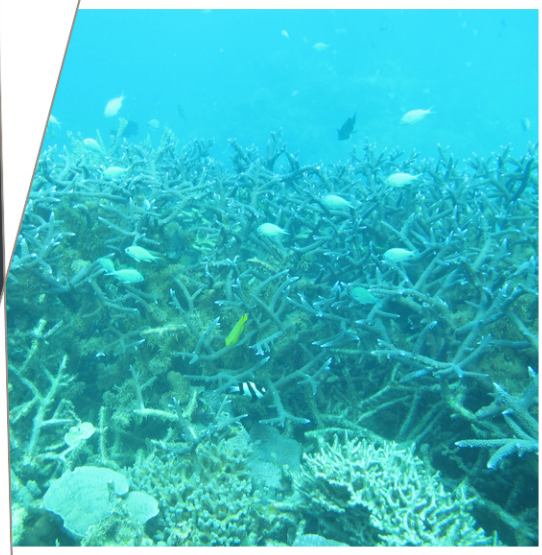
Sampling, Analysis and Quality Plan

Tantabiddi Boating Facility - Marine Environmental Quality Investigations & Benthic Communities and Habitat Assessment



Prepared for

Department of Transport

28 March 2022

Cardno

Contact Information

Cardno (WA) Pty Ltd
ABN 77 009 119 000

11 Harvest Terrace
West Perth WA 6005
PO Box 447

www.cardno.com
Phone +61 8 9273 3888
Fax +61 8 9486 8664

Document Information

Prepared for	Department of Transport
Project Name	Tantabiddi Boating Facility - Marine Environmental Quality Investigations & Benthic Communities and Habitat Assessment
File Reference	P001
Job Reference	CW1188500
Date	28/03/2022
Version Number	Rev 1

Author(s):

Julian Brown
Environmental Scientist – Coastal & Marine

Effective Date 28/03/2022

Approved By:

Daniel Strickland
Principal – Coastal & Marine

Date Approved 28/03/2022

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
Rev A	31/08/2021	Draft	JB / TC	DRS
Rev 0	7/01/2022	Final	JB / TC	DRS / DoT
Rev 1	28/03/2022	Final	JB / TC	DRS / DoT

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Project Background

The Tantabiddi Boat Ramp is located in the Shire of Exmouth (SoE), Western Australia (WA), approximately 15 km west (37 km by road) of the town centre (**Figure 1-1**). The existing boat ramp is the primary launching and retrieval site along the North West Cape, for both recreational and commercial vessels. In recent times, the dual lane ramp and finger jetty have been overwhelmed, due to the growing demands of tourism related to the Ningaloo Reef.

The Department of Transport (DoT) is investigating redevelopment of the Tantabiddi Boating Facility, to meet current and future demands for the facility. The Tantabiddi Taskforce comprises members from the Department of Biodiversity, Conservation and Attractions (DBCA), Department of Primary Industries and Regional Development, DoT, SoE and Tourism WA. Following the outcomes of various investigations, the Taskforce has supported the proposed redevelopment of the Tantabiddi Boating Facility (the project).

The project aims to accommodate current and future increased demand from recreational and commercial use during peak tourism months. The proposed project site is located approximately 300 m southwest of the existing facility, situated to avoid siltation from outflows from Tantabiddi Creek (**Figure 1-1**). The proposed facility will include up to six boat ramp lanes and other maritime infrastructure, enclosed by rock armoured breakwaters, with increased car and trailer parking capacity and connectivity to the existing road (**Figure 1-2**).

The concept plans propose that up to 130,000 m^3 of seabed material is to be dredged for the facility's basin and entrance channel, to reach a target depth of -2.65 m CD. The majority (~60%) of this dredged material is proposed to be re-used by the project (breakwater core fill and land reclamation), while any remaining volume is proposed to either be re-used off-site or disposed of in landfill.

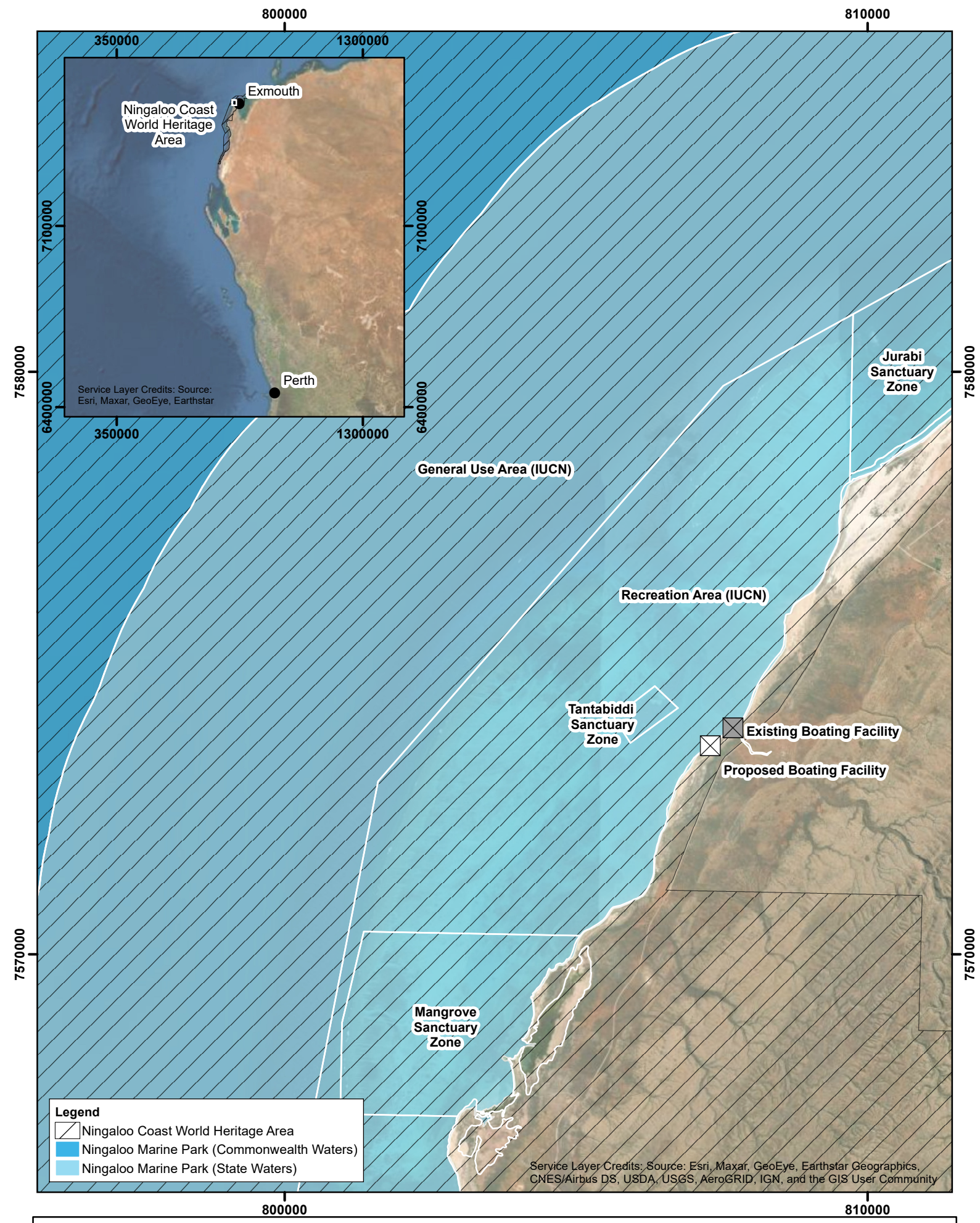
Cardno have been engaged by the DoT to undertake marine environmental field investigations, which are described in this Sampling, Analysis and Quality Plan (SAQP). These investigations include:

- Sediment sampling and analysis – to characterise dredge material with respect to its proposed use/disposal and provide data to contribute to establishing baseline sediment quality characteristics;
- Water quality sampling and analysis - to provide data to contribute to establishing baseline water quality characteristics; and
- Benthic communities and habitat (BCH) sampling – to inform BCH mapping of a local assessment unit (LAU), allowing the relative impact of the project to be assessed.

1.2 Purpose of this SAQP

This SAQP outlines the methods proposed to collect, analyse and report on field data as part of Cardno's work scope. The specific objectives of the SAQP are to:

- Describe the history of the project site and summarise the relevant previous investigations undertaken, as presented in **Section 2**;
- Describe the methods and equipment to be used to undertake the water quality, sediment quality and BCH sampling campaigns, as presented in **Section 3**;
- Describe the proposed methods used for data analysis, comparison against guidelines and reporting, as presented in **Section 3**;
- Describe the data quality management objectives and indicators for each sampling campaign, as presented in **Section 3**;
- Describe the health, safety and environmental management procedures for the field work (**Section 4**); and
- Outline the specific deliverables associated with the sampling and analysis, as presented in **Section 5**.



N

1:80,000 Scale at A4

Kilometers

0 2

Locality Plan

FIGURE 1-1

Cardno

Map Produced by Cardno, Perth
Date: 2022-03-24
Coordinate System: GDA 1994 MGA Zone 49
Project: CW1188500
Map: CW1188500_Figure 1-1_Locality Plan (WA).mxd 01

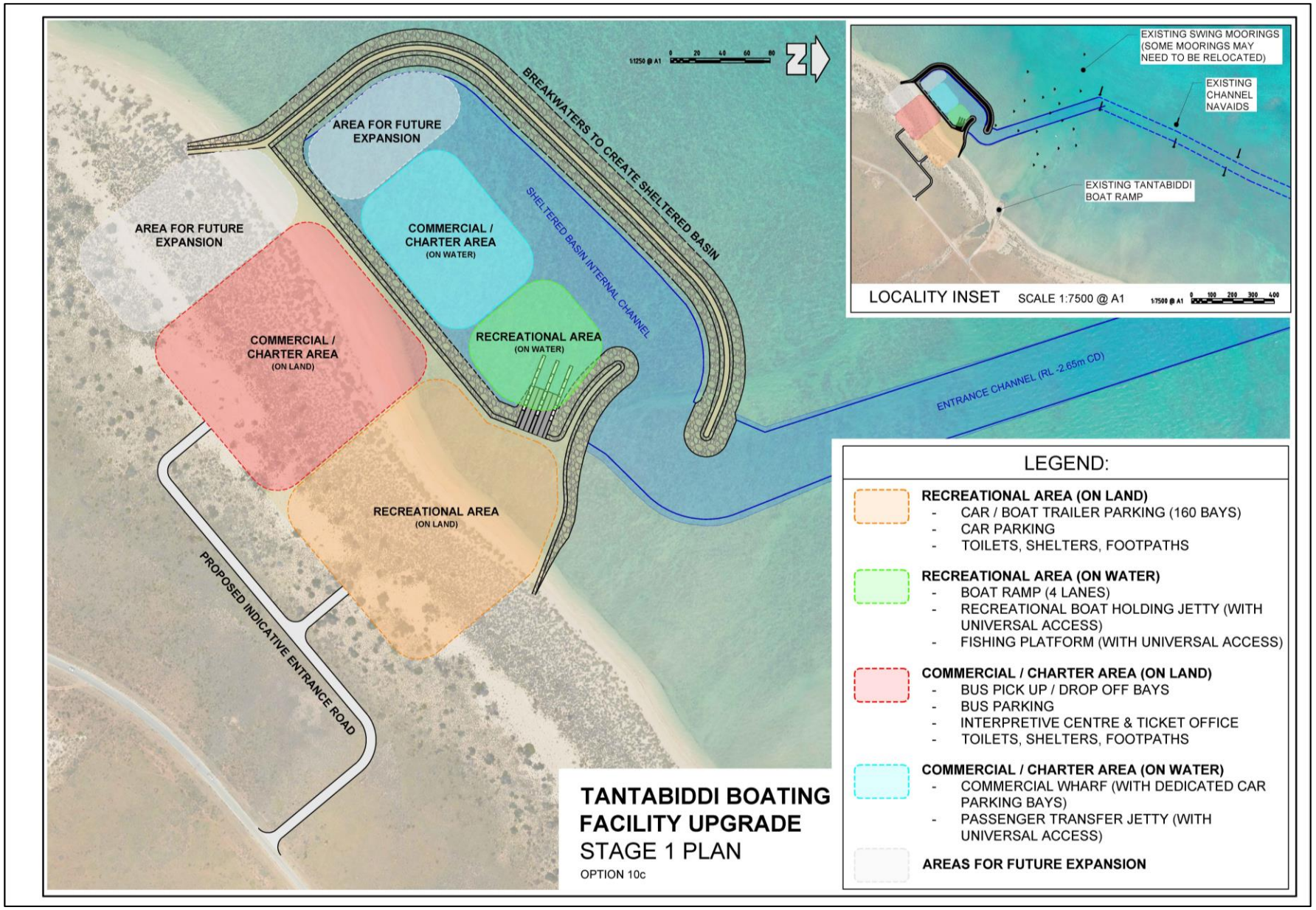


Figure 1-2 Draft concept layout – Option 10C (DoT, 2021)

2 Site and Project Description

2.1 Site Setting and Project Details

The proposed Tantabiddi Boating Facility is located on the North West Cape of WA, within the SoE, Ningaloo Coast World Heritage Area, Ningaloo Marine Park (State Waters), Ningaloo Coast National Heritage Area and Jurabi Coastal Park (**Figure 1-1**). The project area is under joint management, shared by the SoE and DBCA.

The existing boat ramp, built prior to 1985 and then upgraded in 1987 by the SoE, provides access for recreational and commercial/tourism vessels to the Indian Ocean and Ningaloo Reef. Accessible via Yardie Creek Road, the facilities associated with the current boat ramp include:

- 2 boat launching and retrieval ramps and finger jetties;
- Charter bus, car and trailer carpark; and
- Publicly accessible ablution block.

The preferred concept plan for the proposed boating facility includes:

- A safe harbour formed by two rock-armoured breakwaters connected to the land, with a protected entrance channel at the northern side;
- Six boat ramp lanes with adjacent finger jetties;
- Maritime infrastructure including a service wharf and passenger loading jetty;
- Dredging of up to130,000 m^3 for the facility's access channel and internal basin, to a depth of -2.65 m CD;
- Dredged material is proposed to be reused in the new facility, as fill for land reclamation and breakwater fill. Surplus material is proposed to be disposed onshore, as land fill or for use in other projects;
- Designated commercial (≈ 90) and public (≈ 280) parking bays for cars, buses and trailers; and
- New access/entrance road connecting to Yardie Creek Road.

2.2 Surrounding Land Use

Existing land uses in the vicinity of the project are those associated with the existing boating facility, which are the same as those that will be associated with the new facility. Noting that the existing facility is located approximately 300 m south west of the proposed facility, these existing uses are listed in the following sub-sections.

2.2.1 Marine Uses

- Recreational and commercial boat launching and retrieval;
- Public and private swing moorings;
- Charter vessel loading and unloading (passengers and equipment); and
- Recreational activities: boating, kayaking, swimming, snorkelling (Tantabiddi Sanctuary Zone) and fishing.

2.2.2 Terrestrial Uses

- Commercial and recreational parking for cars, buses and trailers;
- Public ablutions;
- Road and minor drainage infrastructure; and
- Recreational activities: viewing and beach walking.

2.3 Site Characteristics

The natural characteristics of the proposed project site, including topography/bathymetry, geology, environmental quality and marine flora and fauna are summarised below in **Table 2-1**.

Table 2-1 Site Identification

Item	Description
Topography and Bathymetry	DoT bathymetric survey data for the Tantabiddi Boat Ramp from survey conducted in 2019 shows the topography of the foreshore adjacent to the boat ramp and proposed project area to be 1 to 4 metres above Australian Height Datum (AHD). The bathymetry of the Proposed project area ranges from approximately 0 m AHD to -3 m AHD with a channel of lower elevation from previous dredging operations evident immediately seaward of the existing boat ramp.
Regional Geology	Regional geological mapping at 1:250,000 scale (Department of Mines, Industry Regulation and Safety 2017), indicates the following: ▪ Immediate offshore area consists of living coral (Ningaloo Reef); ▪ Onshore areas consist of beaches and coastal dunes which are classified as unconsolidated and poorly consolidated quartzose calcarenite, sporadically fringed by calcareous clay, silty sand and intertidal flats; ▪ Immediate landward areas are based upon the Tantabiddi Member (Qbt) made up of calcarenites, calcirudites; and shallow marine and minor eolian coralgal reef deposits; and ▪ The Cape Ridge is based upon the Tulki Limestone (Tk) classified as reddish to yellowish partly clayey foraminiferal calcarenitic packstone; shallow marine.
Local Geology	Marine geotechnical investigations were undertaken at the proposed project site in 2021 by CMW Geosciences. The borehole data suggests that the majority of the marine footprint is rock (Calcarenite or Calcisiltite) with thin, isolated layers of unconsolidated material such as gravel and sand.
Water Quality	Previous water quality monitoring within the Ningaloo Marine Park and at the Exmouth Boat Harbour suggest the water quality at the project site is likely to be high (Cardno, 2014 to 2018). The Leeuwin Current draws warmer water from the north providing optimum reef building temperatures between 23°–29°Celsius (NOAA, 2016) while a low average annual precipitation of 260 mm means there is limited terrestrial runoff. This combined with natural protection provided by the fringing reef and ongoing tidal flushing are likely to maintain good water quality. However, the areas nearby the site can experience high levels of turbidity and sedimentation following infrequent significant rainfall events and discharge of sediment from Tantibiddi Creek (Advisian & Hydrobiology, 2020). It should be noted that the proposed facility has been located sufficient distance from the creek to avoid significant siltation and sedimentation from such runoff.
Sediment Quality	Previous sediment quality investigations of natural sediments within the Ningaloo Marine Park (Cardno, 2014 to 2018) have found the sediment chemistry to be benign, with few contaminants of potential concern occurring at low levels, if not below detectable levels for laboratory analysis.
Acid Sulfate Soils Mapping	The DWER acid Sulfate Soil (ASS) risk mapping indicates that the Tantabiddi foreshore has a “moderate to low” risk of ASS occurring within 3 metres of the natural soil surface.
Regional Benthic Habitats	Ningaloo Marine Park provides diverse assemblages of benthic habitats including inshore, fringing and coral reef systems; mudflats and intertidal mangroves. The area specifically adjacent to Tantabiddi Creek is understood to be dominated by limestone pavement with macroalgae, rubble or sand and areas of hard coral (DoT, 2020).
Regional Marine Fauna	The Ningaloo region is characterised by abundant and diverse populations of fauna finfish, invertebrates, sharks and rays, whale sharks, manta rays, whales and dolphins, turtles and dugongs. The Jurabi Coastal Park is a known nesting area for several marine turtle species (DBCA, 2020).

2.4 Site History

2.4.1 Boat Ramp Infrastructure

Key historical planning, construction and facility upgrades for the existing (nearby) facility were as follows:

- **Prior to 1985** – The original Tantabiddi Boat Ramp was constructed;
- **1987** – Boat ramp upgraded by SoE, having one launch and retrieval ramp (**Figure 2-1**);
- **2004** – Department of Planning and Infrastructure (DPI) designed various options for upgrading the facility, including offshore wave protection structures;
- **2012** – The original boat ramp facility was upgraded to two ramp lanes with additional scour protection, two finger jetties and a larger vehicle turning area, which were designed by URS Australia Pty Ltd (URS) (**Figure 2-1**);
- **2013** – New ablution facilities were constructed and an original fish cleaning station removed;
- **2015** – Maintenance dredging (between 12 June and 22 September – see **Section 2.4.2**) and revetment repair work (between 28 October and 7 November) followed significant weather events in 2014. A total of 271.15 t of armour rock was supplied and placed by Exmouth Quarries during this time (URS, 2016);
- **2018** – MP Rogers and Associates (MRA) investigated the existing facility and concept designed upgrades to accommodate increased usage and include additional ramps, finger jetties, commercial loading jetty and breakwater protection; and
- **2020** – The Tantabiddi Taskforce (DBCA, DoT, DPIR, SoE, Tourism WA) supported the redevelopment of the Tantabiddi Boating Facility at a location approximately 300 m south of the existing facility to avoid the increased sedimentation associated with Tantabiddi Creek and its sediment transport behaviour under flood conditions.

Figure 2-1 Aerial Photographs of the original facility (left) and the facility following 2012 upgrade (right).

2.4.2 Dredging

Due to longshore sediment transport processes and terrestrial runoff depositing sediment on, and seaward of, the existing boat ramp, several maintenance dredging/excavation campaigns have been required for the facility since approximately 2011, to ensure adequate depth for the safe navigation of vessels.

Small excavation campaigns are coordinated by SoE and are generally undertaken by long reach excavator, removing sediment from the base of the ramp and nearshore access channel, depositing it on Tantabiddi Beach to the north of the carpark. Such maintenance may be required annually or multiple times per year (URS, 2016). For offshore areas that cannot be accessed by land-based plant, dredgers have been employed as part of some maintenance campaigns.

The largest dredging campaign was required following a significant runoff event in April 2014, which caused Tantabiddi Creek to flood and deposit large volumes of sediment, cobbles and rubble (Advisian, 2020). A combined effort of long reach excavator and small dredger removed up to 5,600 m^3 of material, which was placed on the beach immediately north of the boat ramp (URS, 2016). The timing (and volume if recorded) of known dredging campaigns (Advisian, 2020) are listed below:

- **2011** – Minor excavation at base of boat ramp;
- **2015** (June to September) – Dredging at boat ramp base and navigation channel (up to ≈ 5,600 m^3);
- **2017** – Dredging/excavation at boat ramp base and navigation channel;
- **2019** – Dredging/excavation at base of boat ramp and navigation channel;
- **2021** (March) – Excavation at the base of the boat ramp; and
- **2021** (November) – Excavation at base of boat ramp and access channel (≈ 1,000 m^3).

2.5 Previous Investigations

Previous investigations that are relevant to the project and this SAQP are summarised below.

Tantabiddi Creek Hydrology and Geomorphology Study (Advisian & Hydrobiology, 2020)

The primary purpose of this study was to inform siting of the proposed facility to avoid potential siltation and sedimentation from terrestrial runoff discharging from Tantabiddi Creek. For this SAQP, it is useful to inform the areas in the vicinity of the project where marine environmental quality (sediment and water) may be influenced by outflows from the creek.

Tantabiddi Boating Facility – Factual Geotechnical Investigation Report (CMW Geosciences, 2021)

The report presents the results of geotechnical borehole investigations carried out within the project's marine footprint. It is useful for this SAQP in informing the volume and areas of unconsolidated material, where contamination has the potential to be present. The volume of unconsolidated material within the dredge area also dictates the required number of sample sites as per NAGD (see **Section 2.5**).

The fieldwork also returned photographs of the seabed at each borehole location, which have been used to inform an initial understands of the BCH within the project footprint.

Tantabiddi Boating Facility – Coastal Processes Investigations (MRA, ongoing)

The results of coastal processes investigations will be useful in understanding the influence that the proposed facility will have on local hydrodynamic and sediment transport regimes. These processes will indicate the potential impacts of the facility on marine environmental quality, guiding the establishment of baseline monitoring sites.

Tantabiddi Boating Facility Site Selection Report (Teal, Seashore, DoT, 2020)

The report presents the basis for the selection of the preferred site and option for the proposed facility. It provides a high-level summary of existing understanding of the site's environmental quality and characteristics.

Coral Bay Boating Facility – Baseline and Ongoing Marine Environmental Quality Monitoring (various, 2007 to present)

The environmental quality data (baseline and control sites) collected for the facility has regional relevance for the project, given its location within the Ningaloo Reef Marine Park.

Exmouth Boat Harbour and Marina Village Canals – Baseline and Ongoing Marine Environmental Quality Monitoring (various, 1999 to present)

The environmental quality data (baseline and control sites) collected for the facility has regional relevance for the project, given its nearby location within the Exmouth Gulf.

2.6 Contaminated Sites

The proposed location for the project is not a known site of contamination according to the DWER Contaminated Sites online database as either:

- Remediated for restricted use;
- Contamination – restricted use; or
- Contaminated – remediation required.

2.7 Contaminants of Potential Concern

The following activities were outlined as potential contamination sources, extracted from *Contaminated Sites Management Series, Assessment and Management of Contaminated Sites* (2014) by the Department of Water and Environmental Regulation:

- Vessel servicing, building and maintenance; and
- Port/dock/wharf activities (including dredge spoil).

The following CoPC have been identified, based on the above list, and taking a precautionary approach given the sensitivity of the nearby marine environment:

- Metals (Ag, Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Se, Th, U, V & Zn);
- Monocyclic aromatic hydrocarbons (e.g. benzene, toluene, ethyl benzene and xylenes);
- Polycyclic aromatic hydrocarbons (PAH) (e.g. creosote, naphthalene);
- Tributyl tin (TBT) and Dibutyl tin (DBT);
- Organochlorine pesticides (OCPs);
- Organophosphate pesticides (OPPs);
- Total recoverable hydrocarbons (TRH); and
- Potential and actual acid sulfate soils (PASS & ASS).

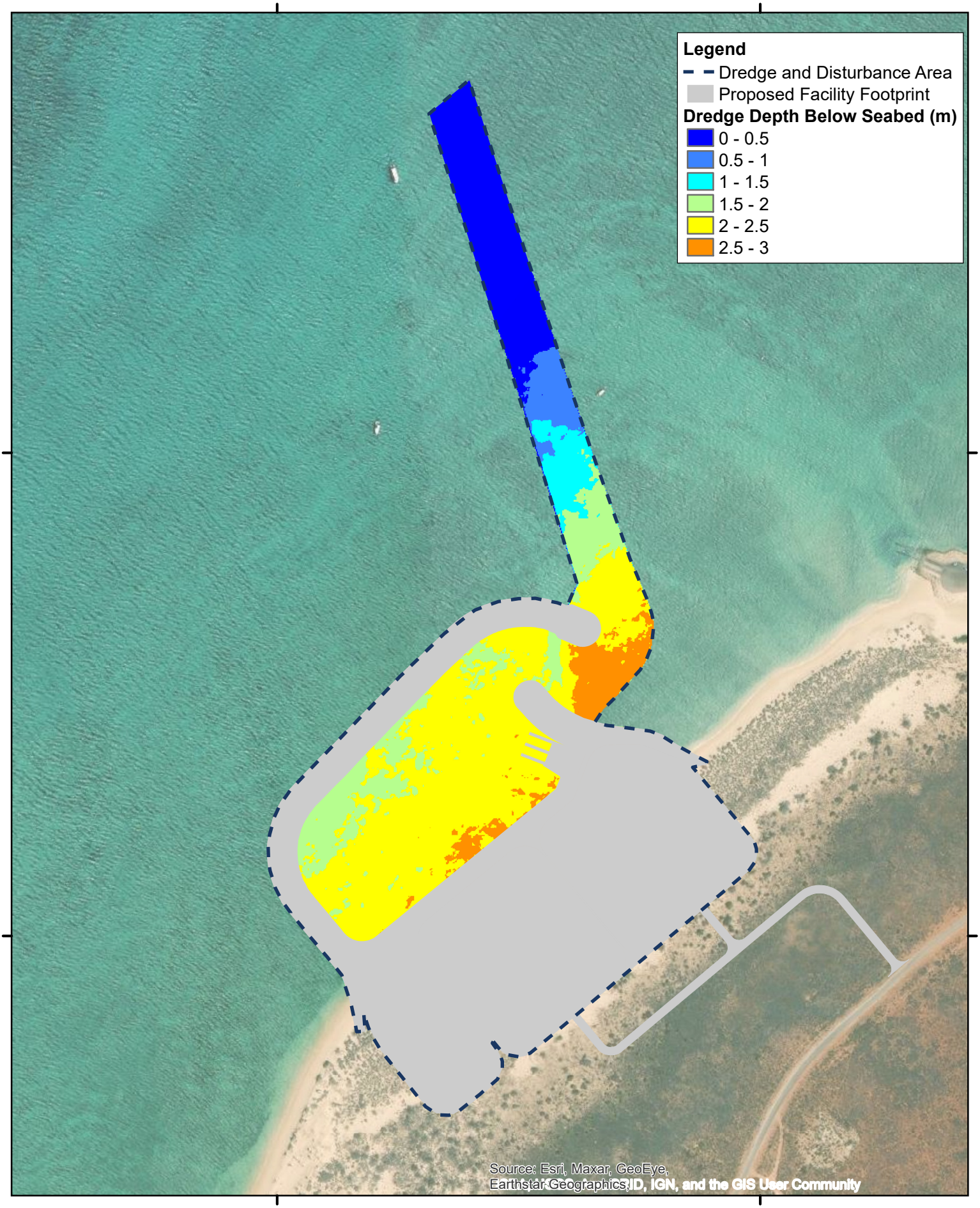
2.8 Proposed Dredge Area

The proposed dredge area, with the depth of dredging below existing surface, has been presented in **Figure 2-2**. The proposed dredge area footprint covers approximately 81,700 m^2. To achieve the proposed design depth of -2.65 m CD, a total volume of 156,050 m^3 would require removal, comprising 107,350 m^3 for the basin and 48,700 m^3 for the channel. If an overdredge allowance of 0.25 m is incorporated, the total volume is 176,500 m^3. While the project is still in the planning stage, it is likely that the material would be removed in a single capital dredging campaign. Based on the outcomes of the geotechnical borehole investigation, it is likely that the activity would require a cutter suction dredge (CSD) or backhoe dredge.

The geotechnical investigation found very little surficial sediment across the project footprint. Of the nine boreholes conducted in the project footprint, only three found sediment at the surface (CMW Geosciences, 2021). This surface sediment can be distinguished from the rock/reef areas in aerial photography. Similarly, soundings carried out by DoT in 2019 across the nearshore area (up to 200m offshore) adjacent the existing boat ramp found rock at the surface at the majority of locations. These findings suggest that limited surficial sediment resides in the nearshore area at the project site. Given the large volume of rock anticipated to be included in the overall dredge volume, the effective volume of material for sediment quality testing (i.e. excluding the volume of “underlying natural geological material”, as per NAGD) has been estimated (conservatively) by assuming a 0.2 m layer of surface sediment across the dredge footprint. This equates to just under 17,000 m^3.

2.9 Proposed Disposal

Assuming chemical and physical suitability of the proposed dredge material, onshore disposal of the majority of the dredge material (≈ 60%) for reclamation within the project area is the preferred method. Any suitable rock material won may be used to construct the breakwaters. Surplus dredge material will be used in other projects or disposed of in landfill.



N

1:5,000 Scale at A4

Meters

0 100

Proposed Dredge and Disturbance Area

FIGURE 2-2

Cardno

Map Produced by Cardno, Perth
Date: 2022-03-24
Coordinate System: GDA 1994 MGA Zone 49
Project: CW1188500
Map: CW1188500_Figure 2-2_Proposed Dredged and Disturbance.mxd 01

3 Sampling and Analysis

3.1 Guidance

All sampling activities will be conducted by Cardno's suitably qualified personnel adhering with site specific safe work method statement (SWMS) and standard operating procedures (SOP). The work will be carried out under a Lawful Authority to collect samples, as approved by DBCA on 29 December 2021, and adhere to all requirements of this permit (included in **Appendix A**). SOP's ensure that samples are collected in a consistent, quality controlled, and safe manner, and follow best practice procedures in accordance with the following standards and guidelines, where relevant:

- *Handbook for Sediment Quality Assessment*. CSIRO, Bangor, NSW. Simpson et al. 2005;
- *National Acid Sulfate Soils Guidance – Guidelines for dredging of acid sulfate soil sediments and associated dredge spoil management*. Commonwealth of Australia, 2018;
- *National Assessment Guidelines for Dredging (NAGD)*. Department of the Environment, Water, Heritage and the Arts, 2009;
- *National Environment Protection (Assessment of Site Contamination) Measure.* National Environmental Protection Council. 1999, as amended 2013 (NEPM 2013);
- *Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)*. Department of Water and Environmental Regulation, 2019;
- *Assessment and Management of Contaminated Sites.* Department of Water and Environmental Regulation, 2014;
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018);
- *Water Quality—Sampling. Part 9: Guidance on sampling from marine waters.* Standards Australia. 1998. AS/NZS 5667.9:1998;
- *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Compounds.* Standards Australia. 1999. AS 4482.2;
- Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016); and
- Environmental Factor Guideline – Benthic Communities and Habitats (EPA, 2016).

Cardno's overall sampling and analysis approach is outlined for each sampling component in the sections below.

3.2 Sediment Quality Sampling and Analysis

3.2.1 Sediment Sampling Locations

The selection of sediment quality sampling locations has been based on the following guidance from NAGD (2009):

- As this is the first intrusive investigation of marine sediments in the proposed dredge area, the material is conservatively considered to be *'probably contaminated'* (pg. 58)*;*
- A total potentially contaminated dredge volume of between 100,000 – 141,000 m^3 requires a total of 19 sampling locations (pg. 59);
- NAGD stipulates that natural geological material should not be included in the total dredging volume when determining the number of sampling locations for assessment of sediment quality. Cardno has conservatively calculated, from preliminary assessment of geotechnical results at the site and assessment of aerial photographs, an unconsolidated material volume of between 10,000 – 17,000 m^3. This requires a total of 7 sampling locations (pg. 59);

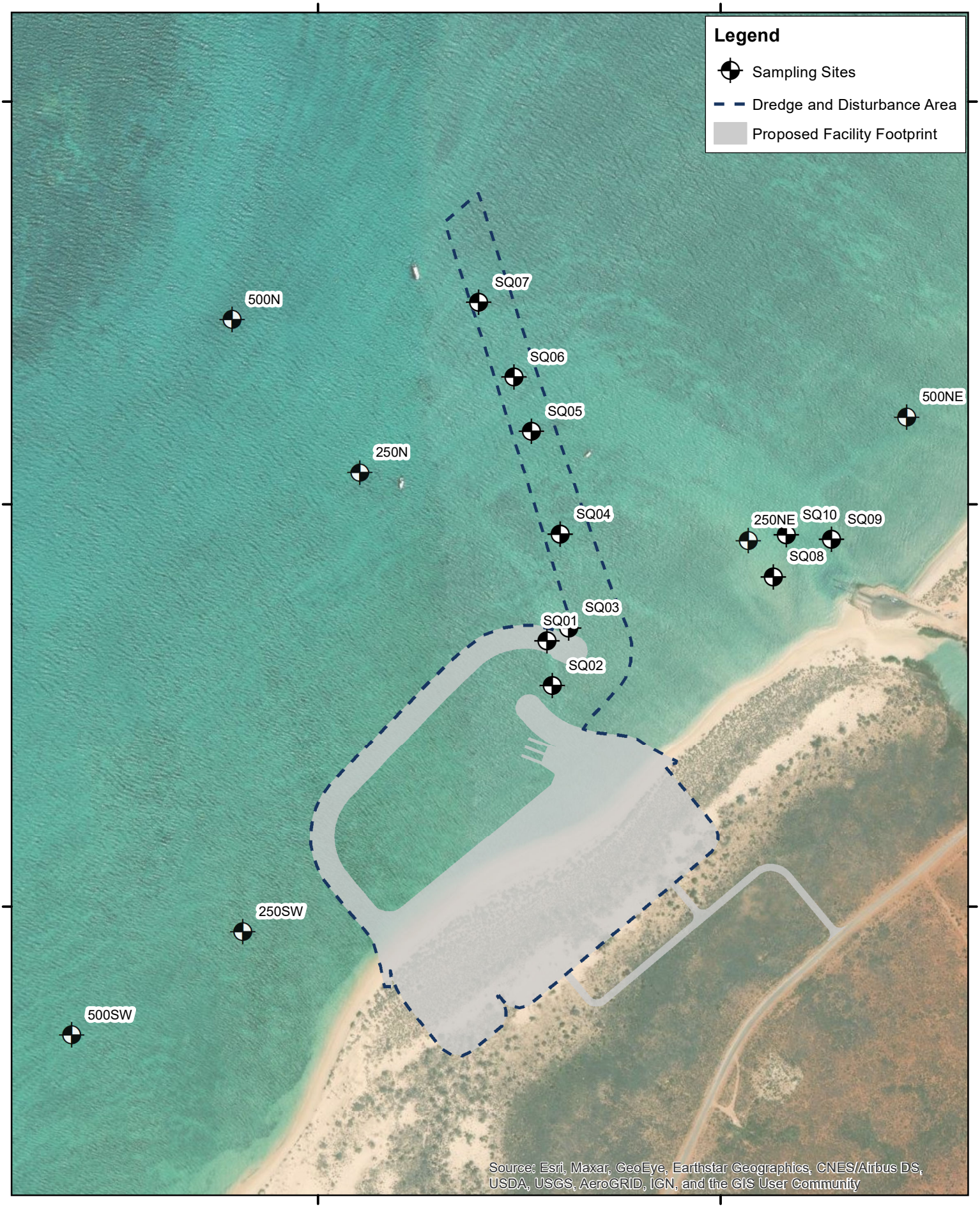
- Specific sample locations have been selected by (pg. 61):
  - Identifying and outlining the areas where surface sediment is present, guided by aerial photographs and geotechnical borehole logs;
  - Considering the depth/volume of sediment and target dredge depth for the distinct areas;
  - Laying a square grid over the distinct dredge areas, sized so that there are at least five times the number of grid squares as the number of sampling locations assigned to each area;
  - The grid squares have been numbered and random numbers used to select the sample locations; and
  - Samples will be collected at the centre of each of the selected grid squares.

Additional sediment quality sample sites have also been proposed to establish baseline sediment quality at potential future ongoing monitoring sites for the facility. These have been nominally located 250 and 500 metres offshore and alongshore either side from the proposed facility.

The proposed sediment sample site details are presented in **Table 3-1** and depicted in **Figure 3-1**.

Table 3-1 Sediment quality sampling site details (GDA2020)

Site	Description	Easting	Northing	Water Depth (m CD)	Dredge Depth Below Seabed (m)
SQ1	Dredge sample site 1	807284	7573830	0.87	1.78
SQ2	Dredge sample site 2	807291	7573774	0.84	1.83
SQ3	Dredge sample site 3	807311	7573846	0.66	1.95
SQ4	Dredge sample site 4	8073001	7573963	1.22	1.42
SQ5	Dredge sample site 5	807265	7574090	2.16	0.45
SQ6	Dredge sample site 6	807244	7574158	2.37	0.28
SQ7	Dredge sample site 7	807199	7574251	2.41	0.30
SQ8	Existing boat ramp sample site 1	807565	7573910	0.56	N/A
SQ9	Existing boat ramp sample site 2	807637	7573956	0.51	N/A
SQ10	Existing boat ramp sample site 3	807582	7573962	0.76	N/A
250SW	Baseline south 1	806907	7573469	0.48	N/A
500SW	Baseline south 2	806694	7573340	0.82	N/A
250N	Baseline north 1	807052	7574039	2.41	N/A
500N	Baseline north 2	806893	7574229	2.92	N/A
250NE	Baseline north east 1	807534	7573955	0.16	N/A
500NE	Baseline north east 2	807731	7574108	0.44	N/A



N

1:6,000 Scale at A4

Meters

0 100

Sediment Quality Sampling Sites

FIGURE 3-1

Cardno

Map Produced by Cardno, Perth
Date: 2022-03-24
Coordinate System: GDA 1994 MGA Zone 49
Project: CW1188500
Map: CW1188500_Figure 3--1_Sediment Quality Sample Sites.mxd 01

3.2.2 Sediment Sampling Methodology

Based on geotechnical borehole data, it is anticipated that unconsolidated seabed layers to be sampled will be relatively thin (0-1 metres). As such, mechanical/hydraulic drilling will not be employed. Cardno will undertake coring by snorkeller/diver. Any diving or snorkelling activities would be planned for and carried out under Cardno's diving system, certified to AS/NZS2299.1.

Sample collection will be undertaken as per NAGD, ANZG (2018) and Simpson et al. (2013). The specific sampling details are provided in **Table 3-2**. See also the analytical schedule (**Appendix B**).

Table 3-2 Sediment quality sampling details

Item	Details
Sample Sites	A total of sixteen (16) sites will be sampled across the project area. Seven (7) sites have been selected as per the methodology outlined in NAGD within the dredge footprint. Six (6) sites have been located around the facility as baseline for future monitoring sites. Three (3) sites will be sampled at the existing boat ramp to characterise sediment quality associated with the facility. Exact coordinates of each sample site will be recorded by GPS upon collection.
Sampling Method	Sampling to be undertaken by trained, experienced staff to ensure that the correct procedures are followed and documented. *Coring by snorkeller or diver (depth and location dependant) from small vessel* Sediment samples from each core will be collected over 0.5 m intervals, from the surface, i.e., 0-0.5 m, 0.5-1.0 m, 1.0-1.5 m until target depth or refusal (as per NAGD). It is expected that the majority of cores will be less than 0.5m. Core tubes will be clear polycarbonate, 50mm diameter.
Field Sample Documentation	Field records include the following information: ▪ Sampling time, date and name of the sampler ▪ Weather conditions ▪ Sample collection method ▪ Sample photographs/core logs ▪ GPS point reference of coordinates ▪ Sampling equipment decontamination procedures where non-disposable sampling equipment is utilised; All sample documentation including field notes/logs, reporting records, COC and equipment calibration certificates and procedures are retained within project files.
Sample Preservation and Holding Times	Samples will be collected and placed directly into appropriately labelled and preserved laboratory supplied jars/containers and chilled (esky/refrigerator) until delivery to the laboratory, under Chain of Custody documentation. Sample containers, preservation procedures, sample storage requirements and holding times will be undertaken in accordance with those recommended by Standards Australia (AS/NZS 5667.1:1998 and AS 4482.1 as appropriate). Volatiles (such as BTEXN) will be sampled in accordance with the NAGD and AS4482.2 1999 – noting that volatiles cannot be mixed. All samples to be labelled with an indelible marker pen on water resistant labels attached to the sample jars/bags.
Decontamination Procedures	Vessel plant to be washed down and inspected before work. Surfaces to be covered by plastic sheeting for sample preparation. Core tubes to be rinsed with dilute acid, deionised water and a suitable solvent. Disposable, powder-free gloves to be used when taking samples and changed after each sample. Sample mixing bowls and apparatus to be decontaminated between each sample.
Laboratory Testing	Sediment samples will be submitted to a NATA accredited laboratory for the following analysis. ▪ Particle size distribution (PSD)

Item	Details
	▪ Total Metals – Aluminium, Antimony, Arsenic, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thorium, Uranium, Vanadium and Zinc ▪ Total Organic Carbon (TOC) ▪ Nutrients – NH_3, NO_2, NO_3, NO_X, Total Kjeldahl Nitrogen (TKN), Total Nitrogen (TN), Total Phosphorous (TP) and Reactive Phosphorous (RP) ▪ Total recoverable hydrocarbons (TRH) ▪ Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene (BTEXN) ▪ Organotins – Monobutyltin, Dibutyltin (DBT) and TBT ▪ Ultra-trace Polycyclic Aromatic Hydrocarbons (PAHs) ▪ Ultra-trace Organochlorine (OC) / Organophosphate (OP) Pesticides ▪ Acid Sulfate Soil testing - Suspension Peroxide Oxidation Combined Acidity and Sulphur method (SPOCAS)
Laboratory testing – quality control	Quality control procedures to be followed in accordance with guidelines for sampling presented in the Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds Australian Standard (AS4482.1-2005). Standard laboratory QA/QC procedures. Duplicate, split and triplicate sampling as required by NAGD.
Laboratory accreditation	All laboratory analysis to be carried out by NATA accredited facilities.

3.2.3 Assessment Criteria

3.2.3.1 National Environment Protection (Assessment of Site Contamination) Measure

To assess the suitability of dredged material for project reuse/reclamation purposes (should this be desired), sediment chemistry results will be assessed with respect to the *National Environment Protection (Assessment of Site Contamination) Measure.* Specifically:

> Schedule B1 Guideline on Investigation Levels for Soils and Groundwater (NEPM 2013), specifically:
  - Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for areas of ecological significance; and
  - Health Investigation Levels (HILs) for recreational (HIL-C) and commercial (HIL-D).
> Health Screening Levels (HSLs) for Petroleum Hydrocarbons in Soils and Groundwater (CRC CARE 2011), specifically:
  - Soil vapour HSLs for recreational (HSL-C) and commercial (HSL-D);
  - Groundwater HSLs for recreational (HSL-C) and commercial (HSL-D); and
  - Soil HSLs for direct contact, for recreational (HSL-C) and commercial (HSL-D).

The 95% UCL of sediment sample results within the dredge area is used to determine compliance with the Screening Levels.

3.2.3.2 National Acid Sulfate Soils Guidance

As dredged sediment will be exposed to oxygen when brought onshore, there is potential for it to become acid producing. The results of SPOCAS testing will be assessed with respect to the *Guidelines for dredging of acid sulfate soil sediments and associated dredge spoil management* (Commonwealth Government, 2018) to identify any areas of potential or actual acid sulfate soils (PASS or ASS).

3.2.3.3 Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)

Dredged sediment may be required to be disposed to landfill and, as such, testing results will be compared contaminant threshold values prescribed in the *Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)* (DWER, 2019). This will allow the material to be classified for waste disposal.

3.2.3.4 National Assessment Guidelines for Dredging

As unconsolidated sediment will be disturbed in the marine environment during its extraction, it is recommended that sediment sample results are also compared to the following guidelines, as per NAGD:

- National Assessment Guidelines for Dredging (2009):
  - Sediment Quality Screening Levels (ISQG-Low values).
- ANZG - Guidelines for Fresh and Marine Water Quality (2018):
  - Interim Sediment Quality Guidelines – High (ISQG-High).

The 95% UCL of sediment sample results within the dredge area is used to determine compliance with the Screening Levels.

Rock material won by dredging for the project may be suitable for use as breakwater core or armour material. This natural geological material does not require testing, as per NAGD.

3.3 Marine Water Quality Sampling and Analysis

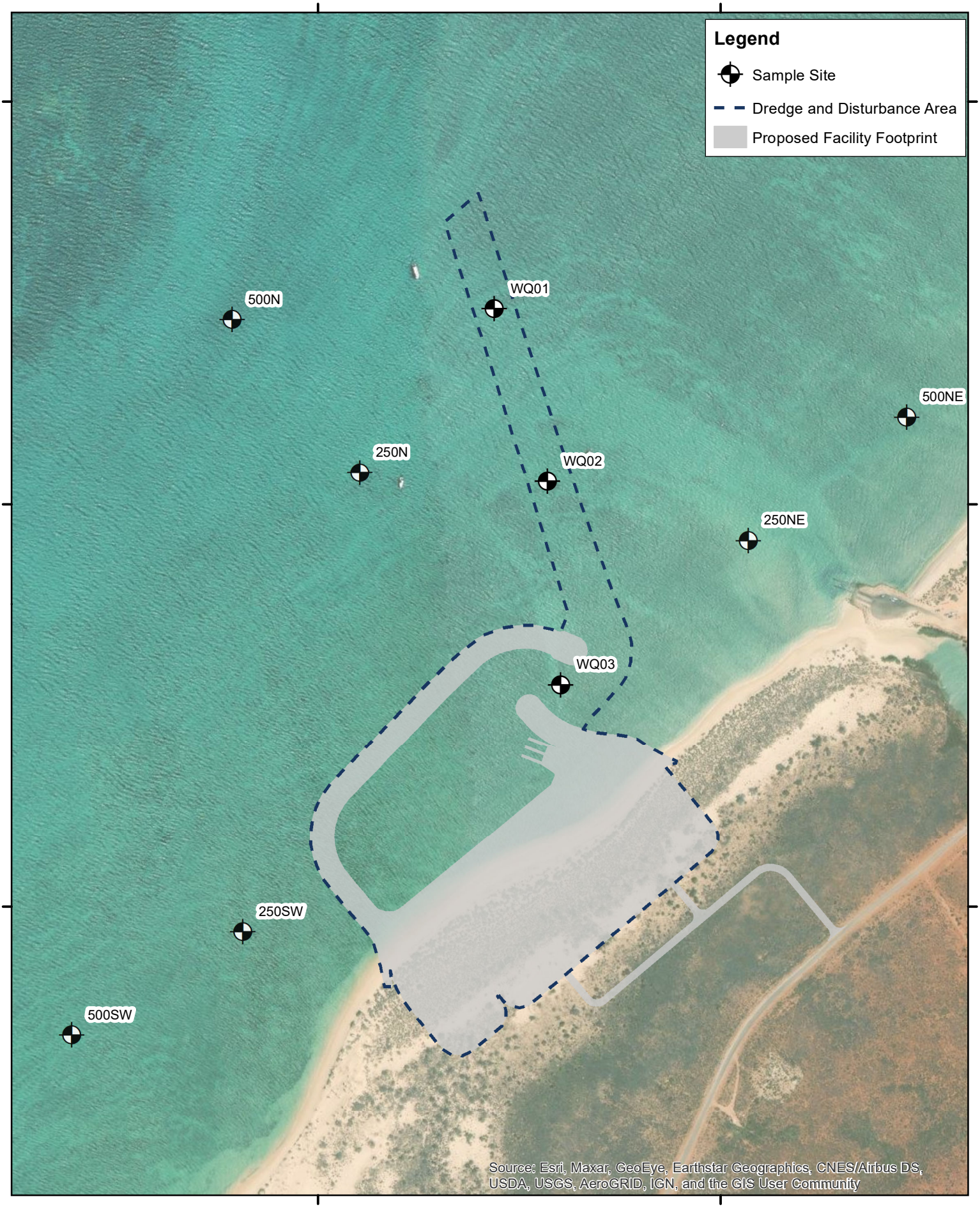
3.3.1 Marine Water Quality Sampling Locations

Water quality sampling locations have been proposed at the project site and at potential future ongoing monitoring sites for the facility, so that the sampling contributes to the establishment of baseline water quality conditions. It is expected that compliance water quality monitoring for the facility may include monitoring inside the harbour and at locations adjacent the facility. These have been nominally located at the channel, entrance, basin and 250 and 500 metres offshore and alongshore either side of the proposed facility (co-located with control sediment quality sites). The sampling locations will also be useful baseline locations for likely dredging and construction monitoring (e.g. turbidity).

The proposed water quality sample site details are presented in **Table 3-3** and depicted in **Figure 3-2**.

Table 3-3 Water quality sampling site details (GDA2020)

Site	Description	Easting	Northing	Depth (m CD)
WQ01	Monitoring site 1	807219	7574243	1.85
WQ02	Monitoring site 2	807285	7574029	1.67
WQ03	Monitoring site 3	807301	75737756	0.24
250SW	Baseline south 1	806907	7573469	0.48
500SW	Baseline south 2	806694	7573340	0.82
250N	Baseline north 1	807052	7574039	2.41
500N	Baseline north 2	806893	7574229	2.92
250NE	Baseline north east 1	807534	7573955	0.16
500NE	Baseline north east 2	807731	7574108	0.44



N

1:6,000 Scale at A4

Meters

0 100

Water Quality Sampling Sites

FIGURE 3-2

Cardno

Map Produced by Cardno, Perth
Date: 2022-03-24
Coordinate System: GDA 1994 MGA Zone 49
Project: CW1188500
Map: CW1188500_Figure 3-2_Water Quality Sample Sites.mxd 01

3.3.2 Marine Water Sampling Methodology

Marine water sampling will be carried out in line with the aforementioned industry standards and guidelines. Cardno's specific approach is outlined in **Table 3-4**. See also the analytical schedule (**Appendix C**).

Table 3-4 Water quality sampling details

Item	Details
Sample Sites	Nine (9) sites will be sampled, nominally located 250 and 500 metres offshore and alongshore either side of the proposed facility. Exact coordinates of each sample site will be recorded by GPS upon collection.
Sampling Method	Sampling to be undertaken by trained, experienced staff to ensure that the correct procedures are followed and documented. Depth integrated water samples will be collected from the vessel using a 12-volt submersible pump, attached to a clear PVC hose. The full water sample will be collected into a PVC bucket, which will be mixed then poured into laboratory supplied plastic bottles. Water quality profiling will be conducted through the water column by a YSI ProDSS multi-parameter water quality instrument. Profiling will proceed at a rate of 0.5 m/s on both upcast and downcast, with three profiles at each site.
Field Sample Documentation	Field records include the following information: ▪ Sampling time, date and name of the sampler ▪ Weather conditions ▪ Sample collection method ▪ GPS point reference or coordinates ▪ Sampling equipment decontamination procedures where non-disposable sampling equipment is utilised; All sample documentation including field notes, reporting records, COC and equipment calibration certificates and procedures are retained within project files.
Water Aesthetics & Field Parameters	During water sample collection, an aesthetic assessment of water quality will also be made. This included noting any surface films, colour variation, odours, floating debris, dead marine organisms or plant material in the vicinity of each sampling site. Field parameters [including pH, salinity, turbidity, dissolved oxygen (DO) and temperature] are recorded by profiling with three replicate profiles collected at each site.
Sample Filtration	Samples collected for dissolved heavy metal analysis are filtered in the field using an in-line 0.45 micron (µm) filter to remove suspended solids and colloids.
Sample Preservation and Holding Times	Samples are collected directly into appropriately labelled and preserved laboratory supplied bottles and packed in chilled containers for delivery to the laboratory under Chain of Custody documentation. Sample containers, preservation procedures, sample storage requirements and holding times are undertaken in accordance with those recommended by Standards Australia (AS/NZS 5667.1:1998 and AS 4482.1 as appropriate). All holding times comply with the requirements set out in "Australian Standard AS/NZS 5567.1:1998 and AS 4482.1".
Decontamination Procedures	Vessel plant to be washed down and inspected before work. All non-disposable equipment is thoroughly washed with detergent (Decon 90), then double rinsed with clean water and dried before the collection of each sample.
Laboratory Testing	Sediment samples will be submitted to a NATA accredited laboratory for the following analysis. ▪ Total suspended solids (TSS) ▪ Total Metals – Aluminium, Antimony, Arsenic, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thorium, Uranium, Vanadium and Zinc

Item	Details
	▪ TBT (as Sn) ▪ TOC ▪ Nutrients – NH_3, NO_2, NO_3, TKN, TN, NO_x, RP ▪ Major Ions – CO_3, SO_4, HCO_3, Cl, Ca, Na ▪ TRH ▪ BTEXN ▪ PAHs ▪ Microbial Indicators - Enterococci, Thermotolerant coliforms
Laboratory testing – quality control	Two replicate water quality samples will be obtained at each location, in accordance to AS/NZS 5667.1:1998. Exact data quality objectives are provided in **Table 3-4**.
Laboratory accreditation	All laboratory analysis to be carried out by NATA accredited facilities.

3.3.3 Assessment Criteria

The Australian and New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality (2018) Default guidelines values (DGVs, previously known as trigger values) for protection of 95% of marine ecosystems have been adopted to inform the assessment of analytical results. 90% and 99% DGVs will also be included for comparison.

Microbiological results will be compared to the ANZECC & ARMCANZ (2000) guidelines for primary and secondary contact recreation.

3.4 Data Quality Objectives and Management

In addition to the quality control and assurance procedures outlined in the above sections, the below chemistry data quality objectives will be adhered to with respect to sediment and water sampling and analysis. Outliers and extremes, if present will be identified, discussed and excluded from discussions regarding contamination.

Table 3-1 Sampling QA/QC Indicators

Item	Frequency	Description
Field duplicate and triplicate samples	Intra-laboratory at 1 per 10 primary samples Inter-laboratory at 1 per 20 primary samples	Samples collected analysed for the same analytes as the primary samples < 50% relative percentage difference (RPD)
Trip Blanks	One per event	< Limit of reporting (LOR) for blanks
Rinsate blank samples	One per event requiring re-usable equipment)	< LOR for blanks
Sample Volume, Preservation and Holding Times	All samples	Sample containers, preservation procedures, sample storage requirements and holding times are undertaken in accordance with those recommended by Standards Australia (AS/NZS 5667.1:1998 and AS 4482.1 as appropriate). All holding times comply with the requirements set out in “Australian Standard AS/NZS 5567.1:1998 and AS 4482.1”.
Chain of Custody (CoC)	All samples	Samples are collected directly in into appropriately labelled and preserved laboratory supplied bottles and packed in chilled containers for delivery to the laboratory under Chain of Custody documentation.
Complete SAQP objective met	All samples	Minimum 95% of all data on submitted samples validated as suitable for use
Analysis Methods	All samples	All samples to be subsampled, extracted/ digested & analysed at NATA-accredited laboratory (ALS, NATA accreditation No. 825).

Item	Frequency	Description
		Methods adhere to adopted trigger levels and assessment criteria
Laboratory duplicates	1 per batch and per 20 samples	<5 x LOR = no limit on RPD >5 x LOR = 0-30% RPD
Matrix outliers	1 per batch and per 20 samples	Recovery of 70-130% for inorganics/metals, 60-140% for organics, or as per lab requirement RPDs for duplicates should be less than 30%
LOR	All samples	LORs are consistent between laboratories and batches and for all analytes.
Calibration	Annual	Water quality instrument/probes (YSI ProDSS) to have been factory calibrated within the past 12 months, with certificate(s) reported.

3.5 Benthic Communities and Habitats Confirmation Sampling

Benthic communities and habitats (BCH) confirmation will be carried out based on the project footprint and potential zone of influence of dredging activities and conform to the *Technical Guidance – Protection of Benthic Communities and Habitats* (EPA, 2016a) and the *Environmental Factor Guideline – Benthic Communities and Habitats* (EPA, 2016b).

3.5.1 Proposed Sampling Locations

To dictate sampling areas for BCH, a presumptive benthic habitat map has been prepared for the project's Local Assessment Unit (LAU) (**Figure 3-3**).

3.5.1.1 Local Assessment Unit

The LAU has been defined based on the guidance in EPA (2016a). A minimum 50 km^2 LAU area has been defined, generally extending from the shoreline to the edge of the reef flat offshore, and extending either side of the proposed facility for a total alongshore extent of approximately 12 km. The offshore extent (edge of the reef flat) has been defined so that any potential impact or loss associated with the project can be measured with respect to the adjacent coverage of comparable BCH (e.g. shallow reef and associated assemblages). Beyond the edge of the reef flat (forereef), the bathymetry deepens rapidly and benthic communities are likely to be distinct. There are not expected to be dredging dispersion impacts beyond the edge of the reef flat along the majority of the LAU due to the reef's hydrodynamic regime, as discussed further below.

A portion of LAU has been included beyond the outer reef edge, where a gap in the reef exists. The hydrodynamics of Ningaloo Reef are such that waves break over the outer reef, creating elevated water levels inside the reef lagoon. The difference in water level (pressure gradient) then drives circulation currents, flushing water out of intermittent gaps in the outer reef (Strickland, 2010). Such a reef gap and circulation pattern are present offshore of the proposed facility. The adjacent flows may transport sediment plumes associated with dredging for the project through the reef gap (subject to further investigation - see **Section 3.5.1.2**). The gap in the reef is also the main accessway for recreational and commercial vessels using the existing facility, and that will make use of the new facility. As impacts have the potential to occur beyond the reef flat in this area, and sensitive biota may be present, it is considered important to understand the associated BCH. The extent of the LAU offshore at this reef gap has generally been limited to the 50-60m depth contour. Below this depth, light attenuation is such that there is very unlikely to be sensitive receptors (corals and seagrasses) present.

BCH sample sites have been proposed within the LAU using a minimum 500 m x 500 m resolution throughout. A higher resolution of sample sites (250 m x 250 m) has been proposed for the project's preliminary Zone of Influence (ZoI) (see **Section 3.5.1.2**) and within the project footprint (100 m x 100 m).

3.5.1.2 Project Zone of Influence

While the potential direct project footprint of the project is understood at this stage, the project's marine ZoI has not yet been predicted. This will generally be defined by the extents of dredge plume dispersion (suspended sediment and sediment deposition) and the longer-term effect of changes to coastal processes

on local geomorphology. At this stage, a conservative area has been defined around the project site that is likely to contain the ZoI. This area has been approximated based on investigations and observations at other locations, where similar geology, bathymetry, dredging techniques/volumes and hydrodynamic regime exist. The area has been defined conservatively to ensure the actual ZoI, once modelled, is contained within the area. The purpose of defining this area is for increased sampling resolution, to improve the accuracy of BCH mapping where impact of the project is most likely to occur.

3.5.1.3 Presumptive Benthic Habitat Map

No existing, recent BCH survey data is understood to exist within the defined LAU. Cardno have made initial estimates of percentage reef coverage throughout the LAU, by interpreting high resolution aerial imagery. Seabed photographs collected during the geotechnical campaign (CMW Geosciences, 2021) have also been reviewed to ground truth assumptions of coverage within the project footprint. The mapping is preliminary and is based on the relative tone of the imagery when converted to greyscale (white being 0% and black being 100%). The mapping will be improved, in terms of accuracy and more broad BCH classifications, once field sampling has been undertaken (see **Section 3.5.4**).

3.5.2 Sampling Equipment

High definition video and photographic imagery of the seabed will be captured using a FiFish V6 ROV to verify benthic composition at each predetermined sampling location. The FiFish V6 is a compact-sized OMNI-directional ROV equipped with 4K UHD camera which supports a 166° field of view. For intertidal or nearshore areas that cannot be accessed by vessel, a high-resolution, underwater digital camera will be used.

3.5.3 Sampling Methodology

Each predetermined sampling location will be navigated to by the vessel with GPS accurate to < 5m to ensure sufficient precision. Once the vessel is in position the ROV – still tethered to the controls and live feed – will descend to 1m above the seabed allowing the operator to confirm the extent and distribution of habitat. This will also allow a still image to be extracted from video for quantitative analysis. At each sampling location Cardno's field staff will review video in real time and record general observed habitat classifications and substrate.

At each site, following capture of the seabed still, the ROV will move to 3 metres above the bed (depth permitting) and undertake a 10m longitudinal and 10m latitudinal transect with camera angled at 45 degrees. This will allow qualitative assessment and identification of each area with greater spatial resolution. This will improve the potential to identify any important habitats or species. Any incidental fauna, including epifauna and infauna, would also be recorded during the survey.

For nearshore and intertidal areas that are too shallow to access by vessel, the same data collection techniques (seabed quadrat and transects) will be undertaken by snorkeller using a high-resolution digital camera. The sites will be accessed from shore and located by handheld GPS.

3.5.4 Data Processing

Video footage collected at each sampling point will be reviewed and a single representative (of the overall transect) snapshot will be extracted for analysis by an experience marine scientist. Each snapshot/sample site will be classified for BCH as per the guidance of Seamap Australia (Butler et al, 2017). This includes classifying each location for its:

- Aquatic setting:
  - Nearshore;
  - Offshore;
  - Intertidal; and
  - Subtidal;
- Substratum component:
  - Consolidated hard substrata;

- Unconsolidated hard substrata;
- Mixed hard substrata;
- Coarse sediments;
- Fine sediments; and
- Mixed soft substrata;

> Biotic component:

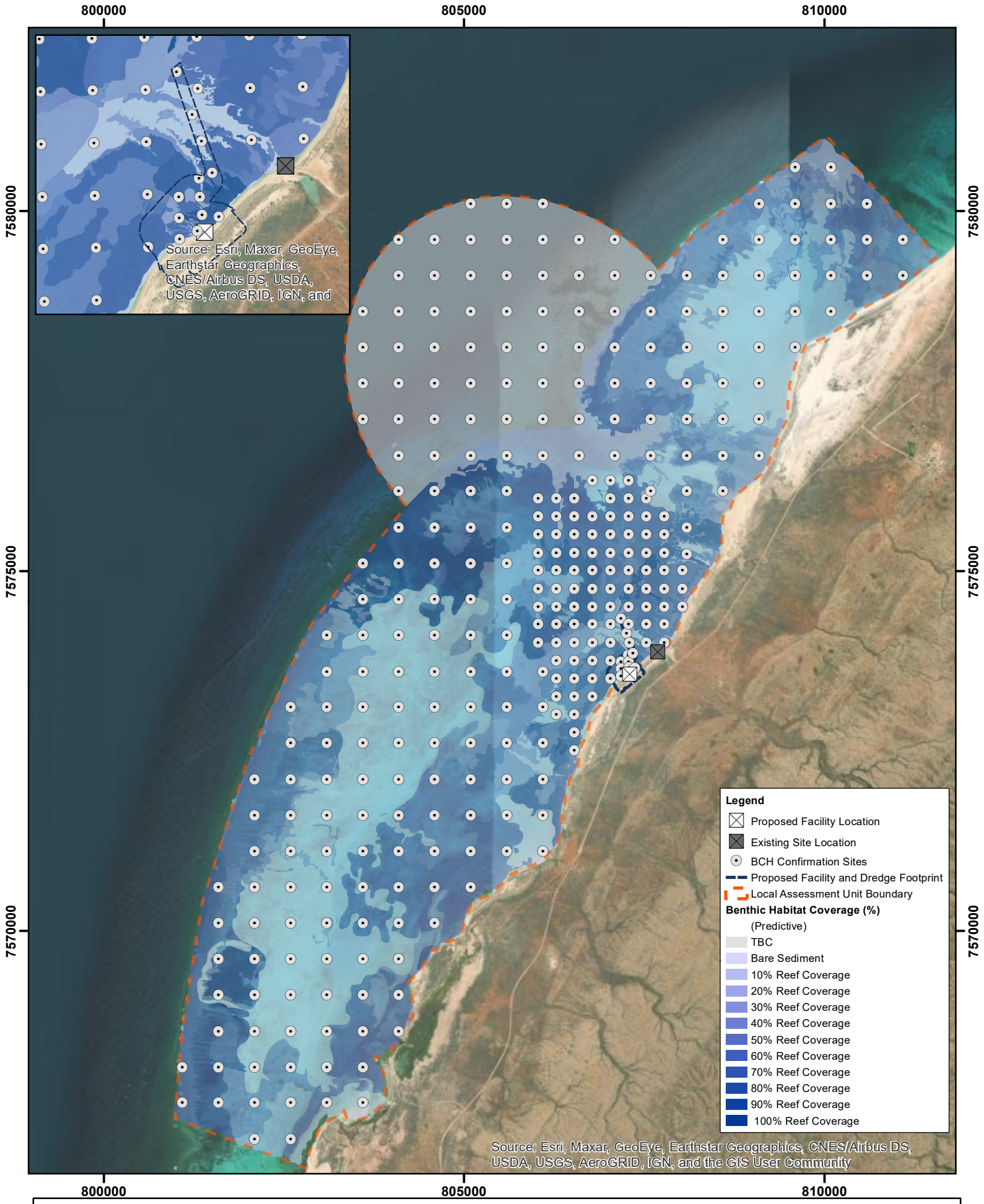
- Non-coral Cnidaria;
- Coral biota;
- Worm biota;
- Bryozoans;
- Sponges;
- Ascidians;
- Mixed filter feeder community;
- Oyster;
- Mussel;
- Screwshell biota;
- Other shelled biota;
- Mixed shelled biota;
- Macroalgae;
- Seagrass;
- Mixed macrophytes;
- Mangrove;
- Saltmarsh; and
- Mixed wetland vegetation.

As part of categorising each habitat category, an estimated density will also be assigned to each biotic classification, where present, estimated to the nearest 10%.

Transect video footage will be reviewed to carry out an absence/presence assessment of benthic communities and habitats, from a qualitative perspective, in the vicinity of each assessment location. Photographs of any critical habitat or species will be extracted, identified and reported on.

Once classified, the location and classification of each sample site will be loaded into ArcMap. The benthic habitat classifications will be used to improve the BCH map for the LAU. Available bathymetry data and aerial imagery will be interpreted to define BCH in the unsurveyed areas amongst sample sites. Effectively, connected areas of consistent bathymetry (or roughness if data has sufficient resolution) and appearance (tone) in aerial imagery will be assigned the same BCH as the connected sample site, for BCH categories where this assumption is considered appropriate. It is likely to be appropriate when assigning the sub-stratum. The variability of biotic components within each video transect will be assessed to determine how appropriate extrapolation is for these. Interpolation between sample sites will also be applied, where deemed appropriate.

The mapping will be executed with a combination of manual interpretation and automated image analysis techniques, given that high resolution seabed bathymetry is not expected to be available throughout the LAU.



N

1:65,000 Scale at A4

Kilometers

0 2

Local Assessment Unit and Benthic Communities and Habitat

FIGURE 3-3

Cardno

Map Produced by Cardno, Perth
Date: 2022-03-24
Coordinate System: GDA 1994 MGA Zone 49
Project: CW1188500
Map: CW1188500_LAU & BCH.mxd 01

4 Health, Safety, Environment and Quality Management

4.1 Quality Assurance and Quality Control

Cardno will provide a documented review of the Quality Assurance (QA) and Quality Control (QC) results for the sampling program. Quality assurance encompasses the actions, procedures, checks and decisions undertaken to ensure the sample integrity and representativeness, and the reliability and accuracy of analysis results. The QA documentation should also include an indication of the Data Quality Objectives sought in relation to each significant action, test or process involved in the assessment.

QC activities measure the effectiveness of the QA procedures by undertaking testing, and then comparing results to previously established objectives. QC work will include the internal laboratory testing as well as results of QC samples submitted such as trip blanks and duplicates. The quality of the information and/or data is deemed satisfactory when the QC results demonstrate that agreed objectives have been met. The review will effectively report, in table format, against each of the objectives in **Section 3.4**. Demonstrated evidence or documentation to confirm whether or not objectives have been met. Conclusions as to the suitability of data for use will then be made.

4.2 Health and Safety Management

A specific safe work method statement (SWMS) has been developed to cover all field activities for the work. The document outlines the job steps, associated risks and risk level, and mitigation measures (**Appendix D**). Daily toolbox meetings will be held before commencing investigation activities. This will re-iterate all job steps and the safety procedures associated with them, as well as identify any new actual or potential risks. Activities that need to be undertaken outside the SWMS are captured in a Job Hazard Analysis (JHA), to be signed off by the field leader.

Field planning is governed by Cardno's Field Trip Plan, which includes details such as call-in procedures and expected weather conditions. Timing of works with respect to forecast conditions is critical to increased safety and the precision of data collection in the field. Flexibility in the schedule so that more exposed sites are targeted for better conditions than those are more protected is also important. Overall and daily field planning will be coordinated by Cardno's experienced marine field staff and the vessel operator. Should adverse weather prevent sampling from occurring, the works will be postponed until suitable conditions return.

Commercial vessel operators are legally responsible to make all possible preparations for severe weather and maintain contact with the harbour master and follow evacuation advice from police and emergency services in the event of severe weather. Cardno staff will monitor marine weather forecasts frequently and follow the safety direction of the Vessel Master at all times. Boat owners are responsible for maintaining their boat and property to survive severe weather and adhere to AMSA's safety management system guidelines.

Where diving becomes required, all diving activities would be planned for and carried out under Cardno's diving system, certified to AS/NZS2299.1 with appropriate dive plans produced and signed off by one of Cardno's diving supervisors.

Should there be issues with plant or equipment, the sampling work will be postponed until the equipment is repaired or replaced. The full site sampling plan and sample set will be achieved.

5 Deliverables

Following the completion of the works as outlined in this Sampling, Analysis and Quality Plan, Cardno will produce a SAQP Implementation Report and a BCH Assessment Report which will include the following:

- *Maine Water and Sediment SAQP Implementation Report:*
  - A description of the sampling carried out, along with the actual sample locations, sample numbers, completed COC forms, field logs and descriptions of the samples, and any problems encountered or deviations from the procedures set out in the SAQP (including justifications for deviations);
  - Presentation and review of the results, including QA/QC assessment of both field and laboratory data, comparison to data quality objectives, and data validation. Presentation of results including a visual presentation of contaminant distribution at depths and across the site. All laboratory and field data will be appended in full;
  - Results and data provided in a suitable digital format for inclusion in long-term database for the facility (e.g. Excel spreadsheet), as per the analytical schedules (**Appendix B** & **C**);
  - An assessment of the results in accordance with NEPM, NAGD and other relevant guidelines;
  - The environmental values and environmental quality objectives (including level of ecological protection) to be achieved; and
  - Conclusions as to the acceptability or unacceptability of the material for reuse during construction, reuse onshore at another location and for disposal to landfill, as well as recommendations as to further assessment required.
- *Benthic Communities & Habitat Mapping and Assessment Reports:*
  - Detailed mapping and description of the marine communities in and around the area and discussion of their sensitivity to physical effects;
  - BHC cumulative loss assessment detailing potential direct and indirect impacts caused to significant marine fauna through habitat removal; construction, vessel and dredge plant activities; increased turbidity and sedimentation; and underwater noise. This will required interpretation with respect to sediment transport modelling; and
  - Conclusions as to the likelihood the project will have significant impact on those communities and species identified.
- *Desktop Marine Fauna Assessment*
  - A desktop assessment will be undertaken to identify the likelihood of listed (EPBC Act) marine fauna being present within the LAU. This will include as assessment of seasonality and the impact of this on presence likelihood (nesting, breeding etc.);
  - The BCH assessment will be used to inform this likelihood assessment, through improved understanding of available habitats types within the LAU; and
  - Potential risks towards listed threatened and priority marine fauna will be highlighted and assessed in line with the *Environmental Factor Guideline – Marine Fauna (EPA, 2016c).*

6 References

Advisian & Hydrobiology (2020) *Tantabiddi Creek Hydrology and Geomorphology Study*. Prepared for DoT, September 2020.

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*

Butler, C., Lucieer, V., Walsh, P., Flukes., E and Johnson, C (2017) *Seamap Australia [Version 1.0] the development of a national benthic marine classification scheme for the Australian continental shelf.* Final Report to the Australian National Data Service (ANDS) High Values Collection #19. Institute for Marine and Antarctic Studies, University of Tasmania. 52 pgs.

CMW Geosciences (2021) *Tantabiddi Boating Facility – Factual Geotechnical Investigation Report*. Draft prepared for DoT, June 2021.

Commonwealth of Australia (2009) *National Assessment Guidelines for Dredging*, Canberra.

Commonwealth of Australia (2018) *National Acid Sulfate Soils Guidance – Guidelines for dredging of acid sulfate soil sediments and associated dredge spoil management*. Department of Agriculture and Water Resources.

DBCA (2020) *Ningaloo Turtle Program Annual Report 2018-2019,* Department of Biodiversity, Conservation and Attractions and the Ningaloo Turtle Program, Exmouth, Western Australia.

Department of Water and Environmental Regulation (2014) *Assessment and Management of Contaminated Sites*. Government of Western Australia.

Department of Water and Environmental Regulation (2019) *Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)*.

DoT (2020) *Tantabiddi Boating Facility Site Selection*, Prepared by Teal Solutions, Seashore Engineering & DoT for DoT and Tantabiddi Agency Working Group.

Environmental Protection Authority (2016a) *Technical Guidance – Protection of Benthic Communities and Habitats*.

Environmental Protection Authority (2016b) *Environmental Factor Guideline – Benthic Communities and Habitats*.

Environmental Protection Authority (2016c) *Environmental Factor Guideline – Marine Fauna*.

M P Rogers & Associates (2018) *Tantabiddi Boat Launching Facility Investigation*. Prepared for Shire of Exmouth, July 2018.

Standards Australia (1998) *Water Quality—Sampling. Part 9: Guidance on sampling from marine waters*. AS/NZS 5667.9:1998.

Strickland, D., R. (2010) *Variations in coral condition within the hydrodynamic regime at Sandy Bay, Ningaloo Reef, Western Australia*. Prepared as partial fulfilment of the Bachelor of Engineering (Environmental) degree at the University of Western Australia. November 2010.

Teal, Seashore & DoT (2020) *Tantabiddi Boating Facility Site Selection Report*. Draft prepared October 2020.

URS (2016) *Tantabiddi Boat Ramp: Sand Bypass Dredging & Revetment Repair – Close Out Report.* Prepared for Shire of Exmouth by URS Australia Pty Ltd. January 2016.

Tantabiddi Boating Facility - Marine Environmental Quality Investigations & Benthic Communities and Habitat Assessment

APPENDIX A

LAWFUL AUTHORITY TO COLLECT SAMPLES

Cardno

now

Stantec

OFFICE USE ONLY

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

PARKS AND WILDLIFE SERVICE

CONSERVATION AND LAND MANAGEMENT REGULATIONS 2002 Regulation 30 and Regulation 35A

LAWFUL AUTHORITY

TO UNDERTAKE WATER AND SEDIMENT SAMPLING ACTIVITIES

This lawful authority is a written notice for the purposes of Regulation 30 and Regulation 35A of the Conservation and Land Management Regulations 2002 (the regulations) and it grants lawful authority to the person named herein as the authority holder to undertake certain activities in the areas specified below, an act that would otherwise be unlawful under the regulations.

This authority is not valid without the signature of the Chief Executive Officer or a delegate of the CEO (Regional or District Manager/Regional Parks Manager) of the Department of Biodiversity, Conservation and Attractions.

The Chief Executive Officer of the Department of Biodiversity, Conservation and Attractions hereby grants to:

Department of Transport (DoT)

lawful authority to take water and to undertake quarrying, removing or disturbing soil etc on Conservation and Land Management Act (1984) Land (CALM Land) as specified below:

Waters to the west, north and south of Tantabiddi Boat Ramp, within Ningaloo Marine Park as outlined in Figure 1

This lawful authority is issued subject to the provisions of the Conservation and Land Management Regulations 2002, the terms and conditions as set out in the next section “Conditions for Approval” and “Other Conditions to be observed” (if applicable).

This lawful authority is valid for the period specified below:

Start date:	**January 3, 2022**	Expiry date:	**February 28, 2022**

*Name: Leah Pearson District Manager	Signed: Date: 31 Dec 2021

*District Manager as a Delegate of the CEO under Section 133(2) of the *Conservation and Land Management Act 1984*

Upon arrival to commence the activities listed above, please report to Sallyann Gudge 9947 8000 or 0484 915 279.

OFFICE USE ONLY

CONDITIONS FOR APPROVAL

This application will need to be consistent with the conditions as outlined below:

1. Lawful Authority is granted to DoT to undertake marine environmental field investigations within waters surrounding Tantabiddi Boat Ramp as identified in Figure 1.
2. This Lawful Authority is subject to relevant consultation and approval from the applicable Native Title Prescribed Body Corporate and/or Joint Management Body.
3. If Aboriginal artefacts or culturally significant sites (confirmed or suspected) are uncovered during ground disturbance, all works must cease and must be immediately reported to the DBCA Exmouth District Office on 99478000.
4. Sediment sampling will be conducted by a diver or snorkeler using a 50mm diameter corer, with a maximum depth of one metre below seabed.
5. Water quality sampling will be conducted from a research vessel using a submersible pump.
6. Benthic communities and habitat mapping will be undertaken with an ROV from a research vessel, that will capture high resolution images and video from above the seabed.
7. All works and operations are to be undertaken in accordance with the guidelines, specifications and management actions of DBCA's Disturbance Assessment System, Approval Number A000622.
8. Contact details of the successful contractor are to be provided to DBCA prior to works commencing.
9. Any changes to the proposal are to be approved by DBCA prior to works commencing.
10. 'Research' banners or similar must be displayed on vessels when working within Ningaloo Marine Park.
11. The Authority holder is responsible for repairing and/or restoring any damage to CALM land or property sustained whilst undertaking activities permitted under this authority as directed by the District Manager.
12. A spill kit suitable for containing any spill contamination must be available onsite at all times. All spills and uncontrolled releases of hydrocarbons to the marine environment will be recorded as an environmental incident and will be reported to DBCA.
13. Incidents involving injuries to wildlife must be immediately reported to the DBCA District Office: Elise Launer 0459 845 123 or Sallyann Gudge 0484 915 279.
14. The Authority holder will be responsible for remediation of any impacts resulting from an environmental incident.

15. All equipment/vessels brought onto approved CALM land via any landings under this Authority must be checked to ensure it is clean and free of plants (including seeds), animals marine pests and soil.
16. No animals (including pets) or plants are to be taken onto approved CALM land via any activity undertaken under this Authority.
17. Vehicles and heavy equipment entering CALM lands must be in good running condition: free of fuel, oil and hydraulic leaks.
18. All rubbish and waste brought onto approved CALM land via any activity approved under this Authority must be removed from CALM land upon departure and disposed of at an appropriate disposal site.

Safety

19. The Authority holder shall manage potential risks to public safety arising from the proposed works.

20. **Liability**
    Unless otherwise specified in this application, a group or organisation shall at all times during the currency of this permit maintain a policy of public liability insurance for a sum of not less than $10 million. The applicant must sign the deed poll clause (Part C) of this form. Individuals conducting an activity by themselves of not as a leader of a group for which they have duty of care, are not required to have public liability insurance (Part B).

21. **Reporting**
    The Authority holder shall advise the District or Regional Manager as soon as practicable of any problems encountered in conducting the approved activity or of any personal injuries or damage to property sustained as a consequence of undertaking the activity.
22. The Authority holder is to provide the results and data from the research to DBCA on conclusion of the project.

OTHER CONDITIONS TO BE OBSERVED

1. General

2.7 Fires within a Park must be in an approved site.

1.1 This Lawful Authority must be carried by the Authority Holder or authorised agents (contractors) at all times for the purposes of proving their authority to access Ningaloo Marine Park when questioned by a Wildlife Officer, CALM Officer, Ranger, any other state or local government employee or member of the public.

1.2 Approved activities or events must adhere to all conditions as specified in the Conservation and Land Management Act 1984, the Conservation and Land Management Regulations 2002, Biodiversity Conservation Act 2016 and Biodiversity Conservation Regulations 2018 which are to be read in conjunction with this lawful authority.

1.3 This approval is subject to any necessary permission being obtained from other authorities.

1.4 This approval is subject to compliance with all relevant State and Commonwealth laws, including any relevant Act, regulations, by-laws, ordinances and other forms of statutory instrument

1.5 The Director General retains the right to terminate the Authority at any time.

1.6 The District Manager (Leah Pearson – 0418 416 442) and/or A/Marine Parks Coordinator (Sallyann Gudge – 9947 8000) is to be notified before the commencement of any activity.

1.7 The District Manager or his/her delegate has on-site control of all activities.

1.8 The Authority holder shall keep the Authority on hand during all periods of collection activity and produced on demand to an officer of the Department of Biodiversity, Conservation and Attractions.

1.9 Authorities are not transferrable.

1.10 All individuals assisting with the project must be supervised by the Authority holder. The Authority holder remains fully responsibility for all actions undertaken under this Authority.

1.11 Commercial use or sale of any specimens taken under this Authority is prohibited.

1.12 The Authority does not allow the taking of Declared (or Threatened) Rare Flora or Fauna.

1.13 The Authority provides no entry to Parks or Reserves, or parts thereof, listed as limited access or prohibited areas.

1.14 The Director General shall be provided with a report at the expiry of the Authority detailing the results of the project and a copy of all publications arising from the project. Details of all specimens taken, where lodged and registration numbers in those collections must be provided.

2. Environmental Considerations

2.1 Disturbance to the environment must be minimal

2.2 Rocks, logs, litter or similar material are to be returned to their original orientation on completion of research.

2.3 Excavations, regardless of size, must be backfilled upon completion of work.

2.4 Pit traps must be filled or capped following completion of the work period and removed entirely after completion of the project.

2.8 On-site camping in a park may be permitted on a site selected by the District Manager or his/her delegate.

3. Specimens

3.1 A licence to take fauna for education or public purposes, or a scientific or other prescribed purposes licence (Flora), or a Regulation 89 licence to take flora and fauna in a Marine Reserve for Scientific Purposes is required to collect flora or fauna.

3.2 Plant specimens are to be restricted to standard herbarium sheet size or smaller unless specifically indicated.

3.3 Rootstocks of plants are to remain undisturbed unless specifically indicated.

3.4 All fauna including invertebrates are to be released at the site of collection unless otherwise indicated.

3.5 The taking of Buprestidae beetles is not permitted.

2.5 All reference markers must be removed before the expiry date of the Authority.

2.6 Camping or lighting fires on Nature Reserves is prohibited.

Permission is granted to conduct the activity/event nominated in this application subject to the above-mentioned conditions of approval.

Department of Biodiversity, Conservation and Attractions contact

Name:	**Sallyann Gudge 0484 915 279**		
Office:	Exmouth (Pilbara Region)		
Contact:	(08) 9947 8000	0484 915 279	sallyann.gudge@dbca.wa.gov.au

Invoiced		Invoice No.	
Admin Officer		Date / /	

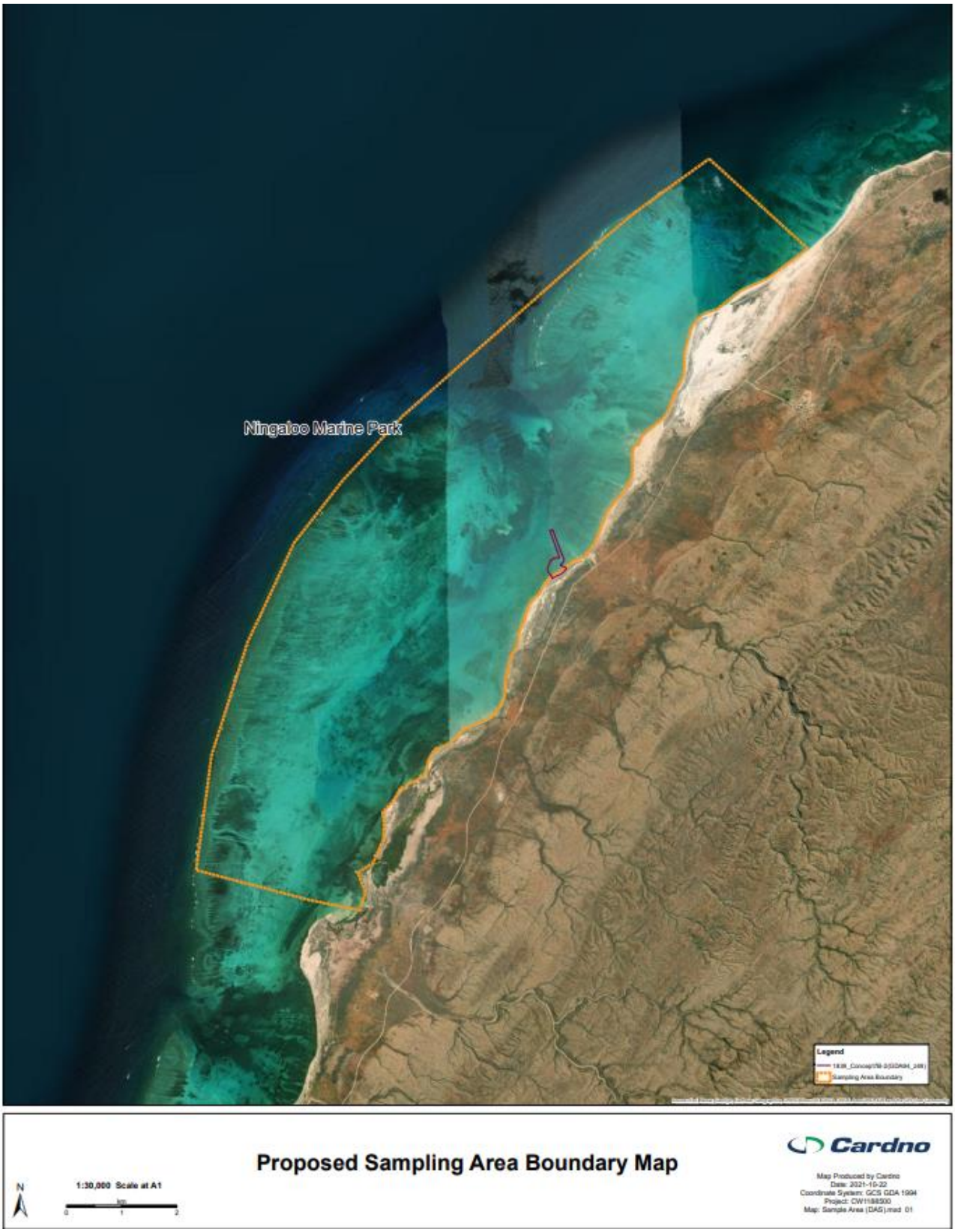


Figure 1. Area adjacent and to the north and south of Tantabiddi Boat Ramp where the Department of Transport is authorised to conduct baseline marine investigations under the conditions of the accompanying Lawful Authority and consistent with the management measures of DAS Approval Number A000622.

APPENDIX I

Activities that require Lawful Authority under CALM Regulations

Regulation No.	Activity
12 (1)	Possession or use of firearms, spears, restricted devices etc.
15	Bringing and allowing an animal on to CALM Act land
31(1) (a),(b),(c) & (4)	Cause any significant damage or disturbance to a naturally occurring feature, damage or disturb any naturally occurring feature, remove any naturally occurring feature from CALM land (includes fossicking activities)
33 (1)	Abseiling on CALM Act land (except in an abseiling area)
34(1)	Placement of any structure on CALM Act land.
38 (1)	Erecting any sign or notice on CALM Act land (unauthorised signs)
39 (1)	Lighting, kindling, maintaining or using, or assisting another person in lighting, kindling or maintaining, a campfire, barbeque or portable stove on CALM Act land; in a restricted area where that activity is prohibited under r. 5; or contravenes a restriction imposed on that activity under r. 5; or where flora and forest produce is in danger of being burnt or injured
39 (2)	Lighting, kindling, maintaining or using, or assisting another person in lighting, kindling or maintaining, any fire within the boundaries or within 20 metres of any boundary of CALM Act land; or leave a fire described above without taking due precaution against its spreading or causing injury, if in either case any flora or forest produce is in danger of being burnt or injured
49	Being in a cave (cave means a cave or part of a cave which is on or under CALM Act land) and complying with the specified conditions and restrictions
50	Cross country and other events - organising, promoting or conducting any event involving cross country running, orienteering, rogaining, cross country navigation exercises or equestrian events on CALM Act land
51 (1)	Driving or using a vehicle (other than a bicycle) on CALM Act land other than on a road or in a designated area
51A (1)	Bicycles - Riding a bicycle on CALM Act land other than on a road or bicycle path or in a designated area
52	Off- road vehicles into CALM Act land - under the *Control of vehicles (Off-road areas) Act 1978*
53	Car rallies etc. - organising, promoting or conducting a car rally, associated navigation exercise, mountain bike event or other race involving vehicles on or through CALM Act land
58	Races - organising, promoting or conducting a race involving vessels on or through CALM Act land
60 (1) (a) & (b)	Anchoring vessels - in a restricted area if that activity is prohibited under Regulation 5, or contravening a restriction on the anchoring of vessels in a restricted area imposed under Regulation 5
65	Launching, landing or making a touch down in an aircraft on CALM Act land (does not apply to an aircraft that is required to launch or touch down contrary to that subregulation to avoid or mitigate danger to human life or significant damage to property)
66	Camping controlled - camping on CALM Act land except in a camping area or on a vessel that is moored or anchored in accordance with these regulations
105 (1)	Organised events and meetings - organising, advertising or holding a meeting, function or event on CALM Act land which is likely to involve or involves the attendance of more than 100 persons

Department of Transport
5 Newman Court
Fremantle WA 6160
Australia

29/12/2021

APPROVAL OF PROPOSAL Tantabiddi Boating Facility – Marine Environmental Investigations P001191 TO UNDERTAKE DISTURBANCE ACTIVITY IN Pilbara - Exmouth

The submitted proposal Tantabiddi Boating Facility – Marine Environmental Investigations P001191 has been assessed and approved. The approval is granted on the understanding that:

- The potential impacts of the proposal on values the department manages have been removed or minimised to a level 'As Low As Reasonably Practicable' (ALARP) and the proposal is consistent with departmental objectives, associated management plans and the land use category/s in the activity area.
- Approval is granted for the period 03/01/2022 to 28/02/2022. This approval is not valid if Department of Transport makes changes to what has been proposed or the proposal has expired. To change the proposal or seek an extension, the proponent must re-submit the proposal for assessment.
- The proponent accepts responsibility for advising DBCA of new information or unforeseen threats that may affect the risk of the proposed activity.
- Information provided by DBCA for the purposes of this proposal will not be provided to third parties without permission from DBCA.
- The proponent accepts responsibility for supervising and monitoring implementation of activity/ies to ensure compliance with this proposal. DBCA reserves the right to request documents and records demonstrating compliance for departmental monitoring and auditing.
- Non-compliance with the conditions of the proposal may trigger a suspension or withdrawal of the approval for this activity.
- Management actions listed in Appendix 1 are implemented.

Should you have any queries about this approval, please contact Alicia Whittington, on (08) 9182 2041 or by email at alicia.whittington@dbca.wa.gov.au

To provide feedback on the system used to submit the approval or update contact details, please contact DAS Works Coordinator - das@dbca.wa.gov.au

Approved on behalf of the
Department of Biodiversity, Conservation and Attractions

Alicia Whittington
Pilbara - Exmouth

29/12/2021

Appendix 1 - Management Actions

3.0.3 Specify management actions consistent with pre-approval
N/A
3.3.3 Specify management actions consistent with joint vesting/management/agreement/arrangements
DBCA notes that the JMB resolved to support the proposal during its 1 Dec meeting, on the condition that the JMB are briefed on the results from the research.
4.1.3 Specify management actions to conserve identified fauna and/or special habitat values
Marine fauna observer on vessel, threshold distances for stop work procedures to minimise impacts on marine species. These distances will be in line with the Biodiversity Conservation Regulations 2018, separation distances for vessels - whales - 300m at front or rear, 100m at the sides (also applied for whale sharks), 100m for killer whales, dolphins, dugongs, seals and turtles. Work will cease when marine fauna are observed within these distances and recommence when marine fauna are observed leaving the area beyond these distances. If fauna cannot be confirmed as leaving the area and cannot be seen, a ten minute wait since last observation will be adhered to before recommencing work. No work to be undertaken at night time. Small vessel travelling at low speed reduces risk of impact. Equipment to be maintained and inspected to avoid oil leaks etc. Visual inspections of work area to be undertaken for spills/waste/rubbish. Monitor VHF Channel 16 and respond to any incidents relative to the project Maintain and monitor a register of received public complaints
8.0.1.3 Specify management actions to conserve identified cultural and heritage values
The work is non-invasive research with minimal disturbance. Management actions for the works will aim to minimise environmental impact and, therefore any potential impacts to cultural and heritage values.

Tantabiddi Boating Facility - Marine Environmental Quality Investigations & Benthic Communities and Habitat Assessment

APPENDIX B

ANALYTICAL SCHEDULE – SEDIMENT QUALITY

Cardno now Stantec

Tantabiddi Boating Facility - Sediment Quality Analysis Schedule

Department of Transport

					Organotin Compounds			TOC	BTEX							Metals / Metaloids										
					Sample analysed via GC/MS and high volume injection. (µg/kg dry weight, 1% TOC)				Purge and Trap, Capillary GC/FID analysis executed on samples.							Total Metals in Sediments by ICPMS (Inductively Coupled Plasma-Mass-Spectrometry) (NODG). Ionisation via argon plasma allows elements to pass thro in Sediments by ICPAES (Inductively Coupled Plasma Atomic Emission Spectroscopy) (NODG). The ICPAES technique ionises samples in plasma. Mercu												
					Monobutyltin	Dibutyltin	Tributyltin	TOC	Benzene	Ethylbenzene	Toluene	Total BTEX	Xylene (m & p)	Xylene (o)	Xylene Total	TOTAL Phosphorus	Aluminium (total)	Vandium (total)	Chromium (total)	Manganese (total)	Iron (total)	Cobalt (total)	Nickel (total)	Copper (total)	Zinc (total)	Arsenic (total)	Selenium (total)
					µgSn/kg	µgSn/kg	mgSn/kg	% C	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg.P/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR					1	1	0.5	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.05	10	0.2	0.2	0.2	10	0.1	0.2	0.2	0.5	0.1	0.1
ANZG (2018) Sediment Quality Guidelines (GV-high)																							52	270	410	70	
NAGD Screening Levels																							21	65	200	20	
CRCCARE 2011 Soil HSL for Direct Contact, HSL-B Residential									140	5,900	21,000				17,000											
CRCCARE 2011 Soil HSL for Direct Contact, Intrusive Maintenance Worker									1,100	85,000	120,000				130,000											
NEPM 2013 ESL Areas of Ecological Significance, Coarse Soil									8	1.5	10				10											
NEPM 2013 HIL, Residential B																										
NEPM 2013 Soil HSL Commercial/Industrial D, for Vapour Intrusion, Sand									3 | 3 | 3 | 3						230 | | |										
DWER ASS Criteria for excavations of > 1000 tonnes																										
Location ID	**Sample ID**	**Sample Depth Range mbgl**	**Location Description**	**Matrix Description**																						
SQ01	SQ01_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ01	SQ01_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ08	SQ08_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ09	SQ09_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ10	SQ10_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Statistical Summary																										
Total samples					23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Field Triplicates					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Tantabiddi Boating Facility - Sediment Quality Analysis Schedule

Department of Transport

												Inorganics															
				ugh spectrometer, detected via certain mass to charge ratios. Iron analysis: Total Iron and Aluminium ury in Sediments: by FIMS (Flow Injection Mercury System). Appropriate acid digestion procedure.								Sieve and hydrometer or laser diffraction (PSD)								Acid is introduced to dried and pulverised samp							
				Silver (total)	Cadmium (total)	Antimony (total)	Lead (total)	Thorium (total)	Uranium (total)	Hexavalent Chromium	Mercury (total)	Moisture Content	Particle size distribution	Ammonia as N	Kjeldahl Nitrogen Total	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total)	Reactive Phosphorus as P	4,4-DDE	a-BHC	Aldrin	b-BHC	chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR				0.02	0.02	0.2	0.1	0.1	0.1	1	0.01	1	2	20	20	0.1	0.1	20	0.1	0.0005	0.0005	0.0005	0.0005	0.00025	0.00025	0.00025	0.0005
ANZG (2018) Sediment Quality Guidelines (GV-high)				**4**	**10**	**25**	**220**				**1**													**0.009**			
NAGD Screening Levels				**1**	**1.5**	**2**	**50**				**0.15**													**0.005**			
CRCCARE 2011 Soil HSL for Direct Contact, HSL-B Residential																											
CRCCARE 2011 Soil HSL for Direct Contact, Intrusive Maintenance Worker																											
NEPM 2013 ESL Areas of Ecological Significance, Coarse Soil																											
NEPM 2013 HIL, Residential B																							**90**				
NEPM 2013 Soil HSL Commercial/Industrial D, for Vapour Intrusion, Sand																											
DWER ASS Criteria for excavations of > 1000 tonnes																											
Location ID	**Sample ID**	**Sample Depth Range mbgl**	**Location Description**	**Matrix Description**																							
SQ01	SQ01_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ01	SQ01_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ08	SQ08_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ09	SQ09_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ10	SQ10_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Statistical Summary

Total samples	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Field Triplicates	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Cardno

					Organochlorine Pesticides																	Organophosphorous Pesticides									
					ple, followed by combustion, with quantiative measurements extracted via infra-red detection (CO2 during combustion). (µg/kg dry weight, 1% OC)																	Ultra-trace recordings of Organochroline P									
					DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Oxychlordane	Azinophos methyl	Bromophos-ethyl	Carbophenothion	Chlorfenvinphos E	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	cis-Chlorfenvinphos	Dichlorvos	Dimethoate
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR					0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00025	0.0005	0.0005	0.0005	0.0005	0.0005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
ANZG (2018) Sediment Quality Guidelines (GV-high)								**0.007**					**0.06**			**0.0014**															
NAGD Screening Levels								**0.28**					**0.001**			**0.00032**															
CRCCARE 2011 Soil HSL for Direct Contact, HSL-B Residential																															
CRCCARE 2011 Soil HSL for Direct Contact, Intrusive Maintenance Worker																															
NEPM 2013 ESL Areas of Ecological Significance, Coarse Soil																															
NEPM 2013 HIL, Residential B							**600**		**400**				**20**				**10**		**15**	**500**						**340**					
NEPM 2013 Soil HSL Commercial/Industrial D, for Vapour Intrusion, Sand																															
DWER ASS Criteria for excavations of > 1000 tonnes																															
Location ID	**Sample ID**	**Sample Depth Range mbgl**	**Location Description**	**Matrix Description**																											
SQ01	SQ01_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ01	SQ01_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ08	SQ08_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ09	SQ09_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ10	SQ10_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Statistical Summary																															
Total samples					23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Field Triplicates					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Cardno®

Tantabiddi Boating Facility - Sediment Quality Analysis Schedule

Department of Transport

								PAH/Phenols																													
	esticides.						Capillary GC/MS analyse executed on sample, with results compared against calibration curve. (µg/kg dry weight, 1% OC)																			Capillary GC/MS analyse executed on s									
	Ethion	Fenthion	Malathion	Methyl parathion	Monocrotophos	Prothiofos	Benzo(b+j)fluoranthene	2-methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Pyrene	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C6-C10
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	0.01	0.01	0.01	0.01	0.01	0.01	0.004	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.004	0.004	3	3	3	5	3	3
ANZG (2018) Sediment Quality Guidelines (GV-high)																						**50**								
NAGD Screening Levels																						**10**							**550**	
CRCCARE 2011 Soil HSL for Direct Contact, HSL-B Residential																					**2,200**									**5,600**
CRCCARE 2011 Soil HSL for Direct Contact, Intrusive Maintenance Worker																					**29,000**									**82,000**
NEPM 2013 ESL Areas of Ecological Significance, Coarse Soil																									**25**					
NEPM 2013 HIL, Residential B							**4**															**400**								
NEPM 2013 Soil HSL Commercial/Industrial D, for Vapour Intrusion, Sand																														
DWER ASS Criteria for excavations of > 1000 tonnes																														
Location ID	**Sample ID**	**Sample Depth Range mbgl**	**Location Description**	**Matrix Description**																																
SQ01	SQ01_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ01	SQ01_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ08	SQ08_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ09	SQ09_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ10	SQ10_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Statistical Summary

Total samples	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Field Triplicates	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

					TPH						SPOCAS							
					ample, with results compared against calibration curve.						Suspension Peroxide Oxidation Combined Acidity and Sulfate / Acid base counting							
					C10-C16	C16-C34	C34-C40	C10 - C40 (Sum of total)	F1: C6-C10 less BTEX	F2-NAPHTHALENE	sulfidic - Acid Reacted Ca equiv. S% pyrite	Liming Rate	Acid trail - Titratable Actual Acidity	Net Acidity (Sulfur Units)	Net Acidity (Acidity Units)	pH-F	pHfox	sulfidic - TSA equiv. S% pyrite
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	% S	kg CaCO3/t	mol H+/t	% S	mol H+/t	PH UNITS	PH UNITS	% PYRITE S
LOR					3	3	5	3	3	3	0.02	1	2	0.02	10	0.1	0.1	0.02
ANZG (2018) Sediment Quality Guidelines (GV-high)																		
NAGD Screening Levels								**550**										
CRCCARE 2011 Soil HSL for Direct Contact, HSL-B Residential					**4,200**	**5,800**	**8,100**											
CRCCARE 2011 Soil HSL for Direct Contact, Intrusive Maintenance Worker					**62,000**	**85,000**	**120,000**											
NEPM 2013 ESL Areas of Ecological Significance, Coarse Soil					**25**				**125**									
NEPM 2013 HIL, Residential B																		
NEPM 2013 Soil HSL Commercial/Industrial D, for Vapour Intrusion, Sand									**260 | 370 | 630 |**									
DWER ASS Criteria for excavations of > 1000 tonnes														**18**	**0.03**	**<4.0**	**<4.0**	**0.02**
Location ID	**Sample ID**	**Sample Depth Range mbgl**	**Location Description**	**Matrix Description**														
SQ01	SQ01_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ01	SQ01_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ02	SQ02_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ03	SQ03_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ04	SQ04_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ05	SQ05_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ06	SQ06_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_0.5	0.0 - 0.5	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ07	SQ07_1.0	0.5 - 1.0	Dredge area	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ08	SQ08_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ09	SQ09_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SQ10	SQ10_0.5	Surface grab sample	Baseline boat ramp	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N_0.5	Surface grab sample	Baseline offshore	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW_0.5	Surface grab sample	Baseline south west	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE_0.5	Surface grab sample	Baseline north east	Sediment	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Statistical Summary																		
Total samples					23	23	23	23	23	23	23	23	23	23	23	23	23	23
Field Triplicates					1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)					1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks					1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1

LOR
ANZG (2018) Sediment Quality Guidelines (GV-high)
NAGD Screening Levels
CRCCARE 2011 Soil HSL for Direct Contact, HSL-B Residential
CRCCARE 2011 Soil HSL for Direct Contact, Intrusive Maintenance Worker
NEPM 2013 ESL Areas of Ecological Significance, Coarse Soil
NEPM 2013 HIL, Residential B
NEPM 2013 Soil HSL Commercial/Industrial D, for Vapour Intrusion, Sand
DWER ASS Criteria for excavations of > 1000 tonnes

Location ID	Sample ID	Sample Depth Range mbgl	Location Description	Matrix Description
SQ01	SQ01_0.5	0.0 - 0.5	Dredge area	Sediment
SQ01	SQ01_1.0	0.5 - 1.0	Dredge area	Sediment
SQ02	SQ02_0.5	0.0 - 0.5	Dredge area	Sediment
SQ02	SQ02_1.0	0.5 - 1.0	Dredge area	Sediment
SQ03	SQ03_0.5	0.0 - 0.5	Dredge area	Sediment
SQ03	SQ03_1.0	0.5 - 1.0	Dredge area	Sediment
SQ04	SQ04_0.5	0.0 - 0.5	Dredge area	Sediment
SQ04	SQ04_1.0	0.5 - 1.0	Dredge area	Sediment
SQ05	SQ05_0.5	0.0 - 0.5	Dredge area	Sediment
SQ05	SQ05_1.0	0.5 - 1.0	Dredge area	Sediment
SQ06	SQ06_0.5	0.0 - 0.5	Dredge area	Sediment
SQ06	SQ06_1.0	0.5 - 1.0	Dredge area	Sediment
SQ07	SQ07_0.5	0.0 - 0.5	Dredge area	Sediment
SQ07	SQ07_1.0	0.5 - 1.0	Dredge area	Sediment
SQ08	SQ08_0.5	Surface grab sample	Baseline boat ramp	Sediment
SQ09	SQ09_0.5	Surface grab sample	Baseline boat ramp	Sediment
SQ10	SQ10_0.5	Surface grab sample	Baseline boat ramp	Sediment
250N	250N_0.5	Surface grab sample	Baseline offshore	Sediment
500N	500N_0.5	Surface grab sample	Baseline offshore	Sediment
250SW	250SW_0.5	Surface grab sample	Baseline south west	Sediment
500SW	500SW_0.5	Surface grab sample	Baseline south west	Sediment
250NE	250NE_0.5	Surface grab sample	Baseline north east	Sediment
500NE	500NE_0.5	Surface grab sample	Baseline north east	Sediment

Statistical Summary
Total samples
Field Triplicates
Field Duplicate (inter lab refrence sample)
Field (Trip) blanks
Laboratory blanks (per batch)
Laboratory Duplicate (per batch)

Tantabiddi Boating Facility - Marine Environmental Quality Investigations & Benthic Communities and Habitat Assessment

APPENDIX C

ANALYTICAL SCHEDULE – WATER QUALITY

Cardno

now

Stantec

Cardno

Tantabiddi Boating Facility - Water Quality Analysis Schedule

Department of Transport

					Microbial Indicator		BTEX						Inorganics																	
					Thermotolerant coliforms	Enterococci	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene Total	Alkalinity (total) as CaCO3	Ammonia as N	Kjeldahl Nitrogen Total	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total)	Reactive Phosphorus as P	Chloride	COD	Ferrous Iron	Sodium	Sulphate	TOC	Lead	Tributyltin	Cadmium	Calcium
					CFU/100 ml	CFU/100 ml	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg Sn/L	mg/L	mg/L
LOR							1	1	1	2	1	3	20	0.005	20	0.1	0.1	20	0.1	1	25	0.05	0.5	5	5	0.001	0.001	0.0002	0.5
ANZG (2018) Marine water 90% toxicant DGVs							**900**							**1.2**												**0.0066**	**0.02**	**0.014**	
ANZG (2018) Marine water 95% toxicant DGVs							**700**							**0.91**												**0.0044**	**0.006**	**0.0055**	
ANZG (2018) Marine water 99% toxicant DGVs							**500**							**0.05**												**0.0022**	**0.0004**	**0.0007**	
ANZECC & ARMCANZ (2000) Marine Waters					**100**	**100**																							
Location ID	**Sample ID**	**Sample Depth**	**Location Description**	**Matrix Description**																										
WQ01	WQ01	composite	Baseline/dredge area	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WQ02	WQ02	composite	Baseline/dredge area	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WQ03	WQ03	composite	Baseline/dredge area	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW	composite	Baseline/reference	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW	composite	Baseline/reference	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N	composite	Baseline/reference	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N	composite	Baseline/reference	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE	composite	Baseline/reference	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE	composite	Baseline/reference	Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Statistical Summary																														
Total samples					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Field Triplicates					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Tantabiddi Boating Facility - Water Quality Analysis Schedule

Department of Transport

			Metals										PAH/Phenols											
			Chromium (hexavalent)	Chromium (III+VI)	Chromium (Trivalent)	Copper	Ferric Iron	Iron	Magnesium	Manganese	Nickel	Potassium	Zinc	Benzo(b+j)fluoranthene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR			0.005	0.001	0.001	0.001	0.05	0.05	0.5	0.005	0.001	0.5	0.005	0.001	1	1	1	1	1	1	1	1	1	1	1
ANZG (2018) Marine water 90% toxicant DGV			0.02		0.0486	0.003					0.2		0.023												
ANZG (2018) Marine water 95% toxicant DGV			0.0044		0.0274	0.0013					0.07		0.015												
ANZG (2018) Marine water 99% toxicant DGV			0.00014		0.0077	0.0003					0.007		0.007												
ANZECC & ARMCANZ (2000) Marine Waters																									
Location ID	**Sample ID**	**Sample Depth**																							
WQ01	WQ01	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WQ02	WQ02	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WQ03	WQ03	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Statistical Summary

Total samples	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Field Triplicates	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

							TPH										
			Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Pyrene	C10-C16	C16-C34	C34-C40	F2-NAPHTHALENE	C6 - C9	+C10 - C36 (Sum of total)	C10 - C14	C15 - C28	C29-C36	C10 - C40 (Sum of total)	C6-C10
			µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
LOR			1	1	1	1	1	0.05	0.1	0.1	0.05	20	100	50	100	100	100	0.02
ANZG (2018) Marine water 90% toxicant DGV				**90**		**4**												
ANZG (2018) Marine water 95% toxicant DGV				**70**		**2**												
ANZG (2018) Marine water 99% toxicant DGV				**50**		**0.6**												
ANZECC & ARMCANZ (2000) Marine Waters																		
Location ID	**Sample ID**	**Sample Depth**																
WQ01	WQ01	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WQ02	WQ02	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WQ03	WQ03	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250SW	250SW	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500SW	500SW	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250N	250N	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500N	500N	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
250NE	250NE	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500NE	500NE	composite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Statistical Summary																		
Total samples			9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Field Triplicates			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Duplicate (inter lab refrence sample)			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field (Trip) blanks			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory blanks (per batch)			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Laboratory Duplicate (per batch)			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Tantabiddi Boating Facility - Marine Environmental Quality Investigations & Benthic Communities and Habitat Assessment

APPENDIX D

SAFE WORK METHOD STATEMENT

Cardno now Stantec

Safe Work Method Statement

SWMS No. …1…… Revision No…1……

NOTE: Work must be performed in accordance with this SWMS.

This SWMS must be kept and be available for inspection until the work (including high risk construction work) to which this SWMS relates is completed. If the SWMS is revised, all versions should be kept.

Project Name:	Tantabiddi Marine Environment Investigations	**Project Number:**	CW1188500
Client:	Department of Transport	**Location:**	Tantabiddi, WA
Cardno Project Manager:	**Daniel Strickland**	**Principal Contractor (PC):**	
SWMS Developed by:	Daniel Strickland / Julian Brown	**Date:**	31/08/21
Work Description:	Nearshore water and sediment sampling for environmental analysis; and benthic habitat inspection.		

High risk activities associated with the work activity:	☐ Work at height (including ladders & roofs)	☐ Work on or near energised electrical installations or services	☐ Demolition works
	☒ Work in areas with natural or artificial extremes of temperature	☒ Work out, on, in or adjacent to a road, railway, shipping lane or other traffic corridor in use by traffic other than pedestrians	☐ Work in an area that may have a contaminated or flammable atmosphere
	☐ Excavation work or work in a tunnel or trench	☒ Work in or near water	☐ Work on or near pressurised gas mains or piping
	☐ Work on or near chemical, fuel or refrigerant lines	☒ Work in an area with movement of powered mobile plant	☐ Work in or near a confined space
	☒ Diving work	☐ Actual or potential asbestos exposure	☒ Working in a remote or isolated location
	☒ Management of Subcontractors	☐ Other High Risk Activities (not listed)	
Client Requirements:	**HSE to be managed under Cardno's systems with SWMS(s) provided for their information/review prior to commencement of work.**		

Minimum PPE requirements (tick all that apply):

☒ Long sleeve/long pants	☒ Safety footwear	☒ Eye Protection	☒ Hard hat	☒ Gloves	☐ Face shield
☐ Hi-Vis vest	☒ Hearing protection	☐ Disposable respirator	☐ Half-face respirator	☐ Full-face respirator	☐ Tyvek suit
☒ Wide brim hat	☒ Sunscreen	☒ Insect repellent	☐ Fall Protection	☒ Other (specify): x Type 1 PFD rated to 150kg minimum	

Plant and equipment required for activity:

Item	Inspection & Maintenance Requirements	Licence/Ticket Required to Operate?
Powered vessel. Sampling Equipment	**Outboard-powered boat, ponar grab, ROV**	☒ Yes ☐ No
General hand tools / sampling utensils. Dive/Snorkelling gear	**Check all is in good working order before use**	☐ Yes ☒ No

Hazardous substances required for activity – Attach copies of Safety Data Sheets (SDS):			
Product Name	**Quantity (Kg/L)**	**Product Name**	**Quantity (Kg/L)**

Qualifications and licences:											
Name	**Site Specific Induction**		**White Card**		**Driver's Licence**		**Boat License**	
Julian Brown	☐ Yes ☐ No ☒ N/A	Ref:	☐ Yes ☐ No ☒ N/A	Ref:	☒ Yes ☐ No ☐ N/A	Ref:	☒ Yes ☐ No ☐ N/A	Ref:
Daniel Strickland	☒ Yes ☐ No ☒ N/A	Ref:	☐ Yes ☐ No ☒ N/A	Ref:	☒ Yes ☐ No ☐ N/A	Ref:	☒ Yes ☐ No ☐ N/A	Ref:
Cory Smith	☒ Yes ☐ No ☒ N/A	Ref:	☐ Yes ☐ No ☒ N/A	Ref:	☒ Yes ☐ No ☐ N/A	Ref:	☒ Yes ☐ No ☐ N/A	Ref:

Emergency planning (tick or add as applicable):				
☒ Fire extinguisher	☒ First aid kit	☒ Rescue Plan	☒ EPIRB	☒ Mobile phone
☒ Radio	☒ Flares / flags	☒ Lifejacket or PFD	☒ Spill kit	☐ Satellite phone
☐ Other (specify):			☐ Other (specify):	

Permit/s Required (List below)	
Temporary Notice to Mariners (DoT)	
DBCA Lawful Authority Reg 35A	

SWMS approval:			
Name:	**Signature:**	**Position:**	**Date:**
Daniel Strickland		**Project Manager**	**31/08/2019**

Safe Work Method Statement

SWMS No. …1…… Revision No…1……

#	**Job Step** *Describe the job by step*	**Hazard** *What are the hazards of each step?*	**Possible Consequences** *What are the possible injury/incident consequences of each step?*	**Risk Rating** *Use the Risk Matrix to give an initial rating*	**Control Methods to be Implemented** *What control measures will be used?*	**Residual Risk Rating** *Use the Risk Matrix to give a residual risk rating*	**Responsible Person**
1	**Working outside, in or near water**	Exposure to the natural elements (e.g. wind, sun, rain, heat, cold).	• Sunburn, heat related illness, dehydration. • Marine life and wildlife.	High	• Consult weather forecast prior to day of sampling and re-schedule activity if required. • Re-assess weather conditions throughout the day and return from field or modify activities as required. • Staff training in working in the sun and in hot weather. • Wear appropriate PPE, to include as a minimum a hat, sunscreen, long sleeves/pants, sunglasses, walking boots and gloves. • Staff monitor each other while out on site. • Carry adequate supplies of water. • Be aware of surroundings, steep walking tracks and vegetation.	Low	All those involved
		Lifting/carrying equipment	• Risk of back or muscular strain. • Cuts, abrasions or crushing injuries.	Medium	• Staff receive training in manual handling procedures. • Project HSE Induction for staff • Wear gloves as required, keep on person at all times in the field. • Staff do not lift objects 20kgs or heavier.	Low	
2	**Working on vessels (general)**	Exposure to the natural elements (e.g. sea spray, wind, sun, rain, heat, cold).	Sunburn, heat stroke, hypothermia, dehydration.	High	• Consult weather forecast prior to day of sampling and re-schedule activity if required. • Re-assess weather conditions throughout the day and return	Low	

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
					from field or modify activities as required. • Staff training in working in the sun, in hot weather, during storms and in cold. • Wear appropriate PPE, to include as a minimum a hat, sunscreen, long sleeves/pants, sunglasses and covered shoes. • Staff monitor each other while out on site. • Carry adequate supplies of water. • Be aware of surroundings, particularly wind and waves.		
		Falling into water.	Drowning or near drowning.	High	• Team members to wear life jackets when vessel is under way or working over water. • Type 1 PFD life jackets to be rated for at least 150kg.	Medium	
		Remoteness from emergency services.	Increased response time for emergency services, with potential to result in increased severity of injury/illness or death.	High	• At least one First Aider must be present on each field trip. • First Aid Kit part of standard field gear • Staff are aware of Emergency Procedures and carry a copy of the emergency contact details. • Carry a fully charged mobile phone. • Access to ancillary emergency contact device (e.g. satellite	Medium	

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
					phone, VHF radio and/or emergency beacon) for more remote sites. • Staff are trained in the use of emergency equipment on the vessel. • Staff nominate an office contact person. In the event staff do not check in as agreed, the contact person should assess the need to contact the emergency services.		
		Lifting/carrying equipment	• Risk of back or muscular strain. • Cuts, abrasions or crushing injuries.	High	• Staff completed Cardno Training Module 'Manual tasks for Workers' • Wear gloves as required. • Staff do not lift objects 20kgs or heavier.	Low	
3	**Environmental sampling**	Pinch points, moving parts, crushing	Injury / lost time / equipment damage	Med	• All handling of drilling equipment by subcontractor. Subcontractor to prepare collected material for sampling. • Personnel should wear PPE including long sleeve clothing, cut-resistant gloves, sunglasses, steel capped boots, PFDs.	Low	All personnel

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
		Marine life –	Injury bites and stings	Med	• Personnel should wear appropriate PPE including long sleeve clothing, cut-resistant gloves, sunglasses, steel capped boots, PFDs. • Person extracting sediment should wear rubber gloves beneath cut-resistant gloves • Visually inspect before handling • Appropriate first aid equipment and sufficient first aiders on board • Emergency procedure in place • Equipment wash down	Low	All personnel
		Repetitive task	Strain or Sprain	Med	• Use correct manual handling techniques • Use fit for purpose lifting equipment and mechanical lifting wherever possible • Rotate/share repetitive tasks • Setup work area correctly with best possible ergonomics	Low	All personnel
		Exposure to contaminants	Illness, reaction	Med	• Gloves to be worn and sampling to occur in open space. • Wash facilities on board.	Low	All personal

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
4	Diving / Snorkelling	Accident due to equipment failure.	Injury and/or drowning.	Low	• All equipment and emergency equipment shall be checked prior to mobilization.	Low	Field Team Leader/diver supervisor
		Incident during dive due to health issue or pre-existing medical condition.	Injury and/or drowning.	High	• All staff will hold a current dive medical. • Dive Supervisor to conduct pre-dive hazard assessment to consider health of field team members.	Low	
		Accident due to lack of staff training and/or preparedness.	Injury and/or drowning.	High	• All divers are to hold Commercial or Scientific Diver qualifications and are trained in the procedures outlined in the Cardno Diving Operations Manual (DOM). • Dive Plan to be prepared and approved prior to diving operations. • The procedures in the DOM and Dive Plan shall be followed by all team members. • The dive vessel shall maintain an oxygen supply in addition to the normal First Aid Kit. • The meteorological and marine forecasts shall be checked prior to mobilization as outlined	Low	

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
					above in relation to boat based activities.		
		Failure to follow dive procedures with respect to ascent and duration underwater. Undertake inappropriate activities post-dive.	Decompression sickness (“the bends”).	High	• All divers are familiar with the DOM. • All divers understand and follow the Dive Plan. • All field team members to participate in an on-site diving hazard assessment. • All field team members are familiar with the emergency procedures, including the location of local hospitals, hyperbaric chambers and the use of emergency equipment. • Divers should consider activities undertaken post-dive to ensure they are not at risk of decompression sickness (e.g. travel to high altitudes). • Divers may not fly within 12 hours of completing a dive. • All dives will be logged in accordance with the DOM.	Low	
		Snorkeller struck by vessel.	Injury or death.	Med	• Maintain watch for passing boats. • Consider the need for snorkellers to attach to themselves a highly visible float	Low	

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
					(e.g. where diving near navigational channels). • Vessel to be in neutral during diver entry and egress. • Vessel to approach snorkellers from a down wind direction.		
		Disorientation underwater, poor visibility, or strong currents. Loss of vessel/dive partner.	Snorkeller/diver lost at sea.	Low	• All Assess risk at site and identify most suitable mitigation measures as part of on-site hazard assessment. • Supervisor to assess the need for a float line or safety line on one or more divers where depth exceeds 6 m, there is current or if visibility is poor. If used, the line shall be attached to the diver in such a way that it does not inhibit the use of the dive equipment (e.g. regulator, BCD, etc.). • Before entering the water, an audible diver recall signal will be agreed on by all team members. • Visual contact with each diver will be maintained from the surface by observation of diver's bubbles or a float towed by a diver for the duration of the dive. When a float is used	Low	

#	Job Step *Describe the job by step*	Hazard *What are the hazards of each step?*	Possible Consequences *What are the possible injury/incident consequences of each step?*	Risk Rating *Use the Risk Matrix to give an initial rating*	Control Methods to be Implemented *What control measures will be used?*	Residual Risk Rating *Use the Risk Matrix to give a residual risk rating*	Responsible Person
					the boat will not be anchored, instead it will follow the float towed by the divers at a safe distance.		

Sign-Off Sheet

All persons performing any activity covered by this SWMS MUST sign off prior to commencement of this task as recognition of having read and understood the work steps and preventative actions required to reduce the risk of harm, and ensure safe work practices are maintained. I, the undersigned declare that I have read and understand the requirements of this SWMS and will work in accordance with the prescribed controls:

Name	Signature	Position	Date	Name	Signature	Position	Date

Safe Work Method Statement

SWMS No. …1…… Revision No…1……

The following steps are to be taken in accordance with the HSE Risk Management Procedure HSEANZ-PR-3-01.

STEP 1 - Hazard Identification
Find out what could cause harm

STEP 2 – Risk Assessment
Identify the **consequence (Table A)**
Identify the **likelihood (Table B)**
Rate the uncontrolled risk using the **HSE Risk Matrix (Table C)**
Determine Actions to be taken in accordance with the **Action Table (Table D)**

STEP 3 – Control Risks
Implement the most effective control measure/s that is/are reasonably practicable in the circumstances and in accordance with the **Hierarchy of Controls (Table E)**

STEP 4 Review Controls
Ensure they are effective in controlling the risk and are working as planned. Take corrective action as required.

Table A - Establish the consequence

Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
First aid or no treatment required. Minor onsite environmental impact which can be remediated in 24 hours	Medically treated injury/illness. Locally contained environmental impact which can be remediated in the short term	Lost Time Injury/illness; Environmental damage at multiple locations/ can be remediated in the medium term with possible ongoing monitoring required.	Extensive injury, illness or impairment to one or more persons; Notifiable Incident. Environmental damage which can be remediated in the longer term with ongoing monitoring and management.	One or more fatalities and/or severe irreversible disability to one or more people; Sustained, large scale ecological damage which cannot be remediated or wilful environmental harm.

Table B - Establish the likelihood

Almost Certain A	Likely B	Possible C	Unlikely D	Rare E
Is expected to occur in most circumstances	Will probably occur in most circumstances	Might occur at some time	Could occur at some time	May occur only in exceptional circumstances
Once a year or more	Once every 1-3 years	Once every 10 years	Once every 30 years	Once every 100 years

Table C - HSE Risk Matrix

Likelihood	Consequence: Insignificant	Minor	Moderate	Major	Catastrophic	
Almost Certain	Medium (11)	High (16)	Extreme (20)	Extreme (23)	Extreme (25)	A
Likely	Medium (7)	High (12)	High (17)	Extreme (21)	Extreme (24)	B
Possible	Low (4)	Medium (8)	High (13)	High (18)	Extreme (22)	C
Unlikely	Low (2)	Low (5)	Medium (9)	High (14)	High (19)	D
Rare	Low (1)	Low (3)	Low (6)	Medium (10)	High (15)	E
	1	2	3	4	5	

Table D - Action Table

Residual Risk Rating	Action Required
Extreme	Do not commence the activity or stop work if in progress. Immediate action required to implement better controls in accordance with the Hierarchy of Controls. Senior management approval is required before the activity commences.
High	Activity must not be undertaken prior to review and implementation of additional risk controls Approver/s must ensure the Hierarchy of Controls has been applied so far as is reasonably practicable and the risk has been minimised to ALARP.
Medium	Consult Site Hazard Control Register and ensure identified controls are effectively implemented in accordance with the Hierarchy of Controls .Confirm activity, risk assessment and controls with the immediate line Supervisor.
Low	Carry out activity following review and implementation of effective risk controls. Monitor risk controls to ensure that they are maintained at their present level or lower in accordance with the Hierarchy of Controls.

Table E - Hierarchy of Controls

Hierarchy of Controls – must be implemented so far as is reasonably practicable	
Eliminate	**First Option – most effective** can the hazard be removed altogether by elimination of the item, plant, process or substance.
Substitute	Involves replacing the hazard with once that presents lower risk.
Isolate	Separate people from the hazard.
Engineer	Change design of the equipment, workplace, task or process.
Administrative	Reduce exposure to the hazard by following procedures, instructions or training.
PPE	**Last Option – least effective**, provides a barrier between a person and a hazard.