

BEFORE THE ENVIRONMENT COURT
I MUA I TE KOOTI TAIAO O AOTEAROA

ENV-2018-AKL-000078

IN THE MATTER of the Resource Management
Act 1991 (**RMA**)

AND

IN THE MATTER of the direct referral of
applications for resource
consent for the necessary
infrastructure and related
activities associated with
holding the America's Cup in
Auckland

BETWEEN **PANUKU DEVELOPMENT
AUCKLAND**

Applicant

AND

AUCKLAND COUNCIL

Regulatory Authority

**REBUTTAL EVIDENCE OF CRAIG FITZGERALD ON BEHALF OF
PANUKU DEVELOPMENT AUCKLAND
(Noise and Vibration)
4 September 2018**

1. INTRODUCTION

1.1 My full name is Craig Michael Fitzgerald. I have prepared a primary statement of evidence dated 7 August 2018, and confirm my qualifications and experience as set out in paragraph 1.2 – 1.4 of that evidence.

2. CODE OF CONDUCT

2.1 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and that I agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise.

3. SCOPE OF EVIDENCE

3.1 I have reviewed the evidence in chief (**EIC**) of the following witnesses:

- a) Richard Finley on behalf of Point Body Corporate (37) dated 21 August 2018;
- b) Jon Styles on behalf of Auckland Council dated 21 August 2018;

3.2 Agreement has since been reached on Noise Events Condition 183Q¹. I understand that there are no outstanding matters between the parties in relation to noise and vibration.

3.3 In my rebuttal evidence, I address the matters raised in other parties' evidence based on the following issues:

- c) Underwater Noise Measurements;
- d) Construction Noise and Vibration Management Plan (**CNVMP**); and
- a) Amendments to Noise Events Condition 183Q.

4. UNDERWATER NOISE ENVIRONMENT

4.1 In paragraph 8.14, Mr Styles notes we have some differences in the way the existing underwater noise environment is measured and reported. These matters were discussed in the Noise and Vibration Joint Witness Statement dated 25 July 2018 (JWS)

¹ Applicant's Proposed Conditions (Rebuttal) dated 4 September 2018

at paragraph 4.4. While the minor differences remain unresolved, I agree they are not material to the assessment, proposed conditions² and management strategies.

5. CNVMP

5.1 In paragraph 9.8, Mr Styles recommends amending the definition of “infrastructure” in condition 1 to include base buildings. As a result, the CNVMP requirements for infrastructure activities in condition 110 would also apply to base building activities. I understand that the Council and Panuku have since agreed that condition 110 and the requirement for a CNVMP should not apply to the construction of base buildings and this matter has been resolved. However, for completeness I record that I do not consider it necessary for the following reasons:

- a) The draft CNVMP addresses the ground improvement activities on the base sites (e.g. demolition, piling, excavation, ground stabilisation). The ground improvements are the noisy works that trigger the need for a CNVMP; and
- b) I understand the base building works thereafter would generally consist of a low-rise lightweight structure erected on a concrete slab (e.g. concrete truck/pump, cranes, handtools). These activities are predicted to comply with relevant noise limits given the nature of the activities and the separation to sensitive receivers.

5.2 I presented the draft CNVMP to the Community Liaison Group (**CLG**) on Tuesday 21 August. Apart from general interest, the only specific feedback was received from Mr Lance Wiggs. Mr Wiggs considers that the night-time period defined in condition 109 should commence at 7pm, rather than 10.30pm. I explained that the night-time period aligns with, or is slightly more restrictive than, other relevant AUP:OiP rules applying in the Business City Centre Zone. Furthermore, I identified and explained measures in the draft CNVMP that prioritise high noise activities early in the daytime period where practicable. No changes were required to the CNVMP or conditions.

5.3 An updated revision of the draft CNVMP³ is attached to my rebuttal evidence as **Appendix A**. It updates the conditions in Section 1 and includes the CLG feedback in a

² Applicant’s Proposed Conditions (Rebuttal) dated 4 September 2018

³ Wynyard Edge Alliance CNVMP rev E (4 September 2018)

new Appendix D. There are no changes to the main body of the plan (e.g. predicted levels, mitigation, management, engagement and monitoring).

6. AMENDMENTS TO NOISE EVENTS CONDITION 183Q

6.1 Agreement has been reached on Noise Events Condition 183Q⁴. The following paragraphs summarise the amendments.

6.2 In paragraph 28, Mr Finley states: “*Because of this [the nature of outdoor concerts] an appropriate dBA criterion can be used to adequately describe the impact of the concert noise and manage its effects on residents without requiring specific low frequency controls.*” I agree with Mr Finley that outdoor daytime concerts do not need low frequency noise controls and the low frequency limits have been removed from the Noise Events Condition.

6.3 The High Noise Events limits in Condition 183Q⁵ are 82 dBA for Wynyard Precinct and 80 dBA in the Viaduct Harbour Precinct. The lower limit applying in the Viaduct Harbour Precinct is agreed with The Point (37), VHHL (33) and Princes Wharf Residents (54).

6.4 In reaching this agreement, Panuku have accepted a reduction in the number of events to 3 per AC Event and limited the period to between 12 noon and 10pm. In my opinion, the AC High Noise Events limits are reasonable in this situation for the following reasons:

- a) The surrounding mixed-use areas have a higher noise expectation than suburban residential;
- b) The duration of high noise events is limited to 3 hours;
- c) Events occur in the defined day period (not night-time); and
- d) The number of high noise events is limited to 3 per AC Event (with up to three AC Events in the 10 year consent period sought).

⁴ Applicant's Proposed Conditions (Rebuttal) dated 4 September 2018

⁵ Applicant's Proposed Conditions (Rebuttal) dated 4 September 2018

7. CONCLUSION

- 7.1** There remain some minor differences in the way the existing underwater noise environment is measured and reported, however, these are not material.
- 7.2** An updated reversion of the draft CNVMP is attached. It applies to infrastructure activities only (i.e. excluding base building activities).
- 7.3** With respect to the Viaduct Harbour Precinct Noise Events:
- a) I consider that the overall dBA noise limits applying to Noise Events are reasonable for receivers and accept the agreed lower High Noise Event limit of 80 dBA applying to the Viaduct Harbour Precinct; and
 - b) I consider that it is appropriate that the low frequency controls applying to Noise Events in the Viaduct Harbour Precinct have been removed.

Craig Michael Fitzgerald

4 September 2018

APPENDIX A – Construction Noise and Vibration Management Plan

WYNYARD EDGE ALLIANCE



Wynyard Edge Alliance

America's Cup – Wynyard / Hobson Construction Noise and Vibration Management Plan

Revision History

Revision N°	Description	Prepared By	Reviewed by	Approved on behalf of Wynyard Edge Alliance	Date
A	Draft plan for Auckland Council pre-submission comment	Craig Fitzgerald (Marshall Day Acoustics)	Brendon Barnett Bob Mawdsley Edwin Zwanenburg Kurt Grant Ted Polley	Ian Campbell	03-07-18
B	Draft plan for Auckland Council pre-submission comment	Craig Fitzgerald (Marshall Day Acoustics)	Bob Mawdsley Kurt Grant	Deborah Morley	18-07-18
C	Draft plan following submitter feedback	Craig Fitzgerald (Marshall Day Acoustics)	Kurt Grant	Ian Campbell	23-07-18
D	Draft plan for inclusion in evidence	Craig Fitzgerald (Marshall Day Acoustics)	Kurt Grant Bob Mawdsley Brendon Barnett	Ian Campbell	03-08-18
E	Updated draft plan for inclusion in rebuttal evidence	Craig Fitzgerald (Marshall Day Acoustics)	Kurt Grant Bob Mawdsley Brendon Barnett	Iain Simmons	04-09-18

Disclaimer

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Community Liaison Group Feedback on the draft CTMP

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1 Relevant Consent Conditions

The consent conditions relevant to the Construction Noise and Vibration Management Plan (“CNVMP”) are summarised in Table 1.1 below. The conditions referenced are as per in the proposed draft resource consent conditions¹.

Table 1.1: Summary of Consent Conditions Relevant To the CNVMP.

Condition Number	Condition Requirement	Section Referenced In The Plan
109	Construction noise shall be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 “ <i>Acoustics – Construction Noise</i> ” and comply with Project Standards (see Table 4.1) unless otherwise provided for in any CNVMP (refer condition 110).	4.1
109A	Vibration arising from construction activities which may affect people and buildings shall be measured in accordance with ISO 4866:2010 <i>Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures</i> and shall comply with the Category A vibration standards (see Table 4.2).	4.2
109B	Vibration from construction activities shall comply with the Category A standards in Condition 109A unless otherwise provided for in any CNVMP (refer condition 110).	4.2
109C	Vibration may only exceed Category B standards at existing buildings located on Hobson Wharf, and only subject to compliance with the management procedures set out in the CNVMP required by condition 110.	4.2
110	The consent holder shall prepare a Construction Noise and Vibration Management Plan (CNVMP) for the Infrastructure construction in consultation with the CLG in accordance with Condition 22. At least five (5) working days prior to Commencement of Construction of the Infrastructure for the Project, the consent holder shall submit the CNVMP to the Team Leader Compliance Monitoring – Central for certification that the CNVMP gives effect to the objectives in Condition 110A and complies with the requirements in Condition 110B. The CNVMP shall be in general accordance with the Draft Construction Noise and Vibration Management Plan as referenced in Annexure B.	This Plan
110A	The objectives of the CNVMP are to: <ol style="list-style-type: none"> a) Identify and implement the Best Practicable Option (BPO) for the management of all construction noise and vibration effects; b) Define the procedures to be followed where the noise and vibration standards (Conditions 109 and 109A) are not met (following the implementation of the BPO); c) Set out the methods for scheduling works to minimise disruption; d) Ensure engagement with affected receivers and timely management of complaints; and e) Protect wellbeing of marine mammals. 	2.1
110B	The CNVMP shall include: <ol style="list-style-type: none"> a) A description of the works; 	2.2

¹ Unio Environmental, 4 September 2018. America’s Cup Wynyard Hobson – Applicant’s Revised Conditions.

Condition Number	Condition Requirement	Section Referenced In The Plan
	<ul style="list-style-type: none"> b) Hours of operation, including a specific section on works permitted at night (2230h – 0700h), incorporating clear definitions of the works undertaken at night; c) Contact details for staff responsible for implementation of the CNVMP; d) The construction noise and vibration performance standards for the project; e) The selection of construction equipment that: <ul style="list-style-type: none"> (i) Where practicable, minimises noise and vibration, prioritises electric motors over diesel engines, prioritises rubber tracked equipment over steel tracked equipment; (ii) Is suitably sized for the task; (iii) Is maintained and fitted with exhaust silencers and engine covers; and (iv) Avoids tonal reversing or warning alarms. f) Minimum separation distances from receivers for plant and machinery where compliance with the construction noise and vibration standards is achieved; g) Identification of affected sensitive receivers where noise and vibration performance standards apply; h) Avoidance of night works where practicable; i) A specific section setting out the predicted noise and/or vibration levels, mitigation, monitoring and management measures (including communication with stakeholders and use of temporary noise barriers) that will be adopted for works which cannot comply with the project standards specified in Conditions 109 and 109A. This section shall include the information above for each activity that cannot practicably comply. This section may be in the form of site specific plans which would require certification from the Council before the works can proceed in a manner that would achieve the objectives outlined in Condition 110A; j) Management and mitigation options to manage the underwater noise effects on marine mammals from impact and vibratory piling methods, including defined marine mammal management zones, marine mammal observation procedures, measurements of underwater noise at the commencement of vibratory and impact piling to calibrate underwater noise model, and procedures to adopt when marine mammals are present inside the management zones; k) Methods and frequency of monitoring and reporting of noise and vibration. This shall include monitoring during the first occurrence of impact piling, bored piling, vibro piling, other activities that are predicted to exceed the project standards in Condition 109 and the Category A standards in Condition 109A, and repeated if different equipment is utilised to undertake these activities; l) Communication, consultation and complaints response protocol including specific provisions for determining the times that receivers are sensitive to noise and vibration and the extent to which-high noise and vibration works can be scheduled around those times where 	<p>3.1, 6.3</p> <p>2.5</p> <p>4</p> <p>6.2</p> <p>5, Appendix C</p> <p>5, Appendix B, Appendix C</p> <p>6.3</p> <p>6, 7, 8</p> <p>6.7, 8.4</p> <p>8.1, 8.2</p> <p>7</p>

Condition Number	Condition Requirement	Section Referenced In The Plan
	<p>practicable (including residential, office, hospitality and tourism activities);</p> <p>m) A section requiring that impact and vibratory piling within 30m of occupied buildings (including on Hobson Wharf) shall be scheduled between 8am and 10am unless otherwise agreed with the building occupants;</p> <p>n) A section requiring that all impact piling within 100m of any occupied building on Princes Wharf is restricted to between the hours of 7am and 7pm, unless the Council certifies that impact piling outside of these hours is consistent with the BPO;</p> <p>o) A section requiring building condition survey to be undertaken for the Maritime Museum; and</p> <p>p) A section requiring that impact piling and concrete cutting may only be undertaken during the daytime periods defined in Condition 109.</p>	<p>3.1, 3.2, 6.7, Appendix B</p> <p>3.1, 3.2, 6.7</p> <p>7.3, 8.3</p> <p>3, 6.3, 6.6, 6.7</p>
110C	In all cases, piling work may not commence until the absence of marine mammals inside the effects management zones identified in the CNVMP is confirmed visually. All piling work shall cease in the event that a marine mammal is detected within the effects management zones identified in the CNVMP.	6.7
110D	In the event of a noise and/or vibration complaint, monitoring shall be undertaken where the activity and methodology has not already been shown to be compliant with the Project Standards in Conditions 109 – 109C at that location. Council may waive the requirement for further monitoring where it would not better inform the complaint.	7.4

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2 Introduction

This Construction Noise and Vibration Management Plan (“CNVMP”) forms part of a comprehensive suite of environmental controls within the Construction Environmental Management Plan (“CEMP”) for the America’s Cup Infrastructure Project (“the Project”). The Project is being delivered by the Wynyard Edge Alliance (“the Alliance”).

2.1 Scope and Objectives of the Construction Noise and Vibration Management Plan

This CNVMP identifies the performance standards for the Project and sets out best practicable options (BPO) for noise and vibration management.

The objectives of the CNVMP, as outlined in Condition 110A are to:

- a) Identify and implement the BPO for the management of all construction noise and vibration effects;
- b) Define the procedures to be followed where the noise and vibration standards (Conditions 109 and 109A) are not met (following the implementation of the BPO);
- c) Set out the methods for scheduling works to minimise disruption;
- d) Ensure engagement with affected receivers and timely management of complaints; and
- e) Protect wellbeing of marine mammals.

This Plan addresses the matters in Conditions 109 – 110D (refer to the quick reference guide to conditions in Section 1 at the front of this Plan). This CNVMP has been prepared in consultation with the Project Community Liaison Group (refer to Appendix D).

The final version of this CNVMP will be submitted to the Team Leader Compliance Monitoring – Central in accordance with Condition 110 for certification.

This CNVMP shall be implemented throughout the construction period. It shall be considered a ‘living document’ that is expanded and updated as the Project progresses and working conditions become clearer. It is intended to be the primary tool to manage the Project’s construction noise and vibration effects.

This CNVMP will be updated if necessary to reflect changes in design, construction methods or to manage effects. In accordance with the consent Condition 19, any amendments to the certified CNVMP shall be discussed with, and submitted to, the Team Leader Compliance Monitoring – Central in writing prior to implementation of any changes. Any changes to the CNVMP that would result in a materially different outcome to the certified plan shall be submitted to the Team Leader Compliance Monitoring – Central for certification (Condition 20). Any material change must be consistent with the purpose of the CNVMP and the requirements of the relevant conditions. A copy of the original CNVMP and subsequent versions will be kept for the Project records, and marked as obsolete. Each update of the Plan will be issued with a version number and date.

A glossary of terminology is included in Appendix A.

2.2 Project Description

For a description of the Project, refer to the Project Description within the CEMP. The construction details relevant to this plan are set out in Section 3.

2.3 Associated Management Plans

The CEMP outlines the environmental management framework for the Project and details the relationship between the CEMP, environmental management plans, design certification requirements and the resource consent conditions. It also provides an overview of the management plans required by the conditions (their purpose and content etc.) and other environmental mitigation measures to be implemented during construction.

The CEMP outlines the Project construction methodology, which is relevant to the context of this CNVMP.

2.4 Responsibilities

The Alliance Project Director has the overall responsibility for the Alliance complying with the requirements outlined in this CNVMP.

The Alliance Construction Manager in conjunction with the Alliance Construction Environmental Manager will implement the CNVMP. Refer to the CEMP for more detail on roles and responsibilities within the Alliance as they relate to construction environmental management of the Project.

2.5 Project Contacts

Table 2.1 provides the contract details for key Alliance staff as they relate to this CNVMP, along with the Project hotline, for general queries or complaints. Further, complaint response requirements specific to this CNVMP are detailed in Section 7.4.

Table 2.1: Project Contact Details

Project hotline	0800 WYNYARD (0800 996 9273)	
Stakeholder Manger	Michael Goudie	021 810 194
Construction Manager	Kurt Grant	021 834 512
Construction Environmental Manager	Brendon Barnett	021 527 461
Acoustic Specialist	Craig Fitzgerald (MDA)	021 534 899

Further Project contact details are provided in the CEMP.

3 America's Cup Infrastructure Works

3.1 Construction Timing

Construction works will occur over a duration of approximately 24 months, commencing in November 2018. The majority of works will be completed within a 15 month period. Due to the constrained construction programme, some works may be undertaken 24 hours per day, 7 days per week. However:

- Impact pile driving and concrete cutting will not be undertaken at night (refer Sections 6.3, 6.6 and 6.7).
- Impact and vibratory piling within 30m of occupied buildings will be scheduled between 8am and 10am unless otherwise agreed with the building occupants (refer Section 6.7 and Appendix B).
- Impact piling within 100m of any occupied building on Princes Wharf will be scheduled between 7am and 7pm, unless otherwise certified by Council (refer Section 6.7).

3.2 Construction Methodology

Construction activities relevant to this plan include:

- Piling activities for wharf construction works, breakwater construction, pontoon and fender installation and temporary construction platform construction (further methodology detail is provided below).
- Construction of wharf superstructures using cranes to lift precast elements, pumping and placing of concrete etc.
- Dredging using a long reach excavator on a barge.
- Wynyard Point buildings platforms - flat concrete raft foundations; cranes and concrete pumps required.
- Services relocation - trench excavation and reinstatement.

Refer to the CEMP for a detailed description of the proposed construction method for the various Project activities. Site maps identifying the Project works area, sensitive receivers and pile layout are provided in Appendix B.

3.2.1 Piling Methodology

Piling activities are predicted to generate the most significant potential construction noise and vibration effects. For the purposes of this CNVMP, the assumed methodology described in Table 3.1 is based on an installation rate of three piles per day. The structures noted are shown in Appendix B.

Table 3.1: Summary of Piling Activities

Activity	Description
Hobson Wharf extension and breakwaters	<p>Structures:</p> <ul style="list-style-type: none"> • Wharf extension, including breakwater 4: 813mm steel piles (x98) • Breakwater 5: 1,200mm steel piles (x16) • Breakwater 6: 1,200mm steel piles (x12) • Breakwater 7: 1,200mm steel piles (x20) • Breakwater 8: 610mm steel piles (x140) <p>Primary piling methodology (except breakwater 8):</p> <ol style="list-style-type: none"> 1. Vibrate casing into mud (1 – 2 minutes actuation time) 2. Impact pile into rock (20 – 50 impacts) 3. Drill rock socket

Activity	Description
	4. Install rebar cage in pile 5. Fill pile with concrete to top of pile Piling methodology breakwater 8: Primary method above, but without stage 2
Halsey Wharf	Structures: <ul style="list-style-type: none"> • Breakwater 2: 1,200mm steel piles (x24) • Breakwater 3: 1,200mm steel piles (x24) Refer primary piling methodology for Hobson Wharf.
Wynyard Wharf infill and breakwaters	Structures: <ul style="list-style-type: none"> • Wharf infill: 1,500mm steel piles (x71) and 1,050mm steel piles (x19) • Breakwater 1: 1,200mm steel piles (24 piles) • Breakwater 1b: 1,200mm steel piles (x4) Refer primary piling methodology for Hobson Wharf (except wharf infill). Piling methodology for wharf infill: <ol style="list-style-type: none"> 1. Excavation through seawall rock bund by progressively inserting an oversized casing with a vibrohammer and using a clamshell grab to remove the basalt rock from within the casing 2. Once the casing reaches the underside of the bund, backfill the casing with weak concrete or pea gravel 3. Use a vibrohammer to extract the temporary casing 4. Vibrate the permanent pile into seabed (1min actuation time) 5. Impact drive the pile into the underlying bedrock (20 – 50 impacts) 6. Drill out material within pile 7. Install rebar cage in pile 8. Fill pile with concrete to top of pile
Pontoon and Fender piles various locations	310 UC and 600 – 700mm diameter steel piles (x229 approx.) Vibrate directly into mud to embedment (up to 15min actuation time)
Temporary construction platforms	If temporary work platforms and associated support piles are installed for construction access, the temporary piles will likely be vibrated in (setup) and out (on removal).

The potential for significant noise and vibration effects primarily relate to Hobson Wharf piling works. The typical timing and duration of these activities are described further below.

The Hobson Wharf extension will require approximately two weeks of piling per row of piles. Seven rows of piles require installation, resulting in a cumulative piling period of approximately 14 weeks. Similarly, breakwater structures 5, 6 and 7 will each require approximately 10 days of piling. Structure 8 will require approximately 7 weeks of piling, however the Maritime Museum buildings will serve to mitigate noise levels received to the east of Hobson Wharf.

The typical daily schedule for Hobson Wharf piling works is summarised as follows:

- Prior to 7am: Daily staff briefing and site setup;
- Morning: Piling activities, including 1 – 2 minutes of vibro piling, followed by 1 – 5 minutes of impact piling and 0.5 – 2 hours of pile boring per pile;
- Afternoon / evening: Balance of pile boring, craneage, concrete works and setup for next piles;
- After 10.30pm: Ancillary activities (e.g. reposition tug, survey piles, weld piling gates).

Impact and vibratory piling required within 30m of occupied buildings on Hobson Wharf will be scheduled between 8am and 10am to mitigate noise and vibration effects (refer Section 3.1). This timing will avoid these activities during the Maritime Museum opening hours and typical busy periods for bars and restaurants (lunchtime and evening peaks). However, timing may be varied by agreement with the building occupants. Piles located within 30m of buildings are identified in Appendix B.

Impact piling within 100m of any occupied building on Princes Wharf will be scheduled between 7am and 7pm, unless otherwise certified by Council (refer Section 3.1). This timing will mitigate the effects on residents. Due to the more restrictive constraint on piling within 30m of any building above, this requirement will likely apply to the eastern most piles on Breakwater 6.

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4 Performance Standards

4.1 Noise

Construction noise shall be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "*Acoustics - Construction Noise*". The noise limits apply at 1m from external façades of occupied buildings.

Construction noise shall comply with the Project Standards in Condition 109 and outlined in Table 4.1, unless otherwise provided for in this CNVMP.

Table 4.1: Project Standards for Noise as Per Condition 109

Day	Time	L _{Aeq} (30min)	L _{AF} (max)
Monday to Saturday	0700 – 2230	75	90
Sunday	0900 – 1900	65	80
All other times (night-time)		60	75

4.2 Vibration

Construction vibration shall comply with the Project Standards in Condition 109A – 109B and outlined in Table 4.2, and shall comply with the Category A vibration standards unless otherwise provided for in this CNVMP. Vibration may only exceed Category B standards at existing buildings located on Hobson Wharf and within the CMA.

Table 4.2: Project Standards for Vibration as Per Condition 109A

Receiver	Time	Category A	Category B
Occupied dwellings, hotels and motels	2230 – 0700	0.3mm/s PPV	1mm/s PPV
	0700 – 2230	2mm/s PPV	5mm/s PPV
Other occupied buildings	All times	2mm/s PPV	5mm/s PPV
All buildings	All times	5mm/s PPV	Tables 1 and 3 of DIN4150-3:1999

Construction vibration which may affect people and buildings shall be assessed in accordance with ISO 4866:2010 "*Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures*".

4.2.1 Cosmetic Building Damage

Construction vibration to be measured in accordance with German Standard DIN 4150-3:1999 "*Structural vibration – Part 3: Effects of vibration on structures*". The short-term (transient)² vibration limits in Figure 4-1 will apply at building foundations in any axis. The vibration limits in all other cases are summarised in Table 4.3.

² Short-term (transient) vibration is "vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated"

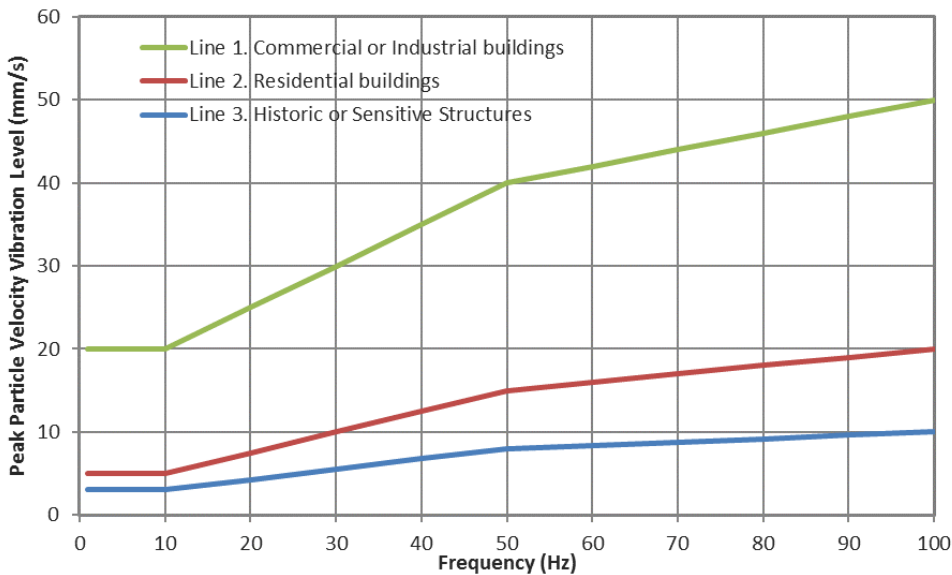


Figure 4-1: Short-Term (Transient)² Vibration at Building Foundations (DIN 4150-3 1999: Figure 1)

Table 4.3: Vibration at Horizontal Plane of Highest Floor (DIN 4150-3 1999: Tables 1 And 3)

Structure Type	Peak Particle Velocity Vibration Level (mm/s)	
	Short-term (transient) ²	Long-term (continuous) ^{3, 4}
Line 1. Commercial or Industrial buildings	40	10
Line 2. Residential buildings	15	5
Line 3. Historic or Sensitive Structures	8	2.5

The criteria relate to the avoidance of cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in the Standard and can generally be easily repaired. The cosmetic building damage thresholds are much lower than those that would result in structural damage. The Standard states: "Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur."

4.3 Underwater Noise

There are no underwater noise limits in New Zealand legislation. Therefore, this CNVMP relies on guidance from the US Department of National Oceanic and Atmospheric Administration (NOAA)⁵.

The marine mammal 'species of interest' in the Waitematā harbour are Orca, common dolphin and bottlenose dolphin. These species are all classified as mid-frequency cetaceans (MF). There is also the potential for fur seals to be in the project vicinity, which are classified as otariid pinnipeds (OW), and there is a resident leopard seal in Westhaven Marina. Leopard Seals are classed as phocid pinnipeds (PW).

³ Long-term (continuous) vibration includes types not covered by the short-term vibration definition

⁴ The long-term (continuous) criteria can apply at all floor levels, but levels are normally highest at the top floor

⁵ 'Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing', NOAA (July 2016)

The NOAA criteria for MF cetaceans, OW pinnipeds and PW pinnipeds are summarised in Table 4.4.

Table 4.4: Summary of NOAA TTS and PTS Thresholds⁶

Species	Threshold Type	Impulsive sources (e.g. impact piling)	Non-impulsive sources (e.g. vibro piling)
Mid-Frequency Cetaceans	Temporary Threshold Shift (TTS)	224 dB L_{peak} 170 dB $SEL_{cum(mf)}$	178 dB $SEL_{cum(mf)}$
	Permanent Threshold Shift (PTS)	230 dB L_{peak} 185 dB $SEL_{cum(mf)}$	198 dB $SEL_{cum(mf)}$
Otariid Pinnipeds	TTS	226 dB L_{peak} 188 dB $SEL_{cum(ow)}$	199 dB $SEL_{cum(ow)}$
	PTS	232 dB L_{peak} 203 dB $SEL_{cum(ow)}$	219 dB $SEL_{cum(ow)}$
Phocid Pinnipeds	TTS	212 dB L_{peak} 170 dB $SEL_{cum(pw)}$	181 dB $SEL_{cum(pw)}$
	PTS	218 dB L_{peak} 185 dB $SEL_{cum(pw)}$	201 dB $SEL_{cum(pw)}$

Safety guidelines for human divers published in a NATO Undersea Research Centre (NURC) publication⁷ recommends divers should avoid areas where noise levels exceed 160 dB re 1 μ Pa rms (125Hz – 4kHz). This is considered an acceptable threshold for experienced divers, or those in shallow water at the coastline. We note that for inexperienced divers, behavioural responses such as changing heart rates or breathing frequency have been found to occur at levels above 154 dB re 1 μ Pa rms⁸, however we consider it unlikely that inexperienced divers would be in the vicinity while works are being undertaken.

⁶ SEL thresholds have a reference of 1 μ Pa²s and L_{peak} thresholds have a reference of 1 μ Pa

⁷ 'NATO Undersea Research Centre Human Diver and Marine Mammal Risk Mitigation Rules and Procedures', NURC-SP-2006-008, September 2006

⁸ US Navy (US Federal Register, 2002)

5 Predicted Levels

5.1 Noise

Table 5.1 provides indicative construction noise levels for the key Project construction activities, proposed construction machinery, their sound power levels and unmitigated setback distances to comply with noise levels of 75 dB L_{Aeq} and 60 dB L_{Aeq} . It will be used by the Alliance Project Director (or nominated person) prior to construction to inform what equipment will require mitigation and/or management and when. The table will be kept up to date by the Project's Acoustic Specialist (Table 2.1) when new information becomes apparent through noise monitoring (Section 8.1) or other means.

Table 5.1: Indicative Noise Levels At 1m from a Building Façade⁹ without Effective Noise Barriers¹⁰

Equipment	Sound Power Level (dB L_{WA})	Noise Level (dB L_{Aeq}) at a distance of			Setback to achieve compliance (m)	
		10 m	20 m	50 m	75 dB L_{Aeq}	60 dB L_{Aeq}
Vibro piling	116	91	85	76	52	209
Concrete cutting	115	90	84	75	48	191
Impact piling (with casing and dolly)	114	89	83	74	44	174
Bored or CFA piling	111	86	80	71	33	132
Long reach excavator (39t)	106	81	75	66	20	83
Excavator (20t)	103	78	72	63	14	63
Concrete truck and pump discharging	103	78	72	63	14	63
Mobile crane (35t) operating	98	73	67	58	8	40

Piling and concrete cutting activities have the potential to exceed the standard 75 dB L_{Aeq} weekday daytime construction noise limit for brief periods. Noise contours for representative piling activities are included in Appendix C. In summary, brief intermittent exceedances during pile driving activities are predicted to locally exceed 75 dB L_{Aeq} at the following occupied commercial buildings (based on the piling methodology outlined in Section 3.2.1):

- Maritime Museum: Up to 85 dB L_{Aeq} during the Hobson Wharf extension, (approximately 1 week for each of the closest three rows of piles), breakwaters 6 and 7 (approximately 10 days each) and breakwater 8 (7 weeks).
- Hobson Wharf restaurants: Up to 85 dB L_{Aeq} for the south end of breakwater 7 (approximately 2 – 3 days).
- North Wharf restaurants: Up to 80 dB L_{Aeq} for the closest pontoon pile (approx. 1 – 2 days per site / restaurant).

Vibro and impact piling will be the loudest construction activities and have a character that is more intrusive than other noise sources at a similar level (e.g. bored piling). With reference to Section 3.2.1, the

⁹ In accordance with the requirements of NZS 6803: 1999, inclusive of 3 decibels façade reflection

¹⁰ Effective noise barriers typically provide 10 decibels shielding (Section 6.5)

duration of vibro and impact piling will be minimised, and scheduled to mitigate disturbance for residents, avoid the Maritime Museum opening hours, and avoid typical busy periods for bars and restaurants on Hobson Wharf and North Wharf.

5.2 Vibration

Table 5.2 provides indicative construction vibration levels for key construction activities that have the potential to result in vibration in building structures and their approximate safe distances to enable compliance with the vibration limits at building foundations. It will be used by the Alliance Project Director (or nominated person) prior to construction to inform what equipment will require mitigation and/or management and when. The table will be kept up to date by the Project Acoustic Specialist (Table 2.1) when new information becomes apparent through vibration monitoring (Section 8.2) or other means.

Table 5.2: Indicative Distances to Comply With Vibration Limits at Building Foundations

Equipment	Cosmetic Building Damage Setback (m) ¹¹			
	Amenity Setback (m) ¹¹ 2mm/s PPV	Heritage & Sensitive Structures	Residential	Commercial
Impact piling ¹²	61	36	19	3
Vibrated pile casings	19	15	6	3

Impact and vibratory piling will be undertaken within a few metres of the Maritime Museum and will therefore be located within the cosmetic building damage setback for a commercial building. With reference to Section 7.3, building condition survey(s) will be undertaken in accordance with Section 8.3.

In addition to the above, impact and vibratory piling is predicted to exceed the vibration amenity limit of 2mm/s PPV at restaurants at the south end of Hobson Wharf and fronting North Wharf. With reference to Section 3.1, impact and vibratory piling will be scheduled to avoid occupied or busy periods, prior communication will be required in accordance with Section 7.1.

5.3 Underwater Noise

The indicative zones of influence for the worst-case impact piling works are presented in Table 5.3. The zones are shown as distances from the pile being installed.

The zones are graphically shown on the figures in Appendix C. Three representative piling locations are shown:

- Figure 6: Hobson Wharf.
- Figure 7: Breakwater 2.
- Figure 8: Breakwater 1.

Vibro piling works will be very short in duration (approximately 1 – 2 minutes per pile). Therefore, the zones of influence for vibro piling will be negligible (i.e. <20m) and not addressed in detail. These zones include the mitigation measures of a wooden cushion between the impact hammer and pile cap. Refer to Appendix C for a description of these mitigation measures.

¹¹ Based on regression analysis of available vibration measurements, plus a 100% safety factor

¹² Assumes transient low frequency vibration criterion from Table 1 of DIN 4150-3 :1999 is applicable

Table 5.3: Zones of Influence for Steel Piles

Species	Threshold	Impact piling zones			Vibro piling zones	
		1,200mm dia	813mm dia	667mm dia	600mm dia	310mm UC
All species	PTS – peak	Below criteria				
	TTS – peak	Below criteria				
Mid-frequency cetaceans	PTS – cumulative exposure	<20m	<20	Below criteria		
	TTS – cumulative exposure	50m	50m	25m	50m	<20m
Otariid pinnipeds	PTS – cumulative exposure	<20	Below criteria			
	TTS – cumulative exposure	50m	<20	<20m	<20m	Below criteria
Phocid pinnipeds	PTS – cumulative exposure	50m	<20	<20m	<20m	Below criteria
	TTS – cumulative exposure	220m	155m	125m	75m	<20m

For any temporary work platforms and associated support piles installed to provide construction access, smaller temporary piles will likely be vibrated into the ground and removed on completion of the works. The temporary piles will be quicker and quieter to install than permanent piles. As such, the associated management zones will be notably smaller.

6 Mitigation and Management

6.1 Training

All staff will participate in a Project induction prior to the start of construction as outlined in the CEMP. Attention given to the following matters related to implementation of this CNVMP:

- Construction noise and vibration limits (Section 4).
- Activities with the potential to generate high levels of noise and/or vibration (Section 5).
- Noise and vibration mitigation and management procedures (Section 6).
- The sensitivity of receivers and any operational requirements and constraints identified through communication and consultation (Section 7).

Awareness of current noise and vibration matters on, or near active worksites, will be addressed during regular site meetings and/or 'toolbox' training sessions.

Refer to the CEMP for further detail on Project environmental training.

6.2 Equipment Selection

When selecting construction equipment, the following will be implemented:

- Prioritise construction methodologies that minimise noise and vibration where practicable (e.g. bored piling instead of impact or vibro piling methods).
- Prioritise electric motors over diesel engines where practicable.
- Prioritise rubber tracked equipment over steel tracked equipment where practicable.
- Equipment shall be suitably sized for the proposed task.
- Equipment shall be maintained and fitted with exhaust silencers and engine covers.
- Avoid tonal reversing or warning alarms (suitable alternatives may include flashing lights, broadband audible alarms or reversing cameras inside vehicles).

6.3 Night Works

Where practicable, night works will be avoided. Where necessary, noisy works will be programmed early in the evening or night-time period to avoid sleep disturbance. It is noted that people tend to be less disturbed by low frequency, continuous engine noise, as opposed to intermittent noise or activities with special audible character (e.g. reversing beepers, whistling, banging tailgates or shouting).

Activities which have a distinctive impulsive or tonal character, such as impact pile driving, concrete breaking and concrete cutting can cause significant adverse effects when undertaken at night-time, even when complying with the construction noise limits. Therefore, these activities will not be undertaken at night, including impact piling and concrete cutting.

Other works may be undertaken at night provided they are not in close proximity to residential receivers and provided they comply with the night-time noise limits. These potentially include bored piling, vibro piling, generator use, concrete pours and vehicle movements. The Construction Environmental Manager shall involve the Acoustic Specialist (Table 2.1) in the scheduling of night works and monitoring to ensure compliance with the consent conditions.

Stakeholder engagement will be critical in relation to night works (refer to Section 7 of this Plan for further detail).

6.4 General Measures

Complaints can arise whether or not noise and vibration levels comply with the Project limits. To avoid complaints, general mitigation and management measures will include, but are not be limited to, the following:

- Avoid unnecessary noise, such as shouting, the use of horns, loud site radios, rough handling of material and equipment, and banging or shaking excavator buckets.
- Avoid steel on steel contact, such as during the loading of scaffolding on trucks.
- Avoid high engine revs through appropriate equipment selection and turn engines off when idle.
- Maintain site access ways to avoid pot holes and corrugations.
- Mitigate track squeal from tracked equipment, such as excavators (may include tensioning and watering or lubricating the tracks regularly).
- Minimise construction duration near sensitive receivers.
- Stationary equipment (e.g. generators) shall be located away from noise sensitive receivers and site buildings and material stores used to screen them.
- Utilise noise barriers where appropriate (Section 6.5).
- Implement specialised mitigation measures for concrete cutting (Section 6.6) and piling (Section 6.7).
- Ensure advanced communication is complete (Section 7) prior to commencing activities that are predicted to exceed the noise and vibration performance standards (Section 5).
- Undertake monitoring as appropriate (Section 8).

6.5 Noise Barriers

Temporary noise barriers will be used where a construction noise limit is predicted to be exceeded (refer to Section 5.1) and the barriers will noticeably reduce the construction noise level. The barriers shall be installed prior to works commencing and maintained throughout the works. Effective noise barriers typically reduce the received noise level by 10 decibels.

The following guidelines shall be incorporated in the design and utilisation of temporary noise barriers:

- The panels shall be constructed from materials with a minimum surface mass of 6.5 kg/m². Suitable panels include 12 mm plywood or the following proprietary 'noise curtains':
 - Duraflex 'Noise Control Barrier - Performance Series' (www.duraflex.co.nz)
 - Soundex 'Acoustic Curtain - Performance Series' (www.ultimate-solutions.co.nz)
 - Flexshield 'Sonic Curtain with 4 kg/m² mass loaded vinyl backing' (www.flexshield.co.nz)
 - Alternatives shall be approved by a suitably qualified acoustic specialist (it is noted that some proprietary noise curtains have insufficient surface mass for general use)
- The panels shall be a minimum height of 2 m, and higher if practicable to block line-of-sight.
- The panels shall be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels.
- The panels shall be positioned as close as practicable to the noisy construction activity to block line-of-sight between the activity and noise sensitive receivers.

Where positioned on the site boundary, additional local barriers shall be considered near the activity to ensure effective mitigation for sensitive receivers on upper floor levels.

6.6 Concrete Cutting

Concrete cutting will be managed to:

- Avoid evening and night-time periods (refer Section 3.1).
- Minimise the cutting period, and, the number of cutting periods where practicable (e.g. complete all cutting in one extended period rather than two shorter periods with the same overall duration).
- Use a unit fitted with a blade shroud and a 'quiet' blade type (tooth design) where practicable.

6.7 Piling

Piling shall be managed to:

- Avoid impact pile driving at night (refer Section 3.1).
- Schedule impact and vibratory piling within 30m of occupied buildings between 8am and 10am unless otherwise agreed with the building occupants (refer Section 3.1 and Appendix B).
- Schedule impact piling within 100m of any occupied building on Princes Wharf between 7am and 7pm, unless otherwise certified by Council (refer Section 3.1 and Appendix B).
- Prioritise piling methods that minimise noise and vibration where practicable (e.g. augured or press-in piles over impact driven or vibratory piling methods).
- Avoid alternating rotation of the bored piling auger to loosen spoil into the muck bin where practicable. The kelly bar connection typically creates a very loud banging that often results in noise complaints. This action is unnecessary for general auger use, but may be necessary if a coring barrel is required to drill through obstructions.
- Use a non-metallic 'dolly' or 'cushion cap' between the impact piling hammer and the driving helmet to reduce underwater and airborne noise levels (e.g. plastic or plywood – preferably plywood).
- Use an enclosed impact piling driving system that shrouds the point of impact.

In accordance with condition 110A, the following procedure shall be implemented to manage the effects of underwater noise on marine mammals and divers:

- Undertake visual monitoring 30 minutes prior to commencing piling operations to ensure there are no marine mammals or divers in the area.
- Use 'soft starts' (gradually increasing the intensity of piling) and minimise duty cycle where practicable.
- Undertake visual monitoring during piling operations to identify any marine mammals or divers that enter the area.
- Implement low power or shut down procedures when a marine mammal is identified within the TTS zones (based on the current methodology, Table 5.3 identifies a zone of up to 220m for phocid pinnipeds and 50m for mid-frequency cetaceans and otariid pinnipeds).

7 Engagement

7.1 Communication

Written communication (e.g. newsletter) will be provided to occupiers of buildings within 100 m of the site at least 1 week prior to the Project commencing. Communication shall acknowledge that some construction activities are predicted to generate high noise and/or vibration levels that may result in disturbance for short periods. It shall include details of the overall works, its timing, duration and Project contact details, including for complaints and enquiries.

Written communication during the works will include:

- Public site signage, which will include Project contact details.
- Regular Project updates, which shall include details of impending activities that may result in disturbance, including night works (Section 6.3), concrete cutting (Section 6.6) and piling (Section 6.7). It shall also include scheduled timing and duration of these activities and contact details complaints and enquiries.
- Occupants of buildings predicted to receive noise levels exceeding the noise limits in Section 4.1 shall be advised at least 48 hours prior to the works commencing. With reference to Section 5.1, this relates to occupied buildings up to 52m from daytime piling activities.
- Occupants of buildings predicted to receive vibration levels exceeding the Category A performance standards in Section 4.2 shall be advised at least 48 hours prior to the works commencing. With reference to Section 5.2, this relates to occupied buildings within 60m of impact piling and 20m of vibro piling.

7.2 Consultation

Table 7.1 and Figure 8-5 in Appendix B identify sensitive receivers where noise and/or vibration is predicted to exceed the performance standards. In addition, if vibro/impact piling is undertaken within 50m of the existing Wynyard Point tanks, appropriate vibration thresholds and mitigation measures will be identified and agreed with the potentially affected bulk liquids company, and included in this CNVMP.

Table 7.1: Sensitive Receivers

Address	Building Type ¹³	Occupancy	Noise (Section 5.1)	Vibration (Section 5.2)	
				Amenity	Cosmetic Building Damage
Hobson Wharf	Commercial	Maritime Museum	X	X	X
North Wharf (47 Jellicoe St)	Commercial	North Wharf Restaurants	X	X	-

Consultation will be undertaken to address reasonable concerns about noise and vibration on a case-by-case basis. The Alliance Project Director shall address any concerns and complaints in accordance with

¹³ Classifications with respect to Tables 1 and 3 of DIN 4150-3:1999 "Structural Vibration - Effects of Vibration on Structures" (i.e. historic/sensitive, residential or commercial/industrial)

Section 7.3. When discussing vibration concerns, it is important to convey that vibration can be felt at levels well below those that pose a risk of cosmetic building damage. A copy of all correspondence will be made available to Council upon request.

The following process will be implemented by the Alliance Project Director (or nominated person) in relation to any construction activity that when measured, exceeds the relevant construction noise and vibration performance standards:

- For exceedances of the construction cosmetic building damage vibration standards, activities shall cease as soon as safe and practicable to do so.
- Review the construction methodology, mitigation and management strategies to ensure they represent the BPO.
- Undertake consultation with affected parties to understand their sensitivities, including times, activities and locations. Consultation shall focus on a collaborative approach to managing the adverse effects from construction noise and vibration. A project representative shall be contactable during works. A record of consultation shall be kept at the site office and be available to the affected parties and Council if requested.
- Implement measures to avoid significant adverse effects as agreed with the affected party and monitor the activity to verify the extent of any adverse effects
- For exceedances of the construction vibration cosmetic building damage thresholds in Section 4.2, a detailed building condition survey will be undertaken in accordance with Section 8.3. If damage has not occurred, then that activity can continue provided the measured vibration level is not exceeded further and the construction methodology is the BPO. If damage has occurred, alternative construction methods will be investigated and the consent holder shall commit to repairing the damage within a reasonable timeframe.
- Temporary relocation shall be considered for sensitive receivers where all practicable noise and vibration management and mitigation measures have been implemented and significant adverse noise effects are predicted. This will be in exceptional cases only, and advice from the Acoustic Specialist (Table 2.1) will be sought prior.

7.3 Maritime Museum

The Maritime Museum has provided written approval for the Americas Cup construction activities, acknowledging the potential noise and vibration effects. Regardless, the following section identifies noise and vibration sensitive activities, potential effects, and measures to avoid, or mitigate adverse effects as far as practicable.

The Maritime Museum comprises of a series of connected buildings located on Hobson Wharf. The northern most building that will be adjacent to most of the construction activities, appears to be a modern steel frame building. It contains the 'Blue Water Black Magic' exhibition across multiple levels around a central atrium, which features many boats, yachting memorabilia and interactive experiences. The older buildings at the southern end of Hobson Wharf house the more historic features and traditional displays.

The publicly listed opening hours for the museum are 10am – 5pm every day (except Christmas Day). Pile driving represents a small proportion of the overall time required to install a pile. Much of the associated time relates to formwork setup and pile alignment prior to driving. The driving component of the pile installation is the activity with the potential to generate high noise and vibration levels and is the focus of the noise and vibration predictions in Section 5. To avoid significant amenity effects, impact and vibratory pile driving within 30m of the museum buildings will be scheduled between 8am and 10am, Monday to Saturday, unless otherwise agreed with the Maritime Museum.

7.3.1 Noise

Noise levels of 75 – 85 dB L_{Aeq} are predicted on the closest façade of the Maritime Museum within 30m of bored piling works. Based on the façade construction, it is predicted that internal noise levels will be up to 55 – 65 dB L_{Aeq} for short periods inside the immediately adjacent gallery space.

The predicted noise levels are comparable to those from the recently completed Hobson Wharf remediation works. At the time, a CNVMP was prepared to address noise and vibration effects from the Hobson Wharf remediation works. The key difference is that the America's Cup piling works are of a shorter duration (Section 2.1).

For bored piling within 30m of the museum buildings between 10am and 5pm:

- The exhibitions feature a large collection of display objects with accompanying written information. These features will generally not be significantly affected by noise from piling works. However, patrons may potentially spend less time in the space immediately adjacent to the piling works.
- When a tour group is taken through the museum, piling noise may affect communication when a guide is addressing the group near the piling works. In this case, it would be advisable for the guide to address the group in the adjacent gallery prior to entering, and/or after leaving, the exhibition.
- Three audio-visual experiences are provided near the northern façade and are reliant on a relatively low noise environment. These are the 'Teamwork Challenge' sailing experience on the ground floor and the 'No Latitude for Error' and 'Blakey' documentary booths on first floor level. It is expected that noise from piling would influence intelligibility of the audio component of these displays. Increasing the volume levels produced by these displays may mitigate the intelligibility issues to a point, but these displays may be affected for short periods while the closest piling works are undertaken.

7.3.2 Vibration

Impact and vibratory piling methods are proposed in close proximity to the Maritime Museum buildings. These activities have the potential to exceed the commercial cosmetic building damage thresholds (Section 5.2). Therefore, building condition survey(s) shall be undertaken in accordance with Section 8.3.

With reference to Section 3.1, impact and vibratory piling methods will be timed to avoid significant vibration amenity effects on customers. Vibration from other activities will be minimal, but may be perceptible at times. Staff and patrons shall be informed about the vibration levels they may experience and assured vibration damage can only occur at magnitudes well above the threshold of perception, and is unlikely to affect the quality of projected images associated with the audio-visual experiences identified above.

7.3.3 Consultation

Consultation with the Maritime Museum will be undertaken to mitigate and manage the noise and vibration effects. For example, this may include timing of the closest piles to avoid school holidays or target morning and evening periods when the gallery is often less busy.

Noise and vibration levels in other more distant areas of the museum are predicted to be significantly lower, and minimal disturbance is anticipated.

7.4 Complaints Response

All construction noise and/or vibration complaints will be recorded in a complaints file that is available to Council on request. For each complaint, an investigation will be undertaken involving the following steps as soon as practicable:

- Acknowledge receipt of the concern or complaint within 24 hours and record:
 - Time and date the complaint was received and who received it

- Time and date of the activity subject to the complaint (estimated where not known)
 - The name, address and contact details of the complainant (unless they elect not to provide)
 - The complainants' description of the activity and its resulting effects
 - Any relief sought by the complainant (e.g. scheduling of the activity).
- Identify the relevant activity and the nature of the works at the time of the complaint.
 - If a reasonable complaint relates to building damage, inform the on-duty site manager as soon as practicable and cease associated works pending an investigation.
 - Review the activity noise and/or vibration levels (Section 5) to determine if the activity is predicted to comply with the relevant performance standards (Section 4) at the complainants' building.
 - Monitoring shall be undertaken (Section 8) where;
 - The activity and methodology has not already been shown to be compliant through prior monitoring
 - The complainants building has been determined to be within a potentially affected area
 - The complaint has not already been suitably addressed.
 - Where there are repeat complaints that have been suitably addressed on previous occasions and further monitoring would not better inform the complaint, in agreement with Auckland Council additional monitoring may be waived.
 - Review the mitigation and management measures in to ensure the activity represents the BPO (Section 6). Review the relief sought by the complainant. Adopt further mitigation and management measures as appropriate.
 - Review the potential residual effects (Section 5) of activities that are predicted to exceed the relevant performance standards (Section 4).
 - Report the findings and recommendations to the Alliance Project Director, implement changes and update this CNVMP as appropriate.
 - Report the outcomes of the investigation to the complainant, identifying where the relief sought by the complainant has been adopted or the reason(s) otherwise.

In most cases, ceasing the activity will provide immediate relief. In some cases, this may not be practicable for safety or other reasons. The complainant shall be kept updated regularly during the time it takes to resolve the matter.

8 Monitoring

8.1 Noise

Construction noise levels shall be monitored as follows during construction:

- During the first occurrence of impact piling, bored piling, vibro piling and other activities that are predicted to exceed the noise limits (Section 5.1).
- In response to a noise complaint (Section 7.4).
- At 1m from the most affected building façade, or proxy position and adjusted for distance and façade reflections where appropriate.
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) in accordance with the requirements of New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise".
- For a representative duration, reported with the measured level (e.g. 65 dB L_{Aeq} (30min)).
- The results will be used to update Section 5.1 if appropriate.

A noise monitoring flowchart is presented in Figure 8-1.

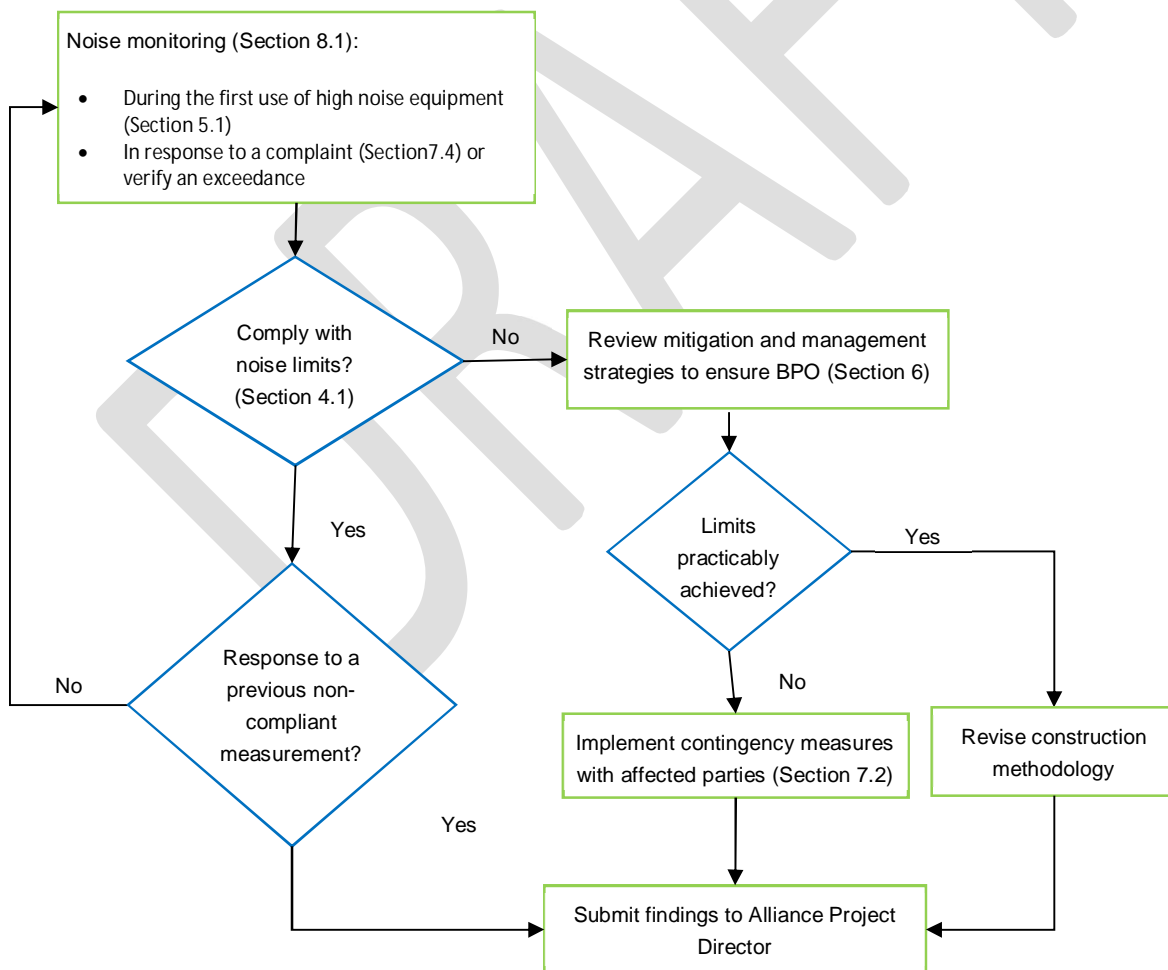


Figure 8-1: Noise Monitoring Flow Chart

8.2 Vibration

Construction vibration shall be monitored as follows during construction:

- At the Maritime Museum during the first occurrences of impact and vibratory piling (Section 5.2) and following the completion of pre-construction building condition surveys (Section 8.3).
- In response to a vibration complaint (Section 7.37.4).
- At the closest building foundations and/or the top floor level as appropriate where consent to access the building of interest has been requested and granted.
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) in accordance the requirements of German Standard DIN 4150-3:1999 "Structural vibration – Part 3: Effects of vibration on structures".
- For a representative construction duration, measured in 2 second intervals.
- The results will be used to update Section 5.2 if appropriate.

A vibration monitoring flowchart is presented in Figure 8-2.

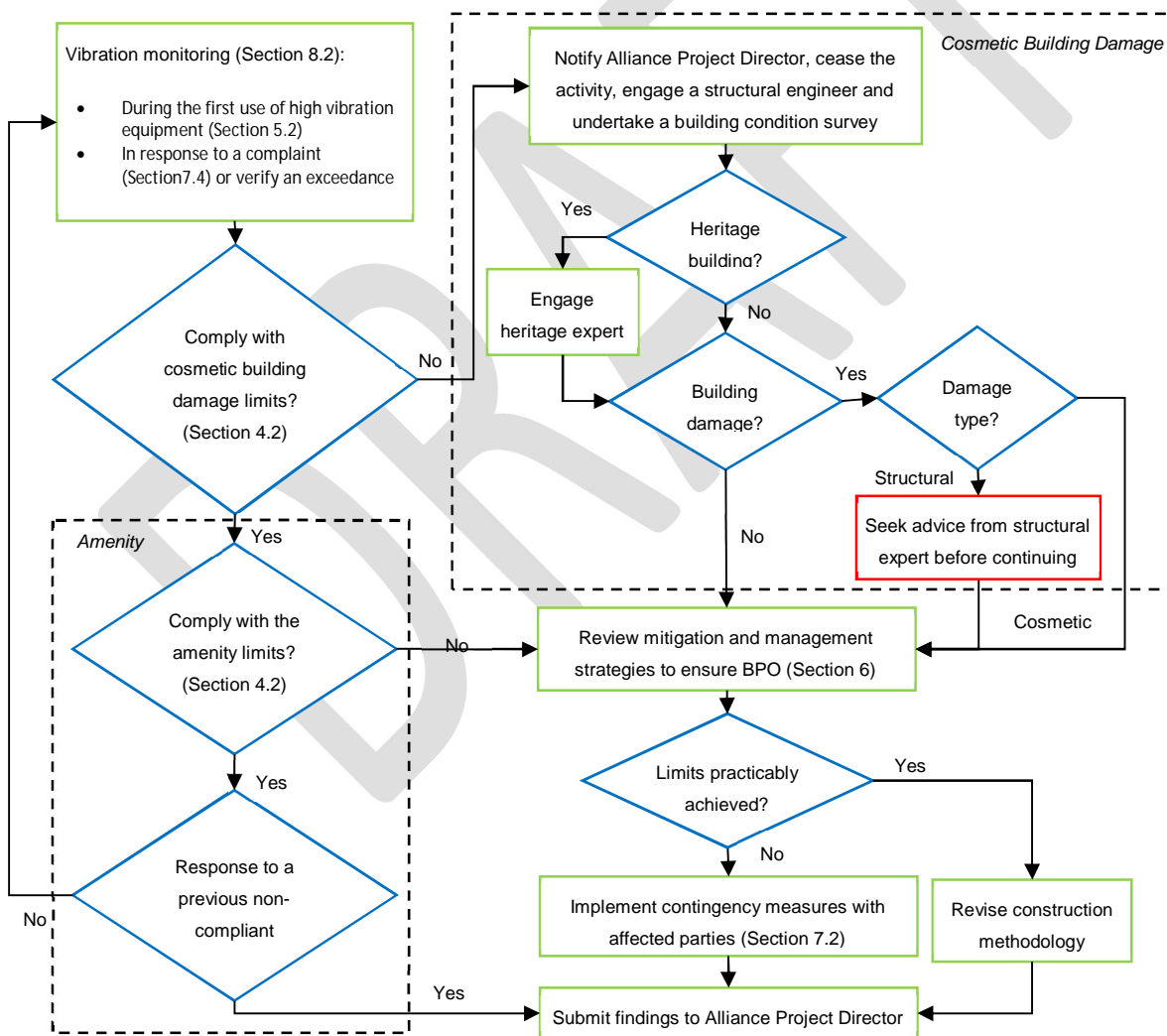


Figure 8-2: Vibration Monitoring Flow Chart

8.3 Building Condition Surveys

Cosmetic building damage (e.g. plaster or paint cracking) is an effect that is relevant to the building owner only (i.e. rather than tenants or leaseholders). People generally perceive vibration at levels significantly lower than those levels that would result in cosmetic building damage and an understanding of this often alleviates receivers' concerns.

A condition survey will be undertaken for the Maritime Museum (Sections 5.2 and 7.3).

The Alliance Project Director shall request, in writing, the approval of the property owner to undertake a building condition survey at the following times:

- Prior to construction commencing and where vibration is predicted to exceed the cosmetic building damage limits (Section 5.2).
- During construction, where vibration is measured to exceed the cosmetic building damage limits in (Section 5.2) and/or in response to a reasonable claim of damage from construction vibration (Section 7.3).
- Post construction, to avoid subsequent claims of damage from construction vibration (Section 7.3).

If a vibration exceedance has occurred but there is no resulting cosmetic damage, then that activity will continue provided the measured vibration level is not exceeded further and the construction methodology already adheres to the BPO. If damage has occurred, alternative construction methods shall be investigated and the Alliance will rectify the damage at its own cost, as soon as practicable, in consultation with the owner of the property.

Each building condition survey shall:

- Be undertaken by a suitably qualified person.
- Provide a description of the building.
- Determine the appropriate structure type classification¹⁴ with respect to DIN 4150-3:1999 "*Structural Vibration - Effects of Vibration on Structures*" (i.e. historic/sensitive, residential or commercial/industrial).
- Document and photograph the condition of the building, including any cosmetic and/or structural damage.

The results will be provided to the property owner and be available to Council on request.

8.4 Underwater Noise

The Alliance will visually monitor the water inside the 'zones of influence' identified in Section 5.3 and implement the management measures in Section 6.7.

Underwater construction noise levels shall be monitored:

- During the first occurrence of impact piling.
- By a suitably qualified and experienced specialist.
- For a representative duration.

¹⁴ Classifications with respect to Tables 1 and 3 of DIN 4150-3:1999 "*Structural Vibration - Effects of Vibration on Structures*" (i.e. historic/sensitive, residential or commercial/industrial)

- The results will be used to update the Sections 5.3 and Section 6.7 as appropriate.

The underwater noise measurements will be undertaken using compact self-contained hydrophones (underwater sound recording units). The Acoustic Specialist (Table 2.1) will supply the hydrophone units and rigging. The Alliance will supply a boat to deploy and retrieve the units at agreed locations. Calm sea state is required for good acoustic measurement conditions. The generic setup for each hydrophone unit is shown in Figure 8-4.

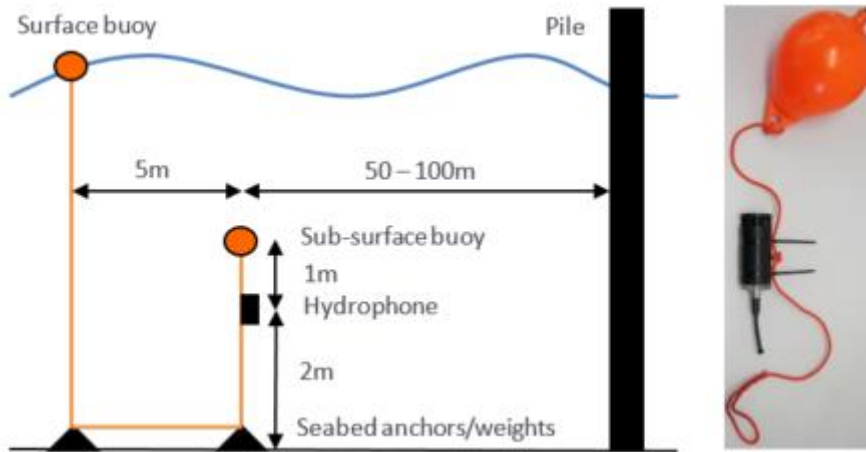


Figure 8-3: Hydrophones Indicative Setup (Not To Scale)

Appendix A

Glossary of Terminology

DRAFT

Noise	A sound that is unwanted by, or distracting to, the receiver.
dB	Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where $dB = 20 \times \log(P/Pr)$. The convention is a reference pressure of $Pr = 20 \mu\text{Pa}$ in air and $Pr = 1 \mu\text{Pa}$ underwater.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) to more closely approximate the frequency bias of the human ear. A-weighting is used in airborne acoustics.
$L_{Aeq}(t)$	The equivalent continuous (time-averaged) A-weighted sound level commonly referred to as the average level. The suffix (t) represents the period, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into vertical (up and down vibration), horizontal transverse (side to side) and horizontal longitudinal direction (front to back) components.
PPV	Peak Particle Velocity (PPV) is the measure of the vibration amplitude, zero to maximum, measured in mm/s.
DIN 4150-3:1999	German Standard DIN 4150-3:1999 " <i>Structural Vibration - Effects of Vibration on Structures</i> "
Underwater noise	A sound that is unwanted by, or distracting to, the receiver underwater.
L_{peak}	The peak instantaneous pressure level (un-weighted).
RMS	Root Mean Square (RMS) is the equivalent continuous (time-averaged) sound level commonly referred to as the average level (period matches the event duration).
SEL	Sound exposure level (SEL) is the total sound energy of an event, normalised to an average sound level over one second. It is the time-integrated, sound-pressure-squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels and temporal characteristics.
SEL_{cum}	The SEL_{cum} is the 'cumulative' sound energy of all events in a 24 hour period, normalised to an average sound level over one second.
TTS	Temporary Threshold Shift (TTS) is the temporary loss of hearing caused by sound exposure. The duration of TTS varies depending on the nature of the stimulus, but there is generally recovery of full hearing over time.
PTS	Permanent Threshold Shift (PTS) is the permanent loss of hearing caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear.

Appendix B

Overview of Construction
Works

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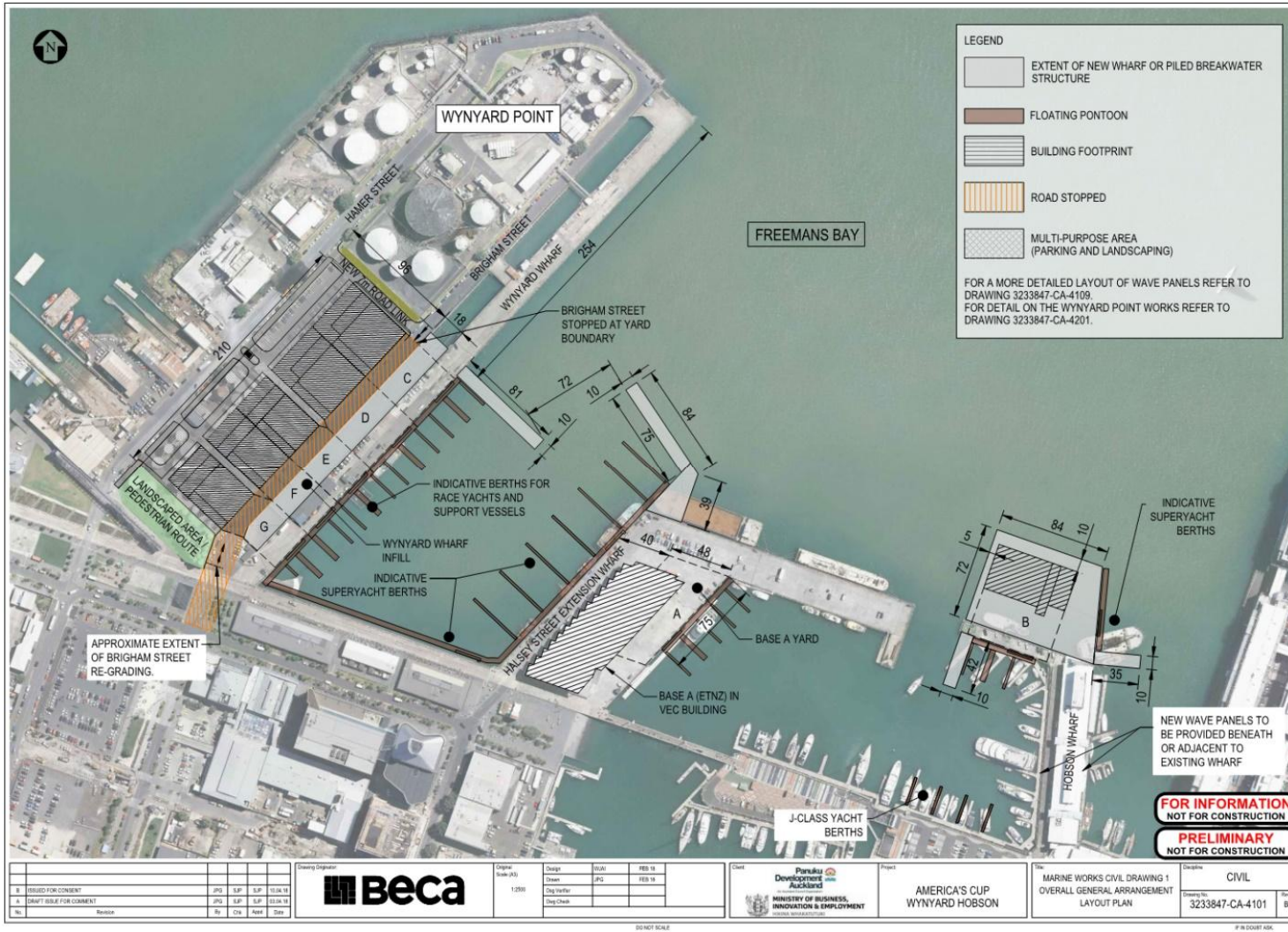


Figure 8-4: Proposed Infrastructure¹⁵

¹⁵ BECA report 'America's Cup Engineering Concept Drawings', drawing 3233847-CA-4101 rev B, dated 10 April 2018

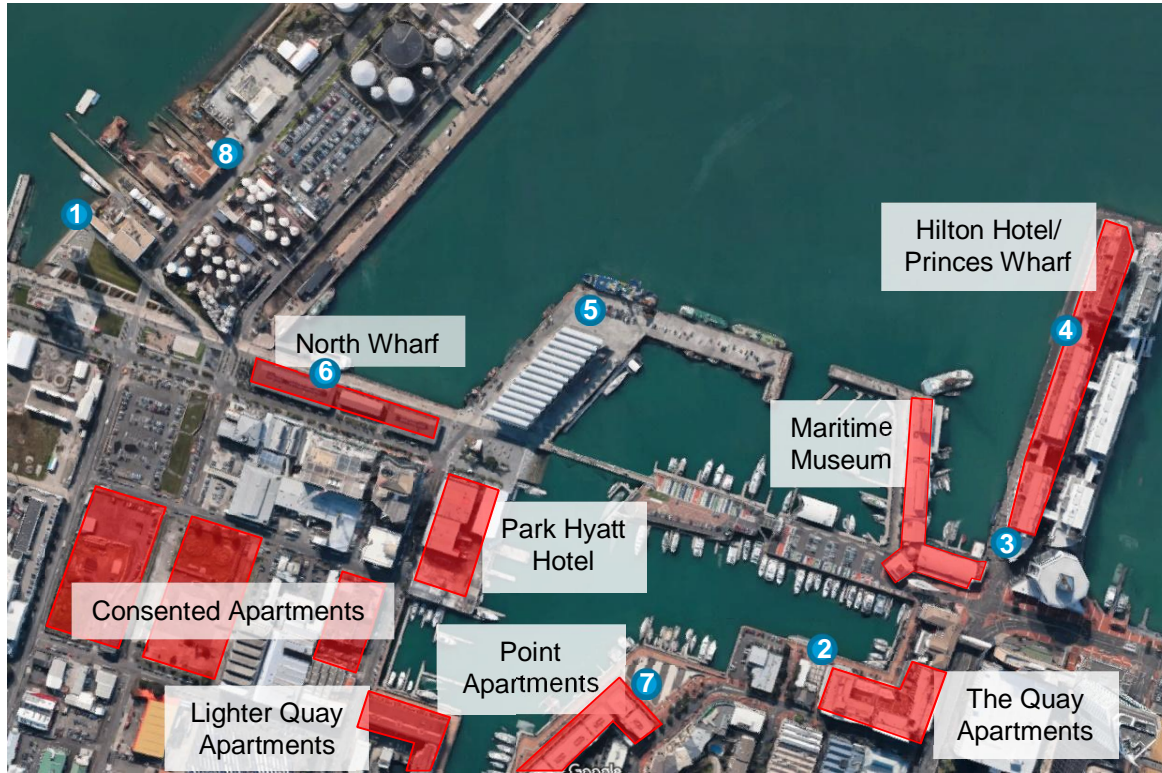


Figure 8-5: Noise sensitive receivers and monitoring locations

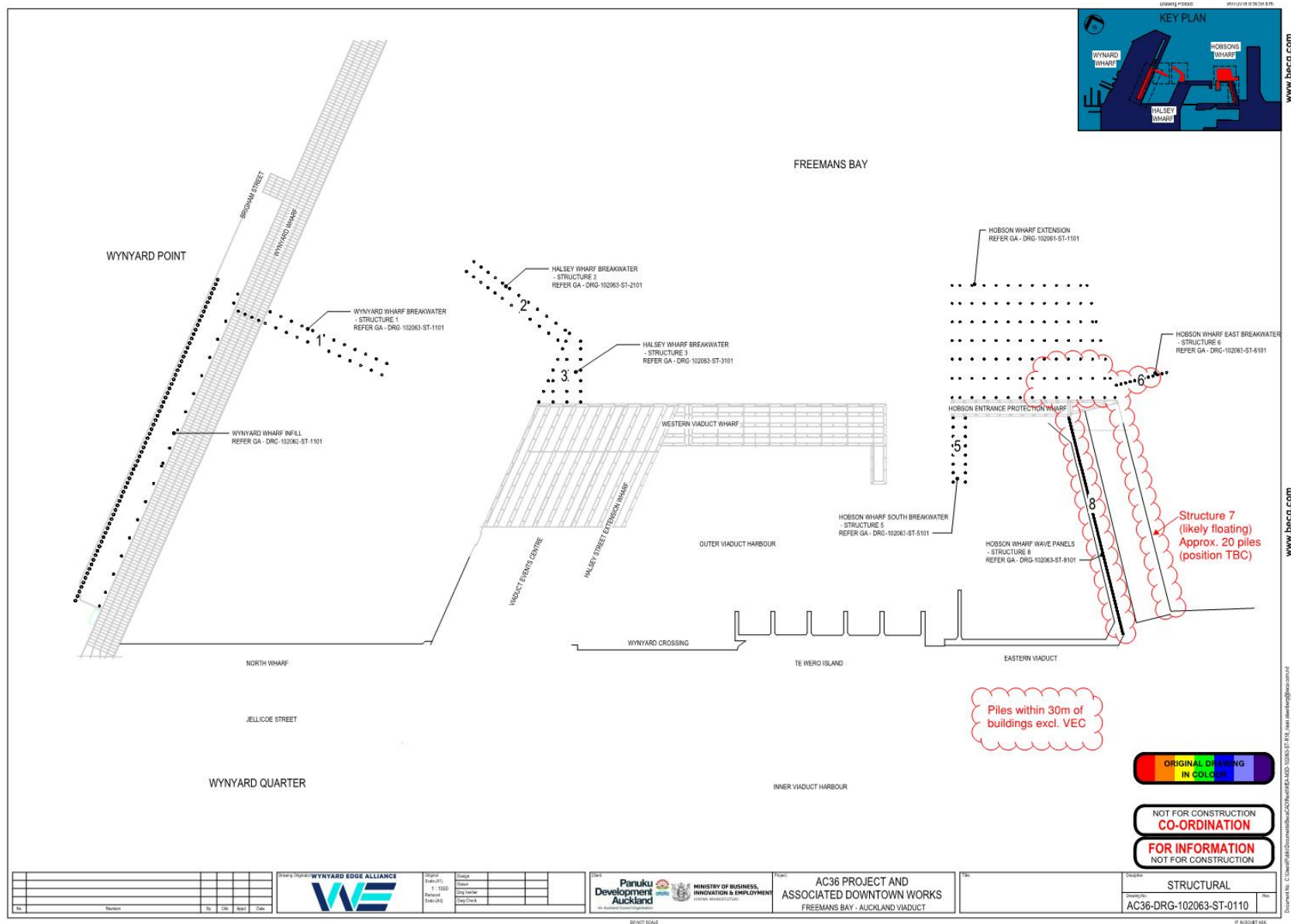


Figure 8-6: Noise sensitive receivers and monitoring locations

		Original Date (Y/M/D): 11/10/20 Revised Date (Y/M/D): Drawn: Design: Checked: Approved:			Project: AC36 PROJECT AND ASSOCIATED DOWNTOWN WORKS FREEMANS BAY - AUCKLAND VIADUCT	Drawing No.: AC36-DRG-102063-ST-0110 Title: STRUCTURAL
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Appendix C

Construction Noise Contours

Airborne construction noise contours:

- Figure 1: Hobson Wharf Impact Piling
- Figure 2: Halsey Wharf Impact Piling
- Figure 3: Wynyard Wharf Infill Impact Piling
- Figure 4: Hobson Wharf Structure 7 Bored Piling
- Figure 5: North Wharf Pontoon Vibro Piling

Underwater construction noise management zones:

- Figure 6: Hobson Wharf Impact Piling
- Figure 7: Halsey Wharf Breakwater 2 Impact Piling
- Figure 8: Wynyard Wharf Structure 1 Impact Piling



Key:

- Noise source
- Buildings
- Property boundary

Noise Level (dB LAeq) @ 1.5m above ground

55
60
65
70
75
80



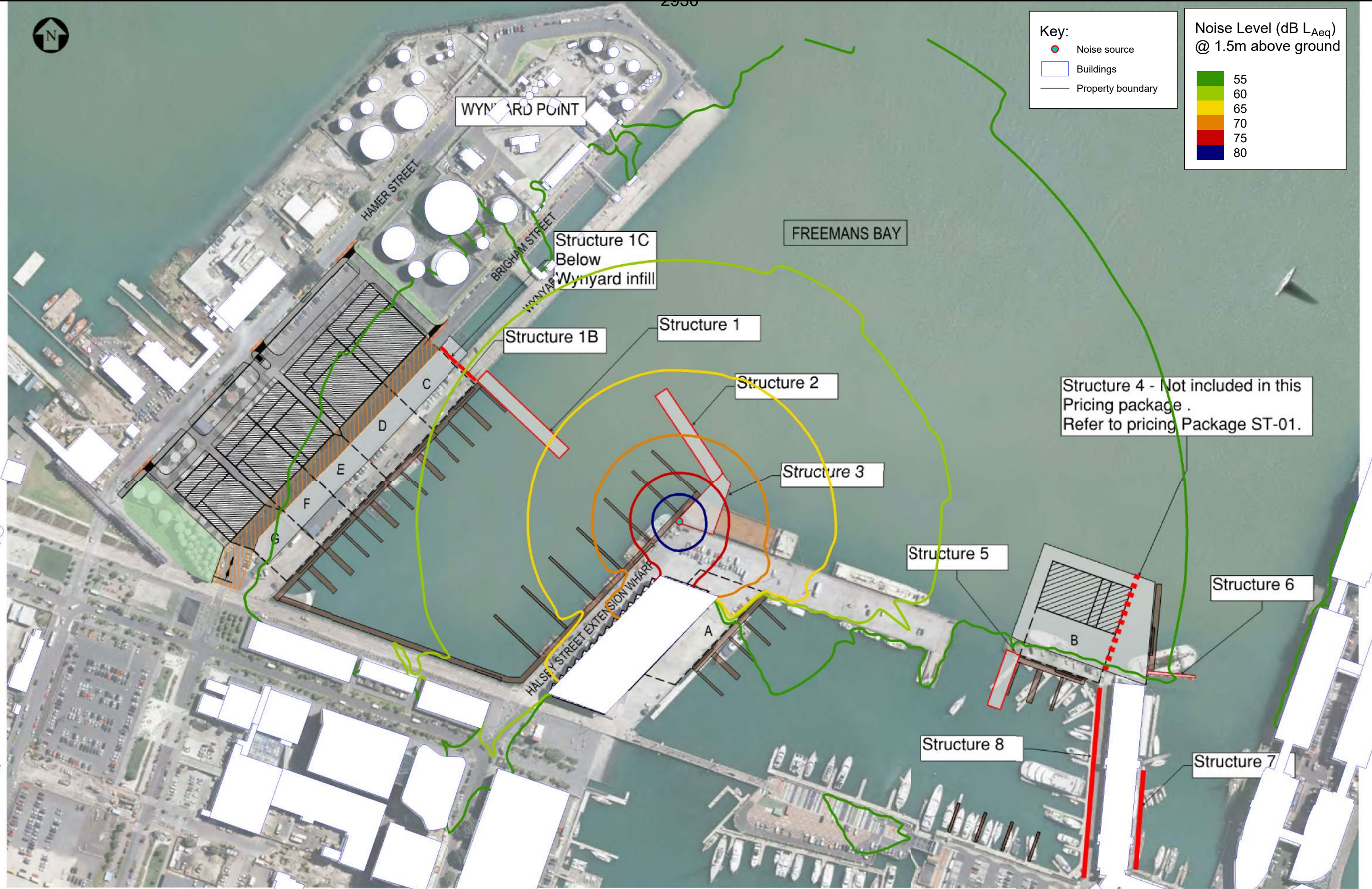


Key:

- Noise source
- Buildings
- Property boundary

Noise Level (dB L_{Aeq}) @ 1.5m above ground

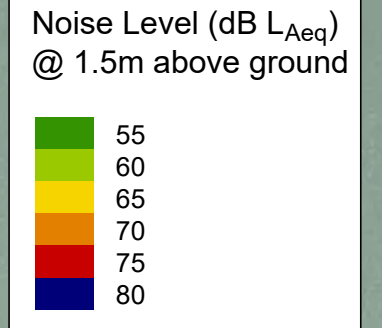
	55
	60
	65
	70
	75
	80

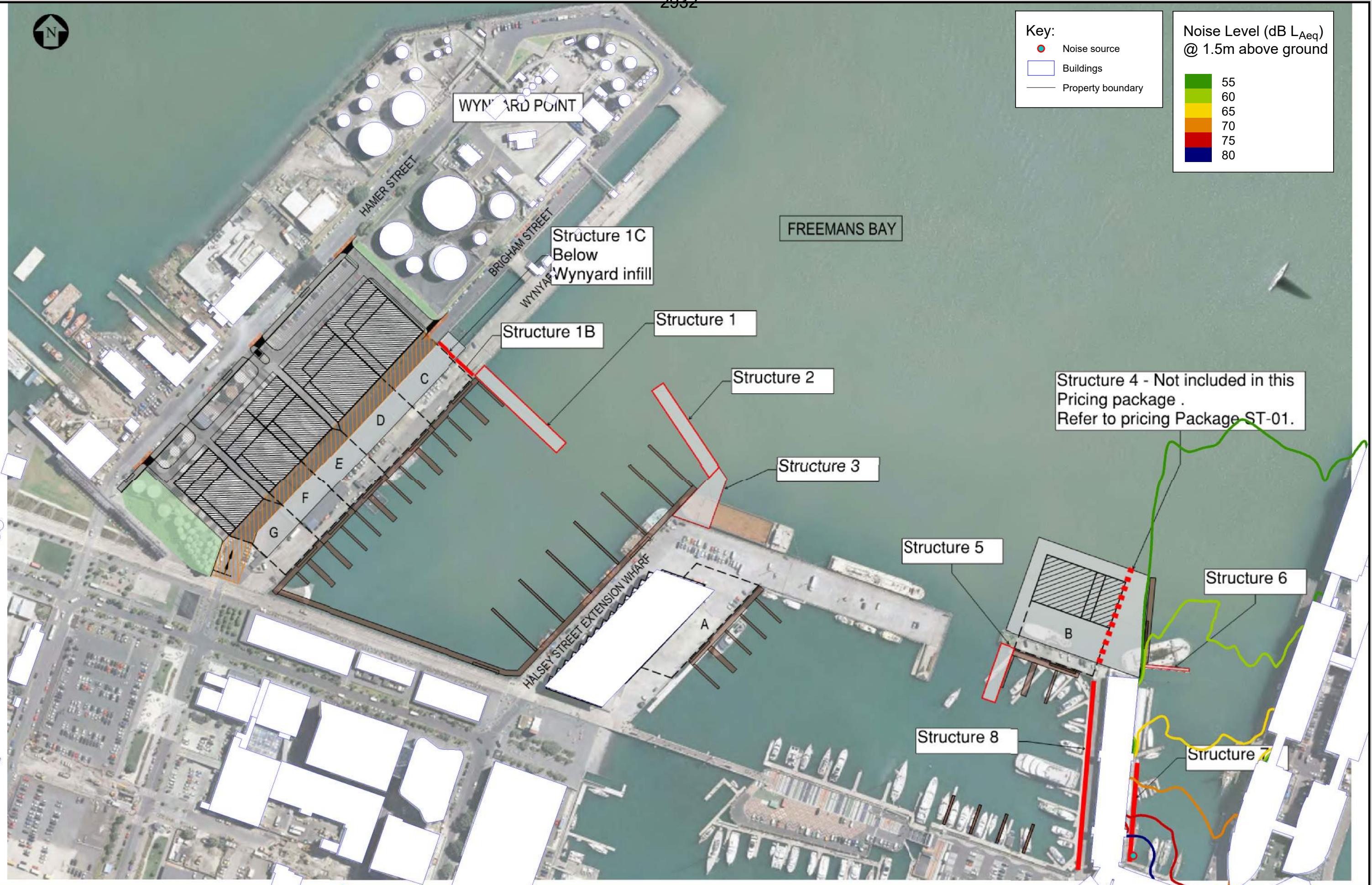




Key:

- Noise source
- Buildings
- Property boundary







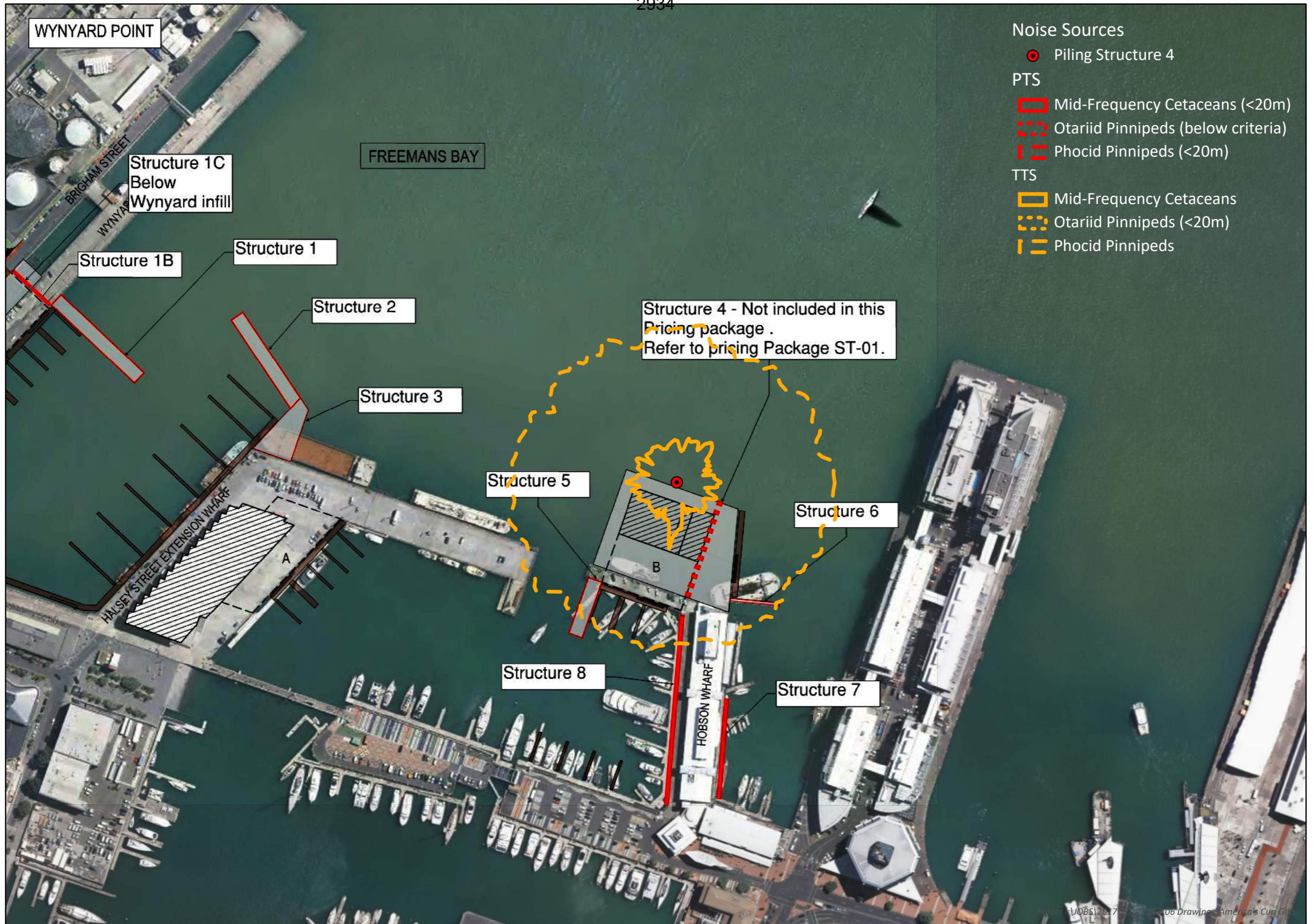
Key:

- Noise source
- Buildings
- Property boundary

Noise Level (dB LAeq) @ 1.5m above ground

55
60
65
70
75
80





Noise Sources

● Piling Structure 4

PTS

▭ Mid-Frequency Cetaceans (<20m)

▭ Otariid Pinnipeds (below criteria)

▭ Phocid Pinnipeds (<20m)

TTS

▭ Mid-Frequency Cetaceans

▭ Otariid Pinnipeds (<20m)

▭ Phocid Pinnipeds

Structure 4 - Not included in this Pricing package . Refer to pricing Package ST-01.

Power:\V0BS\2017-09\AC36 Drawings\America's Cup GIS

Noise Sources

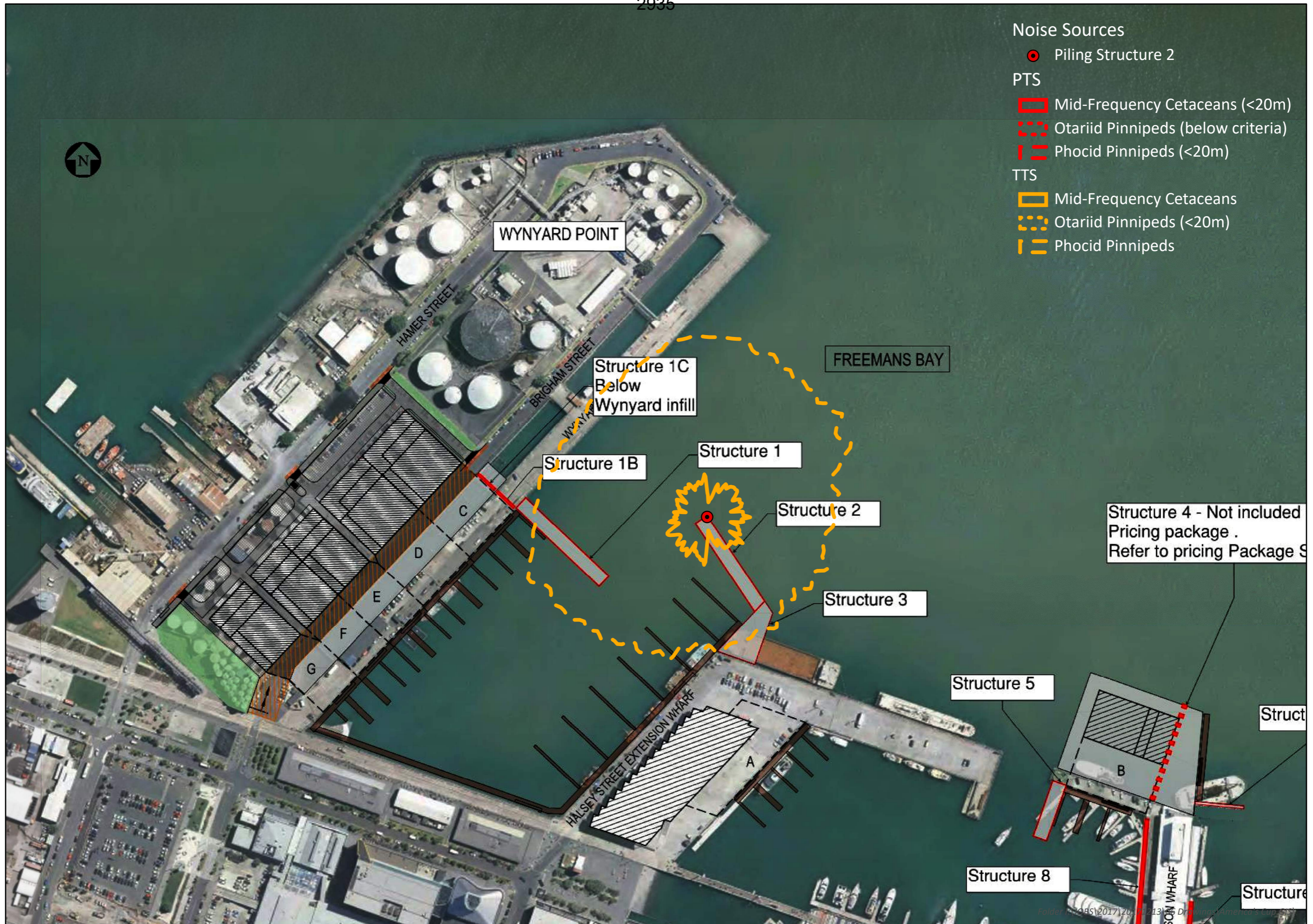
- Piling Structure 2

PTS

- ▭ Mid-Frequency Cetaceans (<20m)
- ▭ Otariid Pinnipeds (below criteria)
- ▭ Phocid Pinnipeds (<20m)

TTS

- ▭ Mid-Frequency Cetaceans
- ▭ Otariid Pinnipeds (<20m)
- ▭ Phocid Pinnipeds





- Noise Sources**
- Piling Structure 1
- PTS**
- ▭ Mid-Frequency Cetaceans (<20m)
 - ▭ Otariid Pinnipeds (below criteria)
 - ▭ Phocid Pinnipeds (<20m)
- TTS**
- ▭ Mid-Frequency Cetaceans
 - ▭ Otariid Pinnipeds (<20m)
 - ▭ Phocid Pinnipeds

AC36 - Underwater Management Zones
Figure 8: Structure 1 Impact Piling (1,200mm steel piles, 3 piles/day @ 50 strikes/pile)

Appendix D

Community Liaison Group
Feedback on the draft CTMP

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- Community Liaison Group Comments

Comments received from the CLG are as follows:

Date	CLG Member	Comment	Response
21 st August 2018	Lance Wiggs (resident)	General discussion about noisy activities and timing, particularly at night.	Discussed piling noise levels and timing, including commitment that there will be no impact piling and concrete cutting at night. Due to the distance to Mr Wiggs property and screening from other buildings, construction activities are predicted to comply with the noise and vibration standards at his apartment at all times.
		Mr Wiggs provided feedback that he considers that the night-time period defined in condition 109 should commence at 7pm, rather than 10.30pm.	Explained that the night-time period aligns with, or is slightly more restrictive than, other relevant AUP:OP rules applying in the Business City Centre Zone. Furthermore, examples of measures in the draft CNVMP were identified that prioritise high noise activities early in the daytime period where practicable. No changes are required to the CNVMP or conditions.
21 st August 2018	Lighter Quay Body Corporate (Peter Fuller)	General discussion about impacts on Lighter Quay residents.	Discussed piling noise levels and timing, including commitment that there will be no impact piling and concrete cutting at night. Due to the distance to the Lighter Quay apartments, construction activities are predicted to comply with the noise and vibration standards at their apartments at all times. No changes are required to the CNVMP or conditions.
21 st August 2018	ASB (Bernard Trevor).	General discussion about impacts on ASB building occupants.	Explained that a small number of fender piles are proximate to North Wharf. These will be timed during the morning to manage impacts on adjacent restaurants but are predicted to comply at ASB further away regardless. No changes are required to the CNVMP or conditions.
		Will there be noise management plan for events?	Yes, but this will be prepared post consent in accordance with the Event consent requirements.

<p>25 August 2018</p>	<p>James Gardiner (represents MacGregor Brothers Ltd who own and operate Rushworth Café on North Wharf)</p>	<p>Concern about timing of the vibro and impact piling proposed between 8 and 10am in front of North Wharf. As a café, this period represents their busiest and most sensitive time.</p>	<p>An emailed response was provided to Mr Gardiner on 28 August.</p> <p>In summary, a small number of pontoon and fender piles are proposed near Rushworth Café (refer Appendix B of the CNVMP). With respect to Section 3.2.1 of the CNVMP, each 310 UC or 600 – 700mm diameter steel pile would be vibrated into the mud over approximately 15min. The 8-10am timing was proposed to generally mitigate effects on restaurants (after 10am) and Hotels (before 8am). Consultation is required in advance of these works in accordance with Section 7.2 of the CNVMP, so there will be a further opportunity to discuss timing.</p> <p>No changes are required to the CNVMP or conditions.</p>
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