

Kurnell Terminal SSD-5544 MOD-7

Appendix H - Updated Noise & Vibration Impact
Assessment

16-Mar-2026

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Appendix H - Updated Noise & Vibration Impact Assessment

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Executive summary

The Kurnell Terminal (the Site) is located on the southern side of Botany Bay, in Kurnell, New South Wales (NSW). In 2012, Ampol Refineries (NSW) Pty Ltd (Ampol) decided that the oil refinery and fuel terminal would be converted to a finished product terminal (the approved project), ceasing refinery operations in 2014. Development consent was received to complete the approved project under State Significant Development (SSD) application reference 5544 (SSD-5544). Ampol has modified SSD-5544 six times to facilitate the conversion and demolition works.

Ampol intends to consolidate operational infrastructure, remove redundant assets, and undertake remediation. Completion of these works (the proposed modification, MOD-7) would continue the viable, safe, reliable, and sustainable operation of the Kurnell Terminal. The location within the Site that these works would occur is referred to as the Project Area.

The Noise and Vibration Assessment Report for the proposed modification was one of a number of technical documents that formed part of the Modification Report and supported the modification application. This Updated Noise and Vibration Assessment Report has been produced to address submissions received by agencies during the exhibition of the Modification Report and refinements to the proposed modification. It has been prepared to support the Submissions Report.

The construction activities have been assessed against the noise management levels (NML) determined in accordance with the EPA's Interim Construction Noise Guideline (ICNG) (DECC, 2009), as outlined in this report. The modelling adopted a conservative assumption of one item of each distinct equipment type operating concurrently for the entire 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. In reality, it is highly unlikely that all equipment would operate concurrently at the nearest location to sensitive receivers. An indicative timeline of construction activities has been provided.

The assessment considered four construction scenarios:

- Scenario 1 – All works up to Year 3, including preparation works and relocation of critical infrastructure, construction of new infrastructure in Zone 1, and remedial activities
- Scenario 2 – Construction of the new shed in Zone 1A (three months only)
- Scenario 3 – All works up to Year 3, including preparation works and relocation of critical infrastructure, construction of new infrastructure in Zone 1, construction of the new shed in Zone 1A (three months only), and remedial activities
- Scenario 4 – Remedial activities from Year 3 onwards.

Under these conservative assumptions, the predicted construction noise levels are expected to exceed the construction noise management levels at some noise sensitive receivers, at times during all of the construction scenarios. The following number of receivers could, under the highly conservative assumptions assessed, experience noise levels above the ICNG standard hours NMLs, under each construction scenario if works are occurring as close as possible to sensitive receivers:

- Up to 746 receivers during Scenario 1
- Up to 303 residential receivers during Scenario 2
- Up to 748 receivers during Scenario 3
- Up to 102 receivers for Scenario 4.

The majority of exceedances relate to noise levels which would be 'clearly audible', whilst other exceedances would be 'moderately intrusive' and a lesser number would be 'highly intrusive'. Construction noise levels at residential receivers are also predicted to exceed the 'highly noise affected' level of 75 dB(A). Up to 54 receivers for Scenario 1 could be highly affected under the conservative scenario assessed; up to eight receivers for Scenario 2; up to 66 receivers for Scenario 3; and no receivers in Scenario 4.

This is primarily due to works occurring in close proximity to residents, particularly along the northern boundary of the Site. These works would include construction of a new storage shed in Zone 1A to store boats and emergency aquatic spill response kits; relocation of the firewater system (FWS) into Zone 1, adjacent to Solander Street; and augmentation of FWS infrastructure in Zone 1, in close proximity to residences along Cook Street and Reserve Road. Each of these works would be undertaken for limited periods of time within the overall construction period, as shown in the indicative construction program, and would be predominantly limited to standard construction hours as defined by the ICNG (DECC, 2009).

Temporary groundwater dewatering would be required where groundwater accumulates in excavations. Dewatering pumps may be required to be in operation 24 hours per day during excavation activities, dependent on weather conditions. Provided minimum setback distances from the Site boundary are maintained, noise levels at residential receivers would meet the night-time NMLs at residential receivers.

Construction mitigation measures have been recommended to manage the potential construction noise impacts. These would include relevant feasible and reasonable noise mitigation measures as per the ICNG (DECC, 2009), a monitoring program to assess performance against relevant noise and vibration criteria, and arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures.

Minimal vibration intensive works are expected to take place. Vibration intensive works to occur onsite would be outside minimum working distances. For vibration intensive works, such as the use of hydraulic hammers, the minimum working distances provided in this report would be adhered to.

An assessment of the likely construction traffic indicated that noise increases on Captain Cook Drive would likely be less than 2 dB(A) during the peak construction periods and therefore no further consideration of construction traffic noise is required, in accordance with the NSW Road Noise Policy (DECC, 2011).

Results show predicted operational noise emissions from the proposed modification comply with the most stringent (night-time) operational noise criteria at all locations for typical operations. The operational noise assessment considers all existing and proposed operational equipment operating simultaneously at full capacity during the night-time period.

The FWS would be relocated within the FWS Relocation Area in Zone 1, including a new firewater tank, pumphouse, and pipework to allow it to service the terminal infrastructure. For the purpose of assessment in this *Updated Noise and Vibration Impact Assessment*, two indicative locations have been considered in the FWS Relocation Area, with specific siting to be selected during detailed design. Additional operational scenarios considering the monthly and annual testing of the system (daytime only) have been included. Operation would include three diesel engines that would be tested individually on a monthly basis and simultaneously on an annual basis.

The predicted operational noise emissions from the proposed modification for the Option 1 monthly FWS testing scenario would generally comply with criteria during the daytime under both neutral and noise-enhancing meteorological conditions, noting a minor exceedance of 2 dB at Marton Park under noise-enhancing meteorological conditions. An exceedance of 2 dB(A) is considered negligible, provided all feasible and reasonable noise mitigation measures have been considered. The Option 1 annual FWS testing scenario may also lead to exceedances of the criteria during the daytime at Marton Park under both neutral and noise-enhancing meteorological conditions, with exceedances of up to 4 dB(A) and 5 dB(A) respectively. However, it is noted that this testing only occurs once per year for a limited time (two hours).

The predicted operational noise emissions from the proposed modification for the Option 2 monthly and annual FWS testing scenario comply with the daytime operational noise criteria at all receivers under both neutral and noise enhancing meteorological conditions.

The main source of noise from the FWS would be the exhausts; as such, it is assumed that mufflers on the exhausts would be upgraded, providing improve performance of 5 dB at each octave band. Equipment specifications and noise mitigation measures would be verified at the detailed design stage.

On this basis, the modified operation of the approved project would not affect the ability of the terminal to meet the operational noise limits contained within the development consent for SSD-5544.

1.0 Introduction

1.1 Overview

The Kurnell Terminal (the Site) is located on the southern side of Botany Bay, in Kurnell, New South Wales (NSW) (Figure 1-1). In 2012, Ampol Refineries (NSW) Pty Ltd (Ampol) decided that the oil refinery and fuel terminal would be converted to a finished product terminal (the approved project), ceasing refinery operations in 2014.

Development consent was received to complete the approved project under State Significant Development (SSD) application reference 5544 (SSD-5544). Ampol has modified SSD-5544 six times to facilitate the conversion and demolition works.

Currently, the operational infrastructure is primarily located in the northern part of the Site (Zones 1 and 1A, as shown in Figure 1-1). Other parts of Ampol's landholdings at Kurnell include largely vacant areas of previously developed land (Zones 2 and 3) and areas of undeveloped land containing extensive native vegetation (Zones 4 and 5).

Ampol intends to consolidate operational infrastructure, remove redundant assets, and undertake remediation. Completion of these works (the proposed modification, MOD-7) would continue the viable, safe, reliable, and sustainable operation of the Kurnell Terminal. The location within the Site that these works would occur is referred to as the Project Area.

A Modification Report has been prepared to support a modification application to SSD-5544 and was placed on public exhibition for 23 days from Thursday 10 July 2025 until Friday 1 August 2025 in accordance with the *Environmental Planning & Assessment Act 1979* (EP&A Act).

The Noise and Vibration Impact Assessment Report for the proposed modification (prepared by AECOM in accordance with Ampol instructions) was one of a number of technical documents that formed part of the Modification Report. This Updated Noise and Vibration Impact Assessment Report has been produced to address submissions received by agencies during the exhibition of the Modification Report and refinements to the proposed modification. It has been prepared to support the Submissions Report.



Legend

- Site Boundary
- Ampol Ownership
- Project Area
- Former Refinery Area
- Operational Fuel Terminal
- Undeveloped Land
- Watercourse
- Primary Road
- Local Road



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Figure 1-1 Ampol Kurnell Terminal (the Site)

1.2 The proposed modification

1.2.1 Key elements of the proposed modification

To support the continued viable, safe, reliable, and sustainable operation of the Kurnell Terminal, the proposed modification works involve:

- **Stage 1 – Preparation works:** Preparing the Project Area for proposed modification works
- **Stage 2 – Removal, relocation and/or augmentation of infrastructure,** including:
 - Relocation and/ or augmentation of firewater systems (FWS) and oily water sewer (OWS) systems and construction of new operational facilities, including replacement warehouses
 - Decommissioning and removal of non-operational assets, redundant structures and electrical assets
- **Stage 3 – Remediation:** Addressing legacy ground contamination in specific locations across the Site
- **Stage 4 – Demobilisation:** Demobilisation of construction and remediation equipment.

Depending on where different works are required across the Site, these stages may be completed sequentially or concurrently.

A summary of project elements requiring modification and how they relate to the approved project is provided in Table 1-1. Infrastructure to be removed is presented in Figure 1-2, whilst infrastructure to be relocated or upgraded is presented in Figure 1-3. The proposed modification works would be undertaken within the Project Area.

All activities would adhere to the Kurnell Terminal permit to work system to ensure compliance with environmental and safety protocols.

Table 1-1 Modified project summary table

Stage	Element	Approved project	Modified project
Stage 1	Project Area	Project Area delineation	<ul style="list-style-type: none"> • Prepare the Project Area for the proposed modification works required under Stages 2 and 3 and exclude other parts of the Site from workers completing these works as required.
Stage 2	Oily water sewer (OWS)	Maintain location in Zones 2 and 3	<ul style="list-style-type: none"> • Divert surface water runoff from potentially contaminated areas in Zone 2 to OWS system in Zone 1 via new OWS interception pits/lines until Stage 3 remediation is complete • Divert potential leachate from Asbestos Contaminated Soils (ACS) Containment Cell in Zone 2 to Zone 1 OWS system • Install one new pump station and emergency storage tank adjacent to the ACS Containment Cell. Two indicative site options have been identified (refer to Figure 1-3) with specific siting to be selected during detailed design • Once Stage 3 remediation is complete in each specified area, isolate and remove redundant OWS infrastructure from identified areas in Zone 2 and Zone 3. Where complete removal is not feasible, existing pipes would be left in-situ.

Stage	Element	Approved project	Modified project
	Firewater systems (FWS)	Maintain location in Zone 1, 2 and 3	<ul style="list-style-type: none"> • Augment FWS infrastructure in Zone 1 and the centre of Zone 2 • Excavate and install footings for the new firewater tank, pumphouse, and pipelines • Construct new firewater tank and pumphouse within the FWS Relocation Area. Two indicative site options have been identified (refer to Figure 1-3) with specific siting to be selected during detailed design • Connect relocated firewater tank and pumphouse to existing FWS via new pipework • Commission new firewater tank, pumphouse, and pipework to confirm operation of amended FWS • Isolate and remove redundant FWS infrastructure from Zones 2 and 3 when appropriate.
	Electrical assets	Maintain location in Zone 2 and 3	<ul style="list-style-type: none"> • Isolate and remove redundant electrical assets in Zones 2 and 3, including five substations.
	Structures	Maintain location in Zone 2 and 3	<ul style="list-style-type: none"> • Construct new 'fit for purpose' warehouse to house maintenance supplies and activities in Zone 1 • Construct new Oil Spill Equipment Storeroom within Zone 1 • Construct new storage shed to house boats and emergency aquatic spill response equipment in Zone 1A • Demolish identified structures in Zones 2 and 3.
Stage 3	Remediation	Removal of ACS from pipeways and either containment onsite or offsite disposal	<ul style="list-style-type: none"> • Remediate identified land in Zone 1 to reduce operational site safety risks (refer to Figure 1-3) • If required, remediate land in Zone 1 where infrastructure is proposed to be relocated or augmented • Undertake targeted remediation in Zones 2 and 3 (refer to Figure 1-3) • Return excavated areas to existing ground levels, with the exception of RPIP Mountain (which would be regraded) and removal of the bund in Source Area Excavation 5.
Stage 4	Demobilisation	Demobilisation of construction equipment.	<ul style="list-style-type: none"> • Demobilisation of construction and remediation equipment.



Figure 1-2 Proposed modification – Infrastructure to be removed (Stage 2)

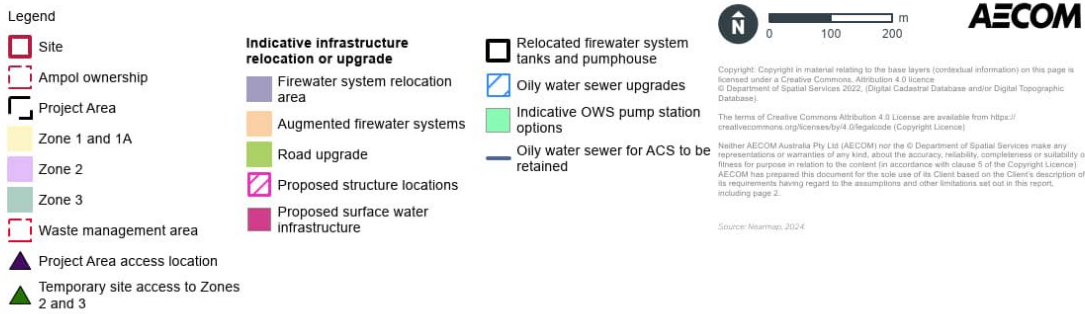


Figure 1-3 Proposed modification – Infrastructure to be relocated/ upgraded (Stage 2)



Figure 1-4 Targeted remediation activities (Stage 3)

Once the modification works are complete, the Site would continue to operate as described in the SSD documentation for the approved project and would be consistent with the development consent for SSD-5544.

In line with Figure 1-3, relocated equipment would operate in the new locations.

1.2.2 Construction timeline and equipment

Works would be staged in accordance with the indicative program in Table 1-2. Construction and remediation are anticipated to commence in 2026 and be completed by 2030.

In line with the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009), construction works would comply with following hours:

- Monday to Friday – 7am to 6pm
- Saturday – 8am to 1pm
- Sunday and public holidays – No work is permitted.

However, in line with Condition 20 of SSD-5544, construction works may be undertaken outside of the work hours identified above in the following circumstances:

- Works that are inaudible at nearest sensitive land receivers
- Works that are consistent with Ampol's existing maintenance procedures and are in accordance with EPL 837
- Works agreed to in writing by the EPA or DPHI
- For the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons
- Where it is required in an emergency to avoid the loss of lives, property and/ or to prevent environmental harm.

In addition, the following activities may be required on a 24-hour basis to support construction activities:

- Biopiling blowers in identified Biopiling Areas (refer to Figure 1-4). Given their proposed location within the Site, noise from the blowers would be inaudible at the nearest noise sensitive receivers.
- Dewatering of excavations. Dewatering would only occur at night in locations where plant would not exceed night-time limits, i.e.:
 - Where it is located a minimum of at least 200 m within the Site boundary; or
 - Where it is located a minimum of 120 m within the Site boundary if temporary noise barriers are positioned as near as practicable to the pumps, and monitoring confirms that nighttime noise limits are not exceeded.

Plant and equipment that would be used to deliver the modification works is shown in Table 1-3.

Table 1-3 Indicative plant and equipment

Plant/ equipment	Maximum number of plant and equipment required per day		
	All stages except Stage 3		Stage 3 (Remediation) only
	Entire Site	Zone 1A	
Front end loader	6	2	6
Excavator	-	2	6
Excavator (including large hydraulic hammer)	6	-	-
Dump truck	6	2	6
Grader (up to 7 m blade)	2	1	4
Large crane (60 t)	4	1	-
Elevated work platform	6	4	-
Franna crane (30 t)	6	1	-
Cement truck	6	2	-
Bobcat	6	2	2
Water cart	6	2	6
Concrete crusher	1	-	-
Telehandler	6	-	-
Truck and dog (offsite disposal)	6	6	6
Truck and dog (imported fill)	-	6	12
Generator	2	1	2
Biopiling blower	-	-	8
Dewatering pump	6	-	6

1.2.3 Other relevant elements of the proposed modification

Operational activities

The FWS would be relocated within the FWS Relocation Area in Zone 1, including a new firewater tank and pipework to allow it to service the terminal infrastructure, with specific siting to be selected during detailed design.

For the purpose of assessment in this Updated Noise and Vibration Assessment Report, two indicative locations have been considered for the relocation of the FWS, which have been selected based on optioneering completed in the concept design phase in consultation with key stakeholders, such as Firewater and Process Safety Subject Matter Experts. The location of each option is shown Figure 1-5.



Figure 1-5 Relocated FWS – Indicative locations

Operation and maintenance of the relocated FWS would be consistent with existing operations. The FWS would include three diesel engines used to operate FWS pumps housed within an enclosed area. Regular maintenance testing of the pumps would include:

- Operation of all three pumps separately for approximately half an hour once a month
- One annual maintenance test of all three pumps simultaneously conducted over a two-hour period once per year.

1.3 Purpose of this report

This Updated Noise and Vibration Impact Assessment Report is one of a number of technical documents that forms part of the Submission Report for the proposed modification. The purpose of this report is to understand potential impacts of the proposed modification upon noise and vibration.

2.0 Existing environment

2.1 The surrounding area

The Site is located in the Sutherland Shire Local Government Area (LGA), on the Kurnell Peninsula in Sydney, NSW. The closest residential area to the Project Area is Kurnell, which is located adjacent to the north and north-west boundaries of the Site.

The Site is bounded by the Kamay Botany Bay National Park to the south and east, Captain Cook Drive to the north-west, and St Joseph Banks Drive to the south-west. The northern Site boundary is bordered by Solander Street, a small southern section of Cook Street, light industry, residential dwellings off the eastern side of Cook Street, and undeveloped land on the southern side of Reserve Road. The Eastern Right of Way (Zone 1A) is bounded by Prince Charles Parade to the north, and residential dwellings along Prince Charles Parade, Captain Cook Drive and Cook Street along the east and west.

There are a number of reserves in proximity of the Site. Marton Park, comprising a developed recreational park area and an undeveloped wetland area, is located adjacent to the northern boundary of the Site on the northern side of Solander Street. Captain Cook's Landing Place Park is located approximately 500 m to the north of the Site, while Bonna Point Reserve is located approximately 1.4 km north-west of the Site. Towra Point Nature Reserve is a Ramsar wetland and located west of the Site, on the opposite side of Captain Cook Drive. Quibray Bay also includes Towra Point Aquatic Reserve which, whilst not part of Towra Point Nature Reserve or Ramsar wetland, forms a wider ecosystem with it. To the north of Kurnell is Botany Bay, a large bay with a diverse number of uses and habitats and where the Georges and Cooks Rivers meet before joining the Pacific Ocean.

2.2 Noise sensitive receivers

Residential receivers which could potentially be affected by the proposed modification are located within the Kurnell township. The closest residential receivers directly adjoin some works areas (within Zone 1A). The assessment receiver locations for the operational noise assessment, along with the land use classification (as defined in the *Noise Policy for Industry* (NPfI) (EPA, 2017)), of each receiver are presented in Table 2-1. All receivers within the Kurnell township area have been considered for the construction noise assessment as per the methodology presented in Section 3.2.

Table 2-1 Operational noise assessment receiver locations

Receiver	Address	Land use classification
R1	16 Tasman Street, Kurnell	Residential – Suburban
R2	3 Torres Street, Kurnell	Residential – Suburban
R3	127 Captain Cook Drive, Kurnell	Residential – Suburban
R4	41 Cook Street, Kurnell	Residential – Suburban
R5	30D Cook Street, Kurnell	Residential – Suburban
R6	7 Jeffrey Street, Kurnell	Residential – Suburban
R7	8 Bridges Street, Kurnell	Residential – Suburban
R8	9 Bridges Street, Kurnell	Residential – Suburban
E1	96 Captain Cook Drive, Kurnell (Marton Community Hall)	Education
AR1	92-94 Captain Cook Drive, Kurnell (Marton Park)	Active Recreation Area
PR1	Kamay Botany Bay National Park	Passive Recreation Area
PR2	Kamay Botany Bay National Park	Passive Recreation Area

Receiver	Address	Land use classification
C1	160 Captain Cook Drive, Kurnell (Kurnell Recreation Club)	Commercial
I1	171-189 Captain Cook Drive, Kurnell (Ausgrid substation)	Industrial
I2	58-64 Cook Street, Kurnell	Industrial
I3	18-28 Sir Joseph Banks Drive, Kurnell	Industrial
I4	21 Sir Joseph Banks Drive, Kurnell	Industrial

Compliance with the relevant operational noise criteria at the receivers outlined in Table 2-1 would result in compliance with the criteria at other residential and non-residential receivers located further away from the Site. Noise sensitive receivers are shown in Figure 2-1 Although receivers outlined in Table 2-1 are not all two storey residences, noise levels at the receivers have been assessed at 1.5 m and 4.5 m to represent the two storey affected receivers in the vicinity of the Project.

Operational receivers have been selected based on the primary operational areas of the Site. Operational activities occurring in satellite areas external to the main site (i.e. Zone 1A) must also operate within the noise limits outlined in EPL 837.



Legend

Project Area

Site

Ampol Land Ownership

Existing Noise Wall

Sensitive Receivers

Sensitive Receivers

Commercial

Community

Education

Industrial

Place of Worship

Residential

Terminal Infrastructure

Long term noise loggers

Noise Catchment Area (NCA)



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Source: Neormap, 2022.

Figure 2-1 Site location and assessment receivers (operational and construction)

2.3 Unattended noise monitoring

2.3.1 Study area

All areas where construction or operational elements of the proposed modification would take place are encompassed within the Project Area, which is presented in Figure 1-2.

The study area for the noise and vibration assessment includes all locations that may be affected during construction of the proposed modification. This considered noise and vibration sensitive receivers within 2 km of the Project Area and has been split into two noise catchment areas (NCAs) based on similar acoustic environments (refer to Figure 2-1). The NCAs were determined by reviewing existing land use and identifying groups of noise sensitive receivers which are likely to be exposed to a similar noise environment.

2.3.2 Noise monitoring

Long-term unattended noise monitoring was previously undertaken at two representative locations within the NCAs, to establish the existing ambient and background noise environment in the vicinity of the Project Area. The locations are shown in Figure 2-1. Noise monitoring was conducted between Thursday 19 and Friday 27 October 2023. The noise loggers were placed at:

- Noise Logger 1 (NL2) – 11 Reserve Road, Kurnell
- Noise Logger 2 (NL1) – 9 Tasman Road, Kurnell.

The monitoring locations were selected as they are considered representative of the noise environments of their respective residential clusters.

The equipment used for the unattended noise monitoring is detailed in Table 2-2.

Table 2-2 Unattended noise monitoring equipment

Location	Equipment	Serial number
11 Reserve Road (NL2)	Rion NL-52	164394
9 Tasman Road, Kurnell (NL1)	Rion NL-52	1043455

All the acoustic instrumentation employed during the noise monitoring and measurements comply with the requirements of Australian/New Zealand Standard AS/NZS IEC 61672.1:2019 *Electroacoustics – Sound level meters – Part 1: Specifications* and were calibrated prior to and after the monitoring session with a drift in calibration not exceeding ± 0.5 dB.

All instruments used were within their current National Association of Testing Authorities certified in-calibration period (i.e. calibrated in the last two years).

In accordance with the excluded. The NPfI advises that data may be affected where adverse weather, such as wind speeds higher than 5 m/s or rain, occurs.

2.3.3 Noise monitoring results

The background noise level is defined by the EPA as *'the underlying level of noise present in ambient noise... when extraneous noise is removed.'* It can include sounds that are typical features of a location and may include birds, traffic and insects. The background noise level is represented by the L_{A90} descriptor. The noise levels previously measured provide a single rated background level (RBL) for each day, evening and night period in accordance with the NPfI, for each monitoring location. The RBL is established by determining the lowest ten percentile level of the L_{A90} noise data acquired over each period of interest. A summary of the measurement data is presented in Table 2-3.

Table 2-3 Existing background (L_{A90}) and ambient (L_{Aeq}) noise levels around subject site

Noise monitoring location	L_{Aeq} ambient noise levels, dB(A)			L_{A90} background noise levels, dB(A)		
	Day ¹	Evening ¹	Night ¹	Day ¹	Evening ¹	Night ¹
NL1	55	49	47	37	36	36
NL2	57	57	50	40	38	34

1. Day is defined as 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays.
Evening is defined as 6pm to 10pm Monday to Sunday and Public Holidays.
Night is defined as 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

2.4 Attended ambient noise measurements

Attended noise measurements were conducted at each unattended monitoring location on 19 October 2023. Each measurement was conducted over a 15-minute period.

These measurements were conducted using a Brüel & Kjær Type 2250 sound level meter. The sound level meter used is designated as a Class 1 instrument and has accuracy suitable for laboratory and field use. The sound level meter was calibrated before and after the measurements with a no drift in calibration exceeding ± 0.5 dB.

The results of the attended noise monitoring are presented in Table 2-4. The daytime measurements indicated that residential receivers are generally affected by road industrial noise and aircraft noise.

Table 2-4 Attended noise measurement results

Location	Time	L_{Aeq} , dB(A)	L_{A90} , dB(A)	Comments
NL1	11:41am	47	40	Birds chirping, dogs barking occasionally. Birds 43-44 dB(A). Plane flyover 54 dB(A) instantaneous. Minimal road traffic. Industrial hum and birds dominant noise source.
NL2	11:18am	59	41	Flight arrivals at airport 76 dB(A). Distant traffic from main road. No car pass by on Tasman Street. General industrial hum and distant traffic noise. Car pass by on Captain Cook Road about 47 dB(A).

2.5 Attended site noise measurements

Attended noise measurements were conducted within the Ampol Kurnell Terminal on 5 September 2023 and 21 August 2024. Each source measurement was conducted over a period deemed to be representative of typical operation. Weather conditions were clear and calm on each day of monitoring.

Attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meter. The sound level meter used is designated as a Class 1 instrument and has accuracy suitable for laboratory and field use. The sound level meter was calibrated before and after the measurements with a no drift in calibration exceeding ± 0.5 dB.

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "AS IEC 61672.1-2019 Electroacoustics - Sound level meters – Specifications" and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

Table 2-5 presents the attended noise measurements of existing sources within the Site.

Table 2-5 Attended noise measurements

No.	Date and time	L _{Aeq} dB(A)	L _{A90} dB(A)	Comments
1	05/09/2023 12:15pm	80	79	Adjacent to Tank 166, 1 of 2 jet fuel pumps operating (measured at 5 m from operating pump)
2	05/09/2023 12:23pm	84	83	Adjacent to Tank 204, 1 of 4 gasoline transfer pumps operating (measured at 4 m from operating pump)
3	05/09/2023 12:33pm	84	84	Adjacent to Aerobic Digester Tank, wastewater treatment air blower exhaust (measured at 8 m from exhaust, at ground level)
4	05/09/2023 12:35pm	81	80	Adjacent to Aerobic Digester Tank, wastewater treatment air blower outlet (measured at 6 m from outlet)
5	05/09/2023 12:48pm	78	73	Wastewater pumping area, 1 of 2 small pumps operating (measured at 3 m from operating pump)
6	05/09/2023 12:52pm	87	86	Wastewater pumping area, 1 of 3 treated effluent pumps operating (measured at 1.5 m from operating pump)
7	21/08/2024 11:18am	90	89	Southern firewater system pumphouse with one diesel powered pump operating (measured 3 m from side of engine case, with access panel closed)
8	21/08/2024 11:22am	92	92	Southern firewater system pumphouse with one diesel powered pump operating (measured 3 m from air intake)
9	21/08/2024 11:24am	94	93	Southern firewater system pumphouse with one diesel powered pump operating (measured 2 m from exhaust)

3.0 Assessment methodology

3.1 Relevant legislation and guidelines

Applicable legislation, regulation, and policy for this noise and vibration impact assessment (NVIA) for the construction assessment include:

- *Interim Construction Noise Guideline*, Department of Environment and Climate Change, NSW (ICNG, DECC 2009)
- *Assessing Vibration: a technical guideline*, Department of Environment and Conservation (AVTG, DEC 2006)
- *NSW Road Noise Policy*, Department of Climate Change, Environment and Water, NSW (RNP, DECCW 2011)
- Australian Standard 1055 *Acoustics – Description and measurement of environmental noise – Part 2: Application to specific situations*, AS 1055.2-1997.

Applicable legislation, regulation, and policy for this NVIA for the operational assessment include:

- *NSW Protection of the Environment Operations Act 1997* (POEO Act 1997)
- *NSW Noise Policy for Industry*, NSW Environment Protection Authority (NPfl, EPA 2017).

3.2 Construction noise criteria

3.2.1 EPA's Interim Construction Noise Guideline

The EPA's *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) has been used to determine the impact of proposed construction activities based on recent ambient noise levels.

The potential risk of adverse impact of construction noise on a receiver is determined by the extent of its emergence above the existing background noise level, the duration of the event and the characteristics of the noise.

The ICNG is a NSW Government document (DECC, 2009) that identifies ways to manage impacts of construction noise on residences and other sensitive land uses. It is the principal guideline for the assessment and management of construction noise in NSW and is used to establish construction noise management levels (NMLs).

As the construction stage of the proposed modification is expected to continue for a period of more than three weeks and some construction activities would occur within relatively close proximity to noise sensitive receivers at times, a quantitative assessment based on 'reasonable' worst case construction scenarios, has been carried out for the proposed modification, in accordance with this guideline.

Noise levels resulting from construction activities were predicted at nearby noise sensitive receivers using environmental noise modelling software SoundPLAN 8.2, industry standard noise modelling software, and compared to the NMLs, derived in accordance with the ICNG.

Where an exceedance of the noise management levels is predicted, the ICNG advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially affected residents of the nature of the works to be carried out, the expected noise level and duration, as well as provide contact details to facilitate feedback from affected residents during construction.

Where construction noise levels at a receiver reach 75 dB(A), residential receivers are considered to be 'highly noise affected' and the proponent should, in consultation with the community, consider restrictions to the hours of construction to provide respite periods.

The ICNG defines what is considered to be feasible and reasonable as follows:

Feasible

A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.

Reasonable

Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.

The NMLs for the residential receivers in proximity to the Project Area are detailed below. Guidance for setting construction NMLs for residential receivers is summarised in Table 3-1.

Table 3-1 Setting and applying construction noise management levels for residential receivers (ICNG)

Time of day	NML, $L_{Aeq,15min}$, dB(A) ¹	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	'Noise affected' level RBL + 10 dB	The 'noise affected' level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	'Highly noise affected' level 75 dB(A)	The 'highly noise affected' level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	NML, $L_{Aeq,15min}$, dB(A) ¹	How to apply
Outside recommended standard hours	'Noise affected' level RBL + 5 dB	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.</p> <p>For guidance on negotiating agreements see section 7.2.2 (ICNG).</p>

1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Summary of proposed modification residential noise management level

Details of the proposed modification construction NMLs for residential receivers in each NCA are provided in Table 3-2. The NMLs are based on the measured background noise levels at each NCA, refer to Section 2.3 for details of existing measured background noise levels at each NCA.

Table 3-2 Noise catchment areas and construction noise management levels – Residential land uses

NCA	Representative logger	Period	RBL, L_{A90} dB(A)	Construction noise management level (NML)	
				Standard hours ¹ , $L_{Aeq,15min}$, dB(A)	Out of hours ² , $L_{Aeq,15min}$, dB(A)
1	NL1	Day	37	47	42
		Evening	36	N/A	41
		Night	36	N/A	41
2	NL2	Day	40	50	45
		Evening	38	N/A	43
		Night	34	N/A	39

1. Standard construction working hours are Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm:
Day noise management levels = RBL + 10 dB
2. Outside of standard construction hours:
Day out of hours noise management level = RBL + 5 dB, day refers to Saturday from 1 pm to 6 pm, Sunday 8 am to 6:00 pm and public holidays.
Evening/night noise management level = RBL + 5 dB

Transport for NSW's Construction Noise and Vibration Guideline (Roads) (Transport for NSW, 2024) sets out community perceptions of construction noise dependent upon the level of exceedance of the rating background level and NMLs. These are presented in Table 3-3.

Table 3-3 Community perception of construction noise

Perception	dB above rating background level	dB above noise management level – Standard hours	dB above noise management level – Out of hours
Noticeable	5 to 10	0	0 to 5
Clearly audible	11 to 20	0 to 10	6 to 15
Moderately intrusive	21 to 30	11 to 20	16 to 25
Highly intrusive	>30	>20	>25

Non-residential noise management level

Construction NMLs recommended by the ICNG for non-residential sensitive land uses, such as schools, hospitals, or places of worship are provided in Table 3-4. NMLs for commercial and industrial premises are provided in Table 3-5.

To allow for external noise criteria to be set, it has been assumed that open windows would provide a 10 dB reduction from outside noise sources to indoors. Therefore, the external noise criteria for non-residential receivers provided in Table 3-4 and Table 3-5 has been set 10 dB above the internal noise level.

Table 3-4 Construction noise management levels – Non-residential sensitive land uses

Land use	Construction noise management level, $L_{Aeq,15min}$ (external)
Education (classrooms at schools and other educational institutions)	55 dB(A) ¹
Places of worship	55 dB(A) ¹
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended upper internal levels in AS/NZS 2107 for specific uses.

1. Internal criteria given in the ICNG. For the purposes of this assessment, it is assumed that an open window would achieve a 10 dB noise reduction from outside to inside.

Table 3-5 Construction noise management levels – Commercial and industrial land uses

Land use	Construction noise management level, $L_{Aeq,15min}$
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)

3.2.2 Construction hours

As noted in Section 1.2.2, construction works would comply with following hours:

- Monday to Friday – 7am to 6pm
- Saturday – 8am to 1pm
- Sunday and public holidays – No work is permitted.

Refer to Section 1.2.2 (Construction timeline and equipment) for exclusions to this. In addition, biopiling blowers may operate on a 24-hour basis in identified Biopiling and Stabilisation Areas (refer to Figure 1-4). Given their location within the Site, noise from the blowers would be inaudible at the nearest noise sensitive receivers.

3.2.3 Construction road traffic noise criteria

Noise from construction traffic on public roads is not covered by the *ICNG*. However, the *ICNG* does refer to the *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999), now superseded by the *Road Noise Policy* (RNP), (DECCW, 2011) for the assessment of noise arising from construction traffic on public roads.

In accordance with the RNP, to assess noise impacts from construction traffic, an initial screening test should be undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A). Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion, then noise mitigation should be considered for those receivers affected. The road category specific criteria are presented in Table 3-6 below. The RNP does not require assessment of noise impacts to commercial or industrial receivers.

Table 3-6 Road traffic noise assessment criteria

Road category	Type of land use	Assessment criteria, dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/ arterial/ sub-arterial roads generated by land use developments	L _{Aeq,15hr} 60 dB(A)	L _{Aeq,9hr} 55 dB(A)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	L _{Aeq,1hr} 55 dB(A)	L _{Aeq,1hr} 50 dB(A)

3.2.4 Construction vibration criteria

3.2.5 Construction vibration objectives

The relevant standards and guidelines for the assessment of construction vibration are summarised in Table 3-7.

Table 3-7 Standards/guidelines used for assessing construction vibration

Item	Standard/guideline
Structural damage	Heritage structures – German Standard DIN 4150 – Part 3 – Structural Vibration in Buildings – Effects on Structures Non-heritage structures – Evaluation and Measurement for Vibration in Buildings Part 2, (British Standard (BS) 7385:Part 2-1993)
Human comfort (tactile vibration)	Assessing Vibration: A Technical Guideline ¹

1. This document is based upon the guidelines contained in British Standard 6472:1992, "Evaluation of human exposure to vibration in buildings (1-80 Hz)." This British Standard was superseded in 2008 with BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting" and the 1992 version of the Standard was withdrawn. Although a new version of BS 6472 has been published, the Environment Protection Authority still requires vibration to be assessed in accordance with the 1992 version of the Standard at this point in time.

Vibration, at levels high enough, has the potential to cause damage to structures and disrupt human comfort. Vibration and its associated effects are usually classified as continuous, impulsive, or intermittent as follows:

- Continuous vibration continues uninterrupted for a defined period and includes sources, such as machinery and continuous construction activities
- Impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- Intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

3.2.6 Structural damage

At present, no Australian Standards exist for the assessment of building damage caused by vibration. DIN 4150 and BS 7385-2 provide recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in Table 3-8 and Table 3-9. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage. Structural damage criteria for heritage items have been taken from DIN 4150, whilst criteria for commercial/ residential items have been taken from BS 7385.

Table 3-8 Structural damage safe limits (DIN 4150) for building vibration

Group	Type of structure	At foundation – Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz ¹	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s

Group	Type of structure	At foundation – Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz ¹	Vibration at the horizontal plane of the highest floor for all frequencies
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/ heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values

Table 3-9 BS 7385-2: Transient vibration guide values for cosmetic damage

Group	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	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

3.2.7 Human comfort

Humans are sensitive to vibration such that they can detect vibration levels well below those required to cause any risk of damage to a building or its contents. Criteria to avoid annoyance are therefore more stringent than those to prevent structural damage.

Intermittent vibration

The assessment of intermittent vibration outlined in AVTG is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDV for intermittent vibration arising from construction activities are listed in Table 3-10. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 3-10 Preferred and maximum vibration dose values for intermittent vibration (m/s^{1.75})

Location	Day time		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas ¹	0.10	0.20	0.10	0.20
Residences ²	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.
2. Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

Continuous and impulsive vibration

Acceptable levels of human exposure to continuous and impulsive vibration are dependent on the time of day and the activity taking place in the occupied space. AVTG provides the preferred values for continuous and impulsive vibration. These are presented in Table 3-11. There is low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values in Table 3-11. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short duration. Vibration levels above those indicated in Table 3-11 may be dealt with through negotiation with the regulator of the affected community.

Table 3-11 Peak particle velocity for continuous and impulsive vibration (mm/s)

Location	Assessment period	Preferred	Maximum
Continuous vibration			
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices, schools, educational institutions, and places of worship	When in use	0.56	1.10
Impulsive vibration			
Residences	Day	8.60	17.0
	Night	2.80	5.60
Offices, schools, educational institutions, and places of worship	When in use	18.0	36.0

3.3 Operational noise criteria

3.3.1 Development Consent SSD-5544

Operational noise limits for the Site are defined in the development consent for SSD-5544, dated 7 January 2013. Condition C17 of the Consent states that noise generated by the Site shall not exceed the criteria in Table 3-12. These operational noise criteria were developed specifically for the operation of the Kurnell Terminal and the Site in consultation with the EPA (DP&I, 2013) and are also presented in EPL 837.

Operational noise is assessed at the boundary of the noise sensitive receiver site in accordance with the NPfl. These criteria apply to environmental noise emissions from any plant installed as part of the proposed modification.

Table 3-12 Operational noise limits

Location	Day	Evening	Night	
	L _{Aeq15min} , dB(A)	L _{Aeq15min} , dB(A)	L _{Aeq15min} , dB(A)	L _{Amax} , dB(A)
At any private residential receiver	60	50	50	55

3.3.2 Environmental Protection Authority – NSW Noise Policy for Industry

Condition C17 of SSD-5544 applies to residences only, non-residential criteria have been determined from the NPfl, as provided in Table 3-13.

Table 3-13 Recommended L_{Aeq} amenity noise levels for non-residential receivers

Type of receiver	Time of day	Recommended L _{Aeq} noise level dB(A) (external)
School classroom	Noisiest 1-hour period when in use	50 ¹
Active recreation area	When in use	55
Commercial premises	When in use	65
Industrial premises	When in use	70

1. Internal criteria given in the NPfl. For the purposes of this assessment, it is assumed that an open window would achieve a 10 dB noise reduction from outside to inside. An external criterion has been presented. In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB

L_{Aeq(1hr)}.

3.3.3 Tonality and Noise Policy for Industry modifying factors

The NPfl provides additional guidance and criteria for assessing noise emissions from sources with “annoying characteristics” such as tonality, intermittency, or dominant low-frequency content. Penalties of up to a maximum of 10 dB(A) may be applied where the subject noise has such characteristics at the receiver.

3.3.4 Maximum noise level assessment

The criteria for maximum noise level events under SSD-5544 are presented in Table 3-12. Onsite equipment is proposed to operate during the night-time period. Noise from the new plant and equipment and other equipment onsite is predicted to be steady-state and non-impulsive. Given this, compliance with the SSD-5544 Condition C17 L_{Aeq} noise criteria would imply compliance with the maximum noise level criteria for these steady-state noise sources.

3.3.5 Operational vibration

Operational vibration is not expected to be an issue as a result of the proposed modification as the operational activities would be in line with the existing development consent for SSD-5544 and would not involve activities that would create vibration levels at nearby sensitive receivers or adjacent properties. Therefore, an assessment of the operational vibration impacts was not undertaken.

4.0 Assessment of construction impacts

4.1 Construction noise modelling scenarios

Works would be staged in accordance with the indicative program in Table 1-2. Construction and remediation are anticipated to commence in 2026 and be completed by 2030.

Construction scenarios are based on the following:

- Scenario 1 – All works up to Year 3, including preparation works and relocation of critical infrastructure, construction of new infrastructure in Zone 1, and remedial activities (Stages 1 to 4)
- Scenario 2 – Construction of the new shed in Zone 1A (three months only)
- Scenario 3 – All works up to Year 3, including preparation works and relocation of critical infrastructure, construction of new infrastructure in Zone 1, construction of the new shed in Zone 1A (three months only), and remedial activities (Stages 1 to 4)
- Scenario 4 – Remedial activities from Year 3 onwards (Stages 3 and 4).

Temporary groundwater dewatering would be required where groundwater accumulates in excavations. Dewatering pumps may be required to be in operation 24 hours per day during excavation activities, dependent on weather conditions. The operation of these pumps has been modelled during the night-time in addition to standard hours.

Table 4-1 provides a summary of the construction activities including the proposed construction equipment and associated sound power levels.

Table 4-1 Construction activities and equipment – Standard hours

Plant/equipment	SWL, dB(A)	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Front end loader	104	X	X	Scenario 1 equipment noise levels in Zone 1	X
Excavator	99	-	X		X
Excavator (including large hydraulic hammer)	116	X	-	Scenario 2 equipment noise levels in Zone 1A	-
Dump truck	110	X	X		X
Grader (up to 7 m blade)	113	X	X		X
Large crane (60 t)	98	X	-		-
Elevated work platform	95	X	X		-
Franna crane (30 t)	98	X	X		-
Cement truck	109	X	X		-
Bobcat	97	X	X		X
Water cart	107	X	X		X
Concrete crusher ²	112	X	-		X
Telehandler	99	X	-		-
Truck and dog (off-site disposal)	108	X	X		X
Truck and dog (imported fill)	108	X	X		X
Generator	103	X	X		X
Welder	101	-	X		-

Plant/equipment	SWL, dB(A)	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Handheld angle grinder	108	-	X		-
Biopiling blower ³	86	X	-		X
Dewatering pump ⁴	96	X	-		X
Total¹		121	118		119

4.2 Noise modelling methodology

Noise levels due to the construction activities, shown in Section 4.1, have been predicted at nearby noise sensitive receivers using SoundPLAN 8.2 noise modelling software.

The noise model was created to represent 'reasonable' worst periods of construction works.

The following features were included in the noise model:

- Ground topography
- Buildings and structures
- Ground absorption and reflection
- Receivers
- Construction noise sources.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant/ equipment.

4.2.1 Construction modelling assumptions

The following assumptions have been made in modelling all construction noise scenarios:

- For all construction scenarios, one item of each distinct equipment type is considered to be operating concurrently within the same area which is unlikely, and is a conservative assumption
- Construction activities would be occurring at all work fronts concurrently, which is unlikely, and is a conservative assumption
- Equipment is assumed to be operating at the closest point within the construction boundary to each receiver, in order to present the worst-case scenario for each receiver. In reality, the equipment would only be at the closest point to each receiver for very limited periods
- Neutral atmospheric conditions, i.e. relatively calm, no wind
- Outside of standard hours, dewatering pumps would only be operated under the following conditions:
 - Dewatering pumps are located a minimum of 200 m from the Site boundary; or
 - Dewatering pumps are located a minimum of 120 m from the Site boundary if temporary noise barriers are positioned as near as practicable to the pumps, to provide effective shielding in the direction of nearby noise sensitive receivers, and monitoring confirms that nighttime noise limits are not exceeded. Temporary noise barriers can be constructed from hoarding (plywood boards, panels of steel sheeting or compressed fibre cement board) with no gaps between the panels.

4.3 Predicted construction noise levels

Predicted construction noise levels associated with the proposed modification are presented in this Section. Construction noise contours calculated at 1.5 m above ground level are presented as figures in Annexure A. These contours are indicative only and should not be referred to for noise levels at specific receivers, rather reference should be made to Table 4-2.

4.3.1 Residential receivers

Table 4-2 presents the construction noise modelling results for residential properties and shows the number of properties where the construction noise management levels (NMLs) and the highly affected level (HAL) of 75 dB(A) are likely to be exceeded during the daytime period (Monday to Friday – 7am to 6pm; Saturday – 8am to 1pm).

It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. In reality, this scenario is highly unlikely to occur for extended periods. As such, the assessed scenarios do not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time.

Particularly noisy activities, such as concrete crushing, are likely to persist for only a fraction of the overall construction period. In addition, the predictions use the shortest separation distance to each sensitive receiver; however, in reality, separation distances would vary between plant and sensitive receivers, with most works being a greater distance from receivers than modelled. Typical noise levels could be 5 to 10 dB(A) lower, dependent on the location and nature of works.

Feasible and reasonable mitigation measures would be detailed in the Construction Noise and Vibration Management Plan (CNVMP), which is further discussed in Section 7.0.

Table 4-2 Number of residential buildings where noise levels may exceed NML/HALs – worst case scenario

Scenarios	Exceedance of NML daytime construction hours			Highly noise affected level, >75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	
NCA1				
Scenario 1	26	76	68	12
Scenario 2	73	55	23	6
Scenario 3	2	77	91	22
Scenario 4	43	0	0	0
NCA2				
Scenario 1	421	92	63	42
Scenario 2	105	38	9	2
Scenario 3	383	123	72	44
Scenario 4	42	17	0	0

During Scenario 1, under conservative assessment assumptions, a total of 746 receivers within Kurnell could experience noise levels above the construction NMLs in both NCAs in the unlikely event of construction plant operating concurrently from a location close to the sensitive receiver during construction. Exceedances are mostly considered to be ‘clearly audible’ at receivers, with around 168 receivers experiencing moderately intrusive noise levels and 131 receivers experiencing highly intrusive noise levels. Up to 58 receivers for Scenario 1 are expected to be highly affected under the conservative scenario assessed. Under this scenario, the number of affected receivers would be due to works occurring in close proximity to residents along the northern boundary of the Site. These works would include the relocation of the firewater system (FWS) into Zone 1, adjacent to Solander Street; and augmentation of FWS infrastructure in Zone 1, in close proximity to residences along Cook Street and Reserve Road. Each of these works would be undertaken for limited periods of time within the overall construction period, as shown in the indicative construction program (Table 1-2).

During Scenario 2, up to 303 residential receivers may experience noise above the construction NMLs in both NCAs at times during construction. Exceedances are considered to be ‘noticeable’ or ‘clearly audible’ at most receivers, with up to 32 receivers experience highly intrusive noise levels. Up to eight receivers are expected to be highly affected during Scenario 2 under the conservative scenario assessed. The large number of highly affected receivers is due to the close proximity of the works to the residential areas within the Kurnell township. The works within Zone 1A would be conducted over a period of three months only and would be intermittent.

During Scenario 3, up to 748 receivers may experience noise levels above the construction NMLs in both NCAs at times during construction. Exceedances are mostly considered to be ‘clearly audible’ at receivers, with around 200 receivers experiencing moderately intrusive noise levels and 163 receivers experiencing highly intrusive noise levels. A total of 66 residential receivers could be highly affected under the conservative scenario assessed. This scenario represents all activities occurring across all stages across the entire Site, resulting in a large number of highly affected receivers. However, as shown in the indicative program (Table 1-2), this is highly unlikely to occur.

For Scenario 4, up to 102 receivers may experience noise levels above the construction NMLs in both NCAs at times during construction. It is noted that the exceedances are mostly considered to be ‘clearly audible’ at receivers, with 17 receivers experiencing moderately intrusive noise levels. No receivers are expected to be highly affected during Scenario 4 under the conservative scenario assessed.

Outside of standard hours, noise levels at all residential receivers would be compliant with the night-time NMLs presented in Table 3-2, on the basis that dewatering pumps would be located a sufficient distance from the Site boundary and temporary noise barriers are employed to provide effective shielding in the direction of nearby noise sensitive receivers (refer to Section 4.2.1).

4.3.2 Other receivers

Table 4-3 presents the construction noise modelling results for non-residential properties which shows the number of properties where the NMLs are likely to be exceeded during their hours of use. It is important to consider that this assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each receiver location.

Table 4-3 Number of non-residential buildings where noise levels may exceed NMLs – Worst case scenario

Phase	Exceedance of NML		
	1-10 dB	11-20 dB	> 20 dB
Scenario 1	5	3	-
Scenario 2	4	-	-
Scenario 3	6	3	-
Scenario 4	-	-	-

Noise levels at seven non-residential receivers are expected to exceed the construction NMLs for Scenario 1. These receivers include Marton Park, Marton Community Hall, Kurnell Public School and Kurnell Preschool, one commercial receiver and three industrial receivers. The maximum predicted exceedance at the Preschool is 8 dB(A), which is considered 'clearly audible', and 1 dB(A) at the Public School.

Noise levels at four non-residential receivers are expected to exceed the construction NMLs for Scenario 2. These receivers include Marton Park, Marton Community Hall, Kurnell Preschool and St John's Catholic Church. The predicted exceedance at the Preschool is 4 dB(A).

Noise levels at nine non-residential receivers are expected to exceed the construction NMLs for Scenario 3. These receivers include Marton Park, Marton Community Hall, Kurnell Preschool, Kurnell Public School, St John's Catholic Church, one commercial receiver and three industrial receivers. The predicted exceedances at the Preschool and Public School are 8 dB(A) and 1 dB(A) respectively.

Noise levels are not expected to exceed the construction NMLs at any non-residential receiver for Scenario 4.

4.4 Construction traffic noise assessment

The traffic generated by the proposed modification would incorporate a mix of construction plant vehicles, delivery vehicles and construction personnel movements that would scale up and down throughout construction. A summary of the construction vehicles and associated staff numbers that would be required during the works is summarised in Table 4-4.

Table 4-4 Workforce and plant requirements for construction

Description		Daily movements (return trips)	Peak hour trips ¹
Heavy vehicles	Construction vehicles (cranes, semi-trailers, etc.)	10	0
	Truck and Dog (offsite disposal and imported fill)	120	12
	Equipment/ material delivery vehicles	6	2
	Subtotal	136	14
Private vehicles	Construction personnel ²	200	100
Total		336	114
Heavy vehicle proportion		40%	12%

1. Assumptions include:

- Conservatively, that all personnel would arrive to Site during the AM Peak Hour and depart during the PM Peak Hour (this is unlikely but provides a conservative assessment).
- Personnel would utilise their own private vehicle with no use of car-pooling or public transport.
- Heavy vehicle movements would be evenly distributed throughout the hours of operation (10-hour workdays).
- All plant delivery vehicles are assumed to occur on the same day in order to produce a 'worst-case' scenario.

2. Maximum number of construction staff.

Captain Cook Drive would provide primary access to the Project Area for construction traffic. Traffic surveys were conducted in 2024 at the intersection of Captain Cook Drive and Sir Joseph Banks Drive. These counts were used to determine a peak hour volume for 2026¹ of 767 vehicles.

¹ Peak construction year. Updated in the Submissions Report from the peak construction year of 2025 in the Traffic and Transport Impact Assessment (Appendix L of the Modification Report).

The expected peak hours trips of 114 from construction vehicles would increase traffic noise levels on Captain Cook Drive by 0.6 dB. Given that the noise increase on Captain Cook Drive is likely to be less than 2 dB(A) during the peak construction period for a worst-case scenario, no further consideration assessment is required, in accordance with the RNP.

4.5 Construction vibration assessment

Vibrations may be generated by the equipment proposed to be utilised. The minimum working distances of these items of equipment from off-site receivers are shown in Table 4-5. This is based on recommendations of the *Construction Noise and Vibration Guideline (Roads)* (CNVG-R) (Transport for NSW, 2024) and AECOM's previous project experience. If these minimum working distances are complied with, no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage. Equipment size would be selected by the construction contractor and would take into account the minimum working distances and the distance between the area of construction and the nearest receiver.

Table 4-5 Recommended safe working distances for vibration intensive plant

Plant	Rating/Description	Minimum working distance	
		Cosmetic damage (BS7385) Light-framed structures	Human response
Small hydraulic hammer	(300 kg – 5 to 12 t excavator)	2 m	5 m
Medium hydraulic hammer	(900 kg – 12 to 18 t excavator)	7 m	19 m
Large hydraulic Hammer	(1,600 kg – 18 to 34 t excavator)	22 m	60 m

5.0 Assessment of operational impacts

Once the modification works are complete, the Site would continue to operate as described in the approval documentation for the approved project and would be consistent with the development consent for SSD-5544 (as modified).

In line with Figure 1-2, relocated equipment would operate in their new locations. Noise sources that have the potential to affect nearby receivers during operation include:

- Existing operational equipment
- The relocated FWS (tank and pumphouse, containing three diesel engines) in the FWS Relocation Area (two indicated locations)
- The new onsite OWS operational plant (one new pump station and emergency storage tank) in the south of Zone 2 (two indicative locations).

Operational noise assessment equipment locations are presented in Figure 5-1.

5.1 Modelled operational scenarios

In order to assess a reasonable worst-case operational scenario, it is assumed that all of the proposed equipment within the Site would operate at full capacity, 24 hours a day, seven days a week.

Given that the night-time residential proposed modification noise criteria are the most stringent, the worst-case operational scenario has been assessed against the night-time residential criteria as per SSD-5544. The night-time noise criteria demonstrates compliance during the day and evening periods for all residential receivers for typical operation.

New onsite OWS operational plant (one new pump station and emergency storage tank) in the south of Zone 2 would only operate after rainfall events to support the upgraded OWS in capturing potentially contaminated stormwater flows and directing them towards the WWTP. The pump system would include two electric pumps in a duty/ standby arrangement, meaning that only one pump would be operational at any one time. At this stage, two location options are being considered for the OWS pump station (Figure 5-1). Conservatively, the location option that places the pump station closer to noise sensitive receivers has been assessed. If the alternative pump station option is selected, noise levels are predicted to be lower than those presented in this report. The proposed pumps would be submersible and therefore be mounted below the existing ground level in a sealed chamber submerged in liquid. Noise egress on this account is expected to be negligible.

It is understood that up to 80 ships per year are berthed at Kurnell berth for two to three days on average. It is therefore considered a typical worst case for a ship to be at berth during the daytime, evening and night-time.

Operation of the relocated FWS in the FWS Relocation Area (Zone 1) would include three diesel engines that are subject to regular (monthly and annual) testing. As such, three operational scenarios have been assessed, which include:

- Typical operation without FWS equipment operating
- Typical operation with the FWS equipment operating:
 - Monthly testing and maintenance activities for both options of the relocated FWS equipment, where the three diesel engines are tested individually; as such, only one pump has been included in this scenario
 - Annual testing and maintenance activities for both options of the relocated FWS equipment, where all three diesel engines are tested simultaneously; as such, three pumps have been included in this scenario.

Maintenance of the FWS is only proposed during the daytime period, and therefore typical operation with the FWS equipment operating has been assessed against daytime criteria as per SSD-5544.



Legend

- Project Area
- Site
- Ampol Land Ownership
- Existing equipment
- OWS pump station
- Firewater System Relocation Area
- Indicative relocated FWS tank and pumphouse



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Figure 5-1 Operational noise assessment equipment locations

It is assumed that the pumphouse would be relocated without significant changes to the system. The main source of noise from the FWS would be the exhausts; as such, it is assumed that mufflers on the exhausts would be upgraded, providing improved performance of 5 dB at each octave band. Similar to the existing pumphouse, it is assumed that the pumphouse would consist of a 5 m tall barrier around three sides, and a roof, with steel cladding and steel roof sheeting.

The operational equipment is generally categorised as steady-state or quasi steady-state noise sources which typically produce continuous and consistent noise levels.

Operational noise impacts at non-residential receivers were compared with the relevant amenity noise trigger levels for non-residential receivers (refer to Section 3.3.2).

5.1.1 Assessment noise source levels

The sound power level inputs presented in Table 5-1 were used in the noise modelling and were assumed to be operating continuously for the entire 15-minute period.

Table 5-1 Plant items sound power levels – Worst case scenario

Plant item/ Operation	Usage factor in 15 minute period	Calculated sound power level, L_{Aeq} , dB(A)
Proposed equipment		
Electric OWS pump	100%	95 ¹
Relocated diesel FWS pump engine intake ²	100%	109 ³
Relocated diesel FWS pump engine exhaust ²	100%	103 ⁴
Relocated diesel FWS pump case noise ²	100%	107 ³
Existing equipment		
Jet fuel pump	100%	95
Gasoline transfer pump	100%	98
Waste water treatment blower exhaust	100%	101
Treated effluent pump	100%	87
Pumping area small compressor	100%	81
Five product pumps	30%	93 ⁵
Slop pump	30%	81 ⁵
Diesel additives injection system	5%	90 ⁵
Chemical drum and dosing pump	5%	80 ⁵
Two compressors	40%	90 ⁵
Ship at berth	100%	105 ⁵

Plant item/ Operation	Usage factor in 15 minute period	Calculated sound power level, L_{Aeq} , dB(A)
1		<i>Calculated sound power level based on SPL of 87 dB(A) @ 1 metre. Conservatively this prediction is based on a 35 kW pump operating at high RPM (3,000-3,600 RPM). Any noise source levels that differ from what has been provided in this report should be verified by a qualified acoustic engineer prior to commissioning.</i>
2		<i>Two of the three required FWS pumps are proposed to be relocated from their existing location. A third new pump would be procured to make up the new FWS. Procurement of the third pump would require an equivalent or lower noise level than the existing FWS pumps.</i>
3		<i>Based on onsite measurements of the existing CAT 3406B powered fire pump located in the southern pumphouse with existing noise treatment.</i>
4		<i>Based on onsite measurements of the existing CAT 3406B powered fire pump exhaust located in the southern pumphouse with a new or upgraded muffler with an improved insertion loss of 5 dB at each octave band.</i>
5		<i>Sound power level based on noise level presented in SSD-5544 Noise and Vibration Assessment, Report reference 12315 dated May 2013.</i>

Locations of existing and proposed noise generating sources included in the operational noise assessment are shown in Figure 5-1.

The new onsite equipment installed as part of the Kurnell Stormwater Separation Improvement Project would include eight vertical electric pumps and five diesel pumps. The equipment would only operate during adverse weather events, i.e. during storms or other high precipitation events. As such, this is not considered part of normal operating conditions and has not been included in the operational scenarios.

5.1.2 Maximum noise levels

In AECOM's experience, L_{Amax} sound power levels of steady state pumping equipment are typically not greater than 5 dB above L_{Aeq} sound power levels. Given that the L_{Amax} criterion is 5 dB less stringent than the L_{Aeq} noise criteria, compliance with the L_{Aeq} noise criteria would result in compliance with the L_{Amax} criterion.

5.2 Modelling methodology

5.2.1 General modelling assumptions

Noise levels due to the operational activities at the Site were predicted to nearby noise sensitive receivers using SoundPLAN version 8.2 (industry standard) noise modelling software. The operational noise levels were predicted using an implementation of CONCAWE² algorithms in the SoundPLAN noise propagation software. It is especially suited to predicting noise propagation over large distances because it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances.

5.2.2 Meteorological conditions

Standard weather and noise enhancing meteorological conditions were considered for this assessment. This accounted for the following parameters:

- Standard meteorological conditions – Pasquill-Gillford stability category D with wind speed up to 0.5 m/s at 10 m
- Noise enhancing meteorological conditions – Pasquill-Gillford stability category D with wind speed up to 3 m/s at 10 m.

The noise modelling includes:

- Ground topography
- Buildings and structures
- All sources behave as point, or moving point sources

² CONCAWE – The oil companies' international study group for conservation of clean air and water – Europe (established in 1963) Report 4/81 "The propagation of noise from petroleum and petrochemical complexes to neighbouring communities."

- Ground absorption
- Representative operational noise sources as required.

The noise model considers significant noise sources and locations, screening effects, receiver locations, ground topography and noise attenuation due to geometrical spreading, air absorption, ground absorption and the effects of the prevailing weather conditions. The noise model was based on ground topography, and indicative plant equipment sound power levels. All predicted noise levels are free field and 1.5 m/ 4.5 m above ground level at the most-affected point within a residential property boundary within 30 m of the nearest facade.

The location, quantity, and specification of equipment is subject to change during the detailed design stage. Operational noise levels should be verified at the detailed design stage.

5.3 Predicted operational noise levels

Predicted noise levels at nearby noise sensitive receivers are presented in tables below. Compliance with the night-time noise criteria implies compliance to the less stringent daytime criterion for the operation of the modified project.

Operational noise contours calculated at 1.5 m above ground are provided in the figures in Annexure B. These contours are indicative only and should not be referred to for noise levels at specific receiver locations. Operational noise levels presented here have been calculated under neutral and noise enhancing weather conditions.

Third octave results are presented in Annexure C to allow identification of any annoying characteristics in accordance with Section 3.3.3.

5.3.1 Night-time standard operational scenario

Results of the night-time standard operational scenario are presented in Table 5-2. This scenario considers all existing typically operating equipment onsite with the addition of the proposed new OWS pumps. This scenario does not consider the testing of FWS as this is not proposed to occur at night.

It can be seen in Table 5-2 that the predicted operational noise emissions from the modified project comply with the most stringent (night-time) operational noise criteria at all locations under both neutral and noise-enhancing meteorological conditions.

A review of predicted noise levels indicates that the noise from existing pumps are not considered tonal at noise sensitive receivers in accordance with Fact Sheet C of NPfI. The predicted one third octave band noise levels from operation of the site during standard weather conditions are presented in Annexure C.

Table 5-2 Predicted operational noise levels

Receiver type	Receiver	Night-time noise criteria, $L_{Aeq,15min}$, dB(A)	Predicted L_{Aeq} noise levels, dB(A)			
			Standard weather ¹	Exceedance	Noise enhancing weather ²	Exceedance
Residential	R1	50	31	-	33	-
	R2		36	-	38	-
	R3		36	-	39	-
	R4		36	-	38	-
	R5		47	-	50	-
	R6		33	-	36	-
	R7		43	-	45	-
	R8		39	-	42	-
Education	E1	50	32	-	35	-
Active recreation	AR1	55	37	-	40	-
Passive recreation	PR1	50	22	-	26	-
	PR2		22	-	25	-
Commercial	C1	65	34	-	37	-
Industrial	I1	70	34	-	36	-
	I2		44	-	46	-
	I3		32	-	35	-
	I4		26	-	30	-

1. Neutral weather considers 0.5 m/s winds source to receiver.

2. Noise enhancing weather considers the worst case of 3 m/s source to receiver wind and temperature inversions.

5.3.2 Daytime FWS testing operational scenario – Option 1

The Option 1 FWS testing scenario considers all existing typically operating equipment onsite with the addition of the proposed new OWS pumps and the testing of the relocated FWS at the Option 1 location. Monthly testing assumes the noise impact of one FWS pumphouse engine operating. Annual testing assesses the noise impact of all three FWS pumphouse engines operating.

Monthly FWS testing

Monthly testing assesses the noise impact of one FWS engine operating. Results of the daytime FWS testing operational scenario for Option 1 are presented in Table 5-3 under standard and noise-enhancing meteorological conditions.

Table 5-3 Predicted operational noise levels for monthly FWS testing (Option 1)

Receiver type	Receiver	Daytime noise criteria, $L_{Aeq,15min}$, dB(A)	Predicted L_{Aeq} noise levels, dB(A)			
			Standard weather ¹	Exceedance	Noise enhancing weather ²	Exceedance
Residential	R1	60	54 ⁴	-	55 ⁴	-
	R2		49	-	50	-
	R3		44	-	46	-
	R4		36	-	38	-
	R5		47	-	50	-
	R6		34	-	37	-
	R7		58 ⁴	-	54	-
	R8		58 ⁴	-	59 ⁴	-
Education	E1	50	35	-	37	-
Active recreation	AR1	55	55 ⁴	-	57 ⁴	2 ³
Passive recreation	PR1	50	32	-	35	-
	PR2		29	-	32	-
Commercial	C1	65	50	-	51 ⁴	-
Industrial	I1	70	43	-	46	-
	I2		45	-	47	-
	I3		33	-	37	-
	I4		28	-	31	-

1. Neutral weather considers 0.5 m/s winds source to receiver
2. Noise enhancing weather considers the worst case of 3 m/s source to receiver wind and temperature inversions.
3. In accordance with the EPA NPfl, exceedances of up to 2 dB are considered negligible provided all feasible and reasonable noise mitigation measures have been considered. They would not be discernible to the average listener.
4. Tonality penalty added in accordance with Fact Sheet C of the NPfl

It can be seen in Table 5-3 that the predicted operational noise emissions from the proposed modification under the Option 1 monthly FWS testing scenario generally comply with the operational noise criteria for the daytime period under both neutral and noise-enhancing meteorological conditions. Feasible and reasonable mitigation measures to manage the impacts of operation of the Site are discussed in Table 5-7.

The predicted one third octave band noise levels from Option 1 monthly testing of the FWS during standard weather conditions are presented in Annexure C.

Annual FWS testing

Results of the daytime FWS testing operational scenario for Option 1 are presented in Table 5-4 under standard and noise-enhancing meteorological conditions. Annual testing assesses the noise impact of all three FWS pumphouse engines operating together.

Table 5-4 Predicted operational noise levels for annual testing (Option 1)

Receiver type	Receiver	Daytime noise criteria, L _{Aeq,15min} , dB(A)	Predicted L _{Aeq} noise levels, dB(A)			
			Standard weather ¹	Exceedance	Noise enhancing weather ²	Exceedance
Residential	R1	60	57 ⁴	-	59 ⁴	-
	R2		58 ⁴	-	60 ⁴	-
	R3		48	-	50	-
	R4		42	-	45	-
	R5		47	-	50	-
	R6		36	-	39	-
	R7		56 ⁴	-	52	-
	R8		59 ⁴	-	60 ⁴	-
Education	E1	50	37	-	39	-
Active recreation	AR1	55	59 ⁴	4	60 ⁴	5
Passive recreation	PR1	50	34	-	38	-
	PR2		32	-	35	-
Commercial	C1	65	53 ⁴	-	55 ⁴	-
Industrial	I1	70	48	-	55 ⁴	-
	I2		45	-	48	-
	I3		34	-	37	-
	I4		28	-	32	-

1. Neutral weather considers 0.5 m/s winds source to receiver.
2. Noise enhancing weather considers the worst case of 3 m/s source to receiver wind and temperature inversions.
3. In accordance with the EPA NPfl, exceedances of up to 2 dB are considered negligible provided all feasible and reasonable noise mitigation measures have been considered. They would not be discernible to the average listener.
4. Tonality penalty added in accordance with Fact Sheet C of the NPfl

It can be seen in Table 5-4 that the predicted operational noise emissions from the proposed modification under the Option 1 annual testing scenario may lead to exceedance of criteria during the daytime at one active recreational receiver under both neutral and noise-enhancing meteorological conditions. The exceedances are due to the FWS pumphouse exhaust which has tonal characteristics that attract a penalty in accordance with Fact Sheet C of the NPfl. It is noted that this testing only occurs once per year for a limited time (two hours) and would therefore have a limited impact.

To further reduce the impact of annual testing, feasible and reasonable mitigation measures to manage the impacts of operation of the Site are discussed in Table 5-7.

5.3.3 Daytime FWS testing operational scenario – Option 2

The Option 2 FWS testing scenario considers existing typically operating equipment onsite with the addition of the proposed new OWS pumps and the testing of the relocated FWS when located in the Option 2 location.

Monthly FWS testing

Monthly testing assesses the noise impact of one FWS pumphouse engine operating. Results of the daytime FWS testing operational scenario for Option 2 are presented in Table 5-5 under standard and noise-enhancing meteorological conditions.

Table 5-5 Predicted operational noise levels for monthly testing (Option 2)

Receiver type	Receiver	Daytime noise criteria, $L_{Aeq,15min}$, dB(A)	Predicted L_{Aeq} noise levels, dB(A)			
			Standard weather ¹	Exceedance	Noise enhancing weather ²	Exceedance
Residential	R1	60	33	-	45	-
	R2		43	-	45	-
	R3		42	-	45	-
	R4		42	-	44	-
	R5		47	-	50	-
	R6		36	-	39	-
	R7		45	-	48	-
	R8		44	-	47	-
Education	E1	50	36	-	39	-
Active recreation	AR1	55	45	-	48	-
Passive recreation	PR1	50	25	-	28	-
	PR2		23	-	26	-
Commercial	C1	65	42	-	44	-
Industrial	I1	70	34	-	37	-
	I2		45	-	47	-
	I3		33	-	37	-
	I4		28	-	32	-

1. Neutral weather considers 0.5 m/s winds source to receiver.

2. Noise-enhancing conditions considers the worst case of 3 m/s source to receiver wind and temperature inversions.

It can be seen in Table 5-5 that the predicted operational noise emissions from the proposed modification under the Option 2 monthly FWS testing scenario comply with the daytime operational noise criteria at all receivers under both neutral and noise enhancing meteorological conditions.

The predicted one third octave band noise levels from Option 2 monthly testing of the FWS during standard weather conditions are presented in Annexure C.

Annual FWS testing

Annual testing assesses the noise impact of three FWS pumphouse engines operating. Results of the daytime FWS testing operational scenario for Option 2 are presented in Table 5-6 under standard and noise-enhancing meteorological conditions.

Table 5-6 Predicted operational noise levels for annual testing (Option 2)

Receiver type	Receiver	Daytime noise criteria, L _{Aeq,15min} , dB(A)	Predicted L _{Aeq} noise levels, dB(A)			
			Standard weather ¹	Exceedance	Noise enhancing weather ²	Exceedance
Residential	R1	60	34	-	37	-
	R2		44	-	46	-
	R3		38	-	41	-
	R4		44	-	46	-
	R5		47	-	50	-
	R6		35	-	38	-
	R7		48	-	50	-
	R8		47	-	49	-
Education	E1	50	36	-	39	-
Active recreation	AR1	55	46	-	48	-
Passive recreation	PR1	50	26	-	29	-
	PR2		23	-	27	-
Commercial	C1	65	46	-	48	-
Industrial	I1	70	34	-	37	-
	I2		47	-	49	-
	I3		34	-	37	-
	I4		29	-	32	-

1. Neutral weather considers 0.5 m/s winds source to receiver.

2. Noise enhancing weather considers the worst case of 3 m/s source to receiver wind and temperature inversions.

It can be seen in Table 5-6 that the predicted operational noise emissions from the proposed modification for the FWS testing scenario comply with the daytime operational noise criteria at all receivers under neutral and noise-enhancing meteorological conditions.

To further reduce the impact of annual testing, feasible and reasonable mitigation measures to manage the impacts of operation of the Site are discussed in Table 5-7. Equipment specifications and noise mitigation measures would be verified at the detailed design stage.

5.3.4 Feasible and reasonable mitigation measures

Noise levels from annual testing of the FWS for Option 1 exceed the operational noise criteria. Feasible and reasonable mitigation measures to manage the impacts of operation of the Site are discussed in Table 5-7.

Table 5-7 'Feasible and reasonable' mitigation decision-making matrix

Mitigation option	Feasible mitigation test	Reasonable mitigation test	Justification for adopting or disregarding this option
Selection of quieter equipment	Feasible as equipment for FWS not yet installed.	Reasonable due to: <ul style="list-style-type: none"> Reduction in source noise levels Total cost of noise mitigation 	Adopted, review of equipment noise levels would be conducted during detailed design
Add/ upgrade FWS mufflers	Feasible as equipment for FWS not yet installed.	Reasonable due to: <ul style="list-style-type: none"> Reduction in source noise levels Total cost of noise mitigation 	Adopted, review of equipment noise levels would be conducted during detailed design.
Choice of FWS location Option 2	Feasible to an extent considering operational constraints such as access by fire department	Reasonable due to: <ul style="list-style-type: none"> Reduction in source noise levels Total cost of noise mitigation 	Disregarded due to site constraints other than noise
Restricting FWS testing activities to daytime only	Feasible	Reasonable due to: <ul style="list-style-type: none"> Reduction in source noise levels Total cost of noise mitigation 	Adopted
Community consultation with local residents would be undertaken prior to the annual testing	Feasible	Reasonable	Adopted

Mitigation measures proposed to be adopted are also presented in Section 7.0 (Management of impacts).

6.0 Assessment of cumulative impacts

Cumulative impacts have the potential to occur when benefits or impacts from a project overlap or interact with those of other projects, potentially resulting in a larger overall effect (positive or negative) on the environment or local communities. Cumulative impacts may occur when projects are constructed or operated concurrently or consecutively.

Projects were reviewed against the following screening criteria for this cumulative impact assessment:

- Spatially relevant (i.e. the development or activity overlaps with, is adjacent to or within two kilometres of the Project Area)
- Scale (i.e. large-scale major development or infrastructure projects that have the potential to result in cumulative impacts with the proposed modification, as listed on the NSW Government Major Projects website and on the relevant council websites)
- Timing (i.e. the expected timing of its construction and/or operation overlaps or occurs consecutively to construction and/or operation of the proposed modification)
- Status (i.e., projects in development with sufficient publicly available information to inform this noise impact assessment, with an adequate level of detail to assess the potential cumulative impacts).

The following projects were considered to have met the above criteria, with the potential to have cumulative impacts with the proposed modification:

- Kamay Ferry Wharves (350 m north of the Project Area)
- Breen Resource Recovery Facility (2 km west of the Project Area)
- Woolooware to Kurnell Tower Replacement Project (120 m south-west of the Project Area)
- Kurnell Planning Proposal (800 m south-west of the Project Area).

The locations of these projects are shown on Figure 6-1.

Since lodgement of the Modification Report, one project, Kurnell Stormwater Separation Improvement Project, has finished construction and has been removed from the cumulative impact assessment. Cumulative noise impacts were identified for this project, and therefore the combined impacts have been addressed as part of the baseline assessment of this Updated Noise and Vibration Assessment Report.

Kamay Ferry Wharves has also completed construction. However, as ferry services have not yet commenced, the project continues to be included in the operational cumulative impact assessment.

Given the potential impacts from the modified project and the distance between the cumulative projects listed above and the terminal, no cumulative operational noise impacts on sensitive noise receivers in Kurnell are anticipated. As such, the cumulative operational noise has been scoped out of the assessment.



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Figure 6-1 Cumulative development projects

6.1 Construction

The projects shown in Table 6-1 are considered relevant under the criteria set out above, and overlapping construction programs have potential to lead to cumulative construction noise impacts for nearby receivers. Generally, where a receiver is affected by construction noise from more than one project at any one time, it is possible that an increase of up to 3 dB(A) of the highest noise level predicted for any project may occur (assuming that at any one location equal noise levels from two projects are experienced).

Table 6-1 Cumulative construction noise screening assessment

Future project	Distance to proposal	Project status and potential overlap	Potential cumulative impact
Breen Resource Recovery Facility	2 km west	Approved. Construction expected to continue until 2028.	Cumulative noise impact is expected to be negligible based on the large distance between the recovery facility and the Project Area.
Woolooware to Kurnell Tower Replacement Project	120 m south west	Approved in 2024, however a re-assessment is underway. If approved work is expected to be undertaken over a two year period and finish in 2028.	Overlap in construction may lead to a 3 dB increase in noise for industrial receivers surrounding the Project Area. However, as noise levels are not expected to exceed established NMLs for industrial receivers, cumulative impacts are not anticipated.
Kurnell Planning Proposal	860 m south west	Planning proposal submitted. Once approved, construction would be completed in a phased manner in 10-20 years.	Cumulative noise impact is expected to be negligible based on the large distance between the planning proposal area and the Project Area.

7.0 Management of impacts

Environmental mitigation measures to manage potential Noise and Vibration impacts of the proposed modification are outlined in Table 7-1. Additional and/ or modified environmental safeguards and management measures to those presented in the approved SSD-5544 are shown in **bold**. Deleted measures, or parts of measures, have been ~~struck out~~. Where approved measures have been consolidated to reduce duplication, previously agreed text that has been brought into existing or new measures has been underlined.

Table 7-1 Management and mitigation measures – Noise and vibration

ID	Issue	Mitigation measure
G1	Noise and vibration	<p>The CEMP/DEMP for the Project would include a Noise and Vibration Management Plan (NVMP). The NVMP would outline:</p> <ul style="list-style-type: none"> • The locations of noise sensitive receivers • Potential significant noise and vibration generating activities associated with the proposed modification • <u>Relevant feasible and reasonable noise mitigation measures as per the Interim Construction Noise Guideline (DECC, 2009)</u> • Measures to be implemented during construction to minimise noise and vibration impacts, such as restrictions on working hours, staging, placement and operation of work compounds, parking and storage areas, temporary noise barriers, haul road maintenance and controlling the location and use of vibration generating equipment • Construction noise monitoring procedures; and • Construction equipment maintenance to ensure good working order • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures.
G2	Noise	Low-noise plant and equipment would be selected, where practicable, in order to minimise potential for noise and vibration. All equipment would be regularly checked to ensure that the mufflers and other noise reduction equipment are working correctly.
G3	Noise and vibration	Community consultation with local residents would be undertaken to assist in the alleviation of community concerns. Prior to the proposed modification demolition works commencing within the Eastern and Western Right of Ways (Zone 1A), at Silver Beach, on the Wharf or prior to particularly loud demolition works occurring on the main terminal site, potentially affected residents within Kurnell would be notified in advance. Should complaints be received, the complaints register would continue to be maintained and managed in line with the existing feedback process at the Site.
G4	Noise	Any noise complaint(s) would be investigated immediately. Reasonable and feasible measures would be implemented to reduce noise impacts.
G5	Noise	Construction/ demolition equipment would be located to reduce noise emission to sensitive receptors, where practicable.

ID	Issue	Mitigation measure
G6	Noise and vibration	<p>In line with the Interim Construction Noise Guideline (ICNG) (DECC, 2009), construction works would comply with following hours:</p> <ul style="list-style-type: none"> • Monday to Friday – 7am to 6pm • Saturday – 8am to 1pm • Sunday and public holidays – No work is permitted. <p>Construction works outside of the work hours identified above would only be undertaken in the following circumstances (in line with Condition C20 of SSD 5544):</p> <ul style="list-style-type: none"> • Works that are inaudible at nearest sensitive land receivers • Works that are consistent with Ampol’s existing maintenance procedures and are in accordance with the existing Environment Protection Licence (No. 837) (EPL) • Works agreed to in writing by the Environment Protection Authority or the Department of Planning, Housing and Infrastructure • For the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons. <p>Biopiling blowers may operate on a 24-hour basis in identified Biopiling Areas.</p> <p>Dewatering may occur on a 24-hour basis. Outside of standard hours, dewatering pumps would only be operated under the following conditions:</p> <ul style="list-style-type: none"> • Dewatering pumps are located a minimum of 200 m from the Site boundary; or • Dewatering pumps are located a minimum of 120 m from the Site boundary if temporary noise barriers are positioned as near as practicable to the pumps, and monitoring confirms that nighttime noise limits are not exceeded. <p>The majority of the conversion works for the Project would typically be completed between 7.00am to 10.00pm seven days a week. Some works consistent with Caltex Ampol’s existing day-to-day operational and maintenance procedures would continue to occur over a 24 hour period as regulated by the EPL for the Site.</p>
G7	Noise and vibration	<p>Construction/Demolition staff and contractors would undergo training in environmental noise issues including:</p> <ul style="list-style-type: none"> • Minimising the use of horn signals and maintaining a low volume. Alternative methods of communication should be considered • Avoiding any unnecessary noise when carrying out manual operations and when operating plant • Switching off any equipment not in use for extended periods during construction work • Ensuring works occur within approved hours.
G8	Noise and vibration	<p>Should any unexpected construction activities occur which could potentially generate significant noise not described in this report, monitoring would be undertaken to ensure construction noise emission levels do not exceed EPL limits construction NMLs.</p>
G12	Noise	<p>Caltex Ampol would ensure that the noise generated by the proposed construction demolition works does not exceed the construction NMLs criteria defined in Table 3-2 Table 2 (from Condition of Consent C16 of SSD-5544) unless the reasonable and feasible noise mitigation strategies outlined within the DNVMP have been implemented. Reasonable and feasible noise mitigation strategies would include appropriate respite periods during particularly noisy or prolonged activities.</p>

ID	Issue	Mitigation measure
G16	Vibration	Vibration intensive equipment would be selected and minimum working distances, as presented in Table 4-5 of the Noise and Vibration Impact Assessment, would be adhered to. The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable.
G17	Operational noise	Equipment associated with the relocated firewater system would be treated so that operational noise levels do not exceed the criteria defined in Condition of Consent C17 of SSD-5544. Maintenance and testing activities associated with the firewater system would be conducted during standard daytime hours only: <ul style="list-style-type: none"> • Monday to Saturday – 7am to 6pm • Sunday – 8am to 6pm. Equipment associated with the relocated firewater system would reduce running times as far as practical during maintenance and testing activities.
G18	Operational noise	Equipment specifications and physical upgrades to the exhaust, diesel pumps, and pumphouse in the Relocation FWS Area to limit noise (such as a new or upgraded muffler with an improved insertion loss of 5 dB at each octave band) would be verified during detailed design.

8.0 Conclusion

This report presents the results of an assessment of the construction and operational noise and vibration impact of the proposed modification to existing state significant development consent (SSD-5544).

8.1 Construction noise and vibration

The construction activities have been assessed against the noise management levels (NML) determined in accordance with the EPA's Interim Construction Noise Guideline (ICNG) (DECC, 2009), as outlined in this report. The modelling adopted a conservative assumption of one item of each distinct equipment type operating concurrently within the same area for the entire 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. In reality, it is highly unlikely that all equipment would operate concurrently, as shown in the indicative program (refer to Table 1-2).

The assessment considered four construction scenarios:

- Scenario 1 – All works up to Year 3, including preparation works and relocation of critical infrastructure, construction of new infrastructure in Zone 1, and remedial activities
- Scenario 2 – Construction of the new shed in Zone 1A (three months only)
- Scenario 3 – All works up to Year 3, including preparation works and relocation of critical infrastructure, construction of new infrastructure in Zone 1, construction of the new shed in Zone 1A (three months only), and remedial activities
- Scenario 4 – Remedial activities from Year 3 onwards.

Under these conservative assumptions, the predicted construction noise levels are expected to exceed the construction noise management levels at some noise sensitive receivers, at times during all the construction scenarios. The following number of receivers could experience noise levels above the ICNG standard hours NMLs at times, under each construction scenario:

- Up to 746 receivers during Scenario 1
- Up to 303 residential receivers during Scenario 2
- Up to 748 receivers during Scenario 3
- Up to 102 receivers for Scenario 4.

The majority of exceedances relate to noise levels which would be 'clearly audible', whilst other exceedances would be 'moderately intrusive,' and a lesser number would be 'highly intrusive'. Construction noise levels at residential receivers are also predicted to exceed the 'highly noise affected' level of 75 dB(A). Up to 54 receivers for Scenario 1 are expected to be highly affected under the conservative scenario assessed; up to eight receivers for Scenario 2; up to 66 receivers for Scenario 3; and no receivers in Scenario 4.

This is primarily due to works occurring in close proximity to residents, along the northern boundary of the Site. These works would include construction of a new storage shed in Zone 1A to store boats and emergency aquatic spill response kits; relocation of the firewater system (FWS) into Zone 1, adjacent to Solander Street; and augmentation of FWS infrastructure in Zone 1, in close proximity to residences along Cook Street and Reserve Road. Each of these works would be undertaken for limited periods of time within the overall construction period, as shown in the indicative construction program.

Temporary groundwater dewatering would be required where groundwater accumulates in excavations. It is assumed that dewatering pumps would be in operation 24 hours per day during excavation activities, dependent on weather conditions. By locating dewatering pumps at a sufficient distance from the Site boundary and implementing appropriate mitigation, such as temporary noise barriers to provide effective shielding, noise levels at all residential receivers would comply with night-time NMLs outside of standard hours.

Minimal vibration intensive works are expected to take place. Vibration intensive works to occur onsite are likely to be outside of minimum working distances. For vibration intensive works, such as the use of hydraulic hammers, the minimum working distances provided in this report would be adhered to.

An assessment of the likely construction traffic indicated that noise increases on Captain Cook Drive are likely to be less than 2 dB(A) during the peak construction periods and therefore no further consideration of construction traffic noise is required, in accordance with the RNP.

Cumulative construction noise impacts are expected to be unlikely given the timing and location of other projects in the area.

8.2 Operational noise

Results show predicted operational noise emissions from the proposed modification comply with the most stringent (night-time) operational noise criteria at all locations for typical operations. The operational noise assessment considers all existing and proposed typical operational equipment operating simultaneously, and at full capacity during the night-time period.

Additional operational scenarios entailing the monthly and annual testing of the proposed new firewater tank and pumphouse within the FWS Relocation Area have been included in the assessment. For the purpose of assessment in this Updated Noise and Vibration Impact Assessment Report, two indicative locations have been considered for the relocation of the FWS.

The predicted operational noise emissions from the proposed modification for the Option 1 monthly FWS testing scenario complies with the criteria during the daytime under both neutral and noise-enhancing meteorological conditions, noting a minor exceedance of 2 dB at Marton Park under noise-enhancing meteorological conditions. An exceedance of 2 dB(A) is considered negligible provided all feasible and reasonable noise mitigation measures have been considered. The Option 1 annual FWS testing scenario may also lead to exceedances of the criteria during the daytime at Marton Park under both neutral and noise-enhancing meteorological conditions, with exceedances of up to 4 dB(A) and 5 dB(A) respectively. However, it is noted that this testing only occurs once per year for a limited time (two hours).

The predicted operational noise emissions from the proposed modification for the Option 2 monthly and annual FWS testing scenario comply with the daytime operational noise criteria at all receivers under both neutral and noise enhancing meteorological conditions.

The main source of noise from the FWS would be the exhausts; as such, it is assumed that mufflers of the pumphouse would be upgraded, providing improve performance of 5 dB at each octave band. Equipment specifications and noise mitigation measures would be verified at the detailed design stage.

On this basis, the modified operation at the Site would not affect the ability of the Kurnell Terminal to meet the operational noise limits contained within the development consent for SSD-5544.

Cumulative impacts from other projects are not expected to significantly impact the same nearby noise sensitive receivers during typical operation.

References

Australian Standard 1055 *Acoustics – Description and measurement of environmental noise – Part 2: Application to specific situations*, AS 1055.2-1997.

Australian Standard AS2436 2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*, 2010

British Standard 5228-1:2009+A1:2014 – *Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1: Noise*.

British Standard 7385: Part 2 1993 – *Evaluation and Measurement of Vibration in Buildings*, 1993

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Glossary and abbreviations

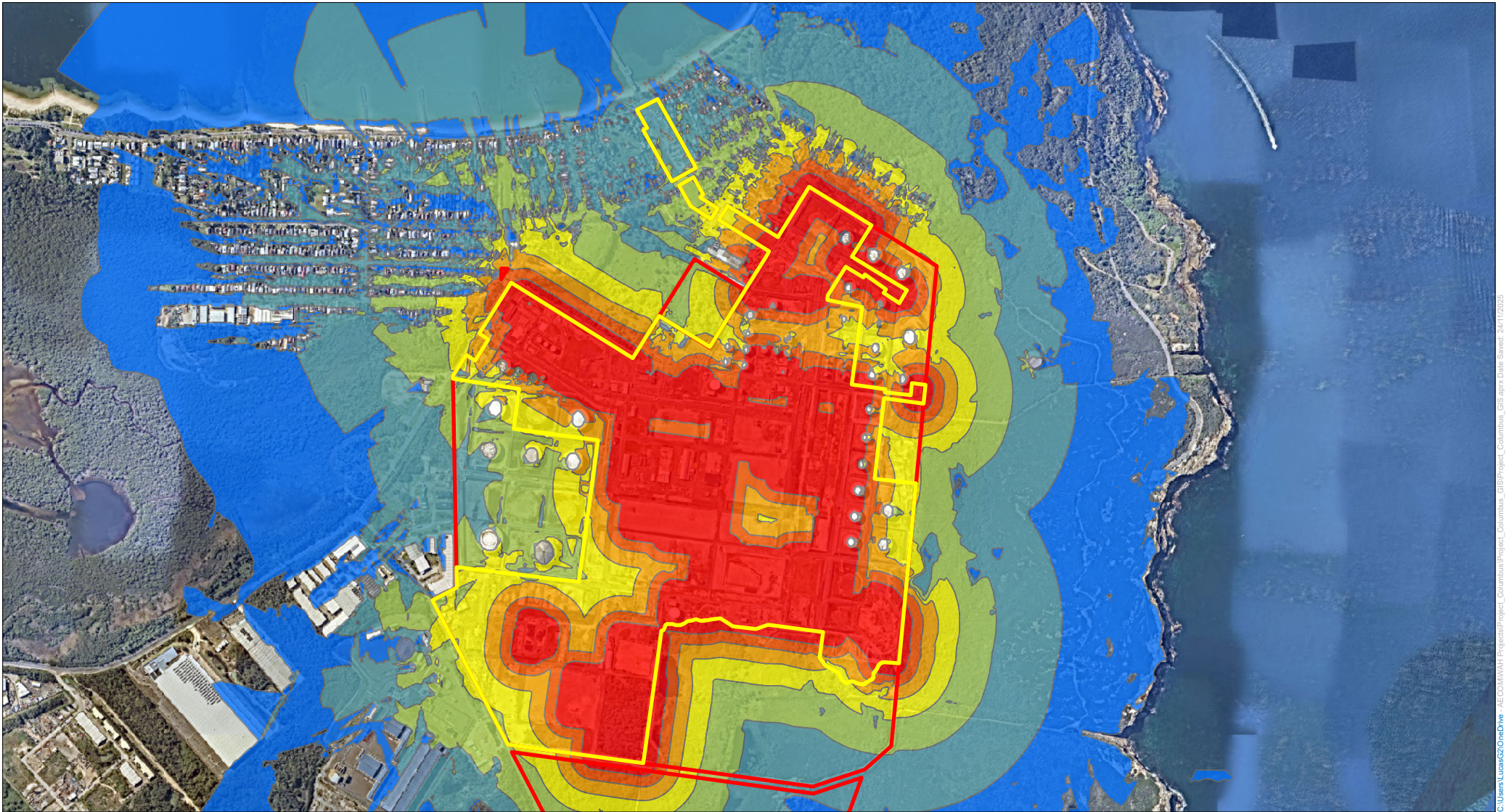
Term	Definition
Sound power level	The total sound emitted by a source.
Sound pressure level	The amount of sound at a specified point.
Decibel [dB]	The measurement unit of sound.
A Weighted decibels [dB(A)]	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1 kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB(A) increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB(A) increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows: 0 dB(A) Threshold of human hearing 30 dB(A) A quiet country park 40 dB(A) Whisper in a library 50 dB(A) Open office space 70 dB(A) Inside a car on a freeway 80 dB(A) Outboard motor 90 dB(A) Heavy truck pass-by 100 dB(A) Jack hammer / subway train 110 dB(A) Rock concert 115 dB(A) Limit of sound permitted in industry 120 dB(A) 747 take off at 250 m
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Insertion loss	Reduction in noise by inserting a barrier between the source and receiver.
L_{max}	The maximum sound pressure level measured over the measurement period.
L_{min}	The minimum sound pressure level measured over the measurement period.
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10} .
L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90} .
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.

Term	Definition
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Daytime	Industrial/ construction noise: The period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and public holidays. Road traffic noise: The period from 0700 to 2200 h every day of the week.
Evening	Industrial/ construction noise: The period from 6pm to 10pm Monday to Sunday and Public Holidays. Road traffic noise: Not applicable.
Night-time	Industrial/ construction noise: The period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and public holidays. Road traffic noise: The period from 10pm to 7am every day of the week.
Standard construction hours	Between 7:00 am and 6:00 pm, Monday-Friday; 8:00 am and 1:00 pm, Saturday; No works on Sunday or Public Holidays.
Assessment background level [ABL]	The overall background level for each day, evening and night period for each day of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the entire length of noise monitoring.
Noise management level [NML]	The level which represents the point above which there may be some community reaction to noise.

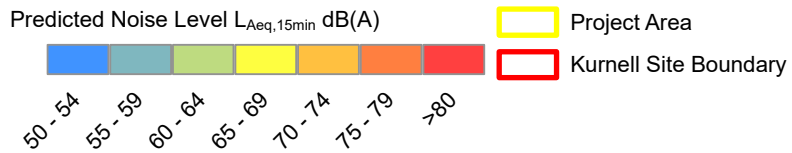
*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 “Acoustics – Glossary of terms and related symbols”, the EPA’s NPfl and RNP.

Annexure A

Construction Noise Contours



Construction Noise - Scenario 01
 Noise contours are shown 1.5 meters above ground level



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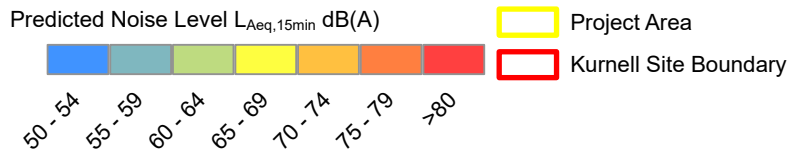
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Construction Noise - Scenario 02
 Noise contours are shown 1.5 meters above ground level



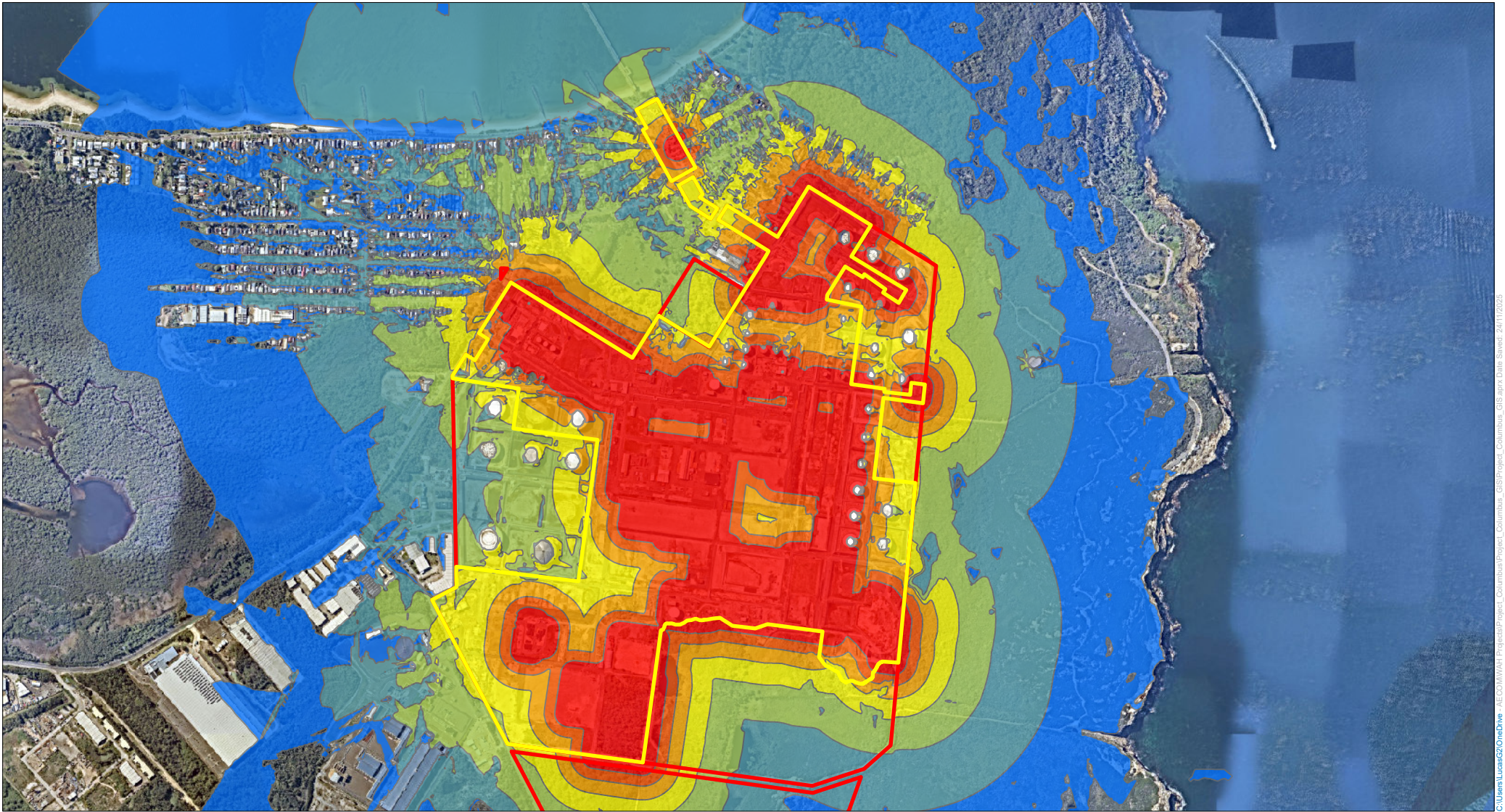
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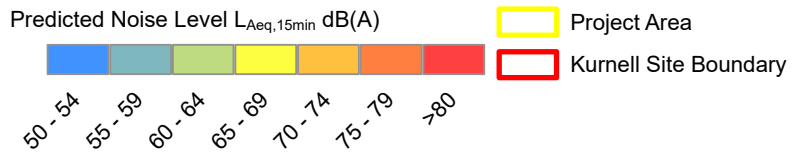
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Construction Noise - Scenario 03
 Noise contours are shown 1.5 meters above ground level

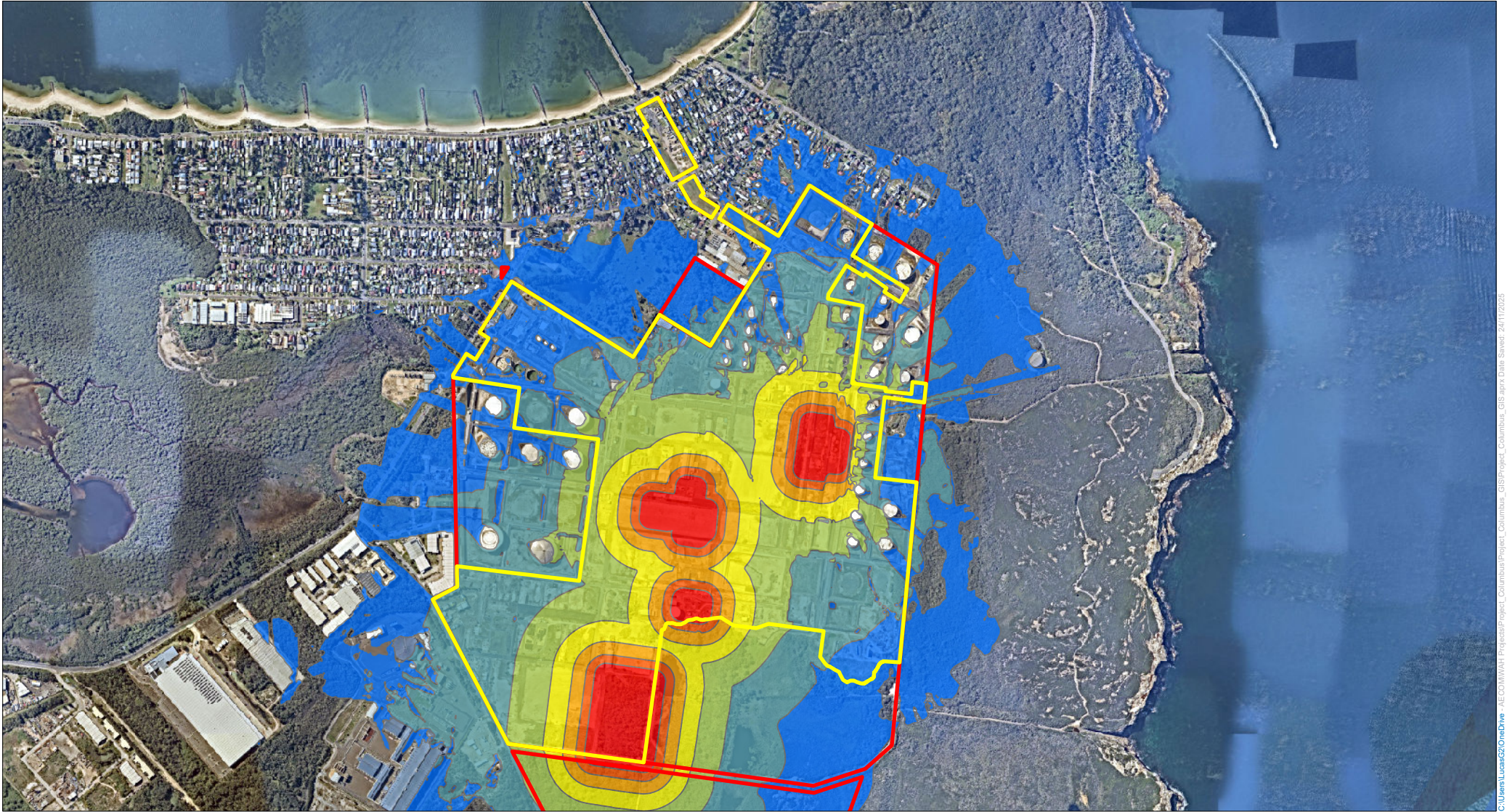


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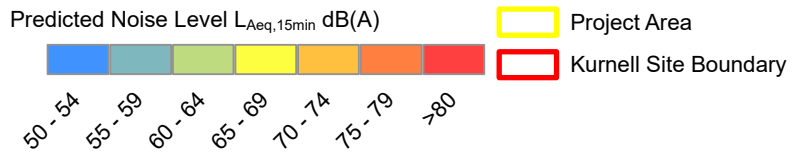
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Construction Noise - Scenario 04
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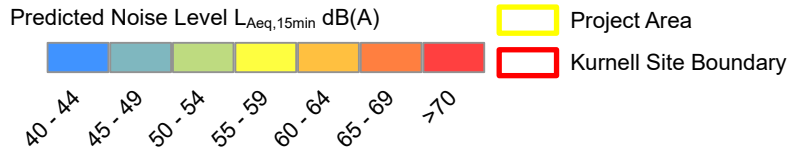
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Construction Noise - Dewatering Pumps
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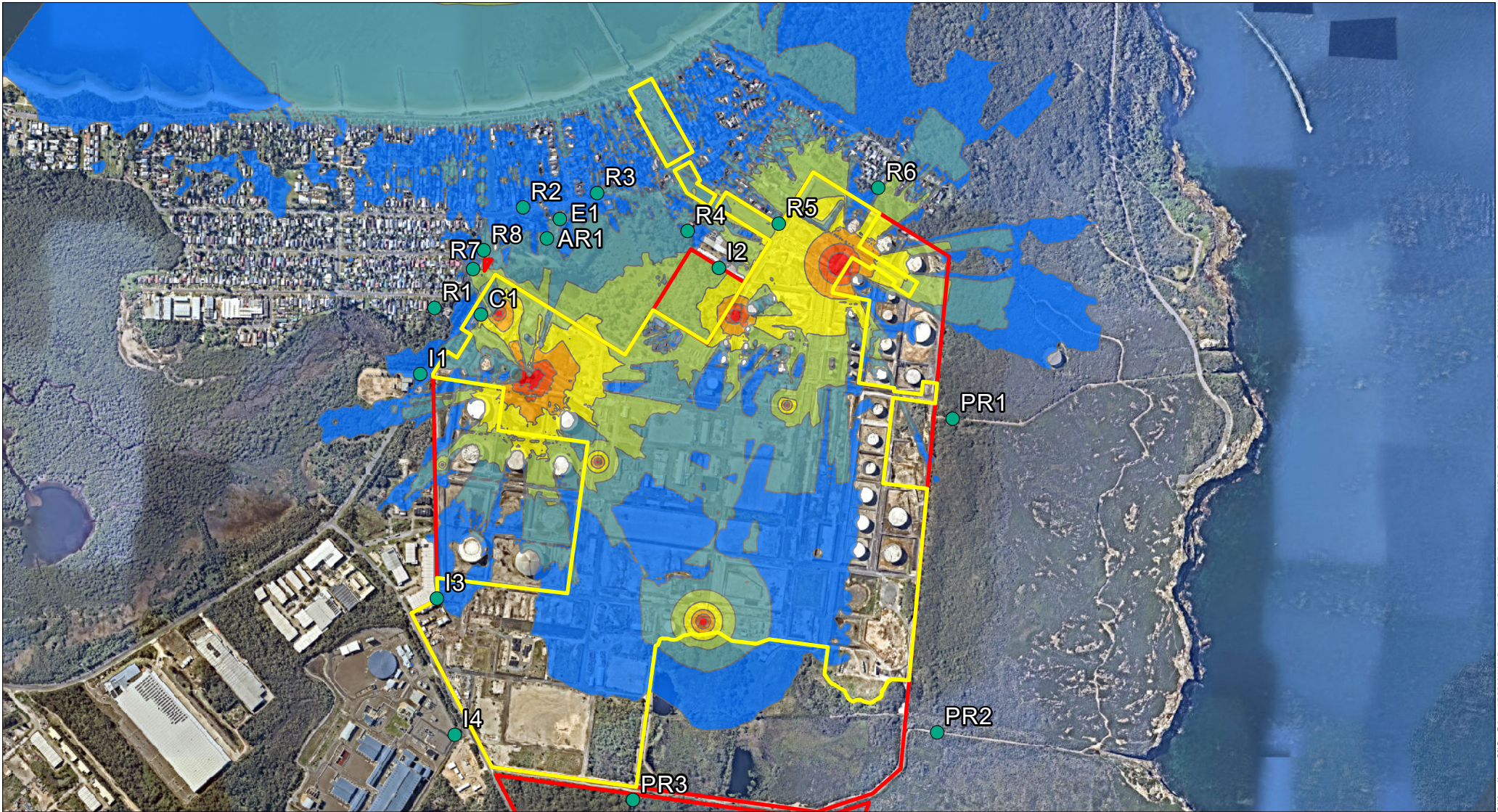
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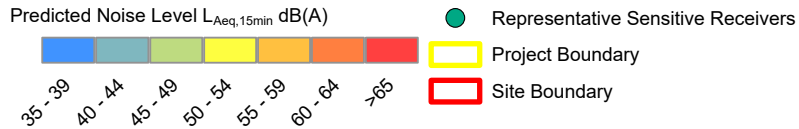
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Annexure B

Operational Noise Contours



Operational Noise - Night-time standard operation - Noise enhancing weather conditions
 Noise contours are shown 1.5 meters above ground level



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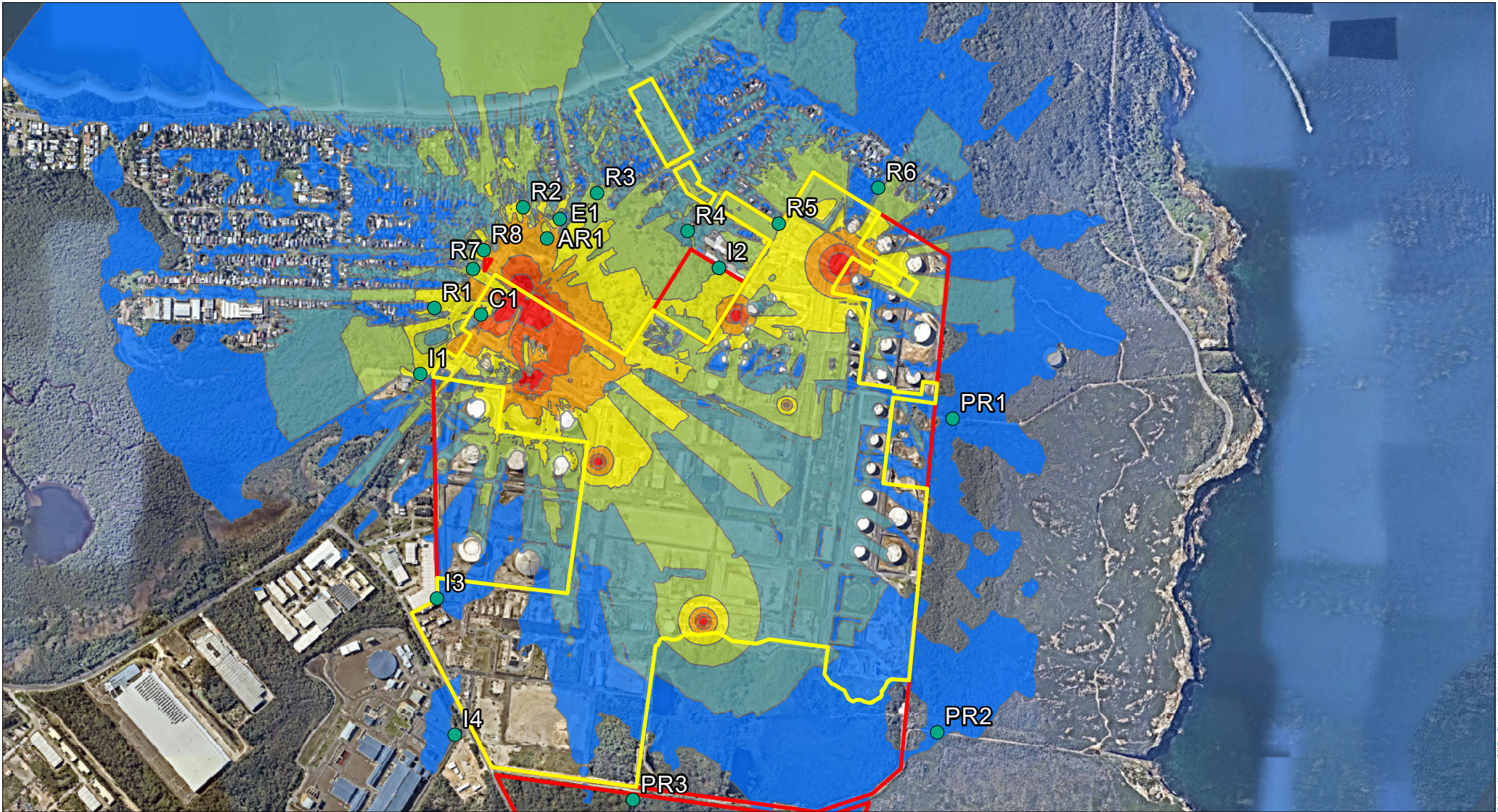
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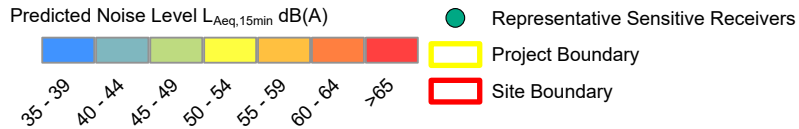


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Operational Noise - Daytime Annual FWS Testing Option 1 - Noise enhancing weather conditions
 Noise contours are shown 1.5 meters above ground level



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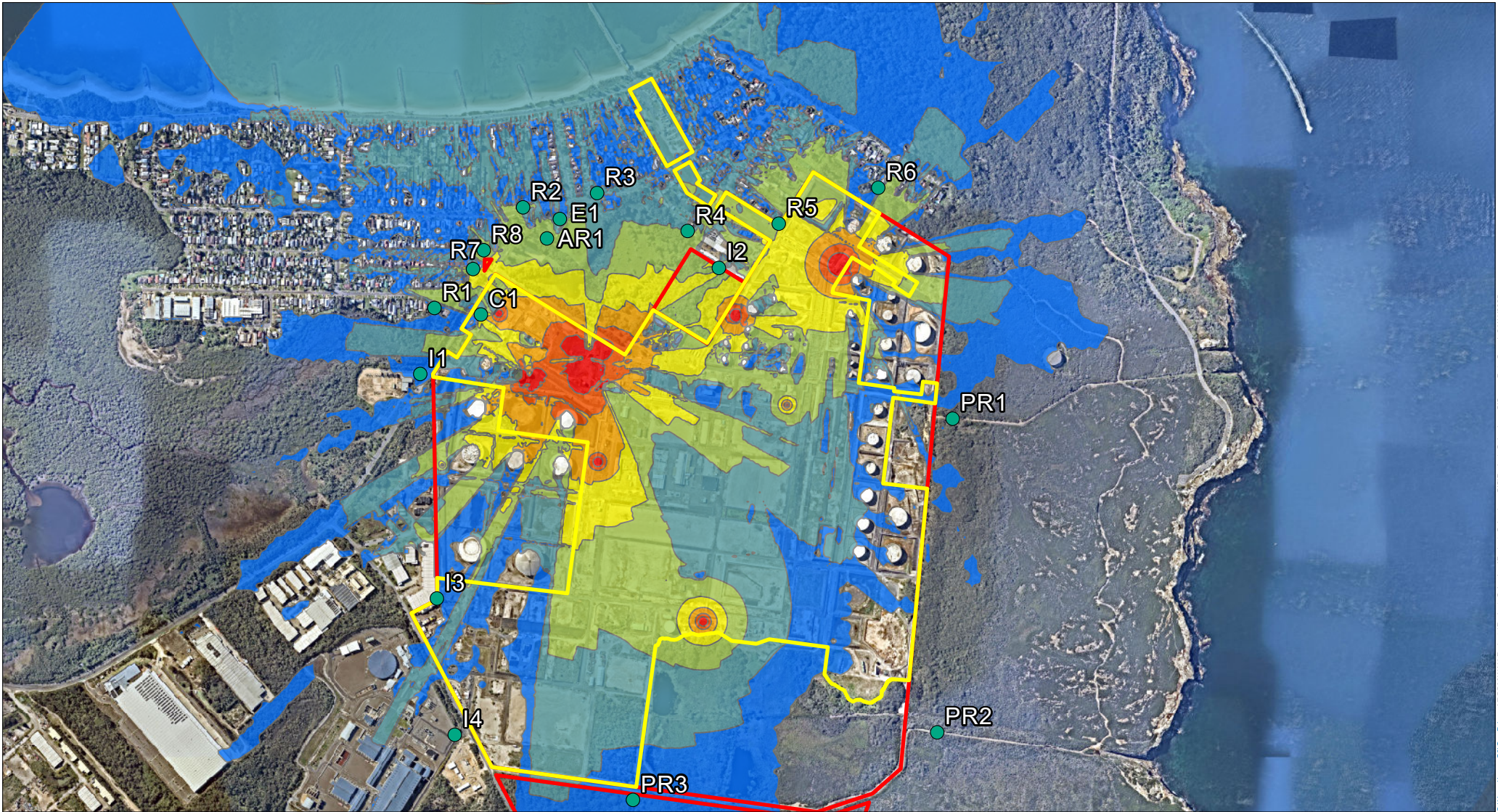


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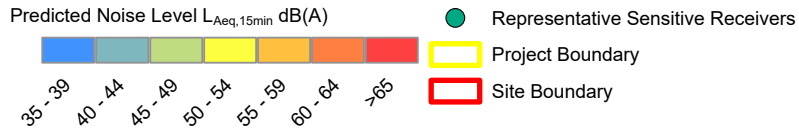


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Operational Noise - Daytime Annual FWS Testing Option 2 - Noise enhancing weather conditions
 Noise contours are shown 1.5 meters above ground level



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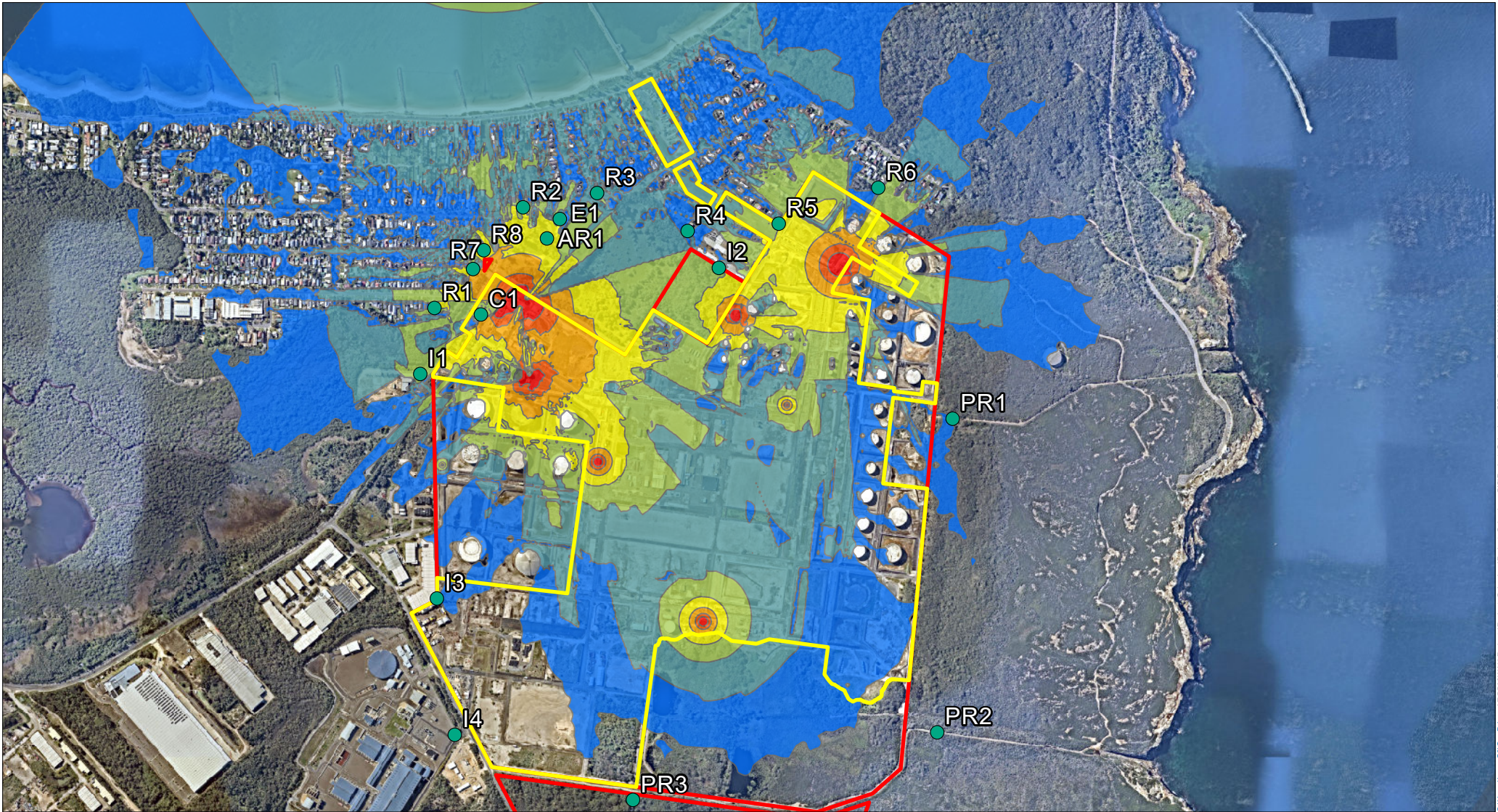


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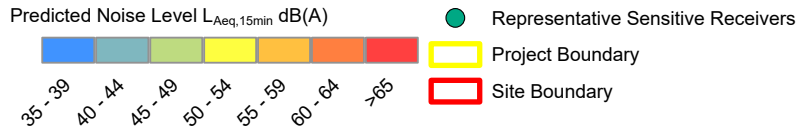
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Operational Noise - Daytime Monthly FWS Testing Option 1 - Noise enhancing weather conditions
 Noise contours are shown 1.5 meters above ground level



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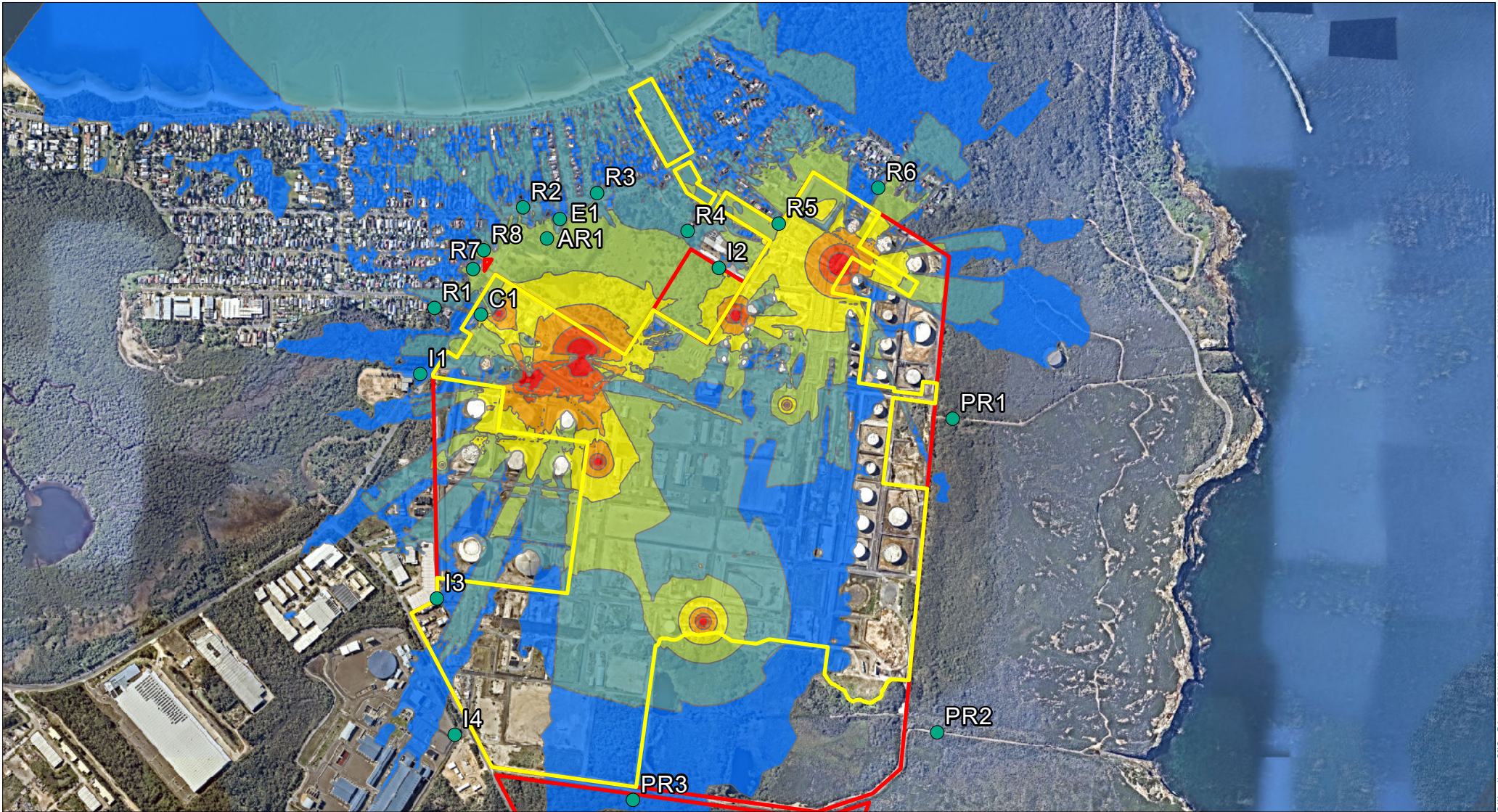
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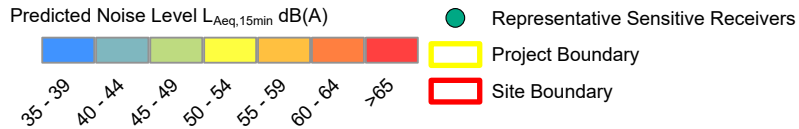


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Operational Noise - Daytime Monthly FWS Testing Option 2 - Noise enhancing weather conditions
 Noise contours are shown 1.5 meters above ground level



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Annexure C

Predicted 1/3 octave
band noise levels

Annexure C Predicted 1/3 octave band noise levels

Table C-1 Predicted one third octave band operational noise levels

Receiver Type	Frequency, Hz																								Overall level	
	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	dB(A)	dB(C)
R1	-	-	-	-	5	7	11	11	14	12	14	16	19	21	21	24	21	23	22	19	17	12	10	7	31	31
R2	-	-	1	2	8	10	14	14	16	15	17	19	23	26	25	28	27	28	28	25	22	18	12	8	36	36
R3	-	-	2	3	9	12	16	15	15	16	16	19	23	25	24	28	26	27	28	26	28	21	18	14	36	36
R4	-	-	-	1	6	9	13	14	16	14	16	18	21	22	23	25	25	26	27	27	27	21	19	14	36	35
R5	-	-	-	11	7	11	18	21	20	22	27	28	35	38	34	38	36	37	39	39	35	34	32	28	47	47
R6	-	-	-	5	4	8	12	14	13	14	18	20	25	27	23	27	24	24	24	22	19	14	12	6	33	34
R7	-	-	1	4	8	11	16	18	22	20	24	26	26	27	28	32	32	33	34	34	33	29	30	26	43	42
R8	-	-	1	4	9	12	16	17	19	18	21	24	25	26	27	29	28	29	31	31	29	26	26	22	39	39
E1	-	-	-	-	7	10	13	12	13	12	12	15	18	21	21	25	21	22	24	22	18	15	8	3	32	32
AR1	-	-	-	-	6	10	14	14	16	16	18	21	24	27	27	29	28	28	28	26	27	21	19	17	37	37
PR1	-	-	-	-	-	-	-	3	3	2	4	6	13	16	13	16	14	14	13	10	5	-	-	-	22	23
PR2	-	-	-	-	-	-	-	-	-	-	-	2	11	14	12	17	12	13	14	11	6	1	-	-	22	23
C1	-	-	-	1	7	10	13	13	16	15	17	20	23	26	26	26	26	27	25	22	21	18	17	16	34	35
I1	-	-	-	-	6	10	14	14	16	15	16	19	21	23	24	26	25	26	25	22	21	17	14	11	34	34
I2	-	-	-	-	5	12	19	23	23	18	19	23	24	29	29	36	31	33	37	36	33	32	29	26	44	44
I3	-	-	-	-	-	1	7	10	11	10	13	14	22	25	21	25	22	22	23	22	23	15	11	7	32	33

Receiver Type	Frequency, Hz																								Overall level	
	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	dB(A)	dB(C)
I4	-	-	-	-	-	-	1	5	5	4	7	9	18	20	17	21	17	17	17	14	8	3	-	-	26	28

Table C-2 Predicted one third octave band operational noise levels for monthly FWS testing (Option 1)

Receiver Type	Frequency, Hz																								Overall level	
	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	dB(A)	dB(C)
R1	36	41	36	35	40	51	47	33	36	41	33	36	37	37	38	36	39	44	39	43	41	34	27	21	50	55
R2	38	43	39	37	42	55	50	37	38	43	35	37	38	38	38	37	39	44	39	42	40	33	27	21	50	57
R3	37	42	39	36	40	49	45	34	33	37	30	32	33	33	34	34	36	40	35	37	36	29	23	19	46	52
R4	35	38	35	33	35	42	37	32	31	29	28	28	30	29	28	29	27	28	29	28	29	24	22	18	38	46
R5	41	39	37	43	35	37	39	39	36	35	37	37	42	43	38	41	38	38	41	41	37	36	35	31	50	52
R6	37	36	34	38	32	34	34	32	28	28	29	29	33	33	29	30	27	25	26	24	20	17	14	9	37	44
R7	41	45	42	41	47	59	55	40	42	47	39	41	40	40	41	40	42	48	43	47	45	38	35	31	54	61
R8	40	45	41	41	46	58	54	39	41	46	38	40	40	39	41	39	43	48	42	47	45	38	33	28	54	61
E1	37	42	38	36	40	47	42	32	31	32	26	27	28	30	28	29	25	28	27	26	23	19	13	8	37	50
AR1	38	44	39	38	43	55	51	36	37	44	36	38	38	38	39	38	40	45	40	44	42	35	30	25	51	58
PR1	26	25	21	25	23	34	31	25	28	25	26	25	29	30	30	27	27	23	21	18	11	6	-1	-9	35	40
PR2	19	20	15	18	18	29	27	22	25	22	23	22	26	28	27	25	23	20	18	15	8	5	-3	-10	32	36
C1	39	44	39	36	42	53	49	35	36	38	32	33	34	35	34	32	33	40	35	39	37	29	25	22	46	55
I1	36	40	36	34	39	49	45	34	35	39	31	33	34	33	34	33	35	40	34	37	35	28	21	17	46	52

Receiver Type	Frequency, Hz																								Overall level	
	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	dB(A)	dB(C)
I2	33	36	33	36	35	44	42	40	39	32	32	33	33	36	36	39	36	35	39	38	35	34	31	28	47	50
I3	33	32	29	31	28	36	32	29	27	25	25	26	32	33	28	29	26	25	25	24	24	18	15	11	37	42
I4	25	24	21	25	20	29	26	23	21	19	19	20	27	28	24	25	20	20	19	16	10	6	1	-6	31	36

Notes: *Red bold text denotes tonal characteristics*

Table C-3 Predicted one third octave band operational noise levels for monthly FWS testing (Option 2)

Receiver Type	Frequency, Hz																							Overall level		
	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	dB(A)	dB(C)
R1	35	38	35	32	35	43	38	29	29	29	25	25	28	28	26	27	24	25	24	22	26	19	14	11	35	46
R2	36	40	37	34	38	46	42	33	33	36	30	32	34	35	34	34	35	39	34	37	35	27	20	14	45	50
R3	37	41	39	36	40	50	45	34	33	36	31	32	34	34	33	34	34	38	33	35	34	27	22	19	45	53
R4	36	39	36	35	40	51	46	34	34	37	31	32	33	32	33	32	34	38	33	35	33	27	23	19	44	53
R5	41	40	38	43	36	40	40	39	35	35	37	37	42	43	38	41	38	38	41	41	37	36	35	31	50	52
R6	37	36	34	38	33	40	37	32	29	31	29	30	33	33	30	30	29	30	27	26	22	17	15	9	39	46
R7	38	41	38	37	39	51	47	37	37	39	35	36	35	35	35	36	37	40	37	39	37	33	33	29	48	54
R8	38	42	38	37	41	51	46	36	36	38	33	34	35	34	35	35	36	40	36	38	36	31	30	26	47	54
E1	35	40	37	35	38	43	39	32	30	29	26	26	28	29	28	29	25	33	29	30	27	21	14	8	39	47
AR1	36	41	37	36	41	53	47	35	35	38	32	34	35	36	36	36	37	42	36	39	37	30	25	21	48	55
PR1	26	27	22	26	25	36	31	22	20	22	17	18	23	24	20	20	18	18	15	13	7	3	-2	-9	28	38
PR2	19	20	15	18	17	27	23	18	18	14	14	14	20	21	19	21	16	16	17	13	8	5	-3	-10	26	32
C1	37	41	37	35	39	48	43	32	33	36	29	31	32	34	33	31	34	39	33	36	33	26	22	19	44	51
I1	35	36	34	32	34	35	35	32	31	28	27	28	29	29	29	28	27	27	27	24	22	20	16	14	37	44
I2	34	37	34	36	39	50	45	40	38	36	31	33	33	34	34	38	35	38	39	39	36	34	31	28	47	53
I3	33	32	29	31	27	34	32	29	29	25	26	25	32	33	28	29	25	25	25	24	24	18	15	11	36	42
I4	25	25	21	25	21	30	27	24	23	21	21	21	27	28	25	25	21	20	19	16	10	7	1	-6	32	37

Notes: Red bold text denotes tonal characteristics