The Quays Marina

Noise Impact Assessment

The Quays Marina Pty Limited
1856 Pittwater Road, Church Point
NSW 2105

Report Reference: 240391 – The Quays Marina – Noise Impact Assessment – R0

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1 INTRODUCTION

1.1 Background

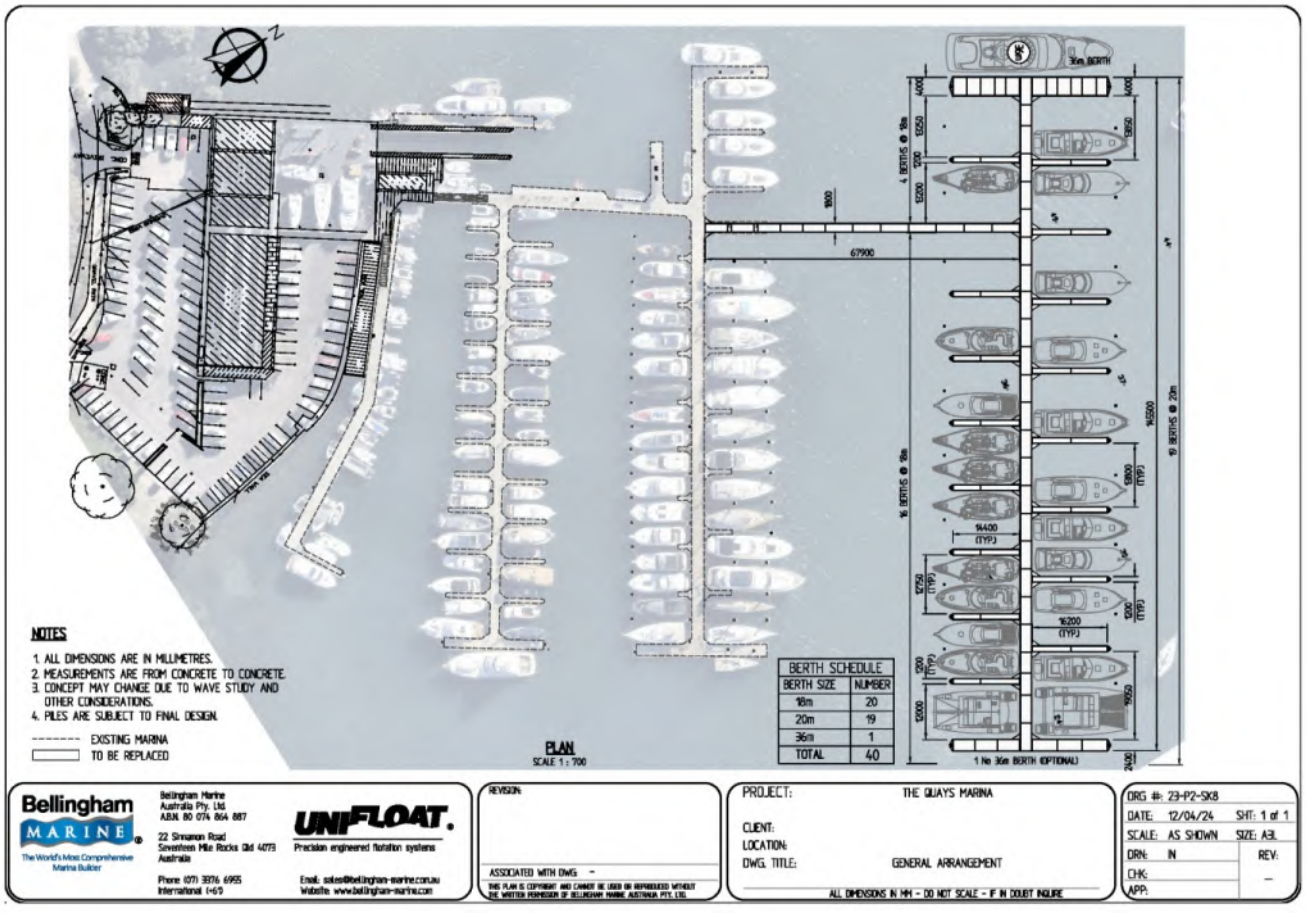
The Quays Marina (located at 1856 Pittwater Road, Church Point NSW) are proposing to expand the existing marina to create an additional 40 berths. Specifically, the proposed development includes the addition of a new marina arm and removal of existing swing moorings. The resulting number of wet berths will therefore be increased to a total of 150, whilst reducing the number of swing moorings to 29. Resulting in an overall net zero change to the capacity of the marina.

The existing marina operations includes: café, existing marina branches, wet berth, shipyard and carparking.

The proposed standard operational hours of the marina expansion are Monday to Friday: 7:00 am – 3:30 am. However, clients are permitted to access the marina / stay overnight at the marina during all time periods.

The proposed site layout of the facility is depicted in Figure 1 below.

Figure 1 Proposed site layout.



1.2 Planning Secretary's Environmental Assessment Requirements

The project Planning Secretary's Environmental Assessment Requirements (SEARs) were received for this project on 10 July 2024. This report has been specifically developed to address the development proposal SEARs. Presented below is a summary of the SEARs relevant to noise and vibration and where they have been addressed in the report.

Requirement	Where it is addressed
The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed: Noise and vibration – including:	This report.
A description of all potential noise and vibration sources during construction and operation, including road traffic noise / marina and cumulative impacts	Section 4.2 – Construction Noise Sources Section 4.6 – Construction vibration Sources Section 4.5 – Construction Road Traffic Section 6.1 – Cumulative (construction) Section 5.2 – Operational Nosie Sources Section 5.7 – Operational Road Traffic Section 6.2 – Cumulative (Operational)
A description and appraisal of noise and vibration mitigation and monitoring measures.	Section 7.1.5
Construction management and noise mitigation during works	Section 7.1
Hours of operation for the use and collective operations on site.	Section 1

1.3 Scope of this report

Pulse White Noise Acoustics (PWNA) has been engaged to undertake a Noise and Vibration Impact Assessment (NVIA) for the proposed development. This NVIA is required as part of the designated and integrated development application to address noise and vibration impacts that have the potential to be generated by the proposal.

This report:

- Identifies the existing noise sensitive receivers,
- Presents details about existing noise environment,
- Identifies the existing EPA licence, the applicable NSW noise and vibration policies and applicable construction and operational design criteria
- Assesses the construction and operational noise and vibration impacts in accordance with the applicable NSW policies; and
- Provides construction and operational noise and vibration mitigation and management measures to comply with the applicable design criteria.

2 EXISTING AMBIENT NOISE ENVIRONMENT

2.1 Land uses

The proposed expansion to the existing The Quays Marina is located at Lot 329 (DP 46686), 1856 Pittwater Road, Church Point, NSW 2105. The proposed expansion is situated to the north-east of the existing floating berths, property which currently consists of undeveloped, open water. Pittwater Road is located along the southern boundary of the development site. Open water / estuary shoreline surrounds the site, with residential dwellings located across Pittwater Road, to the south and west of the site.

The nearest residential receivers are located approximately 35 m to the south-west from the lot boundary, with additional residential receivers located further along Pittwater Road.

The existing noise environment of the site is generally composed of moderate traffic noise from Pittwater Road. The general noise environment is otherwise composed of general residential noise and environmental noise sources (wind, water (waves), birds, insects etc.) As such, the general noise environment is characteristic as a Rural environment.

One Noise Catchment Area (NCA) has been setup and are depicted in Figure 2 below.

Presented below in Table 1 are the location of the potentially most affected sensitive receivers. These locations are illustrated in Figure 2 below.

Table 1 Noise sensitive receivers.

ID	Address	Noise Catchment Area	Use	Receiver Height (m)
R01	2149 PITTWATER ROAD CHURCH POINT	NCA01	Residential	1.5
R02	2145 PITTWATER ROAD CHURCH POINT	NCA01	Residential	1.5
R03	2141 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R04	2137 PITTWATER ROAD CHURCH POINT	NCA01	Residential	1.5
R05	2125 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R06	2121 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R07	2117 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R08	2113 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R09	2107 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R10	2105 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R11	2101 PITTWATER ROAD CHURCH POINT	NCA01	Residential	4.5
R12	1 BAKERS ROAD CHURCH POINT	NCA01	Residential	4.5
R13	2075 PITTWATER ROAD BAYVIEW	NCA01	Residential	4.5
R14	2053 PITTWATER ROAD BAYVIEW	NCA01	Residential	4.5
R15	1806 PITTWATER ROAD BAYVIEW	NCA01	Residential	4.5
R16	1804 PITTWATER ROAD BAYVIEW	NCA01	Residential	4.5

2.2 Noise survey

Background noise logging was undertaken in location between the 26th of June 2024 and the 4th of July 2024. Noise Logger A was positioned along the south-western boundary of the development site. The results from logger A have been presented in Appendix B.1, and not been corrected (i.e., raw data is presented).

Instrumentation for the survey comprised one Rion NL-42 sound level meters (Logger A - Serial number 00396931). Calibration of the loggers was checked prior to and following the measurements. Drift in calibration did not exceed ± 0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Charts presenting summaries of the measured daily noise data are attached in Appendix B.1. The charts present each 24-hour period and show the LA01, LA10, LAeq and LA90 noise levels for the corresponding 15-minute periods. This data has been filtered to remove periods affected by adverse weather conditions based on weather information.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events have been excluded from the results, and also excluded from the data used to determine the noise emission criteria. Meteorological information has been obtained from the Terry Hills AWS (ID 066059) which is located within 7 km of the project site. Noise levels provided are processed results with extraneous weather events removed.

The noise logger location illustrated below in Figure 2 have been selected to measure the existing noise environment representative of the nearby noise sensitive receivers.

Figure 2 Site Map, Measurement locations and surrounding receivers – Site Map source from SixMaps.

The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes at the nearest potentially affected receiver. It is the 90th percentile of the daily background noise levels during each assessment period, being day, evening and night. The L_{Aeq} is the ambient noise level (logarithmically averaged) over the period.

The standard measurement periods used in NSW for site noise impacts are:

- Daytime – 7 am to 6 pm
- Evening – 6 pm to 10 pm
- Night-time – 10 pm to 7 am

Presented in Table 2 is a summary of the ambient and RBL noise levels measured over the entire measurement period. Noise logging charts are presented in Appendix B.1. These noise levels are used throughout the assessment to determine the existing noise environment and establish appropriate site-specific noise criteria.

Table 2: Measured ambient noise levels, dB(A).

ID	Address	Rating background level			Ambient noise level, $L_{Aeq,period}$		
		Daytime	Evening	Night	Daytime	Evening	Night
Noise Logger 01 (NCA01)	South-western boundary of the development site (refer to Figure 2).	42	33	30	61	55	51

The dominant noise source for Noise Logger 01 consists of primarily road traffic noise, residential receiver noise, and environmental noise sources (wildlife, water (waves), wind noise and rustling tress / grasses etc.).

3 NOISE AND VIBRATION CRITERIA

3.1 Existing EPA Licence

The site has an existing EPA Licence – EPL Number: 10890, originally established 30 January 2001, which provides quantitative noise criteria for the site. Presented below are the licence conditions for noise.

L3 Noise Limits

L3.1 Where a noise limit has not been prescribed, all operations and activities occurring on the premises must be conducted in a manner that will not cause offensive noise.

Since the current EPL does not provide any numerical criteria, paired with the fact that the proposed changes to the development will further intensify the area, and therefore it is considered appropriate to update the noise criteria in line with the EPAs current guideline requirements, the EPAs Noise Policy for Industry.

3.2 Construction noise

The EPA's Interim Construction Noise Guideline (ICNG) provides guidance on appropriate construction noise management levels that should be adhered to on construction projects throughout NSW. This guideline identifies that potential impacts from construction noise are determined based on time of day of the noise, the increase in site noise above background noise, the duration of the event, and any adverse characteristics of the noise.

The ICNG provides assessment procedures for the assessment of noise impacts, and management and mitigation measures procedures to address potential impacts on sensitive receivers. The main objectives of the ICNG are:

- Promote a clear understanding of ways to identify and minimise noise from construction works,
- Focus on applying all feasible and reasonable work practices to minimise construction noise impacts,
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours,
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

The ICNG identifies a quantitative assessment approach which is applicable to this project. The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with site specific Noise Management Levels (NMLs). The NML affectation categories for receivers have been reproduced from the guideline and are listed in Table 3.

Table 3 Construction noise management levels – residential receivers.

Receiver type	Time of day	Noise management level $L_{Aeq(15minute)}$[1,2]	How to apply
Residential	Monday-Friday 7am-5pm and Saturday 8am-1pm	Noise affected 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 $L_{Aeq(15minute)}$ 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 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: 1. 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. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
	Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 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.

Note 2 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).

The ICNG also provides NMLs for non-residential land uses. Unlike residential receivers, these criteria are fixed levels, independent of local background noise levels. Presented below in Table 4 are NMLs for non-residential land uses.

Table 4 Construction noise management levels – other receivers.

Land use	Location applied	Noise management level, $L_{Aeq,15min}$
Places of worship	Internal noise level	45 dB(A)
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)	External noise level	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)	External noise level	60 dB(A)
Community centres	Refer to the recommended "maximum" internal levels in AS2107 for specific uses	
Industrial premises	External noise level	75 dB(A)
Offices, retail outlets	External noise level	70 dB(A)

3.2.1 Site specific noise management levels

Presented below in Table 5 is the receiver specific external construction noise management noise criteria.

Table 5 Site specific external construction noise management levels, dB(A).

Area	Type	Daytime 7am to 6pm	Evening 6pm to 10pm	Night-time 10pm to 7am	Highly noise affected
Noise Logger 01	Residential	52	38	35	75

3.3 Construction vibration criteria

Effects of ground borne vibration on buildings may be segregated into two major categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself

Vibration criteria – human comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"* (AVATG). Vibration impacts can be defined based on the nature of the construction works and vibration generated, specifically:

- Continuous vibration – from uninterrupted sources (refer to Table 6).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 7).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 8).

Presented below in Table 6, Table 7, and Table 8 is a summary of the applicable human comfort vibration criteria, for continuous, impulsive, and intermittent vibration respectively.

Table 6 Continuous vibration acceleration criteria (m/s^2) 1 Hz-80 Hz.

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 7 Impulsive vibration acceleration criteria (m/s2) 1 Hz-80 Hz.

Location	Assessment period	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 8 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz.

Location	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Residences	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

Vibration criteria – building contents and structures

The vibration effects on the building are provided by British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration" (BSI 1993).

The criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 9 and illustrated in Figure 3.

Table 9 Transient vibration criteria as per standard BS 7385 Part 2 – 1993.

Line in standard	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

The vibration standard BS 7385 Part 2 – 1993 states that the values in Table 9 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 9 may need to be reduced by up to 50% (refer to Line 3 in Figure 2).

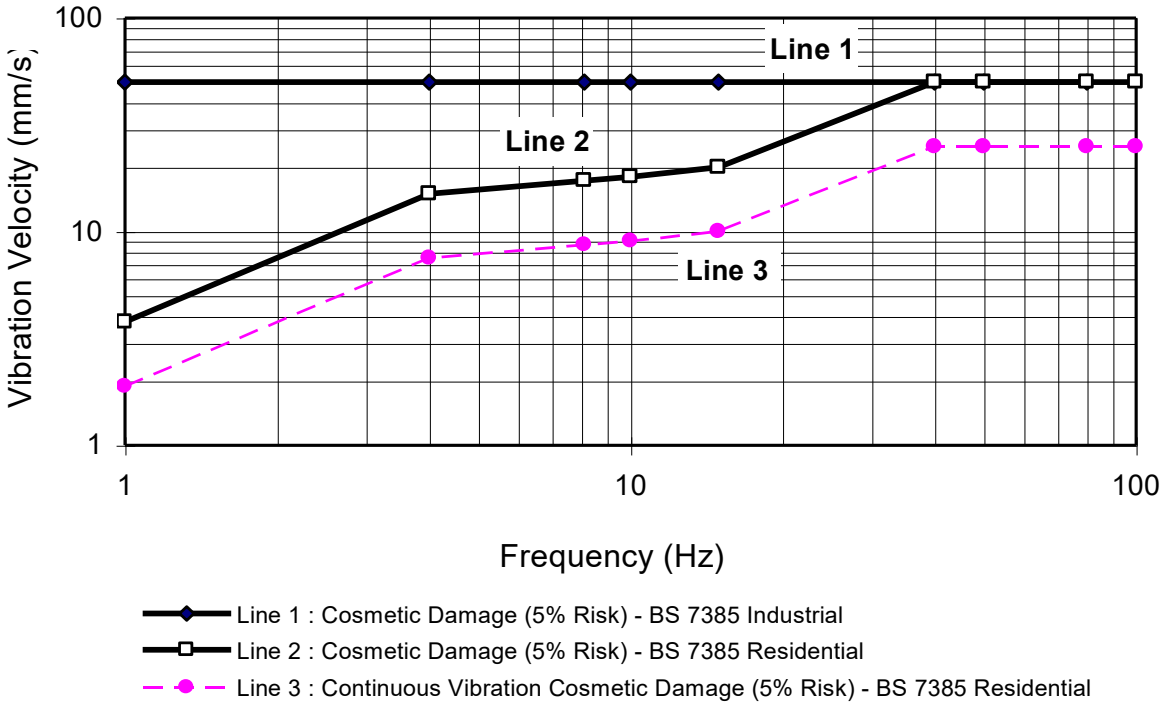


Figure 3 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is

associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 9, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 9 should not be reduced for fatigue considerations.

Project vibration criteria

Based on the details included in the sections above the project specific vibration criteria to protect the surrounding residential receivers from structural or architectural damage includes the following:

- Project construction vibration management level at all surrounding building structures – 7.5 mm/s.

In the event that this vibration criterion is exceeded, further investigation is required, including an assessment of the nature of the vibration and frequency characteristics to determine if the vibration criterion can be relaxed for the specific nature of the works.

3.4 Operational noise criteria

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the NSW Environment Protection Authority (EPA).

The EPAs NSW Noise Policy for Industry (NPfI) provides guidance on appropriate noise levels for external noise emissions from fixed facilities on surrounding sensitive receivers. The NPfI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity of defined land uses for residents and sensitive receivers in other land uses.

The intrusiveness noise level protects against significant changes in noise, while the amenity noise level seeks to protect against cumulative noise impacts from industry. Together, these levels are used to assess the potential impact of noise and assess reasonable and feasible noise mitigation measures. Project noise trigger levels are developed through this process. They are not used directly as regulatory limits.

The NPfI requires a project to take consideration of other industrial noise sources in setting amenity noise objectives. In cases of a new development where there are no existing industrial sources, the NPfI accepts a default of the amenity noise level minus 5 dB to take account of future industrial sources.

For this project, the default amenity noise level minus 5 dB adjustment will be used to account for cumulative noise sources.

3.4.1 Intrusive noise impacts – residential receivers

The intrusiveness noise level protects against significant changes in noise levels and is applicable to residential receivers only. The criterion is defined by the formula below:

$$L_{Aeq,15min} = rating\ background\ noise\ level + 5\ dB$$

The RBL is the average background noise level over a measurement period of at least one week. Using the RBL results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of

noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

To determine the intrusiveness period shoulder period, a similar approach has been taken as the other time periods. The shoulder periods RBL is determined from the 90th percentile of the L_{A90} noise levels over the measurement period.

Presented below in Table 10 is a summary of the measured RBL and corresponding intrusiveness level for each time period.

Table 10 Intrusive noise criteria, dB(A).

Location	Rating background level			Intrusive noise level, $L_{Aeq,15min}$		
	Daytime	Evening	Night-time	Daytime	Evening	Night-time
Noise Logger 01 (NCA01)	42	33	30	47	38	35

3.4.2 Protecting noise amenity

The amenity noise level seeks to protect against cumulative noise impacts from industry.

The NPfI uses project noise trigger levels measured over a 15-minute time period, assessed as an $L_{Aeq,15min}$. To account for converting $L_{Aeq,period}$ to $L_{Aeq,15min}$, the NPfI accepts a default conversion factor of $L_{Aeq,15min} = L_{Aeq,period} + 3$ dB.

To ensure industrial noise levels do not gradually increase with new developments, a minus 5 dB correction is applied to the amenity noise level. The amenity noise levels have been presented in Table 11.

Table 11 Amenity noise levels, dB(A).

Receiver	Noise amenity area	Time of day	Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day		
Place of worship	All	When in use	40
Passive recreation	All	When in use	50
Active recreation	All	When in use	55
Commercial	All	When in use	65
Industrial	All	When in use	70

3.4.3 Corrections for annoying noise characteristics

Table C1 of the NPfI provides corrections for tonality, intermittency, irregularity or dominant low-frequency content. These corrections are to be added to the measured or predicted noise levels at the receiver before comparison with the project noise trigger levels. NPfI also provides adjustments for duration that can increase the project noise criterion for unusual or one-off high-noise level events.

3.4.4 Low frequency noise correction

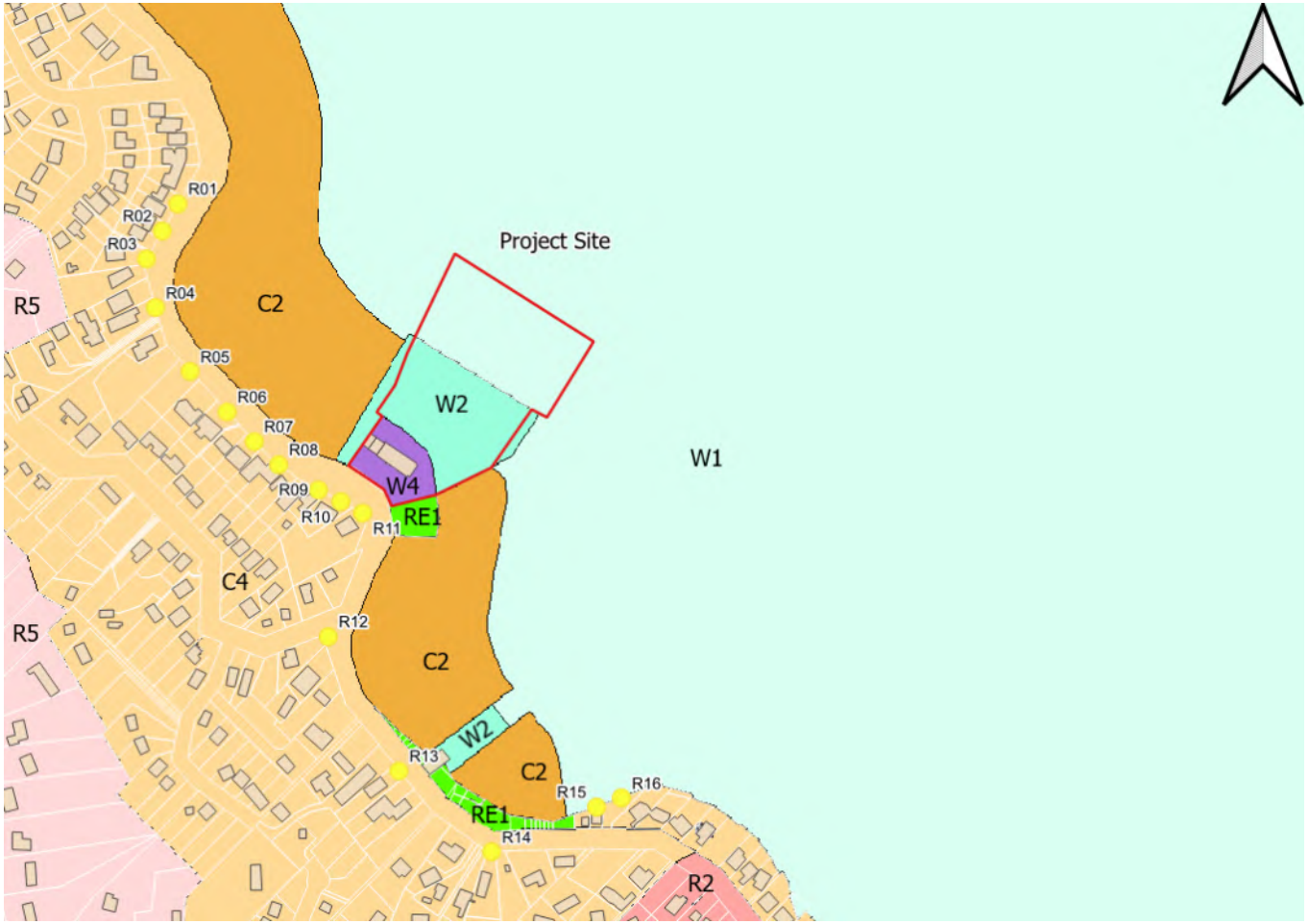
A difference of 15 dB or more between the C- and A-weighted noise measurements, identifies the potential for an unbalanced spectrum and an increased likelihood of low frequency noise annoyance.

The difference between C- and A-weighted noise levels is typically used as a screening tool to determine if further investigation is required. Where further investigation confirms significant low frequency content, a low frequency noise correction is applied to the predicted or measured noise levels.

The NPfI identifies that the corrections should "reflect external assessment locations", or sensitive receiver locations so the existing noise environment should be considered.

3.4.5 Residential Receivers – Area Classification

Figure 4 NSW ePlanning Spatial Viewer.



As shown in Figure 4 above, the existing Quays Marina is located within areas classified as W2 and W4 (Recreational Waterways and Working Waterfront). The proposed expansion of the development is currently zoned as W1 (Natural Waterways). All of the nearest surrounding residential receivers are within an area also classified as C4 (Environmental Living) (Receivers R01 – R16).

3.4.6 Project specific noise trigger levels

The NPfI characterises the Rural Residential area noise environment as an area with an acoustical environment that is:

An area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse.

Daytime RBL < 40 dB(A)

Evening RBL < 35 dB(A)

Night RBL < 30 dB(A)

Whilst the NPfI characterises a Suburban Residential area noise environment as an area with an acoustical environment that is:

As area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics: evening ambient noise levels defined by the natural environment and human activity.

Daytime RBL < 45 dB(A)

Evening RBL < 40 dB(A)

Night RBL < 35 dB(A)

Based on the above descriptions, the surrounding receivers would be more typical of Suburban Residential, however, considering the area classifications presented in Figure 4 and the measured background noise levels (Table 2), we believe that the most appropriate, conservative classification for the surrounding residential receivers is Rural Residential.

Presented below in Table 12 is a summary of the project specific noise trigger levels.

Table 12 Project specific noise trigger level, $L_{Aeq,15minute}$ dB(A).

Receiver	Time period	RBL	L_{Aeq}	Intrusiveness	Amenity[1]	Overall[2]
Residential NCA 01	Daytime	42	61	47	48	**47**
	Evening	33	55	38	43	**38**
	Night-time	30	51	35	38	**35**

Note 1 As previously discussed, the amenity noise level has been reduced by 5 dB(A) to account for other industrial noise sources and increased by 3 dB(A) to convert from LAeq,period to LAeq,15minute.

Note 2 The overall PNTL are show in bold.

3.5 Operational road traffic noise

Developments of this type have the potential to generate additional road traffic and associated noise impacts from the vehicles accessing the site. The EPAs Road Noise Policy provides guidance on appropriate noise criteria which should be considered.

Presented in Table 13 below are the applicable noise criteria for road traffic on arterial and sub-arterial roads. Access routes for vehicles accessing the site at 1856 Pittwater Road, Church Point, is limited to a sub-arterial road only (Pittwater Road). Hence, the noise criteria for local roads has not been provided.

Table 13 Road noise criteria.

Road category	Type of project / land use	Assessment criteria, dB(A)	
		Daytime 7am-10pm	Night-time 10pm-7am
Freeway /arterial / sub-arterial roads	Existing residences affected by noise from redevelopment of existing freeway / arterial / sub-arterial roads.	$L_{Aeq,15hour}$ 60 (external)	$L_{Aeq,9hour}$ 55 (external)

Where the predicted noise levels with the project indicate likelihood to exceed the noise criteria presented in Table 13, it is considered not reasonable and feasible to provide noise mitigation measures if the project does not increase noise by greater than 2.0 dB. A change of 2 dB to 3 dB in road traffic noise is often considered to be indiscernible.

3.6 Maximum noise level criteria

During night-time periods, increased night-time noise levels have the potential to create sleep disturbance noise impacts.

The NPfI identifies the amenity noise level, discussed in Section 3, 'will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance'. However further guidance is provided in Section 2.5 of the NPfI, which requires consideration of maximum noise level events. This approach provides a screening criterion. The NPfI identifies that where the screening criterion is exceeded, a detailed maximum noise level event assessment should be undertaken. The screening criteria are:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater

These screening criteria were developed based on a review of research provided by the EPAs NSW Road Noise Policy. The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

Based on the measured noise levels outlined in Section 2.2 the resulting maximum noise level event requirements are:

- **NCA 01:**
  - 30 dB(A) $L_{A90\ (10pm-7am)}$ + 5 dB(A) = 35 dB(A) $L_{Aeq(15-mins)}$, which is less than 40 dB(A) and therefore the **40 dB(A)** will be adopted.
  - 30 dB(A) $L_{A90\ (10pm-7am)}$ + 15 dB(A)= 45 dB(A) $L_{AFMax)}$, which is less than the 52 dB(A) and therefore the **52 dB(A)** will be adopted.

4 CONSTRUCTION NOISE AND VIBRATION IMPACTS

4.1 Construction site noise

Noise impacts from construction works associated with the project have been predicted in accordance with the requirements in the EPAs ICNG. A three-dimensional noise model was developed using SoundPLAN v8.2 using the ISO9613 noise propagation algorithm and the noise impacts modelled for each major construction scenario.

Presented below is a summary of the construction activities, equipment and associated sound power levels, and a summary of the predicted noise impacts from the works. An assessment has been completed of the typical worst-case noise impacts. Noise from the project is often likely to be lower than the noise levels presented in this assessment.

In the absence of the appointment of a construction contractor, a schedule identifying the duration and timing of construction works is not available at the time of writing this report. Further detail would be provided in the contractors Construction Noise and Vibration Management Plan (CNVMP) which will be developed before construction is commenced.

4.2 Construction noise scenarios

It is anticipated that the construction of the new arm of the marina will require the installation of multiple piles. For this assessment, it has been assumed that the piling operations will entail the use of a bored piling rig, that is mounted on a barge. At this stage, it is expected that the piling operations will only take place during standard construction hours.

General construction of the marina will entail the use of trucks and articulated vehicles to deliver the piles, marina platforms, and other general equipment / items. Barges will be utilised to transport the marina pontoons from the boat ramp to the installation location. General power hand tools have also been included within the assessment.

The equipment anticipated for use in each task is based on previous project experience. The sound power levels for the equipment likely to be used for each of the listed task is provided in Table 14 below.

Table 14 Summary of predicted sound power levels, dB(A).

Tasks	Equipment	Sound power levels (dB(A) re 1pW)	Aggregate per task (dB(A) re 1pW)
Piling works	Piling Rig (Bored)	116	116
	Pile testing (Bored)[2]	116	
	Barge	100	
	Power hand tools	99	
Construction of Marina	Trucks and articulated vehicles to move materials and components	106	108
	Barge	100	
	Power hand tools	99	
	Mobile cranes	98	

Note 1	Aggregate sound power determined by the logarithmic addition of each individual sound power level component.
Note 2	Piling and pile testing are not to occur simultaneously, and hence both are not summed to determine the aggregate sound power level.

4.3 Assessment methodology

Calculations of the noise impacts have been undertaken in accordance with the ISO9613 noise propagation algorithm at the most affected sensitive receiver locations. Receivers located further from the site would have lower noise levels from the proposed works.

The construction hours are generally restricted to:

- Monday to Friday 7:00 am to 6:00 pm
- Saturday 8:00 am to 1:00 pm
- Sunday/Public Holiday No work or ancillary activity

Evening / Night-time construction works are not envisaged to be required for this project.

The following modelling assumptions are utilised for the construction noise assessment:

- The noise generating scenario is a worst case 15-minute period;
- Terrain has been sourced from the NSW Land and Property Information database Six Maps;
- Ground Absorption has been included in the model with the project site (and surrounding waterways) as 0, and the surrounding residential areas have a ground absorption of 0.3;
- Receptors located on ground level has been modelled at a receiver height of 1.5 m above ground, receptors located on level 1 have been modelled at a height of 4.5 m above ground.

Presented in Table 15 is a summary of the representative sensitive receivers which have been assessed for this project. The location of the receivers listed below in relation to the site and noise catchment area is illustrated in Figure 2. Construction noise contours for all surrounding receivers are also included in this assessment within Appendix C.

4.3.1 Out of hours works

Out of hours works are currently not proposed as part of this project. However, out of hours works may be required under the following limited circumstances:

- Works which are determined to comply with the relevant Noise Management Level (NML) at the most affected sensitive receiver,
- The delivery of materials as required by the Police or other authorities for safety reasons,
- Where it is required to avoid the loss of lives, property and/or to prevent environmental harm in an emergency; or
- Where agreement is reached with affected receivers work may also be undertaken where explicitly approved through an Environment Protection Licence.

Table 15 Sensitive receiver daytime construction noise management levels, dB(A).

ID	Address	Noise Catchment Area	Use	Construction noise management level	Highly noise affected level
R01	2149 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R02	2145 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R03	2141 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R04	2137 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R05	2125 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R06	2121 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R07	2117 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R08	2113 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R09	2107 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R10	2105 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R11	2101 PITTWATER ROAD CHURCH POINT	NCA01	Residential	52	75
R12	1 BAKERS ROAD CHURCH POINT	NCA01	Residential	52	75
R13	2075 PITTWATER ROAD BAYVIEW	NCA01	Residential	52	75
R14	2053 PITTWATER ROAD BAYVIEW	NCA01	Residential	52	75
R15	1806 PITTWATER ROAD BAYVIEW	NCA01	Residential	52	75
R16	1804 PITTWATER ROAD BAYVIEW	NCA01	Residential	52	75

4.4 Predicted construction noise impacts

An assessment of the likely construction noise impacts has been calculated using the ISO9613 noise propagation algorithm. The assessment has been based on the likely equipment which would be used during the proposed works as identified in Section 4.2.

Presented below in Table 16 is a summary of the worst-case predicted noise impacts for standard construction hours for all proposed construction phases. Construction noise contours are also presented in Appendix C.

Table 16 Predicted standard hours work construction noise impacts, $L_{Aeq,15min}$ dB(A).

Receiver ID	Noise management level	Predicted level		Exceedance		Highly noise affected
		Receiver height (m)		Receiver height (m)		
		1.5	4.5	1.5	4.5	
Piling Works						
R01	52	55	-	3	-	-
R02	52	54	-	2	-	-
R03	52	54	54	2	2	-
R04	52	55	-	3	-	-
R05	52	55	56	3	4	-
R06	52	57	58	5	6	-
R07	52	58	60	6	8	-
R08	52	58	61	6	7	-
R09	52	61	61	9	9	-
R10	52	61	62	9	10	-
R11	52	59	60	7	8	-
R12	52	52	53	-	1	-
R13	52	52	52	-	-	-
R14	52	49	51	-	-	-
R15	52	53	53	1	1	-
R16	52	51	53	-	1	-

Receiver ID	Noise management level	Predicted level		Exceedance		Highly noise affected
		Receiver height (m)		Receiver height (m)		
		1.5	4.5	1.5	4.5	
Construction of Marina						
R01	52	47	-	-	-	-
R02	52	46	-	-	-	-
R03	52	45	46	-	-	-
R04	52	47	-	-	-	-
R05	52	47	47	-	-	-
R06	52	49	50	-	-	-
R07	52	50	52	-	-	-
R08	52	50	53	-	1	-
R09	52	53	53	1	1	-
R10	52	53	54	1	2	-
R11	52	51	52	-	-	-
R12	52	44	45	-	-	-
R13	52	44	44	-	-	-
R14	52	41	43	-	-	-
R15	52	44	45	-	-	-
R16	52	43	45	-	-	-

The predicted construction noise impacts provided in Table 16 identify that moderate exceedances of the noise management levels are likely to occur at most receivers (all receivers except receivers R13 and R14) during extensive piling construction works.

No noise sensitive receivers have been identified to be highly noise affected by the piling works.

The predicted construction noise impacts provided in Table 16 identify that minor exceedances of the noise management levels are likely to occur at a limited number of receivers (specially receivers: R08, R09, and R10) during extensive general construction of the marina works.

No noise sensitive receivers have been identified to be highly noise affected by the general construction of the marina works.

Provided in Section 7.1 is a summary of recommended management and mitigation measures which should be followed to reduce the impacts on the local community.

4.5 Construction traffic noise assessment

Construction traffic movements will occur on Pittwater Road, a sub-arterial road with residential receivers that would be affected by both light and heavy vehicles during the construction phase of the project.

The traffic assessment for the development has been provided by Traffic and Safety Solutions PTY LTD report 'Traffic & Parking Impact Assessment Construction of a new arm to existing marina to create 40 additional berths Quays Marina 1856 Pittwater Road – Revision A'.

Based on a review of the forecasted construction traffic movements, the anticipated truck and vehicle movements would be:

- Peak construction Stage (Pile Construction and Pontoon Construction):
  - Heavy vehicle – 7
  - Light vehicle - 4

The noise propagation algorithm Calculation of Road Traffic Noise (CoRTN) has been proven to effectively calculate road traffic noise from free-flowing traffic throughout Australia. Construction noise levels have been predicted for noise sensitive receivers along Pittwater Road (Sub-arterial road).

Presented in Table 17 is the predicted existing and predicted construction noise impacts, assessed against the applicable criteria.

The additional truck volumes would increase noise levels by on Pittwater Road by approximately 0.2 dB in the peak AM period, construction traffic is not predicted to occur during the nighttime period.

Table 17 Construction traffic noise impacts.

Period	Criteria	Existing, dB(A)	Future, dB(A)	Change in noise, dB
Construction Traffic Noise Impacts				
Pittwater Road (Daytime)	$L_{Aeq(15hour)}$ External 60 dB(A)	63	63.2	0.2

As evident in Table 17 above, an insignificant increase in road traffic noise is expected to result from the construction of the proposed development. While an increase in noise from construction traffic noise may not be discernible, management of potential impacts is still recommended. Further consideration is provided in Section 7.1.

4.6 Construction vibration assessment

To maintain compliance with the human comfort vibration criteria identified in Section 3.3, it is recommended that the indicative safe distances listed in Table 18 should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking operator-attended measurements of vibration levels generated by construction equipment to be used on site.

If applicable, the criteria for scientific or medical equipment (should any of these exist close to the site) can be more stringent than those required for human comfort. Vibration validating measurements should be conducted at each site to determine the vibration level and potential impact onto this sensitive equipment.

Recommended safe working distances for various typical items of plant are included in the following table.

Table 18 Recommended indicative safe working distances for vibration intensive plant.

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage	Human Comfort (AVTG)
Piling Rig (Bored)	≤ 800 mm	2 m (nominal)	N/A

An assessment of the potential for vibration generated as part of the required construction activities on the project has been undertaken based on the expected vibration detailed in the table above. The nearby residential receivers are very unlikely to exceed the project vibration criteria, or safe working distances.

Although the project vibration criteria is not predicted to exceed at any residential receivers, vibration management measures are discussed further in Section 7.1.4 to manage vibration impacts to receivers for completeness.

5 OPERATIONAL NOISE IMPACTS

5.1 Modelling methodology

Site operational noise emissions have been calculated using the CONCAWE algorithm. The CONCAWE algorithm has been selected to ensure that noise enhancing weather conditions including temperature inversions and downwind conditions have been appropriately considered in the noise assessment. These effects will have a moderate impact on some of the residential receivers due to the distance of the residential receivers to the site (furthest receiver approximately 400 m away).

CONCAWE provides six meteorological categories, which are different to the Pasquil Stability Category usually referenced. Both adverse wind and temperature inversions fall into CONCAWE Category 6.

The meteorological assessment has assessed a worst-case situation, which entails the calculation of the worst-case weather in all directions for all receivers. The following weather conditions have been included in the assessment, in accordance with the requirements of the NPfI – Fact Sheet D.

Standard meteorological conditions:

- 0.5 m/s wind speeds; and
- Stability category D.

This is equivalent to CONCAWE Meteorological Category 4

Daytime and evening noise enhancing properties:

- 3 m/s wind speeds; and
- Stability category D.

This is equivalent to CONCAWE Meteorological Category 5

Night-time noise enhancing properties:

- 2 m/s wind speeds; and
- Stability category F.

This is equivalent to CONCAWE Meteorological Category 6 (the highest category)

5.2 Operational site noise emissions

The proposed expansion to The Quays Marina includes the addition of a new arm to the existing marina, which would provide an additional 40 x wet berths. Specifically, the 40 x wet berths are split into the following classes: 20 x 18 m berths, 19 x 20 m berths, 1 x 36 m berth. The existing swing moorings are also proposed to be removed.

Typical noise generating scenarios associated with the proposed expansion to the marina include boat engine startup / warm up, boat bow thruster, occupants of the boat talking, and land-based people talking.

There are a range of activities that could potentially occur on site, however only the greatest noise generating activities in each time period have been considered. This approach has been taken to clearly state the greatest potential noise impacts generated by the site which is required to comply with the requirements of the NPfI. With the compliance of these operations, all site operations would comply with the design criteria. As such, this assessment considers the exclusive use of vessels within the 25 - 45 m length category, corresponding to the largest allowable vessels within the proposed expansion to the marina.

These operations can occur during all time periods. Table 19 below depicts the modelled worst-case noise scenarios for each time of operation. The operational equipment represents a single movement and corrected for the number

of boat movements in a 15-minute period. The noise data has been obtained from noise measurements on similar sites, and from Pulse White Noise Acoustics extensive database.

Table 19 Predicted worst-case site operations.

Scenario	Description
Daytime (7:00 am – 6:00 pm)	3 x Boat engine warm up (45 m vessel) – Each operational for 3 / 15 minutes 3 x Boat bow thruster – boats operating at 4 knots whilst within the boundary of the marina (Refer to Figure 5 below.) 4 x People talking with raised voices (occupants of boat) – (continuous within 15-minute period) 8 x People talking with raised voices (land-based) - (continuous within the 15-minute period)
Evening (6:00 pm – 10:00 pm)	2 x Boat engine warm up (45 m vessel) – Each operational for 3 / 15 minutes 2 x Boat bow thruster – boats operating at 4 knots whilst within the boundary of the marina (Refer to Figure 6 below.) 4 x People talking with raised voices (occupants of boat) – (continuous within 15-minute period) 8 x People talking with raised voices (land-based) - (continuous within the 15-minute period)
Night-time (10:00 pm – 7:00 am)	1 x Boat engine warm up (45 m vessel) – Each operational for 3 / 15 minutes 1 x Boat bow thruster – boats operating at 4 knots whilst within the boundary of the marina (Refer to Figure 7 below.) 4 x People talking with raised voices (occupants of boat) – (continuous within 15-minute period) 8 x People talking with raised voices (land-based) - (continuous within the 15-minute period)

5.3 Source noise levels and modelling assumptions

- The Boat engine warm up has been modelled at a height of 1 m above the surface level. Boat movements have been modelled at a speed of 4 knots whilst within the lot boundary of the marina;
- Boat bow thrusters have been modelled at a height of 1 m above the surface level;
- Boat occupants have been modelled at a height of 3 m above the surface level;
- People talking with raised voices during the daytime period have also been considered;
- The locations of modelled sources are illustrated in Figure 5, Figure 6, and Figure 7 below for the daytime, evening, and nighttime periods respectively;
- Nosie generating scenarios are modelled on a worst-case 15-miute period;
- Terrain has been sourced from the from Elvis database;
- Ground absorption has been included within the model with water areas having an absorption factor 0 (completely reflective) and land areas having an absorption factor of 0.3;
- The noise sources, sound power levels, heights and durations have been modelled with respect to the information present in Table 19 and Table 20, and Section 5.3;
- It is assumed that boats may leave and arrive at the marina 24 hours a day.

Figure 5 Modelled noise source layout – Daytime.

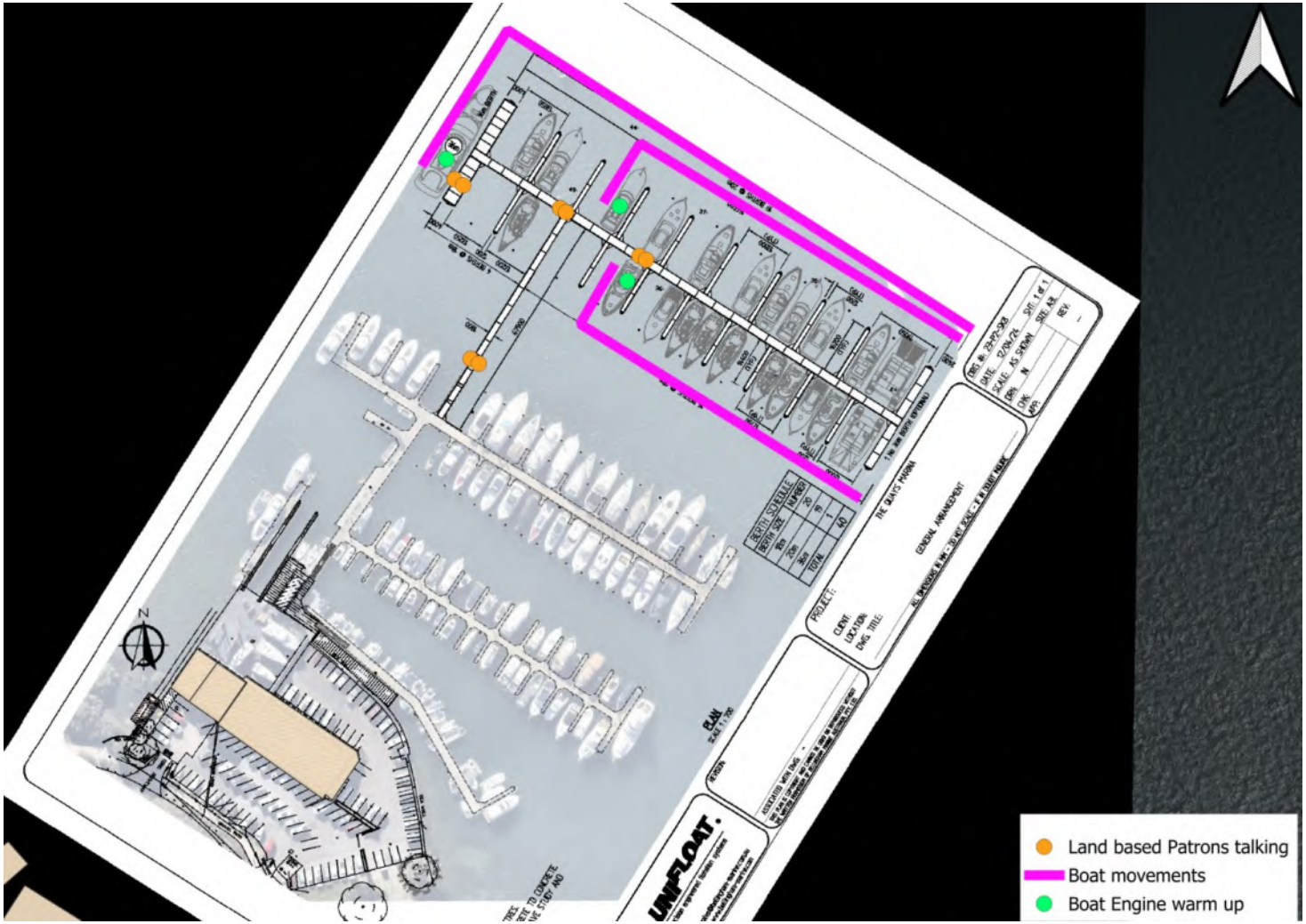


Figure 6 Modelled noise source layout – Evening.

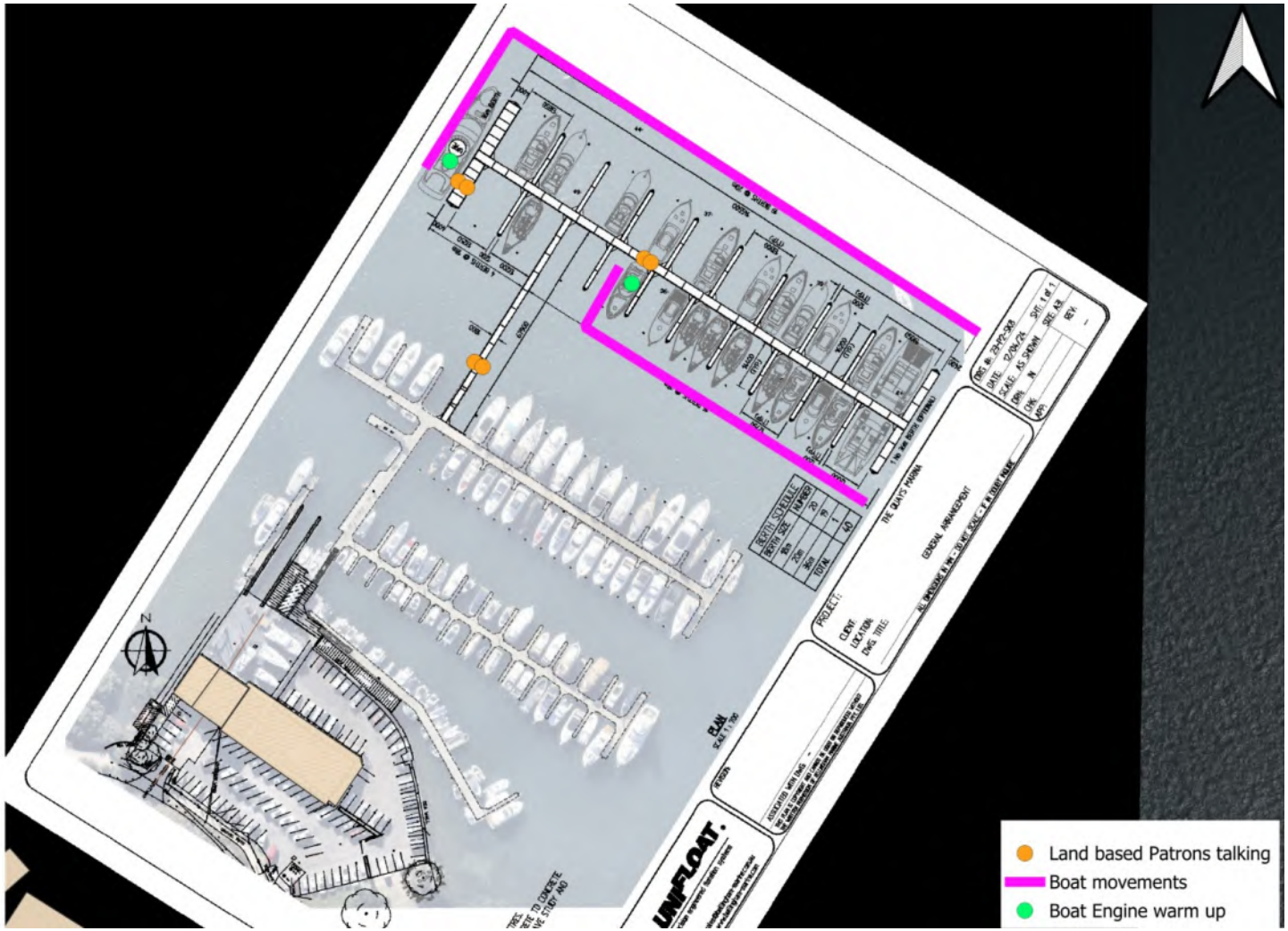


Figure 7 Modelled noise source layout – Nighttime.

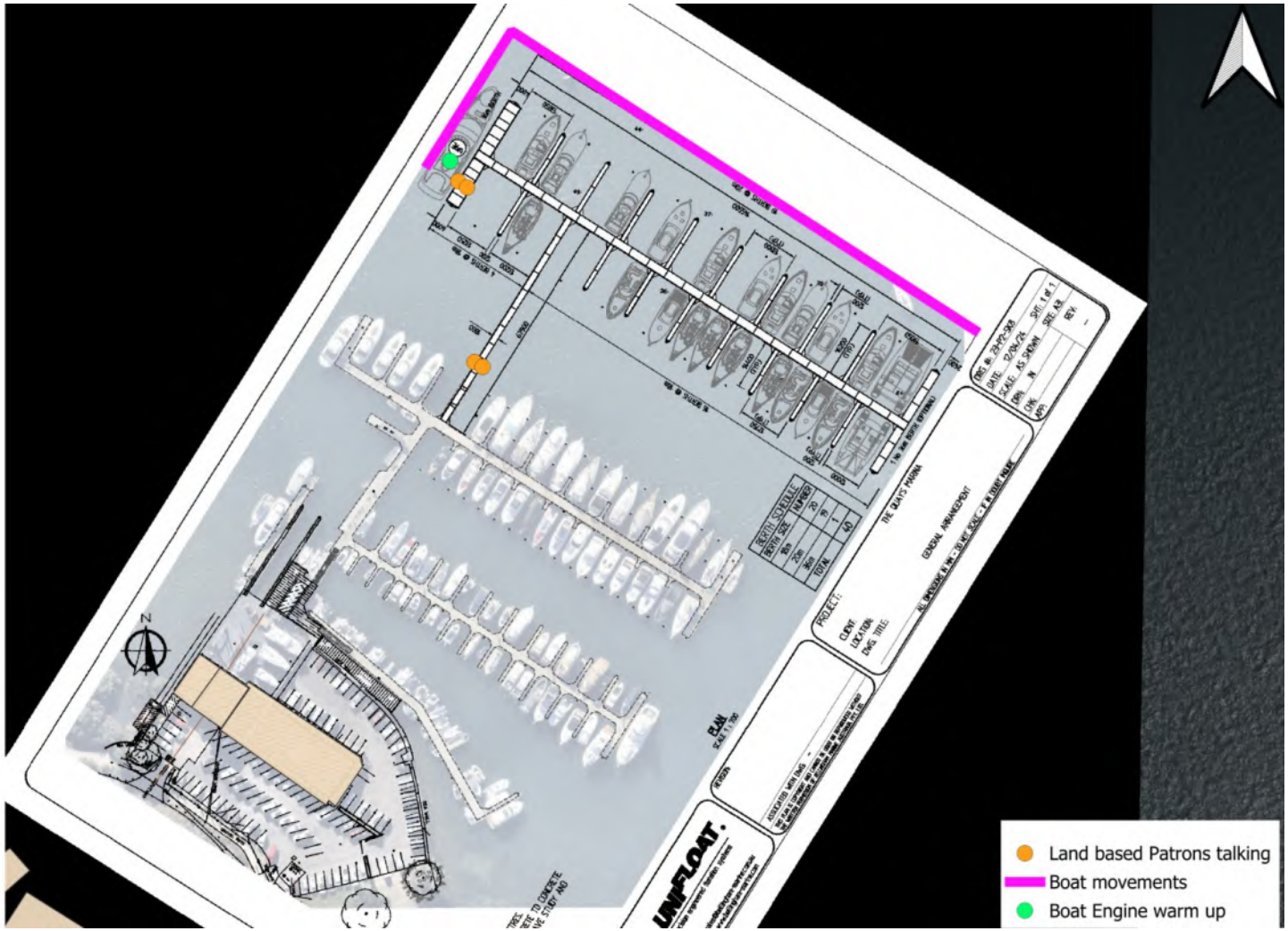


Table 20 Single event source noise levels, L_{Aeq} SWL.

Equipment	Sound power level L_{Aeq} dB(A)	LA Max dB(A)
Boat engine warm up (vessel length > 25 m and < 45 m)	85	95
Boat bow thruster	90	95
Boat patron with raised voice	73	78
Land-based patrons with raised voice	73	78

5.4 Annoying characteristics of noise

The NPfI requires annoying characteristics of noise to be taken into consideration in the assessment of noise. Annoying characteristics include:

- Tonal noise – noise containing a prominent frequency and characterised by a defined pitch.
- Low frequency noise – where a source has a significant component of noise in the 10 – 160 Hz range
- Intermittent noise – where the noise source at the receiver varies by more than 5 dB(A)

For the characteristics to be relevant, they must be assessed at the receiver location, so the propagation characteristics of noise and existing ambient noise level should be taken into consideration.

5.5 Predicted site operational noise impacts

Presented below in Table 21 is a summary of the predicted noise levels for each scenario and the applicable noise criteria. Noise contours of these scenarios are presented in Appendix D.

Table 21 Predicted operational noise impacts, $L_{Aeq,15minute}$, dB(A).

Receiver ID	NCA	PSNTL	Standard meteorology		Noise enhancing meteorology	
			Receiver height (m)		Receiver height (m)	
			1.5	4.5	1.5	4.5
Peak daytime operations						
R01	NCA 01	47	31	-	34	-
R02	NCA 01	47	30	-	33	-
R03	NCA 01	47	30	30	33	33
R04	NCA 01	47	30	-	33	-
R05	NCA 01	47	31	31	34	34
R06	NCA 01	47	32	33	34	36
R07	NCA 01	47	32	33	35	36
R08	NCA 01	47	32	34	35	37
R09	NCA 01	47	34	34	37	37
R10	NCA 01	47	32	34	35	36

Receiver ID	NCA	PSNTL	Standard meteorology		Noise enhancing meteorology	
			Receiver height (m)		Receiver height (m)	
			1.5	4.5	1.5	4.5
R11	NCA 01	47	32	33	35	36
R12	NCA 01	47	27	28	30	31
R13	NCA 01	47	26	27	30	30
R14	NCA 01	47	25	25	29	29
R15	NCA 01	47	28	28	32	32
R16	NCA 01	47	27	28	31	32
Peak evening period operations						
R01	NCA 01	38	29	-	32	-
R02	NCA 01	38	29	-	32	-
R03	NCA 01	38	29	29	32	32
R04	NCA 01	38	29	-	32	-
R05	NCA 01	38	30	30	33	33
R06	NCA 01	38	31	31	33	34
R07	NCA 01	38	31	32	33	35
R08	NCA 01	38	31	33	33	35
R09	NCA 01	38	33	33	35	35
R10	NCA 01	38	31	32	33	35
R11	NCA 01	38	31	32	33	34
R12	NCA 01	38	25	27	28	30
R13	NCA 01	38	25	25	28	29
R14	NCA 01	38	24	24	28	28
R15	NCA 01	38	27	27	31	31
R16	NCA 01	38	26	27	29	31
Peak nighttime period operations						
R01	NCA 01	35	28	-	30	-
R02	NCA 01	35	27	-	30	-
R03	NCA 01	35	27	27	30	30
R04	NCA 01	35	27	-	30	-
R05	NCA 01	35	28	28	31	31
R06	NCA 01	35	29	30	31	32

Receiver ID	NCA	PSNTL	Standard meteorology		Noise enhancing meteorology	
			Receiver height (m)		Receiver height (m)	
			1.5	4.5	1.5	4.5
R07	NCA 01	35	29	30	31	33
R08	NCA 01	35	29	31	31	33
R09	NCA 01	35	31	31	33	33
R10	NCA 01	35	28	30	31	32
R11	NCA 01	35	29	29	31	31
R12	NCA 01	35	20	24	24	28
R13	NCA 01	35	22	23	26	26
R14	NCA 01	35	21	22	25	25
R15	NCA 01	35	25	25	28	28
R16	NCA 01	35	23	25	27	28

The results in Table 21 indicate that compliance with the noise criteria is achieved at all locations (for both standard and noise enhancing meteorological conditions) without the implication of any noise management and / or mitigation methods, for all time periods.

This assessment has identified that the worst-case scenario would comply with the project noise trigger levels, which have been established in accordance with the requirements of the NPfI and the project SEARs. While further consideration of noise management and mitigation measures are not required, recommendations have been included in Section 7.2 to minimise the potential for noise impacts to the surrounding community.

5.6 Sleep disturbance noise impacts

A maximum noise impact assessment has been undertaken in accordance with the requirement of the NPfI to determine the potential noise impact on sleep disturbance. It is understood that occasionally clients stay on their boats at the marina overnight, and may have conversations on their boats, or transporting luggage to/from their boat. To assess the worst-case scenario, boat engine startups and bow thrusters have been considered for the maximum noise level event assessment, representing the worst-case scenario where boats were to depart during the nighttime period. Maximum noise levels resulting from patrons has also been considered, however given the source level, patron noise will not drive the sleep disturbance when compared to the boat operations.

The noise has been modelled using SOUNDPLAN under both neutral and adverse weather conditions.

The maximum noise levels presented in Table 22 below.

Table 22 Maximum event source noise levels, L_{AFmax} SWL dB(A).

Equipment	LAF Max dB(A)
Boat engine warm up (vessel length > 25 m and < 45 m)	95
Boat bow thruster	95
Boat patron with raised voice	78

Land-based patrons with raised voice	78

Presented in Table 23 is a summary of the predicted maximum noise levels at the identified sensitive receiver locations.

Table 23 Predicted maximum level noise impacts L_{AFmax}, dB(A) – Nighttime operations.

Receiver ID	NCA	Screening criterion (L_{AFMax})	Standard meteorology		Noise enhancing meteorology	
			Receiver height (m)		Receiver height (m)	
			1.5	4.5	1.5	4.5
Peak nighttime operations						
R01	NCA01	52	39	-	41	-
R02	NCA01	52	38	-	41	-
R03	NCA01	52	38	38	41	41
R04	NCA01	52	38	-	41	-
R05	NCA01	52	39	39	41	41
R06	NCA01	52	39	41	42	44
R07	NCA01	52	40	41	42	43
R08	NCA01	52	40	41	42	44
R09	NCA01	52	42	42	44	44
R10	NCA02	52	40	41	42	43
R11	NCA02	52	39	39	41	41
R12	NCA02	52	26	34	30	38
R13	NCA02	52	33	34	36	38
R14	NCA02	52	31	31	35	35
R15	NCA02	52	34	34	38	38
R16	NCA02	52	34	34	37	38

Evident in Table 23, the predicted maximum noise levels comply with the NPfI screening criterion at all noise sensitive receiver locations during the nighttime period, for both standard and noise enhancing meteorological conditions.

5.7 Operational road traffic noise

Operational traffic movements will occur on Pittwater Road, a sub-arterial road with residential receivers that would be affected by light vehicles during the general operations of the project.

The traffic assessment for the development has been provided by Traffic and Safety Solutions PTY LTD report 'Traffic & Parking Impact Assessment Construction of a new arm to existing marina to create 40 additional berths Quays Marina 1856 Pittwater Road – Revision A'.

The traffic report concludes that as the net overall capacity of the marina will remain the same (the increase in wet berths is offset by the equal reduction of swing moorings). As such, the expansion of the marina will not result in an increase in traffic generation.

The noise propagation algorithm Calculation of Road Traffic Noise (CoRTN) has been proven to effectively calculate road traffic noise from free-flowing traffic throughout Australia. Operational noise levels have been predicted for noise sensitive receivers along Pittwater Road (Sub-arterial road).

Presented in Table 24 is the predicted existing and predicted operational noise impacts, assessed against the applicable criteria.

Table 24 Operational traffic noise impacts.

Period	Criteria	Existing, dB(A)	Future, dB(A)	Change in noise, dB
Operational Traffic Noise Impacts				
Pittwater Road (Daytime)	$L_{Aeq(15hour)}$ External 60 dB(A)	63	63	No change in traffic volumes predicted.

As evident in Table 24 above, the existing road traffic noise resulting from Pittwater Road already exceeds the sub-arterial road noise criteria at the nearest residential receivers. Additionally, due to the predicted zero net increase to traffic volumes as a result of the marina arm extension, no increase in traffic noise is expected. Hence, the change is noise is below 2.0 dB, which is not considered reasonable nor feasible to provide noise mitigation to reduce road traffic noise impacts as part of the proposal.

6 CUMULATIVE NOISE IMPACTS

6.1 Cumulative construction noise impacts with other construction sites

Construction noise from multiple sites has the potential to increase noise at sensitive receiver locations. Dependent on the nature of the work, multiple construction sites have the potential to:

- Increase overall noise levels by as much as 3 dB greater than noise from the loudest site; and/or
- Impact sensitive receivers by generating noise on multiple sides of the property simultaneously.

Both of these impacts can increase the annoyance from construction activities. At the planning stage of the project, it is very difficult to determine the likelihood of impacts. Specific timing and noise impacts from this project can be estimated, but cannot be confirmed until a contractor has been appointed and the construction methodology and programme confirmed.

This project is currently unaware of other planned construction works that may occur at the time of this proposal, however this does not rule out the potential for cumulative noise impacts. The chance of simultaneous construction projects is highly unlikely due to the geographic location of the development site (no adjacent development lots etc.).

The uncertainty highlights the importance of the contractors Construction Noise and Vibration Management Plan (CNVMP). Construction works from other projects should by identified during the establishment of this plan, and management strategies established the minimise the potential impacts of the surrounding community. The plan will require:

- consultation with other projects to confirm their construction schedules,
- identification of the potential of cumulative noise and vibration impacts,
- a plan to establish how these impacts would be managed on an ongoing basis; and
- a communication strategy to provide notifications to the surrounding community.

6.2 Operational cumulative impacts

The existing The Quays Marina operations are located withing the same lot boundary (Lot 329 (DP 46686)), 1856 Pittwater Road, Church Point NSW. The existing marina operations include: café, existing marina branches, wet berth, shipyard and carparking. As such, in the designation of the operational project noise trigger levels, the NPfI requires the consideration of intrusiveness and amenity levels.

The intrusiveness level considers the existing noise environment, with existing noise generating sources active. The background noise level is measured, and the intrusiveness set 5 dB above this level. For this project, the intrusiveness level was established to be between 18 and 22 dB lower than existing ambient noise levels.

The amenity noise level establishes noise targets for different areas and the project specific amenity noise criteria for the project specific noise trigger levels. The final design predicted site operational noise impacts of the marina have been established to range from 18 – 24 dB below the existing ambient noise level (night-time noise enhancing and daytime enhancing respectively).

In summary, cumulative operational noise levels have been considered throughout the development of the project noise trigger levels by basing the noise trigger on:

- The existing noise generated by operational industrial noise (the intrusiveness level); and
- The potential for future developments to generate noise (the amenity noise level).

Further consideration of the potential for cumulative noise impacts are not required.

7 MANAGEMENT AND MITIGATION MEASURES

7.1 Construction management measures

The construction predicted noise levels identified in Section 4 indicate that the noise impacts have the potential to occur from the proposed works. These impacts are typical for a construction such as this and highlight the importance for appropriate noise management and mitigation measures.

Presented in Table 25 is a summary of site-specific management procedures recommended to manage the predicted airborne noise and vibration impacts.

Table 25 Summary of mitigation procedures.

Procedure	Abbreviation	Description	Further reference
General Management Measures	GMM	Introduce best-practice general mitigation measures in the workplace which are aimed at reducing the acoustic impact onto the nearest affected receivers.	Refer to Section 7.1.3 For vibration impact, also refer to section 4.6
Project Notification	PN	Issue project updates to stakeholders, discussing overviews of current and upcoming works. Advanced warning of potential disruptions can be included. Content and length to be determined on a project-by-project basis.	Refer to Section 0
Verification Monitoring	V	Monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers. If the measured levels are higher than those predicted, then the measures will need to be reviewed and the management plan will need to be amended.	For noise impact, refer to Section 7.1.4. For vibration impact, refer to Section 4.6
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders	Refer to Section 0
Specific Notification	SN	Individual letters or phone calls to notify stakeholders that noise levels are likely to exceed noise objectives. Alternatively, contractor could visit stakeholders individually in order to brief them on the noise impact and the mitigation measures that will be implemented.	Refer to Section 0

Procedure	Abbreviation	Description	Further reference
Alternative Construction Methodology	AC	Contractor to consider alternative construction options that achieve compliance with relevant criteria. Alternative option to be determined on a case-by-case basis. It is recommended that the selection of the alternative option should also be determined by considering the assessment of on-site measurements (refer to Verification Monitoring above).	-

The application of these procedures is in relation to the exceedances over the relevant criteria. For airborne noise, the criteria are based on NMLs. The allocation of these procedures is discussed in Section 7.1.1

For vibration, the criteria either correspond to human comfort, building damage or scientific and medical equipment. The application of these procedures is discussed in Section 3.3.

7.1.1 Allocation of noise management procedures

For residences, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs (refer to section 4.4). The allocation of these procedures is summarised in Table 26 below.

Table 26 Allocation of noise management procedures.

Construction Hours	Exceedance over NML (dB)	Management procedures (see definition above)
Standard Hours Mon – Fri: 7:00 am to 6:00 pm Sat: 8:00 am – 1:00 pm	0 - 3	GMM
	4 - 10	GMM, PN, V [1], CMS, AC
	> 10	GMM, PN, V, CMS, SN, AC
Outside Standard Hours No works are proposed to occur outside standard hours.	0 - 10	GMM, AC
	11 - 20	GMM, PN, V [1], CMS, AC
	> 20	GMM, PN, V, CMS, SN, RO, AC
Note 1 Verification monitoring to be undertaken upon complaints received from affected receivers		

Please note the following regarding the allocation of these procedures:

- The exceedances have been predicted as part of the acoustic assessment, and these are summarised in Section 4.4.
- The allocation of procedures is based on the assumptions used for noise level predictions (refer to Section 4.4).

7.1.2 Allocation of vibration management procedures

Table 27 summarises the vibration management procedures to be adopted based on exceedance scenarios (i.e., whether the exceedance occurs over human comfort criteria, building damage criteria, or criteria for scientific and medical equipment). Please note these management procedures apply for any type of affected receiver.

Table 27 Allocation of vibration management procedures.

Construction Hours	Exceedance Scenario	Management procedures
Standard Hours Mon – Fri: 7:00 am to 6:00 pm Sat: 8:00 am – 1:00 pm	Over human comfort criteria (refer to Section 4.6)	GMM, PN, V, RO
	Over building damage criteria (refer to Section 4.6)	GMM, V, AC
Outside Standard Hours No works are proposed to occur outside of standard hours.	Over human comfort criteria (refer to Section 4.6)	GMM, SN, V, RO, CMS
	Over building damage criteria (refer to Section 4.6)	GMM, V, AC

7.1.3 General comments

The contractor will, where reasonable and feasible, apply best practice noise mitigation measures. These measures shall include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same site area.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

To minimise noise impacts during the works, the contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal.

Alternate equipment or process

Exceedance of the site's NMLs should result in an investigation as to whether alternate equipment could be used, or a difference process could be undertaken.

In some cases, the investigation may conclude that no possible other equipment can be used, however, a different process could be undertaken.

Acoustic enclosures/screening

Typically, on a construction site there are three different types of plant that will be used: mobile plant (i.e., excavators, skid steers, etc.), semi mobile plant (i.e., hand tools generally) or static plant i.e. (diesel generators).

For plant items which are static it is recommended that, in the event exceedances are being measured due to operation of the plant item, an acoustic enclosure/screen is constructed to reduce impacts. These systems can be constructed from Fibre Cement (FC) sheeting or, if airflow is required, acoustic attenuators or louvres.

For semi mobile plant, relocation of plant should be investigated to either be operated in an enclosed space or at locations away from a receiver.

With mobile plant it is generally not possible to treat these sources. However, investigations into the machine itself may result in a reduction of noise (i.e., mufflers/attenuators etc).

General mitigation measures (Australia Standard 2436-2010)

As well as the above project specific noise mitigation controls, AS 2436-2010 *"Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites"* sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

Adoption of universal work practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevating work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

Plant and equipment

The operation of plant and equipment on the site should be undertaken, including the following:

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

Work scheduling

- Providing respite periods which could include restricting very noisy activities to time periods that least affect the nearby noise sensitive locations, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.

Source noise control strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. To minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site.
- Siting of equipment: locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective maintenance.

Miscellaneous comments

Deliveries should be undertaken, where possible, during standard construction hours.

Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site and monitor the profiles in use.

It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards.

No public address system should be used on site.

7.1.4 Construction vibration mitigation measures

The following vibration mitigation measures should be implemented:

- Any vibration generating plant and equipment is to be in areas within the site to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of construction plant and equipment; that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Undertake the removal of concrete within the building using saw cutting or pulverising where possible.

7.1.5 Noise and vibration monitoring

Noise monitoring, if required, will be performed by an acoustical consultant directly engaged by the contractor in accordance with the projects Conditions of Consent.

Noise monitoring is recommended to be undertaken by attended noise measurements at the start of any new phase of works (i.e. demolition, ground works or remediation works etc.). The statistical parameters to be measured should include the following noise descriptors: LAmin, LA90, LA10, LA01, LAmax and LAeq. Unattended noise measurements should be conducted over consecutive 15-minute periods.

The survey methodology and any equipment should comply with the requirements discussed in Standard AS 1055.1-1997.

As part of the management of noise and vibration from the proposed demolition and ground works activities to be undertaken on the site the following noise and vibration measurements are recommended to be undertaken:

1. Noise Monitoring –
    a. Attended noise level measurements of typical demolition and ground works activities should be undertaken at site. Attended construction noise surveys of the site and surrounding impacts on neighbours should be undertaken during the following as a minimum:
        i. Commencement of piling activities.
        ii. In response to any ongoing complaints received from neighbours.

2. Vibration Monitoring– To confirm vibration magnitudes are within the expected levels the following attended vibration measurements are required:
    a. Short term attended vibration measurements – Attended short term vibration measurement of activities with the potential to generate maximum vibration to be undertaken on commencement at the site, including the following:
        i. Measurements to be undertaken at a representative location from the activity being conducted with a similar distance to the potentially affected receiver.
        ii. Activities with the potential to generate the greatest magnitudes of vibration include:

iii. Piling works.

7.1.6 Community consultation

Active community consultation and the maintenance of positive relations with nearby court houses, local residents, and businesses would assist in alleviating concerns and thereby minimising complaint.

This form of notification should provide specific notification of the duration and timing of the required ground works activities so that residents are informed about the works ahead of time. The letter should also provide the community with a hotline number for a community liaison officer available to adequately respond to all project related enquiries.

Ideally the hotline number should provide concerned locals an opportunity to raise any concerns with the project proponent and provide an opportunity to determine the best method to satisfy all requirements.

Prior to the works onsite being undertaken, community consultation with the neighbouring affected parties be undertaken. Community engagement and consultation should not be limited to the beginning of the onsite works but throughout, providing the community with constant updates on the progress and upcoming works. In our experience these could include:

- Site noticeboard,
- Email notifications; and
- Letterbox drops.

Complaints management system

Should complaints arise they must be dealt with in a responsible and uniform manner, therefore, a management system to deal with complaints is detailed below:

Local residents and landowners should be informed by direct mail of a direct 24-hour telephone line where any noise complaints related to the required ground works will be recorded. The 24-hour telephone line number will be made available on the construction site signage.

All complaints should be investigated by the Contractor in accordance with the procedures outlined in Australia Standard 2436-2010. Consequently, a complaint response procedure should be implemented. Information to be gathered as part of this process should include:

- location of complainant
- time/s of occurrence of alleged noise or vibration impacts
- nature of impact particularly with respect to vibration
- Perceived source
- Prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint.

All resident complaints will be responded to in the required timeframe and action taken recorded.

Post receiving a noise and or vibration complaint, the process outlined in the Contingency Plans below should be undertaken.

Contingency plans

Contingency plans are required to address noise or vibration problems if excessive levels are measured at surrounding sensitive receivers and/or if justified complaints occur. Such plans include:

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most required ground works noise and vibration at the sensitive receivers; and

- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.
- Respite periods to be scheduled during potentially noise sensitive periods of the surrounding receivers.

The Superintendent (if the Superintendent has been allocated to the project) shall have access to view the Contractor's noise measurement records on request. The Superintendent may undertake noise monitoring if and when required.

7.2 Operational management measures

The noise impact assessment has predicted compliance with the operational noise criteria for all assessment periods. However, noise management measures are recommended to minimise the potential impact on the surrounding noise sensitive receivers. Noise mitigation measures are not feasible or reasonable to install due to the positioning of the marina branch, located offshore, where physical noise mitigation measures (such as noise barriers) are not possible to install.

7.2.1 Operational management measures

Noise management measures can be effective to control noise impacts associated with behaviours. The corner stone to noise management measures is making employees and people accessing the site aware of their site requirements and obligations.

All clients that occasionally stay on their boats at the marina overnight / depart / arrive from the marina should be advised to minimise conversations whilst on the marina, minimise engine idle times, and other noise generating activities.

8 CONCLUSION

The Quays Marina (located at 1856 Pittwater Road, Church Point NSW) are proposing to expand the existing marina to create an additional 40 berths. Specifically, the proposed development includes the addition of a new marina arm and removal of existing swing moorings.

The existing marina operations includes: café, existing marina branches, wet berth, shipyard and carparking.

This report presents a noise and vibration impact assessment to support the development's development application.

The Quays Marina is located at 1856 Pittwater Road, Church Point NSW 2105 (Lot 329 (DP 46686)).

The proposed expansion is situated to the north-east of the existing floating berths, property which currently consists of undeveloped, open water. Pittwater Road is located along the southern boundary of the proposed expansion. Open water / estuary shoreline surrounds the site, with residential dwellings located across Pittwater Road, to the south and west of the site.

The nearest residential receivers are located approximately 35 m to the south-west from the lot boundary, with additional residential receivers located further along Pittwater Road.

Background noise logging was undertaken in June 2024 to establish the existing noise environment at residential properties near the site.

Both standard and noise enhancing meteorological conditions have been included in this report.

Appropriate construction noise management noise levels have been established in accordance with the EPAs Interim Construction Noise Guideline and the background noise logging. Appropriate vibration criteria were derived from the EPAs Assessing Vibration: a technical guideline. The EPAs Road Noise Policy provided appropriate noise criteria for the assessment of construction traffic noise associated with the site.

A range of construction noise scenarios were modelled using SOUNDPLAN v8.2 and assessed against the derived project specific NMLs. The assessment identified that there were no receivers which would be Highly Noise Affected, however a number of receivers were predicted to exceed the project NMLs. Appropriate construction noise management and mitigation measures have been recommended to reduce the potential for impacts on the surrounding community.

Construction vibration has been assessed based on a range of equipment that could be used on the project. The most significant vibration impacts would be experienced during the piling activities.

Noise impacts from construction traffic are predicted to increase road traffic noise levels by less than 0.2 dB as a result of the additional construction vehicle movements. A change in noise of less than 2 or 3 dB is typically not considered discernible.

Operational noise emission criteria have been derived from the background noise logging in accordance with the EPAs Noise Policy for Industry and background noise logging undertaken for this project.

An operational noise model has been developed using SOUNDPLAN v8.2. The noise model assessed the dominant noise sources generated from the operation of the site. The predicted noise levels identified compliance with the applicable noise criteria is achieved. Despite this, operational management measured have been provided in Section 7.2.

Sleep disturbance noise impacts have been assessed against the NPfI screening criterion. Compliance is achieved at all locations and further consideration of impacts and noise mitigation is not required.

Operational road noise criteria have been derived from the EPAs Road Noise Policy. Due to the net zero increase in road traffic from the proposed expansion of the marina, road traffic noise levels are not expected to increase. Further considerations of road traffic noise impacts are not required.

This report has identified that with the inclusion of appropriate noise management and mitigation measures, compliance with appropriate noise criteria would be achieved. The mitigation recommendations will be incorporated in the design of the project to ensure noise (and vibration) emitted from the developed is appropriately controlled.

APPENDIX A. ACOUSTIC TERMINOLOGY

The following is a brief description of the acoustic terminology used in this report:

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0 dB the faintest sound we can hear 30 dB a quiet library or in a quiet location in the country 45 dB typical office space. Ambience in the city at night 60 dB Martin Place at lunch time 70 dB the sound of a car passing on the street 80 dB loud music played at home 90 dB the sound of a truck passing on the street 100 dB the sound of a rock band 115 dB limit of sound permitted in industry 120 dB deafening
dBA	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dBA. Practically all noise is measured using the A filter. The sound pressure level in dBA gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{max}	The maximum sound pressure level measured over a given period.
L_{min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dBA.
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt.

APPENDIX B. NOISE LOGGING DATA

B.1. Noise Logger 01 – NCA01

Weather Station: Terry Hills AWS

Weather Station ID: 066059

1856 Pittwater Road, Church Point

Ambient noise monitoring report

Item	Information
Logger Type	NL-42
Serial number	00396931
Address	1856 Pittwater Road, Church Point
Location	1856 Pittwater Road, Church Point
Facade / free field	Free field
Environment	

Measured noise levels

Logging date	Rating Background Level			$L_{Aeq,period}$		
	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-7am	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-7am
Wed 26 Jun 2024	-	33	-	58	55	50
Thu 27 Jun 2024	42	28	26	58	53	52
Fri 28 Jun 2024	43	31	27	61	54	50
Sat 29 Jun 2024	41	33	27	61	53	49
Sun 30 Jun 2024	38	34	30	58	53	50
Mon 01 Jul 2024	42	35	34	58	57	51
Tue 02 Jul 2024	45	37	36	67	56	51
Wed 03 Jul 2024	43	40	36	60	57	54
Thu 04 Jul 2024	-	-	-	59	-	50
Summary	**42**	**33**	**30**	**61**	**55**	**51**

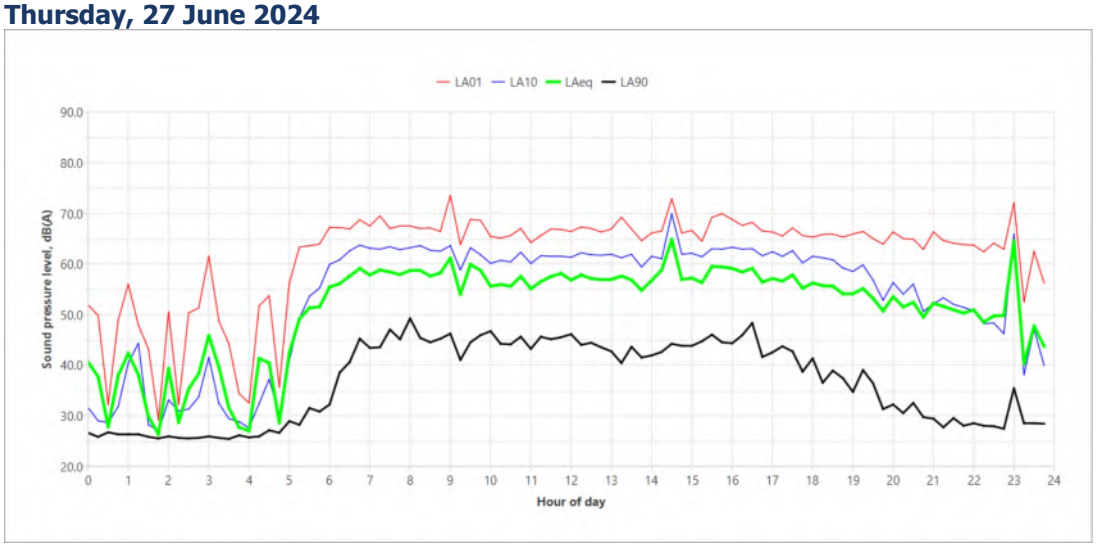
Note: Results with a '-' identify that there were not enough measurements available to correctly calculate the level, in accordance with the Noise Policy for Industry. The data has been excluded either from weather or manual exclusions. See the charts for more information

Logger location

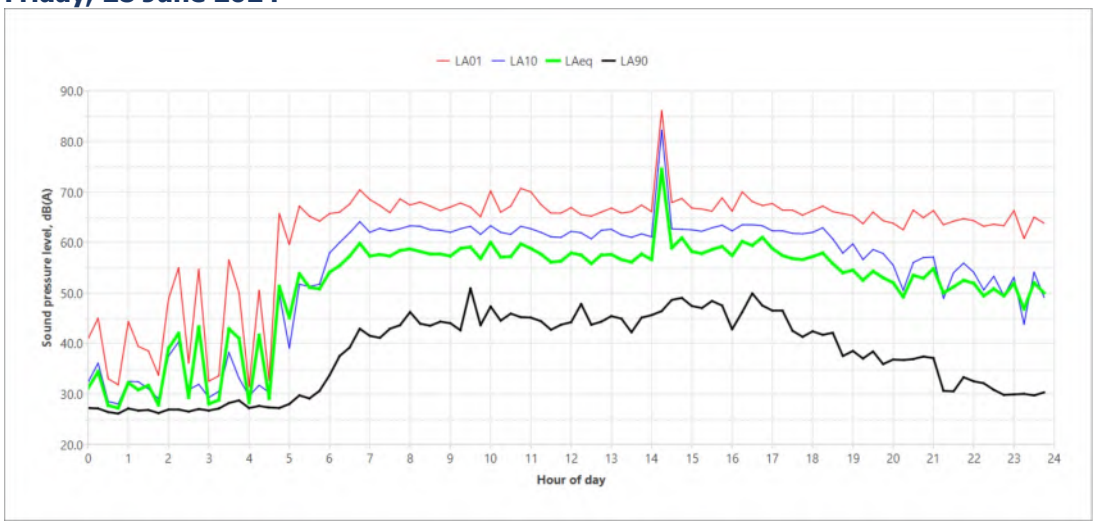
Logger deployment photo

Wednesday, 26 June 2024

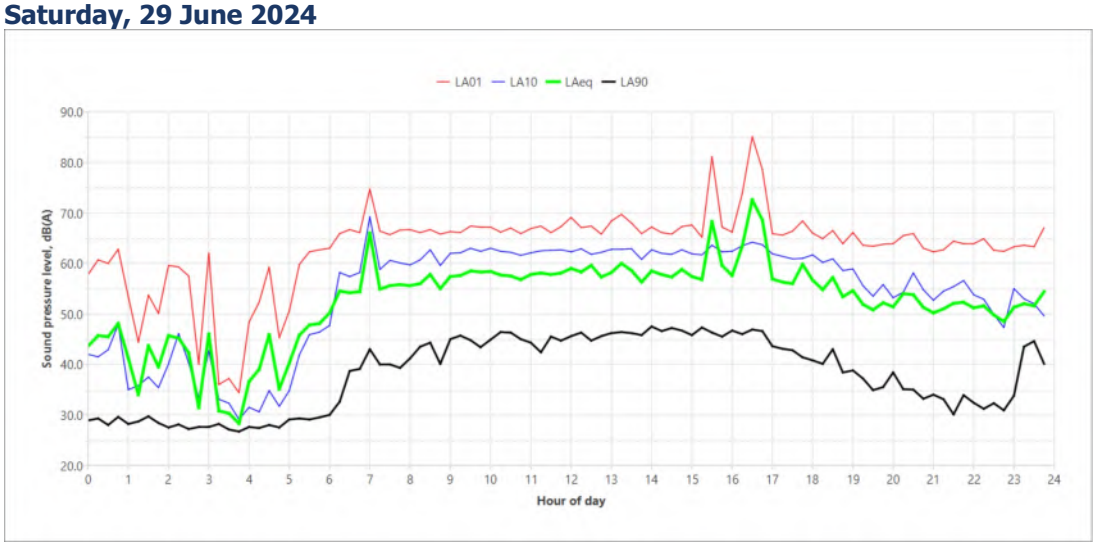
Thursday, 27 June 2024



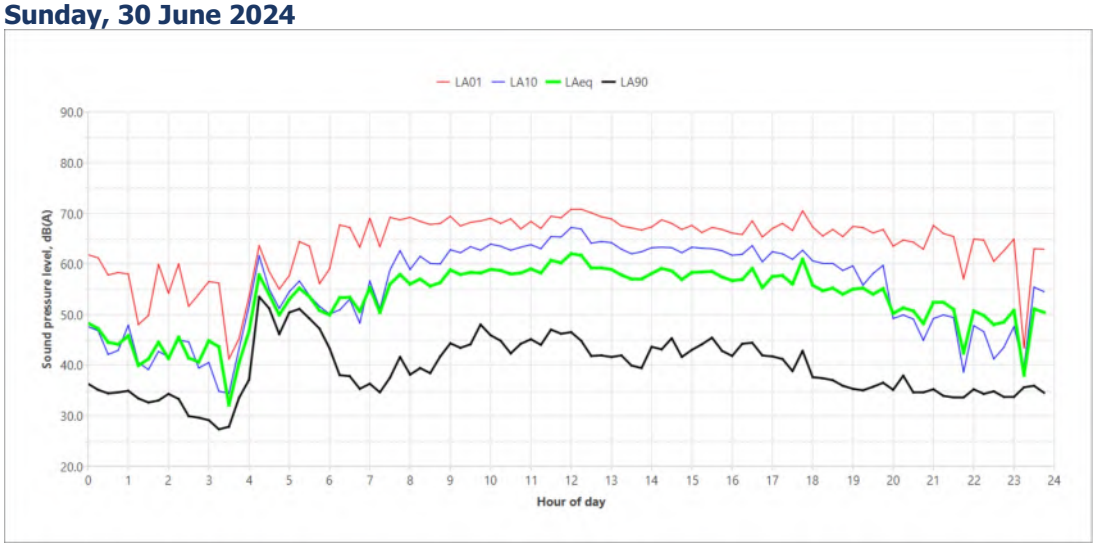
Friday, 28 June 2024



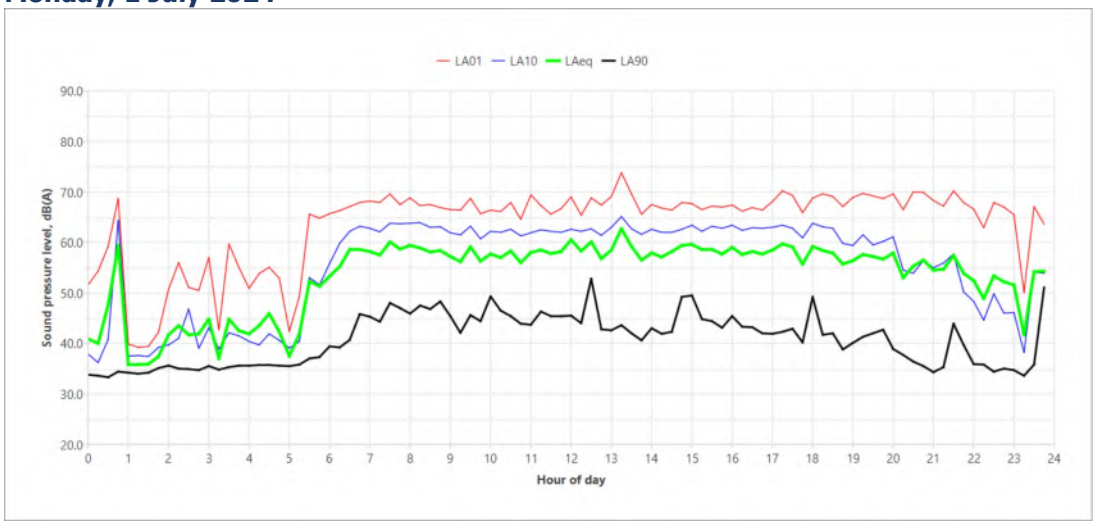
Saturday, 29 June 2024



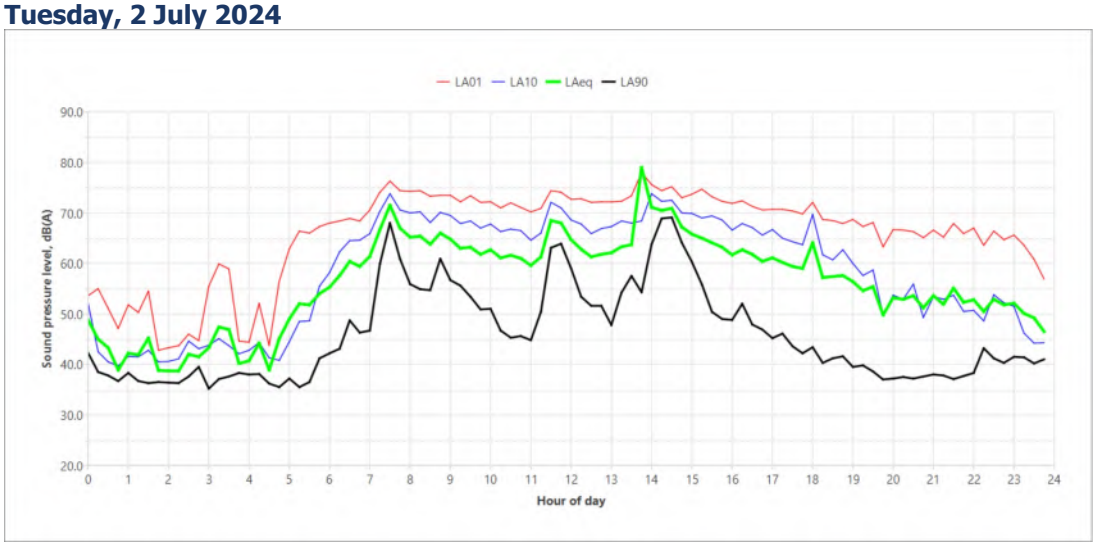
Sunday, 30 June 2024



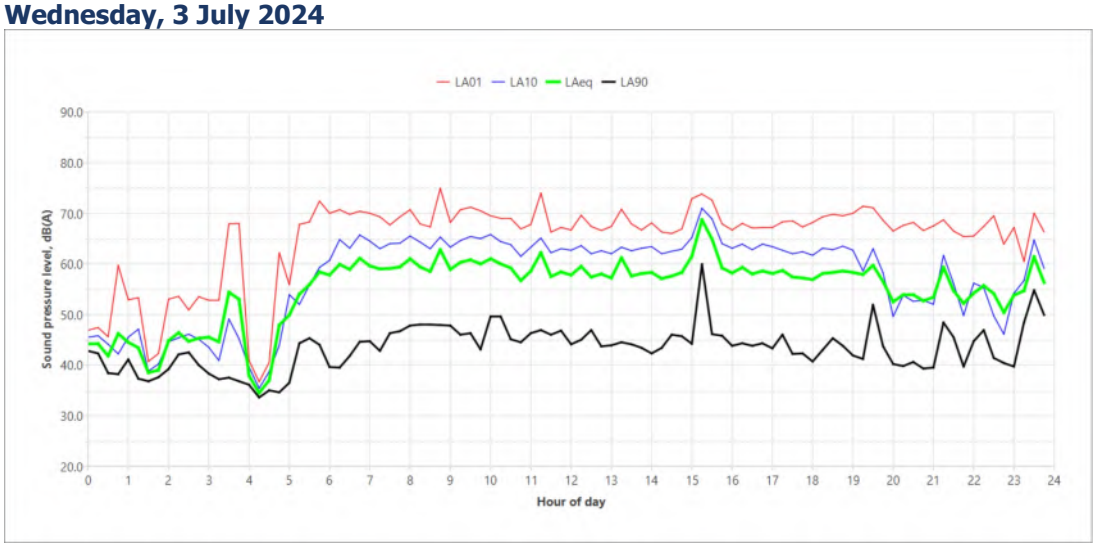
Monday, 1 July 2024



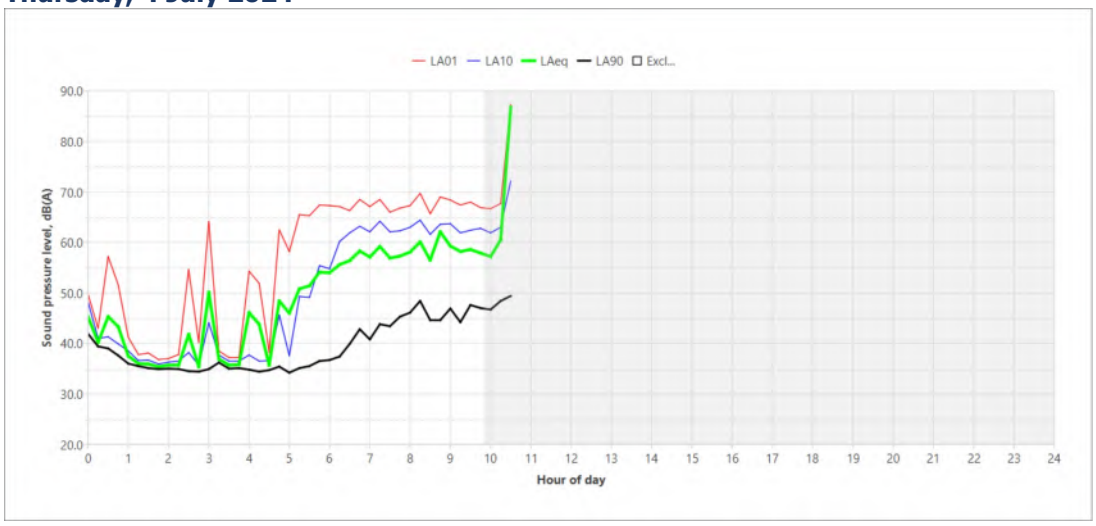
Tuesday, 2 July 2024



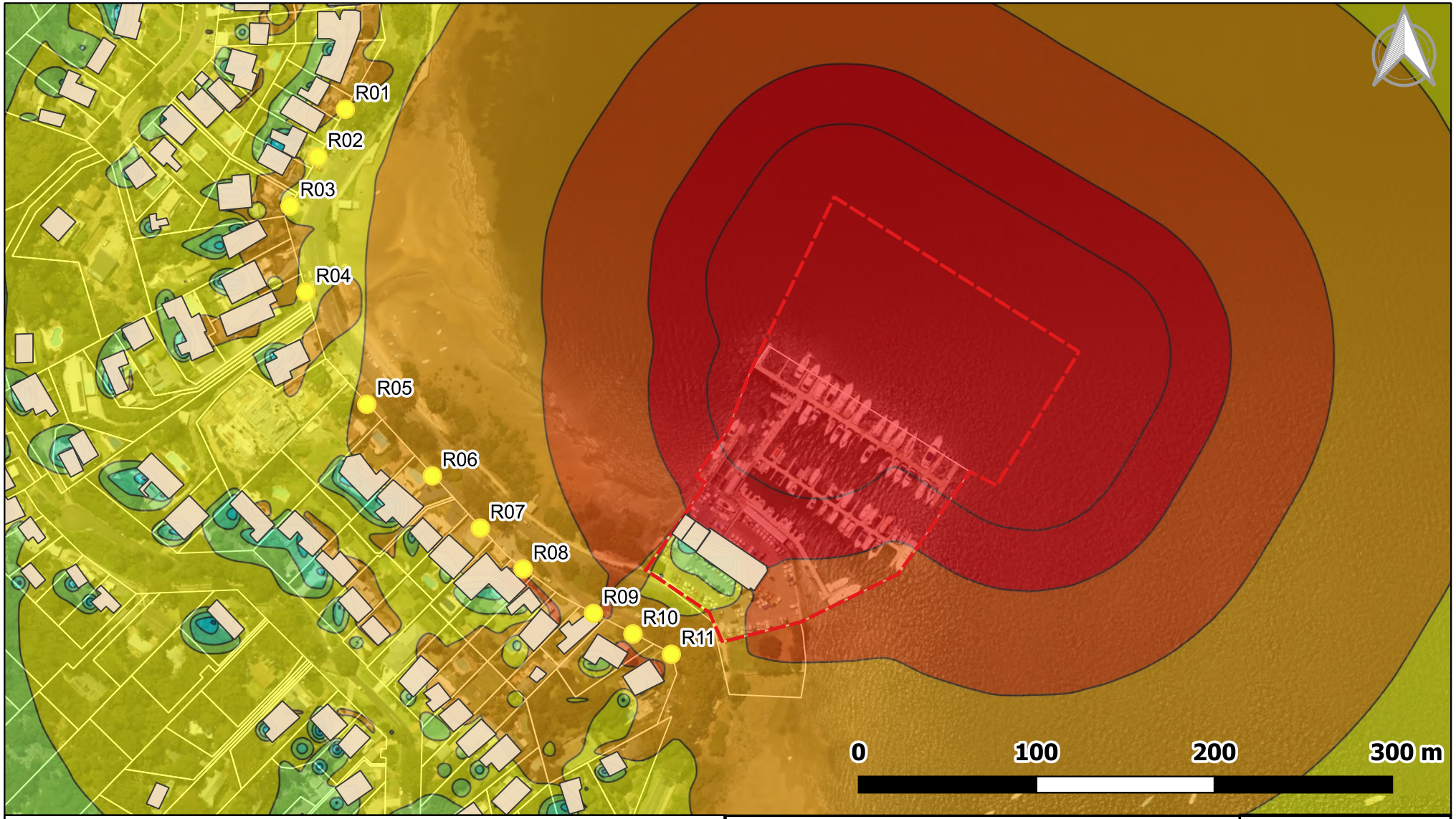
Wednesday, 3 July 2024



Thursday, 4 July 2024



APPENDIX C. CONSTRUCTION NOISE IMPACT CONTOURS

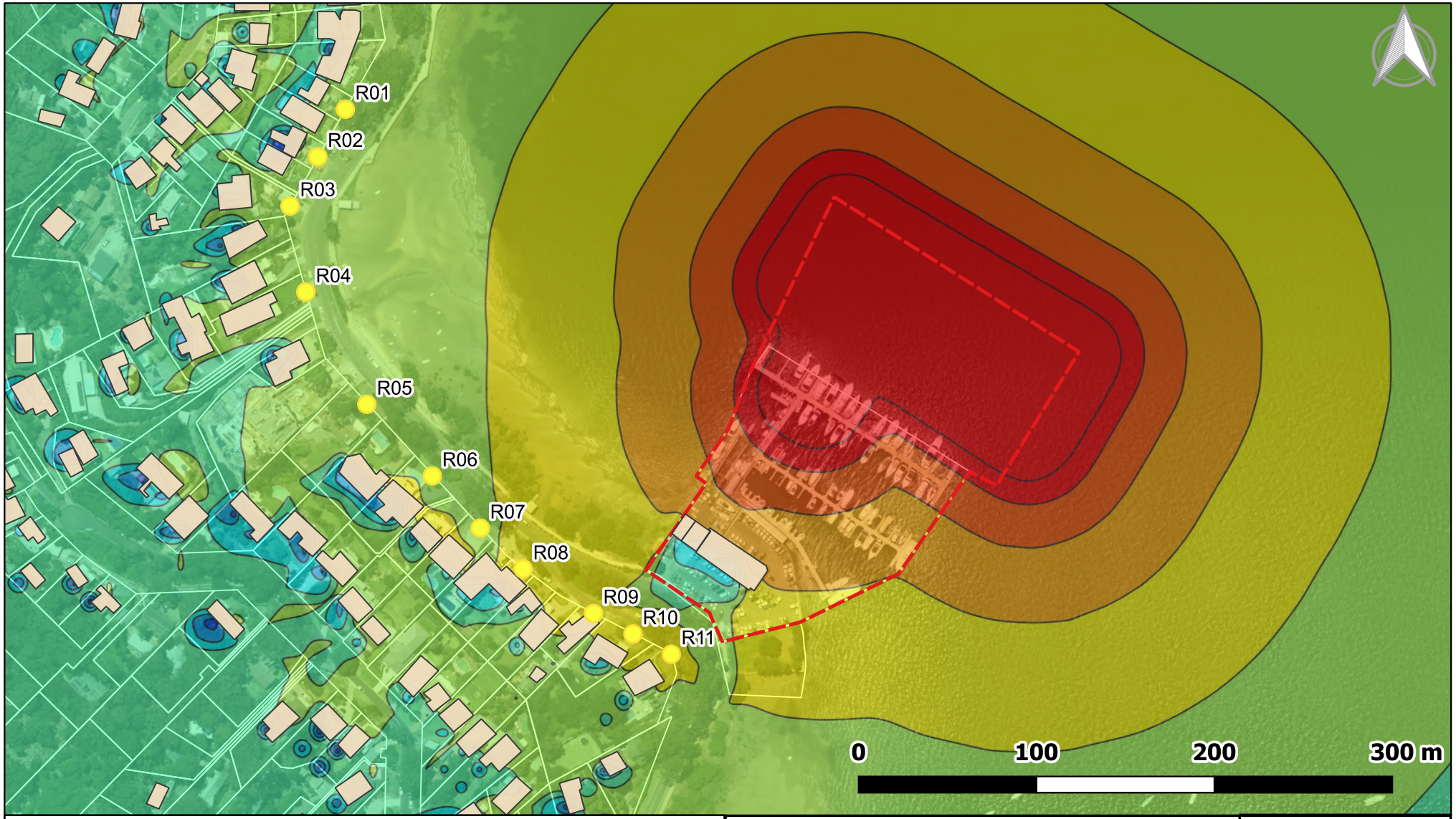


LAeq,15 min noise level

- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- 45 to 50
- 50 to 55
- 55 to 60
- 60 to 65
- 65 to 70
- >70

The Quays Marina
Construciton noise contours
Piling Works LAeq,15 minute noise impact

Contour Height 1.5 m

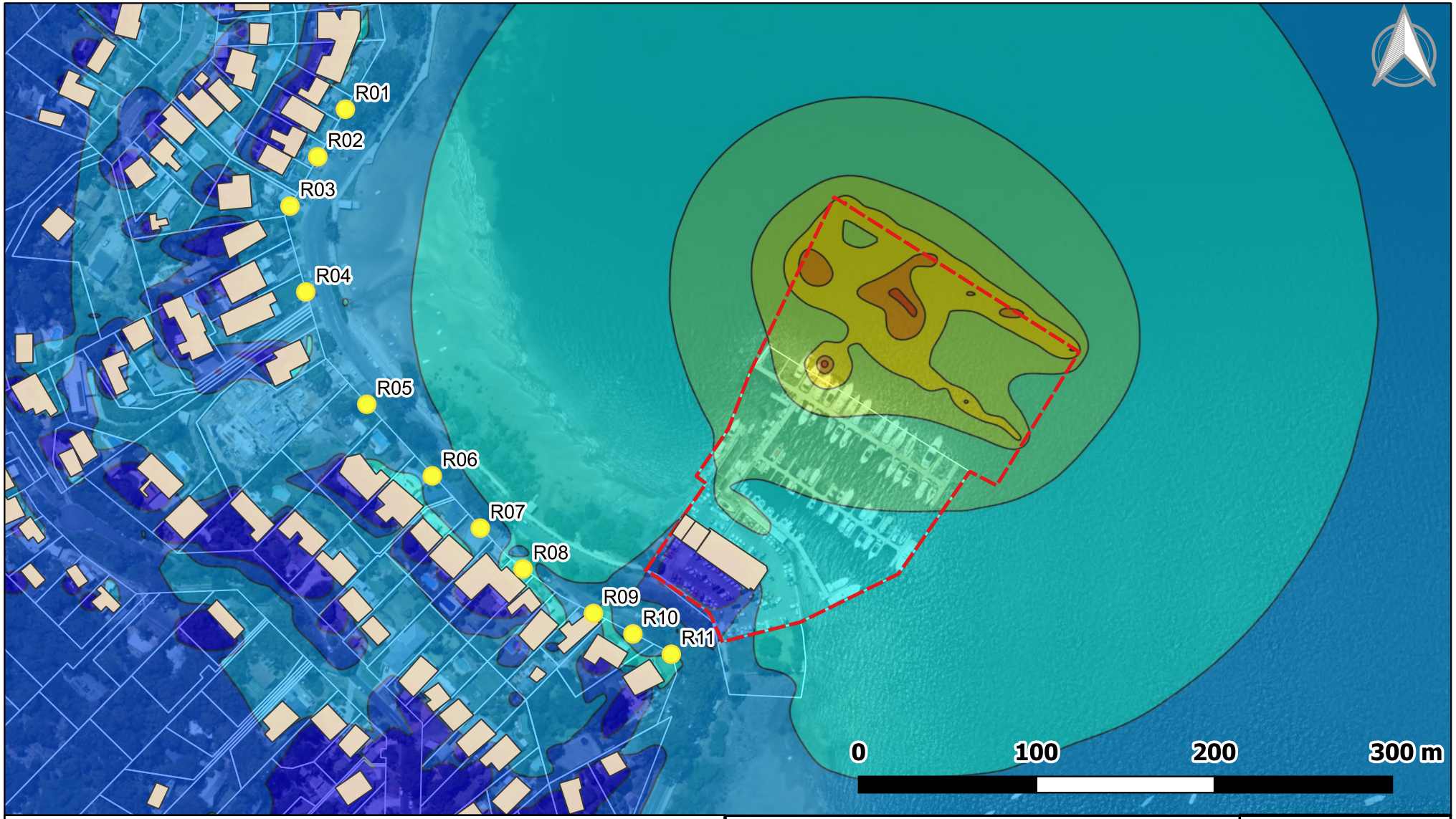


LAeq,15 min noise level		
25 to 30	40 to 45	60 to 65
30 to 35	45 to 50	65 to 70
35 to 40	50 to 55	>70
	55 to 60	

The Quays Marina
Construciton noise contours
General Marina Construction LAeq,15 minute noise impact
Contour Height 1.5 m

PWNA

APPENDIX D. OPERATIONAL NOISE IMPACT CONTOURS

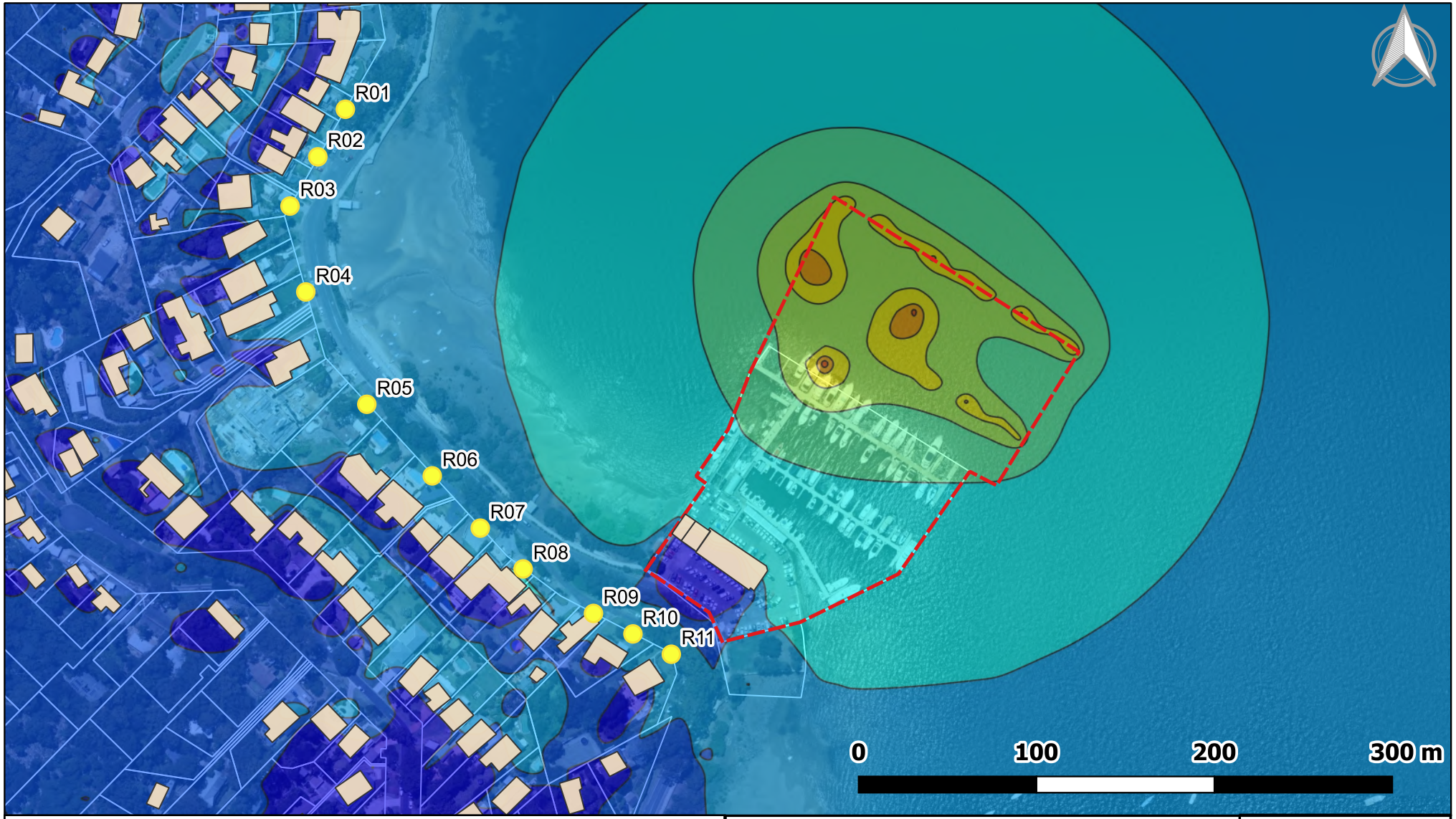


LAeq,15 min noise level

- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- 45 to 50
- 50 to 55
- 55 to 60
- 60 to 65
- 65 to 70
- >70

The Quays Marina
Operational noise contours
Daytime - Noise Enhancing Weather
LAeq,15min noise impact
Contour Height 1.5 m

PWNA

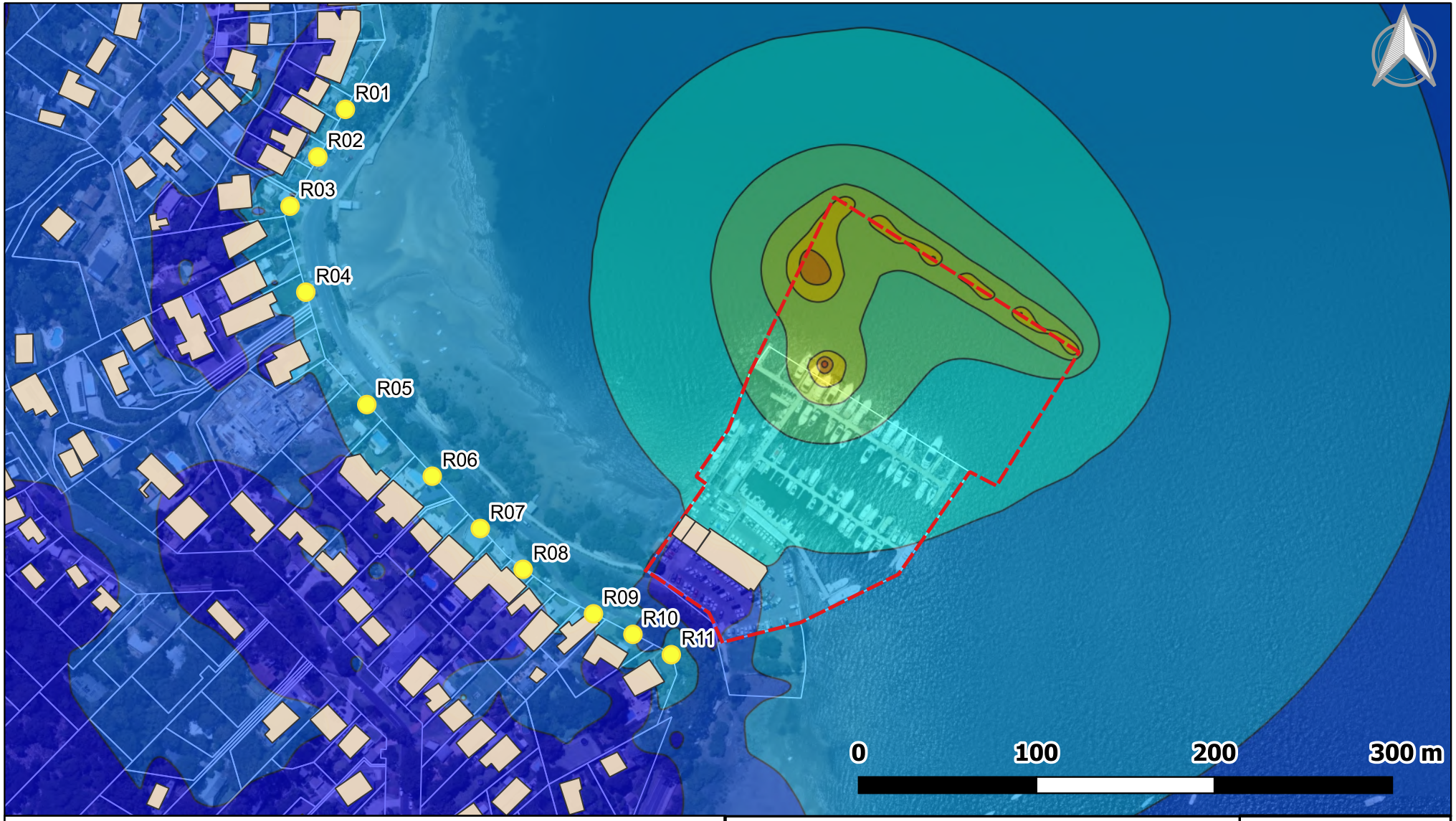


LAeq,15 min noise level

- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- 45 to 50
- 50 to 55
- 55 to 60
- 60 to 65
- 65 to 70
- >70

The Quays Marina
Operational noise contours
Evening - Noise Enhancing Weather
LAeq,15min noise impact
Contour Height 1.5 m

PWNA



LAeq,15 min noise level

- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- 45 to 50
- 50 to 55
- 55 to 60
- 60 to 65
- 65 to 70
- >70

The Quays Marina
Operational noise contours
Nighttime - Noise Enhancing Weather
LAeq,15min noise impact
Contour Height 1.5 m

PWNA