VOLUME 3

Draft : Environmental Impact Statement

Chapter B10 Noise and Vibration

B10.1 Introduction

The acoustic chapter of this Environmental Impact Statement (EIS) provides an assessment of potential impacts from airborne noise, underwater noise or vibration to the identified sensitive receptors from the construction and operation of the proposed Cairns Shipping Development Project (the project). This assessment provides an understanding of the existing terrestrial and marine acoustic environment and the potential implications of the project on it.

This chapter presents assessments of the airborne noise, vibration and underwater noise impacts (where applicable) from relevant sources.

As a result, there is a significant amount of data presented in this chapter. For clarity and ease of interpretation, the overall conclusions and findings are presented in the main body of this chapter, and supporting information including large tables and figures are presented separately in **Appendix D7**.

B10.2 Policy Context and Legislative Framework

A summary of legislation, policies, guidelines and standards relevant to the assessment and management of noise and vibration, including guidelines required by the project Terms of Reference (TOR) and EIS Guidelines, is provided in **Table B10.2a and B10.2b**.

Table B10.2a Summary of Relevant Legislation and Policy

Document	Relevance	Application
QLD Environment Protection Act 1994 (EP Act) (QLD Government, 1994)	The EP Act is the governing legislation covering policy that concerns noise and vibration within Queensland. Subordinate policy was developed underneath the EP Act, as described below.	The EP Act forms the governing framework for all impact criteria developed for assessing the project. The EP Act contains default noise standards regulating the hours of operation of construction equipment. The EP Act requires activities to take "all reasonable and practicable measures… to protect environmental values from all sources of environmental harm". This requirement forms the framework for assessing underwater noise impacts from the project.
QLD Environmental Protection (Noise) Policy 2008 (EPP (Noise) 2008) (QLD Government, 2008)	The EPP (Noise) sets long-term acoustic quality objectives to be progressively achieved.	The impact criteria for the project have been developed using the subordinate Planning for Noise Control Guideline (PNCG) under the EPP (Noise).

Document	Relevance	Application
Far North Queensland Regional Plan 2009 (FNQRP) (QLD Department of Infrastructure and Planning, 2009)	The FNQRP aims to maintain high levels of environmental quality in noise sensitive land usages. The FNQRP references the EP Act and the EPP (Noise).	The developed impact criteria are consistent with the aims of the FNQRP
Planning for Noise Control Guideline 2004 *(QLD Environmental Protection Agency, 2004)*	The Planning for Noise Control Guideline (PNCG) contains procedures for making planning decisions regarding noise emission from industrial developments. PNCG provides planning levels to gradually approach the long-term policy objectives of EPP (Noise).	Impact criteria for potential operational noise from the project have been developed with guidance from the PNCG.
Noise Measurement Manual 2000 (QLD Environmental Protection Agency 2000)	The Noise Measurement Manual contains procedures for conducting environmental noise surveys in Queensland.	Baseline noise survey conducted generally in accordance with the Department of Environment and Heritage Protection (DEHP) Noise Measurement manual.
Interim Construction Noise Guideline 2009 (ICNG) (NSW Department of Environment and Climate Change 2009)	In the absence of Queensland construction noise criteria, the NSW ICNG (which represents Australian best practice in management of construction noise) has been used for guidance in setting construction noise impact criteria.	Impact criteria for construction of the project have been developed using the ICNG. Criteria for works outside the standard hours described in the EP Act have been developed using the ICNG.
Assessing Vibration: A Technical Guideline 2006 (NSW Department of Environment and Conservation 2006)	In the absence of specific Queensland guidance for vibration, the New South Wales guideline (which represents Australian best practice) is commonly adopted for setting impact criteria for vibration.	Impact criteria for human comfort have been developed using the guidance of the Assessing Vibration guideline.
Underwater Piling Noise Guidelines 2012 (UPNG) (SA Department of Planning, Transport and Infrastructure 2012)	In the absence of Queensland guidance for managing underwater noise impacts from piling, the South Australian UPNG has been used for guidance in managing underwater noise impacts from piling and construction of the project.	Impact criteria for underwater noise and standard mitigation measures have been developed using the UPNG.

Table B10.2b Guidelines and Standards

Document	Relevance
CONCAWE, The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities, C.J. Manning, 1981	Prediction methodology used for the prediction of environmental noise from the operation of the project. CONCAWE is commonly used in Australia as an environmental noise prediction model as it allows prediction of noise levels under different meteorological conditions.
Australian Standard AS 2436:2010 Guide to noise and vibration control on construction, demolition and maintenance sites	Construction noise and vibration predictions, assessment and mitigation have been conducted in accordance with AS 2436.

Document	Relevance
Australian Standard AS2670.2:1990 Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)	Criteria for assessing human comfort impacts of vibration have been derived using the guidance of AS2670.2 as a screening method in favour of using the more complicated methodology in the Assessing Vibration guideline.
British Standard BS 5228.1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise	In accordance with AS 2436, source noise levels of construction plant has been obtained from BS 5228.1.
British Standard BS 5228.2:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration	Methodology of construction vibration prediction and assessment has been based on recommended calculations and criteria from BS5228.2.
German Standard DIN 4150.3 1986 Structural vibration in buildings; effects on structures.	DIN4150 contains criteria for assessing impacts on dilapidated or heritage-significant structures and is commonly used as a conservative threshold for building damage impacts in Australia.
Calculation of Road Traffic Noise, Department of Transport, Welsh Office 1988	Noise levels from road traffic noise have been predicted using Calculation of Road Traffic Noise (CoRTN), which is commonly used for road traffic noise prediction in Australia.

B10.3 Methodology

B10.3.1 Methodology Overview

For acoustic impacts, the adopted assessment methodology is outlined below:

- Determine representative airborne background noise levels in the absence of operation of the Port of Cairns at identified sensitive receptors in the study area

(Note that underwater noise impacts are assessed against absolute thresholds for physiological effects on species and hence underwater background noise levels are not required for assessing underwater noise impacts)

- Present the results of predicted typical scenarios for construction noise and vibration impacts of the project on sensitive receptors
- Present the results of predicted typical scenarios for operation noise and vibration impacts of the project on sensitive receptors
- Assessment of these potential impacts/effects against identified acoustic impact criteria
- Provide project mitigation measures where performance criteria are predicted to be exceeded
- Present the potential residual effects of the project (with mitigation) on the acoustic environment.

Full details of the adopted acoustic assessment methodology are contained in **Appendix D7**.

A baseline noise survey was conducted to determine existing noise levels at sensitive receptors within the acoustic study area, as outlined in **Section B10.4.1**. Additional detail regarding the noise survey methodology is contained in **Appendix D7**.

B10.3.2 Assumptions and Technical Limitations

As with most proposed developments, 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 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 will be implemented as documented in a Noise Management Plan to be prepared for the project. Actual residual impacts will, however, be determined by the acoustic impacts after appropriate mitigation is applied.

For underwater noise impacts, the following environmentally-significant species have been identified as potentially being present within the project study area (refer to **Chapter B7, Marine Ecology**):

Cairns Harbour

- Loggerhead Turtle *(Caretta caretta)*
- Green Turtle *(Chelonia mydas)*
- Hawksbill Turtle *(Eretmochelys imbricate)*
- Saltwater Crocodile *(Crocodylus prosus)*
- Flatback Turtle *(Natator depressus)*
- Dugongs *(Dugong dugong)*
- Bottlenose dolphin *(Tursiops truncatus)*
- Dwarf Sawfish, Queensland Sawfish *(Pristis clavata)*
- Australian Snubfin, Irrawaddy Dolphin *(Orcaella heinsohni (previously O. brevirostris)*
- Indo-Pacific Humpback Dolphin *(Sousa chingensis)*.

Offshore

- Loggerhead Turtle (Caretta caretta)
- Green Turtle (Chelonia mydas)
- Hawksbill Turtle (Eretmochelys imbricate)
- Flatback Turtle (Natator depressus)
- Saltwater Crocodile (Crocodylus prosus)
- Whale Shark (Rhincodon typus)
- Humpback Whale (Megaptera novaeangliae)
- Australian Snubfin, Irrawaddy Dolphin (Orcaella heinsohni (previously O. brevirostris))
- Killer Whale, Orca (Orcinus orca)
- Indo-Pacific Humpback Dolphin (Sousa chingensis).

B10.3.3 Acoustic Impact Criteria

Impact criteria used for assessing the acoustic impacts of the project have been determined for construction and operational noise and vibration. The criteria have been determined based on the relevant state legislation, policies and guidelines. In some cases, no specific Queensland State policy or guidelines exist (e.g. for construction noise and vibration impacts) and guidance from other states, particularly NSW, has been used to assign relevant impact assessment criteria. Full derivation of the noise impact criteria and the derived criteria are given in **Appendix D7**.

A summary of relevant impact criteria for construction and operational noise and vibration are given in **Tables B10.3a-f**.

B10.3.4 Operational Noise

Table B10.3a Operational Noise Impact Criteria for the project

Receptors	Time Period	Project Noise Impact Criteria LAeq,1hour dB(A)
Wharf Street Residential	Day	57
	Evening	51
	Night	49
East Trinity	Day	43
	Evening	38
	Night	33
Trinity Inlet	Day	45
	Evening	43
	Night	43

B10.3.5 Road Traffic Noise

The impact threshold for road traffic noise is the planning level of 63 dB $L_{A10,18hr}$; however, existing noise levels on roads commonly already exceed the noise planning levels.

In cases where existing noise levels exceed the planning levels, impact criteria for road traffic noise are typically based on the magnitude of the increase in traffic noise levels.

Table B10.3b Road Traffic Noise Criteria

Predicted Noise Change	Magnitude of Impact
Increase of more than 15dB	Very major increase
Increase of 10-15 dB	Major increase
Increase of 6-10dB	Moderate increase
Increase of 3-5dB	Minor increase
Increase of less than 3dB	Negligible increase

B10.3.6 Maximum Noise Levels

Impact criteria for maximum noise levels from the project have been developed to assess sleep disturbance impacts for human receptors and to assess disturbance to migratory bird receptors.

Sleep disturbance is a complicated phenomenon and needs to be evaluated on a case-by-case basis and hence it is not possible to provide a single numerical criterion for sleep disturbance impacts. When considering sleep disturbance, the following factors need to be considered:

- The number of loud noise events
- The absolute level of the loud noise events
- The relative level ('emergence') of the loud event compared to the ambient noise level.

Criteria for absolute level (10 percent chance of awakening based on a single noise event) and for emergence (BG + 15 dB) are presented below as screening criteria for sleep disturbance.

Table B10.3c Maximum Noise Impact Criteria

Receptors	Project Noise Impact Criteria	
	L_{Amax} dB(A) (absolute level)	L_{Amax} dB(A) (emergence)
Wharf Street Residential	62	61
East Trinity	62	45
Trinity Inlet	62	55

B10.3.7 Construction Noise

Table B10.3d Construction Noise Impact Criteria for CSDP

Receptors	Time Period	Noise Affected Level	Highly Noise Affected Level
		dB(A)	dB(A)
Wharf Street Residential	Day	64	75
	Evening	53	58
	Night	51	56
East Trinity	Day	50	75
	Evening	40	45
	Night	35	40
Trinity Inlet	Day	52	75
	Evening	45	50
	Night	45	50

Note that the construction noise impact criteria are based on a screening approach from the ICNG. These criteria are not targets that must be met, but means of quantifying the expected impact of construction noise on the community.

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.

Where construction noise levels exceed the “Highly Noise Affected Level”, a strong adverse reaction to the construction noise from the community would be expected.

B10.3.8 Construction Vibration

Human comfort vibration impacts may be expected for vibration levels above approximately 0.3mm/s PPV. For levels above 0.3mm/s PPV, vibration impacts have been classified based on the following ranges.

Table B10.3e Construction Vibration Criteria

Impact Category	PPV (mm/s)	Subjective Impact (from BS5228.2)
Negligible	PPV ≤ 0.3	Vibration just perceptible
Minor	0.3 < PPV ≤ 1.0	Vibration perceptible, potential for complaint
Moderate	1.0 < PPV ≤ 10	Complaints likely
Major	PPV > 10	Vibration likely intolerable

B10.3.9 Impacts on Fauna

Impact thresholds for different physiological or behavioural impacts on marine species have been developed based on an extensive literature study as detailed in **Appendix D7**. These criteria are a combination of unweighted criteria and criteria weighted according to the hearing sensitivity of particular species (e.g. 'M-weighted' levels or the dBht metric). Criteria are generally presented as underwater noise levels (dB re 1 µPa) except for criteria for migratory birds (in air) which are presented using A-weighted dB re 20 µPa sound pressure levels.

Table B10.3f Summary of Noise Thresholds for Species

Impact	Species	Sound Pressure dB re 1 µPa	Sound Exposure Level dB re 1 µPa²·s
50% Mortality (all sizes)	Fish		210dB
	Migratory birds and shorebirds		198dB
Serious Physical Injury	Marine Mammals	$240dB_{peak}$	
	Fish		195dB (onset of mortality)
	Migratory birds and seabirds (diving)		195dB (onset of mortality)
Permanent Hearing Damage (PHD)	All species	$130dB_{ht}$	135dBht
	Whales –Baleen	$230dB_{peak}$	198dB(Mlf) (impulsive) 215dB(Mlf) (continuous)
	Whales – Toothed	$230dB_{peak}$	198dB(Mmf) (impulsive) 215dB(Mmf) (continuous)
	Dugongs	220 dB_{peak}	188dB(Mmf) (impulsive) 205dB(Mmf) (continuous)
	Seabirds (airborne)	110 dB(A) (continuous) 125 dB(A) (impulsive)	
	Seabirds (diving)		193dB

Impact	Species	Sound Pressure dB re 1 µPa	Sound Exposure Level dB re 1 µPa²·s
Temporary Hearing Damage (TTS)	Whales –Baleen	224dB$_{peak}$ 160dBrms (continuous)	183dB(Mlf) (impulsive)
	Whales – Toothed	224dB$_{peak}$ 160dBrms (continuous)	183dB(Mmf) (impulsive)
	Dugongs	214dB$_{peak}$ 150dBrms (continuous)	173dB(Mmf) (impulsive)
	Seabirds (airborne)	93 dB(A) (continuous) 110 dB(A) (impulsive)	
	Seabirds (diving)		190dB (safe level for no injuries)
Disturbance – Strong (~90% avoidance) (SA)	All species	90dBht	
	Marine Mammals	160dBrms (impulsive) 120dBrms (continuous)	
	Fish	140-160dB$_{peak}$ (impulsive)	
	Seabirds (airborne)	72 dB(A)	
Masking	Whales – Toothed and Baleen	115dBrms	
Detection	Whales -Toothed	90dB (for frequencies below 1000 Hz)	
	Dugongs	80dB (for frequencies below 1000 Hz)	

B10.3.10 Significance Criteria

This section should be read in conjunction with the noise impact criteria detailed in **Appendix D7**. An assessment of the significance of the noise impact has been conducted using the significance criteria outlined in **Table B10.3g**.

Determination of the significance criteria has been undertaken using the following methodology:

- Predicted exceedance (if any) of noise impact criteria
- Number of receptors exposed to a particular level of impact.

Impacts that occur only at a small number of receptors would not be considered as significant for project decision-making as widespread impacts. The duration of the noise exposure (in the case of temporary noise or vibration sources such as construction) is also a consideration.

Noise impacts occurring at a receptor for more than one month have been assessed as being more-significant than the same impact occurring for less than one month.

As outlined in **Chapter A1, Project Introduction**, the impact assessment process involves a risk assessment of the predicted exceedance of the acoustic impact criteria occurring (e.g. some exceedances are only predicted to occur under adverse meteorological conditions and/or under uncommon/unlikely operational scenarios).

A summary of the adopted significance criteria are provided in **Table B10.3g**.

Table B10.3g Acoustic Significance Criteria

Project Aspect			
Significance of Impact	**Construction Noise and Vibration**	**Airborne Operational Noise**	**Underwater Noise Construction and Operation**
Very High	Construction noise levels are predicted to regularly exceed the 'Highly Noise Affected Level' by more than 10 dB(A) at the majority of noise-sensitive receptors for more than one month. Vibration levels of > 10 mm/s at majority of sensitive receptors for more than one month. Building damage to any heritage-listed structure.	Operational noise levels are predicted to regularly exceed the impact criteria by more than 15dB(A) at most noise sensitive receptors. Road traffic noise levels experience a Very Major increase above pre-construction levels and resulting levels exceed 63 dB $L_{A10,18hr}$.	Noise from construction or operational activities, in particular underwater piling that result in mortality or permanent threshold shift (hearing damage) which leads to mortality, permanent or long-term (greater than five years) disappearance of a population of nationally and state significant species, (refer to **Section B10.3.2** and **Chapter B7, Marine Ecology** for listed species).
High	Construction noise levels are predicted to exceed the 'Highly Noise Affected Level' by 15dB(A) or more at the majority of noise-sensitive receptors for up to one month. Construction noise levels are predicted to regularly exceed the 'Highly Noise Affected Level' by up to 10dB(A) at the majority of noise-sensitive receptors for more than onemonth. Vibration levels of > 10mm/s at majority of sensitive receptors for up to one month. Building damage to any permanently-occupied structure.	Operational noise levels are predicted to exceed the impact criteria by between 10 to 15dB(A) or occasionally by more than 15dB(A) at noise sensitive receptors. Road traffic noise levels experience a Major increase above pre-construction levels and resulting levels exceed 63 dB $L_{A10,18hr}$.	Noise from construction or operational activities, in particular underwater piling that result in mortality or permanent threshold shift (hearing damage) which leads to mortality or permanent disappearance of a population of non-significant species. Noise from construction or operational activities, in particular underwater piling that result in temporary threshold shift or disruption to habitat, which leads to short term disappearance (less than five years) of a population of nationally and state significant species. Noise from construction activities, in particular underwater piling that result in temporary threshold shift or disruption to habitat, which leads to long-term (greater than five years) disappearance of a population of non-significant species.

Project Aspect			
Significance of Impact	**Construction Noise and Vibration**	**Airborne Operational Noise**	**Underwater Noise Construction and Operation**
Moderate	Construction noise levels are predicted to exceed the 'Highly Noise Affected Level' by between 10dB(A) to 15dB(A) at the majority of noise-sensitive receptors for up to one month. Construction noise levels are predicted to regularly exceed the 'Highly Noise Affected Level' by up to 5dB(A) at the majority of noise-sensitive receptors for more than 1 month. Vibration levels of 1 10mm/s at majority of receptors for more than 1 month.	Operational noise levels are predicted to exceed the impact criteria by between five to 10dB(A) or occasionally by more than 10dB(A) at noise sensitive receptors. Road traffic noise levels experience a Moderate increase above pre-construction levels and resulting levels exceed 63dB $L_{A10,18hr}$.	Noise from construction activities, in particular underwater piling that result in temporary threshold shift or disruption to habitat, which leads to short-term (less than five years) disappearance of a population of non-significant species. Noise from construction or operational activities which leads to a temporary (less than one week) disturbance of significant or non-significant species.
Minor	Construction noise levels are predicted to exceed the 'Highly Noise Affected Level' by up to 5 dB(A) at the majority of noise-sensitive receptors for up to one month. Construction noise levels exceed the 'Noise Affected Level' but do not exceed the 'Highly Noise Affected Level' for more than one month. Vibration levels of 1 10 mm/s at majority of receptors for up to one month Vibration levels of 0.3 1 mm/s at majority of receptors for more than one month.	Operational noise levels are predicted to exceed the impact criteria regularly by between three dB(A) up to five dB(A), or rarely by up to than 10dB(A) at noise sensitive receptors. Road traffic noise levels experience a Minor increase above pre-construction levels and resulting levels exceed 63 dB $L_{A10,18hr}$.	

Project Aspect			
Significance of Impact	**Construction Noise and Vibration**	**Airborne Operational Noise**	**Underwater Noise Construction and Operation**
Negligible	Construction noise levels do not exceed the 'Highly Noise Affected Level' at the majority of noise-sensitive receptors for up to one month. Construction noise levels do not exceed the 'Noise Affected Level' at the majority of noise-sensitive receptors for more than one month. Vibration levels of 0.3 1mm/s at majority of receptors receptor for up to one month. Vibration levels of <0.3mm/s at majority of receptors for greater than one month at all receptors.	Operational noise levels are predicted to meet the impact criteria or exceed by less than three dB(A). Road traffic noise levels experience a Negligible increase above pre-construction levels; or post-resulting levels do not exceed 63 dB $L_{A10,18hr}$.	Noise from construction or operational activities does not have an impact on species
Beneficial	Construction contributes to the reduction of noise. For example, construction or operation shuts down an existing source of noise such as a road and the resulting noise impact is less than the previous noise impact. Construction contributes to the reduction of vibration. For example, construction or operation shuts down an existing source of vibration.	Operation contributes to the reduction of noise. For example, operation shuts down an existing source of noise such as a road and the resulting noise impact is less than the previous noise impact. Road traffic noise levels decrease below pre-construction noise levels.	Construction or operational activities result in a decrease in underwater noise levels.

B10.4 Existing Conditions

B10.4.1 Site Description and Study Area

The project description for construction and operation phases and the general study area is outlined in **Chapter A4, Project Description**. The land immediately adjacent to the CCLT is used for port operations or is set aside for future port development. The area surrounding the Port of Cairns controlled land includes the Cairns CBD, East Trinity, Trinity Inlet and Trinity Bay.

The aim of the project is to allow access of larger cruise ships, including a portion of those that currently anchor off Yorkeys Knob, into the Port of Cairns via the upgraded shipping channel. As the project will therefore result in a reduction in the number of ships utilising Yorkeys Knob, it was not considered necessary to assess noise impacts at Yorkeys Knob, however this change is likely to result in a small beneficial impact since the project will result in reduction in associated noise levels.

Note that the project will not change the routes used by ships to approach the Cairns/Yorkeys Knob vicinity and hence noise impacts from individual ship movements on the wider Far North Queensland coastal area (including the Great Barrier Reef Marine Park and the World Heritage Area) will not change compared to the 'do nothing' scenario.

There will be a cumulative noise impact from the greater number of ships accessing the Port of Cairns as a result of the project, which is addressed in **Chapter B18, Cumulative Impacts Assessment**.

The acoustic study area for this assessment encompasses:

- The immediate vicinity of the Port of Cairns, including Trinity Inlet and the Cairns CBD
- Residential areas at East Trinity
- Marine areas adjacent to the Port of Cairns shipping channel and Dredge Material Placement Area (DMPA).

B10.4.2 Noise Sensitive Receptors

Sensitive receptors are defined in Schedule 1 of the *Environmental Protection (Noise) Policy 2008*, the EPP (Noise), to include dwellings, libraries and educational institutions, childcare centres and kindergartens, outdoor school playground areas, medical institutions, commercial and retail activities, protected areas, marine parks and passive parks and gardens.

The nearest noise sensitive receptors within or adjacent to the acoustic study area have been identified and assigned to catchment areas where existing noise conditions are characterised by similar noise sources and levels. The most-affected single representative sensitive receptor (generally the closest receptor unless factors such as screening are relevant) has been adopted for each catchment area.

Some areas of land adjacent to the CCLT are proposed to be redeveloped in the future (potentially as residential) as part of the approved CityPort development. The noise assessment has also included these proposed future development areas.

These areas and their approximate distances to the cruise terminal are provided in **Table B10.4a**.

Table B10.4a Noise Sensitive Receptor Locations

Noise Sensitive Receptor Catchment	Representative Receptor	Direction from Project to Receptor	Approximate Minimum Distance to Receptor
1. Hotels and residences along Wharf St	31 Wharf Street, Cairns	West	125m from CCLT
2. Hotels along the Marina, including the Cairns Hilton	Hilton Hotel, 34 Esplanade, Cairns	North-west	250m from CCLT
3. Residences along the coastline at East Trinity (South)	2 Esplanade, East Trinity	East	2300m from Shipping Channel
4. Residences along the coastline at East Trinity (North)	2427 Pine Creek Road, East Trinity	East	2500m from Shipping Channel
5. Residential receptors on boats moored on Trinity Inlet	Closest receptor to shipping channel	East	Varies. Closest receptor approximately 100m from shipping channel (for specific locations refer to **Chapter B9, Socio-Economic**)
6. Cityport development (proposed only, not built)	Closest receptor to Cruise Ship Terminal	North-west	125m from CCLT
7. Marine life	For species refer to Chapter B7, Marine Ecology	Varies	Varies

These areas have been identified in pink in **Figure B10.4.2a, Figure B10.4.2b** and **Figure B10.4.2c**.

B10.4.3 Existing Acoustic Environment

Noise impact criteria for assessment of construction and operational noise sources from the project are based on representative background noise levels measured during the site survey. Noise monitoring locations are shown in **Figure B10.4.3a** and **Figure B10.4.3b**. Refer to **Appendix D7** for details of the measured noise levels and the measurement methodology.

The CCLT vicinity 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.

The Trinity Inlet vicinity is an intermediate noise environment in that, although typical long-term noise levels are characterised by natural noise sources (particularly wave noise) there is also noise exposure from man-made noise sources from shipping movements on the channel.

Figure B10.4.3a

Figure B10.4.3b

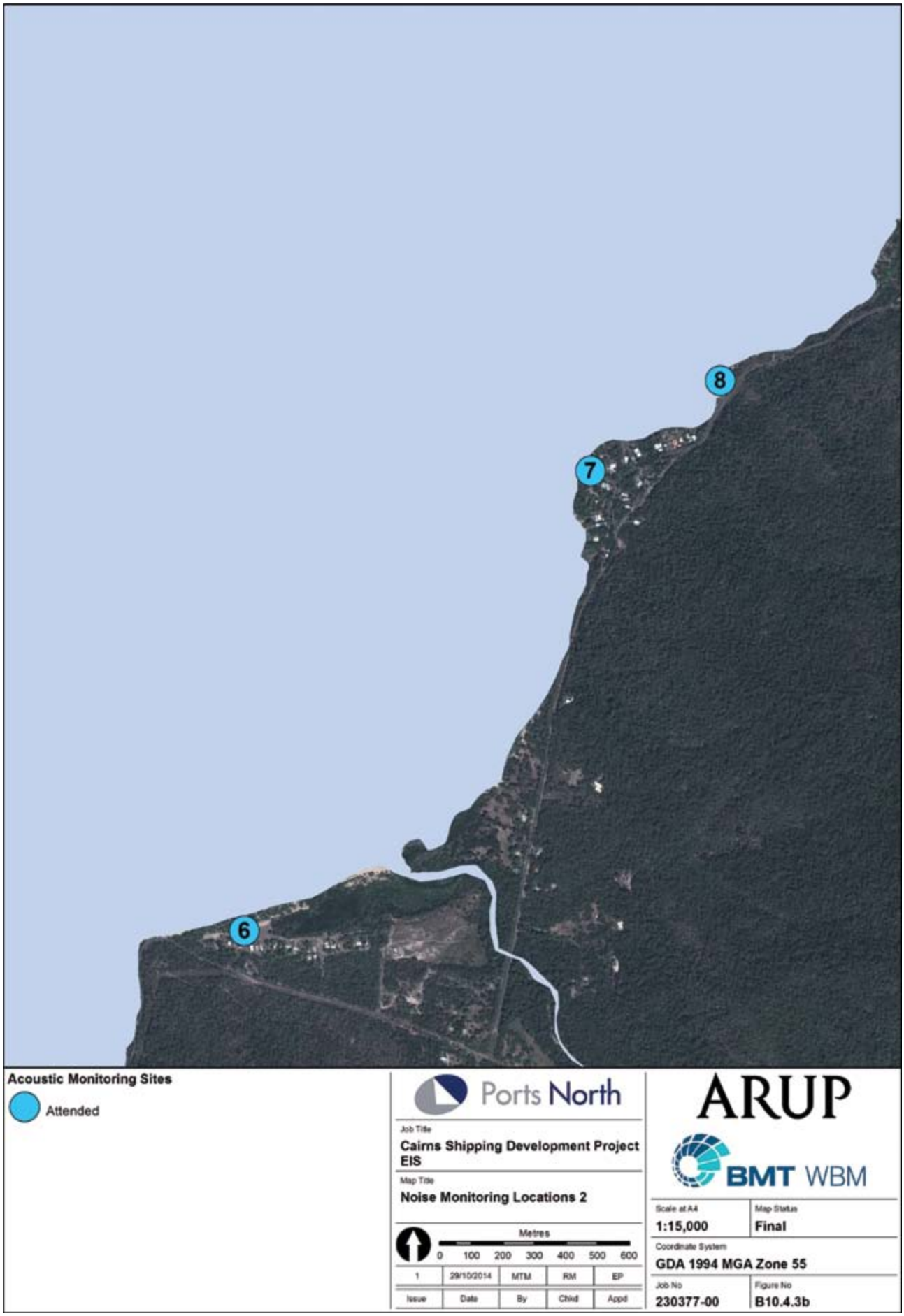


Figure B10.4.3c

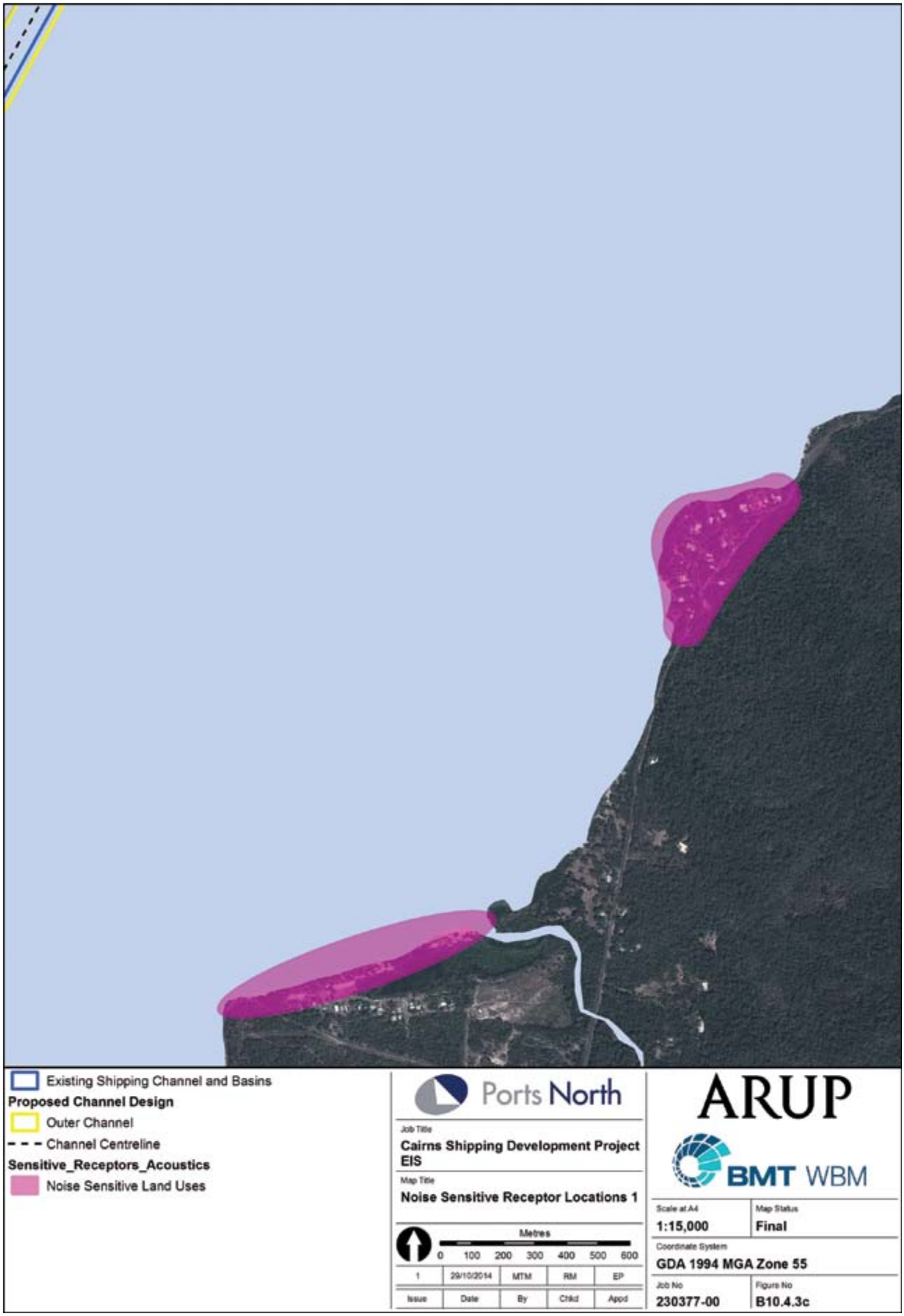


Figure B10.4.3d

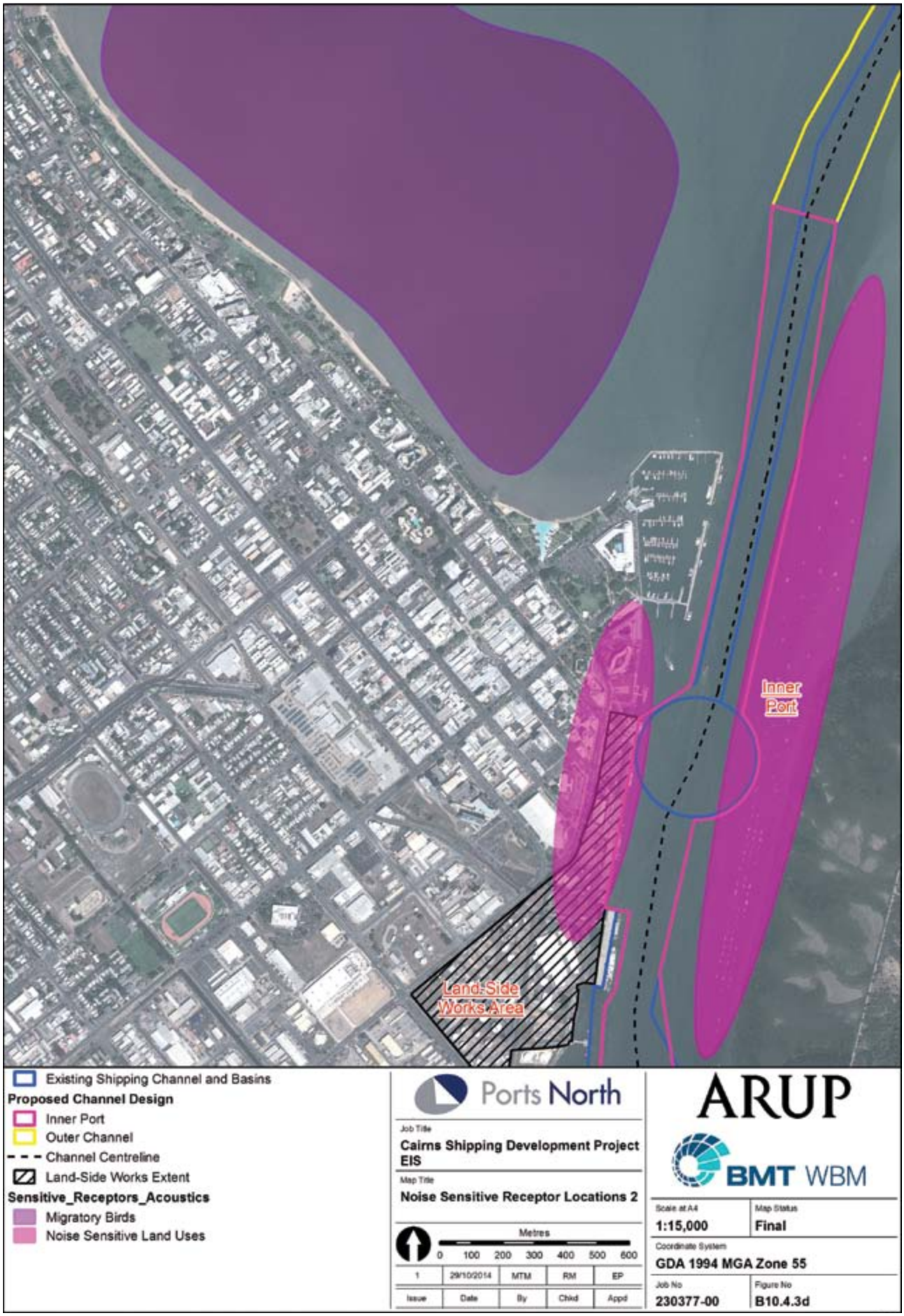
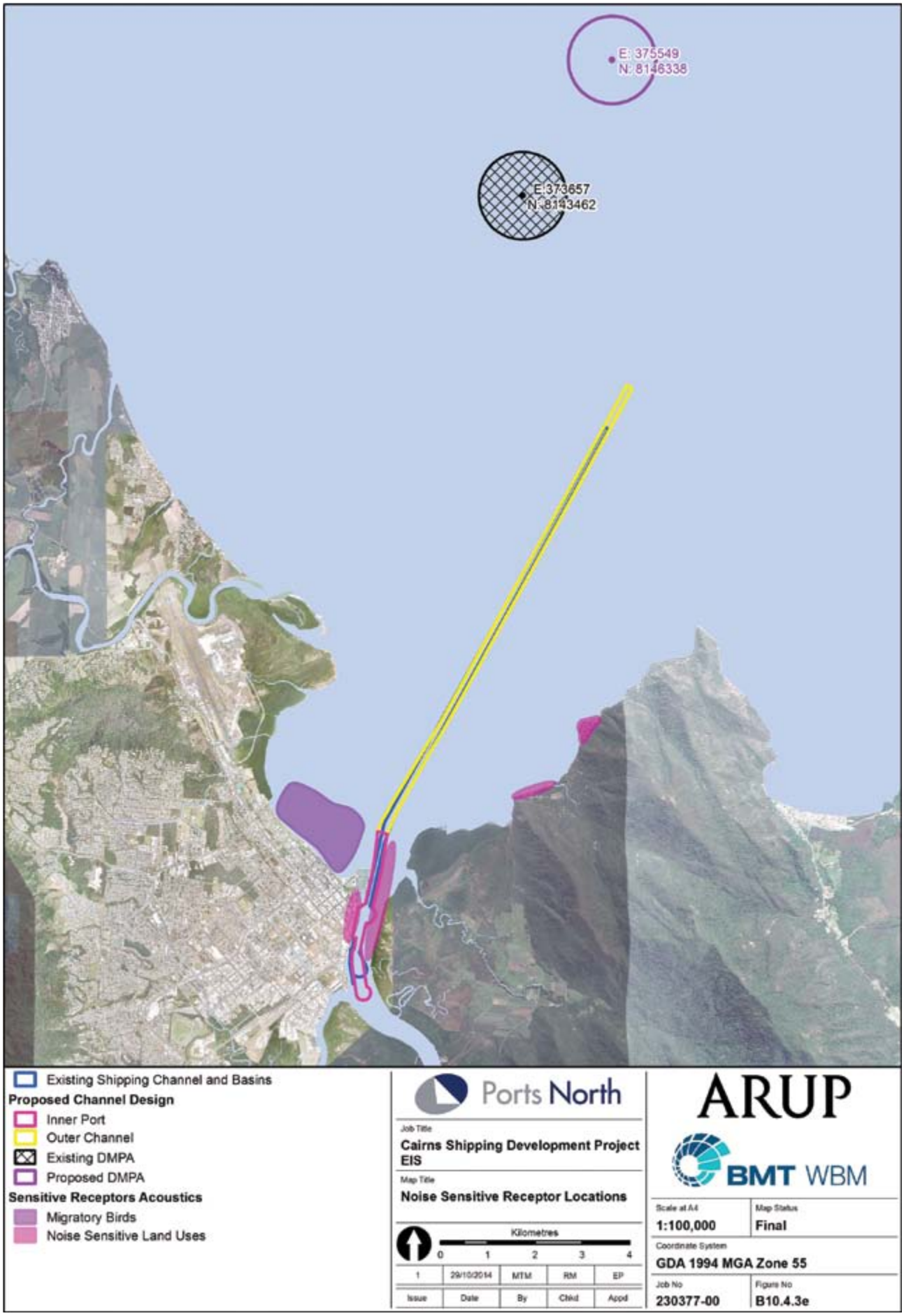


Figure B10.4.3e



Existing noise sources within the noise study area include:

- Noise from cruise ships when berthing at the CCLT and associated vehicular traffic during visits. Currently the largest (and loudest) cruise ship regularly accessing the terminal is the 78,000 tonne Rhapsody of the Seas
- Noise from other ship visits to the Port of Cairns, including navy and cargo ships at berth
- Noise from reef boats leaving from and returning to the Marina
- Industrial noise from the Port of Cairns (includes vessel movements from reef tour boats and other smaller work and recreational vessels)
- Event noise e.g. fireworks, functions and music events which occur irregularly
- Vehicular and pedestrian traffic
- Wave noise from Trinity Inlet
- Aircraft noise from aircraft approaching/departing Cairns Airport
- Seaplane and helicopter operations from Cairns Esplanade/Pier
- Mechanical services noise from buildings within the Cairns Central Business District (CBD) which was audible at the properties along Wharf St and at both the eastern and southern facades of the Hilton hotel.

Once operational, the project will result in increased number of cruise ship visits, but will not introduce new noise sources into the area; rather, it will increase the number of existing cruise ship port visit events for surrounding noise-sensitive receptors.

Beyond the Port of Cairns, at noise sensitive receptors at East Trinity, additional noise sources that were audible included:

- Road traffic from local roads
- Bird noise.

During the measurement period, no perceptible vibration from existing sources was observed.

B10.5 Assessment of Potential Impacts

Acoustic impacts from the project may consist of:

- Airborne noise
  - Impacts on humans
  - Annoyance or loss of acoustic amenity
  - Sleep disturbance
  - Impacts on migratory birds
  - Behavioural disturbance / disruption of nesting
- Vibration
  - Human comfort (disturbance)
  - Building damage to structures
  - Heritage listed wharf (refer to **Chapter B13, Cultural Heritage**)
  - Other occupied structures
- Underwater noise
  - Impacts on underwater fauna
  - Auditory masking
  - Avoidance/disturbance behaviour
  - Temporary hearing damage
  - Permanent hearing damage
  - Physical injury
  - Fatality.

Potential acoustic impacts from the project are predominantly anticipated to occur from the following project sources:

- Construction of the project, including:
  - Capital dredging
  - Piling for wharf construction
  - Other landside construction activities associated with the IFO pipeline and the upgrade of other services (See **Chapter A4, Project Description**).
- Operational noise, including:
  - Noise from ship transits through the Shipping Channel
  - Noise from ship loading and unloading
  - Noise from berthed ships
  - Increased traffic noise levels both on site and on roads serving the project
  - Ongoing additional maintenance dredging associated with the expanded channel.

*Note that whilst ongoing maintenance dredging is an 'operational stage activity' it is best assessed against "construction" noise impact criteria since it is a short-term noise activity that occurs only for a defined period every year. Maintenance dredging already occurs for the Port of Cairns but the expanded channel associated with the project will necessitate an extension in the duration of maintenance dredging. However, the increased dredging will predominantly occur in the outer channel and the potential impacts of noise from maintenance dredging in the inner port will remain unchanged.

An assessment of the potential impacts of the project (without mitigation) is provided below in the following sections. A summary of potential impacts is also provided together with proposed mitigation measures and predicted residual impacts in **Section B10.8**.

B10.5.1 Construction

B10.5.1.1 Airborne Noise

Airborne noise levels from the construction activities listed below have been predicted at the nearest affected noise sensitive receptors, assuming that no noise mitigation measures have been applied.

Source noise levels of construction activities have been taken from a range of sources including relevant standards and noise measurements used for previous assessments. Refer to **Appendix D7** for details of the source levels.

- Construction methodology, plant numbers, and hours of operation have been based on the construction methodology outlined in Chapter A4, Project Description.
- Potentially-significant construction noise impacts are anticipated from the following main activities:
  - Piling
  - IFO Pipeline installation
  - Construction traffic
  - Capital dredging.
- Full details of construction activities used in the assessment are included in **Appendix D7**. Noise impacts from road traffic noise associated with construction is discussed further in **Section B10.5.2.3**.
- Due to the distances involved and changing wind conditions in the coastal area, it is possible that meteorological effects may impact noise levels at receptors. As such, noise levels have been calculated for both neutral weather conditions and adverse weather conditions.

Noise contours have been produced and are included as **Appendix D7**.

Detailed tables presenting the noise levels are given in **Appendix D7**.

A discussion of results is given below for each of the main noise sources.

Table B10.5a Summary of Construction Noise Impacts

Noise Source	Summary of Construction Noise Impacts
Capital dredging – TSHD	TSHD dredging is predicted to have negligible impacts during standard construction hours. Outside standard construction hours, TSHD dredging is predicted to have a Minor noise impact on moored residential receivers located on Trinity Inlet. If the program of TSHD dredging results in the dredge staying in the vicinity of a receiver for greater than one month, noise impacts outside standard construction hours would increase to be Moderate.
Capital dredging – Backhoe	Backhoe dredging is predicted to result in Minor noise impacts to receivers at Wharf Street and Trinity Inlet during standard construction hours. Outside standard construction hours, Backhoe dredging is predicted to result in High noise impacts to receivers at Wharf Street and Trinity Inlet.
IFO Pipeline Construction	Construction of the IFO pipeline is predicted to result in negligible noise impacts at all times.
Piling	Piling is predicted to have a Minor noise impact during standard construction hours. If piling occurs outside standard construction hours, increased noise impacts are predicted for residential receivers at Wharf Street (High) and on Trinity Inlet (Moderate).

Construction noise impacts are predicted to occur for Wharf Street and Trinity Inlet receivers. No impacts are predicted to occur for East Trinity receivers, due to the distance (approximately two km) to these receivers from construction activity.

The activity predicted to result in the highest noise impacts is Backhoe dredging, which may potentially be conducted 24 hours per day. Minor noise impacts are predicted during standard construction hours; however high noise impacts are expected outside of standard hours, where construction noise levels are predicted to be approximately 20dB higher than the background noise level. The sleep disturbance screening assessment indicates that there is a high risk of sleep disturbance impacts for Wharf Street and Trinity Inlet receivers.

Additional mitigation measures will likely be required for backhoe dredging to mitigate noise impacts outside of standard construction hours. These mitigation measures are discussed in more detail in **Section B10.6**.

TSHD is predicted to have lower noise impacts, due to lower noise emission of the dredge itself and also because the dredge noise source is moving, meaning that the duration of noise exposure at any single receiver is reduced. If TSHD dredging occurs in the vicinity of receivers at night, there is a minor risk of sleep disturbance impacts for Trinity Inlet receivers. This may require measures to mitigate noise from the TSHD dredging, as discussed further in **Section B10.6**.

Piling is predicted to have lower impacts because piling operations will likely be limited to standard construction hours. Minor impacts are predicted during standard construction hours. However, if piling occurs outside of standard construction hours, Moderate to High noise impacts are predicted to occur. Additional mitigation measures for piling are discussed in **Section B10.6**.

B10.5.1.2 Vibration

Vibration levels from vibration-inducing equipment have been predicted at the nearest sensitive receptors.

The closest receptors for human comfort vibration effects from construction activities are the apartments/hotels on Wharf Street.

The closest receptor for building damage is the heritage wharf at Port of Cairns.

The highest vibration inducing activities during construction will be:

- Impact piling
- Dredging (TSHD and backhoe)
- Directional drilling from IFO pipeline installation (if required).

Vibration from Piling

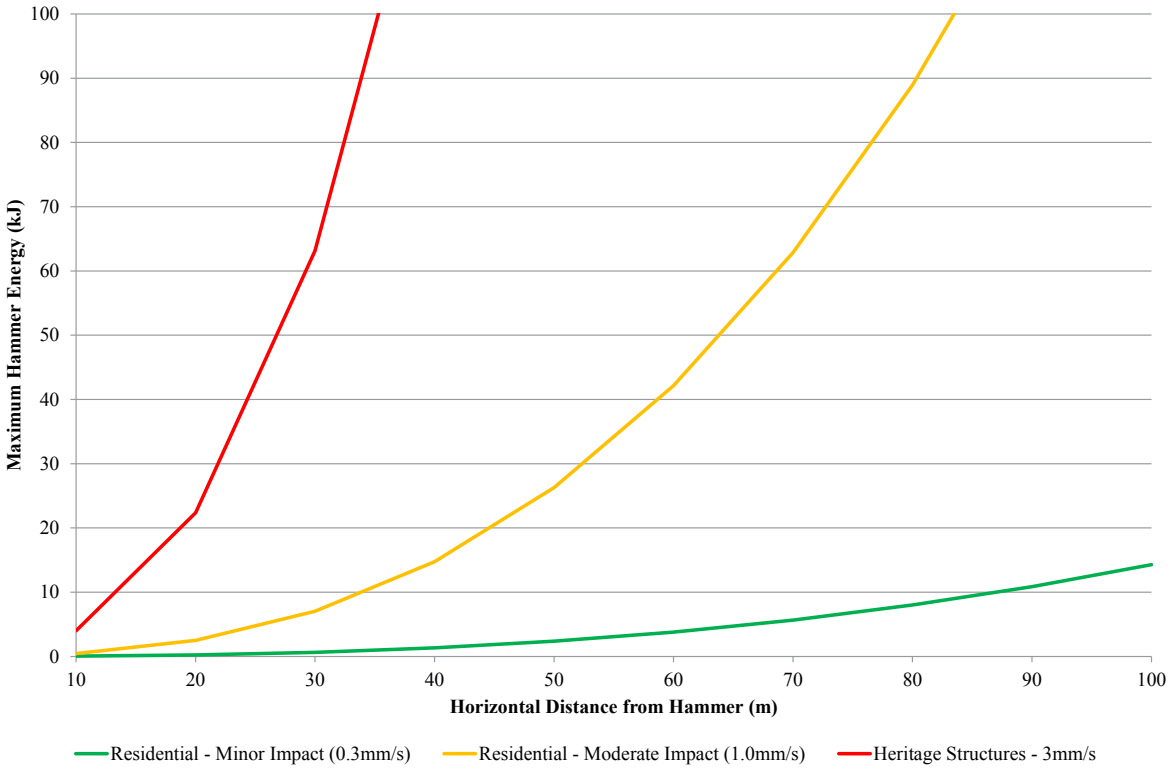
Vibration levels from piling are dependent on the hammer energy, which in turn is related to the hammer mass and drop height. These factors will be determined as part of the detailed planning of construction activities.

Accordingly, this assessment is based on providing calculated stand-off distances (i.e. horizontal buffer zone between the piling rig and sensitive receptors) for piling as a function of the drop energy in order to comply with the project vibration goals.

These stand-off distances will be used in planning piling operations to ensure that vibration goals are not exceeded.

A graph of nominal hammer energies relative to distance is provided for vibration criteria relevant to this study (see **Figure B10.5.1.2a**).

Figure B10.5.1.2a Maximum nominal hammer energy (kJ) to comply with project vibration targets for piling as a function of distance from receiver.



For typical hammer energies predicted vibration impacts on the Wharf Street residential receptors are likely to be in the range 0.3<PPV<1.0 for the duration of piling (>1 month). This corresponds to a minor impact.

To prevent impacts to the heritage wharf, the piling rig hammer energy will be controlled, with the hammer energy being reduced as the piling rig approaches the wharf. This will be achieved by limiting the drop height relative to the hammer mass so that piling has a negligible impact. From the experience of past installation of piles during capital works such as the CCLT wharf refurbishment in 2010 and installation of piles for maintenance of the actual heritage structure, vibration impacts are predicted to be negligible.

Terrestrial Vibration from Dredging

Vibration impacts from dredging are not commonly assessed because of the source-receiver distances encountered in typical EIS projects. The Port of Cairns is unusual in that port operations occur in close proximity to residential land usage and hence it is relevant to consider vibration levels from dredging activities.

There is little or no specific information of groundborne vibration levels from dredging in the literature (likely because in a typical assessment there are no vibration-sensitive receivers in the vicinity).

In the absence of specific vibration information from dredging in the literature, dredging impacts have been modelled using the TRL construction vibration methodology (Hiller and Crabb 2000) data for tunnelling operations.

Data from tunnelling indicates that the ground conditions are the main factor determining vibration levels from an excavation type activity.

For soft soils (clay and sand+clay), which are the closest available data to the seabed conditions for dredging, tunnelling vibration levels are expected to be below 0.1mm/s for all distances. Note that this is likely a conservative approach since a fluid seabed is likely even softer than the data assumed in this assessment.

This is well below vibration impact criteria for all receptor types and therefore represents a negligible impact.

B10.5.1.3 Underwater Noise – Piling

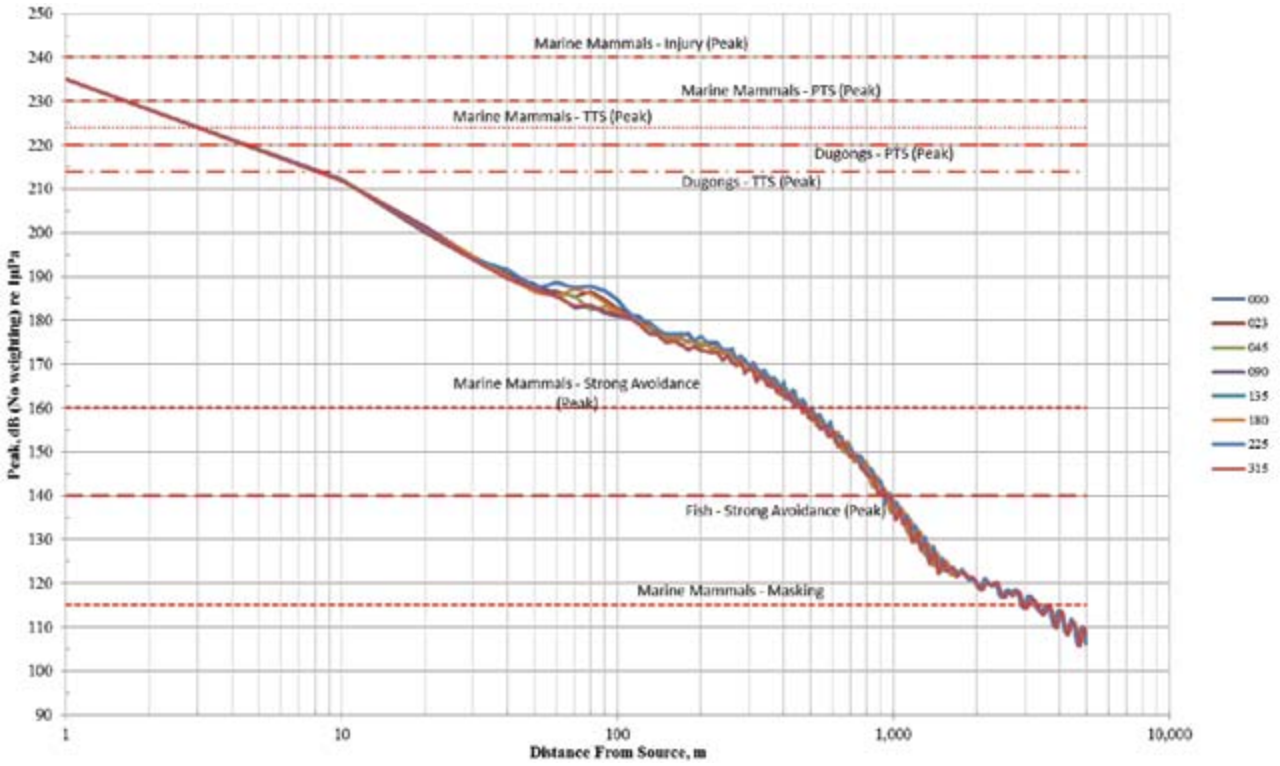
Underwater noise impacts from piling have been predicted using measured underwater noise source spectra of previous piling operations, scaled to the size of pile likely to be used for the project. Full details of the prediction methodology are given in **Appendix D7**.

Example plots of underwater noise levels as a function of distance are given in **Figure B10.5.1.3a**. Full plots of predicted underwater noise levels are presented in **Appendix D7**.

Noise levels are presented as unweighted sound pressure level (dB re 1 µPa) as a function of distance. Each line corresponds to a different direction from the source (labelled based on the bearing, i.e. 000 is north). Noise impact thresholds for different species are overlaid on the plot to show the predicted distance of impact.

The noise impact thresholds are summarised in **Appendix D7** and are based on a literature review of sensitivity of the marine species identified in **Chapter B7, Marine Ecology**.

Figure B10.5.1.3a Example Plot of Underwater Noise Levels – Piling at Dock



Piling noise is predicted to have **minor** impacts on fish, with localised fish mortality possible within the immediate vicinity (approximately two-three m) of the piling rig and behavioural changes (avoidance) expected at distances within 1,000m of the piling rig.

Piling noise is expected to have minor impacts on marine mammals (dugongs and whales), with hearing damage limited to the immediate vicinity of the piling rig (up to approximately 10m). Although behavioural changes (avoidance) are expected, these are predicted to be limited to the local vicinity of the piling rig (approximately between 100-500m depending on the metric considered) and hence not considered likely to have significant long-term impacts, especially considering the general absence of such species from within Trinity Inlet and the presence of existing noise sources from the existing level of ship traffic in Trinity Inlet.

B10.5.1.4 Underwater Noise - Dredging

Dredging noise is predicted to have **negligible** impacts on sensitive marine fauna (refer to **Section B10.3.2** and **Chapter B7, Marine Ecology**), with localised behavioural changes (avoidance) within approximately100-200m of the dredge. Hearing damage would only be expected if animals remain in the immediate vicinity (approximately10m of the dredge) for prolonged periods, which is considered extremely unlikely to ever occur.

Refer to **Chapter B7, Marine Ecology** for a further discussion of sensitive marine fauna and the impacts of underwater noise.

B10.5.2 Operational Impacts

Airborne noise levels from the operational activities associated with the development have been predicted at the nearest affected noise sensitive receptors, assuming that no noise mitigation measures have been applied, and are outlined in the following section.

B10.5.2.1 Shipping Noise - Airborne

The Port of Cairns currently operates with port visits from cruise ships and other vessels (including visiting Navy ships). The project will increase the number of port visits but will not result in the addition of a completely new noise source.

The largest cruise ship currently regularly accessing the Port of Cairns is the ***Rhapsody of the Seas*** (78,000 tons). This represents the existing "largest or potential worst case" cruise ship noise exposure for the Port of Cairns.

Once the project is operational, the Port of Cairns will be able to be accessed by cruise ships which are currently unable to access Port of Cairns due to draught, length and/or manoeuvrability constraints. These include a mix of some "mid-size" cruise ships such as the P&O Australia fleet (***Pacific Dawn/Pacific Pearl/Pacific Jewel***), as well as mega cruise ships such as ***Sun Princess/Dawn Princess***, ***Carnival Spirit*** or ***Radiance of the Seas***.

Note that some of the smaller mega class ships (e.g ***Sun Princess/Dawn Princess/Sea Princess***) have approximately the same sound emission characteristics as mid-size ships such as ***Pacific Dawn*** etc.

To capture the noise impacts, two categories of ship have been defined:

- Medium ship (mid-sized ship such as ***Pacific Dawn*** and smaller mega ships such as ***Sun Princess***)
- Large ship (All other mega ships such as ***Rhapsody of the Seas, Radiance of the Seas, Carnival Spirit***, etc.).

Examination of the published visit schedules for Port of Cairns for 2013 and 2014 (including ships mooring off Yorkeys Knob) (Ports North 2013a) shows that approximately 60 percent of ship visits to Yorkeys Knob are medium ships (i.e. ***Pacific Dawn, Sea Princess***, etc.).

Hence these medium ships would initially represent the majority of additional port visits associated with the project, with the mix of ships progressively moving towards large-type ships as mid-size ships are removed from service.

As such, noise levels have been predicted for the following scenarios:

- Existing situation (***Rhapsody of the Seas***), using measured noise data for ***Rhapsody of the Seas***
- Future medium cruise ship (e.g. ***Pacific Dawn, Sun Princess***), using average source levels for a mid-size cruise ship
- Future large cruise ship (e.g. ***Radiance of the Seas***), using average source levels for a mega cruise ship.

Source sound power levels of operational activities have been taken from a range of sources including:

- Internal Arup noise database (measurements from previous projects)
- Measurements of noise levels associated with cruise ships at existing cruise terminals
- Publicly available data from similar noise impact assessments
- Noise data from peer-reviewed technical papers addressing noise from similar developments
- Noise measurements of existing ship activities provided by Ports North.

Modelling methodology for operational activities have been based on the typical operational activities outlined in **Chapter A4, Project Description**, and from the above data sources. Full details of the types of plant, location and sound power levels that have been used in the assessment are included in **Appendix D7**.

The project is predicted to result in a greater number of overnight ship visits, which will consist of a majority of mid-size cruise ships as well as a smaller number of Mega cruise ship visits. Refer to **Chapter A4, Project Description** for details of the additional cruise ship numbers associated with the project.

Noise levels from docked large cruise ships are likely to be approximately equivalent to the existing "worst case" noise exposure from ***Rhapsody of the Seas*** (measured docked noise levels of significantly larger ships such as the 86,000 ton ***Carnival Spirit*** and the 90,000 ton ***Radiance of the Seas***, or the published data of Di Bella and Rimigi (2013) are within ~±3 dB of the measured noise levels from ***Rhapsody of the Seas***).

Noise levels from typical medium sized cruise ships that will access the Port of Cairns post-project (e.g. ***Pacific Dawn, Sun Princess***) will be quieter than the existing noise levels from ***Rhapsody of the Seas***.

A minor exceedance of the noise criteria at night is predicted for Wharf Street receivers from overnight visits by large cruise ships; however this exceedance is predicted to already occur for ***Rhapsody of the Seas***. No noise complaints have been received by Ports North for ship visits by ***Rhapsody of the Seas***, which suggests that the predicted exceedance from other large cruise ships is unlikely to be significant and is hence low risk.

Receptors on Trinity Inlet are predicted to experience a minor to moderate exceedance of the noise criteria as large cruise ship transit through the channel. Medium cruise ships are predicted to meet the noise criteria except for a minor exceedance if ship transit occurs at night. However, since a cruise ship transit is a discrete sound event and in general will not occur during the night time period, exceedances during ship transits are unlikely to be significant and are assessed as low risk

B10.5.2.2 Shipping Noise – Underwater

Underwater noise levels from cruise ships transiting the Shipping Channel have been predicted based on underwater noise measurements of several cruise ships available in the literature, as discussed in more detail in Appendix B10.

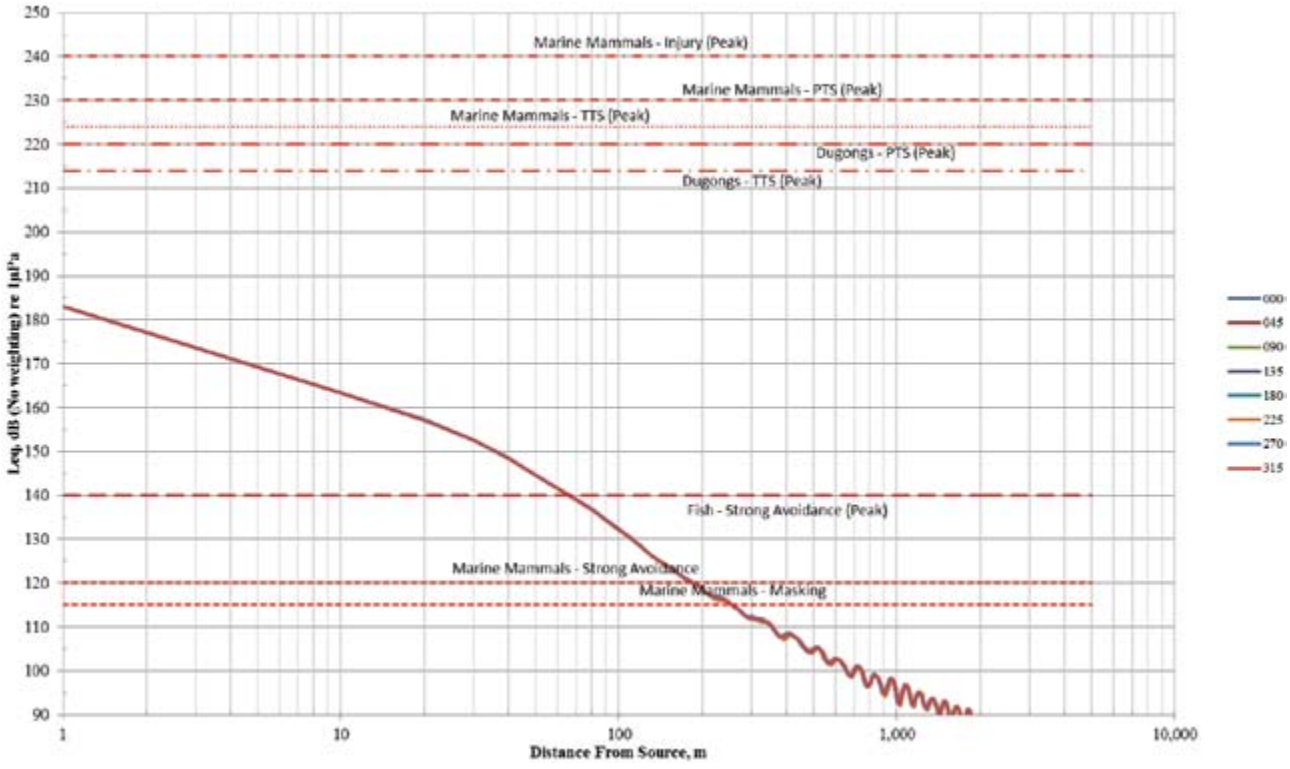
The available data shows that cruise ship noise emission generally falls into two categories:

- Medium ships, older typically-smaller ships with higher noise emission
- Large ships, newer typically-larger ships which have reduced noise emission.

The general trend of cruise ship design is moving towards quieter underwater noise levels from cruise ships, with the EU implementing a long-term initiative (SILENV) to significantly reduce underwater noise levels from ships.

Noise levels from a medium ship (i.e. the expected worst case ship accessing the Port of Cairns post-project) are presented in **Figure B10.5.2.2a** for a ship in the shipping channel. Additional data for different types of cruise ships and for different source locations are presented in **Appendix D7**.

Figure B10.5.2.2a Underwater Noise Levels from Medium Cruise Ship in Cairns Shipping Channel



Shipping noise is predicted to have negligible impact on marine mammals. There is existing vessel traffic at the Port of Cairns and the upgrade will result in additional vessels of similar type to the existing vessels; indeed it is possible that the newer, larger ships associated with the project will be quieter than existing vessels using the Port of Cairns, especially if proposed EU underwater noise initiatives such as SILENV are widely adopted in future.

Noise levels from shipping may cause avoidance behaviour from marine mammals within ~150-200m of the vessel. This avoidance behaviour is unlikely to cause significant disruption to marine mammals and indeed may assist in reducing the incidence of ship strikes.

B10.5.2.3 Traffic

Road traffic volumes for peak period operational times and percent heavy goods vehicles (hgv) have been provided in **Chapter B14, Transport** for the following roads:

- Lake Street
- Wharf Street
- Cairns Port (on-site).

Assessment has been made for the study area immediately adjacent to the site entrance, being the potentially worst affected zone. The traffic count data was collected during a peak period in use of the CCLT but outside of the CBD peak period. This provides the basis for assessment of relative impacts due to proposed alteration to port usage as per criteria.

Existing and predicted operational traffic flows are noted to be highly variable. The worst case traffic volumes from largest ship class, however, are predicted to increase overall traffic volumes a factor of less than two times. Assuming that the mix of heavy and light vehicles is approximately the same, this represents an overall change in road traffic noise impact of less than three dB. It should be noted that this is during peak use of the CCLT, when averaged over an 18-hour period, the increase in noise levels is expected to be even lower.

Construction activities associated with the project are not expected to produce significant additional road traffic compared to existing volumes. Road traffic associated with construction activities is therefore expected to be insignificant in the context of existing traffic flows on the local road network.

The increase in road traffic noise levels are summarised in **Table B10.5f**, along with the predicted significance of impact.

Table B10.5f Cairns Port Road Traffic Noise Impact Assessment

Activity	Potential Impact	Significance	Likelihood	Risk Rating
Additional road traffic noise (operational)	<3dB	Negligible	Likely	Negligible
Additional road traffic noise (construction)	<3dB	Negligible	Likely	Negligible

Traffic movements on site are predicted to comply with relevant operational criteria at all receptor locations during all time periods. Further, predicted noise levels are sufficiently below operational noise impacts from ships to not contribute significantly to noise impacts.

Table B10.5g Predicted Operational Noise Levels at Nearest Noise Sensitive Receptors – On-Site Traffic

Source	Location	Noise Impact Criteria dB(A) re 20µPa L_{Aeq}			Sound Pressure Level dB(A) re 20µPa L_{Aeq}		Significance of Impact	Probability	Risk Rating
		Day	Evening	Night	Meteorological conditions				
					Neutral	Adverse			
Traffic movements	Wharf St	57	51	49	44	44	Negligible	Almost Certain	Low
	East Trinity	43	38	33	-	-	Negligible	Almost Certain	Low
	Trinity Inlet	45	43	38	7	12	Negligible	Almost Certain	Low

B10.5.2.4 Maintenance Dredging

Noise impacts from maintenance dredging have been assessed using construction noise criteria although maintenance dredging is an operational activity.

This is because dredging is a short-term noise source that only occurs for a short, defined period per year.

Source levels for a typical size TSHD are approximately two dB lower than the large size TSHD used for Capital dredging (refer to **Appendix D7**).

B10.5.2.5 Maximum Noise Levels

Maximum noise level impact from operational noise levels have been predicted for assessment against sleep disturbance. These are presented in **Appendix D7**.

Sleep disturbance screening criteria are met for all activities except ships entering and leaving port.

Minor sleep disturbance impacts are expected at sensitive receptors for medium cruise ships. Moderate sleep disturbance impacts are expected for larger cruise ships at sensitive receptors.

The risk rating for noise level impacts for ships leaving/entering port is assessed as Low since cruise ships generally enter/exit the Port of Cairns during the morning (7.00am –10.00am) or early evening (5.00pm –8.00pm) time periods and hence cruise ship movements at night will be infrequent.

B10.5.2.6 Vibration

None of the equipment used in the operation of the project are expected to create vibration levels high enough to create adverse vibration levels at the nearest sensitive receptors.

Ship-based sources will not result in significant terrestrial vibration due to the large cumulative losses from a combination of coupling losses at the ship-water interface and the water-seabed interface and propagation losses through the seabed and ground.

Land-based operational vibration sources are limited to mobile equipment such as forklifts. Vibration from vehicles typically results in negligible impacts because the pneumatic suspension of vehicles isolates the vehicle mass from the ground.

Impact-type vehicle operations (e.g. forklift unloading/loading involving setting down of loads) will result in increased vibration; however these activities would occur alongside the cruise ship at distances of ~100m or greater to sensitive receivers and hence no impacts at receivers are expected to occur.

Hence operational vibration impacts from the project are assessed as being negligible.

B10.6 Mitigation Measures

B10.6.1 Construction

Specific mitigation measures for each of the construction activities that cause exceedances at noise sensitive receptors are included below in **Table B10.6a**

Table B10.6a Construction mitigation measures

Construction Activity	Recommended Mitigation
Backhoe Dredging	Backhoe dredging will be scheduled to avoid dredging of the Trinity Inlet channel in the vicinity of residential receptors during the night time period wherever possible. Where scheduling to avoid impacts is not possible, consultation with affected residents will be conducted to review potential mitigation measures. All works to be undertaken with regard to AS 2436-2010 - Guide to noise and vibration control on construction, maintenance and demolition sites. A Construction Noise and Vibration Management Plan will be prepared for the project construction which will detail noise mitigation measures agreed in consultation with DEHP/local authority.
TSHD Dredging (Capital and Maintenance dredging)	Dredging will be scheduled to avoid dredging of the Trinity Inlet channel in the vicinity of residential receptors during the night time period wherever possible. Where scheduling to avoid impacts is not possible, consultation with affected residents will be conducted to review potential mitigation measures.
IFO Pipeline	No additional mitigation measures required.
Piling	Piling activities will be limited to the daytime period unless approval is obtained from DEHP/local authority based on “sufficient grounds” to justify night time construction. Amarine mammal observation zone of one km, exclusion zone of 100m and a “soft-start” regime will be adopted to mitigate noise impacts on marine fauna. The effectiveness of this measure may be limited in the turbid waters of Trinity Inlet however, and the performance of this measure will be monitored. Underwater noise monitoring will be conducted at the onset of piling to confirm/ calibrate the noise predictions. If night time works are required, e.g. due to tide constraints, community consultation with residents should occur to explore mitigation options. A resilient pad (dolly) will be used where feasible between the pile and hammer head in order to reduce airborne noise impacts, as recommended by BS5228. Vibration impacts will 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. Vibration monitoring will be undertaken on the first day of piling to confirm/ calibrate the vibration predictions. 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 will be carried out in line with and engage the principles of Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) during the construction period to manage the noise impacts:

- The contractor will use modern and well-maintained equipment to undertake the works
- Limiting operation of the construction works to 6:30am to 6:30pm Monday to Saturday except for specific identified activities for which approval from the DEHP/local authority is obtained
- Notifying potentially-affected residents of any out-of-hours construction works (preferably at least one weeks' notice, minimum of two days' notice except for emergency works)
- Ports North will identify and gather contact details (address, phone, email) of stakeholders located in the vicinity of construction areas who could potentially be impacted by activities resulting in noise and vibration. Ports North will communicate with these people via phone, email and post as appropriate. This will also include Trinity Inlet, Port and Marlin Marina users as well as local residents and businesses. A construction engagement program would be developed and implemented to create a dialogue with stakeholders during the construction phase
- Where works are scheduled to occur outside regular construction hours, stakeholders would be advised in advance via email or post
- Ports North would continue to promote and manage feedback channels, such as a project email address and phone number, during construction activities for stakeholders to ask questions, provide feedback and lodge complaints.

B10.6.2 Operational Noise

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.

B10.7 Residual Impacts

B10.7.1 Construction

B10.7.1.1 Airborne Noise

The residual impact of construction noise with all mitigation measures is assessed to be negligible for construction during standard construction hours.

The residual impact of dredging construction noise outside of standard construction hours is assessed to be minor.

B10.7.1.2 Vibration

The residual impact of construction vibration is predicted to be negligible for all receptors with all mitigation measures in place.

B10.7.1.3 Underwater Noise

The residual impact of construction underwater noise is predicted to be negligible for all species with all mitigation measures in place.

B10.7.2 Operation

B10.7.2.1 Airborne Noise

The residual impact of operational noise will be negligible for receptors at Wharf Street and East Trinity.

Residual impacts to receptors at Trinity Inlet will be **minor**, primarily due to ship movements within the channel. However, these impacts are considered less-significant than for land-based receivers due to the location of these receptors adjacent to the shipping channel (and hence it is not considered reasonable to expect these receptors not to be exposed to noise from shipping movements).

B10.7.2.2 Vibration

The residual impact of operational vibration will be negligible for all receptors.

B10.7.2.3 Underwater Noise

The residual impact of underwater noise emission from operation of the project will be negligible for all species considered.

B10.8 Summary of Impacts

A summary of the impacts, mitigation measures and residual impacts is given in **Table B10.8** below.

Table B10.8a Summary of Impacts, Mitigation Measures and Residual Effects

Effect	Assessment of Impact	Mitigation	Residual Risk
Construction noise – land based infrastructure	Negligible to Moderate	Construction activity will not be conducted during the night-time period, unless "sufficient grounds" exist to obtain approval for out-of-hours' work. All works to be undertaken with regard to AS 2436-2010 – Guide to noise and vibration control on construction, maintenance and demolition sites. General site activities to follow the principles of Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA). Community consultation with local residents should seek agreed mitigation measures.	Medium
Construction Noise – dredging	Negligible to Moderate	Back-hoe dredging near sensitive receptors will be avoided during the night-time period wherever possible. All works to be undertaken with regard to AS 2436-2010 – Guide to noise and vibration control on construction, maintenance and demolition sites. Community consultation with local residents should seek agreed mitigation measures if night-time dredging is to occur.	Medium
Construction vibration	Negligible to minor	Implement mitigation measures and monitor at commencement of construction works. Undertake dilapidation survey of existing heritage structures should piling works not be conducted in accordance with the nominated criteria.	Low
Operational vibration	Negligible	N/A	Negligible
Operational noise – shipping and terminal	Negligible to Minor	Updates to existing port operations procedures may be prepared in the future should predicted impacts eventuate, and these may include administrative measures to reduce noise emission during the night time period.	Low
Operational noise – road traffic	Negligible	N/A	Negligible
Impact of piling on fish	Minor	Soft starts	Low
Impacts of piling on marine mammals (including dugongs)	Negligible	Soft starts, safety zones (if necessary, or practicable)	Low
Impacts of dredging on fish, marine mammals and dugongs	Negligible	No mitigation required	Low
Shipping noise	Negligible	No mitigation required	Low