FLANAGAN CONSULTING GROUP
Trusted Advisor to Northern Australia

Ports North

CAIRNS SHIPPING DEVELOPMENT PROJECT

Revised Draft Environmental Impact Statement

APPENDIX R: Baseline Noise Constraints Assessment

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Cairns Shipping Development

Baseline Noise Constraints Assessment

Report: 8483R02V01 ASK Stage 1B Noise.docx

Prepared for:

Flanagan Consulting Group

5 October, 2016

Document Control				
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Document Ref	**Date of Issue**	**Status**	**Author**	**Reviewer**
8483R02V01	5 October, 2016	Final	MR	SP

Document Approval			
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Appendices

1. Introduction

ASK Consulting Engineers Pty Ltd (ASK) was commissioned by Flanagan Consulting Group to provide acoustic consultancy services to describe the existing situation for the Revised Draft Environmental Impact Statement (EIS) for the revised Cairns Shipping Development Project (CSD Project). The recalibration relates to a reduction in the quantity of material to be dredged from 4,400,000 m^3 to 860,000 m^3 in-situ material, and relocation of the dredge material placement area (DMPA) to land instead of sea.

This report assesses the existing environment at each potential DMPA , and provides a constraints assessment for the project. Locations addressed include the wharf areas and:

- dredging slurry pipeline routes for each DMPA
- dredging slurry pipeline booster stations for each DMPA
- the DMPAs.

The main focus of the report is to document the existing acoustic environment for future impact assessment regarding:

- noise emissions from construction and operation of the dredging infrastructure, including dredging slurry pipeline, booster pump stations and DMPAs
- noise emissions from the wharf area construction site
- noise emissions from wharf operational activities.

Other aspects of noise and vibration will be addressed by others during the next stage of the assessment (impacts and mitigation). Accordingly, the existing situation regarding the following is not in the scope of this assessment:

- noise from dredging (from the actual dredge itself)
- 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.**

2. Proposed Development

2.1 Project Description

The CSD Project involves upgrading of existing infrastructure for the Port of Cairns to accommodate larger cruise ships, including expansion of the existing shipping channel and swing basin, and upgrades to the existing wharves and associated services. Associated with this is the construction of infrastructure for placing the dredge material on land.

The following timeframes are anticipated:

- Dredging and hence placement of slurry at the DMPA is anticipated to require approximately 10 weeks, with the duration to be confirmed in the concept refinement / impact assessment phase. For the Northern Sands placement option, the current time estimate is 10.3 weeks plus pipeline mobilisation and demobilisation.
- Construction of the pipeline and boosters (if required) is estimated to require in the order of approximately 3 months, with decommissioning anticipated to require approximately 2 months.
- The construction of the wharf upgrade will take approximately eight to ten months.
- The construction of other land-based infrastructure will be concurrent with the wharf upgrade.
- Site setup and establishment (i.e. bund cosntruction, etc) (timing to be confirmed following further assessment and review).

The anticipated demand for ship berthings is 140 ships by 2026 including 104 megaclass ships.

2.2 Wharf Construction

An additional intermediate fuel oil storage tank, with 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 the Draft EIS, construction of the fuel storage ad transfer infrastructure will 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 - 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 will 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 including driving of piles and drilling of sockets into the seabed. The undertaking of this construction will require:

- 35 – 80 tonne mobile crane
- ~20 tonne Franna crane
- concrete pump truck
- power generators
- concrete delivery trucks.

The extent of the wharf and associated land works are shown in **Figure 2.1**. The extent of the upgrades for the fuel storage works is shown in **Figure 2.2**.

Figure 2.1 Extent of Wharf and Associated Land Works (Figure obtained from Draft EIS)

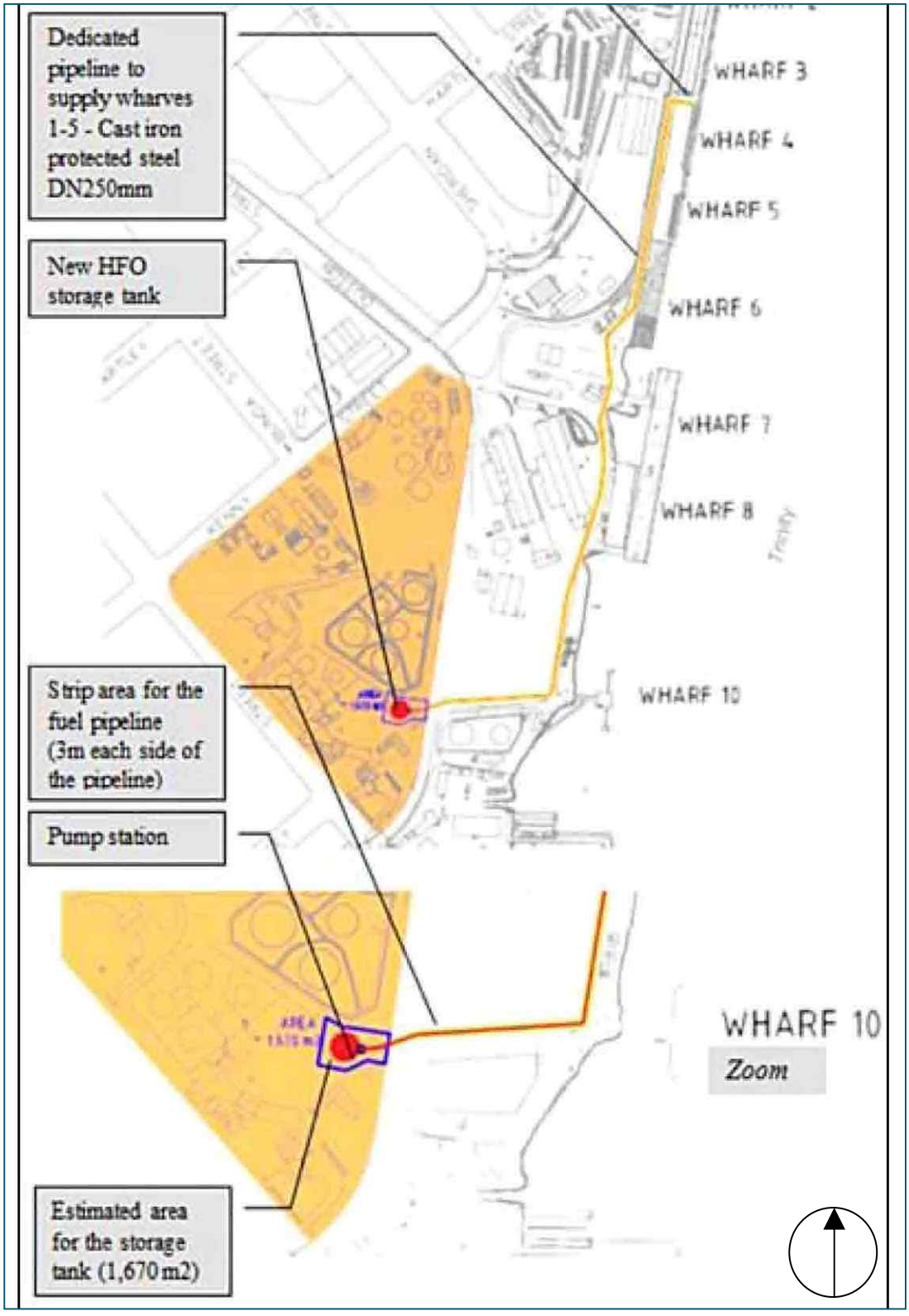

Figure 2.2 Fuel Storage Works (Figure obtained from Draft EIS)

2.3 Temporary Dredging Pipeline Options

The recalibrated project anticipates a reduced total insitu dredge volume of less than 1 million cubic metres (m^3) to be dredged by a trailer suction hopper dredge (TSHD). Two potential onshore precincts for placement of the dredged material have been identified following a detailed options study. The two potential precincts include:

- East Trinity: three potential sites at East Trinity (terrestrial above ground placement in constructed bunds)
- Baron Delta: single proposed placement site (placement into an existing void, possibly below groundwater level).

The potential East Trinity placement locations and associated pipeline routes are presented in **Figure 2.3** to **Figure 2.5**. The potential Baron Delta placement location and the associated pipeline route options are presented in **Figure 2.6** to **Figure 2.8**.

At the seaward extent of the pipelines will be a pump-out facility that will allow the TSHD to discharge the material dredged in the preceding cycle. At this stage it is assumed that the actual pumping will be by the TSHD.

The location of pipe storage (green shaded rectangle) and pipe fabrication areas (purple shaded rectangle), indicative booster locations and Dredge Material Placement Area (DMPA) footprints (red polygon) are also provided in these figures.

Figure 2.3 East Trinity Site A Revised Conceptual Layout

Figure 2.4 East Trinity Site B Revised Conceptual Layout

Figure 2.5 East Trinity Site C Revised Conceptual Layout

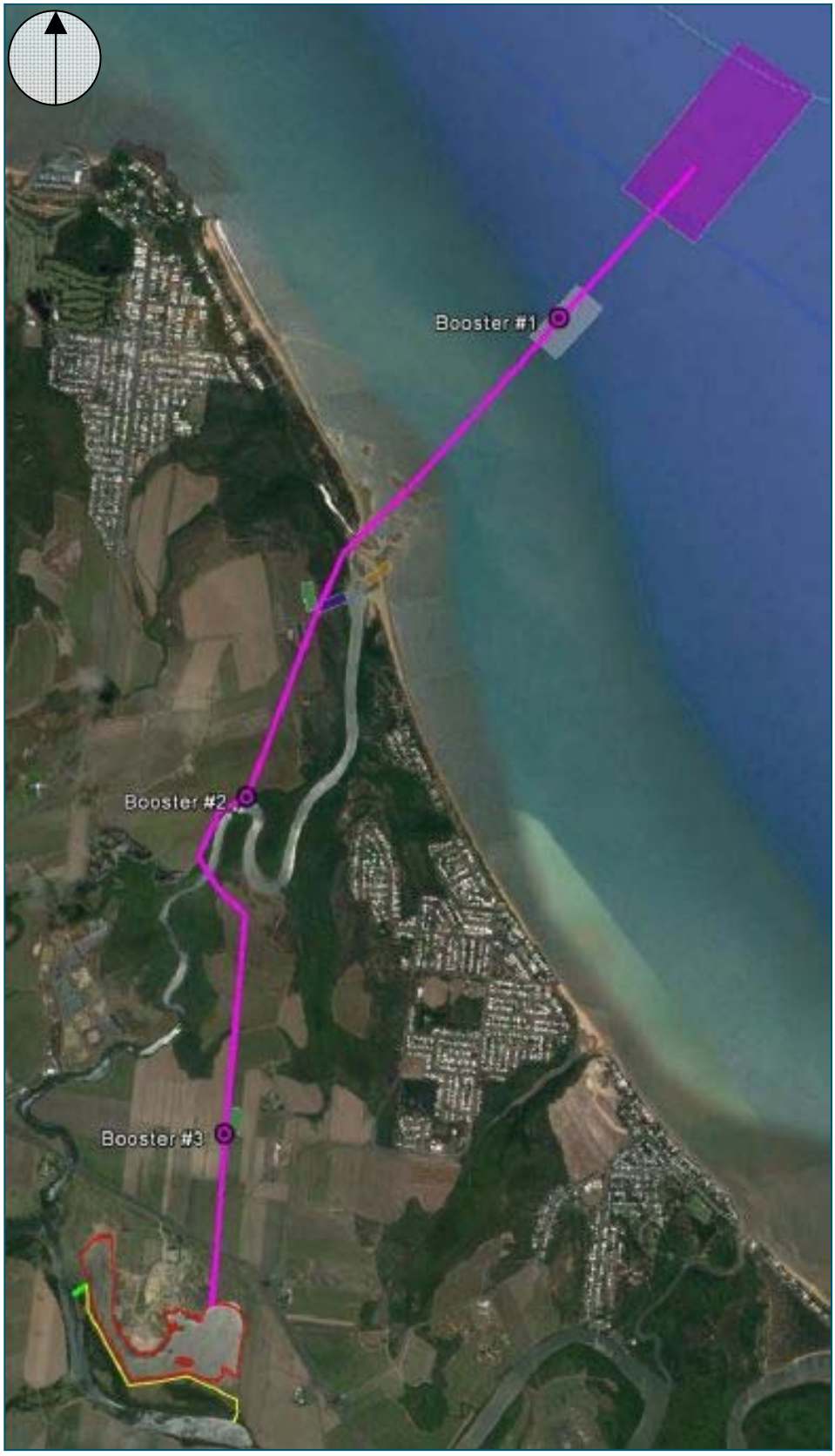

Figure 2.6 Barron Delta – Aquis Pipeline Option with Marine Booster Revised Conceptual Layout

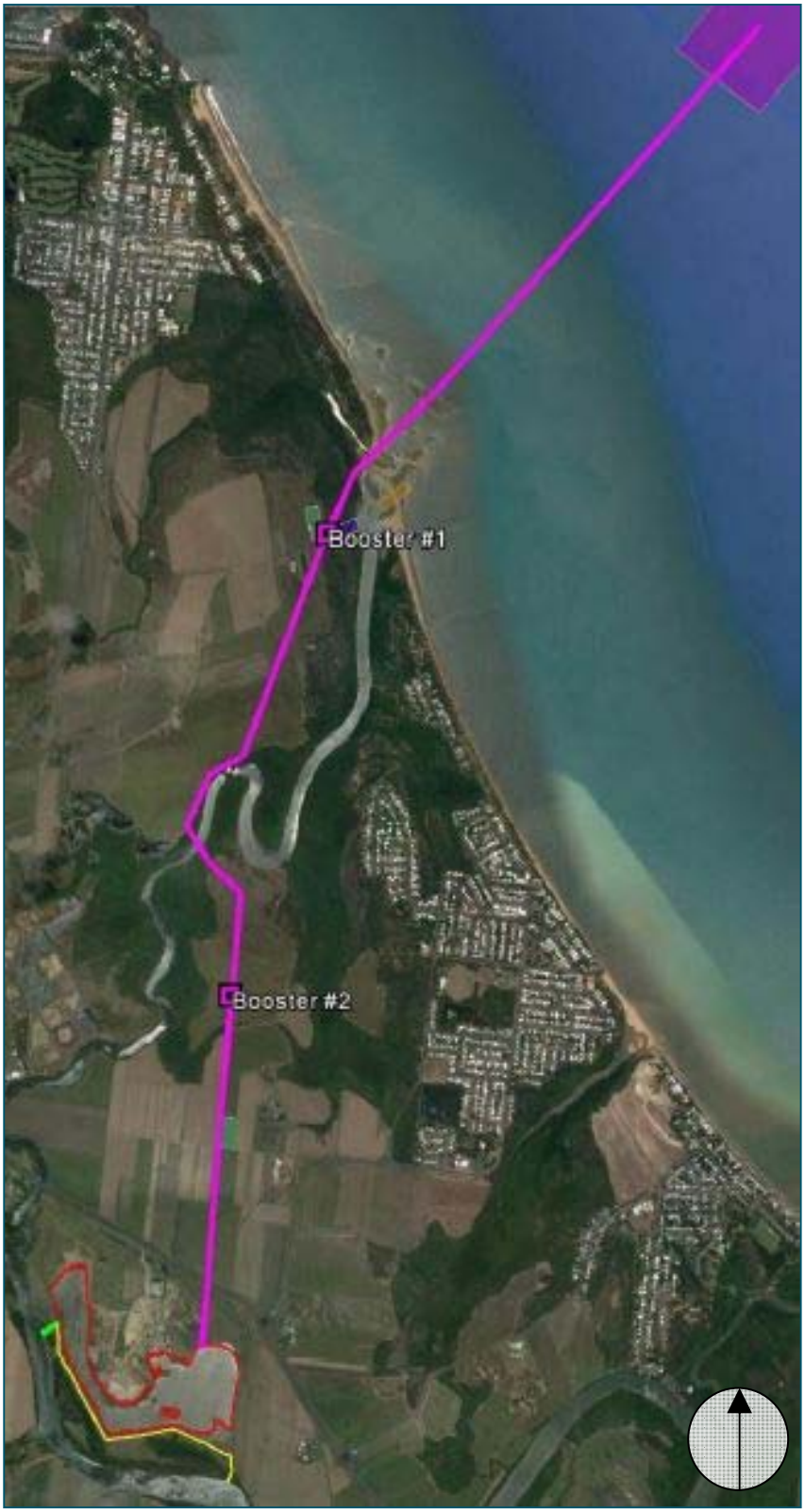

Figure 2.7 Barron Delta – Aquis Pipeline Option with no Marine Booster Revised Conceptual Layout

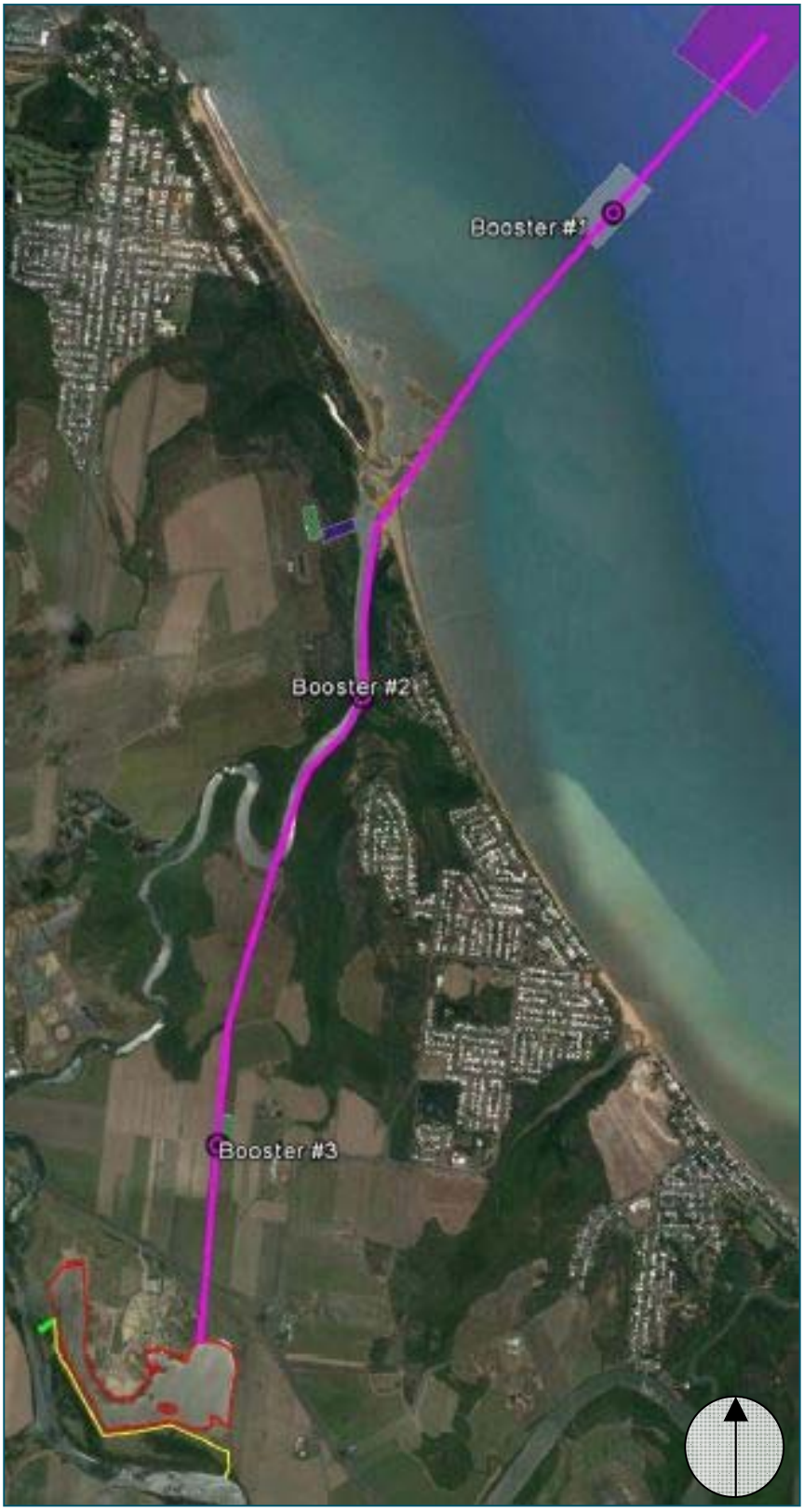

Figure 2.8 Barron Delta – Yorkeys Pipeline Option Revised Conceptual Layout

2.4 Dredging Site Establishment

2.4.1 Marine Equipment

It is expected that the equipment required at sea will be:

- small to medium sized TSHD to dredge soft clays and transport to shore
- backhoe/grab dredge and two hopper barges to dredge stiff clays and transport to shore
- survey/crew change vessel
- work boat
- tug
- sweep bar/plough
- temporary mooring facility at the TSHD pump out location (different options for each DMPA
- booster pump stations (Barron Delta DMPA only)
- barge mounted crane to install pipeline.

2.4.2 Land Equipment

It is expected that the equipment required on land will be:

- swamp dozers (East Trinity only)
- front end loaders
- excavators
- rigid dump trucks
- mobile cranes/telescopic handlers
- water pumps
- booster pump stations (Barron Delta only).

2.4.3 Pipelines

Pipelines will be required to bring the dredged material (as a slurry) to the DMPA, and from the DMPA to a water discharge point. They will be made from mild steel and nominally 1 metre in diameter. Booster pumps will be required along the slurry pipeline for the Barron Delta DMPA.

The potential pipeline routes are presented in **Section 2.3**.

Preliminary estimates of B-double truck movements to transport pipes are 225 movements each way at Barron Delta and 100 each way at East Trinity. Laydown area, fabrication yards and storage areas are expected to total up to 2.5 hectare at Baron Delta and 1.5 hectares at East Trinity.

2.4.4 Dredge Material Placement Areas (DMPA)

Preparation of the placement area (East Trinity only) is expected to include the following noise generating activities:

- mobile equipment clearing, stripping topsoil and stockpiling material
- bund construction; including the use of earthmoving equipment and import of fill materials.

Site activities at the Barron Delta site will be minimal as the pipeline will deliver slurry to an existing water-filled void (possibly expanded slightly to the north-west).

2.5 Dredging and Placement

The Dredge Placement Scope Study (FCG May 2016) identifies that:

- the dredge material consists of approximately 10% sand and 90% silt
- the material has acid sulphate properties that will require lime treatment.

The dredge material is expected to contain greater than 90% fine material (<75 microns) with little or no sand. It will be further characterised prior to the completion of the Revised Draft EIS. Dredgers will operate 24 hours per day, seven days per week.

The TSHD would typically dredge at 1 to 3 knots then steam to and from the pumpout location at 6 to 9 knots. It would then unload at the pumpout location to the discharge pipeline, with seawater pumped into the pipeline to dilute solid material to 10 to 15% by volume.

The backhoe dredge would be between 700 to 1000 kW nominal power. Hopper barges would take the stiffer clays to shore where they would be loaded into trucks for transport to the placement site.

At the East Trinity DMPA, material delivered by pipeline will be distributed by excavators, trucks and dozers. The water levels will be controlled by a weir and bunds to allow solids to settle before the water is discharged. At the Barron Delta site the pipeline will deliver slurry to an existing water-filled void (possibly expanded).

3. Acoustic Criteria

3.1 Overview

The focus of this report is to describe the existing acoustic situation (i.e. the receiving environment) for future construction and operation activities at the DMPAs and wharf area construction site. This section presents criteria relevant to these aspects of the project, which are within the construction phase of the Project.

3.2 Terms of Reference

The Terms of Reference (Section 5.8) for the Project refers to the following documents:

- Environmental Protection (Noise) Policy 2008 (EPP (Noise))
- Noise Measurement Manual (Environment Protection Agency 2000)
- Guideline: Planning for Noise Control (Environmental Protection Agency 2004).

The (EPP (Noise)) contains Acoustic Quality Objectives which can be used as noise limits for assessment. The Objectives are presented in **Section 3.3**.

The Planning for Noise Control Guideline (PNCG) also includes methods for determining noise limits for assessment. This is discussed in Section D.7.6.1.1 of Appendix D.7 of the Draft EIS (Noise and Vibration Technical Report) and therefore only briefly discussed in this report. The sleep disturbance criteria prescribed by the PNCG are not discussed in detail in the Noise and Vibration Technical Report and therefore this is discussed in detail in **Section 3.4.3**.

3.3 Environmental Protection (Noise) Policy

3.3.1 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.

3.3.2 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 EcoAccess Guideline “Planning For Noise Control” 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.

3.4 EcoAccess Guidelines

3.4.1 EcoAccess – Planning for Noise Control

DEHP EcoAccess Guideline "Planning For Noise Control" 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.

3.4.2 Control and Prevention of Background Creep

The 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.

3.4.3 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	Outdoor Criterion dBA
Sleep Disturbance (Short Duration Events)	10 – 15	L_{max} 45	L_{max} 52
	3	L_{max} 50	L_{max} 57
	1	L_{max} 55	L_{max} 62
Sleep Disturbance (Continuous Noise)	Continuous	L_{eq} 30	L_{eq} 37
Annoyance (Night Time)	Continuous	L_{eq} 35	L_{eq} 42

Note: The outdoor criteria 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.

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 applied for this project.

The duration of works (anticipated to be approximately 3 months for pipeline installation, 10 weeks for dredging, and 2 months for decommissioning) should also be taken into consideration when determining appropriate noise limits.

3.5 Construction Noise

As discussed in Section D.7.6.3 of Appendix D.7 of the Draft EIS (Noise and Vibration Technical Report), the noise limits 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 limits were adopted as legislative requirements in Queensland and are based on limiting hours of construction rather than nominating noise limits. Limiting hours of construction may not be feasible for all aspects of construction for this project.

The management levels proposed by ARUP as presented in Table D7.6.3a of the Noise and Vibration Technical Report are presented in **Table 3.2**.

For out-of-hours work, the ICNG uses a 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 (Table D7.6.3a of Draft EIS)

Time of Day	Management Level L_{eq}(15 minute) dBA	How to Apply
Recommended standard hours: Monday to Saturday 6:30 am to 6:30 pm No work on Sundays or Public Holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (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. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noise activities can occur, taking into account: Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences). If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(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 4.6**. **Table 4.1** also nominates the closest distance between the sensitive receptor and the nearest project area or noise source. 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 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.

The Mandingalbay Yidindji Aboriginal Corporation (MYAC) has interests in the area delineated by the yellow polygon in **Figure 4.6**. This overlaps East Trinity DMPA Site C and would be impacted by pipeline construction for other optional East Trinity sites. Consultation with MYAC may be necessary to manage impacts.

It is noted that not all sensitive receptors near the Baron Delta pipeline and East Trinity placement area are identified within **Table 4.1**, but a selection of receptors which indicates the location and spatial distribution of receptors.

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	Approximate Distance and Direction from Site	Easting (m)	Northing (m)
Near Cairns Wharf					
A	Park Regis City Quays Hotel, 6-8 Lake Street, Cairns City	N/A	Approximately 70 metres to Land-side port works area	369960	8128319
B	Park Regis Piermonde Apartments, 2-4 Lake Street, Cairns City	N/A	Approximately 40 metres to Land-side port works area	369988	8128264
C	Jack & Newell Apartments, 27 - 29 Wharf St, Cairns City	N/A	Approximately 40 metres to Land-side port works area	369999	8128312
D	Madison on Abbott Apartments, 3 Abbott Street, Cairns City	N/A	Approximately 50 metres to Land-side port works area	370001	8128362
E	Pullman Reef Hotel Casino, 35/41 Wharf St, Cairns City	N/A	Approximately 30 metres to Land-side port works area	370038	8128438
F	Hilton Hotel, 34 Esplanade, Cairns City	N/A	Approximately 100 metres to Land-side port works area	370105	8128559

ID	Name / Address	Real Property Description	Approximate Distance and Direction from Site	Easting (m)	Northing (m)
G	Cairns Harbour Lights Apartments, 1 Marlin Parade, Cairns City	N/A	Approximately 220 metres to Land-side port works area	370127	8128685
H	Shangri-La Hotel, Pier Point Rd, Cairns City	N/A	Approximately 400 metres to Land-side port works area	370106	8128915
I	Boats used as residences, east side of Trinity Inlet	N/A	Varies	370443	8127598
I	Boats used as residences, east side of Trinity Inlet	N/A	Varies	370554	8128060
I	Boats used as residences, east side of Trinity Inlet	N/A	Varies	370656	8128624
Near Baron Delta Pipeline Routes					
J	Holloways Beach Environmental Education Centre, 46 Poinsettia St, Holloways Beach	122/NR840892	290 metres to booster pump Yorkeys Booster 2	365190	8138963
K	2-4 Deauville Close, Yorkeys Knob	0/BUP105844	1.7 kilometres to booster pump Aquis (Marine) Booster 1	364417	8140742
L	30 Acacia Street, Holloways Beach	328/H9082	180 metres to booster pump Yorkeys Booster 2	365130	8138811
M	280 Yorkeys Knob Road, Yorkeys Knob	2/RP800898	385 metres to booster pump Aquis Booster 2	363937	8138570
N	72 Baronia Crescent Holloways Beach	40/RP742748	450 metres to booster pump Yorkeys Booster 2	364972	8138264
O	108 Baronia Crescent Holloways Beach	22/RP742750	830 metres to booster pump Aquis (No Marine)	364958	8137890
P	101-103 Wistaria Street Holloways Beach	1/RP731885	920 metres to booster pump Aquis (No Marine)	365220	8137538
Q	78 Wistaria Street Holloways Beach	21/RP741077	970 metres to booster pump Aquis (No Marine)	365265	8137228
R	613 Holloways Beach Access Road	5/RP857577	330 metres to booster pumps Yorkeys Booster 3 and Aquis Booster 3	364512	8136716
Near Baron Delta Placement Site					
S	Dwelling under construction, Holloways Beach Access Road	22/SP211748	365 metres to booster pumps Yorkeys Booster 3 and Aquis Booster 3	364587	8136488
T	637 Captain Cook Highway Barron	4/RP800591	Within 200 metres of Baron Delta placement area	363235	8136373
U	637 Captain Cook Highway Barron	4/RP800591	Within 200 metres of Baron Delta placement area	363162	8136228
V	Holloways Beach Access Road	1/RP804218	Approximately 400 metres from Baron Delta placement area	364663	8135785

ID	Name / Address	Real Property Description	Approximate Distance and Direction from Site	Easting (m)	Northing (m)
W	Holloways Beach Access Road	1/RP804218	Within 300 metres of Baron Delta placement area	364566	8135742
X	Holloways Beach Access Road	1/RP804218	Within 300 metres of Baron Delta placement area	364561	8135676
Y	Off Captain Cook Highway	4/RP748713	Within 400 metres of Baron Delta placement area	364662	8135074
Near East Trinity					
Z	1673 Pine Creek Yarrabah Road Glen Boughton	11/SP232030	Approximately 890 metres from East Trinity Placement Site B	373869	8126412
AA	1685 Pine Creek Yarrabah Road, Glen Boughton	3/SP186247	Approximately 930 metres from edge of East Trinity Placement Site B	373925	8126506
AB	Pine Creek Yarrabah Road, Glen Boughton	1/SP178692	Approximately 50 metres from edge of East Trinity Placement Site A	373811	8127765
AC	Pine Creek Yarrabah Road, Glen Boughton	1/SP178692	Approximately 50 metres from edge of East Trinity Placement Site A	373771	8127907
AD	Pine Creek Yarrabah Road, Glen Boughton	785/AP19382	Approximately 490 metres from edge of East Trinity Placement Site A	373652	8128778

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

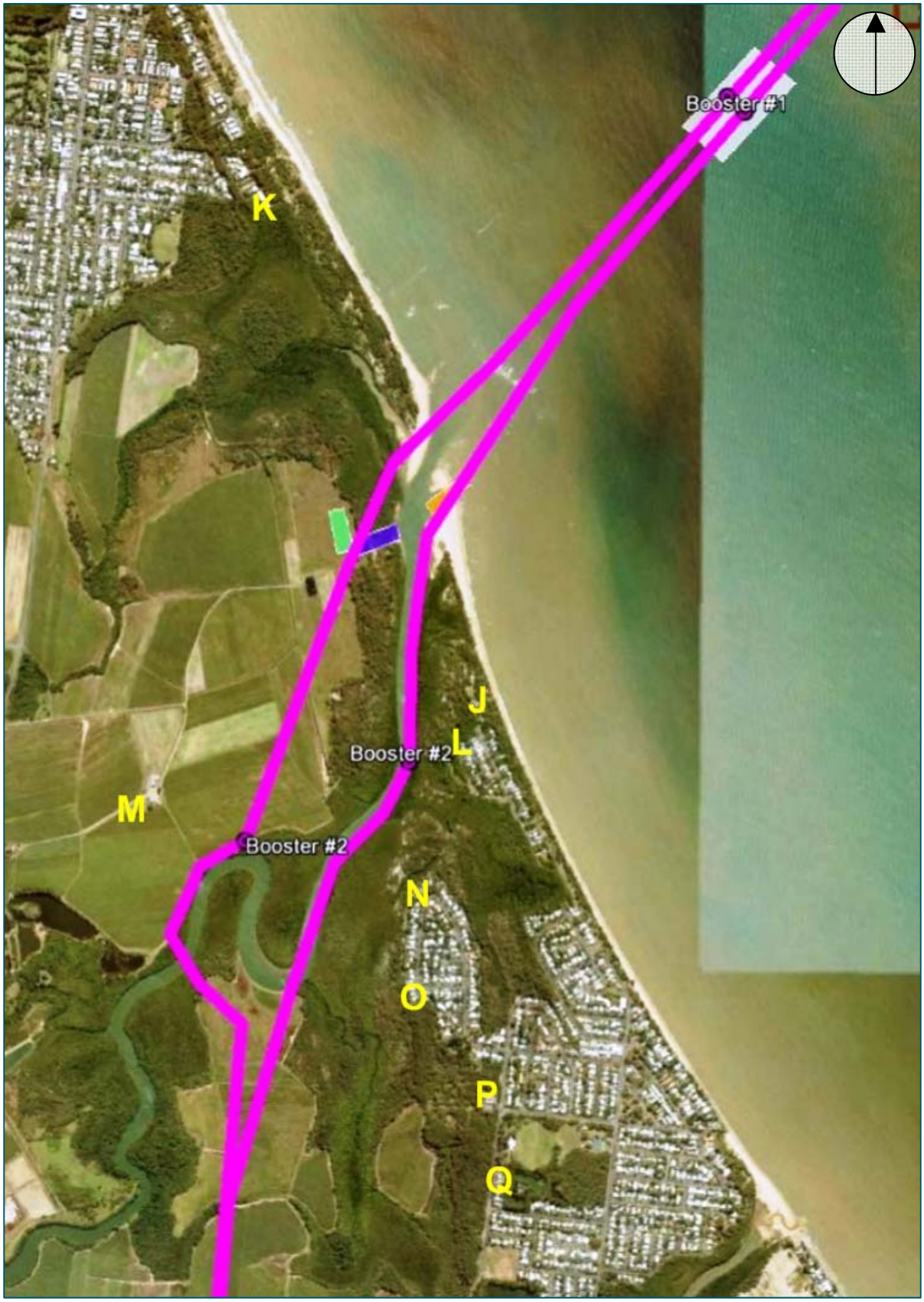

Figure 4.2 Location of Sensitive Receptors near Baron Delta Pipeline - Yorkeys Pipeline and Aquis Marine Pipeline Options Shown (Image from Google Earth Pro)

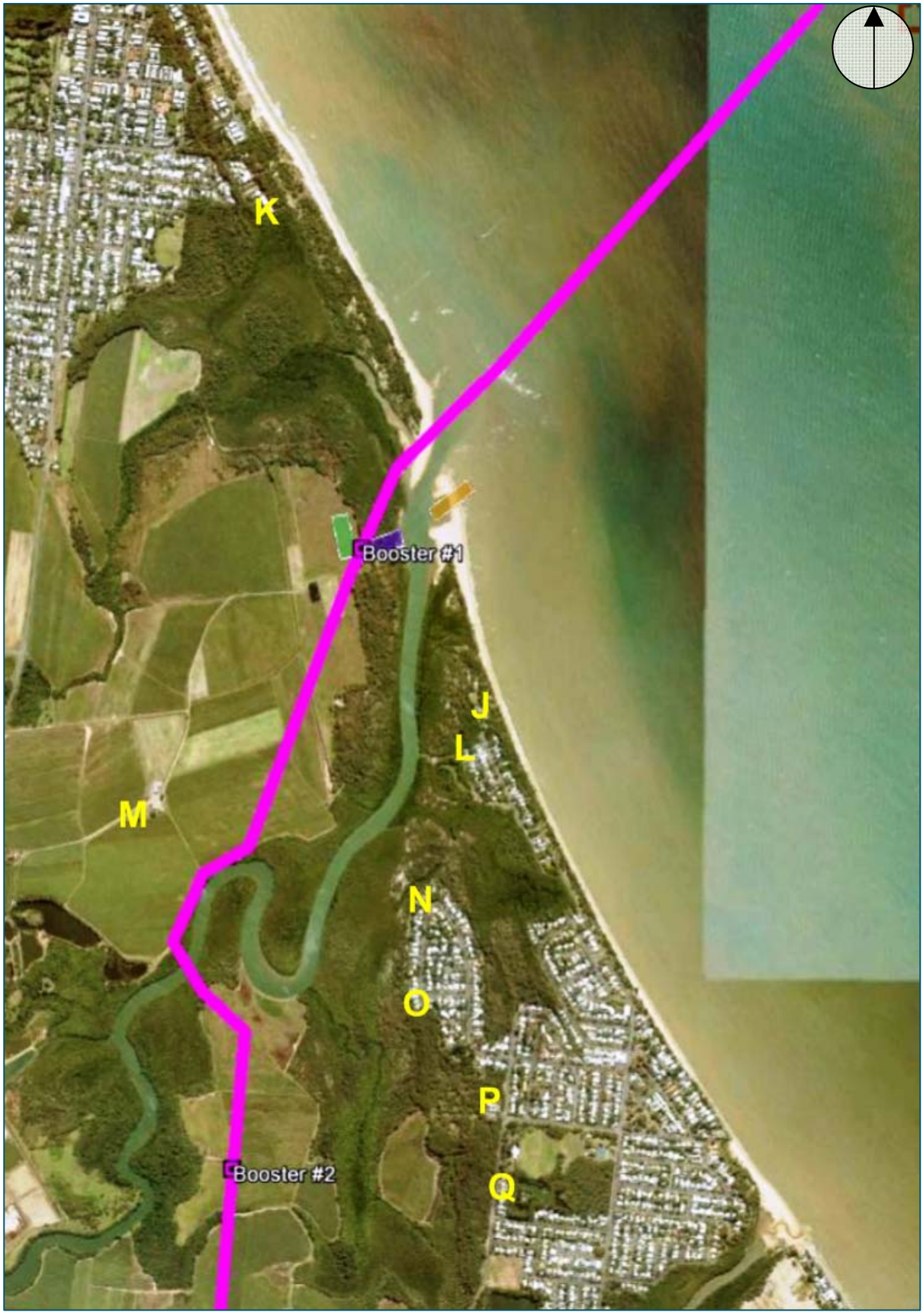

Figure 4.3 Location of Sensitive Receptors near Baron Delta Pipeline - Aquis (No Marine) Pipeline Options Shown (Image from Google Earth Pro)

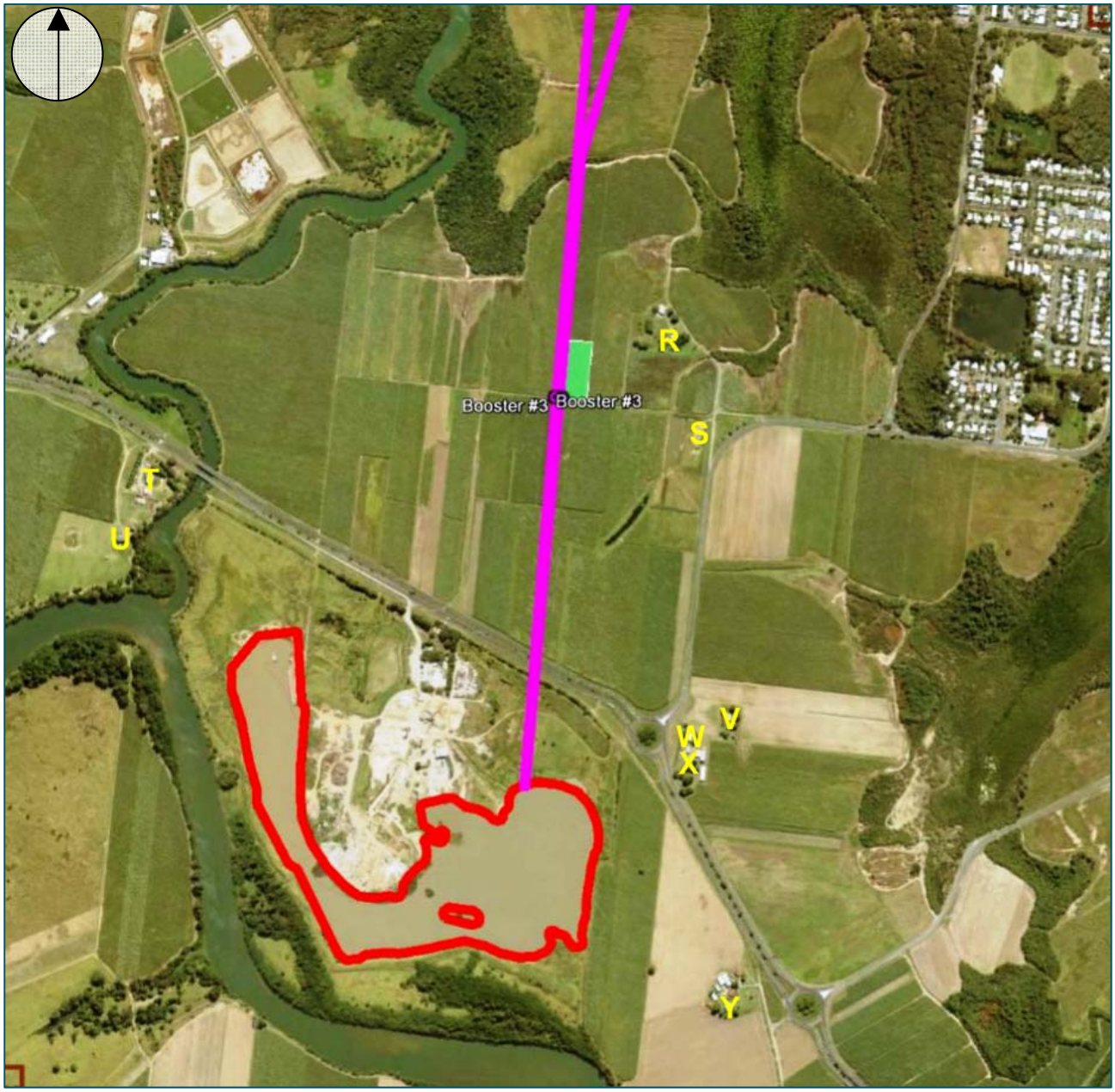

Figure 4.4 Location of Sensitive Receptors near Baron Delta DMPA - Yorkeys Pipeline and Aquis Marine Pipeline Options Shown (Image from Google Earth Pro)

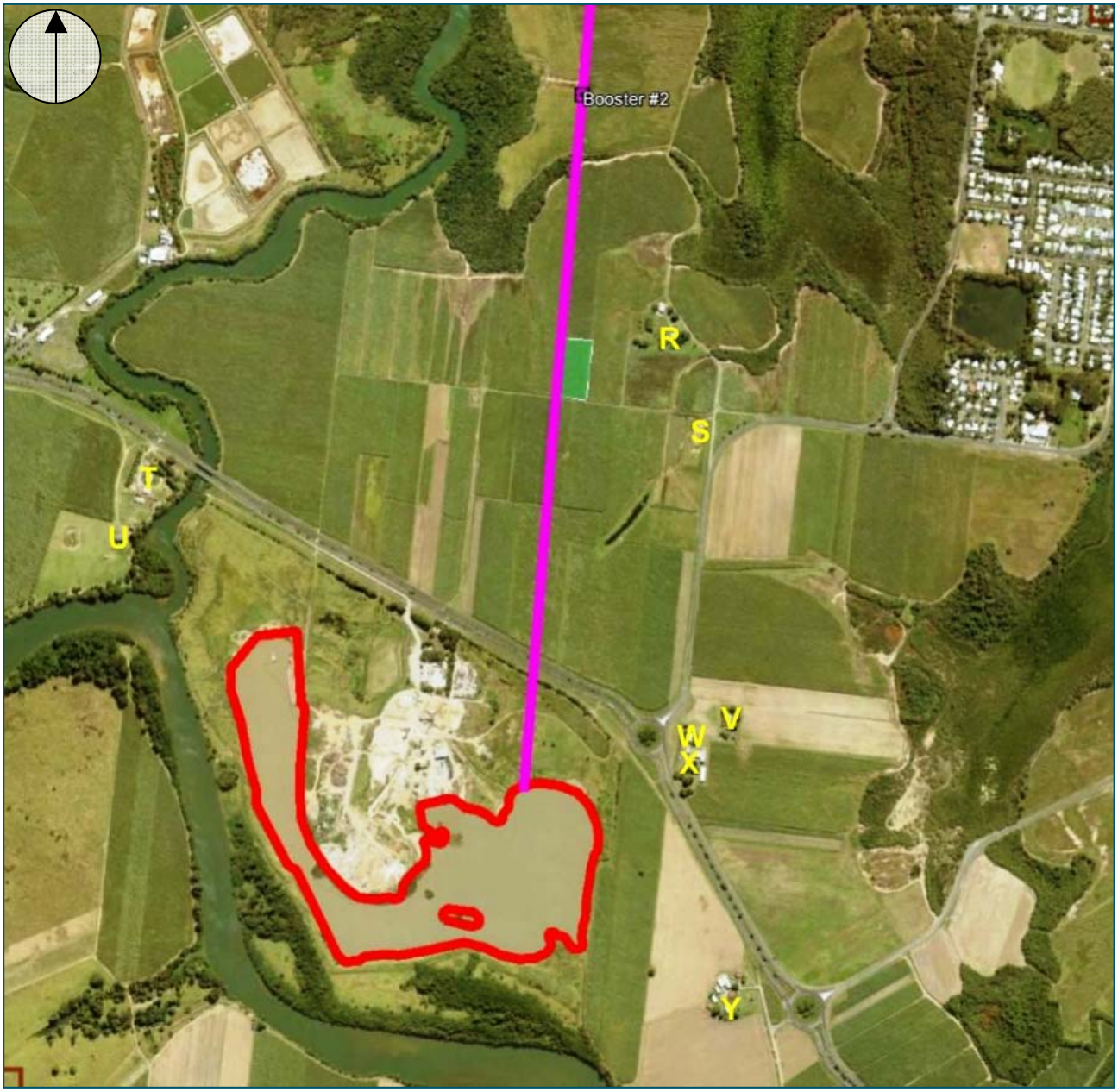

Figure 4.5 Location of Sensitive Receptors near Baron Delta DMPA - Aquis (No Marine) Pipeline Option Shown (Image from Google Earth Pro)

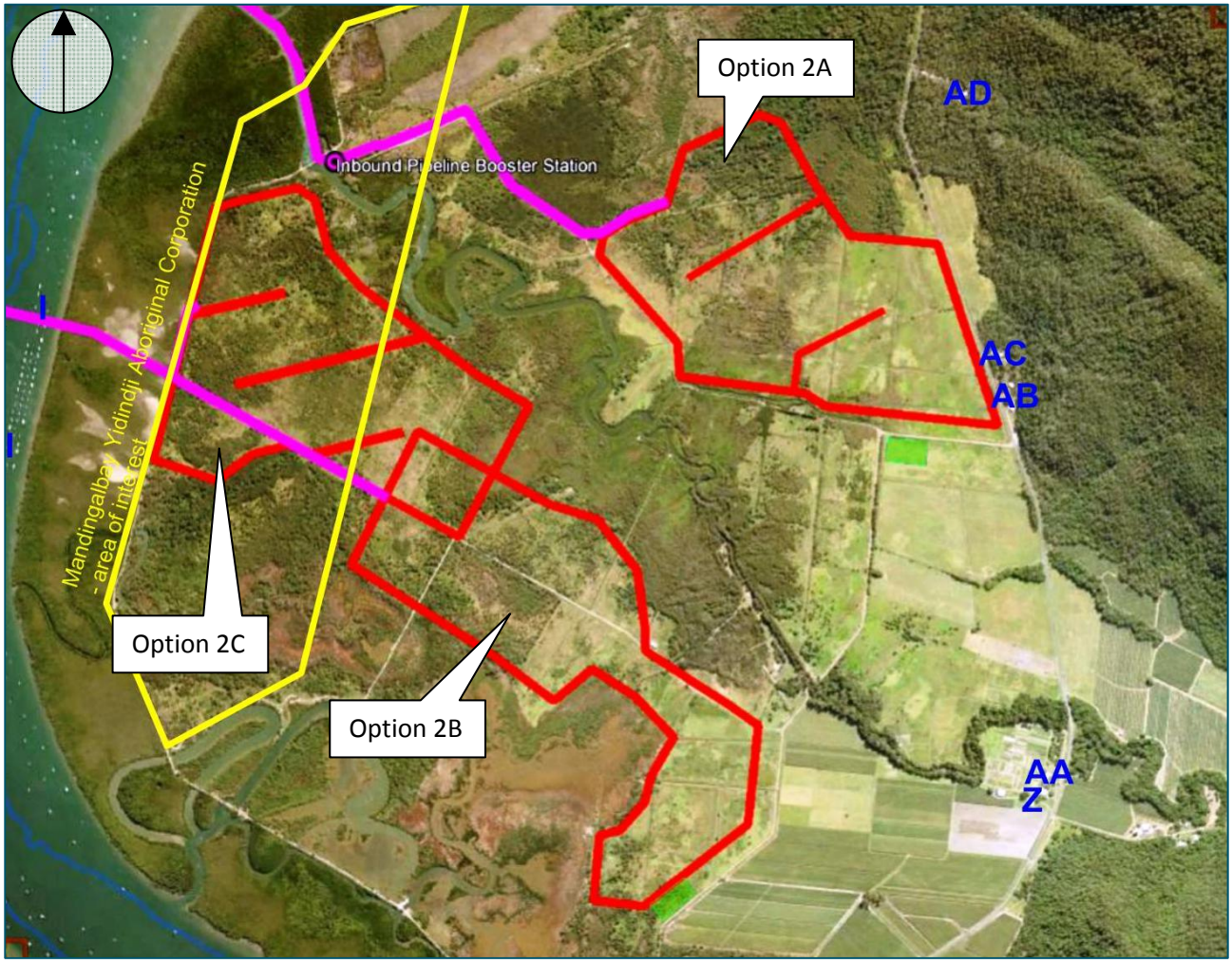

Figure 4.6 Location of DMPAs and Sensitive Receptors in East Trinity Area (Image from Google Earth Pro)

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 project activities. The measurements have consisted of long-term noise logging at three sites over a period of approximately 1 week, and short-term attended noise measurements. Attended noise measurements were conducted at the three logging sites plus additional monitoring sites.

The long-term noise logging measurement results assist in understanding the variation in noise level by time of day and day of week. 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 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 5.6**). Noise monitoring also undertaken by ASK for the Aquis development project is also presented within this section.

5.2 Noise Monitoring Locations

The locations used for noise monitoring are presented in **Figure 5.1** to **Figure 5.4**. 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 monitoring, **Figure 5.3** 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.

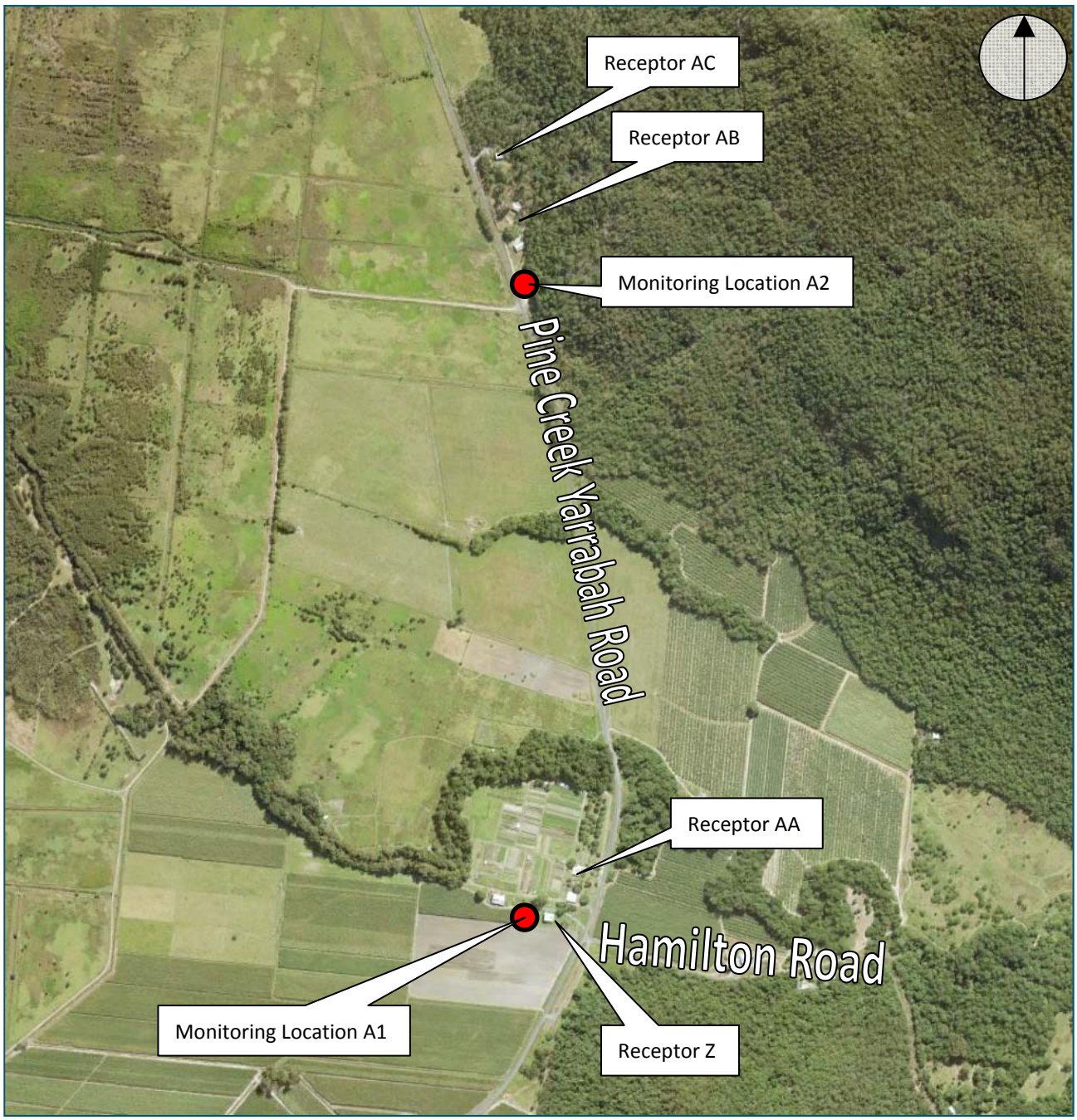

Figure 5.1 East Trinity Monitoring Locations A1 and A2

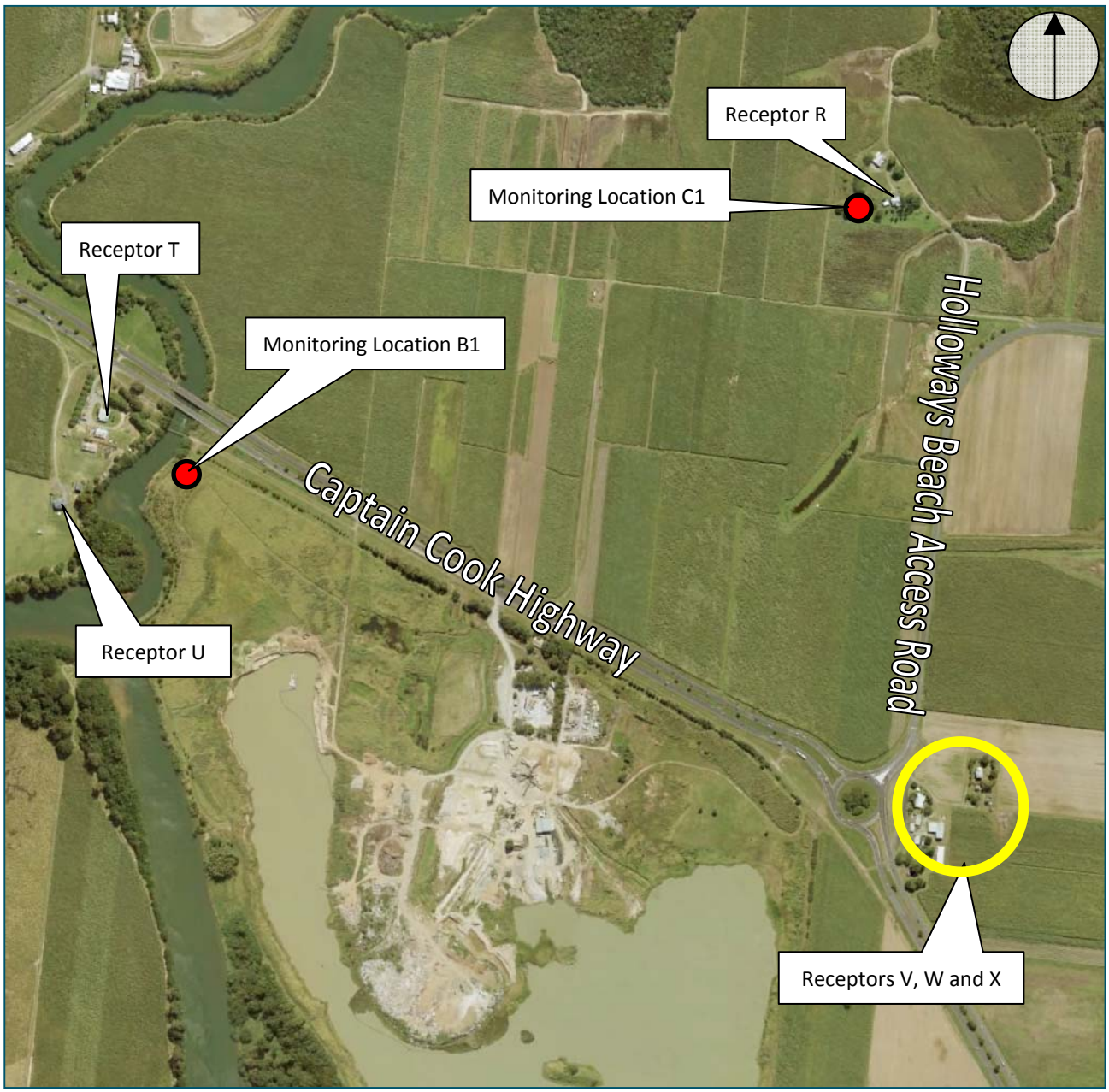

Figure 5.2 Baron Delta Monitoring Locations B1 and C1

Figure 5.3 Baron Delta Monitoring Locations D1 to D4 and L2 (Aquis)

Figure 5.4 Wharf Street Monitoring Locations E1, E2 and F1

5.3 Noise Logging

Noise logging was undertaken at three locations (A1, B1 and C1) as described in **Table 5.1** and shown in **Figure 5.1** and **Figure 5.2**.

Table 5.1 Description of Noise Logging Locations

Location	Description
A1	The logger was located to the west of residential dwelling identified as 1673 Pine Creek Yarrabah Road (receptor Z). The property contains a residential dwelling and sugar cane cropland. The logger was changed to a tree and was approximately 115 metres to the north-west of Pine Creek Yarrabah Road. Sugar cane was at a considerable height to the south of the logger. GPS coordinates were -16.942517° N, 145.815150° E.
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 changed 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 changed 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.

The locations used for noise logging were selected based on the presence of sensitive receptors and consideration of the likely actions and potential impacts resulting from the CSD Project. The selection of noise logging sites also considered previous noise logging undertaken by ARUP (see **Section 5.6**) for the Draft EIS and undertaken by ASK for the Aquis Project (see **Section 5.7**).

Noise logging was undertaken 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.

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 5.2**.

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
A1	Maximum	65	54	51	49	49	45	71	54	66
	Top 10%	54	50	49	44	46	40	52	50	48
	Average	50	46	42	39	38	37	47	44	42
	(Median)	50	45	41	39	38	37	47	43	41
	Bottom 10%	45	42	38	34	34	32	42	40	38
	Minimum	42	40	29	29	29	26	38	37	28
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

Location	Statistic	L_{10} dBA			L_{90} dBA			L_{eq} dBA		
	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

The background noise levels (minL_{90} or rating background level) at each logging location are shown below in **Table 5.3**. The levels presented in **Table 5.3** 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.

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
A1	35	35	35	33	24	23
B1	48	43	35	48	42	27
C1	41	41	38	41	39	28

5.4 Attended Noise Measurements

Attended noise measurements were undertaken at the noise logging locations (A1, 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 5.4**.

Table 5.4 Attended Noise Monitoring Locations

Location	Description
A2	Attended monitoring was undertaken just off Pine Creek Yarrabah Road to the south of existing residential dwellings (receptors AB and AC). The site is within a rural area near the potential East Trinity placement site. GPS coordinates were -16.931650° N, 145.815167° E.
D1	Attended monitoring was undertaken to the south of the residence located at 70 Baronia Crescent, Holloways Beach (near Receptor N). The site is within a residential area near the potential pipeline for the Baron 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 Baron 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 Baronia Crescent, Holloways Beach (receptor O). The site is within a residential area near the potential pipeline for the Baron Delta placement site. GPS coordinates were -16.838450° N, 145.732717° E.

Location	Description
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 Baron 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.
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.

Attended noise measurements were undertaken on Monday 01/08/2016, Tuesday 02/08/2016 and early on Wednesday 03/08/2016. Attended measurements during the night-time (10:00pm - 7:00am) were undertaken at Locations A1 and A2 (East Trinity) on Monday 01/08/2016. An attended measurement was undertaken at Location F1 during the evening on Monday 01/08/2016. Attended measurements during the evening (6:00pm to 10:00pm) and night-time were undertaken at all other locations on Tuesday 02/08/2016 and early on Wednesday 03/08/2016.

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 Location F1). With the exception of Location F1, monitoring positions were free field. Weather during 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 Mechanical plant (pool pump) 53 dBA (continuous) Traffic noise on Wharf Street (incl plant noise) 54 to 59 dBA Intermittent patron noise from Whard Street and wharf area audible.
A1	10:25pm 01/08/2016	15	Statistical noise levels: L_{10} 45 dBA, L_{eq} 42 dBA, L_{90} 38 dBA Insect noise 37 to 43 dBA Traffic on Pine Creek Yarrabah Road up to 50 dBA (2 pass-by events)) Bird noise 37 to 49 dBA (dominant)
A2	10:52pm 01/08/2016	15	Statistical noise levels: L_{10} 47 dBA, L_{eq} 57 dBA, L_{90} 41 dBA Insect noise 41 to 49 dBA (dominant) Bird noise up to 46 dBA Traffic on Pine Creek Yarrabah Road up to 80 dBA (3 pass-by events) Noise from surf faintly audible

Location	Date & Time	Period (Minutes)	Results & Notes
A1	11:31pm 01/08/2016	15	Statistical noise levels: L_{10} 44 dBA, L_{eq} 42 dBA, L_{90} 39 dBA Insect noise 38 to 45 dBA (dominant) Traffic on Pine Creek Yarrabah Road up to 48 dBA (single event) Compressor/pump noise from adjacent farm 40 to 44 dBA (approx 1 minute duration) Some aircraft noise and noise from distant traffic
A2	11:56pm 01/08/2016	15	Statistical noise levels: L_{10} 44 dBA, L_{eq} 55 dBA, L_{90} 42 dBA Insect noise 41 to 43 dBA (dominant) Intermittent bird noise Traffic on Pine Creek Yarrabah Road up to 81 dBA (2 pass-by events) Noise from surf faintly audible Distant traffic noise faintly audible
B1	11:14am 02/08/2016	15	Statistical noise levels: L_{10} 58 dBA, L_{eq} 56 dBA, L_{90} 49 dBA Traffic noise from Captain Cook Hwy 49 to 65 (dominant) Aircraft noise 61 to 68 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 Traffic on Holloways Beach Access Road 33 to 40 dBA Captain Cook Hwy not audible Light aircraft noise 44 to 56 dBA (3 events) Bird noise 36 to 53 dBA (dominant) Jet aircraft noise up to 63 dBA (2 events) 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 Noise from wind in trees 30 to 35 dBA Light aircraft noise 40 to 44 dBA Some bird noise 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 Bird noise 34 to 47 dBA Aircraft noise up to 70 dBA (5 events) Surf noise 31 to 33 dBA
A1	4:03pm 02/08/2016	15	Statistical noise levels: L_{10} 52 dBA, L_{eq} 49 dBA, L_{90} 41 dBA Traffic on Pine Creek Yarrabah Road 42 to 55 dBA Tractor on adjacent farm 45 to 53 dBA Noise from wind in sugar cane audible, approximately 40 dBA
E1	8:31pm 02/08/2016	15	Statistical noise levels: L_{10} 55 dBA, L_{eq} 53 dBA, L_{90} 41 dBA Traffic on Wharf Street 41 to 66 dBA (dominant) Distant traffic noise 41 to 42 dBA No noise from surf/water Mechanical plant noise from nearby apartments/hotels audible, approximately 40 dBA Insects audible but not influencing levels

Location	Date & Time	Period (Minutes)	Results & Notes
E2	8:55pm 02/08/2016	15	Statistical noise levels: L_{10} 53 dBA, L_{eq} 51 dBA, L_{90} 45 dBA Traffic on Wharf Street 44 to 62 dBA (dominant) Patron noise from wharf approximately 48 dBA (brief) Mechanical plant noise from nearby apartments/hotels audible No noise from surf/water 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 Insect noise 46 to 47 dBA (continuous, dominant) Jet aircraft noise 55 to 64 dBA (5 events) Traffic noise from Captain Cook Hwy audible, no level able to be obtained due to insect noise
D3	10:22pm 02/08/2016	15	Statistical noise levels: L_{10} 38 dBA, L_{eq} 37 dBA, L_{90} 35 dBA Insect noise 34 to 37 dBA (continuous, dominant) Distant road traffic noise audible intermittently 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 Insect noise 26 to 30 dBA (dominant) 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 Insect noise 36 to 42 dBA (dominant) Jet aircraft landing 63 dBA L_{max} Other aircraft noise 40 to 45 dBA 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 Insect noise 35 to 46 dBA (dominant) Surf noise approx 35 to 38 dBA Bird noise 38 to 69 dBA 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 Mechanical plant at Jack & Newell Apartments 39 to 40 dBA (continuous) Traffic on Wharf Street 41 to 55 dBA Insects audible but not influencing noise levels Bird noise 45 to 47 (intermittent) 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 Mechanical plant at Jack & Newell Apartments and Pullman Hotel 44 dBA (continuous) Traffic on Wharf Street 46 to 52 dBA

5.5 Discussion of ASK Noise Monitoring Results

From the results in presented in **Table 5.2**, **Table 5.3**, **Table 5.5** and **Appendix B** the following comments are made:

- The noise environment at Locations A1 and A2 is significantly influenced by insect and bird noise. Traffic movements of Pine Creek Yarrabah Road appear to be fairly sporadic however due to the length of the road and speed limit, noise from the road influences the noise environment.
- 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 significantly 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.
- 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.

Overall the results of the monitoring are considered representative and are consistent with the expectations for the noise environment based on the nature of the monitoring locations. It is noted that variations in the noise environment will occur due to seasonal variation. As noted in **Section 5.6**, the results of monitoring at the Wharf Street area are generally consistent with the results obtained from previous ambient noise monitoring undertaken for the Draft EIS.

5.6 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. The monitoring locations used by ARUP are presented in **Figure 5.5** and **Figure 5.6** (Figure B.10.4.3a and Figure B.10.4.3b of the Draft EIS). Details of ARUP's monitoring methodology and the measured noise levels are presented in Appendix D.7 of the 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 (minL_{90} or rating background level) obtained from logging at Location 4 (Hilton Hotel, Location 4 in **Figure 5.5**) 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

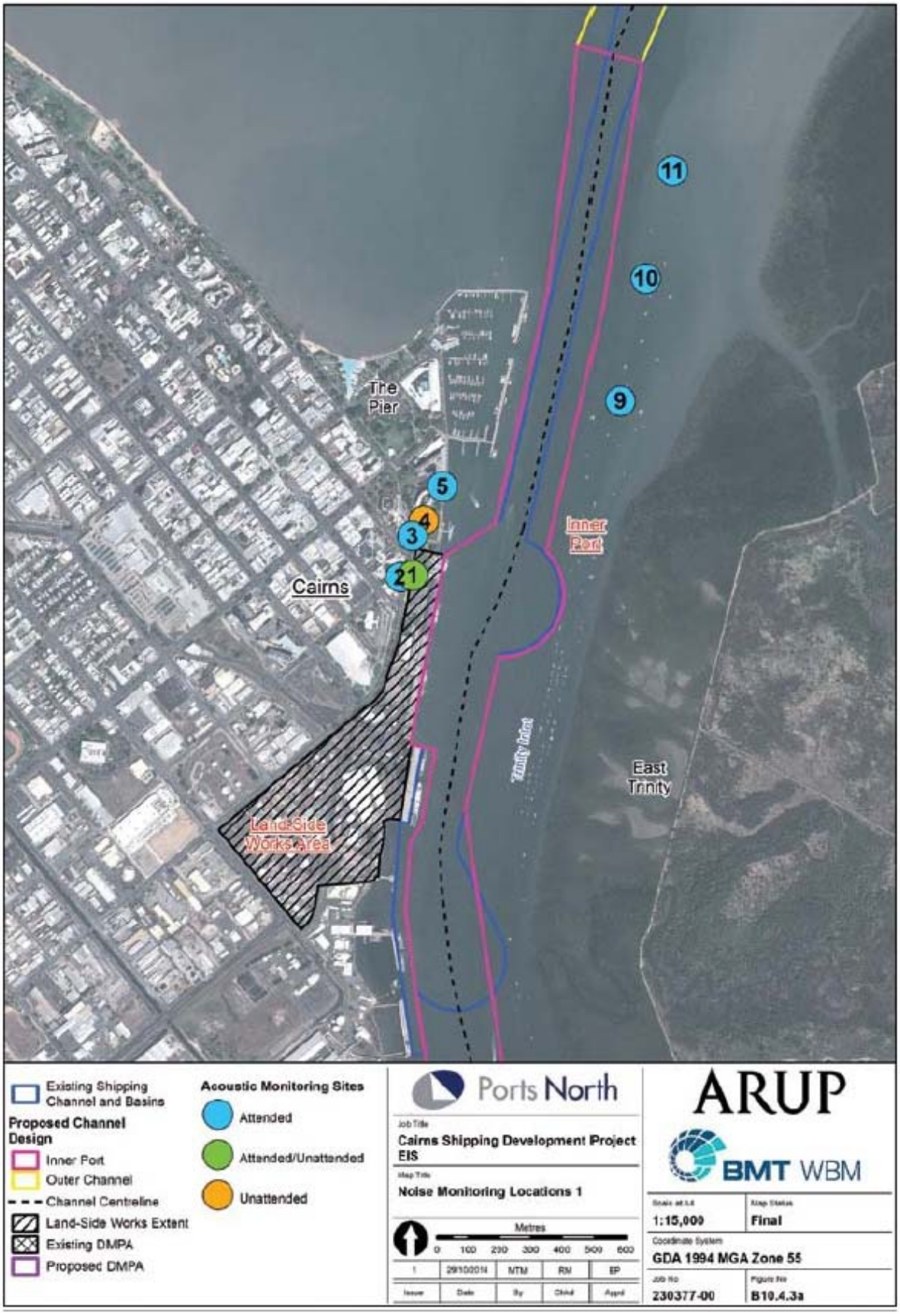

Figure 5.5 ARUP Noise Monitoring Locations - Wharf Street Area (Figure B.10.4.3a of Draft EIS)

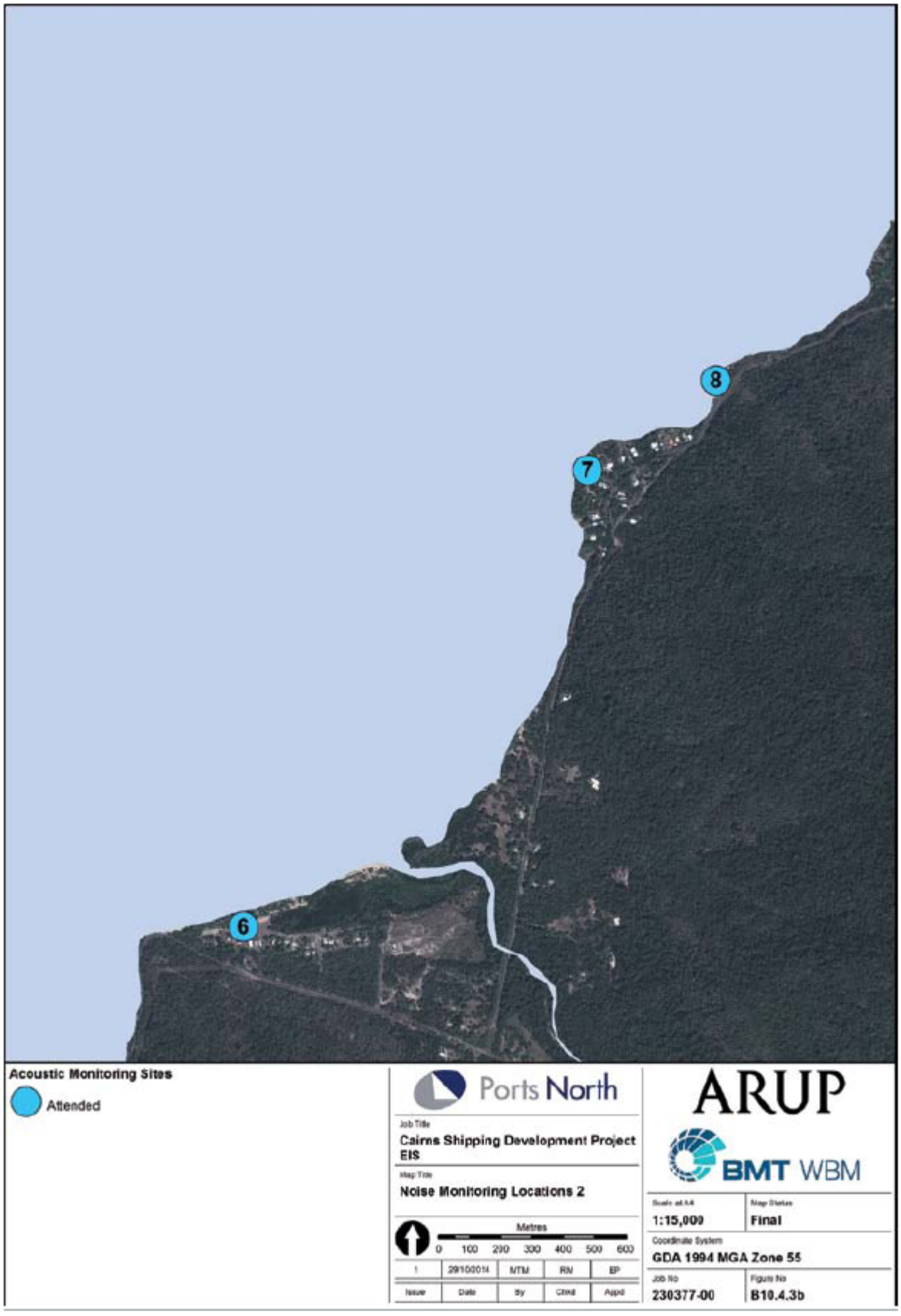

Figure 5.6 ARUP Noise Monitoring Locations - East Trinity Area (Figure B.10.4.3b of Draft EIS)

5.7 AQUIS Noise Monitoring (ASK, August 2013)

Logging was undertaken at Location L2 (see **Figure 5.3**) from 01/08/13 to 08/08/13 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 (minL_{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).

6. Discussion of Noise Limits

6.1 Construction Noise

Construction noise limits for the project have been taken from the NSW Interim Construction Noise Guideline (ICNG) (NSW DECC, 2009) as discussed in **Section 3.5**. The noise limits 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 (less insects) for the day (7:00am to 6:00pm) and night (10:00pm to 7:00am) periods, the range of construction noise limits for the recommended hours (Monday to Saturday from 6:30 am to 6:30 pm) and outside recommended hours are generalised as follows:

- East Trinity (Location A1):
  - Monday to Saturday, 6:30 am to 6:30 pm: 43 dBA L_{eq} (15 minute)
  - Outside Hours: 28 dBA L_{eq} (15 minute)
- Baron Delta (Locations B1, C1 and Aquis):
  - Monday to Saturday, 6:30 am to 6:30 pm: 40 to 51 dBA L_{eq} (15 minute)
  - Outside Hours: 31 to 33 dBA L_{eq} (15 minute)
- Wharf Street Area (ARUP and ASK attendeds):
  - Monday to Saturday, 6:30 am to 6:30 pm: 65 dBA L_{eq} (15 minute)
  - Outside Hours: 44 to 51 dBA L_{eq} (15 minute)

It is noted that when detailed assessment of the Project is undertaken, individual noise limits should be applied for specific sensitive receptors. A range of noise limits has been provided for the purposes of this constraints assessment.

The noise limits indicated above are based on the measured background noise levels with the influence of insect noise removed. Assessment using the background noise level including insects, or using a minimum background noise level (i.e. minimum of 30 dBA L_{90}, as per EHP noise assessment criteria) may be more appropriate and could be applied for the Project.

6.2 Wharf Street Night-time Noise Criteria (Construction and Operation)

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

Time averaged (L_{eq}) noise limits for operational noise emissions (i.e. wharf activities, ship movements) were determined 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 the measured Rating Background Level during each period, and an allowance of + 3 dBA. The noise limits applied in the ARUP assessment using this method are presented **Table 6.1**. For comparison, the calculated external Acoustic Quality Objective noise limit for the night-time (see **Section 3.3.2**) is also presented in **Table 6.1.**

Sleep disturbance noise limits for operation and construction noise occurring during the night-time (10:00pm to 6:00am) 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 Acoustic Quality Objective L_1 noise limit for the night-time and the sleep disturbance noise limits applied by ARUP are presented in **Table 6.2**.

Table 6.1 Night L_{Aeq} Noise Criteria Comparison

Receptors	Time Period	Measured RBL L_{90} (1 hour) dBA	ARUP Proposed Noise Limit L_{eq} (1 hour) dBA (RBL + 3 dBA)	Acoustic Quality Objective Noise Limit (Calculated External Noise Limit) L_{eq} (1 hour) dBA
Wharf Street Residential Area	Night (10:00pm to 6:00am)	46	49	37

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

Table 6.2 Night L_{max} Noise Criteria Comparison

Receptors	Time Period	Measured RBL (1 hour) dBA	ARUP Proposed Sleep Disturbance Criteria dBA L_{max}		Acoustic Quality Objective Noise Limit (Calculated External Noise Limit) L_1 (1 hour) dBA
			Emergence Noise Level (RBL + 15 dBA) (external)	Absolute Noise Limit	
Wharf Street Residential Area	Night (10:00pm to 6:00am)	46	61	62	47

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

It is evident from review of the noise limits presented in **Table 6.1** 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). However, as presented in **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) and therefore it is considered acceptable to apply a higher noise limit. It is noted however that based on ASK's attended noise measurements and observations, the noise logging undertaken at the Hilton Hotel may not be representative of all the residential receptors further south on Wharf Street (i.e. Piermonde Apartments), which are further away from the Pullman Hotel (mechanical plant noise source) and closer to the wharf.

In regards to the short-term noise limits presented in **Table 6.2**, the Acoustic Quality Objectives noise limit (47 dBA L_1) is also significantly lower than the L_{max} noise limit applied by ARUP, however it is noted that the L_1 and L_{max} noise descriptors are not directly comparable. The sleep disturbance noise limits proposed by the PNCG are commonly applied and are considered applicable for this project, however the appropriateness of the use of absolute L_{max} noise limit for 1 event needs further consideration, as does the existing operation of the wharf and the existing noise environment at Wharf Street. Overall it is considered likely that a higher than typical noise limit may be supportable for this area, however further review is required.

This will be addressed in a follow-up report on impacts and mitigation.

7. Constraints Assessment

7.1 Overview

The purpose of this assessment is to identify opportunities and constraints for the Project and recommend project refinements with respect to mitigating noise impacts.

As detailed information regarding equipment and plant selections is unavailable at this time, detailed sound power level (L_w) data for these items for the purposes of noise predictions is also unavailable. This assessment therefore focuses on assessing the current proposed buffer distances based on anticipated sound power levels for different noise generating sources and activities.

Further review of the sound power levels applied in this section can be undertaken in the future when detailed information is available.

7.2 Establishment of Placement Area

7.2.1 Baron Delta

The extent of site establishment workrequired for the Baron Delta DMPA (Site 1) will be determined following further assessment of this option. Expansion of the existing void may be required in the north-western area of the site, in addition to the construction of tailwater ponds, however the need for this workwill be determined in later project stages if this option is selected.

7.2.2 East Trinity

Preparation of the East Trinity placement area is expected to include the following noise generating activities:

- mobile equipment clearing, stripping topsoil and stockpiling material
- bund construction; including the use of earthmoving equipment and import of fill materials.

Based on these activities, the main noise generating sources are anticipated to be mobile equipment (i.e. dozers, front end loaders, excavators, compactors, etc). It is expected that establishment works for the selected placement area will occur during standard construction hours only (Monday to Saturday, 6:30am to 6:30pm).

Noise emissions from preparation of the placement area will be highly variable, depending on the type and intensity of activity, and the equipment in operation. Based on ASK's noise database, the sound power levels for large earthmoving equipment such as dozers (CAT D10 or D11) and excavators (Hitachi EX5500) are in the order of 120 dBA L_{weq}, whilst other equipment such as front end loaders (FEL) (CAT 992K) and graders (CAT 16H) typically have sound power levels in the order of 110 dBA $L_{weq.}$ For the purposes of this assessment, sound power levels of 120 dBA L_{weq} and 110 dBA L_{weq} have been used to provide an indication of potential noise impacts.

Based on the proposed potential placement area locations (see **Section 2.4.3**), the distance between the closest noise sensitive receptors and the potential placement sites are as follows:

- Site 2A: within 100 metres of nearest sensitive receptors (at eastern boundary)
- Site 2B: approximately 900 metres from nearest sensitive receptors (at eastern boundary)
- Site 2C: approximately 1500 metres from nearest sensitive receptors (at eastern boundary)

Note: The extent of establishment works required at the placement sites is unknown, and therefore the actual separation distances may be larger than those nominated above.

Based on the nominated sound power levels, and assuming hemispherical propagation, noise levels at distances from the placement area have been calculated as shown in **Table 7.1**. Noise predictions have been undertaken for neutral conditions (no wind). As discussed in **Section 6.1**, the construction noise limits for standard hours (6:30am to 6:30pm) are anticipated to range from 40 to 51 dBA L_{eq} (15 minute).

Based on the predicted noise levels shown in **Table 7.1**, the construction noise limits are anticipated to be exceeded for establishment activity within the Site 2A location close to receptors (within 400 metres), but should be achievable for Sites 2B and 2C which have larger separation distances to receptors.

Table 7.1 Calculated Noise Levels at Distance from Establishment of Placement Areas

Large Earthmoving Equipment 120 dBA L_{weq}		Earthmoving Equipment 110 dBA L_{weq}	
Distance (m)	**Calculated Noise Level at Distance dBA L_{eq} (Neutral Conditions)**	**Distance (m)**	**Calculated Noise Level at Distance dBA L_{eq} (Neutral Conditions)**
100	67	100	57
200	58	200	48
400	50	400	40
900	40	900	30
1500	33	1500	23

Note: Calculations assume hemispherical propagation, without consideration of shielding which may or may not be provided by the natural topography. The calculations also assume that the equipment is under significant load for the duration of the assessment period (15 minutes), whereas the actual noise level with fluctuating load (as per actual operating conditions) may be lower.

To reduce the potential for noise impacts it recommended that the placement site selected is located as far as possible away from sensitive receptors.

Due to the high sound power levels associated with large mobile equipment, it may not be possible for earthmoving and site establishment works to comply with a background plus type criteria. Therefore it may be considered sufficient to manage site establishment works such that heavy earthmoving work is conducted during daytime hours.

It is noted that the highly affected construction noise level of 75 dBA L_{eq} (15 minutes) (see **Table 3.2**) is not exceeded, even at 100 metres from large earthmoving equipment, and therefore depending on the duration of works required, noise impacts from site establishment may result in acceptable impact to sensitive receptors.

7.3 Operation of Placement Area

At this time, detailed information regarding the operation of the placement area is unknown. In accordance with the operating hours for dredging, the placement area is anticipated to operate 24 hours per day.

As noted in the BMT JFA Consultants Position Paper on Dredging and Disposal Methodology (BMT JFA 2016), the operation of the placement area may involve the use of mobile equipment such as dozers and excavators to ensure dredged material is distributed across the placement area. Pumps will also be required to transport excess water from the DMPA.

Further detailed assessment and modelling of noise emissions from the placement areas will be required once the placement area has been selected, and further information is available regarding the specific day-to-day operations of the placement area and the equipment involved. Noise emissions from tailwater pumps will need to be considered, however it is expected that noise emissions will be able to be adequately controlled through location and mitigation (if required).

7.3.1 Baron Delta

It is understood that operation of the Baron Delta site is not anticipated to require significant use of mobile equipment for the placement of dredged material.

It is noted that the Baron Delta placement site, and nearby sensitive receptors, are located near the Captain Cook Highway which is a significant noise source. Whereas the East Trinity placement areas are located in a more rural environment with a quieter existing noise environment. The Baron Delta placement site is also currently utilised as sand quarry and therefore noise emissions from mobile equipment are an existing noise source.

7.3.2 East Trinity

Based on the calculated noise levels for earthmoving equipment for site establishment as presented in **Section 7.2**, it is recommended that consideration is given to selecting quieter (smaller) equipment if East Trinity Site 2A is the DMPA option selected.

As a general control, it is recommended that use the of mobile earthmoving equipment during outside-standard hours is limited or avoided (if feasible) to reduce the potential for noise impacts.

7.4 Pipe Fabrication and Laydown Areas

For all DMPA options, pipe will be delivered to Cairns either by road transport or sea freight in components typically up to 12m in length, and will require storage and fabrication on-site to construct the dredging slurry pipeline.

It is expected that pipeline construction (i.e. welding, cutting, transport, etc) and use of the laydown areas (including delivery) will occur during standard construction hours only (Monday to Saturday, 6:30am to 6:30pm).

Noise emissions from pipe fabrication and laydown areas will be highly variable, depending on the type and intensity of activity. For the purposes of this assessment, the sound power level assumed for the operation of pipe fabrication areas has been assumed to be 105 dBA L_{weq}, which has been taken from Noise and Vibration Technical Report in the draft EIS (Table D.7.7.3.3a of chapter B10). It is expected that this sound power level represents noise generated by higher noise activities such as drilling and cutting of steel pipes, and therefore predictions using this sound power level are considered conservative as a 15 minute average noise level would be expected to be quieter.

Based on the proposed pipeline and booster pump options (see **Section 2.4.3**), the distance between the closest noise sensitive receptors and the proposed location of fabrication areas is approximately 600 metres for the Baron Delta options and approximately 300 metres for the worst case East Trinity option (Site A).

Based on a sound power level of 105 dBA L_{eq}, and assuming hemispherical propagation, noise levels at distance from the pipe fabrication area have been calculated to be as shown in **Table 7.2**. In addition to a sound power level of 105 dBA L_{weq}, distance calculations have also been undertaken assuming a sound power level of 93 dBA L_{weq} (85 dBA at 1 metre, workplace noise exposure standard). Noise predictions have been undertaken for neutral conditions (no wind) to provide an indication of likely noise levels, and it is noted that noise levels will fluctuate above and below those shown.

Based on the predicted noise levels shown in **Table 7.2**, it is evident that the construction noise limits nominated in **Section 6.1**, which range from 40 to 51 dBA L_{eq} (15 minute) for standard hours (6:30am to 6:30pm), seem achievable for the pipe fabrication areas.

Table 7.2 Calculated Noise Levels at Distance from Pipe Fabrication Areas

Pipe Fabrication Area 105 dBA L_{weq}		Pipe Fabrication Area 93 dBA L_{weq}	
Distance (m)	**Calculated Noise Level at Distance dBA L_{eq} (Neutral Conditions)**	**Distance (m)**	**Calculated Noise Level at Distance dBA L_{eq} (Neutral Conditions)**
100	52	100	40
200	43	200	31
300	38	300	26
400	35	400	23
600	30	600	18

Note: Calculations assume hemispherical propagation, without consideration of shielding which may or may not be provided by the natural topography.

At this time detailed information regarding the frequency of vehicle movements on an hourly basis is unknown, and therefore the potential impact of truck movements cannot be calculated at this time. This activity may require further assessment if deliveries of pipe and other related infrastructure are to be a regular event.

7.5 Booster Pump Stations

In accordance with the operating hours for dredging, booster pump stations are anticipated to operate 24 hours per day.

The applicable sound power level for a booster pump will be specific to the brand and model of the pump. It is also noted that the booster pumps are anticipated to be located within a form of enclosure, and this further complicates the matter. For the purposes of this assessment, the sound power level assumed for the booster pumps is 115 dBA L_{weq}, which has been taken from the BMT JFA Consultants Position Paper on Dredging and Disposal Methodology for the Project.

Based on the proposed pipeline and booster pump options (see **Section 2.4.3**), the distance between noise sensitive receptors and the proposed location of booster pump stations ranges from approximately 200 to 1000 metres (see **Table 4.1**).

Based on a sound power level of 115 dBA L_{eq}, and assuming hemispherical propagation, noise levels at distance from the booster pump station have been calculated to be as shown in **Table 7.3**. In addition to a sound power level of 115 dBA L_{weq}, distance calculations have also been undertaken for a pump station with an assumed sound power level of 100 dBA L_{weq}. Noise predictions have been undertaken for neutral condition (no wind) and adverse (downwind, night-time) conditions to provide an indication of likely noise levels. It is anticipated that the booster pumps will operate at a steady rate, so fluctuations due to load would not be anticipated to be significant, though this may alter dependent on the dredging methodology.

Table 7.3 Calculated Noise Levels at Distance from Booster Pump Station

Booster Pump 115 dBA L_{weq}			Booster Pump 100 dBA L_{weq}		
Distance (m)	Calculated Noise Level at Distance dBA L_{eq}		Distance (m)	Calculated Noise Level at Distance dBA L_{eq}	
	Neutral	Adverse		Neutral	Adverse
100	62	63	100	47	48
200	53	57	200	38	42
300	48	53	300	33	38
500	42	48	500	27	33
800	37	43	800	22	28
1000	34	41	1000	19	26
1500	28	36	1500	13	21
2000	24	32	2000	9	17

Note: Calculations assume hemispherical propagation, without consideration of shielding which may or may not be provided by the natural topography.

Further review of appropriate sound power levels for booster pump stations, and further assessment of noise levels can be undertaken in the future when further detailed information is available. Based on the preliminary noise calculations presented in **Table 7.3**, it is recommended booster pumps are located as far as possible from sensitive receptors. Further discussion of the booster pump stations for the Baron Delta and East Trinity options is provided in the following sections.

7.5.1 Baron Delta Booster Pump Stations

The Baron Delta placement option and associated slurry pipeline options locate booster pumps within 200 to 500 metres of numerous sensitive receptors.

Based on the predicted noise levels shown in **Table 7.3**, it is evident that the construction noise limits nominated in **Section 6.1**, which range from 28 to 33 dBA L_{eq} (15 minute) for the outside hours work (night-time) are likely to be exceeded by noise emissions from the booster pumps based on the nominated sound power levels. Based on the nominated sound power levels, exceedances could occur at distances in excess of 1 kilometre in adverse conditions.

Therefore if the Baron Delta DMPA option was selected, the selection of pumps and the mitigation of these pumps would require detailed consideration. Relocation of the proposed pump station locations would also assist in reducing noise levels.

7.5.2 East Trinity Booster Pump Stations

The only East Trinity DMPA option which requires a booster station is Site 2A. The location of the booster pump for this option is located approximately 2.1 kilometres from the nearest receptor to the east (receptor AD), approximately 1.4 kilometres from the nearest receptor to the west (receptors F and G) and in the order of 800 metres to the nearest potential boat mooring (receptor I).

Based on the calculated noise levels presented in **Table 7.3**, and existing elevated background noise levels along Wharf Street, it is expected that the noise levels at land based receptors (receptors F, G and AD) from the Site 2A booster pump will be acceptable.

Due to the decreased separation distance, if the boat moorings (receptor I) are required to be considered as sensitive receptors for the project, mitigation measures may be required to reduce noise emissions from the booster pump in line with the calculations assuming a sound power level of 100 dBA $L_{weq.}$

Further review of appropriate sound power levels for booster pump stations, and further assessment of noise levels can be undertaken in the future when further detailed information is available.

7.5.3 Summary

Overall, the best pipeline routes are those associated with East Trinity Sites 2B and 2C, which do not require booster pumps. The East Trinity placement options are also located in areas with fewer sensitive receptors than those present near the Baron Delta options.

7.6 Off-shore Pump Out

As noted in the BMT JFA Consultants Position Paper on Dredging and Disposal Methodology (BMT JFA 2016), when the hopper of the TSHD is filled, the TSHD will sail to a temporary mooring to discharge (pump) the dredged material into the dredging pipeline and then on to the DMPA. It is anticipated that off-shore pump out will occur 24 hours per day and seven days per week.

For the purposes of the assessment of this activity it has been assumed that pumping dredge material from the TSHD has similar sound power level to those assumed for the booster pump station. Further refinement of this assumption can be undertaken during future project stages. The following sections discuss the potential impact for each of the DMPA options

7.6.1 Baron Delta

The closest area of the off-shore connection zone for the Baron Delta options is located approximately 2.3 kilometres to the north-east of the closest receptor (receptor K).

Based on the calculated noise levels presented in **Table 7.3** for a sound power level of 115 dBA L_{eq}, it is anticipated that under adverse conditions noise emissions from off-shore pump out from the TSHD will be audible at sensitive receptors near the coast (receptor K and surrounding). Noise emissions from TSHD pump-out alone would likely be compliant, however if a marine booster pump is present and operating then the total noise level from both these sources would likely exceed the construction noise limit for outside-hours work (6:30pm to 6:30am).

It is anticipated that mitigation measures will be available for the booster pump stations which would reduce the overall noise impact at sensitive receptors.

7.6.2 East Trinity

Based on the conceptual layouts for the East Trinity DMPA options (see **Figure 2.3** to **Figure 2.5**), it is anticipated that the TSHD will remain within the channel when pumping out to any of these options.

Based on the anticipated pump out location for Option 2A, the separation distance to the nearest land based receptor (receptor H) is approximately 580 metres, with the separation distance to boat moorings in the order of 100 to 200 metres

Based on the anticipated pump out location for Option 2B and 2C, the separation distance to the nearest land based receptor (receptors A to D) is approximately 400 metres, with the separation distance to boat moorings also in the order of 100 to 200 metres.

Based on the calculated noise levels presented in **Table 7.3** for a sound power level of 115 dBA L_{eq}, it is anticipated that for all DMPA options that under adverse conditions noise levels at receptors along and near Wharf Street (receptors A to H) will be in the order of 48 to 53 dBA L_{eq}. Although the existing noise environment at Wharf Street is elevated due to existing mechanical plant noise levels, these levels are considered high and further consideration of this impact will be required when more detailed information regarding the sound power level for TSHD is available.

Assuming a sound power level of 115 dBA L_{eq}, noise levels at boat moorings would be in the order of 57 to 63 dBA L_{eq}. If these moorings are required to be considered sensitive receptors, it is unlikely these levels would be deemed acceptable and mitigation would be required.

It is noted that dredging will occur in the channel and therefore noise will be generated from the TSHD continuously during this process.

7.6.3 Summary

Overall, the best off-shore pump out location is considered to be the Baron Delta options due to the increased separation distance to sensitive receptors.

7.7 Pipeline

It is recommended that slurry delivery pipelines are located as far as possible away from nearby sensitive receptors. Noise emissions from the pipelines may not be significant, however further detailed assessment can be undertaken in later stages of the development when the placement location and pipeline option has been selected.

It is noted that the Baron Delta pipeline options require sandbar cutting. Sandbar cutting is expected to be undertaken during the day and is not anticipated to require an extended period to complete. Due to the separation distance to the nearest sensitive receptors (700 metres to receptor J), noise impacts from sandbar cutting are not anticipated to be significant but can be considered in further detail in future project stages.

7.8 Wharf Construction Site and Operation of the Wharf

Noise impacts from the wharf construction sites and the operation of the wharf were assessed as part of the Noise and Vibration Technical Report prepared by ARUP (Appendix D.7 of Draft EIS).

As discussed in **Section 6.2**, the criteria applied by ARUP generally seem adequate however further consideration and discussion of the existing wharf operations and the existing noise environment at sensitive receptors on Wharf Street is required to provide a comprehensive assessment of impacts.

Overall it is considered likely that noise emissions from the wharf construction site and the operation of the wharf will be acceptable, however management strategies will be required to mitigate potential impacts.

7.9 Recommendations

Based on the assessment presented in the preceding sections, the following recommendations are made:

- General recommendations:
  - Construction activities should be limited as much as practical to recommended construction hours, being Monday to Saturday, 6:30am to 6:30pm, to reduce the potential for noise impacts.
  - Active project areas (placement areas, fabrication and laydown areas, etc.) and identified noise sources (booster pumps) should be located as far as practical from sensitive receptors to reduce the potential for noise impacts.
- Placement area establishment:
  - The Baron Delta placement site is located near a number of sensitive receptors, but the existing noise environment is influenced significantly by road traffic on the Captain Cook Highway and therefore nearby sensitive receptors may be less sensitive to noise emissions from the placement area.
  - Future assessment is required when equipment has been selected and the extent of establishment works is known.

- Future assessment of noise emissions may consider the duration of significant noise generating works, i.e. use of earthmoving equipment, when assessing the overall noise impact.
- The East Trinity Site 2A placement area is located within 100 metres of sensitive receptors. East Trinity Sites 2C and 2B are preferable due to increased separation distance, with Site 2C having the largest buffer.

- Pipe fabrication and laydown areas:
  - The East Trinity options locate pipe fabrication and laydown areas closer to sensitive receptors than the Baron Delta options.
  - It is anticipated that compliance with noise limits is achievable for these areas, however further assessment is required when equipment has been selected and information regarding the day-to-day operations of the fabrication and laydown areas is known.
  - Future assessment of the fabrication and laydown areas may require consideration of truck movements (i.e. deliveries) depending on the frequency and timing of vehicle movements.
- Placement Areas:
  - East Trinity DMPA Site 2C is the furthest from sensitive receptors, and is the most preferable option with respect to noise impacts.
  - The Baron Delta disposal site is located adjacent Captain Cook Highway, which is a significant noise source. The Baron Delta disposal site is also located within an existing quarry.
- Booster Pumps:
  - Booster pumps are a high noise source item which have the potential to generate significant noise impacts at sensitive receptors. Mitigation is likely to be required to address noise from the booster pumps.
  - The Baron Delta options locate booster pumps closer to receptors than the East Trinity options.
  - Detailed modelling will be required to assess noise emissions from the booster pump stations and determine required mitigation measures.
- Wharf:
  - Further discussion and analysis of the existing noise environment is required to support the proposed night-time noise limits.
- Boat Moorings:
  - Further discussion with regulatory authorities is required to determine if moored boats are required to be considered as sensitive receptors, and if so, if the same noise assessment criteria is required to be applied for these moorings.

A summary of opportunities and constraints for the CSD Project options and comment on the preferred options are presented in **Table 7.4**.

Table 7.4 Summary of Opportunities and Constraints

Project Aspect	Opportunities & Strengths	Constraints & Weaknesses
East Trinity		
Overall	• There are less sensitive receptors in this area. • There are generally larger separation distances to sensitive receptors, both for the DMPA's and other activity areas. • Only one booster pump station is required for Site 2A, and none for other placement sites. Therefore there are less noise sources associated with the dredging pipeline for the East Trinity options as compared with the Baron Delta options.	• Site establishment work is required for East Trinity placement areas and noise will be generated from this work. However the timing of this work could likely be managed effectively to reduce noise impacts. • The proposed placement areas are not currently used for industry (i.e. currently greenfield sites), and therefore the use of these areas would introduce a new noise source. • The ambient noise environment is slightly quieter than the Baron Delta area overall, as it is a more rural environment. • Boat moorings are located in proximity to this area and may need to be considered as sensitive receptors.
DMPA Site Option 2A	• A large portion of the site has good separation to sensitive receptors. • Activity at this site could be managed to occur at areas close to receptors during less-sensitive times (i.e. day). • Only a single booster pump is proposed, with good separation to residential sensitive receptors.	• The north-eastern portion of site is located within 100 metres of sensitive receptors. Noise levels from site establishment and operation of the DMPA will likely exceed criteria for areas close to receptors. • This option is the closest East Trinity option to sensitive receptors, and the only East Trinity option which requires a booster pump. • This option adds a new noise source to a currently greenfield site.
DMPA Site Option 2B	• Good separation to sensitive receptors, both placement area and pipe fabrication area. • It is likely that minimal management of activities would be required to mitigate noise emissions. • No on-shore booster pump is required.	• This option adds a new noise source to a currently greenfield site.
DMPA Site Option 2C	• Good separation to residential sensitive receptors. • Likely that minimal management of activities would be required to mitigate noise emissions. • No on-shore booster pump is required.	• This option is closer to boat moorings which may need to be considered as sensitive receptors. • This option adds a new noise source to a currently greenfield site.

Project Aspect	Opportunities & Strengths	Constraints & Weaknesses
TSHD Off-Shore Pump Out	• Dredging activities are already required for this area.	• Pump-out will likely occur in close proximity to boat moorings. • Noise levels may be high at sensitive receptors along Wharf Street (receptors A to H). This will require further consideration, though it is noted that dredging is proposed for the same area in the channel.
Baron Delta		
Overall	• Minimal DMPA site establishment work is required. • DMPA site is located at an existing quarry, where the existing noise environment is influenced significantly by traffic noise. • The pipe fabrication area is located approximately 600 metres from the nearest receptor (receptor J), this should be an adequate separation distance to prevent noise impacts. • Ambient noise levels are slightly higher than the East Trinity area overall, as the area has more urban development. However night-time background noise levels are still low.	• This option requires more booster pump stations, which are anticipated to be a significant noise source, and will operate 24 hours per day when functional. • Booster pump stations are located near (within 200 to 500 metres) receptors. • There are more sensitive receptors potentially impacted due to the extent of land which the project covers. • Noise from the marine booster pump and TSHD pump-out is likely to be audible and exceed noise limits at coastal receptors (i.e. receptors J and K) under adverse conditions. • There is greater potential for noise impacts/complaints due to a larger population in this area.
DMPA Site	• The existing noise environment is influenced significantly by road traffic on the Captain Cook Highway. • The site is currently a quarry, an industrial use. • Less site establishment work and activity is required for this site.	• Further expansion of north-western area of DMPA site, and potential construction of tailwater ponds, could require activity within 300 metres of receptors U and T. • This DMPA is closer to sensitive receptors than the Trinity options (with exception of Option 2A).
Aquis Pipeline (With Marine Booster)	• Moving the marine booster further south-east (further from receptor K) would reduce the potential for noise impacts and reduce mitigation requirements. • Moving the locations of boosters #2 and #3 would increase the separation distances to receptors and reduce the potential for noise impacts and reduce mitigation requirements. • It is anticipated that mitigation options will be available to reduce noise emissions from booster pump stations.	• The marine booster pump is likely to be audible at coastal receptors at coastal receptors (i.e. receptors J and K) under adverse conditions. • Booster #2 is only approximately 400 metres east of receptor M. Mitigation will likely be required to deal with noise emissions from this booster. • Booster #3 is only approximately 300 metres from receptor R. Mitigation will likely be required to deal with noise emissions from this booster.

Project Aspect	Opportunities & Strengths	Constraints & Weaknesses
Aquis Pipeline (No Marine Booster)	• No marine booster pump is required which reduces the number of noise sources potentially required to be mitigated. • Booster #1 is located 700 metres to the nearest receptor (receptor J), and booster #2 is located 600 metres to nearest receptor (receptor R). These separation distances are greater than is currently the case for on-shore boosters for the other pipeline options. • It is anticipated that mitigation options will be available to reduce noise emissions from booster pump stations.	• As there are only 2 booster pumps, there is a risk that these 2 pumps need to be larger and are louder as a result. This may dictate that further mitigation is required for these pumps to compensate for the higher sound power level.
Yorkeys Pipeline	• If the marine booster was moved further south-east (further from receptor K), this would reduce the potential for noise impacts and reduce mitigation requirements. • There appears to be potential for the locations of boosters #2 and #3 to be moved to increase the separation distances to receptors. • It is anticipated that mitigation options will be available to reduce noise emissions from booster pump stations.	• The marine booster pump is likely to be audible at coastal receptors at coastal receptors (i.e. receptors J and K) under adverse conditions. • Booster pump #2 is only approximately 200 metres west of receptors (see receptors L and K). Mitigation will likely be required to deal with noise emissions from this booster. • Booster #3 is only approximately 300 metres from receptor R. Mitigation will likely be required to deal with noise emissions from this booster.
TSHD Off-Shore Pump Out	• The Baron Delta pump-out area has a larger separation distance than the East Trinity locations.	• Noise from the marine booster pump and TSHD pump-out is likely to be audible and exceed noise limits at coastal receptors (i.e. receptors J and K) under adverse conditions.
Preferred Options		
Preferred Placement Site	East Trinity Options 2B or 2C are the preferred locations for the DMPA, however further consideration of boat moorings as sensitive receptors is required. Options 2B and 2C are the preferred options due to larger separation distances to sensitive receptors and a lower number of sensitive receptors. The Baron Delta placement location alone is also favourable, but has associated risks due to the potential proximity of activity to sensitive receptors. Overall the Baron Delta option is less favourable due to potential impacts associated with the dredging pipeline routes and booster pumps, and the number of receptors potentially impacted.	
Preferred Baron Delta Dredging Pipeline	The Aquis Pipeline (No Marine Booster) is the preferred pipeline option for the Baron Delta DMPA. This option requires less booster pumps and the booster pump locations have larger separation distances to sensitive receptors.	

8. Conclusion

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

- Noise monitoring has been undertaken to assess the existing noise environment in the various projects areas and at the location of sensitive receptors as presented in **Section** 5. As discussed in **Section 5**, the noise environment at sensitive receptors includes low background noise levels due to the rural nature of some of the monitoring areas. The noise environment at Wharf Street was identified to be influenced by mechanical plant noise emissions (exhaust fans) from residential apartments and Hotel's located along Wharf Street. 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.
- The presence and locations of noise sensitive receptors are presented in **Section** 4. As discussed within the report, there are more noise sensitive receptors located near the Baron Delta DMPA and associated dredging pipeline options, as compared with the East Trinity options, due to the extent of land based project areas and infrastructure. There is considered to be a higher potential for noise impacts to sensitive receptors for the Baron Delta DMPA option. Further discussion with regulatory authorities of the definition of boat moorings as sensitive receptors is required to be undertaken.
- Assessment of noise emissions from the construction phase of the project is presented in **Section** 7. The project aspects with the highest potential to generate noise impacts are anticipated to be the operation of dredging pipeline booster pumps, and off-shore TSHD pump out to the dredging pipeline.
- A summary of the recommendations of the assessment are presented in **Section 7.9** and **Table 7.4**. The preferred DMPA sites are East Trinity Sites 2B and 2C, due to the separation distances for the sites. If the Baron Delta DMPA site was selected, the preferred dredging pipeline option would be the Aquis (No Marine) option, which does not require a marine booster and locates on-shore booster pumps in areas with larger separation distances than the other pipeline routes.
- Further consideration of noise emissions from construction phase noise sources will be required when the DMPA site has been selected. It is understood this additional assessment has been allowed for in CSD Project planning.

References

BMT JFA Consultants (2016), Position Paper: Dredging and Disposal Methodology Memo - CSD Project - Revised Draft EIS, Project Number: J16021

Cairns Shipping Development Project (CSD Project) (2014), Draft Environmental Impact Statement (EIS), Prepared for Ports North

Department of Environment and Heritage Protection (EHP) (2004), EcoAccess Guideline - Planning For Noise Control (PNCG)

Department of Environment and Heritage Protection (EHP) (2012), Environmental Protection (Noise) Policy 2008

New South Wales (NSW) Department of Environment & Climate Change (2009), Interim Construction Noise Guideline (INCG)

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.
min$L_{90,1hour}$	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 Graphs and Tables (ASK Monitoring)

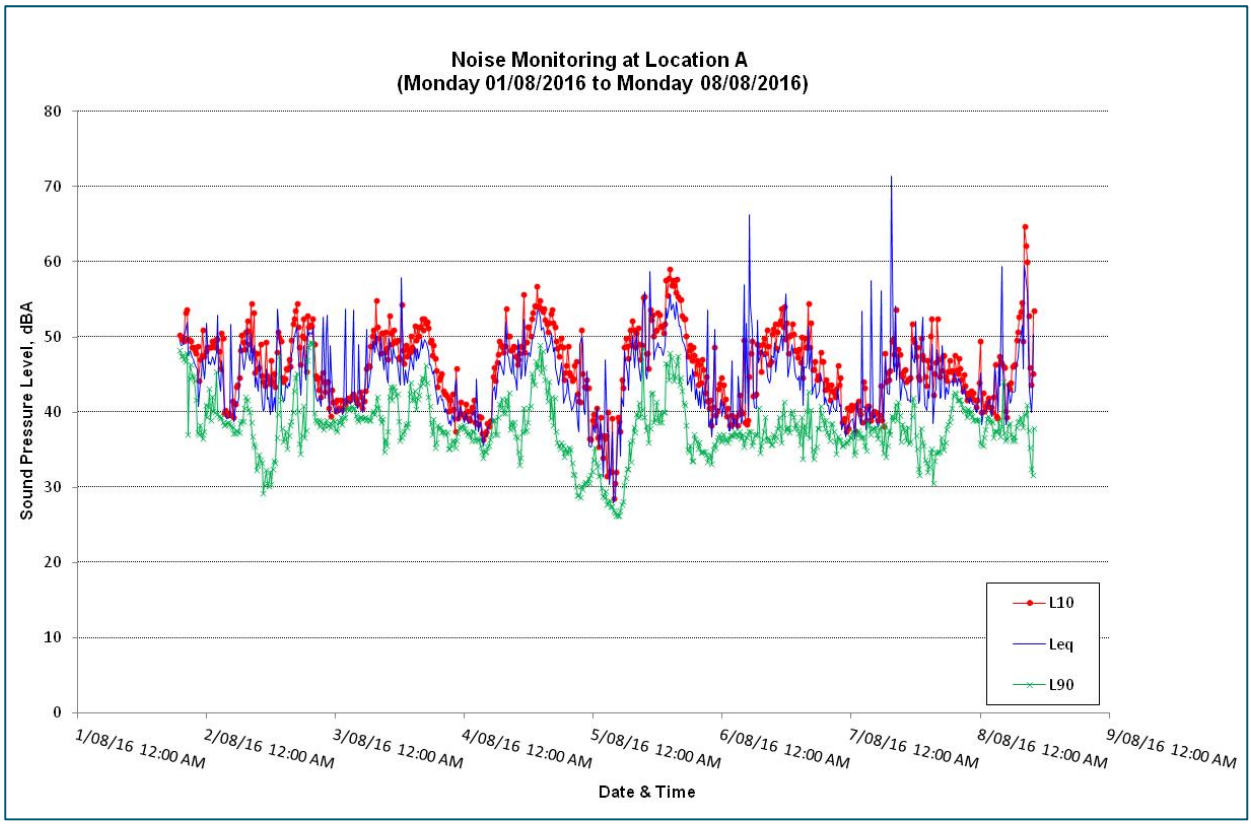

Figure B1. Daily Statistical Noise Monitoring Results at Location A (East Trinity)

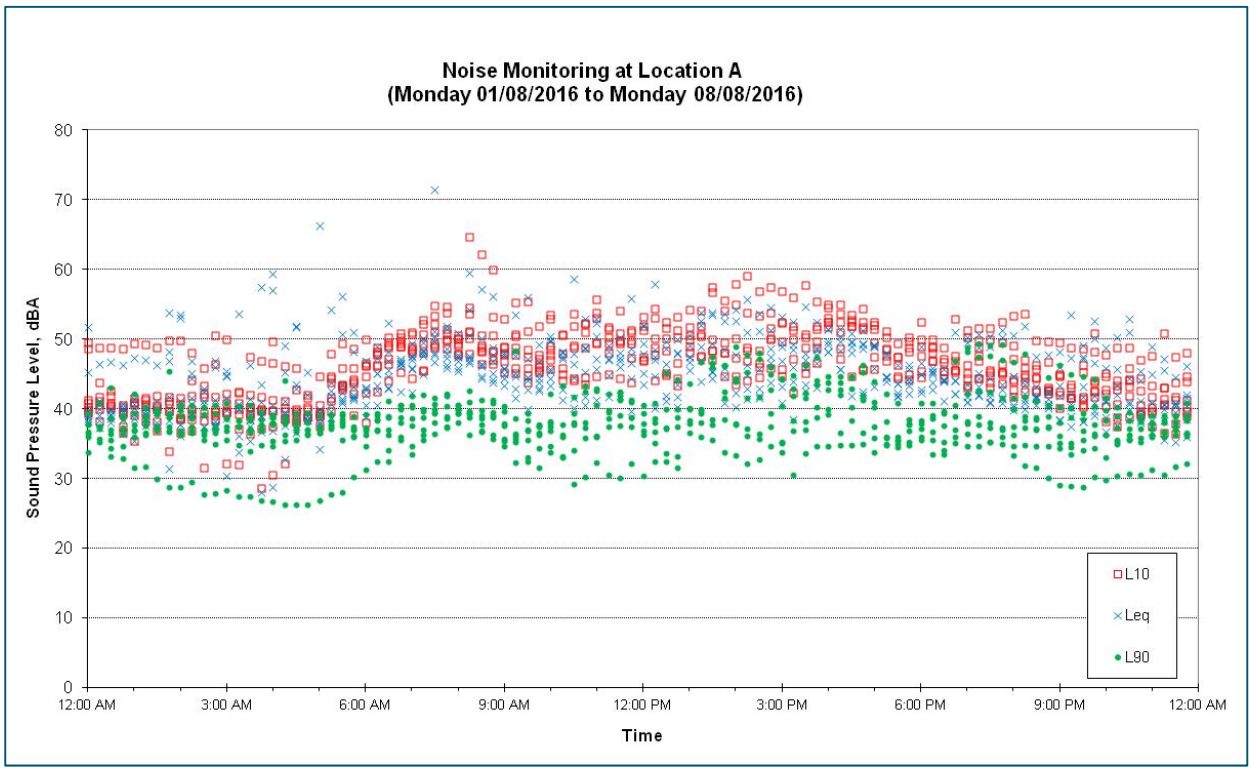

Figure B.2 Diurnal Statistical Noise Monitoring Results at Location A (East Trinity)

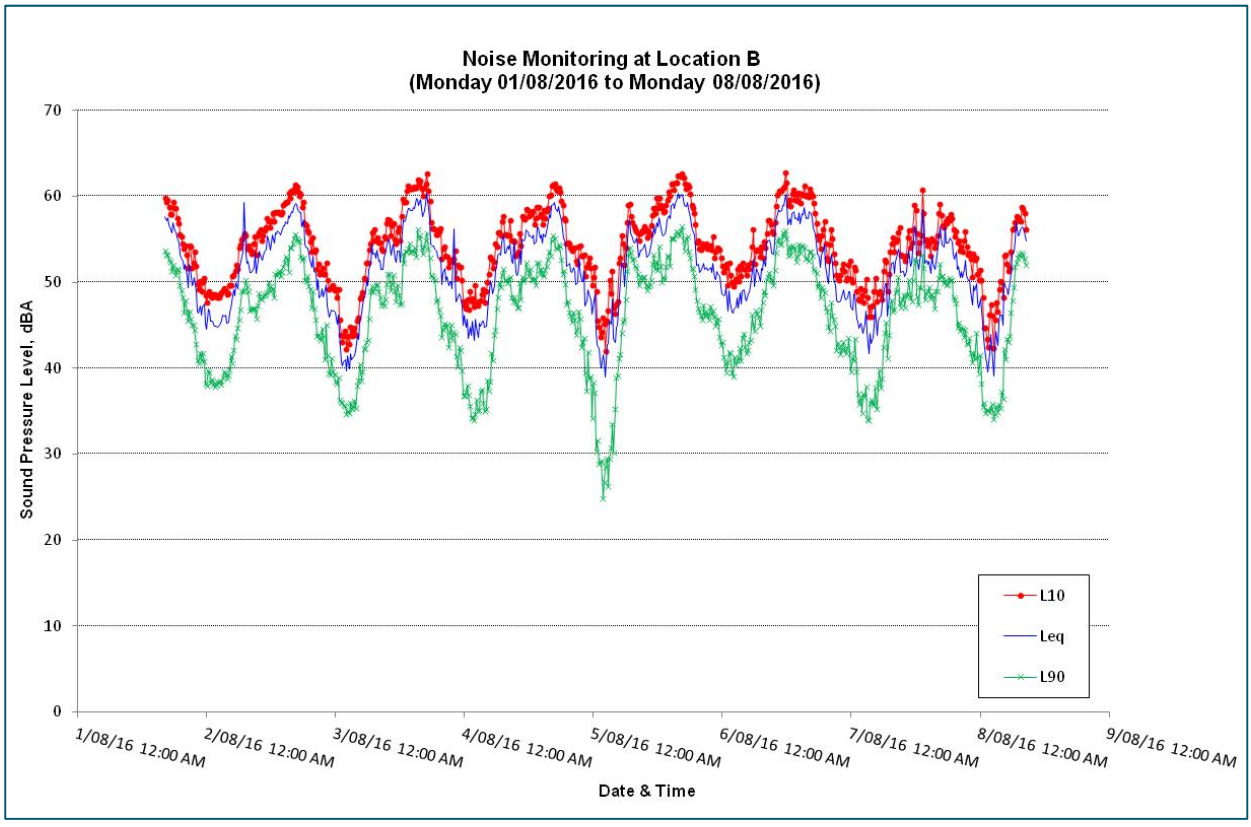

Figure B.3 Daily Statistical Noise Monitoring Results at Location B (Northern Sands Quarry)

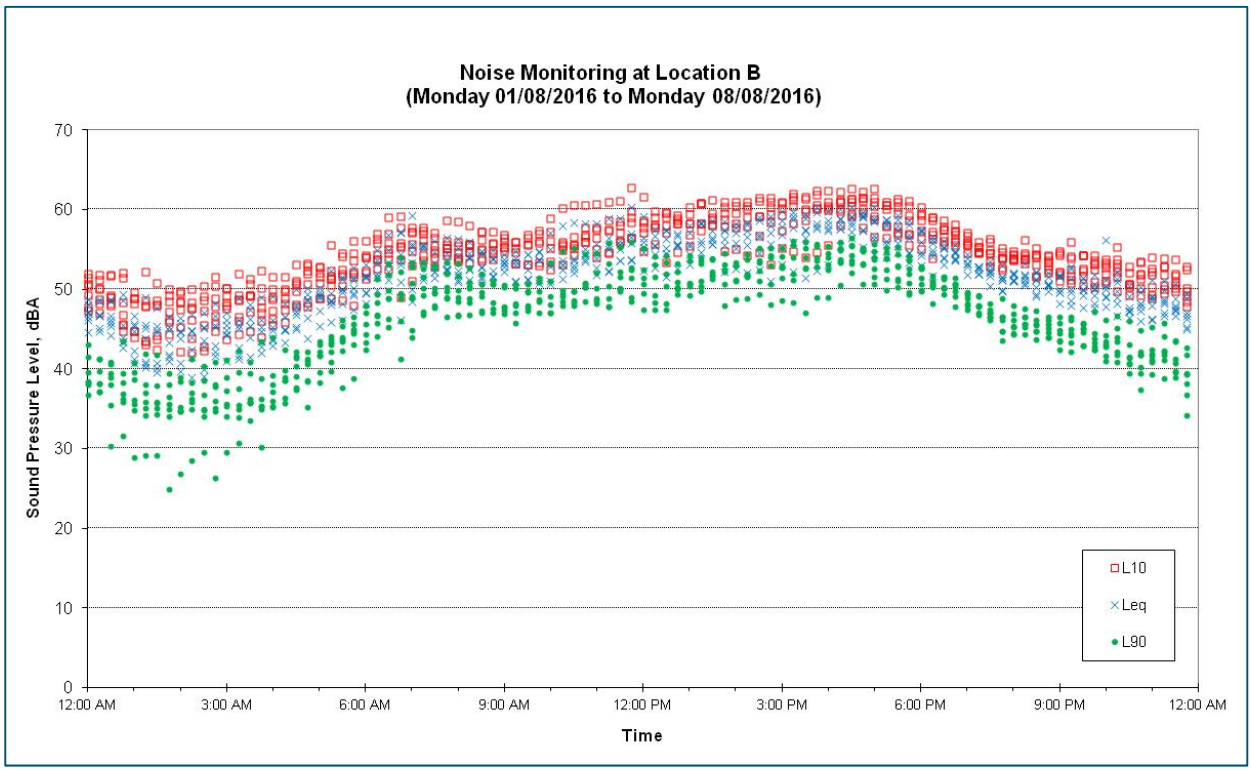

Figure B.4 Diurnal Statistical Noise Monitoring Results at Location B (Northern Sands Quarry)

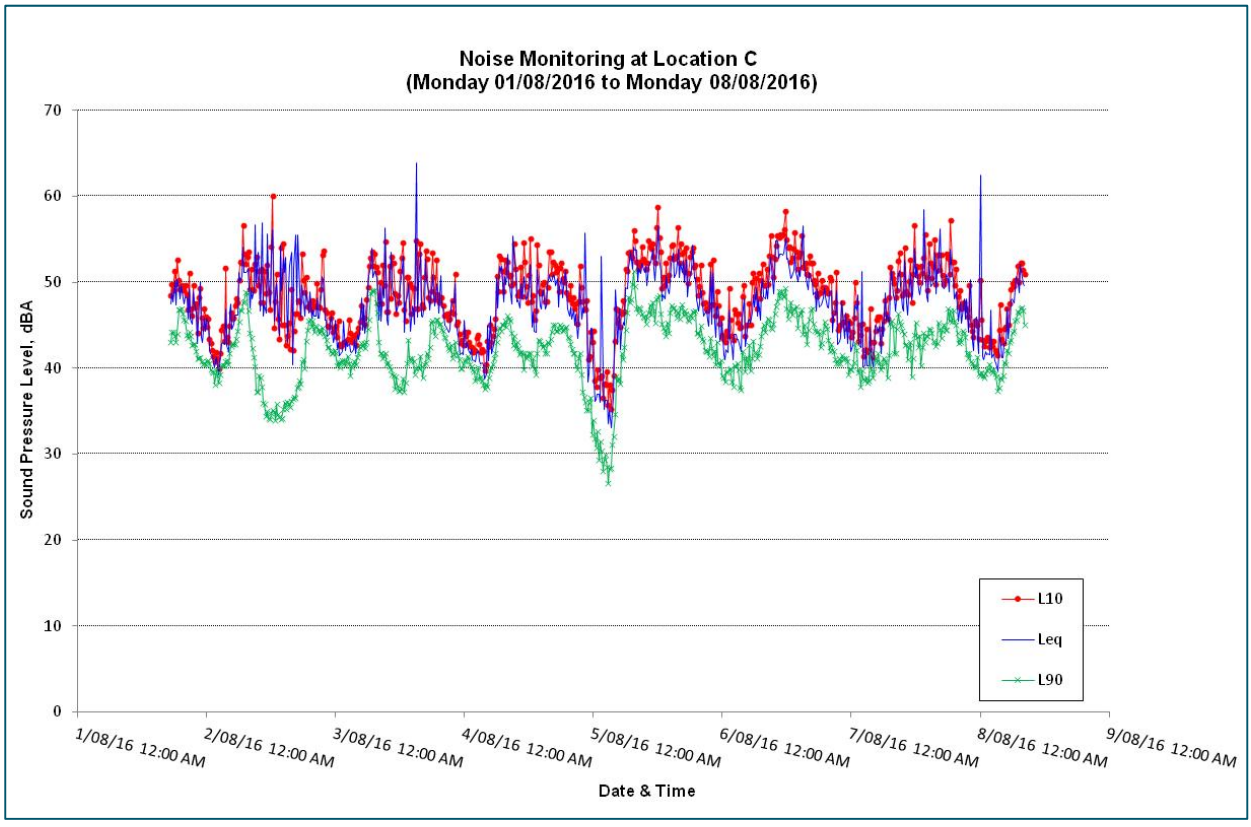

Figure B.5 Daily Statistical Noise Monitoring Results at Location C (Holloways Beach Access Road)

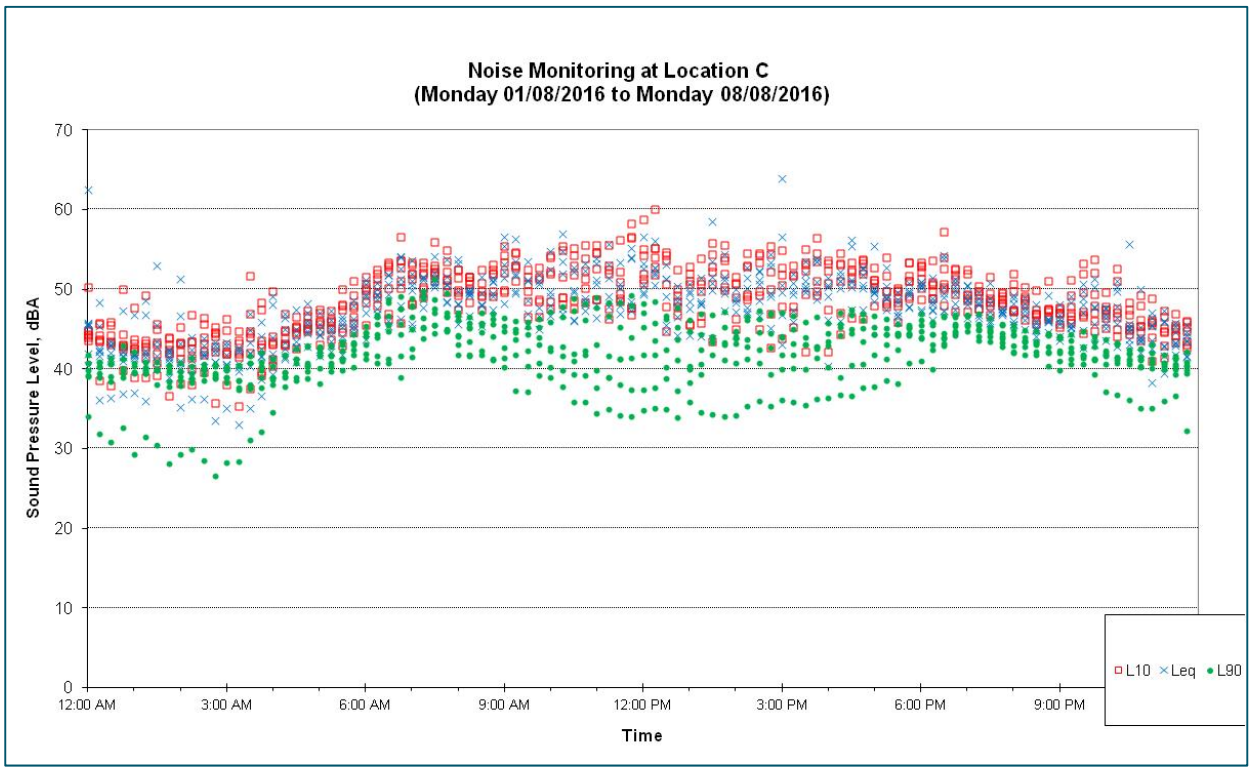

Figure B.6 Diurnal Statistical Noise Monitoring Results at Location C (Holloways Beach Access Road)

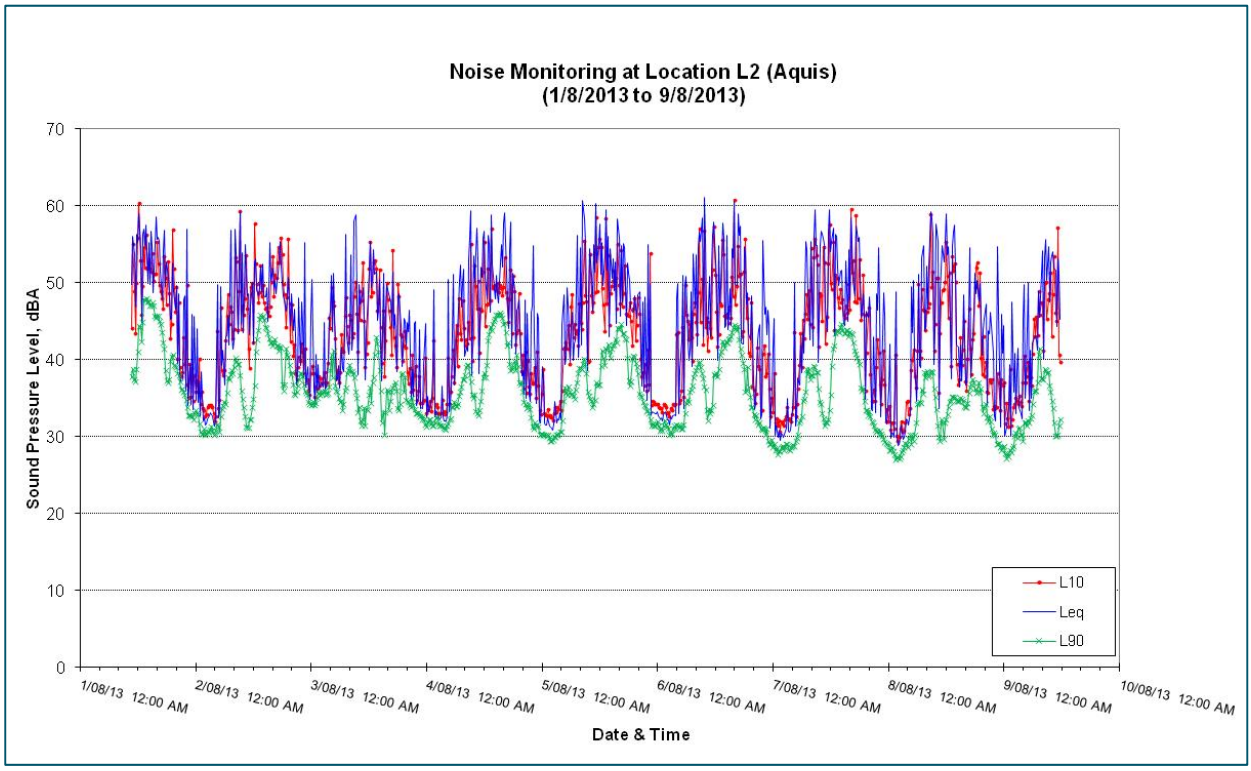

Figure B.7 Daily Statistical Noise Monitoring Results at Location L2 (Aquis)

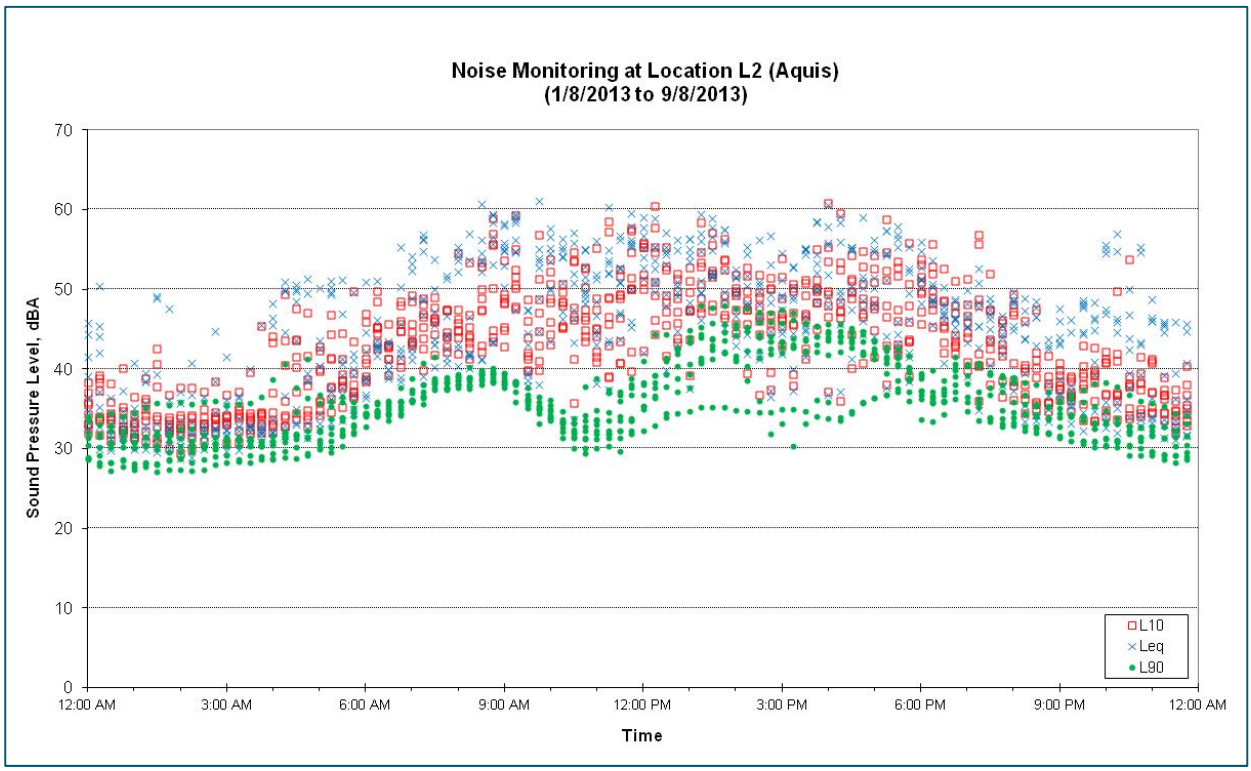

Figure B.8 Diurnal Statistical Noise Monitoring Results at Location L2 (Aquis)