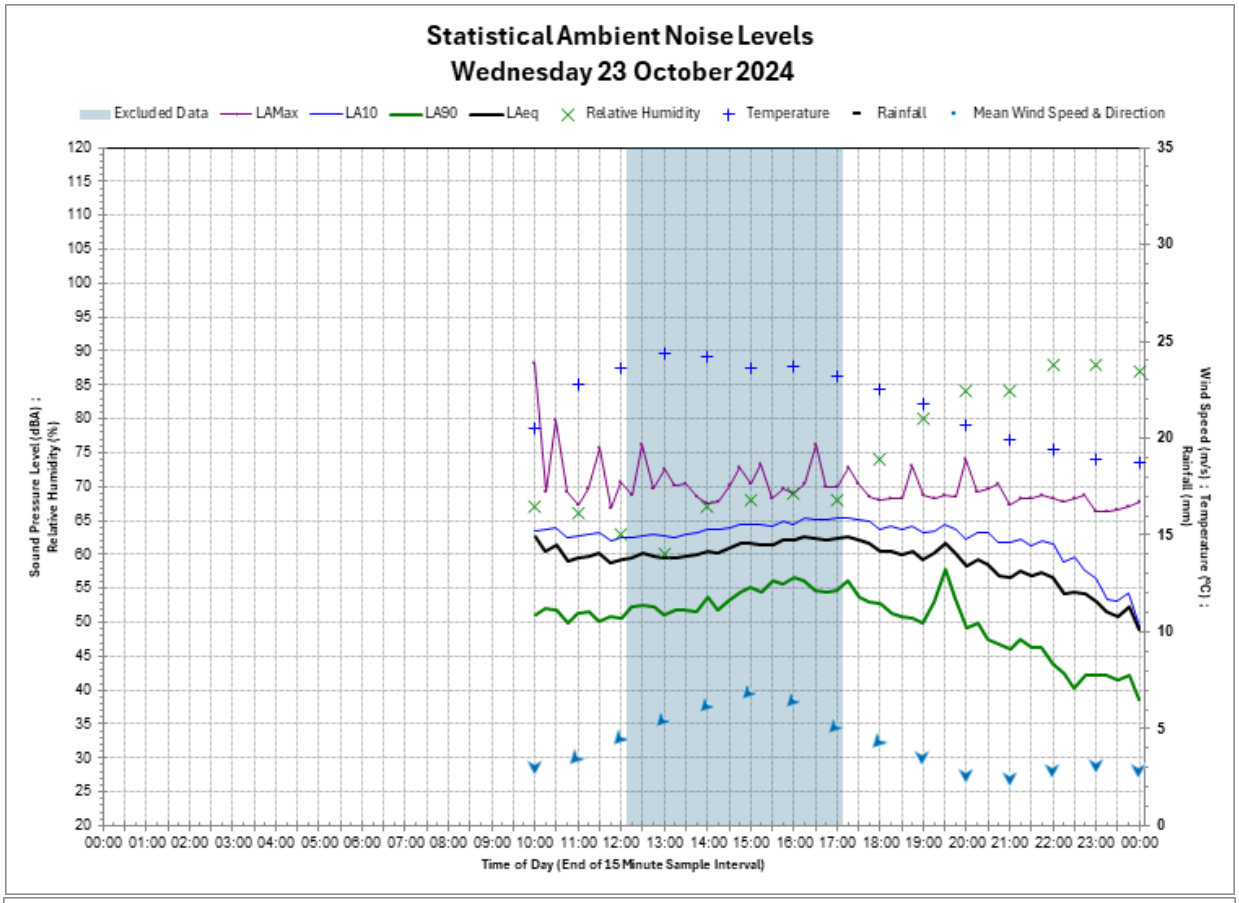
Appendix B

Unattended Noise Monitoring Results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Wednesday 23 October 2024
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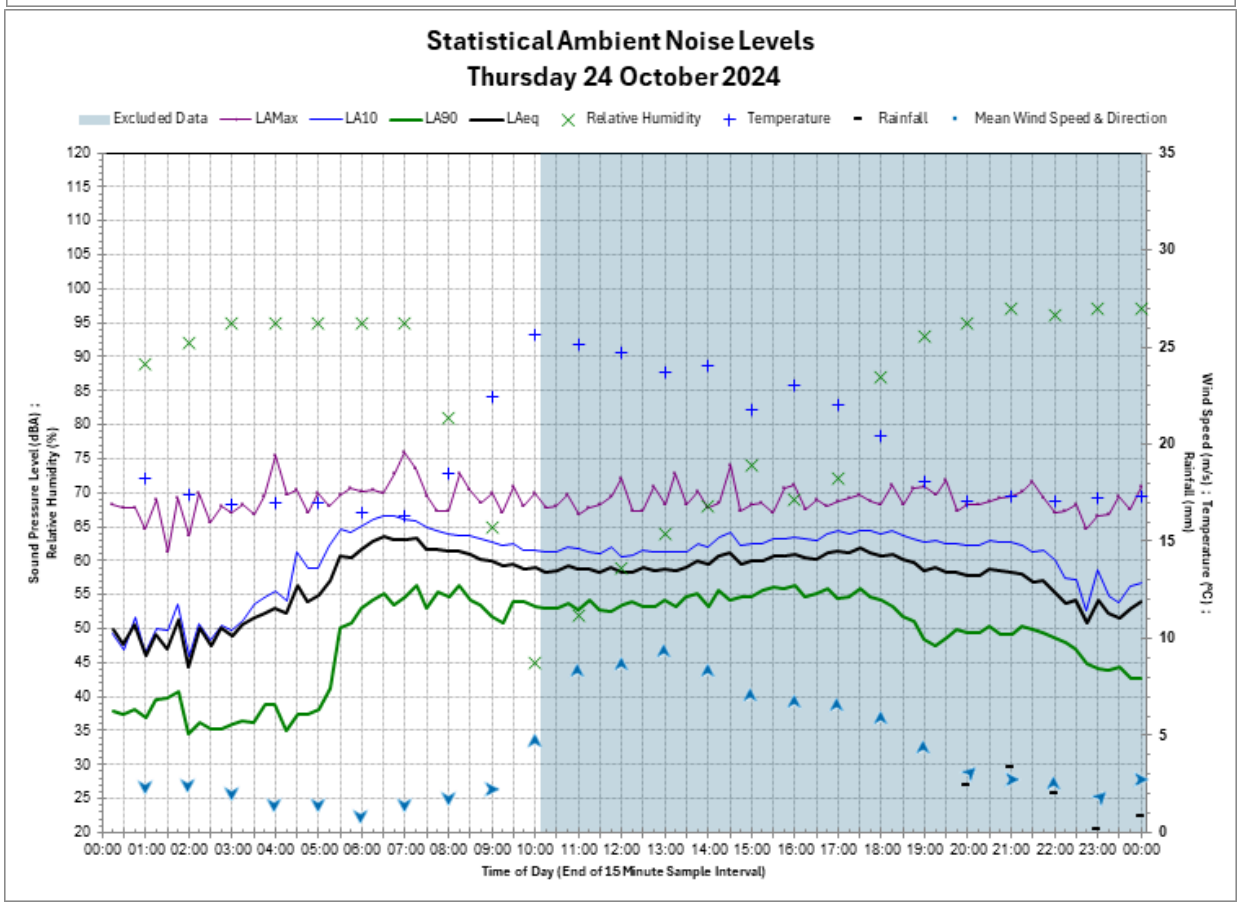
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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LAeq
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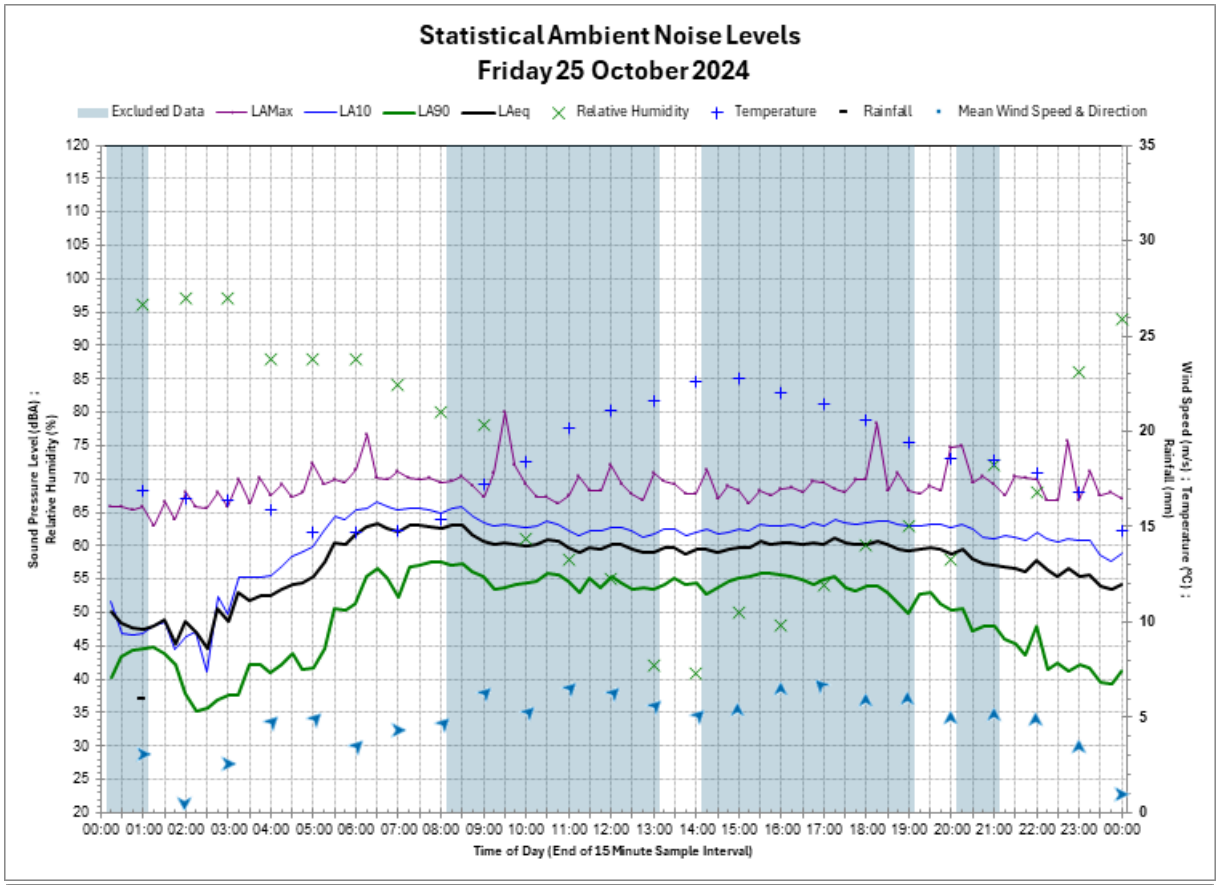
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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LAeq
Relative Humidity
Temperature
Rainfall
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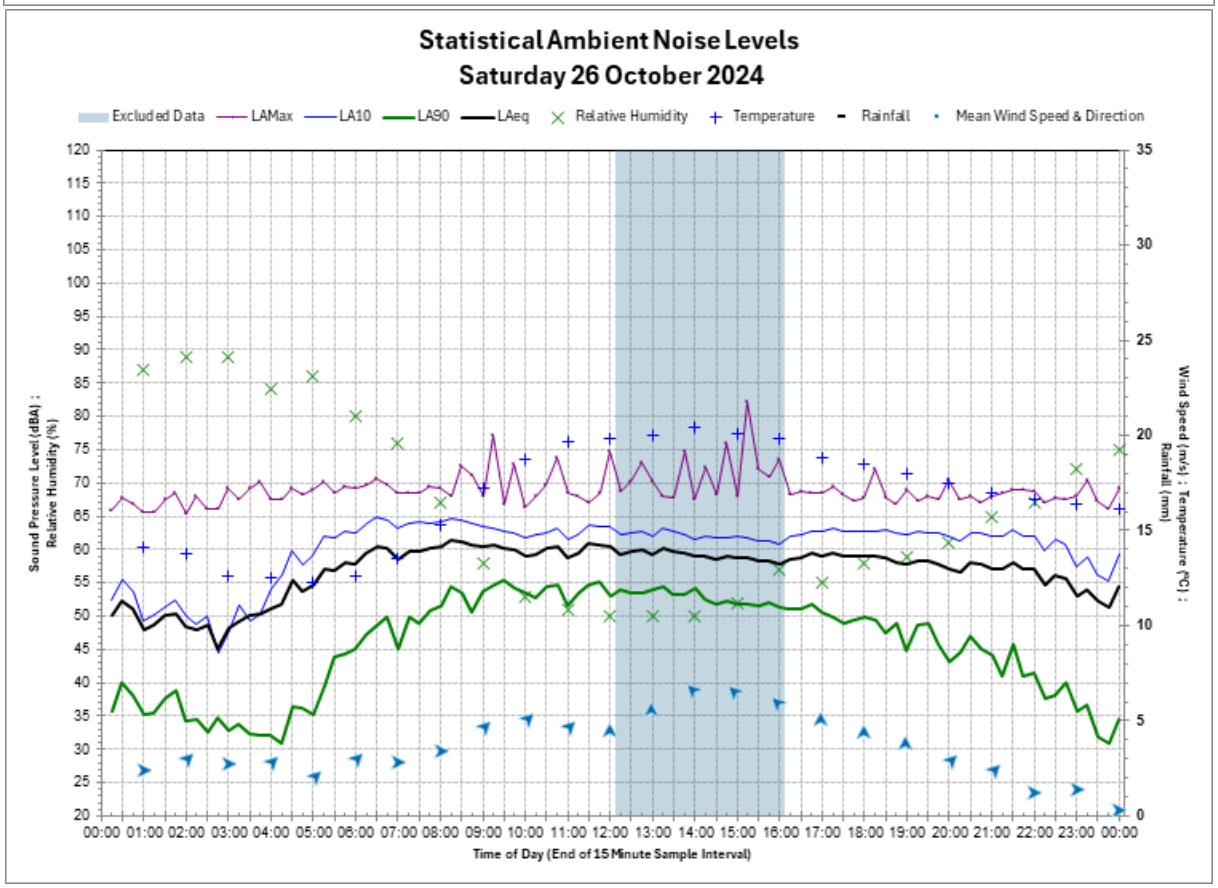
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Temperature
Rainfall
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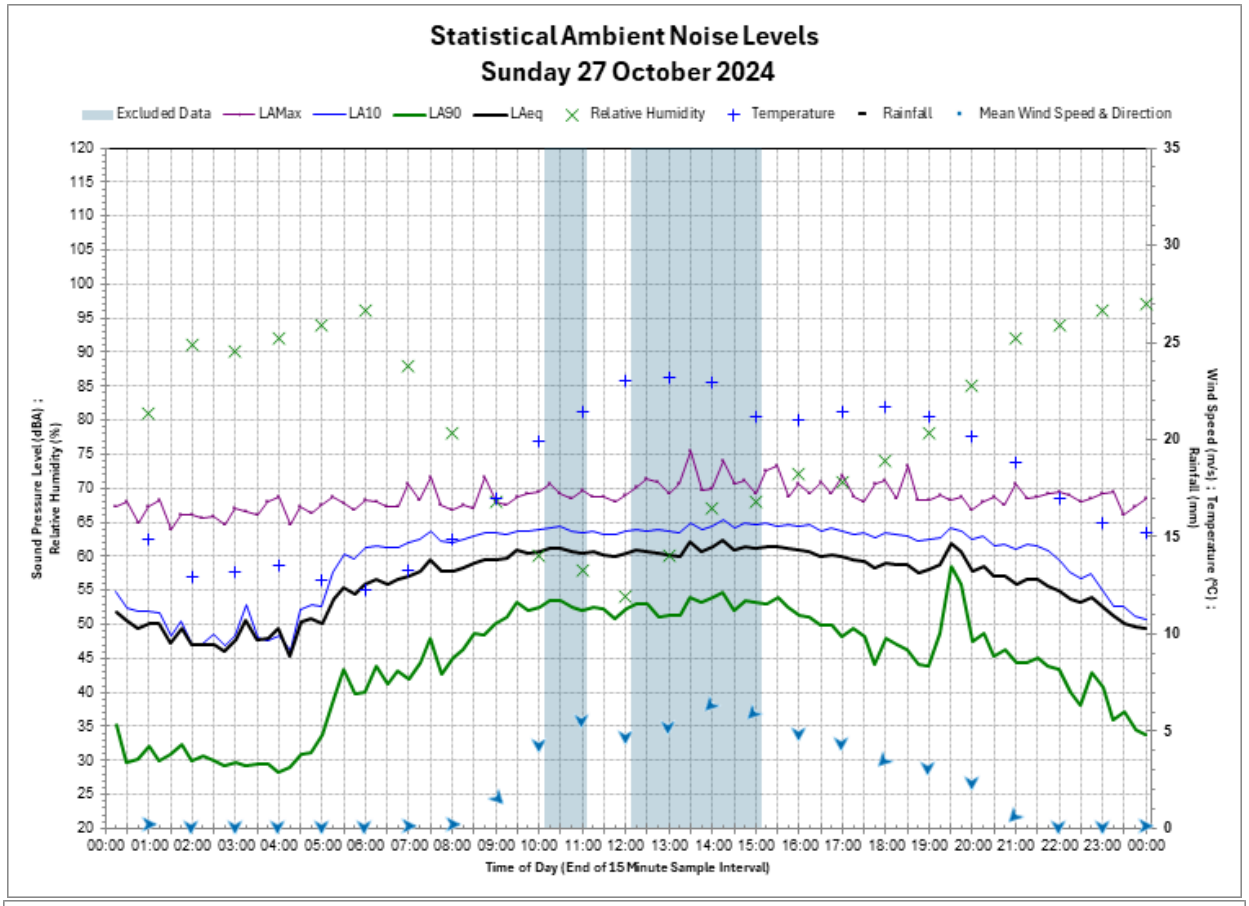
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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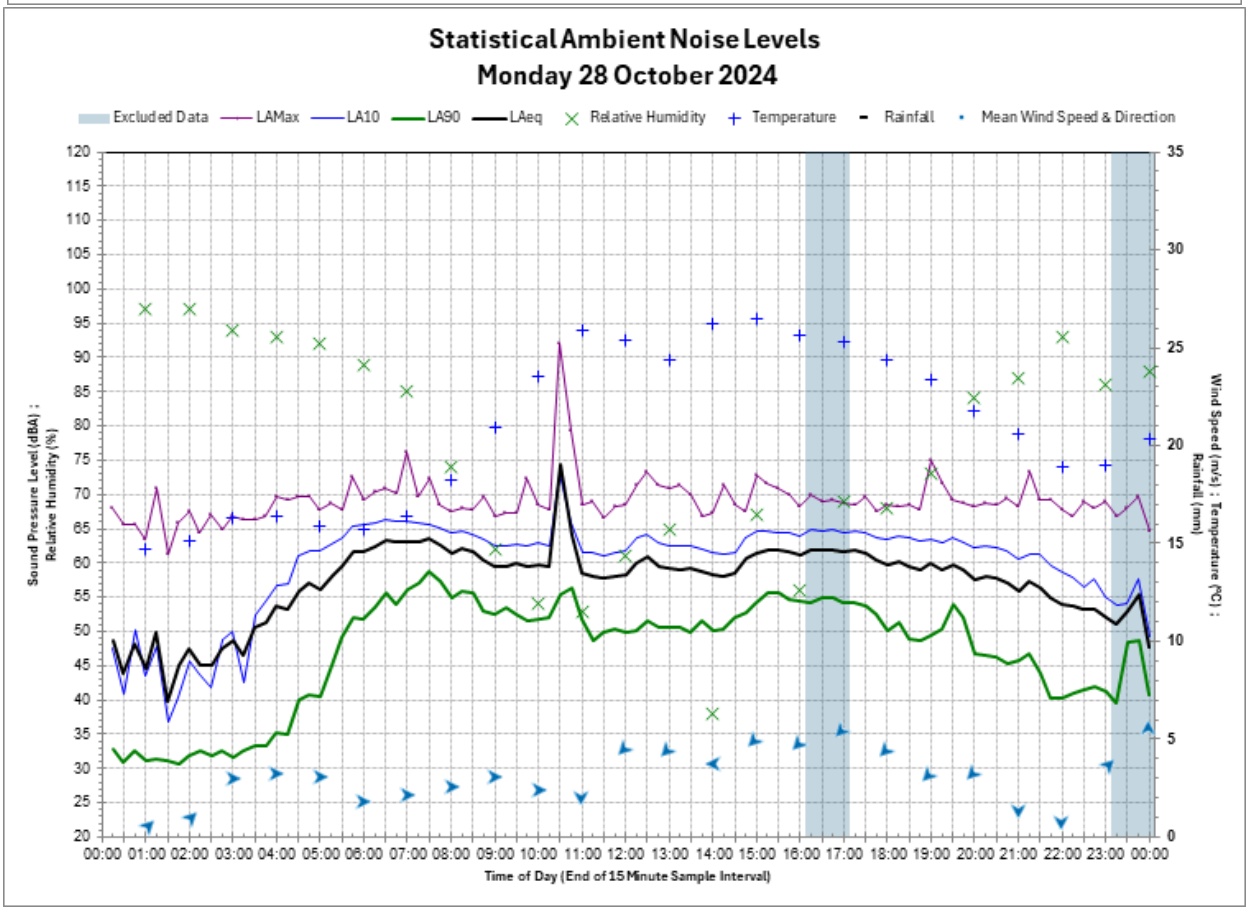
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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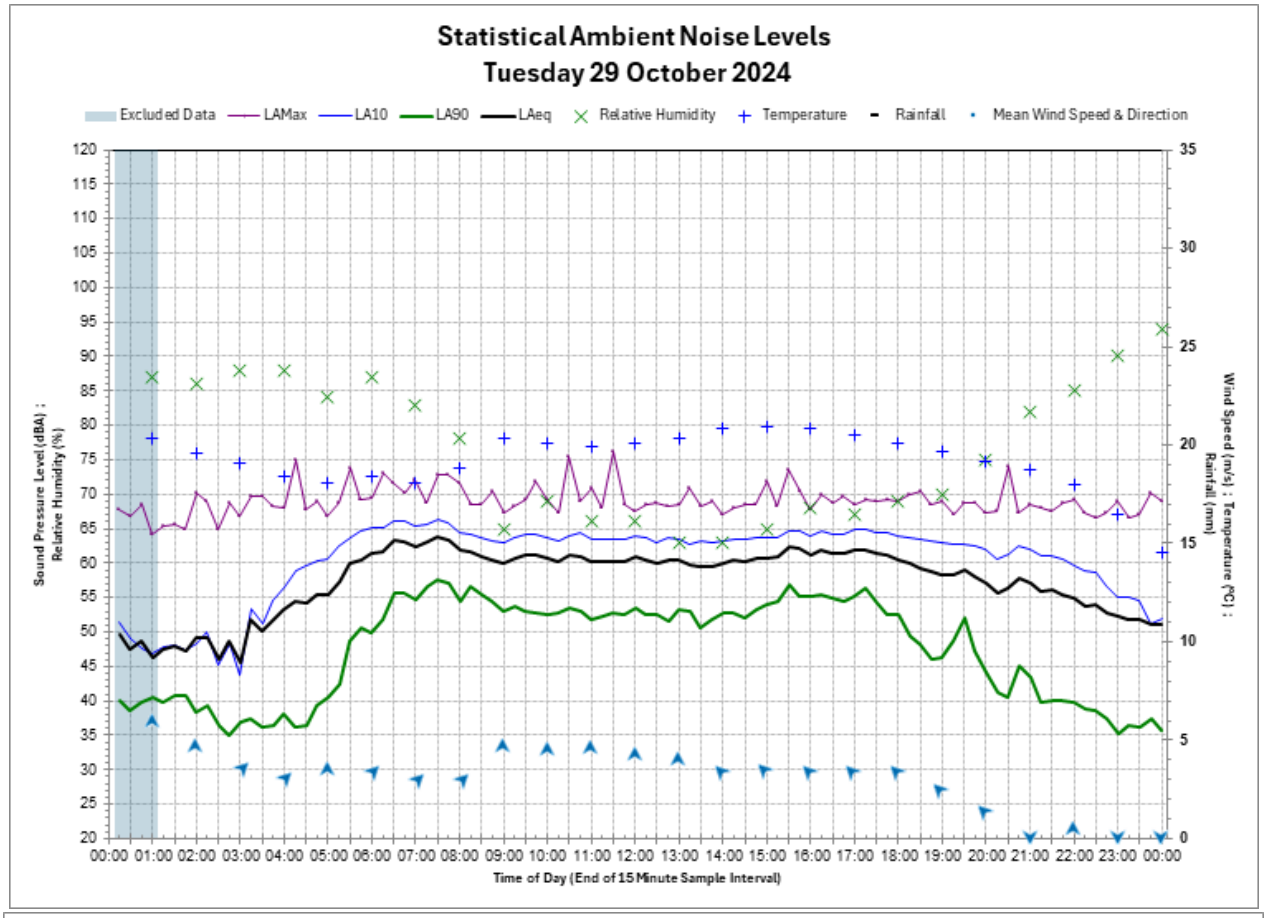
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Tuesday 29 October 2024
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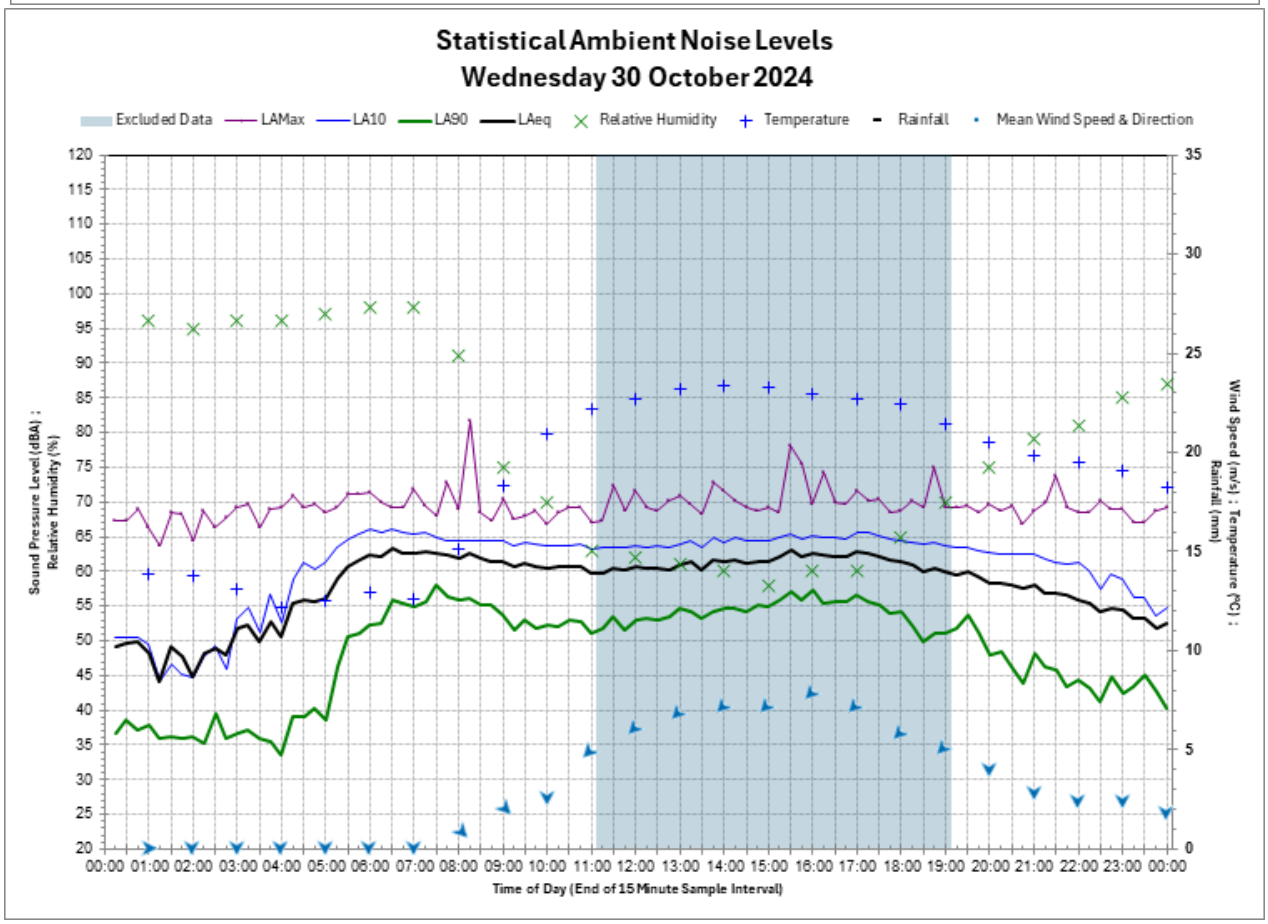
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Wednesday 30 October 2024
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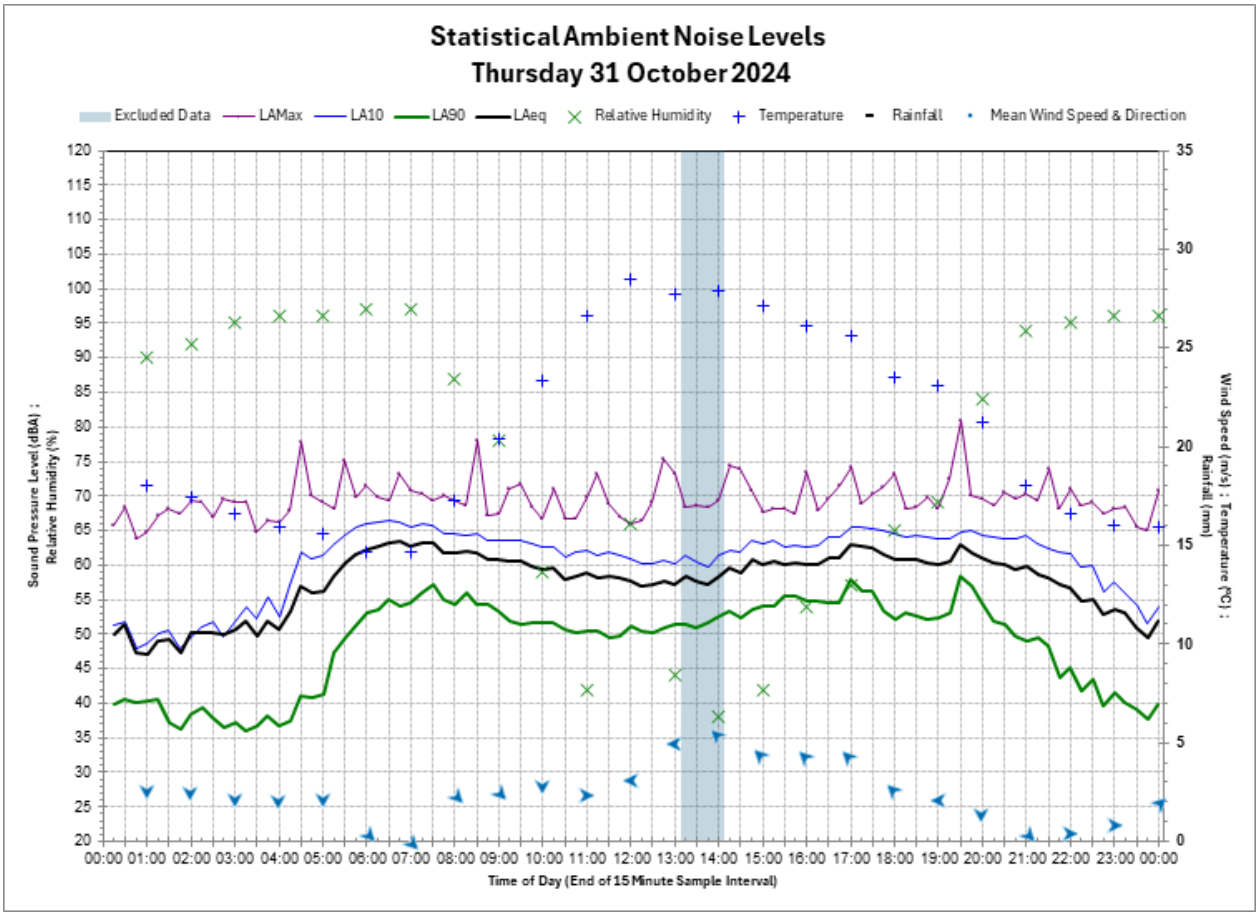
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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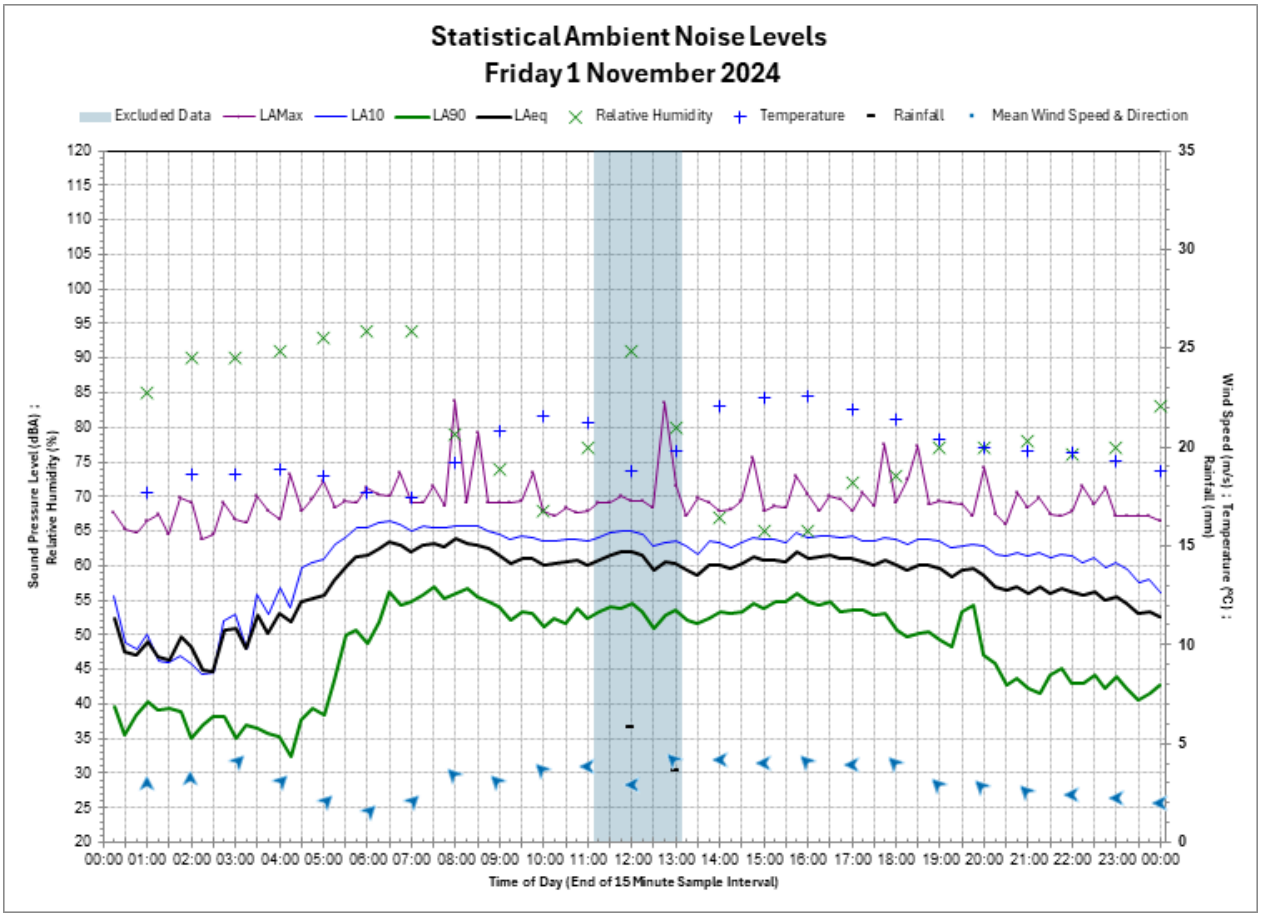
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Friday 1 November 2024
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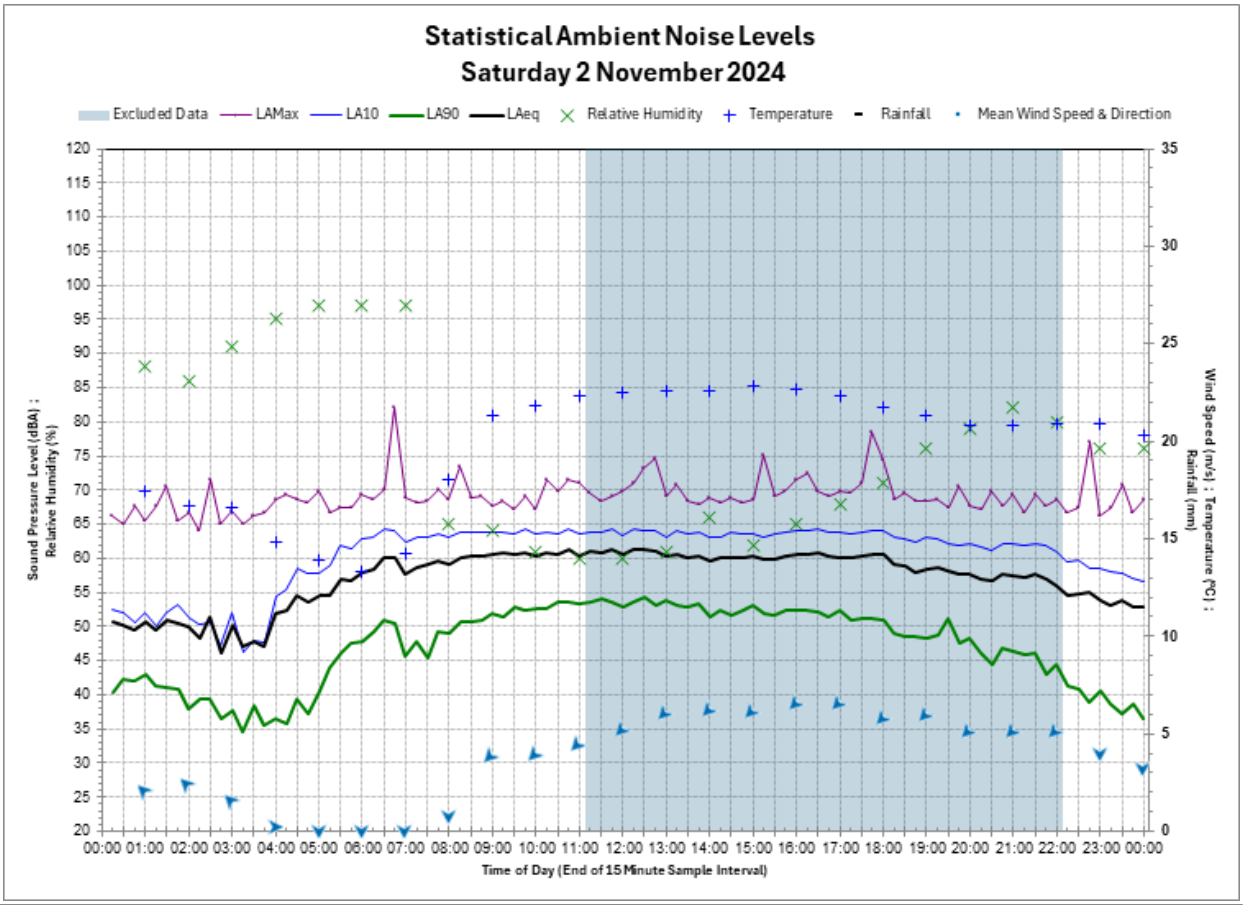
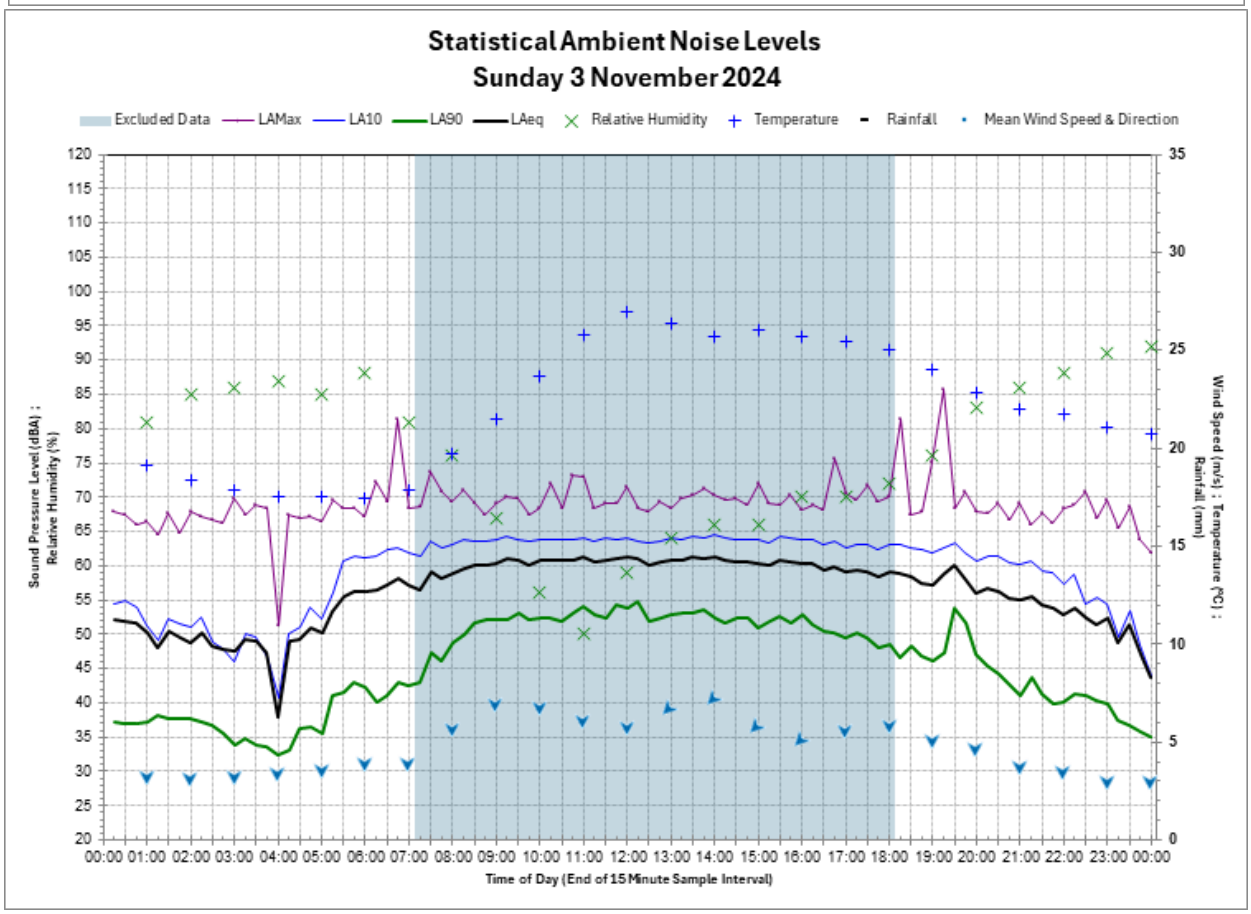
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Saturday 2 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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Sunday 3 November 2024
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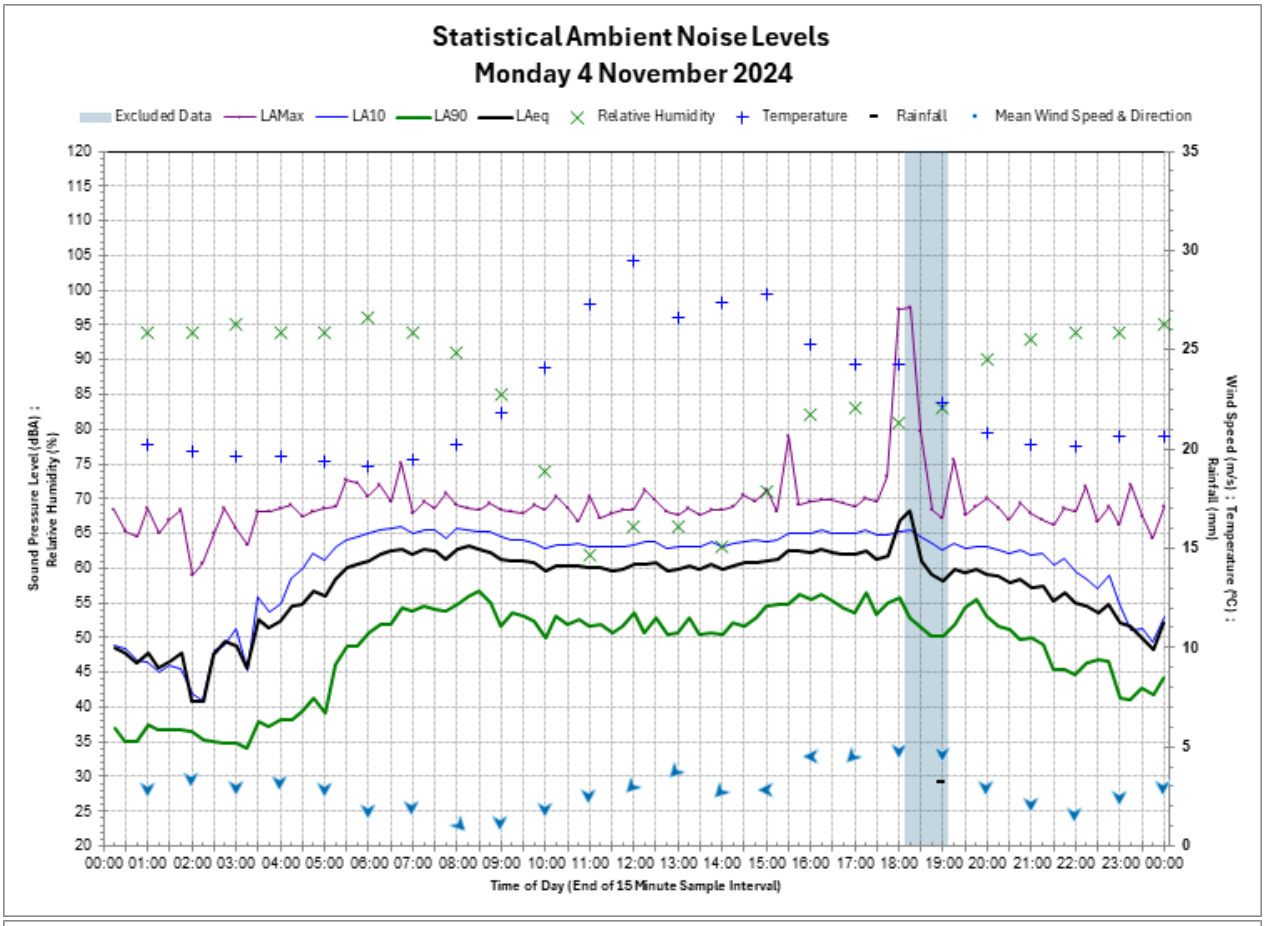
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)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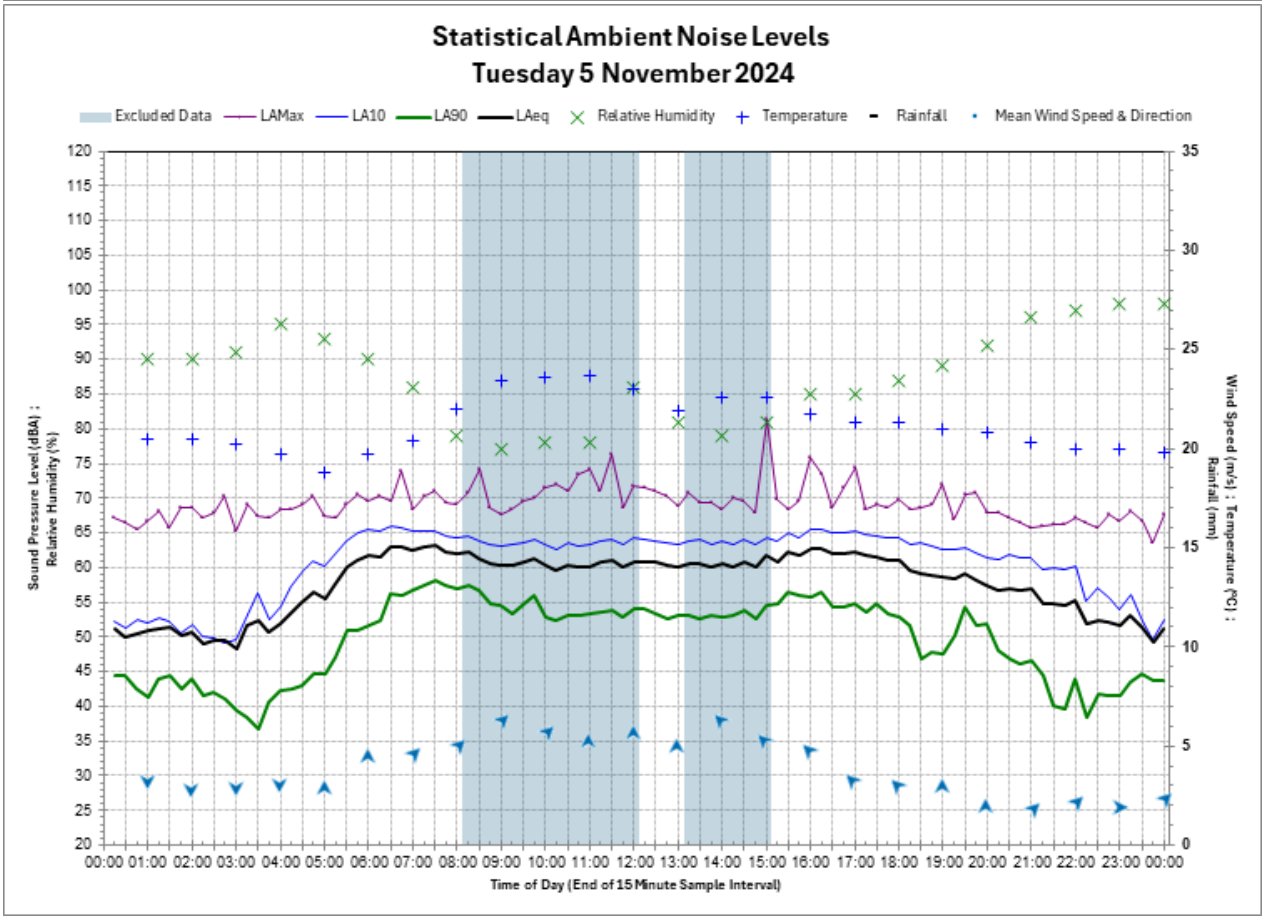
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Tuesday 5 November 2024
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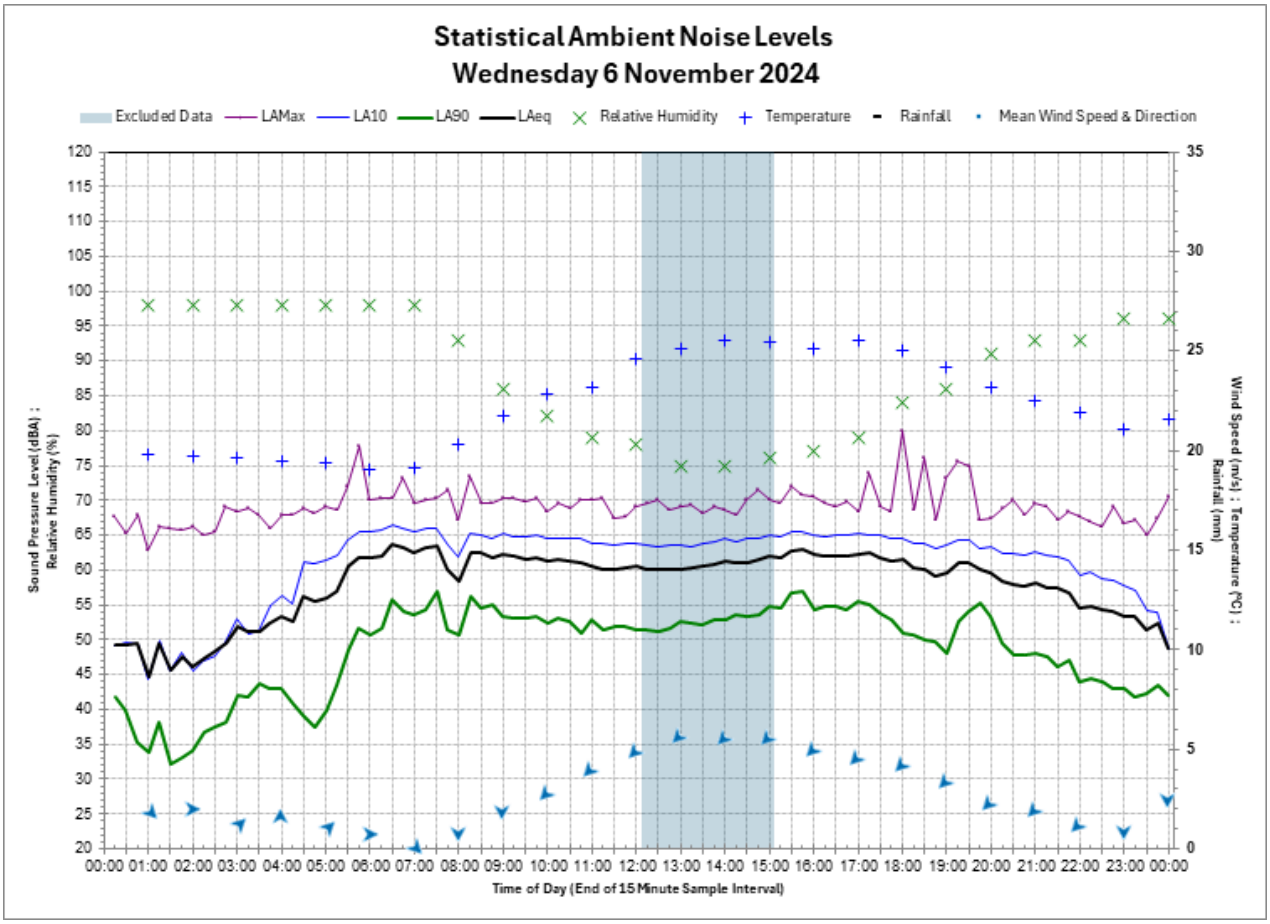
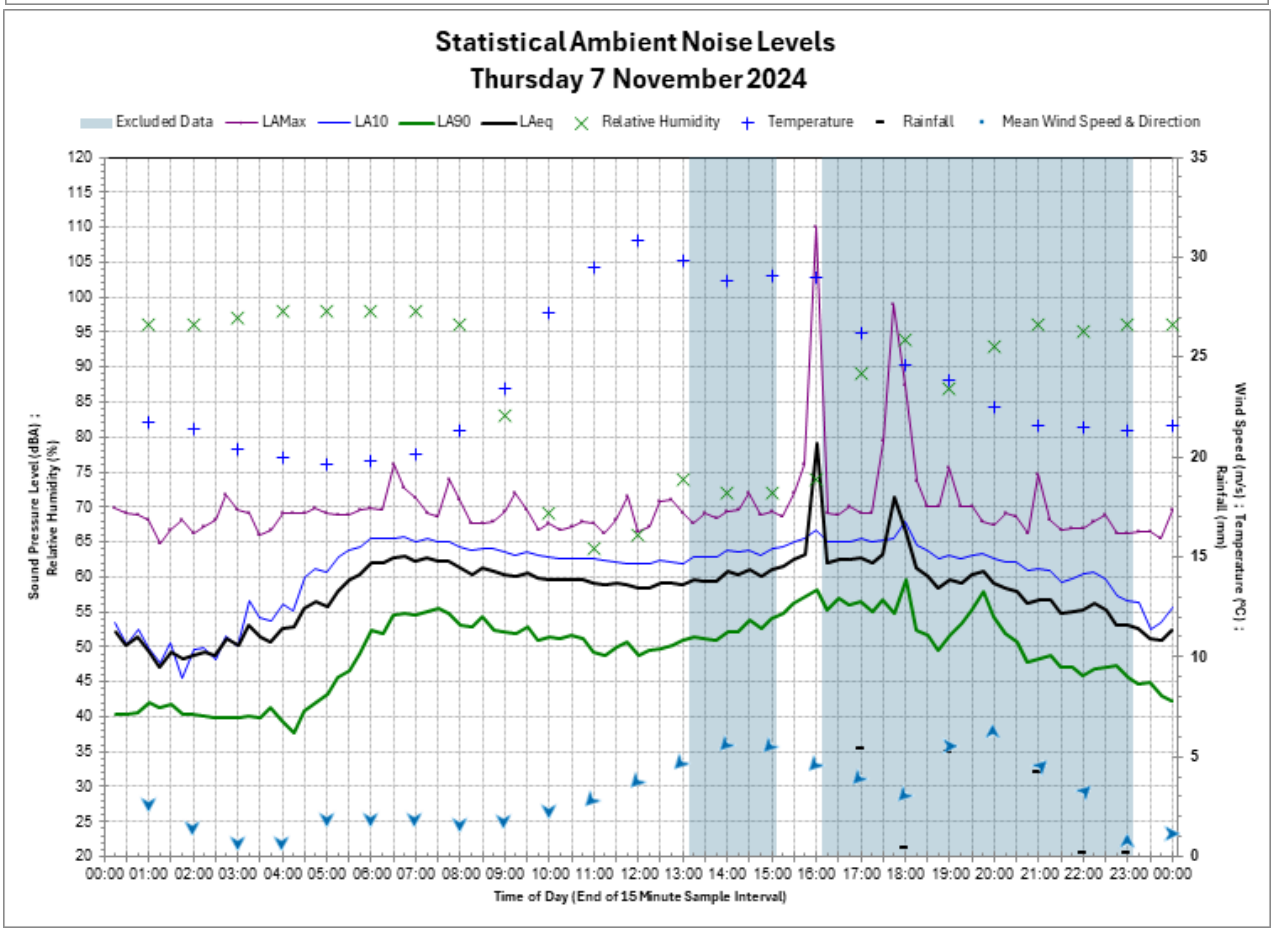
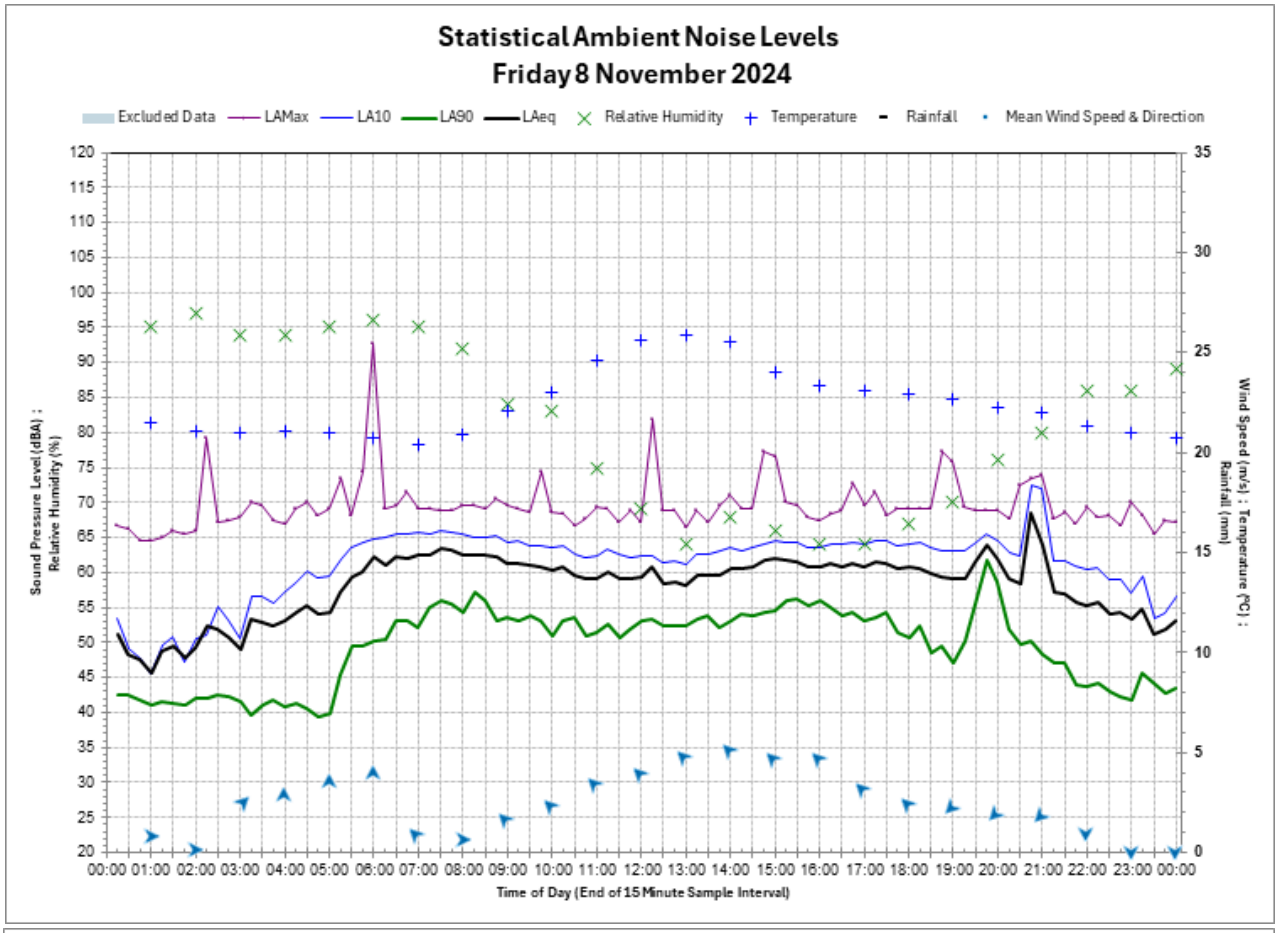
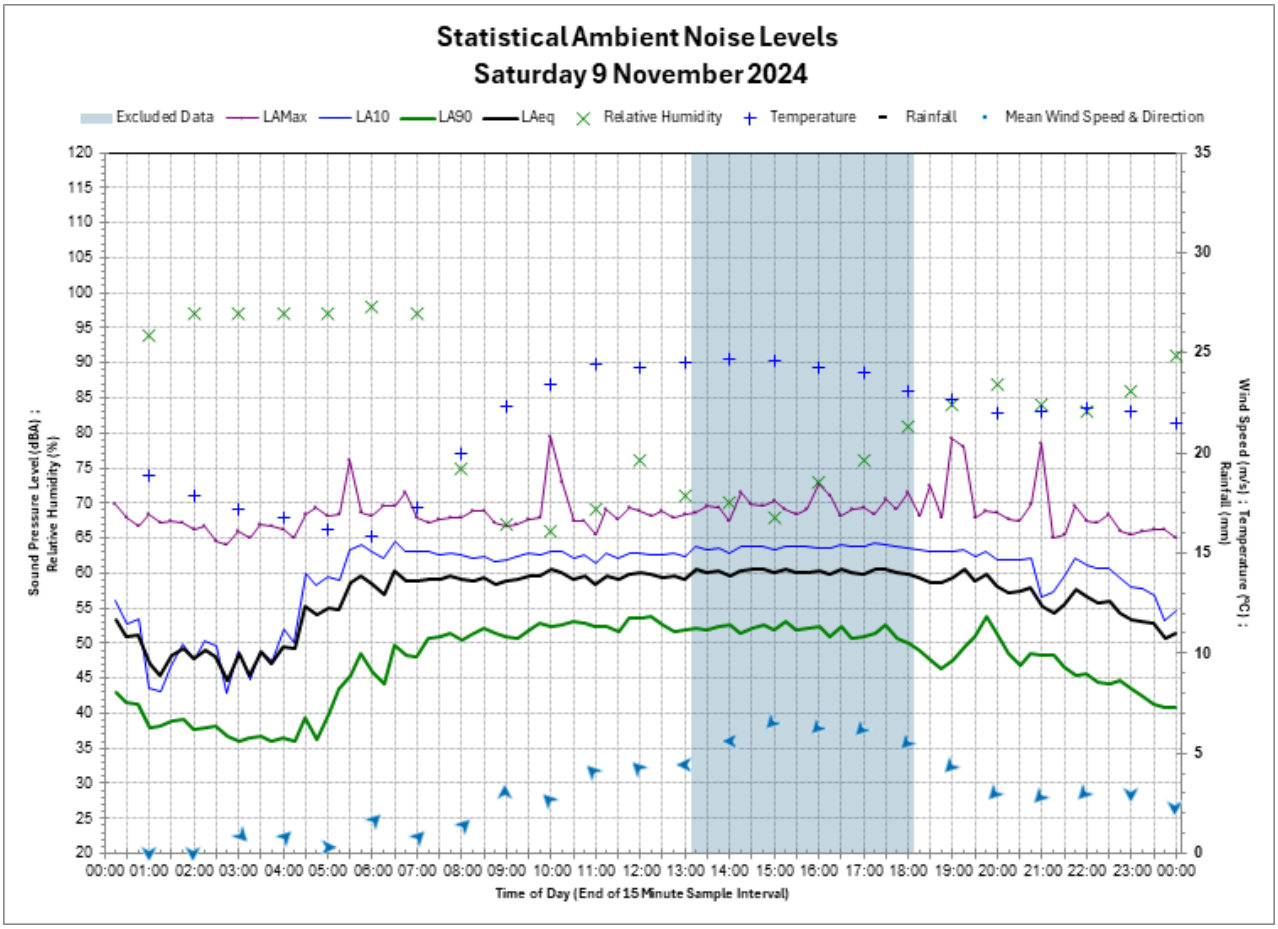
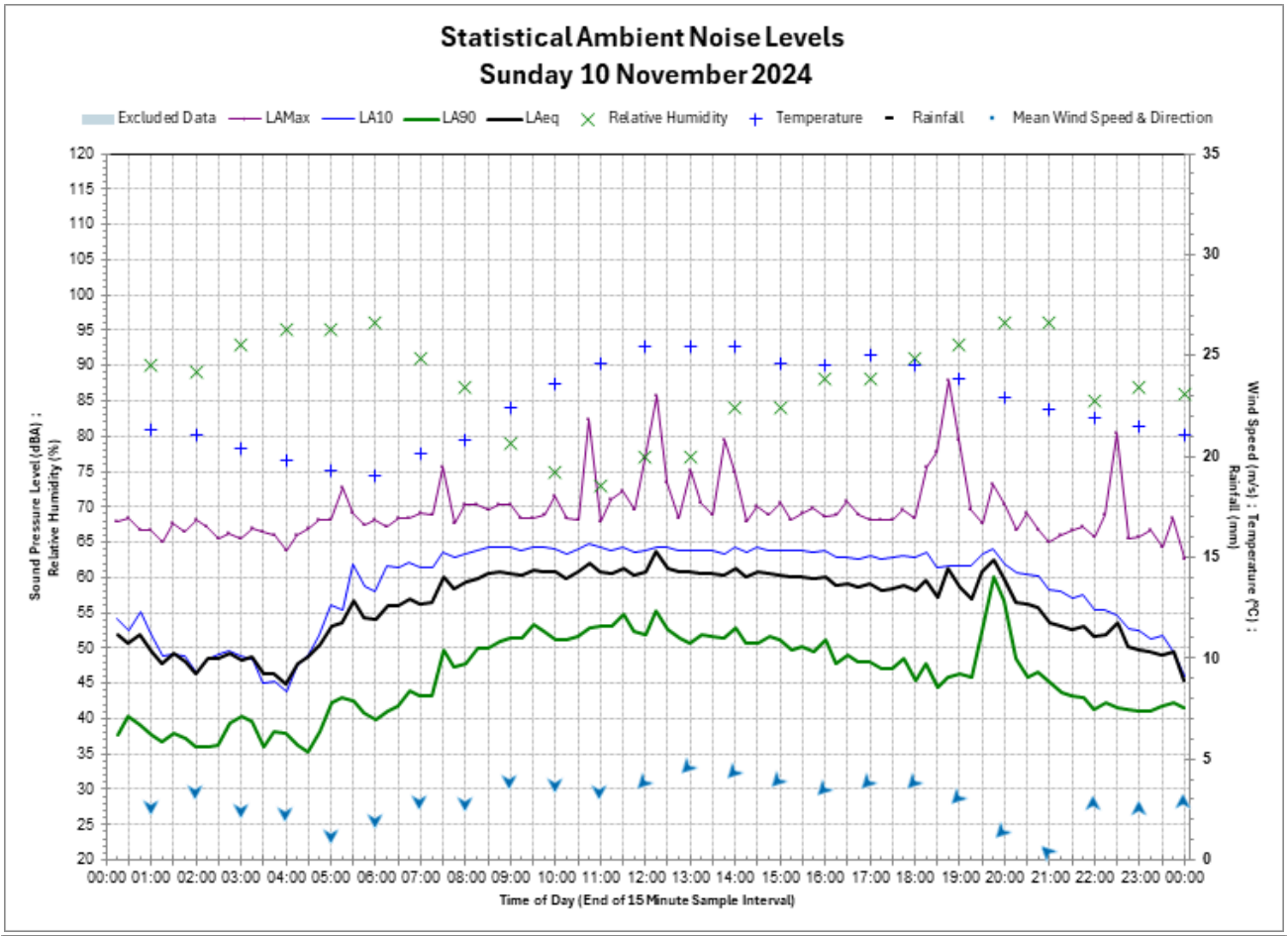
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

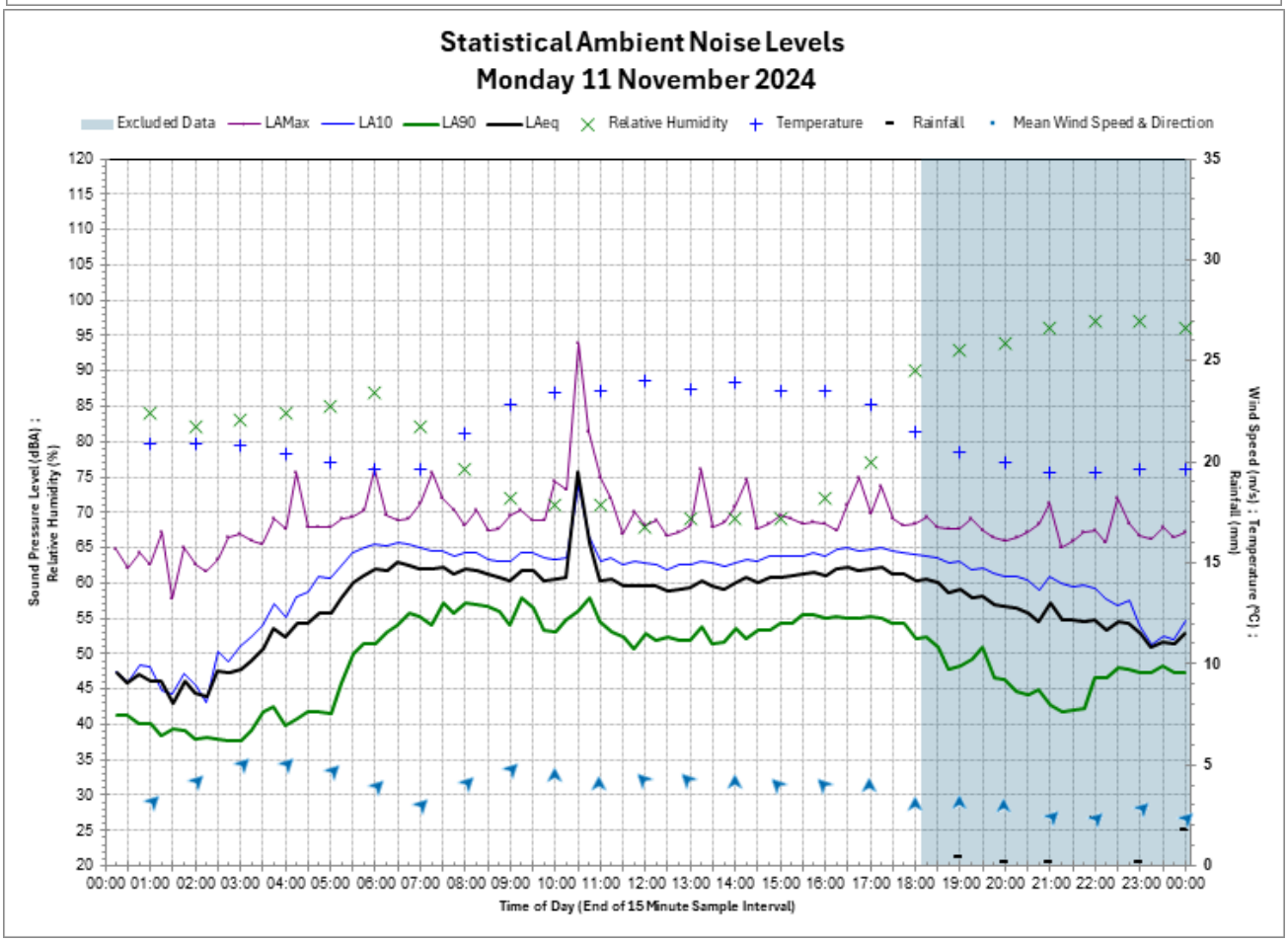

Statistical Ambient Noise Levels
Wednesday 6 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

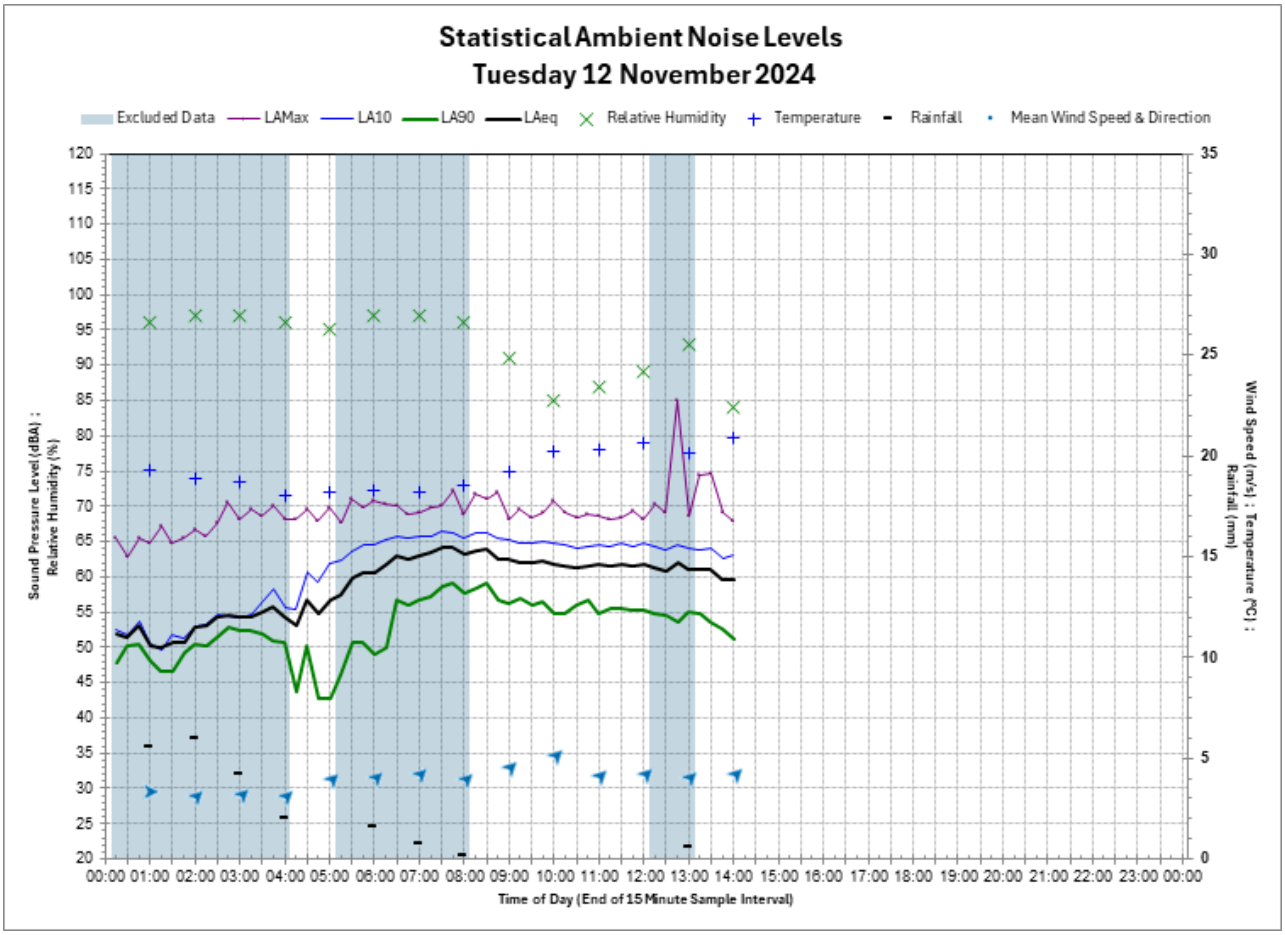

Statistical Ambient Noise Levels
Thursday 7 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Friday 8 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Saturday 9 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

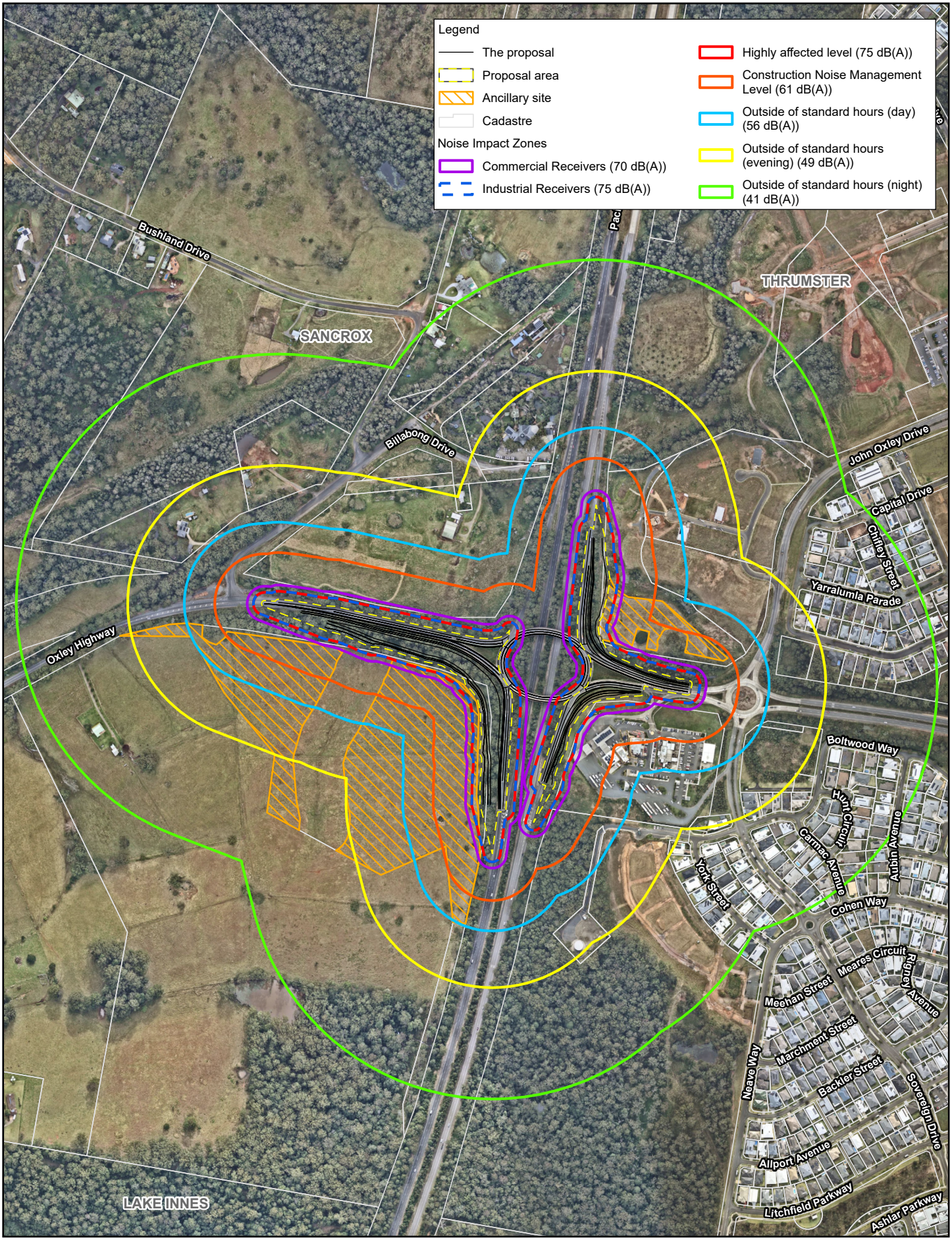

Statistical Ambient Noise Levels
Sunday 10 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Monday 11 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Tuesday 12 November 2024
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Appendix C

Construction Noise Contours



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

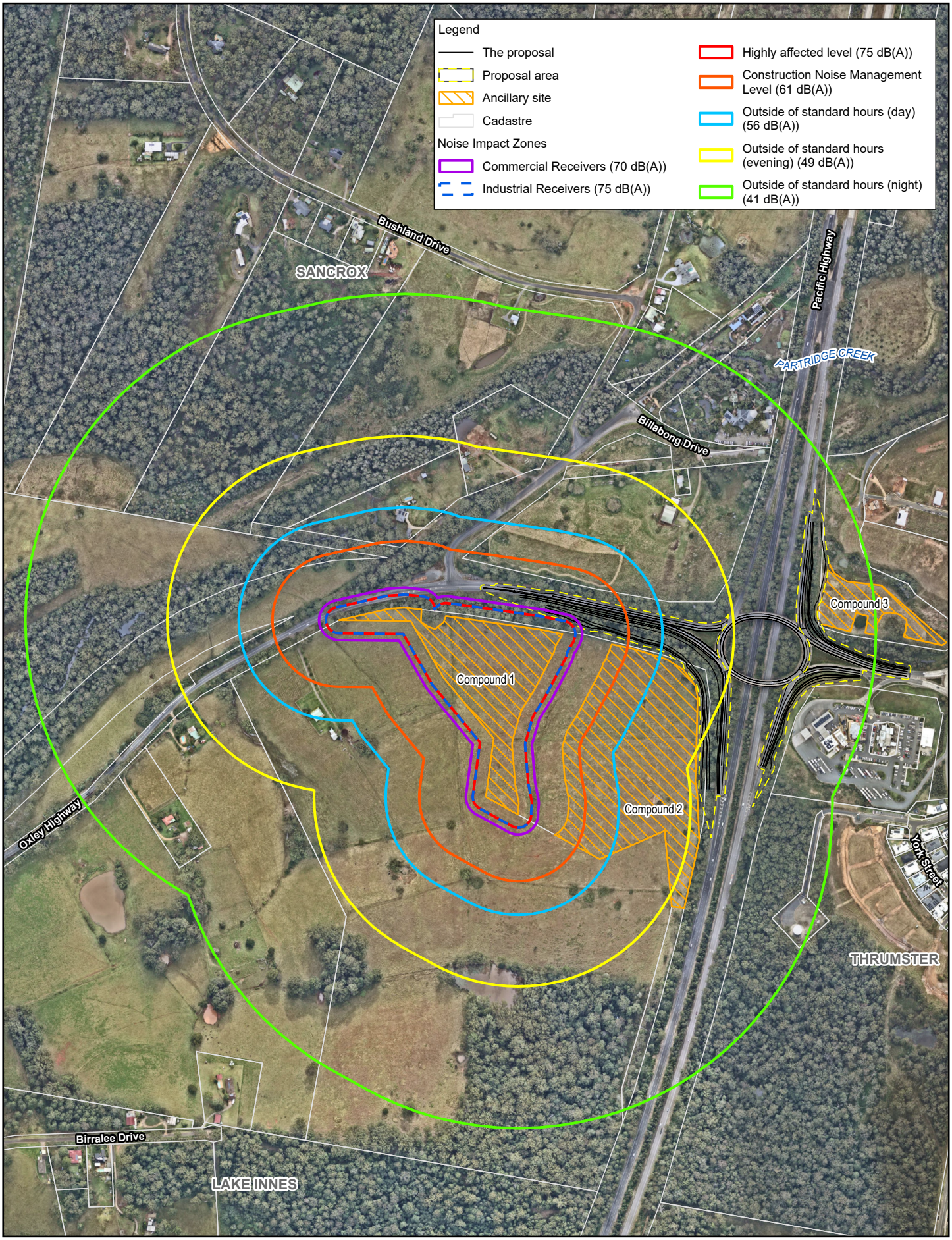
Mobilisation & Site Establishment

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-1

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

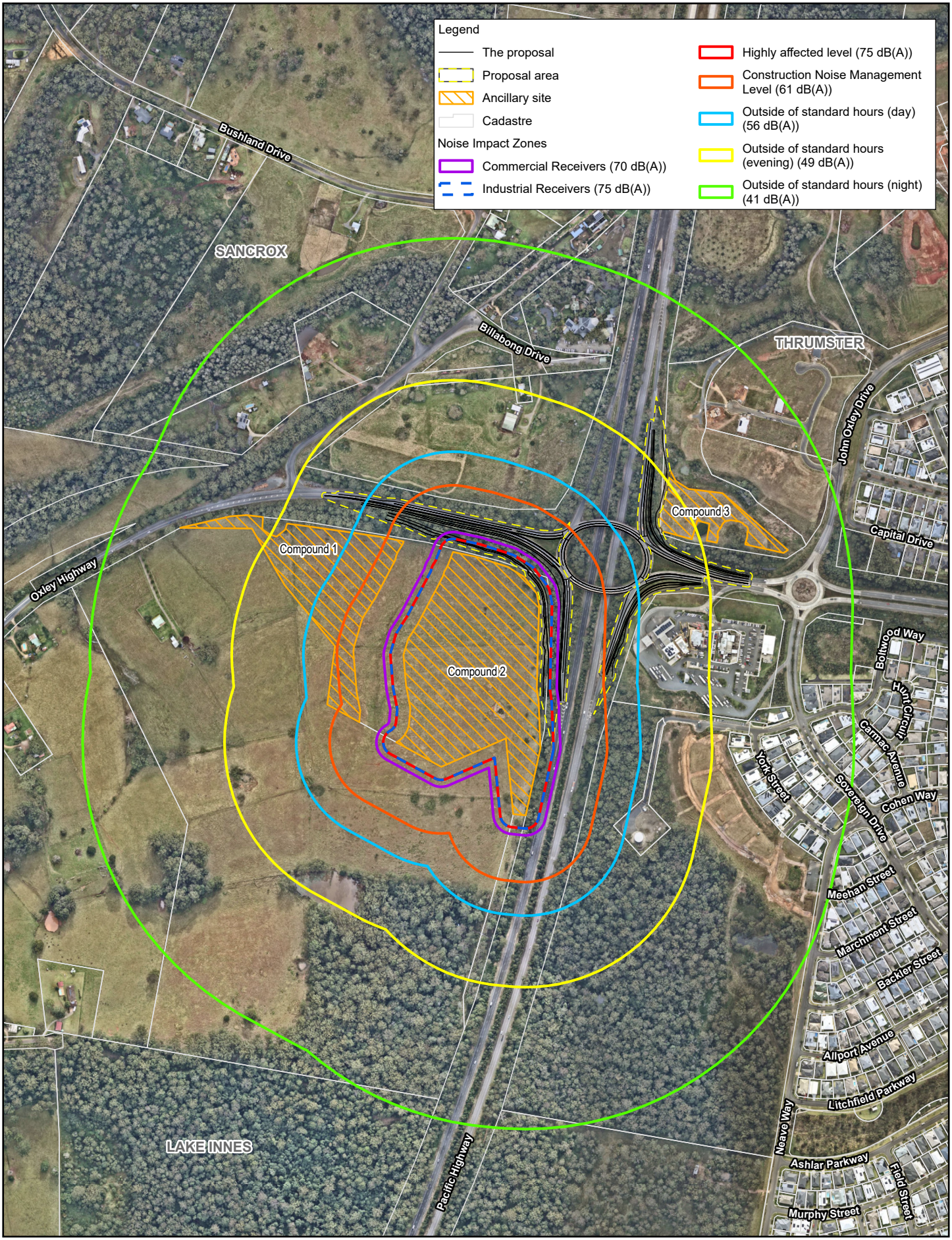
Compounds - compound 1

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-2a

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

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Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

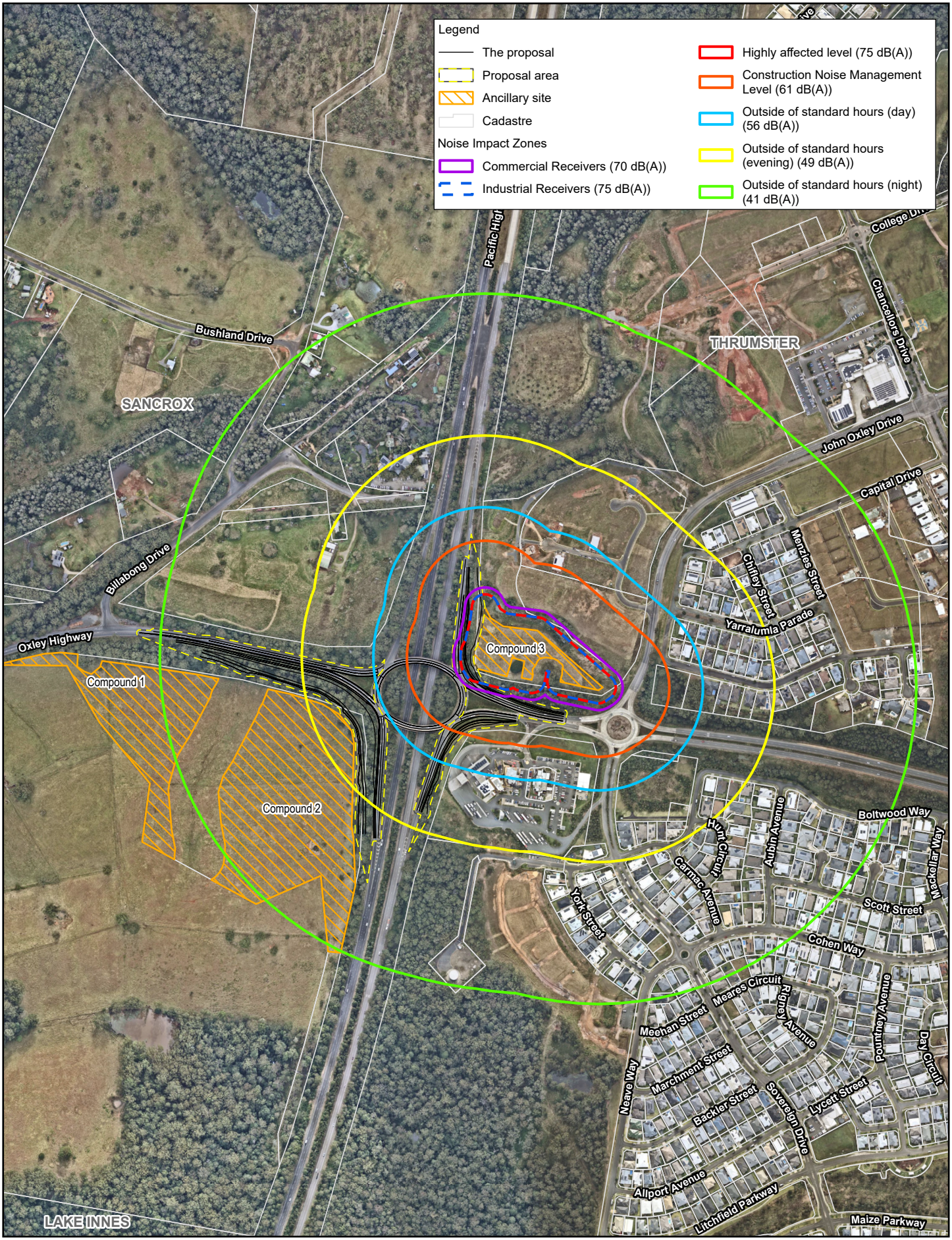
Compounds - compound 2

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-2b

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

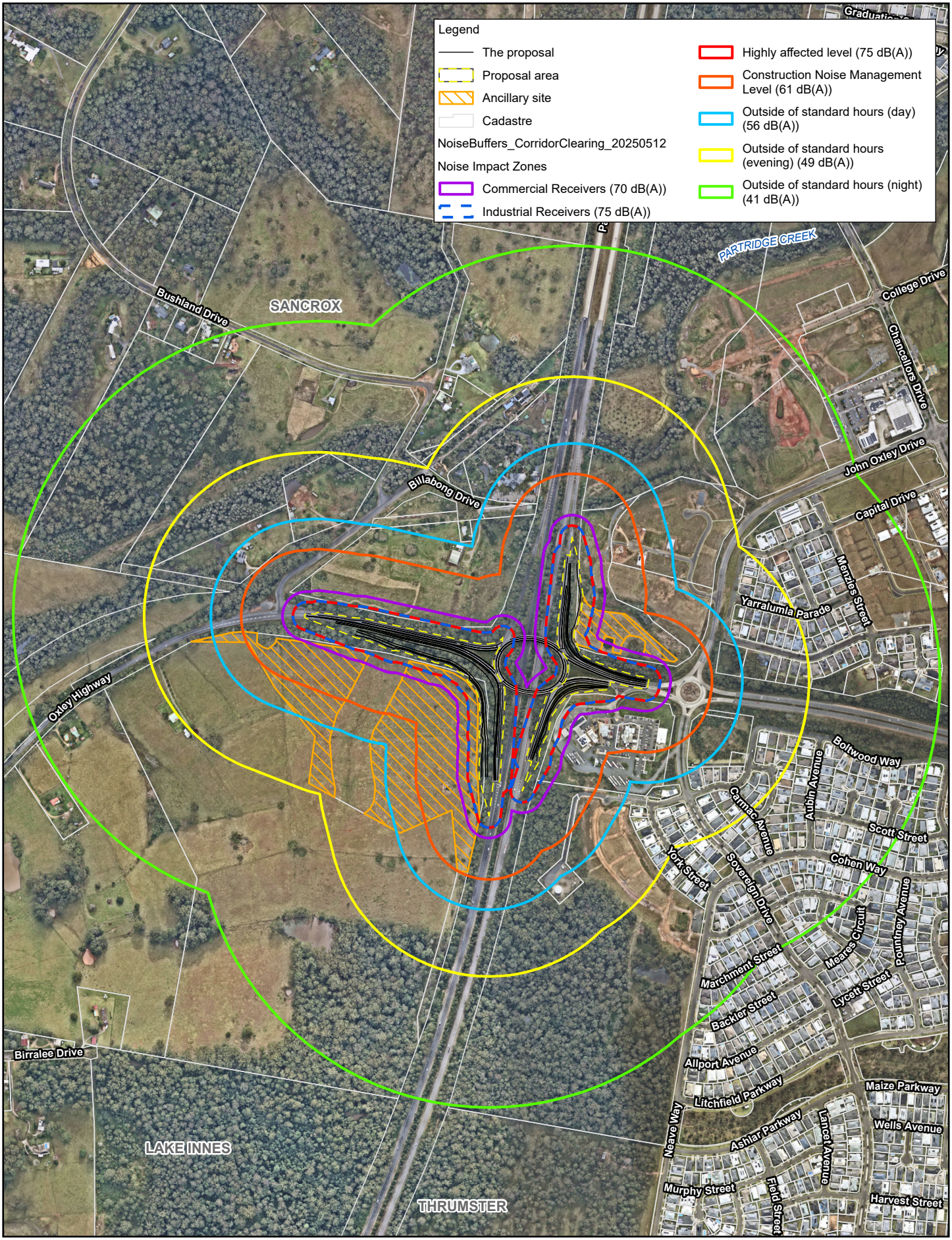
Compounds - compound 3

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-2c

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

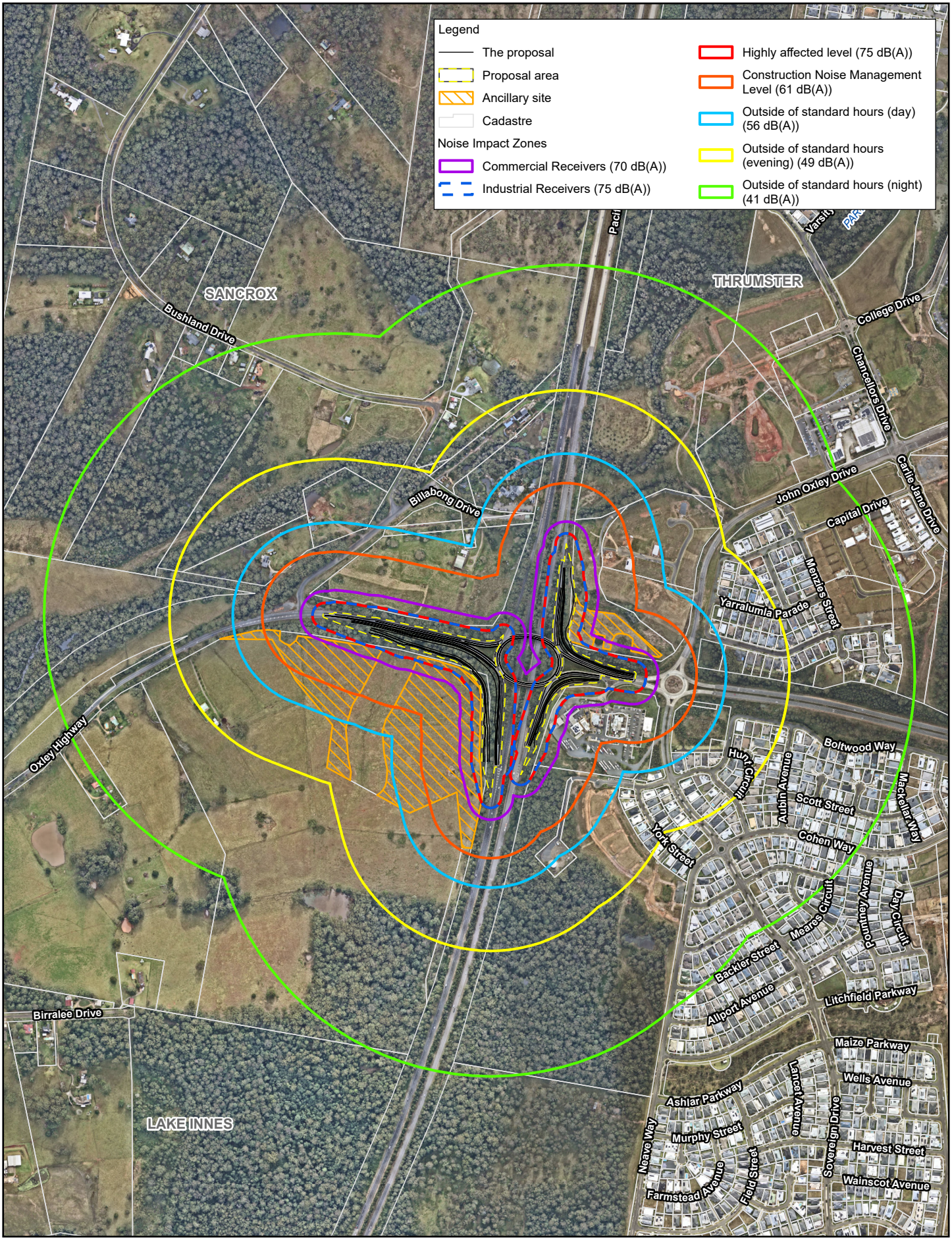
Corridor clearing

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-3

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

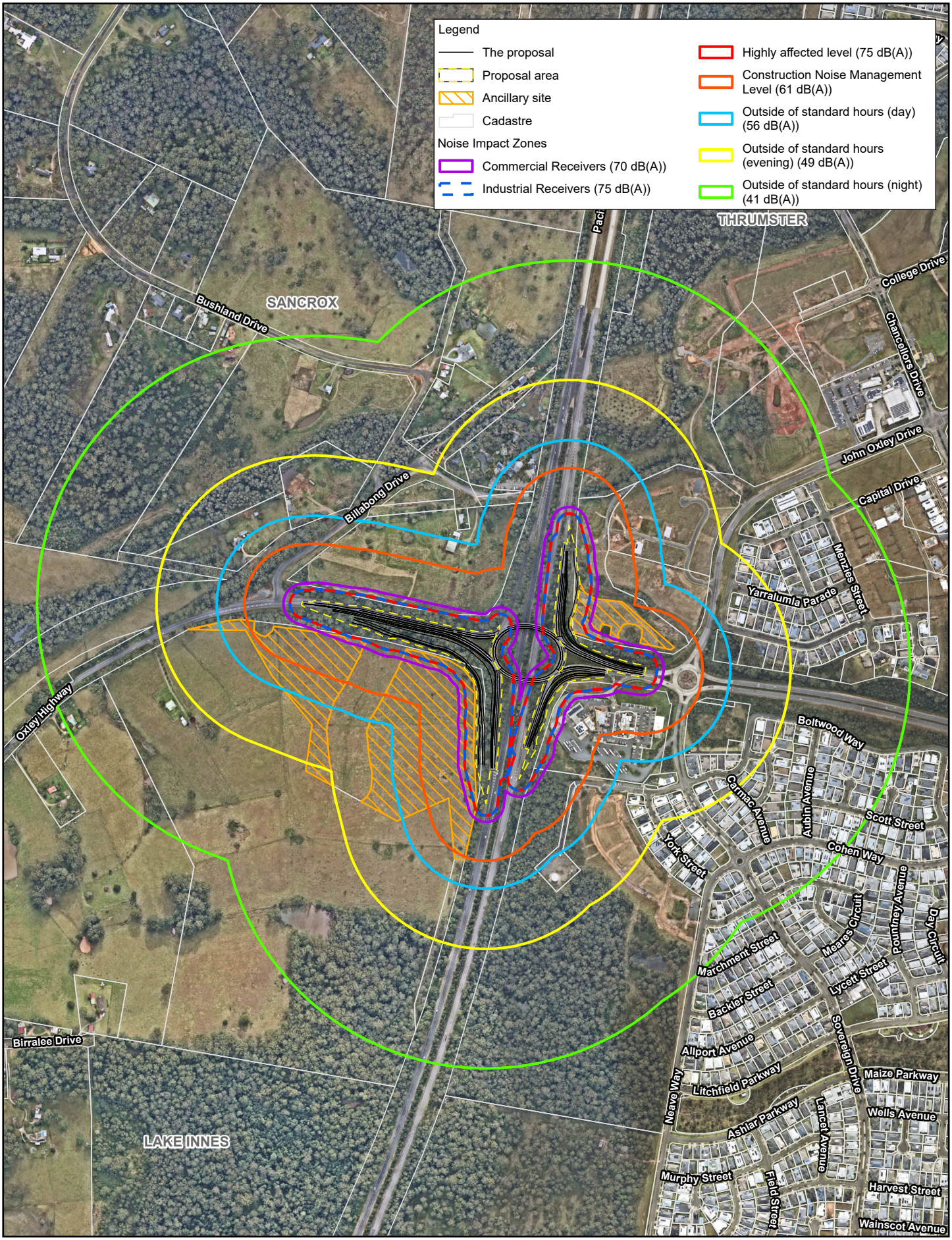
Bulk Earthworks

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-4

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

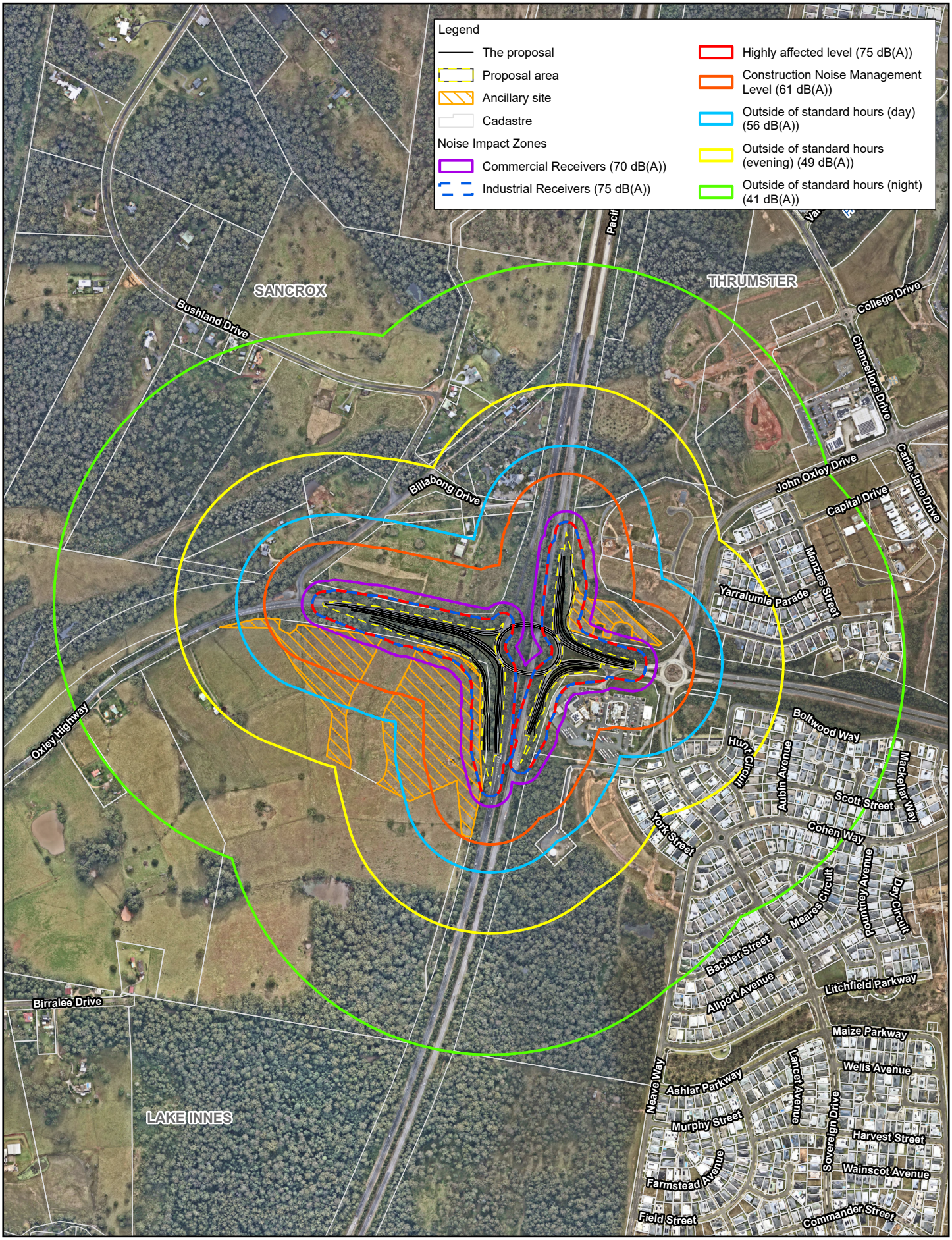
Drainage Infrastructure

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-5

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:47

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Disclaimer: Subject to detailed design

Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

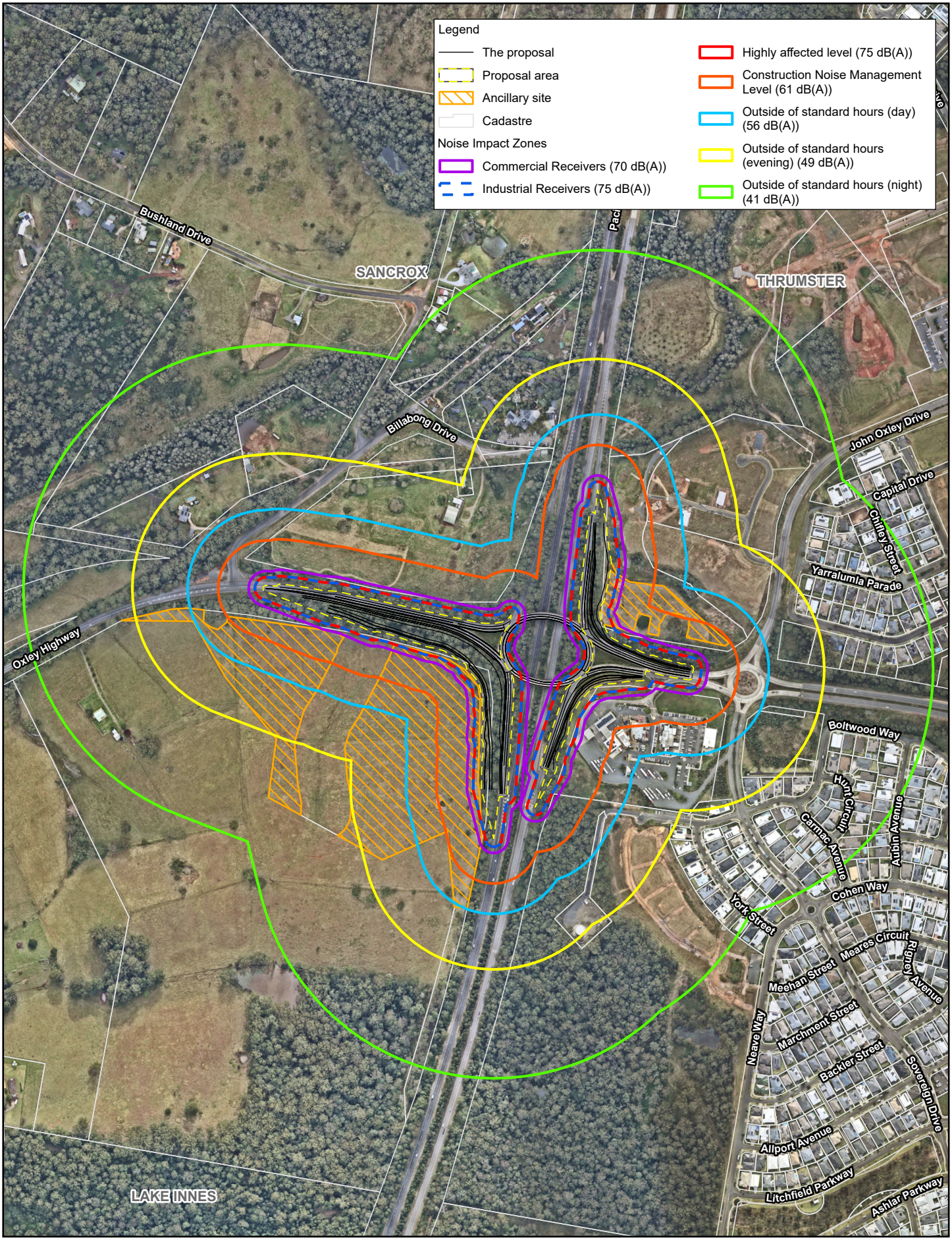
Paving / Asphalting

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-6

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:47

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

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Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

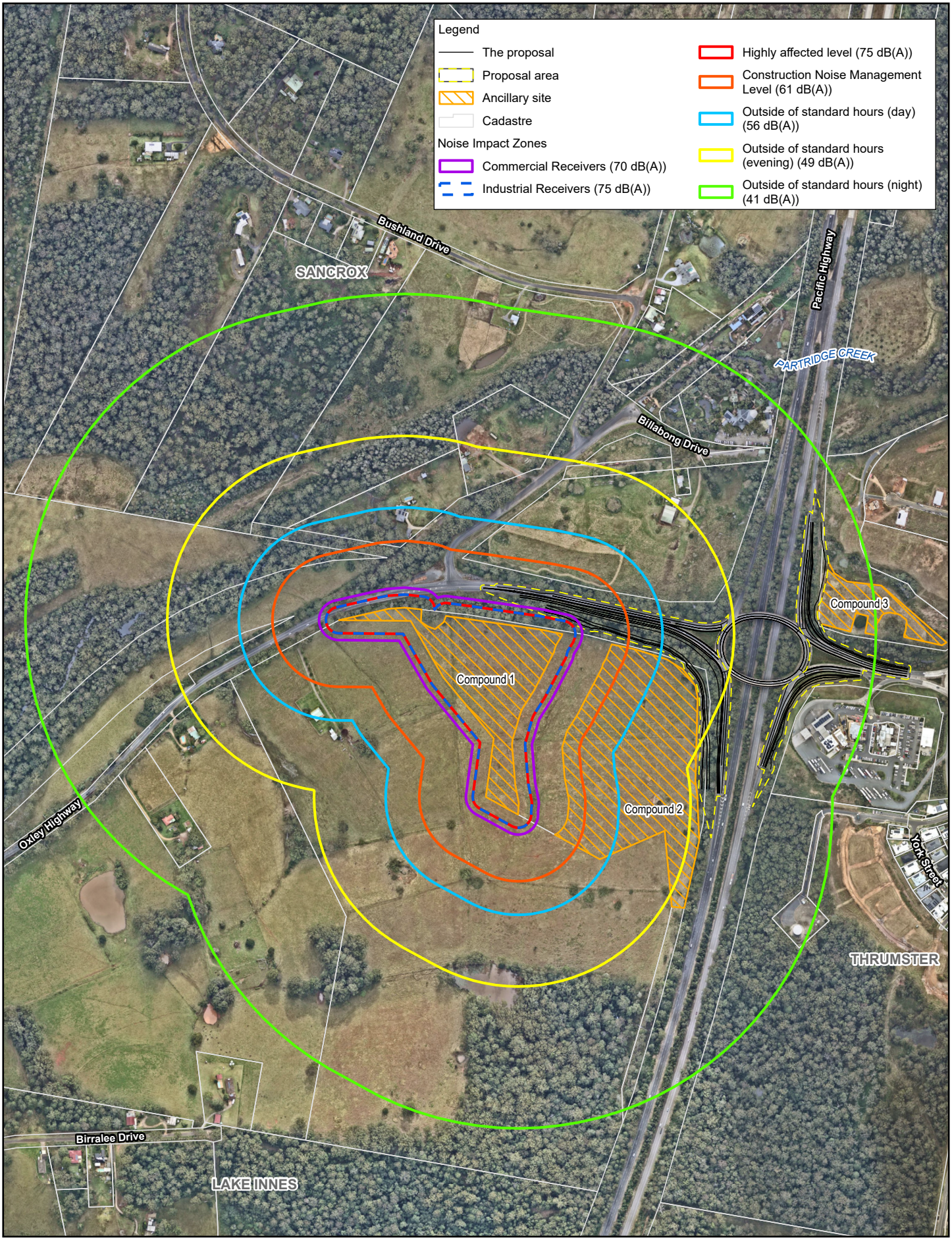
Road Furniture Installation

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-7

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

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Transport for NSW
Oxley Highway Interchange
Noise Impact Assessment

Compounds - compound 1

Project No. **12624683**
Revision No. **0**
Date **22 Jul 2025**

FIGURE A-2a

\\ghdnet\ghd\AU\Newcastle\Projects\22\12624683\GIS\Maps\12624683_Noise.aprx
Print date: 22 Jul 2025 - 14:46

Data source: NSW Spatial Services: General topography, Cadastre, 2024; TfNSW: The proposal, 2025; Nearmap: Imagery (Date extracted: 22/07/2025)Nearmap WMS Server: Nearmap WMS Server: . Created by: ehaverkamp

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