# CAIRNS SHIPPING DEVELOPMENT PROJECT

## Revised Draft Environmental Impact Statement

## APPENDIX AU: CSDP Impact Assessment Noise

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# Cairns Shipping Development Project

## Noise Impact Assessment

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**Prepared for:**

Flanagan Consulting Group

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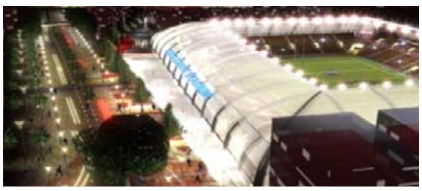

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# Contents

# Appendices

# 1. Introduction

## 1.1 Overview

ASK Consulting Engineers Pty Ltd (ASK) was commissioned by Flanagan Consulting Group to provide acoustic consultancy services to assess the impacts of the revised Cairns Shipping Development Project (CSD Project) for the Revised Draft Environmental Impact Statement (EIS). The project revision relates to a reduction in the quantity of material to be dredged from 4,400,000 $m^3$ to 1,000,000 $m^3$ in-situ material, and relocation of the dredge material placement area (DMPA) to land instead of sea. ASK previously provided the existing baseline acoustic constraints assessment as part of initial environmental values assessments for the revised EIS.

A brief overview of the elements of the overall CSD project which are relevant for the noise impact assessment is as follows:

- Dredge material is to be transported to the shore based Dredge Material Placement Areas (DMPAs) at the Northern Sands sand extraction operation on the Barron Delta, and two sites on Tingira Street, Portsmith.
- The soft clays are to be dredged via a 5,600$m^3$ capacity Trailer Suction Hopper Dredge (TSHD), discharging to a temporary floating pump-out facility between approximately 2.6 and 3.6 km NE of Yorkeys Knob.
- Soft clay dredge material will be pumped from the pump-out facility via a submerged steel pipeline, which will make landfall near the Richters Creek mouth, thence to the Northern Sands DMPA via cane farm headlands and Captain Cook Highway culverts.
- Due to the 8 km pipeline distance from pump-out to the NS DMPA, up to three pipeline booster pumps will be required, depending on TSHD pumping capacity.
- Tailwater at the Northern Sands DMPA is proposed to be discharge adjacent to site or pumped to an outfall at the Barron River highway bridge.
- Stiff clays are to be dredged by a backhoe dredger to split hopper barges for transport to the Tingira Street DMPA. The stiff clay DMPA will operate during daylight hours only. It is expected that the Northern Sands DMPA will operate 24 hours per day.

This noise impact assessment addresses:

- construction and decommissioning of the dredge material pipeline
- operation of the dredge material pipeline with respect to noise emissions from booster stations
- operation of the Northern Sands DMPA
- TSHD off-shore dredge pump-out
- wharf upgrade construction activities
- cruise ship wharf operation activities.

Other aspects of noise and vibration are being addressed by other parties and therefore are not assessed in this report. The aspects not considered in this assessment (addressed by others) include:

- noise from dredging (i.e. from the actual dredging process itself) is addressed in the Draft EIS (Ports North, 2014a and Ports North, 2014b). The salient aspects have been included in this report.
- impacts on the underwater noise environment (all areas)
- the effect of noise emissions on fauna.

To aid in the understanding of the terms in this report a glossary is included in **Appendix A.**

ACOUSTICS & AIR QUALITY

## 1.2 Study Team Details

**Table 1.1 Noise Assessment Study Team Details**

| Name | Relevant Experience | Role |
|---|---|---|
| Stephen Pugh | An ASK Director with 20 years relevant experience, Stephen has undertaken numerous noise impact assessments for EIS projects within multiple engineering sectors.<br>Stephen has local experience in Cairns, having undertaken the noise impact assessment for the EIS for the AQUIS project.<br>• Stephen is a Registered Professional Engineer of Queensland (RPEQ). Bachelor of Engineering (Mechanical)<br>• Member of Australian Acoustic Society<br>• Member of the Institute of Engineers Australia.<br>• Registered Professional Engineer of Queensland (RPEQ). | Technical review and guidance for the noise impact assessment (Technical Study 10 (TS10) Noise and Vibration). |
| Mitch Ryan | Mitch Ryan has more than 5 years experience in the fields of environmental noise and air quality. Mitch has undertaken noise and air quality impact assessments for numerous EIS projects in Queensland within the transport and extractive industry sectors.<br>Mitch has considerable knowledge of environmental noise, including both field monitoring and noise propagation modelling, in addition to significant knowledge in air quality dispersion modelling and emission inventory development.<br>• Bachelor of Engineering (Environmental)<br>• Bachelor of Science<br>• Member of Australian Acoustic Society<br>• Member of the Institute of Engineers Australia. | Principal author on the noise impact assessment (Technical Study 10 (TS10) Noise and Vibration). Responsible for undertaking the noise impact assessment and propagation modelling, undertaking the baseline environmental noise survey and field survey field of sensitive receptors. |
| Bill Elder | Bill Elder has 2 years experience as a graduate acoustic engineer.<br>Bill is experienced in environmental noise monitoring in accordance with the requirements of Queensland environmental noise policy.<br>• Bachelor of Engineering (Mechanical)<br>• Member of Australian Acoustic Society<br>• Member of the Institute of Engineers Australia. | Responsible for undertaking baseline environmental noise survey at Wharf Street and field survey of sensitive receptors at Tingira Street. |

# 2. Proposed Development

## 2.1 Project Definition

The objective of the Cairns Shipping Development Project (CSDP) is to accommodate larger cruise ships and a potential expansion of HMAS Cairns Navy Base through widening and deepening of the Cairns Shipping Channel and improvement of navigation and wharf facilities.

The channel design to be assessed in the Revised Draft EIS will involve the following elements (**Figure 2.1**):

- -8.8m Declared Channel depth
- Expanded Crystal Swing Basin to 380m
- Smith's Creek Swing Basin to 310m
- Outer Channel width 90 -100m
- Inner Channel width generally to 110m (outer bend to 180m)
- Further optimisation may occur at dredging contract negotiation stage.

The widening and deepening of the channel will be achieved via dredging. Soft clays within the channel will be dredged via a Trailer Suction Hopper Dredge (TSHD). Stiff clays within the channel will be dredged using a Back Hoe Dredge (BHD).

Soft clay dredge material will be transported to a shore based Dredge Material Placement Area (DMPA) via a constructed pipeline. Stiff clays will be transported to a different shore based DMPA via barge transfer.

The general activity areas of the project with respect to the dredge material pipeline and the soft clay DMPA (Northern Sands DMPA) are presented in **Figure 2.2**.

Further discussion of each of the activity areas with respect to noise is provided in the following sections.

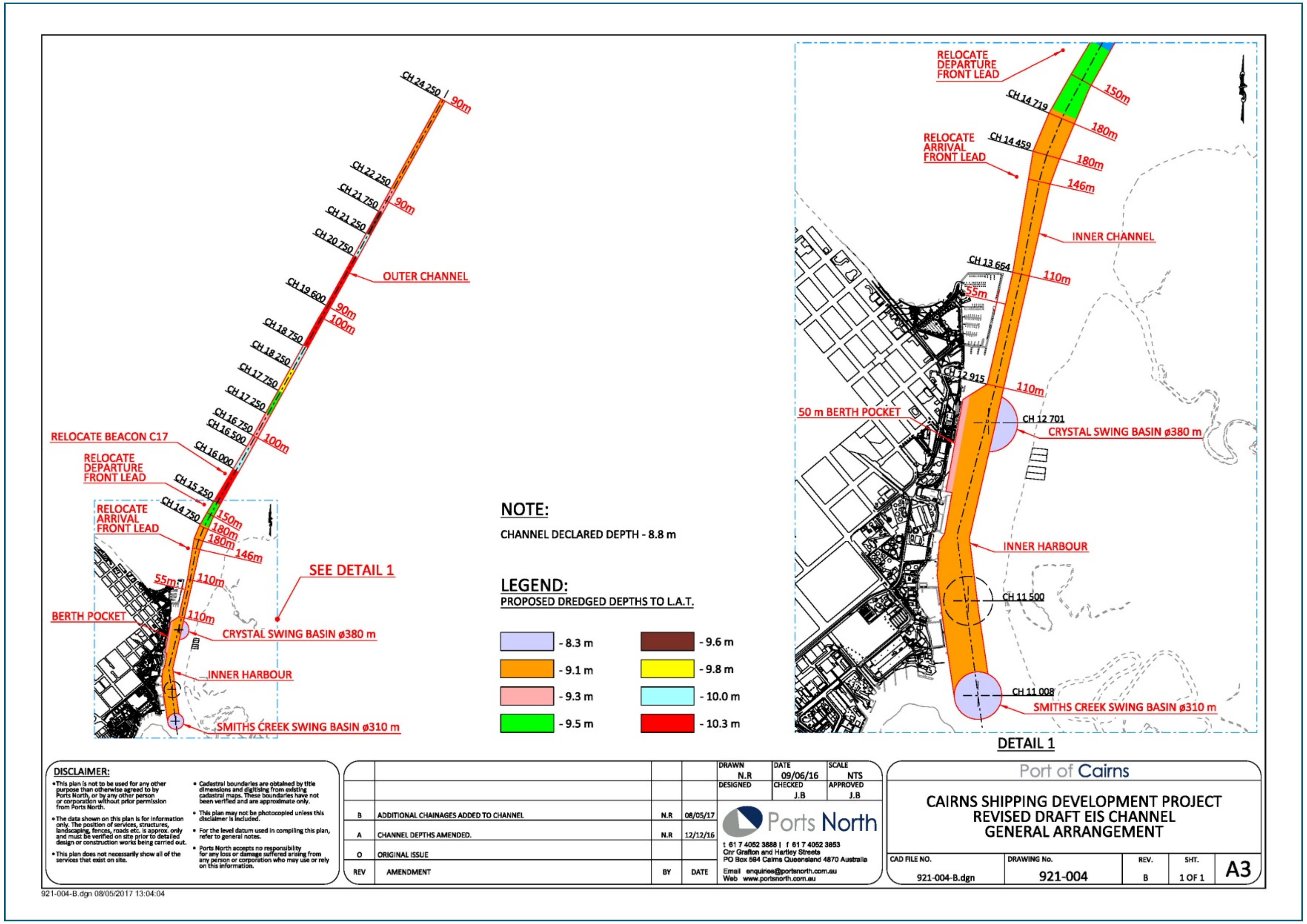


**Figure 2.1 Revised EIS Channel Arrangement**

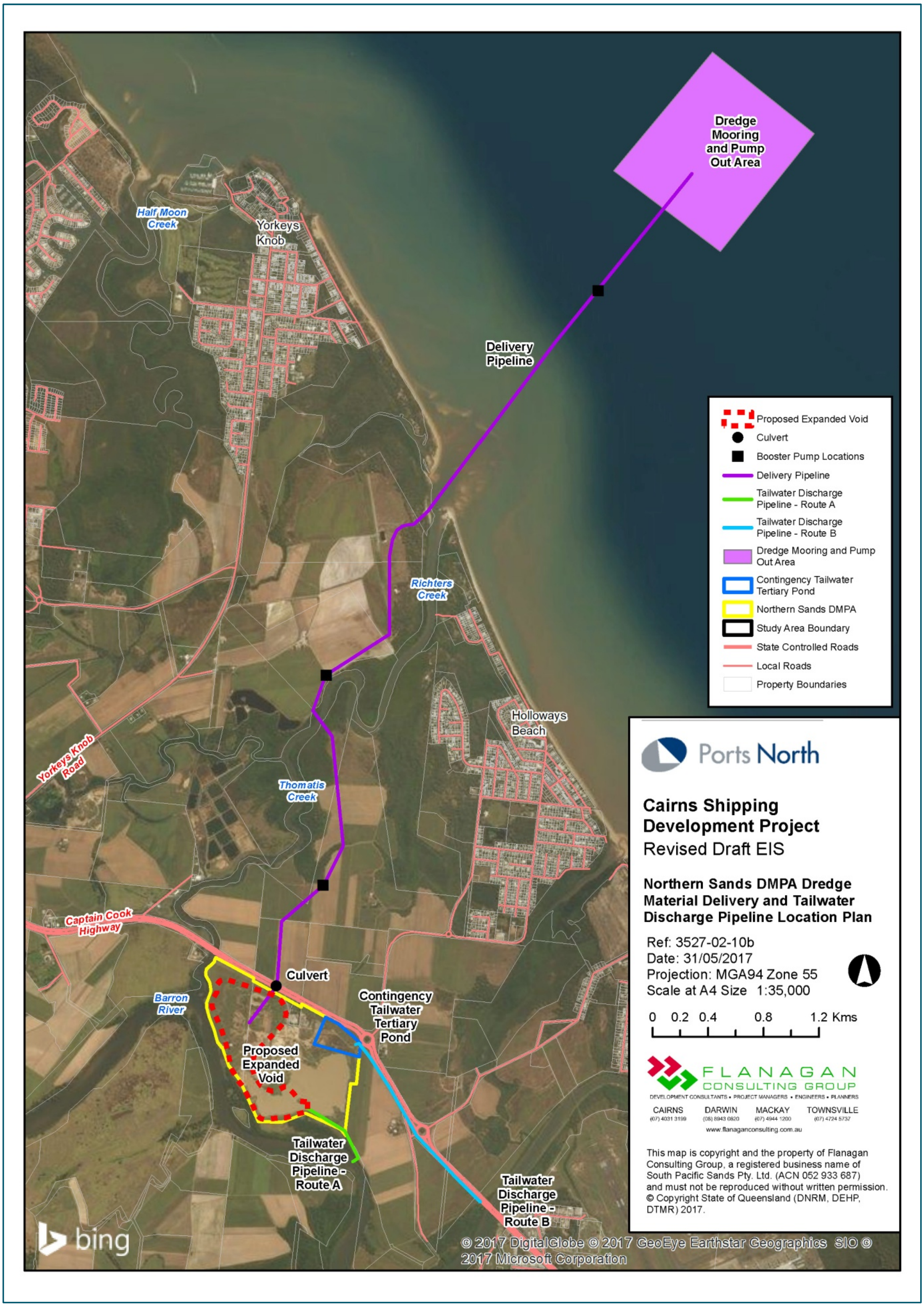


**Figure 2.2 Northern Sands Dredge Material Delivery and DMPA Layout**

## 2.2 Wharf Construction

An additional Intermediate Fuel Oil (IFO) storage tank, with a capacity of approximately 10,000 $m^3$ will be required within the existing fuel farm to store monthly deliveries from fuel ships via the existing fuel wharf 10. Fuel will be delivered from the storage tank to cruise ships via pump station and pipeline to wharves 1 to 5. According to project documentation, construction of the fuel storage and transfer infrastructure is likely to require:

- 35 – 80 tonne mobile crane
- ~20 tonne Franna crane
- 20 tonne excavator
- rigid dump trucks
- power generators
- welding equipment.

New water, firefighting and sewerage services are required for wharves 1 to 5. These will include replacement / extension of existing water mains and installation of a sewage pump station, underground storage tank and odour control system. Equipment required for the construction of these services may include:

- ~20 tonne Franna crane
- 20 tonne excavator
- rigid dump trucks
- concrete pump truck
- concrete delivery trucks.

Work required for the wharf upgrade includes installation of new berthing structures involving driving of piles and drilling of sockets into the seabed. The anticipated duration of construction works for the wharf is seven to eight months. The undertaking of this construction may require:

- 35 – 80 tonne mobile crane
- ~20 tonne Franna crane
- concrete pump truck
- power generators
- 7 dump/concrete delivery trucks per day intermittently.

The extent of the wharf and associated land-based construction works are shown in **Figure 2.3**. The extent of the upgrades for the fuel storage works is shown in **Figure 2.4**. The undertaking of this construction may require:

- mobile crane
- rigid dump trucks

An assessment of the noise emissions from the construction and operation of the upgraded wharf was undertaken by ARUP as part of the Draft EIS for the previous proposed version of the CSD Project.

As a detailed assessment has already been undertaken for this aspect, and as the construction methods and operational details for the wharf upgrade have not altered as part of the revised EIS, the assessment of this aspect is based on review of the original ARUP technical study. The review of the ARUP study has also included consideration of regulatory authority comments and new ambient monitoring which has been obtained since the ARUP assessment was completed.


**Figure 2.3 Extent of Wharf and Associated Land Works (Figure obtained from Draft EIS)**

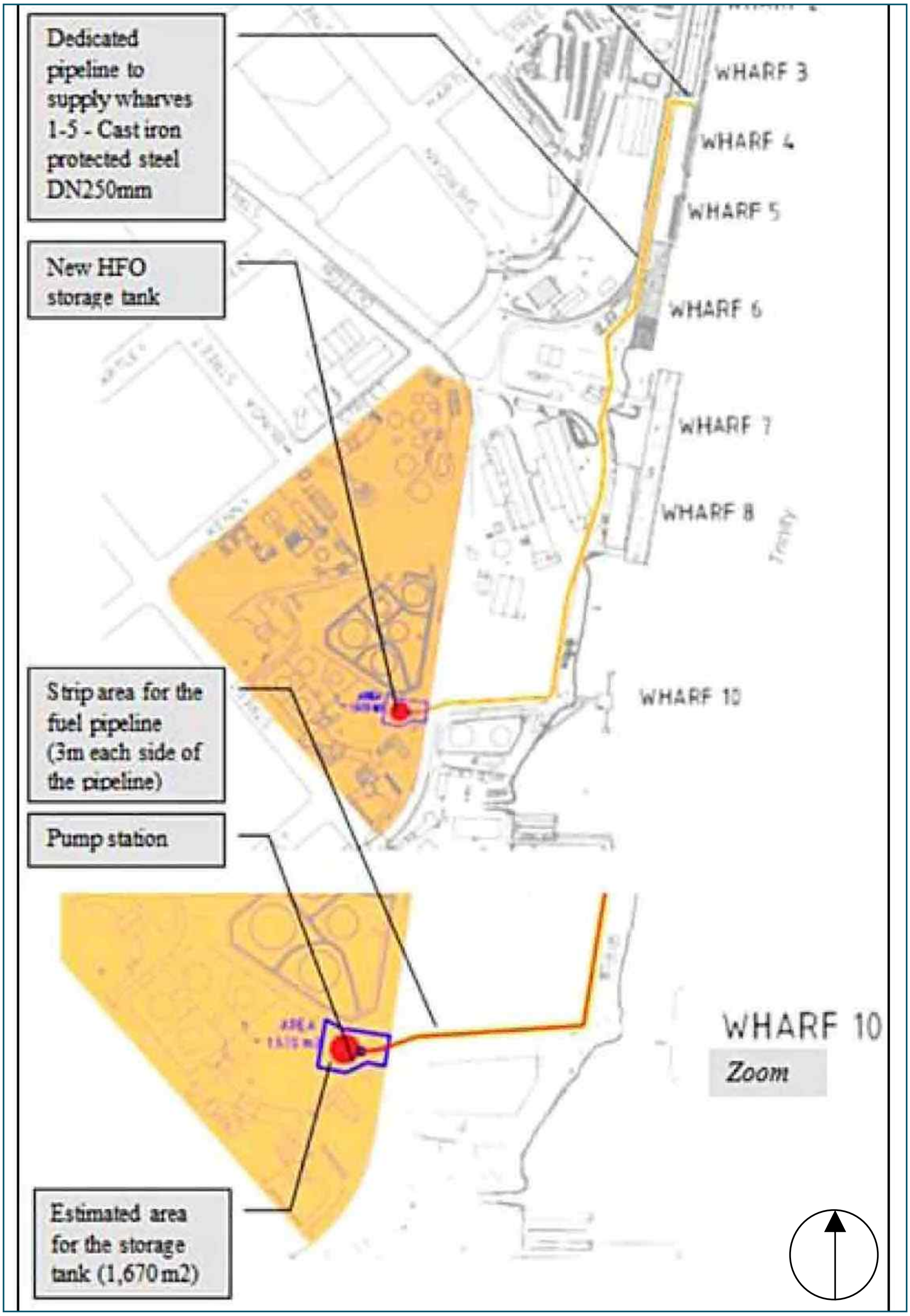


**Figure 2.4 Fuel Storage Works**

## 2.3 Wharf Operation

### 2.3.1 Existing Shipping Movements

For 2016, the scheduled total ship cruise visits to Cairns was 65 (as at 29 April 2016, AEC Group), with 40 of these scheduled to dock at the Trinity wharves.

Additional cargo ships are also received by the wharf, however these dock further south of sensitive receptor on Wharf Street, and cargo ship activity is not proposed to alter significantly and therefore noise from these ships has not been addressed.

Projections of ship visits (AEC Group, 2016) are provided in **Table 2.1** for the lowest baseline scenario (AEC scenario 1 without Brisbane Cruise Terminal and without home porting) and in **Table 2.2** for the highest with project scenario (scenario 16 with Brisbane Cruise Terminal and home porting and bunkering).

AEC provided low, medium and high projections for the years 2016, 2021, 2026 and 2031. For this assessment, the medium baseline and high project projections have been used. ASK has interpolated these linearly to obtain 2018 and 2028.

**Table 2.1 Projected Baseline (without the Project) (AEC Scenario 1) Cruise Ship Visits to Trinity Wharves**

| Classification | 2016 | 2018 | 2021 | 2026 | 2028 | 2031 |
|---|---|---|---|---|---|---|
| Sub-regal | 29 | 27 | 25 | 33 | 37 | 42 |
| Regal | - | 1 | 3 | 2 | 2 | 2 |
| Sun | 15 | 15 | 16 | 14 | 12 | 10 |
| Vista | - | - | - | - | - | - |
| Grand | - | - | - | - | - | - |
| **TOTAL** | **44** | **43** | **44** | **49** | **51** | **54** |

**Table 2.2 Projected Project (AEC Scenario 16) Cruise Ship Visits to Trinity Wharves**

| Classification | 2016 | 2018 | 2021 | 2026 | 2028 | 2031 |
|---|---|---|---|---|---|---|
| Sub-regal | 29 | 31 | 33 | 43 | 48 | 55 |
| Regal | - | 3 | 7 | 4 | 5 | 6 |
| Sun | 15 | 25 | 40 | 31 | 27 | 20 |
| Vista | - | 27 | 67 | 77 | 69 | 57 |
| Grand | - | 3 | 7 | 22 | 31 | 45 |
| **TOTAL** | **44** | **89** | **154** | **177** | **180** | **183** |

Regal cruise ship visits to Trinity Wharves for the baseline scenario as presented in Table 2.1 is recent data and these visits have not been taken into account in this assessment. However, the additional number of cruise ship visits are relatively minor and inclusion of these in the assessment would unlikely affect the conclusions of this report.

## 2.4 Dredging

### 2.4.1 Trailer Suction Hopper Dredge

The outer channel and parts of the inner port will be dredged using a Trailer Suction Hopper Dredge vessel (TSHD). The seabed material to be dredged in the outer channel comprises of very soft to soft clay and firm clay suitable for a TSHD. A TSHD may also be used to dredge the firm clays in the inner port although they are more likely to be removed by a back hoe dredger. Stiff clay in all locations will be dredged by a BHD.

A TSHD is a self-propelled, sea-going hydraulic dredger equipped with a hopper and dredging installations to fill and unload the hopper. The dredging takes place at the draghead on the seabed which is connected to a suction pipe to fill the hopper. One or two sets of suction pipes and dragheads, one on each side of the TSHD, are used when dredging. The dredging process and hopper filling takes place while the TSHD is sailing along the dredged areas. The TSHD would typically dredge at 1 to 3 knots then steam to and from the pump-out location at 6 to 9 knots.

For the project, widening of the navigation channel requires dredging in areas as shallow as about -2.0 m to -2.5 m CD. Therefore, a shallow draft TSHD is required, which still can comparatively hold large amounts of dredged material in the hopper and have enough power to dredge the firm clay. A medium-size TSHD of hopper capacity of about 5,500m$^3$ with suction pipe of 1.0 m diameter is proposed for the project. The loaded draft of the TSHD is in the order of 6 m to 7 m, therefore dredging has to be planned to commence at low tide at deeper areas and progress to shallow areas during high tide.

Material dredged by the TSHD will be placed at the Northern Sands Dredge Material Placement Area (NS DMPA), which is discussed further in **Section 2.5.1**.

The TSHD dredging process involves the following sequences:

1) Position TSHD at the dredging area.
2) Lower the suction pipe with draghead at the end.
3) Dredge at draghead and hopper filling simultaneously while sailing.
4) When the hopper is filled to its capacity, TSHD will sail to the off-shore load-out point.
5) At the load-out point the dredge will pump seawater into the hopper, diluting the solid material to a ratio of approximately 6:1 solid-to-liquid. The dredge then pumps the diluted slurry into the dredge material transfer pipeline.
6) The dredge material will be transferred via steel pipeline to the land based NS DMPA. The pipeline will include a series of booster pumps, potentially including an off-shore marine booster pump.
7) The TSHD sails back to the dredging area, and repeats the process.

The TSHD will operate 24 hours per day, seven days per week with the aim of more than 90 percent efficiency. In order to achieve full loads and minimise the number of dredging cycles and overall duration, operation of the dredge in controlled overflow mode will be required for part of the dredging campaign. Overflowing will only occur on approximately 50% of the dredge cycles and will typically be less than 3.5% of the time of an individual cycle

This assessment addresses noise emissions from the TSHD at the pump-out location. Noise emissions from TSHD dredging activity within the channel were undertaken as part of the Draft EIS which represent a conservative assessment of noise impacts for the revised project, given the significant reduction in required dredging duration.

### 2.4.2 Back Hoe Dredger (BHD)

The stiff and potentially the firm clays in the inner port will be dredged using a Back Hoe Dredger (BHD). Also, in addition to the firm and stiff clays, a BHD will be more efficient to dredge berth pockets, swing basins and other complex dredging areas. Therefore, a dredging fleet comprising BHD, barges and tug boats is also proposed for some areas of the inner port.

A BHD is a mechanical dredger, similar to an excavator which is mounted on a barge. A BHD is a stationary dredger anchored by three spud piles. It works by dredging the seabed using the bucket at the end of the excavator arm and placing the dredged material into a hopper barge which is moored alongside for disposal at the preferred dredge material placement area.

A medium-size backhoe dredger having installed power in the order of 700 to 1,000 kW with bucket capacity of about 5 $m^3$ to 11 $m^3$ is proposed for the project.

The BHD will be supported by two hopper barges of about 1,000 $m^3$ capacity towed by tug boats.

Material dredged by the BHD will be placed at the Tingira Street Dredge Material Placement Area (TS DMPA), which is discussed further in **Section 2.5.2**. Detailed assessment of noise emissions from the TS DMPA, including transport of material to the DMPAis presented in a separate report.

The dredging process of BHD will involve the following sequence:

(1) position BHD at the dredging area
(2) excavation using bucket fixed at the end of the excavator arm
(3) load the dredged material into a hopper barge or barge mounted skips moored alongside the BHD
(4) tug boat tows hopper barge when it is full to the Tingira Street DMPA
(5) barge mounted excavator(moored to shore) transfers material to off road haulage vehicles for short hauling then end dumping at placement site or transfer of skips to flat top haulage vehicles for dumping at placement site
(6) tug boat tow hopper barge back to the BHD.

The BHD will operate concurrently to the TSHD. The BHD will operate 24 hours a day, seven days per week at an anticipated efficiency of 60%. Based on these production rates it is expected the BHD campaign will require 5 weeks.

Noise emissions from back hoe dredging activity within the channel were undertaken as part of the Draft EIS, which represent a conservative assessment of noise impacts for the revised project, given the significant reduction in required dredging duration.

## 2.5 Dredge Material Placement Areas (DMPA)

### 2.5.1 Northern Sands Dredge Material Placement Area (NS DMPA)

The NS DMPA will be located on flat land in the Barron Delta, within the existing sand quarry (Northern Sands Pty Ltd), and within the same site as a Boral concrete batching plant.

The operation of the NS DMPA will consist of underwater placement of soft clay dredge material within the existing water filled quarry void, which will be bunded and enlarged to the north as part of future ‘business as usual’ quarry expansion plans, forming a total bunded placement area of 29.6 ha. The DMPA operations will be separated from ongoing sand extraction and construction and demolition waste disposal by a temporary clay lined rock wall.

The Northern Sands void holds permanent water, consisting primarily of groundwater and seasonally influenced stormwater runoff.

The Northern Sands DMPA will consist of the following elements:

- The capacity required during placement is 3,000,000 $m^3$. Material is expected to further consolidate with time to approximately 1,700,000 $m^3$.
- Perimeter bunding (to at least 100-year Flood immunity plus freeboard, 7.5 m AHD), will be constructed around the placement area as part of future ‘business as usual’ quarry expansion plans. This will be undertaken prior to channel dredging activities and is therefore not in the scope of this assessment.
- A temporary 9 ha tailwater treatment pond may need to be constructed depending on the outcome of further detailed design considerations.
- Tailwater is proposed to be discharged adjacent to site or pumped to an outfall at the Barron River Highway bridge. Tailwater pumps will potentially operate 24 hours per day, 7 days per week, in accordance with the dredging program.
- Dredged material will be delivered into the DMPA as a slurry through the dredged material pipeline. Coarser materials together with non-friable clay ‘balls’ that may form in the pipeline will drop out of suspension closer to the dredged material discharge location more quickly than the finer fractions which will take longer to settle out of suspension.
- The operation of the NS DMPA will not require mobile equipment (i.e. excavators, dozers, etc). The slurry will be distributed within the pond via a floating diffuser that will be able to be moved across the placement area using suspension lines to distribute the slurry. Based on nature of the material expected it should disperse fairly well on its own.

As the preparation of the DMPA (construction of earth bunding) will be undertaken by the quarry as part of 'business as usual' operations this activity is not within the scope of the CSD Project and therefore does not require assessment.

Based on the proposed operation method, the only significant noise source associated with the operation of the NS DMPA are the tailwater pumps. This report addresses noise emisisons from the tailwater pumps.

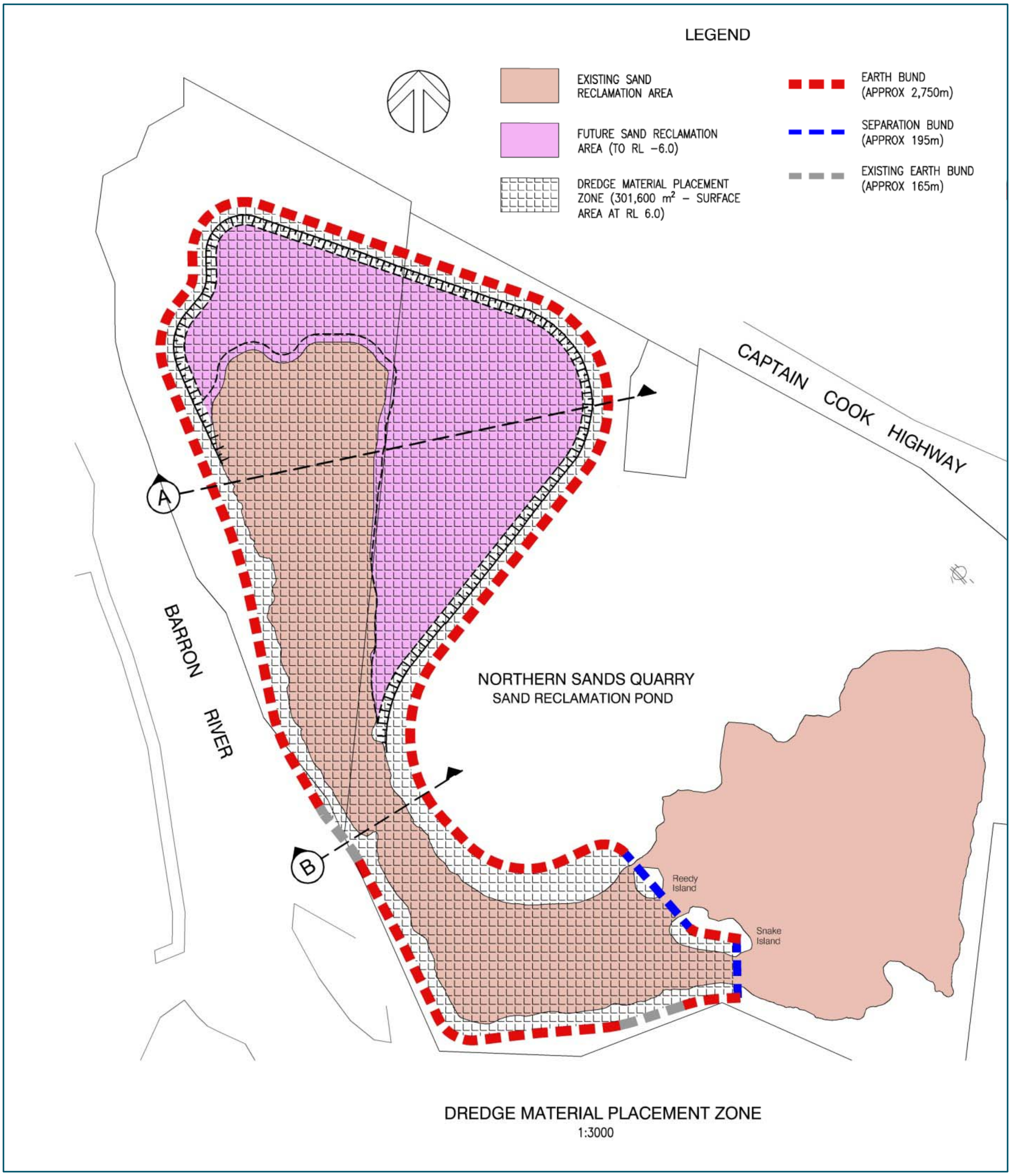


**Figure 2.5 NS DMPA Dredge Material Placement Zone and Bunding**

### 2.5.2 Tingira Street Dredge Material Placement Area (TS DMPA)

The Tingira Street DMPA (TS DMPA) will consist of two areas of port land previously reclaimed by Ports North at the southern end of Tingira Street, Portsmith. The site is located on the southern boundary of an industrial area within Strategic Port Land, abutting Smiths Creek to the east and a mangrove system to the west. The stiff clay dredge material will be placed as engineered fill over previously consolidated dredged material; this will improve the suitability of the area for future port activities. Material will be barged to the TS DMPA where it will be transferred by crane or excavators to heavy vehicles for short hauling to each placement area.

The TS DMPA will consist of two land parcels with a total area of approximately 5 hectares each serviced by a barge landing ramp. The northern barge loading ramp is existing whilst the southern ramp has been approved and is yet to be constructed.

Detailed assessment of noise emissions from the TS DMPA (dredge material receival area) is presented in a separate report (ASK 2017).

## 2.6 Dredge Material Pipeline

A dredge material pipeline is required to transport the dredged material (as a slurry) captured by the TSHD to the NS DMPA.

A section of the pipeline, between the off-shore TSHD load-out point and the shoreline, will be submerged. The submerged pipeline required for the Barron Delta DMPA site will be fabricated by welding pipe components together onshore into ‘strings’ between 300 m to 1,000 m long. Pipe strings will be capped with blank flanges to allow them to float and to be transported (towed) over water by multicat / tug.

A pipe fabrication yard is needed to allow the pipes strings to be welded together.

Once the pipe strings are fabricated the first string can be towed to the submerged pipeline location by multi-cat and/or tugs for connection to the onshore pipeline. It will then be partially submerged with the seaward end kept afloat for connection to the next pipe string. Each pipe string is connected to the next by either a ball joint or a bolted flange connection one at a time and is also partially submerged to wait for the next. The process is repeated until the submerged pipeline reaches its desired length, before it is finally connected to the riser which brings the pipeline to the surface.

The floating pipeline is mild steel pipeline encapsulated in floatation material which keeps it buoyant even when filled with seawater and/or dredged material. It is fabricated onshore to the desired length and towed into position and provides the link between the riser and the TSHD at the pump-out station.

The onshore pipeline will require a construction corridor and road access along the length of its route. The corridor needs to be of sufficient width to allow for delivery of the pipe by truck, the unloading and installation of pipe components, and vehicle access for inspection and maintenance throughout the dredging program. The on-shore pipeline will be constructed from mild steel and is anticipated to be 1 metre in diameter.

The pipeline corridor that is constructed will be of sufficient width (i.e. between 7 m – 10 m) to allow side by side unloading and placement by excavator. The onshore pipeline is joined by bolted, flanged connections and the pipe is seated on discrete earthen mounds of sufficient height to stabilise the pipe and to just elevate the flanges above ground.

The construction of the pipeline is anticipated to be undertaken with the support of two 40 tonne excavators, two dozers (CAT D8) and welding equipment.

In addition to the construction of the pipeline, excavation work will also be required to cut the sandbar at the Barron River mouth at Yorkeys Knob. Sandbar cutting will be undertaken using the two 40 tonne excavators. Sandbar cutting is anticipated to require in the order of up to a week to complete.

The required length of the material pipeline is approximately 8 kilometres, including approximately 5 kilometeres onshore.

Construction (establishment) and decommissioning of the pipeline is anticipated to each require approximately 6 weeks (i.e. 6 weeks for establishment, 6 weeks for decommissioning).

## 2.7 Pipeline Booster Stations

A booster pump is a very large, portable pump which is connected into the dredge pipeline to boost pumping pressure. Multiple booster stations can be connected in series when required, and they can be either land based or located offshore on barges.

Booster pump stations will be required along the length of the dredge material pipeline. At the current time it is anticipated that up to three booster pumps will be required, with two of these being land based and a possible pump located off-shore (floating).

Floating booster stations are barged mounted and are towed to position before they are anchored to the seafloor. The booster pump station is connected either side to small lengths of floating line which are linked to the submerged line by risers.

Land based booster stations are delivered by road transport and sufficient access needs to be maintained at all times to allow inspections, maintenance and refuelling.

Some land based booster stations need to be located close to a suitable water source which can supply and receive large quantities of service water (for gland flushing) and in some cases for engine cooling water. Gland water leaves the system via the dredged pipeline along with the dredged material. Depending on the type of pump selected by the contractor, cooling water may or may not be required. If cooling water is required, a small reticulation pond can be established to recycle the water in a closed system to minimise demand and avoid releases to the environment.

The current proposed location of the booster pumps is shown in **Figure 4.2**. It is noted that the exact location and number of booster pumps will be determined by the contractor, and therefore the location of the booster pumps is subject to change. Noise emissions from the booster stations have been addressed in this report based on the information available to date.

## 2.8 Anticipated Construction Timeframes and Hours

The anticipated construction timeframes and hours are summarised in **Table 2.3**.

**Table 2.3 Anticipated Construction Timeframes**

| Activity | Duration | Hours of Construction/Operation |
|---|---|---|
| Establishment and Decommissioning of Northern Sands DMPA | Up to 6 Weeks (per phase) | Daylight only (anticipated 6:30 am to 6:30 pm). |
| Dredging (TSHD and BHD) | 12 Weeks | 24 hours/7 days per week. |
| Operation of NS DMPA and TS DMPA | Up to 12 Weeks | Attended during day and night shifts (exact times to be confirmed). Tailwater pump to operate intermittently over a 24/7 period in accordance with TSHD cycles. |
| Wharf Upgrade and Associated Land-side Infrastructure Works | 7 to 8 Months | 6:30am to 6:30pm Monday to Saturday. Some other construction activities that do not generate significant noise may continue on Sundays. |

ACOUSTICS & AIR QUALITY

# 3. Acoustic Criteria

## 3.1 Overview

The objective of this report is to assess noise emissions from the construction and operational (wharf operation) phases of the CSD Project. This section presents acoustic criteria relevant to these aspects.

## 3.2 Terms of Reference

The Terms of Reference (ToR) for the Project refers to the following documents:

- Environmental Protection (Noise) Policy 2008 (EPP (Noise))
- Noise Measurement Manual (formerly Environment Protection Agency, now Department of Heritage and Environmental Protection)
- Guideline: Planning for Noise Control (formerly Environment Protection Agency, now Department of Heritage and Environmental Protection).

The (EPP (Noise)) contains Acoustic Quality Objectives which can be used as noise limits for assessment of operational noise emissions from the wharf. The Acoustic Quality Objectives are presented in **Section 3.3.1**.

The Planning for Noise Control Guideline (PNCG) also includes methods for determining noise limits for assessment. These noise limits are considered applicable for the assessment of operational noise. The PNCG noise limits were applied by ARUP (Section D.7.6.1.1 of Appendix D.7 of the Draft EIS) for the previous assessment of wharf operation noise. The PNCG limits are introduced in this section, but discussed in further detail in **Section 8.3.2**.

Noise monitoring undertaken for the CSD Project was undertaken in accordance with the EHP Noise Measurement Manual.

## 3.3 Operational Noise Criteria

### 3.3.1 Environmental Protection (Noise) Policy

**Overview**

In respect of the acoustic environment, the object of the Environmental Protection Act (1994) is achieved by the Environmental Protection (Noise) Policy 2008 (EPP (Noise)). This policy identifies environmental values to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment.

The acoustic criteria prescribed by the EPP(Noise) is considered applicable for the assessment of noise from the operation of the wharf. It is not considered strictly applicable for the assessment of construction noise, however it is useful in providing an indication of the noise level at which sensitive receptors may be impacted.

**Acoustic Quality Objectives**

The EPP (Noise) contains a range of acoustic quality objectives for a range of receptors. The objectives are in the form of noise levels, and are defined for various periods of the day, and use a number of acoustic parameters.

Schedule 1 of the EPP(Noise) includes the following acoustic quality objectives to be met at residential dwellings:

- Outdoors
  - Daytime and Evening: 50 dBA $L_{Aeq,adj,1hr}$, 55 dBA $L_{A10,adj,1hr}$ and 65 dBA $L_{A1,adj,1hr}$
- Indoors
  - Daytime and Evening: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$
  - Night: 30 dBA $L_{Aeq,adj,1hr}$, 35 dBA $L_{A10,adj,1hr}$ and 40 dBA $L_{A1,adj,1hr}$

In the DEHP Planning for Noise Control Guideline (PNCG) documentation it is proposed that the noise reduction provided by a typical residential building façade is 7 dBA assuming open windows. That is, with an external noise source, a 7 dBA reduction in noise levels from outside a house to inside a house is expected when windows are fully open. Thus the indoor noise objectives noted above could be converted to the following external objectives (with windows open):

- Daytime and Evening: 42 dBA $L_{Aeq,adj,1hr}$, 47 dBA $L_{A10,adj,1hr}$ and 52 dBA $L_{A1,adj,1hr}$
- Night: 37 dBA $L_{Aeq,adj,1hr}$, 42 dBA $L_{A10,adj,1hr}$ and 47 dBA $L_{A1,adj,1hr}$

A sensitive receptor is defined as “an area or place where noise is measured”.

The EPP(Noise) states that the objectives are intended to be progressively achieved over the long term.

The acoustic quality objectives do not take into consideration the existing noise environment and therefore may not be applicable for areas that are particularly quiet or particularly noisy.

### 3.3.2 EcoAccess Guidelines

**EcoAccess – Planning for Noise Control**

DEHP Planning for Noise Control Guideline (PNCG) contains procedures and methods that are applicable for setting conditions relating to noise emitted from industrial premises for planning purposes. The guideline is applicable to noise from all sources, individually and in combination, which contribute to the total noise from a site. The noise limits derived for the project using the PNCG limits are discussed further in **Section 8.3.2**.

**Control and Prevention of Background Creep**

The PNCG procedure takes into account three factors: firstly, the control and prevention of background noise creep in the case of a steady noise level from equipment such as caused by ventilation fans and other continuously operating machinery; secondly, the containment of variable noise levels and short-term noise events such as those caused by forklifts and isolated hand tools to an acceptable level above the background noise level; thirdly, the setting of noise limits that should not be exceeded to avoid sleep disturbance.

For CSDP, the noise sources associated with operation of the development will consist of additional discrete ship visit events (over and above the existing ship visit events associated with current operation of the Port of Cairns). Hence ARUP proposed in the Draft EIS that the implementation of the CSDP will not result in permanent increases to the background noise level at surrounding receptors, and therefore the “background noise creep” criteria are not addressed. This approach is discussed further in **Section 8.3.2** of the report.

**Sleep Disturbance Criteria**

The World Health Organization (WHO) issued its “Guidelines for Community Noise” in April 1999. The WHO guideline states the following in regard to sleep disturbance from continuous noise from activities such as mining operations:

"Where noise is continuous, the equivalent sound pressure level should not exceed 30 dBA indoors, if negative effects on sleep are to be avoided. When noise is composed of a large proportion of low-frequency sounds a still lower guideline value is recommended, because low-frequency noise (eg from a ventilation system) can disturb rest and sleep even at low sound pressure levels."

The EcoAccess Guideline "Planning for Noise Control", in referring to the World Health Organisation guidelines, makes the following general recommendation regarding short term transient noise events:

"As a rule in planning for short-term or transient noise events, for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dBA maxLpA more than 10 to 15 times per night."

For less regular night events, the allowable internal noise level is higher, as follows:

- Approximately 3 events per night: 50 dBA $L_{max}$.
- Approximately 1 event per night: 55 dBA $L_{max}$.

Note: For the purpose of this assessment the $maxL_{pA}$ level is defined using the $L_{max}$ descriptor.

The WHO guideline states the following in regard to annoyance response to community noise:

"Annoyance to community noise varies with the type of activity producing the noise. During the daytime few people are seriously annoyed by activities with $L_{Aeq}$ levels below 55 dBA; or moderately annoyed by $L_{Aeq}$ levels below 50 dBA. Sound pressure levels during the evening and night should be 5 – 10 dBA lower than during the day. Noise with low frequency components requires even lower levels."

DEHP propose that the noise reduction provided by a typical residential building façade is 7 dBA assuming open windows. Thus the indoor noise objectives noted above could be considered external objectives (with windows open) with the appropriate correction.

The criteria are summarised in **Table 3.1**.

**Table 3.1 Summary of WHO Sleep Disturbance and Annoyance Criteria**

| Descriptor | Number of Noise Events | Indoor Criterion dBA | Equivalent Outdoor Criterion dBA | |
|---|---|---|---|---|
| | | | Doors/Windows Open | Doors/Windows Closed |
| Sleep Disturbance (Short Duration Events) | 10 – 15 | $L_{max}$ 45 | $L_{max}$ 52 | $L_{max}$ 65 |
| | 3 | $L_{max}$ 50 | $L_{max}$ 57 | $L_{max}$ 70 |
| | 1 | $L_{max}$ 55 | $L_{max}$ 62 | $L_{max}$ 75 |
| Sleep Disturbance (Continuous Noise) | Continuous | $L_{eq}$ 30 | $L_{eq}$ 37 | $L_{eq}$ 50 |
| Annoyance (Night Time) | Continuous | $L_{eq}$ 35 | $L_{eq}$ 42 | $L_{eq}$ 55 |

Note: The outdoor criteria with doors/windows open are based on a DEHP EcoAccess nominated outdoor-to-indoor noise reduction of 7 dBA for noise transmission through a facade with an open window. The outdoor criteria with doors/windows closed are based on an outdoor-to-indoor noise reduction of 20 dBA as it typically expected for standard modern dwelling construction

It is noted that it is not unusual for these sleep disturbance noise limits to be exceeded by common noise sources such as road traffic or other transport infrastructure. Therefore alternate sleep disturbance noise limits, which are higher than those presented in **Table 3.1**, may be considered justifiable and able to be applied for this project in those instances.

The duration of works (anticipated to be approximately 6 weeks for pipeline installation, 10 weeks for dredging, and 4 to 6 weeks for decommissioning) should also be taken into consideration when determining appropriate noise limits.

## 3.4 Construction Noise

### 3.4.1 Environmental Protection Act

In Queensland, the environment is protected under the Environmental Protection Act 1994. The object of the Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

This legislation refers to noise as including *"vibration of any frequency, whether emitted through air or another medium"* and thus includes underwater noise.

The Act states a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm. This is termed the 'general environmental duty'. Environmental harm is defined as any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance. Environmental nuisance is unreasonable interference or likely interference with an environmental value caused by noise or vibration.

The following noise sources are excluded from the Act – audible traffic signals, warning signals for railway crossings, safety signals from reversing vehicle, operating a ship, aircraft, public and state controlled roads, busway, light rail, rail, and non-domestic animals.

This Act refers to the Environmental Protection Policies as being subordinate legislation to the Act.

The Act describes a number of offences relating to noise standards, including building work, regulated devices (e.g. power tools), pumps, air-conditioning equipment, refrigeration equipment, indoor venues, outdoor events, amplifier devices other than at indoor venue or open-air event, power boat sports in waterway, operating power boat engine at premises, blasting, and outdoor shooting ranges. The relevant standard for building work is presented below.

**440R Building Work**

(1) A person must not carry out building work in a way that makes an audible noise—

(a) on a business day or Saturday, before 6.30a.m. or after 6.30p.m; or

(b) on any other day, at any time.

(2) The reference in subsection (1) to a person carrying out building work—

(a) includes a person carrying out building work under an owner-builder permit; and

(b) otherwise does not include a person carrying out building work at premises used by the person only for residential purposes.

### 3.4.2 Discussion of the Environmental Protection Act

As discussed in **Section 3.4.1**, legislative requirements with respect to construction noise impacts in Queensland only relate to the restriction of the hours of work for construction sites which produce audible noise at a noise sensitive receptor.

For a major project such as CSD Project, work during the restricted hours may be necessary for reasons of public safety or to minimise disruption to essential services.

Dredging is proposed to occur 24 hours per day, while piling is proposed to be restricted to the standard hours wherever possible.

Accordingly, it is important to adopt a procedure for managing noise impacts from construction of CSDP both during standard construction hours and outside standard hours, since it is not feasible to undertake dredging activities entirely during standard hours.

In the absence of State noise criteria, the NSW Interim Construction Noise Guideline (ICNG) (NSW DECC, 2009) has been adopted as noise level targets however they are not considered prescriptive.

#### 3.4.3 NSW Interim Construction Noise Guideline (ICNG)

The noise level targets adopted for the assessment of noise impacts from construction have been taken from the NSW Interim Construction Noise Guideline (ICNG) (NSW DECC, 2009). These noise level targets were adopted as legislative requirements in Queensland and are based on limiting hours of construction rather than nominating discrete noise limits.

The ICNG provides recommended noise levels for airborne construction noise at sensitive land uses. The guideline provides construction managers with noise levels above which all feasible and reasonable work practices should be applied to minimise the construction noise impact.

The ICNG sets out management levels for noise at sensitive receptors, and how they are to be applied. Management levels are based on the existing background noise levels in the absence of construction activity (represented by the Rating Background Level (RBL) parameter).

The management levels from the ICNG are presented in **Table 3.2**.

For out-of-hours work, the ICNG nominates a noise level 5 dB above the rating background level (RBL) as the noise affected level to represent a threshold where the proponent should negotiate with the community.

It is important to note that the ICNG targets are not noise limits as such, but screening criteria for assessing whether construction noise is likely to have adverse impacts and hence whether “feasible and reasonable” work practices should be implemented during the construction process in order to reduce noise levels.

**Table 3.2 ICNG Management Level for Airborne Construction Noise at Residences**

| Time of Day | Management Level $L_{eq}$(15 minute) dBA | How to Apply |
|---|---|---|
| Recommended standard hours:<br>Monday to Saturday<br>6:30 am to 6:30 pm<br>No work on | Noise affected<br>RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq}$ (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>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. |

| Time of Day | Management Level $L_{eq}$(15 minute) dBA | How to Apply |
|---|---|---|
| Sundays or Public Holidays | Highly noise affected<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noise activities can occur, taking into account:<br>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).<br>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<br>RBL + 5 dB | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. |

# 4. Sensitive Receptors

Sensitive land uses are defined in the State Planning Policy (2014) as caretakers accommodation, child care centre, community care centre, community residence, detention facility, dual occupancy, dwelling house, dwelling unit, educational establishment, health care services, hospital, hotel, multiple dwelling, non-resident workforce accommodation, relocatable home park, residential care facility, resort complex, retirement facility, rooming accommodation, rural workers accommodation, short-term accommodation or tourist park.

A summary of the nearest sensitive receptors are presented in **Table 4.1** including their northing and easting locations and are shown in **Figure 4.1** to **Figure 4.3**. All of the receptors listed in **Table 4.1** are existing residential dwellings (houses or units) with the exception of Receptor J which is an educational centre, Receptor S which is a residential dwelling currently under construction, and Receptor I which are boat moorings.

Boat berths (Receptor I) where permanent pylons are provided for mooring are considered sensitive locations under the definition of relocatable home park. It is understood that Ports North control the lease of these mooring pylons, and that during construction activity (including dredging), that Ports North may limit the use of boat moorings to prevent the potential for noise impacts to these receptors. Therefore the receptors have been identified in this report for completeness, but have not been considered in the noise assessment as they may not be present during construction activity. The operation of the wharf, with respect to impacts onto the boat moorings, is not considered to require assessment based on the nature of these moorings.

It is noted that not all sensitive receptors near the project areas are identified within **Table 4.1**, but a selection of receptors which indicates the location and spatial distribution of receptors, and accurately represents the potentially worst affected receptors for the different project areas.

As discussed in **Section 5.2**, the presence of sensitive receptors was considered in the selection of noise monitoring locations utilised for this constraints assessment.

**Table 4.1 List of Sensitive Receptors with UTM Coordinates (WGS84 Z55)**

| ID | Name / Address | Real Property Description | Easting (m) | Northing (m) |
|---|---|---|---|---|
| **Near Cairns Wharf** | | | | |
| A | Park Regis City Quays Hotel, 6-8 Lake Street, Cairns City | N/A | 369960 | 8128319 |
| B | Piermonde Apartments, 2-4 Lake Street, Cairns City | N/A | 369988 | 8128264 |
| C | Jack & Newell Apartments, 27 - 29 Wharf Street, Cairns City | N/A | 369999 | 8128312 |
| D | Madison on Abbott Apartments, 3 Abbott Street, Cairns City | N/A | 370001 | 8128362 |
| E | Pullman Reef Hotel Casino, 35/41 Wharf Street, Cairns City | N/A | 370038 | 8128438 |
| F | Hilton Hotel, 34 Esplanade, Cairns City | N/A | 370105 | 8128559 |
| G | Cairns Harbour Lights Apartments, 1 Marlin Parade, Cairns City | N/A | 370127 | 8128685 |
| H | Shangri-La Hotel, Pier Point Road, Cairns City | N/A | 370106 | 8128915 |
| I | Boats used as residences, east side of Trinity Inlet | N/A | 370443 | 8127598 |
| I | Boats used as residences, east side of Trinity Inlet | N/A | 370554 | 8128060 |
| I | Boats used as residences, east side of Trinity Inlet | N/A | 370656 | 8128624 |

| ID | Name / Address | Real Property Description | Easting (m) | Northing (m) |
|---|---|---|---|---|
| **Near Barron Delta Pipeline Routes** | | | | |
| J | Holloways Beach Environmental Education Centre, 46 Poinsettia Street, Holloways Beach | 122/NR840892 | 365190 | 8138963 |
| K | 2-4 Deauville Close, Yorkeys Knob | 0/BUP105844 | 364417 | 8140742 |
| K2 | Clinton Street, Yorkeys Knob (Yorkeys Knob Primary School) | 178/NR6811 | 363987 | 8140490 |
| K3 | Yorkeys Knob Road, Yorkeys Knob (near Antonetta Close) | 4/RP749342 | 363646 | 8139820 |
| L | 30 Acacia Street, Holloways Beach | 328/H9082 | 365130 | 8138811 |
| M | Morabito Road (off Yorkeys Knob Road), Yorkeys Knob | 2/RP800898 | 363937 | 8138570 |
| N | 72 Barronia Crescent, Holloways Beach | 40/RP742748 | 364972 | 8138264 |
| O | 108 Barronia Crescent, Holloways Beach | 22/RP742750 | 364958 | 8137890 |
| P | 101-103 Wistaria Street, Holloways Beach | 1/RP731885 | 365220 | 8137538 |
| Q | 78 Wistaria Street, Holloways Beach | 21/RP741077 | 365265 | 8137228 |
| R | 613 Holloways Beach Access Road | 5/RP857577 | 364512 | 8136716 |
| S | Dwelling under construction, Holloways Beach Access Road | 22/SP211748 | 364587 | 8136488 |
| **Near Barron Delta DMPA** | | | | |
| T | 637 Captain Cook Highway<br>Barron | 4/RP800591 | 363235 | 8136373 |
| U | 637 Captain Cook Highway<br>Barron | 4/RP800591 | 363162 | 8136228 |
| V | Holloways Beach Access Road | 1/RP804218 | 364663 | 8135785 |
| W | Holloways Beach Access Road | 1/RP804218 | 364566 | 8135742 |
| X | Holloways Beach Access Road | 1/RP804218 | 364561 | 8135676 |
| Y | 417-419 Captain Cook Highway | 4/RP748713 | 364662 | 8135074 |


**Figure 4.1 Location of Sensitive Receptors in Wharf Street Area (Image from Google Earth Pro)**

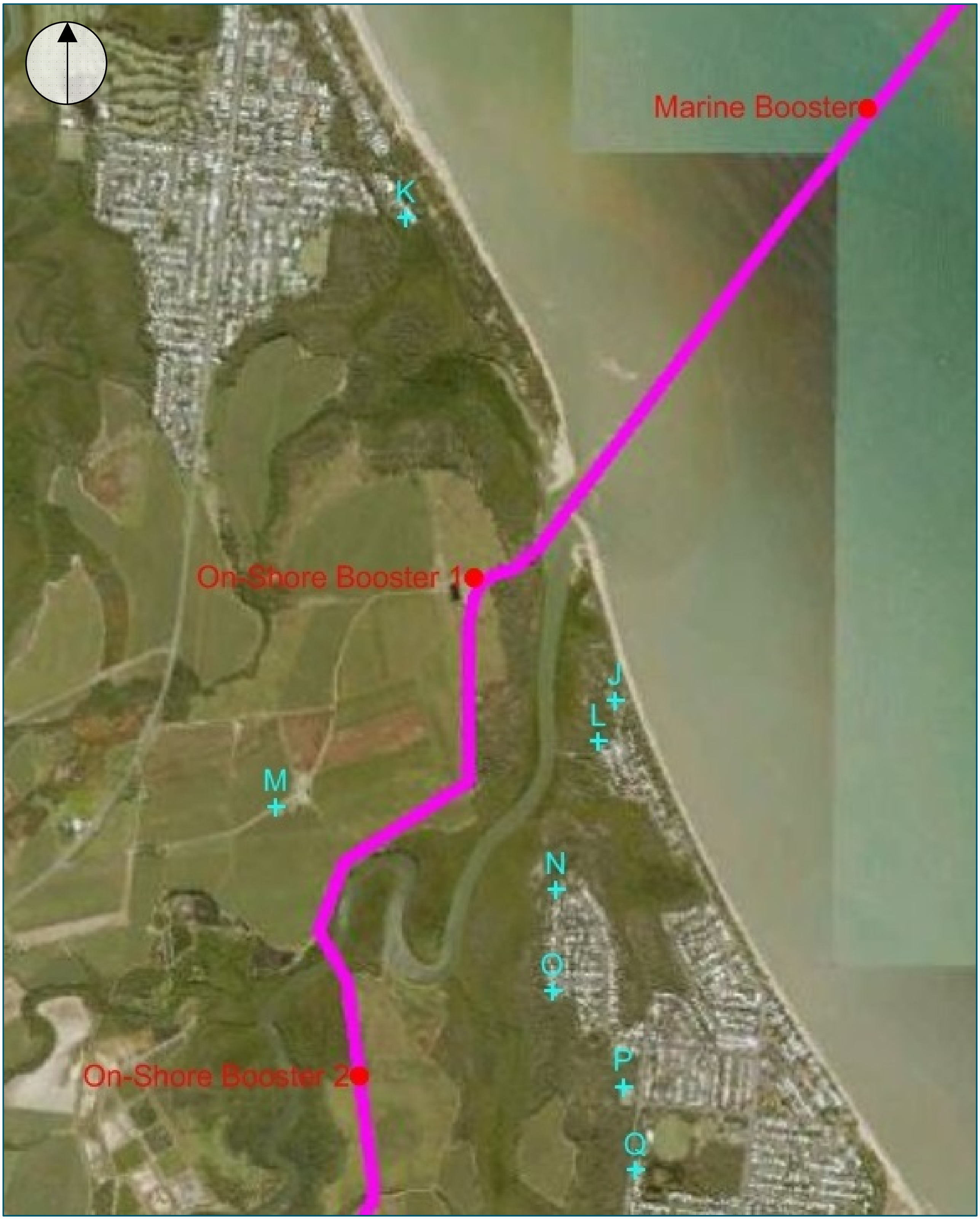


**Figure 4.2 Location of Sensitive Receptors near Barron Delta Pipeline - Yorkeys Pipeline and Aquis Marine Pipeline Options Shown (Image from Google Earth Pro)**

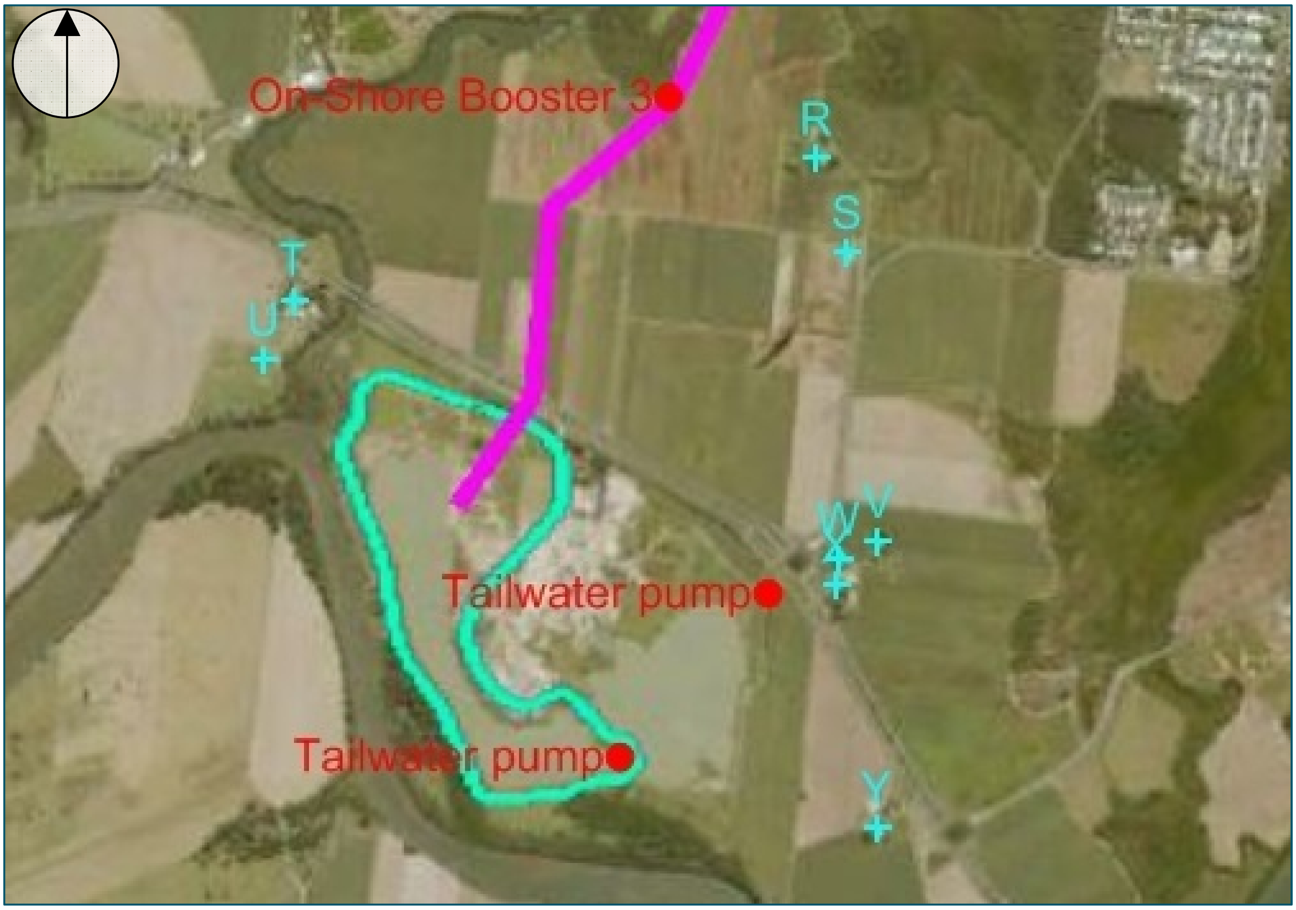


**Figure 4.3** **Location of Sensitive Receptors near Barron Delta DMPA - Yorkeys Pipeline and Aquis Marine Pipeline Options Shown (Image from Google Earth Pro)**

# 5. Existing Noise Environment

## 5.1 Overview

Noise measurements have been undertaken to determine the existing noise environment at and around areas that could be affected by the project activities. The measurements have consisted of long-term noise logging at three sites over a period of approximately one week, and short-term attended noise measurements. Attended noise measurements were conducted at the three logging sites and at additional monitoring sites.

The long-term noise logging measurement results assist in understanding the variation in the ambient noise environment noise level by time of day and at different locations. The attended measurements provide additional information on the sources contributing to the noise levels as an ASK engineer was present during the measurement period. The short period of the attended measurements allows additional measurement positions to be considered.

This section presents the results of the ASK noise monitoring, undertaken in August 2016 and May 2017, and also provides a brief overview of the noise monitoring undertaken by ARUP as part of the Draft EIS assessment work for the project (see **Section 5.5**). Noise monitoring results also undertaken by ASK for a separate development project near the CSD project area (Aquis development) are also presented within this section.

## 5.2 Noise Monitoring Locations

The locations used for noise monitoring are presented in **Figure 5.1** to **Figure 5.3**. The locations used for noise monitoring were selected based on the presence of sensitive receptors and consideration of likely actions and potential impacts resulting from the CSD Project.

In addition to the monitoring locations used in the August 2016 and May 2017 monitoring, **Figure 5.2** also presents monitoring location L2, at which noise logging was undertaken by ASK from Monday 01/08/2013 to Monday 08/08/2013 for the Aquis development project.

Note: Monitoring locations start with alphabetical descriptor B (Barron Delta). Additional noise monitoring was previously undertaken at East Trinity, which used the alphabetical descriptor A, however this area is no longer part of the project area.

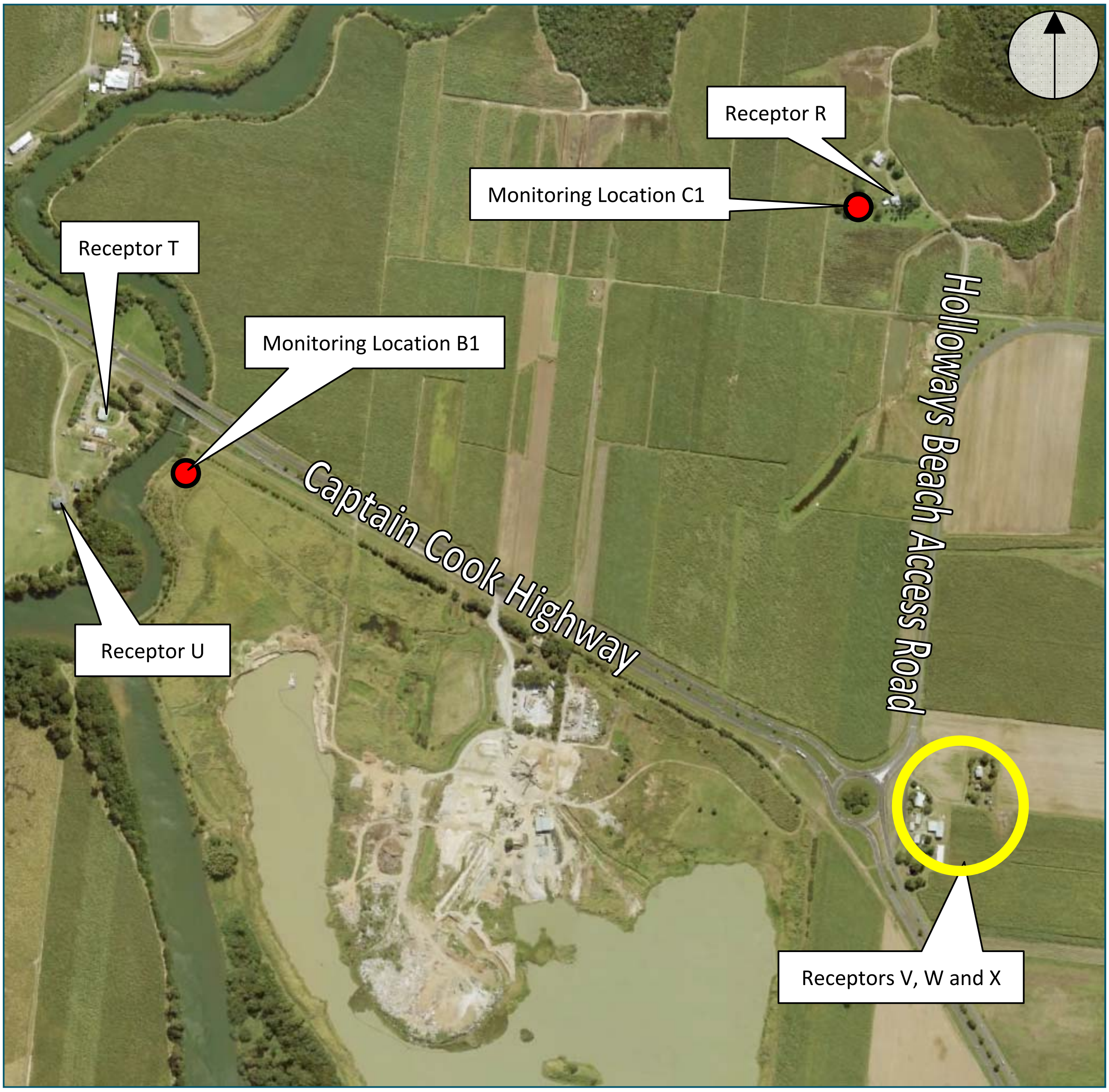


**Figure 5.1 Barron Delta Monitoring Locations B1 and C1**


**Figure 5.2 Barron Delta Monitoring Locations D1 to D4 and L2 (Aquis)**


**Figure 5.3 Wharf Street Monitoring Locations E1, E2, F1, G1 and G2**

## 5.3 Noise Logging (ASK 2016 and 2017)

Noise logging was undertaken at three locations (B1, C1 and G1) as described in **Table 5.1** and shown in **Figure 5.1** and **Figure 5.3**.

**Table 5.1 Description of Noise Logging Locations**

| Location | Description |
|---|---|
| B1 | The logger was located within the Northern Sands Quarry, towards the north-west corner of the quarry site (near Receptors T and U). The logger was chained to a tree and was approximately 75 metres to the south-west of the edge of the nearest lane of the Captain Cook Highway. There were significant trees and grass vegetation in the local area of the logger. GPS coordinates were -16.852800° N, 145.717367° E. |
| C1 | The logger was located to the west of residential dwelling identified as 613 Holloways Beach Access Road (Receptor R). The logger was chained to a tree and was approximately 800 metres to the north-east of the Captain Cook Highway. GPS coordinates were -16.848917° N, 145.727717° E. |
| G1 | The logger was located on the balcony of Room 604 within the Park Regis Piermonde Apartments (Receptor B). The balcony of this apartment faces east towards the wharf. GPS coordinates were -16.9256°N, 145.7792°E. |

Noise logging was undertaken at Locations B1 and C1 from Monday 01/08/2016 to Monday 08/08/2016 using field and laboratory calibrated Larson Davis LD831 environmental noise loggers. Noise logging was undertaken in the free field at all locations.

Noise logging was undertaken at Location G1 from Tuesday 09/05/2017 to Wednesday 17/05/2017 using field and laboratory calibrated Larson Davis LD831 environmental noise logger. The noise logger was located on a balcony, and therefore was influenced by facade reflection.

The measured noise levels during the logging periods are presented graphically in **Appendix B**. The parameters used in the section and within **Appendix B** are described in the glossary in **Appendix A**. A summary of the results of the noise logging is presented in **Table 5.2**.

**Table 5.2 Noise Logging Statistical Results**

| Location | Statistic | $L_{10}$ dBA | | | $L_{90}$ dBA | | | $L_{eq}$ dBA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Day | Evening | Night | Day | Evening | Night | Day | Evening | Night |
| B1 | Maximum | 63 | 60 | 59 | 57 | 53 | 54 | 60 | 57 | 57 |
| | Top 10% | 61 | 57 | 54 | 55 | 51 | 46 | 59 | 55 | 51 |
| | Average | 58 | 55 | 50 | 51 | 47 | 40 | 55 | 52 | 47 |
| | (Median) | 58 | 54 | 50 | 51 | 47 | 40 | 55 | 52 | 47 |
| | Bottom 10% | 54 | 52 | 46 | 48 | 44 | 35 | 52 | 50 | 42 |
| | Minimum | 51 | 50 | 42 | 44 | 42 | 25 | 48 | 48 | 39 |
| C1 | Maximum | 60 | 57 | 57 | 51 | 47 | 49 | 64 | 54 | 62 |
| | Top 10% | 55 | 52 | 50 | 47 | 46 | 43 | 54 | 50 | 49 |
| | Average | 51 | 49 | 45 | 43 | 44 | 40 | 50 | 48 | 44 |
| | (Median) | 51 | 49 | 45 | 44 | 44 | 40 | 50 | 47 | 44 |
| | Bottom 10% | 48 | 47 | 42 | 37 | 41 | 37 | 47 | 45 | 40 |
| | Minimum | 42 | 45 | 35 | 34 | 39 | 27 | 40 | 43 | 33 |

| Location | Statistic | $L_{10}$ dBA | | | $L_{90}$ dBA | | | $L_{eq}$ dBA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| G1 | Maximum | 70 | 73 | 67 | 65 | 68 | 58 | 68 | 70 | 66 |
| | Top 10% | 65 | 67 | 63 | 57 | 56 | 53 | 63 | 64 | 60 |
| | Average | 62 | 60 | 56 | 54 | 52 | 49 | 60 | 57 | 54 |
| | (Median) | 62 | 59 | 55 | 54 | 51 | 48 | 60 | 57 | 53 |
| | Bottom 10% | 61 | 57 | 51 | 52 | 49 | 47 | 58 | 54 | 50 |
| | Minimum | 58 | 56 | 47 | 50 | 48 | 46 | 55 | 53 | 47 |

The background noise levels (min$L_{90}$ or rating background level) at each logging location are shown below in **Table 5.3**. The levels presented in **Table 5.3** of Locations B1 and C1 include the as-measured $L_{90}$ levels, and the $L_{90}$ noise levels with the influence of insect noise (4 kHz and 8 kHz octave bands) removed. The ambient environment at Location G1 does not include significant contribution from insects.

**Table 5.3 Background Noise Levels from Noise Logging**

| Location | Background Noise Level $L_{90}$ | | | Background Noise Level $L_{90}$ (less insects) | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| B1 | 48 | 43 | 35 | 48 | 42 | 27 |
| C1 | 41 | 41 | 38 | 41 | 39 | 28 |
| G1 | 52 | 50 | 47 | n/a | n/a | n/a |

## 5.4 Attended Noise Measurements (ASK 2016 and 2017)

Attended noise measurements were undertaken at the noise logging locations (B1 and C1) and at several other locations. The non-logging locations are described in **Table 5.4** and presented in **Figure 5.1** to **Figure 5.3**.

**Table 5.4 Attended Noise Monitoring Locations**

| Location | Description |
|---|---|
| D1 | Attended monitoring was undertaken to the south of the residence located at 70 Barronia Crescent, Holloways Beach (near Receptor N). The site is within a residential area near the potential pipeline for the Barron Delta placement site. GPS coordinates were - 16.834933° N, 145.733033° E. |
| D2 | Attended monitoring was undertaken to the west of the residence located at 28 Acacia Street, Holloways Beach (near Receptor L). The site is within a residential area near the potential pipeline for the Barron Delta placement site. GPS coordinates were -16.830300° N, 145.733833° E. |
| D3 | Attended monitoring was undertaken to the east of the residence located at 108 Barronia Crescent, Holloways Beach (Receptor O). The site is within a residential area near the potential pipeline for the Barron Delta placement site. GPS coordinates were -16.838450° N, 145.732717° E. |
| D4 | Attended monitoring was undertaken at the northern end of Poinsettia Street, Holloways Beach (near Receptor J). The site is within a residential area near the potential pipeline for the Barron Delta placement site. GPS coordinates were -16.829650° N, 145.734683° E. |
| E1 | Attended monitoring was undertaken in the park to the east of the intersection of Lake Street and Wharf Street near the Cairns CBD (near Receptors A to D). The site is within a communal area to the east of high-rise apartment and hotel accommodation. GPS coordinates were -16.926350° N, 145.779867° E. |

| Location | Description |
|---|---|
| E2 | Attended monitoring was undertaken in the park to the east of the intersection of Abbott Street and Wharf Street near the Cairns CBD (near Receptors E and F). The site is within a communal area to the east of high-rise apartment and hotel accommodation. GPS coordinates were -16.924650° N, 145.780150° E. |
| F1 | Attended monitoring was undertaken on the balcony on Room 538 within the Hilton Hotel (Receptor F). The balcony of this room faces south-east towards the wharf. GPS coordinates were -16.923337° N, 145.780265° E. |
| G1 | Attended monitoring was undertaken on the balcony on Room 604 within the Park Regis Piermonde Apartments (Receptor B). The balcony of this apartment faces east towards the wharf. GPS coordinates were -16.9256°N, 145.7792°E. |
| G2 | Attended monitoring was undertaken on the balcony on Room 902 within the Park Regis Piermonde Apartments (Receptor B). The balcony of this apartment faces east towards the wharf, but is located further around to the northern side of the building facing the Jack & Newell Apartments. GPS coordinates were -16.9255°N, 145.7792°E. |
| T1 | Attended monitoring was undertaken at the southern end of Tingira Street. The site is within a commercial and industrial area near the proposed Tingira Street Dredge Material Placement Area. GPS coordinates were -16.952701°N, 145.770985°E. |
| T2 | Attended monitoring was undertaken at the southern end of Tingira Street next to the public boat ramp. The site is within a commercial and industrial area near the proposed Tingira Street Dredge Material Placement Area. GPS coordinates were -16.952683°N, 145.772212°E. |
| T3 | Attended monitoring was undertaken at the southern end of Tingira Street in front of the Great Barrier Reef International Marine College. The site is within a commercial and industrial area near the Tingira Street Dredge Material Placement Area. GPS coordinates were -16.949232°N, 145.770205°E. |
| T4 | Attended monitoring was undertaken at the southern end of Tingira Street behind the Queensland Marine Services and Queensland Park and Wildlife Services offices. The site is within a commercial and industrial area near the proposed Tingira Street Dredge Material Placement Area. GPS coordinates were -16.951392°N, 145.772328°E. |

Attended noise measurements were undertaken using a field and laboratory calibrated Norsonic NOR 140 sound level meter. The microphone height was approximately 1.3 metres above ground level (balcony level in the case of Locations F1, G1 and G2). With the exception of Locations F1, G1 and G2, monitoring positions were free field. Weather during attended monitoring was generally fine.

The measured noise levels are summarised in **Table 5.5**. The parameters noted in **Table 5.5** are described in the glossary in **Appendix A**.

**Table 5.5 Attended Noise Measurement Results**

| Location | Date & Time | Period (Minutes) | Results & Notes |
|---|---|---|---|
| F1 | 8:45pm 01/08/2016 | 15 | Statistical noise levels: $L_{10}$ 55 dBA, $L_{eq}$ 54 dBA, $L_{90}$ 53 dBA<br>Mechanical plant (pool pump) 53 dBA (continuous)<br>Traffic noise on Wharf Street (incl plant noise) 54 to 59 dBA<br>Intermittent patron noise from Whard Street and wharf area audible. |
| B1 | 11:14am 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 58 dBA, $L_{eq}$ 56 dBA, $L_{90}$ 49 dBA<br>Traffic noise from Captain Cook Hwy 49 to 65 (dominant)<br>Aircraft noise 61 to 68<br>No noise audible from quarry activities |
| C1 | 12:28pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 47 dBA, $L_{eq}$ 47 dBA, $L_{90}$ 35 dBA<br>Traffic on Holloways Beach Access Road 33 to 40 dBA<br>Captain Cook Hwy not audible<br>Light aircraft noise 44 to 56 dBA (3 events)<br>Bird noise 36 to 53 dBA (dominant)<br>Jet aircraft noise up to 63 dBA (2 events)<br>No insect noise |
| D1 | 1:32pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 41 dBA, $L_{eq}$ 54 dBA, $L_{90}$ 32 dBA<br>Noise from wind in trees 30 to 35 dBA<br>Light aircraft noise 40 to 44 dBA<br>Some bird noise<br>Intermittent noise from nearby residences |
| D2 | 2:11pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 57 dBA, $L_{eq}$ 53 dBA, $L_{90}$ 33 dBA<br>Bird noise 34 to 47 dBA<br>Aircraft noise up to 70 dBA (5 events)<br>Surf noise 31 to 33 dBA |
| E1 | 8:31pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 55 dBA, $L_{eq}$ 53 dBA, $L_{90}$ 41 dBA<br>Traffic on Wharf Street 41 to 66 dBA (dominant)<br>Distant traffic noise 41 to 42 dBA<br>No noise from surf/water<br>Mechanical plant noise from nearby apartments/hotels audible, approximately 40 dBA<br>Insects audible but not influencing levels |
| E2 | 8:55pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 53 dBA, $L_{eq}$ 51 dBA, $L_{90}$ 45 dBA<br>Traffic on Wharf Street 44 to 62 dBA (dominant)<br>Patron noise from wharf approximately 48 dBA (brief)<br>Mechanical plant noise from nearby apartments/hotels audible<br>No noise from surf/water<br>Insects audible but not influencing levels |
| C1 | 9:42pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 55 dBA, $L_{eq}$ 51 dBA, $L_{90}$ 46 dBA<br>Insect noise 46 to 47 dBA (continuous, dominant)<br>Jet aircraft noise 55 to 64 dBA (5 events)<br>Traffic noise from Captain Cook Hwy audible, no level able to be obtained due to insect noise |

| Location | Date & Time | Period (Minutes) | Results & Notes |
|---|---|---|---|
| D3 | 10:22pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 38 dBA, $L_{eq}$ 37 dBA, $L_{90}$ 35 dBA<br>Insect noise 34 to 37 dBA (continuous, dominant)<br>Distant road traffic noise audible intermittently<br>Noise from nearby residences audible intermittently |
| D1 | 10:47pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 30 dBA, $L_{eq}$ 29 dBA, $L_{90}$ 27 dBA<br>Insect noise 26 to 30 dBA (dominant)<br>Distant traffic noise 29 to 32 (intermittent) |
| D2 | 11:16pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 43 dBA, $L_{eq}$ 45 dBA, $L_{90}$ 36 dBA<br>Insect noise 36 to 42 dBA (dominant)<br>Jet aircraft landing 63 dBA $L_{max}$<br>Other aircraft noise 40 to 45 dBA<br>Distant traffic noise audible |
| D4 | 11:41pm 02/08/2016 | 15 | Statistical noise levels: $L_{10}$ 46 dBA, $L_{eq}$ 47 dBA, $L_{90}$ 34 dBA<br>Insect noise 35 to 46 dBA (dominant)<br>Surf noise approx 35 to 38 dBA<br>Bird noise 38 to 69 dBA<br>Distant traffic noise faintly audible |
| E1 | 12:20am 03/08/2016 | 15 | Statistical noise levels: $L_{10}$ 46 dBA, $L_{eq}$ 45 dBA, $L_{90}$ 39 dBA<br>Mechanical plant at Jack & Newell Apartments 39 to 40 dBA (continuous)<br>Traffic on Wharf Street 41 to 55 dBA<br>Insects audible but not influencing noise levels<br>Bird noise 45 to 47 (intermittent)<br>No noise from wharf |
| E2 | 12:41am 03/08/2016 | 10 | Statistical noise levels: $L_{10}$ 48 dBA, $L_{eq}$ 46 dBA, $L_{90}$ 44 dBA<br>Mechanical plant at Jack & Newell Apartments and Pullman Hotel 44 dBA (continuous)<br>Traffic on Wharf Street 46 to 52 dBA |
| G1 | 3:04pm 09/05/2017 | 15 | Statistical noise levels: $L_{10}$ 62 dBA, $L_{eq}$ 59 dBA, $L_{90}$ 53 dBA<br>Traffic on Wharf Street 58 to 64 dBA<br>Distant traffic noise and mechanical plant 50 to 52 dBA |
| T1 | 5:18pm 09/05/2017 | 15 | Statistical noise levels: $L_{10}$ 44 dBA, $L_{eq}$ 43 dBA, $L_{90}$ 34 dBA<br>Very distant Industry noise audible coming from the north<br>Bird song 39 to 41 dBA (46),(55) loud bird screech<br>Car travelling on Tingira Street 47 dBA<br>Loader moving in laydown yard to the north 40 to 42 dBA<br>Loader grading rocks in laydown yard to the north 46 to 48 dBA |
| G1 | 9:08pm 09/05/2017 | 15 | Statistical noise levels: $L_{10}$ 57 dBA, $L_{eq}$ 54 dBA, $L_{90}$ 49 dBA<br>Traffic on Wharf Street 55 to 60 dBA<br>Loud motorbike on Wharf Street 68 dBA<br>Loud Car on Wharf Street 66 dBA<br>Mechanical Plant from neighbouring residential tower 47 to 50 dBA |
| G2 | 9:54pm 09/05/2017 | 15 | Statistical noise levels: $L_{10}$ 56 dBA, $L_{eq}$ 54 dBA, $L_{90}$ 51 dBA<br>Traffic on Wharf Street 55 to 58 dBA<br>Mechanical plant noise from neighbouring residential tower 50 to 51 dBA<br>Clock tower ringing on the hour 60 dBA |

| Location | Date & Time | Period (Minutes) | Results & Notes |
|---|---|---|---|
| T2 | 8:05am 10/05/2017 | 15 | Statistical noise levels: $L_{10}$ 45 dBA, $L_{eq}$ 42 dBA, $L_{90}$ 37 dBA<br>Car doors closing in car park 41, 44, 46 dBA<br>Reverse beeper in car park 53 dBA<br>Bird song 37 to 44 dBA<br>Car engine start in carpark 43 to 47 dBA<br>Car pulling boat through car park 56 dBA<br>Small boat travelling along river 43 to 44 dBA |
| T3 | 9:00am 10/05/2017 | 15 | Statistical noise levels: $L_{10}$ 61 dBA, $L_{eq}$ 61 dBA, $L_{90}$ 49 dBA<br>Distant industry noise 48 to 49 dBA<br>Trucks/Loaders/Cranes moving in laydown yard directly opposite 54 to 58 dBA<br>Traffic on Tingira Street 61 to 67 dBA<br>Trucks on Tingira Street 72, 78, 82 dBA<br>Forklift on Tingira Street 63, 66 dBA<br>Truck idling in laydown yard directly opposite 50 dBA |
| T4 | 9:51am 10/05/2017 | 15 | Statistical noise levels: $L_{10}$ 55 dBA, $L_{eq}$ 53 dBA, $L_{90}$ 45 dBA<br>Distant noise from laydown yard on Tingira Street 50 to 56 dBA<br>Cars moving through carpark 54 to 64 dBA<br>Plane overhead 60 dBA<br>Boat travelling along river 55 dBA<br>Distant industry noise 45 to 46 dA<br>Mechanical plant for offices 43 to 44 dBA |
| T2 | 11:44am 10/05/2017 | 15 | Statistical noise levels: $L_{10}$ 46 dBA, $L_{eq}$ 45 dBA, $L_{90}$ 37 dBA<br>Wind through trees and grass 38 to 39 dBA<br>Bird song 40 to 42 dBA<br>Cars moving in car park 44 to 55 dBA<br>Car door slams 58, 60, 44, 55, 44 dBA<br>Small boat travelling along river 42 to 50 dBA |
| T3 | 12:23pm 10/05/2017 | 15 | Statistical noise levels: $L_{10}$ 66 dBA, $L_{eq}$ 64 dBA, $L_{90}$ 50 dBA<br>Cars on Tingira Street 62 to 75 dBA<br>Trucks on Tingira Street 84, 80, 74, 80 dBA<br>Industry noise 51 to 54 dBA<br>Noise from laydown yard directl opposite 55 to 57 dBA<br>Distant traffic and industry noise 47 to 48 dBA |

In addition to the above 15 minute measurements, short 2-3 minute measurements were also made at Location G2, with the observations as follows:

- Location G2 (10/05/2017 2:30am): Plant noise dominant noise source ~ 50 - 51 dBA
- Location G2 (10/05/2017 7:26am): Plant noise ~ 50 - 51 dBA, traffic noise present.

## 5.5 ARUP Noise Monitoring (August 2013)

Attended noise monitoring and unattended noise logging was undertaken by ARUP from Tuesday 27/08/2013 to Friday 30/08/2013. Details of ARUP's monitoring methodology and the measured noise levels are presented in Appendix D.7 of the initial Draft EIS.

Based on the results of the noise monitoring, ARUP provided the following comments:

- The Wharf Street area is typical of an urban noise environment, with ambient noise levels generally characterised by man-made noise sources such as traffic noise from local roads and mechanical plant noise from surrounding buildings.
- The East Trinity vicinity is a rural noise environment characterised by natural noise sources such as wave and wind noise, with intermittent man-made noise sources such as aircraft movements.

These comments are consistent with the results of the noise monitoring undertaken by ASK (August 2016).

The background noise levels (min$L_{90}$ or rating background level) obtained from logging at the Hilton Hotel are presented in **Table 5.6**.

**Table 5.6 Background Noise Levels from ARUP Noise Logging at Hilton Hotel**

| Location | Background Noise Level $L_{90}$ | | |
|---|---|---|---|
| | Day | Evening | Night |
| Hilton Hotel (Location 4) | 54 | 48 | 46 |

## 5.6 AQUIS Noise Monitoring (ASK, August 2013)

Logging was undertaken at Location L2 (see **Figure 5.2**) from 01/08/2013 to 08/08/2013 using a field and laboratory calibrated Larson Davis LD831 environmental noise logger. Noise logging was undertaken in the free field.

The logger was located in bushland near the entrance to Richters Creek. There were cane fields several hundred metres to the west. GPS coordinates were -16.824°N, 145.730°E.

The measured noise levels from logging are shown in **Appendix B**. The parameters in **Appendix B** are described in the glossary in **Appendix A**. A summary of the results of the noise logging is presented in **Table 5.7**.

**Table 5.7 Noise Logging Statistical Results (Aquis Logging, Location L2)**

| Location | Statistic | $L_{10}$ dBA | | | $L_{90}$ dBA | | | $L_{eq}$ dBA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Day | Evening | Night | Day | Evening | Night | Day | Evening | Night |
| L2 | Maximum | 61 | 57 | 54 | 48 | 42 | 41 | 61 | 56 | 57 |
| | Top 10% | 55 | 50 | 43 | 44 | 39 | 36 | 57 | 50 | 49 |
| | Average | 48 | 43 | 37 | 39 | 36 | 32 | 50 | 44 | 38 |
| | Bottom 10% | 42 | 36 | 32 | 33 | 32 | 29 | 42 | 35 | 31 |
| | Minimum | 36 | 33 | 29 | 29 | 30 | 27 | 34 | 32 | 29 |

The background noise levels (min$L_{90}$ or rating background level) are shown below in **Table 5.8**. The levels presented in **Table 5.8** include the as-measured $L_{90}$ levels, and the $L_{90}$ noise levels with the influence of insect noise (4 kHz octave band) removed.

**Table 5.8 Background Noise Levels from Noise Logging**

| Location | Background Noise Level $L_{90}$ | | | Background Noise Level $L_{90}$ (less insects) | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| L2 | 32 | 33 | 30 | 30 | 29 | 26 |

As expected for the nature of this area, the background noise levels measured at Location L2 are considered low, and the existing noise environment at this location is not influenced by steady-state noise sources (i.e. industry, mechanical plant, etc).

## 5.7 Discussion of Noise Monitoring Results

From the results in presented in the previous sections the following comments are made:

- The dominant noise source at Location B1 is road traffic noise on the Captain Cook Highway. The noise environment is also influenced by insects.
- The noise environment at Location C1 is influenced by insect and bird noise. Aircraft noise associated with jet aircraft landing at the Cairns Airport is also a dominant noise source with semi-regular events.
- It is noted that aircraft noise will change with runway heading changes due to wind directions and approach methods.
- The noise environment at Locations D1 to D4 is representative of a quiet residential area. Insect noise influences the noise environment.
- The existing noise environment at Locations E1 and E2 is heavily influenced by traffic on Wharf Street and mechanical plant associated with the Jack & Newell Apartments and the Pullman Hotel. In the absence of traffic noise, mechanical plant noise is the dominant noise source. The items of plant which were observed to be the source of the noise were exhaust air fans.
- Noise monitoring at the Wharf Street area did not capture noise events from operation of the port, and therefore does not provide an indication of the noise environment with the inclusion of this existing noise source.
- Noise monitoring at Locations G1 and G2 (Piermonde Apartments, receptor B) indicates that the apartments at higher levels are also influenced by mechanical plant noise.

# 6. Determination of Construction Noise Level Targets (Dredging)

Construction noise level targets for the project have been adopted from the NSW Interim Construction Noise Guideline (ICNG) (NSW DECC, 2009) as discussed in **Section 3.4**. The noise level targets for construction are based on the ambient background noise level plus an allowance of 10 dB for activity during Monday to Saturday from 6:30 am to 6:30 pm (recommended standard hours), or an allowance of 5 dB (as a guide) for activity outside standard hours.

Based on the results of noise logging for the day (7:00am to 6:00pm), evening (6:00pm to 10:00pm) and night (10:00pm to 7:00am) periods, the range of construction noise level targets for each period of the day are presented in **Table 6.1**. It is noted that the ICNG noise limits are recommended for within and outside standard operating hours (6:30am to 6:30pm), for purpose of the assessment noise limits have been nominated for day, evening and night as some activities will operate 24 hours per day. For the purpose of the assessment the daytime period is considered to be from 6:30am to 6:30pm, consistent with the recommended hours of construction.

The noise level targets presented in **Table 6.1** are based on the as-measured lowest 10th percentile noise logging data, i.e. the measured noise level without the influence of insect noise removed.

Although insect noise is variable with respect to climate and seasonal changes, it is noted that noise logging was undertaken at Locations L2, B1 and C1 during August. Winter months are anticipated to include less insect noise due to cooler temperatures, and therefore it is expected that the measured noise levels provide an accurate representation of the background noise environment with reduced influence from insects. It is also noted that due to the rating background level (RBL) derivation method, the RBL $L_{90}$ is selected as the median of the lowest 10th percentile $L_{90}$ noise levels across the monitoring period. Therefore the as-measured $L_{90}$ level likely will be based on the background level measured when there was less than typical insect noise.

To protect receptors during the night-time, which is generally considered the most sensitive time period to noise, the night-time construction noise level targets have been capped at a maximum of 37 dBA $L_{eq}$, as per the recommended Acoustic Quality objectives noise limits (see **Section 3.3.1**).

The noise level targets in **Table 6.1** have been derived for specific receptors, based on the most appropriate noise logging location for each receptor, and the measured RBL at these locations (see **Section** 5).

**Table 6.1 Construction Noise Screening Criteria**

| Receptor | Representative Noise Logging Locations | Background Noise Level $L_{90}$ dBA from Noise Logging (level less insects) | ICNG Noise Affected Level dBA $L_{eq}$ (15 minute) |
|---|---|---|---|
| J, K, L, M, N, O, P, Q | L2 | D: 32 (30)<br>E: 33 (<u>29</u>)<br>N:30 (<u>26</u>) | **D: 42**<br>**E: 37**[1]<br>**N: 35** |
| R, S | C1 | D: 41 (41)<br>E: 41 (39)<br>N: 38 (<u>28</u>) | **D: 51**<br>**E: 46**<br>**N: 37**[2] |
| T, U, V, W, X, Y | B1 | D: 48 (48)<br>E: 43 (42)<br>N: 35 (<u>27</u>) | **D: 58**<br>**E: 48**<br>**N: 37**[2] |

Note: 1. Based on the measured daytime $L_{90}$ of 32 dBA, which is 1 dB lower than the evening level.

2. Capped at a maximum of 37 dBA $L_{eq}$ as per the Acoustic Quality Objectives (see **Section 3.3.1**).

It is important to note that the ICNG targets are not noise limits as such, but screening criteria for assessing whether construction noise is likely to have adverse impacts and hence whether “feasible and reasonable” work practices should be implemented during the construction process in order to reduce noise levels. Where noise levels exceed the “Noise Affected Level” some community reaction to construction noise is expected and the project should implement mitigation measures to reduce noise impacts.

# 7. Construction Noise Assessment

## 7.1 Prediction Methodology

The SoundPLAN environmental noise modelling program has been used for assessment of noise impacts from construction work associated with the development.

The construction contractors for CSD Project have not been selected at the time of this assessment, and therefore the assessment has been undertaken on the basis of an assumed construction methodology. It is expected that the assumed methodology considered in this assessment is representative of the method which will be utilised, however it is also likely that some refinements will be made.

Assumptions included in the assessment which may be refined by the contractor include the following aspects:

- selection of fixed and mobile equipment
- location of plant (including booster pumps).

It is also highlighted that the availability of equipment at the time of construction work will also influence the plant utilised.

The sound power levels ($L_w$) applied in this assessment have been chosen based on information provided regarding the anticipated type and specifications (brand, model, size, etc) for mobile and fixed plant provided to ASK. The sound power levels applied in the assessment for this plant have been obtained from ASK's extensive noise source database, which includes data obtained from ASK noise measurements as well as review of published literature.

It should be noted that at this stage, the plant items detailed in this study are indicative of the plant required to complete the construction of the Project. The accuracy of the SoundPLAN noise model may be affected should plant be modified, moved (substantially) or replaced. Any major changes to plant can be updated in the SoundPLAN noise model as and when required.

The successful contractor, in preparing noise control measures for their Environmental Management Plan (EMP) will need to confirm noise levels of the actual equipment to be used.

## 7.2 Assumptions and Technical Limitations

As with most proposed developments, and as indicated in the Draft EIS, the impact assessment process is based on defining representative scenarios reflecting typical conditions likely to be experienced during construction and operation of the project.

The nature of the project is that the main operational noise source, the cruise ships, are 'external' to the project in that Ports North has no direct control or specific prior knowledge of the noise emission characteristics of individual ships.

The assessment is therefore based on 'typical' noise impacts for different categories of cruise ship.

To a similar extent, prediction of noise impacts from any construction project involves unknown source characteristics in that the particular construction equipment to be used on site is not confirmed until detailed planning for the construction process is conducted.

Therefore the representative acoustic scenarios for the project have been determined based on measurements and assumptions of representative plant and vessels and a comparative review of source levels used for previous EIS assessments. In the case of construction noise and vibration predictions, the adopted methodology based on the NSW ICNG is a "screening criterion" approach – i.e. the assessment identifies which construction activities have higher risks of resulting in noise or vibration impacts and therefore which activities require noise mitigation measures or management strategies to be incorporated into planning the activity.

During the detailed planning of the construction sequence, these activities should be planned and managed to minimise noise impacts, e.g. by including mitigation measures as discussed in this EIS chapter.

The prediction of acoustic impacts based on representative sources, means that there is the possibility that the actual source construction or operational noise levels may be higher (or lower) than predicted in this EIS chapter (e.g. an individual 'loud ship' or a particularly noisy construction activity). If this occurs in practice, additional mitigation measures or management strategies will be implemented as documented in a Noise Management Plan within the Contractors EMP to be prepared for the project. Actual residual impacts will, however, be determined by the acoustic impacts after appropriate mitigation is applied.

## 7.3 Noise Model Settings

The inputs presented in **Table 7.1**, have been used in the SoundPLAN noise model development for the CSD Project. Noise modelling has been undertaken using the CONCAWE propagation methodology.

For the purpose of the assessment, two meteorological scenarios have been modelled, i) a neutral condition, and ii) an adverse condition, representative of a temperature inversion as per the requirements of the EHP PNCG.

It is noted that the noise assessment for the previous version of the CSD Project (undertaken by ARUP) included an adverse weather condition including a wind speed of 6.5 m/s and Category D stability. It is noted that the adverse (temperature inversion) scenario modelled in this assessment provides comparable results to the high-wind weather condition applied by ARUP. Therefore this adverse condition could be considered representative of a temperature inversion or a high wind speed scenario.

**Table 7.1 Noise Model Settings**

| Input Parameter | Details |
|---|---|
| Propagation Methodology | Concawe |
| Ground Absorption Factor | Over land: 0.6<br>Over water: 0.0 |
| Receptor Height | 1.8m above ground level |
| Weather Conditions - Neutral | Wind speed: 0 m/s<br>Temperature: 25°C<br>Humidity (%): 60%<br>Pasquill Stability Class: D |
| Weather Conditions - Adverse (temperature inversion) | Wind speed: 2 m/s<br>Temperature: 15°C<br>Humidity (%): 80%<br>Pasquill Stability Class: F |
| Terrain Height | LiDAR Data |

## 7.4 Pipeline Commissioning and Decommissioning

It is expected that pipeline commissioning and decommissioning will take up to approximately 6 weeks to complete (approximately 12 weeks in total). Construction of the pipeline will occur during daylight hours only, and therefore is expected to occur during standard construction hours of 6:30 am to 6:30 pm, Monday to Saturday.

The mobile equipment required for commissioning and decommissioning includes two dozers (anticipated to be Cat D8 model) and two 40 tonne excavators, with welding equipment also required. It is anticipated that the mobile equipment will be split into two crews (each with a dozer and excavator), with each crew starting at opposite (northern and southern) ends of the pipeline.

The pipeline will be built during cane harvesting season, which occurs between June and November, and also requires mobile agricultural equipment.

A pipe fabrication area will be located near the coastline (as shown in **Figure 7.1**) which will be used for the construction of the off-shore pipeline to the off-shore pump-out area.

In addition to the construction of the pipeline, excavation work will also be required to cut the sandbar at the Barron River mouth at Yorkeys Knob as shown in **Figure 7.1**. Sandbar cutting will be undertaken using the two 40 tonne excavators. Sandbar cutting is anticipated to require in the order of up to a week to complete.

Noise predictions from pipeline commissioning and decommissioning have been undertaken for the following scenarios:

- Pipe fabrication: pipe fabrication work being undertaken in the fabrication area.
- Sandbar cutting: 2 x excavators working at the sandbar.
- Pipe construction and decommissioning: A crew of 1 x dozer and 1 x excavator working along sections of the pipeline. Noise predictions at receptors for this scenario are based on the equipment being located at the closest part of the pipeline to each receptor.
- Cumulative noise from pipe construction: combined assessment of noise levels from the pipe fabrication yard and pipe construction occurring concurrently.

The sound power levels applied for the assessment of noise emissions from pipeline commissioning and decommissioning are presented in **Table 7.2**.

**Table 7.2 Pipeline Fabrication and Decommissioning Equipment Sound Power Levels ($L_{weq}$)**

| Equipment or Activity | Specifications, Brand & Model | Quantity | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | | Overall Sound Power Level, $L_{weq}$, dBZ | Overall Sound Power Level, $L_{weq}$, dBA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | | |
| Dozer | CAT D8 | 2 | 114 | 114 | 107 | 107 | 105 | 102 | 96 | 87 | 118 | 110 |
| Excavator | 40 Tonne Excavator [1] | 2 | 103 | 115 | 107 | 101 | 108 | 99 | 93 | 90 | 117 | 110 |
| Pipeline Fabrication (i.e. drilling, cutting, lifting) | n/a | n/a | 106 | 105 | 101 | 100 | 101 | 98 | 94 | 90 | 111 | 105 |

Note: 1. The exact brand/model of the excavator is to be confirmed. For the purpose of the assessment it has been assumed that the excavator is a Komatsu PC 450 excavator (43 tonne).

Based on the proposed alignment of the pipeline (see **Figure 7.1**), the nearest sensitive receptors to the pipeline are identified as follows:

- Receptors J, L, K, K2 and K3: near the sandbar cutting area, pipe fabrication area and northern pipe storage area.
- Receptors M, N and O: near the pipeline just north of Richters Creek
- Receptors R and S: near the pipeline and southern pipe storage area.

The predicted noise levels at the worst affected sensitive receptors for both the neutral and adverse meteorological conditions are presented in **Table 7.3**. In addition to the predicted levels, the derived construction noise level targets, and the determined noise exceedance (if any) is also shown.

Receptors T, U, V, W, X and Y are located much closer to the Captain Cook Highway than the pipeline, and based on the measured background noise level at Location B1 during the day (48 dBA $L_{90}$, see **Table 5.3**) it is expected that noise from road traffic on the highway during the day will provide significant masking of noise associated with the construction of the pipeline.

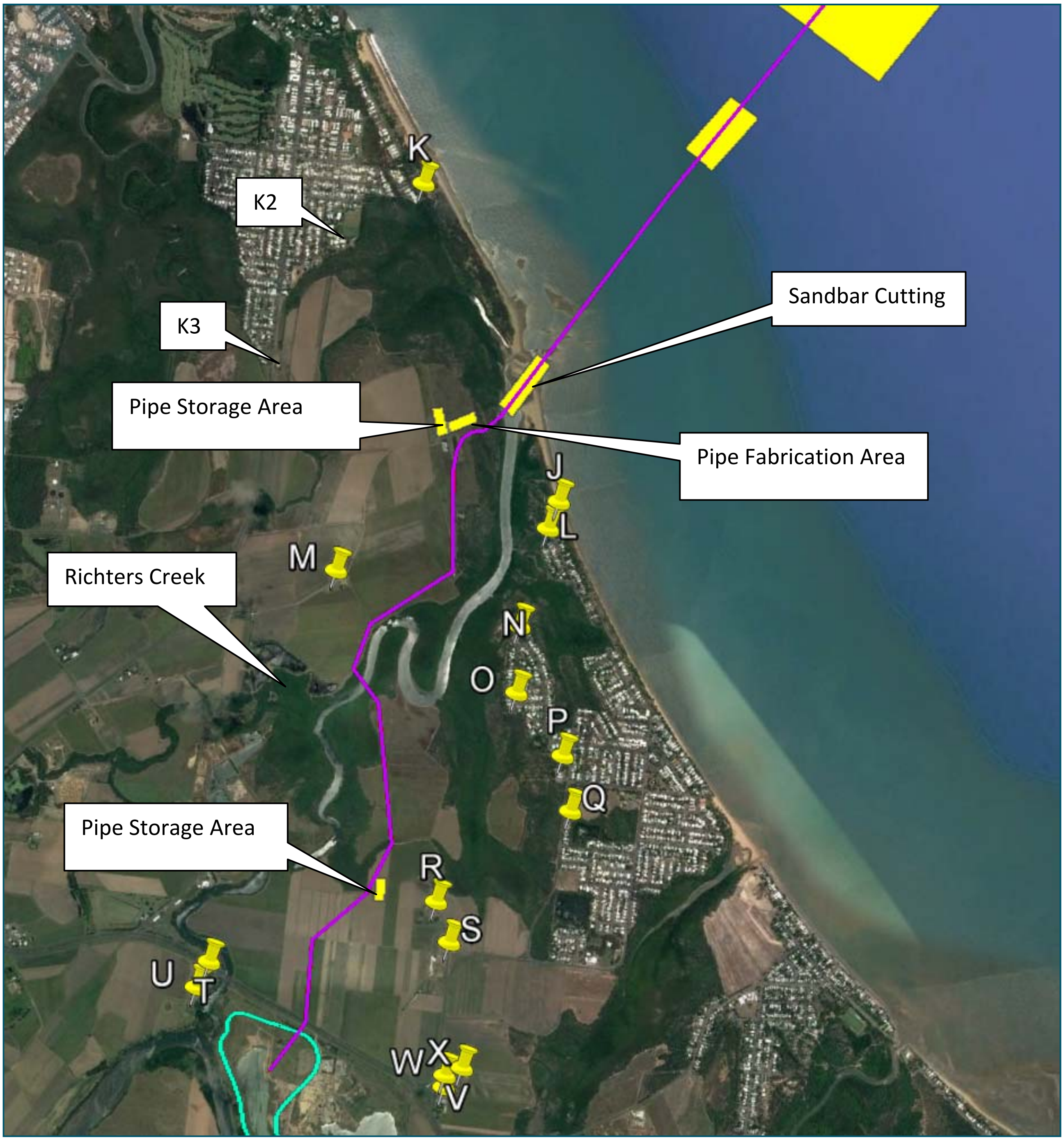


**Figure 7.1 Location of Pipe Storage and Laydown, Fabrication Areas and Sensitive Receivers**

**Table 7.3 Predicted Noise Levels from Pipeline Commissioning and Decommissioning**

| Activity/Noise Source | Sensitive Receptor | Predicted Noise Level $L_{eq}$(15 minute) dBA | | Construction Noise Level Target (from Table 6.1 (Day) $L_{eq}$(15 minute) dBA | Exceedance of Noise Level Target | |
|---|---|---|---|---|---|---|
| | | Neutral | Adverse | | Neutral | Adverse |
| Pipe Fabrication | J | 31 | 37 | 42 | 0 | 0 |
| | K | 21 | 28 | 42 | 0 | 0 |
| | K2 | 23 | 29 | 42 | 0 | 0 |
| | K3 | 26 | 32 | 42 | 0 | 0 |
| | L | 29 | 35 | 42 | 0 | 0 |
| | M | 24 | 31 | 42 | 0 | 0 |
| | N | 23 | 30 | 42 | 0 | 0 |
| | O | 20 | 26 | 42 | 0 | 0 |
| Sandbar Cutting | J | 41 | 46 | 42 | 0 | 4 |
| | K | 32 | 37 | 42 | 0 | 0 |
| | K2 | 31 | 36 | 42 | 0 | 0 |
| | K3 | 32 | 37 | 42 | 0 | 0 |
| | L | 39 | 44 | 42 | 0 | 2 |
| | M | 30 | 36 | 42 | 0 | 0 |
| | N | 32 | 38 | 42 | 0 | 0 |
| | O | 30 | 35 | 42 | 0 | 0 |
| Dozer and Excavator Working Along Pipeline Route (i.e. construction and decommissioning) | J | 42 | 47 | 42 | 0 | 5 |
| | K | 24 | 30 | 42 | 0 | 0 |
| | K2 | 26 | 32 | 42 | 0 | 0 |
| | K3 | 30 | 36 | 42 | 0 | 0 |
| | L | 45 | 49 | 42 | 3 | 7 |
| | M | 52 | 55 | 42 | 10 | 13 |
| | N | 44 | 49 | 42 | 2 | 7 |
| | O | 38 | 43 | 42 | 0 | 1 |
| | P | 33 | 38 | 42 | 0 | 0 |
| | Q | 34 | 39 | 42 | 0 | 0 |
| | R | 49 | 52 | 51 | 0 | 1 |
| | S | 43 | 48 | 51 | 0 | 0 |
| Cumulative Noise (Pipe Fabrication and Dozer and Excavator Crew) | J | 42 | 47 | 42 | 0 | 5 |
| | K | 26 | 32 | 42 | 0 | 0 |
| | K2 | 27 | 34 | 42 | 0 | 0 |
| | K3 | 32 | 37 | 42 | 0 | 0 |
| | L | 45 | 49 | 42 | 3 | 7 |

| Activity/Noise Source | Sensitive Receptor | Predicted Noise Level $L_{eq}$(15 minute) dBA | | Construction Noise Level Target (from Table 6.1 (Day) $L_{eq}$(15 minute) dBA | Exceedance of Noise Level Target | |
|---|---|---|---|---|---|---|
| | | Neutral | Adverse | | Neutral | Adverse |
| | M | 52 | 55 | 42 | 10 | 13 |
| | N | 44 | 49 | 42 | 2 | 7 |
| | O | 38 | 43 | 42 | 0 | 1 |
| | P | 33 | 38 | 42 | 0 | 0 |
| | Q | 34 | 39 | 42 | 0 | 0 |
| | R | 49 | 52 | 51 | 0 | 1 |
| | S | 43 | 48 | 51 | 0 | 0 |

The following comments are made regarding the predicted noise levels:

- Noise from the pipe fabrication area is predicted to be compliant with the noise level targets at all receptors.
- Noise from sandbar cutting is predicted to slightly exceed (up to 4 dB) the construction noise level targets during adverse conditions.
- Noise from the dozer and excavator crew is predicted to exceed the noise limits at numerous receptors during both neutral and adverse conditions. The highest exceedance is up to 13 dB at Receptor M, which is the closest receptor to the pipeline route. The predicted noise level at Receptor M is well below the highly affected noise level of 75 dBA $L_{eq}$(15 minute).
- The cumulative noise levels also exceed the noise criteria at numerous receptors during both neutral and adverse conditions. The predicted cumulative noise levels are dominated by noise from the dozer and excavator crew, with noise from the fabrication area having only a minor influence on the overall noise level at some receptors.

It is noted that the highest predicted noise level from pipeline construction activity is 55 dBA $L_{eq}$(15 minutes) at Receptor M, which is the closest receptor to the pipeline route. This noise level is well below the highly affected noise level of 75 dBA $L_{eq}$(15 minute) as prescribed by the ICNG (see **Table 3.2**).

Based on the anticipated construction time and decommissioning time required (up to 6 weeks), and the current proposed length of the pipeline (approximately 4.5 kilometres onshore), the anticipated pipeline construction rate is approximately 200 metres per day. Therefore it is considered unlikely that receptors will be subject to the noise levels presented in **Table 7.3** for more than a few days.

As the anticipated duration required for sandbar cutting is up to one week, receptors will only be exposed to noise associated with this activity for a short period of time.

It is also noted that as the pipeline will be built during cane harvesting season, it is possible that noise from the pipeline construction may not be discernible from cane harvesting operations at some locations.

Overall, it is expected that noise emissions from pipeline construction and decommissioning will not significantly impact sensitive receptors. Mitigation methods and management strategies to reduce noise impacts onto sensitive receptors are discussed in **Section 9**.

## 7.5 Booster Pump Stations

Dredge material will be transferred via the pipeline via the installation of a number of booster pump stations. The dredge material pipeline will operate over a period of approximately 12 weeks consistent with the capital dredging program. The booster pump stations will operate 24 hours per day, 7 days per week for the duration of the operation of the pipeline.

At the current time it is anticipated that three booster pumps will be required, two of these being land based and a third located off-shore (floating). The current proposed location of the booster pumps is shown in **Figure 7.2**. The coordinates of the proposed pump stations are presented in **Table 7.4**.

**Table 7.4 Proposed Booster Pump Station Coordinates**

| Pump Station | UTM Coordinates (metres) (Zone 55) | |
|---|---|---|
| | X Coordinate | Y Coordinate |
| Marine Booster | 366123 | 8141151 |
| On-Shore Booster 1 | 364667 | 8139416 |
| On-Shore Booster 2 | 364245 | 8137576 |

Based on project tenders, the following power requirements are estimated for the booster stations (subject to confirmation by the appointed contractor):

- marine booster pumps: 4,475 kW
- on-shore booster pumps: approximately 2,000 kW

Noise predictions have been undertaken for the booster pumps assuming the sound power levels for the pumps as presented in **Table 7.5**. The sound power levels presented in **Table 7.5** are based on the sound power level data applied for booster pumps for the Sunshine Coast Airport EIS noise impact assessment (Sunshine Coast Regional Council, 2014) which was a similar project to the proposed CSD Project.

The sound power level data presented in **Table 7.5** assumes that the booster pumps are attenuated. It is expected that an overall reduction in the order of 15 dB would be achieved with the installation of plant specific attenuation. This attenuation may include:

- Enclosing the engine with an acoustically robust enclosure including internal acoustic absorption.
- Fitting industrial mufflers.
- Selection of the quietest available plant or perhaps over specified equipment (allowing lower operating speeds for the same throughput).
- Enclosing the pump.

Additional mitigation could also be provided for land-based pump stations using bunding, or temporary acoustic barriers, however this has not been assumed in the base assessment as the feasibility of these additional measures will need to be confirmed with the appointed contractor.

Table 7.5 Booster Pump Station Sound Power Levels ($L_{weq}$)

| Pump | Quantity | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | | | Sound Power Level, $L_{weq}$, dBZ | Sound Power Level, $L_{weq}$, dBA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31 | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | | |
| Marine Booster | 1 | 109 | 107 | 103 | 100 | 105 | 103 | 100 | 94 | 86 | 112 | 108 |
| On-shore Booster | 2 | 106 | 104 | 100 | 97 | 102 | 100 | 97 | 91 | 83 | 109 | 105 |


**Figure 7.2 Location of Booster Pump Stations**

Noise predictions for pump station operation have been undertaken for the worst affected receptors. The predicted noise levels at each receptor are presented in **Table 7.6**. As the booster pumps will operate 24 hours/day, the predicted noise levels have been assessed against the night-time construction noise limit for each receptor. The derived exceedance of the night-time noise level targets (if any) is also presented in **Table 7.6**.

Table 7.6 Predicted Noise Levels from Booster Pumps (attenuated) (locations as per Table 7.4)

| Sensitive Receptor | Predicted Noise Level $L_{eq}$(15 minute) dBA | | Construction Noise Level Targets (from Table 6.1) (Night) $L_{eq}$(15 minute) dBA | Exceedance of Noise Limit | |
|---|---|---|---|---|---|
| | Neutral | Adverse | | Neutral | Adverse |
| J | 33 | 38 | 35 | 0 | 3 |
| K | 28 | 35 | 35 | 0 | 0 |
| K2 | 25 | 31 | 35 | 0 | 0 |
| K3 | 27 | 33 | 35 | 0 | 0 |
| L | 32 | 38 | 35 | 0 | 3 |
| M | 29 | 35 | 35 | 0 | 0 |
| N | 29 | 35 | 35 | 0 | 0 |
| O | 31 | 36 | 35 | 0 | 1 |
| P | 28 | 34 | 35 | 0 | 0 |
| Q | 27 | 33 | 35 | 0 | 0 |
| R | 29 | 34 | 40 | 0 | 0 |
| S | 25 | 31 | 40 | 0 | 0 |
| T | 21 | 27 | 40 | 0 | 0 |
| U | 20 | 26 | 40 | 0 | 0 |
| V | 19 | 25 | 40 | 0 | 0 |
| W | 18 | 25 | 40 | 0 | 0 |
| X | 18 | 25 | 40 | 0 | 0 |
| Y | 14 | 21 | 40 | 0 | 0 |

It is evident from the results presented in **Table 7.6** that the predicted noise levels comply with the night-time noise level targets under neutral conditions, but exceed the night-time noise level targets at Receptors J, L and O under adverse conditions. The predicted noise exceedance under adverse conditions is up to 3 dB at Receptors J and L, and up to 1 dB at Receptor O.

Overall the level of these exceedances is considered minor, and it expected that further mitigation (i.e. bunding or quieter plant selection) will result in compliance with the noise level targets.

A detailed assessment of noise emissions from the booster pumps will be required when pump selections, the number of stations required is confirmed, and potential locations for the stations is confirmed. Further discussion of the requirements for this further assessment is provided in **Section 9**.

## 7.6 Northern Sands Dredge Material Placement Area

As discussed in **Section 2.5.1**, the NS DMPA will operate throughout the duration of the capital dredging program (approximately 12 weeks).

The NS DMPA will operate using day and night shifts, however based on the methodology for the material placement, the only significant noise source associated with operation of the DMPA is anticipated to be the tailwater discharge pump.

The preparation of the DMPA (construction of earth bunding) will be undertaken by the quarry as part of 'business as usual' operations. Construction will be daytime only and use equipment such as dozers and excavators which are typically used in a quarry or on farms in the area – but for extended periods during bund construction. This activity is not within the scope of the CSD Project and therefore does not require assessment.

### 7.6.1 Tailwater Discharge Pump

A separate return water pump (separate to on-shore booster pumps) will be required to return the tailwater from the NS DMPA to the Barron River. Depending on water quality requirements, tailwater from the DMPA may be pumped directly from the placement pond, or from an additional tailwater pond. The location of the placement pond and the contingency tailwater pond are shown in **Figure 7.3**.

At the current time the exact brand and model of tailwater pump to be used is unknown, and this detail will be determined by the future appointed contractor responsible for the operation of DMPA. The anticipated pump capacity required is up to 100,000 $m^3$/day.

Similar to the booster pump stations, the tailwater pumps at the DMPA may operate during the day, evening and night periods, and therefore compliance during the night-time will be the limiting factor with respect to controlling noise emissions from the pumps.

To assess noise emissions from the tailwater pump, noise predictions were undertaken assuming a sound power level of 90 dBA $L_{weq}$, which is considered applicable for an industrial pump within a standard acoustic enclosure (i.e. providing 10 dB attenuation). This assumption is considered a reasonable estimate for the pump based on the information available and ASK's database of sound power level data. The sound power spectrum applied for the pump is presented in **Table 7.7**.

It is noted that the required size of the DMPA tailwater pump will be significantly less than the size required for the pipeline booster pumps, as the DMPA pump is only pumping water (not slurry), and is pumping significantly less volume.

**Table 7.7 Assumed Sound Power Level for Tailwater Pump ($L_{weq}$) (Attenuated)**

| Pump | Quantity | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | | Sound Power Level, $L_{weq}$, dBZ | Sound Power Level, $L_{weq}$, dBA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | | |
| Tailwater Pump | 1 | 89 | 85 | 82 | 87 | 85 | 82 | 76 | 68 | 94 | 90 |

At the present time the exact location of the tailwater pumps is unknown, and will depend on the requirement for a separate tailwater pond. For the purposes of the assessment, two potential pump locations have been modelled as shown in **Figure 7.3**. The coordinates for the locations are also presented in **Table 7.8**.

**Table 7.8 Assumed Tailwater Pump Locations**

| Pump Station | UTM Coordinates (metres) (Zone 55) | |
|---|---|---|
| | X Coordinate | Y Coordinate |
| P1. Tailwater Pump for Discharge from Placement Pond | 364104 | 8135187 |
| P2. Tailwater Pump for Discharge from Separate Tailwater Pond | 364384 | 8135657 |

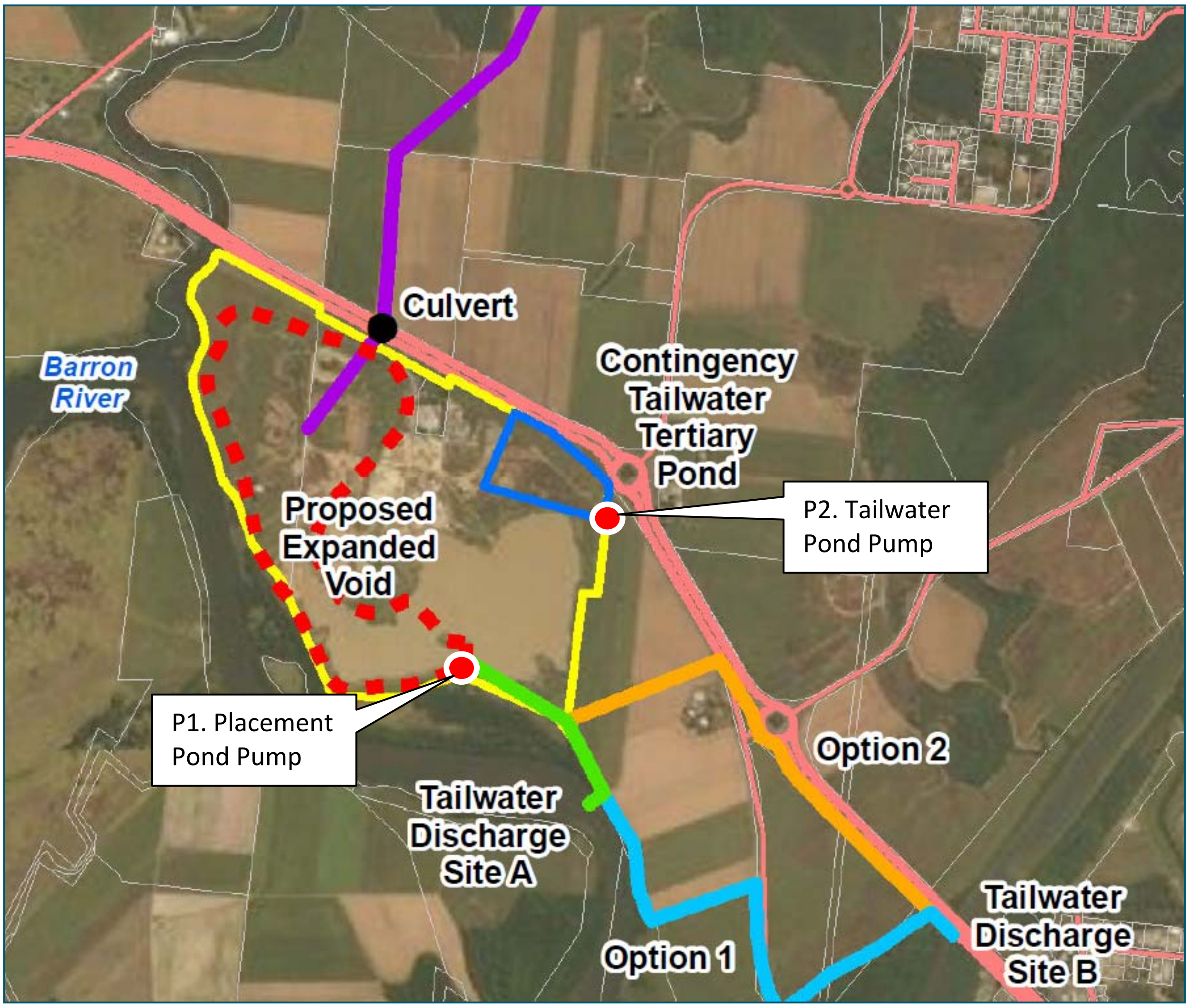


**Figure 7.3 Placement Pond, Tailwater Pond and Assessed Tailwater Pump Locations**

Using the assumed attenuated sound power level of 90 dBA $L_{weq}$ (see **Table 7.7**) and the nominated pump locations, noise predictions were undertaken for the nearest sensitive receptors for each pump location separately. The results of the noise predictions are presented in **Table 7.9**. As the pumps may operate 24 hours/day, the predicted noise levels have been assessed against the night-time construction noise limit for each receptor. The derived exceedance of the night-time noise limit (if any) is also presented in **Table 7.9**.

It has been assumed for the purpose of the noise predictions that the pumps operate continuously (i.e. 100% of the assessment period of 15 minutes).

The nearest sensitive receptors to the potential pump locations are Receptors T to Y. It is noted that Receptors V, W and X are all located on the opposite (northern) side of the Captain Cook Highway.

**Table 7.9 Predicted Noise Levels from Tailwater Pumps**

| Pump | Sensitive Receptor | Predicted Noise Level $L_{eq}$(15 minute) dBA | | Construction Noise Level Targets (from Table 6.1) (Night) $L_{eq}$(15 minute) dBA | Exceedance of Noise Level Targets | |
|---|---|---|---|---|---|---|
| | | Neutral | Adverse | | Neutral | Adverse |
| Placement Pond | T | 9 | 16 | 40 | 0 | 0 |
| | U | 10 | 16 | 40 | 0 | 0 |
| | V | 16 | 22 | 40 | 0 | 0 |
| | W | 18 | 24 | 40 | 0 | 0 |
| | X | 18 | 24 | 40 | 0 | 0 |
| | Y | 18 | 24 | 40 | 0 | 0 |
| Tailwater Pond | T | 9 | 15 | 40 | 0 | 0 |
| | U | 9 | 16 | 40 | 0 | 0 |
| | V | 26 | 31 | 40 | 0 | 0 |
| | W | 33 | 35 | 40 | 0 | 0 |
| | X | 34 | 36 | 40 | 0 | 0 |
| | Y | 18 | 23 | 40 | 0 | 0 |

As evident by **Table 7.9**, based on the assumed locations (see **Table 7.8**) and sound power level (90 dBA $L_{weq}$) for the tailwater pump, the predicted noise levels for both pump locations are compliant with the night-time noise level targets, being the strictest noise level target, at all receptors. It is noted that the predicted noise levels from the pump located at the tailwater pond (P2, see **Figure 7.3**) are close to the noise level targets (compliant by 1 dB under adverse conditions).

Overall it is expected that if the tailwater is to be pump from the placement pond, with a pump located at the southern extent of the placement area (see **Table 7.8** and **Figure 7.3**) it is likely that noise emissions from the pump will be compliant at sensitive receptors, and minimal mitigation would be required. However, if an additional tailwater pond is required, and the pump is required to be located towards the northern boundary of the DMPA (similar to P2, see **Figure 7.3**), more detailed consideration of noise mitigation will be required.

It is recommended that an assessment of tailwater pump noise is undertaken when the exact location of the pump is known, and when the pump model has been selected.

## 7.7 TSHD Pump-Out

As part of the dredging process, soft clay dredge material captured by the TSHD will be transferred to the dredge material pipeline via an off-shore pump-out area. Noise emissions from the TSHD pump-out process are required to be considered in the assessment of construction noise impacts.

The off-shore pump-out location is located approximately 2.5 to 3.5 kilometres north-east of the coastline at Yorkeys Knob, as shown in **Figure 2.2**. The TSHD pump-out will occur via the following process:

- The TSHD will travel to the pump-out location, which will consist of the moored marine booster station and a floating pipeline.
- A multicat or shoalbuster will be deployed at the pump-out to assist the TSHD with coupling to the floating pipeline.

- The TSHD will fill the material hopper with seawater, diluting the dredge material into a slurry with a ratio of 6:1 solids-to-liquid.
- The TSHD will then pump the slurry into the floating pipeline, for transfer via the material pipeline to the NS DMPA. The pump used to expel the slurry is the same pump used for the suction dredging.

Consistent with the dredging program, TSHD pump-out will occur during day, evening and night-time periods for the duration of the capital dredging program (anticipated 12 weeks).

Noise predictions have been undertaken for the TSHD pump-out assuming a sound power level of 110 dBA $L_{weq}$, as presented in **Table 7.10**. This sound power level is based on information presented in MDA (2009) for operation of the TSHD. As the TSHD uses the same pump for suction (operation) as it does for pump-out, the use of this operational sound power level is considered acceptable.

**Table 7.10 Assumed Sound Power Level for TSHD Pump-Out ($L_{weq}$)**

| Source | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | | Sound Power Level, $L_{weq}$, dBZ | Sound Power Level, $L_{weq}$, dBA |
|---|---|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | | |
| TSHD Pump-Out | 111 | 119 | 108 | 106 | 106 | 101 | 94 | 86 | 120 | 110 |

For the purpose of the noise predictions the TSHD has been assumed to be located at the following coordinates: TSHD Pump-out location (UTM coordinates): X: 366831, Y: 8142025.

Noise predictions have undertaken including the influence of the operation of the booster pumps, i.e. cumulative assessment of TSHD pump-out and booster pumps, as these sources will operate simultaneously when the TSHD is pumping out. The predicted noise levels are presented in **Table 7.11**.

For the purpose of the noise predictions it has been assumed that the multicat (or shoalbuster) will not be operating under significant load whilst the TSHD is pumping out. This is considered reasonable as the purpose of the vessel is to assist with connection to the pipeline.

**Table 7.11 Predicted Noise Levels from TSHD Pump-Out**

| Sensitive Receptor | Predicted Noise Level $L_{eq}$(15 minute) dBA | | Construction Noise Level Targets (from Table 6.1) (Night) $L_{eq}$(15 minute) dBA | Exceedance of Noise Level Targets | |
|---|---|---|---|---|---|
| | Neutral | Adverse | | Neutral | Adverse |
| J | 33 | 39 | 35 | 0 | 4 |
| K | 30 | 37 | 35 | 0 | 2 |
| K2 | 27 | 33 | 35 | 0 | 0 |
| K3 | 27 | 33 | 35 | 0 | 0 |
| L | 32 | 38 | 35 | 0 | 3 |
| M | 30 | 35 | 35 | 0 | 0 |
| N | 30 | 36 | 35 | 0 | 1 |
| O | 31 | 37 | 35 | 0 | 2 |
| P | 28 | 34 | 35 | 0 | 0 |
| Q | 27 | 33 | 35 | 0 | 0 |
| R | 29 | 34 | 37 | 0 | 0 |
| S | 25 | 31 | 37 | 0 | 0 |
| T | 21 | 27 | 37 | 0 | 0 |
| U | 20 | 26 | 37 | 0 | 0 |
| V | 19 | 25 | 37 | 0 | 0 |
| W | 18 | 25 | 37 | 0 | 0 |
| X | 18 | 25 | 37 | 0 | 0 |
| Y | 14 | 21 | 37 | 0 | 0 |

It is evident from the results presented in **Table 7.11** that the predicted cumulative noise levels from TSHD pump-out and booster pump operation comply with the night-time noise level targets under neutral conditions, but exceed the night-time noise level targets at Receptors J, K, L, N and O under adverse conditions. The highest predicted noise exceedance under adverse conditions is up to 4 dB at Receptor J.

It is noted that the predicted noise level from the TSHD pump-out by itself is compliant, however the influence of the booster stations resulting in an overall noise level which exceeds the night-time noise level targets.

Overall the level of the predicted exceedances is considered moderate. It is expected that further mitigation of the booster pump stations to achieve compliance would be possible.

A detailed assessment of noise emissions from the booster pumps and TSHD pump-out process will be required when pump selections, the number of stations and their locations, is confirmed. Further discussion of the requirements for this further assessment is provided in **Section 9**.

# 8. Noise Assessment of Wharf Construction and Operation

## 8.1 Overview

The original noise assessment for the previous proposal for the CSD Project was undertaken by ARUP. The details of the assessment were presented in Appendix D.7 of the Draft EIS (Noise and Vibration Technical Report).

As the revised CSD Project has not altered the proposed construction or operation of the wharf, the previous assessment undertaken by ARUP is still applicable. Therefore the assessment for the Revised EIS is based on the outcomes derived from ARUP assessment, with additional discussion provided.

The main components of the wharf construction work include the construction of the intermediate fuel oil (IFO) pipeline and the upgrade of the wharf itself. As summarised in **Section 2.8**, wharf upgrade construction work will be undertaken over a period of approximately 12 months, and will be predominantly be undertaken during regular construction hours (6:30 am to 6:30 pm, Monday to Saturday), with only minor works (not generating significant noise) being undertaken outside of these times. IFO pipeline construction is expected to take longer than 1 month, and will also be undertaken during standard construction hours.

For wharf construction and operation, the potentially worst affected receptors at Receptors A - E, being the residential apartments and hotels located on Wharf Street (see **Figure 4.1**).

## 8.2 Present Restrictions on Port Operations

It is understood that currently there are no time restrictions on port operations with respect to ship arrival and departure times or docked activities (i.e. 24/7 operation is permitted). Time restrictions on port activity are not desired for the following reasons:

- Ship travel through the channel is influenced by tide height, and therefore further limitation of the travel times jeopardises the cruise schedules.
- It is attractive for cruise vessels to be able to stay late into the night and depart in the early hours of the morning to maximise passenger time ashore.

Ports North has advised that to-date, no noise complaints have been lodged regarding current cruise ship activity at the wharf.

## 8.3 Assessment Criteria

### 8.3.1 Construction

**Airborne Noise**

The noise assessment criteria applied by ARUP in the assessment of construction noise impacts were the ICNG construction noise limits also applied in this assessment, and discussed in detail in **Section 3.4.3**. These criteria are considered applicable for the assessment of wharf construction and wharf 6 demolition noise.

As part of the ARUP assessment ambient noise logging was undertaken at the Hilton Hotel (Receptor F, see **Figure 4.1)**. It is assumed that this noise logging was undertaken at ground level, however this detail is not provided in the ARUP report. Noise logging was also undertaken at the Piermonde Hotel (Receptor B, see **Figure 4.1**), at a balcony on Level 6 as discussed in **Section 5.3.** As discussed in **Section 5.3** and **Section 5.5**, the ambient noise environment at both logging locations is influenced by mechanical plant from nearby residential buildings.

The measured rating background noise levels from the ASK logging are deemed to be the most appropriate for the assessment as they have been obtained from logging at one the nearest sensitive receptors (Location G1, Piermonde Apartments, receptor B) to the wharf construction area. The derived construction noise screening limits using the RBL obtained from Location G1 are presented in **Table 8.1**.

**Table 8.1 Construction Noise Screening Criteria - Wharf Construction**

| Background Noise Level $L_{90}$ dBA (Noise Logging at Location G1, see Section 5.3) | Derived ICNG Noise Affected Level dBA $L_{eq}$ (15 minute) (D = Bg + 10 dB, E/N = Bg + 5 dB) |
|---|---|
| D: 52<br>E: 50<br>N: 47 | D: 62<br>E: 55<br>N: 52 |

It is important to note that the ICNG targets are not noise limits as such, but screening criteria for assessing whether construction noise is likely to have adverse impacts and hence whether "feasible and reasonable" work practices should be implemented during the construction process in order to reduce noise levels.

Assessment of construction noise has also considered the potential for sleep disturbance.

**Vibration**

ARUP assesses the impact of vibration on human comfort by applying the vibration impact criteria recommended by "Assessing vibration: A Technical Guideline 2006" (NSW Department of Environment and Conservation, 2006) and British Standard BS 5228.2 (2009). The vibration impact criteria applied are presented in **Table 8.2** (Table D.7.6.4.1a of the ARUP Technical Report). These criteria are considered appropriate for the assessment.

**Table 8.2 Vibration Impact Criteria for Construction Vibration – Human Comfort**

| Impact Category | PPV (mm/s) | VDV ($m/s^{1.75}$) | | Subjective Impact (from BS 5228.2) |
|---|---|---|---|---|
| | | Day/Evening (7:00am to 10:00pm) | Night (10:00pm to 7:00am) | |
| Negligible | PPV ≤ 0.3 | VDV ≤ 0.2 | VDV ≤ 0.13 | Vibration just perceptible |
| Minor | 0.3 < PPV ≤ 1.0 | 0.2 < VDV ≤ 0.4 | 0.13 < VDV ≤ 0.26 | Vibration perceptible, potential for complaint |
| Moderate | 1.0 < PPV ≤ 10 | 0.4 < VDV ≤ 0.8 | 0.26 < VDV ≤ 0.52 | Complaints likely |
| Major | PPV > 10 | VDV > 0.8 | VDV > 0.52 | Vibration likely intolerable |

ARUP assessed the impact of vibration on buildings using German Standard DIN 4150:3 (1986). A screening criterion for vibration velocity ($v_i$) of 3mm/s was applied for impacts to heritage wharf structure, with a screening criterion of 5mm/s applied for residential structures.

### 8.3.2 Operation

**Planning Level Criterion**

Time averaged ($L_{eq}$) noise limits for operational noise emissions (i.e. wharf activities, ship movements) were determined by ARUP using the "determination of planning noise level" method from the PNCG, which determines an $L_{Aeq}$ (1 hour) noise limit for each period of the day (day, evening and night) based on (i) the specific noise limit calculated as the measured Rating Background Level during each period plus an allowance of + 3 dBA; and (ii) the amenity criteria based on the noise area category.

The ARUP assessment varied from the standard PNCG determination of the specific noise limit, by not imposing a background creep limit. This approach was taken as it was considered that for the CSDP, the noise sources associated with operation of the development will consist of additional discrete ship visit events (over and above the existing ship visit events associated with current operation of the Port of Cairns).

Given the operation occurs 24 hours per day, the night period is the most stringent and of greatest interest. The noise limits applied in the ARUP assessment using this method are presented **Table 8.3**. For comparison, the calculated external Acoustic Quality Objective noise limits for the night-time (see **Section 3.3.1**) are also presented in **Table 8.3**. The external Acoustic Quality Objective noise limits are presented based on windows/doors open (7 dBA facade reduction) or closed (20 dBA facade reduction).

**Table 8.3 Planning Level Noise Criteria for Operational Noise**

| Receptors | Time Period | Measured RBL $L_{90}$ (1 hour) dBA | ARUP Proposed Noise Limit (RBL + 3 dBA) $L_{eq}$ (1 hour) dBA | Acoustic Quality Objective Noise Limit (Calculated External Noise Limit)* $L_{eq}$ (1 hour) dBA |
|---|---|---|---|---|
| Wharf Street Residential Area | Day (6:00am to 6:00pm) | 54 | 57 | 42 – Doors/windows Open<br>55 – Doors/windows Closed |
| | Evening (6:00pm to 10:00pm) | 48 | 51 | 42 – Doors/windows Open<br>55 – Doors/windows Closed |
| | Night (10:00pm to 6:00am) | 46 | 49 | 37 – Doors/windows Open<br>50 – Doors/windows Closed |

Note: It was stated by ARUP that due to the existing noise environment, day was considered to be between 6:00 am and 6:00 pm (typically 7:00 am to 6:00 pm).

* There is also an outdoor 50 dBA $L_{eq}$(1hour) noise limit included in the Acoustic Quality Objectives for day and evening periods. It is considered more likely that an indoor noise limit will be most critical, particularly at night, and thus external noise limits corresponding to achieving the internal noise limit are listed.

Since the ARUP report was prepared, ASK has conducted additional background noise measurements at the nearby Piermonde Units (Locations G1 and G2) which resulted in similar background noise levels (refer **Table 5.3** and **Table 5.5**), including a background noise level of 47 dBA $L_{90}$ at night at Location G1.

It is evident from review of the noise limits presented in **Table 8.3** that the noise limit applied by ARUP (49 dBA $L_{eq}$ (1 Hour)) is significantly higher than the Acoustic Quality Objectives noise limit of 37 dBA $L_{eq}$ (1 Hour) proposed with windows/doors open. However, as presented in **Tables 5.3** and **Table 5.5** and discussed in **Section** 5, the noise environment at Wharf Street is significantly influenced by mechanical plant emissions from the Pullman Hotel and the Jack & Newell Apartments, and the RBL determined by unattended noise logging (undertaken by ARUP at the Hilton Hotel, measured at 46 dBA $L_{90}$) is higher than the Acoustic Quality Objectives noise limit of 37 dBA $L_{eq}$ (1 Hour). Additionally, it is noted that the internal Acoustic Quality Objectives will be achieved with the windows/doors closed, which we expect to be a more normal scenario at night. Therefore it is considered acceptable to apply a higher noise limit.

**Sleep Disturbance Criterion**

Sleep disturbance noise limits for operation and construction noise occurring during the night-time (10:00 pm to 6:00 am) were derived by ARUP based on the sleep disturbance criteria presented within the PNCG, and also a screening criterion for "emergence" as discussed by the NSW Road Noise Policy (NSW DECCW, 2011) and NSW RTA Environmental Noise Management Manual (NSW RTA, 2001). The NSW emergence level is based on the measured background noise level ($L_{90}$) plus 15 dBA. The PNCG sleep disturbance noise limit applied by ARUP was the single event $L_{max}$ noise level (assuming one noise event per night). For comparison, the calculated external Sleep Disturbance noise limits (doors/windows open and closed as per **Table 3.1**) are also presented in **Table 8.4**.

**Table 8.4 Night $L_{max}$ Noise Criteria Comparison**

| Receptors | Time Period | Measured RBL $L_{90}$ (1 hour) dBA | ARUP Proposed Sleep Disturbance Criteria dBA $L_{max}$ | | Sleep Disturbance Noise Limit (Calculated External Noise Limit) $L_{max}$ dBA |
|---|---|---|---|---|---|
| | | | Emergence Noise Level (RBL + 15 dBA) (external) | Absolute Noise Limit | |
| Wharf Street Residential Area | Night (10:00pm to 6:00am) | 46 | 61 | 62 | 52 to 62 – Doors/windows Open<br>65 to 75 – Doors/windows Closed |

Note: * Absolute Noise limit is based on 1 event per night.

** Range in Sleep Disturbance noise limits is presented as it is dependent on the number of events.

It is noted that the noise logging conducted by ASK at Piermonde Units (Location G1) resulted in average noise levels of 69 dBA $L_{max,15min}$ and 63 dBA $L_{1,15min}$ at night. Based on the comments in **Table 5.5** the maximum noise level results are likely due to road traffic on nearby roads. Therefore, the proposed ARUP noise criteria are already generally exceeded at this location due to other noise sources, and consideration to the additional sleep disturbance criteria calculated with doors/windows closed may be appropriate in this instance.

## 8.4 Airborne Noise Assessment

### 8.4.1 Model Settings

The model settings used by ARUP for the SoundPLAN modelling of the wharf are summarised in **Table 8.5**. Overall the settings are considered acceptable for the assessment.

**Table 8.5 ARUP Noise Model Settings**

| Input Parameter | Details |
|---|---|
| Propagation Methodology | Concawe |
| Ground Absorption Factor | 0.6 |
| Receptor Height | 1.5m |
| Weather Conditions - Neutral | Wind speed: 0 m/s<br>Temperature: 25°C<br>Humidity (%): 80%<br>Pasquill Stability Class: D |
| Weather Conditions - Adverse | Wind speed: 6.5 m/s<br>Temperature: 25°C<br>Humidity (%): 80%<br>Pasquill Stability Class: D |

### 8.4.2 Assessment of Operational Noise Impacts

Operational activities were separated into four categories for the assessment:

- Cruise ships entering/leaving port (transit)
- Cruise ships berthing at the cruise terminal
- Cruise ships unloading and loading, including ship refuelling, goods and passenger loading and unloading activities (including associated dockside traffic movements)
- Docked cruise ship noise (constant noise from ship auxiliary engines and ventilation system).

Sound power levels used in the ARUP assessment were obtained based on attended measurements of various size cruise ships in transit and whilst docked at ports in Sydney and Brisbane in 2013 and 2014.

For the purpose of noise predictions, ships were divided into size categories, being medium and large cruise ships.

For each of operational categories, noise levels were predicted were assessed based on activities listed in **Table 8.6**.

**Table 8.6 Noise Activities for Prediction of Operational Noise Impacts**

| Activity | Noise Sources |
|---|---|
| Transit | Primary propulsion engines<br>Ventilation system |
| Berthing | Primary propulsion engines<br>Ventilation system<br>Berthing motors<br>PA system |
| Loading/unloading (at dock) | Auxillary engines<br>Ventilation system<br>Forklifts<br>Refueling |
| Docked | Auxillary engines<br>Ventilation system |

The sound power levels applied by ARUP in the noise modelling (for the activities listed in **Table 8.6**) are included in **Appendix C** in **Figure C.1** and **Figure C.2**. The sound power levels applied by ARUP are considered reasonable based on the available information for the Project.

The predicted noise levels at nearest sensitive receivers for existing ships and future medium and large ships are included in **Table 8.7**.

**Table 8.7 ARUP Predicted Cruise Ship Activity Noise Levels (Table D.7.8.2a, Table D.7.8.2b, Table D.7.8.2c, Table D.7.8.2.1a and Table D.7.8.2.1b of ARUP Technical Report)**

| Source | Predicted Noise Level $L_{eq}$ dBA | | Predicted Noise Level $L_{max}$ dBA | |
|---|---|---|---|---|
| | Neutral | Adverse | Neutral | Adverse |
| Existing Scenario – Large Ship, Rhapsody of the Seas | | | | |
| Cruise Ship Docked | 54 | 55 | n/a | n/a |
| Cruise Ship Loading/Unloading | 54 | 55 | n/a | n/a |
| Cruise Ship Berthing | 54 | 55 | n/a | n/a |
| Cruise Ship Transit | 50 | 51 | n/a | n/a |
| Future Scenario - Medium Ship (e.g. Pacific Dawn, Sun Princess) | | | | |
| Cruise Ship Docked | 46 | 46 | n/a | n/a |
| Cruise Ship Loading/Unloading | 51 | 52 | 60 | 61 |
| Cruise Ship Berthing | 52 | 53 | 62 | 62 |
| Cruise Ship Transit | 46 | 47 | 66 | 66 |
| Future Scenario - Large Ship (e.g. Radiance of the Seas) | | | | |
| Cruise Ship Docked | 53 | 54 | n/a | n/a |
| Cruise Ship Loading/Unloading | 54 | 55 | 60 | 61 |
| Cruise Ship Berthing | 53 | 54 | 62 | 62 |
| Cruise Ship Transit | 49 | 50 | 74 | 75 |

Note: n/a = not presented in ARUP report.

From review of the ARUP noise predictions presented in **Table 8.7**, the following comments are made:

- The predicted $L_{eq}$ noise levels for the future ships are the same or lower than predicted for the existing ships. Maximum noise levels are not provided for the existing ships, but it is considered reasonable to presume that they will be similar to the future ships.
- The predicted $L_{eq}$ noise levels:
  - Achieve the ARUP and Acoustic Quality Objective (Doors/windows closed) daytime noise criteria in **Table 8.3**.
  - Exceed the ARUP evening criteria in **Table 8.3** by up to 4 dBA but achieve the Acoustic Quality Objective criteria in **Table 8.3** with windows and doors closed in this period.
  - Exceed the ARUP night criteria in **Table 8.3** by up to 6 dBA and the Acoustic Quality Objective criteria in **Table 8.3** by up to 5 dBA.
- The predicted $L_{max}$ noise levels:
  - Achieve the ARUP limits in **Table 8.3** when loading/unloading and berthing, but exceed these limits by up to 14 dBA when in transit.
  - Achieve the Sleep Disturbance criterion with doors/windows closed.

The exceedances of criteria have been considered acceptable by ARUP on the basis that noise levels are generally not increasing and there have been no complaints regarding the existing noise levels. A further review of the noise levels indicates that noise level exceedances are nil or relatively small when compared to alternative criteria determined on the basis of achieving internal noise levels with doors/windows closed. Therefore, it could be considered that on the basis of these alternative criteria, and the outcome that noise levels will not be increasing, that the impacts are acceptable.

### 8.4.3 Assessment of Construction Noise Impacts

The construction sound power levels used in the assessment of construction noise impacts are presented in **Figure C.3** in **Appendix C**. The overall sound power levels are summarised below:

- Piling: 117 $L_{weq}$ dBA, 134 $L_{wmax}$ dBA
- IFO Construction: 105 $L_{weq}$ dBA

The predicted construction noise levels as presented in the ARUP report (Table D.7.8.1a and Table D7.8.1.1a) are presented below in **Table 8.8**.

**Table 8.8 ARUP Predicted $L_{eq}$ and $L_{max}$ Noise Levels at Wharf Street Receptors (Table D.7.8.1a and Table D7.8.1.1a of ARUP assessment Report)**

| Source | Predicted Noise Level $L_{eq}$ dBA | | Predicted Noise Level $L_{max}$ dBA | |
|---|---|---|---|---|
| | Neutral | Adverse | Neutral | Adverse |
| IFO Pipeline Construction | 51 | 51 | 56 | 57 |
| Piling | 67 | 67 | 77 | 77 |

The following comments are made regarding the ARUP noise predictions and method:

- The locations of the noise sources used in the assessment of construction noise are not indicated in the report and therefore no comment can be made on this aspect of the ARUP assessment. It is assumed that modelling has been undertaken with sources located at the closest construction area to sensitive receptors at Wharf Street.
- It is uncertain why the difference between the predicted $L_{max}$ and $L_{eq}$ noise levels from piling is not the same as the difference between the sound power levels (17 dB).

Based on the ARUP predicted noise levels presented in **Table 8.8** it is expected that pipeline construction will comply with the construction noise level targets at sensitive receptors near the wharf if construction is limited to standard construction hours as is proposed.

As for any construction project where piling is to occur near sensitive receptors, it is expected that noise from piling has the potential to impact sensitive receptors, and therefore it is recommended that piling is only undertaken during standard construction hours.

If piling is required to be undertaken outside of standard construction hours, it is recommended that it is not undertaken between the hours of 10:00 pm to 7:00 am (night-time), as it is expected that piling during this period may result in sleep disturbance.

## 8.5 Vibration Assessment

The ARUP report noted that TRL guidance recommends the use of the following relationship for the prediction of upper bound vibration velocity levels from piling works:

$$v_{res} \leq k_p \left[ \sqrt{W} / r^{1.3} \right]$$

Where $v_{res}$ is the resultant PPV velocity level (mm/s), W is the nominal hammer energy (J), r is the distance from the source (m) and kp is an empirical scaling factor based on ground conditions.

Soft cohesive soil was used as the basis of calculating vibration levels as being representative of the channel bed. The ARUP predicted PPV velocity levels have been calculated for nominal typical hammer energies to the heritage wharf (30m) and nearest potentially affected residential receptors (100m). The results were presented in table for varying nominal hammer energies.

**Table 8.9 Predicted Construction Vibration Levels**

| Location | Nominal Hammer Energy (W) (kJ) | Predicted PPV Vibration Velocity Level (mm/s) |
|---|---|---|
| Heritage Wharf | 25 | 1.9 |
| | 45 | 2.5 |
| | 65 | 3.0 |
| Wharf Street Residences | 25 | 0.4 |
| | 45 | 0.5 |
| | 65 | 0.6 |

It was noted by ARUP that predicted vibration impacts on residential receptors are calculated to be in the range 0.3<PPV<1.0 for all nominal hammer energies. This corresponds to a “minor” impact.

Vibration from other construction activities and operational activities was otherwise considered minor or insignificant.

# 9. Mitigation Measures and Management Strategies

## 9.1 Construction Noise

Specific mitigation measures and management Strategies for each of the assessed construction activities have been identified and are presented in **Table 9.1**.

**Table 9.1 Recommended Construction Noise Mitigation Measures and Management Strategies**

| Construction Activity | Recommended Mitigation |
|---|---|
| Construction Activity Near Boat Moorings | • Ports North should consult with users of boat moorings near construction areas within the channel and near the wharf to prevent the potential for noise impacts to these receptors. Users will have the choice to stay or leave during temporary construction activity. |
| Pipe Fabrication | • No additional mitigation measures are required based on the outcomes of the assessment.<br>• Temporary noise barriers or earth bunding around the fabrication area could reduce noise impacts in the event of a noise complaint. |
| Sandbar Cutting | • Based on the anticipated duration of this activity (up to one week), the recommended mitigation measure is communication with stakeholders to inform them of the dates and times when sandbar cutting will be undertaken, and that noise from this work may be audible during these periods. |
| Pipeline Construction and Decommissioning | • Selection of lower noise plant (excavator and dozers) which is suitable for performing the construction and decommissioning work.<br>• Communication with stakeholders should be undertaken prior to and during pipeline construction and decommissioning work. A pipeline construction and decommissioning plan should be developed by the appointed contractor, determining where noise generating activity will occur along the length of the pipeline route, when this work will occur and the likely duration of the work. This information should then be made available to stakeholders and residents to inform them of the potential for noise from construction activity. Special attention should be provided to sensitive receptors located closer to the pipeline route, (i.e. sensitive receivers represented by Receptors J, L, M, N, O and R).<br>• If the selected contractors pipeline construction and decommissioning method varies from the method assumed in this assessment report, or the alignment of the pipeline alters significantly with respect to proximity to sensitive receptors, a revised assessment of noise emissions from pipeline construction and decommissioning may be required to assess potential noise impacts and determine required mitigation measures. |

<table>
<tr><th>Construction Activity</th><th>Recommended Mitigation</th></tr>
<tr><td>Booster Pump Stations</td><td><ul><li>A detailed noise assessment of the booster pump stations will be required once the location and number of pump stations has been defined by the contractor, and the actual pump stations have been selected. The assessment should determine if compliance with the construction noise limits will be achieved with the selected booster pumps as standard, or whether additional mitigation measures are required to achieve compliance.</li><li>Mitigation measures which could be considered in a detailed noise assessment of the booster pump stations may include:<ul><li>Enclosing the engine with an acoustically robust enclosure including internal acoustic absorption.</li><li>Fitting industrial mufflers.</li><li>Enclosing the pump.</li><li>Altering the location of pump stations.</li><li>Selection of alternative (quieter) or over-specified equipment (allowing lower operating speeds for the same throughput) plant.</li></ul></li></ul></td></tr>
<tr><td>Tailwater Pumps</td><td><ul><li>A detailed assessment of noise emissions from the selected pumps should be undertaken to determine if compliance with the construction noise limits will be achieved with the selected pump/s as standard, or whether additional mitigation measures are required to achieve compliance.</li><li>Mitigation measures which could be considered in a detailed assessment of noise emissions from the tailwater pumps may include:<ul><li>Enclosing the pump with an acoustically robust enclosure including internal acoustic absorption.</li><li>Installation of temporary noise barriers or earth bunding.</li><li>Locating the pump further away from receptors.</li><li>Using smaller pumps in series.</li><li>Selection of alternative (quieter) or over-specified equipment (allowing lower operating speeds for the same throughput) plant.</li></ul></li></ul></td></tr>
<tr><td>TSHD Pump-Out</td><td><ul><li>A detailed assessment of noise emissions from the TSHD pump-out process should be undertaken when the TSHD has been selected, and when the booster pump stations and locations have been confirmed.</li><li>During pump-out the TSHD should be located as far off-shore as practically possible to minimise noise levels at on-shore receptors, subject to the results of the detailed noise assessment.</li></ul></td></tr>
<tr><td>IFO Pipeline Construction</td><td>With the exception of limiting IFO pipeline construction work to standard hours, no additional mitigation measures for this activity.</td></tr>
</table>

| Construction Activity | Recommended Mitigation |
|---|---|
| Piling | • Piling activities should be limited to the typical construction hours (6:30 am to 6:30 pm, Monday to Saturday) unless approval is obtained from DEHP/local authority based on "sufficient grounds" to justify construction outside these hours.<br>• If piling is to occur outside of typical construction hours, advance notice (preferably at least one weeks' notice) should be provided to stakeholders who may potentially be affected.<br>• Piling between the hours of 10:00 pm to 7:00 am (night-time) should be avoided as much as practically possible.<br>• A resilient pad (dolly) should be used where feasible between the pile and hammer head in order to reduce airborne noise impacts, as recommended by BS5228.<br>• Vibration impacts should be controlled by limiting the hammer energy used to undertake piling based on the distance to the nearest sensitive receptors and structures. This will be achieved by setting the relevant drop height relative to the mass of the piling rig hammer.<br>• Vibration monitoring should be undertaken during piling to confirm/calibrate the vibration predictions.<br>• Contractor to review existing dilapidation survey(s) for the heritage wharf during planning of / prior to commencement of construction and adjust construction program accordingly. |

In addition to the above measures for specific activities, all general activities relating to the construction works should be carried out in accordance with best practice measures to reduce the potential for noise impacts, including the following:

- Modern and well-maintained equipment should be used to undertake the works.
- Noisy or vibration generating plant, equipment and activities should be substituted with lower impact options where possible.
- Arrange work flow to minimise the use of reversing alarms on vehicles and plant. Use equipment with broadband (squashed duck) alarms where possible.
- Locate noisy plant, site vehicle entrances and off-site truck parking areas away from sensitive receptors where possible.
- Plant known to emit noise strongly in one direction should, where possible, be orientated so that the noise is directed away from the closest noise-sensitive areas.
- Where machines are fitted with mufflers, these should be kept in good condition and replaced if degradation has lead to noticeably increased noise emissions.
- There should be continuous training of operators, labourers, subcontractors and supervisors through induction training and ongoing meetings on the need to minimise noise impacts on surrounding local residents.
- Where machines are fitted with engine covers, these should be kept closed when the machine is in use.
- The drivers of machinery should be provided with appropriate communication equipment, to ensure that signalling by other means (e.g. horns) is kept to a minimum.
- When workers arrive prior to 6:30 am, care should be taken to ensure unloading of tools and equipment and preparation work does not generate significant noise.
- Construction work should be limited as much as possible to between the hours of 6:30 am to 6:30 pm Monday to Saturday.
- Noise sensitive receptors should be informed of any out-of-hours construction works in advance (preferably at least one weeks' notice, except for emergency works) of works occurring.
- Provide advanced notice, where possible, to stakeholders when loud construction or demolition activity is proposed to be undertaken.

- Open communication should occur with stakeholders located in the vicinity of construction areas who could potentially be impacted by activities resulting in noise and vibration emissions. A construction engagement program should be developed and implemented to create a dialogue with stakeholders during the construction phase.
- A designated communication channel, i.e. email and phone number, should be established, to facilitate communication with stakeholders. This communication method should be actively managed to ensure complaints and issues can be addressed as soon as practically possible.

A Construction Noise and Vibration Management Plan should be developed for the Project, including these mitigation strategies.

## 9.2 Operational Noise

There is no significant change to the operational noise assessment compared with the ARUP Draft EIS, and therefore reference is made to the mitigation requirements of that report:

> *The main contributing noise source to operational noise impacts are from the ship itself, either on arrival to the Port of Cairns or while docked at the CCLT.*
>
> *It is relevant to note that Port of Cairns has been operating for decades with vessel movements potentially occurring 24-hours per day in the immediate vicinity of the Cairns CBD. As such, although the project will introduce a greater number of overnight port visits, the project will not result in the introduction of a completely new noise source. It is also relevant that Ports North have received few, if any, noise complaints regarding noise emission from existing operation at the CCLT (with the exception of complaints against specific "loud ships", particularly visiting Navy vessels).*
>
> *There is little opportunity to reduce noise emissions from individual ships accessing the CCLT; however progressively as newer, quieter ships are introduced into service noise levels may reduce in future. Available noise data generally supports this trend: e.g. despite its larger size, measured docked noise levels from the Carnival Spirit were lower than measured docked noise levels from Rhapsody of the Seas.*
>
> *Existing "worst case" noise exposures, represented by the Rhapsody of the Seas cruise ship, which is the largest ship currently regularly visiting Port of Cairns, are predicted to result in minor exceedances of the noise criteria during the night time period, with noise levels from docked ships, loading/unloading activities and ship arrival/departure predicted to exceed the noise criteria. Although loading/unloading and ship arrival/departure are unlikely to occur at night for a typical ship visit, the noise from the ship itself is predicted to exceed the noise criteria at night.*
>
> *Future noise impacts associated with the project can be divided into two categories:*
>
> *• Medium-sized cruise ships (e.g. Pacific Dawn, Sun Princess), which will likely represent the majority (~60 percent or greater) of future cruise ship visits following the project, and are predicted to be quieter than Rhapsody of the Seas and to meet noise criteria for all activities except ships arriving/departing at night (which is unlikely to occur in practice)*
>
> *• Large-sized cruise ships (e.g. Radiance of the Seas), which are predicted to have very similar noise impacts to the existing noise impacts from Rhapsody of the Seas.*
>
> *The lack of historical noise complaints regarding cruise ship noise at Port of Cairns suggests that future large cruise ships with similar noise emission characteristics to Rhapsody of the Seas are unlikely to cause significant additional noise impacts.*
>
> *The "typical" future scenario, with Medium-sized cruise ships, is unlikely to result in significant noise impacts on residences.*

*Noise impacts from ship arrival/departure at Trinity Inlet receptors are not expected to be significant. This is because ship arrivals will only occur once per assessment time period (i.e. a single noise event); will generally not occur during the Night time period; and because the location of receptors adjacent to the shipping channel means that these receptors should reasonably be expected to be exposed to ship noise.*

*In the event that noise impacts occur, updates to future Port Operations and CCLT procedures to ensure ship operators are aware of the need to reduce noise impacts on surrounding residences and such measures may include:*

*• Where possible, avoiding running the ships primary propulsion engines at night (between 2200-0600)*

*• Where possible, avoiding conducting loading/unloading activities or refuelling at night*

*• Where possible, avoiding the use of the ships external PA system at night.*

*Where operational circumstances require ships to conduct noise-generating activities at night, future Port Operations procedures may require ship operators to provide Ports North with advance warning (e.g. 24 hours' notice) so that Ports North may, at its discretion, implement additional management measures (e.g. notifying surrounding residents). Such procedures may be required in future, and could include mechanisms for notifying residents of ship visits (e.g. link to appropriate section of Ports North website), as well as details of complaints handling procedures to deal with any future noise complaints associated with operation of the CCLT, and provisions for dealing with individual noisy ships.*

In addition to the above text, Council (or Ports North for areas of Strategic Port Land) could consider imposing minimum acoustic construction requirements for new buildings in the vicinity of the wharf to minimise the potential for future noise complaints. This could be provided in the form of a Wharf Overlay Code or similar.

# 10. Risk Assessment

Based on the results of the noise assessment and the identified mitigation measures, a risk assessment has been undertaken for noise impacts associated with the construction and operation of the CSD Project.

The risk assessment has applied the significance criteria outlined in **Table 10.1**, which refers to the duration criteria in **Table 10.2**, and the likelihood of impact criteria (**Table 10.3**) to determine the overall risk of impact for individual project activities based on the risk matrix presented in **Table 10.4**. The risk rating legend is included in **Table 10.5**.

The derived risk rating for each of the project activities is then summarised in **Table 10.6**, with and without the additional mitigation measures discussed in **Section 9**.

It is noted that human response to noise is subjective, and varies between individuals. The risk assessment provides a summarised review of the potential for impact, but may not accurately represent all individuals.

**Table 10.1 Significance Criteria**

| Impact Significance/Consequence | Description of Significance<br>(refer to Table 10.2 for duration criteria) |
|---|---|
| Very High | The management of the impact is critical to decision-making, including the selected methodology for delivering the Project and the development of management measures.<br>Noise emissions will:<br>• significantly exceeds noise limits at receptors occur over a medium or long-term duration<br>• moderately exceed noise limits for permanent duration<br>• occur during noise sensitive periods (night) or outside standard construction hours (6:30 am - 6:30 pm, Monday to Saturday). |
| High | Addressing the impact is very important to decision-making, including the selected methodology for delivering the Project and the development of management measures.<br>Noise emissions will:<br>• significantly exceeds noise limits for a temporary to short term activity, or, moderately exceed the noise limits for a medium to long-term duration activity, or, result in a minor exceedance of noise limits for a permanent activity<br>• occur during noise sensitive periods (night) or outside standard construction hours (6:30 am - 6:30 pm, Monday to Saturday)<br>• not be consistent with the existing noise environment. |
| Moderate | The effects of the impact are important to decision-making including the selected methodology for delivering the Project and the development of management measures.<br>Noise emissions will:<br>• significantly exceeds the derived noise limit for a temporary to short term activity, or, result in minor or moderate exceedance of noise limits for a medium to long-term duration activity, or, result in a minor exceedance of noise limits for a permanent activity<br>• occur during standard construction hours (6:30am - 6:30pm, Monday to Saturday), or, be consistent with the existing noise environment. |

| Impact Significance/Consequence | Description of Significance<br>(refer to Table 10.2 for duration criteria) |
|---|---|
| Minor | Impacts are recognisable/detectable but acceptable and are unlikely to influence decision making.<br>Noise emissions will:<br>• significantly exceeds the derived construction noise limit, but not the 'highly affected noise limit, for a temporary activity.<br>• result in a minor exceedance of the derived noise limits for any activity duration for activities which occur during standard construction hours (6:30 am - 6:30 pm, Monday to Saturday) only.<br>• comply with noise limits at all receptors, but occur outside of standard construction hours or during noise sensitive periods (i.e. night) and therefore may impact people more sensitive to noise. |
| Negligible | Negligible impacts are anticipated.<br>Noise emissions will:<br>• be compliant at all receptors<br>• will not occur outside of standard construction hours (6:30am - 6:30pm, Monday to Saturday) in the vicinity of sensitive receptors. |
| Beneficial | Amenity of the area in respect to noise is improved. |

**Table 10.2 Duration Criteria**

| Classification | Duration | Applicable Project Noise Sources |
|---|---|---|
| Temporary | 1 - 2 Weeks | Sandbar cutting, pipeline construction and decommissioning |
| Short Term | Up to 1 Month | Pipe fabrication, |
| Medium Term | Up to 3 Months (~12 Weeks) | IFO construction, booster pump operation, tailwater pump operation |
| Long Term | Up to 12 Months | Wharf upgrade construction |
| Permanent | In excess of 12 Months | Wharf operation |

**Table 10.3 Likelihood of Impact**

| Likelihood of Impacts | Risk Probability Categories |
|---|---|
| Highly Unlikely | Highly unlikely to occur but theoretically possible |
| Unlikely | May occur during construction of the project but probability well below 50%; unlikely, but not negligible |
| Possible | Less likely than not but still appreciable; probability of about 50% |
| Likely | Likely to occur during construction or during a 12 month timeframe; probability greater than 50% |
| Almost Certain | Very likely to occur as a result of the proposed project construction and/or operations; could occur multiple times during relevant impacting period |

**Table 10.4 Risk Matrix**

| Likelihood | Significance | | | | |
|---|---|---|---|---|---|
| | Negligible | Minor | Moderate | High | Very High |
| Rare | Negligible | Negligible | Low | Medium | High |
| Unlikely | Negligible | Low | Low | Medium | High |
| Possible | Negligible | Low | Medium | Medium | High |
| Likely | Negligible | Medium | Medium | High | Extreme |
| Almost Certain | Low | Medium | High | Extreme | Extreme |

**Table 10.5 Risk Rating Legend**

| Risk Rating | Risk Probability Categories |
|---|---|
| Extreme | An issue requiring change in project scope to reduce risk. |
| High | An issue requiring further detailed investigation and planning to manage and reduce risk. |
| Medium | An issue requiring project scope specific controls and procedures to manage. |
| Low | Manageable by standard mitigation and similar operating procedures. |
| Negligible | No additional management required. |

**Table 10.6 Impact Assessment Table**

| Project Area | Construction Activity / Noise Source | Initial Assessment with Standard Mitigation Measures | | | Residual Assessment with Additional Mitigation in Place | | |
|---|---|---|---|---|---|---|---|
| | | Significance | Likelihood | Risk Rating | Significance | Likelihood | Risk Rating |
| **Construction** | | | | | | | |
| Pipeline Commissioning and Decommissioning | Sandbar Cutting | Minor | Possible | Low | Minor | Possible | Low |
| | Pipe Fabrication | Negligible | Possible | Negligible | Negligible | Possible | Negligible |
| | Pipeline Construction and Decommissioning | Minor | Possible | Low | Minor | Possible | Low |
| Pipeline Operation | Booster Pump Stations | Moderate | Almost Certain | High | Minor | Possible | Low |
| DMPA Operation | Tailwater Pumps | Minor | Almost Certain | Medium | Minor | Possible | Low |
| TSHD Dredging | TSHD Pump-Out | Moderate | Likely | Medium | Minor | Possible | Low |
| Wharf Construction | IFO Construction | Minor | Likely | Medium | Minor | Possible | Low |
| | Piling | Moderate | Likely | Medium | Minor[1] | Possible | Low |
| Operation | | | | | | | |
| Wharf Operation | Cruise Ships | Minor | Possible | Medium | Minor | Possible | Low[2] |

Note: 1 Minor significance if piling is limited to standard construction hours, and therefore does not occur at night.

2 Low risk rating attributed to understanding of lack of historical noise complaints, and recommendation for imposing minimum acoustic construction requirements in the vicinity of the wharf for new buildings to minimise the chance of future noise complaints.

# 11. Project Commitments

The following items should be included as Project Commitments:

(1) Engage with potentially affected residents with respect to proposed potentially noisy activities.

(2) Detailed assessment of noise impacts from the booster pump stations, and specification of required mitigation measures, should be undertaken when:

   (a) the project contractor has been selected

   (b) the need for a marine booster station has been determined

   (c) the type of booster pumps has been selected

   (d) the proposed locations for booster pump stations has been confirmed

(3) Detailed assessment of noise impacts from the TSHD pump-out process should be undertaken following the assessment of the booster pump stations.

(4) A construction Noise and Vibration Management Plan should be developed for specific project areas, i.e. the wharf, the dredge material pipeline, etc. The management plan should include the mitigation measures nominated in **Section 9** of the report.

# 12. Conclusion

ASK Consulting Engineers Pty Ltd (ASK) was commissioned by Flanagan Consulting Group to provide acoustic consultancy services to provide an acoustic assessment for the Revised Draft EIS for the Cairns Shipping Development Project (CSD Project). The results of this assessment are as follows:

- Noise emissions from pipeline construction and decommissioning will not significantly impact sensitive receptors.
- Noise emissions from booster pump stations may result in minor noise exceedances but it is expected that further mitigation (i.e. bunding or quieter plant selection) will result in compliance with the noise limits. A detailed assessment of noise emissions from the booster pumps will be required when pump selections, the number of stations required is confirmed, and potential locations for the stations is confirmed.
- Noise emissions from the tailwater pump may require minor mitigation or more detailed analysis, depending on the proposed location. It is recommended that an assessment of tailwater pump noise is undertaken when the exact location of the pump is known, and when the pump model has been selected. With appropriate noise mitigation the noise levels should be compliant.
- Noise emissions from the TSHD pump-out in combination with the booster pump stations may result in moderate exceedances, however, it is expected that further mitigation of the booster pump stations will achieve compliance. A detailed assessment of noise emissions from the booster pumps and TSHD pump-out process will be required when pump selections, the number of stations and their locations, is confirmed.
- Noise emissions from wharf operations may result in minor exceedances of night-time acoustic objectives within nearby units, with windows and doors closed. However, the exceedance is considered acceptable on the basis that noise levels are not increasing in magnitude, only frequency of occurrence, and there are no historical complaints from existing noise levels.
- Noise emissions from wharf construction activities, including capital dredging (Ports North, 2014a and Ports North, 2014b), will be acceptable if occurring during standard construction hours. However, backhoe and TSHD dredging would be conducted for 24 hours per day and may at times occur close to the receptors. These activities may result in unacceptable noise impacts outside the standard construction hours and hence noise mitigation measures for these are recommended in Section B10.6.1 of the Draft EIS (Ports North, 2014b).
- A range of noise mitigation measures is included in **Section 9**.
- The risks associated with noise and vibration emissions are considered low with the implementation of the mitigation measures in **Section 10**.

# References

AEC Group (2016), *Cairns Shipping Development Project, Demand Study Update* , Report 18279BNE Final Draft v02 for Ports North, November 2016.

ASK (2017) *Cairns Shipping Development Project – Tingira Street DMPA* (ASK report 8483R08V02 16 June 2017)

Ports North (2014a) *Cairns Shipping Development Project Draft Environmental Impact Statement, Appendix D7 Noise and Vibration Technical Report,* November 2014.

Ports North (2014b) *Cairns Shipping Development Project Draft Environmental Impact Statement, Chapter B10 Noise and Vibration,* November 2014.

Sunshine Coast Regional Council (2014) *Sunshin Coast Airport Expansion Project Environmental Impact Statement 2014, Chapter B15 Airport and Surrounds Noise and Vibration,* September 2014.

# Appendix A Glossary

| Parameter or Term | Description |
|---|---|
| CSD Project | Cairns Shipping Development Project |
| dB | The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert). |
| dBA | Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared. |
| Octave band | Ranges of frequencies where the highest frequency of the band is double the lowest frequency of the band. The band is usually specified by the centre frequency, i.e, 31.5, 63, 125, 250, 500 Hz, etc. |
| Low frequency noise | Noise that occurs in the 10 Hz to 200 Hz frequency range, as defined in the Queensland Department of Environment and Heritage Protection (DEHP) EcoAccess "Assessment of Low Frequency Noise" draft guideline document. |
| Day | The period between 7am and 6pm. |
| Evening | The period between 6pm and 10pm. |
| Night | The period between 10pm and 7am. |
| Free-field | The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls). |
| Reverberant field | The description of a noise receiver or source location which is in a room or near significant reflective objects (e.g. surrounded by walls). |
| Noise sensitive receiver OR Noise sensitive receptor | The definition can vary depending on the project type or location, but generally defines a building or land area which is sensitive to noise. Generally it includes residential dwellings (e.g. houses, units, caravans, marina), medical buildings (e.g. hospitals, health clinics, medical centres), educational facilities (e.g. schools, universities, colleges), |
| $L_1$ | The noise level exceeded for 1% of the measurement period. |
| $L_{10}$ | The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level. |
| $L_{10,adj,T}$ | As for $L_{10}$ except the measurement interval is defined as duration of 'T' and the level is adjusted for tonality or impulsiveness, if required. |
| $L_{10,15min}$ | As for $L_{10}$ except the measurement intervals are defined as 15 minute duration. |
| $L_{90}$ | The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. |
| $L_{90,adj,T}$ | As for $L_{90}$ except the measurement interval is defined as duration of 'T' and the level is adjusted for tonality or impulsiveness, if required. |
| $minL_{90}$ and/or Rating Background Level | The background noise levels calculated using the 'lowest 10th percentile' of the $L_{90}$ levels in each period of the day. This 'lowest 10th percentile' method is defined in the Queensland Department of Environment and Heritage Protection (DEHP) guidelines. |
| $minL_{90,1hour}$ | As for $minL_{90}$ except the measurement interval is defined as 1 hour duration. |
| $L_{eq}$ | The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period. |
| $L_{eq,1hour}$ | As for $L_{eq}$ except the measurement interval is defined as 1 hour duration. |
| $L_{eq,T}$ | As for $L_{eq}$ except the measurement interval is defined as duration of 'T'. |
| $L_{eq,adj,T}$ | As for $L_{eq}$ except the measurement interval is defined as duration of 'T' and the level is adjusted for tonality or impulsiveness, if required. |
| $L_{max}$ OR $maxL_{pA}$ | Maximum sound pressure level. |

| Parameter or Term | Description |
|---|---|
| $L_w$ | The sound power level of a noise source is its inherent noise, which does not vary with distance from the noise source. It is not directly measured with a sound level meter, but rather is calculated from the measured noise level and the distance at which the measurement was undertaken. |
| $L_{weq}$ | The sound power level expressed as the equivalent sound level. |

# Appendix B Noise Monitoring Data

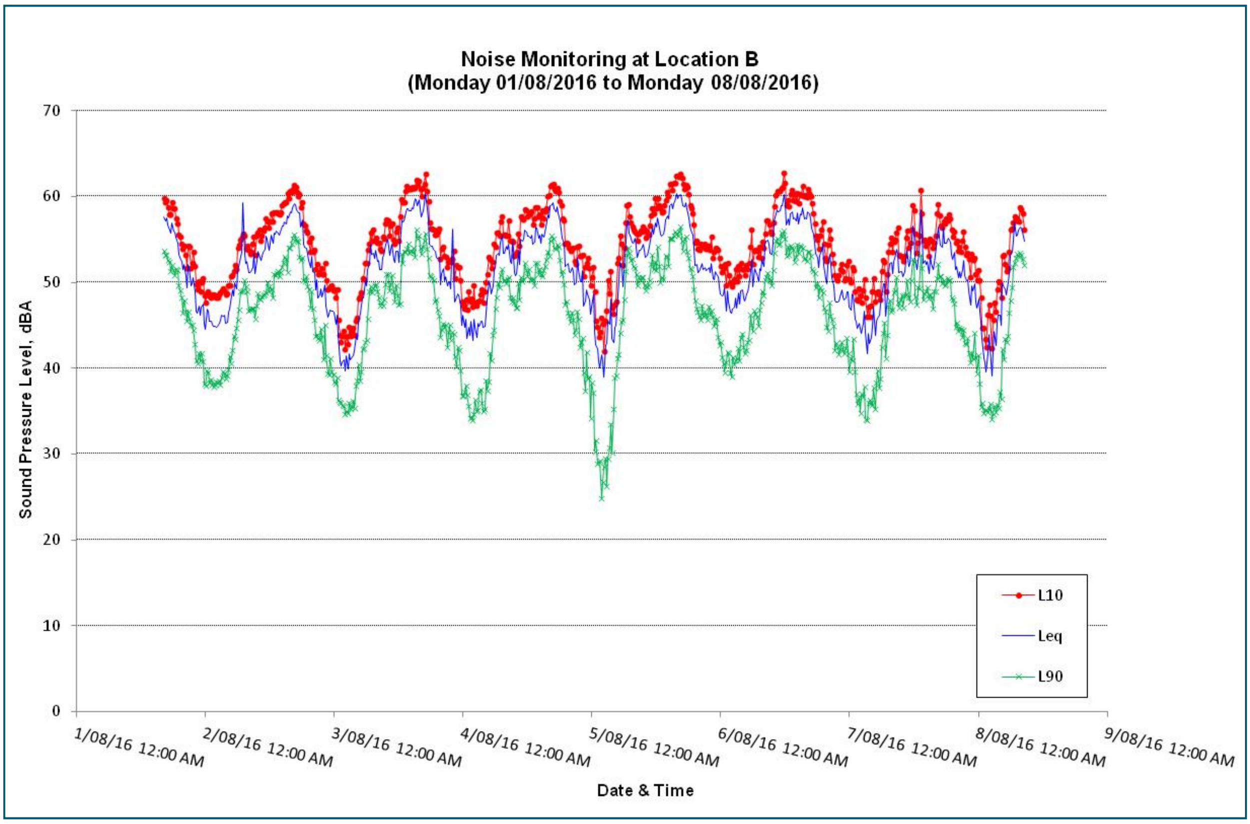


**Figure B.1 Daily Statistical Noise Monitoring Results at Location B1 (Northern Sands Quarry)**

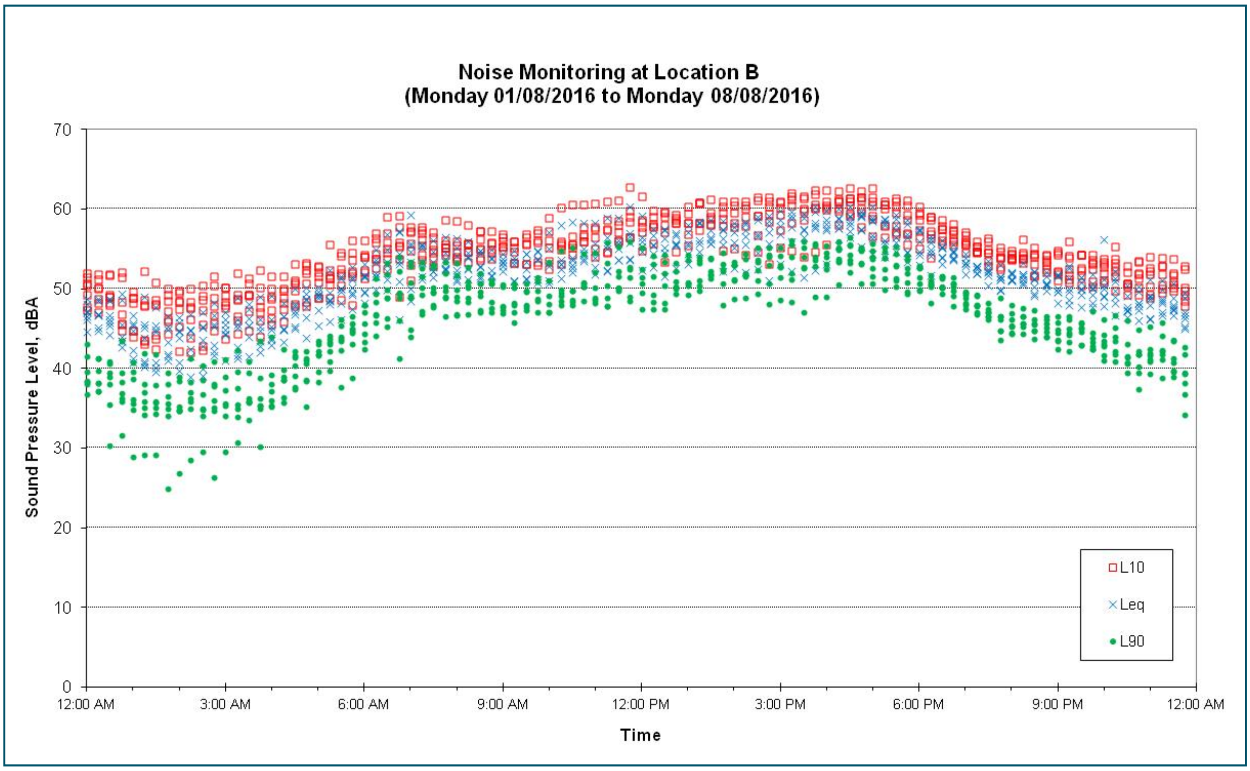


**Figure B.4 Diurnal Statistical Noise Monitoring Results at Location B1 (Northern Sands Quarry)**

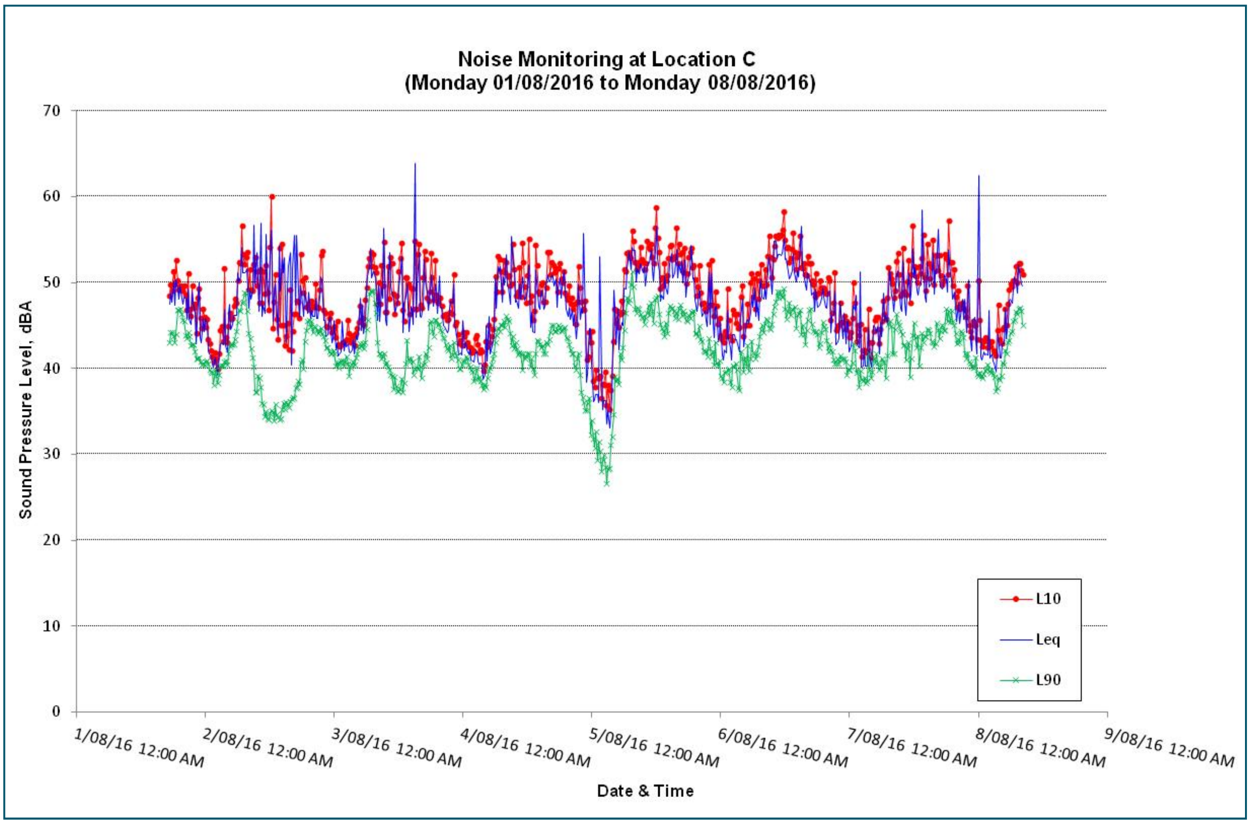


**Figure B.5 Daily Statistical Noise Monitoring Results at Location C1 (Holloways Beach Access Road)**

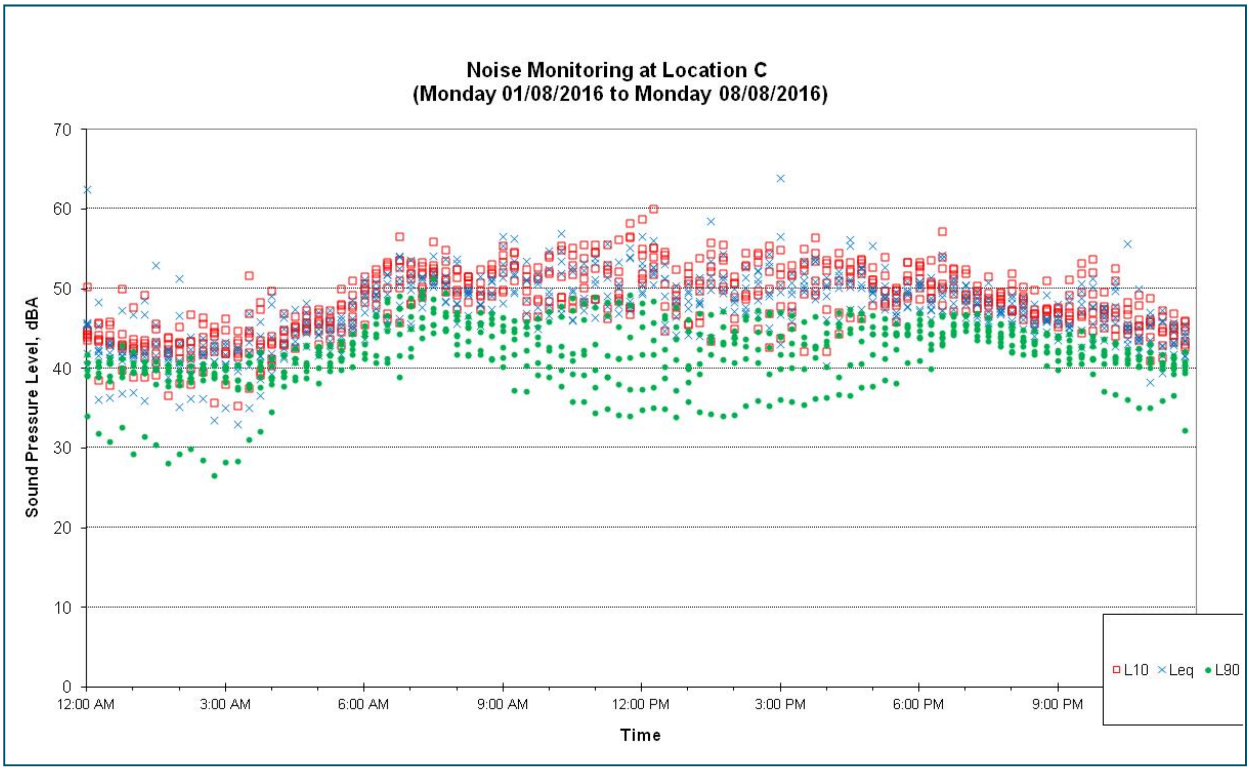


**Figure B.6 Diurnal Statistical Noise Monitoring Results at Location C1 (Holloways Beach Access Road)**

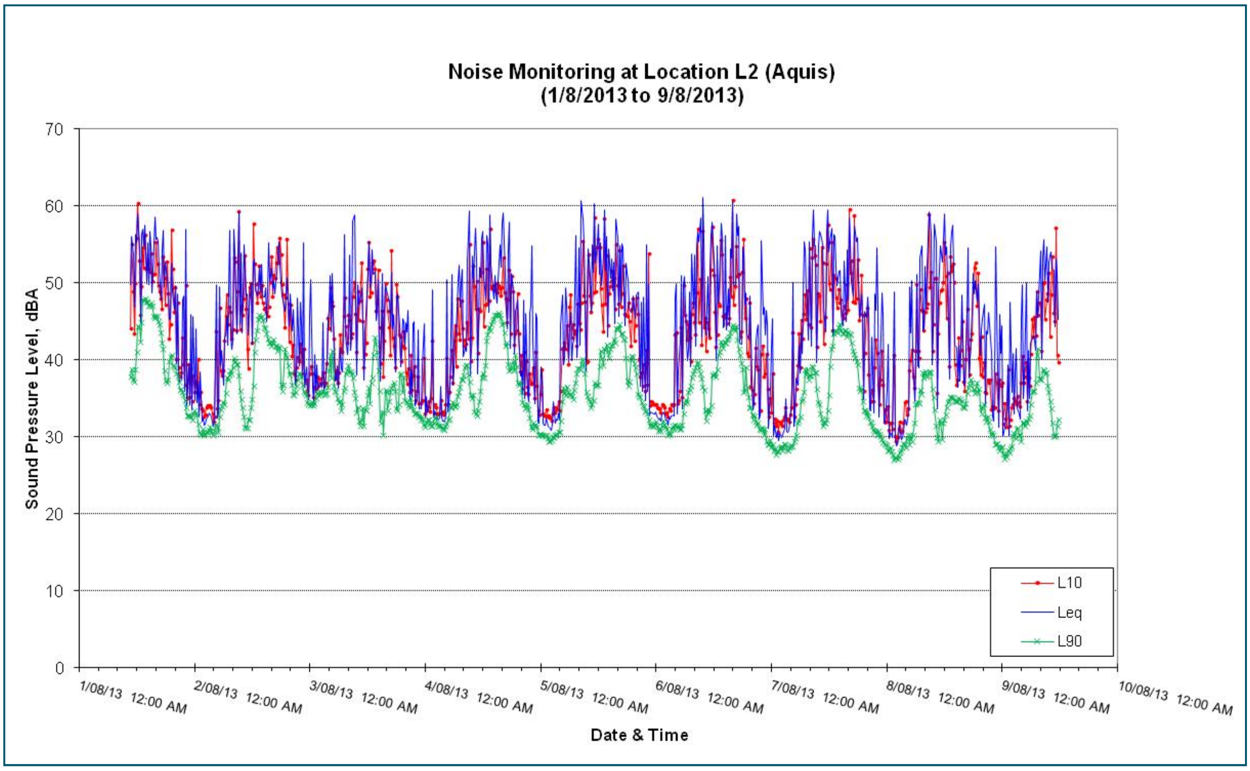


**Figure B.7 Daily Statistical Noise Monitoring Results at Location L2 (Aquis)**

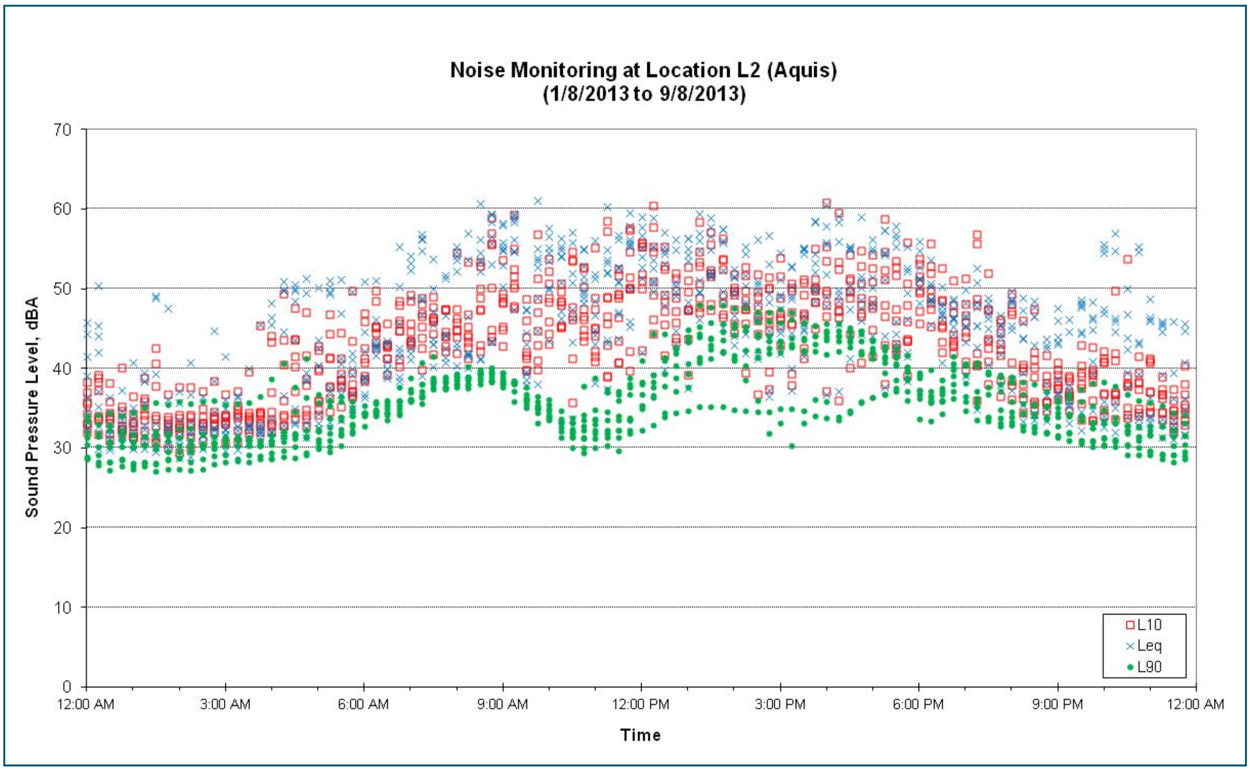


**Figure B.8 Diurnal Statistical Noise Monitoring Results at Location L2 (Aquis)**

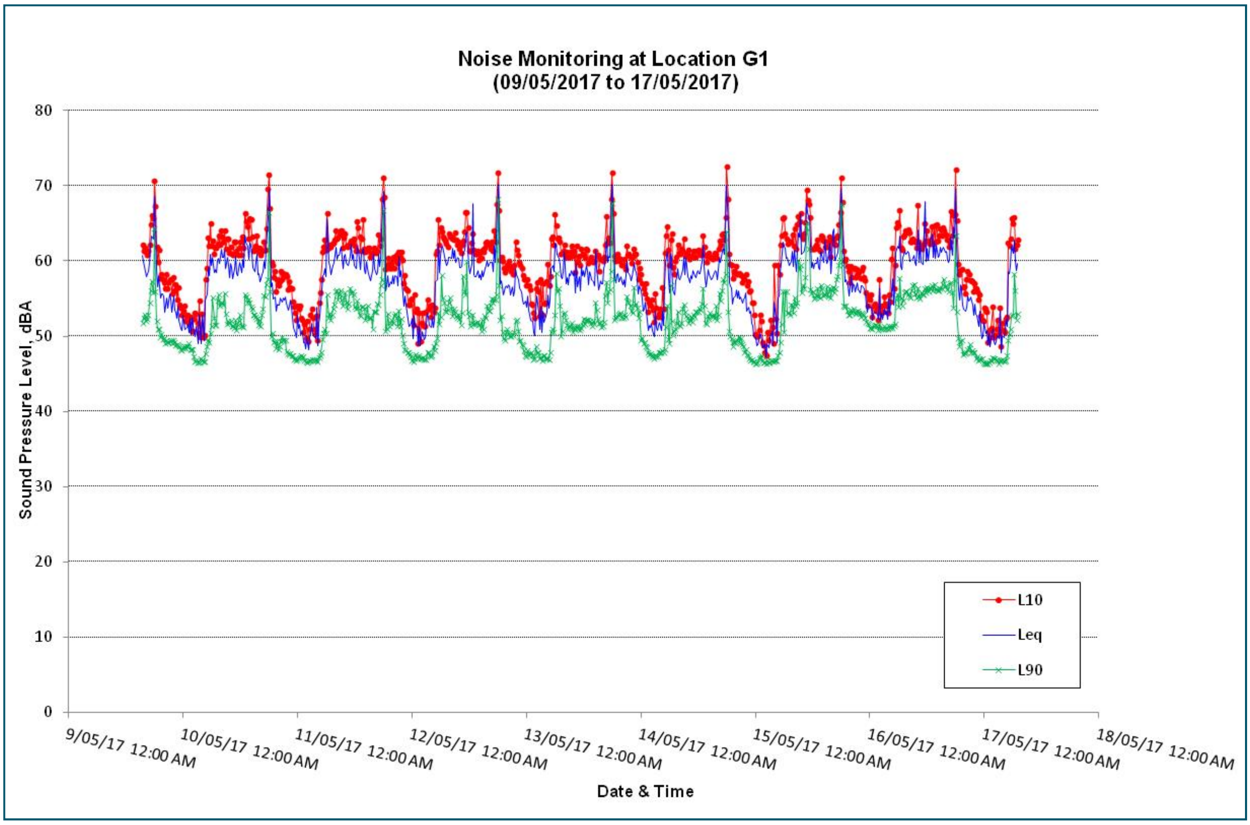


**Figure B.9 Daily Statistical Noise Monitoring Results at Location G1 (Piermonde)**

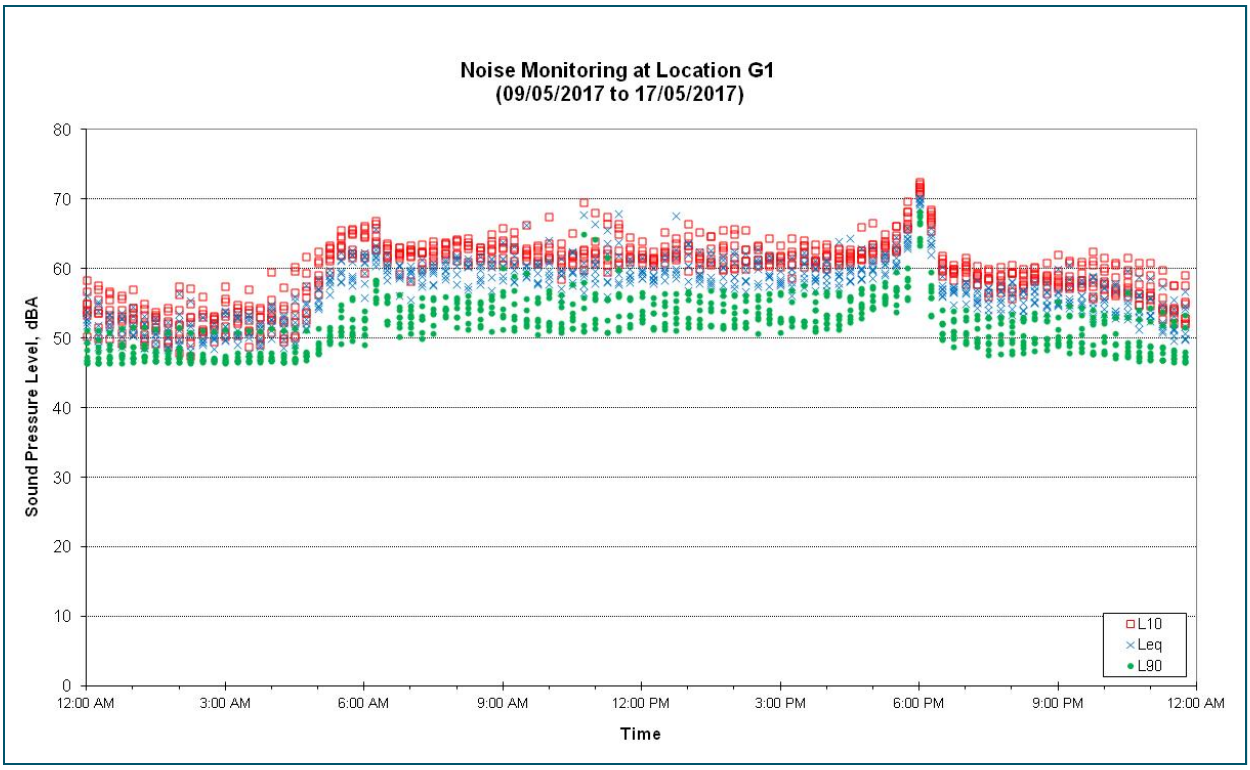


**Figure B.10 Diurnal Statistical Noise Monitoring Results at Location G1 (Piermonde)**

# Appendix C ARUP Noise Assessment Sound Power Level Data

| Activity | Noise Source Reference | Input Type | Overall Sound Power Level, $L_w$, dB(A) | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Docked medium cruise ship exhaust stack, e.g. *Pacific Dawn* *Sun Princess* | Arup measurements of cruise ships using existing ports | $L_{eq}$ | 102.1 | 114.3 | 108.2 | 100.9 | 98.5 | 97.4 | 93.2 | 87.1 | 80.4 |
| Docked large cruise ship exhaust stack, e.g. *Rhapsody of the Seas* | Arup measurements of cruise ships using existing ports and from published literature (DiBella and Remigi 2013) | $L_{eq}$ | 114.3 | 122.0 | 117.3 | 113.1 | 110.6 | 107.6 | 106.2 | 105.5 | 102.0 |
| Cruise ship engine room vent when docked | Arup measurements of cruise ships using existing ports | $L_{eq}$ | 90.7 | 91.9 | 91.3 | 88.0 | 88.2 | 86.4 | 83.4 | 70.6 | 56.0 |
| Fuel pump | Empirical data | $L_{eq}$ | 98.6 | 89 | 90 | 92 | 92 | 95 | 92 | 88 | 82 |
| Forklift operating length of dock | Arup measurements of cruise ships using existing ports | $L_{eq}$ | 101.8 | 105.4 | 99.7 | 99 | 98.9 | 96.6 | 95.4 | 87.3 | 76.8 |
| Forklift operating length of dock | Arup measurements of cruise ships using existing ports | $L_{max}$ | 113.3 | 115.0 | 111.8 | 108.1 | 109.8 | 106.2 | 108.5 | 101.8 | 91.2 |
| Forklift unloading cruise ship | Arup measurements of cruise ships using existing ports | $L_{eq}$ | 101.0 | 102.9 | 99.7 | 99.3 | 98.2 | 96.4 | 93.7 | 86.5 | 76.6 |
| Forklift unloading cruise ship | Arup measurements of cruise ships using existing ports | $L_{max}$ | 116.6 | 110.6 | 113.9 | 115.5 | 112.5 | 110.7 | 110.9 | 104.1 | 91.8 |
| Medium cruise ship berthing rope motor | Empirical data | $L_{eq}$ | 98.7 | 88.8 | 90.8 | 91.8 | 91.8 | 96.8 | 90.8 | 81.8 | 73.8 |
| Cruise ship PA chime | Arup measurements of cruise ships using existing ports | $L_{max}$ | 115.1 | 106.6 | 105 | 120.7 | 114.3 | 102.1 | 98.3 | 92.5 | 82.1 |
| Medium cruise ship entering/leaving port, e.g. *Pacific Dawn* *Sun Princess* | Arup measurements of cruise ships using existing ports | $L_{eq}$/m | 72.8 | 81.9 | 75.9 | 73.1 | 70.4 | 67.5 | 63.3 | 57.4 | 56.4 |
| | Arup measurements of cruise ships using existing ports | $L_{max}$ | 121.9 | 126.1 | 119.2 | 117.3 | 113.5 | 118.6 | 115.0 | 108.8 | 110.5 |

**Figure C.1 ARUP Cruise Ship Sound Power Levels Used in Modelling (Table D7.7.3.2a of ARUP Technical Report Appendix D.7)**

| Activity | Noise Source Reference | Input Type | Overall Sound Power Level, $L_w$, dB(A) | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Large cruise ship entering/leaving port, e.g. *Rhapsody of the Seas* | Arup measurements of cruise ships using existing ports. Published SEL measurements from Di Bella (nd) | $L_{eq}$/m | 77.9 | 83.9 | 80.1 | 75.7 | 66.4 | 69.2 | 69.7 | 67.7 | 74.8 |
| | Arup measurements of cruise ships using existing ports | $L_{max}$ | 134.0 | 130.9 | 120.9 | 117.1 | 129.6 | 122.7 | 129.8 | 122.9 | 126.9 |
| Trucks/busses entering site | Arup database – measurements of previous projects | $L_{eq}$/m | 82.6 | 91.6 | 85.2 | 81.3 | 80.3 | 77.3 | 73.6 | 69.0 | 68.5 |
| Trucks/busses leaving site | Arup database – measurements of previous projects | $L_{eq}$/m | 75.2 | 87.6 | 76.7 | 75.3 | 72.8 | 70.6 | 65.4 | 58.7 | 49.9 |
| Idling trucks/busses at cruise terminal | Arup database – measurements of previous projects | $L_{eq}$ | 90.8 | 92.0 | 91.0 | 94.0 | 89 | 83.7 | 78.6 | 68.8 | 53.8 |

**Figure C.2 ARUP Cruise Ship Sound Power Levels Used in Modelling (Cont) (Table D7.7.3.2a of ARUP Technical Report Appendix D.7)**

| Activity | Noise Source Reference | Type | Overall Sound Power Level, $L_w$, dB(A) | Sound Power Level, Octave Band Centre Frequency, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Piling | BS5228 Table C3 | $L_{eq}$ | 117 | 116 | 121 | 113 | 115 | 111 | 108 | 103 | 100 |
| | Transport for NSW Construction Noise Strategy (with adjusted spectrum from BS5228) | $L_{max}$ | 134 | 133 | 138 | 130 | 132 | 129 | 126 | 120 | 117 |
| IFO pipeline construction | BS5228 Table C3 (data for drilling/cutting and lifting of steel piles) | $L_{eq}$ | 105 | 106 | 105 | 101 | 100 | 101 | 98 | 94 | 90 |

**Figure C.3 ARUP Construction Activity Sound Power Levels Used in Modelling) (Table D7.7.3.3a of ARUP Technical Report Appendix D.7)**